Final Report

Underwater Noise Level Study During Impact Pile Driving
FDOT Contract No. BDV34 985-03

Submitted To:

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DISCLAIMER

APPROXIMATE CONVERSIONS TO SI UNITS

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
SYMBOL	**WHEN YOU KNOW**	**MULTIPLY BY**	**TO FIND**	**SYMBOL**
AREA				
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
SYMBOL	**WHEN YOU KNOW**	**MULTIPLY BY**	**TO FIND**	**SYMBOL**
VOLUME				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
NOTE: volumes greater than 1000 L shall be shown in m^3				
SYMBOL	**WHEN YOU KNOW**	**MULTIPLY BY**	**TO FIND**	**SYMBOL**
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
SYMBOL	**WHEN YOU KNOW**	**MULTIPLY BY**	**TO FIND**	**SYMBOL**
TEMPERATURE (exact degrees)				
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
SYMBOL	**WHEN YOU KNOW**	**MULTIPLY BY**	**TO FIND**	**SYMBOL**
ILLUMINATION				
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
SYMBOL	**WHEN YOU KNOW**	**MULTIPLY BY**	**TO FIND**	**SYMBOL**
FORCE and PRESSURE or STRESS				
lbf	pound force	4.45	newtons	N
lbf/in^2	pound force per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS TO ENGLISH UNITS

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
LENGTH				
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
SYMBOL	**WHEN YOU KNOW**	**MULTIPLY BY**	**TO FIND**	**SYMBOL**
AREA				
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
SYMBOL	**WHEN YOU KNOW**	**MULTIPLY BY**	**TO FIND**	**SYMBOL**
VOLUME				
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
SYMBOL	**WHEN YOU KNOW**	**MULTIPLY BY**	**TO FIND**	**SYMBOL**
MASS				
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
SYMBOL	**WHEN YOU KNOW**	**MULTIPLY BY**	**TO FIND**	**SYMBOL**
TEMPERATURE (exact degrees)				
^oC	Celsius	1.8C+32	Fahrenheit	^oF
SYMBOL	**WHEN YOU KNOW**	**MULTIPLY BY**	**TO FIND**	**SYMBOL**
ILLUMINATION				
lx	lux	0.0929	foot-candles	fc
cd/m^2	$candela/m^2$	0.2919	foot-Lamberts	fl
SYMBOL	**WHEN YOU KNOW**	**MULTIPLY BY**	**TO FIND**	**SYMBOL**
FORCE and PRESSURE or STRESS				
N	newtons	0.225	pound force	lbf
kPa	kilopascals	0.145	pound force per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003)

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EXECUTIVE SUMMARY

This project was motivated by recent federal developments regarding anthropogenic noise during construction. In particular, during previous sound-level data collected in Florida, discrepancies were observed between measured sound data and predicted levels from the National Marine Fisheries Service (NMFS) calculator. This study's goals were to better characterize peak and cumulative attenuation distance of underwater noise due to pile driving and to develop a better understanding of sound transmission/attenuation during typical pile drives in Florida.

Several methods were used to better understand pile driving noise. First, a unique buoy-mounted data collection system was developed that allowed investigators to simultaneously measure sound-levels at five locations during a pile drive. This system was used to obtain noise data during approximately 88 pile drives from 13 pile driving sites in Florida. Data were analyzed in both the time and frequency domains. During time series analyses, decay associated with sound exposure levels, root-mean squared sound levels, and peak sound level was modeled via base-10 logarithmic functions. Results showed that sound may be attenuated more efficiently than suggested by the NMFS calculator, especially for concrete piles of typical dimensions used during Florida roadway construction. During spectral analysis, it was observed that logarithmic decay patterns were present in each octave band and that at lower frequencies (less than 100 Hz), sound decayed faster than it did at higher (greater than 1000 Hz) frequencies.

Concurrent with data collection, several computer simulations were conducted using computational fluid dynamics (CFD). Both site-specific data and hypothetical data were analyzed to get a better understanding of the effects of bathymetry, geotechnical absorption, and source-levels on attenuation. If unfamiliar with CFD, it is simply a method of discretizing and numerically solving the governing fluid flow equations (i.e., momentum conservation, mass conservation, turbulence, sound, etc.) everywhere in a flow domain with known boundary conditions. Results suggested that while geotechnical absorption undoubtedly plays a role in sound attenuation, the interplay between attenuation and source-levels was likely a more important factor in predicting attenuation during pile driving for piles of typical shape and dimension in Florida.

As a result of this, field data were used to develop a new design tool associated with underwater sound production/transmission that was based upon the interplay between the sound source-level and attenuation. This tool was dubbed the <u>F</u>lorida <u>A</u>ttenuation <u>C</u>oefficient <u>T</u>ool (FACT) This relationship between source-level and attenuation was consistently observed in all data regardless of drive-type (i.e., impact versus vibrations), material (steel versus concrete), hammer blow, sound oscillation, location, or geotechnical condition and was consistently observed across all frequency bands as well. The FACT was verified using data from 32 pile drives reported by CalTrans, and results were consistently relatively accurate or conservative, although sometimes data were so conservative that generating a best-fit verification plot was not possible. The verification was repeated using piles that were of typical size and shape to piles typically used in Florida in water depths that conformed to water depths studied here. Doing so produced an excellent best-fit verification line through the data.

However, there were a limited number of vibrational data in both this study and the CalTrans reports. There were also a limited number of steel percussion drives during this study, but despite this, the FACT appeared to perform well when compared with data from CalTrans. Overall, data suggest for steel percussion drives, using attenuation coefficients close to those recommended by CalTrans (i.e., an attenuation coefficient of 15) returned relatively accurate attenuation, although the FACT also returned accurate attenuation. The most significant results associated with the FACT were observed for concrete piles where attenuation coefficients may be much higher than steel piles. Verification showed that for concrete piles of similar size and shape to piles in Florida, the FACT appears to accurately predict attenuation.

The FACT should be thought of as a NOAA/NMFS transmission loss coefficient calibration factor for typical pile conditions in Florida during roadway construction. Results from the FACT could be used in conjunction with the existing NOAA/NMFS calculator to predict the radius of influence associated with an underwater pile driving event. Accompanying this report is a modified version of the NOAA/NMFS calculator with the new attenuation coefficient predictor embedded in the calculator spreadsheet as an example of how the FACT could be integrated into the existing tool.

CHAPTER 1
INTRODUCTION AND BACKGROUND INFORMATION

1.1 In-Water Pile Driving

Generally, in Florida, piles are driven via a ram/anvil system illustrated below in Fig. 1-1. To summarize, a pile cushion is positioned between a helmet and a hammer cushion (i.e., cap block). A striker plate is placed above the hammer cushion, and a ram/anvil are used to impart blows onto the striker plate/hammer cushion/helmet/pile cushion system. Each blow transmits energy to the pile and causes the pile to move downward through the soil But, each blow may also generate sound waves that move downward through the pile and are subsequently transmitted to the pile's surrounding fluid media – either air or water (in the case of underwater pile driving). A schematic associated with this noise transmission is presented below in Fig. 1-2.

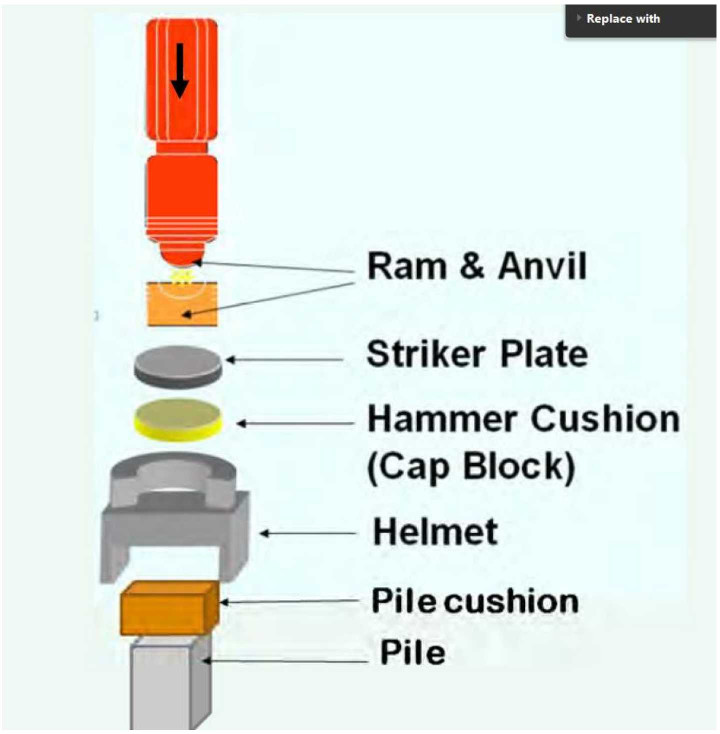


Figure 1-1. Schematic of pile driving hammer setup; adapted from Castellanos (2015)

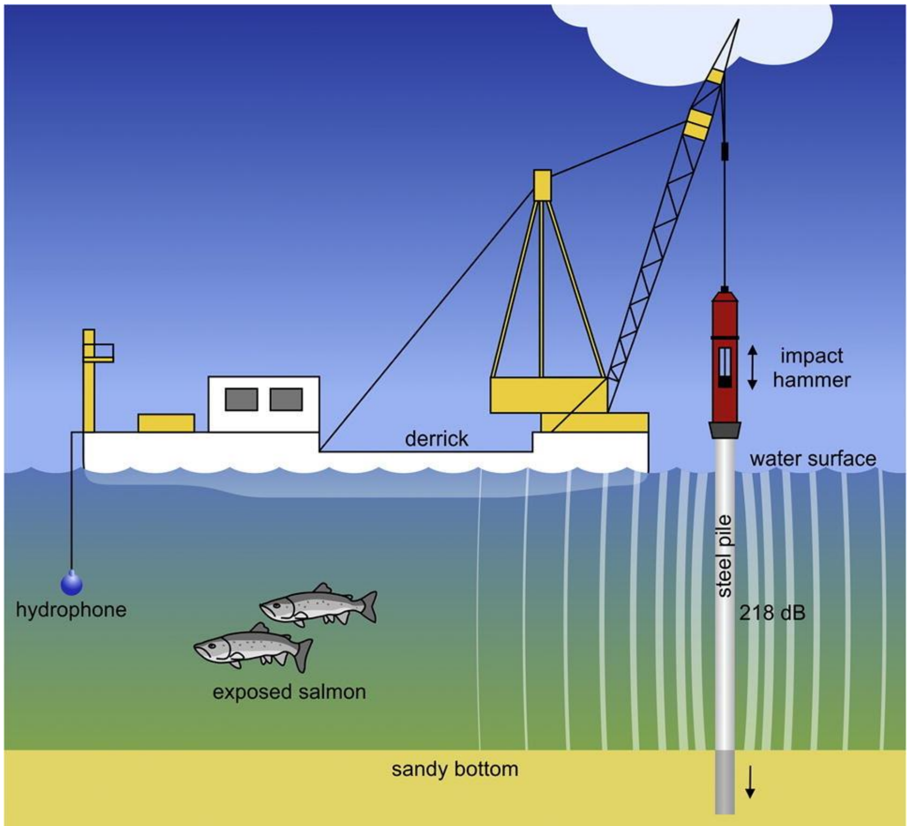


Figure 1-2. Schematic of pile driving showing transmission in water; adapted from Bagočius (2015)

1.2 Recent Federal Developments

In 2009 ten federal agencies, as a part of the Joint Subcommittee on Ocean Science and Technology, formed an interagency task force on anthropogenic sound and the marine environment. As a result of this task force, agencies agreed on high priority research recommendations to:

- Develop and validate mitigation measures to minimize demonstrated adverse effects from anthropogenic noise.
- Test/validate mitigating technologies to minimize sound output and/or explore alternatives to sound sources with adverse effects.
- Explore need for and effectiveness of time/area closures versus operational mitigation measures.

Following this interagency task force, the National Marine Fisheries Service (NMFS) developed the Ocean Noise Strategy initiative, which is now recognized by all the offices within the National Oceanic & Atmospheric Administration (NOAA). The purpose of this initiative was to articulate NOAA's vision for addressing ocean noise impacts over the next ten years and guide management actions towards that vision. In November 2016 NMFS approved the Ocean Noise

Policy, which required NMFS to address noise impacts to species and their habitats over the next ten years in accordance with the Ocean Noise Strategy Roadmap. With this policy, NMFS will begin to have more focus on projects with noise impacts such as those that require in-water pile driving. In-water pile driving is the major focus of this report.

1.3 Developments in Florida

In December 2016 (and subsequently in May 2022), the Federal Highway Administration (FHWA) assigned all federal National Environmental Policy Act (NEPA) responsibilities to the Florida Department of Transportation (FDOT). This memorandum of understanding required the FDOT Office of Environmental Management to ensure the NEPA process is completed on all federal roadway projects statewide. This includes conducting species consultations as needed. During the environmental review process, agency representatives from NMFS and United States Fish and Wildlife Service (USFWS) have repeatedly expressed concerns about the effects that pile-driving activities have on Florida's protected species. The required species consultations are taking place project by project and do not always have predictable outcomes. Considering the recent initiatives set forth by NOAA, these concerns are anticipated to become more frequent and have the potential to set higher standards for mitigation of noise impacts on transportation projects. This could potentially slow the review process or delay projects by requiring the incorporation of new sound attenuation techniques. Sound attenuation devices such as bubble curtains, cofferdams, or double piles (Reinhall et al. 2015) are expensive and may significantly increase project cost.

1.4 Current Guidelines for Sound Propagation

In the context of marine organisms subjected to underwater pile driving noise, there are few guidelines available. At the beginning of this project, the following table from Buehler et al. (2015) was considered the state-of-the-art in terms of assessing sound pressure levels' effects on fish:

Table 1-1. Guidelines for Pile Driving Adverse Effects on Fish (Buehler et al. 2015)

Effect	Metric	Fish Mass (g)	Threshold (dB re 1 μPa)
Onset of Physical Injury	Peak Pressure	N/A	206
	Accumulated SEL	≥ 2 g	187
		≤ 2 g	183
Adverse Behavior	RMS Pressure	N/A	150

Since then, a more in-depth study was conducted by Popper and Hawkins (2019) to more precisely quantify underwater sound effects on fish and other marine organisms (Table 1-2). As discussed by Popper and Hawkins (2019), Table 1-2 was based upon 960 sound events that were measured at 1.2 second intervals. In both Table 1-1 and Table 1-2, each sound-level is presented in decibels (dB) relative to 1 μPa where 1 dB is defined as:

$$\mathrm{dB} = 10\log_{10}\left(\frac{p}{p_0}\right)^2 = 20\log_{10}\left(\frac{p}{p_0}\right) \tag{1-1}$$

where p is the sound pressure-level and p_0 is the reference pressure (i.e., 1 μPa). Both Table 1-1 and Table 1-2 highlight three important concepts associated with sound propagation. The first is peak pressure or simply "PEAK" which refers to the highest sound-level from a given sound event. The second is sound exposure-level (SEL) which is defined as the cumulative amount of sound exposure over some a time interval, t. Mathematically:

$$\text{SEL (dB)} = 10\log_{10}\left[\int\left(\frac{p}{p_0}\right)^2 dt\right] \tag{1-2}$$

RMS is the root-mean-squared of the sound pressure level and is defined as:

$$\text{RMS (dB)} = 10\log_{10}\left[\sqrt{\frac{1}{t}\int_0^t\left(\frac{p}{p_0}\right)^2 dt}\right] \tag{1-3}$$

Please note that in the context of Table 1-1 and Table 1-2, SEL and RMS refer to single-strike sound-levels. Other parameters from Table 1-2 are as follows:

- Temporary threshold shift (TTS) is a temporary shift in the auditory threshold that results from loud noise. Thus, a fish with no swim bladder (i.e., first line) would experience TTS for SEL above 186 dB.

- Masking refers to loud sound interfering with a marine animal's ability to hear a sound of interest. These data are presented in terms of an organism's position relative to a sound source. Thus, a sea turtle would experience high masking if it were near (N) a sound source; low masking if it were far (F) from a sound source; and moderate masking if it were an intermediate (I) range from a sound source.

- Behavior refers to adverse behavioral effects expressed relatively in terms of N, F, or I distance from a sound source.

- Mortality and potential mortal injury represent thresholds beyond which death of the organism is likely.

- Most recently, NMFS updated their underwater noise calculator as shown below in Table 1-3.

Table 1-2. Enhanced guidelines for sound effects on underwater organisms (adapted from Popper and Hawkins 2019)

Type of Animal	Mortality and potential mortal injury	Impairment			
		Recoverable injury	Temporary threshold shift (TTS)	Masking	Behavior
Fish: no swim bladder (particle motion detection)	> 219 dB SEL_{cum} or > 213 dB peak	> 216 SEL_{cum} or > 213 dB peak	>> 186 dB SEL_{cum}	(N) Moderate (I) Low (F) Low	(N) High (I) Moderate (F) Low
Fish: swim bladder is not involved in hearing (particle motion detection)	210 dB SEL_{cum} or > 207 dB peak	203 dB SEL_{cum} or > 207 dB peak	> 186 dB SEL_{cum}	(N) Moderate (I) Low (F) Low	(N) High (I) Moderate (F) Low
Fish: swim bladder involved in hearing (primarily pressure detection)	210 dB SEL_{cum} or > 207 dB peak	203 dB SEL_{cum} or > 207 dB peak	186 dB SEL_{cum}	(N) High (I) High (F) Moderate	(N) High (I) Moderate (F) Moderate
Sea Turtles	210 dB SEL_{cum} or > 207 dB peak	(N) High (I) Low (F) Low	(N) High (I) Low (F) Low	(N) High (I) Moderate (F) Low	(N) High (I) Moderate (F) Low
Eggs and Larvae	210 dB SEL_{cum} Or > 207 dB peak	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low

Table 1-3. Updated NMFS noise thresholds for ESA-listed species in the southeast

Drive Type	Species	Effect	Subcategory (if applicable)	Threshold (dB)	Stat of Interest
Impact	Fishes	Behavioral change	N/A	150	RMS
		Onset of physical injury	N/A	206	Peak
			Fish ≥ 2 g	187	SEL
			Fish ≤ 2 g	183	SEL
	Sea Turtles	PTS onset	N/A	232	Peak
			N/A	204	SEL
		Behavioral change	N/A	175	RMS
	Marine Mammals	PTS onset	Low-frequency cetacean	219	Peak
				183	SEL
			Mid-frequency cetacean	230	Peak
				185	SEL
			High-frequency cetacean	202	Peak
				155	SEL
			Phocid pinnipeds	218	Peak
				185	SEL
			Otariid pinnipeds	232	Peak
				203	SEL
		Behavioral change	N/A	160	RMS
Vibratory	Fishes	Behavioral change	N/A	150	RMS
	Sea Turtles	PTS onset	N/A	220	SEL
		Behavioral change	N/A	175	RMS
	Marine Mammals	PTS onset	Low-frequency cetacean	199	SEL
			Mid-frequency cetacean	198	SEL
			High-frequency cetacean	173	SEL
			Phocid pinnipeds	201	SEL
			Otariid pinnipeds	219	SEL
		Behavioral change	N/A	120	RMS

1.5 The Importance of Transmission Loss (TL)

For underwater organisms subjected to pile driving noise, it is important to understand both *if* the thresholds for SEL, RMS, and peak sound-level are exceeded and *where* these thresholds are exceeded in terms of distance from a given pile drive. As sound propagates from a source, sound level will tend to decay because of geometrical spreading and other factors; this phenomenon is known as transmission loss (TL) and is defined as the difference between sound pressure at the source, L_s, and sound pressure at some distance, r, L_r. At the beginning of this project, the best guidance for estimating TL due to pile driving was the Practical Spreading Loss Model (PSLM; i.e., the NMFS calculator) given by:

$$L_s - L_r = \text{TL (dB)} = 15 \log_{10}\left(\frac{r}{r_0}\right) \tag{1-4}$$

where r is the range (i.e., distance) from a pile; and r_0 is some reference range usually taken to be 1 m.

1.6 Previous Data Collection Results

Prior to this project, several sets of underwater noise data during pile driving had been collected. Examples include Buehler et al. (2015), Dahl (2013), Reinhall and Dahl (2011) – just to name a few. Results showed that the coefficient in Eq. 1-4 – i.e., the 15 – may not accurately predict TL. More generally Eq. 1-4 may be written as:

$$\text{TL (dB)} = F \log_{10}\left(\frac{r}{r_0}\right) \tag{1-5}$$

where F is what is known as the TL coefficient.

Prior to this project, the FDOT hired several consultants to collect data from various pile drive events in Florida. Results showed that F-values much higher than $F = 15$ (as prescribed by NMFS) were often observed. The FDOT hypothesized that this discrepancy may be due to geotechnical conditions (and as will be discussed in this report, this hypothesis is likely correct to some extent). Likewise, in the literature, F-values as low as 5 or as high as 30 have been reported. We note that the F = 15 assumption was largely based upon data collected from CalTrans and that these data were mostly from steel piles. In Florida however, the vast majority of piles used during road construction (between 80% and 90%) are concrete. As will be shown in this report, we believe that concrete versus steel is the primary factor that is governing the F-value in Eq. 1-5.

1.7Goals and Objectives

The overall goal associated with this research was to develop a better understanding of sound-levels due to pile driving in Florida both in terms of the overall sound-level in a water column during a pile drive event and how that sound propagates as a function of distance. In the context of predicting underwater TL, the goal of the work presented herein was to develop a simple, easy to implement tool for predicting underwater TL. Ultimately investigators sought to carry out an objective study that could be used for future decision-making processes by all agencies that have an interest in in-water piling driving activities. Within this main goal were several sub-objectives which were as follows:

1.7.1 Objective 1 – Data Collection and Analysis

The first objective of this study was to sample noise levels of in-water pile driving events at project locations throughout the State of Florida.

1.7.2 Objective 2 – Development of a Predictive Model for Future Pile Driving Events

The study's second objective was to use the data collected during Objective 1 to calculate attenuation factors based on Florida-specific conditions – especially in the context of concrete piles versus steel piles. Along these lines, a user-friendly method was developed for predicting F-values for concrete piles in Florida.

1.7.3 Objective 3 – Coordination with Federal Agencies

This study's third objective was to coordinate with federal agencies throughout the process. Investigators held several virtual meetings with officials from USFWS, NOAA, and NMFS at both the regional and federal level to complete this objective.

CHAPTER 2
METHODOLOGY

This chapter details the methodology associated with meeting the objectives discussed in Chapter 1.

2.1 Data Collection

2.1.1 Data Collection System Description

A data collection system was developed that consisted of several floating platforms from which hydrophones could be deployed to various water depths and multiple ranges from a pile. Each floating platform consisted of two small pontoons that were attached to aluminum frames via aluminum pins. Each frame held a Pelican^{TM} 1450 box that housed the electronics for the system. Scanstrut cable clam/deck seals were used to pass a hydrophone cable and a thermocouple cable from the exterior into the box while a MENCOM MDE45-8FR-RJ45-BM waterproof Ethernet connection was used to route an Ethernet cable into the case. Electronics in the cases consisted of Bruel and Kjaer 2250 handheld analyzers; Bruel and Kjaer 2647 charge converters; L-Com BT-CAT5-P1 power-over-Ethernet converters; 24-volt motorcycle batteries connected in series; and Pace Scientific XR-440M pocket loggers for the thermocouples. Outside of each box were a Pace Scientific PT960 temperature probe (i.e., thermocouple); a Bruel and Kjaer 8103 hydrophone; an Ubiquiti Bullet M2 wireless access point; and an L-COM HG2409UP antenna.

Cables associated with the hydrophones and thermocouple were attached to a stainless-steel strain-relief cable via a series of cinch knots that were spaced every 12 inches. During deployment, the strain relief cable was affixed to the frame to prevent tension-related damage to the hydrophone and thermocouple cable. Excess cable was coiled manually and strapped to the top of the box. A system using two bungie cables and a carabiner was used to affix the boxes to their corresponding aluminum frames. During deployment, river anchors were connected to small plastic buoys that were in turn connected to the buoys' anchor bridle systems. Thus, during deployment, the field team was able to sequentially deploy the anchors, and then the data collection buoys. After deployment, Garmin GPSMAP global position system (GPS) units were affixed to the buoys' antennas to record buoy locations. During field visits, the buoys' low profiles allowed them to be easily stacked in a watercraft before and after deployment. Several photographs of the data collection system are presented in Appendix A.

2.1.2 Data Collection Procedure

Approximately one day before deployment, the hydrophones, WiFi system, Doppler acoustic current profiler (i.e., AquaDOP), GPS units, and thermocouples were set up. Specific procedures associated with setting up each instrument are detailed in Appendix A. We emphasize that prior to each day of driving (usually, the morning before driving began), the hydrophones were calibrated using a Bruel and Kjaer 5229 and the procedures outlines in Appendix A.

After setup, all equipment was fully charged, loaded, and transported along with a watercraft. Once at the site, investigators located the pile bent that would be driven that day and assessed geographical constraints to determine where to space the buoys relative to the pile. In general, investigators' goal was to collect potential worst-case sound-levels by ensuring that there was a clear line of sight between the pile or piles that were being driven each day each buoy in the array.

2.1.2.1 Buoy Spacing

Once geographical constraints associated with the clear line-of-sight were considered, buoys were placed in an approximate straight line from the pile bent that was being driven on a particular day. First, the buoy closest to the bent was placed as close to the bent as possible without interfering with construction operations while ensuring field team safety. Generally, this distance was between 10 m and 20 m from the bents. While this distance was often greater than the standard 10 m distance used in many other studies, it was often necessary from a safety perspective due to strong currents at most construction sites. The first buoy's distance to the pile was verified using a laser rangefinder and recorded. Note however that during data analysis, GPS coordinates were used and the rangefinder data were only used as a check against GPS coordinates.

Once the distance from the first buoy to the pile bent was approximately established, the subsequent buoys were positioned. When possible geographically, a "double the distance" rule of thumb was used. For example, if the first buoy was ~20 m from a bent, then the second buoy would be positioned at ~40 m; the third at ~80 m; the fourth at ~160 m; and the fifth at ~320 m. In all cases, the rangefinder was used to approximate the distances. Sometimes, this "double-the-distance" rule of thumb failed – either due to malfunctioning hydrophones that knocked buoys offline or due to geographical constraints. In these cases, new appropriate ranges were determined based upon these constraints, and again, the approximate range data from the rangefinder were recorded. In addition, the exact positions of the buoys relative to the piles and their bents were verified during data analysis using GPS data.

Once in position, each data collection buoy was secured to a smaller buoy that was in turn anchored to the waterway bottom using a river anchor. Due to currents, wave action, and slack in the buoy lines, the buoys often drifted out of perfect alignment with one another. This was considered during data analysis by using GPS coordinates, but its net effect appeared to be mostly negligible.

2.1.2.2 Hydrophone Depths

After each buoy was positioned along the water surface, its hydrophone was lowered into position. To determine the hydrophone position, first the watercraft's depth finder was used to approximate the water depth. Then, the appropriately measured cinch knot was connected to the strain relief system at the appropriate length so that the hydrophone would be positioned approximately at mid-depth in the water column. Next, a 2-kg fishing weight was affixed to the end of the hydrophones' strain relief cables to pull the cable taught in the vertical direction and ensure that the hydrophone hung approximately vertically from the water surface. Finally, the hydrophone was lowered into position. Both the water depth and the hydrophone depth were recorded.

2.1.2.3 Recording Data

After setup (see Appendix A) the buoys' hydrophones, GPS units, and thermocouples recorded sound pressure level (SPL) until they are turned off or their batteries completely discharged. As such, after buoy placement, data collection began automatically. Data were collected at a sampling rate of 48 kHz. During pile driving, start-times and stop-times associated with each drive were noted. Usually during data analysis, the start-stop of a pile drive was obvious just by visual inspection of the data, but when not obvious, the start-stop times were crossreferenced with field notes. Ambient SPLs were estimated by sampling data using the buoy furthest from the construction site either after pile driving was completed or between pile drives.

2.1.3 Site Information

The testing procedures and newly developed underwater noise measurement system described above were used to record sound at thirteen sites in Florida as shown below in Fig. 2-1:

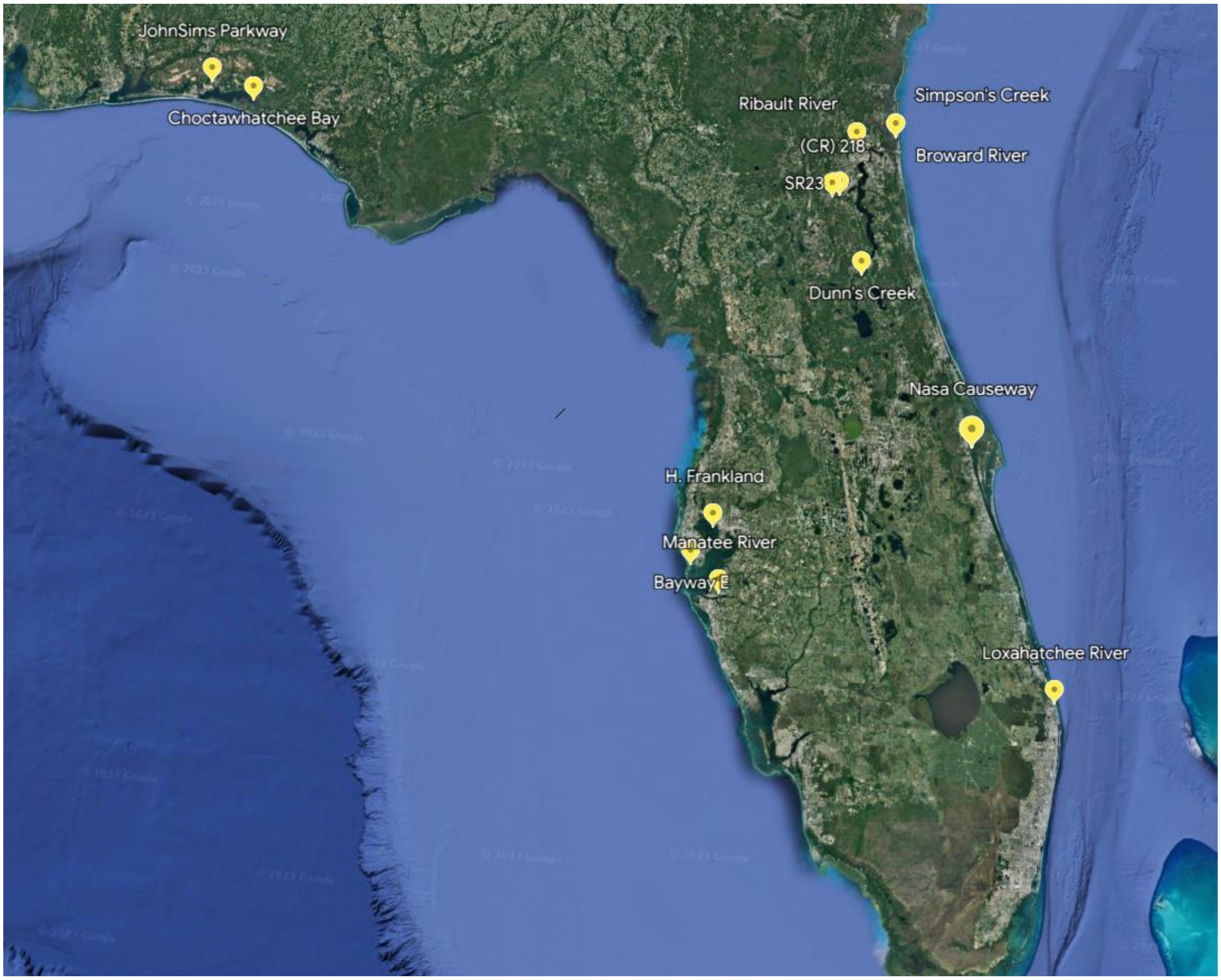


Figure 2-1. Data collection location map

In addition to recording sound-levels, geotechnical data including pile driving and boring logs were collected from each location and are presented in Appendix B.

2.2 Field Data Analysis

Field data analysis was conducted following the procedure outlined in Madsen et al. (2006). Fig. 2-2 below helps to illustrate this procedure:

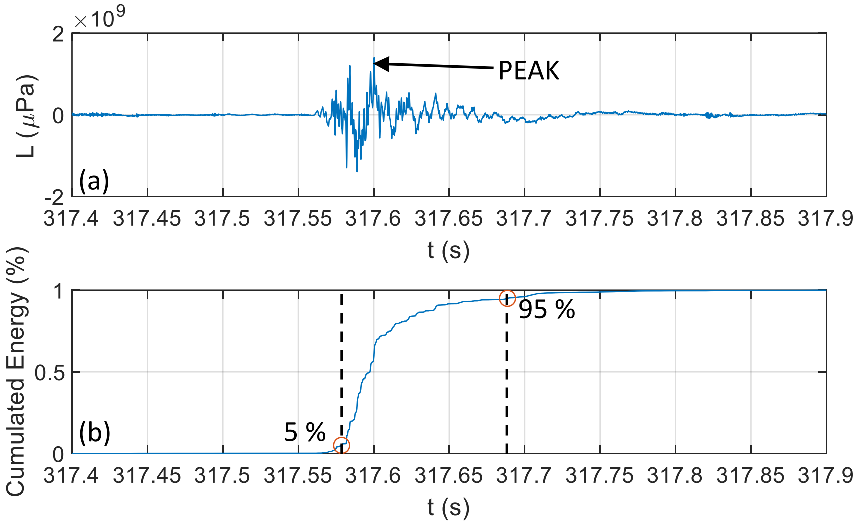


Figure 2-2. Sample single strike sound-level from 29th drive at Howard Frankland Bridge showing (a) sound-level; and (b) cumulated sound energy percentage over the drive

At each buoy, for each hammer blow, the PEAK sound-level was defined as the highest-pressure oscillation magnitude as indicated in Fig. 2-2(a). RMS was computed using SPL readings from 5% cumulated energy to 95% cumulated energy. SEL was computed using 100% of the sound energy associated with each blow via the following expression:

$$\mathrm{SEL} = \mathrm{RMS} + 10\log_{10}\tau \qquad (2\text{-}1)$$

where τ is the length of time associated with each blow's pressure oscillation. To determine τ, it was assumed that τ was halfway between each blow's PEAK value. Then, mean PEAK, RMS, and SEL values were computed for each drive by averaging the results from Eq. 2-1. These mean values were plotted as a function of distance from the pile (i.e., range), and best-fit regression was used to fit decay curves to the data of the form:

$$L_r = b + a\log_{10}\left(\frac{r}{r_0}\right) \qquad (2\text{-}2)$$

Note that a must correspond to F from Eq. 1-5. As pointed out by Ainslie et al. (2014), equations of the form of Eq. 1-5 and Eq. 2-2 are not entirely correct for underwater pile driving noise. A better expression for describing TL is:

$$TL = L_s - L_r = B + A\log_{10}\left(\frac{r}{r_0}\right) \qquad (2\text{-}3)$$

Eq. 1-5 is simply a special case of Eq. 2-3 where $B = 0$. As such, b in Eq. 2-2 must correspond to $(L_s - B)$.

In addition to this analysis, spectral analysis was conducted using three methods. First, the entire sound spectra were analyzed using the Nyquist frequency (i.e., 24 kHz). These data were later integrated to yield total spectral energy. Spectral energy was plotted as a function of distance from a pile, and best-fit regression was used to fit equations of the form of Eq. 2-2 to the data. Then, a 1/3 octave analysis was conducted from the 16 Hz band through the 20 kHz band (Table

2-1). Finally, a 1/1 octave analysis was conducted (Table 2-2). Drive data at each buoy were filtered via the 1/1 octave limits. Then, within each band, PEAK, SEL, and RMS were computed and plotted as a function of distance from each pile. Again, best-fit regression was used to fit equations of the form of Eq. 2-2 to these data.

Table 2-1. 1/3 Octave Band Frequencies

Band No	Lower Band Limit (Hz)	Center Frequency (Hz)	Upper Band Limit (Hz)
1	14.1	16	17.8
2	17.8	20	22.4
3	22.4	25	28.2
4	28.2	31.5	35.5
5	35.5	40	44.7
6	44.7	50	56.2
7	56.2	63	70.8
8	70.8	80	89.1
9	89.1	100	112
10	112	125	141
11	141	160	178
12	178	200	224
13	224	250	282
14	282	315	355
15	355	400	447
16	447	500	562
17	562	630	708
18	708	800	891
19	891	1000	1122
20	1122	1250	1413
21	1413	1600	1778
22	1778	2000	2239
23	2239	2500	2818
24	2818	3150	3548
25	3548	4000	4467
26	4467	5000	5623
27	5623	6300	7079
28	7079	8000	8913
29	8913	10000	11220
30	11220	12500	14130
31	14130	16000	17780
32	17780	20000	22390

Table 2-2. 1/1 Octave Band Frequencies

Band No	Lower Band Limit (Hz)	Center Frequency (Hz)	Upper Band Limit (Hz)
-1	11	16	22
0	22	31.5	44
1	44	63	88
2	88	125	177
3	177	250	355
4	355	500	710
5	710	1000	1420
6	1420	2000	2840
7	2840	4000	5680
8	5680	8000	11360
9	11360	16000	22720

Finally, a blow-by-blow analysis was conducted whereby each blow was analyzed in the context of PEAK, RMS, and SEL. These values were plotted as a function of range for each blow, and then an equation of the form of Eq. 2-2 was fit to each of these curves. The goal of this analysis was to get a better understanding of how sound statistics may vary from blow-to-blow in a given pile drive.

2.3 Computational Analysis

In addition to using physical data, several computational analyses were conducted using computational fluid dynamics (CFD). Specifically, Siemens' Star-CCM+ (Siemens 2021) was used to model data at two sites to study the effects of geotechnical absorption and in several hypothetical flow domains to better understand the terms *A* and *B* from Eq. 2-3. Details of these models are as follows:

2.3.1 Governing Equations

The complete set of acoustic perturbation equations used by Star-CCM+ are as follows:

$$\frac{\partial p'}{\partial t} + c^2 \nabla \cdot \left(\overline{\rho} u^a + \overline{v} \frac{p'}{c^2} \right) \approx 0 \tag{2-4}$$

$$\frac{\partial u^a}{\partial t} + \nabla(\overline{v} \cdot u^a) + \nabla \left(\frac{p'}{\overline{\rho}} \right) \approx \nabla \Phi_p \tag{2-5}$$

Where:

- p' = perturbation pressure;
- u^a = irrotational perturbation velocity;
- $\overline{\rho}$ = time-averaged density; 7
- $\overline{v}$ = time-averaged (i.e., mean) velocity;
- c = speed of sound;
- Φ_p = the noise source function.

The relationship among the perturbation pressure, the noise source function, and the acoustic pressure, p^a that was used was:

$$p' = \overline{\rho}\Phi_p + p^a \tag{2-6}$$

Substituting Eq. 2-6 into Eq. 2-4 and Eq. 2-5 and assuming incompressible flow leads to following equation that describes sound waves (Siemens 2021):

$$\frac{1}{c^2}\frac{\partial^2 p^a}{\partial t^2} + \frac{2\overline{v}}{c^2} \cdot \frac{\nabla \partial p^a}{\partial t} + \frac{\overline{v}\cdot\nabla}{c^2}(\nabla \cdot \overline{v} p^a) - \nabla^2\left(p^a + \tau\frac{\partial p^a}{\partial t}\right) = \\ -\left[\frac{1}{c^2}\frac{\partial^2 \Phi_p}{\partial t^2} + \frac{2\overline{v}\cdot\nabla}{c^2}\frac{\partial P'}{\partial t} + \frac{\overline{v}\cdot\nabla}{c^2}(\nabla \cdot \overline{v} P')\right] \tag{2-7}$$

where τ is the physical damping term defined as:

$$\tau = \chi\frac{\Delta t}{\pi\lambda} \tag{2-8}$$

in which:

- χ = the damping coefficient (0 for no damping; 1 for maximum damping);
- Δt = the time-step;
- $\lambda = c\frac{\Delta t}{\Delta x}$; i.e., the local Courant Number (i.e., the Courant-Friedrichs-Lewy or CFL condition).

The acoustic wave model was coupled with an inviscid flow model where conservative of energy was enforced via the built-in segregated fluid enthalpy equation:

$$\frac{\partial(\rho E)}{\partial t} + \nabla \cdot (\rho E v) = f_b \cdot v + \nabla \cdot (v \cdot \sigma) - \nabla \cdot q + S_E \tag{2-9}$$

where:

- E = total energy per unit mass;
- q = heat flux;
- S_E = energy source per unit volume;
- f_b = the resultant of the buoyant forces such as gravity, centrifugal force, etc. per unit volume acting on the continuum;
- ρ = the density of the fluid medium;

σ, the stress tensor, is computed as the sum of normal stresses, $-pI$ and viscous (i.e., shear) stresses, *T*:

$$\sigma = -pI + T \tag{2-10}$$

The Star-CCM+ acoustic wave model is simply a repurposing of its aeroacoustics model in the sense that the equations above are applied to water instead of air. Star-CCM+'s built-in International Association for the Properties of Water and Steam, Industrial Formulation, 1997

(IAPWS-IF97) model was used throughout all models' flow domains. As such, water was assumed to be incompressible with a molecular weight of $18\ \mathrm{kg/kmol}$. The speed of sound was assumed to be 1,450 m/s.

The acoustic wave equations above are valid both within the flow domain and at reflective or partially absorbing boundaries. Sometimes, it was necessary to focus a CFD model on an area of interest by "cutting" computational mesh where a wall would not physically exist in nature. Under these conditions, it was necessary to specify a non-reflective boundary condition that allows acoustic waves to leave the computational domain without any spurious reflections. By applying the $\nabla\cdot$ operator to Eqn. 2-4, one can show that at these non-reflective boundaries (Siemens 2021):

$$\nabla p^a \cdot s = -\frac{(1-\overline{v}\cdot n/c)}{\left(1-|\overline{v}^2|/c^2\right)c}\left(\frac{\partial p^a}{\partial t}\right)|s| \tag{2-11}$$

in which s is the face normal area vector and |s| is its magnitude.

2.3.2 Mesh Conditions

It was hypothesized that local bathymetry may significantly affect pile driving sound transmission due to acoustic wave reflectivity in the sense that certain geometries may cause wave reflection that promotes constructive interference; certain geometries may promote destructive interference; and certain geometries may promote very little interference. Under the little interference conditions, factors like absorption would likely play a larger role in governing *TL*. With assistance from FDOT, local bathymetry data were collected from the Ribault River and Bayway E locations and supplemented with additional data from NOAA. These NOAA data tended to be lower resolution than data provided from FDOT in the sense that fewer soundings were available per unit area. In the context of channels, where bridges are located, this meant assuming trapezoidal bathymetries beyond the extents of NOAA's soundings. Note that in both cases, and in most cases in Florida, water depths were relatively shallow (i.e., 10 m or less). The combined FDOT/NOAA data were used to draw geometrical meshes that captured local bathymetry. Water surfaces were assumed to be flat while upstream/downstream mesh extents were assumed to be vertical planes. Field buoys were geolocated on these meshes so they could be later used as comparison points for downstream noise data. This means that comparison points in the model corresponded to locations where buoys were located in the field. A pile extrusion was "cut" though each mesh (see Fig. 2-3, for example). In addition to this, several computational simulations were conducted using hypothetical, rectangular channels with varying water depths and widths (Table 2-3).

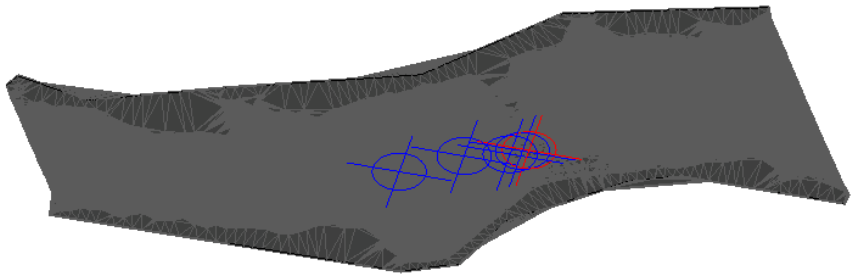


Figure 2-3. Example of geometrical mesh from the Bayway E location showing the buoy locations (in blue crosshairs); and the pile location (in red crosshairs)

Table 2-3. CFD hypothetical rectangular channel dimensions

Sim. Name	Water depth (m)	Channel width (m)
S-Y15Z10	10	15
S-Y30Z10	10	30
S-Y60Z10	10	60
S-Y100Z10	10	100
S-Y15Z15	15	15
S-Y30Z15	15	30
S-Y60Z15	15	60
S-Y100Z15	15	100
S-Y15Z30	30	15
S-Y30Z30	30	30
S-Y60Z30	30	60
S-Y100Z30	30	100

Once the geometrical mesh had been developed for each simulation, it was imported in Star-CCM+. If necessary, the meshes were "cut" to focus on the bridge/buoy locations and narrow the computational "channels." This ensured that the resultant mesh would contain a reasonable number of cells relative to available computational resources. Currently, the University of North Florida's (UNF's) computational cluster contains 584 cores (12 nodes @ 28 cores/node; and 4 nodes @ 48 cores/node). Given these constraints, the cell quantity upper limit is approximately 10 million cells per model. Then, the built-in Star-CCM+ surface wrapper was used to ensure that the meshes were water-tight (i.e., no "holes" were present). Next, each geometry surface was remeshed using Star-CCM+'s surface mesher. The remeshed surfaces were used to create volume meshes using Star-CCM+'s built-in polyhedral meshing scheme (Fig. 2-4).

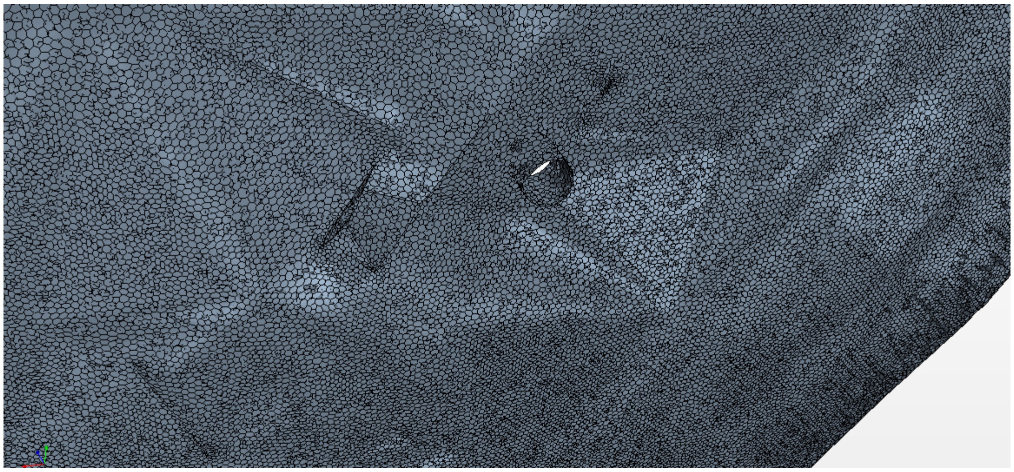


Figure 2-9. Example of polyhedral mesh showing the Bayway E location

For models using local bathymetry data, ~2.45 million and ~1.74 million cells were used for the Ribault River and Bayway E bridges respectively which led to approximate resolutions of 0.75 m and 0.3 m respectively. For the hypothetical channels, base resolution of approximately 1.0 m or less were achieved for all models.

2.3.3 Run Conditions

Initial conditions of each model were such where it was assumed that no flow was present in each computational domain. At the pile, a pile drive function was assumed. Based upon field data, an exponentially decaying sine wave of the form:

$$S = C\exp(-kt)\cos(\omega t) \qquad (2\text{-}12)$$

was used. The damping coefficient, k was assumed to be 3 Hz for the models that used field bathymetry. All hypothetical models were run using k = 3 Hz and k = 1.5 Hz to better understand the effect of source-level decay on TL. The frequency term, ω was assumed to equal 100 Hz for all models that utilized field data. For hypothetical models, values of 10π and 20π were used to better understand the effects of frequency on attenuation. The amplitude term, C was assumed to equal 3 MPa for field models; and 1,000 Pa and 5,000 Pa for hypothetical models.

For each set of models, the effect of boundary absorption was tested by varying the models' boundary absorption coefficient in increments. In addition, for the models using field bathymetry, surface absorption was varied even though surface absorption would likely not have a significant effect on sound attenuation (i.e., just to better understand what, if any, effect it would have). For field models, bottom absorption coefficients were varied in 20% increments from 0% to 100%. Water surface coefficients, α_s, focused more on the low-end of the spectrum, and tested values were 0%, 2%, 4%, 6%, 8%, 10%, 15%, 20%, 40%, and 60%. Taken together, this represented 60 surface/bottom coefficient combinations that were tested at both the Bayway E and Ribault River locations. Results from these 60 combinations were used to develop contours between surface and bottom absorption coefficients and F-values. For the hypothetical models, bottom absorption was varied in 10% increments for a total of 120 combinations at each ω and k value.

Each field model was solved using Star-CCM+'s built-in implicit solver with a first-order implicit time step of 0.001 seconds. At each time step, 5 iterations were used; these showed good convergence when examining each model's residuals. For the hypothetical models, a timestep of

0.001 s was used, but all other solver conditions were the same as the field models. For each set of models, a computational convergence study was conducted that examined both mesh and timestep resolution. These analyses suggested that computational convergence had been achieved.

2.4 CFD Data Analysis

Data analysis was similar to analysis that was conducted using field data in the sense that sound-level was tracked at various distances from the modeled pile and best-fit regression was used to fit curves of the form of Eq. 2-2 to the data. For the models that used field bathymetry, modeled sound was monitored at the buoy locations and PEAK data associated with each blow were analyzed. For the hypothetical models, each peak oscillation in a given modeled blow was analyzed separately to better understand how amplitude affected attenuation.

CHAPTER 3
RESULTS

3.1 Field Data Fitting

Examples of field data results are presented below in Fig. 3-1 through Fig. 3-4. A compilation of all results is presented in Appendix C (sound decay curves and 1/3 octave spectra), Appendix D (full demeaned signals, in Pa), Appendix E (full spectra computed using the Nyquist frequency), Appendix F (frequency decay curves), and Appendix G (blow-by-blow results). A summary table is provided below in Table 3-1. Note that the 10-m sound amplitude is included in Table 3-1. This was computed by extrapolating each drive's regression curve and using a value for $\left(\frac{r}{r_0}\right)$ of 10. In addition, for each site, F-values were averaged, and mean decay curves were computed (Fig. 3-5 and Fig. 3-6).

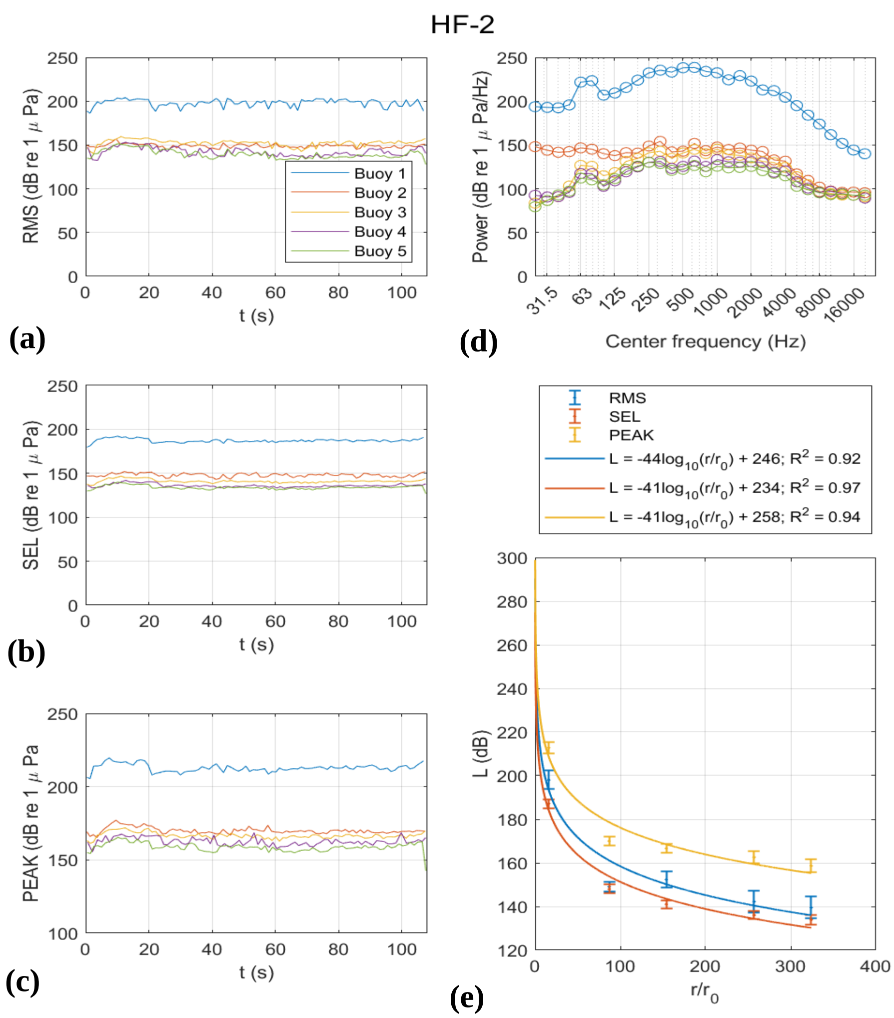


Figure 3-1. Results from the 2nd drive the Howard Frankland Bridge showing (a) RMS at each buoy; (b) SEL at each buoy; (c) PEAK at each buoy; (d) 1/3 octave frequencies at each buoy; and (e) decay curves from the sites for RMS, SEL, and PEAK

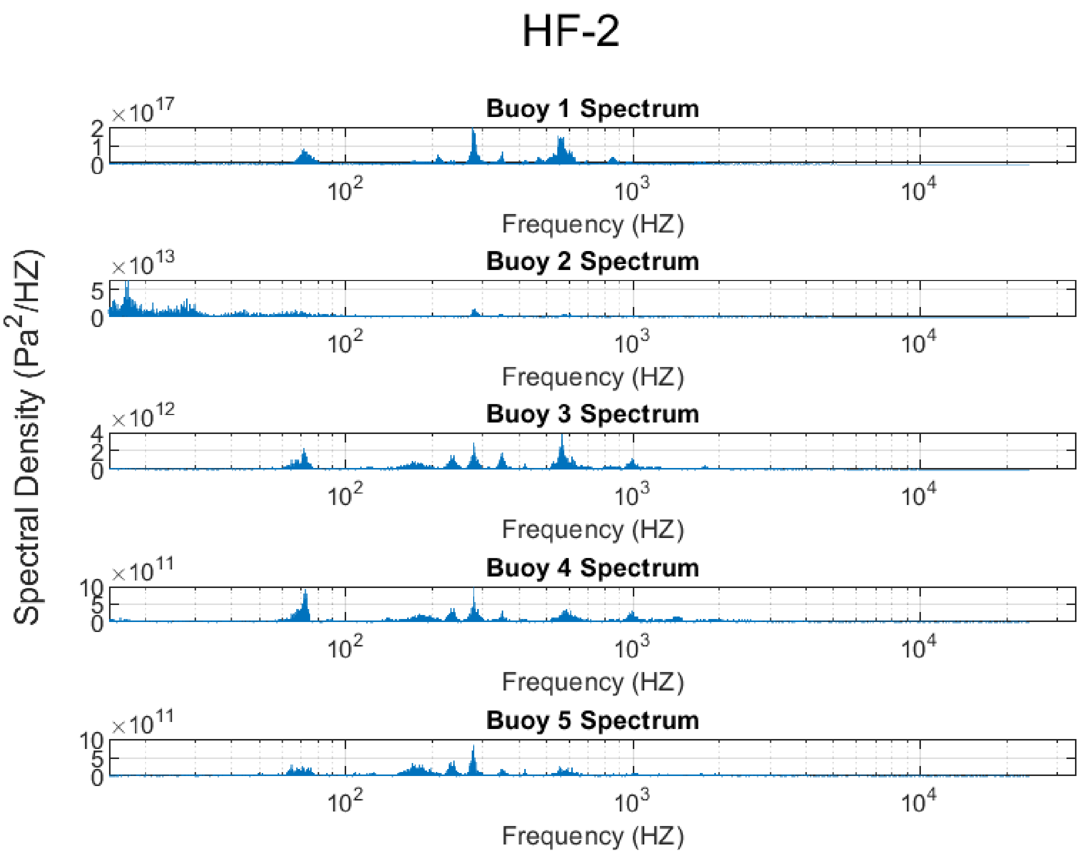


Figure 3-2. Spectral data from 2nd drive at the Howard Frankland Bridge computed using Nyquist frequency

HF - 2

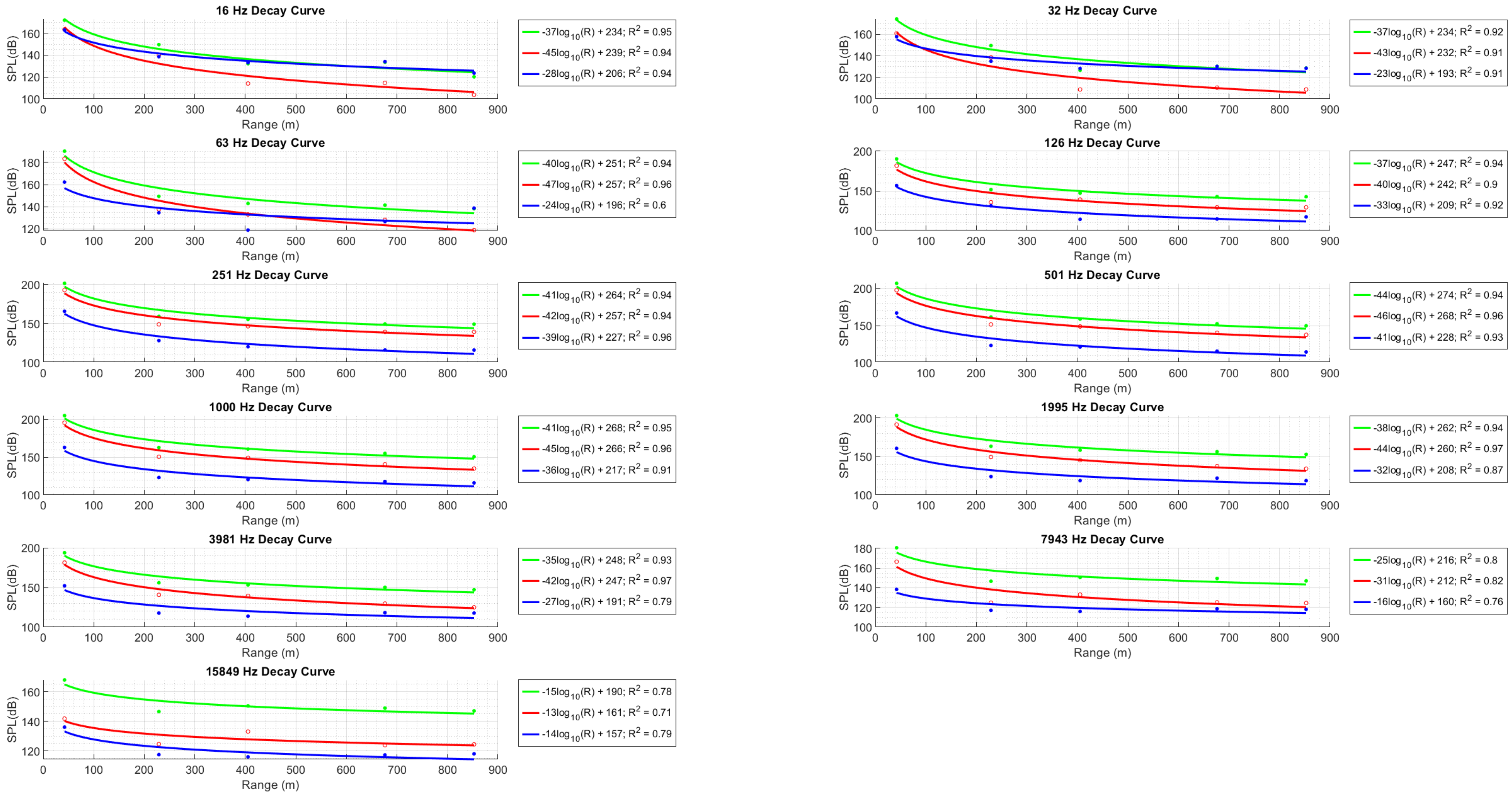


Figure 3-3. Decay curves in each band using 1/1 octave filtering for the 2nd drive at the Howard Frankland Bridge showing SEL (blue), PEAK (green), and RMS (red)

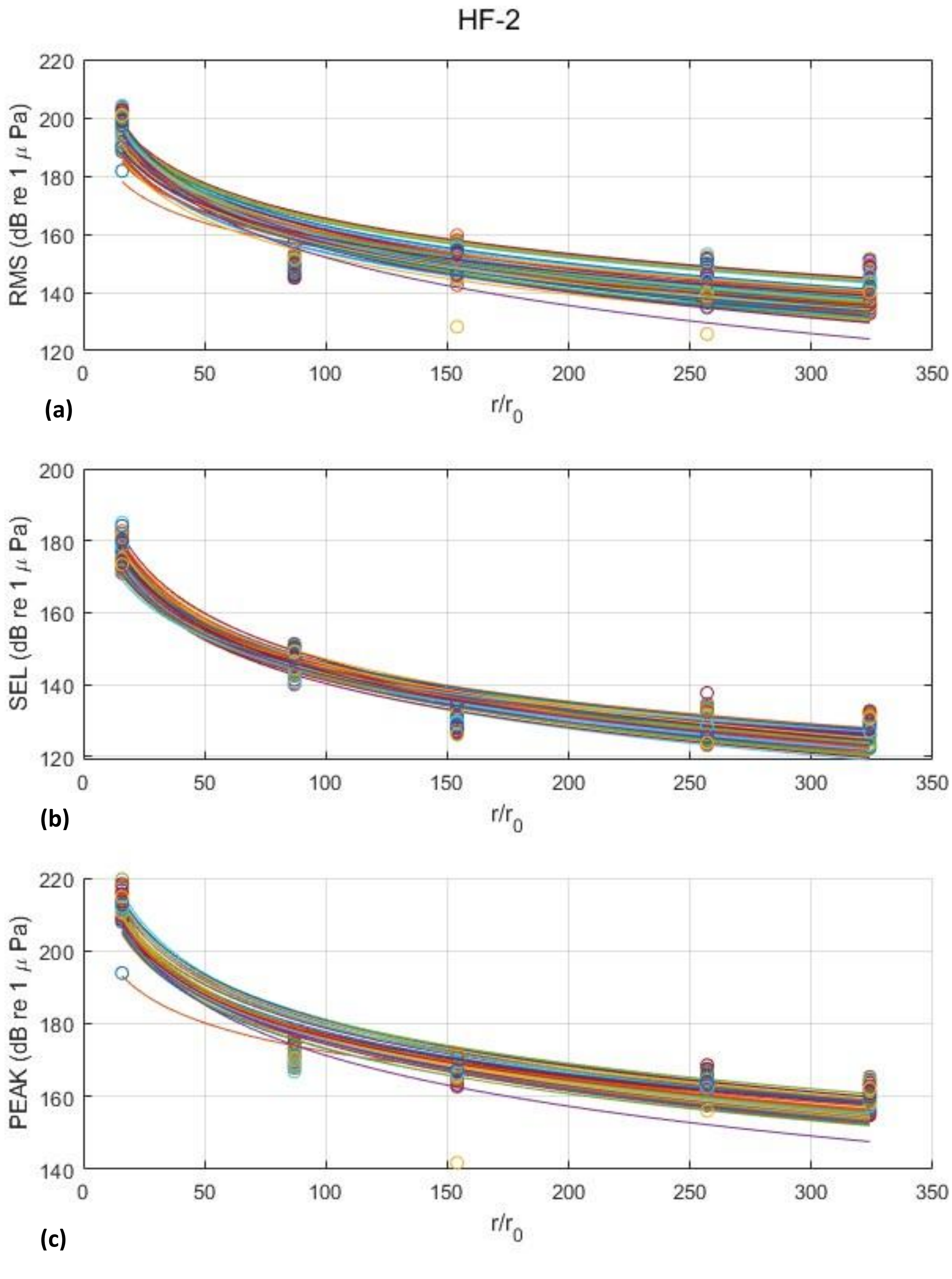


Figure 3-4. Blow-by-blow decay curves for the 2nd drive at the Howard Frankland Bridge showing (a) RMS; (b) SEL; and (c) PEAK

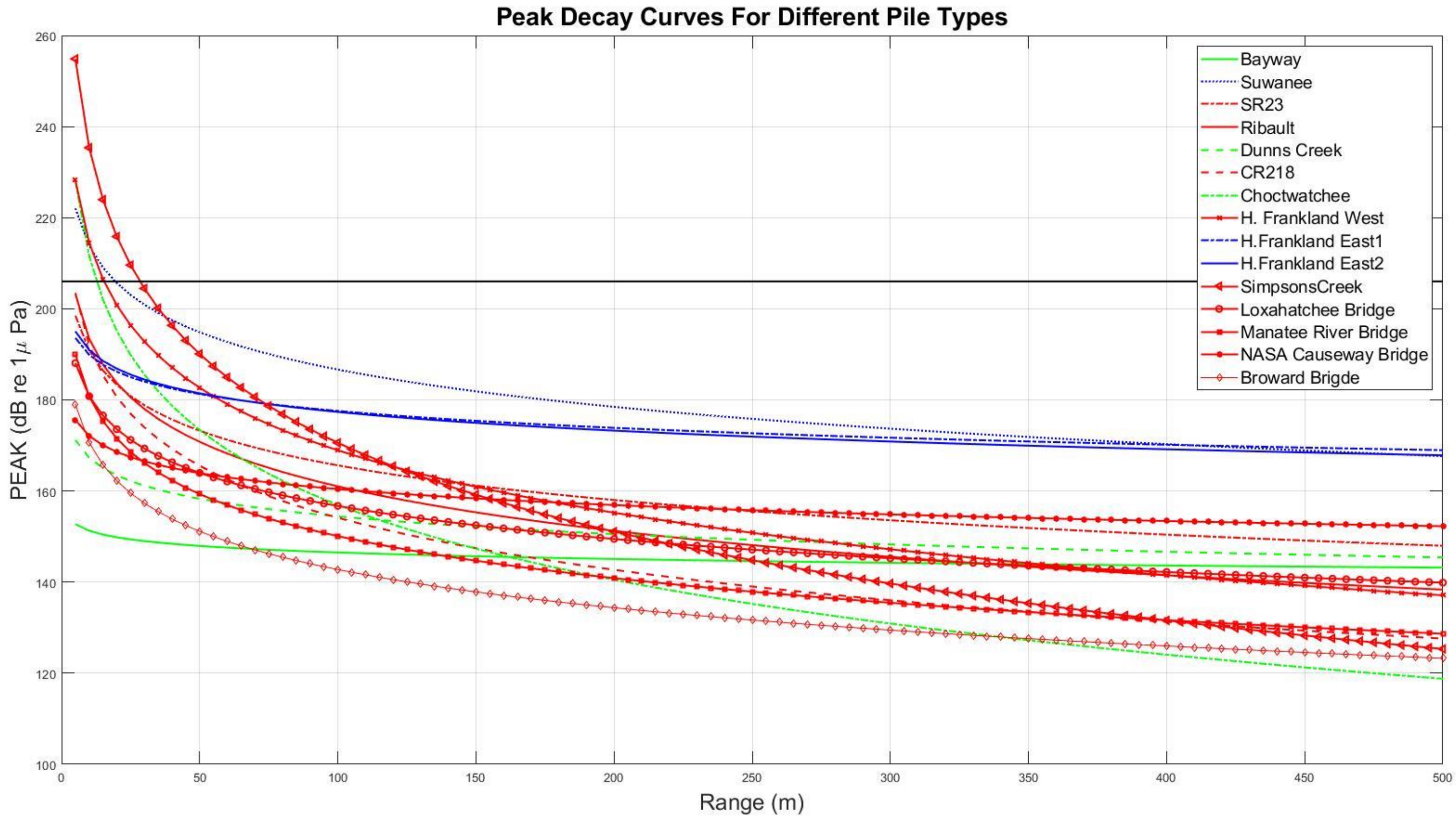


Figure 3-5. Decay curves for sites with different pile types; Red – Concrete Piles Impact Driving; Blue – Steel Piles Impact Driving; Green – Vibration Driving; the black line shows the 206 dB peak threshold; PEAK data shown

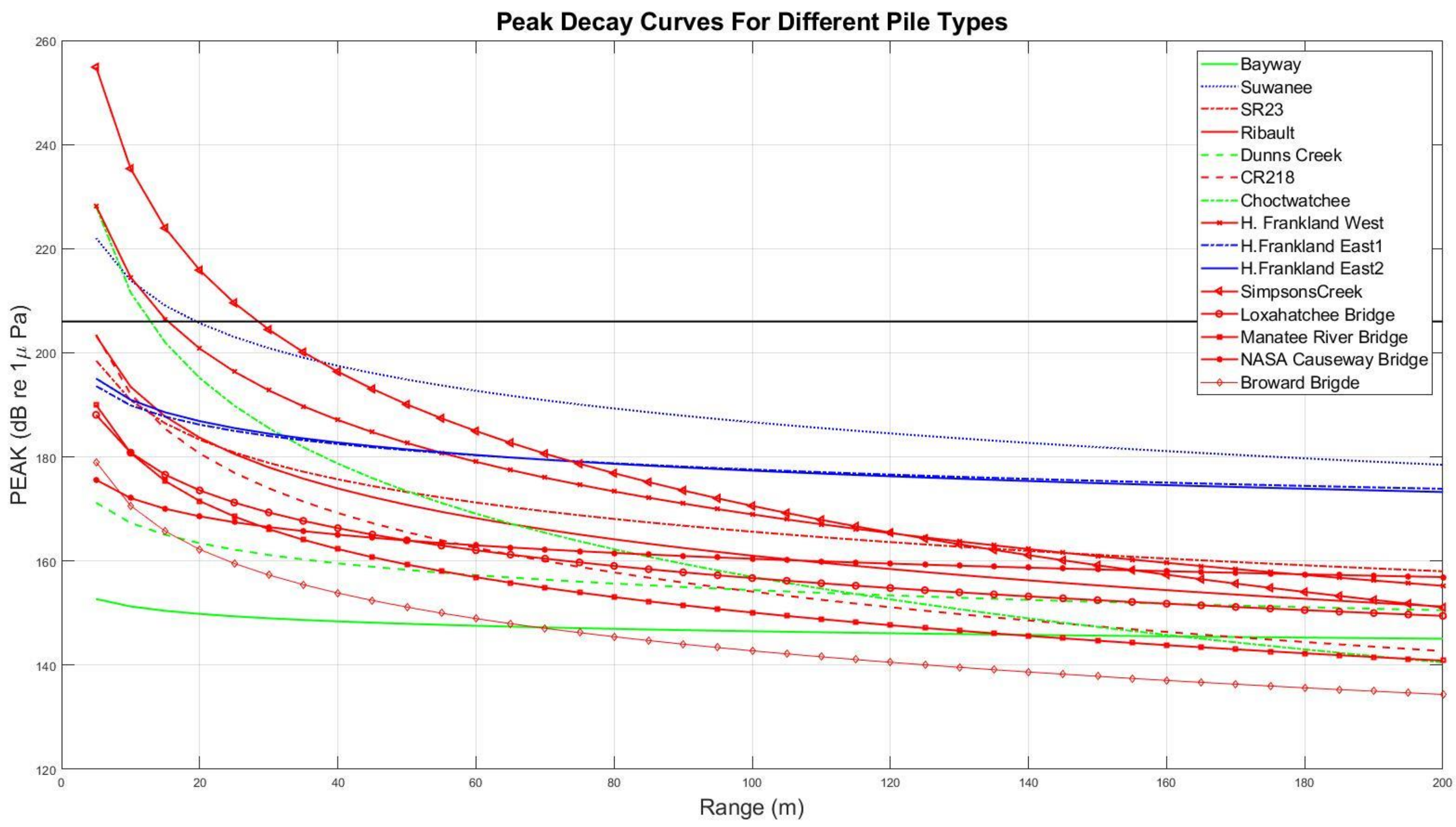


Figure 3-6. Zoomed-in decay curves for sites with different pile types; Red – Concrete Piles Impact Driving; Blue – Steel Piles Impact Driving; Green – Vibration Driving; the black line shows the 206 dB peak threshold; Note that in all cases, sound was below the 206 dB threshold at Range ~30m; PEAK data shown

Table 3-1. Pile drive summary table

Site Name	Pile ID	Drives	Date	Hammer Type	Hammer Cushion	Pile Type	Pile Cushion	Distance to Pile from Hydrophone (m)	Full Event												
									Background	Measured			Level at 10 meters			TL Coefficient			R^2 Value		
										RMS	SEL	PEAK	RMS	SEL	PEAK	RMS	SEL	PEAK	RMS	SEL	PEAK
Bayway E	N/A	1	6/4/2019	200T vibratory driver	N/A	36-inch diam. by 85-ft long open-ended steel piles	N/A	25	121	163	163	161	149	149	155	14	14	6	0.41	0.42	0.12
								73	121												
								25	121												
								370	121												
Dunn's Creek	N/A	1	3/14/2019	200T vibratory driver	N/A	18 in. wide PZ-27 sheet piles driven in pairs	N/A	60	120	175	176	177	158	159	165	17	17	12	0.98	0.98	1.00
								202	120												
								396	120												
		2	3/14/2019	200T vibratory driver	N/A	18 in. wide PZ-27 sheet piles driven in pairs	N/A	60	120	175	176	177	158	159	165	17	17	12	0.98	0.98	1.00
								202	120												
								396	120												
Ribault River	IB3, Pile 1 ID (Test Pile)	1	5/7/2019	APE D36-42	2 x 1 in micarta + 3 x 0.5 in aluminum	24-in. by 24-in. by 110-ft long square PCP	15-inch plywood	25	106	214	193	222	176	163	189	38	30	33	0.53	0.56	0.45
								49	106												
								195	106												
								70	106												
	Pile 2 (Bent 3)	2	6/10/2019	APE D36-42	2 x 1 in micarta + 3 x 0.5 in aluminum	24-in. by 24-in. by 110-ft long square PCP	15-inch plywood	27	106	229	193	225	185	166	193	44	27	32	0.62	0.56	0.44
								50	106												
								107	106												
								200	106												
		3	6/10/2019	APE D36-42	2 x 1 in micarta + 3 x 0.5 in aluminum	24-in. by 24-in. by 110-ft long square PCP	15-inch plywood	27	106	218	187	217	178	161	185	40	26	32	0.65	0.62	0.38
								50	106												
								107	106												
								200	106												
		4	6/10/2019	APE D36-42	2 x 1 in micarta + 3 x 0.5 in aluminum	24-in. by 24-in. by 110-ft long square PCP	15-inch plywood	27	106	238	203	243	189	169	200	49	34	43	0.94	0.92	0.96
								50	106												
								107	106												
								200	106												
Suwannee River	N/A	1	4/18/2019	Del-Mag D-46	Not recorded	24-in. diameter by 60-ft long open ended steel piles	N/A	15	134	232	202	235	199	180	209	33	22	26	0.99	1.00	0.99
								65	134												
								102	134												
		2	4/18/2019	Del-Mag D-46	Not recorded	24-in. diameter by 60-ft long open ended steel piles	N/A	15	134	238	207	242	203	183	213	35	24	29	0.98	0.99	0.99
								65	134												
								102	134												
		3	4/18/2019	Del-Mag D-46	Not recorded	24-in. diameter by 60-ft long open ended steel piles	N/A	15	134	241	209	241	205	184	214	36	25	27	0.98	1.00	1.00
								65	134												
								102	134												

Site Name	Pile ID	Drives	Date	Hammer Type	Hammer Cushion	Pile Type	Pile Cushion	Distance to Pile from Hydrophone (m)	Full Event												
									Background	Measured			Level at 10 meters			TL Coefficient			R^2 Value		
										RMS	SEL	PEAK	RMS	SEL	PEAK	RMS	SEL	PEAK	RMS	SEL	PEAK
CR-218	Pile 4 (Bent 3)	1	12/4/2020	APE D46-32	3-in. aluminum at 0.5-in. + micarta at 1-in.	24-in. by 24-in. by 110-ft long square PCP	15-inch plywood	53 82 124 191 235	105 105 105 105 105	227	199	243	181	165	197	46	34	46	0.93	0.92	0.93
		2	12/4/2020	APE D46-32	3-in. aluminum at 0.5-in. + micarta at 1-in.	24-in. by 24-in. by 110-ft long square PCP	15-inch plywood	53 82 124 191 235	105 105 105 105 105	193	199	230	168	169	192	25	30	38	0.85	0.69	0.86
		3	12/4/2020	APE D46-32	3-in. aluminum at 0.5-in. + micarta at 1-in.	24-in. by 24-in. by 110-ft long square PCP	15-inch plywood	53 82 124 191 235	105 105 105 105 105	194	199	231	169	169	193	25	30	38	0.79	0.64	0.88
SR-23	Pile 5 (Bent 4)	1	1/8/2021	APE D62 with D70	3-in. aluminum at 0.5-in. + micarta at 1-in.	24-in. by 24-in. by 95-ft long square PCP	12-inch plywood	35 80 221 310	102 102 102 102	181	178	182	162	159	171	19	19	11	0.77	0.61	0.53
	Pile 6 (Bent 4)	2	1/8/2021	APE D62 with D70	3-in. aluminum at 0.5-in. + micarta at 1-in.	24-in. by 24-in. by 95-ft long square PCP	12-inch plywood	35 80 221 310	102 102 102 102	180	177	186	162	159	173	18	18	13	0.84	0.64	0.67
SR-23	Pile 4 (Bent 4)	3	1/8/2021	APE D62 with D70	3-in. aluminum at 0.5-in. + micarta at 1-in.	24-in. by 24-in. by 95-ft long square PCP	12-inch plywood	35 80 221 310	102 102 102 102	175	175	181	158	157	169	17	18	12	0.70	0.63	0.60
	Pile 1 (Bent 4)	4	1/8/2021	APE D62 with D70	3-in. aluminum at 0.5-in. + micarta at 1-in.	24-in. by 24-in. by 95-ft long square PCP	12-inch plywood	35 80 221 310	102 102 102 102	174	175	180	157	157	170	17	18	10	0.65	0.66	0.51
	Pile 2 (Bent 4)	5	1/8/2021	APE D62 with D70	3-in. aluminum at 0.5-in. + micarta at 1-in.	24-in. by 24-in. by 95-ft long square PCP	12-inch plywood	35 80 221 310	102 102 102 102	175	175	181	158	158	170	17	17	11	0.68	0.66	0.58
	Pile 3 (Bent 4)	6	1/21/2021	APE D62 with D70	3-in. aluminum at 0.5-in. + micarta at 1-in.	24-in. by 24-in. by 95-ft long square PCP	12-inch plywood	38 97 196 257 348	102 102 102 102 102	203	199	216	175	172	191	28	27	25	0.91	1.00	0.94
	Pile 10 (Bent 4)	7	1/21/2021	APE D62 with D70	3-in. aluminum at 0.5-in. + micarta at 1-in.	24-in. by 24-in. by 95-ft long square PCP	12-inch plywood	38 97 196 257 348	102 102 102 102 102	191	195	211	170	170	189	21	25	22	0.98	0.99	0.94
	Pile 12 (Bent 4)	8	1/21/2021	APE D62 with D70	3-in. aluminum at 0.5-in. + micarta at 1-in.	24-in. by 24-in. by 95-ft long square PCP	12-inch plywood	38 97 196 257 348	102 102 102 102 102	209	203	221	179	175	195	30	28	26	0.94	1.00	0.96

Site Name	Pile ID	Drives	Date	Hammer Type	Hammer Cushion	Pile Type	Pile Cushion	Distance to Pile from Hydrophone (m)	Full Event												
									Background	Measured			Level at 10 meters			TL Coefficient			R^2 Value		
										RMS	SEL	PEAK	RMS	SEL	PEAK	RMS	SEL	PEAK	RMS	SEL	PEAK
SR-23	Pile 9 (Bent 4)	9	1/21/2021	APE D62 with D70	3-in. aluminum at 0.5-in. + micarta at 1-in.	24-in. by 24-in. by 95-ft long square PCP	12-inch plywood	38	102	195	197	208	170	170	185	25	27	23	0.98	0.99	0.96
								97	102												
								196	102												
								257	102												
								348	102												
Choctawatchee Bay	N/A	1	1/25/2021	200T vibratory driver	N/A	PZ-27 SHEET	N/A	23	121	265	264	266	204	205	212	61	59	54	0.76	0.76	0.71
								67	121												
								123	121												
								224	121												
								320	121												
		2	1/29/2021	200T vibratory driver	N/A	PZ-27 SHEET	N/A	14	121	224	224	229	173	173	182	51	51	47	0.88	0.89	0.89
								44	121												
								78	121												
								139	121												
								176	121												
Howard Frankland West	N/A	1	6/28/2021	APE D80-42	2 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	16	117	223	224	245	187	187	208	36	37	37	0.94	0.97	0.92
								87	117												
								154	117												
								257	117												
								324	117												
		2	6/28/2021	APE D80-42	2 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	16	117	247	234	258	203	193	217	44	41	41	0.92	0.97	0.94
								87	117												
								154	117												
								257	117												
								324	117												
		3	6/28/2021	APE D80-42	2 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	16	117	244	231	255	203	193	218	41	38	37	0.89	0.96	0.95
								87	117												
								257	117												
								324	117												
		4	6/28/2021	APE D80-42	2 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	16	117	224	225	243	185	186	206	39	39	37	0.94	0.93	0.95
								87	117												
								257	117												
								324	117												
		5	6/28/2021	APE D80-42	2 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	16	117	225	224	243	187	186	206	38	38	37	0.92	0.92	0.95
								87	117												
								257	117												
								324	117												
		6	6/28/2021	APE D80-42	2 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	16	117	225	222	248	188	186	211	37	36	37	0.98	0.92	0.95
								87	117												
								257	117												
								324	117												
		7	6/28/2021	APE D80-42	2 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	16	117	228	223	248	190	186	210	38	37	38	0.97	0.93	0.95
								87	117												
								257	117												
								324	117												
		8	6/28/2021	APE D80-42	2 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	16	117	231	229	249	191	189	210	40	40	39	0.96	0.96	0.95
								87	117												
								257	117												
								324	117												

Site Name	Pile ID	Drives	Date	Hammer Type	Hammer Cushion	Pile Type	Pile Cushion	Distance to Pile from Hydrophone (m)	Full Event												
									Background	Measured			Level at 10 meters			TL Coefficient			R^2 Value		
										RMS	SEL	PEAK	RMS	SEL	PEAK	RMS	SEL	PEAK	RMS	SEL	PEAK
Howard Frankland West	Pile 3 (Pier 1-112)	9	6/29/2021	APE D80-42	2 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	18 128 175 275	117 117 117 117	240	252	242	201	203	209	39	49	33	0.98	0.97	0.99
		10	6/29/2021	APE D80-42	2 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	18 128 175 275	117 117 117 117	228	242	255	196	199	218	32	43	37	0.98	0.97	0.98
		11	6/29/2021	APE D80-42	2 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	18 128 175 275	117 117 117 117	227	239	227	195	197	202	32	42	25	0.99	0.98	0.99
		12	6/30/2021	APE D80-42	2 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	52 91 183 238	117 117 117 117	256	216	244	209	183	210	47	33	34	0.95	0.98	0.98
Howard Frankland West	Pile 8 (Pier 1-102)	13	6/30/2021	APE D80-42	2 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	18 52 91 183 238	117 117 117 117 117	250	240	264	207	197	221	43	43	43	0.98	0.93	0.95
		14	6/30/2021	APE D80-42	2 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	18 52 91 183 238	117 117 117 117 117	237	238	268	199	196	223	38	42	45	0.97	0.93	0.95
		15	6/30/2021	APE D80-42	2 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	18 52 183 238	117 117 117 117	240	241	262	202	198	220	38	43	42	0.99	0.93	0.94
		16	7/1/2021	APE D80-42	2 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	16 47 224	117 117 117	221	226	234	183	185	199	38	41	35	0.80	0.84	0.83
		17	7/1/2021	APE D80-42	2 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	16 47 224	117 117 117	223	225	235	183	184	199	40	41	36	0.82	0.83	0.84
		18	7/1/2021	APE D80-42	2 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	16 47 224	117 117 117	219	226	236	183	186	202	36	40	34	0.82	0.86	0.83
Howard Frankland East	N/A	1	8/9/2021	APE D30-42	2 x 1 in micarta + 3 x 0.5 in aluminum	W40 x 183 king pile	N/A	0.5 49.5 104 201 395	117 117 117 117 117	190	174	203	177	161	190	13	13	13	0.86	0.87	0.86
		2	8/9/2021	APE D30-42	2 x 1 in micarta + 3 x 0.5 in aluminum	W40 x 183 king pile	N/A	0.5 49.5 104 201 395	117 117 117 117 117	190	174	203	178	162	191	12	12	12	0.82	0.84	0.87

Site Name	Pile ID	Drives	Date	Hammer Type	Hammer Cushion	Pile Type	Pile Cushion	Distance to Pile from Hydrophone (m)	Full Event												
									Background	Measured			Level at 10 meters			TL Coefficient			R^2 Value		
										RMS	SEL	PEAK	RMS	SEL	PEAK	RMS	SEL	PEAK	RMS	SEL	PEAK
Howard Frankland East	N/A	1	8/11/2021	APE D30-42	2 x 1 in micarta + 3 x 0.5 in aluminum	W40 x 183 king pile	N/A	1 54 104.5 201 402	117 117 117 117 117	197	181	210	182	167	195	15	14	15	0.93	0.94	0.94
		2	8/11/2021	APE D30-42	2 x 1 in micarta + 3 x 0.5 in aluminum	W40 x 183 king pile	N/A	1 54 104.5 201 402	117 117 117 117 117	196	179	210	183	166	196	13	13	14	0.91	0.93	0.92
		3	8/11/2021	APE D30-42	2 x 1 in micarta + 3 x 0.5 in aluminum	W40 x 183 king pile	N/A	1 54 104.5 201 402	117 117 117 117 117	194	178	208	182	166	195	12	12	13	0.88	0.91	0.91
		4	8/11/2021	APE D30-42	2 x 1 in micarta + 3 x 0.5 in aluminum	W40 x 183 king pile	N/A	1 54 104.5 201 402	117 117 117 117 117	224	206	237	199	182	212	25	24	25	1.00	1.00	1.00
		5	8/11/2021	APE D30-42	2 x 1 in micarta + 3 x 0.5 in aluminum	W40 x 183 king pile	N/A	1 54 104.5 201 402	117 117 117 117 117	215	198	227	191	176	204	24	22	23	0.93	0.99	0.99
		6	8/11/2021	APE D30-42	2 x 1 in micarta + 3 x 0.5 in aluminum	W40 x 183 king pile	N/A	1 54 104.5 201 402	117 117 117 117 117	217	199	231	194	177	207	23	22	24	0.99	0.99	0.99
		7	8/11/2021	APE D30-42	2 x 1 in micarta + 3 x 0.5 in aluminum	W40 x 183 king pile	N/A	1 54 104.5 201 402	117 117 117 117 117	190	173	202	179	162	192	11	11	10	0.86	0.86	0.85
		8	8/11/2021	APE D30-42	2 x 1 in micarta + 3 x 0.5 in aluminum	W40 x 183 king pile	N/A	1 54 104.5 201 402	117 117 117 117 117	193	176	205	181	164	194	12	12	11	0.85	0.89	0.86
		9	8/11/2021	APE D30-42	2 x 1 in micarta + 3 x 0.5 in aluminum	W40 x 183 king pile	N/A	1 54 104.5 201 402	117 117 117 117 117	196	179	208	183	166	195	13	13	13	0.92	0.94	0.94

Site Name	Pile ID	Drives	Date	Hammer Type	Hammer Cushion	Pile Type	Pile Cushion	Distance to Pile from Hydrophone (m)	Full Event												
									Background	Measured			Level at 10 meters			TL Coefficient			R^2 Value		
										RMS	SEL	PEAK	RMS	SEL	PEAK	RMS	SEL	PEAK	RMS	SEL	PEAK
Howard Frankland East	N/A	1	11/2/2021	APE D80-42	3 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	18	117	185	176	205	170	164	191	15	12	14	0.59	0.84	0.55
								42	117												
								106	117												
								207	117												
								400	117												
		2	11/2/2021	APE D80-42	3 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	18	117	180	174	202	167	162	190	13	12	12	0.51	0.50	0.44
								42	117												
								106	117												
								207	117												
								400	117												
		3	11/2/2021	APE D80-42	3 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	18	117	188	182	210	171	167	196	17	15	14	0.67	0.60	0.52
								42	117												
								106	117												
								207	117												
								400	117												
		4	11/2/2021	APE D80-42	3 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	18	117	185	186	213	173	171	202	12	15	11	0.65	0.76	0.57
								42	117												
								106	117												
								207	117												
								400	117												
		5	11/2/2021	APE D80-42	3 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	18	117	173	171	204	167	164	197	6	7	7	0.44	0.58	0.66
								42	117												
								106	117												
								207	117												
								400	117												
		6	11/2/2021	APE D80-42	3 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	18	117	176	179	210	168	169	199	8	10	11	0.45	0.63	0.53
								42	117												
								106	117												
								207	117												
								400	117												
		7	11/2/2021	APE D80-42	3 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	18	117	189	177	200	172	165	191	17	12	9	0.91	0.68	0.36
								42	117												
								106	117												
								207	117												
								400	117												
Howard Frankland East	N/A	1	11/3/2021	APE D80-42	3 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	62	117	246	231	256	208	194	219	38	37	37	0.92	0.92	0.91
								100	117												
								403	117												
		2	11/3/2021	APE D80-42	3 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	62	117	266	228	258	218	193	220	48	35	38	0.94	0.97	0.98
								100	117												
								403	117												
		3	11/3/2021	APE D80-42	3 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	62	117	278	238	267	225	198	225	53	40	42	0.96	0.98	0.98
								100	117												
								403	117												
		4	11/3/2021	APE D80-42	3 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	62	117	266	224	253	216	190	217	50	34	36	0.97	0.96	0.96
								100	117												
								403	117												
		5	11/3/2021	APE D80-42	3 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	62	117	264	223	248	214	189	213	50	34	35	1.00	0.97	0.99
								100	117												
								403	117												

Site Name	Pile ID	Drives	Date	Hammer Type	Hammer Cushion	Pile Type	Pile Cushion	Distance to Pile from Hydrophone (m)	Full Event												
									Background	Measured			Level at 10 meters			TL Coefficient			R^2 Value		
										RMS	SEL	PEAK	RMS	SEL	PEAK	RMS	SEL	PEAK	RMS	SEL	PEAK
Howard Frankland East	N/A	6	11/3/2021	APE D80-42	3 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	62	117	266	225	263	215	190	221	51	35	42	1.00	0.97	1.00
								100	117												
								403	117												
		7	11/3/2021	APE D80-42	3 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	62	117	271	229	258	218	193	219	53	36	39	1.00	0.97	0.99
								100	117												
								403	117												
		8	11/3/2021	APE D80-42	3 x 1 in micarta + 3 x 0.5 in aluminum	30-in. by 30-in. by 73-ft long square PCP	18-inch plywood	62	117	277	234	263	223	196	223	54	38	40	1.00	0.98	0.98
								100	117												
								403	117												
Simpson's Creek Bridge	Pile 6 (Bent 3)	1	1/31/2022	APE D36-32	3.5" aluminium, Micarta	24-in. by 24-in. by 70-ft long square PCP	12-inch plywood	49	133	298	275	299	224	212	235	74	63	64	0.81	0.79	0.80
								92.5	133												
								145	133												
Loxahatchee Bridge	N/A	1	6/2/2022	Pileco D100-13	8 x 1 in conbest + 3 x 0.5 in aluminum	30-in. by 30-in. by 130-ft long square PCP	30-inch plywood	46	128	199	199	226	173	173	196	26	26	30	0.85	0.81	0.95
								92	128												
								145	128												
		2	6/2/2022	Pileco D100-13	8 x 1 in conbest + 3 x 0.5 in aluminum	30-in. by 30-in. by 130-ft long square PCP	30-inch plywood	46	128	211	198	237	182	173	203	29	25	34	1.00	0.97	0.96
								92	128												
								145	128												
		3	6/2/2022	Pileco D100-13	8 x 1 in conbest + 3 x 0.5 in aluminum	30-in. by 30-in. by 130-ft long square PCP	30-inch plywood	46	128	209	197	228	178	170	197	31	27	31	0.92	0.97	0.98
								92	128												
								145	128												
		4	6/2/2022	Pileco D100-13	8 x 1 in conbest + 3 x 0.5 in aluminum	30-in. by 30-in. by 130-ft long square PCP	30-inch plywood	46	128	232	214	256	188	178	209	44	36	47	0.97	0.92	0.93
								92	128												
								145	128												
Manatee River Bridge	N/A	1	8/102022	APE D62-52	2 x 1 in micarta + 3 x 0.5 in aluminum	24-in. by 24-in. by 95-ft long square PCP	12-inch plywood	52.5	120	181	182	197	161	162	177	20	20	20	0.86	0.86	0.87
								121	120												
								209	120												
		2	8/9/2022	APE D62-52	2 x 1 in micarta + 3 x 0.5 in aluminum	24-in. by 24-in. by 95-ft long square PCP	12-inch plywood	52.5	120	180	182	210	158	160	180	22	22	30	0.85	0.86	0.85
								121	120												
								209	120												
		3	8/9/2022	APE D62-52	2 x 1 in micarta + 3 x 0.5 in aluminum	24-in. by 24-in. by 95-ft long square PCP	12-inch plywood	52.5	120	211	212	223	179	180	190	32	32	33	0.85	0.85	0.84
								121	120												
								209	120												
NASA Causeway Bridge	Pier-20	1	9/20/2022	Pileco D70-32	8 x 2 in conbest + 3 x 0.5 in aluminum	30-in. by 30-in. by 130-ft long square PCP	15-inch plywood	15	125	183	185	184	162	163	170	21	22	14	0.75	0.83	0.42
								50	125												
								200	125												
								300	125												
		2	9/20/2022	Pileco D70-32	8 x 2 in conbest + 3 x 0.5 in aluminum	30-in. by 30-in. by 130-ft long square PCP	15-inch plywood	15	125	228	223	255	185	183	208	43	40	47	0.96	0.96	0.95
								50	125												
								200	125												
								300	125												
		3	9/20/2022	Pileco D70-32	8 x 2 in conbest + 3 x 0.5 in aluminum	30-in. by 30-in. by 130-ft long square PCP	15-inch plywood	15	125	196	197	192	169	169	172	27	28	20	0.93	0.95	0.98
								50	125												
								200	125												
								300	125												

Site Name	Pile ID	Drives	Date	Hammer Type	Hammer Cushion	Pile Type	Pile Cushion	Distance to Pile from Hydrophone (m)	Full Event												
									Background	Measured			Level at 10 meters			TL Coefficient			R^2 Value		
										RMS	SEL	PEAK	RMS	SEL	PEAK	RMS	SEL	PEAK	RMS	SEL	PEAK
NASA Causeway Bridge	Pier-20	1	9/23/2022	Pileco D70-32	8 x 2 in conbest + 3 x 0.5 in aluminum	30-in. by 30-in. by 130-ft long square PCP	15-inch plywood	50	125	177	165	188	162	153	175	15	12	13	0.91	0.91	0.91
								200	125												
								300	125												
		2	9/23/2022	Pileco D70-32	8 x 2 in conbest + 3 x 0.5 in aluminum	30-in. by 30-in. by 130-ft long square PCP	15-inch plywood	50	125	178	154	187	165	147	176	13	7	11	0.88	0.92	0.94
								200	125												
								300	125												
		3	9/23/2022	Pileco D70-32	8 x 2 in conbest + 3 x 0.5 in aluminum	30-in. by 30-in. by 130-ft long square PCP	15-inch plywood	48.5	125	159	162	183	152	151	172	7	10	11	0.85	0.98	1.00
								204	125												
								405	125												
		4	9/23/2022	Pileco D70-32	8 x 2 in conbest + 3 x 0.5 in aluminum	30-in. by 30-in. by 130-ft long square PCP	15-inch plywood	48.5	125	162	163	181	151	152	170	11	11	11	0.90	0.90	0.91
								204	125												
								405	125												
		5	9/23/2022	Pileco D70-32	8 x 2 in conbest + 3 x 0.5 in aluminum	30-in. by 30-in. by 130-ft long square PCP	15-inch plywood	48.5	125	147	152	174	142	146	167	5	6	7	0.64	0.60	0.67
								204	125												
								405	125												
		6	9/23/2022	Pileco D70-32	8 x 2 in conbest + 3 x 0.5 in aluminum	30-in. by 30-in. by 130-ft long square PCP	15-inch plywood	48.5	125	162	162	182	152	152	171	10	10	11	0.97	0.97	0.98
								204	125												
								405	125												
Broward River Bridge	Pile 7(IB-2)	1	2/6/2023	APE D-50 OED	2 ea. 1" Micarta & 3 ea. 1/2" Aluminum	24-in. by 24-in. by 72-ft long square PCP	15-inch plywood	9	127	173	164	205	152	149	172	21	15	33	0.54	0.47	0.78
								15	127												
								32.5	127												
								60	127												

3.2 Results from CFD

An example of decay curve results from CFD using field bathymetry is presented below in Fig. 3-7 while comprehensive results from all CFD field data models are presented in Appendix H. Contours between apparent TL coefficients and absorption coefficients are presented in Fig. 3-8. An example of decay curve results from a set of hypothetical models is presented in Fig. 3-9 while a compendium of these results is presented in Appendix I.

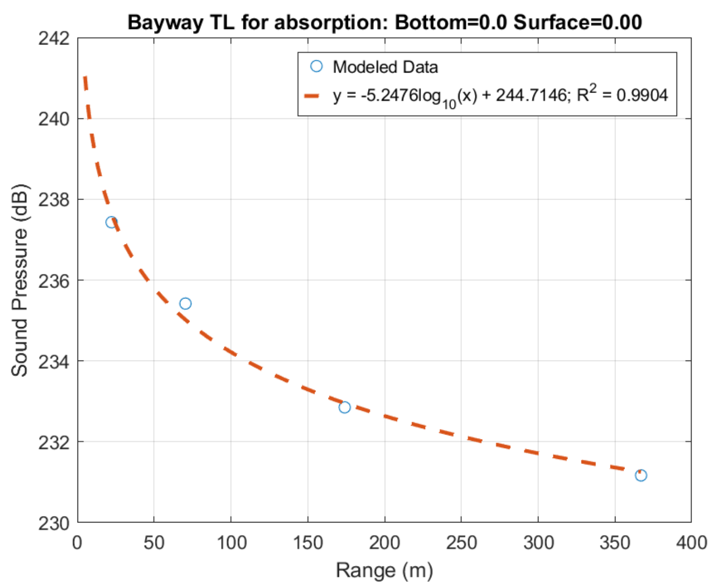


Figure 3-7. Bayway TL curve for 0.0 Bottom-0.00 Surface Absorption

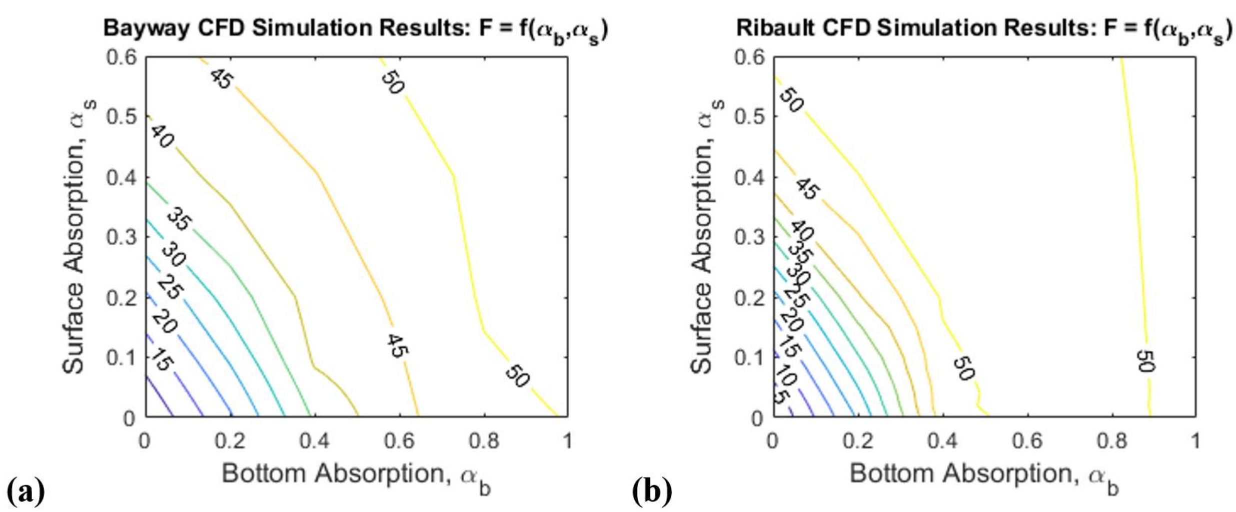


Figure 3-8. Apparent *A*-value contours from CFD simulation showing (a) Bayway E; and (b) Ribault River

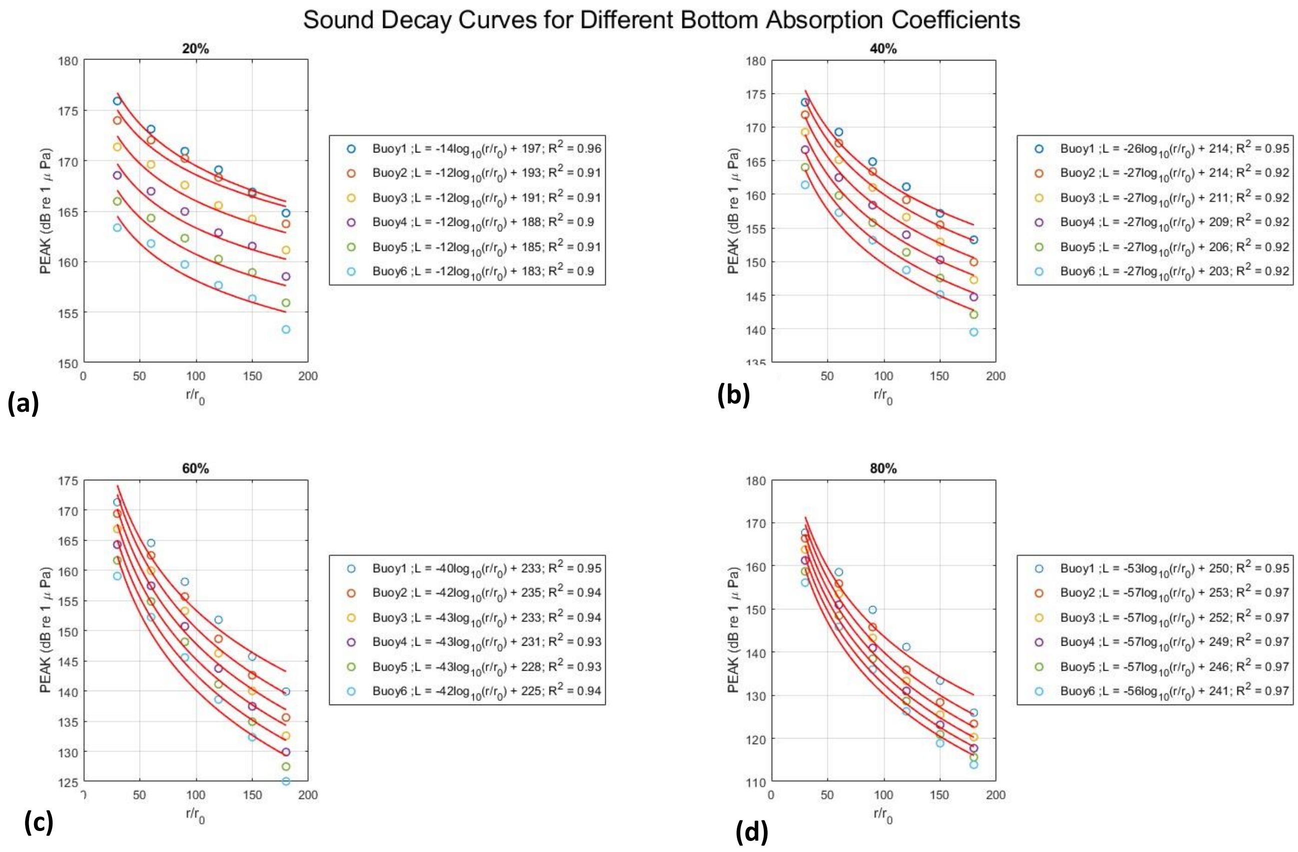


Figure 3-9. Decay curve results from hypothetical model S-Y30Z15 showing results using (a) 20% bottom absorption; (b) 40% bottom absorption; (c) 60% bottom absorption; and (d) 80% bottom absorption

CHAPTER 4
DISCUSSION

4.1 Field Data Analysis and Development of the FDOT Attenuation Coefficient Tool (FACT)

Examination of Table 3-1 would appear to suggest that for steel piles driven using a percussion hammer, TL coefficients near 15 were usually observed. Of the 14 steel percussion drives, the mean F-value was 15.4 dB; the high was 28 dB; the low was 9 dB; the median was 13 dB; and the standard deviation was 6.5 dB. For steel piles driven using a vibratory hammer (these consisted of sheet piles and circular piles), F-values were further away from F=15 dB with a mean value of 26.2 dB; a high of 54 dB; a low of 6 dB; a median of 12 dB; and a standard deviation of 22.5 dB. While these data show much higher attenuation than F = 15 dB, and verification (please see below) produced accurate results, these data are limited and should be treated cautiously.

However, for concrete piles, results were quite different in the sense that much more variability was observed in observed F-values. Concrete data were obtained for 70 drive events. Analysis of Table 3-1 shows that in concrete piles, the mean F-value was 30 dB; the median was 33 dB; the high was 70 dB; the low was 7 dB; and the standard deviation was 13.7 dB. Investigators tried to correlate these variabilities to local site conditions like geotechnical absorption, water depth, and channel width, and even pile driver analyzer (PDA) data, but no strong correlations were observed with any of these variables. However, investigators noticed that there appeared to be a correlation between a (i.e., F or Ainslie's A) and b (i.e., $L_s - B$) from Eq. 2-2 and Eq. 2-3. b was plotted as a function of a and least squares best-fit regression lines of the form $b = a_1 a + a_2$ were fit to the data (see Fig. 4-1 below).

Interestingly, while steel data displayed less F-value variability, a similar linear relationship between a and b was observed in both steel and concrete. Investigators then tested to see if some of the variability observed in the concrete data may be explained by sound frequency. Using the 1/1 octave bands (simply to demonstrate proof of concept and reduce computational filtering time; we expect results would be similar using 1/3 octave bands), data were filtered into frequency bins, and RMS, SEL, and PEAK were computed for each frequency bin subset using best-fit least-squares regression equations like Eq. 2-2. Then, in each frequency bin, b was plotted as a function of a, and best-fit least-squared regression was used to linearly correlate b with a using an equation of the form $b = a_1 a + a_2$ (Fig. 4-2 through Fig. 4-4 below). As shown in Fig. 4-2 through Fig. 4-4, a was always strongly correlated with b in each frequency bin.

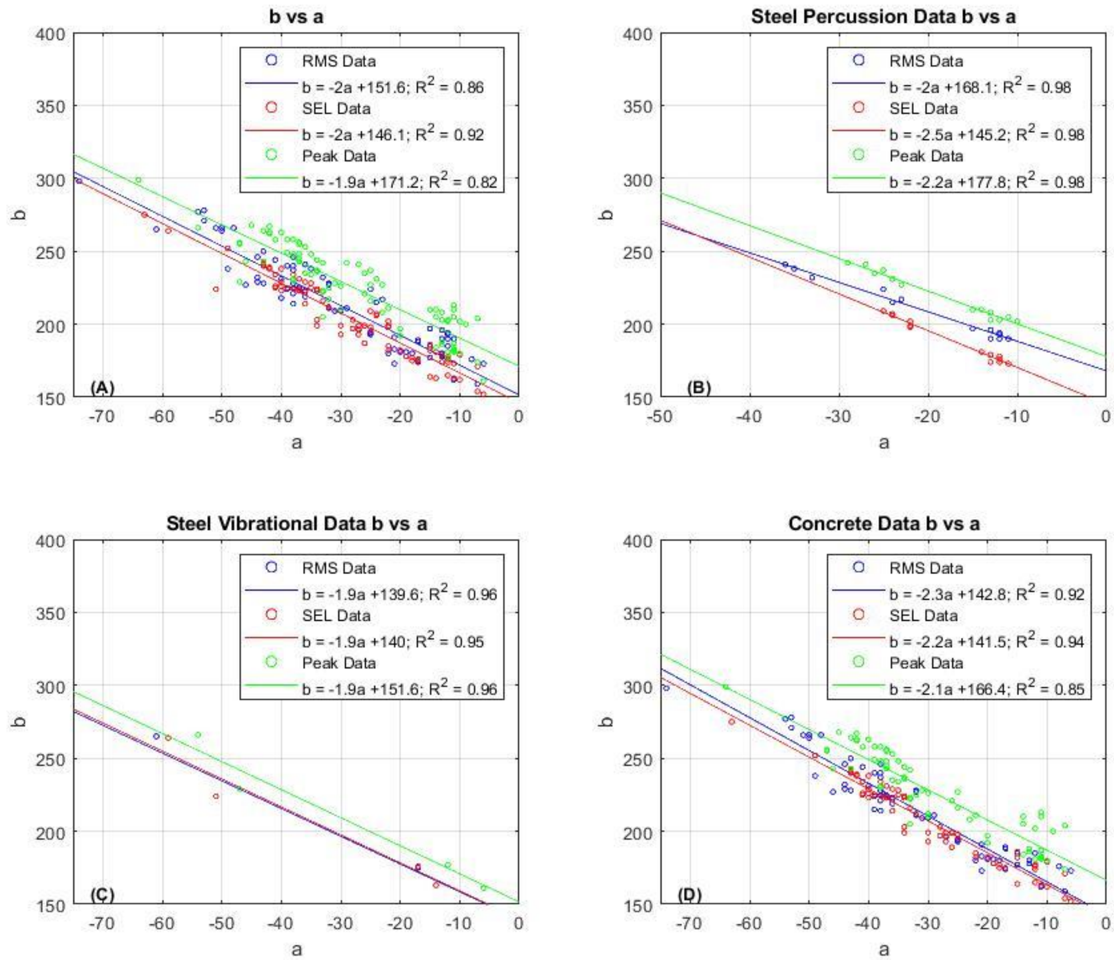


Figure 4-1. Apparent relationship between *b* and *a* shown using (a) all data collected during this study; (b) data for steel percussion drives only; (c) data for steel vibrational drives only; and (d) concrete data only. Note that both *a* and *b* are in dB re 1μPa

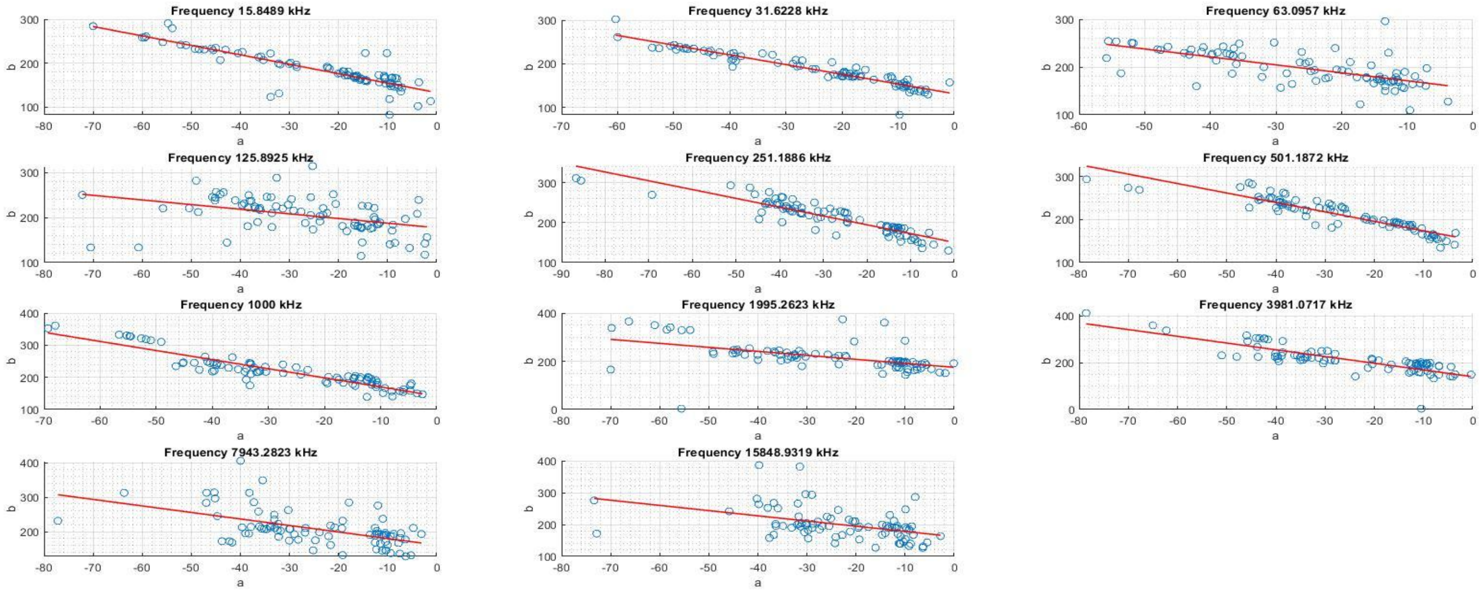


Figure 4-2. Relationships between *a* and *b* as a function of frequency using PEAK data; both *a* and *b* are in dB re 1μPa

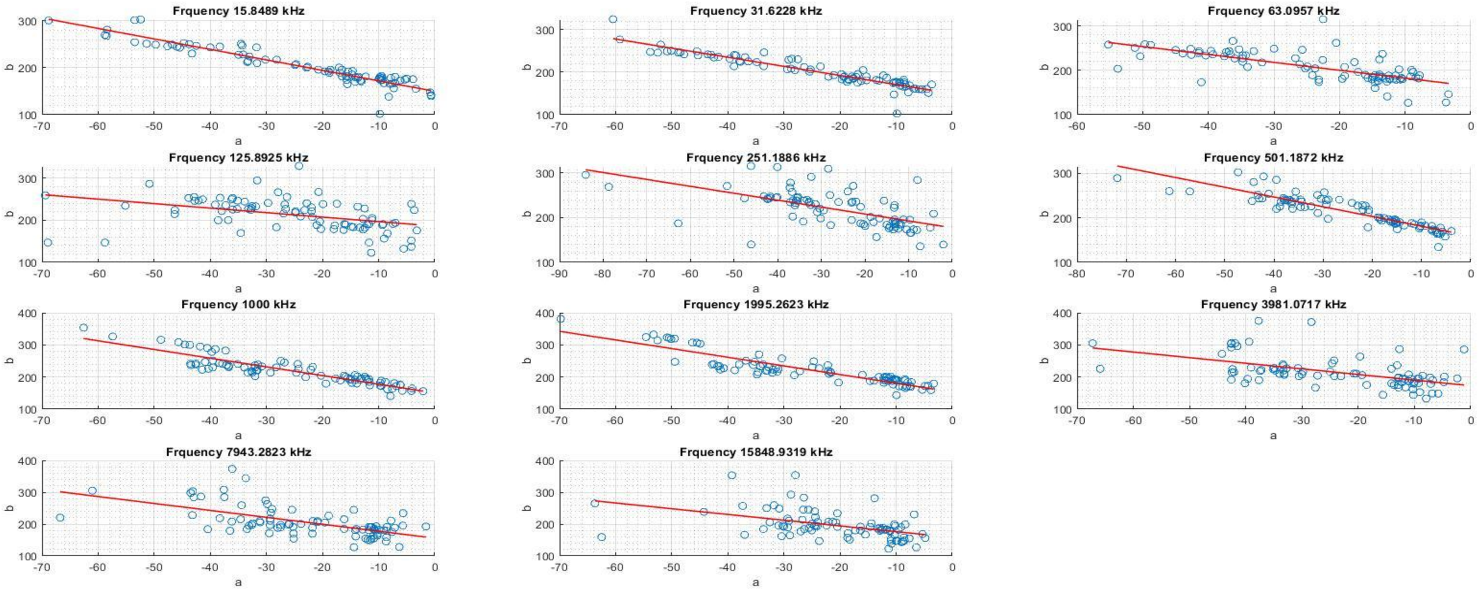


Figure 4-3. Relationships between a and b as a function of frequency using RMS data; both a and b are in dB re 1μPa

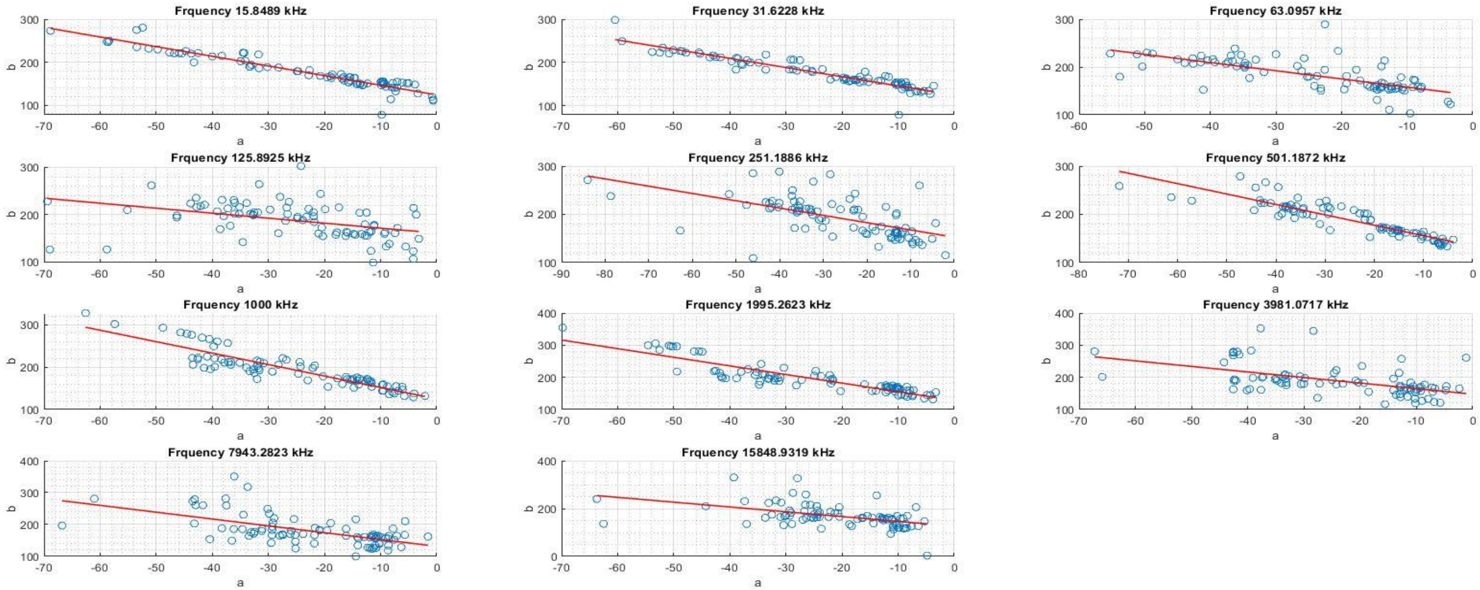


Figure 4-4. Relationships between a and b as a function of frequency using SEL data; both a and b are in dB re 1μPa

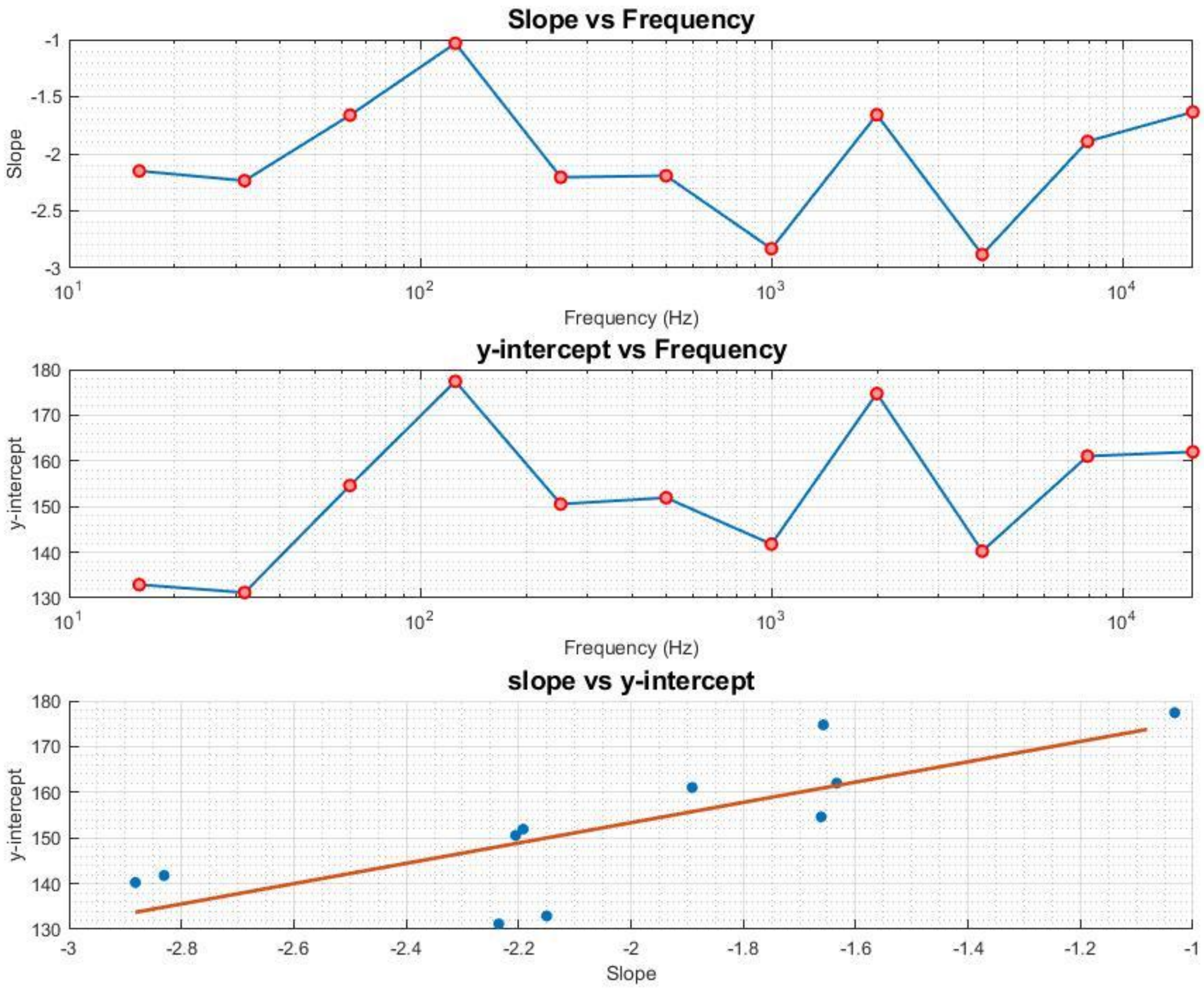


Figure 4-5. Relationships among intercepts and frequencies from all Peak data. Note that the slopes are unitless and the y-intercepts are in dB re 1μPa

Next, a_1 (i.e., slopes in Fig. 4-2 through Fig. 4-4) and a_2 (i.e., intercepts from Fig. 4-2 through Fig. 4-4) were plotted as a function of frequency (Fig. 4-5). The result explains the apparent correlation shown in Fig. 4-1. First, consider a hypothetical example where 200 dB were observed in each frequency band. Using Fig. 4-5, one may compute the resultant a (i.e., *F*) in each band. In other words, from Fig. 4-5, at each frequency, a_1 and a_2 are shown. Since $b = a_1 a + a_2$, solving for a yield $a = (b - a_2)/a_1$ at each frequency. Results of this analysis are shown below in Table 4-1:

Table 4-1. Hypothetical example showing the relative attenuation contribution in each frequency band using a source level (i.e., *b*-value) of 200 dB

Frequency (Hz)	Slope (i.e., a_1; unitless)	Intercept (i.e., a_2; dB)	*F*-value (i.e., a; dB)
16	2.15	133	31
31.5	2.23	131	31
63	1.68	155	27
125	1.02	178	22
250	2.2	151	22
500	2.2	153	21
1000	2.83	142	20
2000	1.65	175	15
4000	2.87	140	21
8000	1.87	161	21
16000	1.65	163	22

As shown, at lower frequencies (i.e., ~100 Hz or less), attenuation (i.e., the *F*-value) was much higher than at higher frequencies. In fact, above frequencies ~100 Hz, the *F*-values are relatively consistent in this hypothetical example.

Recall as well:

$$L_r = b + a \log_{10}\left(\frac{r}{r_0}\right) \tag{4-1}$$

From Fig. 4-1:

$$b = a_1 a + a_2 \tag{4-2}$$

Fig. 4-5 implies that both a_1 and a_2 are functions of the frequency, *f* and of one another. Thus:

$$a_2(f) = C a_1(f) + D \tag{4-3}$$

where *C* and *D* are constants in dB re 1μPa. Substituting Eq. 4-3 into Eq. 4-2:

$$b(f) = a_1(f) a + C a_1(f) + D \tag{4-4}$$

and finally, substituting Eq. 4-4 into Eq. 4-1:

$$L_r = a_1(f)a + Ca_1(f) + D + a\log_{10}\left(\frac{r}{r_0}\right) \tag{4-5}$$

Rearranging:

$$L_r = D + C\,a_1(f) + a\left[a_1(f) + \log_{10}\left(\frac{r}{r_0}\right)\right] \tag{4-6}$$

Or:

$$L_r = D + a_1(f)[C + a] + a\log_{10}\left(\frac{r}{r_0}\right) \tag{4-7}$$

In Eq. 4-7, $a\log_{10}\left(\frac{r}{r_0}\right)$ represents geometrical spreading (i.e., energy conservation). When additional attenuation is observed beyond this, Eq. 4-7 implies that this additional attenuation must be due to the sound's spectral distribution at the source. An F-value of 15 would appear to be a special case of Eq. 4-7 where $C = -15$ and $D = 0$. Note that this is the same argument made by Ainslie et al. (2014) who showed that $TL = A\log_{10}\left(\frac{r}{r_0}\right)$ is simply a special case of $TL = B + A\log_{10}\left(\frac{r}{r_0}\right)$ where $B = 0$. In effect, we have calibrated "Ainslie's *B*" as a function of frequency where $B \sim a_1[C + a] \propto f$.

The frequency dependency on attenuation is illustrated another way in Fig. 4-6 and Fig. 4-7 below which show two drives from the Howard Frankland Bridge. As shown in Fig. 4-6(d), at low frequencies (i.e., less than ~100 Hz), there was less spectral energy than shown in these low frequencies in Fig. 4-7(d). Note as well that the *F*-values shown in Fig. 4-6 are very close to *F* = 15 whereas in Fig. 4-7, *F*-values are much higher than *F* = 15.

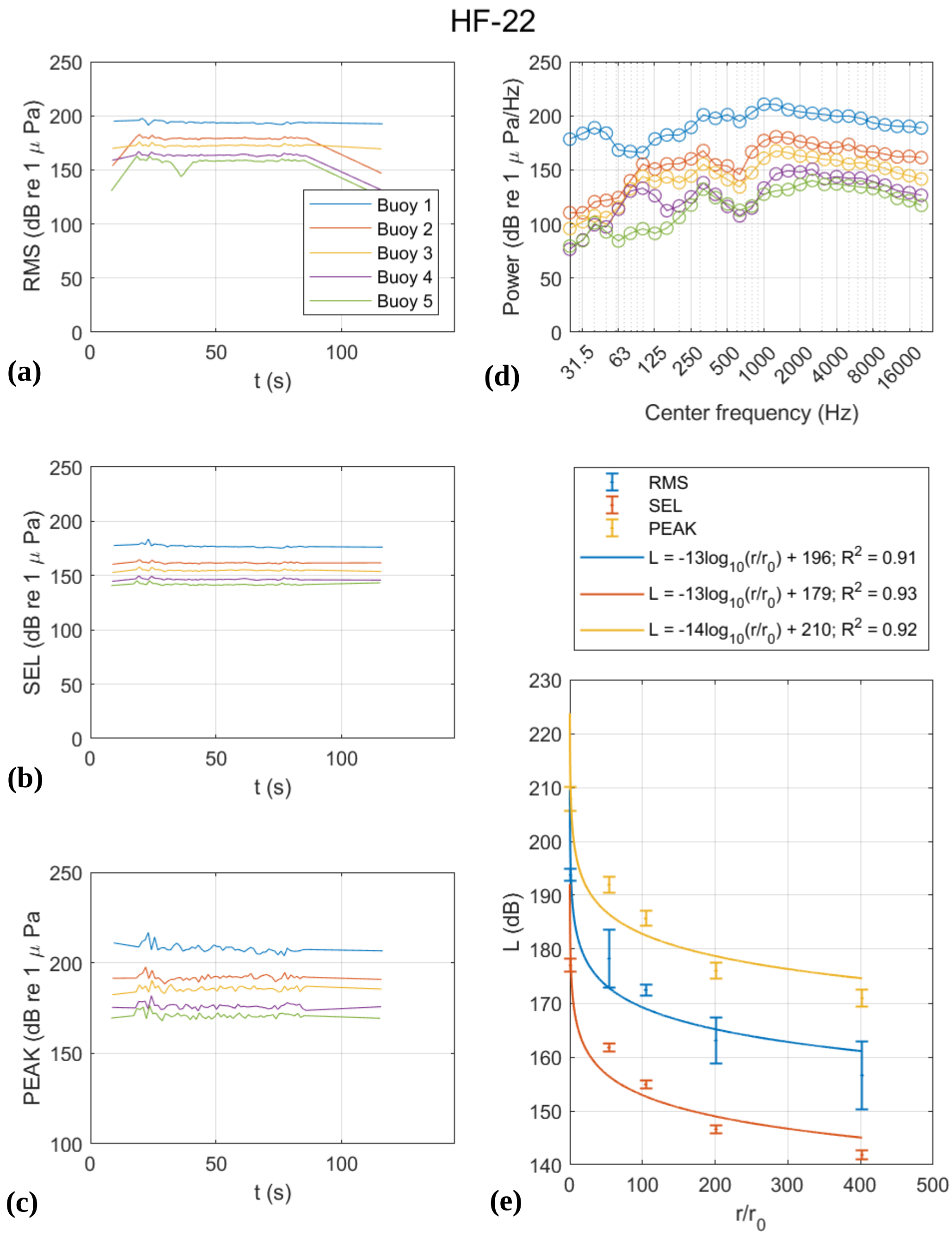


Figure 4-6. Data from the 22nd drive at the Howard Frankland Bridge showing (a) RMS; (b) SEL; (c) PEAK; (d) 1/3 Octave Power; and (e) decay curve.

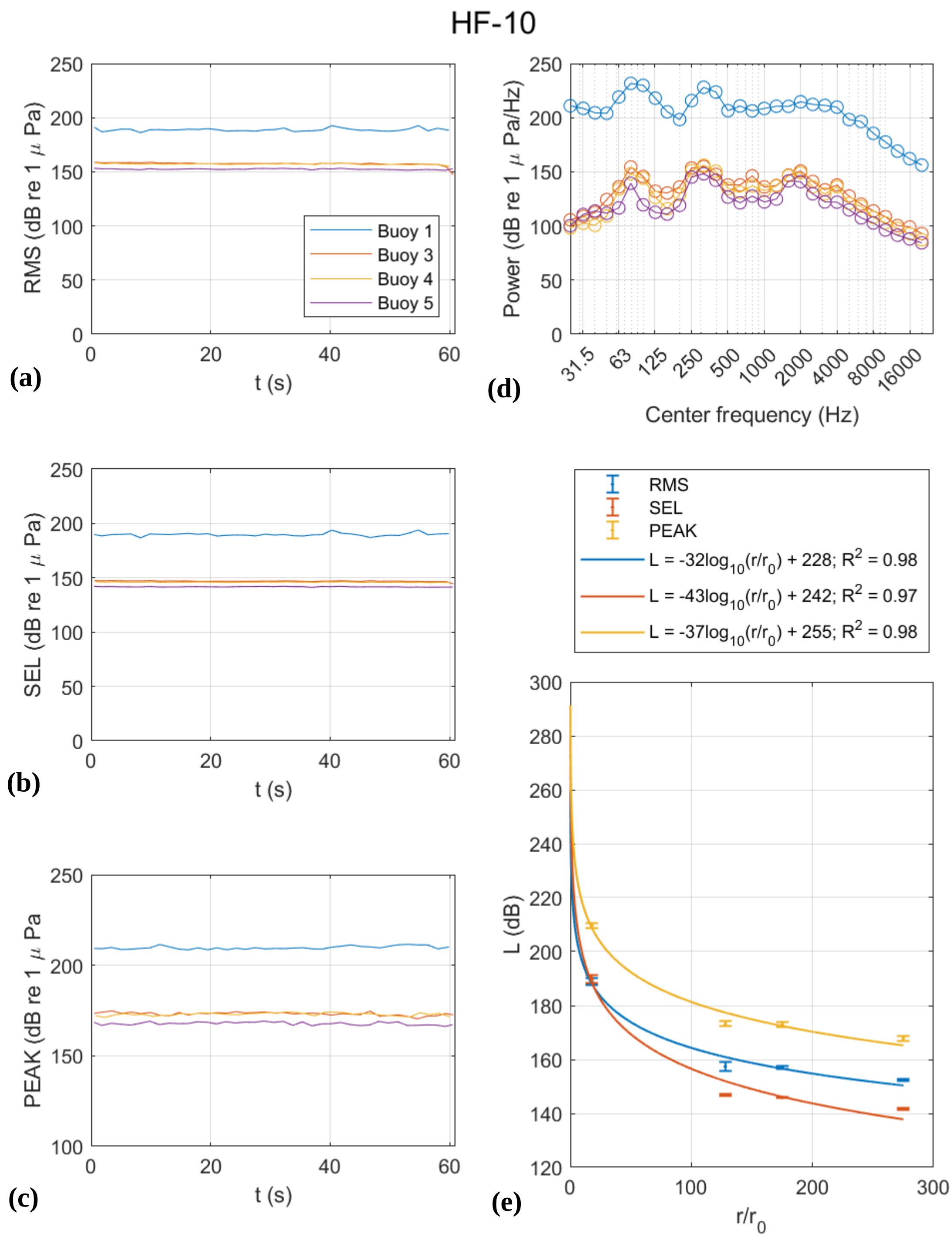


Figure 4-7. Data from the 10th drive at the Howard Frankland Bridge showing (a) RMS; (b) SEL; (c) PEAK; (d) 1/3 Octave Power; and (e) decay curve.

From a practical perspective, predicting the frequency spectrum associated with any particular pile drive would be difficult because predicting this spectrum would be a function of many variables like pile type, pile shape, hammer type, and soil conditions, just to name a few. But, because of the apparent universal relationship between *a* and *b*, we can use the data collected here as a practical design tool. This method has been dubbed the "Florida Attenuation Coefficient Tool" or FACT. If sound is known at any distance from a pile during a pile drive, then Fig. 4-1 may be used to estimate *F* because of linear relationship between *a* and *b*. For example, suppose that during pile driving, one measured a Peak SPL of 220 dB at a distance of 10 m from a pile and was interested in finding the radius of influence associated with a 206 dB threshold. Using Fig. 4-1(A):

$$a = F = \frac{L_m - a_2}{a_1 - \log_{10}(r/r_0)} = \frac{220\ dB - 171.2\ dB}{1.9 - \log_{10}(10\ m/1m)} = 54\ dB \tag{4-8}$$

Then, either the NMFS calculator or the following expression would be used to compute the radius of influence associated with the 206 dB threshold:

$$r = \left\{10^{\left[\frac{L_m - L_r}{F}\right]}\right\} r_m = \left\{10^{\left[\frac{220\ dB - 206\ dB}{54\ dB}\right]}\right\} 10\ m = 18\ m \tag{4-9}$$

Compare this to assuming *F* = 15:

$$r = \left\{10^{\left[\frac{L_m - L_r}{F}\right]}\right\} r_m = \left\{10^{\left[\frac{220\ dB - 206\ dB}{15\ dB}\right]}\right\} 10\ m = 86\ m \tag{4-10}$$

Again, the reason this model appears to work is easily explained by the frequency dependency shown in Fig. 4-5 and Eq. 4-1 through Eq. 4-7. Essentially, it would appear that *F* = 15 is a good approximation for pile drives that behave with certain spectral distributions where most spectral energy is above ~100 Hz. But, if there is sufficient low-frequency spectral energy, additional attenuation may be observed. This is another way of stating that the way the sound is generated (i.e., the source level) is an important factor to consider when describing attenuation.

This concept is further illustrated with the blow-by-blow analysis. As shown below in Fig. 4-8, for a given pile drive, significant variability may be observed from one blow to another.

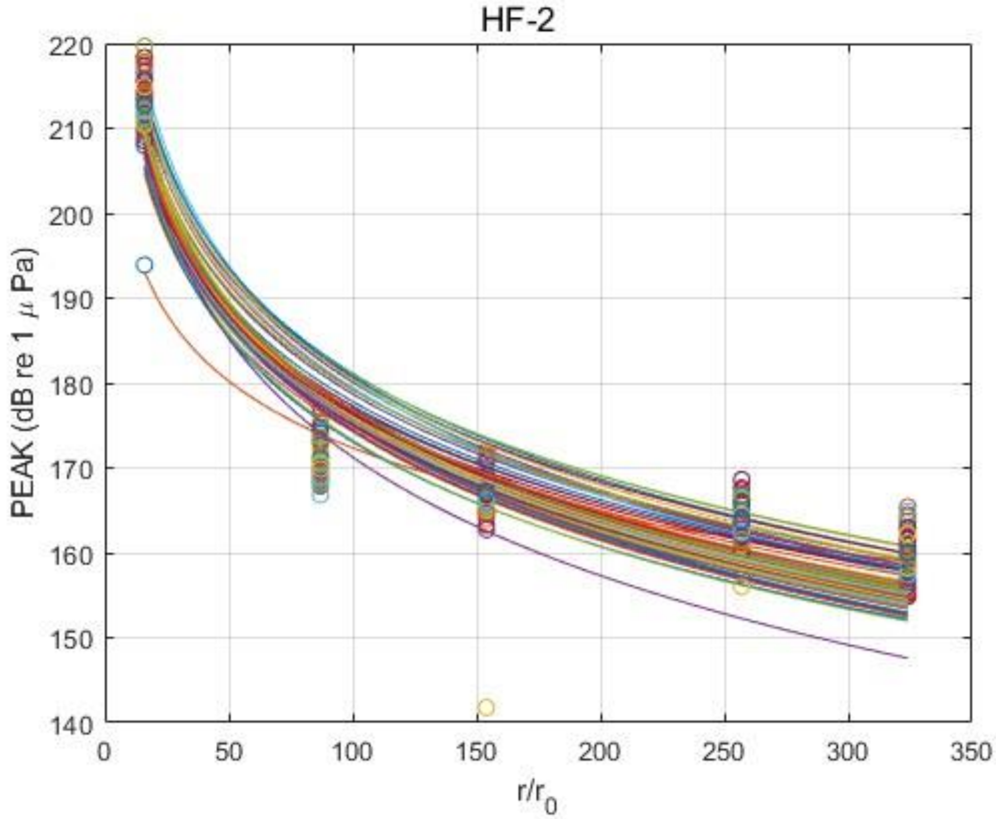


Figure 4-8. Blow-by-blow analysis for the 2nd drive at the Howard Frankland Bridge showing different decay curve for each blow using PEAK data

For the drive shown in Fig. 4-8, F-values as low as 26 and as high as 46 were observed with a mean F-value of 40.7, a median of 40.9, and a standard deviation of 2.4. For each blow-by-blow decay curve, the procedure above was repeated where b was plotted as a function of a and best-fit linear regression was used to fit an equation of the form $b = a_1 a + a_2$ to the data. Sample results are shown below in Fig. 4-9 while a compendium of all results is presented in Appendix G.

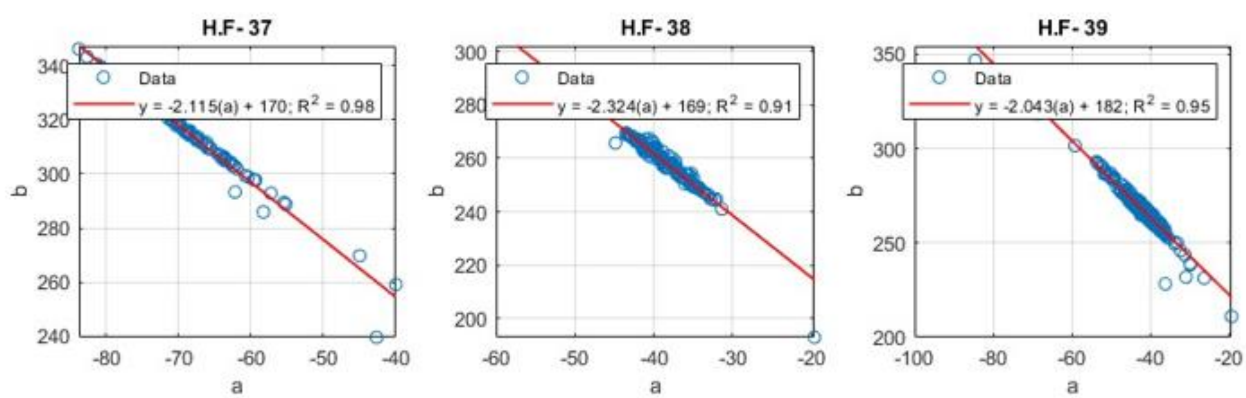


Figure 4-9. Sample results from blow-by-blow analysis showing data from 3 drives at the Howard Frankland Bridge. Both a and b are in dB re 1 μPa.

As shown in Fig. 4-8, while variability was observed in both *a* and *b*, the two were always related to one another, thereby providing further evidence for the apparent universal relationship between *a* and *b*. This is further illustrated below in Fig. 4-10 which shows the relationship between *a* and *b* using all blow-by-blow data:

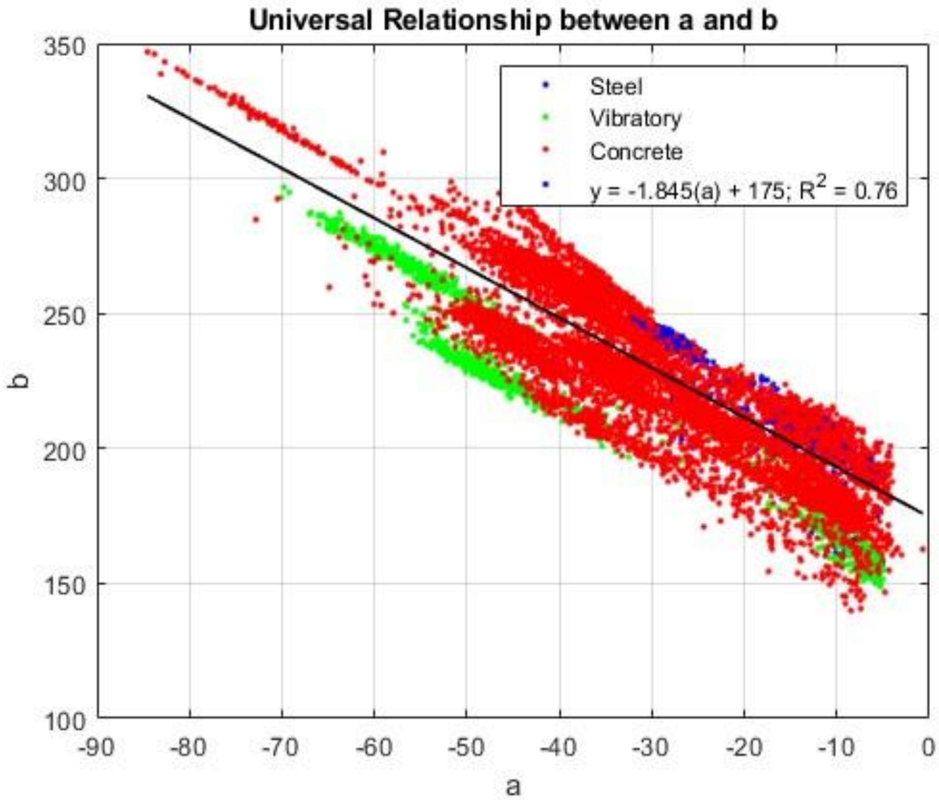


Figure 4-10. Apparent universal relationship between *a* and *b*. Both *a* and *b* are in dB re 1 μPa.

4.2 CFD Results

The field data presented here appear to indicate that one may predict the interrelationship between *a* and *b* is the primary factor that governs attenuation. Results from CFD reinforce that to some extent, but they also indicate that geotechnical absorption plays a role in attenuation. Field measurement data from the Ribault River site gave a mean PEAK *F*-value of 34.5. Assuming less than 10% surface absorption, contours in Fig. 3-8(a) suggest that bottom absorption must have been ~30%. Field measurement data from the Bayway E site gave a *F*-value of 6. Again, assuming low surface absorption, contours from Fig. 3-8(b) suggest little to no bottom absorption. The relevant boring logs associated with each of these sites (Appendix G), show that at Bayway E, surface sediment was classified as SM (i.e., silty sand). Below that, alternating layers of SM and SP (i.e., poorly graded sand)/SP-SM (i.e., mixture of SP and SM) were encountered. On the other hand, at the Ribault River site, PT (i.e., peat or other highly organic sediment) was encountered along the surface of the riverbed. Below that, layers of ML (i.e., inorganic silt, very fine sand, rock flour, silty or clayey fine sand), SP, MH (i.e., inorganic silts) a fossilized limestone layer, and a deep SM layer were observed. These observations would appear to indicate that geotechnical conditions may have been partially responsible for different sound absorption values. And, more generally, the peat and more cohesive sediments at the Ribault River site attenuated more sound than the relatively coarse material at the Bayway E Bridge. However, quantifying these effects in the field proved to be difficult, and any of this geotechnical absorption appears to be "wrapped" in the apparent a versus b relationship described above.

Hypothetical blow-by-blow data reinforce the importance of bottom absorption on determining F-values. Each curve in Fig. 3-7 represents the decay curve for each maximum oscillation for a given vibration. Thus, in Fig. 3-7(a), the top curve represents the decay from the first (and highest) oscillation; the second curve from the top represents the decay from the second (and second highest) oscillation; and so on. Data in Fig. 3-9 show that when bottom absorption was low (i.e., 20%), F-values between 12 and 14 were observed. When bottom absorption was very high (i.e., 80%), F-values between 53 and 57 were observed. Thus, for a given bottom absorption, some F-value variability was observed. Nonetheless, like the field data, each of these hypothetical data curves' a-values and b-values were strongly correlated to one another as shown below in Fig. 4-1.

To test the relative effect of other variables on TL, investigators used a multidimensional curve fitting tool (Cepowski 2017) to fit a model that predicted b where bottom absorption, α, was included; and another model to predict b where water depth, h, and channel width, w were included. Results are shown below in Fig. 4-11. The best models were of the form:

$$b = a_0 + a_1 a + a_2 \alpha \tag{4-11}$$

$$b = a_0 + a_1 a + a_2 \alpha + a_3 z + a_4 w \tag{4-12}$$

for bottom absorption only, and when water depth and channel width were included, respectively. As illustrated in Fig. 4-12, the models in Eq. 4-11 and Eq. 4-12 were able to predict b with high levels of accuracy as evidenced by high R^2 values of 0.94 and 0.95. However, note that in Fig. 4-11, an R^2 of 0.94 was achieved – thereby indicating that inclusion of water depth, channel width, and geotechnical absorption added little predictive value to estimating b and by extension L_r and TL.

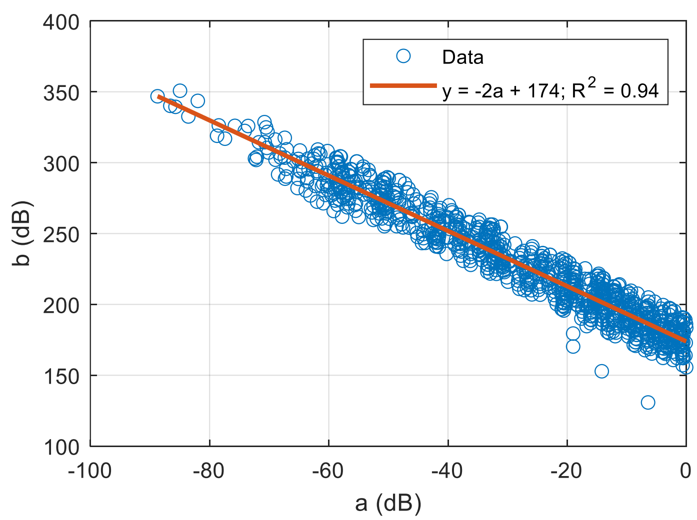
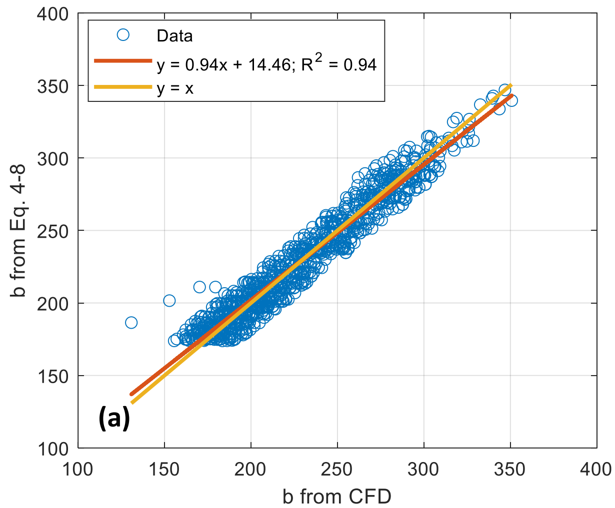


Figure 4-11. Apparent relationship between a and b using hypothetical data showing data from all hypothetical scenarios



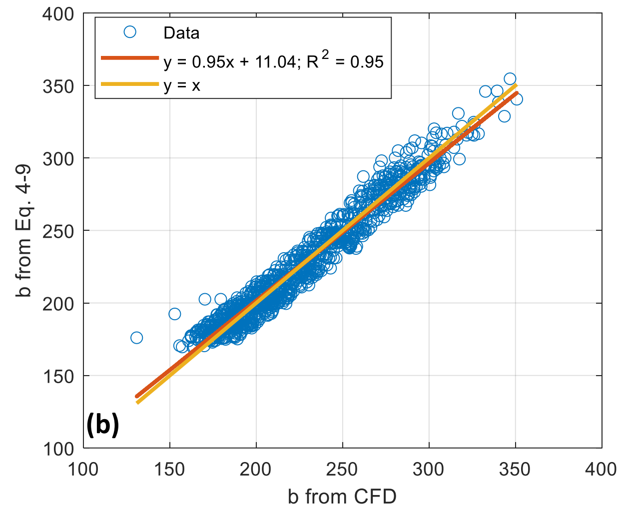


Figure 4-12. Predicted results for *b* versus measured results for *b* using (a) Eq. 4-8 and (b) Eq. 4-9. Note that *b* is in dB.

4.3 Verification of the FACT

A verification study was conducted using the FACT and previous data reported by CalTrans (Buehler et al. 2015). These efforts began by examining the Choctawhatchee Bay Bridge because Buehler et al. (2015) reported sound data there in 2014 and sound data were collected at the same location during this study. Like this study, previous efforts at the Choctawhatchee Bay Bridge involved using regression to estimate *F*-values. Two pile-types were measured: Type I Piles which consisted of 160 ft long by 30-in wide concrete piles with 11 ft solid section at the tips and 139 ft of hollow space; and Type II Piles which consisted of 30-in concrete piles with a solid section of 160 ft length. Results showed Type I Pile *F*-values of 16, 15, and 13 for PEAK, RMS, and SEL respectively. For Type II Piles, *F*-values were 22, 20, and 20 for PEAK, RMS, and SEL respectively. In addition, 10-m data were reported for PEAK, RMS, and SEL. Using these data, the FACT was used (specifically, Fig. 4-1(D)). Conditions and results are tabulated below in Table 4-2 and Table 4-3 for Type I and Type II piles respectively. As shown, the FACT results were relatively comparable with the Buehler et al. (2015) data. For SEL, the design tool performed excellently and displayed almost no error. For RMS and PEAK, the FACT tended to overpredict attenuation by ~5 to 6 dB on average.

We note as well that data collected during this study at the Choctawhatchee Bay Bridge yielded significantly different *F*-values than the *F*-values reported by Buehler et al. (2015). As shown in Table 3-1, during this study, *F*-values between 43 and 61 were observed whereas Buehler et al. (2015) reported *F*-values of 16 and 21. However, the Buehler et al. (2015) data were collected during concrete impact drives whereas our data were collected during vibrational sheet pile driving. The significant difference in *F*-values at the same site but under different drive conditions is exactly what the FACT is trying to capture in the sense that while it is difficult to predict the frequency associated with any source-level, the interconnection between the source level and attenuation can be used to predict attenuation.

After the Choctawhatchee Bay Bridge analysis, verification was repeated using all data reported by Buehler et al. (2015) that fit with the tool developed during this study. The term “fit” here implies the following:

- Note the a_2 values in Fig. 4-1. For the design tool to return a valid F-value, the sound-level must be *above* the a_2 coefficient for a given scenario. For example, if using Fig. 4-2(B) for RMS, the sound-level used for analysis must be above 167.5 dB. This is a limitation of the FACT that should be noted here.

- Buehler et al. (2015) reported much data that looked like Fig. 4-14 below:

Pile Type	Size or Diameter	Project	Location	Hammer Type	Water Depth	Measured Sound Levels: Distance	Peak	RMS	SEL	Distance Attenuation Rate[1]	Comments
CISS Steel Pipe	126-inch	Richmond-San Rafael Bridge, CALTRANS	San Rafael, CA - San Francisco Bay	Hydraulic Impact Submersible IHC	>15m	10m	218-208	206-197			Piles driven below water to mud line using an IHC hydraulic hammer imparting energy up to 358 kJ. Piles were driven for siesmic upgrade work for the Richmond-San Rafael Bridge.
						55m	200	190			
						100m	195	185	170	5 dB at 55-100m	
						230m	190	177	165		
CISS Steel Pipe	150 and 166-inch	Richmond-San Rafael Bridge, CALTRANS	San Rafael, CA - San Francisco Bay		>15m	20m	215-208	206-197	NA		Same as above, but for 150- and 166-inch piles for the Richmond-San Rafael Bridge
						50m	205	192	NA	5-10 dB at 20-50m	
						95m	194	181	NA		
						160m	191	175	NA		
						235m	192	178	NA	2-3 dB at 95-235m	
						~1000m	169	157	NA		
Steel H Pile	~12-inch	Noyo River Bridge	Fort Bragg, CA -	Diesel Impact	2m	30m	179	165	NA		Temporary trestle piles. Piles driven using small diesel impact hammer. Piles installed in shallow water.
						55m	178	164	NA	<5 dB at 30-56m	
						85m	165	150	NA	>5 dB at 56-90m	
					5m	70m	168	156	NA		Same as above, but these piles were driven in deeper water adjacent to the navigational channel.
						90m	170	158	NA		
					Land	25m	174	159	NA		Piles driven using small diesel impact hammer. Piles installed on land next to 2-meter-deep water.
						35m	169	158	NA		
						95m	157	145	NA		
Steel H Pile	10-inch	San Rafael Canal	San Rafeal, CA -	Diesel Impact	2m	10m	190	175	NA		Piles driven using small diesel impact hammer. Piles installed close to slough shore in very shallow water.
						20m	170	160	NA	>10 dB at 20m	
				Vibratory Hammer	2m	10m	161	147	NA		
						20m	152	137	NA	10 dB at 20m	
Steel H Pile	15-inch thin, battered	Ballena Isle Marina	Alameda, CA - San Francisco Bay	Diesel Impact	2-3m	10m	190	165	155		Piles driven using small diesel impact hammer. Piles installed close to slough shore. Piles were battered.
	15-inch thick vertical				2-3m	10m	195	180	170		Same as above, but thick-walled vertical piles.
Steel H Pile	15-inch thick vertical	Ballena Isle Marina	Platte River, Nebraska	Diesel Impact	Dewatered Cofferdam	10m	172	160	147		Piles driven in dewatered cofferdam adjacent to Platte River, which is very shallow - about 2 meters deep.
						25m	177	165	148		

Figure 4-14. Example of data from Buehler et al. (2015)

Note the column labeled “Distance Attenuation Rate.” As shown in Fig. 4-14, no F-value is given explicitly. Rather, what is reported is some attenuation range at several variable distances. During verification, only instances where F-values were reported explicitly were considered.

As with data from the Choctawhatchee Bay Bridge, Fig. 4-1 was used to compute F-values based upon data reported at some distance (when reported, 10-m data were used). Thus, for concrete drives, Fig. 4-1(D) was used; for steel impact drives, Fig. 4-1(B) was used; and for steel vibrational drives, Fig. 4-1(C) was used. Each of these computations followed the FACT procedure outlined in Eq. 4-1 through Eq. 4-3. Results are tabulated below in Table 4-4 through Table 4-6. Then, all data computed using the new design tool were plotted as a function of reported data from Buehler et al. (2015). Results are shown below in Fig. 4-15:

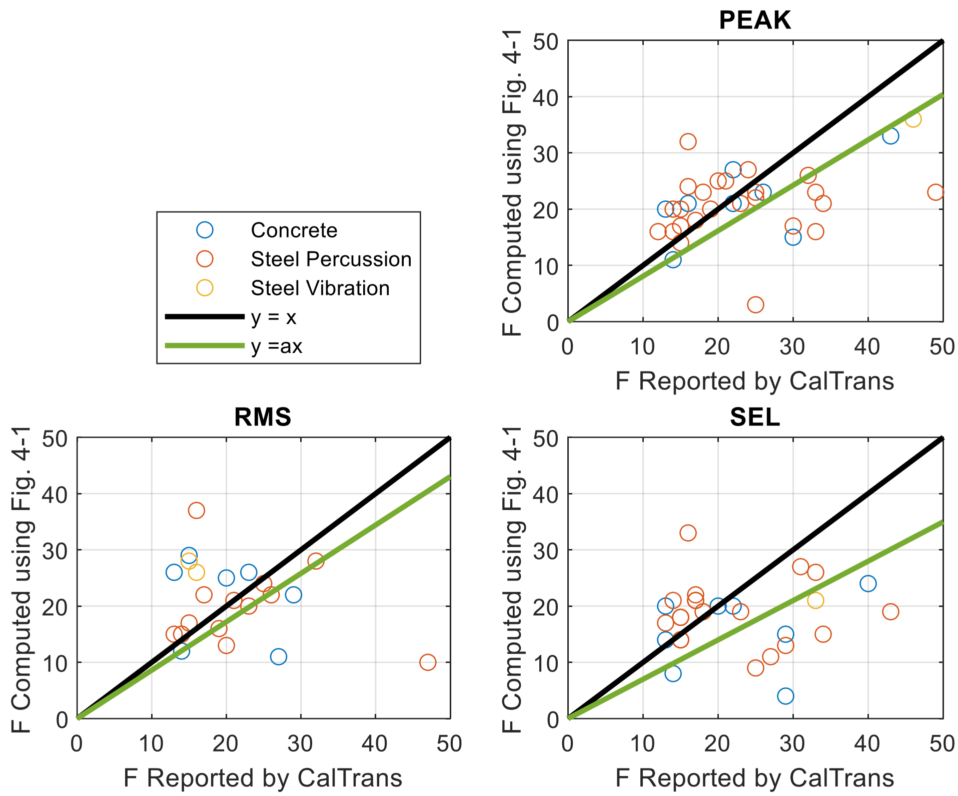


Figure 4-15. *F*-Value Verification Summary for (a) PEAK; (b) RMS; and (c) SEL

As shown in Fig. 4-15, in general, the FACT reproduced results accurately or conservatively. The instances where the design tool produced major errors corresponded to instances where the model probably should not have been applied in the first place due to three factors: either (1) the piles reported by Buehler et al. (2015) were much larger or smaller than the piles that were studied here and used to develop Fig. 4-1; (2) the piles reported by Buehler were differently shaped than the piles used to develop the FACT; or (3) the water depths were very low (less than 1 m at one site). We note that even in the case of major errors, results were generally conservative. However, any best-fit regression through Fig 4-15 would produce a line in poor agreement with y=x. As such, verification was repeated excluding the following data:

- Benicia-Martinez Bridge, Mad River Bridge, Schuyler Heim Bridge, and Northern Rail Extension. Piles at these bridges were much larger than the piles that were used to develop the FACT. Sizes ranged from 72-inch to 144-inch steel pipe piles. We note that even though the FACT was calibrated using piles no greater than 36-in diameter, the FACT appeared to reproduced results accurately in piles up to 66-in as shown at the Russian River Bridge.

- Cleer Creek. For this, site, investigators noted that even though an *F*-value was explicitly reported, it appeared to have been based upon only connecting two datapoints with a logarithmic best-fit line. This of course would lead to a regression line with an R^2 of 1.0, but the results from this procedure would appear to be questionable.

- Northern Rail Extension 24-inch steel piles. At this location, the water was less than 1 m deep.

- Hazel Bridge, Parson Slough, and Petalumia River Bridge all used H-piles, but H-piles were not used to develop the FACT.

- Noyo Harbor Dock used 14-inch square concrete piles, but these piles were much smaller than the piles used to develop the FACT.

Results of this analysis are presented below in Fig. 4-16:

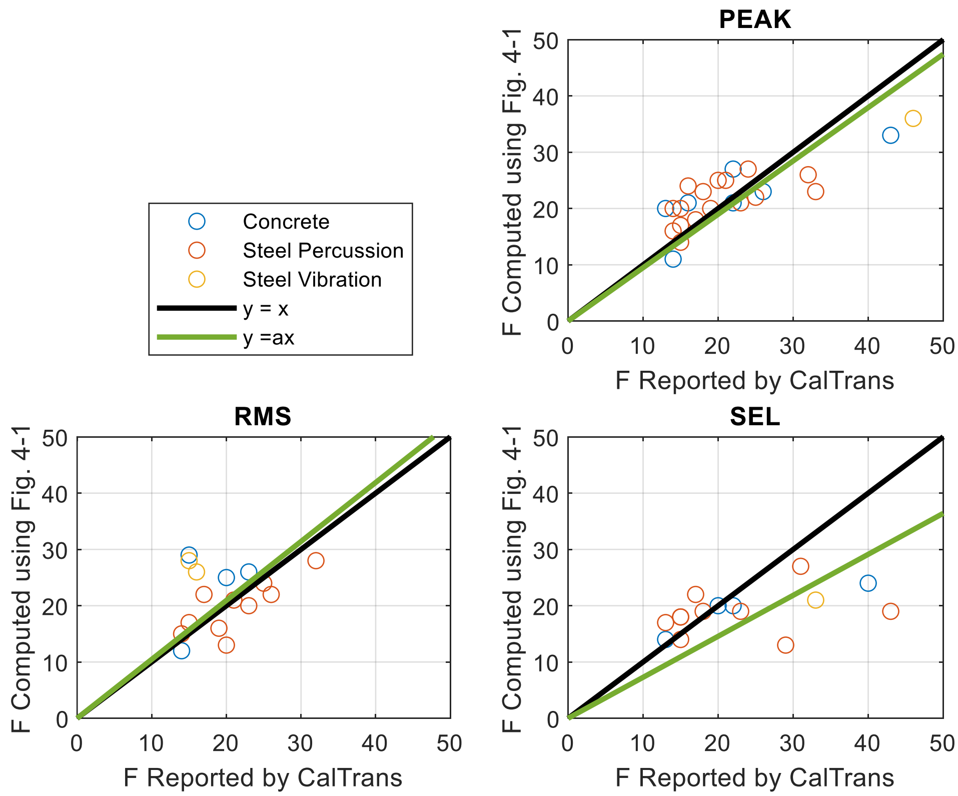


Figure 4-16. Verification reanalysis using only piles and water conditions similar to the conditions used to develop the FACT

As shown in Fig. 4-16, lines of the form y = ax were fit to the data, and results showed excellent agreement with y=x for both PEAK and RMS *F*-values. For SEL, errors were observed, although these errors were conservative in the sense that the FACT tended to skew toward predicting less attenuation than the attenuation reported by Buehler et al. (2015).

We note as well that the piles used to develop the FACT mostly consisted of concrete piles between 24-in and 36-in diameters, yet the FACT performed well in steel piles that were smaller (14-in and 16-in at Richmond/San Rafael Bridge Fender Replacement and Airport Road Bridge respectively) and larger (60-in steel pipe at Noyo Bridge; 66-in steel pipe at Russian River Bridge) than were used to develop the tool. However, the model performed poorly when compared to data from the 14-in concrete piles at Noyo Harbor. It is also interesting to note that the octagonal piles that were used for verification performed well even though they were a different shape than the square piles that were used to develop the FACT. In all cases though, the verification data were limited. In follow-up work, it may be useful to examine different pile dimensions in the context of models like the FACT to determine if the apparent relationships presented here hold. In the interim, data suggest that the FACT predicts *F*-values relatively accurately for piles within the dimensions and water depths presented in this study. We suggest then that the FACT only be used under the following circumstances:

- Concrete piles between 18-inches and 30-inches wide driven via impact driving.
- Circular steel piles or sheet piles driven with an impact hammer up to a maximum diameter of 66-in.
- 18-inch-wide sheet piles driven via a vibrational hammer or 24-inch diameter circular piles driven with a vibrational hammer.
- W40x183 steel piles driven via impact driving.
- Water depths between 2 m and 15 m.

Table 4-2. Verification Summary Table for Type I Piles

Pile ID	Range (m)	PEAK (dB)	RMS (dB)	SEL (dB)	F_{PEAK} Computed Using Fig. 4-1	F_{PEAK} Reported by CalTrans	F_{RMS} Computed Using Fig. 4-1	F_{RMS} Reported by CalTrans	F_{SEL} Computed Using Fig. 4-1	F_{SEL} Reported by CalTrans
26	10	192	169	159	23	16	20	15	15	13
28	10	190	169	159	21	16	20	15	15	13
30	10	191	170	159	22	16	21	15	15	13
25	10	189	168	158	21	16	19	15	14	13
32	10	185	164	154	17	16	16	15	10	13
				Mean value =	**21**	**16**	**19**	**15**	**14**	**13**

Table 4-3. Verification Summary Table for Type II Piles

Pile ID	Range (m)	PEAK (dB)	RMS (dB)	SEL (dB)	F_{PEAK} Computed Using Fig. 4-1	F_{PEAK} Reported by CalTrans	F_{RMS} Computed Using Fig. 4-1	F_{RMS} Reported by CalTrans	F_{SEL} Computed Using Fig. 4-1	F_{SEL} Reported by CalTrans
13	10	197	175	162	28	22	25	20	17	20
15	10	199	177	167	30	22	26	20	21	20
22	10	199	177	167	30	22	26	20	21	20
14	10	189	171	162	21	22	22	20	17	20
18	10	200	180	170	31	22	29	20	24	20
20	10	196	177	167	27	22	26	20	21	20
24	10	195	174	165	26	22	24	20	20	20
				Mean value =	**27**	**22**	**25**	**20**	**20**	**20**

Table 4-4. Verification Summary Table for Concrete Piles Outside of Florida. Data in italics are data that were excluded from Fig. 4-16

	Pile Type	Range (m)	PEAK (dB)	RMS (dB)	SEL (dB)	F_{PEAK} Computed Using Fig. 4-1	F_{PEAK} Reported by CalTrans	F_{RMS} Computed Using Fig. 4-1	F_{RMS} Reported by CalTrans	F_{SEL} Computed Using Fig. 4-1	F_{SEL} Reported by CalTrans
Norfolk Naval Station Norfolk, VA	24-inch square	10	189	176	166	21	22	26	23	20	22
Noyo Harbor Dock Fort Bragg, CA	*14-inch square*	*10*	*183*	*157*	*146*	*15*	*30*	*11*	*27*	*4*	*29*
Kawaihae Harbor Kawaihae, HI	16.5-inch octagonal	10	192	172	160	23	26	22	29	15	29
Shell Martinez Refinery Martinez, CA	24-inch square	17.5	195	176	164	33	43	--	--	24	40
Humboldt Aquatic Center Eureka, CA	24-inch octagonal	10	179	158	151	11	14	12	14	8	14
Berth 22 Reconstruction Oakland, CA	24-inch octagonal	10	188	176	166	20	13	26	13	20	13

Table 4-5. Verification Summary Table from Steel Piles Outside of Florida Driven Using Vibration

	Pile Type	Range (m)	PEAK (dB)	RMS (dB)	SEL (dB)	F_{PEAK} Computed Using Fig. 4-1	F_{PEAK} Reported by CalTrans	F_{RMS} Computed Using Fig. 4-1	F_{RMS} Reported by CalTrans	F_{SEL} Computed Using Fig. 4-1	F_{SEL} Reported by CalTrans
Northern Rail Extension Salcha, AK	24-in steel shell	10	184	--	159	36	46	--	--	21	33
Naval Base Kitsap Bangor, WA	24-in steel shell	10	--	165	--	--	--	28	15	--	--
Naval Base Kitsap Bangor, WA	36-in steel shell	6	--	169	--	--	--	26	16	--	--

Table 4-6. Verification Summary Table from Steel Piles Outside of Florida Driven Using Impact Hammer. Data in italics are data that were excluded from Fig. 4-16

Benicia-Martinez Bridge Benicia, CA	*96-in CISS pipe*	*10*	*220*	*205*	*194*	*32*	*16*	*37*	*16*	*33*	*16*
Richmond/San Rafael Bridge Fender Repair San Fransisco, CA	14-in steel pipe	10	199	--	165	16	14	--	--	13	29
Airport Road Bridge Sacramento, CA	16-in steel pipe	10	204	--	--	20	14	--	--	--	--
Bradshaw Bridge Lathrop, CA	20-in steel pipe	10	204	161	--	20	19	--	19	--	--
Tounge Point Pier Astoria, OR	24-in steel pipe	10	205	188	173	21	23	20	23	19	23
Cleer Creek WWTP Redding, CA	*24-in steel pipe*	*10*	*182*	*--*	*159*	*3*	*25*	*--*	*--*	*9*	*25*
Portland-Milwaukie Light Rail Project Portland, OR	24-in steel pipe	10	200	--	172	17	15	--	--	18	15
SR 520 Test Pile Seattle, WA	30-in steel pipe	10	196	185	172	14	15	17	15	18	15
Noyo Bridge Fort Bragg, CA	60-in steel pipe	10	207	192	--	22	25	24	25	--	--
Russian River Bridge Ukiah, CA	66-in steel pipe	17	197	185	173	18	17	22	17	22	17
Mad River Bridge McKinleyville, CA	*87-in steel pipe*	*35*	*194*	*--*	*160*	*21*	*34*	*--*	*--*	*15*	*34*
Hazel Bridge Sacramento, CA	*H-piles*	*10*	*208*	*--*	*177*	*23*	*25*	*--*	*--*	*21*	*17*
Parson Slough Monterey, CA	*H-piles*	*10*	*200*	*178*	*166*	*17*	*30*	*10*	*--*	*14*	*15*
Schuyler Heim Bridge Long Beach, CA	24-in steel shell	13	207	188	--	25	20	22	26	--	--
Schuyler Heim Bridge Long Beach, CA	*144-in steel shell*	*10*	*199*	*183*	*169*	*16*	*12*	*15*	*13*	*16*	*--*
Northern Rail Extension Salcha, AK	*24-in steel shell*	*10*	*208*	*--*	*173*	*23*	*49*	*--*	*--*	*19*	*43*
Northern Rail Extension Salcha, AK	*72-in steel shell*	*11*	*210*	*195*	*183*	*26*	*32*	*28*	*32*	*26*	*33*
Naval Base Kitsap Bangor, WA	24-in steel shell	10	208	184	173	23	18	16	19	19	18
Naval Base Kitsap Bangor, WA	36-in steel shell	10	204	183	171	20	15	15	14	17	13
Crescent City Inner Harbor Crescent City, CA	24-in steel shell	10	210	181	--	25	21	13	20	--	--
Crescent City Inner Harbor Crescent City, CA	24-in steel shell	10	208	189	--	23	33	21	21	--	--
Coliseum Way Bridge Oakland, CA	36-in steel shell	10	213	--	185	27	24	--	--	27	31
Petaluma River Bridge Petaluma, CA	*H-piles*	*10*	*199*	*178*	*162*	*16*	*33*	*10*	*47*	*11*	*27*
Port of Coeyman Coeyman, NY	24-in steel pipe	10	209	181	176	24	16	13	--	21	14

CHAPTER 6
SUMMARY AND CONCLUSIONS

To summarize:

- Underwater noise data were collected at 13 sites around Florida. Overall, data from 88 drive events were collected. Data were collected from five sites in northeast Florida, two sites from the Panhandle; three sites near Tampa Bay (one sampled twice); one site near Cape Canaveral; and one site near Port St. Lucie.

- Computational analysis using CFD showed that geometrical spreading coupled with local bathymetry data could not explain measured field data. However, inclusion of bottom absorption allowed one to accurately reproduce field data.

- Analysis of these data showed that usually, using an *F*-value of 15 to predict underwater TL may be overly conservative for concrete piles in the sense that this estimate for *F* may underpredict sound attenuation. For steel piles driven via a percussion hammer, using an *F*-value of 15 was relatively close to measured data most of the time. While data from steel vibrational drives showed much higher attenuation than *F* = 15, and verification produced relatively accurate results, these data are limited and should be treated cautiously.

- Field data showed that sound attenuation was frequency dependent in the sense that very low frequencies (i.e., less than ~100 Hz to ~1,000 Hz) tended to attenuate faster than relatively high frequency sound.

- Mathematical analysis showed that the frequency dependency in attenuation was interrelated to the attenuation associated with geometrical spreading (i.e., the *F*-values or a terms presented throughout this report).

- Based upon the field data, a new design tool was developed to estimate *F*-values that was dubbed the FACT. The FACT is based upon the interplay between attenuation and the source-level that were consistently apparent in both field and hypothetical computational data. Specifically, attenuation during pile driving has been shown to obey a logarithmic decay function of the form $L_r = b + a\log_{10}\left(\frac{r}{r_0}\right)$ and b has been shown to be linearly correlated to a in an equations of the form $b = a_1 a + a_2$ where a_1 and a_2 are drive-type dependent. This new design tool should be thought of as an "*F*-value calibration for piles commonly used in Florida roadway construction." Its limitations are that (i) it requires sound-level to be known at some distance from a pile drive; and (ii) the sound-level used in (i) must be above some threshold associated with the design tool's coefficient. In addition, we recommend using this tool only for piles of similar shape and dimension as the piles studied and verified in this report. Specifically, these are:

  i) Concrete piles between 18 inches and 30 inches wide driven via impact driving.

  ii) Circular steel piles or sheet piles driven with an impact hammer up to a maximum diameter of 66 inches.

iii) 18-inch-wide sheet piles driven with a vibrational hammer or 24-inch diameter circular piles driven with a vibrational hammer.

iv) W40x83 steel piles driven via impact driving.

v) Water depths between 2 m and 15 m.

- The FACT was verified using data reported by CalTrans (Buehler et al. 2015) at 32 sites where *F*-values were reported explicitly and where reported sound-levels were above the threshold mentioned above. In general, the FACT performed well in the sense that most of the time, it returned *F*-value that were either within 5 dB of reported values or were conservative. In some instances, *F*-values were egregiously non-conservative, but in these cases, the piles were much larger than the piles that were used to develop Fig. 4-1, were different shape than the round piles and sheet piles that were used to develop Fig. 4-1, or water depths were much lower than the water depths that were used to develop Fig. 4-1. Reanalysis that excluded these situations produced results that indicated that the FACT is capable of predicting *F*-values accurately. That said, as a point of emphasis, the FACT should only be used for piles that are comparable in shape and dimension to the piles presented in this report and recommend studying different pile shapes and dimensions in the future.

APPENDIX A
DATA COLLECTION SYSTEM AND PROCEDURES

A.1 Land-Based Tasks Day Before Deployment

Approximately one day before a field data collection event, several procedures were be followed to ensure accurate data collection.

A.1.1 Programming the Thermocouples

First, when applicable, the thermocouples were programmed. The algorithm for this was as follows:

1. Each thermocouple data logger was connected to the computer via a USB-serial adapter (Figure A-1).

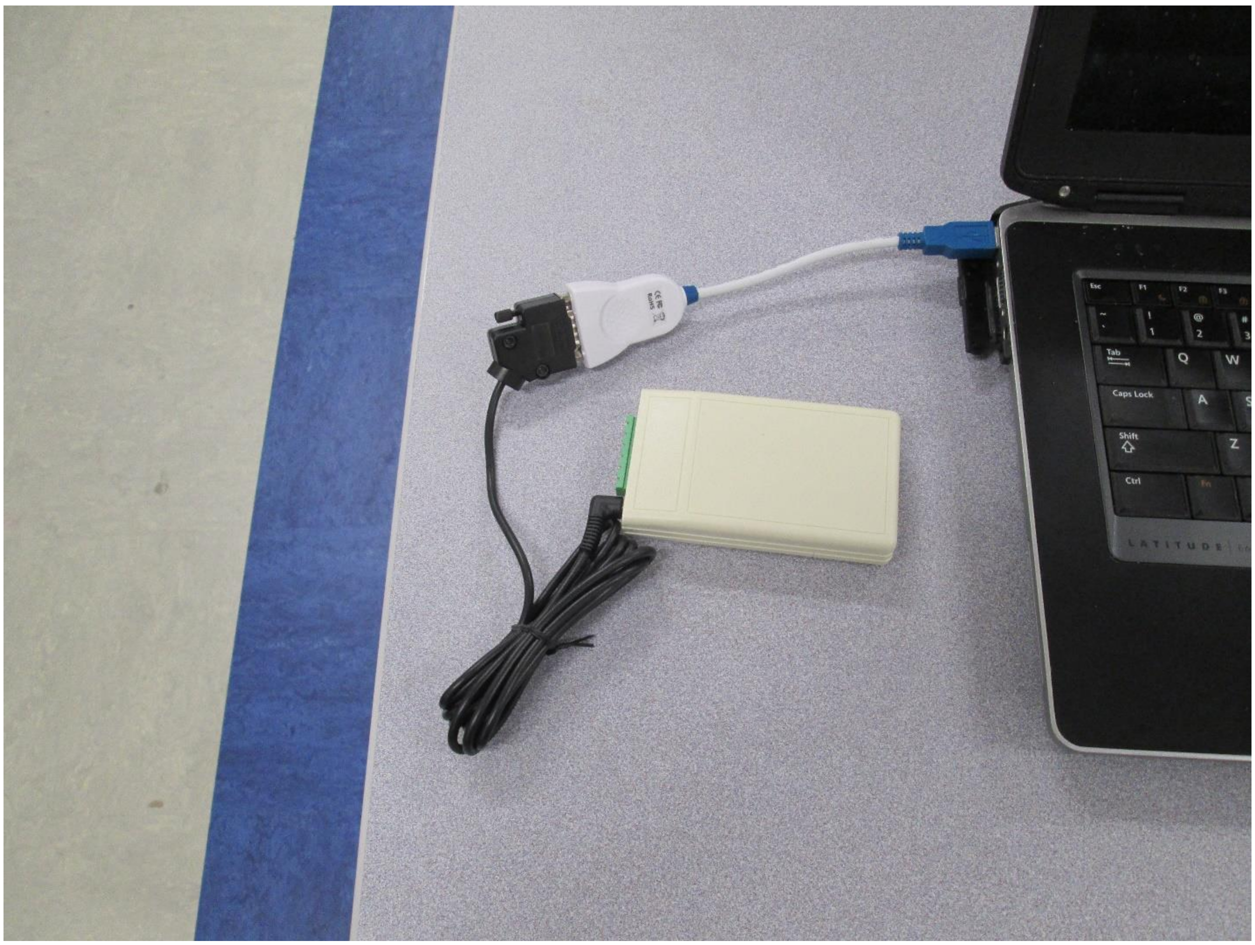


Figure A-1. Thermocouple data logger connected to PC with USB-serial adapter

2. Once connected to the computer, the Pocket Logger software was loaded. Once loaded, either COM1 or COM3 was selected (depending on which computer was being used). The baud rate was set to 19.2k and XR4xx Protocol was checked. The other settings were adjusted as needed (i.e., 24 versus 12-hour time; mm/dd/yyyy versus dd/mm/yyyy).

3. Next, within the software, investigators clicked Send → Setup to ensure that Channel 1 was ON and all other channels were off and that the logger was programmed to received Temp/RH data.

4. The sampling rate was adjusted as needed to read temperature every 10 seconds.

5. The option to begin data collection when the probe was attached was enabled by:

   i) Under Start, clicking "start when ch1 temp. probe is attached"

   ii) Under Run, clicking "until ch1 temp. probe is detached."

   Then, Send was clicked to send these instructions to the data logger. A popup appeared saying that the pocket logger is being formatted, and OK was clicked to continue. To confirm that the logger was programmed, investigators navigated to Receive → Status to verify a return message.

A.1.2 Setting up the Hydrophones

Next, the hydrophone data loggers were programmed. The algorithm for this was as follows:

1. Each of the data loggers was powered on by firmly pressing the button below the screen for 2-3 seconds and that a SD card was installed in each data logger.

2. Once on, the menu button on the touchscreen (button on lower-left-hand corner of the screen) was pressed.

3. Investigators navigated to Template Explorer → Logging → Open. At the top of the screen, the save path was changed to the SD card.

4. Investigators pressed the menu button again. Then, they navigated to Setup → Full → Input to ensure that "Rear Socket" (as opposed to "Top Socket") is selected was the input device.

5. The data loggers were fully charged by plugging them into a wall socket (Figure B-2). Once charged, the data loggers were ready for field deployment.


Figure A-2. Hydrophone data logger plugged into wall sockets.

A.1.3 Charging Wi-Fi Batteries

The Wi-Fi batteries were fully charged before each use. To charge theses batteries, a charging station was developed (Figure A-3). To charge the batteries, the connector from the batteries was simply plugged into its charging station receptacle.

Figure A-3. Wi-Fi battery charging station

A.1.4 Gathering Materials

Next, all field materials were gathered. The following checklist was used:

1. Hydrophone data loggers go into the field data collection boxes.

2. If applicable, e thermocouple data loggers go into the field data collection boxes. <u>Do not</u> plug them in. If plugged in, they will immediately begin to record temperature data.

3. Make sure the batteries are <u>unplugged</u> from their power adapters. If plugged in, the batteries will drain.

4. Place a 12-oz weight into each field data collection box.

5. Gather the anchors, anchor lines, and small plastic buoys; use daisy chains to prevent the lines from tangling with one another.

6. Locate the calibrator. Place the calibrator into the field box.

7. Place other miscellaneous parts (i.e., spare parts, etc.) into the field box.

A.2 On-Site Preparations

A.2.1 Calibration

Either the night before or morning of data collection, the hydrophones were calibrated. The procedure for this was as follows:

1. The small hydrophone receiver attachment was screwed onto the top of the calibrator (Figure A-4).

Figure A-4. Calibrator with hydrophone receiver attachment

2. The hydrophone data logger was plugged into its hydrophone using the Input plug on the rear socket (Figure B-5).

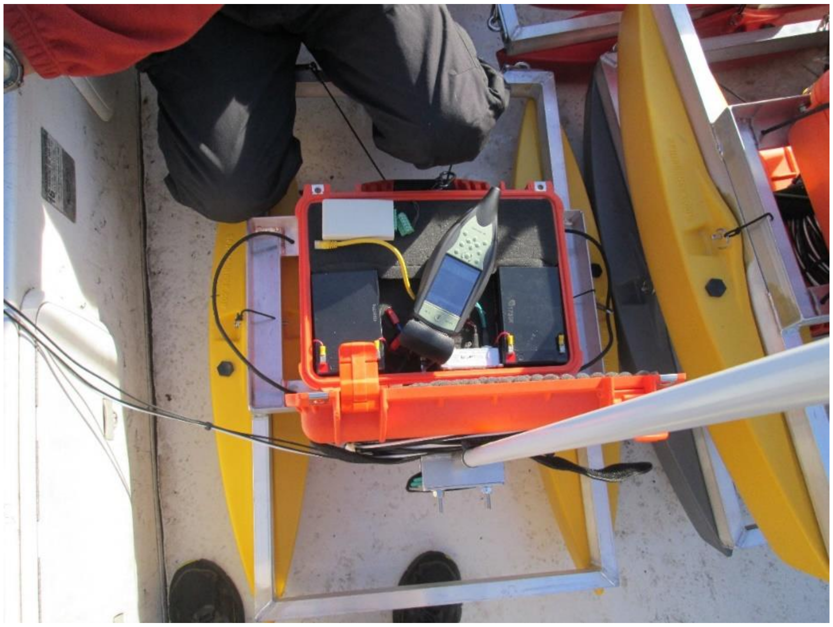


Figure A-5. Hydrophone data logger connected to hydrophone

3. The calibrator was turned on and given at least 10 seconds to stabilize.

4. The hydrophone was inserted into the calibrator hydrophone receiver attachment (Figure A-6).

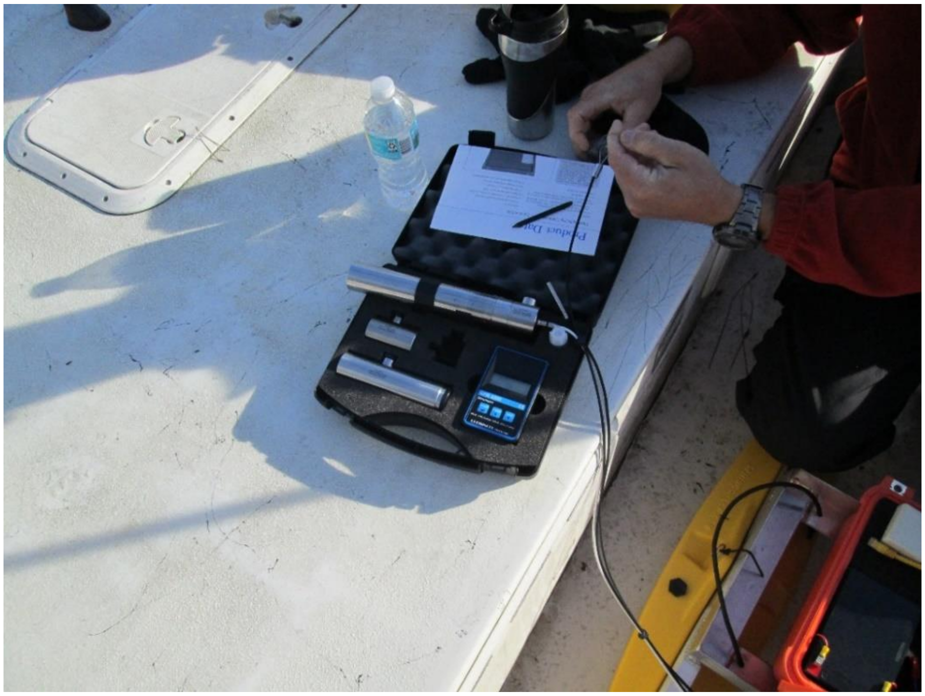


Figure A-6. Hydrophone inserted into calibrator

5. On the hydrophone data logger, investigators navigated to the menu button → Calibration → Start Calibration. The instrument usually automatically calibrated within 2-3 minutes. If it did not calibrate properly, the instrument was not used during data collection.

6. Once calibrated, the hydrophone was removed from the calibrator and placed in its data collection box.

A.2.2 Loading the Buoys

The buoys fit into the bow of the watercraft only if two of them were stacked on top of one another, front-to-back, so that their antennae do not interfere with one another. Please see Figure A-7 and Figure A-8 below for a photograph of the watercraft loaded with the buoys.

Figure A-7. Watercraft loaded with buoys

Figure A-8. Another picture of watercraft loaded with buoys

Other components such as anchors, anchor lines, the computer, the smaller buoys, and the field box were loaded into the stern of the boat at this time as well. O

A.3 Deploying the Buoys

Once the watercraft was in position at the first site, and the water depth has been determined (using the on-board depth finder), the buoys were deployed. The following are the procedures for buoy deployment:

1. One end of the anchor line was connected to the anchor and another end of the anchor line was connected a small, plastic buoy. Then, the anchor was lowered into the water column.

2. Each buoy’s data collection box was opened and when applicable, each thermocouple was plugged into its data logger to initiate temperature recording.

3. Each buoy’s Wi-Fi power system was plugged into its Wi-Fi power adapter to activate real-time WiFi data transmission. Note that the WiFi system was used only to view data as it was being recorded. Data were collected onboard each hydrophone data logger’s SD card.

4. Each hydrophone data logger was powered on and the Play/Pause button (button directly above the touch screen in the middle of the data logger) was pressed to initiate sound data collection.

5. The 12-oz weight was connected to the loop at the end of the stainless-steel instrument cable. Then, each box was closed and sealed.

6. Each buoy was lifted over the side of the boat and the anchor bridle was clipped to the line attached to the small plastic buoy.

7. The appropriate depth marker on the instrument cables corresponding to half the water depth (marked every foot) were located.

8. The strain relief carabiner was clipped to the appropriate cinch knot on the instrument cable.

9. Any excess cable was coiled onto the top of the data collection box and secure it with the Velcro strap.

10. Each box was secured to each buoy’s aluminum frame using Bungie cords.

11. A GPS unit was attached to each buoy’s antenna and powered on to initiate GPS recording.

A.4 Retrieving the Buoys

The following are the procedures for retrieving the buoys after testing:

1. The data cables were pulled out of the water and coiled onto each data collection box. The Velcro strap was used to affix the cables to the box.

2. The bridle clip was disconnected from the small buoy and the hydrophone

3. The buoy was lifted into the watercraft.

4. Each box was opened. Investigators pressed Pause/Play button on each hydrophone data logger to stop the hydrophones from recording data.

5. The thermocouple was unplugged from its data logger to stop it from recording data.

6. The Wi-Fi system was unplugged from its power source to conserve battery life

7. The anchor line and the small buoy were retrieved.

The buoy was now ready to be moved to the next site. Additional photographs of the data collection system are shown below in Fig. A-9 through Fig. A-XX.

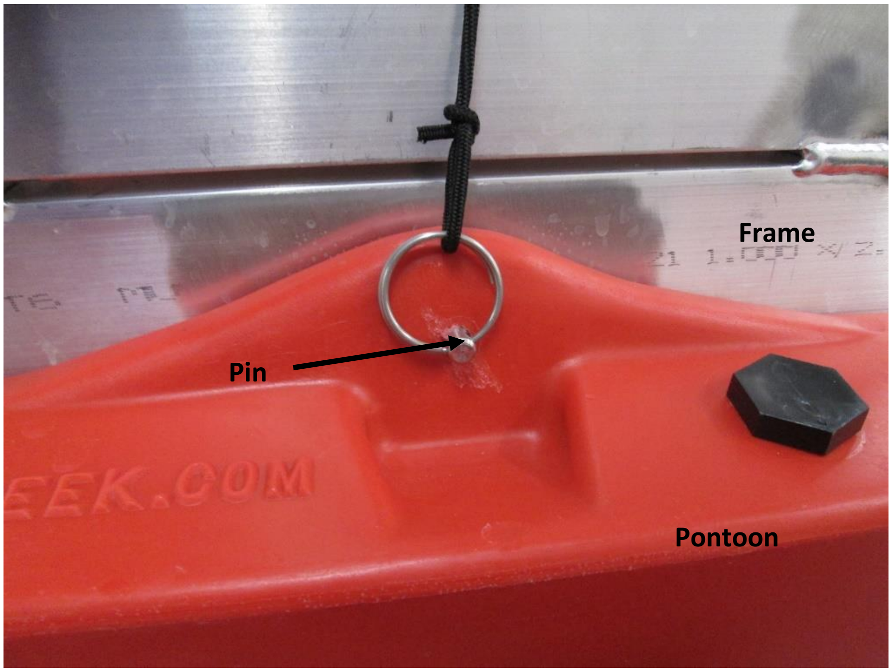


Figure A-9. Box pin connections showing how the aluminum frame attached to the pontoons

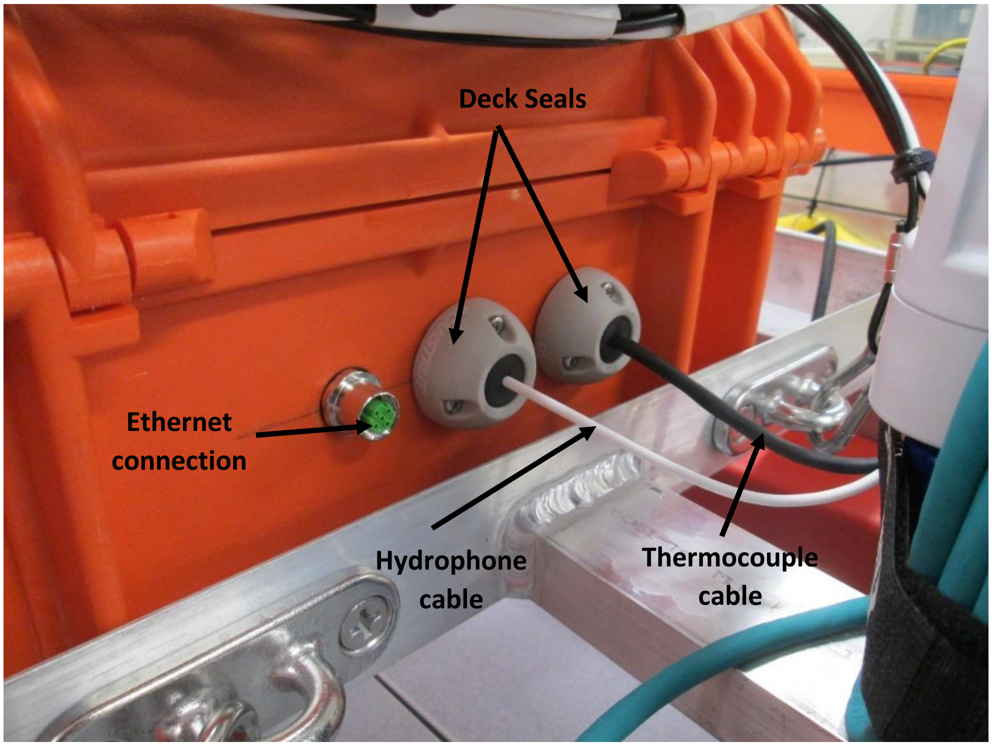


Figure A-10. Representative photograph of Ethernet, hydrophone, and thermocouple connections through each buoy's data collection box

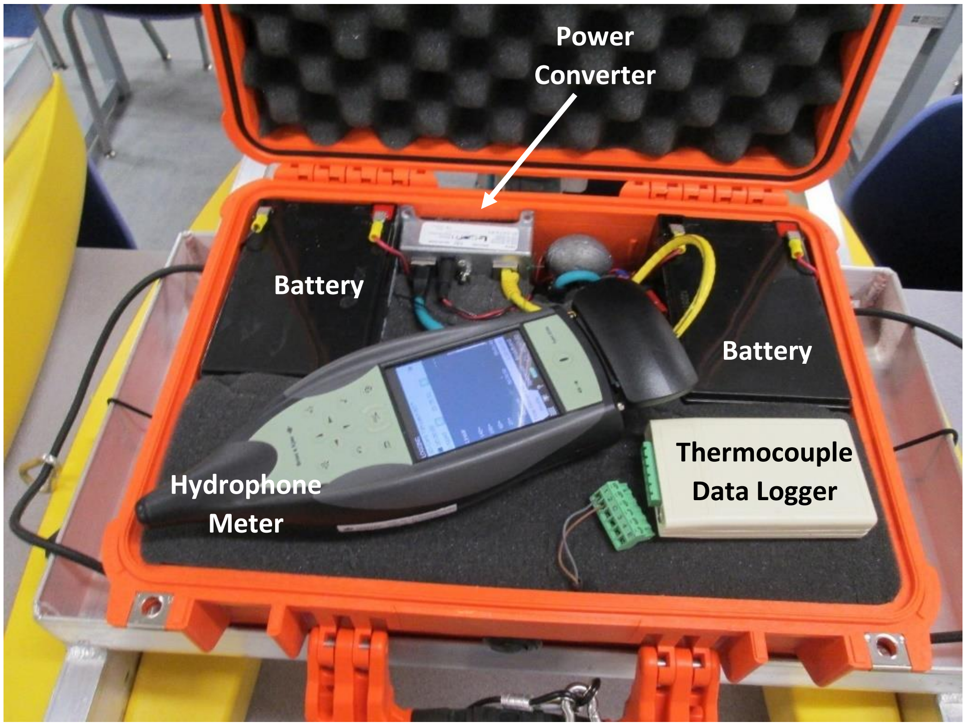


Figure A-11. Electronics inside data collection box showing data loggers and WiFi power converters

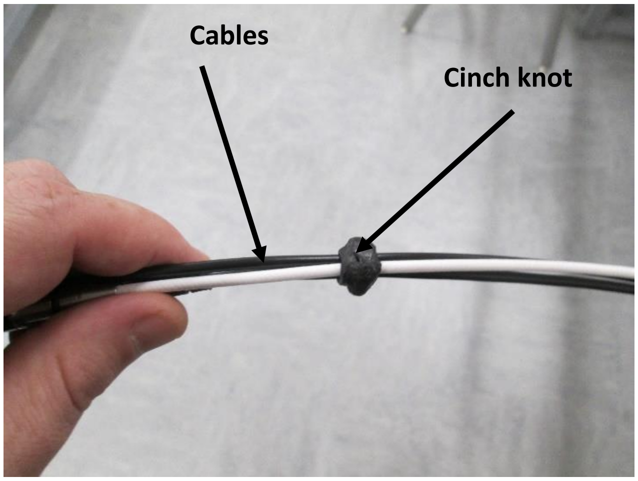


Figure A-12. Example of cinch knot used to join the stainless steel, thermocouple, and hydrophone cables. These knots were spaced every 1 ft to allow for rapid deployment at appropriate (i.e., half the water column) depths

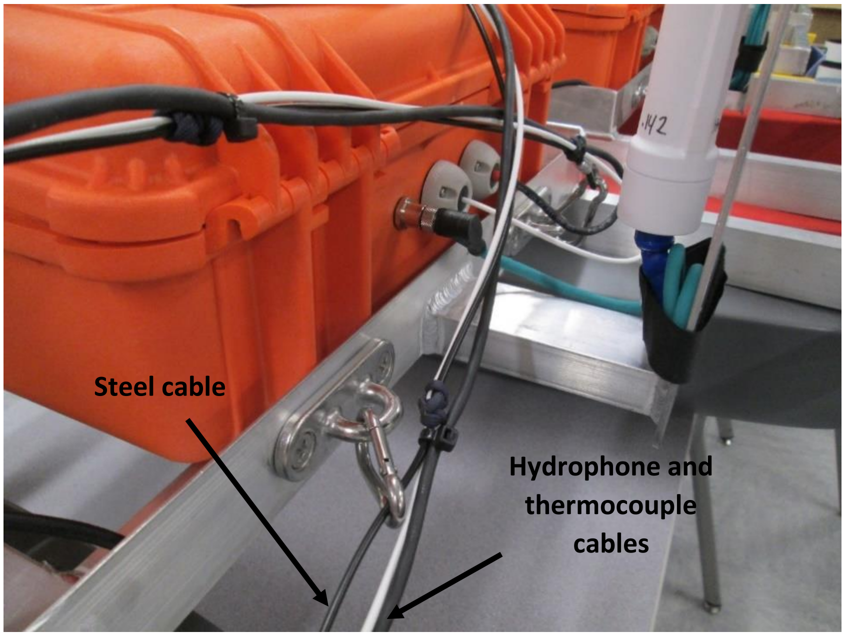


Figure A-13. Strain relief connection. As shown, the data collection cables were adjustable in 1-ft increments

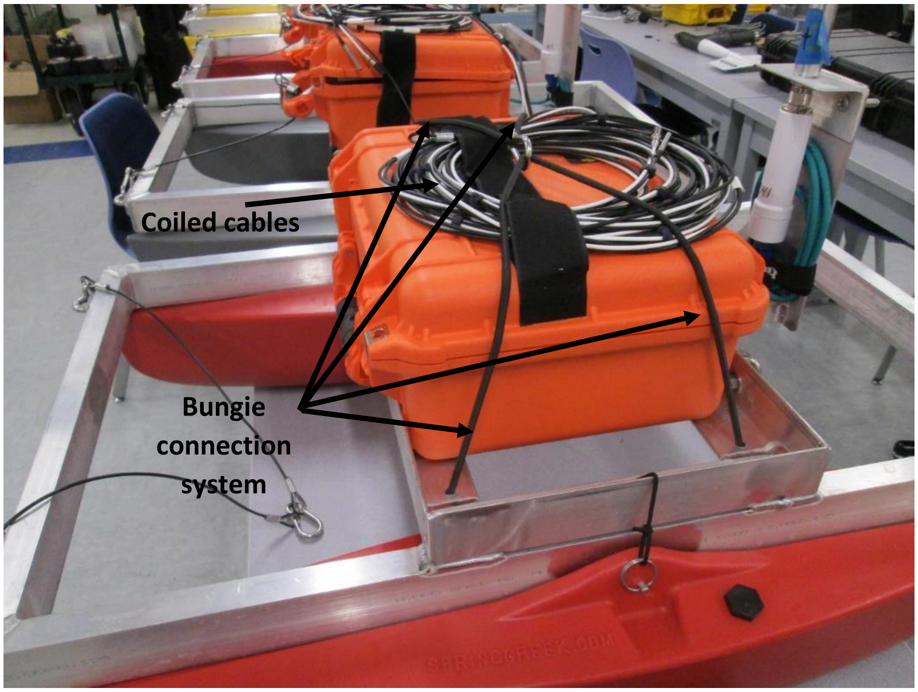


Figure A-14. Strap between aluminum frame and data collection box showing buoy ready for deployment

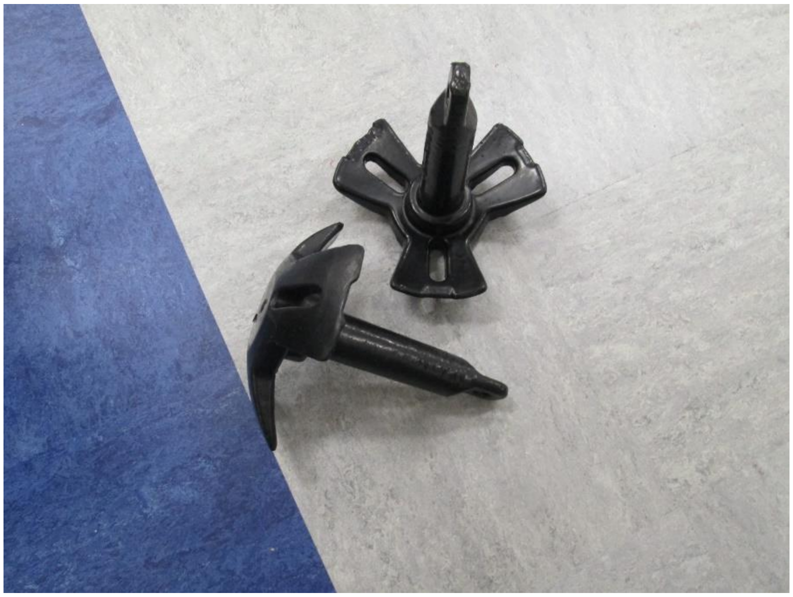


Figure A-15. River anchors used throughout this study

Figure A-16. Small plastic buoys and student coiling anchor lines using daisy chains

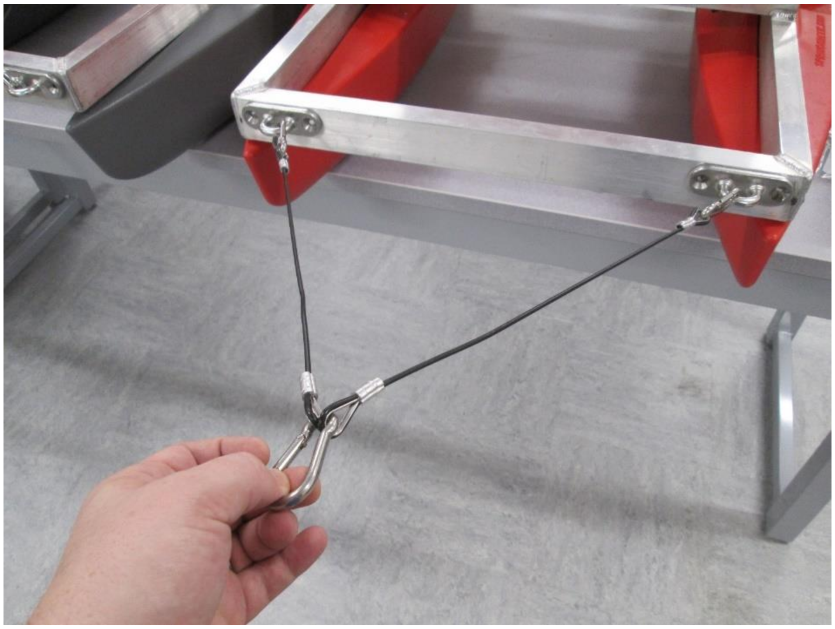


Figure A-17. Anchor bridle system


Figure A-18. Buoys stacked in watercraft preparing for deployment

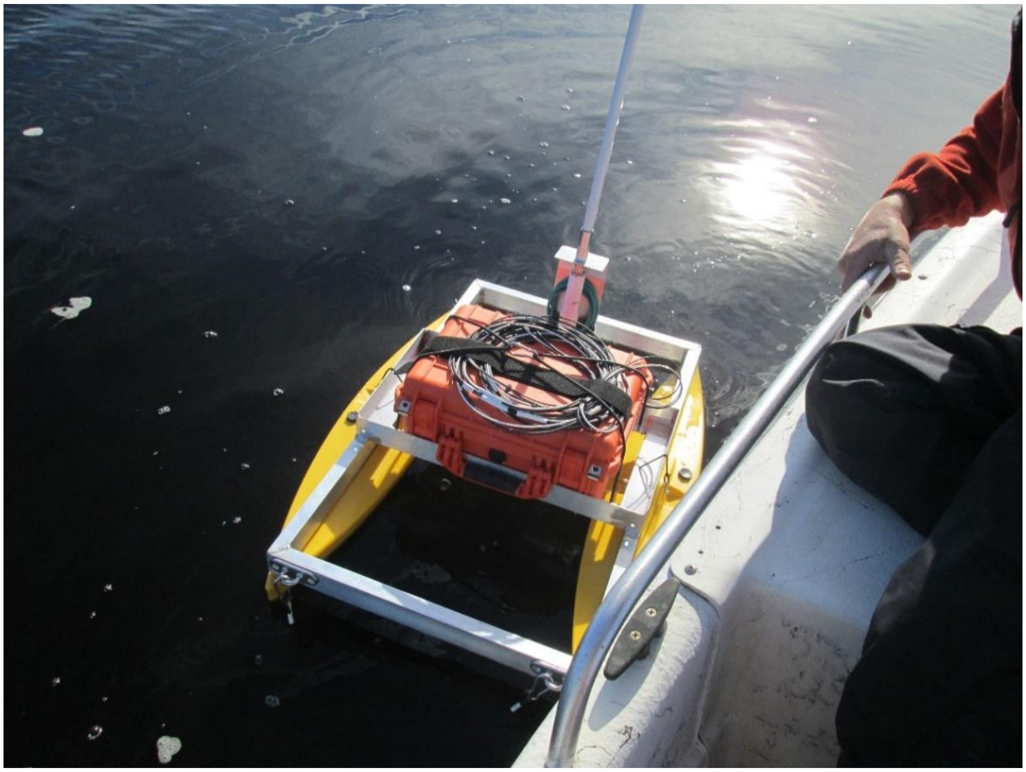


Figure A-19. Close-up of buoy launching from watercraft

Figure A-20. Photograph of data collection buoy on the intracoastal waterway during a test run

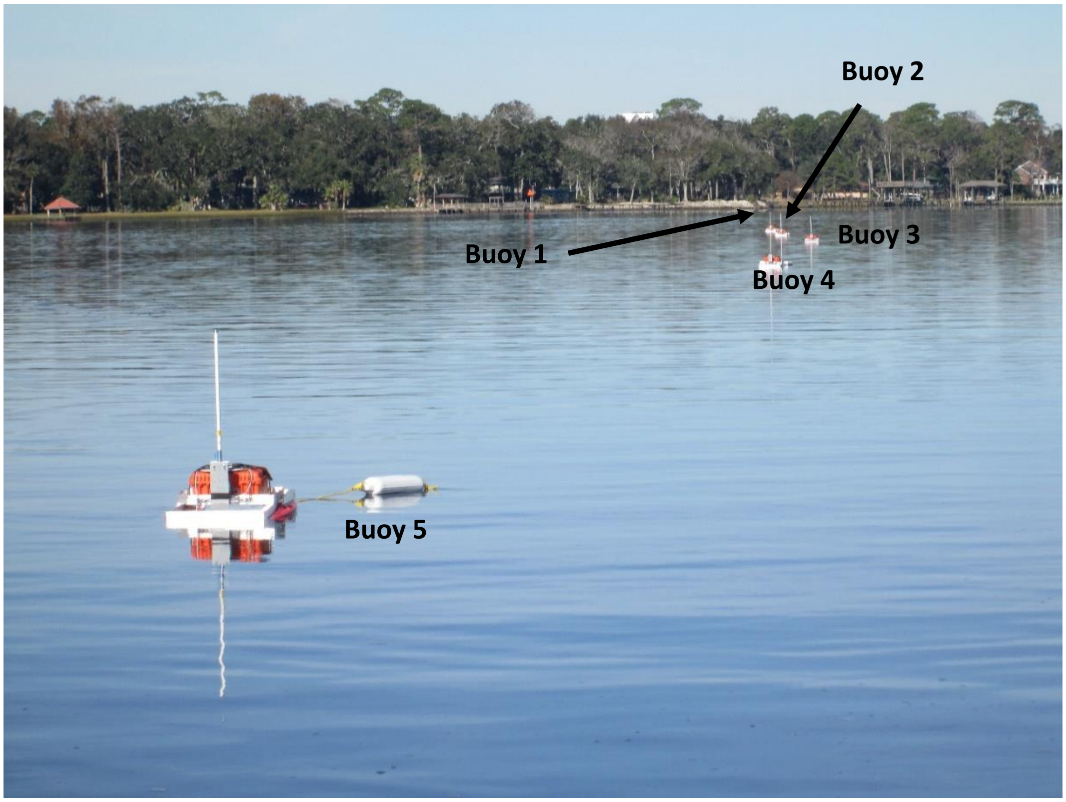


Figure A-21. Photograph of all five buoys deployed in the intracoastal waterway during a test run

APPENDIX B
GEOTECHNICAL DATA

B.1 Dunn's Creek

B.1.1 Boring Logs

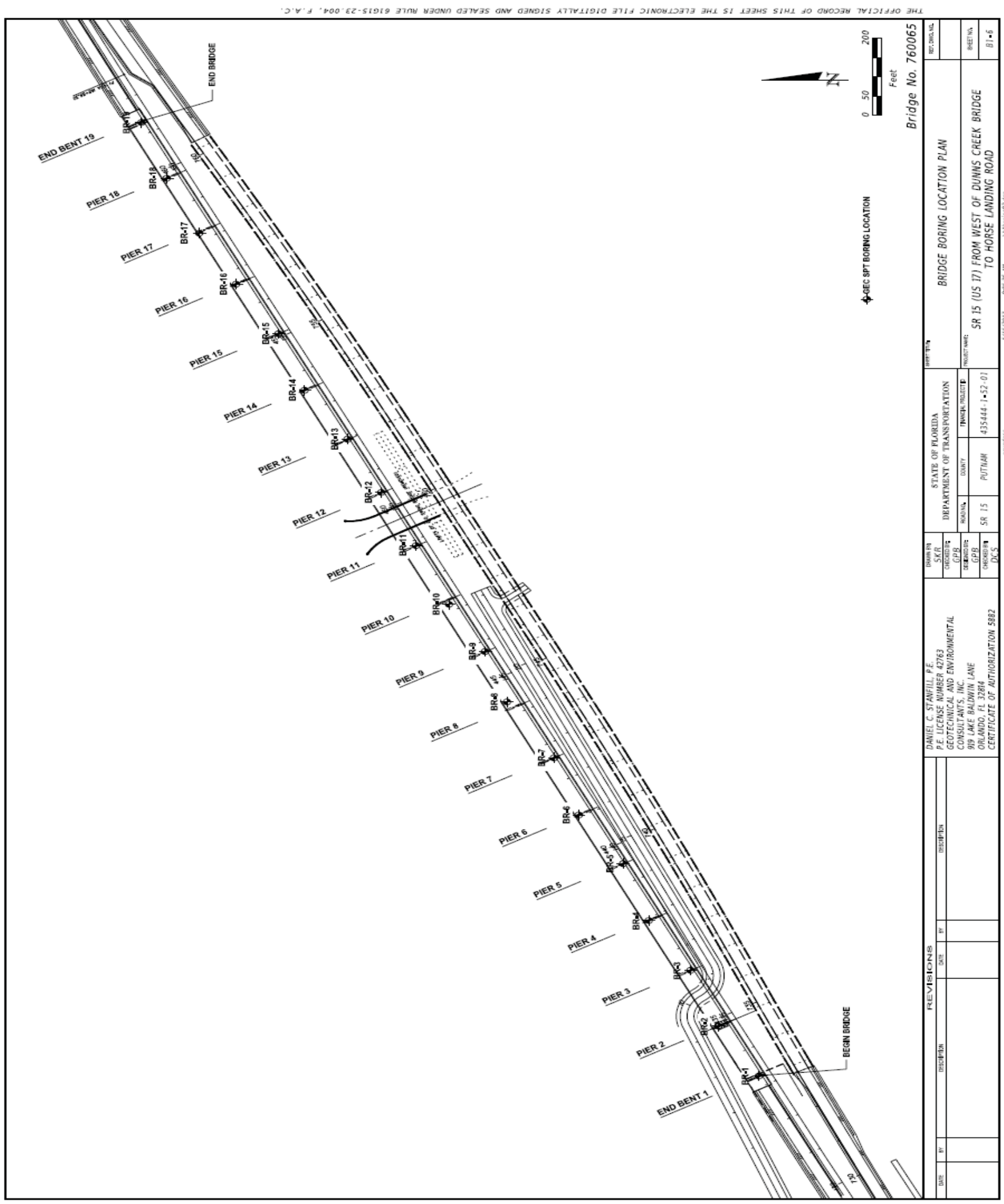


Figure B-1. Boring hole location plan at Dunn's Creek

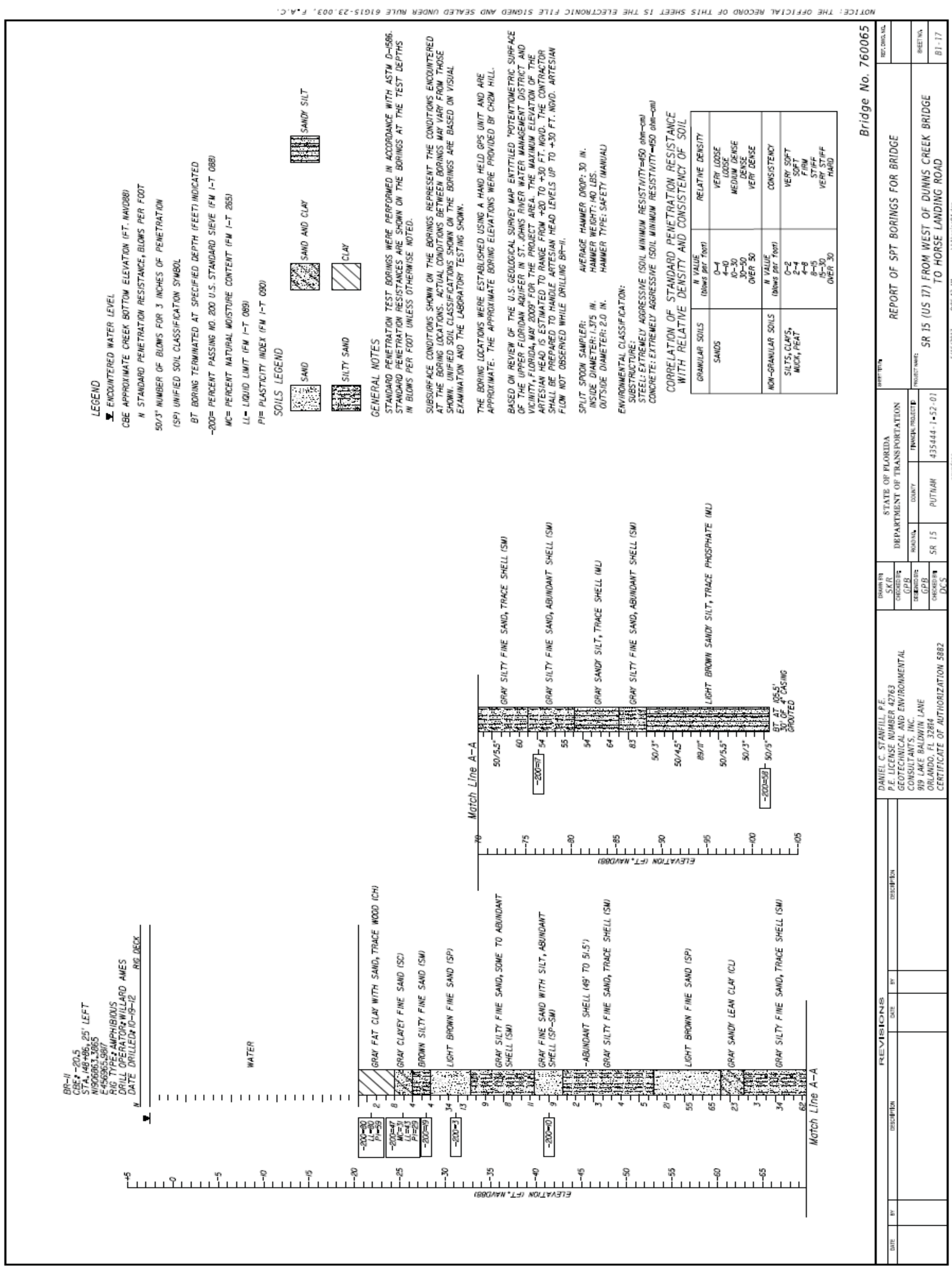
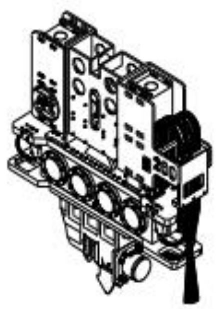


Figure B-2. Relevant boring log data from Dunn's Creek

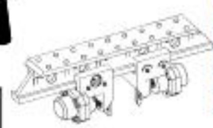
B.1.2 Vibratory Driver Specifications

APE Model 200 Vibratory Driver/Extractor with Model 700 Power Unit with 700 HP (522 kW)



Shows standard universal clamp attachment. See "optional attachments" literature for more information on other types of clamp attachments.

APE Wood Clamp

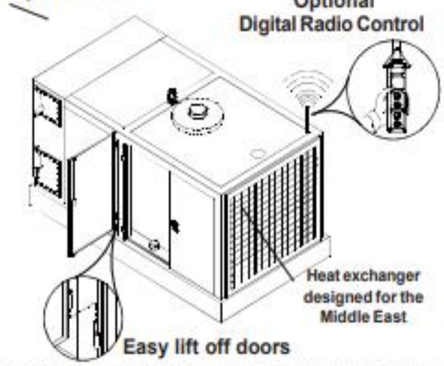


APE caisson clamps with beam for driving and extracting pipe piles

SPECIFICATIONS:	VIBRATOR Model 200
Eccentric moment	5,080 kg-cm (4400 in-lbs)
Frequency (variable)	0-1800 vpm
Driving force @ 1600 vpm	145 metric tons (160 US tons)
Driving force @ 1800 vpm	183 metric tons (202 US tons)
Amplitude	30 mm (1.17 in)
Maximum line pull	1,335 kN (150 US tons)
Suspended Weight (with universal clamp)	6,167 kg (13,600 lbs)
Length	256 cm (101 in)
Width throat	35 cm (14 in)
Width at widest point	43 cm (17 in)
Height (with 223 kN (30 ton) short suppressor & clamp	153 cm(60 in)
Height (with 1,335 kN/150 ton)(suppressor & 200 clamp)	238 cm (94 in)
Hydraulic hose length (standard)	46 meters (150 ft)
Hydraulic hose weight	680 kg (1,500 lbs)

Suspended weight drops when using smaller mini suppressor to 9,000 lbs. (4082 kg).
Suspended weight increases when using bias weights to 17,000 lbs. (7710 kg).

SPECIFICATIONS:	POWER UNIT Model 700
Engine CAT	C18 ACERT Tier III Certified
Power (Caterpillar)	522 kW (700 hp)
Operating speed (No Load)	800 to 2,100 rpm
Drive pressure (max)	344 bar (5,000 psi)
Drive flow (variable)	0-741 lpm (0-196 gpm)
Clamp pressure (max)	310 bar (5,000 psi*)
Clamp flow	41 lpm (10 gpm)
Weight	9,061 kg (19,975 lbs)
Length	401 cm (158 in)
Width	196 cm (77 in)
Height	259 cm (102 in)
Hydraulic reservior	2,498 liters (660 gal)
Fuel tank	662 liters (175 gal)



*All power unit components are designed to operate at 350 bar. The 200 has extremely large hydraulic motors for excellent performance at 282 bar. Engineers using the standard formula for horsepower requirements (psi x flow x .1714) should consult with APE engineers for a more complete understanding of how to properly calculate vibro performance. 200T also operates on APE Model 800 power unit with 801 horsepower (597 kW).

Advanced, profit generating features that are years ahead of the competition:

* *Patented multistage suppressor design reduces vibro weight and height while increasing line pull by 100%.*
* *Vibro will not shake the crane line or boom even during vibro "starting" and "stopping."*
* *Center safety pin shows pile crew and crane operator how much line pull is on pile and crane.*
* *Only vibro on market with detachable suppressor housings to fit any height and weight requirements.*
* *One piece helical gear/eccentric eliminates keyways, pins, splines, and bolts inside the gearbox.*
* *Heavy metal enhanced eccentric design reduces internal parts by up to 75% while increasing dynamic force.*
* *Giant spherical bearings allow for batter operations without damage and reduce heat for extremely long life.*
* *Computer designed gearbox is perfectly balanced with lowest center of gravity on the market.*
* *Rifle bored top plate eliminates all hoses on suppressor and to hydraulic motors. Mechanic's dream come true.*
* *Heavy duty clamp cylinder is machined from one piece of solid steel to eliminate o-rings and bolt-on guards.*
* *Power unit comes standard with spare hydraulic tank, tool kit, dual controls on pendant and control panel.*
* *Very simple open loop hydraulic system with highest quality valves with lighted indicators.*
* *Variable flow in both directions for use on drills, winches, hydraulic hammers, and other attachments.*
* *Oversized radiator and hydraulic oil cooler with proven performance in the heat of Saudi Arabia.*

AMERICAN PILEDRIVING EQUIPMENT, INC. APE

Corporate Offices:
7032 South 196th
Kent, Washington 98032 USA
(800) 248-8498 & (253) 872-0141 Fax (253) 872-8710

Visit our WEB site:
www.apevibro.com
e-mail: ape@apevibro.com

Due to constant improvements we must advise you to call APE for the latest available literature and specifications. 7/8/96

Figure B-3. Hammer specs for hammer at Dunn's Creek

B.2 Ribault River

B.2.1 Boring Logs

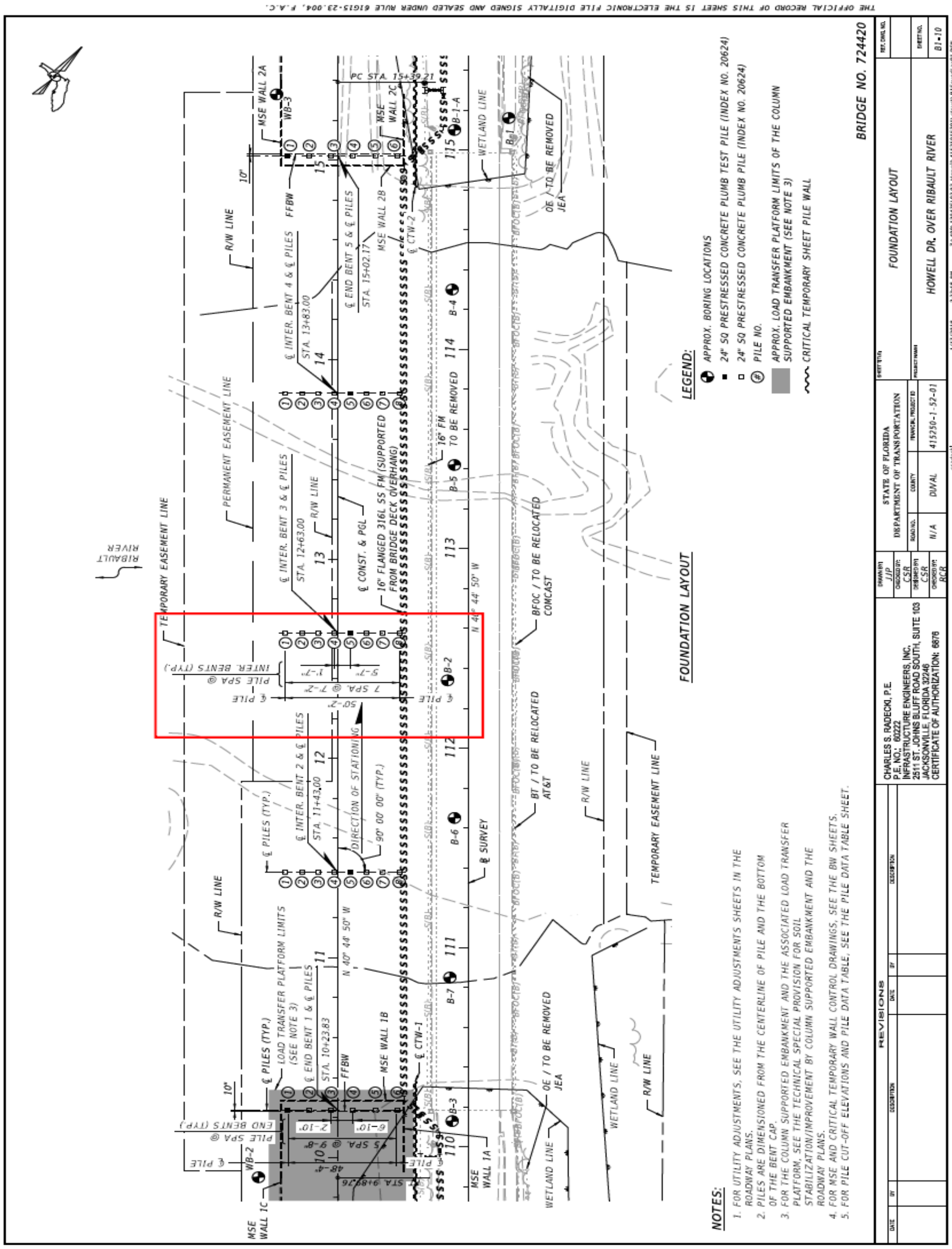


Figure B-4. Boring location data at Ribault River

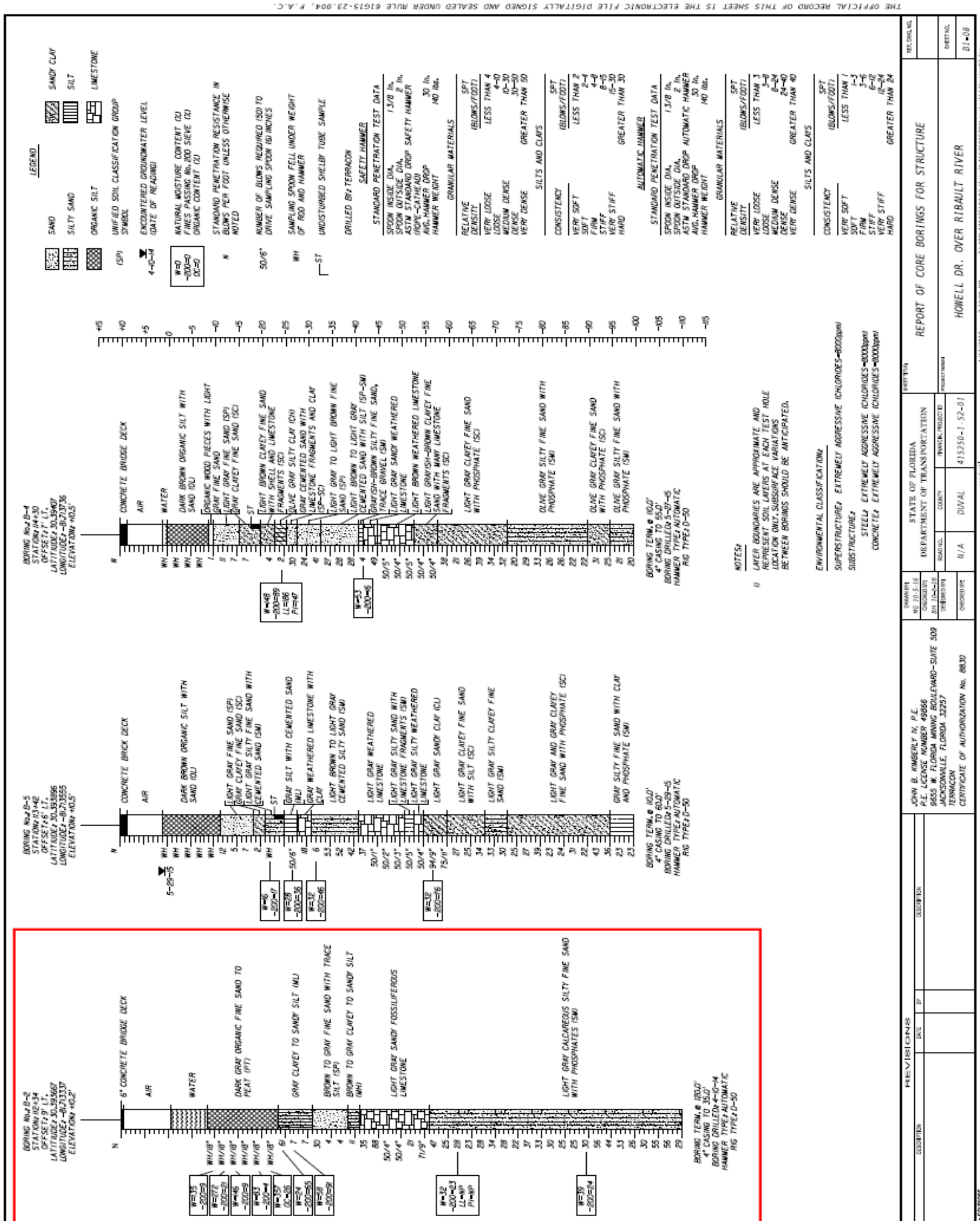


Figure B-5. Relevant boring log data at Ribault River

B.2.2 Driver Specifications

APE Model D50-52 Single Acting Diesel Impact Hammer

D50-52 in a stand-off.

MODEL D50-52 (5.0 metric ton ram)

SPECIFICATIONS

Stroke at maximum rated energy	135 in (343 cm)
Maximum rated energy (Setting 4)	124,031 ft-lbs (167.44 kNm)
Seting 3	102,946 ft-lbs (138.98 kNm)
Seting 2	81,861 ft-lbs (110.51 kNm)
Minimum rated energy (Setting 1)	60,775 ft-lbs (82.05 kNm)
(Variable throttle allows for infinite fuel settings)	
Mximum obtainable stroke	150 in (381 cm)
Maximum obtainable energy	144,243 ft-lbs (196 kNm)
Speed (blows per minute)	34-53

WEIGHTS (Approximate)

Piston	11,025 lbs (5,000 kg)
Anvil	2,255 lbs (1,023 kg)
Anvil cross sectional area	367.94 in² (2373.80 cm²)
Hammer weight (includes trip device)	25,882 lbs (11,737 kg)
Typical operating (weight with DB26 and H-beam insert)	31,184 lbs (14,142 kg)

CAPACITIES

Fuel tank (runs on diesel or bio-diesel)	23.1 gal (87.4 liters)
Oil tank	4.4 gal (16.65 liters)

CONSUMPTION

Diesel or Bio-diesel fuel	4.16 gal/hr (16 liters/hr)
Lubrication	0.39 gal/hr (1.47 liters/hr)
Grease	8 to 10 pumps every 20 minutes of operation time.

Optional Variable Throttle Control.

STRIKER PLATE

Weight	1,036 lbs (470 kg)
Diameter	25 in (63.5 cm)
Area	491 in² (3167.74 cm²)
Thickness	8 in (20.32 cm)

CUSHION MATERIAL

Type/Qty	Micarta / 2 each
Diameter	25 in (63.5 cm)
Thickness	1 in (25.4 mm)
Type/Qty	Aluminum / 3 each
Thickness	1/2 in (12.7 mm)
Diameter	25 in (63.5 cm)
Total Combined Thickness	3.5 in (8.89 cm) 491 in²
Area	(3167.74 cm²)
Elastic-modulus	285 ksi (1,965 mpa)
Coeff. of restitution	0.8

Drive Base Assembly.

DRIVE CAP

DB 32:	2,436 lbs (1,104 kg)

INSERT WEIGHT

H-Beam insert for 12" (305 mm) and 14" (355 mm):	948 lbs (430 kg)
Large pipe insert for sizes 12" to 24" diameter:	1,830 lbs (830 kg)

MINIMUM BOX LEAD SIZE/OPERATING LENGTH

Minimum box leader size	8 in x 32 in (20.32 cm x 81.28 cm)
Operating length as described above	354 in (900 cm)

Corporate Offices
7032 South 196th
Kent, Washington 98032 USA
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(253) 872-8710 Fax

Note: All specifications are subject to change without notice 08/20/2012

Figure B-6. Driver specifications at Ribault River

B.2.3 Pile Driving Logs

B.2.3.1 Test Pile

Excel 2016 (v 16.0) STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION 700-010-60 Construction Nov-18

PILE DRIVING LOG

Structure No: 724420 Page No: 1 of 4

PROJECT No: 415250-1-52-01 Date: 5/7/19 Station No: 12 +63.00

PILE Size/Type: 24" SQ PCP Length (ft): 110.00 Bent/Pier No: 3 PILE No: 1

HAMMER Make/Model: APE D50 S/N: 201407705 Rated Energy (ft-lbs): 124 FT/LB Operating Rate (BPM): 34-53

REF Elev: +17.04 (REF 1) MIN TIP Elev: -45.00 PILE CUTOFF Elev: +8.40

DRIVING CRITERIA (DC): DC2 Elev:

Type: Test Pile DRIVING CRITERIA inputs n/a for TP

DC Max Stk: Min Stk req'd for PR:

Notes: Full PDA by ECS

SC criteria (if applic): bpi @ ft Stk

DC1		DC2, input if applic.	
(1) blows @	ft,	(6) blows @	ft,
(2) blows @	ft,	(7) blows @	ft,
(3) blows @	ft,	(8) blows @	ft,
(4) blows @	ft,	(9) blows @	ft,
(5) blows @	ft,	(10) blows @	ft,

SCOUR Elev:

PILE CUSHION Thickness & Material: 24 in. x 24 in x 15 in. plywood

HAMMER CUSHION Thickness & Material: 2 x 1 in micarta + 3 x 0.5 in. aluminum

Pile Activity	Date	Start Time	Stop Time	Weather	Temp °F	Notes
Preforming	5/3/19	9:12AM	9:45AM	Cloudy	75	1, 2
Stand Pile	5/7/19	11:06AM	11:30 AM	Partly Cloudy	85	
DRIVE Pile	5/7/19	1:10PM	1:24PM	Partly Cloudy	85	

PILE DATA:

PAY ITEM No: 455-34-5 WORK ORDER No: N/A

MANUFACTURED By: CDS MFR's PILE No: HD-24-TP006 DATE CAST: 11/30/18

TBM/BM Elev: N/A TBM/BM Rod Read: N/A H.I. Elev: N/A

PRE-DRILLED Elev: N/A GROUND Rod Read: N/A GROUND Elev: -22.50

Manually input GROUND Elev (no sheet calc)

PREFORMED Elev: -45.00 Bottom of Excav Rod Read: N/A Bottom of Excav Elev: N/A

PILE HEAD Rod Read: N/A PILE HEAD Elev: +63.19 PILE TIP Elev: -46.81

PH Elev = REF - LP + PL = +63.19

Top of SOIL PLUG Elev (for Open Ended Pipe Piles & H-piles): Natural Ground Elev: N/A

Input 'Natural Ground EL' ONLY when natural ground surface is below embankment/fill material. Otherwise, leave this cell BLANK

SPLICE / EACH	PREFORMED HOLE	DYNAMIC LOAD TEST	PAY SET CHECK	NO PAY SET CHECK	REDRIVE	EXTRACTION	DRIVING OF SPLICE	PILE TYPE CODE	Plumb or Batter ? (click & select) ↓	PILE LENGTH (ft) ORIGINAL FURNISHED	PILE LENGTH (ft) TOTAL LENGTH WITH EXTENSION	Pile PENETRATION below GROUND (ft)	EXTENSION/BUILD UP AUTHORIZED (ft)	EXTENSION/BUILD UP ACTUAL (ft)
									PLUMB					
0	1	1	0	0	0	0	0	1		110.00	110.00	24.31	N/A	N/A

Pile PENETRATION (ft), below: GROUND: 24.31 ft

CTQP Trainee (supervised by the Qualified Inspector) experiencing the full pile installation & log inspection: Name: TIN:

Qualified Inspector - I certify the Pile Driving Log content, and as applicable, the above CTQP Trainee's participation during this pile installation: Name & TIN: Sean Johnson J52578470 Signature:

Figure B-7. First page of pile driving log for test pile at Ribault River

DC:

STATE OF FLORIDA DOT

Min Tip | 1 ft to c/o | c/o

700-010-60
Construction
Nov-18

PILE DRIVING LOG

Page No: 2 of 4

Structure No.: 724420 Depth Table Extended (ft): Bent/Pier No.: 3 Pile No.: 1

Depth Input Start LP↓	REF		Blows	Stroke	Notes	Depth	REF		Blows	Stroke	Notes	Depth	REF		Blows	Stroke	Notes
0.00	1	1.00				33.00	-	34.00				**63.85**	-	64.00			
1.00	-	2.00				34.00	-	35.00				64.00	-	65.00			
2.00	-	3.00				35.00	-	36.00				**65.00**	-	69.00			
3.00	-	4.00				36.00	-	37.00				69.00	-	70.00			
4.00	-	5.00				37.00	-	38.00				70.00	-	71.00			
5.00	-	6.00				38.00	-	39.00				71.00	-	72.00			
6.00	-	7.00				39.00	-	40.00				72.00	-	73.00			
7.00	-	8.00				40.00	-	41.00				73.00	-	74.00			
8.00	-	9.00				41.00	-	42.00				74.00	-	75.00			
9.00	-	10.00				42.00	-	43.00				75.00	-	76.00			
10.00	-	11.00				43.00	-	44.00				76.00	-	77.00			
11.00	-	12.00				44.00	-	45.00				77.00	-	78.00			
12.00	-	13.00				45.00	-	46.00				78.00	-	79.00			
13.00	-	14.00				46.00	-	47.00				79.00	-	80.00			
14.00	-	15.00				47.00	-	48.00				80.00	-	81.00			
15.00	-	16.00				48.00	-	49.00				81.00	-	82.00			
16.00	-	17.00				49.00	-	50.00				82.00	-	83.00			
17.00	-	18.00				50.00	-	51.00				83.00	-	84.00			
18.00	-	19.00				51.00	-	52.00				84.00	-	85.00			
19.00	-	20.00				52.00	-	53.00				85.00	-	86.00			
20.00	-	21.00				53.00	-	54.00				86.00	-	87.00			
21.00	-	22.00				54.00	-	55.00				87.00	-	88.00			
22.00	-	23.00				55.00	-	56.00				88.00	-	89.00			
23.00	-	24.00				56.00	-	57.00				89.00	-	90.00			
24.00	-	25.00				57.00	-	58.00	6	6	F1, 3	90.00	-	91.00			
25.00	-	26.00				58.00	-	59.00	13	6.3		91.00	-	92.00			
26.00	-	27.00				59.00	-	60.00	11	6.7		92.00	-	93.00			
27.00	-	28.00				60.00	-	61.00	13	6.4		93.00	-	94.00			
28.00	-	29.00				61.00	-	62.00	15	6.6		94.00	-	95.00			
29.00	-	30.00				62.00	-	63.00	17	6.6		95.00	-	96.00			
30.00	-	31.00				**63.00**	-	63.67	64	7	F4, 4	96.00	-	97.00			
31.00	-	32.00				**63.67**	-	63.77	20	7.5	F2, 5	97.00	-	98.00			
32.00	-	33.00				**63.77**	-	63.85	20	7.5	F1, 6, 7	98.00	-	99.00			

Figure B-8. Second page of pile driving log for test pile at Ribault River

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

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PILE DRIVING LOG

Structure No: 724420 | Page No: 3 of 4

REF inputs & Notes

PROJECT No: 415250-1-52-01 | Bent/Pier No: 3 | PILE No.: 1

REF No.	Input REF EL ↓	*Calculated LP values for each REF used			Input REF description (template, stringline, etc.) for each REF used: ↓
		LP min tip	LP c/o-1	LP c/o	
1	+17.04	62.04	117.64	118.64	Top of pocket.
2					
3					
4					
5					

Standard Notes & Note No.'s 1-28

Std. Notes:	↓ = Pile Ran, F1, F2, F3, F4 = (Fuel Settings 1-4), ST = stop, CC = cushion change, HR = high rebound, TP = Test Pile, DC = Driving Criteria, PR = Practical Refusal, SC = set check, DLT = Dyn. Load Test
Note 1:	The contractor uses a 60 ft. sheet pile and vibratory hammer to break up the hard layer. The sheet pile is marked to
Note 2:	insure that it is not vibrated past minimum tip. They complete drilling to a preformed depth of -45.0 ft.
Note 3:	Contractor dry fires hammer from 57.0 ft. to 57.5 ft. in order to safely seat pile in firm material.
Note 4:	ECS changes to fuel setting 4, to observe stresses on pile, and immediately stops drive at 1317 to mark pile for inches.
Note 5:	Resumed drive at 1319 and drove pile for 20 blows on fuel setting 2. Pile moved 1.25 inches.
Note 6:	Stopped drive at 1320, changed fuel setting to 1, and resumed drive at 1323.
Note 7:	Practical refusal was reached with 20 blows for 1.0 inch, and a 7.5 ft stroke.
Note 8:	
Note 9:	
Note 10:	
Note 11:	
Note 12:	
Note 13:	
Note 14:	
Note 15:	
Note 16:	
Note 17:	
Note 18:	
Note 19:	
Note 20:	
Note 21:	
Note 22:	
Note 23:	
Note 24:	
Note 25:	
Note 26:	
Note 27:	
Note 28:	

Figure B-9. Third page of pile driving log for test pile at Ribault River

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

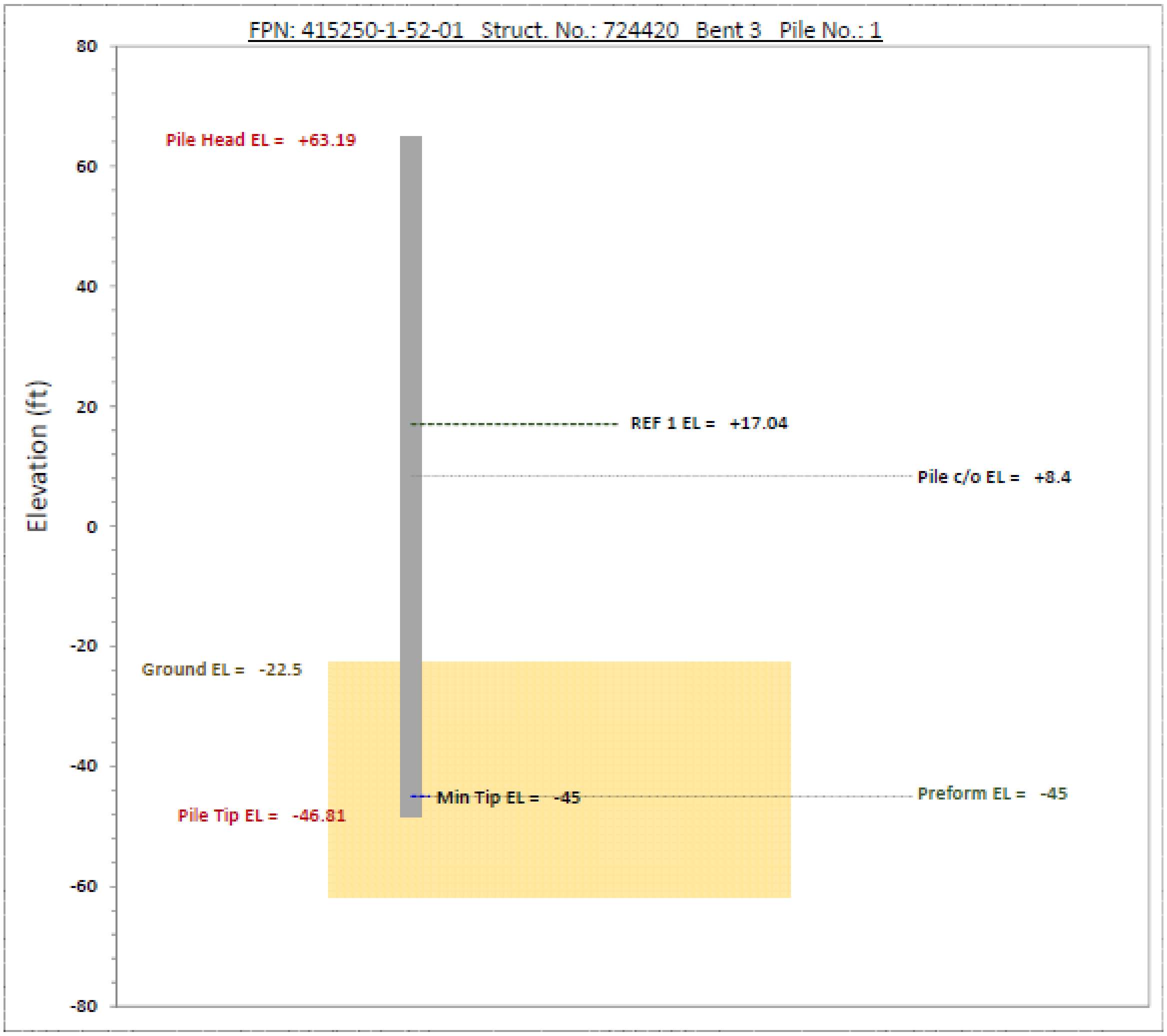
700-010-60
Construction
Nov-18

PILE DRIVING LOG

Structure No: 724420 Page No: 4 of 4

Sketch

PROJECT No: 415250-1-52-01 Bent/Pier No: 3 PILE No.: 1



PLUMB pile, as depicted in this Pile Sketch

Pile Bearing: (click on yellow shaded cell below, and select basis for Pile Bearing acceptance that applies)

Click here to select applicable bearing capacity related input: If none of the conditions below applies, type condition under which the pile was accepted.

Pile Penetration:

Pile Tip EL ≤ bottom EL of Preformed or Predrilled pile hole, meets 455-5 Penetration Requirements.

Current Pile Tip EL ≤ Min Tip EL in plans, meets 455-5 Penetration Requirements.

Min Tip EL is input on the log. Therefore, the 10-20 ft of penetration into firm/soft material, in accordance with 455-5 Penetration Requirements, does not apply.

Figure B-10. Fourth page of pile driving log for test pile at Ribault River

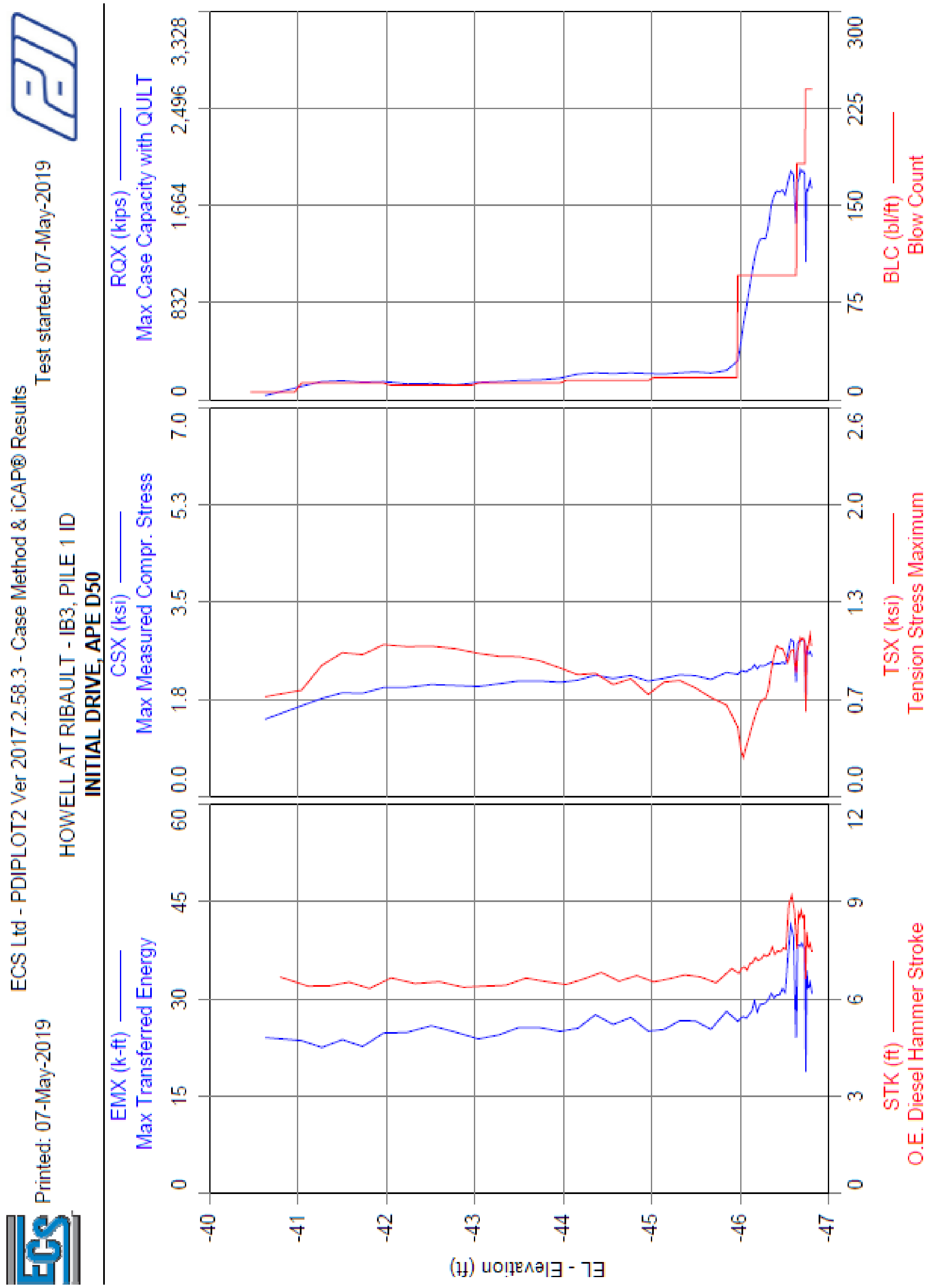


Figure B-11. PDA graphical data for test pile at Ribault River

ECS Ltd
Case Method & iCAP® Results

Page 1
PDIPLOT2 2017.2.58.3 - Printed 07-May-2019

HOWELL AT RIBAULT - IB3, PILE 1 ID
OP: ECS-AT

INITIAL DRIVE, APE D50
Date: 07-May-2019

AR: 576.00 in²
LE: 106.00 ft
WS: 14,700.0 f/s

SP: 0.150 k/ft³
EM: 6,996 ksi
JC: 0.40

EMX: Max Transferred Energy
STK: O.E. Diesel Hammer Stroke
CSX: Max Measured Compr. Stress
CSI: Max F1 or F2 Compr. Stress
CSB: Compression Stress at Bottom
TSX: Tension Stress Maximum
RQX: Max Case Capacity with QULT
RQ9: Max Case Capacity (JC=0.9) with QULT
BTA: BETA Integrity Factor

BL#	Elev.	BLC	TYPE	EMX	STK	CSX	CSI	CSB	TSX	RQX	RQ9	BTA
	ft	bl/ft		k-ft	ft	ksi	ksi	ksi	ksi	kips	kips	(%)
6	-40.96	6	AV4	24.7	6.7	1.4	1.5	0.4	0.7	37	37	100.0
19	-41.96	13	AV13	23.0	6.4	1.8	2.0	0.7	0.9	156	152	100.0
30	-42.96	11	AV11	25.1	6.5	2.0	2.2	0.8	1.0	133	130	100.0
43	-43.96	13	AV13	25.0	6.5	2.1	2.3	1.0	0.9	165	160	100.0
58	-44.96	15	AV15	26.3	6.6	2.1	2.3	1.2	0.8	224	199	100.0
75	-45.96	17	AV17	26.4	6.7	2.2	2.3	1.3	0.7	234	217	100.0
139	-46.63	96	AV64	30.4	7.5	2.4	2.6	2.8	0.7	1,389	1,323	100.0
158	-46.73	182	AV19	37.3	8.6	2.8	2.9	3.4	1.0	1,907	1,857	100.0
178	-46.81	240	AV20	30.2	7.5	2.5	2.6	3.0	1.0	1,731	1,693	100.0
			Average	29.0	7.2	2.3	2.5	2.1	0.8	982	944	100.0

Total number of blows analyzed: 176

BL# Sensors

3-178 F1: [M753] 144.2 (1.02); F2: [G093] 101.2 (1.02); A1: [K2626] 342.0 (0.98);
A2: [K6138] 352.0 (0.98)

BL# Comments

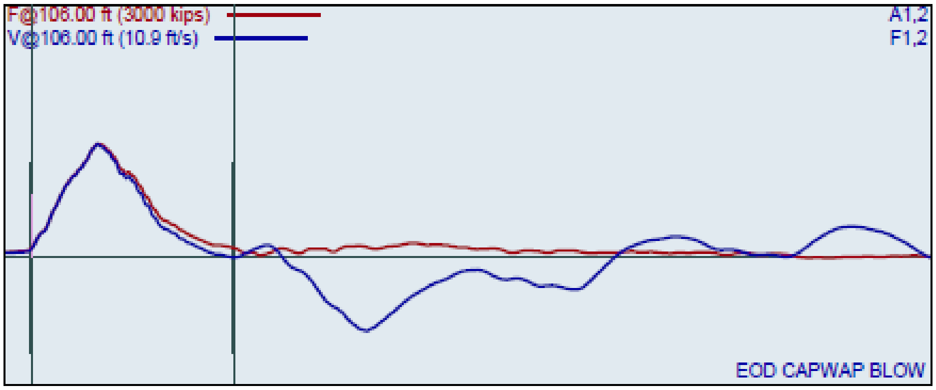
1 FS1, REF. 17.04, C/O 8.4
90 EOD CAPWAP BLOW
139 STOP, MARK IN, FS2, LP 64'-8"
158 19 BL / 1.25", CSB HIGH GO TO FS1
178 20 BL / 1-IN, PR ACHIEVED

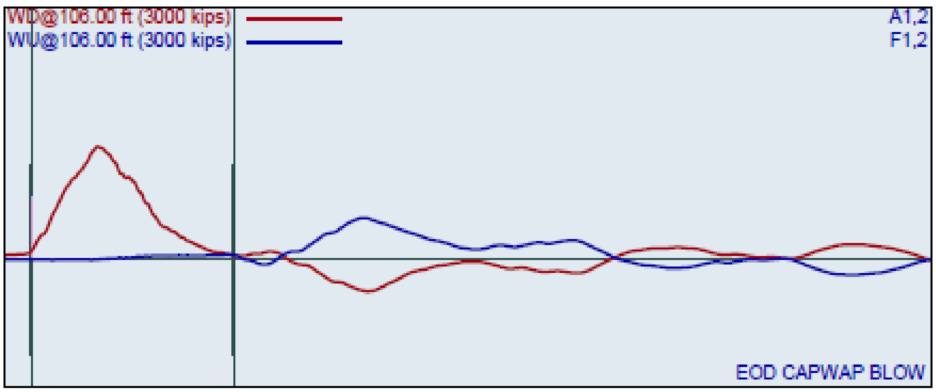
Time Summary

Drive 11 minutes 41 seconds 1:12 PM - 1:24 PM BN 1 - 178

Figure B-12. PDA tabular data for test pile at Ribault River

ECS Florida LLC
Pile Driving Analyzer ® (PDA)
HOWELL AT RIBAULT — IB3, PILE 1 ID





Project Information
PROJECT: HOWELL AT RIBAULT
PILE NAME: IB3, PILE 1 ID
DESC: INITIAL DRIVE
PDA OWNER: ECS Florida LLC
SERIAL NUMBER: 3942L
OPERATOR: ECS-AT
FILE: IB3, PILE 5 ID.pda
07May2019 01:16:14 PM
Blow number 90

Pile Properties

LE	106.00 ft
AR	576.00 in^2
EM	6996 ksi
SP	0.150 k/ft3
WS	14700.0 ft/s
WC	14671.3 ft/s
EA/C	274.1 ksec/ft
2L/C	14.45 ms
JC	0.40
LP	63.16 ft

Quantity Results

CSI	2.51 ksi
CSX	2.33 ksi
CSB	2.41 ksi
TSX	0.44 ksi
EMX	28.8 k-ft
ETR	23.2 %
STK	7.21 ft
RX4	1040 kips
RMX	1040 kips
RX9	980 kips
BTA	100.0 %
FVP	0.99

Sensors
A1 (PR): [K2626] 342 mv/6.4v/5000g (0.98) VF6
A2 (PR): [K6138] 352 mv/6.4v/5000g (0.98) VF6
F1 : [M753] 144.2 PDICAL (1.02) FF6
F2 : [G093] 101.2 PDICAL (1.02) FF6
CLIP: OK

Version 2016.30

Figure B-13. Additional PDA graphical data for test pile at Ribault River

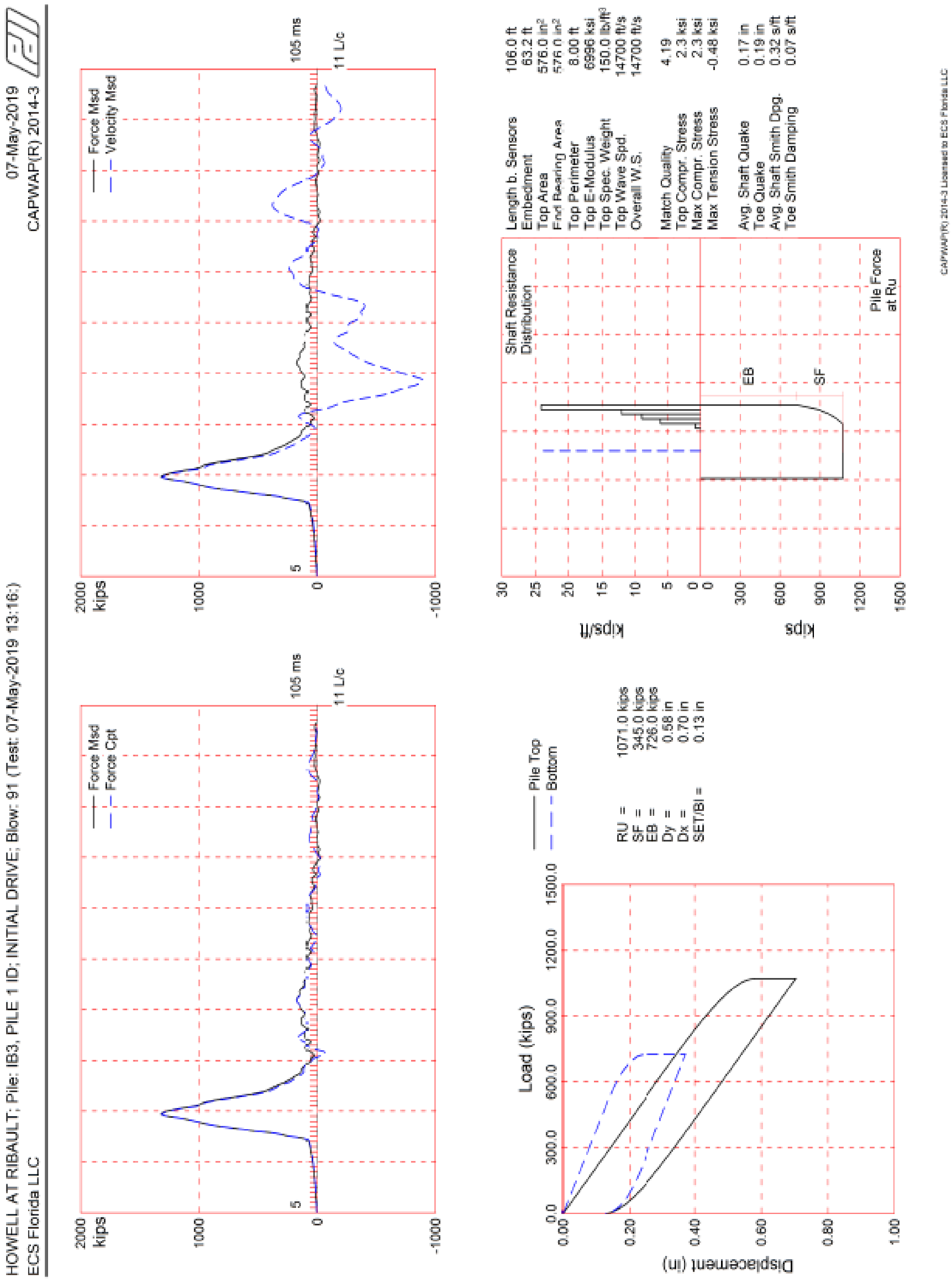


Figure B-14. Additional PDA graphical data for test pile at Ribault River

HOWELL AT RIBAULT; Pile: IB3, PILE 1 ID — Test: 07-May-2019 13:16
INITIAL DRIVE; Blow: 91 — CAPWAP(R) 2014-3
ECS Florida LLC — OP: ECS-AT

About the CAPWAP Results

The CAPWAP program performs a signal matching or reverse analysis based on measurements taken on a deep foundation under an impact load. The program is based on a one-dimensional mathematical model. Under certain conditions, the model only crudely approximates the often complex dynamic situations.

The CAPWAP analysis relies on the input of accurately measured dynamic data plus additional parameters describing pile and soil behavior. If the field measurements of force and velocity are incorrect or were taken under inappropriate conditions (e.g., at an inappropriate time or with too much or too little energy) or if the input pile model is incorrect, then the solution cannot represent the actual soil behavior.

Generally the CAPWAP analysis is used to estimate the axial compressive pile capacity and the soil resistance distribution. The long-term capacity is best evaluated with restrike tests since they incorporate soil strength changes (set-up gains or relaxation losses) that occur after installation. The calculated load settlement graph does not consider creep or long term consolidation settlements. When uplift is a controlling factor in the design, use of the CAPWAP results to assess uplift capacity should be made only after very careful analysis of only good measurement quality, and further used only with longer pile lengths and with nominally higher safety factors.

CAPWAP is also used to evaluate driving stresses along the length of the pile. However, it should be understood that the analysis is one dimensional and does not take into account bending effects or local contact stresses at the pile toe.

Furthermore, if the user of this software was not able to produce a solution with satisfactory signal "match quality" (MQ), then the associated CAPWAP results may be unreliable. There is no absolute scale for solution acceptability but solutions with MQ above 5 are generally considered less reliable than those with lower MQ values and every effort should be made to improve the analysis, for example, by getting help from other independent experts.

Considering the CAPWAP model limitations, the nature of the input parameters, the complexity of the analysis procedure, and the need for a responsible application of the results to actual construction projects, it is recommended that at least one static load test be performed on sites where little experience exists with dynamic behavior of the soil resistance or when the experience of the analyzing engineer with both program use and result application is limited.

Finally, the CAPWAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of structure and other factors. The CAPWAP results should be reviewed by the Engineer of Record with consideration of applicable geotechnical conditions including, but not limited to, group effects, potential settlement from underlying compressible layers, soil resistances provided from any layers unsuitable for long term support, as well as effective stress changes due to soil surcharges, excavation or change in water table elevation.

The CAPWAP analysis software is one of many means by which the capacity of a deep foundation can be assessed. The engineer performing the analysis is responsible for proper software application and the analysis results. Pile Dynamics accepts no liability whatsoever of any kind for the analysis solution and/or the application of the analysis result.

Analysis: 07-May-2019

Figure B-15. PDA description at Ribault River

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 1071.0; along Shaft 345.0; at Toe 726.0 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft
				1071.0				
1	72.9	30.0	0.0	1071.0	0.0	0.00	0.00	0.00
2	79.5	36.7	5.0	1066.0	5.0	0.75	0.09	0.32
3	86.1	43.3	40.0	1026.0	45.0	6.04	0.75	0.32
4	92.8	49.9	60.0	966.0	105.0	9.06	1.13	0.32
5	99.4	56.5	80.0	886.0	185.0	12.08	1.51	0.32
6	106.0	63.2	160.0	726.0	345.0	24.15	3.02	0.32
Avg. Shaft			57.5			5.46	0.68	0.32
Toe			726.0				181.50	0.07

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.17	0.19
Case Damping Factor		0.40	0.19
Damping Type		Viscous	Smith
Unloading Quake	(% of loading quake)	100	63
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	76	
Resistance Gap (included in Toe Quake) (in)			0.07
Soil Plug Weight	(kips)		0.050
Soil Support Dashpot		0.000	3.000
Soil Support Weight	(kips)	0.00	5.50

CAPWAP match quality = 4.19 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.13 in; Blow Count = 96 b/ft
Computed: Final Set = 0.11 in; Blow Count = 111 b/ft
Transducer F1 (M753) CAL: 144.2; RF: 1.02; F2 (G093) CAL: 101.2; RF: 1.02
A1 (K2626) CAL: 342; RF: 0.90; A2 (K6130) CAL: 352; RF: 0.90

max. Top Comp. Stress = 2.3 ksi (T= 24.8 ms, max= 1.027 x Top)
max. Comp. Stress = 2.3 ksi (Z= 69.6 ft, T= 29.5 ms)
max. Tens. Stress = -0.48 ksi (Z= 59.6 ft, T= 47.8 ms)
max. Energy (EMX) = 28.3 kip-ft; max. Measured Top Displ. (DMX)= 0.40 in

Figure B-16. Additional PDA description at Ribault River

EXTREMA TABLE

Pile Sgmnt No.	Dist. Below Gages ft	max. Force kips	min. Force kips	max. Comp. Stress ksi	max. Tens. Stress ksi	max. Trnsfd. Energy kip-ft	max. Veloc. ft/s	max. Displ. in
1	3.3	1316.5	-80.6	2.3	-0.14	28.3	4.8	0.42
2	6.6	1316.1	-86.6	2.3	-0.15	28.3	4.8	0.42
4	13.3	1315.2	-113.1	2.3	-0.20	28.3	4.8	0.42
6	19.9	1314.3	-154.2	2.3	-0.27	28.2	4.8	0.41
8	26.5	1313.4	-176.0	2.3	-0.31	28.2	4.8	0.41
10	33.1	1312.5	-192.1	2.3	-0.33	28.1	4.8	0.41
12	39.8	1311.6	-204.1	2.3	-0.35	28.1	4.8	0.41
14	46.4	1311.2	-248.1	2.3	-0.43	28.0	4.8	0.40
16	53.0	1314.9	-265.5	2.3	-0.46	28.0	4.8	0.39
18	59.6	1325.5	-273.7	2.3	-0.48	27.8	4.7	0.39
20	66.3	1347.3	-251.2	2.3	-0.44	27.6	4.7	0.38
22	72.9	1335.1	-222.0	2.3	-0.39	27.3	4.8	0.36
23	76.2	1294.7	-224.1	2.2	-0.39	27.1	4.9	0.36
24	79.5	1265.5	-216.0	2.2	-0.37	26.9	5.1	0.35
25	82.8	1195.9	-200.8	2.1	-0.35	26.5	5.3	0.34
26	86.1	1143.5	-185.1	2.0	-0.32	26.2	5.4	0.34
27	89.4	1139.7	-163.0	2.0	-0.28	24.0	5.4	0.33
28	92.8	1224.2	-166.6	2.1	-0.29	23.8	5.1	0.32
29	96.1	1153.1	-131.0	2.0	-0.23	20.8	4.7	0.32
30	99.4	1207.0	-122.9	2.1	-0.21	20.5	4.4	0.31
31	102.7	1116.2	-76.8	1.9	-0.13	16.9	4.2	0.30
32	106.0	1180.6	-83.7	2.0	-0.15	11.0	3.9	0.29
Absolute	69.6			2.3			(T =	29.5 ms)
	59.6				-0.48		(T =	47.8 ms)

Figure B-17. Additional PDA tabular data at Ribault River

CASE METHOD

J =	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
RP	158.8	151.3	143.8	136.4	128.9	121.4	114.0	106.5	99.0	91.6
RX	1457.4	1349.1	1245.7	1147.4	1071.9	1043.2	1026.4	1016.4	1015.9	1015.4
RU	1450.9	1331.7	1212.6	1093.5	974.3	855.2	736.1	616.9	497.8	378.7

RAU = 1013.2 (kips); RA2 = 1043.9 (kips)

Current CAPWAP Ru = 1071.0 (kips); Corresponding J(RP)= 0.00; J(RX) = 0.40

VMX	TVP	VT1*Z	FT1	FMX	DMX	DFN	SET	EMX	QUS	KEB
ft/s	ms	kips	kips	kips	in	in	in	kip-ft	kips	kips/in
4.8	24.56	113.3	120.1	1322.4	0.40	0.12	0.13	28.3	1284.7	6050

PILE PROFILE AND PILE MODEL

Depth	Area	E-Modulus	Spec. Weight	Perim.
ft	in^2	ksi	lb/ft^3	ft
0.0	576.0	6996.1	150.000	8.00
106.0	576.0	6996.1	150.000	8.00

Toe Area 576.0 in^2

Top Segment Length 3.31 ft, Top Impedance 274 kips/ft/s

Wave Speed: Pile Top 14700.0, Elastic 14700.0, Overall 14700.0 ft/s
Pile Damping 2.00 %, Time Incr 0.225 ms, 2L/c 14.4 ms
Total volume: 424.000 ft^3; Volume ratio considering added impedance: 1.000

Figure B-18. Additional PDA tabular data at Ribault River

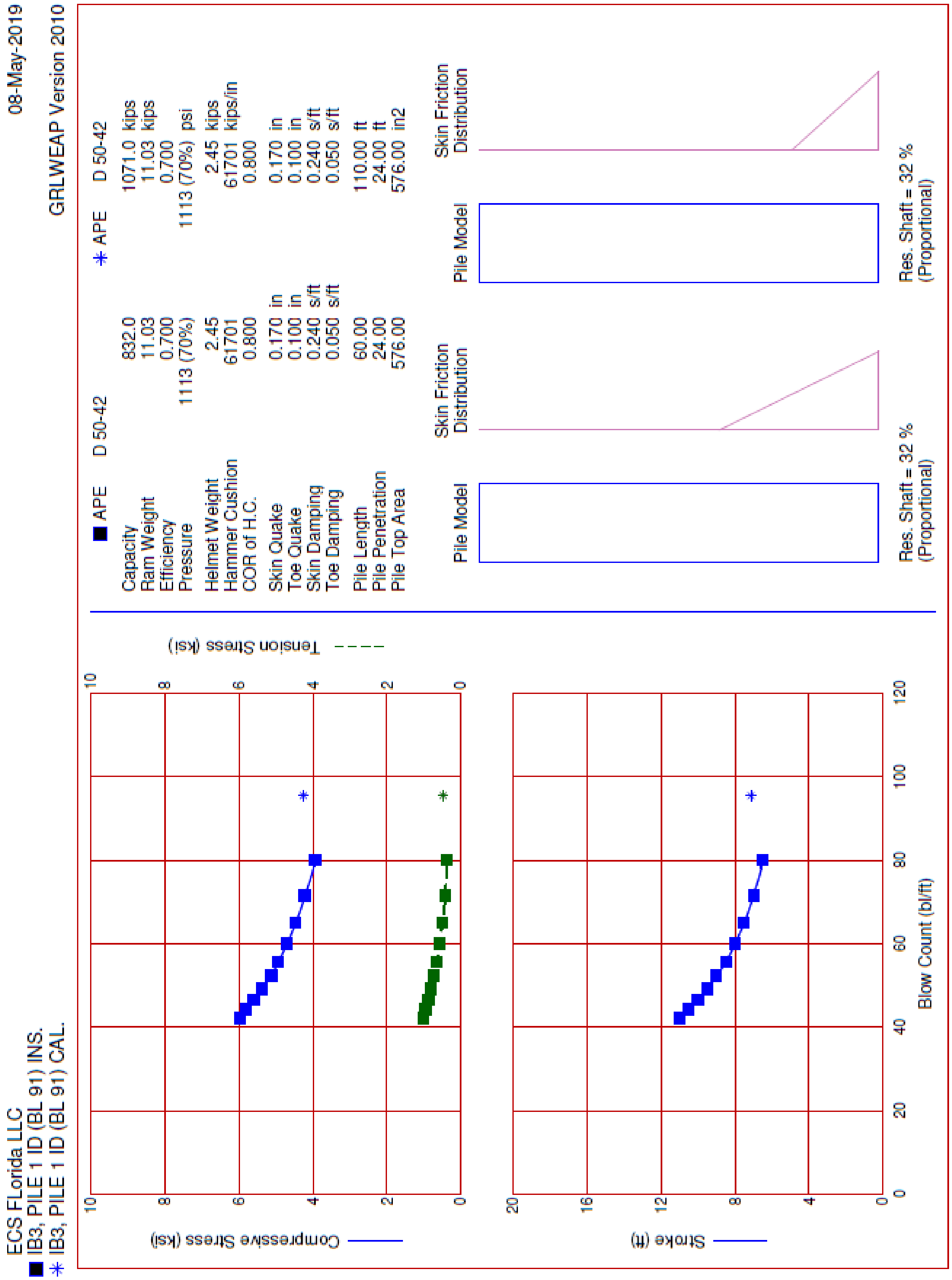


Figure B-19. Additional PDA data at Ribault River

ECS FLorida LLC
IB3, PILE 1 ID (BL 91) INS.

08-May-2019
GRLWEAP Version 2010

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
832.0	3.95	0.36	80.1	6.50	27.70
832.0	4.21	0.41	71.6	7.00	30.91
832.0	4.46	0.49	65.1	7.50	34.06
832.0	4.70	0.57	60.0	8.00	37.19
832.0	4.94	0.65	55.7	8.50	40.36
832.0	5.13	0.72	52.3	9.00	43.46
832.0	5.38	0.80	49.2	9.50	46.63
832.0	5.59	0.87	46.6	10.00	49.74
832.0	5.80	0.94	44.4	10.50	52.86
832.0	5.96	1.00	42.2	11.00	55.96

IB3, PILE 1 ID (BL 91) CAL.

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count blows/ft	Stroke ft	Energy kips-ft
1071.0	4.26	0.48	95.5	7.14	32.72

Figure B-20. Additional PDA data at Ribault River

B.2.3.2 Production Pile Logs

Excel 2016 (v 16.0) — STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION — 700-010-60 Construction Nov-18

PILE DRIVING LOG

Structure No: 724420 — Page No: 1 of 4

PROJECT No:	415250-1-52-01	Date:	6/10/19	Station No:	12 + 63.00
PILE Size/Type:	24" SQ PCP	Length (ft):	60.00	Bent/Pier No: 3	PILE No: 2
HAMMER Make/Model:	APE D50	S/N:	201407705	Rated Energy (ft-lbs): 124 FT/LB	Operating Rate (BPM): 34-53
REF Elev:	+4.50 (REF 1)	MIN TIP Elev:	-45.00	PILE CUTOFF Elev:	+8.40

DRIVING CRITERIA (DC): DC2 Elev:

Type: Prod - DC

DC Max Stk: 8.5 FT. Min Stk req'd for PR: 7.0 FT

Notes:

SC criteria (if applic): bpi @ ft Stk

DC1				DC2, input if applic.		
(1)	72 blows @	7.00 ft,		(6)	blows @	ft,
(2)	66 blows @	7.50 ft,		(7)	blows @	ft,
(3)	60 blows @	8.00 ft,		(8)	blows @	ft,
(4)	blows @	ft,		(9)	blows @	ft,
(5)	blows @	ft,		(10)	blows @	ft,

SCOUR Elev:

PILE CUSHION Thickness & Material: 24 in. x 24 in x 15 in. plywood

HAMMER CUSHION Thickness & Material: 2 x 1 in micarta + 3 x 0.5 in. aluminum

Pile Activity	Date	Start Time	Stop Time	Weather	Temp °F	Notes
Preforming	6/7/19	11:10am	11:26am	Partly Cloudy	85	1, 2
Preforming	6/7/19	3:00pm	3:25pm	Partly Cloudy	90	3
Stand Pile	6/10/19	10:06am	10:15am	Sunny	82	
DRIVE Pile	6/10/19	12:40pm	12:51pm	Sunny	85	

PILE DATA:

PAY ITEM No:	455-34-5	WORK ORDER No:	N/A		
MANUFACTURED By:	CDS	MFR's PILE No:	HD-24-035	DATE CAST:	5/29/19
TBM/BM Elev:	N/A	TBM/BM Rod Read:	N/A	H.I. Elev:	N/A
PRE-DRILLED Elev:	N/A	GROUND Rod Read:	N/A	GROUND Elev:	-22.50
				Manually input GROUND Elev (no sheet calc)	
PREFORMED Elev:	-45.00	Bottom of Excav Rod Read:	N/A	Bottom of Excav Elev:	N/A
PILE HEAD Rod Read:	N/A	PILE HEAD Elev:	+14.58	PILE TIP Elev:	-45.42

PH Elev = REF - LP + PL = +14.58

Top of SOIL PLUG Elev (for Open Ended Pipe Piles & H-piles): Natural Ground Elev: N/A

Input 'Natural Ground EL' ONLY when natural ground surface is below embankment/fill material. Otherwise, leave this cell BLANK

SPLICE / EACH	PREFORMED HOLE	DYNAMIC LOAD TEST	PAY SET CHECK	NO PAY SET CHECK	REDRIVE	EXTRACTION	DRIVING OF SPLICE	PILE TYPE CODE	Plumb or Batter ? (click & select) ↓ PLUMB	PILE LENGTH (ft) ORIGINAL FURNISHED	PILE LENGTH (ft) TOTAL LENGTH WITH EXTENSION	Pile PENETRATION below GROUND (ft)	EXTENSION/BUILD UP AUTHORIZED (ft)	EXTENSION/BUILD UP ACTUAL (ft)
0	1	0	0	0	0	0	0	1		60.00	60.00	22.92	N/A	N/A

Pile PENETRATION (ft), below: GROUND: 22.92 ft

CTQP Trainee (supervised by the Qualified Inspector) experiencing the full pile installation & log inspection:

Name: William S. Middleton

TIN: M34393771

Qualified Inspector - I certify the Pile Driving Log content, and as applicable, the above CTQP Trainee's participation during this pile installation:

Name & TIN: Sean Johnson J52578470

Signature: Sean D. Johnson

Figure B-21. First page of pile driving log from first drive at Ribault River

DC: DC1: 72 blows @ 7 ft stk, 66 @ 7.5, 60 @ 8,

STATE OF FLORIDA DOT

Min Tip | 1 ft to c/o | c/o

700-010-60
Construction
Nov-18

PILE DRIVING LOG

Page No: 2 of 4

Structure No.: 724420 Depth Table Extended (ft): Bent/Pier No.: 3 Pile No.: 2

Depth (Input Start LP↓) REF	Blows	Stroke	Notes	Depth REF	Blows	Stroke	Notes	Depth REF	Blows	Stroke	Notes
0.00 1 1.00				33.00 - 34.00				-			
1.00 - 2.00				34.00 - 35.00				-			
2.00 - 3.00				35.00 - 36.00				-			
3.00 - 4.00				36.00 - 37.00	2		4	-			
4.00 - 5.00				37.00 - 38.00	3			-			
5.00 - 6.00				38.00 - 39.00	2		F1	-			
6.00 - 7.00				39.00 - 40.00			↓	-			
7.00 - 8.00				40.00 - 41.00			↓	-			
8.00 - 9.00				41.00 - 42.00			↓	-			
9.00 - 10.00				42.00 - 43.00			↓	-			
10.00 - 11.00				43.00 - 44.00			↓	-			
11.00 - 12.00				44.00 - 45.00	11	5.5		-			
12.00 - 13.00				45.00 - 46.00	16	5.6		-			
13.00 - 14.00				46.00 - 47.00	16	5.6		-			
14.00 - 15.00				47.00 - 48.00	37	6.4		-			
15.00 - 16.00				48.00 - 49.00	31	7		-			
16.00 - 17.00				49.00 - 49.83	70	7.7		-			
17.00 - 18.00				49.83 - 49.92	20	7.7	5, 6	-			
18.00 - 19.00				49.92 - 50.00				-			
19.00 - 20.00				50.00 - 51.00				-			
20.00 - 21.00				51.00 - 54.00				-			
21.00 - 22.00				54.00 - 55.00				-			
22.00 - 23.00				55.00 - 56.00				-			
23.00 - 24.00				56.00 - 57.00				-			
24.00 - 25.00				-				-			
25.00 - 26.00				-				-			
26.00 - 27.00				-				-			
27.00 - 28.00				-				-			
28.00 - 29.00				-				-			
29.00 - 30.00				-				-			
30.00 - 31.00				-				-			
31.00 - 32.00				-				-			
32.00 - 33.00				-				-			

Figure B-22. Second page of pile driving log from first drive at Ribault River

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

700-010-60
Construction
Nov-18

PILE DRIVING LOG

Structure No: 724420 | Page No: 3 of 4

REF inputs & Notes

PROJECT No: 415250-1-52-01 | Bent/Pier No: 3 | PILE No.: 2

REF No.	Input REF EL ↓	*Calculated LP values for each REF used: LP min tip	LP c/o-1	LP c/o	Input REF description (template, stringline, etc.) for each REF used: ↓
1	+4.50	49.50	55.10	56.10	Top of pocket.
2					
3					
4					
5					

Standard Notes & Note No.'s 1-28

Std. Notes:	↓ = Pile Ran, F1, F2, F3, F4 = (Fuel Settings 1-4), ST = stop, CC = cushion change, HR = high rebound, TP = Test Pile, DC = Driving Criteria, PR = Practical Refusal, SC = set check, DLT = Dyn. Load Test
Note 1:	The contractor intially drills to -40.0. The contractor uses a 60 ft. sheet pile and vibratory hammer to break up the
Note 2:	hard layer. The sheet pile is marked to insure that it is not vibrated past minimum tip. They complete drilling to a
Note 3:	formed depth of -45.0 ft.
Note 4:	Contractor dry fires hammer from 36.0 ft. to 38.0 ft. in order to safely seat pile in firm material.
Note 5:	Practical refusal was reached with 20 blows for 1.0 inch, and a 7.7 ft stroke. Cushions have 208 blows. They will be
Note 6:	used, per driving criteria, to start the drive on pile 3.
Note 7:	
Note 8:	
Note 9:	
Note 10:	
Note 11:	
Note 12:	
Note 13:	
Note 14:	
Note 15:	
Note 16:	
Note 17:	
Note 18:	
Note 19:	
Note 20:	
Note 21:	
Note 22:	
Note 23:	
Note 24:	
Note 25:	
Note 26:	
Note 27:	
Note 28:	

Figure B-23. Third page of pile driving log from first drive at Ribault River

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

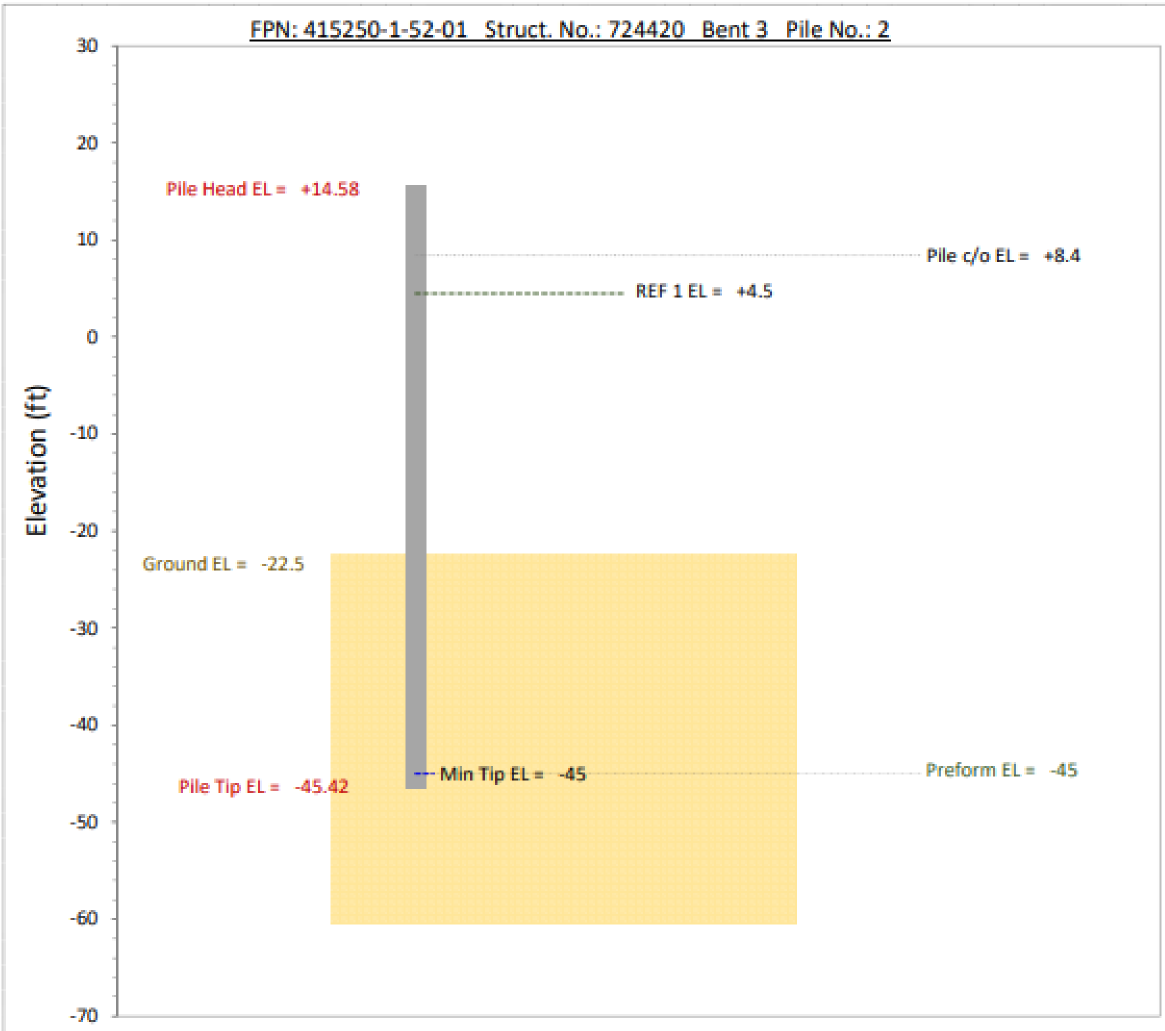
700-010-60
Construction
Nov-18

PILE DRIVING LOG

Structure No: 724420 Page No: 4 of 4

Sketch

PROJECT No: 415250-1-52-01 Bent/Pier No: 3 PILE No.: 2



PLUMB pile, as depicted in this Pile Sketch

Pile Bearing: (click on yellow shaded cell below, and select basis for Pile Bearing acceptance that applies)

Click here to select applicable bearing capacity related input: If none of the conditions below applies, type condition under which the pile was accepted.

Pile Penetration:

Pile Tip EL ≤ bottom EL of Preformed or Predrilled pile hole, meets 455-5 Penetration Requirements.

Current Pile Tip EL ≤ Min Tip EL in plans, meets 455-5 Penetration Requirements.

Min Tip EL is input on the log. Therefore, the 10-20 ft of penetration into firm/soft material, in accordance with 455-5 Penetration Requirements, does not apply.

Figure B-24. First page of pile driving log from first drive at Ribault River

B.3 Suwannee River

B.3.1 Boring Logs

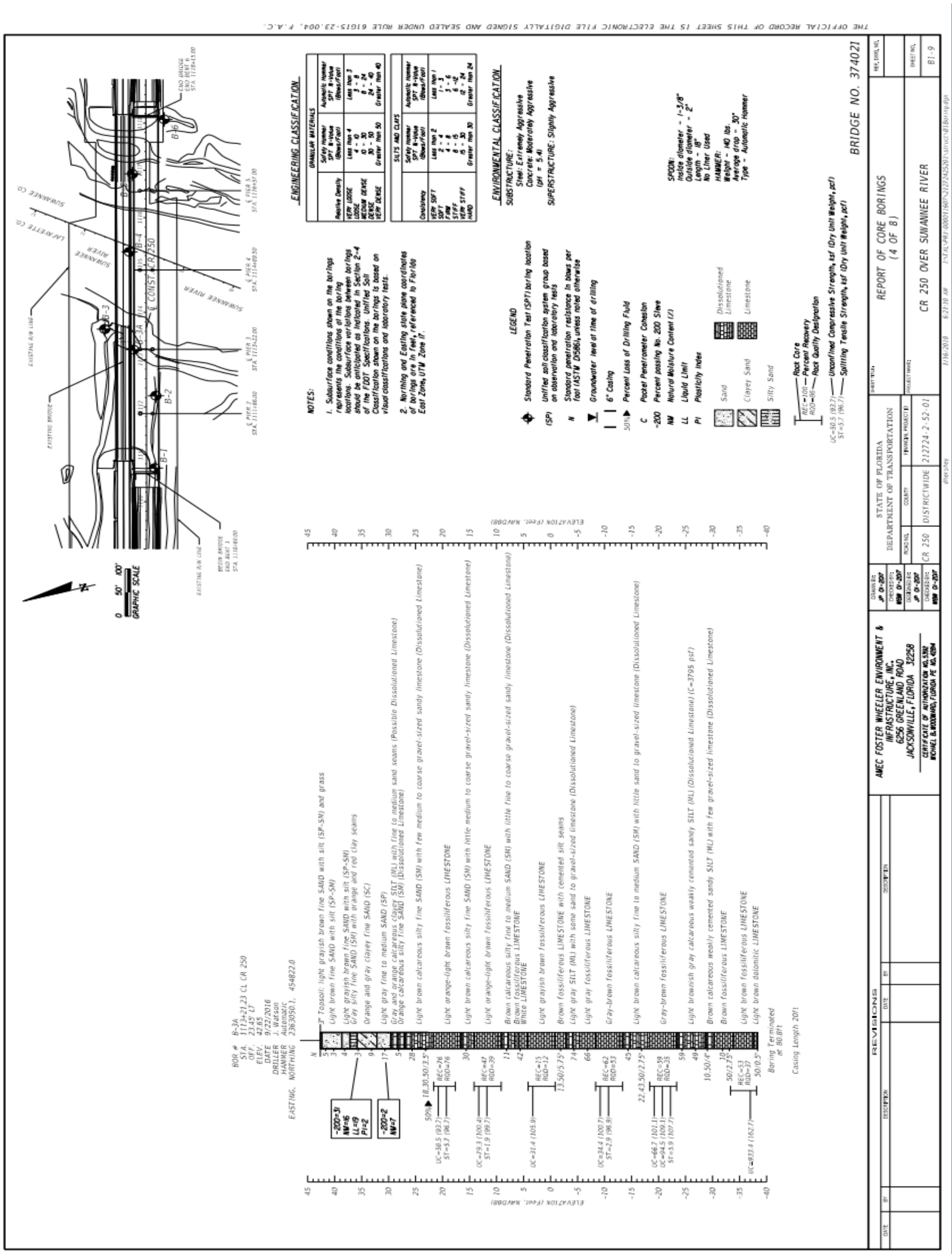


Figure B-25. Relevant boring log from Suwannee River

B.3.2 Driver Specifications

APE Model D62-22 Single Acting Impact Hammer

operates on diesel or bio-diesel for all types of impact pile driving

Bottom drive system for large diameter piles

MODEL D62-22 (6.2 metric ton ram)

SPECIFICATIONS

Maximum Rated Energy	153,770 ft/lbs (208,484 Nm)
Minimum Rated Energy	78,956 ft/lbs (107,050 Nm)
Stroke at Rated Energy	11.24 ft (3.42 m)
Maximum Obtainable Stroke	12.5 ft (3.81 m)
Speed (blows per minute)	36-50

WEIGHTS (Approximate)

Piston	13,669 lbs (6,200 kg)
Anvil	2,833 lbs (1,285 kg)
Hammer Weight (includes trip device)	28,272 lbs (12,823 kg)
Hammer weight w/ DB-32 Drive Base	31,744 lbs (14,399 kg)
Typical Operating Weight w/ Drive Cap	Varies- consult factory

CAPACITIES

Fuel Tank (runs on diesel or bio-diesel)	25.89 gal (98 liter)
Oil Tank	8.32 gal (31.5 liter)

CONSUMPTION

Diesel or Bio-Diesel Fuel	5.28 gal/hour (20 liter/ hour)
Lubrication Oil	.84 gal/hour (3.2 liter/hour)
Grease	twice per day

DIMENSIONS OF HAMMER

a	Length overall	232.68 in (5,910 mm)
a	Length over cylinder extension	272 in (6,908 mm)
a	Length over trip tubes	308 in (7,823 mm)
b	Impact block diameter	27.91 in (709 mm)
c	Width over bolts	35.6 in (904 mm)
d	Hammer width overall	31.5 in (800 mm)
e	Width for guiding- face to face	32 in (812 mm)
f	Hammer center to pump guard	19.3 in (490 mm)
g	Hammer center to bolt center	15 in (381 mm)
h	Hammer depth overall	38.2 in (970 mm)
H	Minimum clearance for leads	19.7 in (500 mm)

Features

Fuel and lube pumps with 50% less parts than ICE
Hardened piston needs no high maintenance wear rings
Optional direct drive for high speed production on steel piles
Fuel pump mounted where heat will not harm it
Variable mechanical cam fuel pump- no air pistons or rings
Optional hydraulic variable fuel remote control
Heavy duty trip system for years of fault free operation
Chrome rings for super long life
Low maintenance and extremely low parts pricing
German design at a reasonable price
Two year APE warranty

AMERICAN PILEDRIVING EQUIPMENT, INC. APE

Corporate Offices
7032 South 196th
Kent, Washington 98032 USA
(800) 248-8498 & (253) 872-0141
(253) 872-8710 Fax

2/06

Visit our WEB site:
www.apevibro.com
e-mail: ape@apevibro.com

Figure B-26. Hammer Specifications from Suwannee River

B.4 Bayway E

B.4.1 Boring Logs

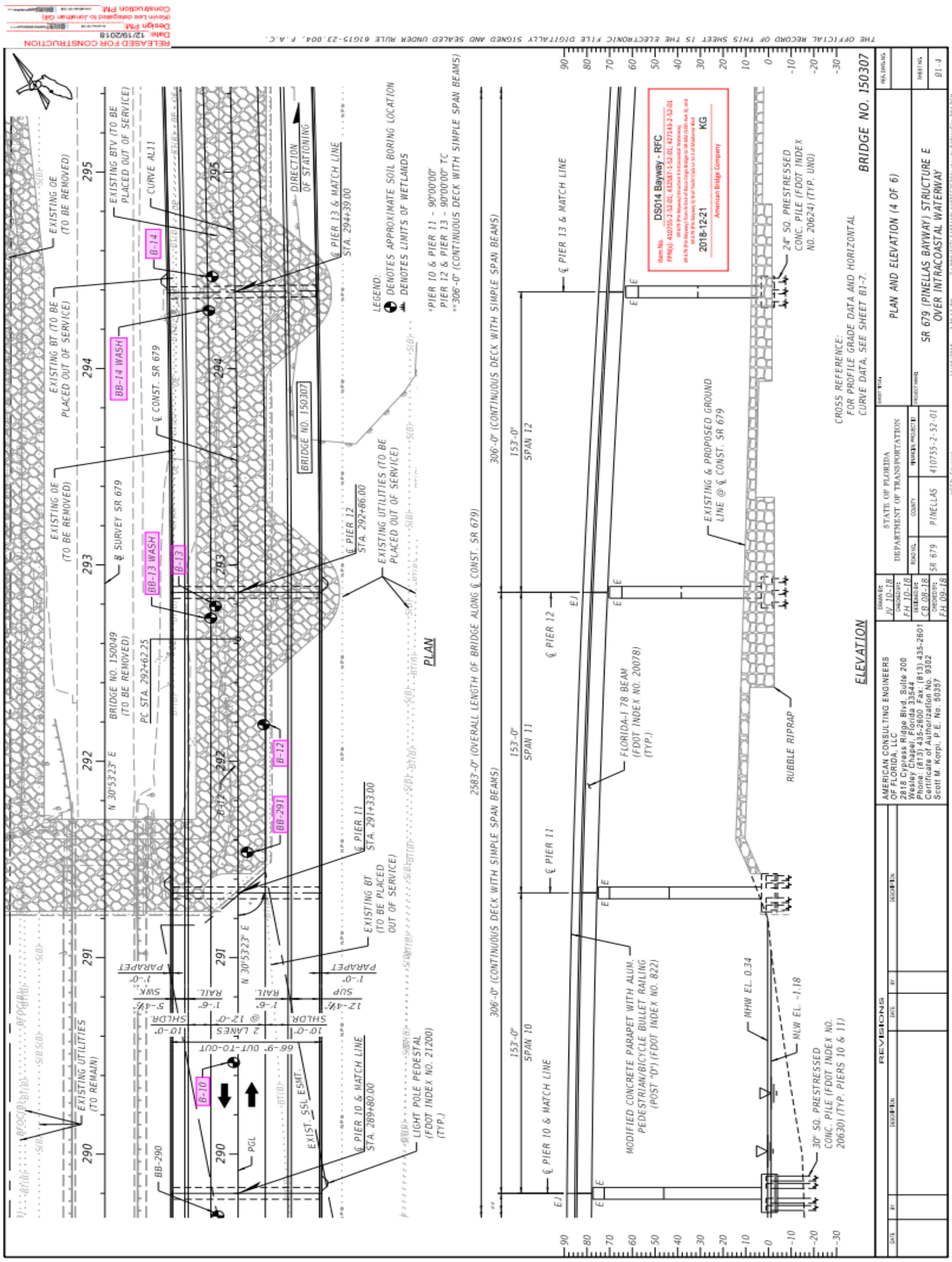


Figure B-27 Boring log location plan at Bayway E

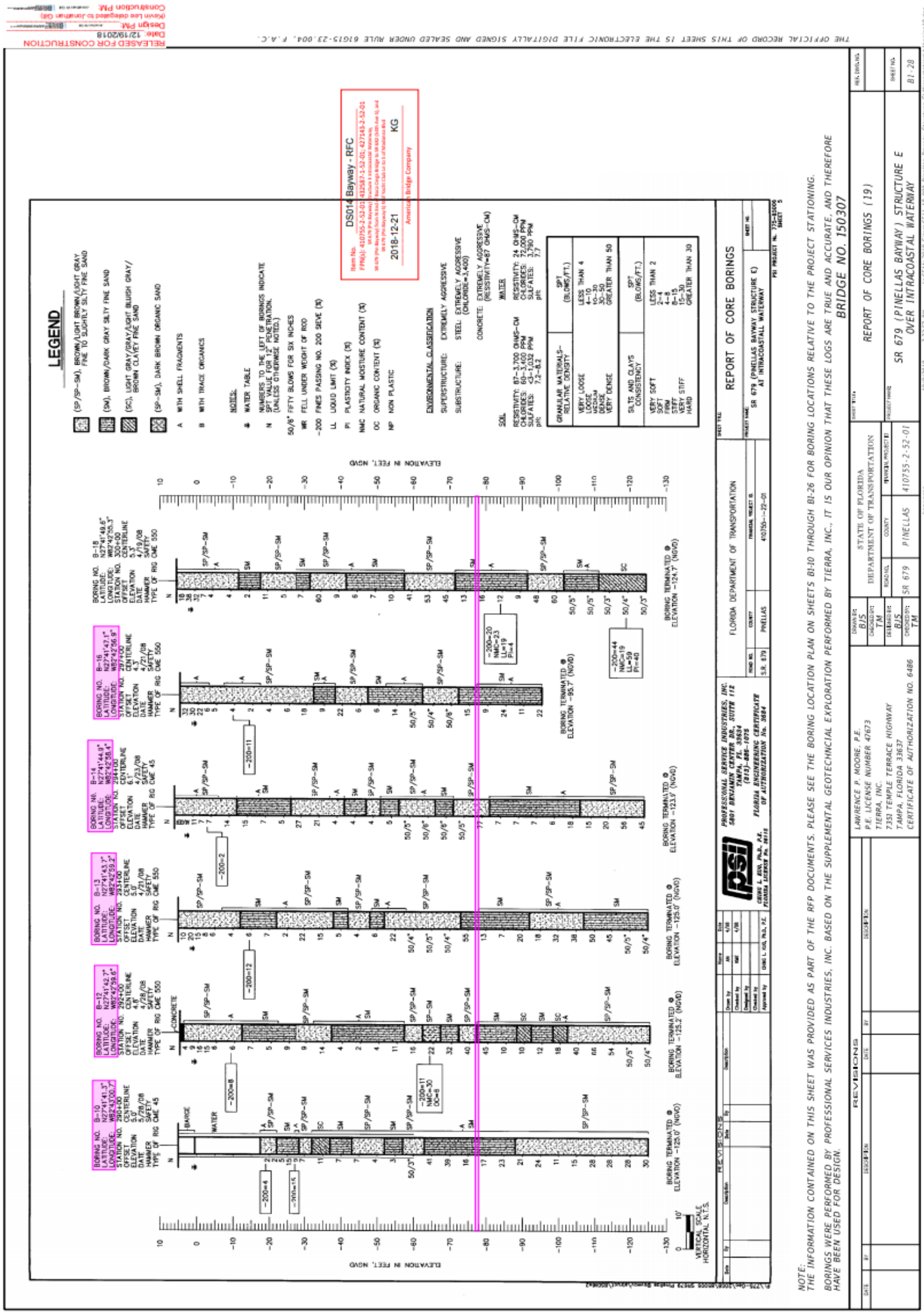


Figure B-28 Relevant boring logs from Bayway E, second and third drive

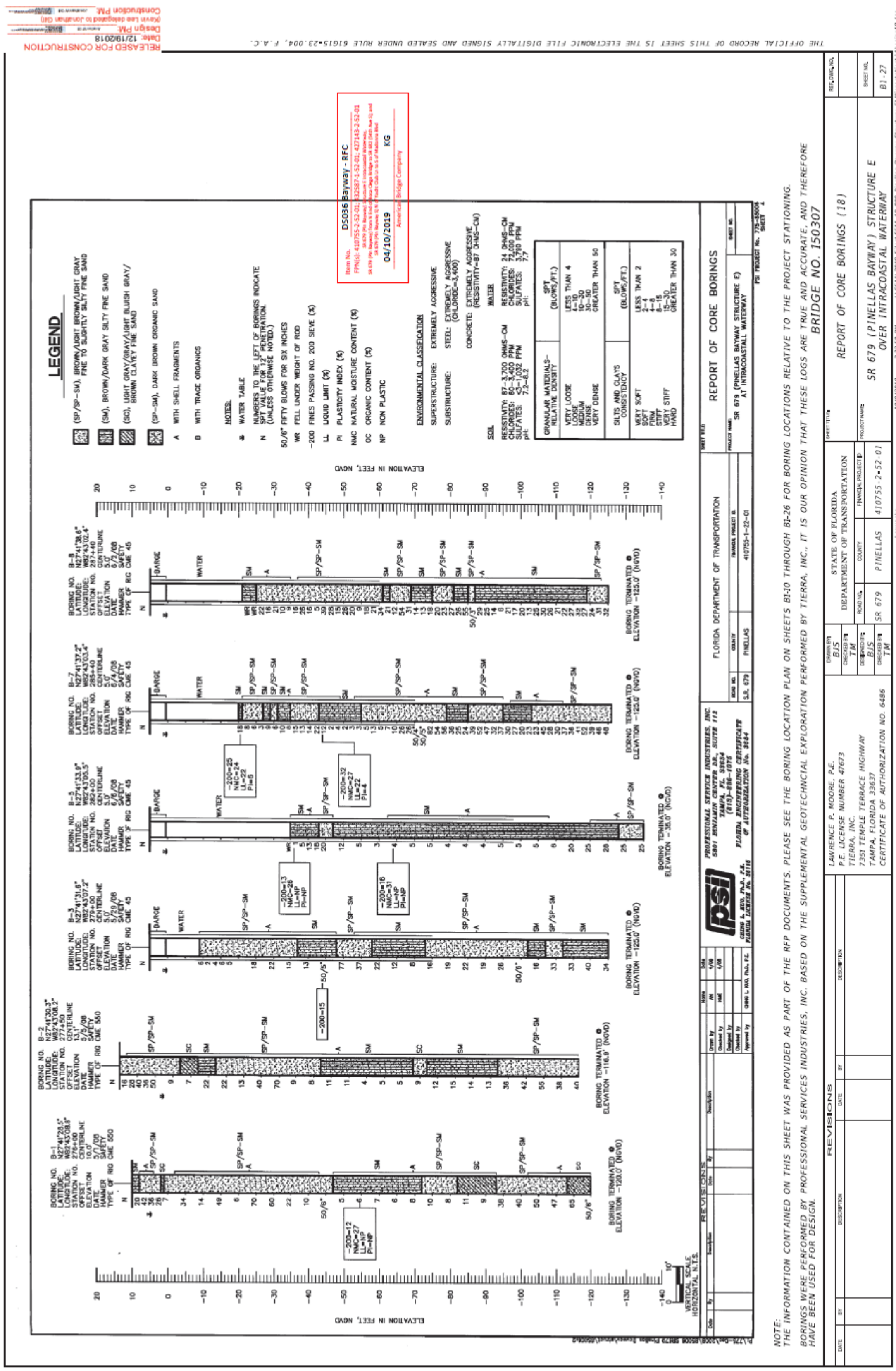


Figure B-29 Relevant boring logs from Bayway E, second and third drive

B.4.2 Driver Specifications

APE Model 200 Vibratory Driver Extractor

The Worlds Largest Provider of Foundation Construction Equipment

SPECIFICATIONS	DATA
Eccentric Moment	4,400 in-lbs (50.69 kgm)
Drive Force	170 tons (1,513 kN)
Frequency Maximum (VPM)	0 - 1,650 vpm
Max Line Pull	133 tons (1,183 kN)
Bare Hammer Weight w/o Clamp	12,760 lbs (5,788 kg)
Throat Width	14.75 in (37 cm)
Length	104.00 in (264 cm)
Height w/o Clamp	65.50 in (166 cm)

APE Model 595 Power Unit

SPECIFICATIONS	DATA
Engine Type	Caterpillar C15 Tier III
Horse Power	595 HP (438 kW)
Drive Pressure	0 - 4,500 psi (310 bar)
Drive Flow	188 gpm (712 lpm)
Clamp Pressure	4,800 psi (69,618 bar)
Clamp Flow	10 gpm (3 lpm)
Engine Speed	2,100 rpm
Weight	19,500 lbs (8,845 kg)
Length	152 in (385 cm)
Width	82 in (208 cm)
Height	94 in (239 cm)
Hydraulic Reservoir	575 gal (2,177 L)
Fuel Capacity	160 gal (606 L)

Specifications may vary due to site conditions, specific hammer conditions or product set up.
Specifications may change without notice.
Consult the factory for details on any specific product (800) 248-8498.

WWW.AMERICANPILEDRIVING.COM
(800) 248-8498
ape@americanpiledriving.com

Figure B-30 Hammer specifications for first drive at Bayway E

APE Model D80-52 Single Acting Diesel Impact Hammer

D80-52 in an offshore Leader.

MODEL D80-52 (8.0 metric ton ram)

SPECIFICATIONS

Stroke at maximum rated energy	135 in (343 cm)
Maximum rated energy (Setting 4)	198,450 ft-lbs (267.91 kNm)
Setting 3	176,621 ft-lbs (238.44 kNm)
Setting 2	146,853 ft-lbs (198.25 kNm)
Minimum rated energy (Setting 1)	127,008 ft-lbs (171.46 kNm)
(Variable throttle allows for infinite fuel settings)	
Maximum obtainable stroke	150 in (381 cm)
Maximum obtainable energy	231,084 ft-lbs (313 kNm)
Speed (blows per minute)	34-53

WEIGHTS (Approximate)

Piston	17,640 lbs (8,000 kg)
Anvil	4,670 lbs (2,118 kg)
Anvil cross sectional area	630.47 in² (4067.54 cm²)
Hammer weight (includes trip device)	38,434 lbs (17,433 kg)
Typical operating (weight with Off-Shore Leader)	68,434 lbs (31,4041 kg)

CAPACITIES

Fuel tank (runs on diesel or bio-diesel)	40.3 gal (96.52 liters)
Oil tank	8.3 gal (31 liters)

Optional Variable Throttle Control.

CONSUMPTION

Diesel or Bio-diesel fuel	6.5 gal/hr (24.6 liters/hr)
Lubrication	0.67 gal/hr (1.96 liters/hr)
Grease	8 to 10 pumps every 20 minutes of operation time.

STRIKER PLATE

Weight	1,036 lbs (470 kg)
Diameter	25 in (63.5 cm)
Area	471 sq-in (696 sq-cm)
Thickness	8 in (20.32 cm)

Cushion material.

CUSHION MATERIAL

Type/Qty	Micarta / 3 each
Diameter	25 in (63.5 cm)
Thickness	1 in (25.4 mm)
Type/Qty	Aluminum / 4 each
Thickness	1/2 in (12.7 mm)
Diameter	25 in (63.5 cm)
Total Combined Thickness	5 in (12.7 cm)
Area	491 in² (3167.74 cm²)
Elastic-modulus	285 ksi (1,965 mpa)
Coeff. of restitution	0.8

Typical 54" offshore.

OFFSHORE LEADER

Offshore for 98"/2.5 meter piles and under	Consult Factory

MINIMUM BOX LEAD SIZE/OPERATING LENGTH

Minimum box leader size	8 in x 37 in (20.32 cm x 94 cm)
Operating length for offshore leader	384 in (975.36 cm)

Corporate Offices
7032 South 196th
Kent, Washington 98032 USA
(800) 248-8498 & (253) 872-0141
(253) 872-8710 Fax

Visit our WEB site:
www.apevibro.com
e-mail: ape@apevibro.com

Note: All specifications are subject to change without notice 08/20/2012

Figure B-31 Hammer specifications for second and third drive at Bayway E

B.5 John Sims Parkway

B.5.1 Boring Logs

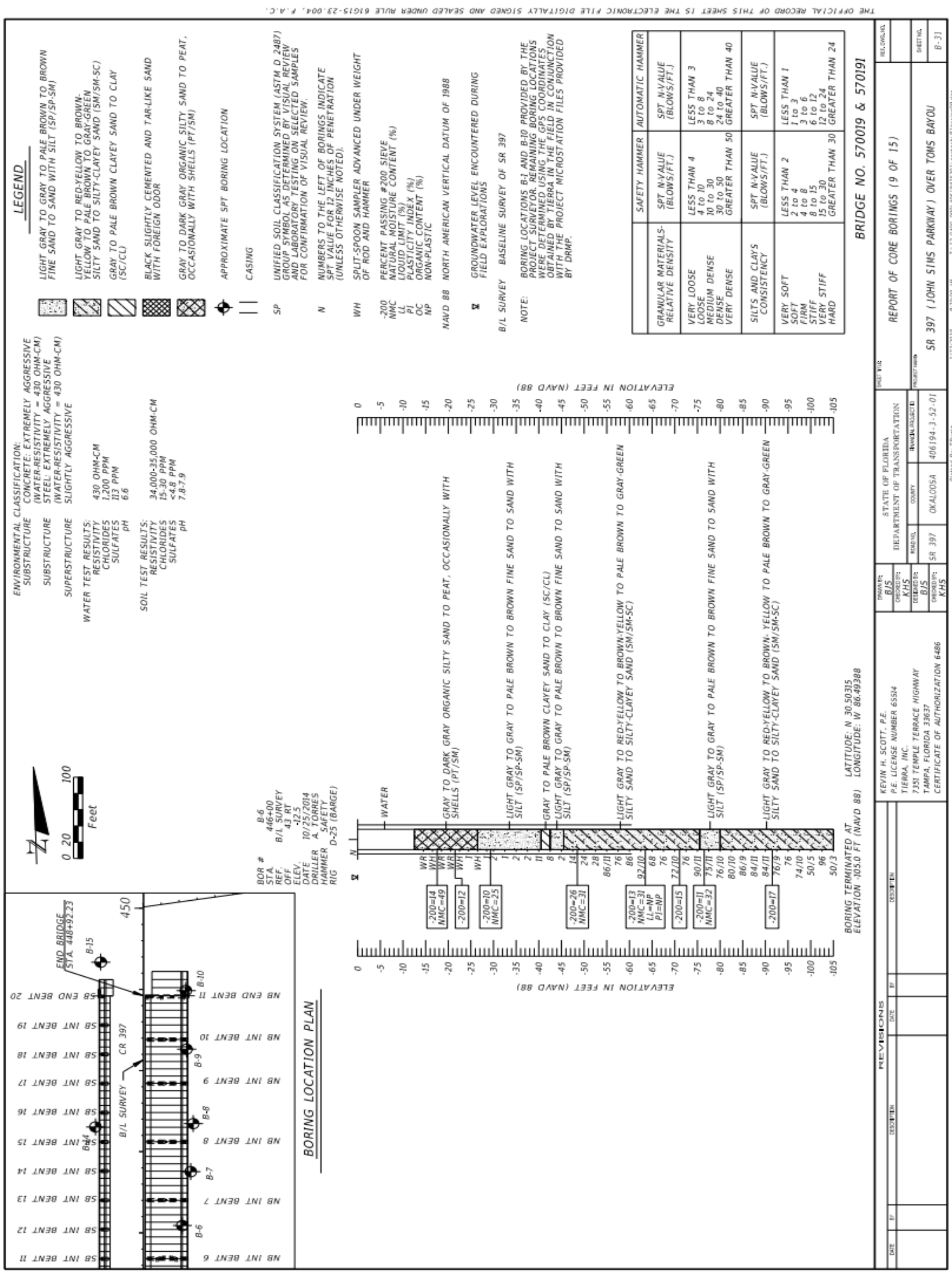


Figure B-32 Relevant boring log data from John Sims Parkway

B.5.2 John Sims Parkway Bridge Impact Driver Specifications

PILE EQUIPMENT INC.

BSP

BSP CX HYDRAULIC HAMMERS Specs

SPECIFICATIONS	CX50-u	CX85-u	CX110-u	CG180	CG240	CG300
RAM MASS	8800	15425	19850	26450	35265	44080
MAXIMUM IMPACT ENERGY - FT. LBS.	35000	60000	78000	132240	176320	220400
BLOW RATE @ rated energy - BPM	50	40	36	34	31	29
BASIC WEIGHT less helmet weight - LBS.	15330	22700	27600	42100	47170	57530
BASIC HAMMER LENGTH	15'-2"	16'-7"	"19'-1"	"20'-7"	"22'-9"	"24'-11"
LEADERS SIZE	"26"	"26"	"32"	"48"	"48"	"48"
OPERATING PRESSURE - PSI	3000	3400	3400	3770	4130	4200
HYDRAULIC FLOW REQUIRED - GPM	42	52	55	102	98	110

Figure B-33 Hammer specifications from John Sims Parkway

B.5.3 Pile Driving Logs

Excel 2013 (v 15.0):

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

700-010-60
Construction
Nov-18

PILE DRIVING LOG

Structure No: 570019 | Page No: 1 of 4

PROJECT No: 406194-3-52-01 | Date: 6/24/19 | Station No: 446+04.23

PILE Size/Type: 18" SQ PCP | Length (ft): 81.00 | Bent/Pier No: IB 12 | PILE No: 1

HAMMER Make/Model: BSP CX85-u | S/N: 31012112/5001 | Rated Energy (ft-lbs): 60,000 | Operating Rate (BPM): 40

REF Elev: +8.35 (REF 2) | MIN TIP Elev: -40.00 | PILE CUTOFF Elev: +9.90

DRIVING CRITERIA (DC): | DC2 Elev:

Type: Prod - DC | #NAME?

DC Max Stk: 2.15 | Min Stk req'd for PR: 2.00

Notes:

SC criteria (if applic): bpi @ ft Stk

	DC1				DC2, input if applic.		
(1)	89 blows @	1.50	ft,	(6)	blows @		ft,
(2)	67 blows @	1.75	ft,	(7)	blows @		ft,
(3)	54 blows @	2.00	ft,	(8)	blows @		ft,
(4)	blows @		ft,	(9)	blows @		ft,
(5)	blows @		ft,	(10)	blows @		ft,

SCOUR Elev: -15.72

PILE CUSHION Thickness & Material: 18" x 8.75" Pine Plywood

HAMMER CUSHION Thickness & Material: 23.5" x 8" Nylon

Pile Activity	Date	Start Time	Stop Time	Weather	Temp °F	Notes
Stand Pile	6/24/19	9:00 AM	9:15 AM	Cloudy	86	
DRIVE Pile	6/24/19	10:25 AM	11:59 AM	Cloudy	86	1,2,3,4,5,6

PILE DATA:

PAY ITEM No: 455-143-3 | WORK ORDER No:

MANUFACTURED By: Gulf Coast Prestress | MFR's PILE No: 18-18 | DATE CAST: 5/17/19

TBM/BM Elev: +16.79 | TBM/BM Rod Read: 6.26 | H.I. Elev: +23.05

PRE-DRILLED Elev: | GROUND Rod Read: | GROUND Elev: -13.98

Manually input GROUND Elev (no sheet calc)

PREFORMED Elev: | Bottom of Excav Rod Read: | Bottom of Excav Elev:

PILE HEAD Rod Read: | PILE HEAD Elev: +19.26 | PILE TIP Elev: -61.11

PH Elev = REF - (LP x R) + PL = +19.26

Top of SOIL PLUG Elev (for Open Ended Pipe Piles & H-piles): | Natural Ground Elev:

Input 'Natural Ground EL' ONLY when natural ground surface is below embankment/fill material. Otherwise, leave this cell BLANK

SPLICE / EACH	PREFORMED HOLE	DYNAMIC LOAD TEST	PAY SET CHECK	NO PAY SET CHECK	REDRIVE	EXTRACTION	DRIVING OF SPLICE	PILE TYPE CODE	Plumb or Batter ? (click & select) ↓ BATTER		PILE LENGTH (ft) ORIGINAL FURNISHED	TOTAL LENGTH WITH EXTENSION	Pile PENETRATION below SCOUR (ft)	EXTENSION/BUILD UP AUTHORIZED (ft)	ACTUAL (ft)
0	0	0	0	0	0	0	0	1	8	: 1.00	74.00	74.00	45.74		

Pile PENETRATION (ft), below: GROUND: 47.5 ft | SCOUR: 45.74 ft

CTQP Trainee (supervised by the Qualified Inspector) experiencing the full pile installation & log inspection: | Name: Valerie Jackson | TIN: J250873657290

Qualified Inspector - I certify the Pile Driving Log content, and as applicable, the above CTQP Trainee's participation during this pile installation: | Name & TIN: James Phillips / P41245382 | Signature: James Phillips

Figure B-34 First page of pile driving logs at Johns Sims Parkway

DC: DC1: 89 blows @ 1.5 ft stk, 67 @ 1.75, 54 @ 2,

STATE OF FLORIDA DOT

Min Tip | 1 ft to c/o | c/o

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PILE DRIVING LOG

Page No: 2 of 4

Structure No.: 570019 Depth Table Extended (ft): Bent/Pier No.: IB 12 Pile No.: 1

Depth (Input Start LP↓)	RCF		Blows	Stroke	Notes	Depth	RCF		Blows	Stroke	Notes	Depth RCF	Blows	Stroke	Notes
53.00	1	54.00	2	0.52	BPM N/A, 1, 2,	74.00	-	75.00				-			
54.00	-	55.00	5	0.92	38	75.00	-	76.00				-			
55.00	-	56.00	3	0.9	38	76.00	-	77.00				-			
56.00	-	57.00	3	0.91	38	77.00	-	78.00				-			
57.00	-	58.00	3	0.91	39	78.00	-	79.00				-			
58.00	-	59.00	6	0.91	44	79.00	-	80.00				-			
59.00	-	60.00	6	0.92	45	80.00	-	81.00				-			
60.00	-	61.00	10	0.91	46	81.00	-	82.00				-			
61.00	-	62.00	16	0.93	47	82.00	-	83.00				-			
62.00	-	63.00	19	0.94	49	83.00	-	84.00				-			
63.00	-	64.00	15	0.94	48	84.00	-	85.00				-			
64.00	-	65.00	12	0.9	49	85.00	-	86.00				-			
65.00	-	66.00	9	0.88	49	86.00	-	87.00				-			
66.00	-	67.00	17	0.84	51	87.00	-	88.00				-			
67.00	-	68.00	20	0.89	47	88.00	-	89.00				-			
68.00	-	69.00	30	0.87	50	89.00	-	90.00				-			
69.00	-	70.00	37	0.85	50	90.00	-	91.00				-			
70.00	-	71.00	46	0.88	52	91.00	-	92.00				-			
71.00	-	72.00	32	1.44	47		-					-			
72.00	-	73.00	42	1.4	48		-					-			
73.00	-	74.00	52	1.4	48		-					-			
74.00	-	75.00	59	1.44	48		-					-			
75.00	-	76.00	68	1.45	48		-					-			
76.00	-	77.00	54	1.8	44		-					-			
77.00	-	78.00	51	1.79	44		-					-			
78.00	-	79.00	61	1.78	45, ST, 4		-					-			
67.33	2	68.00	41	1.8	45, 5		-					-			
68.00	-	69.00	69	1.8	44, DC		-					-			
69.00	-	70.00	79	1.78	45, DC, ST, 6		-					-			
70.00	-	71.00					-					-			
71.00	-	72.00					-					-			
72.00	-	73.00					-					-			
73.00	-	74.00					-					-			

Figure B-35 Second page of pile driving logs at Johns Sims Parkway

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

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Construction
Nov-18

PILE DRIVING LOG

Structure No: 570019

Page No: 3 of 4

REF inputs & Notes

PROJECT No: 406194-3-52-01

Bent/Pier No: IB 12

PILE No.: 1

REF No.	Input REF EL ↓	*Calculated LP values for each REF used: LP min tip	LP c/o-1	LP c/o	Input REF description (template, stringline, etc.) for each REF used: ↓
1	+20.02	60.49	90.19	91.19	Template / Top Roller
2	+8.35	48.73	78.43	79.43	Bottom Template / Bottom angle iron
3					
4					
5					

Standard Notes & Note No.'s 1-28

Std. Notes:	↓ = Pile Ran, F1, F2, F3, F4 = (Fuel Settings 1-4), ST = stop, CC = cushion change, HR = high rebound, TP = Test Pile, DC = Driving Criteria, PR = Practical Refusal, SC = set check, DLT = Dyn. Load Test
Note 1:	Weight of pile, pushed pile into the earth to the LP 53' (Note: Mud line EL. = -13.98)
Note 2:	Weight of hammer did not affect the LP Mark.
Note 3:	Start drive at 10:25 AM. Pile LP was at 53'
Note 4:	ST drive at 10:40 AM to remove top template so contractor could continue to drive pile.
Note 5:	Continued pile drive at 11:52 AM using pile ref. #2.
Note 6:	ST drive at 11:59 AM. Met DC.
Note 7:	
Note 8:	NOTE : The first number in the LP sheet note section, represents the Blows Per Minute.(N/A = Saximeter didn't record BPM)
Note 9:	NOTE : Axial Alignment is within tolerance as per FDOT Spec. 455-5.16.3
Note 10:	NOTE: Ground elevation was acquired with use of a weighted measuring tape from pile reference.
Note 11:	NOTE: Contractor chose to add 7' additional length to pile for their own benefit. (Authorized Production length is 74')
Note 12:	
Note 13:	
Note 14:	
Note 15:	
Note 16:	
Note 17:	
Note 18:	
Note 19:	
Note 20:	
Note 21:	
Note 22:	
Note 23:	
Note 24:	
Note 25:	
Note 26:	
Note 27:	
Note 28:	

Figure B-36 Third page of pile driving logs at Johns Sims Parkway

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

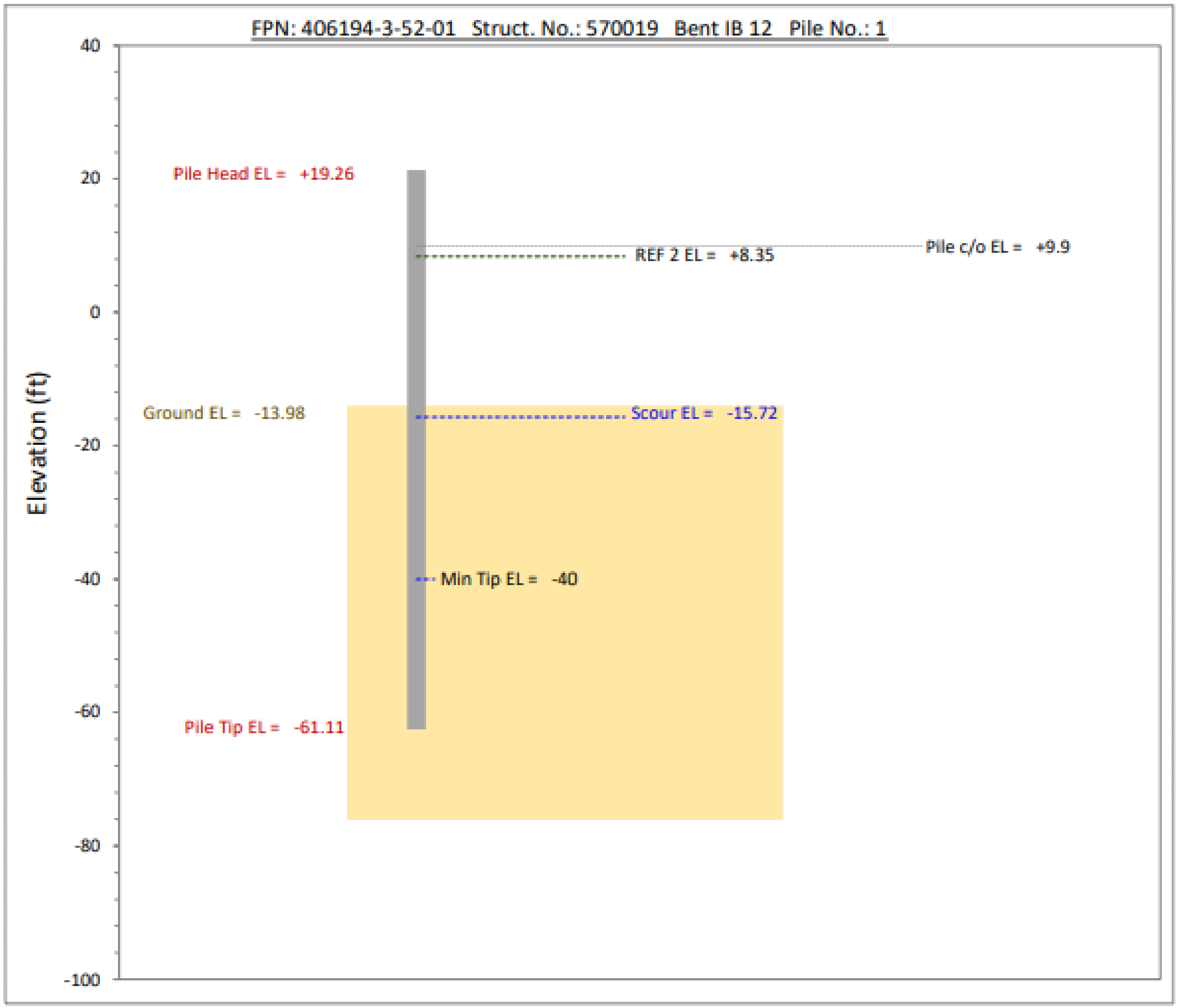
700-010-60
Construction
Nov-18

PILE DRIVING LOG

Structure No: 570019 Page No: 4 of 4

Sketch

PROJECT No: 406194-3-52-01 Bent/Pier No: IB 12 PILE No.: 1



BATTER pile - although batter is not pictorially depicted in this Pile Sketch

[Batter Ratio - Vertical : Horizontal (V : H) = 8 : 1 Calculated Batter Correction Factor R = 0.992]

Pile Bearing: (click on yellow shaded cell below, and select basis for Pile Bearing acceptance that applies)

Pile meets Driving Criteria blow count/stroke.

Pile Penetration:

Preform or Predrill EL is not yet input on the log, or does not apply.

Current Pile Tip EL ≤ Min Tip EL in plans, meets 455-5 Penetration Requirements.

Min Tip EL is input on the log. Therefore, the 10-20 ft of penetration into firm/soft material, in accordance with 455-5 Penetration Requirements, does not apply.

Figure B-37 Fourth page of pile driving logs at Johns Sims Parkway

B.6 CR-218

B.6.1 Boring Logs

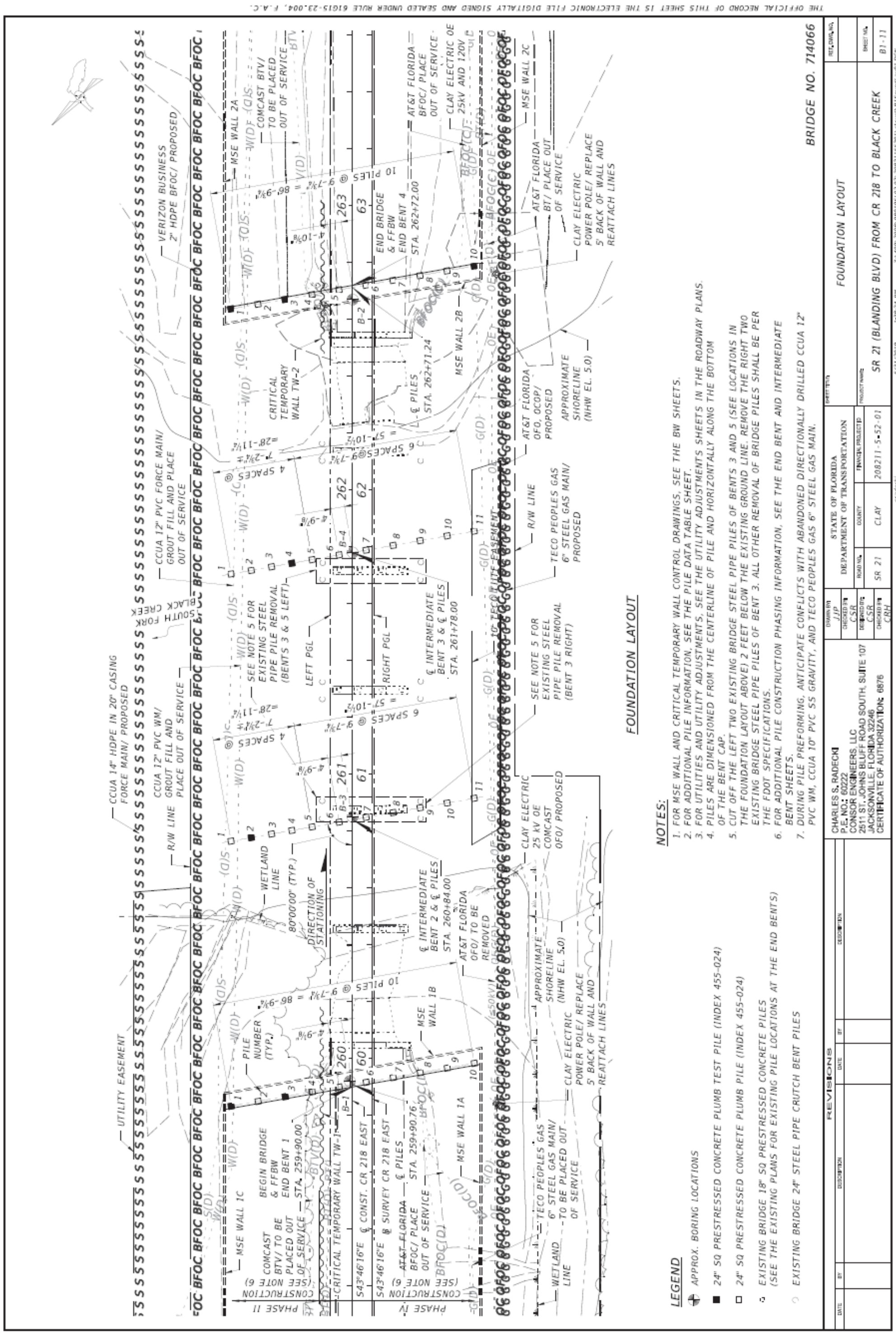


Figure B-38 Boring location plan for CR-218

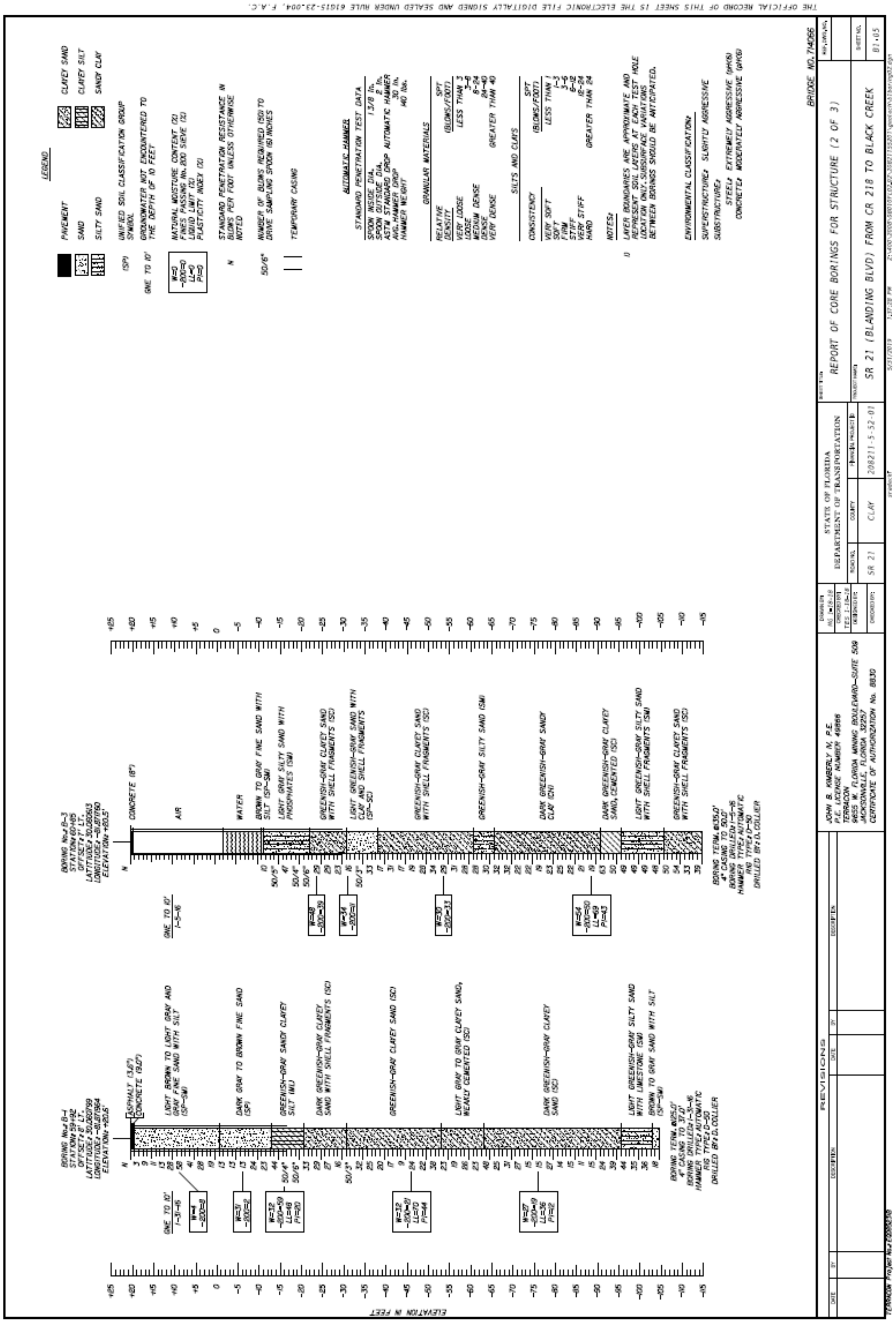


Figure B-39 Relevant boring log for first drive at CR-218

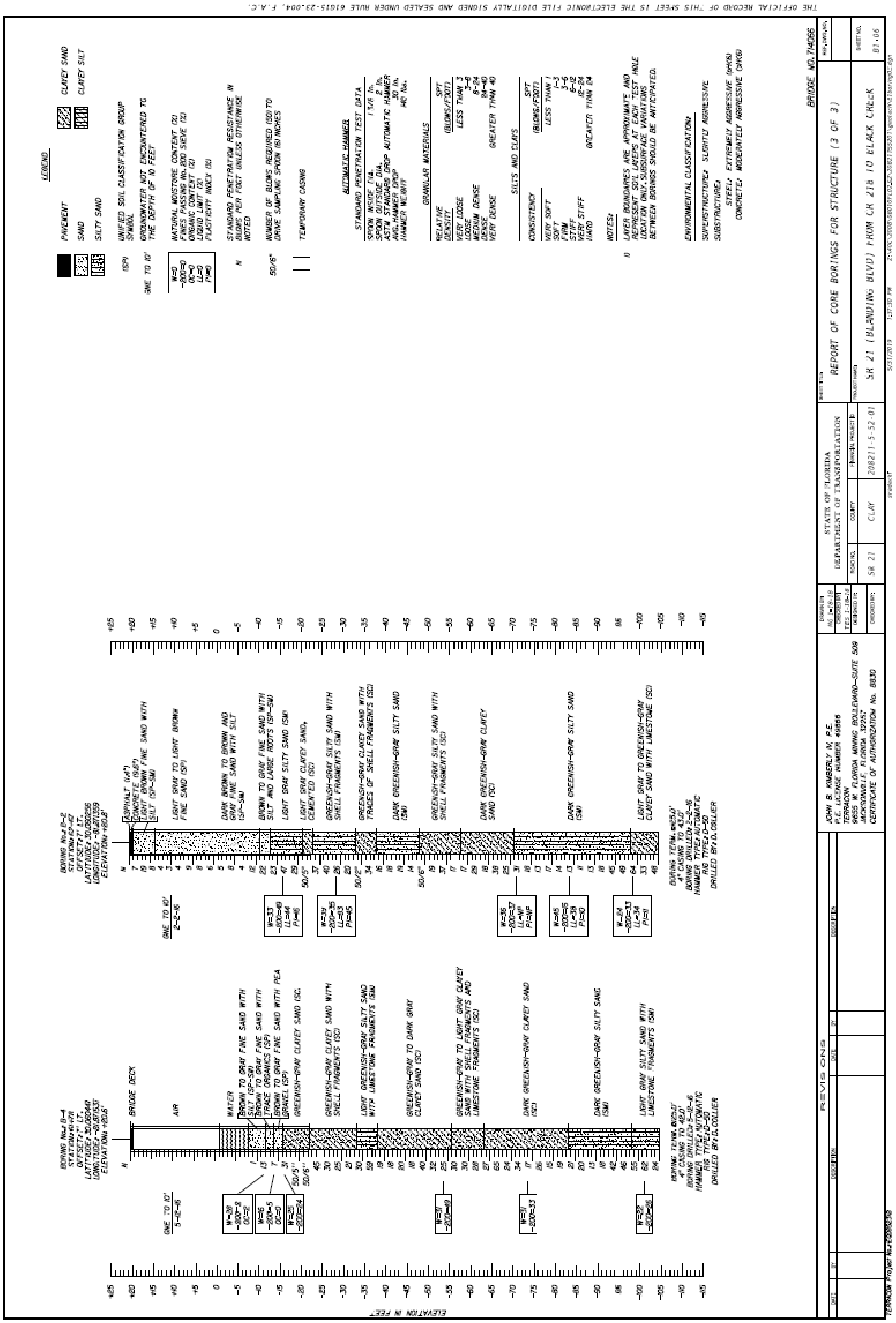


Figure B-40 Relevant boring log for second drive at CR-218

B.6.2 Pile Driving Logs

Excel 2016 (v 16.0)

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

700-010-60
Construction
Oct-20

PILE DRIVING LOG

Structure No: 714066 Page No: 1 of 4

PROJECT No: 208211-5-52-01 Date: 11/13/20 Station No: 260+84/21.7 Lt CL

PILE Size/Type: 24" SQ PCP Length (ft): 110.00 Bent/Pier No: 2 PILE No: 4

HAMMER Make/Model: 46-32/D62-55 S/N: 991046 Rated Energy (ft-lbs): 107,172 Operating Rate (BPM):

REF Elev: +7.88 (REF 2) MIN TIP Elev: -42.00 PILE CUTOFF Elev: +15.20

DRIVING CRITERIA (DC): DC2 Elev:

Type: Prod - Dyn. Test

DC Max Stk: Min Stk req'd for PR:

Notes: Setcheck 2/2/21, see Note 13/14

SC criteria (if applic): bpi @ ft Stk

DC1			DC2, input if applic.		
(1)	blows @	ft,	(6)	blows @	ft,
(2)	blows @	ft,	(7)	blows @	ft,
(3)	blows @	ft,	(8)	blows @	ft,
(4)	blows @	ft,	(9)	blows @	ft,
(5)	blows @	ft,	(10)	blows @	ft,

SCOUR Elev:

PILE CUSHION Thickness & Material: 18"plywood

HAMMER CUSHION Thickness & Material: Alum. (3 @ .5"), Micarta (2 @ 1")

Pile Activity	Date	Start Time	Stop Time	Weather	Temp °F	Notes
Preforming	11/10/20	4:01pm	6:30pm	Cloudy/rain	82	
Preforming	11/11/20	7:15am	8:00am	Cloudy	79	
Stand Pile	11/11/20	12:02pm	1:40pm	Cloudy	79	
DRIVE Pile	11/13/20	11:40pm	12:30pm	Cloudy	75	

PILE DATA:

PAY ITEM No: 455-143-5 WORK ORDER No:

MANUFACTURED By: CDS Manufacturing MFR's PILE No: SR21-24-001 DATE CAST: 3/25/20

TBM/BM Elev: +21.20 TBM/BM Rod Read: 4.07 H.I. Elev: +25.27

PRE-DRILLED Elev: GROUND Rod Read: GROUND Elev:

PREFORMED Elev: -35.00 Bottom of Excav Rod Read: Bottom of Excav Elev:

PILE HEAD Rod Read: PILE HEAD Elev: +61.80 PILE TIP Elev: -48.20

PH Elev = REF - LP + PL = +61.8

Top of SOIL PLUG Elev (for Open Ended Pipe Piles & H-piles): Natural Ground Elev:

Input 'Natural Ground EL' ONLY when natural ground surface is below embankment/fill material. Otherwise, leave this cell BLANK

SPLICE / EACH	PREFORMED HOLE	DYNAMIC LOAD TEST	PAY SET CHECK	NO PAY SET CHECK	REDRIVE	EXTRACTION	DRIVING OF SPLICE	PILE TYPE CODE	Plumb or Batter ? (click & select) ↓ PLUMB	PILE LENGTH (ft) ORIGINAL FURNISHED	PILE LENGTH (ft) TOTAL LENGTH WITH EXTENSION	Pile PENETRATION (FDOT spec 455-5.8) (ft)	EXTENSION/BUILD UP AUTHORIZED (ft)	EXTENSION/BUILD UP ACTUAL (ft)
	1	1	1					1		110.00				

CTQP Trainee (supervised by the Qualified Inspector) experiencing the full pile installation & log inspection: Name: TIN:

Qualified Inspector - I certify the Pile Driving Log content, and as applicable, the above CTQP Trainee's participation during this pile installation: Name & TIN: Darryl Belanger/B45217868 Signature:

Figure B-41. First page of pile driving log at CR-218 first drive

DC:				STATE OF FLORIDA DOT		Min Tip	1 ft to c/o	c/o	700-010-60 Construction Oct-20

PILE DRIVING LOG

Page No: 2 of 4

Structure No.: 714066 | Depth Table Extended (ft): | Bent/Pier No.: 2 | Pile No.: 4

Depth Input Start LP↓	REF		Blows	Stroke	Eq. Stke. & Notes	Depth	REF		Blows	Stroke	Eq. Stke. & Notes	Depth	REF		Blows	Stroke	Eq. Stke. & Notes
0.00	1	1.00				33.00	-	34.00				**56.00**	-	56.08	11	8.75	F3, ST,13,14
1.00	-	2.00				34.00	-	35.00				**56.08**	-	57.00			
2.00	-	3.00				35.00	-	36.00				57.00	-	58.00			
3.00	-	4.00				36.00	-	37.00	4		1	58.00	-	59.00			
4.00	-	5.00				37.00	-	38.00	8		1	59.00	-	60.00			
5.00	-	6.00				38.00	-	39.00	15		1	60.00	-	61.00			
6.00	-	7.00				39.00	-	40.00	16	5.5	2, F1	61.00	-	62.00			
7.00	-	8.00				40.00	-	41.00	18	5.29		62.00	-	63.00			
8.00	-	9.00				41.00		42.00	25	5.76		63.00	-	64.00			
9.00	-	10.00				42.00	-	43.00	21	5.69		64.00	-	65.00			
10.00	-	11.00				43.00	-	44.00	19	5.56		65.00	-	66.00			
11.00	-	12.00				44.00	-	45.00	11	5.14		66.00	-	67.00			
12.00	-	13.00				45.00	-	46.00	6	5.82		67.00	-	68.00			
13.00	-	14.00				46.00	-	47.00	5	4.9		68.00	-	69.00			
14.00	-	15.00				47.00	-	48.00	4	4.9		69.00	-	70.00			
15.00	-	16.00				48.00	-	49.00	3	4.9		70.00	-	71.00			
16.00	-	17.00				49.00	-	50.00	4	6.68		71.00	-	72.00			
17.00	-	18.00				50.00	-	51.00	5	6.19		72.00	-	73.00			
18.00	-	19.00				51.00	-	52.00	18	5.46		73.00	-	74.00			
19.00	-	20.00				52.00	-	53.00	109	6.03	3, F2	74.00	-	75.00			
20.00	-	21.00				53.00	-	54.00	68	6.14		75.00	-	76.00			
21.00	-	22.00				54.00	-	55.00	70	6.41		76.00	-	77.00			
22.00	-	23.00				**55.00**	-	55.63	221	7.3	4, F3, F4, ST	77.00	-	78.00			
23.00	-	24.00				**55.63**	-	55.71	8	7.5	5, F4	78.00	-	79.00			
24.00	-	25.00				**55.71**	-	55.79	22	7.6		79.00	-	80.00			
25.00	-	26.00				**55.79**	-	55.88	40	7.7	6, ST	80.00	-	81.00			
26.00	-	27.00				**55.88**	-	55.96	8	9.91	7, F4, SC	81.00	-	82.00			
27.00	-	28.00				**55.96**	-	56.00	5	7.58		82.00	-	83.00			
28.00	-	29.00				**56.00**	-	56.20	60	7.22	8, F2, F1, F2	83.00	-	84.00			
29.00	-	30.00				**56.20**	-	56.30	21	7.79	9, F2, ST	84.00	-	85.00			
30.00	-	31.00				**55.74**	2	55.83	10	8.64	10, F3, ST	85.00	-	86.00			
31.00	-	32.00				**55.83**	-	55.92	10	8.13	11, F2	86.00	-	87.00			
32.00	-	33.00				**55.92**	-	56.00	24	7.22	12, F1, ST	87.00	-	88.00			

Figure B-42. Second page of pile driving log at CR-218 first drive

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

700-010-60
Construction
Oct-20

PILE DRIVING LOG

Structure No: 714066

Page No: 3 of 4

REF inputs & Notes

PROJECT No: 208211-5-52-01

Bent/Pier No: 2

PILE No.: 4

REF No.	Input REF EL ↓	*Calculated LP values for each REF used LP min tip	LP c/o-1	LP c/o	Input REF description (template, stringline, etc.) for each REF used: ↓
1	+8.44	50.44	102.24	103.24	Top Template / Roller
2	+7.88	49.88	101.68	102.68	Bottom Template/ Roller
3					
4					
5					

Standard Notes & Note No.'s 1-28

Std. Notes:	↓ = Pile Ran, F1, F2, F3, F4 = (Fuel Settings 1-4), ST = stop, CC = cushion change, HR = high rebound, TP = Test Pile, DC = Driving Criteria, PR = Practical Refusal, SC = set check, DLT = Dyn. Load Test
Note 1:	Dry Fire, Seat Pile, Pile sank 3' in 27 Blows to 39' mark on pile.
Note 2:	F1
Note 3:	F2
Note 4:	F3, F4, ST @ 12:30pm
Note 5:	F4, resumed drive @ 1:37pm
Note 6:	ST @ 1:47pm
Note 7:	F4, SC @ 12:42pm 11/16/2020
Note 8:	Resumed Drive @ 1:51pm F2, F1, F2
Note 9:	F2, ST @ 1:56
Note 10:	Redrive 12/4/2020 with different hammer (Ape/D62-55, SN 201504794, Rated energy 153,798). F3, ST.
Note 11:	Pile cushion 15" Plywood. F2
Note 12:	F1, ST
Note 13:	Set Check, 2/2/21, Start Time 11:29am, Stop Time 11:30am, Weather Clear 50 degrees,
Note 14:	F3, 15" used plywood cushion
Note 15:	
Note 16:	
Note 17:	
Note 18:	
Note 19:	
Note 20:	
Note 21:	
Note 22:	
Note 23:	
Note 24:	
Note 25:	
Note 26:	
Note 27:	
Note 28:	

Figure B-43. Third page of pile driving log at CR-218 first drive

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

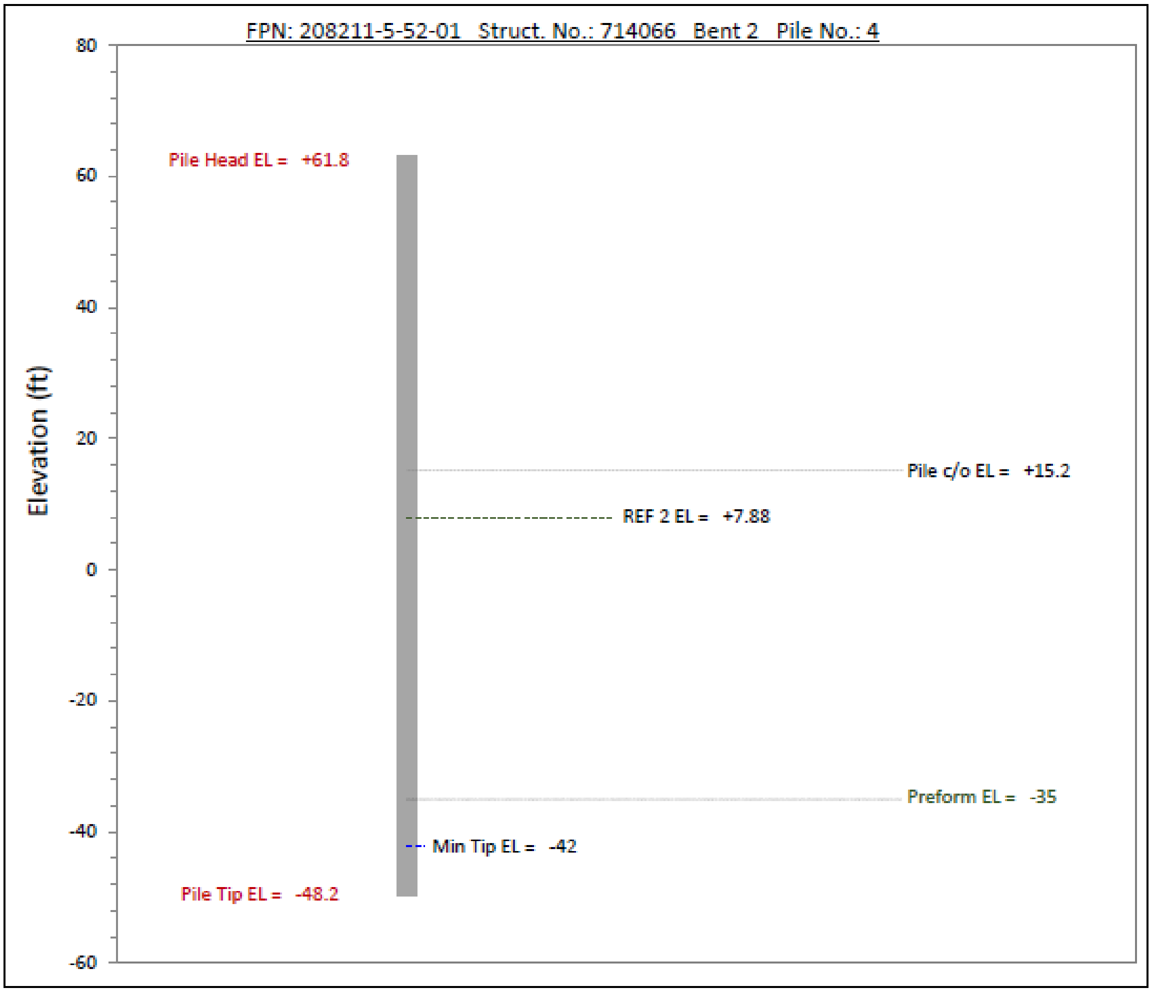
700-010-60
Construction
Oct-20

PILE DRIVING LOG

Structure No: 714066 Page No: 4 of 4

Sketch

PROJECT No: 208211-5-52-01 Bent/Pier No: 2 PILE No.: 4



PLUMB pile, as depicted in this Pile Sketch

Pile Bearing: (click on yellow shaded cell below, and select basis for Pile Bearing acceptance that applies)

Pile Penetration:

Pile Tip EL ≤ bottom EL of Preformed or Predrilled pile hole, meets 455-5 Penetration Requirements.

Current Pile Tip EL ≤ Min Tip EL in plans, meets 455-5 Penetration Requirements.

Figure B-44. Fourth page of pile driving log at CR-218 first drive

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PILE DRIVING LOG

Structure No: 714066 Page No: 1 of 4

PROJECT No: 208211-5-52-01 Date: 12/4/20 Station No: 261+78/21.74 Lt/CL

PILE Size/Type: 24" SQ PCP Length (ft): 110.00 Bent/Pier No: 3 PILE No: 4

HAMMER Make/Model: Ape 62-55 S/N: 201504794 Rated Energy (ft-lbs): 153,799 Operating Rate (BPM):

REF Elev: +7.98 (REF 1) MIN TIP Elev: -42.00 PILE CUTOFF Elev: +15.20

DRIVING CRITERIA (DC): DC2 Elev:

Type: Test Pile DRIVING CRITERIA inputs n/a for TP

DC Max Stk: Min Stk req'd for PR:

Notes: Additional Setcheck 1/26/21, see notes 6, 7

SC criteria (if applic): bpi @ ft Stk

DC1			DC2, input if applic.		
(1)	blows @	ft,	(6)	blows @	ft,
(2)	blows @	ft,	(7)	blows @	ft,
(3)	blows @	ft,	(8)	blows @	ft,
(4)	blows @	ft,	(9)	blows @	ft,
(5)	blows @	ft,	(10)	blows @	ft,

SCOUR Elev: -18.64

PILE CUSHION Thickness & Material: 15" Plywood

HAMMER CUSHION Thickness & Material: Alum. (3 @ .5"), Micarta (2 @ 1")

Pile Activity	Date	Start Time	Stop Time	Weather	Temp °F	Notes
Preforming	12/4/20	9:30am	11:00am	Cloudy	75	
Stand Pile	12/4/20	12:00pm	12:15pm	Cloudy	75	
DRIVE Pile	12/4/20	3:41pm	4:04 AM	Cloudy	75	1
Redrive	12/5/20	10:31am	10:38am	Clear	64	

PILE DATA:

PAY ITEM No: 455-143-5 WORK ORDER No:

MANUFACTURED By: CDS Manufacturing MFR's PILE No: SR21-24-002 DATE CAST: 3/25/20

TBM/BM Elev: +21.20 TBM/BM Rod Read: 4.16 H.I. Elev: +25.36

PRE-DRILLED Elev: GROUND Rod Read: GROUND Elev:

PREFORMED Elev: -35.00 Bottom of Excav Rod Read: Bottom of Excav Elev:

PILE HEAD Rod Read: PILE HEAD Elev: +57.69 PILE TIP Elev: -52.31

PH Elev = REF - LP + PL = +57.69

Top of SOIL PLUG Elev (for Open Ended Pipe Piles & H-piles): Natural Ground Elev: -14.00

Input 'Natural Ground EL' ONLY when natural ground surface is below embankment/fill material. Otherwise, leave this cell BLANK

SPLICE / EACH	PREFORMED HOLE	DYNAMIC LOAD TEST	PAY SET CHECK	NO PAY SET CHECK	REDRIVE	EXTRACTION	DRIVING OF SPLICE	PILE TYPE CODE	Plumb or Batter ? (click & select) ↓ PLUMB	PILE LENGTH (ft) ORIGINAL FURNISHED	TOTAL LENGTH WITH EXTENSION	Pile PENETRATION (FDOT spec 455-5.8) (ft)	EXTENSION/BUILD UP AUTHORIZED (ft)	ACTUAL (ft)
	1	1	1					1		110.00				

Pile PENETRATION (ft), below: Natural Ground: 38.31 ft SCOUR: 33.67 ft

CTQP Trainee (supervised by the Qualified Inspector) experiencing the full pile installation & log inspection: Name: TIN:

Qualified Inspector - I certify the Pile Driving Log content, and as applicable, the above CTQP Trainee's participation during this pile installation: Name & TIN: Darryl Belanger/B45217868 Signature:

Figure B-45. First page of pile driving log at CR-218 second drive

DC:	STATE OF FLORIDA DOT	Min Tip	1 ft to c/o	c/o	700-010-60 Construction Oct-20

PILE DRIVING LOG

Page No: 2 of 4

Structure No.: 714066 Depth Table Extended (ft): Bent/Pier No.: 3 Pile No.: 4

Depth Input Start LP↓	REF		Blows	Stroke	Eq. Stke. & Notes	Depth	REF		Blows	Stroke	Eq. Stke. & Notes	Depth	REF		Blows	Stroke	Eq. Stke. & Notes
50.50	1	51.00	17	6.65	F1, 1, HR	75.00	-	76.00					-				
51.00	-	52.00	166	5.82		76.00	-	77.00					-				
52.00	-	53.00	165	6.25		77.00	-	78.00					-				
53.00	-	54.00	75	7.17		78.00	-	79.00					-				
54.00	-	55.00	60	6.93		79.00	-	80.00					-				
55.00	-	56.00	278	7.49	F2, F3	80.00	-	81.00					-				
56.00	-	56.50	235	6.74	F2, F1, ST	81.00	-	82.00					-				
56.50	-	57.00	75	7.07	CC, F2, 2	82.00	-	83.00					-				
57.00	-	58.00	437	7.3	F2, F1,	83.00		84.00					-				
58.00	-	59.00	240	7.65	ST	84.00	-	85.00					-				
59.00	-	59.08	9	5.85	F3, 3	85.00	-	86.00					-				
59.08	-	59.16	8	6.31	ST,	86.00	-	87.00					-				
59.16	-	59.25	14	7.9	CC, F3, 4	87.00	-	88.00					-				
59.25	-	59.33	16	7.98		88.00	-	89.00					-				
59.33	-	59.41	20	8.25		89.00	-	90.00					-				
59.41	-	59.49	22	8.28	HR, 5	90.00	-	91.00					-				
59.49	-	60.21	480	8.13	F4, ST	91.00	-	92.00					-				
60.21	-	60.29	12	8.11	F3, ST, 6,7	92.00	-	93.00					-				
60.29	-	61.00				93.00	-	94.00					-				
61.00	-	62.00				94.00	-	95.00					-				
62.00	-	63.00				95.00	-	96.00					-				
63.00	-	64.00				96.00	-	97.00					-				
64.00	-	65.00				97.00	-	98.00					-				
65.00	-	66.00				98.00	-	99.00					-				
66.00	-	67.00				99.00	-	100.00					-				
67.00	-	68.00				100.00	-	101.00					-				
68.00	-	69.00				101.00	-	102.00					-				
69.00	-	70.00				102.00	-	103.00					-				
70.00	-	71.00					-						-				
71.00	-	72.00					-						-				
72.00	-	73.00					-						-				
73.00	-	74.00					-						-				
74.00	-	75.00					-						-				

Figure B-46. Second page of pile driving log at CR-218 second drive

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

700-010-60
Construction
Oct-20

PILE DRIVING LOG

Structure No: 714066   Page No: 3 of 4

REF inputs & Notes

PROJECT No: 208211-5-52-01   Bent/Pier No: 3   PILE No.: 4

REF No.	Input REF EL ↓	*Calculated LP values for each REF used			Input REF description (template, stringline, etc.) for each REF used: ↓
		LP min tip	LP c/o-1	LP c/o	
1	+7.98	49.98	101.78	102.78	Top Template / Roller
2					Bottom Template/ Roller
3					
4					
5					

Standard Notes & Note No.'s 1-28

Std. Notes:	↓ = Pile Ran, F1, F2, F3, F4 = (Fuel Settings 1-4), ST = stop, CC = cushion change, HR = high rebound, TP = Test Pile, DC = Driving Criteria, PR = Practical Refusal, SC = set check, DLT = Dyn. Load Test
Note 1:	3/4" HR
Note 2:	Redrive 12/5/2020, 15' Plywood start 10:31am-10:48am 3/4" HR
Note 3:	Redrive 12/14/2020, 15' Plywood start 1:28pm-11:30pm 3/4" HR
Note 4:	Continued Redrive 12/14/2020, 3:36pm-3:59pm with New Cushion 15"
Note 5:	3/4" HR
Note 6:	Setcheck Date 1/26/21, Start Time 4:40pm Stop Time 4:41pm Weather P/C, Temp 76 Degrees,
Note 7:	Used 15" Cushion
Note 8:	
Note 9:	
Note 10:	
Note 11:	
Note 12:	
Note 13:	
Note 14:	
Note 15:	
Note 16:	
Note 17:	
Note 18:	
Note 19:	
Note 20:	
Note 21:	
Note 22:	
Note 23:	
Note 24:	
Note 25:	
Note 26:	
Note 27:	
Note 28:	

Figure B-47. Third page of pile driving log at CR-218 second drive

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

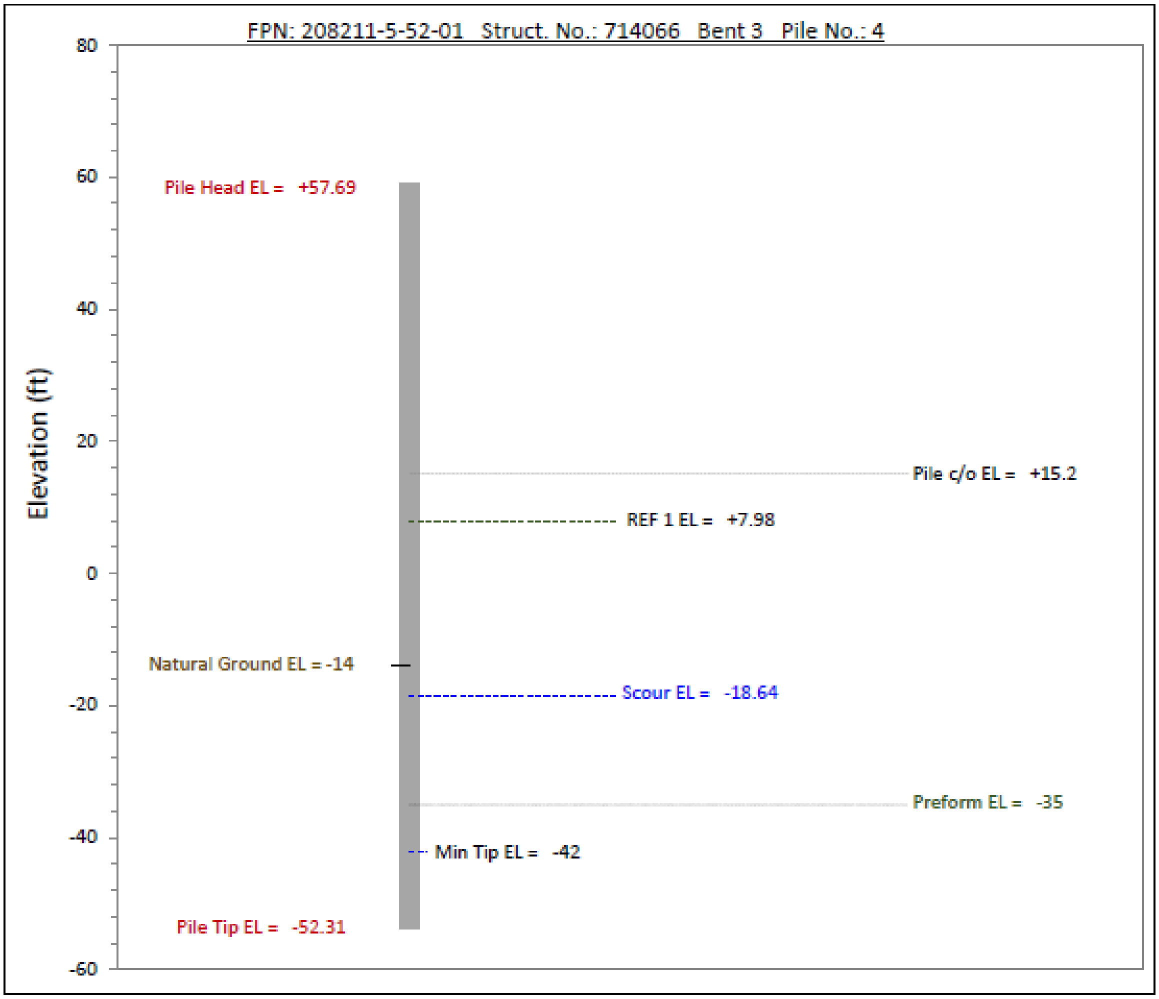
700-010-60
Construction
Oct-20

PILE DRIVING LOG

Structure No: 714066 Page No: 4 of 4

Sketch

PROJECT No: 208211-5-52-01 Bent/Pier No: 3 PILE No.: 4



PLUMB pile, as depicted in this Pile Sketch

Pile Bearing: (click on yellow shaded cell below, and select basis for Pile Bearing acceptance that applies)

Pile Penetration:

Pile Tip EL ≤ bottom EL of Preformed or Predrilled pile hole, meets 455-5 Penetration Requirements.

Current Pile Tip EL ≤ Min Tip EL in plans, meets 455-5 Penetration Requirements.

Min Tip EL is input on the log. Therefore, the 10-20 ft of penetration into firm/soft material, in accordance with 455-5 Penetration Requirements, does not apply.

Figure B-48. Fourth page of pile driving log at CR-218 second drive

B.7 SR-23

B.7.1 Boring Logs

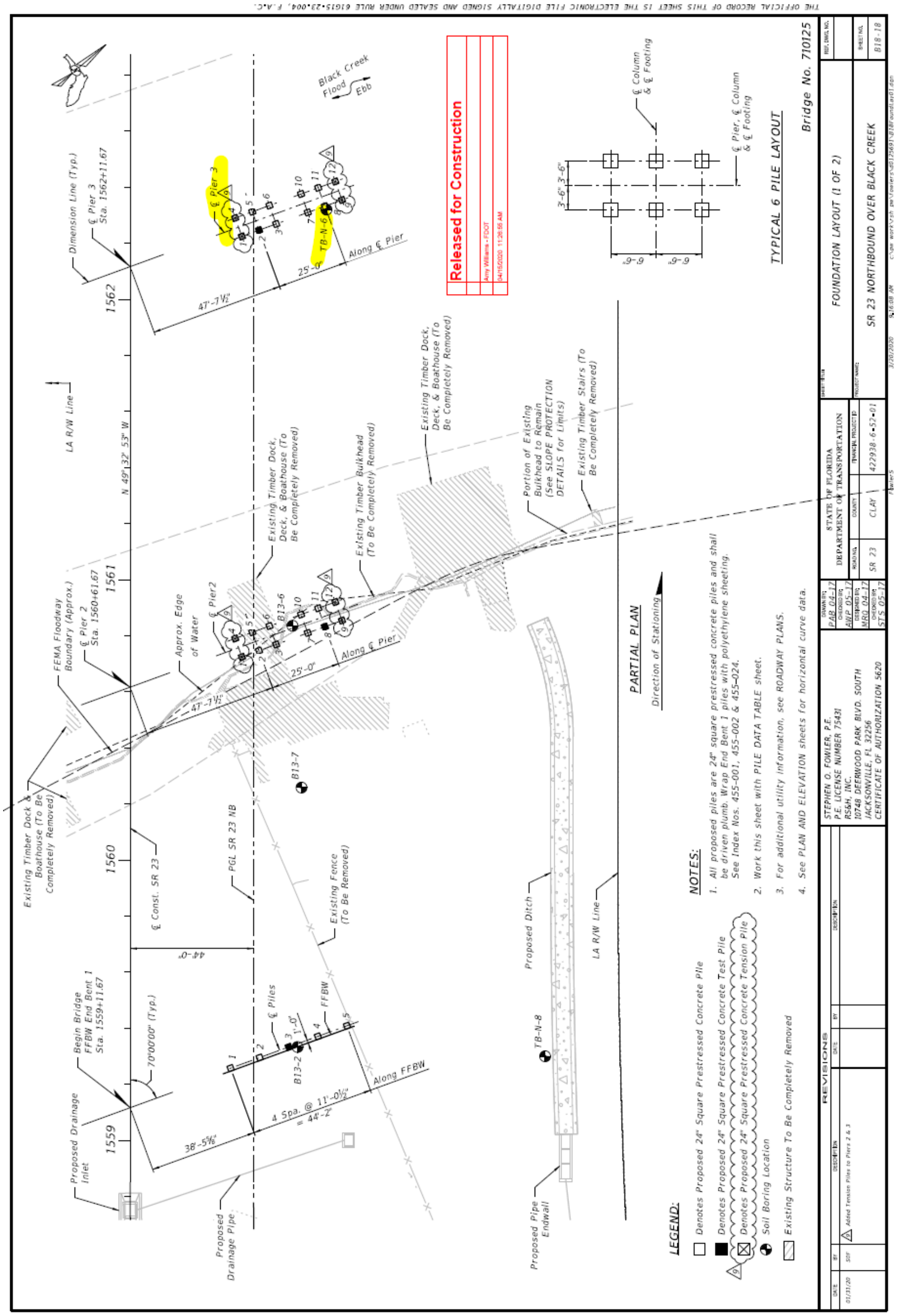


Figure B-49. Boring log layout plan at SR-23

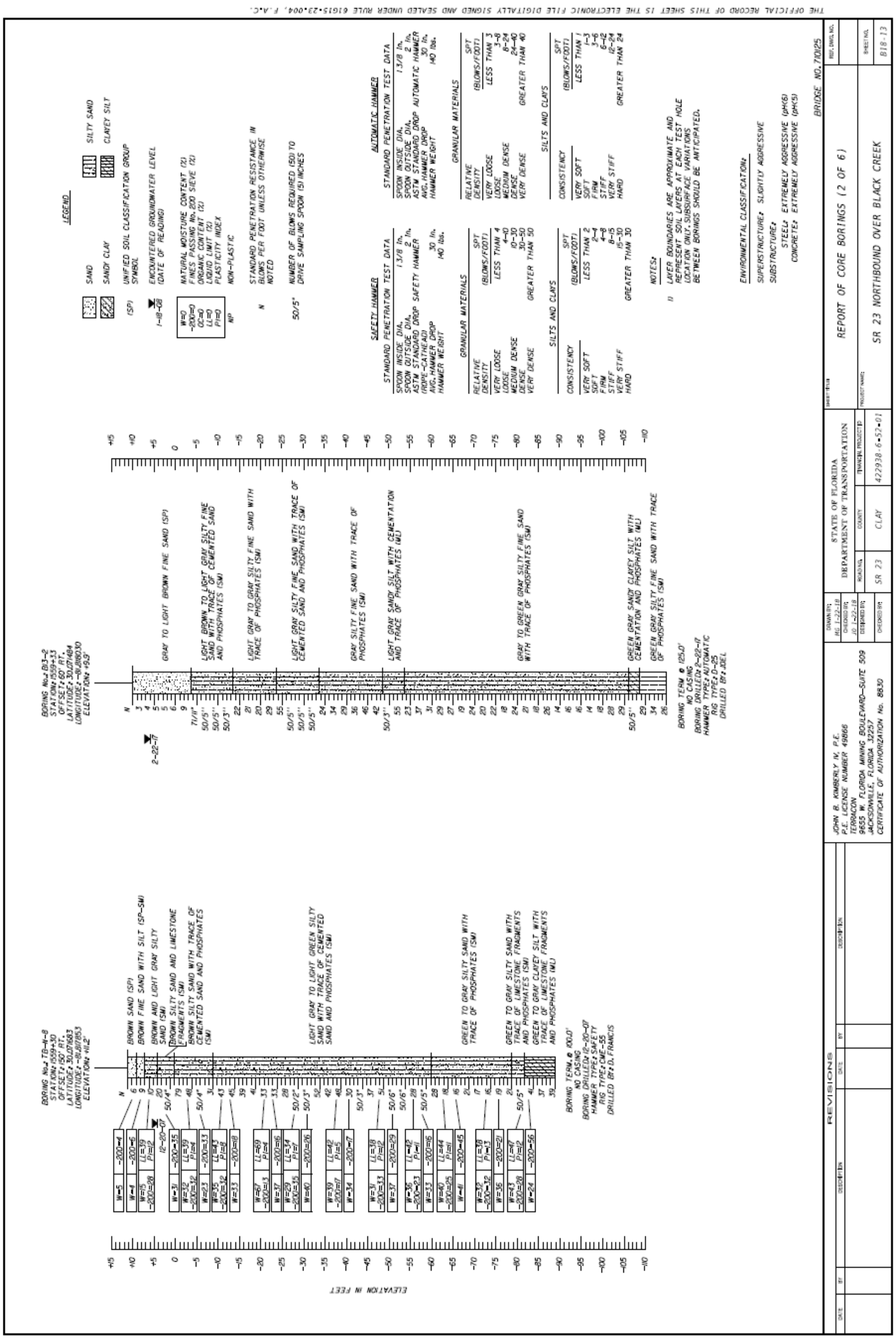


Figure B-50. Boring log for SR-23

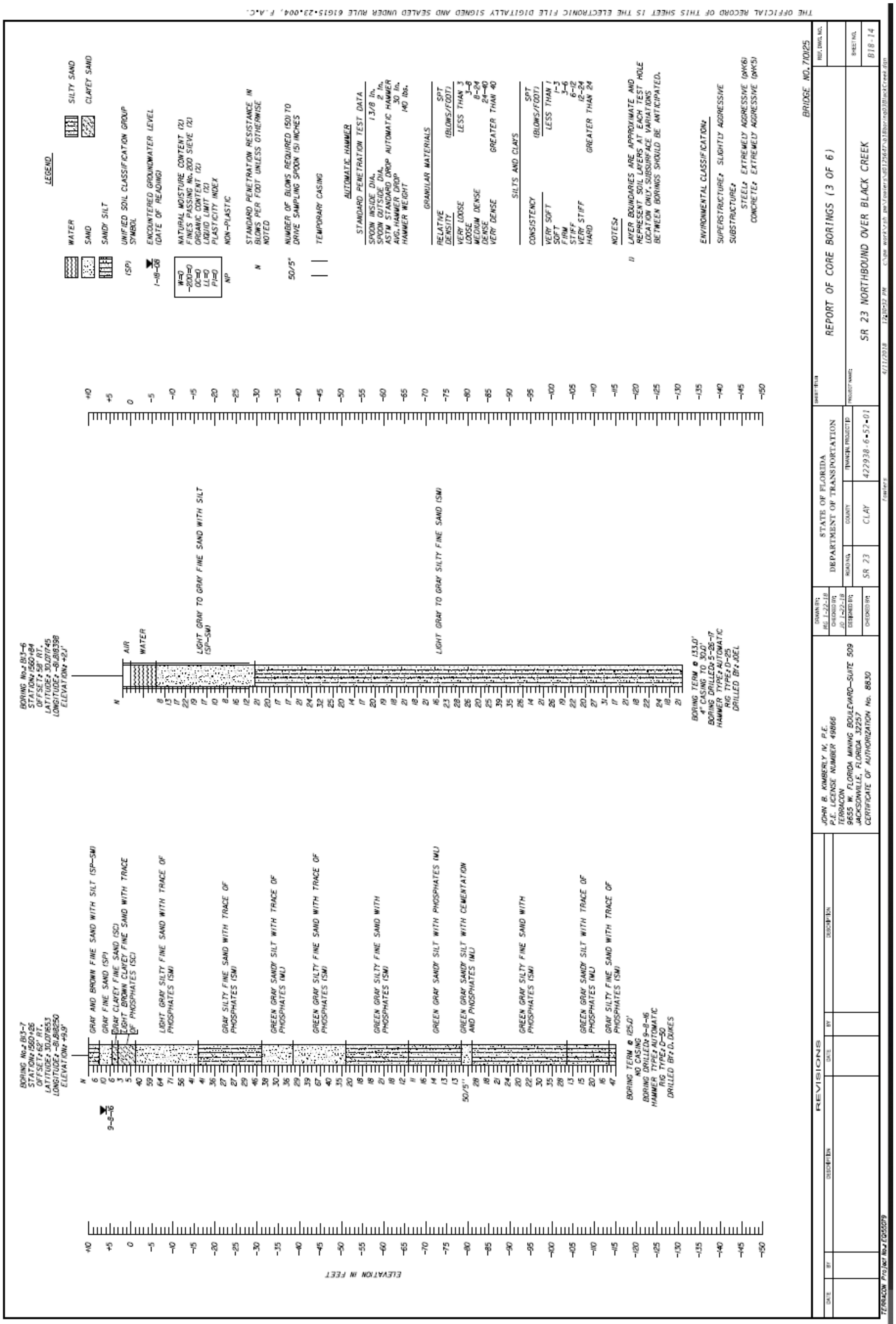


Figure B-51. Boring log for SR-23

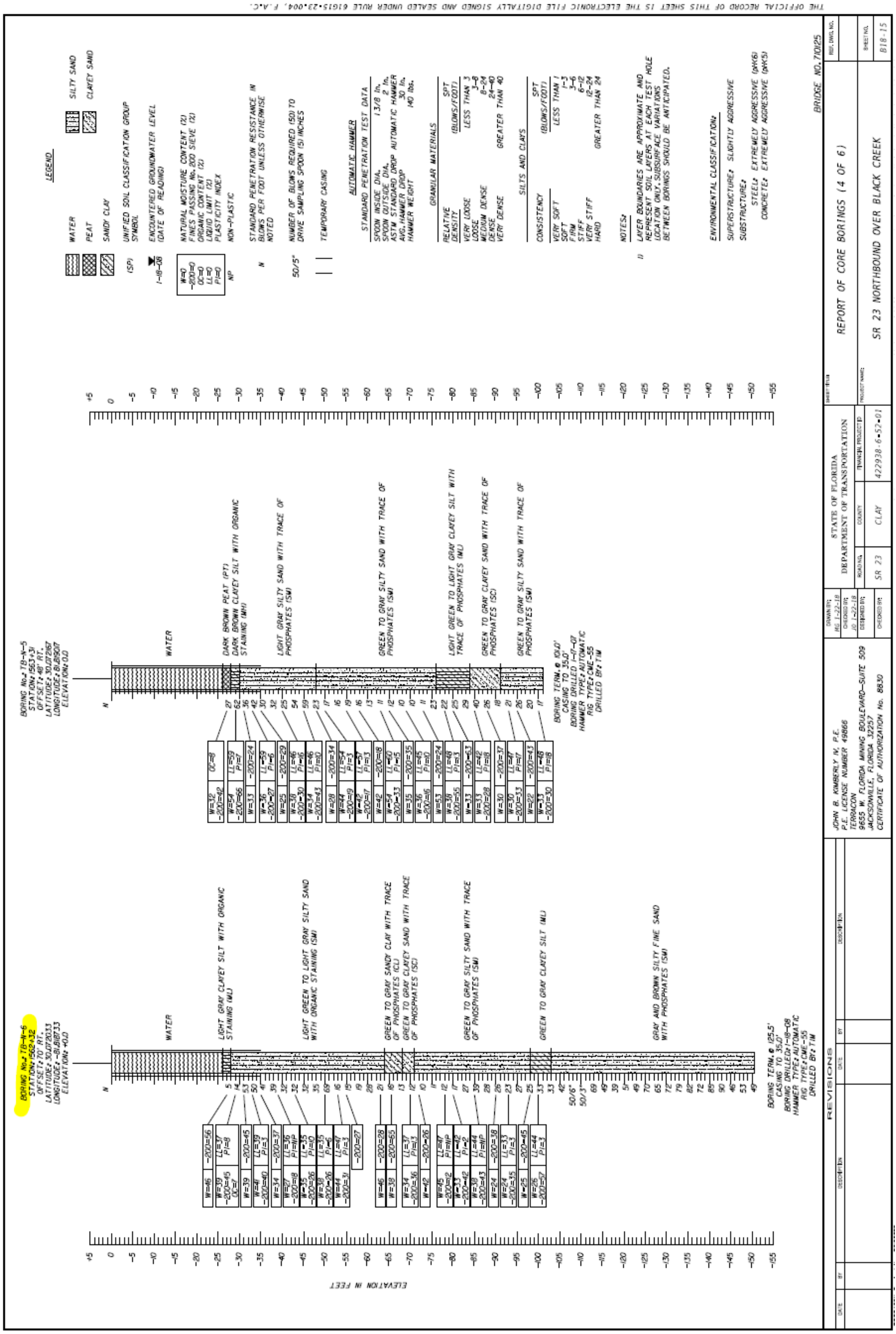


Figure B-52. Boring log for SR-23

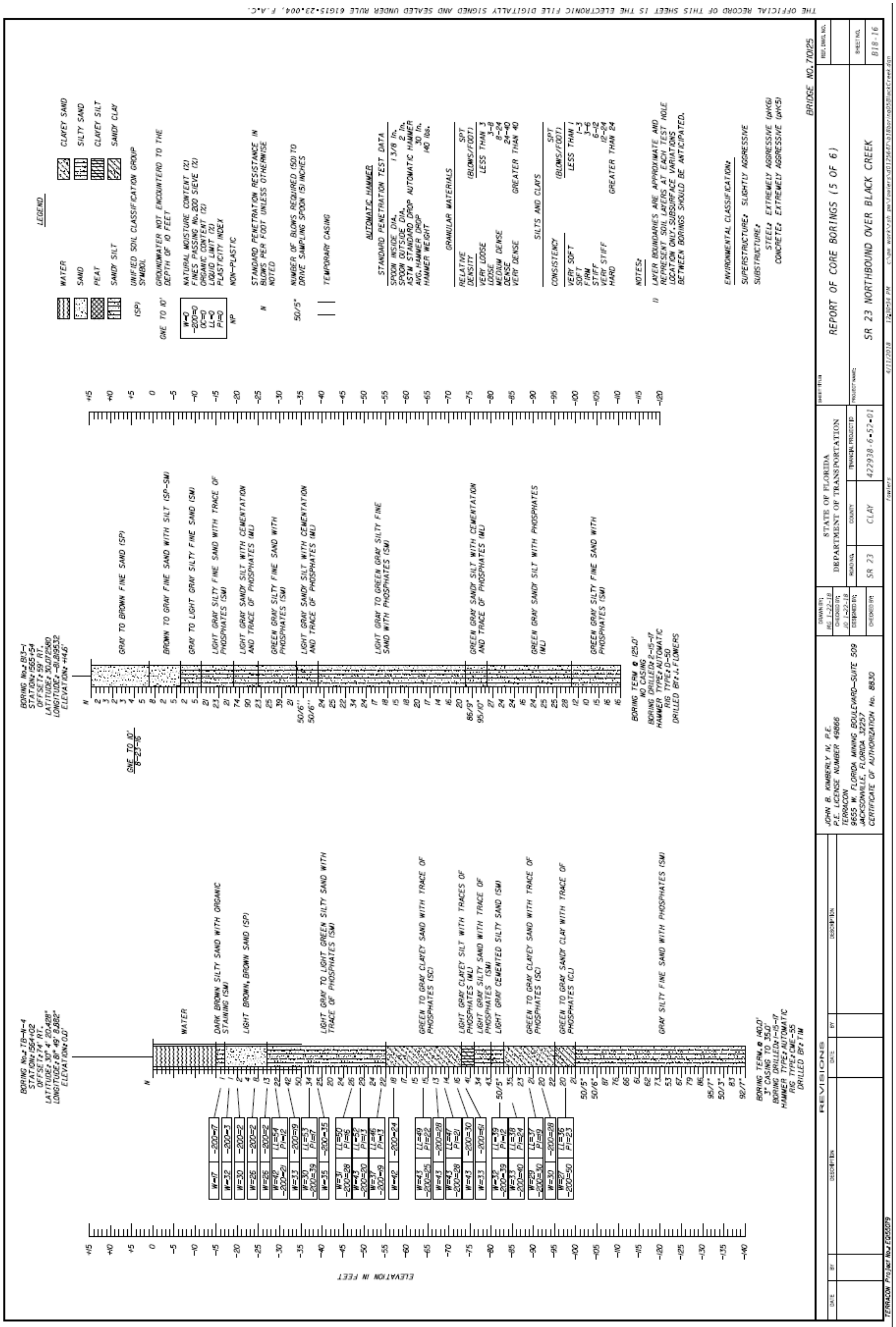


Figure B-53. Boring log for SR-23

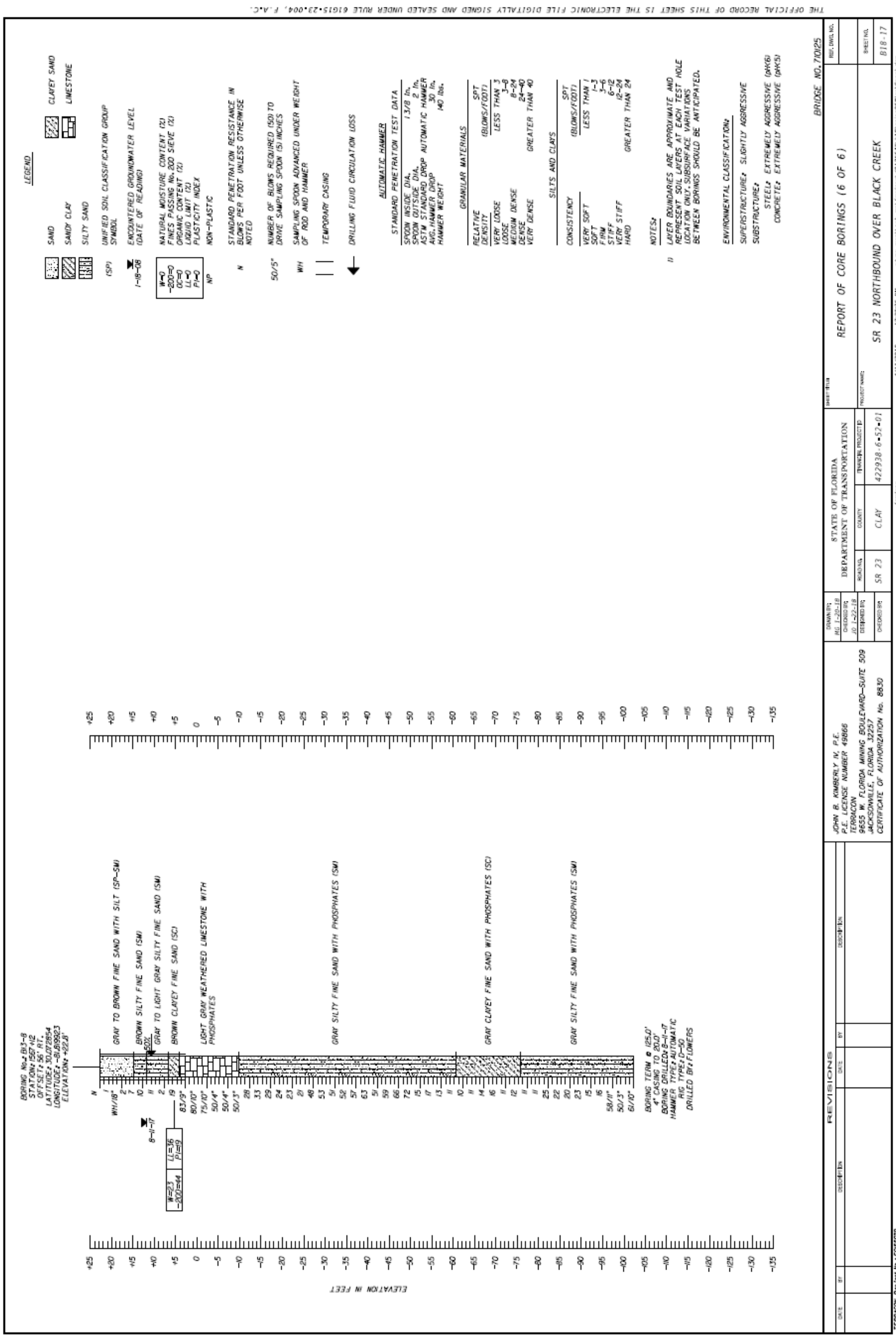


Figure B-54. Boring log for SR-23

B.7.2 Pile Driving Logs

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STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

700-010-60
Construction
May-20

PILE DRIVING LOG

Structure No: 710125 NB   Page No: 1 of 4

PROJECT No: 422938-6-52-01   Date: 11/16/20   Station No: 1562 +12

PILE Size/Type: 24" SQ PCP   Length (ft): 95.00   Bent/Pier No: 3   PILE No: 3

HAMMER Make/Model: APE D62/70   S/N: 410302   Rated Energy (ft-lbs): 173,644   Operating Rate (BPM): 34-53

REF Elev: +5.55 (REF 1)   MIN TIP Elev: -73.00   PILE CUTOFF Elev: +2.50

DRIVING CRITERIA (DC):   DC2 Elev:

Type: Prod - Dyn. Test

DC Max Stk: Min Stk req'd for PR:

Notes:

SC criteria (if applic): bpi @ ft Stk

DC1				DC2, input if applic.			
(1)	blows @		ft,	(6)	blows @		ft,
(2)	blows @		ft,	(7)	blows @		ft,
(3)	blows @		ft,	(8)	blows @		ft,
(4)	blows @		ft,	(9)	blows @		ft,
(5)	blows @		ft,	(10)	blows @		ft,

SCOUR Elev: -38.20

PILE CUSHION Thickness & Material: 12" plywood

HAMMER CUSHION Thickness & Material: 3 alum @ 1/2", 2 micarta @ 1"

Pile Activity	Date	Start Time	Stop Time	Weather	Temp °F	Notes
Preforming	11/16/20	10:20 AM	2:20 PM	clear	65	
Stand Pile	11/17/20	11:02 AM	11:26 AM	clear	60	2 cranes, 2point
DRIVE Pile	11/18/20	9:22 AM	9:32 AM	clear	60	
Set check						

PILE DATA:

PAY ITEM No: 455-34-5   WORK ORDER No:

MANUFACTURED By: CDS   MFR's PILE No: R 23 3AC-24-V0   DATE CAST: 10/14/20

TBM/BM Elev: TBM/BM Rod Read: H.I. Elev:

PRE-DRILLED Elev: GROUND Rod Read: GROUND Elev: -21.80

Manually input GROUND Elev (no sheet calc)

PREFORMED Elev: -73.00   Bottom of Excav Rod Read: Bottom of Excav Elev: -1.50

Manually input BOE Elev (no sheet calc available)

PILE HEAD Rod Read: PILE HEAD Elev: +19.05   PILE TIP Elev: -75.95

PH Elev = REF - LP + PL = +19.05

Top of SOIL PLUG Elev (for Open Ended Pipe Piles & H-piles):   Natural Ground Elev:

Input 'Natural Ground EL' ONLY when natural ground surface is below embankment/fill material. Otherwise, leave this cell BLANK

SPLICE / EACH	PREFORMED HOLE	DYNAMIC LOAD TEST	PAY SET CHECK	NO PAY SET CHECK	REDRIVE	EXTRACTION	DRIVING OF SPLICE	PILE TYPE CODE	Plumb or Batter ? (click & select) ↓	PILE LENGTH (ft) ORIGINAL FURNISHED	PILE LENGTH (ft) TOTAL LENGTH WITH EXTENSION	Pile PENETRATION below SCOUR (ft)	EXTENSION/BUILD UP AUTHORIZED (ft)	EXTENSION/BUILD UP ACTUAL (ft)
									PLUMB					
	15	1						1		95.00	130.00	37.75		

Pile PENETRATION (ft), below: GROUND: 54.15 ft   Bottom of Excav: 74.45 ft   SCOUR: 37.75 ft

CTQP Trainee (supervised by the Qualified Inspector) experiencing the full pile installation & log inspection: Name: Sean Fischer   TIN: F26079391

Qualified Inspector - I certify the Pile Driving Log content, and as applicable, the above CTQP Trainee's participation during this pile installation: Name & TIN: Michael J. Wagner W256-550-67   Signature: Michael J. Wagner

Figure B-55. First page of pile driving log for first pile at SR-23

DC:			STATE OF FLORIDA DOT			Min Tip	1 ft to c/o	c/o	700-010-60 Construction May-20

PILE DRIVING LOG

Page No: 2 of 4

Structure No.: 710125 NB Depth Table Extended (ft): Bent/Pier No.: 3 Pile No.: 3

Depth Input Start LP↓	REF		Blows	Stroke	Eq. Stke. & Notes	Depth	REF	Blows	Stroke	Eq. Stke. & Notes	Depth	REF	Blows	Stroke	Eq. Stke. & Notes
72.00	1	73.00			↓		-					-			
73.00	-	74.00	7	4.5	1		-					-			
74.00	-	75.00	6	5.6			-					-			
75.00	-	76.00	22	5.4	F2		-					-			
76.00	-	77.00	27	5.3			-					-			
77.00	-	78.00	38	5.6			-					-			
78.00	-	79.00	63	5.6	F1		-					-			
79.00	-	80.00	67	6	2		-					-			
80.00	-	81.00	58	6.7								-			
81.00	-	81.50	120	6.8	3		-					-			
81.50	-	82.00					-					-			
82.00	-	83.00					-					-			
83.00	-	84.00					-					-			
84.00	-	85.00					-					-			
85.00	-	86.00					-					-			
86.00	-	87.00					-					-			
87.00	-	88.00					-					-			
88.00	-	89.00					-					-			
89.00	-	90.00					-					-			
90.00	-	91.00					-					-			
91.00	-	92.00					-					-			
92.00	-	93.00					-					-			
93.00	-	94.00					-					-			
94.00	-	95.00					-					-			
95.00	-	96.00					-					-			
96.00	-	97.00					-					-			
97.00	-	98.00					-					-			
98.00	-	99.00					-					-			
	-						-					-			
	-						-					-			
	-						-					-			
	-						-					-			
	-						-					-			

Figure B-56. Second page of pile driving log for first pile at SR-23

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

700-010-60
Construction
May-20

PILE DRIVING LOG

Structure No: 710125 NB   Page No: 3 of 4
REF inputs & Notes

PROJECT No: 422938-6-52-01   Bent/Pier No: 3   PILE No.: 3

REF No.	Input REF EL ↓	*Calculated LP values for each REF used: LP min tip	LP c/o-1	LP c/o	Input REF description (template, stringline, etc.) for each REF used: ↓
1	+5.55	78.55	97.05	98.05	Top Template
2					
3					
4					
5					

Standard Notes & Note No.'s 1-28

Std. Notes:	↓ = Pile Ran, F1, F2, F3, F4 = (Fuel Settings 1-4), ST = stop, CC = cushion change, HR = high rebound, TP = Test Pile, DC = Driving Criteria, PR = Practical Refusal, SC = set check, DLT = Dyn. Load Test
Note 1:	F1, used set from 2 (280 blows).
Note 2:	30 blows, F2.
Note 3:	ST due to high blow count. Pile not accepted.
Note 4:	
Note 5:	
Note 6:	
Note 7:	
Note 8:	
Note 9:	
Note 10:	
Note 11:	
Note 12:	
Note 13:	
Note 14:	
Note 15:	
Note 16:	
Note 17:	
Note 18:	
Note 19:	
Note 20:	
Note 21:	
Note 22:	
Note 23:	
Note 24:	
Note 25:	
Note 26:	
Note 27:	
Note 28:	

Figure B-57. Third page of pile driving log for first pile at SR-23

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

700-010-60
Construction
May-20

PILE DRIVING LOG

Structure No: 710125 NB

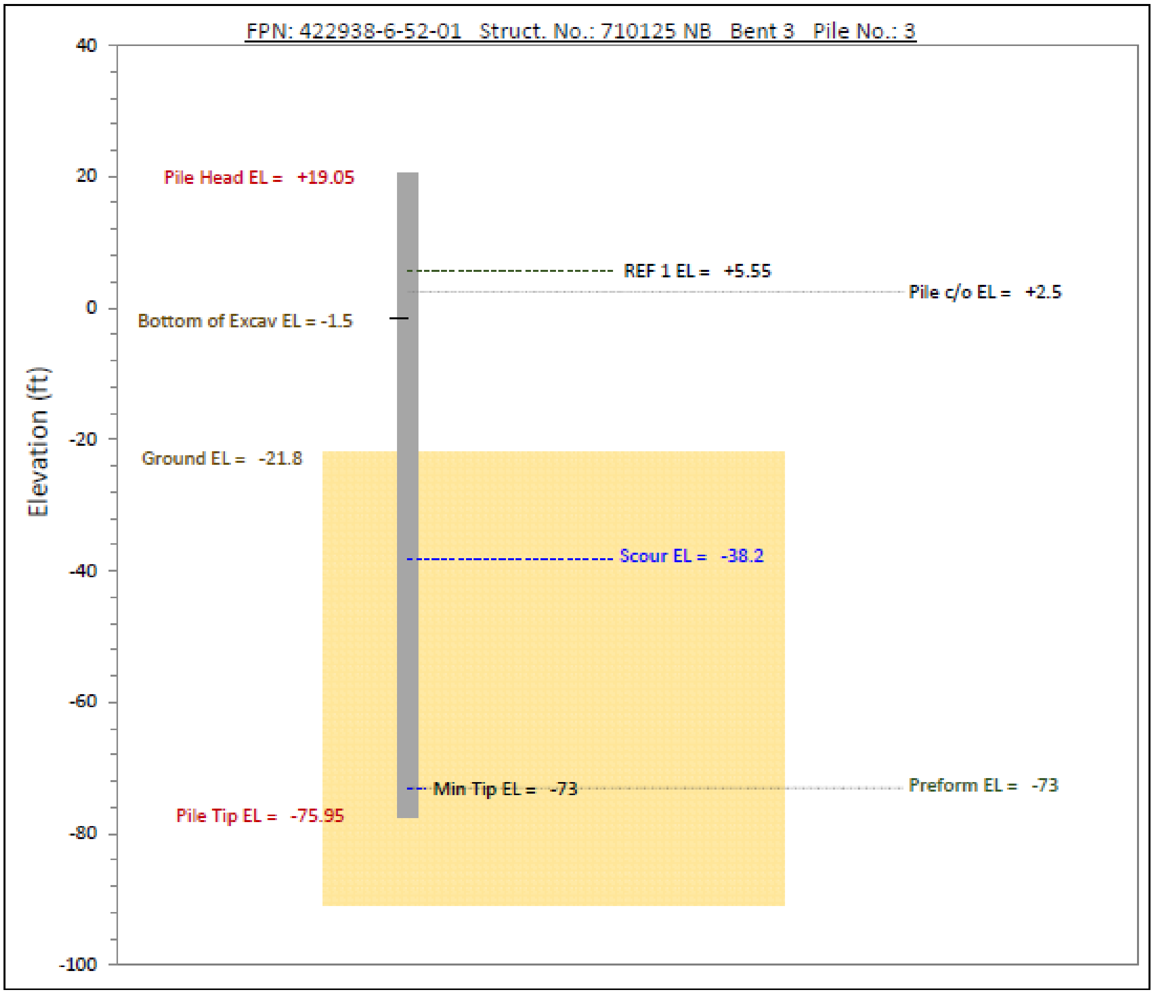
Page No: 4 of 4

Sketch

PROJECT No: 422938-6-52-01

Bent/Pier No: 3

PILE No.: 3



PLUMB pile, as depicted in this Pile Sketch

Pile Bearing: (click on yellow shaded cell below, and select basis for Pile Bearing acceptance that applies)

Pile bearing capacity determined by Dynamic Testing.

Pile Penetration:

Pile Tip EL ≤ bottom EL of Preformed or Predrilled pile hole, meets 455-5 Penetration Requirements.

Current Pile Tip EL ≤ Min Tip EL in plans, meets 455-5 Penetration Requirements.

Min Tip EL is input on the log. Therefore, the 10-20 ft of penetration into firm/soft material, in accordance with 455-5 Penetration Requirements, does not apply.

Figure B-58. Fourth page of pile driving log for first pile at SR-23

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PILE DRIVING LOG

Structure No: 710125 NB — Page No: 1 of 4

PROJECT No: 422938-6-52-01 — Date: 11/16/20 — Station No: 1562 +12

PILE Size/Type: 24" SQ PCP — Length (ft): 95.00 — Bent/Pier No: 3 — PILE No: 7

HAMMER Make/Model: APE D62/70 — S/N: 410302 — Rated Energy (ft-lbs): 173,644 — Operating Rate (BPM): 34-53

REF Elev: +5.60 (REF 1) — MIN TIP Elev: -73.00 — PILE CUTOFF Elev: +2.50

DRIVING CRITERIA (DC): — DC2 Elev:

Type: Prod - Dyn. Test

DC Max Stk: — Min Stk req'd for PR:

Notes:

SC criteria (if applic): bpi @ ft Stk

DC1			DC2, input if applic.		
(1)	blows @	ft,	(6)	blows @	ft,
(2)	blows @	ft,	(7)	blows @	ft,
(3)	blows @	ft,	(8)	blows @	ft,
(4)	blows @	ft,	(9)	blows @	ft,
(5)	blows @	ft,	(10)	blows @	ft,

SCOUR Elev: -38.20

PILE CUSHION Thickness & Material: 12" plywood

HAMMER CUSHION Thickness & Material: 3 alum @ 1/2", 2 micarta @ 1"

Pile Activity	Date	Start Time	Stop Time	Weather	Temp °F	Notes
Preforming	11/16/20	8:00 AM	10:05 AM	clear	63	
Stand Pile	11/17/20	10:27 AM	10:56 AM	clear	60	2 cranes, 2 point
DRIVE Pile	11/18/20	9:57 AM	10:08 AM	clear	61	
Set check						

PILE DATA:

PAY ITEM No: 455-34-5 — WORK ORDER No:

MANUFACTURED By: CDS — MFR's PILE No: R 23 SAC-24-V0 — DATE CAST: 10/20/20

TBM/BM Elev: — TBM/BM Rod Read: — H.I. Elev:

PRE-DRILLED Elev: — GROUND Rod Read: — GROUND Elev: -21.80

Manually input GROUND Elev (no sheet calc)

PREFORMED Elev: -73.00 — Bottom of Excav Rod Read: — Bottom of Excav Elev: -1.50

Manually input BOE Elev (no sheet calc available)

PILE HEAD Rod Read: — PILE HEAD Elev: +18.68 — PILE TIP Elev: -76.32

PH Elev = REF - LP + PL = +18.68

Top of SOIL PLUG Elev (for Open Ended Pipe Piles & H-piles): — Natural Ground Elev:

Input 'Natural Ground EL' ONLY when natural ground surface is below embankment/fill material. Otherwise, leave this cell BLANK

SPLICE / EACH	PREFORMED HOLE	DYNAMIC LOAD TEST	PAY SET CHECK	NO PAY SET CHECK	REDRIVE	EXTRACTION	DRIVING OF SPLICE	PILE TYPE CODE	Plumb or Batter ? (click & select) ↓ PLUMB	PILE LENGTH (ft) ORIGINAL FURNISHED	PILE LENGTH (ft) TOTAL LENGTH WITH EXTENSION	Pile PENETRATION below SCOUR (ft)	EXTENSION/BUILD UP AUTHORIZED (ft)	EXTENSION/BUILD UP ACTUAL (ft)
	15	1						1		95.00	130.00	38.12		

Pile PENETRATION (ft), below: GROUND: 54.52 ft — Bottom of Excav: 74.82 ft — SCOUR: 38.12 ft

CTQP Trainee (supervised by the Qualified Inspector) experiencing the full pile installation & log inspection: Name: Sean Fischer — TIN: F26079391

Qualified Inspector - I certify the Pile Driving Log content, and as applicable, the above CTQP Trainee's participation during this pile installation: Name & TIN: Michael J. Wagner W256-550-67 — Signature: Michael J. Wagner

Figure B-59. First page of pile driving log for second pile at SR-23

DC:

STATE OF FLORIDA DOT

Min Tip | 1 ft to c/o | c/o

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PILE DRIVING LOG

Page No: 2 of 4

Structure No.: 710125 NB   Depth Table Extended (ft):   Bent/Pier No.: 3   Pile No.: 7

Depth Input Start LP↓	REF		Blows	Stroke	Eq. Stke. & Notes	Depth REF	Blows	Stroke	Eq. Stke. & Notes	Depth REF	Blows	Stroke	Eq. Stke. & Notes
74.00	1	75.00			↓	-				-			
75.00	-	76.00	9	5.2	F2, 1	-				-			
76.00	-	77.00	29	6.1		-				-			
77.00	-	78.00	38	6		-				-			
78.00	-	79.00	56	6.1		-				-			
79.00	-	80.00	56	6.4		-				-			
80.00	-	81.00	55	6.7		-				-			
81.00	-	81.92	240	7.1	2	-				-			
81.92	-	82.00								-			
82.00	-	83.00				-				-			
83.00	-	84.00				-				-			
84.00	-	85.00				-				-			
85.00	-	86.00				-				-			
86.00	-	87.00				-				-			
87.00	-	88.00				-				-			
88.00	-	89.00				-				-			
89.00	-	90.00				-				-			
90.00	-	91.00				-				-			
91.00	-	92.00				-				-			
92.00	-	93.00				-				-			
93.00	-	94.00				-				-			
94.00	-	95.00				-				-			
95.00	-	96.00				-				-			
96.00	-	97.00				-				-			
97.00	-	98.00				-				-			
98.00	-	99.00				-				-			
	-					-				-			
	-					-				-			
	-					-				-			
	-					-				-			
	-					-				-			
	-					-				-			
	-					-				-			

Figure B-60. Second page of pile driving log for second pile at SR-23

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PILE DRIVING LOG

Structure No: 710125 NB

Page No: 3 of 4

REF inputs & Notes

PROJECT No: 422938-6-52-01

Bent/Pier No: 3

PILE No.: 7

REF No.	Input REF EL ↓	*Calculated LP values for each REF used			Input REF description (template, stringline, etc.) for each REF used: ↓
		LP min tip	LP c/o-1	LP c/o	
1	+5.60	78.60	97.10	98.10	Top Template
2					
3					
4					
5					

Standard Notes & Note No.'s 1-28

Std. Notes:	↓ = Pile Ran, F1, F2, F3, F4 = (Fuel Settings 1-4), ST = stop, CC = cushion change, HR = high rebound, TP = Test Pile, DC = Driving Criteria, PR = Practical Refusal, SC = set check, DLT = Dyn. Load Test
Note 1:	New cushion, start on F2.
Note 2:	120 blows, F3, 60 blows, F4 60 blows. ST due to high blow count. Pile not accepted.
Note 3:	
Note 4:	
Note 5:	
Note 6:	
Note 7:	
Note 8:	
Note 9:	
Note 10:	
Note 11:	
Note 12:	
Note 13:	
Note 14:	
Note 15:	
Note 16:	
Note 17:	
Note 18:	
Note 19:	
Note 20:	
Note 21:	
Note 22:	
Note 23:	
Note 24:	
Note 25:	
Note 26:	
Note 27:	
Note 28:	

Figure B-61. Third page of pile driving log for second pile at SR-23

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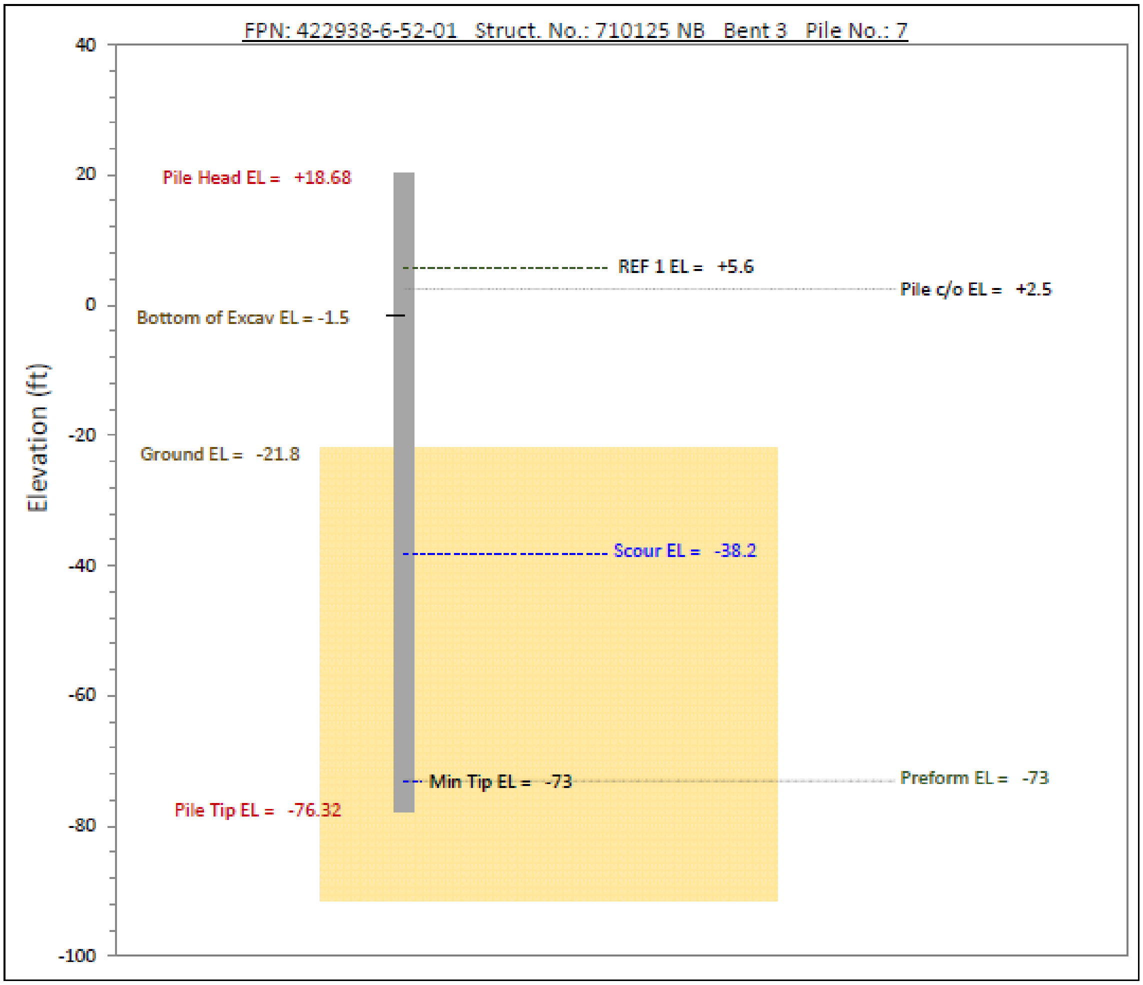
PILE DRIVING LOG

Structure No: 710125 NB   Page No: 4 of 4
Sketch

PROJECT No: 422938-6-52-01   Bent/Pier No: 3   PILE No.: 7



PLUMB pile, as depicted in this Pile Sketch

Pile Bearing: (click on yellow shaded cell below, and select basis for Pile Bearing acceptance that applies)

Pile bearing capacity determined by Dynamic Testing.

Pile Penetration:

Pile Tip EL ≤ bottom EL of Preformed or Predrilled pile hole, meets 455-5 Penetration Requirements.

Current Pile Tip EL ≤ Min Tip EL in plans, meets 455-5 Penetration Requirements.

Min Tip EL is input on the log. Therefore, the 10-20 ft of penetration into firm/soft material, in accordance with 455-5 Penetration Requirements, does not apply.

Figure B-63. Fourth page of pile driving log for second pile at SR-23

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PILE DRIVING LOG

Structure No: 710125 NB | Page No: 1 of 4

PROJECT No: 422938-6-52-01 | Date: 11/11/20 | Station No: 1562 +12

PILE Size/Type: 24" SQ PCP | Length (ft): 95.00 | Bent/Pier No: 3 | PILE No: 8

HAMMER Make/Model: APE D62/70 | S/N: 410302 | Rated Energy (ft-lbs): 173,644 | Operating Rate (BPM): 34-53

REF Elev: +5.65 (REF 1) | MIN TIP Elev: -73.00 | PILE CUTOFF Elev: +2.50

DRIVING CRITERIA (DC): | DC2 Elev:

Type: Prod - Dyn. Test

DC Max Stk: | Min Stk req'd for PR:

Notes:

DC1		DC2, input if applic.	
(1) blows @ ft,		(6) blows @ ft,	
(2) blows @ ft,		(7) blows @ ft,	
(3) blows @ ft,		(8) blows @ ft,	
(4) blows @ ft,		(9) blows @ ft,	
(5) blows @ ft,		(10) blows @ ft,	

SC criteria (if applic): bpi @ ft Stk

SCOUR Elev: -38.20

PILE CUSHION Thickness & Material: 12" plywood

HAMMER CUSHION Thickness & Material: 3 alum @ 1/2", 2 micarta @ 1"

Pile Activity	Date	Start Time	Stop Time	Weather	Temp °F	Notes
Preforming	11/11/20	11:05 AM	7:45 AM	hvy clouds	79	end on 11/16
Stand Pile	11/17/20	9:57 AM	10:18 AM	clear	59	2 cranes, 2 point
DRIVE Pile	11/18/20	10:33 AM	10:46 AM	clear	61	
Set check						

PILE DATA:

PAY ITEM No: 455-34-5 | WORK ORDER No:

MANUFACTURED By: CDS | MFR's PILE No: R 23 SAC-24-V0 | DATE CAST: 10/15/20

TBM/BM Elev: | TBM/BM Rod Read: | H.I. Elev:

PRE-DRILLED Elev: | GROUND Rod Read: | GROUND Elev: -21.80

Manually input GROUND Elev (no sheet calc)

PREFORMED Elev: -73.00 | Bottom of Excav Rod Read: | Bottom of Excav Elev: -1.50

Manually input BOE Elev (no sheet calc available)

PILE HEAD Rod Read: | PILE HEAD Elev: +18.65 | PILE TIP Elev: -76.35

PH Elev = REF - LP + PL = +18.65

Top of SOIL PLUG Elev (for Open Ended Pipe Piles & H-piles): | Natural Ground Elev:

Input 'Natural Ground EL' ONLY when natural ground surface is below embankment/fill material. Otherwise, leave this cell BLANK

SPLICE / EACH	PREFORMED HOLE	DYNAMIC LOAD TEST	PAY SET CHECK	NO PAY SET CHECK	REDRIVE	EXTRACTION	DRIVING OF SPLICE	PILE TYPE CODE	Plumb or Batter ? (click & select) ↓ PLUMB	PILE LENGTH (ft) ORIGINAL FURNISHED	PILE LENGTH (ft) TOTAL LENGTH WITH EXTENSION	Pile PENETRATION below SCOUR (ft)	EXTENSION/BUILD UP AUTHORIZED (ft)	EXTENSION/BUILD UP ACTUAL (ft)
	15	1						1		95.00	130.00	38.15		

Pile PENETRATION (ft), below: GROUND: 54.55 ft | Bottom of Excav: 74.85 ft | SCOUR: 38.15 ft

CTQP Trainee (supervised by the Qualified Inspector) experiencing the full pile installation & log inspection: Name: Sean Fischer

TIN: F26079391

Qualified Inspector - I certify the Pile Driving Log content, and as applicable, the above CTQP Trainee's participation during this pile installation: Name & TIN: Michael J. Wagner W256-550-67

Signature: Michael J. Wagner

Figure B-64. First page of pile driving log for third pile at SR-23

DC:

STATE OF FLORIDA DOT

PILE DRIVING LOG

Min Tip | 1 ft to c/o | c/o

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Page No: 2 of 4

Structure No.: 710125 NB   Depth Table Extended (ft):   Bent/Pier No.: 3   Pile No.: 8

Depth Input Start LP↓	REF		Blows	Stroke	Eq. Stke. & Notes	Depth	REF	Blows	Stroke	Eq. Stke. & Notes	Depth	REF	Blows	Stroke	Eq. Stke. & Notes
72.00	1	73.00			↓	-					-				
73.00	-	74.00	13	5.8	1	-					-				
74.00	-	75.00	11	5.7		-					-				
75.00	-	76.00	25	5.6		-					-				
76.00	-	77.00	31	5.9		-					-				
77.00	-	78.00	35	6.2		-					-				
78.00	-	79.00	61	6.4		-					-				
79.00	-	80.00	64	6.5		-					-				
80.00	-	81.00	92	6.6							-				
81.00	-	82.00	178	7.6	F3, 2	-					-				
82.00	-	83.00				-					-				
83.00	-	84.00				-					-				
84.00	-	85.00				-					-				
85.00	-	86.00				-					-				
86.00	-	87.00				-					-				
87.00	-	88.00				-					-				
88.00	-	89.00				-					-				
89.00	-	90.00				-					-				
90.00	-	91.00				-					-				
91.00	-	92.00				-					-				
92.00	-	93.00				-					-				
93.00	-	94.00				-					-				
94.00	-	95.00				-					-				
95.00	-	96.00				-					-				
96.00	-	97.00				-					-				
97.00	-	98.00				-					-				
98.00	-	99.00				-					-				
	-					-					-				
	-					-					-				
	-					-					-				
	-					-					-				
	-					-					-				
	-					-					-				

Figure B-65. Second page of pile driving log for third pile at SR-23

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PILE DRIVING LOG

Structure No: 710125 NB

Page No: 3 of 4

REF inputs & Notes

PROJECT No: 422938-6-52-01

Bent/Pier No: 3

PILE No.: 8

REF No.	Input REF EL ↓	*Calculated LP values for each REF used: LP min tip	LP c/o-1	LP c/o	Input REF description (template, stringline, etc.) for each REF used: ↓
1	+5.65	78.65	97.15	98.15	Top Template
2					
3					
4					
5					

Standard Notes & Note No.'s 1-28

Std. Notes:	↓ = Pile Ran, F1, F2, F3, F4 = (Fuel Settings 1-4), ST = stop, CC = cushion change, HR = high rebound, TP = Test Pile, DC = Driving Criteria, PR = Practical Refusal, SC = set check, DLT = Dyn. Load Test
Note 1:	New cushion, start on F2.
Note 2:	32 blows for first 6", ST due to high blow count. Pile not accepted.
Note 3:	
Note 4:	
Note 5:	
Note 6:	
Note 7:	
Note 8:	
Note 9:	
Note 10:	
Note 11:	
Note 12:	
Note 13:	
Note 14:	
Note 15:	
Note 16:	
Note 17:	
Note 18:	
Note 19:	
Note 20:	
Note 21:	
Note 22:	
Note 23:	
Note 24:	
Note 25:	
Note 26:	
Note 27:	
Note 28:	

Figure B-66. Third page of pile driving log for third pile at SR-23

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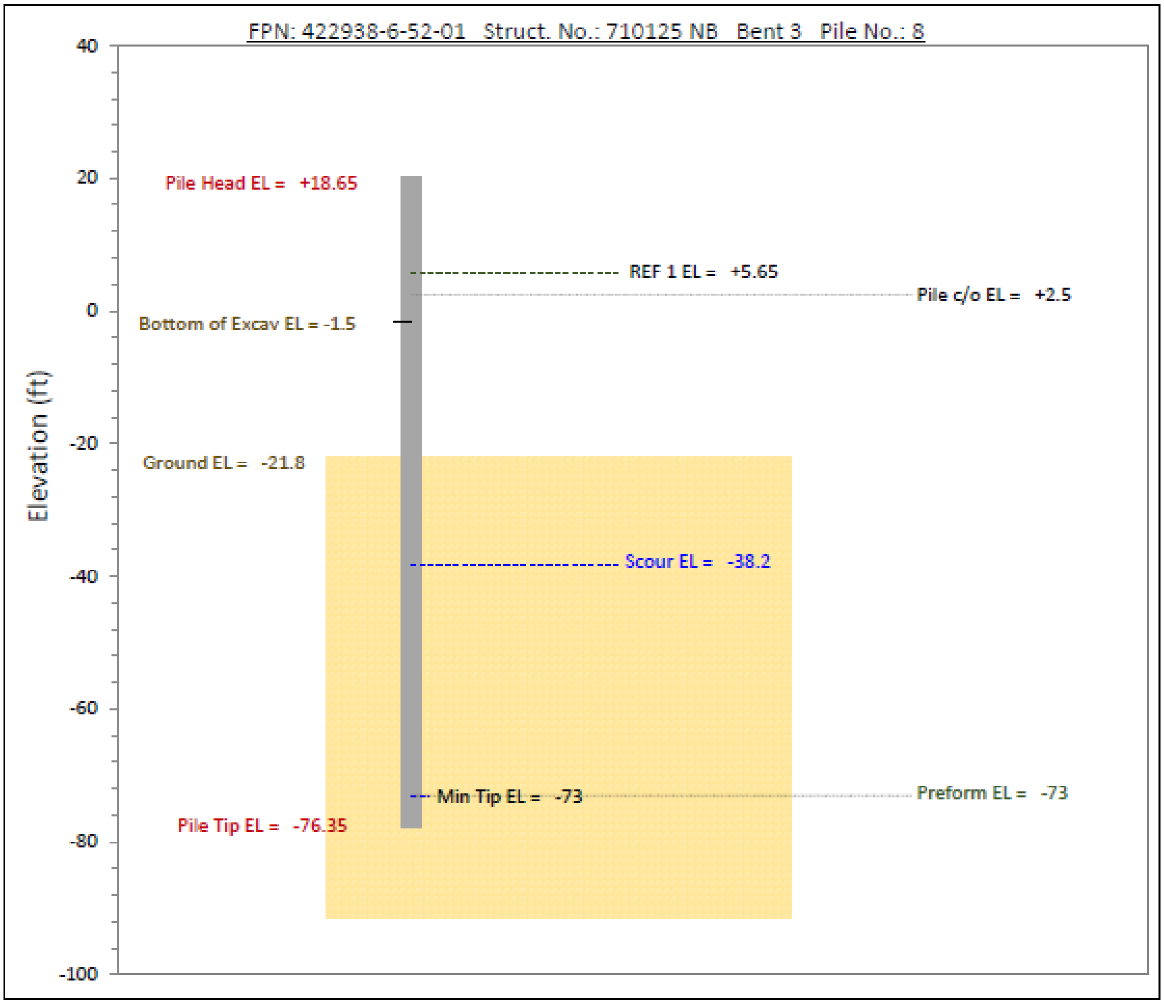
PILE DRIVING LOG

Structure No: 710125 NB   Page No: 4 of 4

Sketch

PROJECT No: 422938-6-52-01   Bent/Pier No: 3   PILE No.: 8



PLUMB pile, as depicted in this Pile Sketch

Pile Bearing: (click on yellow shaded cell below, and select basis for Pile Bearing acceptance that applies)

Pile bearing capacity determined by Dynamic Testing.

Pile Penetration:

Pile Tip EL ≤ bottom EL of Preformed or Predrilled pile hole, meets 455-5 Penetration Requirements.

Current Pile Tip EL ≤ Min Tip EL in plans, meets 455-5 Penetration Requirements.

Min Tip EL is input on the log. Therefore, the 10-20 ft of penetration into firm/soft material, in accordance with 455-5 Penetration Requirements, does not apply.

Figure B-67. Fourth page of pile driving log for third pile at SR-23

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STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

PILE DRIVING LOG

Structure No: 710125 NB | Page No: 1 of 4

PROJECT No: 422938-6-52-01 | Date: 11/11/20 | Station No: 1562 +12

PILE Size/Type: 24" SQ PCP | Length (ft): 95.00 | Bent/Pier No: 3 | PILE No: 9

HAMMER Make/Model: APE D62/70 | S/N: 410302 | Rated Energy (ft-lbs): 173,644 | Operating Rate (BPM): 34-53

REF Elev: +5.70 (REF 1) | MIN TIP Elev: -73.00 | PILE CUTOFF Elev: +2.50

DRIVING CRITERIA (DC): DC2 Elev:

Type: Prod - Dyn. Test

DC Max Stk: Min Stk req'd for PR:

Notes:

SC criteria (if applic): bpi @ ft Stk

DC1			DC2, input if applic.		
(1)	blows @	ft,	(6)	blows @	ft,
(2)	blows @	ft,	(7)	blows @	ft,
(3)	blows @	ft,	(8)	blows @	ft,
(4)	blows @	ft,	(9)	blows @	ft,
(5)	blows @	ft,	(10)	blows @	ft,

SCOUR Elev: -38.20

PILE CUSHION Thickness & Material: 12" plywood

HAMMER CUSHION Thickness & Material: 3 alum @ 1/2", 2 micarta @ 1"

Pile Activity	Date	Start Time	Stop Time	Weather	Temp °F	Notes
Preforming	11/11/20	8:45 AM	10:45 AM	heavy clouds	78	
Stand Pile	11/17/20	9:25 AM	9:50 AM	clear	57	2 cranes, 2 point
DRIVE Pile	11/18/20	11:12 AM	11:32 AM	clear	61	
Set check						

PILE DATA:

PAY ITEM No: 455-34-5 | WORK ORDER No:

MANUFACTURED By: CDS | MFR's PILE No: 23 SAC-24-V0 | DATE CAST: 10/20/20

TBM/BM Elev: | TBM/BM Rod Read: | H.I. Elev:

PRE-DRILLED Elev: | GROUND Rod Read: | GROUND Elev: -21.80

Manually input GROUND Elev (no sheet calc)

PREFORMED Elev: -73.00 | Bottom of Excav Rod Read: | Bottom of Excav Elev: -1.50

Manually input BOE Elev (no sheet calc available)

PILE HEAD Rod Read: | PILE HEAD Elev: +18.70 | PILE TIP Elev: -76.30

PH Elev = REF - LP + PL = +18.7

Top of SOIL PLUG Elev (for Open Ended Pipe Piles & H-piles): | Natural Ground Elev:

Input 'Natural Ground EL' ONLY when natural ground surface is below embankment/fill material. Otherwise, leave this cell BLANK

SPLICE / EACH	PREFORMED HOLE	DYNAMIC LOAD TEST	PAY SET CHECK	NO PAY SET CHECK	REDRIVE	EXTRACTION	DRIVING OF SPLICE	PILE TYPE CODE	Plumb or Batter ? (click & select) ↓	PILE LENGTH (ft) ORIGINAL FURNISHED	PILE LENGTH (ft) TOTAL LENGTH WITH EXTENSION	Pile PENETRATION below SCOUR (ft)	EXTENSION/BUILD UP AUTHORIZED (ft)	EXTENSION/BUILD UP ACTUAL (ft)
									PLUMB					
	15	1						1		95.00	130.00	38.10		

Pile PENETRATION (ft), below: GROUND: 54.5 ft | Bottom of Excav: 74.8 ft | SCOUR: 38.1 ft

CTQP Trainee (supervised by the Qualified Inspector) experiencing the full pile installation & log inspection: Name: Sean Fischer

TIN: F26079391

Qualified Inspector - I certify the Pile Driving Log content, and as applicable, the above CTQP Trainee's participation during this pile installation: Name & TIN: Michael J. Wagner W256-550-67

Signature: Michael J. Wagner

Figure B-68. First page of pile driving log for fourth pile at SR-23

DC:

STATE OF FLORIDA DOT

PILE DRIVING LOG

Min Tip | 1 ft to c/o | c/o

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May-20

Page No: 2 of 4

Structure No.: 710125 NB   Depth Table Extended (ft):   Bent/Pier No.: 3   Pile No.: 9

Depth (Input Start LP↓)	REF	Blows	Stroke	Eq. Stke. & Notes	Depth	REF	Blows	Stroke	Eq. Stke. & Notes	Depth	REF	Blows	Stroke	Eq. Stke. & Notes
74.00 - 75.00	1			↓	-					-				
75.00 - 76.00		38	6.2	1	-					-				
76.00 - 77.00		80	6	HR	-					-				
77.00 - 78.00		87	6.4	F3, HR	-					-				
78.00 - 79.00		90	6.6	HR	-					-				
79.00 - 80.00		156	6.7	2, HR	-					-				
80.00 - 81.00		166	7	HR	-					-				
81.00 - 82.00		211	7.7	3	-					-				
82.00 - 83.00										-				
83.00 - 84.00					-					-				
84.00 - 85.00					-					-				
85.00 - 86.00					-					-				
86.00 - 87.00					-					-				
87.00 - 88.00					-					-				
88.00 - 89.00					-					-				
89.00 - 90.00					-					-				
90.00 - 91.00					-					-				
91.00 - 92.00					-					-				
92.00 - 93.00					-					-				
93.00 - 94.00					-					-				
94.00 - 95.00					-					-				
95.00 - 96.00					-					-				
96.00 - 97.00					-					-				
97.00 - 98.00					-					-				
98.00 - 99.00					-					-				
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-					-					-				
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Figure B-69. Second page of pile driving log for fourth pile at SR-23

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May-20

PILE DRIVING LOG

Structure No: 710125 NB   Page No: 3 of 4

REF inputs & Notes

PROJECT No: 422938-6-52-01   Bent/Pier No: 3   PILE No.: 9

REF No.	Input REF EL ↓	*Calculated LP values for each REF used			Input REF description (template, stringline, etc.) for each REF used: ↓
		LP min tip	LP c/o-1	LP c/o	
1	+5.70	78.70	97.20	98.20	Top Template
2					
3					
4					
5					

Standard Notes & Note No.'s 1-28

Std. Notes:	↓ = Pile Ran, F1, F2, F3, F4 = (Fuel Settings 1-4), ST = stop, CC = cushion change, HR = high rebound, TP = Test Pile, DC = Driving Criteria, PR = Practical Refusal, SC = set check, DLT = Dyn. Load Test
Note 1:	New cushion, start on F2.
Note 2:	110 blows, F4. HR
Note 3:	ST due to high blow count. No rebound in first 6", HR last 6".
Note 4:	
Note 5:	
Note 6:	
Note 7:	
Note 8:	
Note 9:	
Note 10:	
Note 11:	
Note 12:	
Note 13:	
Note 14:	
Note 15:	
Note 16:	
Note 17:	
Note 18:	
Note 19:	
Note 20:	
Note 21:	
Note 22:	
Note 23:	
Note 24:	
Note 25:	
Note 26:	
Note 27:	
Note 28:	

Figure B-70. Third page of pile driving log for fourth pile at SR-23

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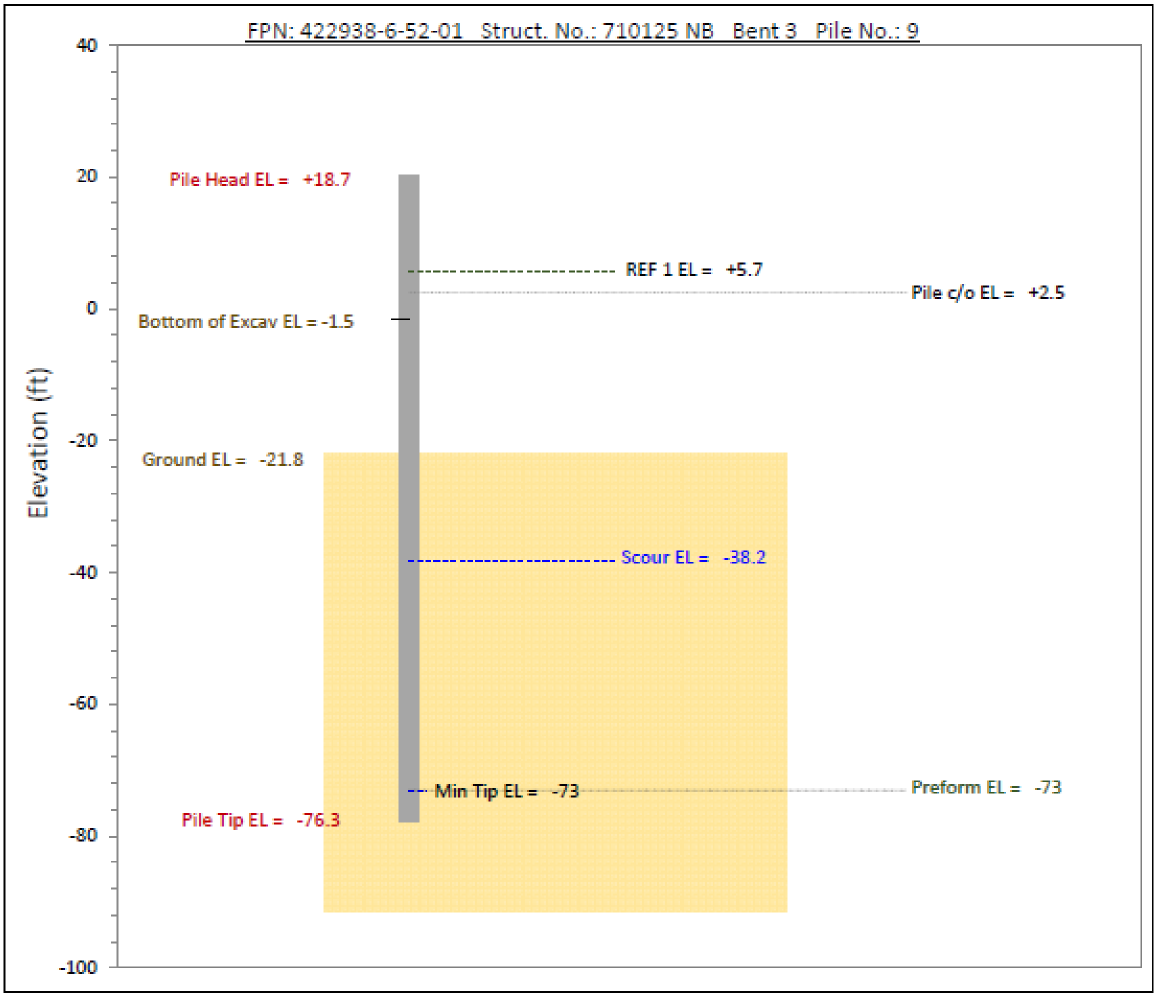
PILE DRIVING LOG

Structure No: 710125 NB   Page No: 4 of 4
Sketch

PROJECT No: 422938-6-52-01   Bent/Pier No: 3   PILE No.: 9



PLUMB pile, as depicted in this Pile Sketch

Pile Bearing: (click on yellow shaded cell below, and select basis for Pile Bearing acceptance that applies)

Pile bearing capacity determined by Dynamic Testing.

Pile Penetration:

Pile Tip EL ≤ bottom EL of Preformed or Predrilled pile hole, meets 455-5 Penetration Requirements.

Current Pile Tip EL ≤ Min Tip EL in plans, meets 455-5 Penetration Requirements.

Min Tip EL is input on the log. Therefore, the 10-20 ft of penetration into firm/soft material, in accordance with 455-5 Penetration Requirements, does not apply.

Figure B-71. Fourth page of pile driving log for fourth pile at SR-23

B.8 Howard Frankland

B.8.1 Boring Logs

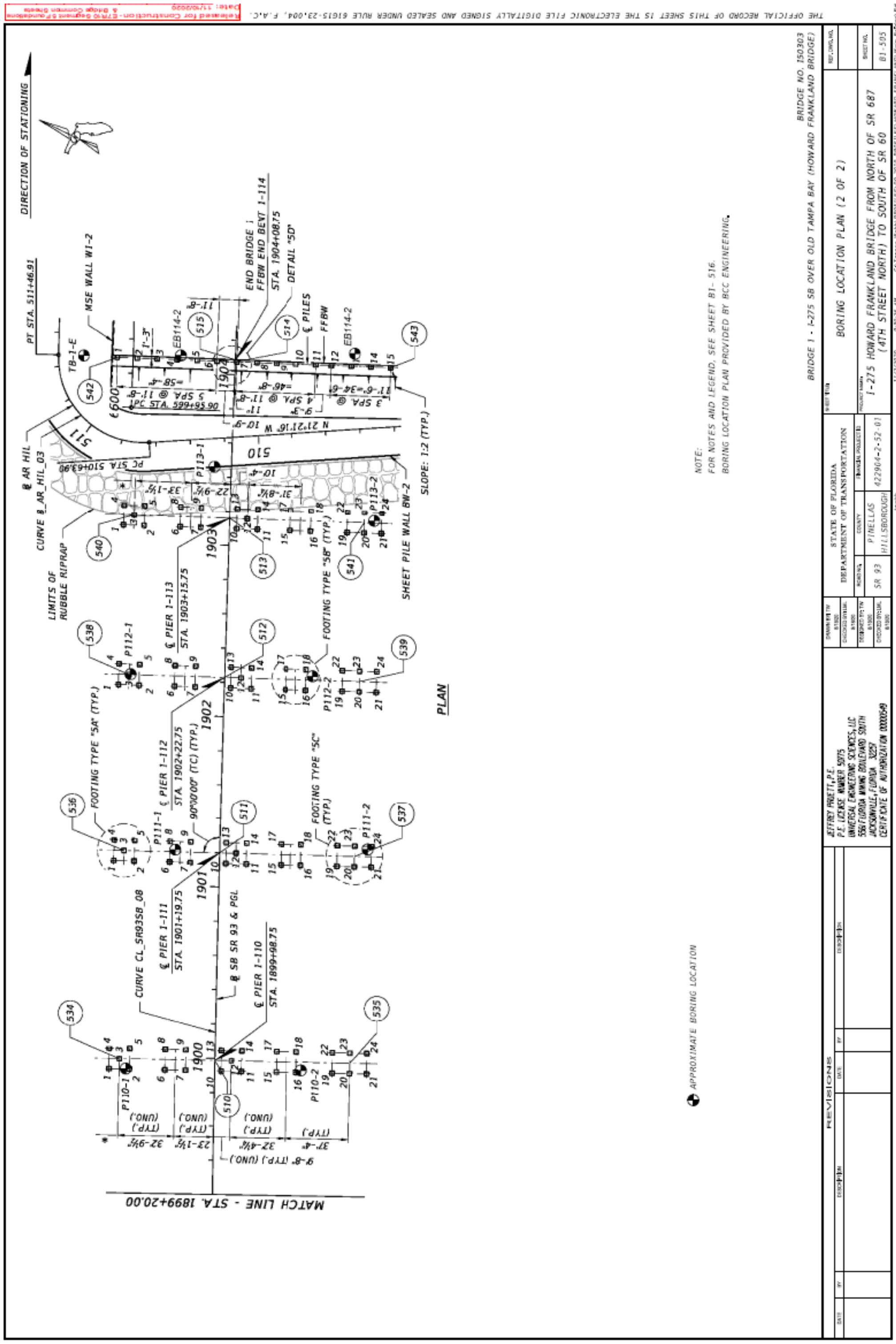


Figure B-72. Relevant boring log plan from Howard Frankland (Pier 112-1)

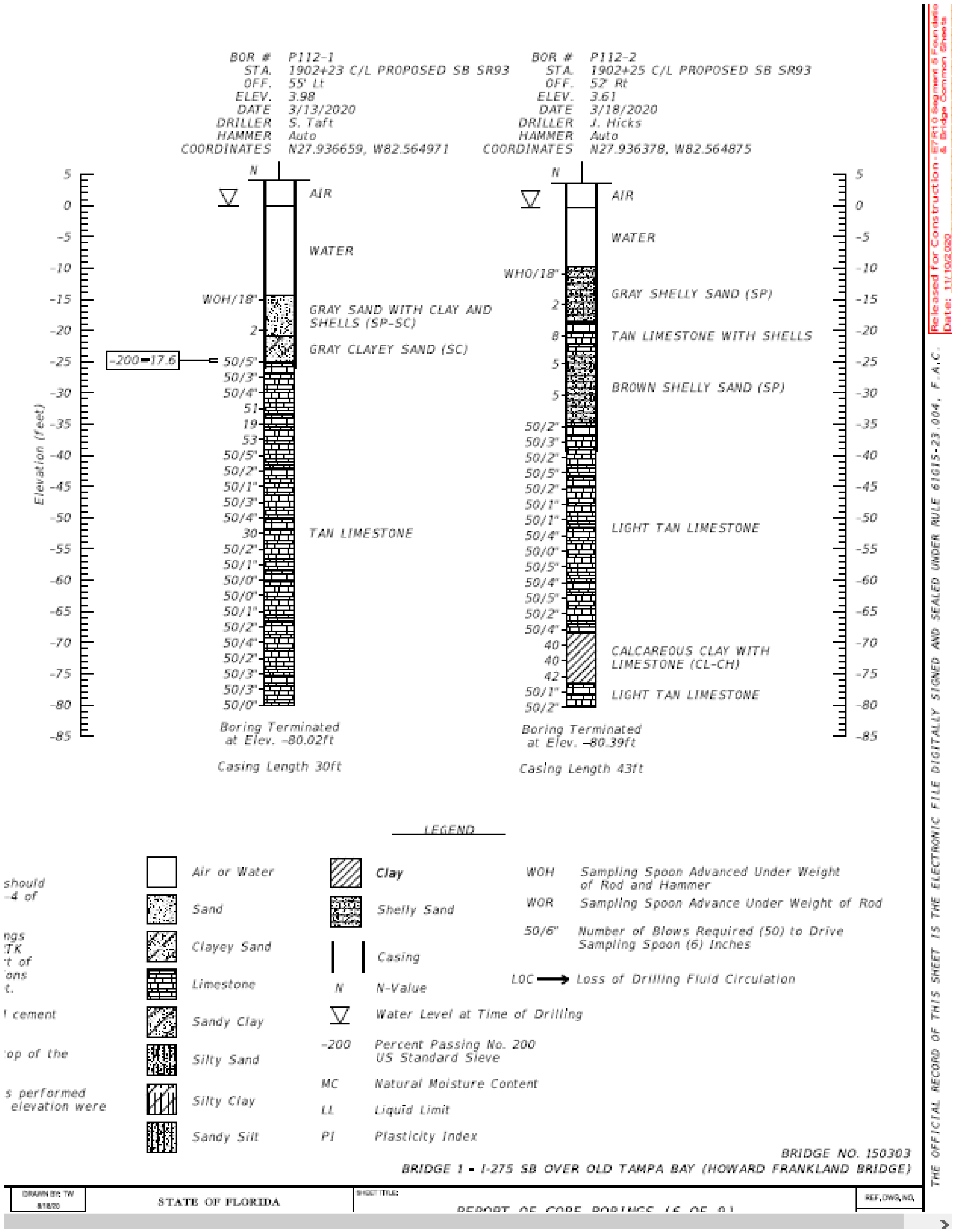


Figure B-73. Relevant boring logs from Howard Frankland (Pier 112-1)

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PILE DRIVING LOG

Structure No: 150303 Page No: 1 of 4

PROJECT No: 422904-2-52-01 Date: 7/1/21 Station No: 1902+22.75

PILE Size/Type: 30" SQ PCP Length (ft): 73.00 Bent/Pier No: Pier 1-112 PILE No: 20

HAMMER Make/Model: APE D80-42 S/N: 202012985 Rated Energy (ft-lbs): 198540 Operating Rate (BPM): 34-53

REF Elev: +5.18 (REF 1) MIN TIP Elev: -59.00 PILE CUTOFF Elev: +1.86

DRIVING CRITERIA (DC): DC2 Elev:

Type: Prod - Dyn. Test #NAME?

DC Max Stk: Min Stk req'd for PR:

Notes:

NBR=468 TONS (936 KIPS)

100% PDA

SC criteria (if applic): bpi @ ft Stk

DC1			DC2, input if applic.		
(1)	blows @	ft,	(6)	blows @	ft,
(2)	blows @	ft,	(7)	blows @	ft,
(3)	blows @	ft,	(8)	blows @	ft,
(4)	blows @	ft,	(9)	blows @	ft,
(5)	blows @	ft,	(10)	blows @	ft,

SCOUR Elev: -30.00

PILE CUSHION Thickness & Material: 18" Plywood

HAMMER CUSHION Thickness & Material: (2x1 Inch) Micarta + (3 x 0.50 inch) Aluminum

Pile Activity	Date	Start Time	Stop Time	Weather	Temp °F	Notes
Predrilling	6/23/21	10:58 AM	11:19 AM	Cloudy	84	
Jetting	6/29/21	1:24 PM	1:44 PM	Cloudy	90	Jetted to elev. -59 ft.
Stand Pile	6/29/21	1:36 PM	1:46 AM	Cloudy	90	
Drive Pile	6/30/21	11:46 AM	11:55 AM	Cloudy	86	

PILE DATA:

PAY ITEM No: WORK ORDER No:

MANUFACTURED By: CDS MFR's PILE No: HFB-30-091 DATE CAST: 9/30/20

TBM/BM Elev: TBM/BM Rod Read: H.I. Elev:

PRE-DRILLED Elev: -59.00 GROUND Rod Read: GROUND Elev: -15.00

Pile Tip EL > Pre-Drilled Elev

Manually input GROUND Elev (no sheet calc)

PREFORMED Elev: Bottom of Excav Rod Read: Bottom of Excav Elev:

PILE HEAD Rod Read: PILE HEAD Elev: +14.03 PILE TIP Elev: -58.97

PH Elev = REF - LP + PL = +14.03

Top of SOIL PLUG Elev (for Open Ended Pipe Piles & H-piles): Natural Ground Elev:

Input 'Natural Ground EL' ONLY when natural ground surface is below embankment/fill material. Otherwise, leave this cell BLANK

SPLICE / EACH	PREFORMED HOLE	DYNAMIC LOAD TEST	PAY SET CHECK	NO PAY SET CHECK	REDRIVE	EXTRACTION	DRIVING OF SPLICE	PILE TYPE CODE	Plumb or Batter ? (click & select) ↓ PLUMB	PILE LENGTH (ft) ORIGINAL FURNISHED	PILE LENGTH (ft) TOTAL LENGTH WITH EXTENSION	Pile PENETRATION below SCOUR (ft)	EXTENSION/BUILD UP AUTHORIZED (ft)	EXTENSION/BUILD UP ACTUAL (ft)
0	0	1	0	0	0	0	0	1		73.00	73.00	28.97	0.00	0.00

Pile PENETRATION (ft), below: GROUND: 43.97 ft SCOUR: 28.97 ft

CTQP Trainee (supervised by the Qualified Inspector) experiencing the full pile installation & log inspection: Name:

TIN:

Qualified Inspector - I certify the Pile Driving Log content, and as applicable, the above CTQP Trainee's participation during this pile installation: Name & TIN: Gilian Diran D65029778

Signature:

Figure B-74. Pile driving logs from Howard Frankland Bridge

DC:

STATE OF FLORIDA DOT

Min Tip | 1 ft to c/o | c/o

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PILE DRIVING LOG

Page No: 2 of 4

Structure No.: 150303 Depth Table Extended (ft): Bent/Pier No.: Pier 1-112 Pile No.: 20

Depth Input Start LP↓	REF		Blows	Stroke	Eq. Stke. & Notes	Depth	REF		Blows	Stroke	Eq. Stke. & Notes	Depth	REF		Blows	Stroke	Eq. Stke. & Notes
0.00	1	1.00				33.00	-	34.00				**64.15**	-	65.00			
1.00	-	2.00				34.00	-	35.00				65.00	-	66.00			
2.00	-	3.00				35.00	-	36.00				66.00	-	67.00			
3.00	-	4.00				36.00	-	37.00				67.00	-	68.00			
4.00	-	5.00				37.00	-	38.00				68.00	-	69.00			
5.00	-	6.00				38.00	-	39.00				69.00	-	70.00			
6.00	-	7.00				39.00	-	40.00				70.00	-	71.00			
7.00	-	8.00				40.00	-	41.00				71.00	-	72.00			
8.00	-	9.00				41.00		42.00				72.00	-	73.00			
9.00	-	10.00				42.00	-	43.00				73.00	-	74.00			
10.00	-	11.00				43.00	-	44.00				74.00	-	75.00			
11.00	-	12.00				44.00	-	45.00				75.00	-	76.00			
12.00	-	13.00				45.00	-	46.00				76.00	-	77.00			
13.00	-	14.00				46.00	-	47.00					-				
14.00	-	15.00				47.00	-	48.00					-				
15.00	-	16.00				48.00	-	49.00					-				
16.00	-	17.00				49.00	-	50.00					-				
17.00	-	18.00				50.00	-	51.00					-				
18.00	-	19.00				51.00	-	52.00					-				
19.00	-	20.00				52.00	-	53.00					-				
20.00	-	21.00				53.00	-	54.00					-				
21.00	-	22.00				54.00	-	55.00					-				
22.00	-	23.00				55.00	-	56.00					-				
23.00	-	24.00				56.00	-	57.00					-				
24.00	-	25.00				57.00	-	58.00					-				
25.00	-	26.00				58.00	-	59.00					-				
26.00	-	27.00				59.00	-	60.00					-				
27.00	-	28.00				60.00	-	61.00					-				
28.00	-	29.00				61.00	-	62.00	13	6.9	F1, 7		-				
29.00	-	30.00				62.00	-	63.00	48	7.36	F3		-				
30.00	-	31.00				63.00	-	64.00	252	6.83	8, 9		-				
31.00	-	32.00				**64.00**	-	64.10	28	8.75	F4, 10, 11		-				
32.00	-	33.00				**64.10**	-	64.15	17	8.18	12		-				

Figure B-75. Pile driving logs from Howard Frankland Bridge

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PILE DRIVING LOG

Structure No: 150303

Page No: 3 of 4

REF inputs & Notes

PROJECT No: 422904-2-52-01

Bent/Pier No: Pier 1-112

PILE No.: 20

REF No.	Input REF EL ↓	*Calculated LP values for each REF used: LP min tip	LP c/o-1	LP c/o	Input REF description (template, stringline, etc.) for each REF used: ↓
1	+5.18	64.18	75.32	76.32	Top of Roller
2					
3					
4					
5					

Standard Notes & Note No.'s 1-28

Std. Notes:	↓ = Pile Ran, F1, F2, F3, F4 = (Fuel Settings 1-4), ST = stop, CC = cushion change, HR = high rebound, TP = Test Pile, DC = Driving Criteria, PR = Practical Refusal, SC = set check, DLT = Dyn. Load Test
Note 1:	6/23/2021 Start Pre-Drilling from 10:58 AM to 11:19 AM (Stopped due to weather bad conditions)
Note 2:	6/24/21 Continued Pre-drilling by reaching Min Tip from 8:09 AM to 10:53 AM
Note 3:	6/28/21 Re-drilling with core drill bit by reaching Min Tip from 1:20 PM to 1:38 PM
Note 4:	6/29/21 Cleanout with Auger by reaching Min Tip 9:01 AM to 9:10 AM
Note 5:	6/29/21 Jetting (Jetted to -59 ft.) from 1:24 PM to 1:44 PM
Note 6:	6/29/21 Stood and jetted pile from 1:36 PM to 1:46 PM
Note 7:	6/30/21 at 11:46 AM Started driving with PDA engaged
Note 8:	6/30/21 at 11:55 AM Stopped driving per PDA (Hammer issues)
Note 9:	6/30/21 High blow count, because of uneven energy blows.(Hammer mis-firing)
Note 10:	6/30/21 at 1:31 PM Redrive with PDA engaged
Note 11:	6/30/21 at 1:32 PM Stopped driving pile per PDA (PR, above the Min Tip).
Note 12:	7/1/21 at 12:56 PM (1DSC) With PDA (17 Blows with 0.5 inches movement with 6 inches of bearing).
Note 13:	
Note 14:	
Note 15:	
Note 16:	
Note 17:	
Note 18:	
Note 19:	
Note 20:	
Note 21:	
Note 22:	
Note 23:	
Note 24:	
Note 25:	
Note 26:	
Note 27:	
Note 28:	

Figure B-76. Pile driving logs from Howard Frankland Bridge

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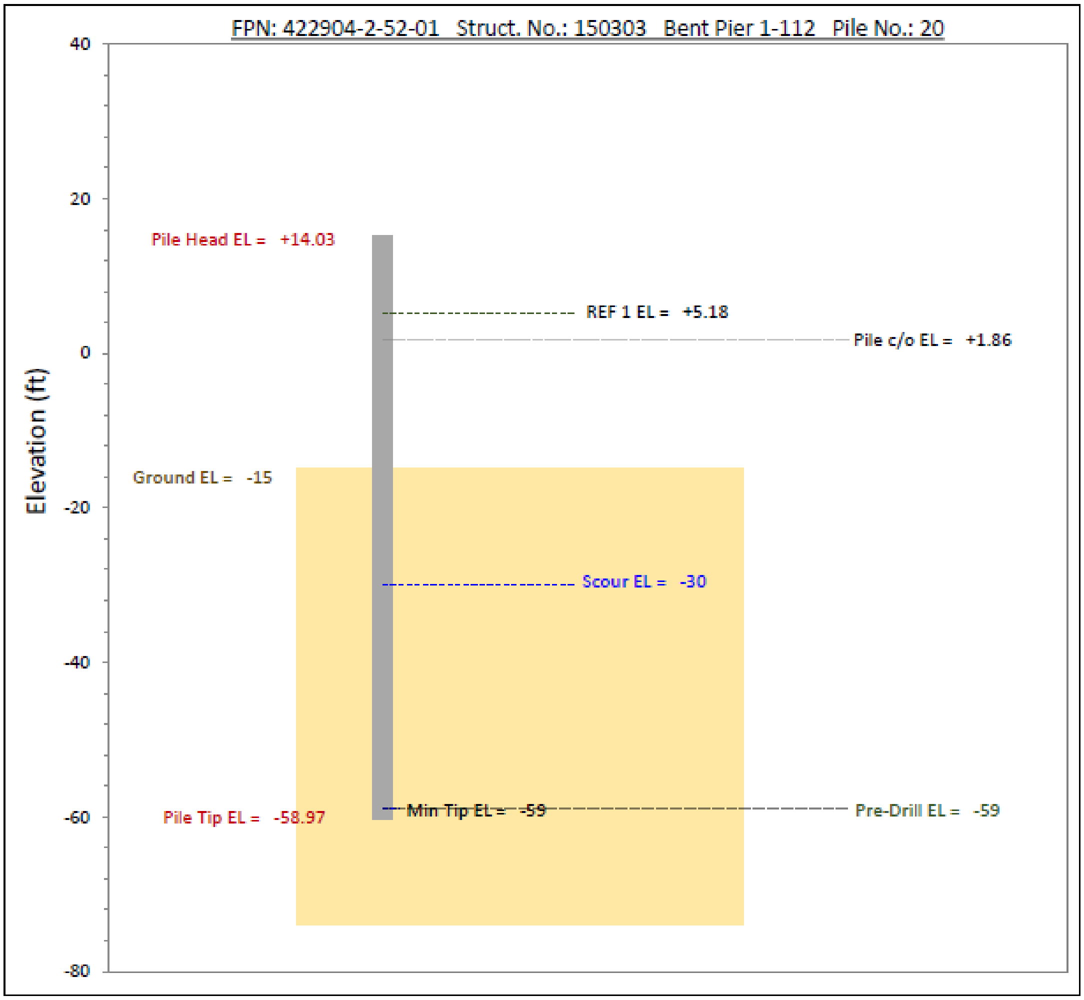
PILE DRIVING LOG

Structure No: 150303 Page No: 4 of 4

Sketch

PROJECT No: 422904-2-52-01 Bent/Pier No: Pier 1-112 PILE No.: 20



PLUMB pile, as depicted in this Pile Sketch

Pile Bearing: (click on yellow shaded cell below, and select basis for Pile Bearing acceptance that applies)

Pile bearing capacity determined by Dynamic Testing.

Pile Penetration:

Pile Tip EL > bottom EL of Preformed or Predrilled pile hole, does not meet 455-5 Penetration Requirements.

Current Pile Tip EL > Min Tip EL in plans, does not meet Std Spec 455-5 Penetration Requirements. Continue driving (without reaching practical refusal), or coordinate with PA to submit to EOR for review.

Min Tip EL is input on the log. Therefore, the 10-20 ft of penetration into firm/soft material, in accordance with 455-5 Penetration Requirements, does not apply.

Figure B-77. Pile driving logs from Howard Frankland Bridge

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PILE DRIVING LOG

Structure No: 150303   Page No: 1 of 4

PROJECT No: 422904-2-52-01   Date: 7/21/22   Station No: 1902+22.75

PILE Size/Type: 30" SQ PCP   Length (ft): 73.00   Bent/Pier No: Pier 1-112   PILE No: 21

HAMMER Make/Model: APE D80-42   S/N: 202012985   Rated Energy (ft-lbs): 198540   Operating Rate (BPM): 34-53

REF Elev: +5.18 (REF 1)   MIN TIP Elev: -59.00   PILE CUTOFF Elev: +1.86

DRIVING CRITERIA (DC):   DC2 Elev:

Type: Prod - Dyn. Test   #NAME?

DC Max Stk: Min Stk req'd for PR:

Notes:

NBR=468 TONS (936 KIPS)

100% PDA

SC criteria (if applic): bpi @ ft Stk

DC1			DC2, input if applic.		
(1)	blows @	ft,	(6)	blows @	ft,
(2)	blows @	ft,	(7)	blows @	ft,
(3)	blows @	ft,	(8)	blows @	ft,
(4)	blows @	ft,	(9)	blows @	ft,
(5)	blows @	ft,	(10)	blows @	ft,

SCOUR Elev: -30.00

PILE CUSHION Thickness & Material: 18" Plywood

HAMMER CUSHION Thickness & Material: (2x1 Inch) Micarta + (3 x 0.50 inch) Aluminum

Pile Activity	Date	Start Time	Stop Time	Weather	Temp °F	Notes
Predrilling	6/23/21	10:06 AM	10:51 AM	Cloudy	84	
Jetting	6/29/21	12:59 PM	1:13 PM	Cloudy	90	Jetted to elev. -59 ft.
Stand Pile	6/29/21	1:06 PM	1:20 PM	Cloudy	90	
Drive Pile	6/30/21	11:30 AM	11:41 AM	Cloudy	87	

PILE DATA:

PAY ITEM No: WORK ORDER No:

MANUFACTURED By: CDS   MFR's PILE No: HFB-30-083   DATE CAST: 9/25/20

TBM/BM Elev: TBM/BM Rod Read: H.I. Elev:

PRE-DRILLED Elev: -59.00   GROUND Rod Read: GROUND Elev: -15.00

Pile Tip EL > Pre-Drilled Elev   Manually input GROUND Elev (no sheet calc)

PREFORMED Elev: Bottom of Excav Rod Read: Bottom of Excav Elev:

PILE HEAD Rod Read: PILE HEAD Elev: +14.37   PILE TIP Elev: -58.63

PH Elev = REF - LP + PL = +14.37

Top of SOIL PLUG Elev (for Open Ended Pipe Piles & H-piles):   Natural Ground Elev:

Input 'Natural Ground EL' ONLY when natural ground surface is below embankment/fill material. Otherwise, leave this cell BLANK

SPLICE / EACH	PREFORMED HOLE	DYNAMIC LOAD TEST	PAY SET CHECK	NO PAY SET CHECK	REDRIVE	EXTRACTION	DRIVING OF SPLICE	PILE TYPE CODE	Plumb or Batter ? (click & select) ↓ PLUMB	PILE LENGTH (ft) ORIGINAL FURNISHED	PILE LENGTH (ft) TOTAL LENGTH WITH EXTENSION	Pile PENETRATION below SCOUR (ft)	EXTENSION/BUILD UP AUTHORIZED (ft)	EXTENSION/BUILD UP ACTUAL (ft)
0	0	1	0	0	0	0	0	1		73.00	73.00	28.63	0.00	0.00

Pile PENETRATION (ft), below: GROUND: 43.63 ft   SCOUR: 28.63 ft

CTQP Trainee (supervised by the Qualified Inspector) experiencing the full pile installation & log inspection: Name: TIN:

Qualified Inspector - I certify the Pile Driving Log content, and as applicable, the above CTQP Trainee's participation during this pile installation: Name & TIN: Gilian Diran D65029778   Signature:

Figure B-78. Pile driving logs from Howard Frankland Bridge

DC:

STATE OF FLORIDA DOT

PILE DRIVING LOG

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Min Tip | 1 ft to c/o | c/o

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Structure No.: 150303 Depth Table Extended (ft): Bent/Pier No.: Pier 1-112 Pile No.: 21

Depth (Input Start LP↓) REF	Blows	Stroke	Eq. Stke. & Notes	Depth REF	Blows	Stroke	Eq. Stke. & Notes	Depth REF	Blows	Stroke	Eq. Stke. & Notes
0.00 1 1.00				33.00 - 34.00				63.81 - 64.00			
1.00 - 2.00				34.00 - 35.00				64.00 - 65.00			
2.00 - 3.00				35.00 - 36.00				65.00 - 66.00			
3.00 - 4.00				36.00 - 37.00				66.00 - 67.00			
4.00 - 5.00				37.00 - 38.00				67.00 - 68.00			
5.00 - 6.00				38.00 - 39.00				68.00 - 69.00			
6.00 - 7.00				39.00 - 40.00				69.00 - 70.00			
7.00 - 8.00				40.00 - 41.00				70.00 - 71.00			
8.00 - 9.00				41.00 42.00				71.00 - 72.00			
9.00 - 10.00				42.00 - 43.00				72.00 - 73.00			
10.00 - 11.00				43.00 - 44.00				73.00 - 74.00			
11.00 - 12.00				44.00 - 45.00				74.00 - 75.00			
12.00 - 13.00				45.00 - 46.00				75.00 - 76.00			
13.00 - 14.00				46.00 - 47.00				76.00 - 77.00			
14.00 - 15.00				47.00 - 48.00				-			
15.00 - 16.00				48.00 - 49.00				-			
16.00 - 17.00				49.00 - 50.00				-			
17.00 - 18.00				50.00 - 51.00				-			
18.00 - 19.00				51.00 - 52.00				-			
19.00 - 20.00				52.00 - 53.00				-			
20.00 - 21.00				53.00 - 54.00				-			
21.00 - 22.00				54.00 - 55.00				-			
22.00 - 23.00				55.00 - 56.00				-			
23.00 - 24.00				56.00 - 57.00				-			
24.00 - 25.00				57.00 - 58.00				-			
25.00 - 26.00				58.00 - 59.00				-			
26.00 - 27.00				59.00 - 60.00				-			
27.00 - 28.00				60.00 - 61.00	11	7.64	F1, 6	-			
28.00 - 29.00				61.00 - 62.00	30	7.12	F2	-			
29.00 - 30.00				62.00 - 63.00	83	6.96		-			
30.00 - 31.00				63.00 - 63.67	208	7.32	F3, 7	-			
31.00 - 32.00				63.67 - 63.75	37	9.23	F4, 8,9	-			
32.00 - 33.00				63.75 - 63.81	17	8.28	10	-			

Figure B-79. Pile driving logs from Howard Frankland Bridge

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

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PILE DRIVING LOG

Structure No: 150303 Page No: 3 of 4

REF inputs & Notes

PROJECT No: 422904-2-52-01 Bent/Pier No: Pier 1-112 PILE No.: 21

REF No.	Input REF EL ↓	*Calculated LP values for each REF used			Input REF description (template, stringline, etc.) for each REF used: ↓
		LP min tip	LP c/o-1	LP c/o	
1	+5.18	64.18	75.32	76.32	Top of Roller
2					
3					
4					
5					

Standard Notes & Note No.'s 1-28

Std. Notes:	↓ = Pile Ran, F1, F2, F3, F4 = (Fuel Settings 1-4), ST = stop, CC = cushion change, HR = high rebound, TP = Test Pile, DC = Driving Criteria, PR = Practical Refusal, SC = set check, DLT = Dyn. Load Test
Note 1:	6/22/2021 Start pre-drilling from 10:06 AM to 10:51 AM.
Note 2:	6/28/21 Re-drilling with core drill bit by reaching Min Tip from 12:42 PM to 1:15 PM.
Note 3:	6/28/21 Cleanout with Auger by reaching Min Tip 8:43 AM to 8:54 AM
Note 4:	6/29/21 Jetting (Jetted to -59 ft.) from 12:59 PM to 1:13 PM
Note 5:	6/29/21 Stood and jetted pile from 1:06 PM to 1:20 PM
Note 6:	6/30/21 at 11:30 AM Started driving with PDA engaged
Note 7:	6/30/21 at 11:41 AM Stopped driving per PDA (Hammer issues).
Note 8:	6/30/21 at 1:38 PM Started driving with PDA engaed
Note 9:	6/30/21 at 1:39 PM Stopped driving pile per PDA (PR with one inch of bearing, above the Min Tip).
Note 10:	7/1/21 at 1:08 PM (1DSC) With PDA (17 Blows with 0.75 inches movement with 6 inches of bearing).
Note 11:	
Note 12:	
Note 13:	
Note 14:	
Note 15:	
Note 16:	
Note 17:	
Note 18:	
Note 19:	
Note 20:	
Note 21:	
Note 22:	
Note 23:	
Note 24:	
Note 25:	
Note 26:	
Note 27:	
Note 28:	

Figure B-80. Pile driving logs from Howard Frankland Bridge

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

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Construction
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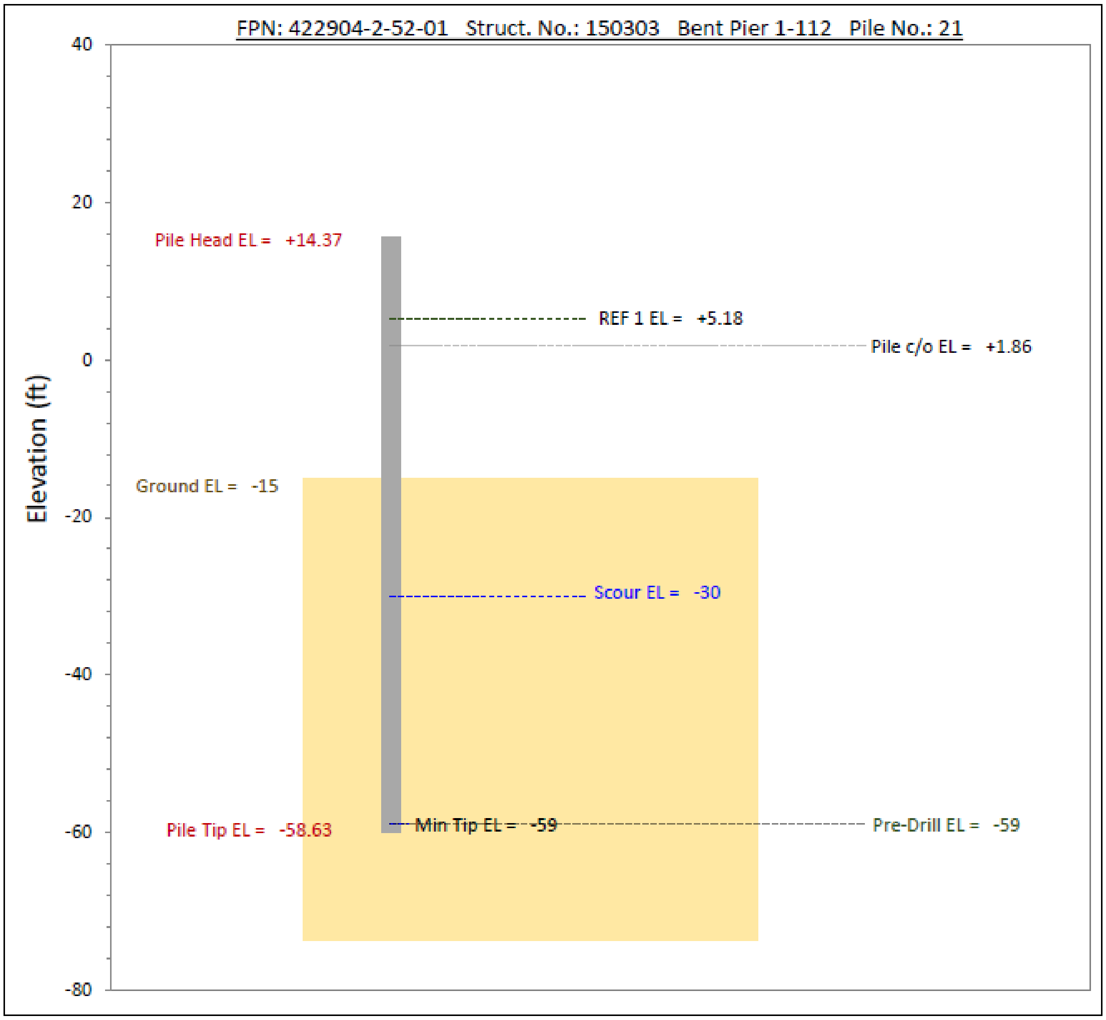
PILE DRIVING LOG

Structure No: 150303 Page No: 4 of 4

Sketch

PROJECT No: 422904-2-52-01 Bent/Pier No: Pier 1-112 PILE No.: 21



PLUMB pile, as depicted in this Pile Sketch

Pile Bearing: (click on yellow shaded cell below, and select basis for Pile Bearing acceptance that applies)

Pile bearing capacity determined by Dynamic Testing.

Pile Penetration:

Pile Tip EL > bottom EL of Preformed or Predrilled pile hole, does not meet 455-5 Penetration Requirements.

Current Pile Tip EL > Min Tip EL in plans, does not meet Std Spec 455-5 Penetration Requirements. Continue driving (without reaching practical refusal), or coordinate with PA to submit to EOR for review.

Min Tip EL is input on the log. Therefore, the 10-20 ft of penetration into firm/soft material, in accordance with 455-5 Penetration Requirements, does not apply.

Figure B-81. Pile driving logs from Howard Frankland Bridge

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STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

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PILE DRIVING LOG

Structure No: 150303   Page No: 1 of 4

PROJECT No: 422904-2-52-01   Date: 7/1/21   Station No: 1888+59.95

PILE Size/Type: 30" SQ PCP   Length (ft): 77.00   Bent/Pier No: Pier 1-102   PILE No: 6

HAMMER Make/Model: APE D80-42   S/N: 202012985   Rated Energy (ft-lbs): 198450   Operating Rate (BPM): 34-53

REF Elev: +5.09 (REF 1)   MIN TIP Elev: -63.00   PILE CUTOFF Elev: +1.86

DRIVING CRITERIA (DC):   DC2 Elev:

Type: Prod - Dyn. Test   #NAME?

DC Max Stk: Min Stk req'd for PR:

Notes: NBR=611 TONS (1222 KIPS)

100% PDA

SC criteria (if applic): bpi @ ft Stk

DC1		DC2, input if applic.	
(1)	blows @ ft,	(6)	blows @ ft,
(2)	blows @ ft,	(7)	blows @ ft,
(3)	blows @ ft,	(8)	blows @ ft,
(4)	blows @ ft,	(9)	blows @ ft,
(5)	blows @ ft,	(10)	blows @ ft,

SCOUR Elev: -29.00

PILE CUSHION Thickness & Material: 18" Plywood

HAMMER CUSHION Thickness & Material: (2x1 Inch) Micarta + (3 x 0.50 inch) Aluminum

Pile Activity	Date	Start Time	Stop Time	Weather	Temp °F	Notes
Preforming	6/28/21	1:12 PM	3:38 PM	Sunny	86	
Jetting	6/30/21	1:34 PM	1:41 PM	Cloudy	82	Jetted to elev. -60 ft
Stand Pile	6/30/21	1:41 PM	1:51 PM	Cloudy	82	
Drive Pile	7/1/21	2:29 PM	2:42 PM	Cloudy	86	

PILE DATA:

PAY ITEM No: WORK ORDER No:

MANUFACTURED By: CDS   MFR's PILE No: THF-30-546   DATE CAST: 4/9/21

TBM/BM Elev: TBM/BM Rod Read: H.I. Elev:

PRE-DRILLED Elev: GROUND Rod Read: GROUND Elev: -15.00

Manually input GROUND Elev (no sheet calc)

PREFORMED Elev: -63.00   Bottom of Excav Rod Read: Bottom of Excav Elev:

Pile Tip EL > Preformed Elev

PILE HEAD Rod Read: PILE HEAD Elev: +18.97   PILE TIP Elev: -58.03

PH Elev = REF - LP + PL = +18.97

Top of SOIL PLUG Elev (for Open Ended Pipe Piles & H-piles):   Natural Ground Elev:

Input 'Natural Ground EL' ONLY when natural ground surface is below embankment/fill material. Otherwise, leave this cell BLANK

SPLICE / EACH	PREFORMED HOLE	DYNAMIC LOAD TEST	PAY SET CHECK	NO PAY SET CHECK	REDRIVE	EXTRACTION	DRIVING OF SPLICE	PILE TYPE CODE	Plumb or Batter ? (click & select) ↓	PILE LENGTH (ft) ORIGINAL FURNISHED	PILE LENGTH (ft) TOTAL LENGTH WITH EXTENSION	Pile PENETRATION below SCOUR (ft)	EXTENSION/BUILD UP AUTHORIZED (ft)	EXTENSION/BUILD UP ACTUAL (ft)
									PLUMB					
0	0	1	0	0	0	0	0	1		77.00	77.00	29.03	0.00	0.00

Pile PENETRATION (ft), below: GROUND: 43.03 ft   SCOUR: 29.03 ft

CTQP Trainee (supervised by the Qualified Inspector) experiencing the full pile installation & log inspection: Name: TIN:

Qualified Inspector - I certify the Pile Driving Log content, and as applicable, the above CTQP Trainee's participation during this pile installation: Name & TIN: Gilian Diran D65029778   Signature:

Figure B-82. Pile driving logs from Howard Frankland Bridge

DC:

STATE OF FLORIDA DOT

Min Tip | 1 ft to c/o | c/o

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PILE DRIVING LOG

Page No: 2 of 4

Structure No.: 150303 Depth Table Extended (ft): Bent/Pier No.: Pier 1-102 Pile No.: 6

Depth Input Start LP↓	REF		Blows	Stroke	Eq. Stke. & Notes	Depth	REF		Blows	Stroke	Eq. Stke. & Notes	Depth	REF		Blows	Stroke	Eq. Stke. & Notes
0.00	1	1.00				33.00	-	34.00				64.00	-	65.00			
1.00	-	2.00				34.00	-	35.00				65.00	-	68.00			
2.00	-	3.00				35.00	-	36.00				68.00	-	69.00			
3.00	-	4.00				36.00	-	37.00				69.00	-	70.00			
4.00	-	5.00				37.00	-	38.00				70.00	-	71.00			
5.00	-	6.00				38.00	-	39.00				71.00	-	72.00			
6.00	-	7.00				39.00	-	40.00				72.00	-	73.00			
7.00	-	8.00				40.00	-	41.00				73.00	-	74.00			
8.00	-	9.00				41.00		42.00				74.00	-	75.00			
9.00	-	10.00				42.00	-	43.00				75.00	-	76.00			
10.00	-	11.00				43.00	-	44.00				76.00	-	77.00			
11.00	-	12.00				44.00	-	45.00				77.00	-	78.00			
12.00	-	13.00				45.00	-	46.00				78.00	-	79.00			
13.00	-	14.00				46.00	-	47.00				79.00	-	80.00			
14.00	-	15.00				47.00	-	48.00				80.00	-	81.00			
15.00	-	16.00				48.00	-	49.00					-				
16.00	-	17.00				49.00	-	50.00					-				
17.00	-	18.00				50.00	-	51.00					-				
18.00	-	19.00				51.00	-	52.00					-				
19.00	-	20.00				52.00	-	53.00					-				
20.00	-	21.00				53.00	-	54.00					-				
21.00	-	22.00				54.00	-	55.00					-				
22.00	-	23.00				55.00	-	56.00					-				
23.00	-	24.00				56.00	-	57.00					-				
24.00	-	25.00				57.00	-	58.00	12	7.78	F1, 5		-				
25.00	-	26.00				58.00	-	59.00	26	7.55	F3		-				
26.00	-	27.00				59.00	-	60.00	30	6.62			-				
27.00	-	28.00				60.00	-	61.00	66	6.98			-				
28.00	-	29.00				61.00	-	62.00	103	7.23			-				
29.00	-	30.00				62.00	-	63.00	240	7.34			-				
30.00	-	31.00				63.00	-	63.08	32	7.34	6,7		-				
31.00	-	32.00				63.08	-	63.12	24	8.3	ST-8-F4-PR-9		-				
32.00	-	33.00				63.12	-	64.00					-				

Figure B-83. Pile driving logs from Howard Frankland Bridge

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

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PILE DRIVING LOG

Structure No: 150303   Page No: 3 of 4
REF inputs & Notes

PROJECT No: 422904-2-52-01   Bent/Pier No: Pier 1-102   PILE No.: 6

REF No.	Input REF EL ↓	*Calculated LP values for each REF used: LP min tip	LP c/o-1	LP c/o	Input REF description (template, stringline, etc.) for each REF used: ↓
1	+5.09	68.09	79.23	80.23	Top of Pocket
2					
3					
4					
5					

Standard Notes & Note No.'s 1-28

Std. Notes:	↓ = Pile Ran, F1, F2, F3, F4 = (Fuel Settings 1-4), ST = stop, CC = cushion change, HR = high rebound, TP = Test Pile, DC = Driving Criteria, PR = Practical Refusal, SC = set check, DLT = Dyn. Load Test
Note 1:	6/28/21 Start Preforming from 1:12 PM to 2:25 PM. (Stopped for maintenance on auger equipment)
Note 2:	6/28/21 Continued preforming by reaching Min Tip from 3:25 PM to 3:38 PM.
Note 3:	6/28/21 Probing around the pile indicates the annular space is filled with sand on all sides of the pile
Note 4:	6/30/21 Jetting (Jetted to -60 ft.) from 1:34 PM to 1:41 PM
Note 5:	6/30/21 Stood and jetted pile from 1:41 PM to 1:51 PM.
Note 6:	7/1/21 at 2:42 PM Started driving with PDA guages connected.
Note 7:	7/1/21 at 2:42 PM Stopped driving pile per PDA (PR, above the Min Tip).
Note 8:	7/26/21 at 12:50 PM Started redriving with PDA engaged.
Note 9:	7/26/21at 12:51 PM Stopped driving per PDA (PR with bearing above the Min Tip).
Note 10:	
Note 11:	
Note 12:	
Note 13:	
Note 14:	
Note 15:	
Note 16:	
Note 17:	
Note 18:	
Note 19:	
Note 20:	
Note 21:	
Note 22:	
Note 23:	
Note 24:	
Note 25:	
Note 26:	
Note 27:	
Note 28:	

Figure B-84. Pile driving logs from Howard Frankland Bridge

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

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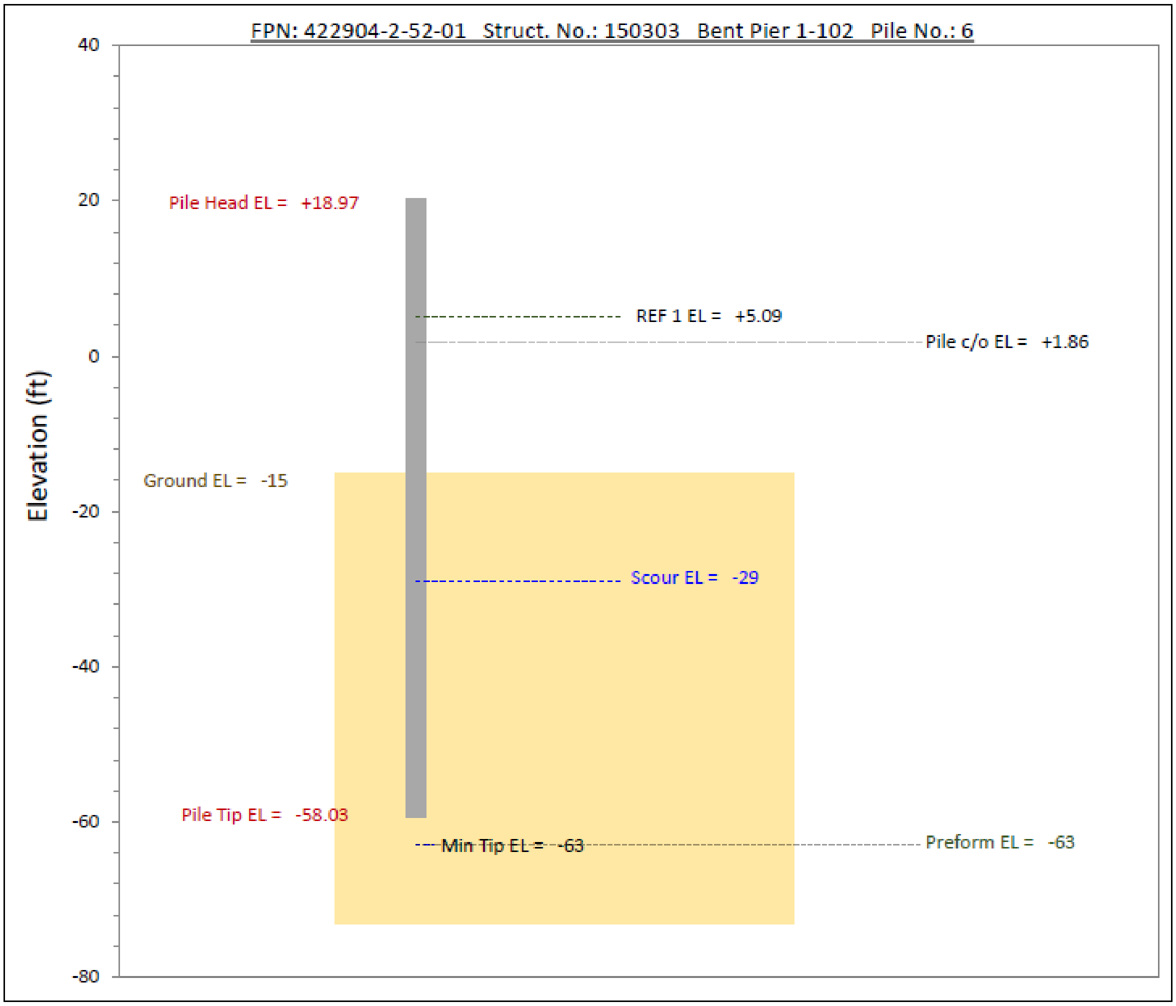
Construction
May-21

PILE DRIVING LOG

Structure No: 150303 Page No: 4 of 4

Sketch

PROJECT No: 422904-2-52-01 Bent/Pier No: Pier 1-102 PILE No.: 6



PLUMB pile, as depicted in this Pile Sketch

Pile Bearing: (click on yellow shaded cell below, and select basis for Pile Bearing acceptance that applies)

Pile bearing capacity determined by Dynamic Testing.

Pile Penetration:

Pile Tip EL > bottom EL of Preformed or Predrilled pile hole, does not meet 455-5 Penetration Requirements.

Current Pile Tip EL > Min Tip EL in plans, does not meet Std Spec 455-5 Penetration Requirements. Continue driving (without reaching practical refusal), or coordinate with PA to submit to EOR for review.

Min Tip EL is input on the log. Therefore, the 10-20 ft of penetration into firm/soft material, in accordance with 455-5 Penetration Requirements, does not apply.

Figure B-85. Pile driving logs from Howard Frankland Bridge

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PILE DRIVING LOG

Structure No: 150303 Page No: 1 of 4

PROJECT No: 422904-2-52-01 Date: 7/1/21 Station No: 1888+59.95

PILE Size/Type: 30" SQ PCP Length (ft): 77.00 Bent/Pier No: Pier 1-102 PILE No: 7

HAMMER Make/Model: APE D80-42 S/N: 202012985 Rated Energy (ft-lbs): 198450 Operating Rate (BPM): 34-53

REF Elev: +5.09 (REF 1) MIN TIP Elev: -63.00 PILE CUTOFF Elev: +1.86

DRIVING CRITERIA (DC): DC2 Elev:

Type: Prod - Dyn. Test #NAME?

DC Max Stk: Min Stk req'd for PR:

Notes: NBR=604 TONS (1208 KIPS)
100% PDA

SC criteria (if applic): bpi @ ft Stk

DC1				DC2, input if applic.			
(1)	blows @	ft,		(6)	blows @	ft,	
(2)	blows @	ft,		(7)	blows @	ft,	
(3)	blows @	ft,		(8)	blows @	ft,	
(4)	blows @	ft,		(9)	blows @	ft,	
(5)	blows @	ft,		(10)	blows @	ft,	

SCOUR Elev: -29.00

PILE CUSHION Thickness & Material: 18" Plywood

HAMMER CUSHION Thickness & Material: (2x1 Inch) Micarta + (3 x 0.50 inch) Aluminum

Pile Activity	Date	Start Time	Stop Time	Weather	Temp °F	Notes
Preforming	6/25/21	12:00 PM	4:25 PM	P. Cloudy	88	
Jetting	7/1/21	8:35 AM	9:13 AM	Cloudy	85	Jetted to elev. -60 ft
Stand Pile	7/1/21	9:09 AM	9:27 AM	Cloudy	85	
Drive Pile	7/1/21	2:56 PM	3:12 PM	Cloudy	86	

PILE DATA:

PAY ITEM No: WORK ORDER No:

MANUFACTURED By: CDS MFR's PILE No: THF-30-624 DATE CAST: 5/18/21

TBM/BM Elev: TBM/BM Rod Read: H.I. Elev:

PRE-DRILLED Elev: GROUND Rod Read: GROUND Elev: -15.00

Manually input GROUND Elev (no sheet calc)

PREFORMED Elev: -63.00 Bottom of Excav Rod Read: Bottom of Excav Elev:

PILE HEAD Rod Read: PILE HEAD Elev: +13.09 PILE TIP Elev: -63.91

PH Elev = REF - LP + PL = +13.09

Top of SOIL PLUG Elev (for Open Ended Pipe Piles & H-piles): Natural Ground Elev:

Input 'Natural Ground EL' ONLY when natural ground surface is below embankment/fill material. Otherwise, leave this cell BLANK

SPLICE / EACH	PREFORMED HOLE	DYNAMIC LOAD TEST	PAY SET CHECK	NO PAY SET CHECK	REDRIVE	EXTRACTION	DRIVING OF SPLICE	PILE TYPE CODE	Plumb or Batter ? (click & select) ↓ PLUMB	PILE LENGTH (ft) ORIGINAL FURNISHED	TOTAL LENGTH WITH EXTENSION	Pile PENETRATION below SCOUR (ft)	EXTENSION/BUILD UP AUTHORIZED (ft)	ACTUAL (ft)
0	0	1	0	0	0	0	0	1		77.00	77.00	34.91	0.00	0.00

Pile PENETRATION (ft), below: GROUND: 48.91 ft SCOUR: 34.91 ft

CTQP Trainee (supervised by the Qualified Inspector) experiencing the full pile installation & log inspection: Name:

TIN:

Qualified Inspector - I certify the Pile Driving Log content, and as applicable, the above CTQP Trainee's participation during this pile installation: Name & TIN: Gilian Diran D65029778

Signature:

Figure B-86. Pile driving logs from Howard Frankland Bridge

DC:

STATE OF FLORIDA DOT

PILE DRIVING LOG

Min Tip | 1 ft to c/o | c/o

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May-21

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Structure No.: 150303 Depth Table Extended (ft): Bent/Pier No.: Pier 1-102 Pile No.: 7

Depth (Input Start LP↓) REF	Blows	Stroke	Eq. Stke. & Notes	Depth REF	Blows	Stroke	Eq. Stke. & Notes	Depth REF	Blows	Stroke	Eq. Stke. & Notes
0.00 1 1.00				33.00 - 34.00				66.00 - 67.00	54	7.55	
1.00 - 2.00				34.00 - 35.00				67.00 - 68.00	116	7.46	
2.00 - 3.00				35.00 - 36.00				68.00 - 69.00	240	8.06	6
3.00 - 4.00				36.00 - 37.00				69.00 - 70.00			
4.00 - 5.00				37.00 - 38.00				70.00 - 71.00			
5.00 - 6.00				38.00 - 39.00				71.00 - 72.00			
6.00 - 7.00				39.00 - 40.00				72.00 - 73.00			
7.00 - 8.00				40.00 - 41.00				73.00 - 74.00			
8.00 - 9.00				41.00 42.00				74.00 - 75.00			
9.00 - 10.00				42.00 - 43.00				75.00 - 76.00			
10.00 - 11.00				43.00 - 44.00				76.00 - 77.00			
11.00 - 12.00				44.00 - 45.00				77.00 - 78.00			
12.00 - 13.00				45.00 - 46.00				78.00 - 79.00			
13.00 - 14.00				46.00 - 47.00				79.00 - 80.00			
14.00 - 15.00				47.00 - 48.00				80.00 - 81.00			
15.00 - 16.00				48.00 - 49.00				-			
16.00 - 17.00				49.00 - 50.00				-			
17.00 - 18.00				50.00 - 51.00				-			
18.00 - 19.00				51.00 - 52.00				-			
19.00 - 20.00				52.00 - 53.00				-			
20.00 - 21.00				53.00 - 54.00				-			
21.00 - 22.00				54.00 - 55.00				-			
22.00 - 23.00				55.00 - 56.00				-			
23.00 - 24.00				56.00 - 57.00				-			
24.00 - 25.00				57.00 - 58.00				-			
25.00 - 26.00				58.00 - 59.00				-			
26.00 - 27.00				59.00 - 60.00				-			
27.00 - 28.00				60.00 - 61.00				-			
28.00 - 29.00				61.00 - 62.00	9	6.72	F1, 5	-			
29.00 - 30.00				62.00 - 63.00	17	6.83	F2	-			
30.00 - 31.00				63.00 - 64.00	28	6.89	F3	-			
31.00 - 32.00				64.00 - 65.00	38	6.4		-			
32.00 - 33.00				65.00 - 66.00	95	5.56		-			

Figure B-87. Pile driving logs from Howard Frankland Bridge

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PILE DRIVING LOG

Structure No: 150303

Page No: 3 of 4

REF inputs & Notes

PROJECT No: 422904-2-52-01

Bent/Pier No: Pier 1-102

PILE No.: 7

REF No.	Input REF EL ↓	*Calculated LP values for each REF used			Input REF description (template, stringline, etc.) for each REF used: ↓
		LP min tip	LP c/o-1	LP c/o	
1	+5.09	68.09	79.23	80.23	Top of Pocket
2					
3					
4					
5					

Standard Notes & Note No.'s 1-28

Std. Notes:	↓ = Pile Ran, F1, F2, F3, F4 = (Fuel Settings 1-4), ST = stop, CC = cushion change, HR = high rebound, TP = Test Pile, DC = Driving Criteria, PR = Practical Refusal, SC = set check, DLT = Dyn. Load Test
Note 1:	6/28/21 Preforming from 12:00 PM to 2:00 PM.
Note 2:	6/28/21 Continued Predrilling by reaching Min Tip from 3:25 PM to 4:25PM.
Note 3:	7/1/21 Jetting (Jetted to -60 ft.) from 8:35 AM to 9:13 AM
Note 4:	7/1/21 Stood and jetted pile from 9:09 AM to 9:27 AM
Note 5:	7/1/21 at 2:56 PM Started driving with PDA guages connected.
Note 6:	7/1/21 at 3:12 PM Stopped driving per PDA by (Reached Min Tip with 6 inches of bearing).
Note 7:	
Note 8:	
Note 9:	
Note 10:	
Note 11:	
Note 12:	
Note 13:	
Note 14:	
Note 15:	
Note 16:	
Note 17:	
Note 18:	
Note 19:	
Note 20:	
Note 21:	
Note 22:	
Note 23:	
Note 24:	
Note 25:	
Note 26:	
Note 27:	
Note 28:	

Figure B-88. Pile driving logs from Howard Frankland Bridge

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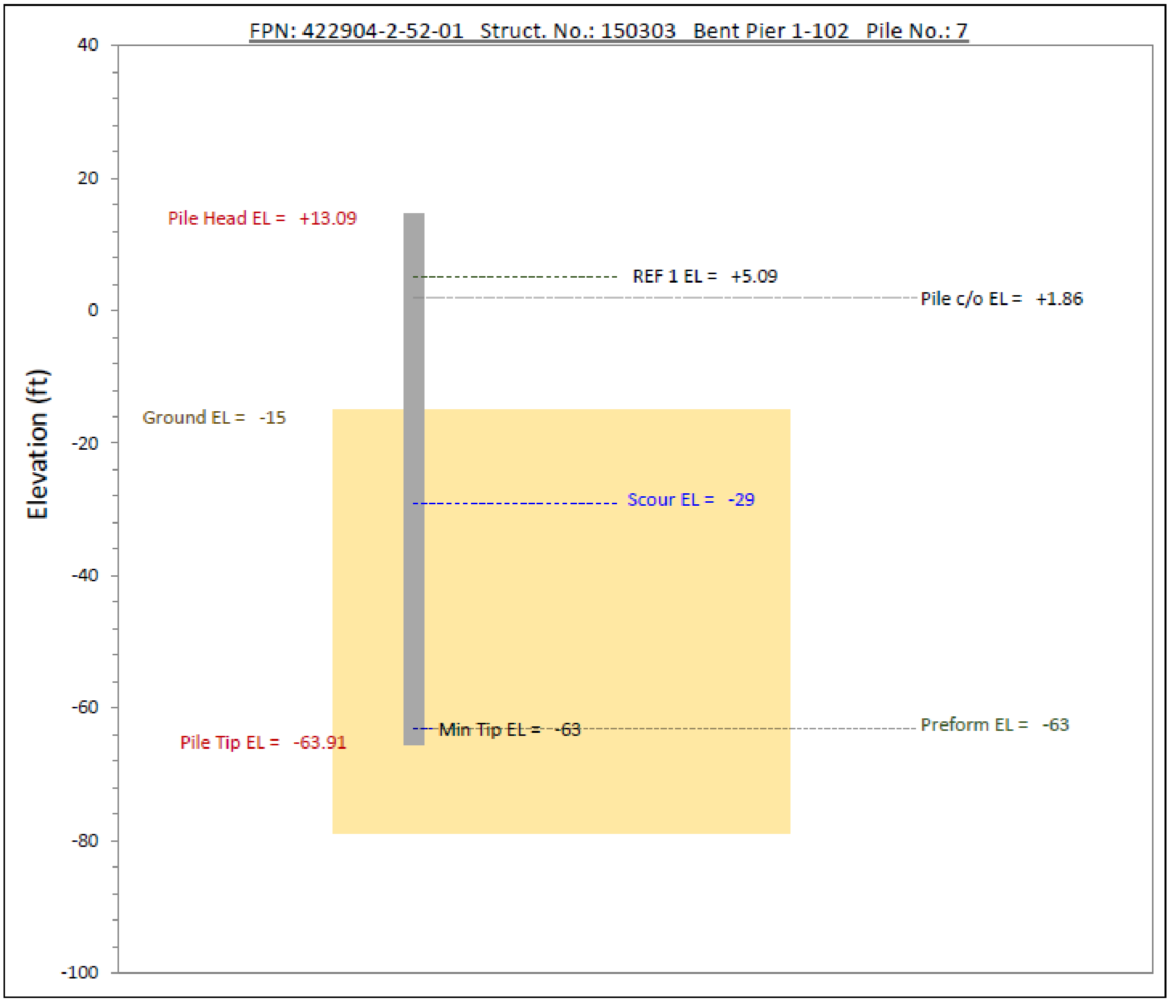
May-21

PILE DRIVING LOG

Structure No: 150303 Page No: 4 of 4

Sketch

PROJECT No: 422904-2-52-01 Bent/Pier No: Pier 1-102 PILE No.: 7



PLUMB pile, as depicted in this Pile Sketch

Pile Bearing: (click on yellow shaded cell below, and select basis for Pile Bearing acceptance that applies)

Pile bearing capacity determined by Dynamic Testing.

Pile Penetration:

Pile Tip EL ≤ bottom EL of Preformed or Predrilled pile hole, meets 455-5 Penetration Requirements.

Current Pile Tip EL ≤ Min Tip EL in plans, meets 455-5 Penetration Requirements.

Min Tip EL is input on the log. Therefore, the 10-20 ft of penetration into firm/soft material, in accordance with 455-5 Penetration Requirements, does not apply.

Figure B-89. Pile driving logs from Howard Frankland Bridge

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PILE DRIVING LOG

Structure No: 150303 | Page No: 1 of 4

PROJECT No: 422904-2-52-01 | Date: 7/1/21 | Station No: 1888+59.95

PILE Size/Type: 30" SQ PCP | Length (ft): 77.00 | Bent/Pier No: Pier 1-102 | PILE No: 8

HAMMER Make/Model: APE D80-42 | S/N: 202012985 | Rated Energy (ft-lbs): 198450 | Operating Rate (BPM): 34-53

REF Elev: +5.09 (REF 1) | MIN TIP Elev: -63.00 | PILE CUTOFF Elev: +1.86

DRIVING CRITERIA (DC): DC2 Elev:

Type: Prod - Dyn. Test #NAME?

DC Max Stk: Min Stk req'd for PR:

Notes: NBR=611 TONS (1222 KIPS)
100% PDA

SC criteria (if applic): bpi @ ft Stk

DC1				DC2, input if applic.			
(1)	blows @		ft,	(6)	blows @		ft,
(2)	blows @		ft,	(7)	blows @		ft,
(3)	blows @		ft,	(8)	blows @		ft,
(4)	blows @		ft,	(9)	blows @		ft,
(5)	blows @		ft,	(10)	blows @		ft,

SCOUR Elev: -29.00

PILE CUSHION Thickness & Material: 18" Plywood

HAMMER CUSHION Thickness & Material: (2x1 Inch) Micarta + (3 x 0.50 inch) Aluminum

Pile Activity	Date	Start Time	Stop Time	Weather	Temp °F	Notes
Preforming	6/23/21	10:04 AM	11:19 AM	Cloudy	86	
Jetting	6/30/21	1:07 PM	1:15 PM	Cloudy	82	Jetted to elev. -60 ft
Stand Pile	6/30/21	1:15 PM	1:29 PM	Cloudy	82	
Drive Pile	7/1/21	3:49 PM	4:02 PM	Cloudy	85	

PILE DATA:

PAY ITEM No: | WORK ORDER No:

MANUFACTURED By: CDS | MFR's PILE No: THF-30-545 | DATE CAST: 4/9/21

TBM/BM Elev: | TBM/BM Rod Read: | H.I. Elev:

PRE-DRILLED Elev: | GROUND Rod Read: | GROUND Elev: -15.00

Manually input GROUND Elev (no sheet calc)

PREFORMED Elev: -63.00 | Bottom of Excav Rod Read: | Bottom of Excav Elev:

Pile Tip EL > Preformed Elev

PILE HEAD Rod Read: | PILE HEAD Elev: +16.34 | PILE TIP Elev: -60.66

PH Elev = REF - LP + PL = +16.34

Top of SOIL PLUG Elev (for Open Ended Pipe Piles & H-piles): | Natural Ground Elev:

Input 'Natural Ground EL' ONLY when natural ground surface is below embankment/fill material. Otherwise, leave this cell BLANK

SPLICE / EACH	PREFORMED HOLE	DYNAMIC LOAD TEST	PAY SET CHECK	NO PAY SET CHECK	REDRIVE	EXTRACTION	DRIVING OF SPLICE	PILE TYPE CODE	Plumb or Batter ? (click & select) ↓	PILE LENGTH (ft): ORIGINAL FURNISHED	PILE LENGTH (ft): TOTAL LENGTH WITH EXTENSION	Pile PENETRATION below SCOUR (ft)	EXTENSION/BUILD UP: AUTHORIZED (ft)	EXTENSION/BUILD UP: ACTUAL (ft)
									PLUMB					
0	0	1	0	0	0	0	0	1		77.00	77.00	31.66	0.00	0.00

Pile PENETRATION (ft), below: GROUND: 45.66 ft SCOUR: 31.66 ft

CTQP Trainee (supervised by the Qualified Inspector) experiencing the full pile installation & log inspection: Name: TIN:

Qualified Inspector - I certify the Pile Driving Log content, and as applicable, the above CTQP Trainee's participation during this pile installation: Name & TIN: Gilian Diran D65029778 Signature:

Figure B-90. Pile driving logs from Howard Frankland Bridge

DC:

STATE OF FLORIDA DOT

PILE DRIVING LOG

Min Tip | 1 ft to c/o | c/o

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Structure No.: 150303 Depth Table Extended (ft): Bent/Pier No.: Pier 1-102 Pile No.: 8

Depth (Input Start LP↓)	REF	Blows	Stroke	Eq. Stke. & Notes	Depth	REF	Blows	Stroke	Eq. Stke. & Notes	Depth	REF	Blows	Stroke	Eq. Stke. & Notes
0.00 1.00	1				33.00 - 34.00					65.75 - 65.75		20	8.3	ST-PR-F4-8-9
1.00 - 2.00					34.00 - 35.00					65.75 - 68.00				
2.00 - 3.00					35.00 - 36.00					68.00 - 69.00				
3.00 - 4.00					36.00 - 37.00					69.00 - 70.00				
4.00 - 5.00					37.00 - 38.00					70.00 - 71.00				
5.00 - 6.00					38.00 - 39.00					71.00 - 72.00				
6.00 - 7.00					39.00 - 40.00					72.00 - 73.00				
7.00 - 8.00					40.00 - 41.00					73.00 - 74.00				
8.00 - 9.00					41.00 42.00					74.00 - 75.00				
9.00 - 10.00					42.00 - 43.00					75.00 - 76.00				
10.00 - 11.00					43.00 - 44.00					76.00 - 77.00				
11.00 - 12.00					44.00 - 45.00					77.00 - 78.00				
12.00 - 13.00					45.00 - 46.00					78.00 - 79.00				
13.00 - 14.00					46.00 - 47.00					79.00 - 80.00				
14.00 - 15.00					47.00 - 48.00					80.00 - 81.00				
15.00 - 16.00					48.00 - 49.00					-				
16.00 - 17.00					49.00 - 50.00					-				
17.00 - 18.00					50.00 - 51.00					-				
18.00 - 19.00					51.00 - 52.00					-				
19.00 - 20.00					52.00 - 53.00					-				
20.00 - 21.00					53.00 - 54.00					-				
21.00 - 22.00					54.00 - 55.00					-				
22.00 - 23.00					55.00 - 56.00					-				
23.00 - 24.00					56.00 - 57.00					-				
24.00 - 25.00					57.00 - 58.00					-				
25.00 - 26.00					58.00 - 59.00					-				
26.00 - 27.00					59.00 - 60.00					-				
27.00 - 28.00					60.00 - 61.00					-				
28.00 - 29.00					61.00 - 62.00		13	7.11	F1, 5	-				
29.00 - 30.00					62.00 - 63.00		21	6.04	F2	-				
30.00 - 31.00					63.00 - 64.00		58	6.31		-				
31.00 - 32.00					64.00 - 65.00		193	6.33		-				
32.00 - 33.00					65.00 - 65.75		245	7.37	F3,6,7	-				

Figure B-91. Pile driving logs from Howard Frankland Bridge

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PILE DRIVING LOG

Structure No: 150303

Page No: 3 of 4

REF inputs & Notes

PROJECT No: 422904-2-52-01

Bent/Pier No: Pier 1-102

PILE No.: 8

REF No.	Input REF EL ↓	*Calculated LP values for each REF used: LP min tip	LP c/o-1	LP c/o	Input REF description (template, stringline, etc.) for each REF used: ↓
1	+5.09	68.09	79.23	80.23	Top of Pocket
2					
3					
4					
5					

Standard Notes & Note No.'s 1-28

Std. Notes:	↓ = Pile Ran, F1, F2, F3, F4 = (Fuel Settings 1-4), ST = stop, CC = cushion change, HR = high rebound, TP = Test Pile, DC = Driving Criteria, PR = Practical Refusal, SC = set check, DLT = Dyn. Load Test
Note 1:	6/23/21 Start Preforming from 10:04 AM to 11:19 AM (Stopped due to bad weather conditions).
Note 2:	6/25/21 Continued Preforming by reaching Min Tip from 10:55 AM to 12:03 PM.
Note 3:	6/25/21 Probing around the pile indicates the annular space is filled with sand on all sides of the pile
Note 4:	6/30/21 Jetting (Jetted to -60 ft.) from 1:07 PM to 1:15 PM
Note 5:	6/30/21 Stood and jetted pile from 1:15 PM to 1:29 PM
Note 6:	7/1/21 at 3:49 PM Started driving with PDA guages connected.
Note 7:	7/1/21 at 4:02 PM Stopped driving pile per PDA (PR, above the Min Tip).
Note 8:	7/26/21 at 1:00 PM Started redriving with PDA engaged.
Note 9:	7/26/21 at 1:01 PM Stopped driving per PDA (PR with bearing above the Min Tip).
Note 10:	
Note 11:	
Note 12:	
Note 13:	
Note 14:	
Note 15:	
Note 16:	
Note 17:	
Note 18:	
Note 19:	
Note 20:	
Note 21:	
Note 22:	
Note 23:	
Note 24:	
Note 25:	
Note 26:	
Note 27:	
Note 28:	

Figure B-92. Pile driving logs from Howard Frankland Bridge

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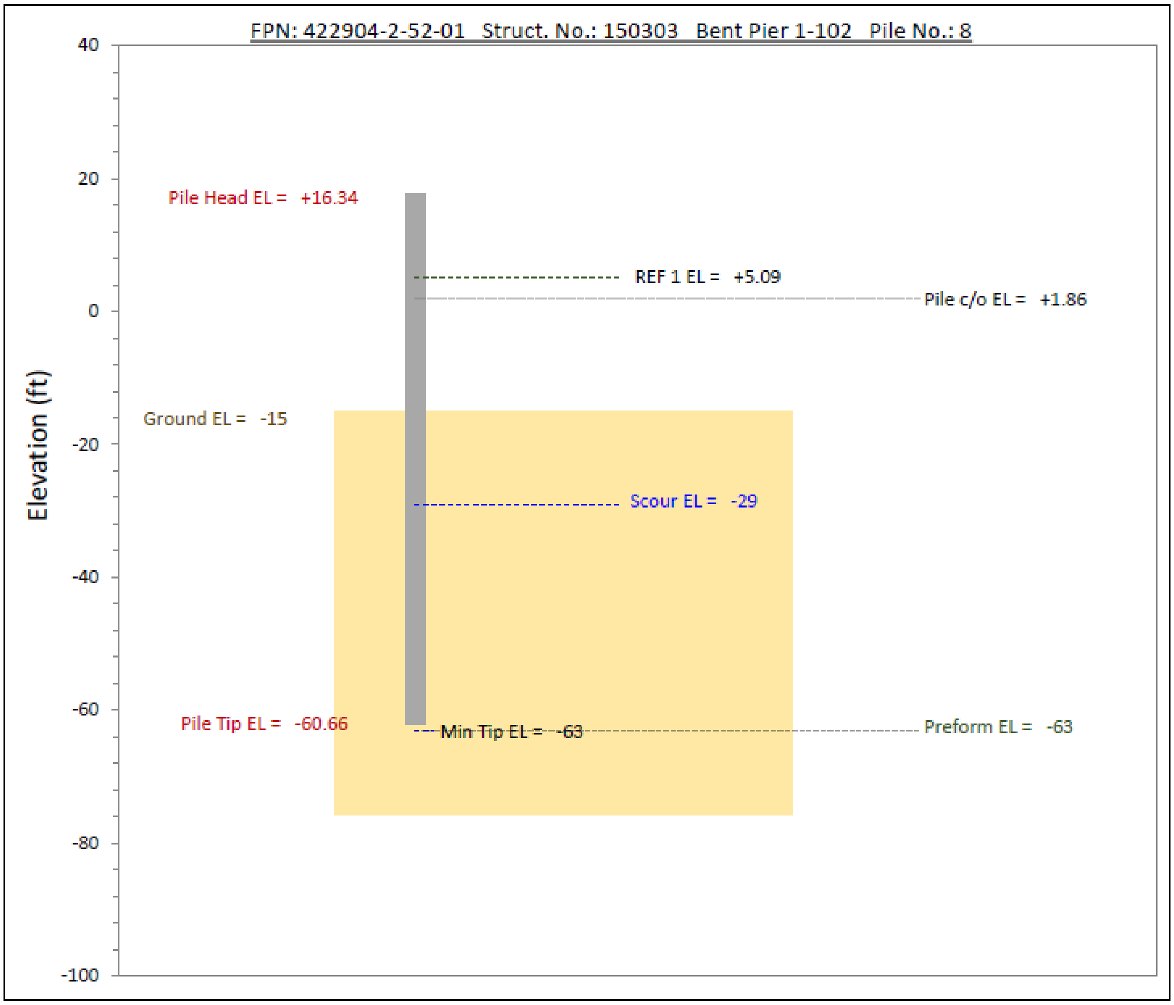
PILE DRIVING LOG

Structure No: 150303 Page No: 4 of 4

Sketch

PROJECT No: 422904-2-52-01 Bent/Pier No: Pier 1-102 PILE No.: 8



PLUMB pile, as depicted in this Pile Sketch

Pile Bearing: (click on yellow shaded cell below, and select basis for Pile Bearing acceptance that applies)

Pile bearing capacity determined by Dynamic Testing.

Pile Penetration:

Pile Tip EL > bottom EL of Preformed or Predrilled pile hole, does not meet 455-5 Penetration Requirements.

Current Pile Tip EL > Min Tip EL in plans, does not meet Std Spec 455-5 Penetration Requirements. Continue driving (without reaching practical refusal), or coordinate with PA to submit to EOR for review.

Min Tip EL is input on the log. Therefore, the 10-20 ft of penetration into firm/soft material, in accordance with 455-5 Penetration Requirements, does not apply.

Figure B-93. Pile driving logs from Howard Frankland Bridge

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PILE DRIVING LOG

Structure No: 150303   Page No: 1 of 4

PROJECT No: 422904-2-52-01   Date: 7/1/21   Station No: 1888+59.95

PILE Size/Type: 30" SQ PCP   Length (ft): 77.00   Bent/Pier No: Pier 1-102   PILE No: 9

HAMMER Make/Model: APE D80-42   S/N: 202012985   Rated Energy (ft-lbs): 198450   Operating Rate (BPM): 34-53

REF Elev: +5.09 (REF 1)   MIN TIP Elev: -63.00   PILE CUTOFF Elev: +1.86

DRIVING CRITERIA (DC):   DC2 Elev:

Type: Prod - Dyn. Test   #NAME?

DC Max Stk: Min Stk req'd for PR:

Notes: NBR=604 TONS (1208 KIPS)

100% PDA

SC criteria (if applic): bpi @ ft Stk

DC1				DC2, input if applic.			
(1)	blows @		ft.	(6)	blows @		ft.
(2)	blows @		ft.	(7)	blows @		ft.
(3)	blows @		ft.	(8)	blows @		ft.
(4)	blows @		ft.	(9)	blows @		ft.
(5)	blows @		ft.	(10)	blows @		ft.

SCOUR Elev: -29.00

PILE CUSHION Thickness & Material: 18" Plywood

HAMMER CUSHION Thickness & Material: (2x1 Inch) Micarta + (3 x 0.50 inch) Aluminum

Pile Activity	Date	Start Time	Stop Time	Weather	Temp °F	Notes
Preforming	6/25/21	12:10 PM	2:05 PM	Sunny	86	
Stand Pile	6/30/21	1:56 PM	2:12 PM	Cloudy	82	Jetted to elev. -60 ft.
Drive Pile	7/1/21	3:26 PM	3:34 PM	Cloudy	85	

PILE DATA:

PAY ITEM No: WORK ORDER No:

MANUFACTURED By: CDS   MFR's PILE No: THF-30-547   DATE CAST: 9/4/21

TBM/BM Elev: TBM/BM Rod Read: H.I. Elev:

PRE-DRILLED Elev: GROUND Rod Read: GROUND Elev: -15.00

Manually input GROUND Elev (no sheet calc)

PREFORMED Elev: -63.00   Bottom of Excav Rod Read: Bottom of Excav Elev:

PILE HEAD Rod Read: PILE HEAD Elev: +13.72   PILE TIP Elev: -63.28

PH Elev = REF - LP + PL = +13.72

Top of SOIL PLUG Elev (for Open Ended Pipe Piles & H-piles):   Natural Ground Elev:

Input 'Natural Ground EL' ONLY when natural ground surface is below embankment/fill material. Otherwise, leave this cell BLANK

SPLICE / EACH	PREFORMED HOLE	DYNAMIC LOAD TEST	PAY SET CHECK	NO PAY SET CHECK	REDRIVE	EXTRACTION	DRIVING OF SPLICE	PILE TYPE CODE	Plumb or Batter ? (click & select) ↓ PLUMB	PILE LENGTH (ft) ORIGINAL FURNISHED	PILE LENGTH (ft) TOTAL LENGTH WITH EXTENSION	Pile PENETRATION below SCOUR (ft)	EXTENSION/BUILD UP AUTHORIZED (ft)	EXTENSION/BUILD UP ACTUAL (ft)
0	0	1	0	0	0	0	0	1		77.00	77.00	34.28	0.00	0.00

Pile PENETRATION (ft), below: GROUND: 48.28 ft   SCOUR: 34.28 ft

CTQP Trainee (supervised by the Qualified Inspector) experiencing the full pile installation & log inspection: Name: TIN:

Qualified Inspector - I certify the Pile Driving Log content, and as applicable, the above CTQP Trainee's participation during this pile installation: Name & TIN: Gilian Diran D65029778   Signature:

Figure B-94. Pile driving logs from Howard Frankland Bridge

DC:

STATE OF FLORIDA DOT

PILE DRIVING LOG

Min Tip | 1 ft to c/o | c/o

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Structure No.: 150303 Depth Table Extended (ft): Bent/Pier No.: Pier 1-102 Pile No.: 9

Depth (Input Start LP↓) REF	Blows	Stroke	Eq. Stke. & Notes	Depth REF	Blows	Stroke	Eq. Stke. & Notes	Depth REF	Blows	Stroke	Eq. Stke. & Notes
0.00 1 1.00				33.00 - 34.00				66.00 - 67.00	61	6.99	
1.00 - 2.00				34.00 - 35.00				67.00 - 68.00	90	7.42	F3
2.00 - 3.00				35.00 - 36.00				68.00 - 68.37	124	8.7	6
3.00 - 4.00				36.00 - 37.00				68.37 - 69.00			
4.00 - 5.00				37.00 - 38.00				69.00 - 70.00			
5.00 - 6.00				38.00 - 39.00				70.00 - 71.00			
6.00 - 7.00				39.00 - 40.00				71.00 - 72.00			
7.00 - 8.00				40.00 - 41.00				72.00 - 73.00			
8.00 - 9.00				41.00 42.00				73.00 - 74.00			
9.00 - 10.00				42.00 - 43.00				74.00 - 75.00			
10.00 - 11.00				43.00 - 44.00				75.00 - 76.00			
11.00 - 12.00				44.00 - 45.00				76.00 - 77.00			
12.00 - 13.00				45.00 - 46.00				77.00 - 78.00			
13.00 - 14.00				46.00 - 47.00				78.00 - 79.00			
14.00 - 15.00				47.00 - 48.00				79.00 - 80.00			
15.00 - 16.00				48.00 - 49.00				80.00 - 81.00			
16.00 - 17.00				49.00 - 50.00				-			
17.00 - 18.00				50.00 - 51.00				-			
18.00 - 19.00				51.00 - 52.00				-			
19.00 - 20.00				52.00 - 53.00				-			
20.00 - 21.00				53.00 - 54.00				-			
21.00 - 22.00				54.00 - 55.00				-			
22.00 - 23.00				55.00 - 56.00				-			
23.00 - 24.00				56.00 - 57.00				-			
24.00 - 25.00				57.00 - 58.00				-			
25.00 - 26.00				58.00 - 59.00				-			
26.00 - 27.00				59.00 - 60.00				-			
27.00 - 28.00				60.00 - 61.00				-			
28.00 - 29.00				61.00 - 62.00	7	6.91	F1, 5	-			
29.00 - 30.00				62.00 - 63.00	12	7.47	F2	-			
30.00 - 31.00				63.00 - 64.00	25	7.37		-			
31.00 - 32.00				64.00 - 65.00	36	6.71		-			
32.00 - 33.00				65.00 - 66.00	39	6.77		-			

Figure B-95. Pile driving logs from Howard Frankland Bridge

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

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PILE DRIVING LOG

Structure No: 150303

Page No: 3 of 4

REF inputs & Notes

PROJECT No: 422904-2-52-01

Bent/Pier No: Pier 1-102

PILE No.: 9

REF No.	Input REF EL ↓	*Calculated LP values for each REF used: LP min tip	LP c/o-1	LP c/o	Input REF description (template, stringline, etc.) for each REF used: ↓
1	+5.09	68.09	79.23	80.23	Top of Pocket
2					
3					
4					
5					

Standard Notes & Note No.'s 1-28

Std. Notes:	↓ = Pile Ran, F1, F2, F3, F4 = (Fuel Settings 1-4), ST = stop, CC = cushion change, HR = high rebound, TP = Test Pile, DC = Driving Criteria, PR = Practical Refusal, SC = set check, DLT = Dyn. Load Test
Note 1:	6/25/21 Preforming from 12:10 PM to 2:05 PM.
Note 2:	6/28/21 Continued Preforming by reaching Min Tip from 10:55 AM to 12:03 PM.
Note 3:	6/30/21 Stood and jetted pile (Jetted to -60 ft.) from 1:56 PM to 2:12 PM.
Note 4:	7/1/21 at 3:26 PM Started driving with PDA guages connected.
Note 5:	7/1/21 at 3:34 PM Stopped driving per PDA (Reached Min Tip with 6 inches of bearing).
Note 6:	
Note 7:	
Note 8:	
Note 9:	
Note 10:	
Note 11:	
Note 12:	
Note 13:	
Note 14:	
Note 15:	
Note 16:	
Note 17:	
Note 18:	
Note 19:	
Note 20:	
Note 21:	
Note 22:	
Note 23:	
Note 24:	
Note 25:	
Note 26:	
Note 27:	
Note 28:	

Figure B-96. Pile driving logs from Howard Frankland Bridge

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

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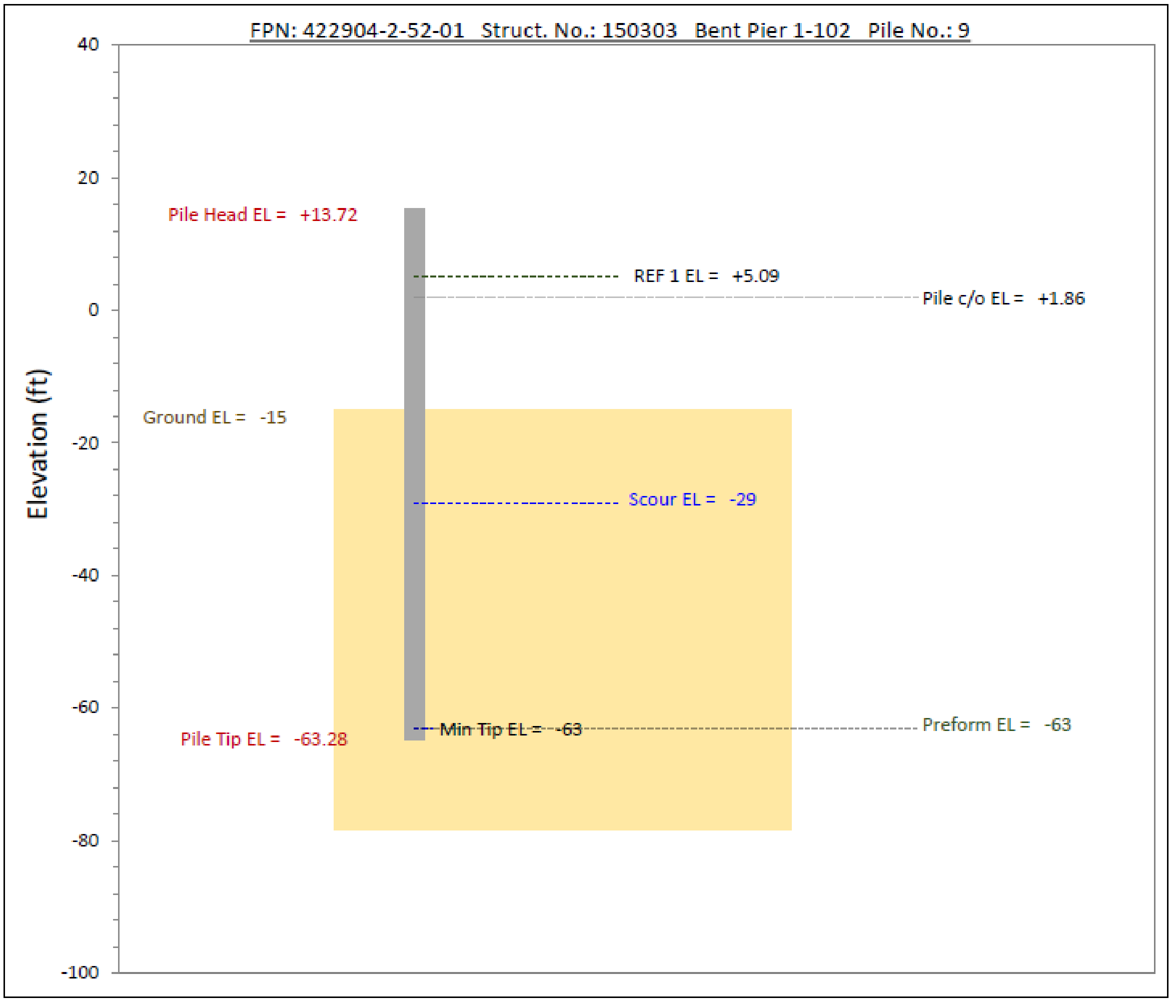
Construction
May-21

PILE DRIVING LOG

Structure No: 150303   Page No: 4 of 4

Sketch

PROJECT No: 422904-2-52-01   Bent/Pier No: Pier 1-102   PILE No.: 9



PLUMB pile, as depicted in this Pile Sketch

Pile Bearing: (click on yellow shaded cell below, and select basis for Pile Bearing acceptance that applies)

Pile bearing capacity determined by Dynamic Testing.

Pile Penetration:

Pile Tip EL ≤ bottom EL of Preformed or Predrilled pile hole, meets 455-5 Penetration Requirements.

Current Pile Tip EL ≤ Min Tip EL in plans, meets 455-5 Penetration Requirements.

Min Tip EL is input on the log. Therefore, the 10-20 ft of penetration into firm/soft material, in accordance with 455-5 Penetration Requirements, does not apply.

Figure B-97. Pile driving logs from Howard Frankland Bridge

B.9 Simpson's Creek

B.9.1 Boring Logs

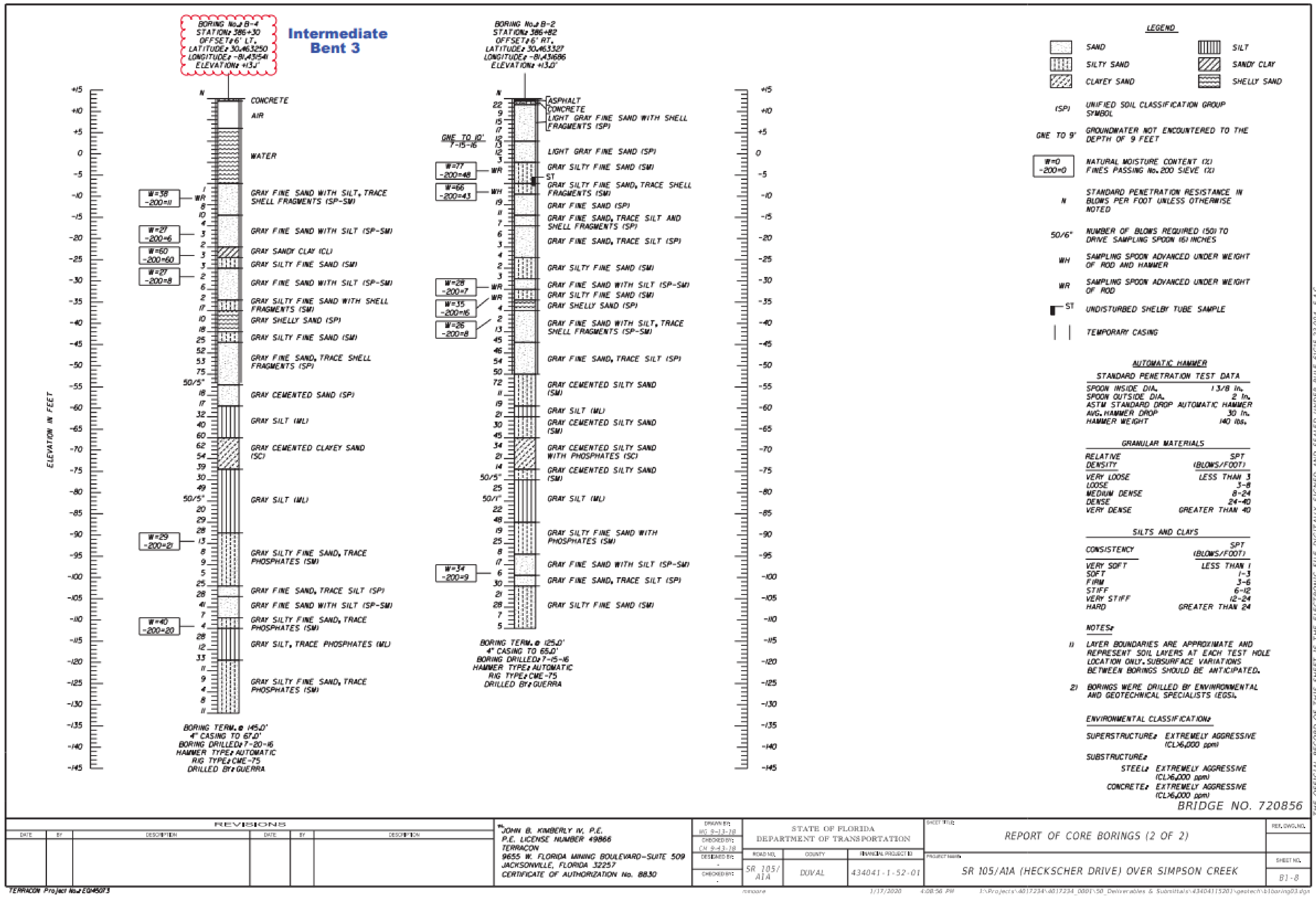


Figure B-98. Relevant boring logs from Simpson's Creek

B.9.2 Pile Driving Logs

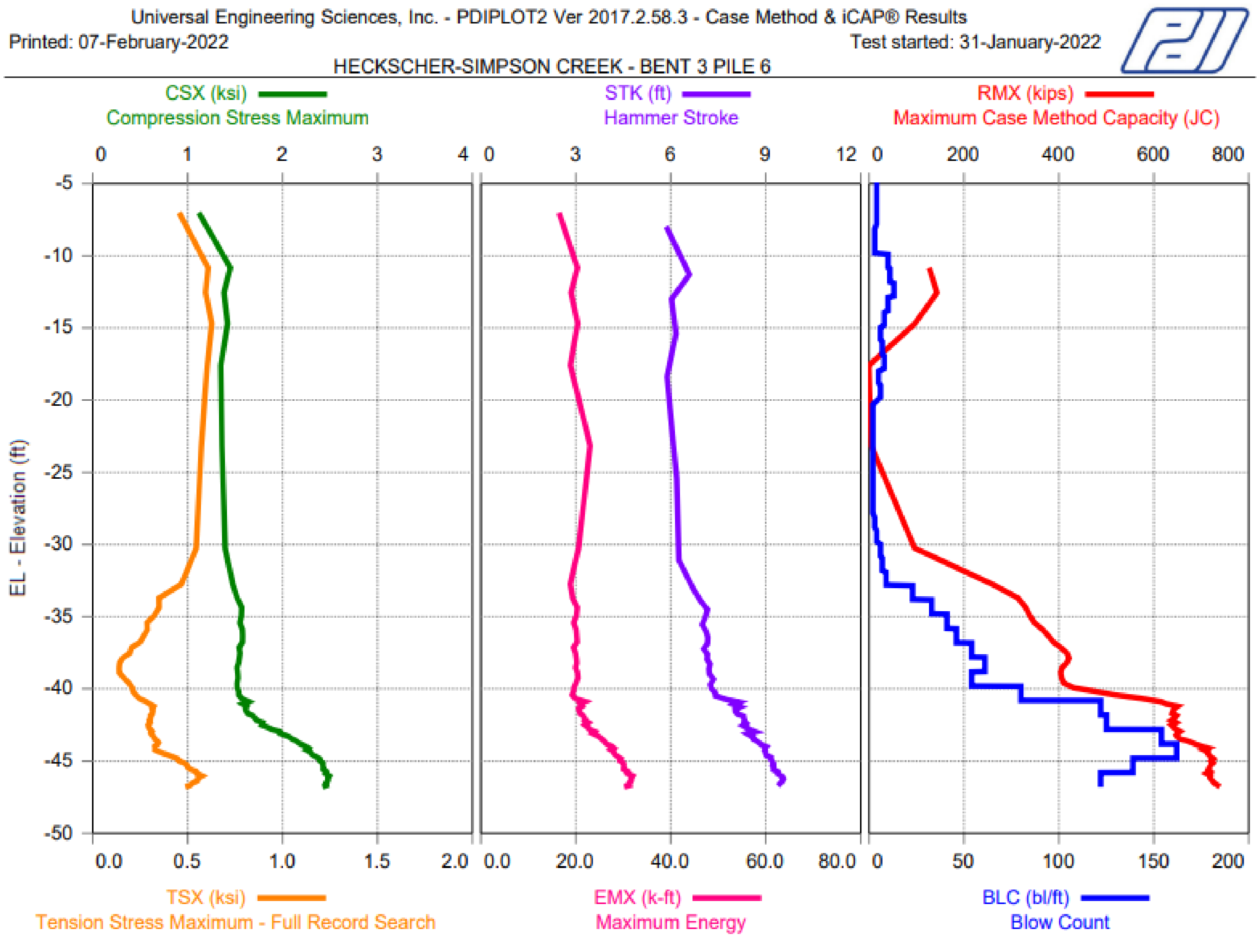


Figure B-99. PDA graphical data for Simpson's Creek

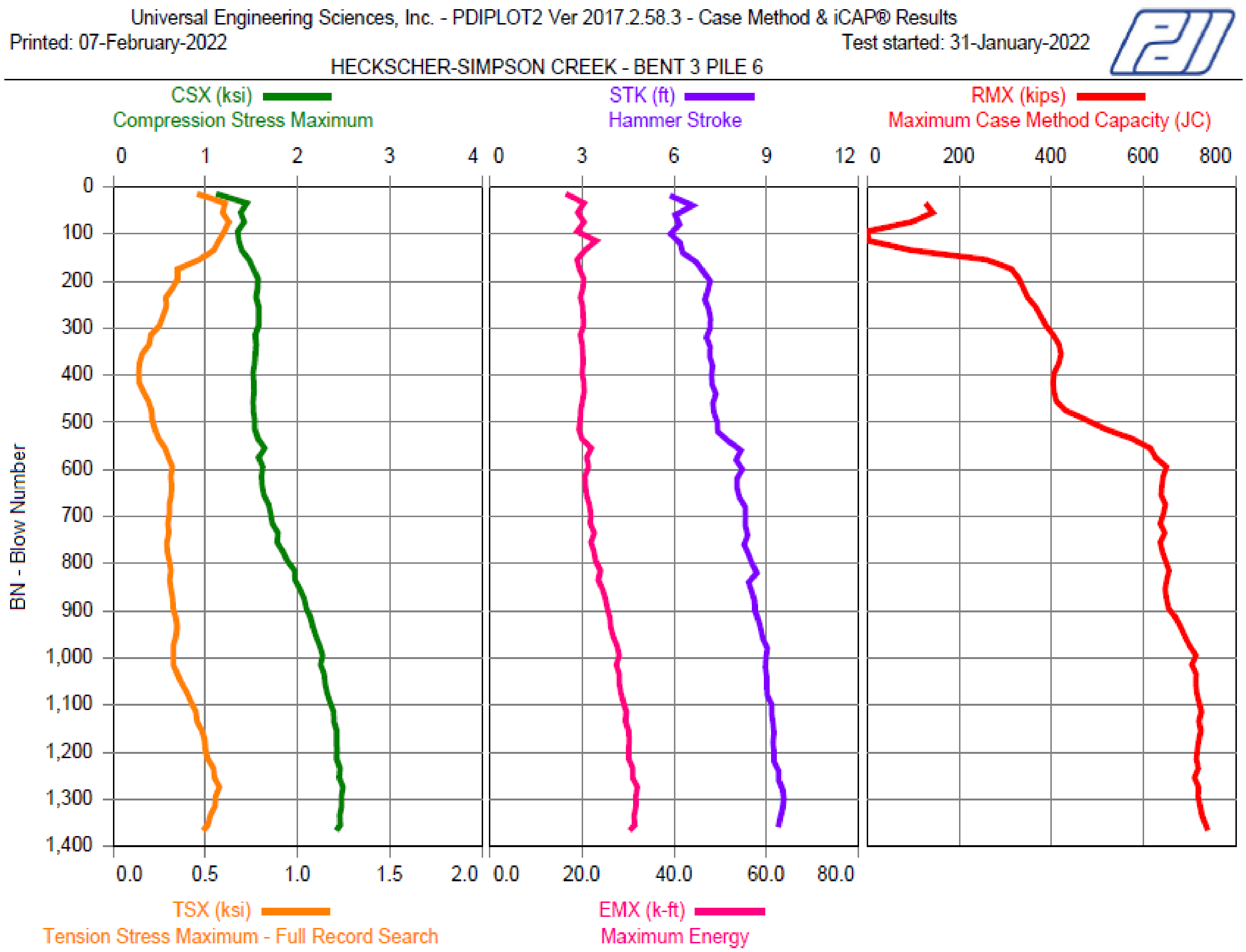
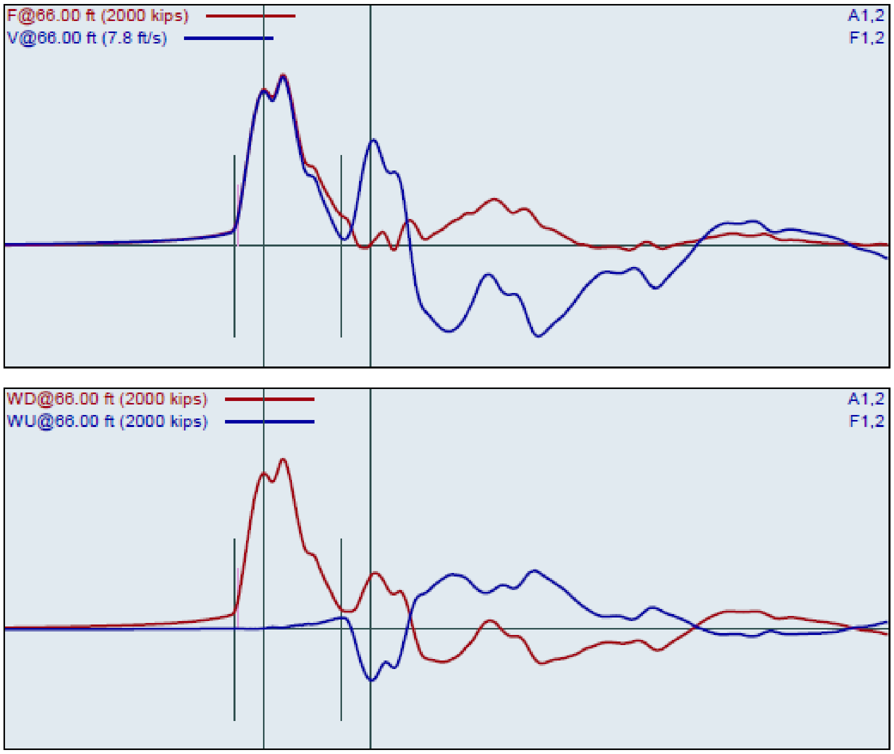


Figure B-100. Additional PDA graphical data for Simpson's Creek

Pile Dynamics, Inc.
Pile Driving Analyzer ® (PDA)
HECKSCHER-SIMPSON CREEK BENT 3 PILE 6



Project Information
PROJECT: HECKSCHER-SIMPSON CREEK
PILE NAME: BENT 3 PILE 6
DESC: BRIDGE 720856
PDA OWNER: Pile Dynamics, Inc.
SERIAL NUMBER: 3829L
OPERATOR: UES-DP
FILE: tmp5CA4.PDA
31Jan2022 11:03:49 AM
Blow number 1360

Pile Properties

LE	66.00 ft
AR	576.00 in^2
EM	6165 ksi
SP	0.150 k/ft3
WS	13800.0 ft/s
WC	13750.0 ft/s
EA/C	257.3 ksec/ft
2L/C	9.60 ms
JC	0.48
LP	50.93 ft

Quantity Results

CSX	2.5 ksi
CSI	3.0 ksi
CSB	1.7 ksi
TSX	0.5 ksi
STK	9.42 ft
EMX	31.3 k-ft
BTA	100.0 %
DMX	0.53 in
DBX	0.40 in
DFN	0.09 in
RMX	740 kips

Sensors
A1 (PR): [K11543] 412 mv/6.4v/5000g (0.99) VF6
A2 (PR): [K1366] 360 mv/6.4v/5000g (0.99) VF6
F1 : [S455] 92.4 PDICAL (1.01) FF6
F2 : [T984] 144.8 PDICAL (1.01) FF6
CLIP: OK

Version 2018.30

Figure B-101. Additional PDA graphical data for Simpson's Creek

HECKSCHER-SIMPSON CREEK; Pile: BENT 3 PILE 6 Test: 31-Jan-2022 11:03
BRIDGE 720856; Blow: 1360 CAPWAP(R) 2014-3
Universal Engineering Sciences, Inc. OP: UES-DP

CAPWAP SUMMARY RESULTS

Total CAPWAP Capacity: 740.0; along Shaft 295.0; at Toe 445.0 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf	Smith Damping Factor s/ft
				740.0				
1	19.8	4.7	0.0	740.0	0.0	0.00	0.00	0.00
2	26.4	11.3	9.7	730.3	9.7	1.47	0.18	0.20
3	33.0	17.9	14.5	715.8	24.2	2.20	0.27	0.20
4	39.6	24.5	24.1	691.7	48.3	3.65	0.46	0.20
5	46.2	31.1	37.3	654.4	85.6	5.65	0.71	0.20
6	52.8	37.7	58.1	596.3	143.7	8.80	1.10	0.20
7	59.4	44.3	73.0	523.3	216.7	11.06	1.38	0.20
8	66.0	50.9	78.3	445.0	295.0	11.86	1.48	0.20
Avg. Shaft			36.9			5.79	0.72	0.20
Toe			445.0				111.25	0.10

Soil Model Parameters/Extensions		Shaft	Toe
Quake	(in)	0.18	0.41
Case Damping Factor		0.23	0.17
Damping Type		Viscous	Sm+Visc
Unloading Quake	(% of loading quake)	100	75
Reloading Level	(% of Ru)	100	100
Unloading Level	(% of Ru)	33	
Resistance Gap (included in Toe Quake) (in)			0.00
Soil Plug Weight	(kips)		0.600

CAPWAP match quality = 2.99 (Wave Up Match) ; RSA = 0
Observed: Final Set = 0.10 in; Blow Count = 122 b/ft
Computed: Final Set = 0.10 in; Blow Count = 122 b/ft
Transducer F1 (S455) CAL: 92.4; RF: 1.01; F2 (T984) CAL: 144.8; RF: 1.01
A1 (K11543) CAL: 412; RF: 0.99; A2 (K1366) CAL: 360; RF: 0.99

max. Top Comp. Stress = 2.5 ksi (T= 39.4 ms, max= 1.033 x Top)
max. Comp. Stress = 2.5 ksi (Z= 33.0 ft, T= 41.5 ms)
max. Tens. Stress = -0.49 ksi (Z= 13.2 ft, T= 46.1 ms)
max. Energy (EMX) = 31.2 kip-ft; max. Measured Top Displ. (DMX)= 0.53 in

Figure B-102. Additional PDA graphical data for Simpson’s Creek

Excel 2016 (v 16.0)

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

700-010-60
Construction
Oct-20

PILE DRIVING LOG

Structure No: 720856

Page No: 1 of 4

PROJECT No: 434041-1-52-01 Date: 1/31/22 Station No: 386+39.11

PILE Size/Type: 24" SQ PCP Length (ft): 70.00 Bent/Pier No: 3 PILE No: 6

HAMMER Make/Model: APE D36-32 S/N: 521374 Rated Energy (ft-lbs): 103855 Operating Rate (BPM): 34-53

REF Elev: +4.16 (REF 2) MIN TIP Elev: -45.00 PILE CUTOFF Elev: +10.26

DRIVING CRITERIA (DC): DC2 Elev: N/A

Type: Prod - Dyn. Test DC1 only, DC2 table n/a

DC Max Stk: N/A Min Stk req'd for PR: N/A

Notes: Production pile driven with PDA (UES) by Contractor

SC criteria (if applic): N/A bpi @ N/A ft Stk

DC1			DC2, input if applic.		
(1)	blows @	ft.	(6)	blows @	ft.
(2)	blows @	ft.	(7)	blows @	ft.
(3)	blows @	ft.	(8)	blows @	ft.
(4)	blows @	ft.	(9)	blows @	ft.
(5)	blows @	ft.	(10)	blows @	ft.

SCOUR Elev: -13.20

PILE CUSHION Thickness & Material: 12" plywood

HAMMER CUSHION Thickness & Material: 3.5" Aluminum, Micarta

Pile Activity	Date	Start Time	Stop Time	Weather	Temp °F	Notes
Stand Pile	1/31/22	8:31 AM	8:55 AM	Partly Cloudy	48	
DRIVE Pile	1/31/22	10:28 AM	11:04 AM	Clear	57	2,3

PILE DATA:

PAY ITEM No: 455-34--5 WORK ORDER No: N/A

MANUFACTURED By: S&S Manufacturing MFR's PILE No: 7 DATE CAST: 1/12/22

TBM/BM Elev: +12.79 TBM/BM Rod Read: 3.75 H.I. Elev: +16.54

PRE-DRILLED Elev: N/A GROUND Rod Read: 18.38 GROUND Elev: -1.85

PREFORMED Elev: N/A Bottom of Excav Rod Read: N/A Bottom of Excav Elev: N/A

PILE HEAD Rod Read: -6.62 PILE HEAD Elev: +23.16 PILE TIP Elev: -46.85

PH Elev: H.I. EL - PH Rod Read = +23.155 REF-LP+PL =+70

Top of SOIL PLUG Elev (for Open Ended Pipe Piles & H-piles): N/A Natural Ground Elev: N/A

Input 'Natural Ground EL' ONLY when natural ground surface is below embankment/fill material. Otherwise, leave this cell BLANK

SPLICE / EACH	PREFORMED HOLE	DYNAMIC LOAD TEST	PAY SET CHECK	NO PAY SET CHECK	REDRIVE	EXTRACTION	DRIVING OF SPLICE	PILE TYPE CODE	Plumb or Batter ? (click & select) ↓	PILE LENGTH (ft) ORIGINAL FURNISHED	PILE LENGTH (ft) TOTAL LENGTH WITH EXTENSION	Pile PENETRATION below SCOUR (ft)	EXTENSION/BUILD UP AUTHORIZED (ft)	EXTENSION/BUILD UP ACTUAL (ft)
									PLUMB					
0	0	0	0	0	0	0	0	1		70.00	70.00	33.65	0.00	0.00

Pile PENETRATION (ft), below: GROUND: 45.01 ft SCOUR: 33.65 ft

CTQP Trainee (supervised by the Qualified Inspector) experiencing the full pile installation & log inspection:

Name: Rion Longfellow

TIN: L52172797

Qualified Inspector - I certify the Pile Driving Log content, and as applicable, the above CTQP Trainee's participation during this pile installation:

Name & TIN: Tance Singletary / S52481363

Signature: Tance Singletary

Figure B-103. Additional PDA graphical data for Simpson's Creek

DC: STATE OF FLORIDA DOT Min Tip 1 ft to c/o c/o 700-010-60

Construction

Oct-20

PILE DRIVING LOG

Page No: 2 of 4

Structure No.: 720856 Depth Table Extended (ft): Bent/Pier No.: 3 Pile No.: 6

Depth (Input Start LP↓)	Blows	Stroke	Eq. Stke. & Notes	Depth	Blows	Stroke	Eq. Stke. & Notes	Depth	Blows	Stroke	Eq. Stke. & Notes
5.00 - 6.00			2, F2 #NAME?	38.00 - 39.00	33	6.38	#NAME?	-			#NAME?
6.00 - 7.00			↓ #NAME?	39.00 - 40.00	41	6.96	#NAME?	-			#NAME?
7.00 - 8.00			↓ #NAME?	40.00 - 41.00	46	6.47	#NAME?	-			#NAME?
8.00 - 9.00			↓ #NAME?	41.00 - 42.00	54	6.65	F3 #NAME?	-			#NAME?
9.00 - 10.00			↓ #NAME?	42.00 - 43.00	61	6.89	#NAME?	-			#NAME?
10.00 - 11.00			↓ #NAME?	43.00 - 44.00	54	6.47	#NAME?	-			#NAME?
11.00 - 12.00			↓ #NAME?	44.00 - 45.00	80	6.48	#NAME?	-			#NAME?
12.00 - 13.00			↓ #NAME?	45.00 - 46.00	122	7.58	F4 #NAME?	-			#NAME?
13.00 - 14.00			↓ #NAME?	46.00 47.00	125	8.5	#NAME?	-			#NAME?
14.00 - 15.00			↓ #NAME?	47.00 - 48.00	154	8.75	#NAME?	-			#NAME?
15.00 - 16.00	11	5.4	#NAME?	48.00 - 49.00	162	9	#NAME?	-			#NAME?
16.00 - 17.00			↓ #NAME?	49.00 - 50.00	139	9.3	#NAME?	-			#NAME?
17.00 - 18.00	10	6.29	#NAME?	50.00 - 51.00	122	9.5	ST, 3 #NAME?	-			#NAME?
18.00 - 19.00	8	5.79	#NAME?	**51.00** 51.06	12	8.27	SC, ST, 4 #NAME?	-			#NAME?
19.00 - 20.00	6	5.95	#NAME?	**51.06** - 52.00			#NAME?	-			#NAME?
20.00 - 21.00	7	6.18	#NAME?	52.00 - 53.00			#NAME?	-			#NAME?
21.00 - 22.00	8	4.4	#NAME?	53.00 - 54.00			#NAME?	-			#NAME?
22.00 - 23.00	5	5.94	#NAME?	54.00 - 55.00			#NAME?	-			#NAME?
23.00 - 24.00	6	5.4	#NAME?	55.00 - 56.00			#NAME?	-			#NAME?
24.00 - 25.00			↓ #NAME?	56.00 - 57.00			#NAME?	-			#NAME?
25.00 - 26.00			↓ #NAME?	57.00 - 58.00			#NAME?	-			#NAME?
26.00 - 27.00			↓ #NAME?	58.00 - 59.00			#NAME?	-			#NAME?
27.00 - 28.00			↓ #NAME?	59.00 - 60.00			#NAME?	-			#NAME?
28.00 - 29.00			↓ #NAME?	60.00 - 61.00			#NAME?	-			#NAME?
29.00 - 30.00			↓ #NAME?	61.00 - 62.00			#NAME?	-			#NAME?
30.00 - 31.00			↓ #NAME?	62.00 - 63.00			#NAME?	-			#NAME?
31.00 - 32.00			↓ #NAME?	63.00 - 64.00			#NAME?	-			#NAME?
32.00 - 33.00			↓ #NAME?	64.00 - 65.00			#NAME?	-			#NAME?
33.00 - 34.00			↓ #NAME?	65.00 - 66.00			#NAME?	-			#NAME?
34.00 - 35.00			↓ #NAME?	66.00 - 67.00			#NAME?	-			#NAME?
35.00 - 36.00	7	6.04	#NAME?	67.00 - 68.00			#NAME?	-			#NAME?
36.00 - 37.00	9	6.48	#NAME?	68.00 - 69.00			#NAME?	-			#NAME?
37.00 - 38.00	23	6.7	#NAME?	-			#NAME?	-			#NAME?

Figure B-104. Additional PDA graphical data for Simpson’s Creek

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

700-010-60
Construction
Oct-20

PILE DRIVING LOG

Structure No: 720856

Page No: 3 of 4
REF inputs & Notes

PROJECT No: 434041-1-52-01

Bent/Pier No: 3

PILE No.: 6

REF No.	Input REF EL ↓	*Calculated LP values for each REF used LP min tip	LP c/o-1	LP c/o	Input REF description (template, stringline, etc.) for each REF used: ↓
1					Top Template / Roller
2	+4.16	49.16	62.90	63.90	Bottom Template/ Roller
3	+9.16	54.16	67.90	68.90	
4					
5					

Standard Notes & Note No.'s 1-28

Std. Notes:	↓ = Pile Ran, F1, F2, F3, F4 = (Fuel Settings 1-4), ST = stop, CC = cushion change, HR = high rebound, TP = Test Pile, DC = Driving Criteria, PR = Practical Refusal, SC = set check, DLT = Dyn. Load Test
Note 1:	Received and unloaded pile on 1/27/22
Note 2:	Started Driving 10:28am, F2
Note 3:	ST 11:04am, QC accepted PDA Results
Note 4:	SC performed by FDOT, Started Driving 10:49am, ST 10:51am
Note 5:	
Note 6:	
Note 7:	
Note 8:	
Note 9:	
Note 10:	
Note 11:	
Note 12:	
Note 13:	
Note 14:	
Note 15:	
Note 16:	
Note 17:	
Note 18:	
Note 19:	
Note 20:	
Note 21:	
Note 22:	
Note 23:	
Note 24:	
Note 25:	
Note 26:	
Note 27:	
Note 28:	

Figure B-105. Additional PDA graphical data for Simpson's Creek

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

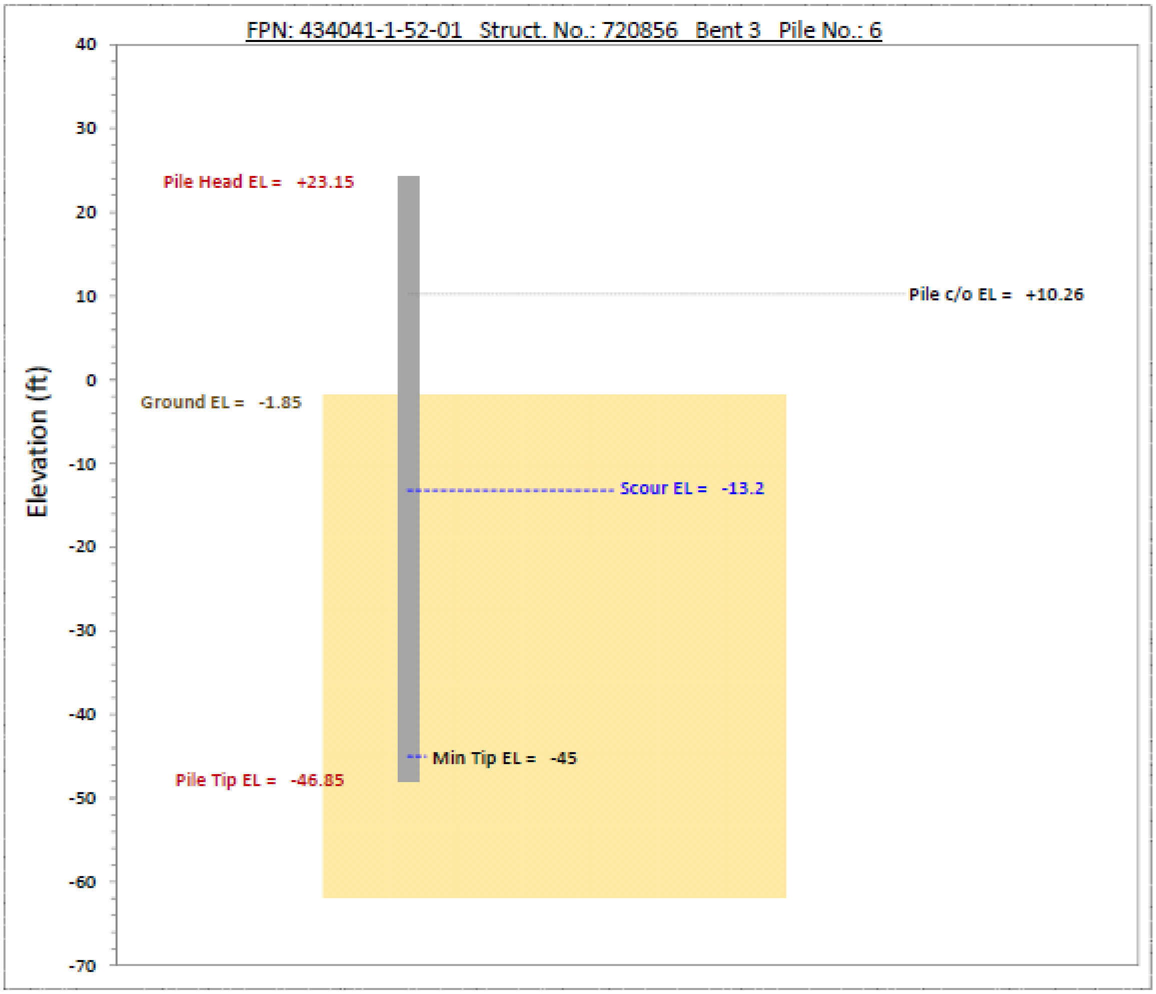
700-010-60
Construction
Oct-20

PILE DRIVING LOG

Structure No: 720856   Page No: 4 of 4

Sketch

PROJECT No: 434041-1-52-01   Bent/Pier No: 3   PILE No.: 6



PLUMB pile, as depicted in this Pile Sketch

Pile Bearing: (click on yellow shaded cell below, and select basis for Pile Bearing acceptance that applies)

Pile bearing capacity determined by Dynamic Testing.

Pile Penetration:

Pile Tip EL ≤ bottom EL of Preformed or Predrilled pile hole, meets 455-5 Penetration Requirements.

Current Pile Tip EL ≤ Min Tip EL in plans, meets 455-5 Penetration Requirements.

Min Tip EL is input on the log. Therefore, the 10-20 ft of penetration into firm/soft material, in accordance with 455-5 Penetration Requirements, does not apply.

Figure B-106. Additional PDA graphical data for Simpson's Creek

B.10 Loxahatchee River Bridge

B.10.1 Pile driving Installation Plan form

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

PILE DRIVING INSTALLATION PLAN FORM

700-020-01
CONSTRUCTION
08/16

Contract No. T4564 Structure Name or No. 930562
FIN Project No. 428400-2-52-01,52-02,52-03,443867-1-52-01 County Palm Beach
Pile Driving Contractor Johnson Bros. Corporation, a Southland Company

HAMMER COMPONENTS
Manufacturer Pileco Model D100-13 Serial No. ____
Type: Diesel X Single/Double acting ____ Air ____ Hydraulic ____ Compressor ____
Rated Energy 246,006 ft-lbs at Fuel Setting #4
Length Stroke
Ram Weight 22,046 lbs Pile Cap Weight 4630 lbs
Modifications ____

HAMMER CUSHION (CAPBLOCK)
Material 30" Primary Helmet with 8"x23" diameter striker plate 3 each 1/2" x 23" dia. Aluminum plates and 2 each 1" x 23" dia Conbest Cushion Diameter/Width 30" Thickness 3.5"
PILE CAP (HELMET, BONNET, ANVIL BLOCK & DRIVEN HEAD)
Inside Diameter or Width 30.25" Total Weight 14,257 lbs Inside Height 21"
PILE CUSHION
Material Plywood Diameter/Width 30" Area 900 sq in Thickness 12 in

PILE
Nominal Bearing Resistance or Ultimate Capacity 530 TN
Type: PCP X Cylinder ___ Steel H ___ Steel Pipe: Open-Ended ___ Closed-Ended ___ Taper ___ Timber ___
Length 130' (varies on bents) Diameter/Width 30" Area 900 sq in Wall Thickness N/A Bottom Plate Thickness N/A
Comments ____
PILE INSTALLATION
Crane: Mobile/Crawler Manitowoc 2250 Lattice Boom Crawler Crane Size 300T
Leads: Fixed ____ Swinging X Semifixed ____
Template (attach sketches) Fixed to Ground Via Jig Fixed to Existing Structure ____ Comments See Sketches

Barge: ☒ Yes ☐ No Description JBC-007, 140' x 64' x 7'
Setting Pile: Predrill ____ Preform X Water Jet ____ Punch ____ Vibratory hammer X
Comments Preform is necessary
Drill/Jet Equipment Hain Drill
Drilling Depth & Size 48" -55'
Underwater driving: ☐ Yes ☒ No Follower: (attach sketch) ____ Length ____ Height ____
Special Driving Requirements: ☐ Yes ☒ No Comments ____
Pile Driving Vibrations: Settlement Monitoring X Vibration Monitoring X Existing structures survey X
(Attach details of procedures for protection of existing structures including any special protection measures)
Comments Preconstruction surveys completed
Method of Determining Production Pile Capacity
Stroke vs. Blows: Saximeter X Bounce Pressure Gauge & Chart ____ 100% Dynamic Testing X
Comments ____

ATTACHMENTS CHECKLIST
- Manufacturer's Data sheets for the pile driving hammer attached: ☒ Yes ☐ No
- For Double Acting Diesel hammers, charts and recent pressure gauge calibrations attached: ☐ Yes ☐ No ☒ NA
- Details/sketches of followers attached: ☐ Yes ☐ No ☒ NA
- Details/sketches of Templates attached: ☒ Yes ☐ No
- Details of Load Test Equipment and procedures including calibrations of jacks and cells attached: ☐ Yes ☐ No ☒ NA
- Sequence of Pile Driving for each configuration of pile layout attached: ☐ Yes ☒ No
- Details of Proposed features and procedures for protection of existing structures attached: ☐ Yes ☒ No ☐ NA
- Required shop drawings for piles, cofferdams, etc. attached: ☐ Yes ☒ No
- Methods to prevent displacement piles during placement and compaction of fill within 15 ft attached: ☐ Yes ☒ No
- Methods to prevent deflection of battered piles during placement and maintain alignment until pile cap is complete attached: ☐ Yes ☐ No ☒ NA
- Proposed splice locations and details of any proprietary splices attached: ☐ Yes ☒ No ☐ NA
- Methods and equipment proposed prevent damage voided or cylinder pile attached: ☐ Yes ☒ No ☐ NA

Figure B-107. Pile driving installation plan form for Loxahatchee River Bridge

B.10.2 Driver Specifications

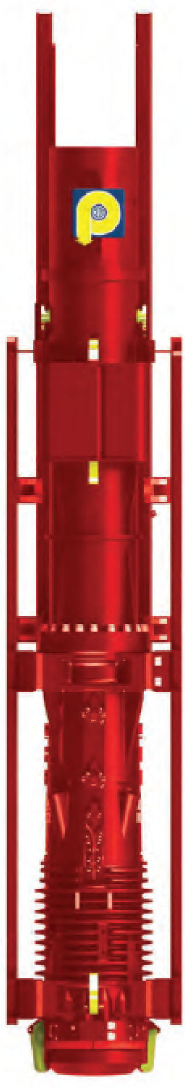
FOR 30" PILING

PILECO INC.

936.494.4200 *tel*
Sales@Pileco.com
www.Pileco.com

3321 E Davis St • Conroe, TX 77301

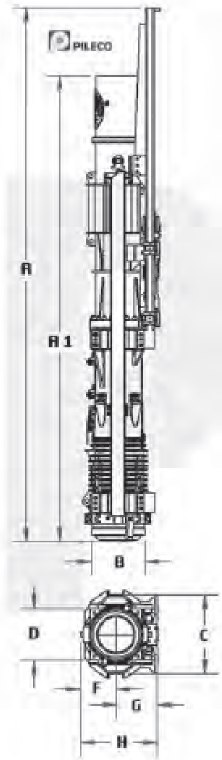
Specifications: D 100-13 Diesel Pile Hammer



Dimensions approx:			
Hammer Length:	A1	7370 mm	24' 2" ft
Hammer Length w/starter guides:	A	8416 mm	27' 7" ft
Outer diameter of impact block:	B	820 mm	2' 8" ft
Min. Guiding Width:	C	1067 mm	42" in
Width of Hammer:	D	900 mm	35.4" in
Hammer Center to Pump Guard:	F	549 mm	1' 10" ft
Hammer Center to Trip:	G	634 mm	2' 1" ft
Hammer Depth:	H	1186 mm	3' 11" ft

VIEW PARTS MANUAL HERE

Pump Setting 1	214.5 kNm	157,735 ft.lbs.
Pump Setting 2	258.7 kNm	190,210 ft.lbs.
Pump Setting 3	300.5 kNm	221,010 ft.lbs.
Pump Setting 4	334.5 kNm	246,006.47 ft.lbs.



Weights approx:		
Weight of diesel pile hammer approx.:	21.484 **US tons**	42,968 lbs
Weight of piston approx.:	10,000 kg	22,046.2 lbs
Impact Block approx.:	2100 kg	4630 lbs
Tripping device approx.:	870 kg	1,918 lbs
Tool box approx.:	125 kg	275.6 lbs
Energy Per Blow		
Max:	334.5 kNm	246,006.47 ft lbf
Min:	214.5 kNm	157,735 ft lbf
Number of blows:		36–45 min
Batter Info		
Max. gradient of batter pile driven:		1:5/1:2
Consumption		
Diesel fuel:	30 L hr.	7.93 gph
Lubrication oil:	2.9 L hr.	0.76 gph
Volume		
Diesel oil tank:	155 L	40.9 gal
Lube tank:	32 L	8.45 gal

3

Figure B-108. Driver specifications at Loxahatchee River Bridge

B.11 Manatee River Bridge

B.11.1 Pile driving Installation Plan form

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

PILE DRIVING INSTALLATION PLAN FORM

700-020-01
CONSTRUCTION
10/17

Contract No. E1R87
Structure Name or No. Bridge Nos. 130156 & 130157
FIN Project No. 201032-5-52-01, 201032-5-56-01, etc.
County Manatee
Pile Driving Contractor Leware Construction Co. of Florida, Inc.

HAMMER COMPONENTS
Manufacturer APE Model 62-52 Serial No. 586224
Type: Diesel Yes Single/Double acting Single Air ____ Hydraulic ____ Compressor ____
Rated Energy 164,052 ft.lbs. at 12'-0" Length Stroke
Ram Weight 13671 Anvil Weight (Impact Block) 2425
Modifications Fuel Settings @ 48%, 66%, 83%, and 100%

HAMMER CUSHION (CAPBLOCK)
Material Alum. (3 @ .5"), Micarta (2 @ 1") Diameter/Width 25" Thickness 3.5"
PILE CAP (HELMET, DRIVING CAP, STRIKER PLATE)
Inside Diameter or Width 26" Total Weight 6610 Inside Height 24"
PILE CUSHION
Material Plywood Diameter/Width 26" Area 676" sq Thickness 12"

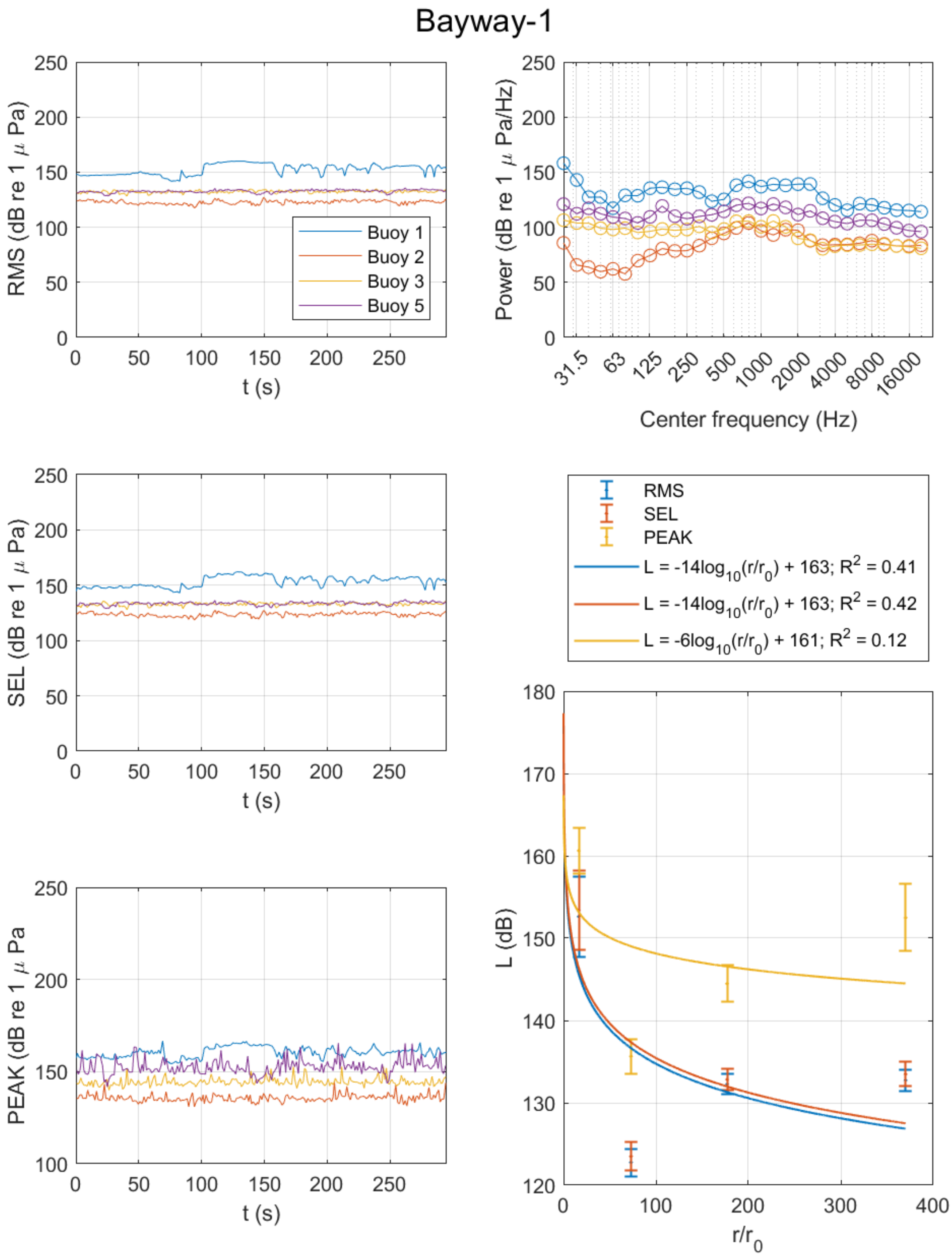
PILE
Nominal Bearing Resistance or Ultimate Capacity See attached Sheets B2-29 & B3-28 for NBR values
Type: PCP Yes Cylinder ___ Steel H ___ Steel Pipe: Open-Ended ___ Closed-Ended ___ Taper ___ Timber ___
Length See attached Sheets B2-29 & B3-28 for Pile Order Lengths Diameter/Width 24" Area 576" sq Wall Thickness ____ Bottom Plate Thickness ____
Comments See Tension Pile Detail on shets B2-30 & B3-29
PILE INSTALLATION
Crane: Mobile/Crawler Crawler, American 9299 or 9310 Size 165 or 225 ton
Leads: Fixed ____ Swinging Yes Semifixed ____
Template (attach sketches) Fixed to Ground Yes Fixed to Existing Structure ____ Comments Drawing will be submitted under separate cover
Barge: ☒ Yes ☐ No Description Poseidon Sectional Barge
Setting Pile: Predrill Yes Preform ____ Water Jet ____ Punch Yes Vibratory hammer ____
Comments Initially stand pile with penetration to min. tip elevation (approx.) See Note 12 on B2-29 & Note 11 on B3-28
Drill/Jet Equipment APE hydraulic drill (30")
Drilling Depth & Size 30" dia. Auger x 60 depth (Actual depth varies from 34' to 61')
Underwater driving: ☐ Yes ☒ No Follower: (attach sketch) n/a Length ____ Height ____
Special Driving Requirements: ☒ Yes ☐ No Comments See Sheets B2-29 & B3-28 for minimum tip elevations
Pile Driving Vibrations: Settlement Monitoring Yes Vibration Monitoring ____ Existing structures survey 130103 & 130104, Details to be provided under separate submittal
(Attach details of procedures for protection of existing structures including any special protection measures)
Comments In accordance with Section 108-2
Method of Determining Production Pile Capacity
Stroke vs. Blows: Saximeter Yes Bounce Pressure Gauge & Chart ____ 100% Dynamic Testing Yes
Comments PDA to be performed by Tierra

ATTACHMENTS CHECKLIST

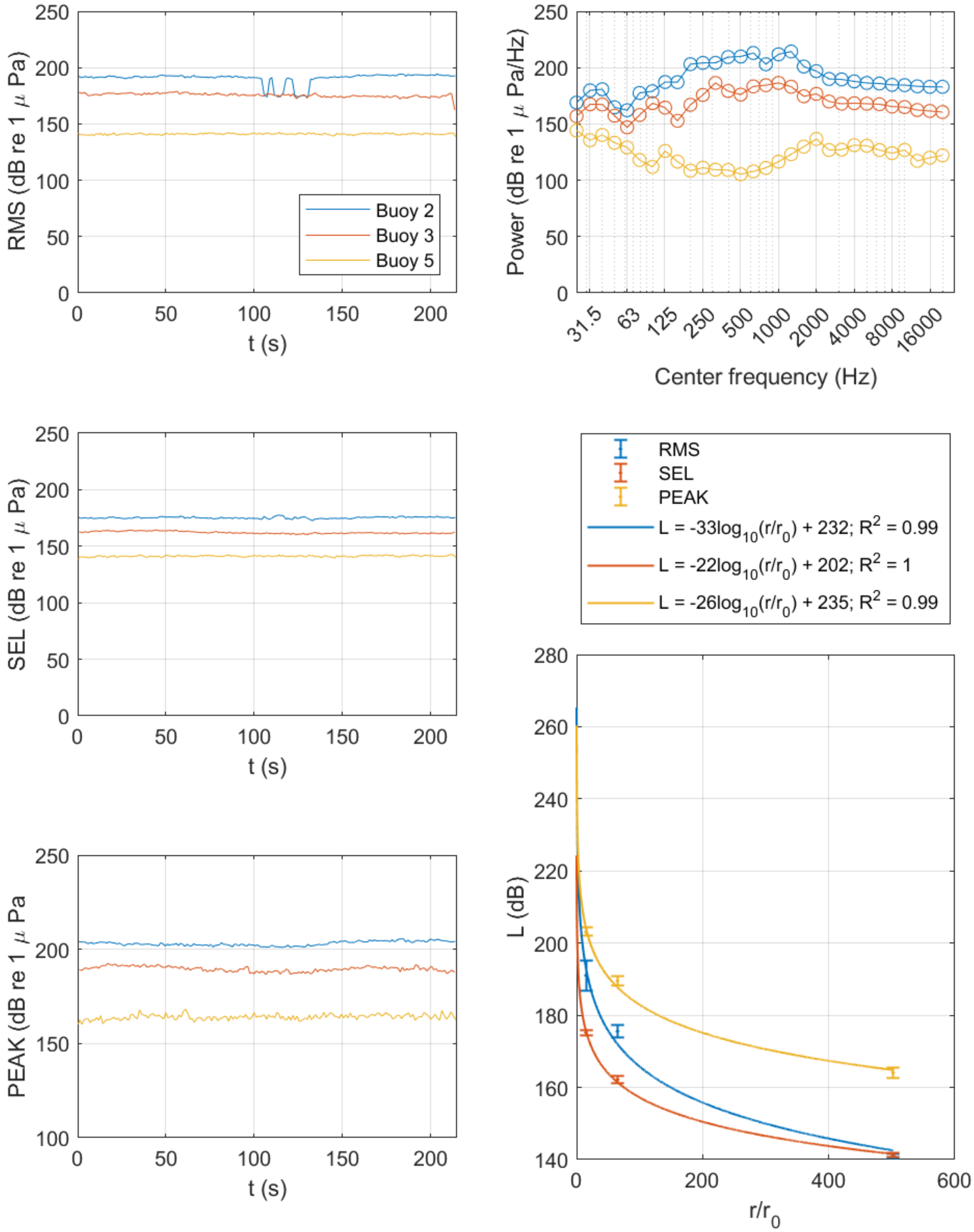
- Manufacturer's Data sheets for the pile driving hammer attached: ☒ Yes ☐ No
- For Double Acting Diesel hammers, charts and recent pressure gauge calibrations attached: ☐ Yes ☐ No ☒ NA
- Details/sketches of followers attached: ☐ Yes ☐ No ☒ NA
- Details/sketches of Templates attached: ☐ Yes ☒ No
- Details of Load Test Equipment and procedures including calibrations of jacks and cells attached: ☐ Yes ☐ No ☒ NA
- Sequence of Pile Driving for each configuration of pile layout attached: ☐ Yes ☒ No
- Details of Proposed features and procedures for protection of existing structures attached: ☐ Yes ☒ No ☐ NA
- Required shop drawings for piles, cofferdams, etc. attached: ☐ Yes ☒ No
- Methods to prevent displacement piles during placement and compaction of fill within 15 ft attached: ☒ Yes ☐ No
- Methods to prevent deflection of battered piles during placement and maintain alignment until pile cap is complete attached: ☐ Yes ☐ No ☒ NA
- Proposed splice locations and details of any proprietary splices attached: ☐ Yes ☐ No ☒ NA
- Methods and equipment proposed prevent damage voided or cylinder pile attached: ☐ Yes ☐ No ☒ NA

Figure B-109. Pile driving installation plan form for Manatee River Bridge

APPENDIX C
SOUND DECAY CURVES

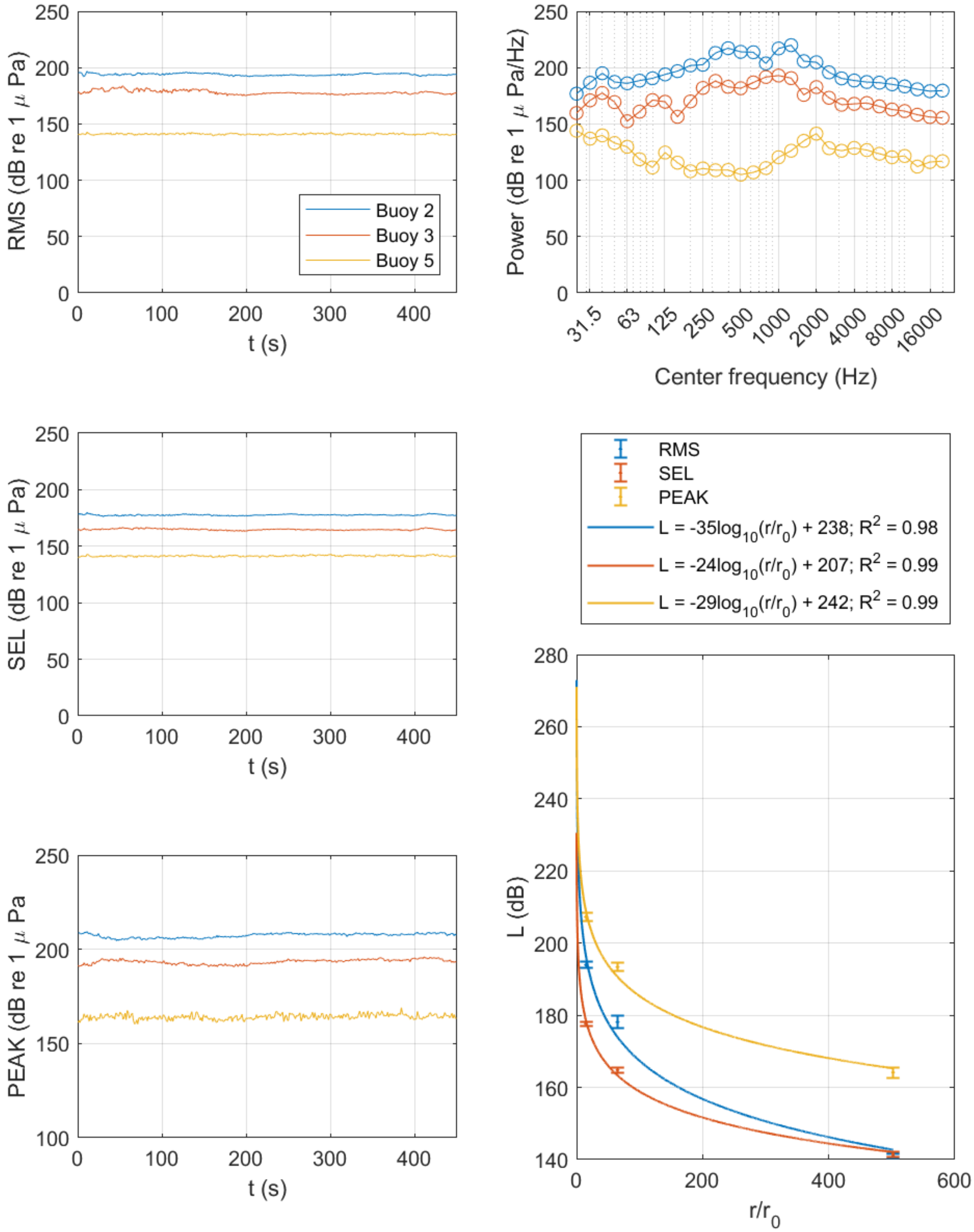

Bayway-1
RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -14log10(r/r0) + 163; R2 = 0.41
L = -14log10(r/r0) + 163; R2 = 0.42
L = -6log10(r/r0) + 161; R2 = 0.12
L (dB)
r/r0

Suwannee-1



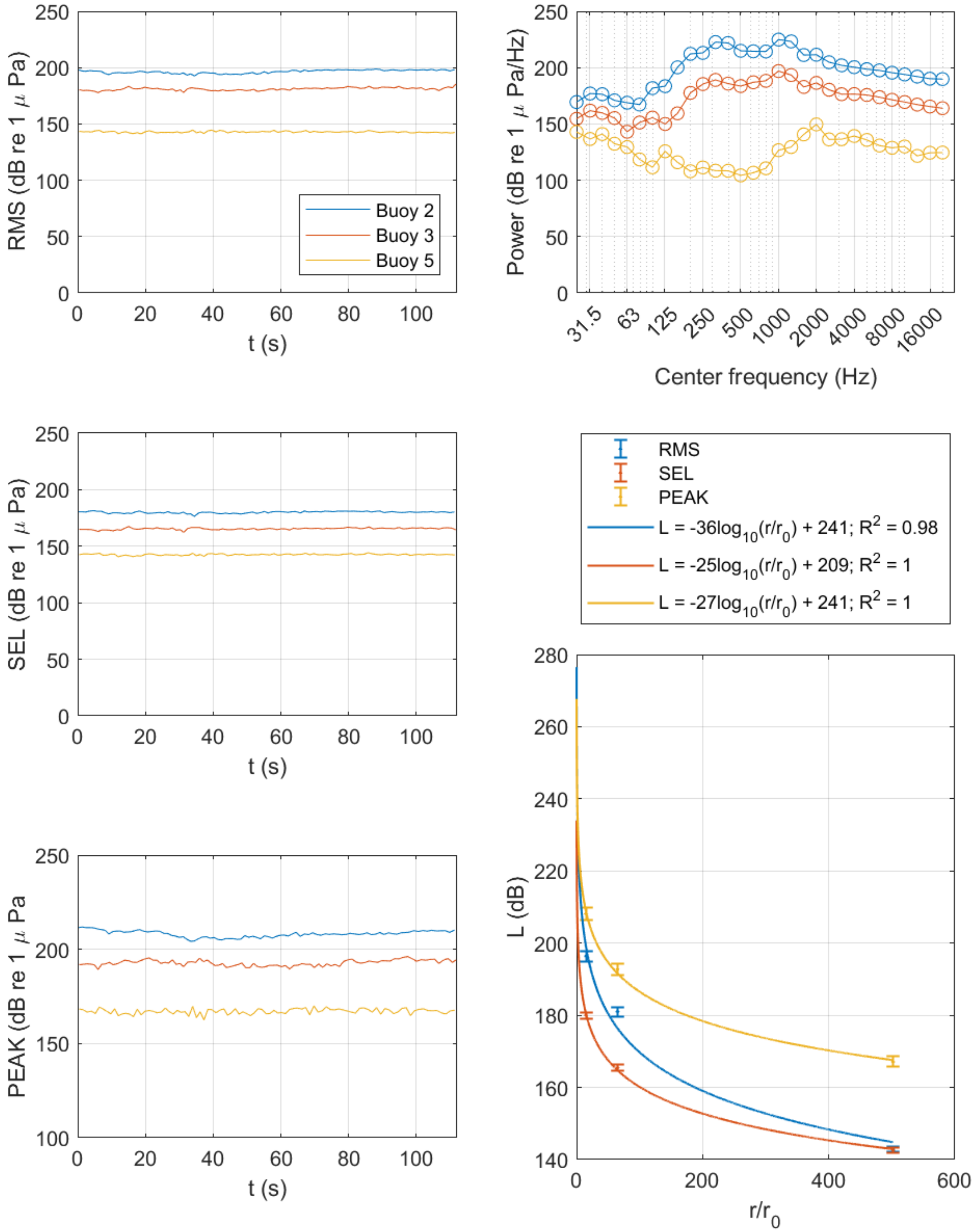
RMS (dB re 1 μ Pa)
t (s)
Buoy 2
Buoy 3
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -33log$_{10}$(r/r$_0$) + 232; R^2 = 0.99
L = -22log$_{10}$(r/r$_0$) + 202; R^2 = 1
L = -26log$_{10}$(r/r$_0$) + 235; R^2 = 0.99
L (dB)
r/r$_0$

Suwannee-2

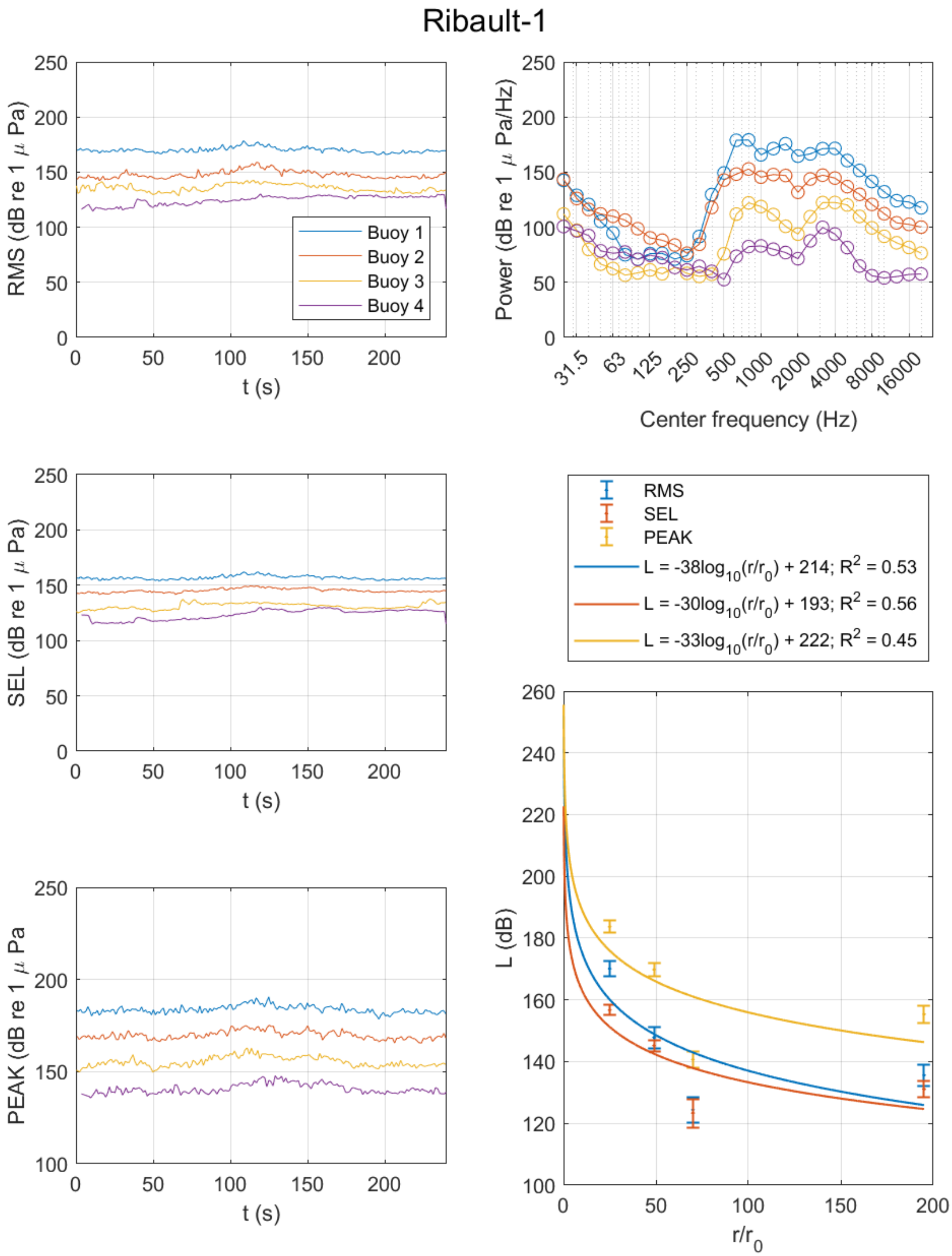


RMS (dB re 1 μ Pa)
t (s)
Buoy 2
Buoy 3
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
RMS
SEL
PEAK
L = -35log10(r/r0) + 238; R2 = 0.98
L = -24log10(r/r0) + 207; R2 = 0.99
L = -29log10(r/r0) + 242; R2 = 0.99
L (dB)
r/r0
PEAK (dB re 1 μ Pa

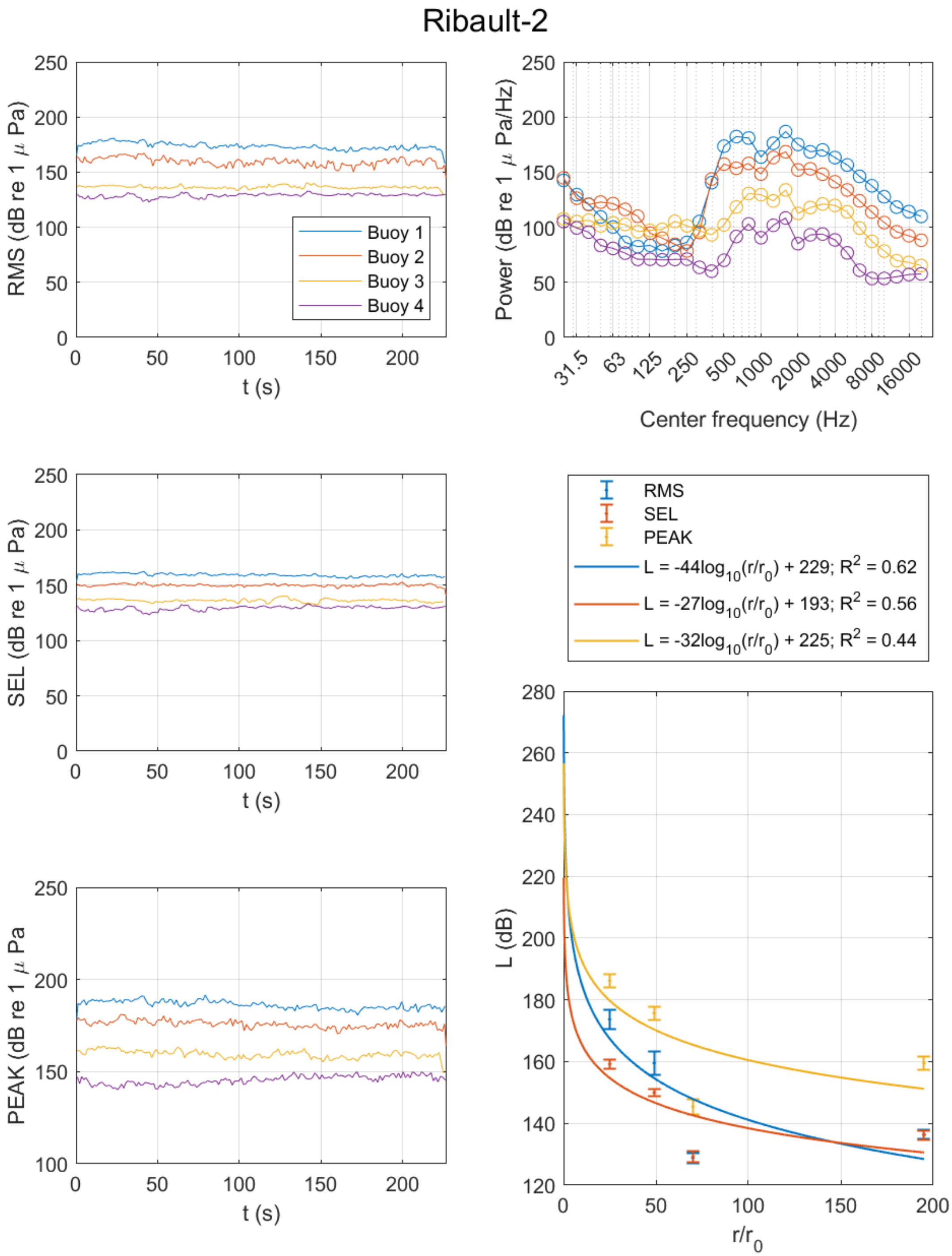
Suwannee-3



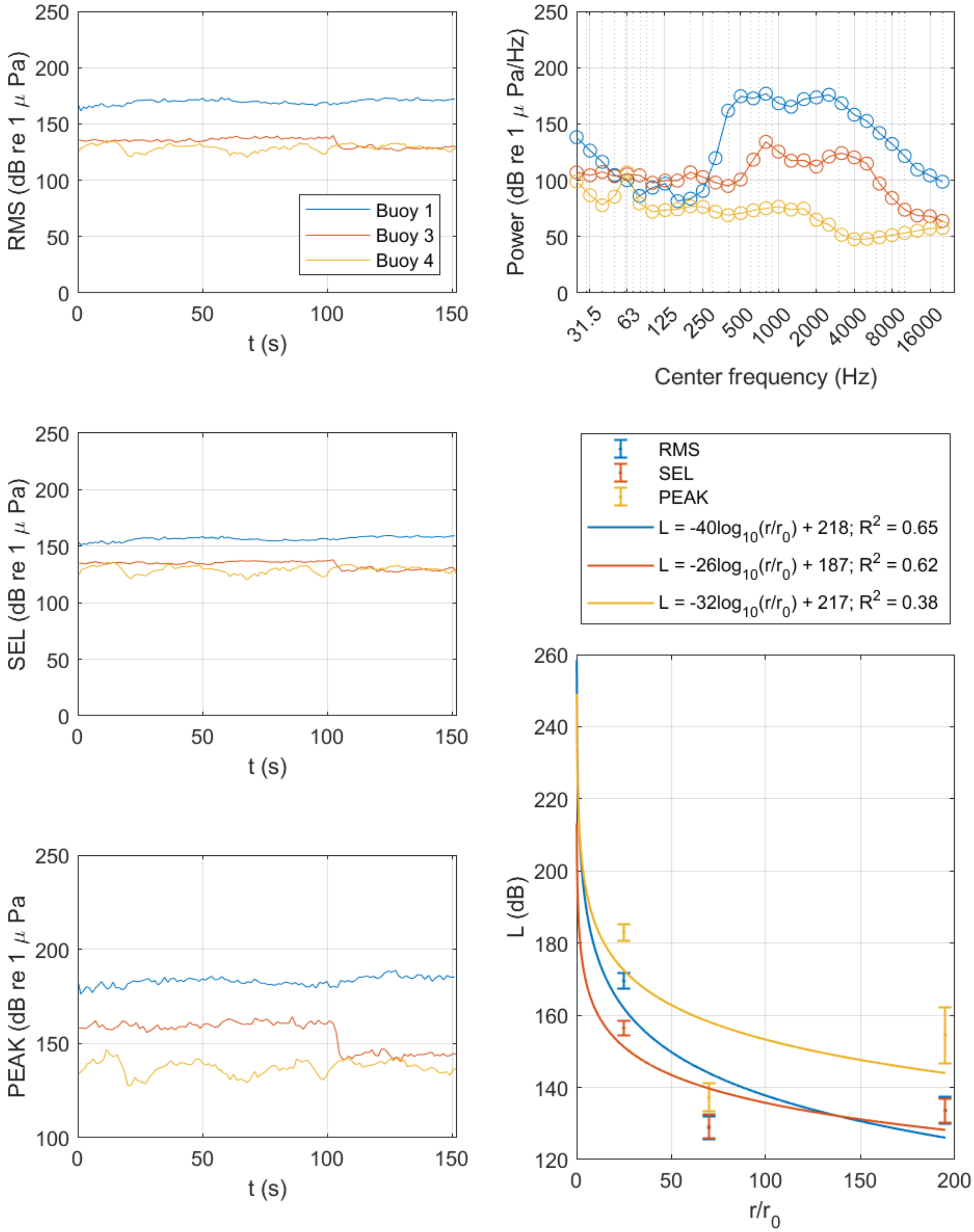
RMS (dB re 1 μ Pa)
t (s)
Buoy 2
Buoy 3
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -36log10(r/r0) + 241; R2 = 0.98
L = -25log10(r/r0) + 209; R2 = 1
L = -27log10(r/r0) + 241; R2 = 1
L (dB)
r/r0



Ribault-1
RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -38log$_{10}$(r/r$_0$) + 214; R^2 = 0.53
L = -30log$_{10}$(r/r$_0$) + 193; R^2 = 0.56
L = -33log$_{10}$(r/r$_0$) + 222; R^2 = 0.45
L (dB)
r/r$_0$

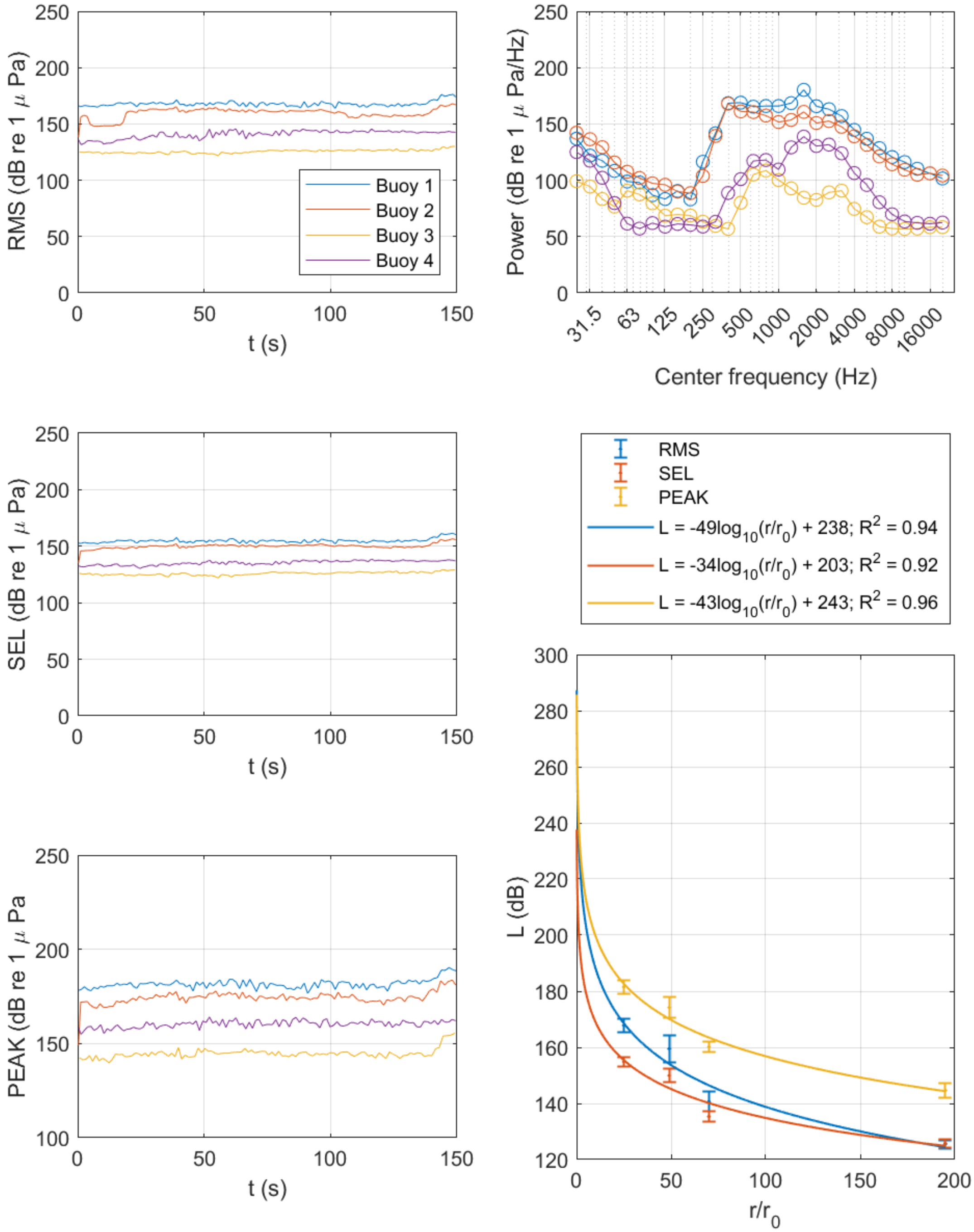

Ribault-2
RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -44log10(r/r0) + 229; R2 = 0.62
L = -27log10(r/r0) + 193; R2 = 0.56
L = -32log10(r/r0) + 225; R2 = 0.44
L (dB)
r/r0

Ribault-3



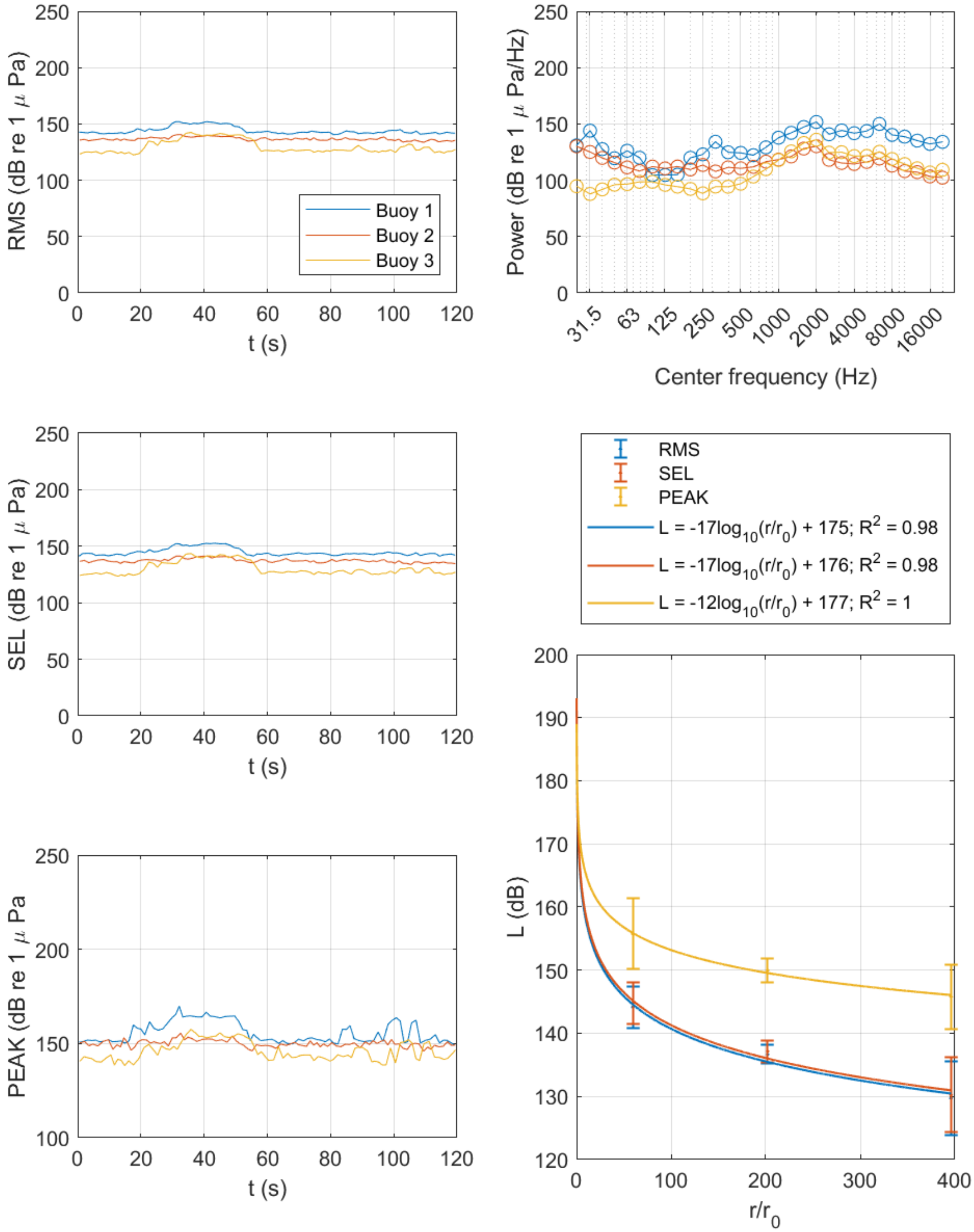
RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 3
Buoy 4
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -40log10(r/r0) + 218; R2 = 0.65
L = -26log10(r/r0) + 187; R2 = 0.62
L = -32log10(r/r0) + 217; R2 = 0.38
L (dB)
r/r0

Ribault-4

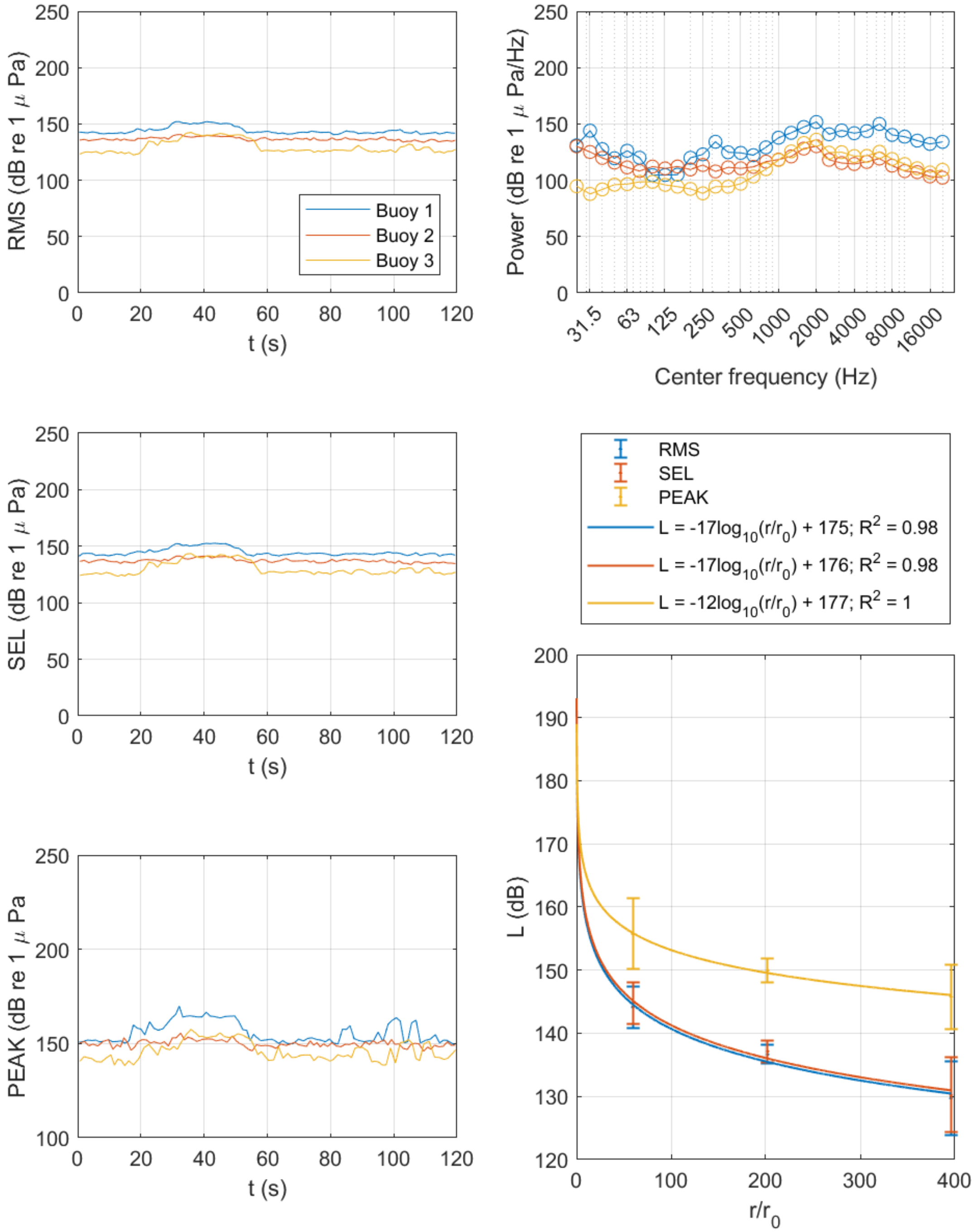


RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -49log10(r/r0) + 238; R2 = 0.94
L = -34log10(r/r0) + 203; R2 = 0.92
L = -43log10(r/r0) + 243; R2 = 0.96
L (dB)
r/r0

Dunns-1

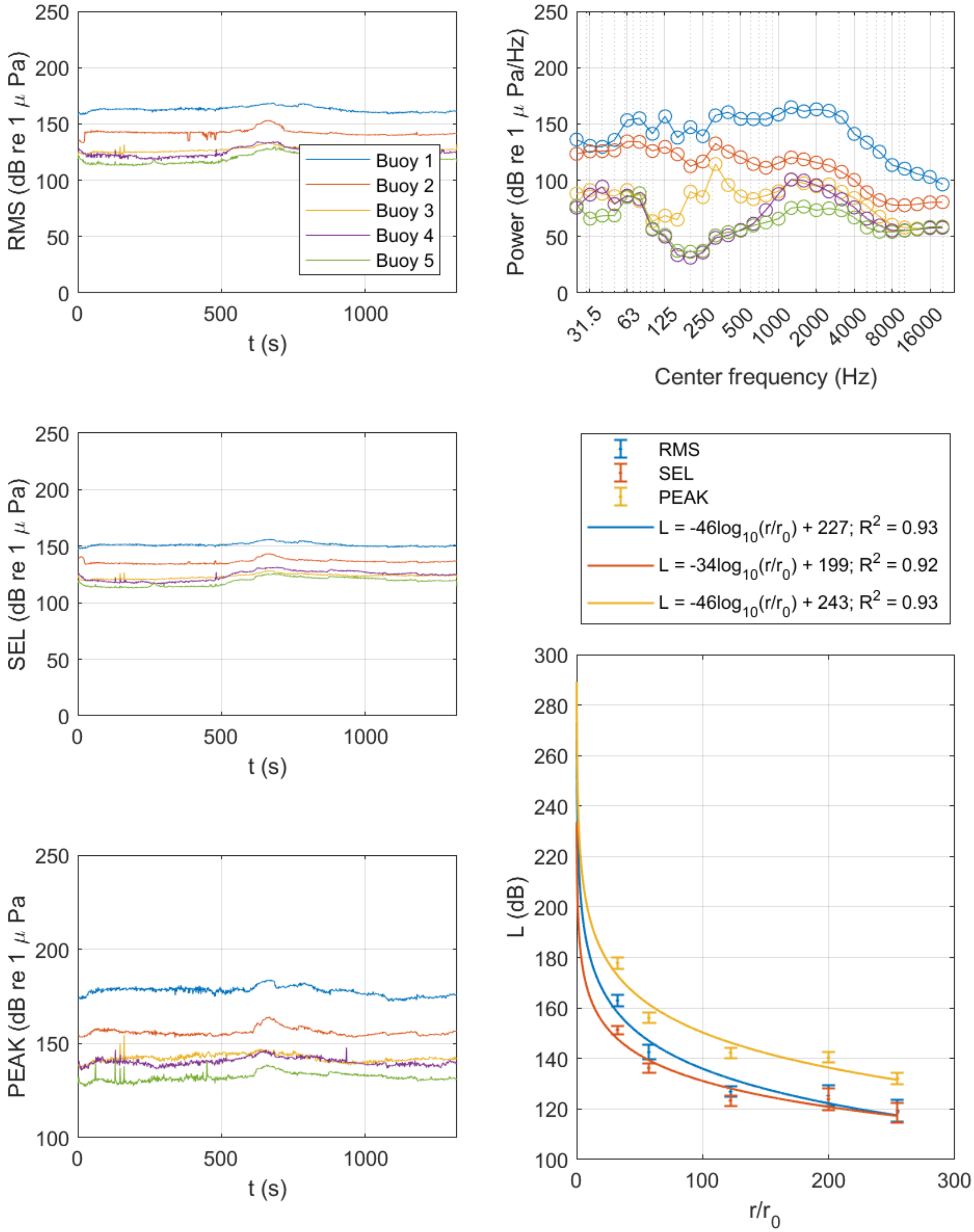

RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -17log10(r/r0) + 175; R2 = 0.98
L = -17log10(r/r0) + 176; R2 = 0.98
L = -12log10(r/r0) + 177; R2 = 1
L (dB)
r/r0

Dunns-2

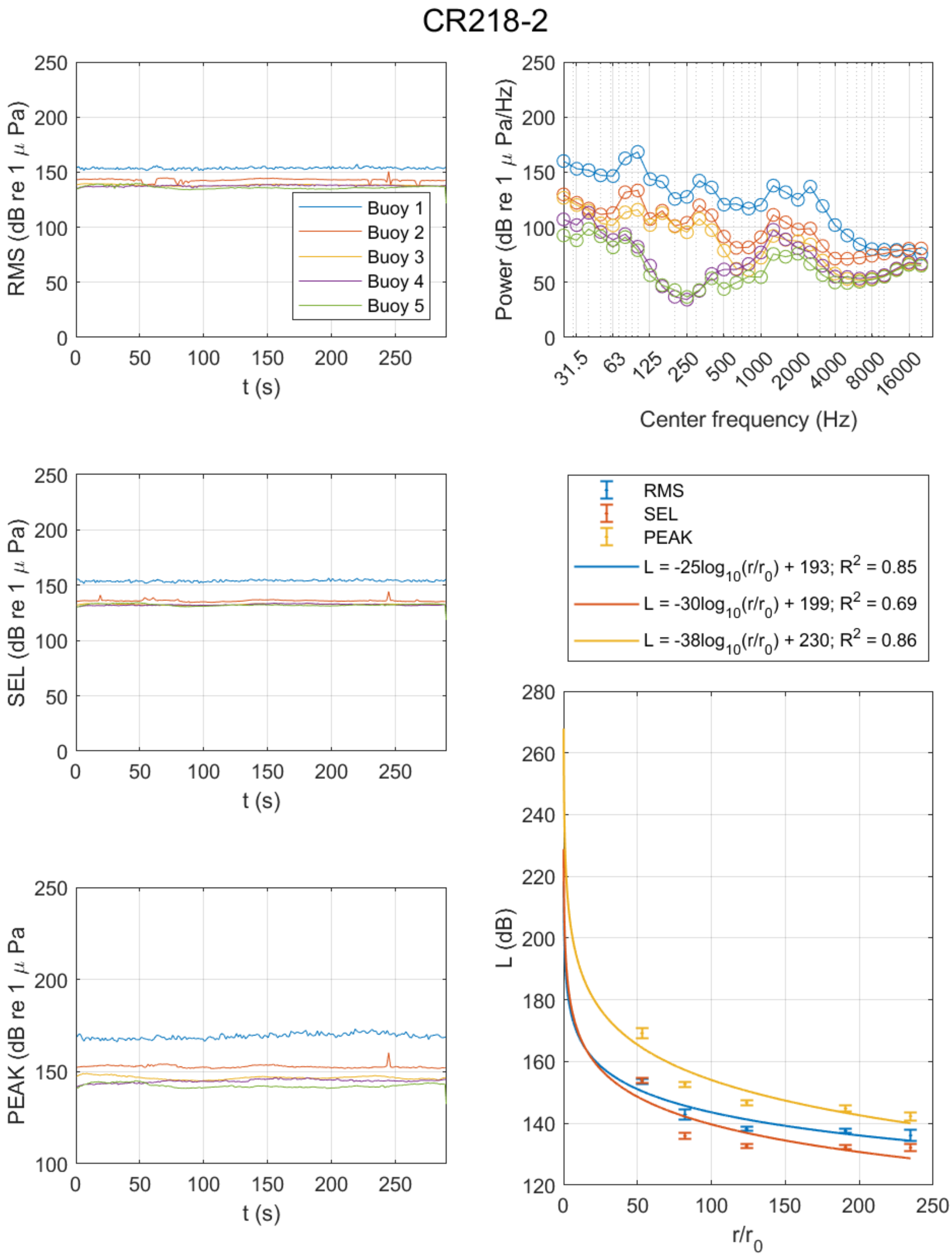


RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -17log10(r/r0) + 175; R2 = 0.98
L = -17log10(r/r0) + 176; R2 = 0.98
L = -12log10(r/r0) + 177; R2 = 1
L (dB)
r/r0

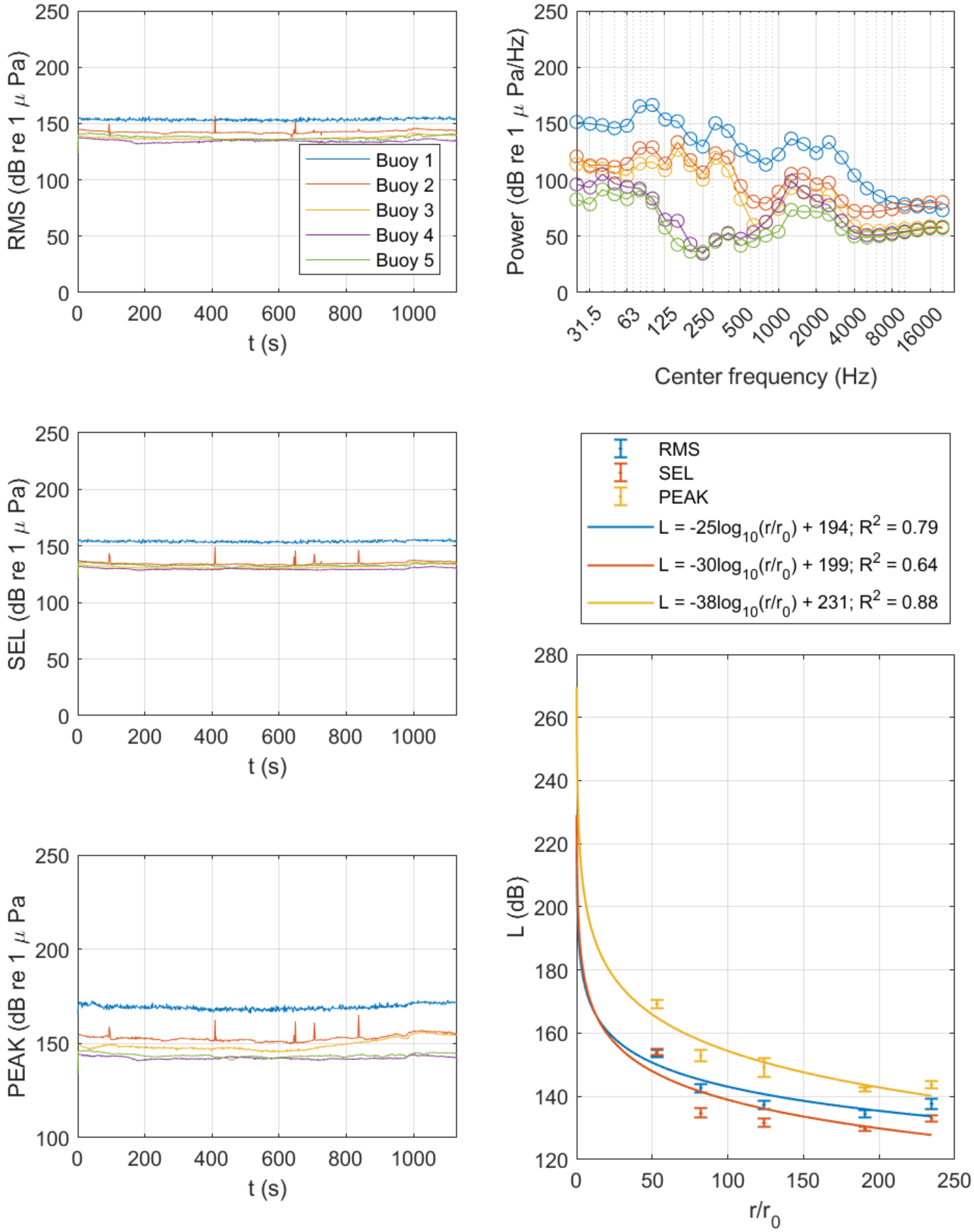
CR218-1



RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
t (s)
RMS
SEL
PEAK
L = -46log10(r/r0) + 227; R2 = 0.93
L = -34log10(r/r0) + 199; R2 = 0.92
L = -46log10(r/r0) + 243; R2 = 0.93
PEAK (dB re 1 μ Pa
t (s)
L (dB)
r/r0

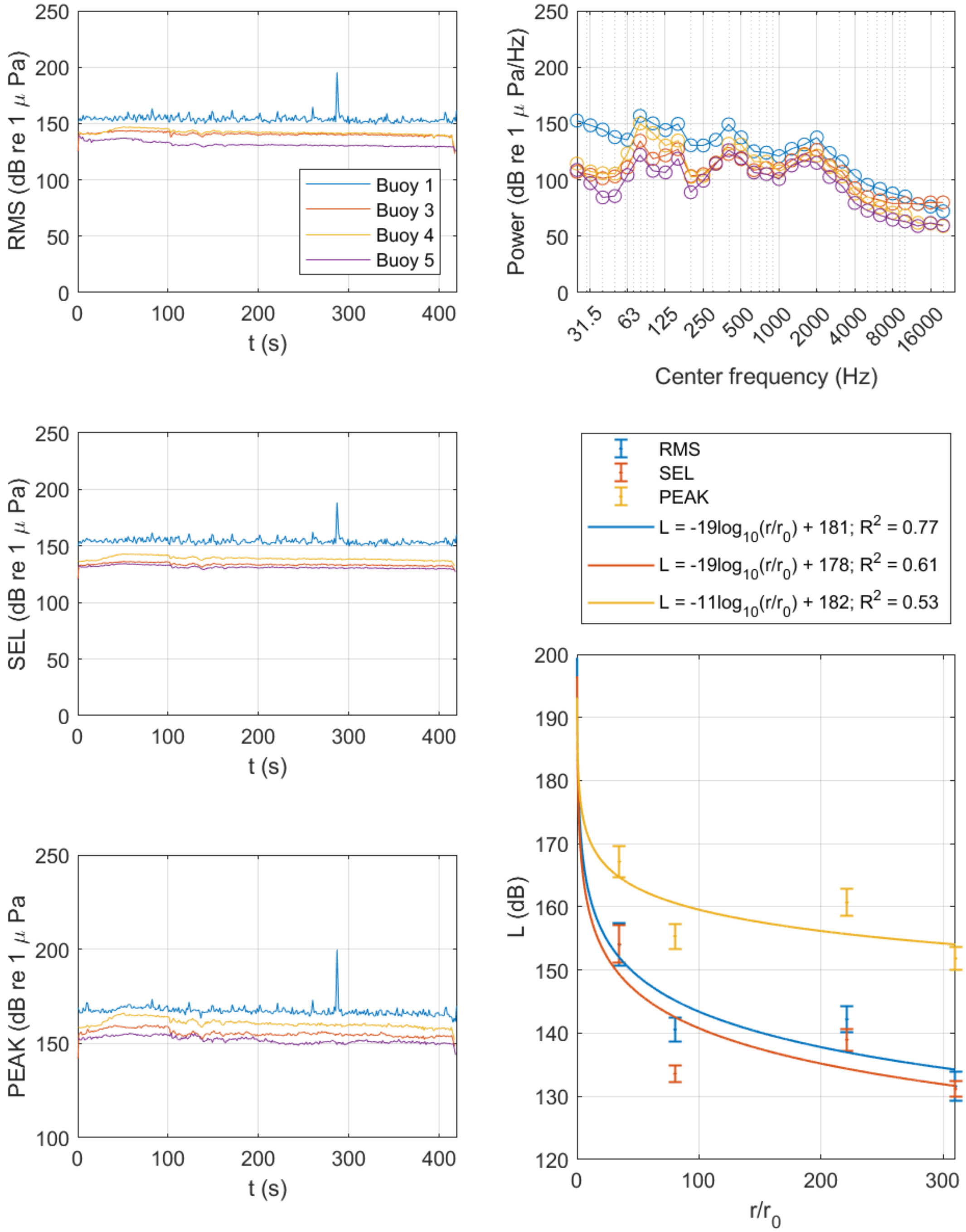

CR218-2
RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -25log10(r/r0) + 193; R2 = 0.85
L = -30log10(r/r0) + 199; R2 = 0.69
L = -38log10(r/r0) + 230; R2 = 0.86
L (dB)
r/r0

CR218-3

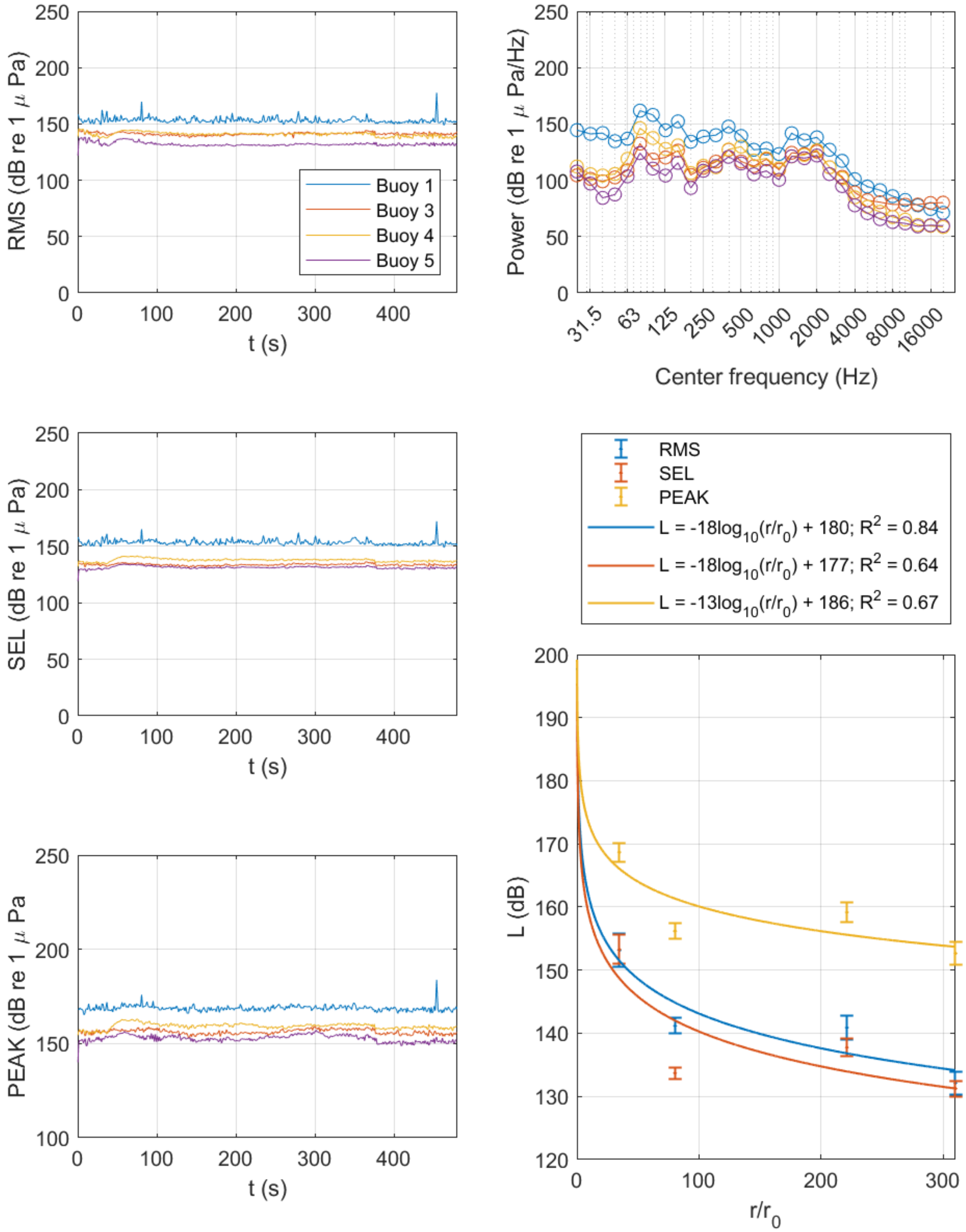


RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -25log$_{10}$(r/r$_0$) + 194; R^2 = 0.79
L = -30log$_{10}$(r/r$_0$) + 199; R^2 = 0.64
L = -38log$_{10}$(r/r$_0$) + 231; R^2 = 0.88
L (dB)
r/r$_0$

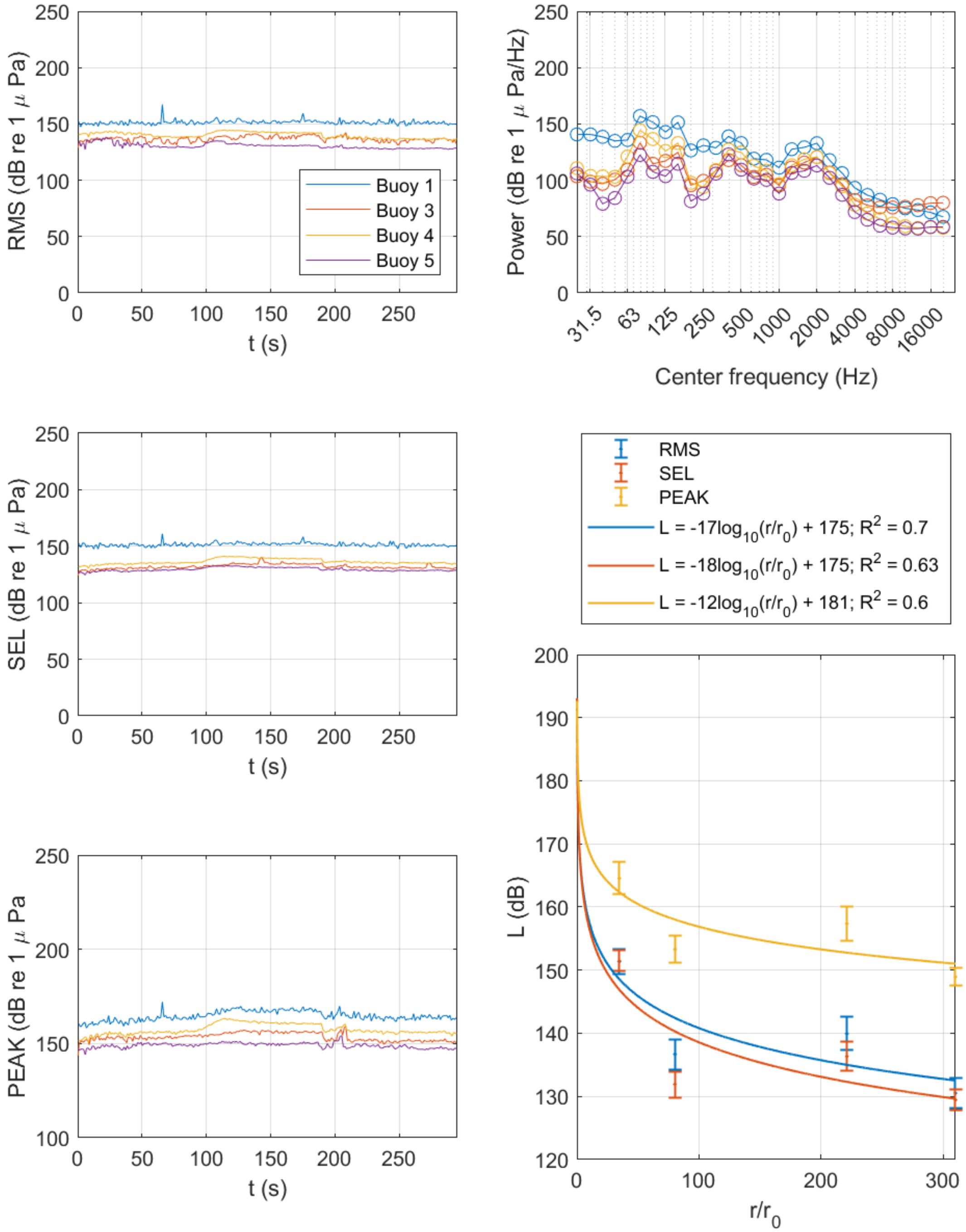
SR23-1


RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
SEL (dB re 1 μ Pa)
RMS
SEL
PEAK
$L = -19\log_{10}(r/r_0) + 181$; $R^2 = 0.77$
$L = -19\log_{10}(r/r_0) + 178$; $R^2 = 0.61$
$L = -11\log_{10}(r/r_0) + 182$; $R^2 = 0.53$
PEAK (dB re 1 μ Pa
L (dB)
r/r_0

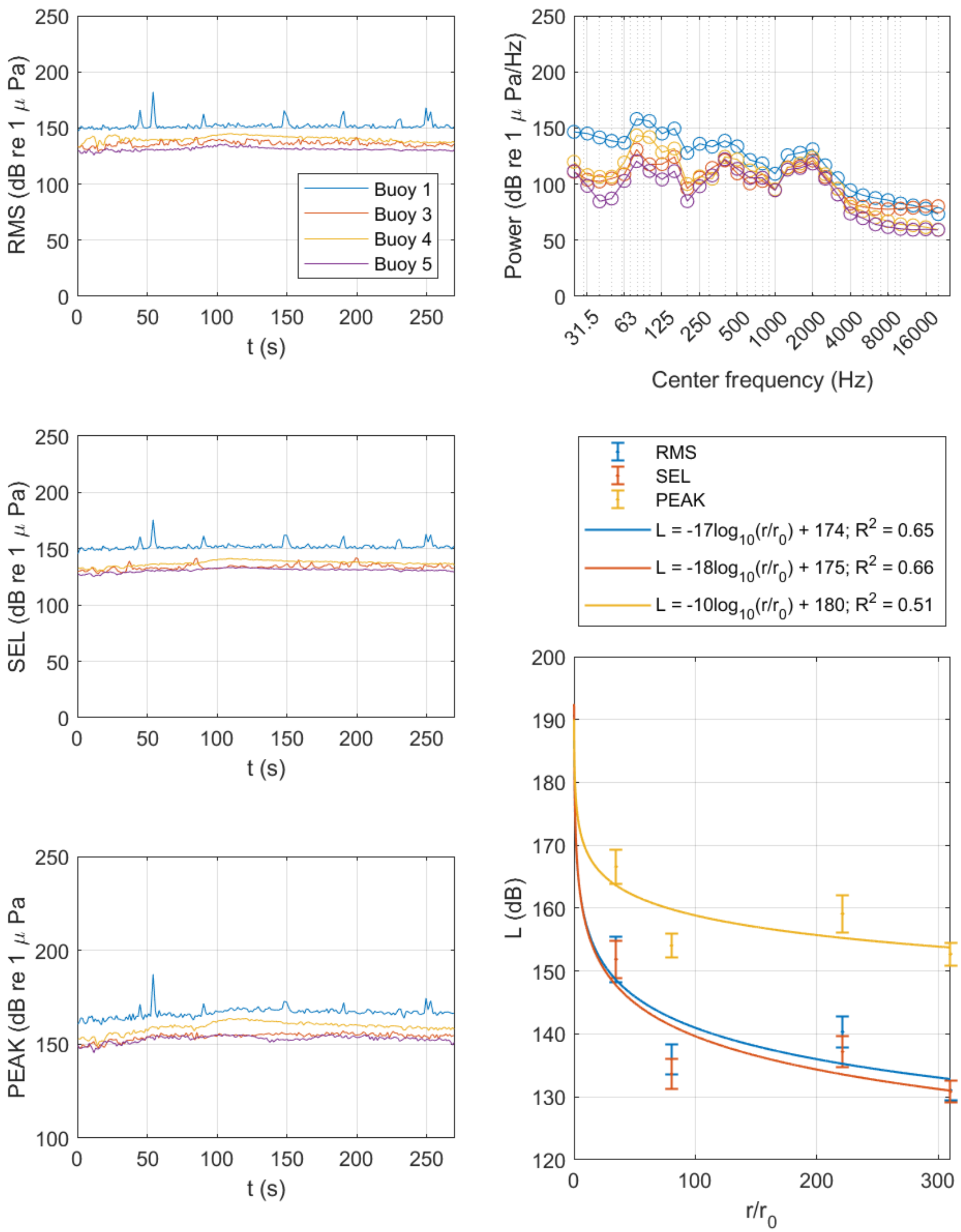
SR23-2


RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -18log10(r/r0) + 180; R2 = 0.84
L = -18log10(r/r0) + 177; R2 = 0.64
L = -13log10(r/r0) + 186; R2 = 0.67
L (dB)
r/r0

SR23-3

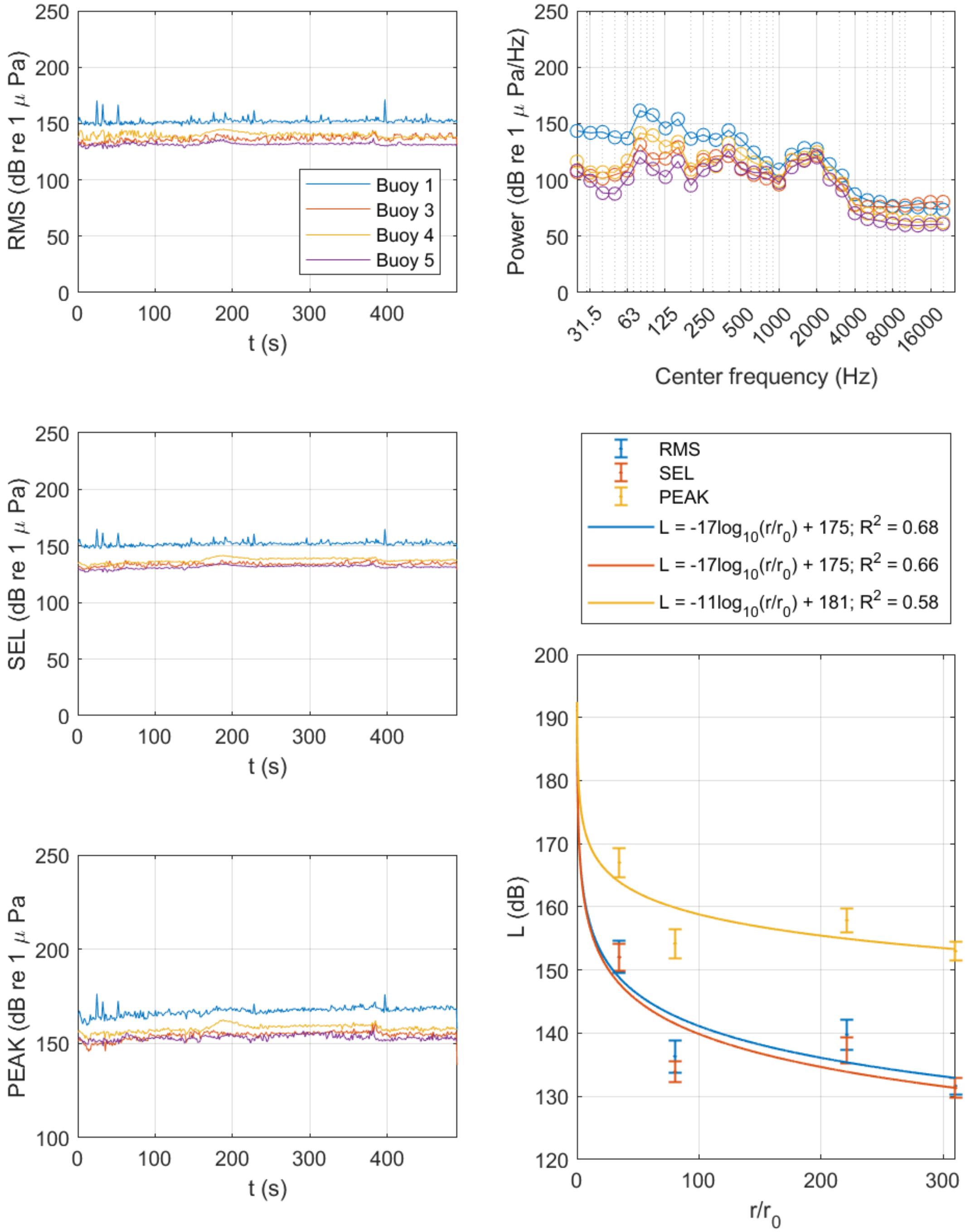

RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -17log10(r/r0) + 175; R2 = 0.7
L = -18log10(r/r0) + 175; R2 = 0.63
L = -12log10(r/r0) + 181; R2 = 0.6
L (dB)
r/r0

SR23-4



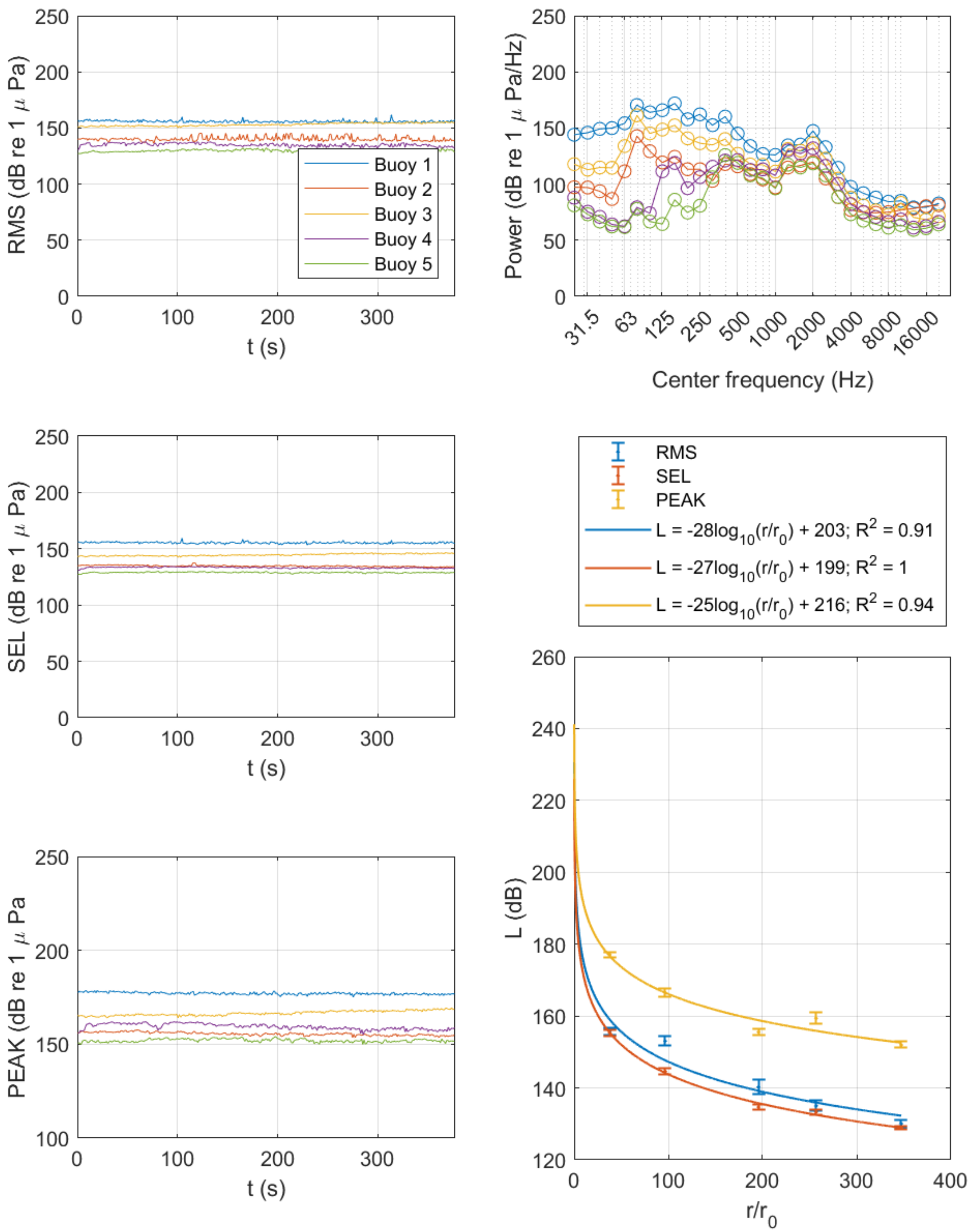
RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
RMS
SEL
PEAK
L = -17log10(r/r0) + 174; R2 = 0.65
L = -18log10(r/r0) + 175; R2 = 0.66
L = -10log10(r/r0) + 180; R2 = 0.51
L (dB)
r/r0
PEAK (dB re 1 μ Pa

SR23-5



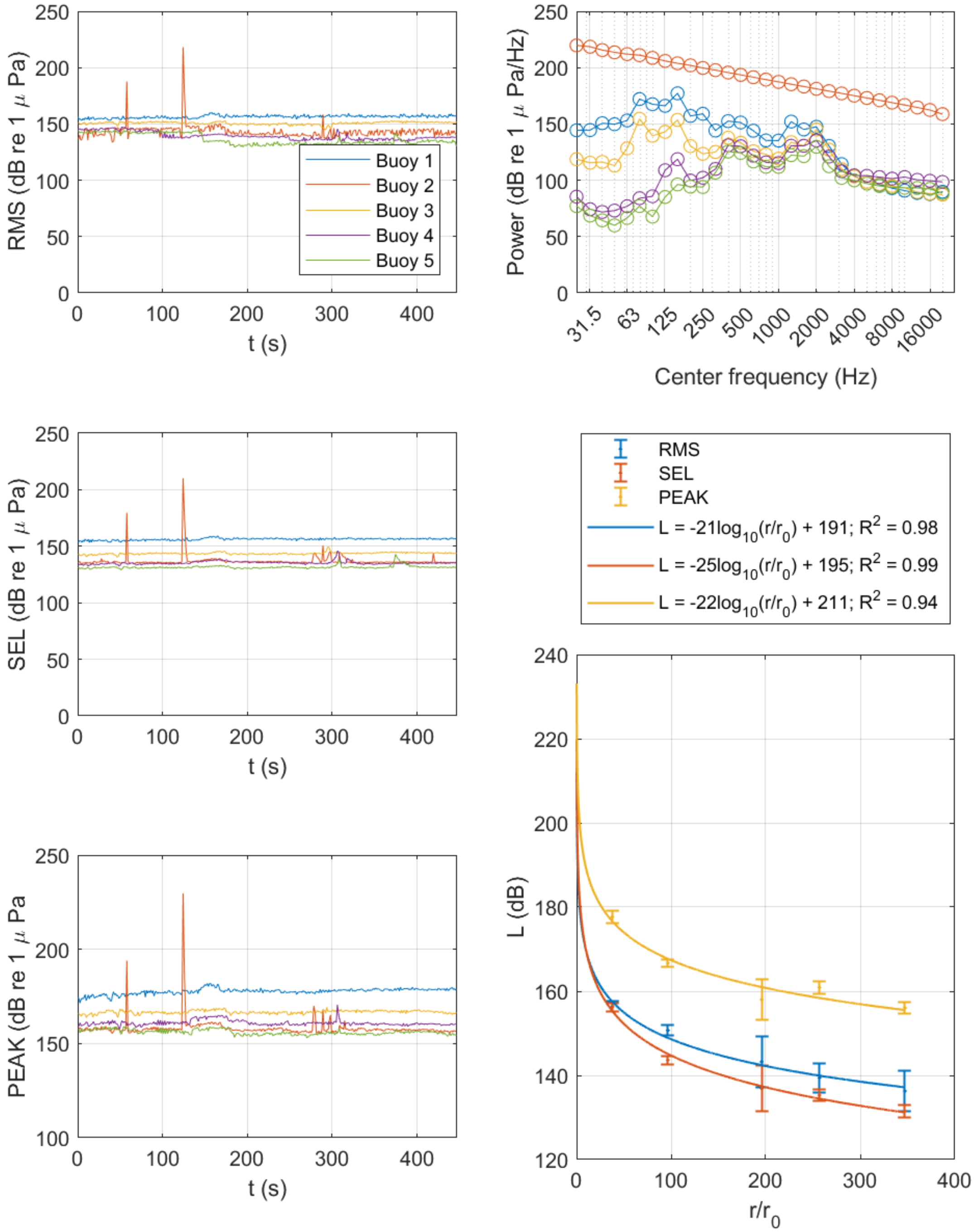
RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -17log10(r/r0) + 175; R2 = 0.68
L = -17log10(r/r0) + 175; R2 = 0.66
L = -11log10(r/r0) + 181; R2 = 0.58
L (dB)
r/r0

SR23-6



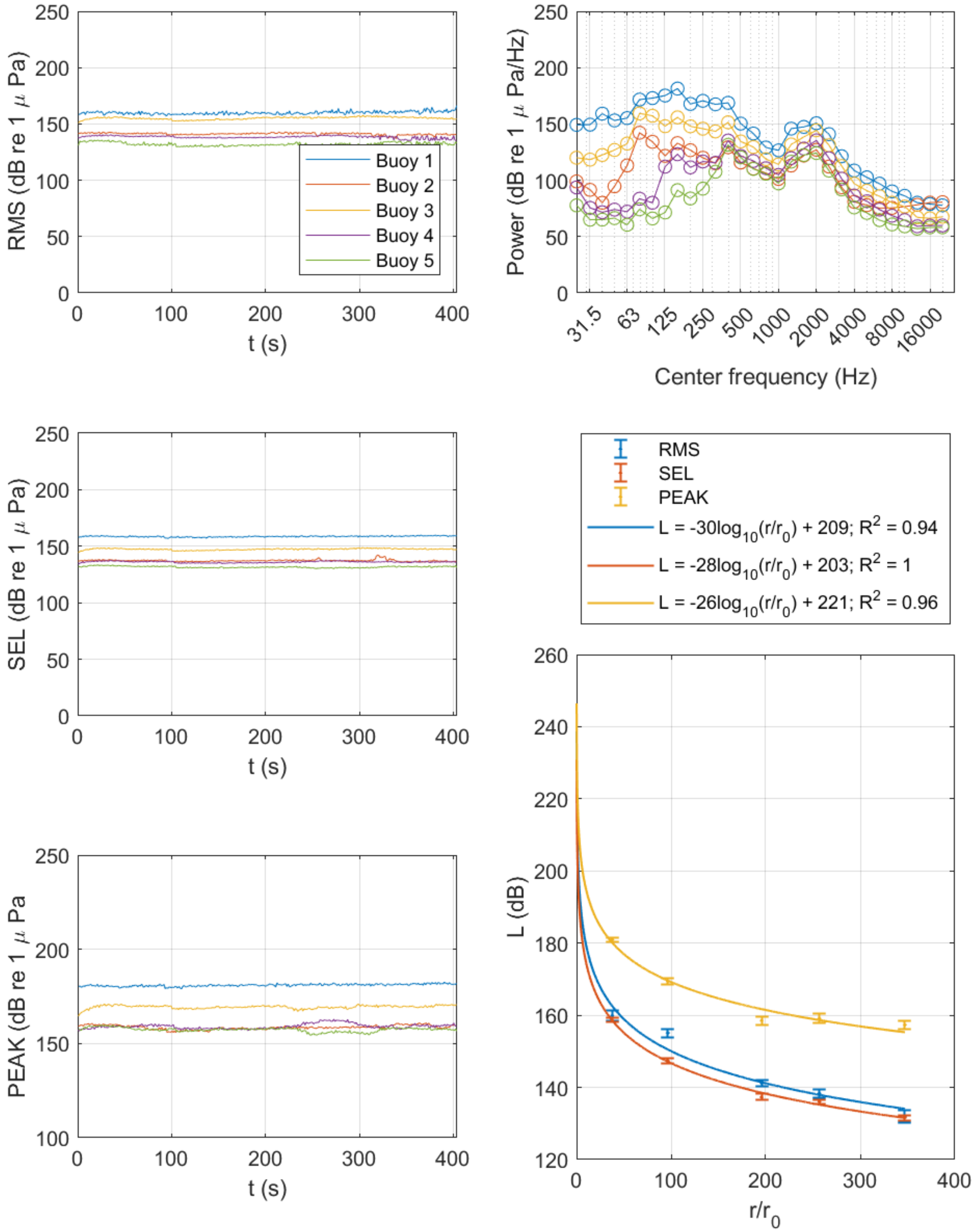
RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -28log10(r/r0) + 203; R2 = 0.91
L = -27log10(r/r0) + 199; R2 = 1
L = -25log10(r/r0) + 216; R2 = 0.94
L (dB)
r/r0

SR23-7

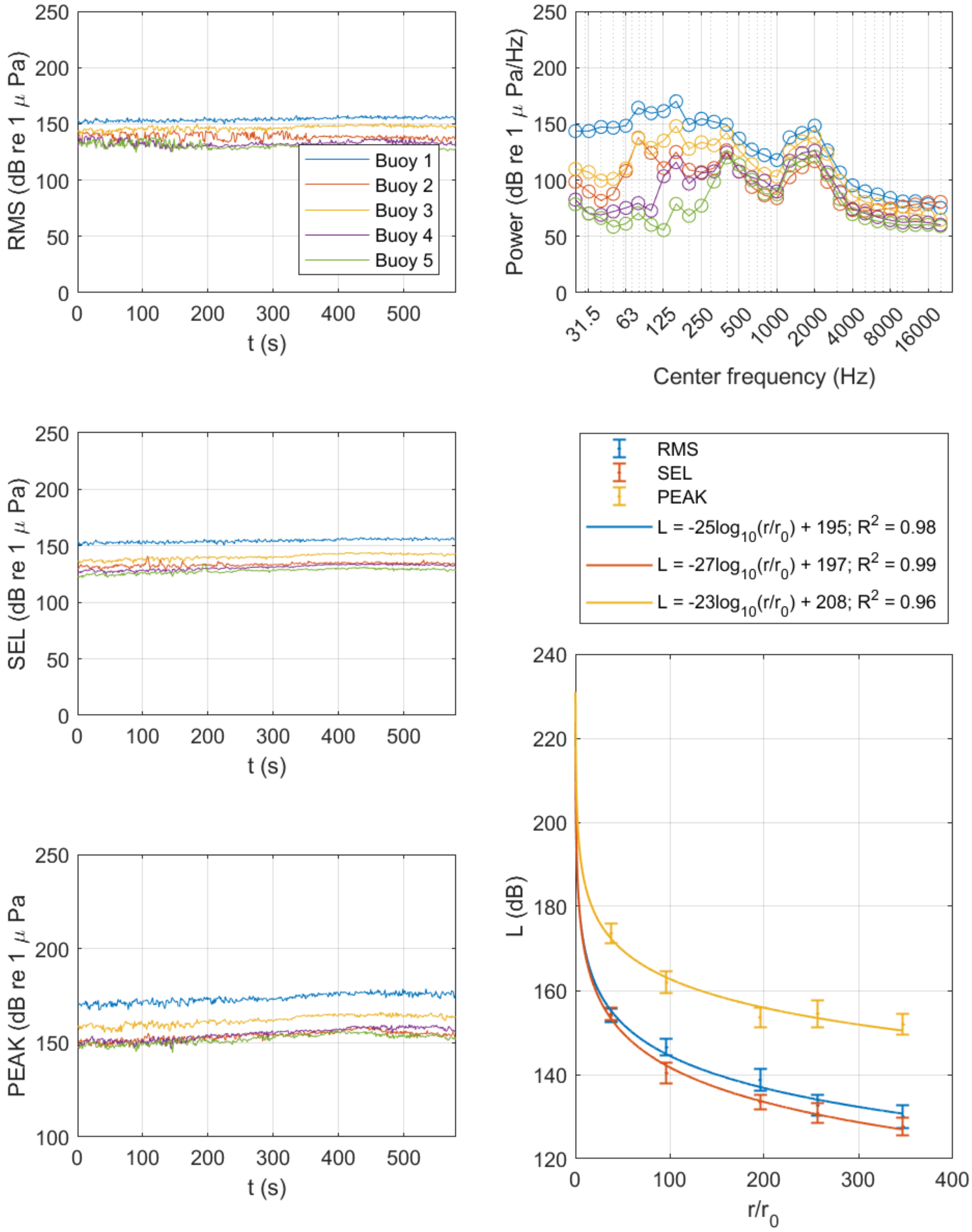


RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
t (s)
RMS
SEL
PEAK
L = -21log10(r/r0) + 191; R2 = 0.98
L = -25log10(r/r0) + 195; R2 = 0.99
L = -22log10(r/r0) + 211; R2 = 0.94
L (dB)
r/r0
PEAK (dB re 1 μ Pa
t (s)

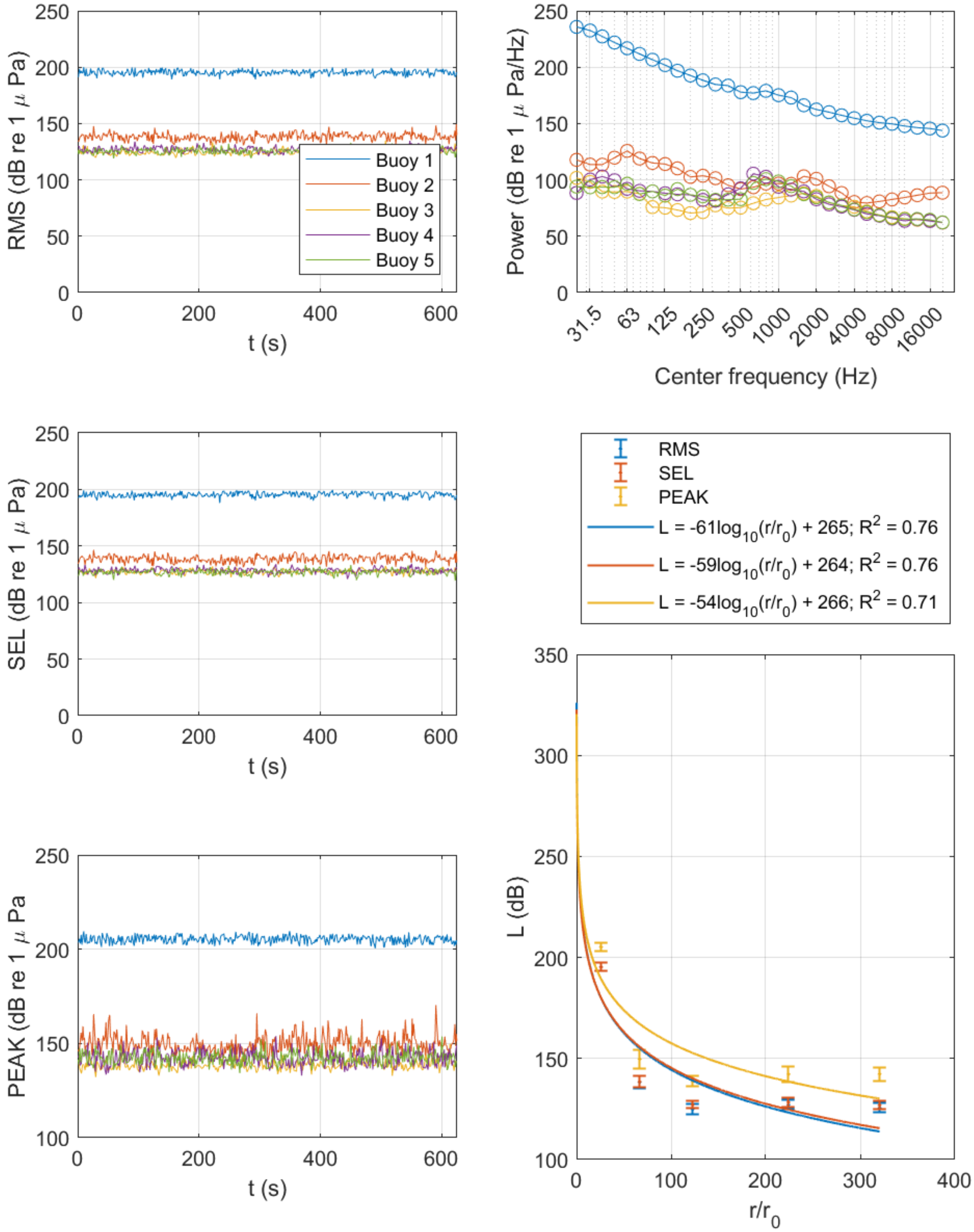
SR23-8


RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
RMS
SEL
PEAK
L = -30log10(r/r0) + 209; R2 = 0.94
L = -28log10(r/r0) + 203; R2 = 1
L = -26log10(r/r0) + 221; R2 = 0.96
PEAK (dB re 1 μ Pa
L (dB)
r/r0

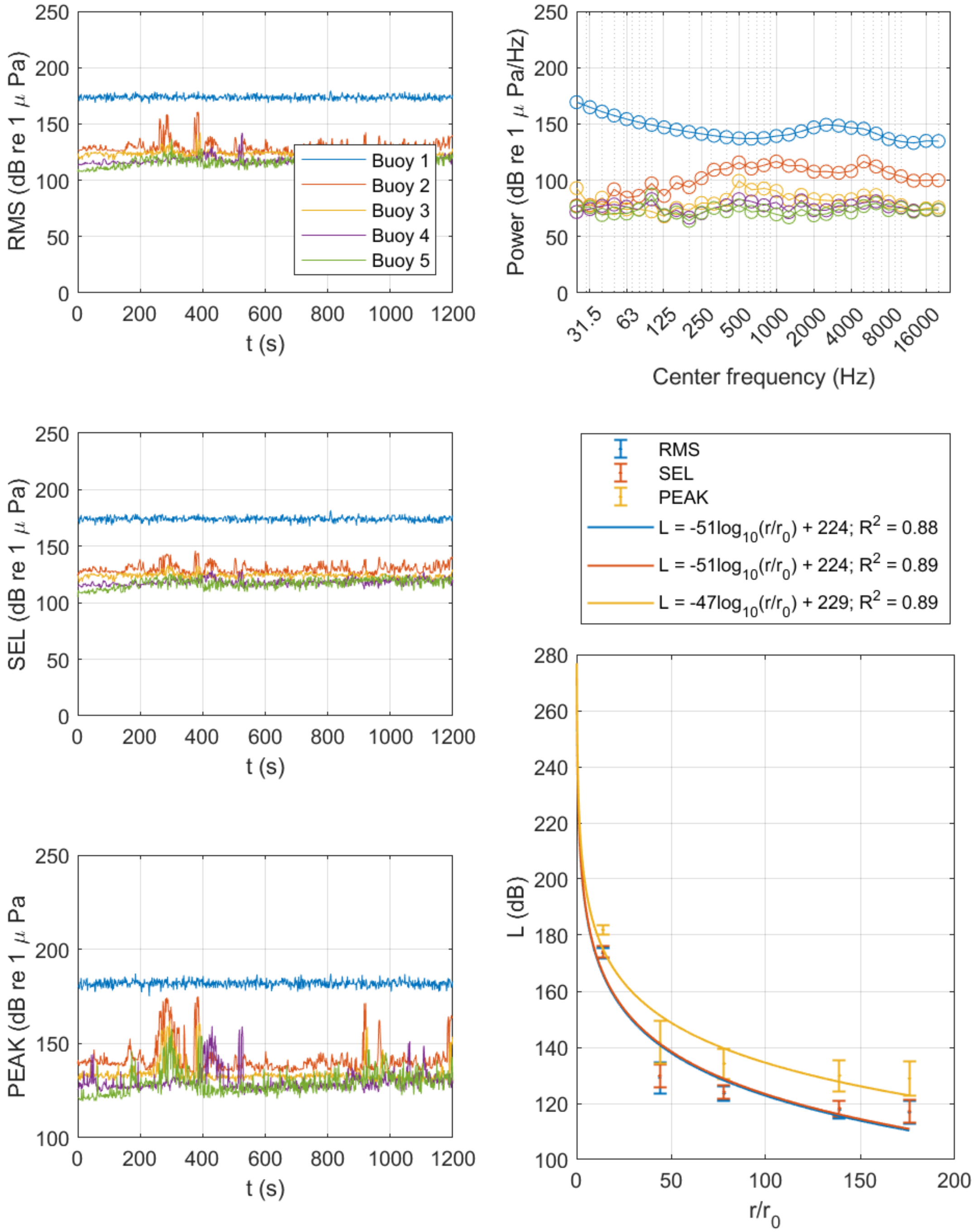
SR23-9


RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
SEL (dB re 1 μ Pa)
t (s)
PEAK (dB re 1 μ Pa
t (s)
RMS
SEL
PEAK
$L = -25\log_{10}(r/r_0) + 195$; $R^2 = 0.98$
$L = -27\log_{10}(r/r_0) + 197$; $R^2 = 0.99$
$L = -23\log_{10}(r/r_0) + 208$; $R^2 = 0.96$
L (dB)
r/r_0

Destin-1

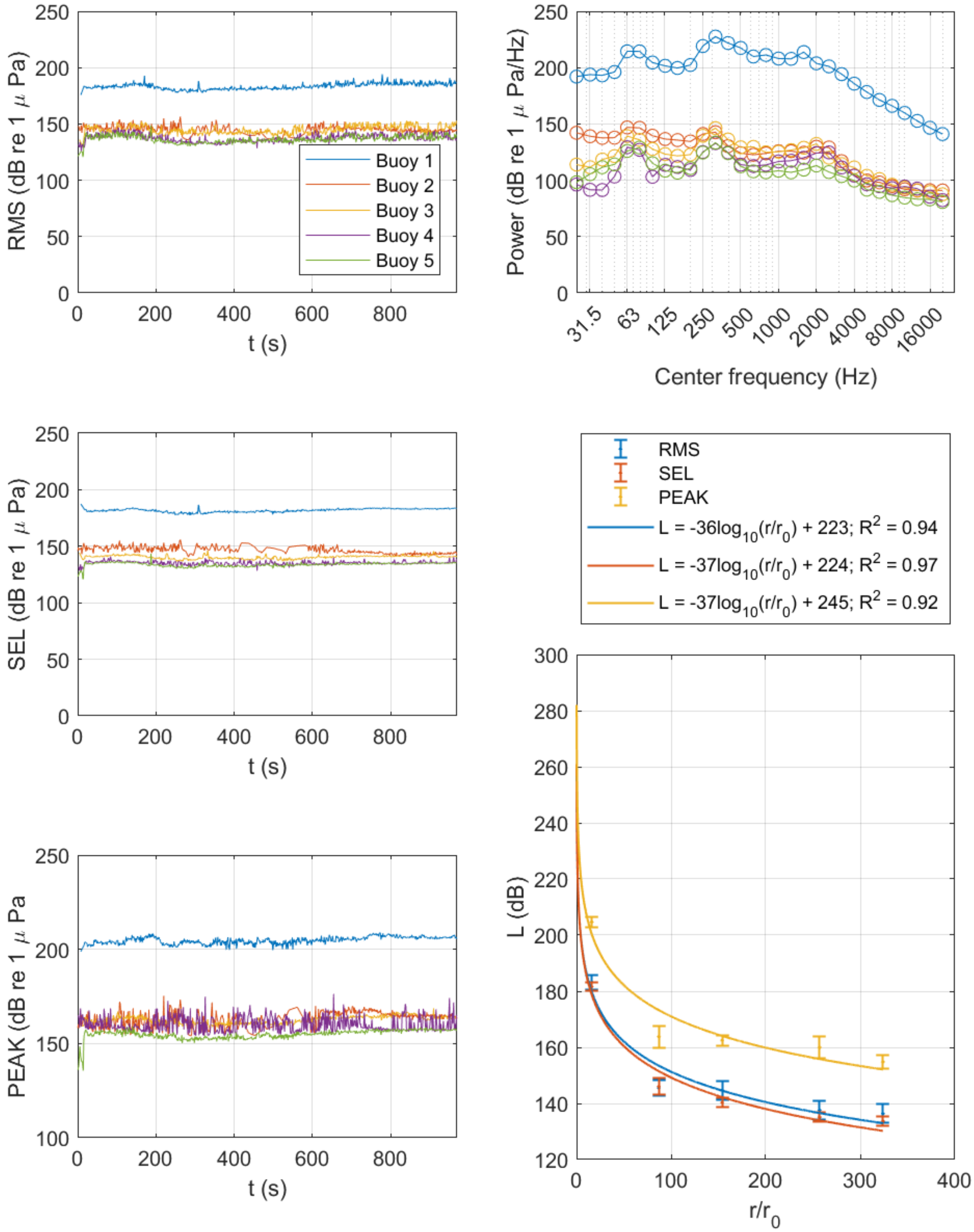

RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
t (s)
RMS
SEL
PEAK
$L = -61\log_{10}(r/r_0) + 265$; $R^2 = 0.76$
$L = -59\log_{10}(r/r_0) + 264$; $R^2 = 0.76$
$L = -54\log_{10}(r/r_0) + 266$; $R^2 = 0.71$
PEAK (dB re 1 μ Pa
t (s)
L (dB)
r/r_0

Destin-2



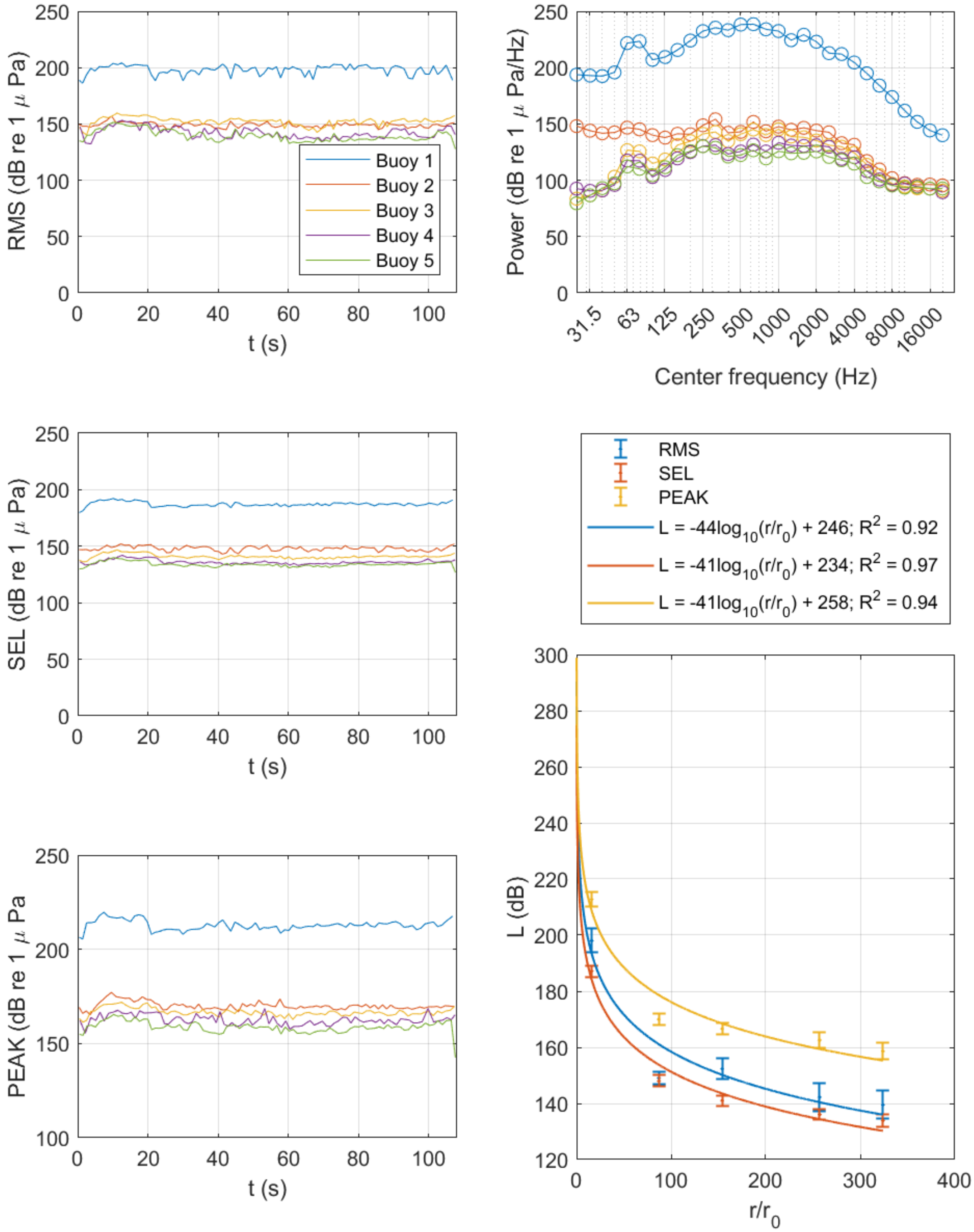
RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -51log10(r/r0) + 224; R2 = 0.88
L = -51log10(r/r0) + 224; R2 = 0.89
L = -47log10(r/r0) + 229; R2 = 0.89
L (dB)
r/r0

HF-1

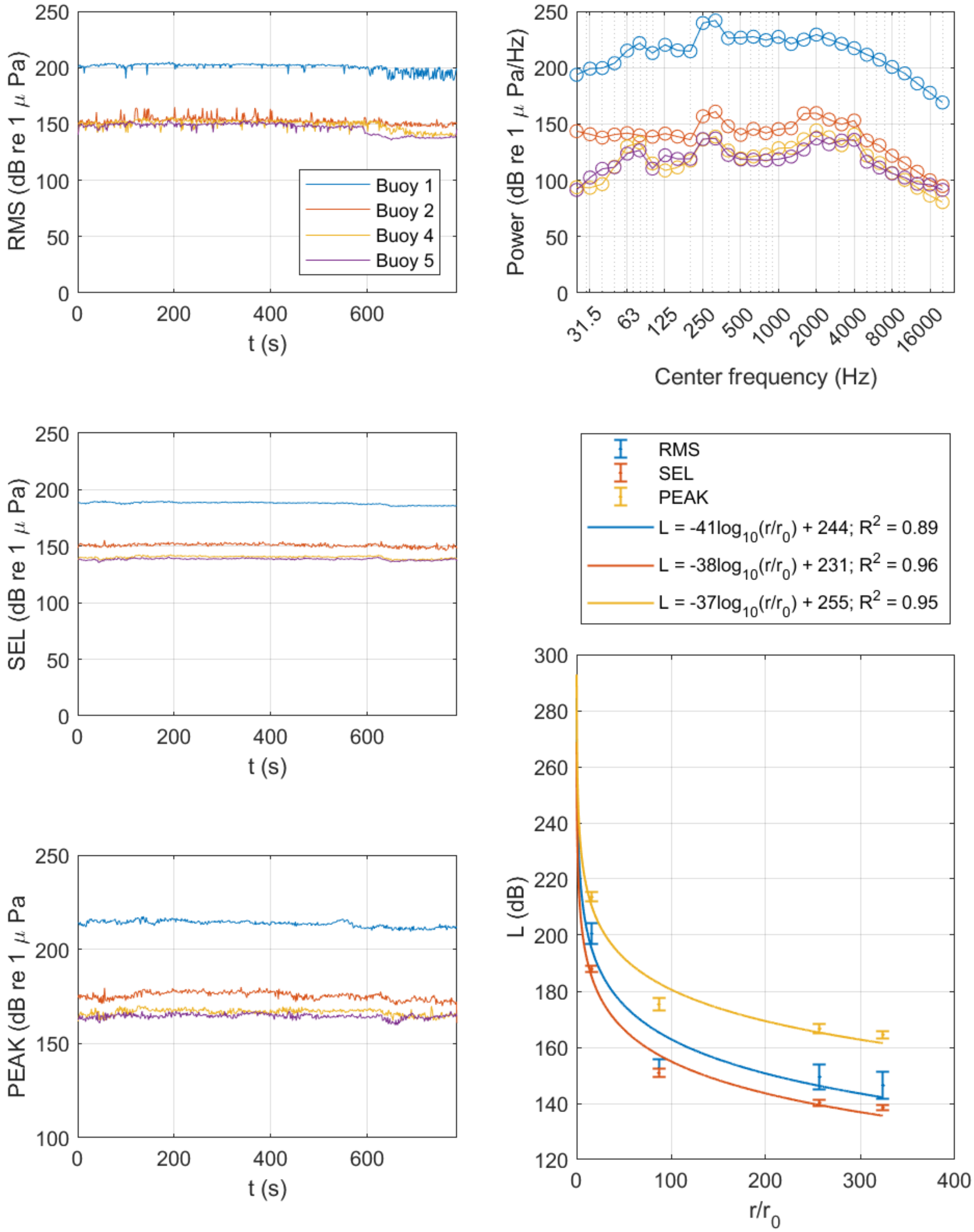


RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -36log10(r/r0) + 223; R2 = 0.94
L = -37log10(r/r0) + 224; R2 = 0.97
L = -37log10(r/r0) + 245; R2 = 0.92
L (dB)
r/r0

HF-2

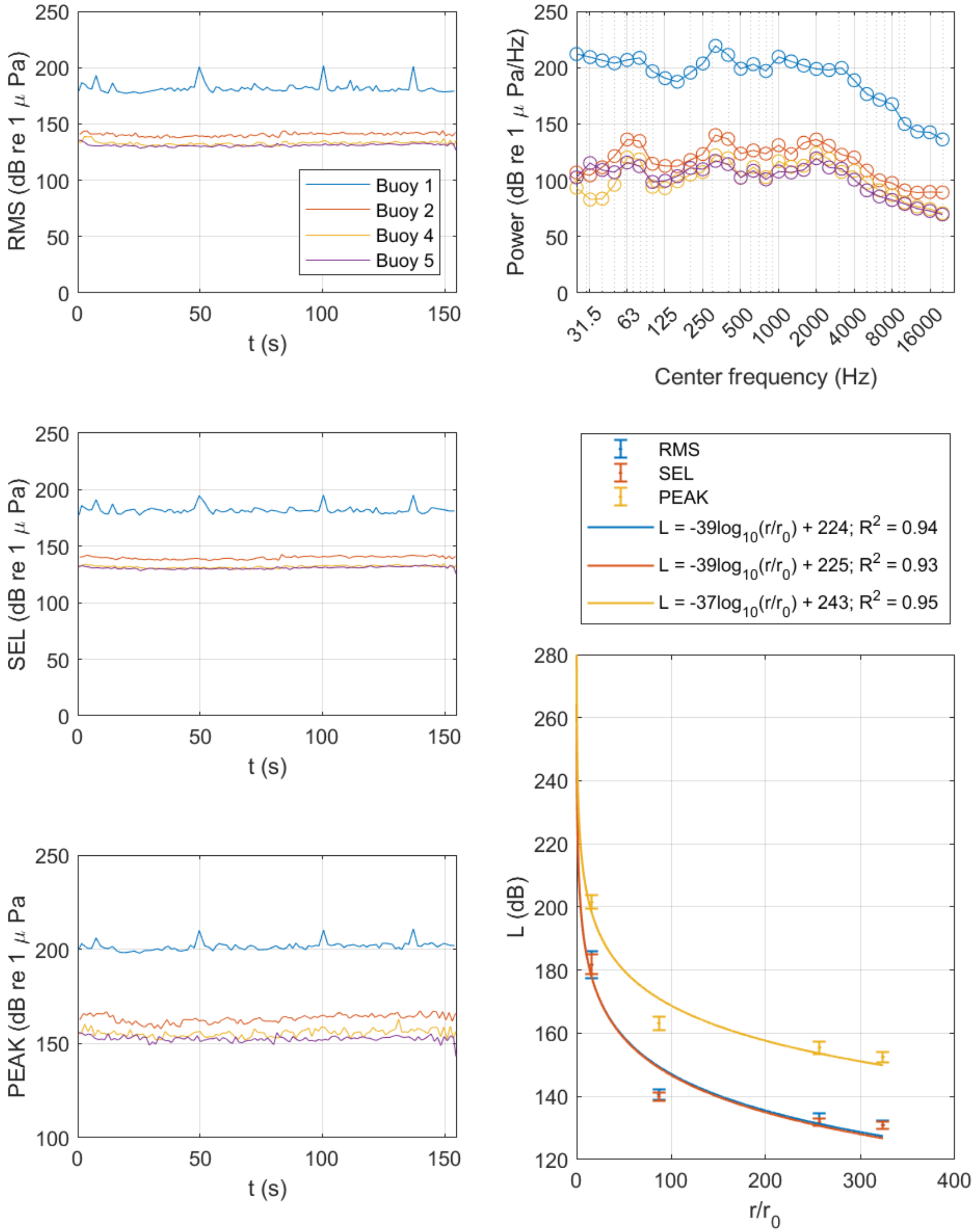

RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
t (s)
PEAK (dB re 1 μ Pa
t (s)
RMS
SEL
PEAK
L = -44log$_{10}$(r/r$_0$) + 246; R^2 = 0.92
L = -41log$_{10}$(r/r$_0$) + 234; R^2 = 0.97
L = -41log$_{10}$(r/r$_0$) + 258; R^2 = 0.94
L (dB)
r/r$_0$

HF-3



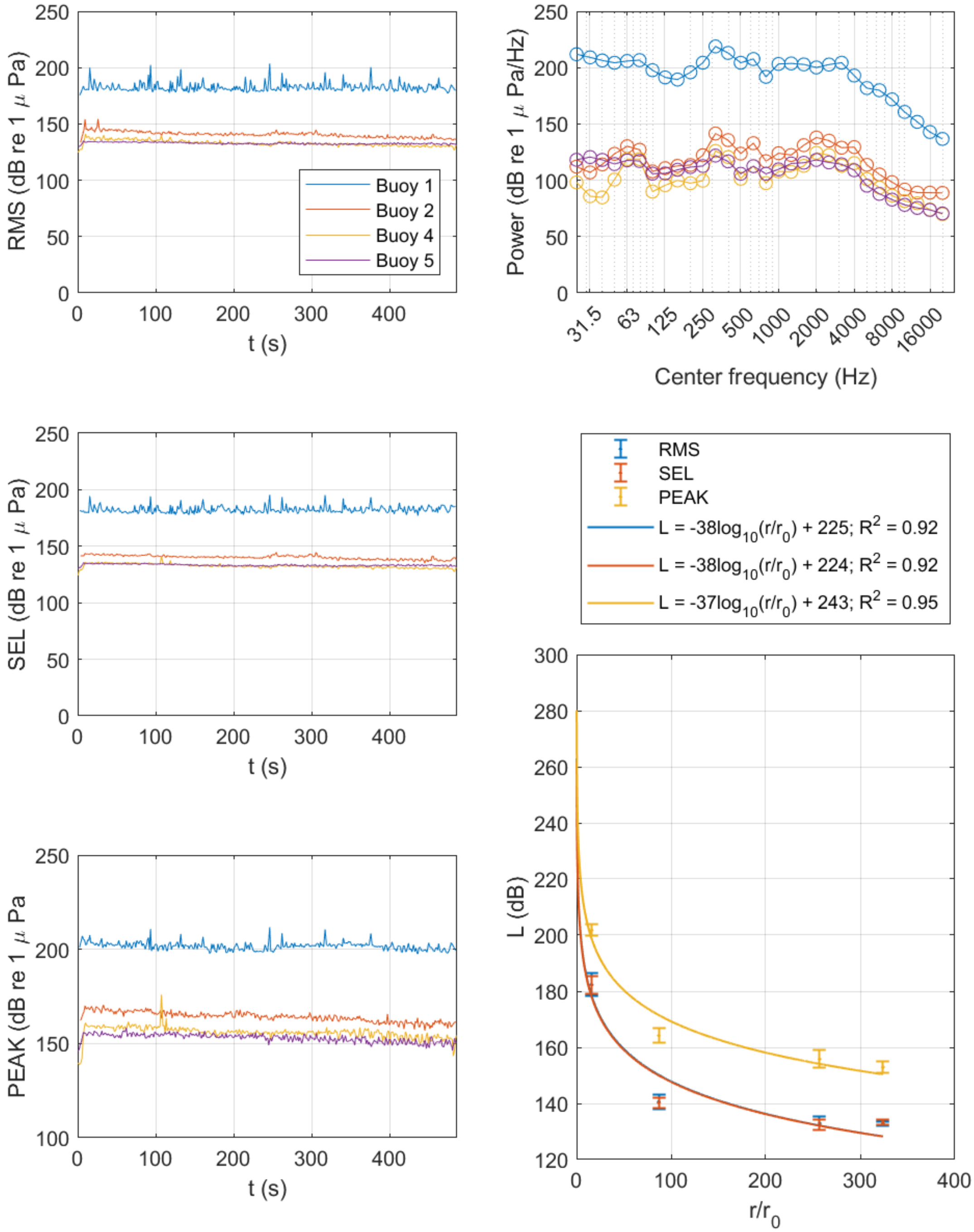
RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -41log10(r/r0) + 244; R2 = 0.89
L = -38log10(r/r0) + 231; R2 = 0.96
L = -37log10(r/r0) + 255; R2 = 0.95
L (dB)
r/r0

HF-4

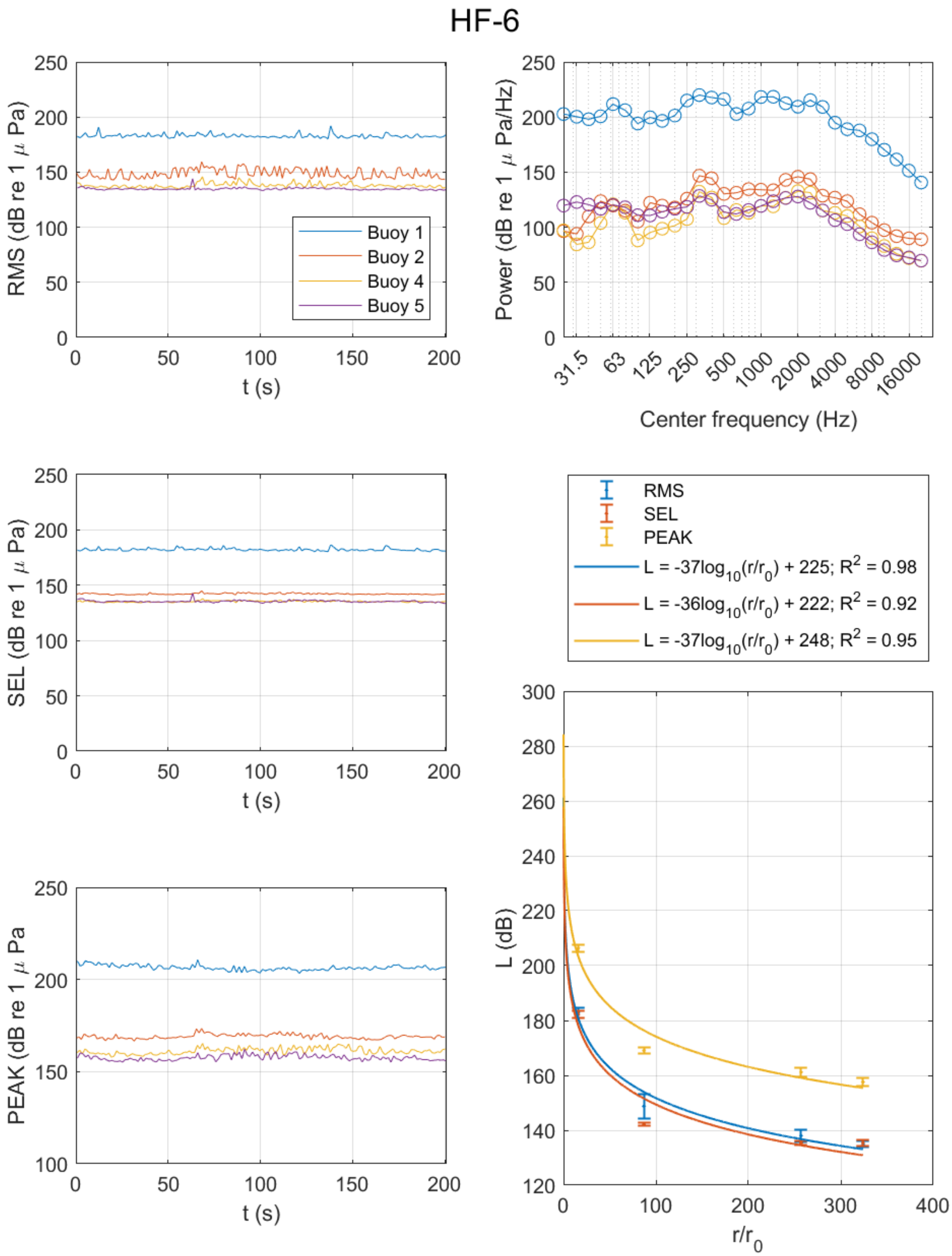


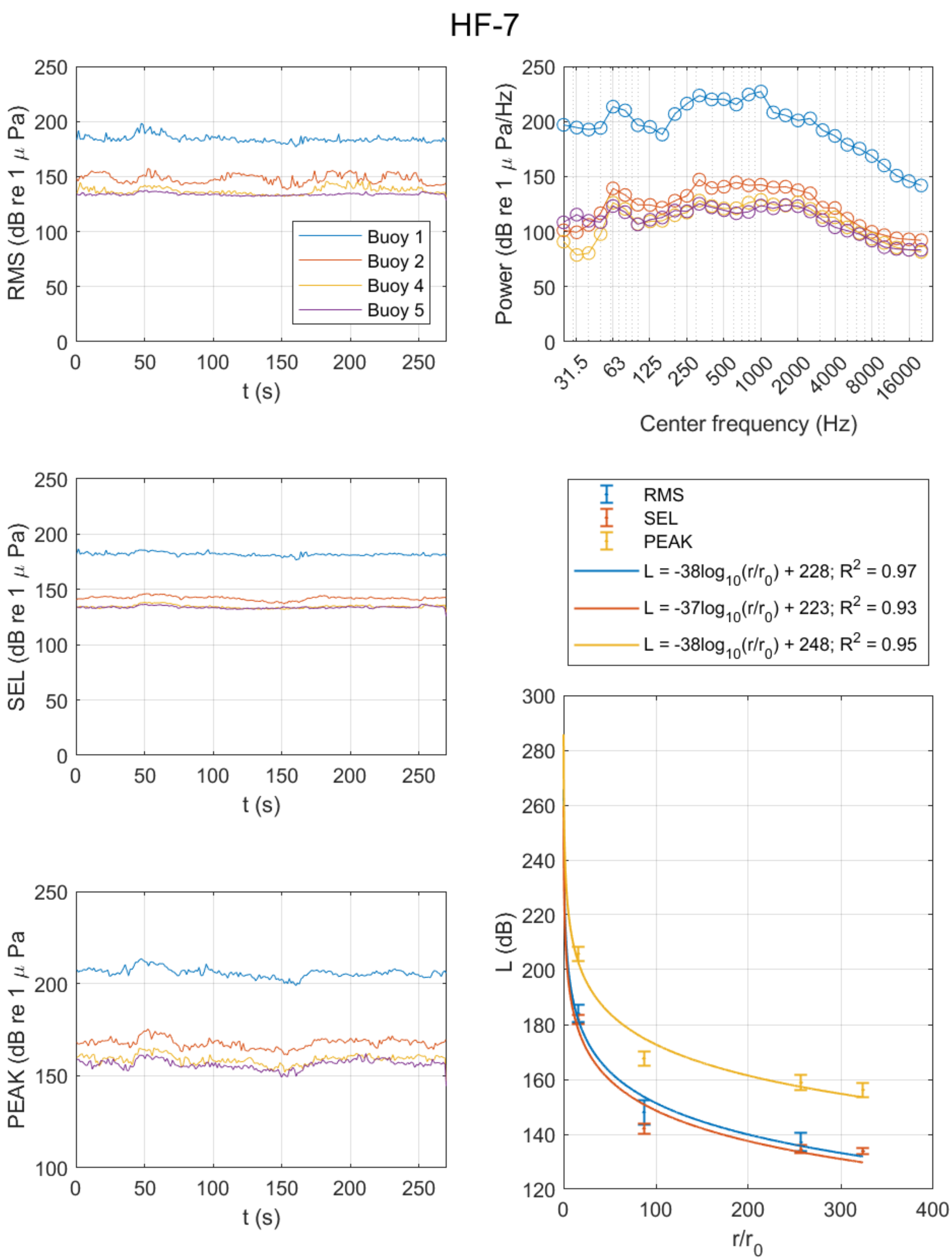
RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -39log10(r/r0) + 224; R2 = 0.94
L = -39log10(r/r0) + 225; R2 = 0.93
L = -37log10(r/r0) + 243; R2 = 0.95
L (dB)
r/r0

HF-5

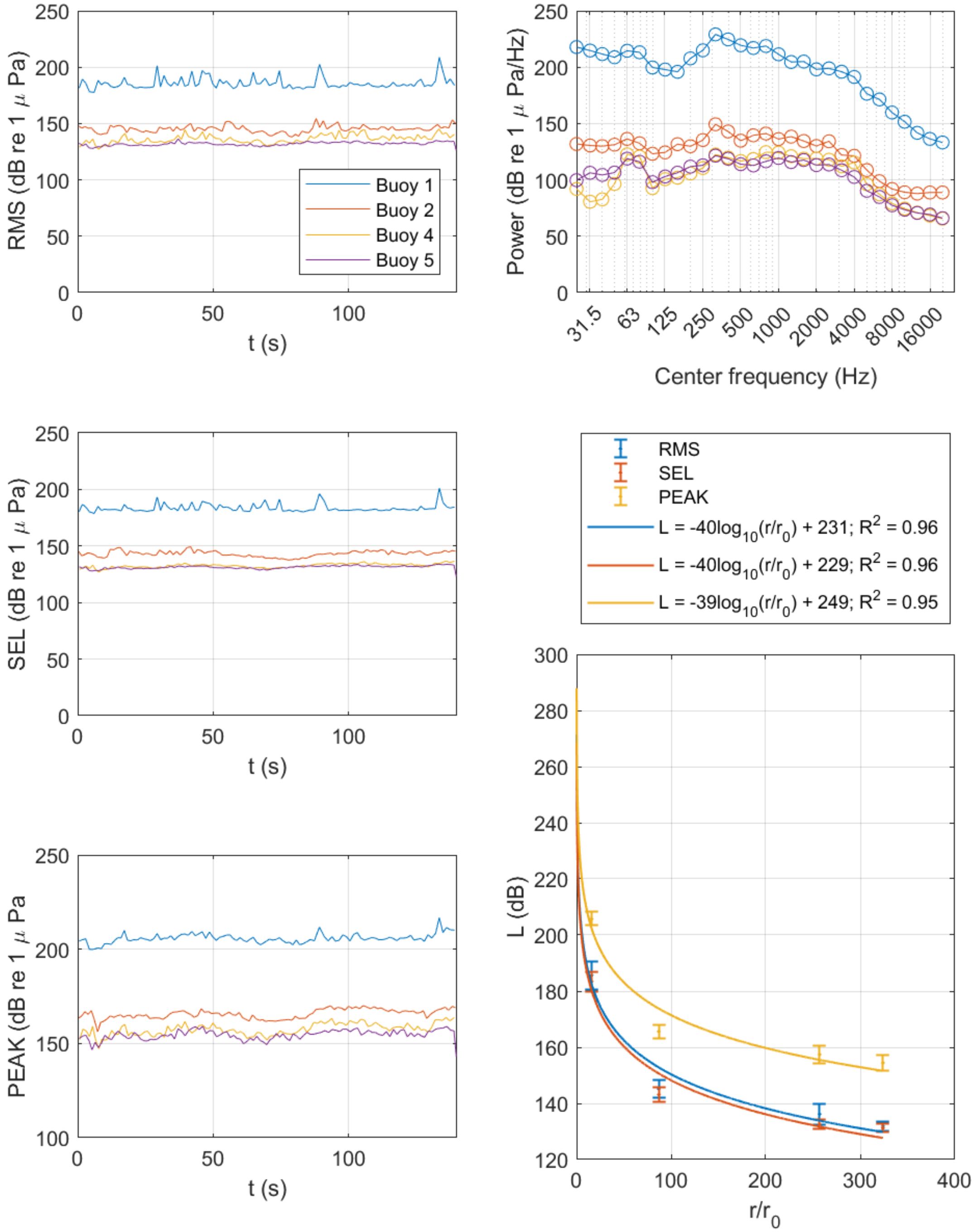


RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
t (s)
RMS
SEL
PEAK
L = -38log10(r/r0) + 225; R2 = 0.92
L = -38log10(r/r0) + 224; R2 = 0.92
L = -37log10(r/r0) + 243; R2 = 0.95
PEAK (dB re 1 μ Pa
t (s)
L (dB)
r/r0

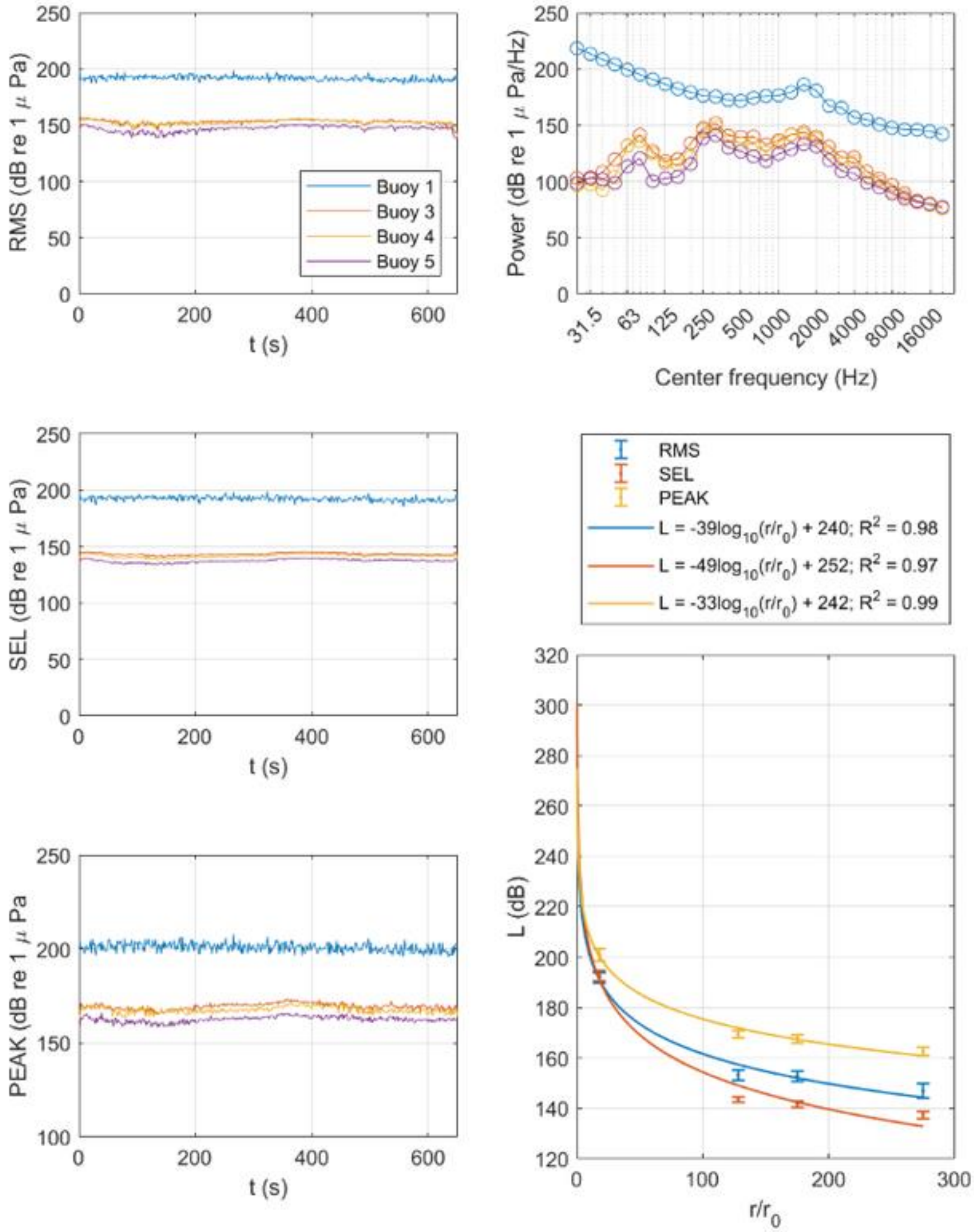

HF-6
RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -37log10(r/r0) + 225; R2 = 0.98
L = -36log10(r/r0) + 222; R2 = 0.92
L = -37log10(r/r0) + 248; R2 = 0.95
L (dB)
r/r0


HF-7
RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -38log10(r/r0) + 228; R2 = 0.97
L = -37log10(r/r0) + 223; R2 = 0.93
L = -38log10(r/r0) + 248; R2 = 0.95
L (dB)
r/r0

HF-8

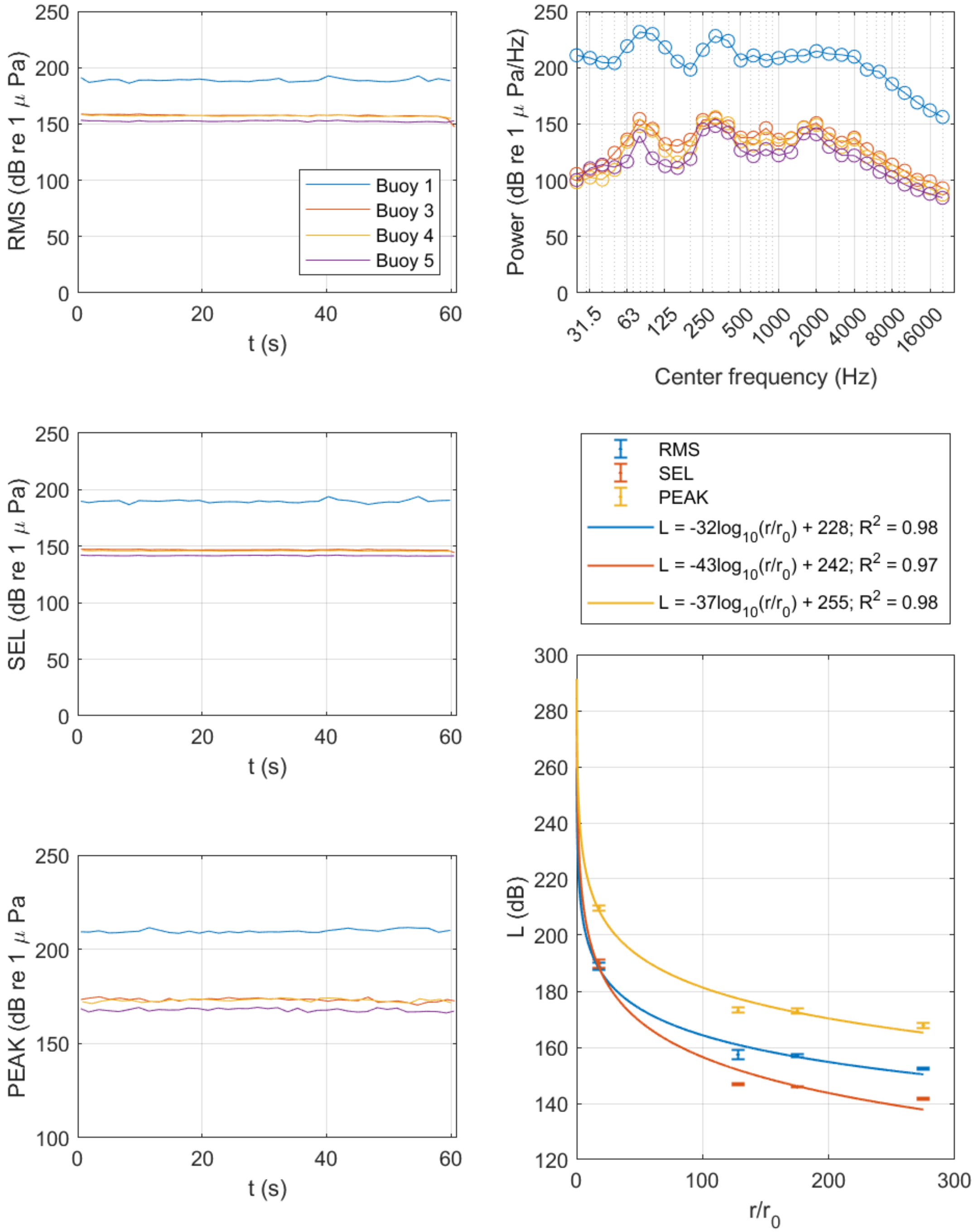

RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -40log10(r/r0) + 231; R2 = 0.96
L = -40log10(r/r0) + 229; R2 = 0.96
L = -39log10(r/r0) + 249; R2 = 0.95
L (dB)
r/r0

HF-9



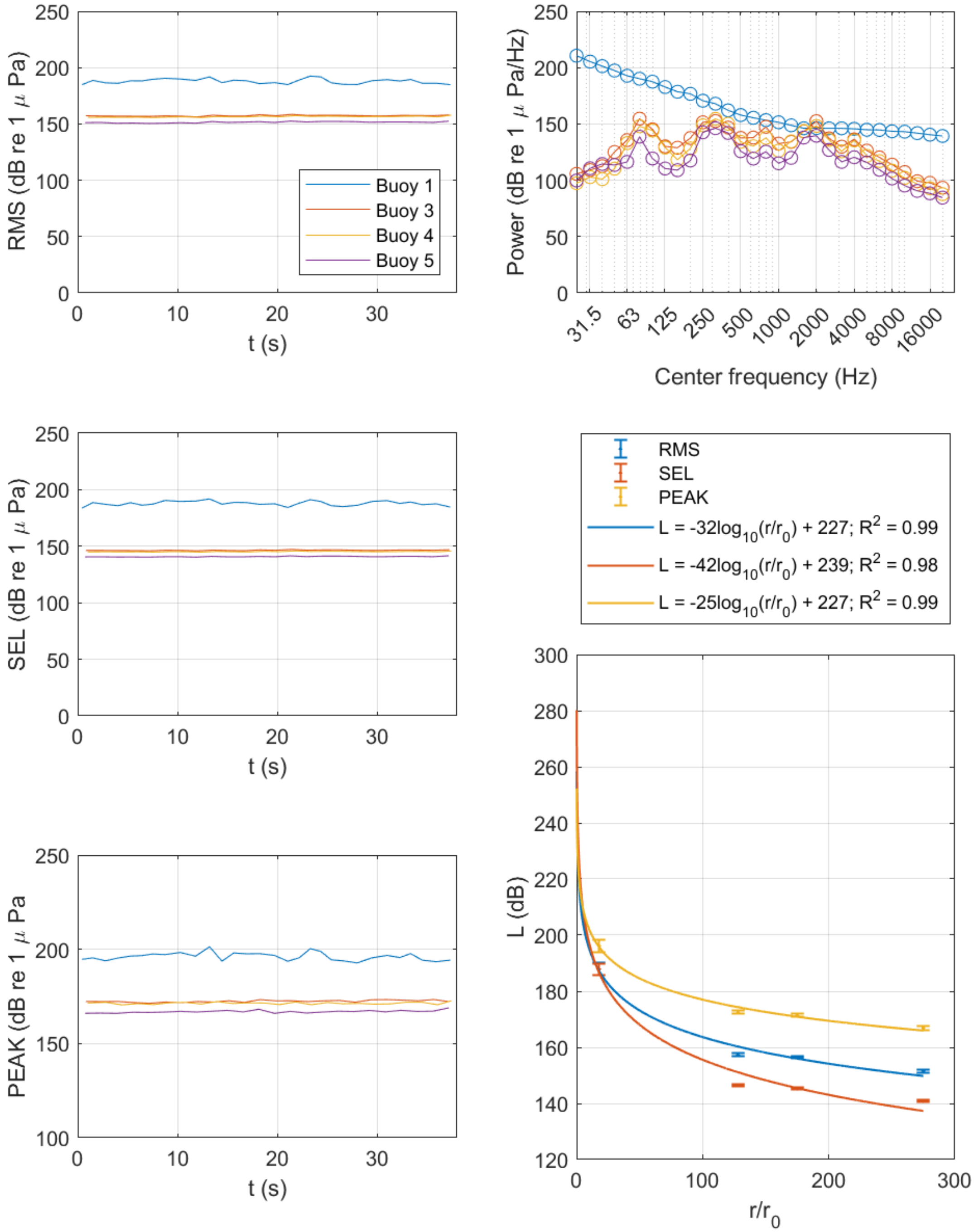
RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -39log10(r/r0) + 240; R2 = 0.98
L = -49log10(r/r0) + 252; R2 = 0.97
L = -33log10(r/r0) + 242; R2 = 0.99
L (dB)
r/r0

HF-10

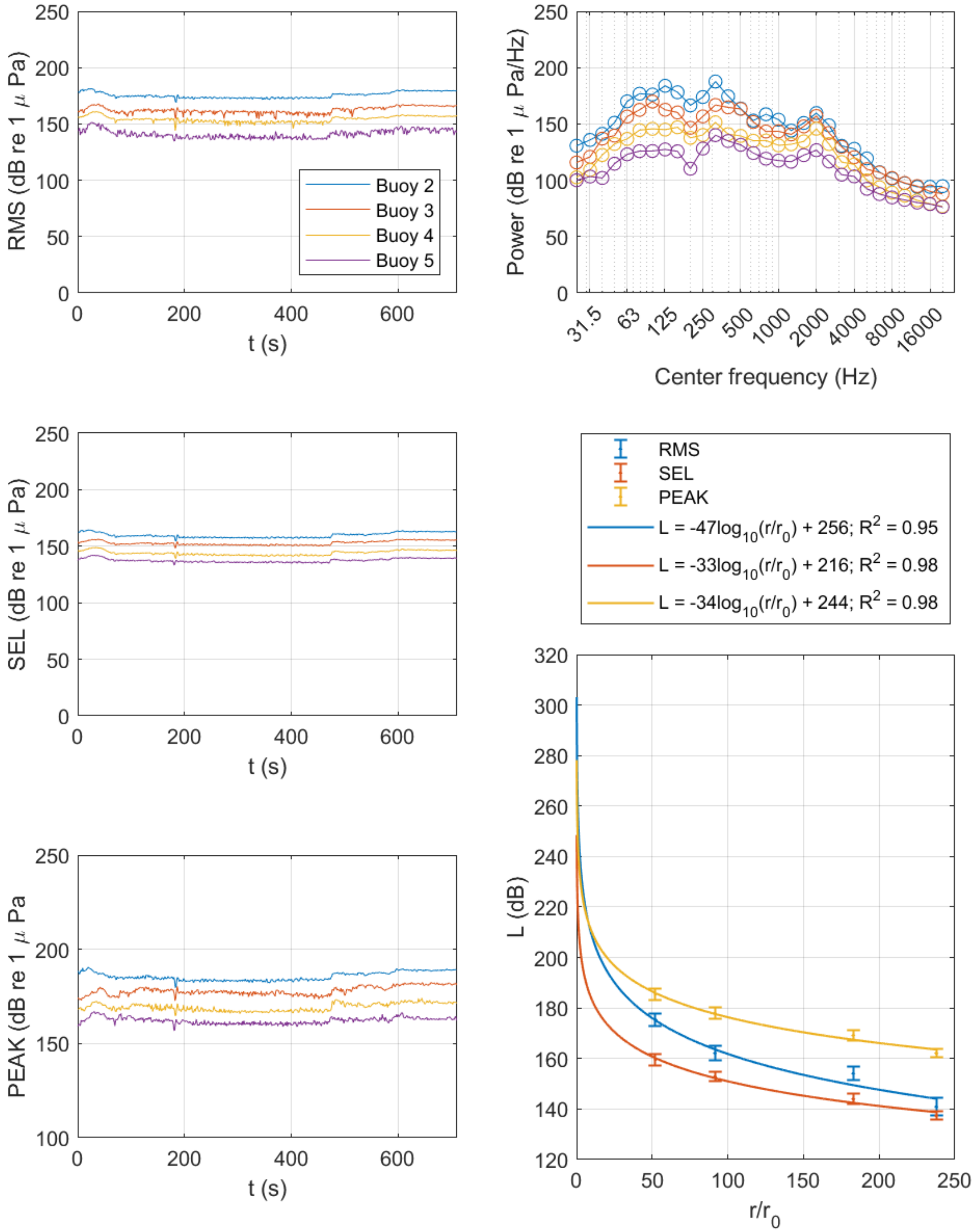


RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
$L = -32\log_{10}(r/r_0) + 228$; $R^2 = 0.98$
$L = -43\log_{10}(r/r_0) + 242$; $R^2 = 0.97$
$L = -37\log_{10}(r/r_0) + 255$; $R^2 = 0.98$
L (dB)
r/r_0

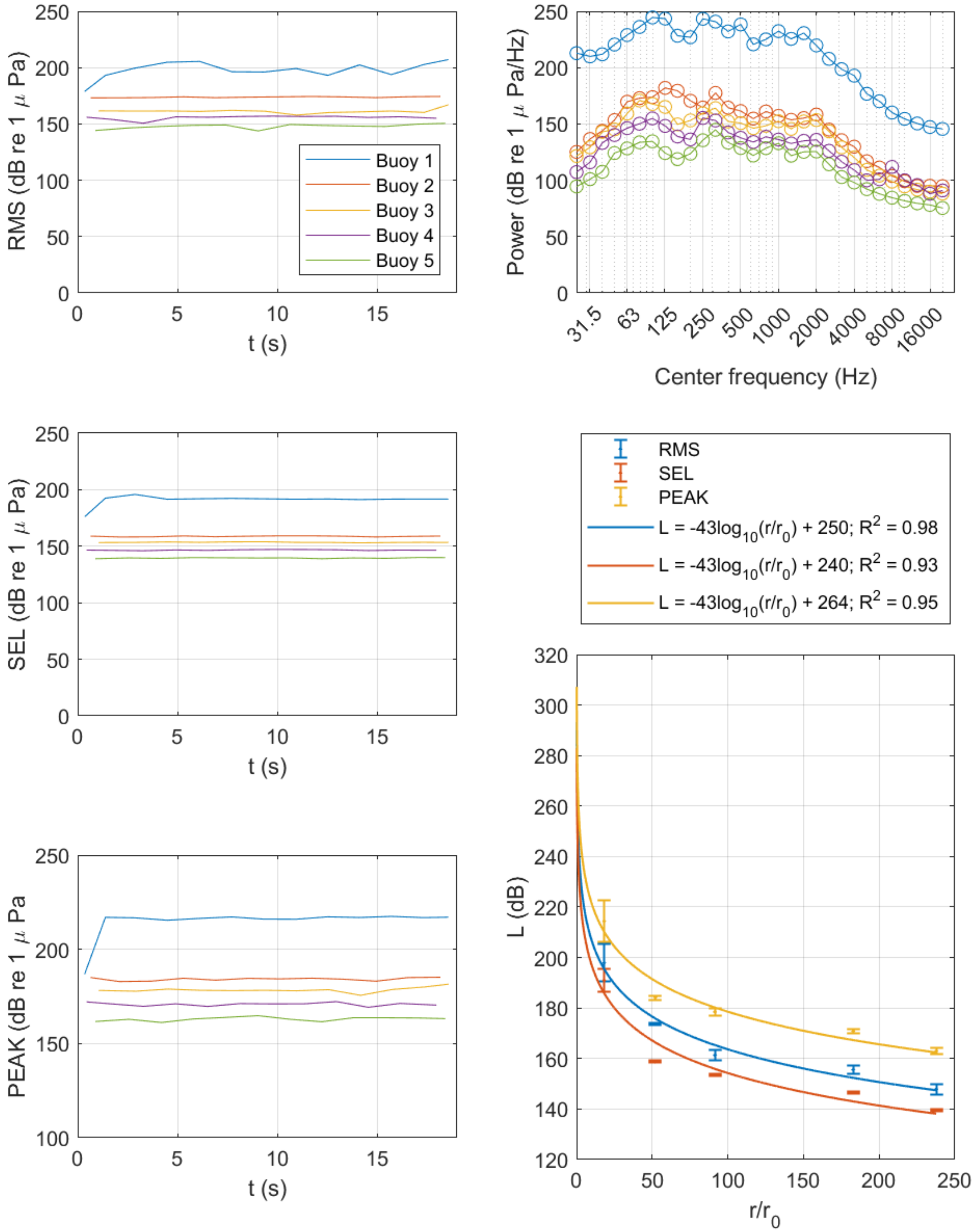
HF-11


RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
RMS
SEL
PEAK
L = -32log10(r/r0) + 227; R2 = 0.99
L = -42log10(r/r0) + 239; R2 = 0.98
L = -25log10(r/r0) + 227; R2 = 0.99
L (dB)
r/r0
PEAK (dB re 1 μ Pa

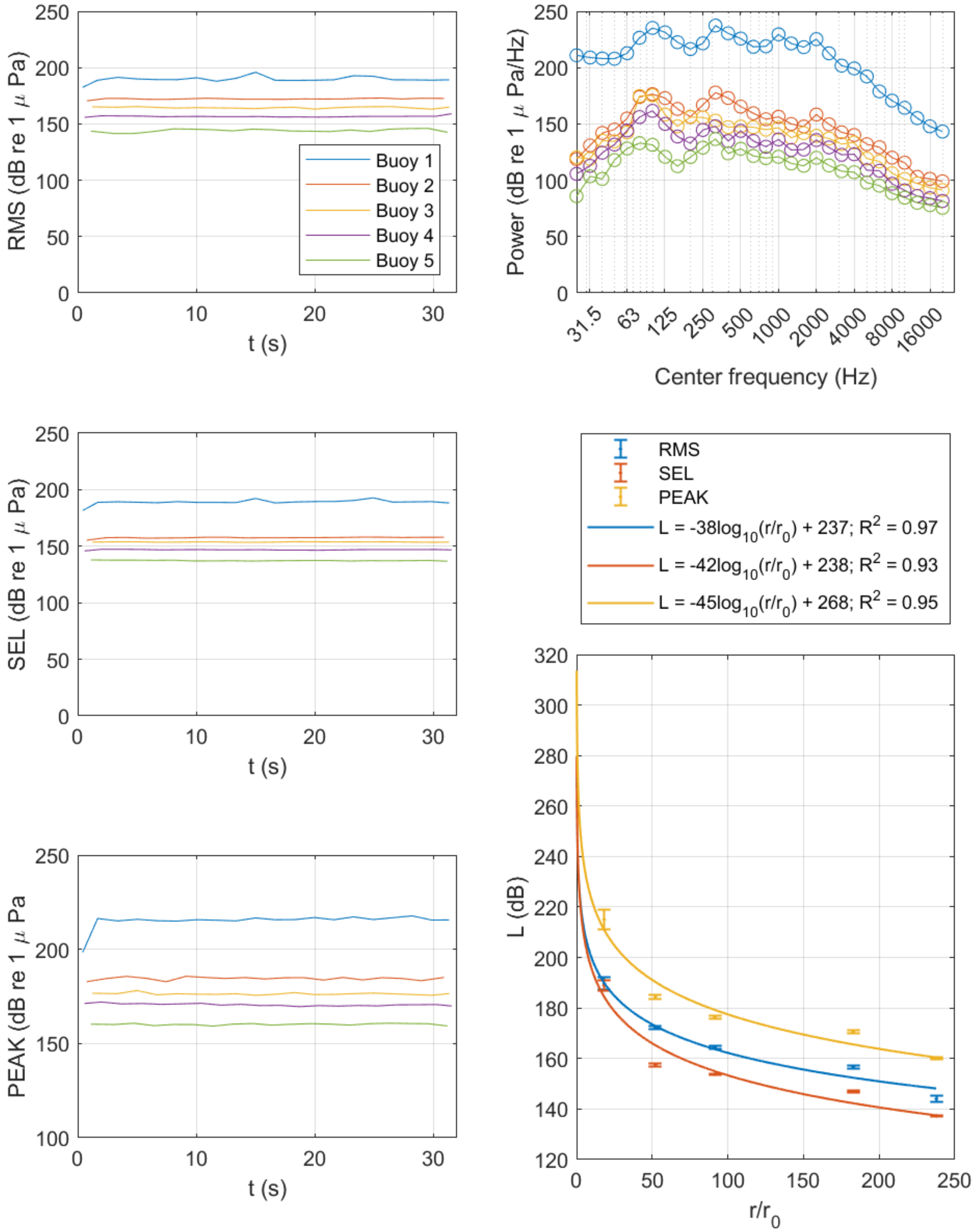
HF-12


RMS (dB re 1 μ Pa)
t (s)
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -47log$_{10}$(r/r$_0$) + 256; R^2 = 0.95
L = -33log$_{10}$(r/r$_0$) + 216; R^2 = 0.98
L = -34log$_{10}$(r/r$_0$) + 244; R^2 = 0.98
L (dB)
r/r$_0$

HF-13

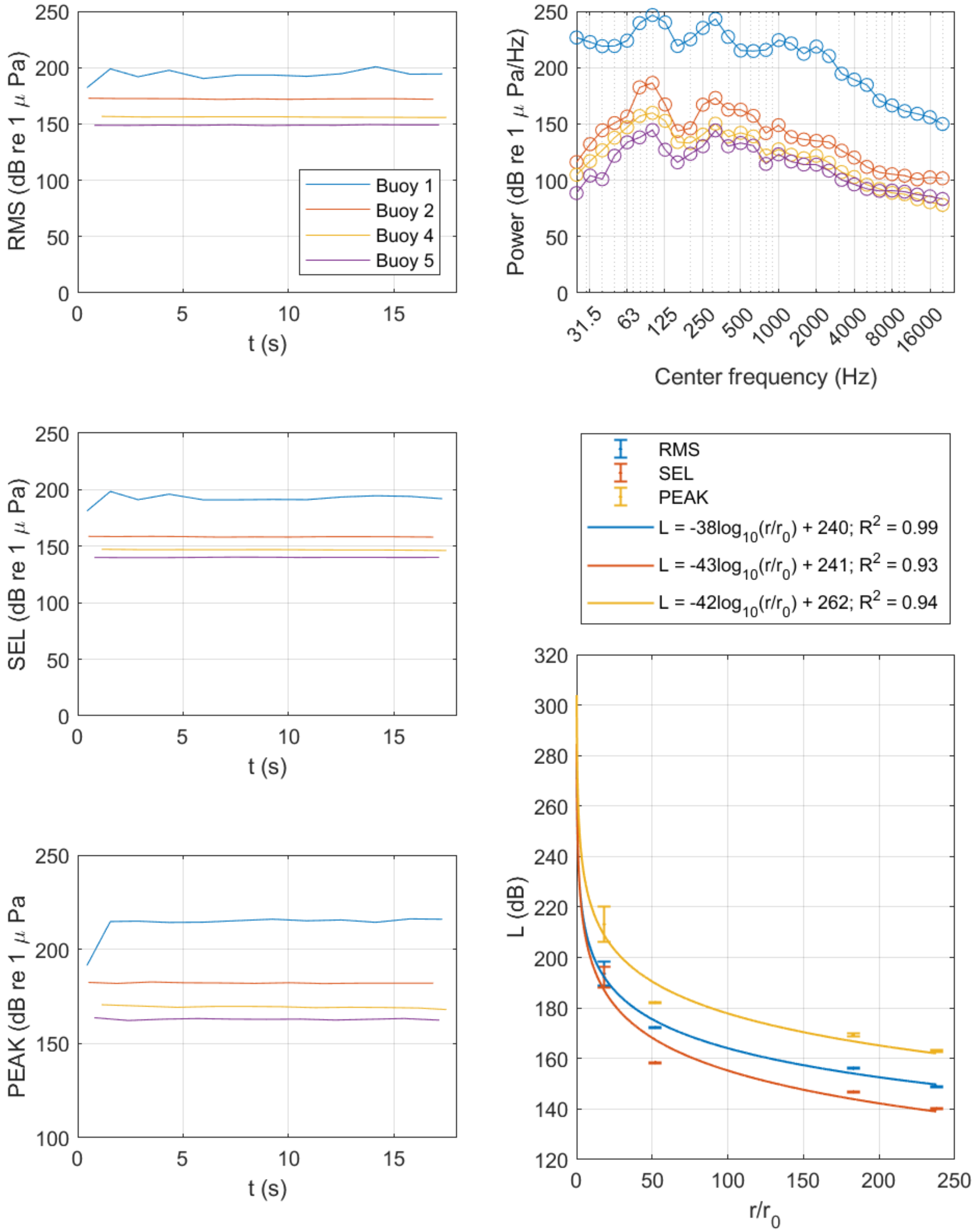

RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
Center frequency (Hz)
SEL (dB re 1 μ Pa)
t (s)
RMS
SEL
PEAK
L = -43log10(r/r0) + 250; R2 = 0.98
L = -43log10(r/r0) + 240; R2 = 0.93
L = -43log10(r/r0) + 264; R2 = 0.95
PEAK (dB re 1 μ Pa
t (s)
L (dB)
r/r0

HF-14



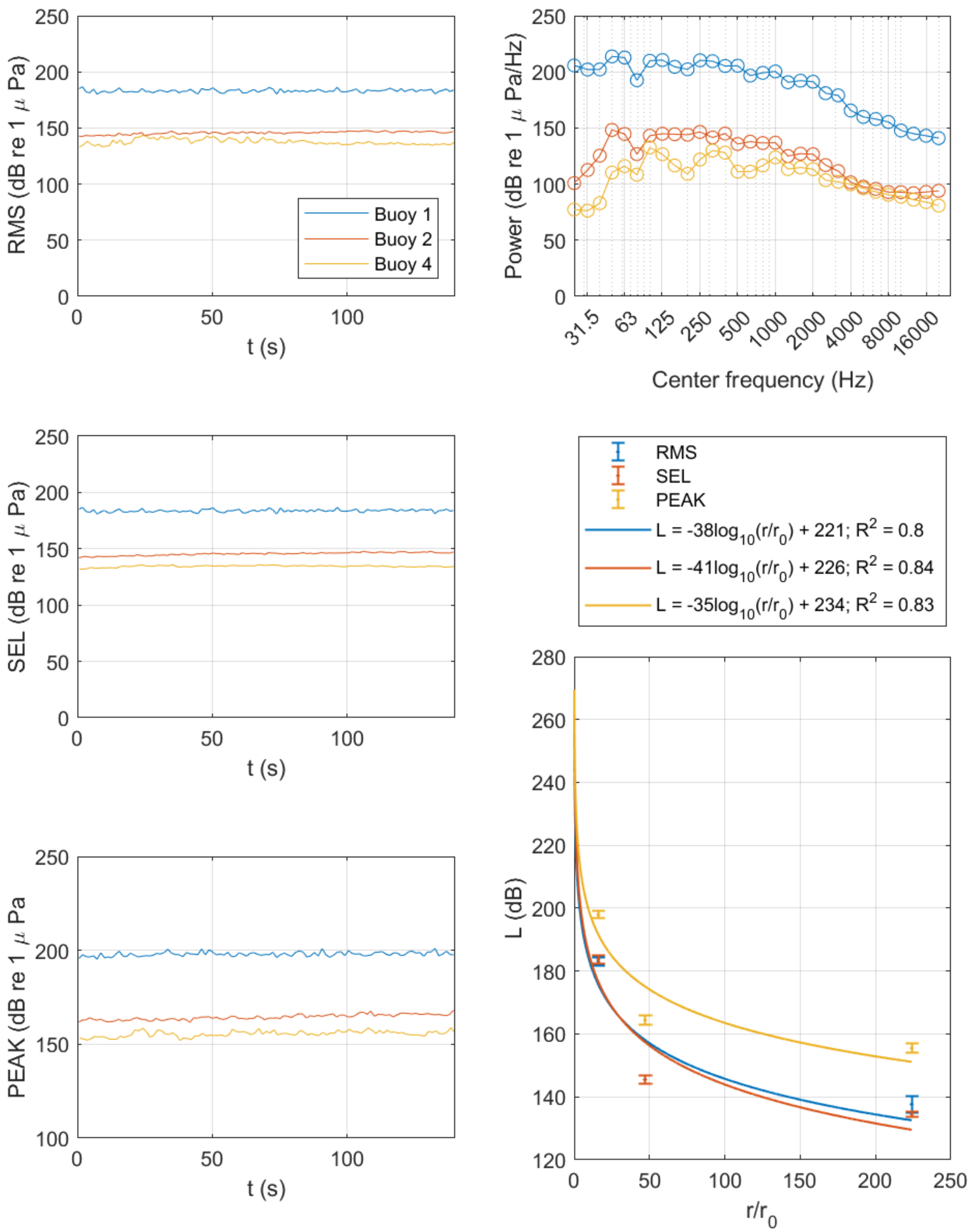
RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -38log10(r/r0) + 237; R2 = 0.97
L = -42log10(r/r0) + 238; R2 = 0.93
L = -45log10(r/r0) + 268; R2 = 0.95
L (dB)
r/r0

HF-15

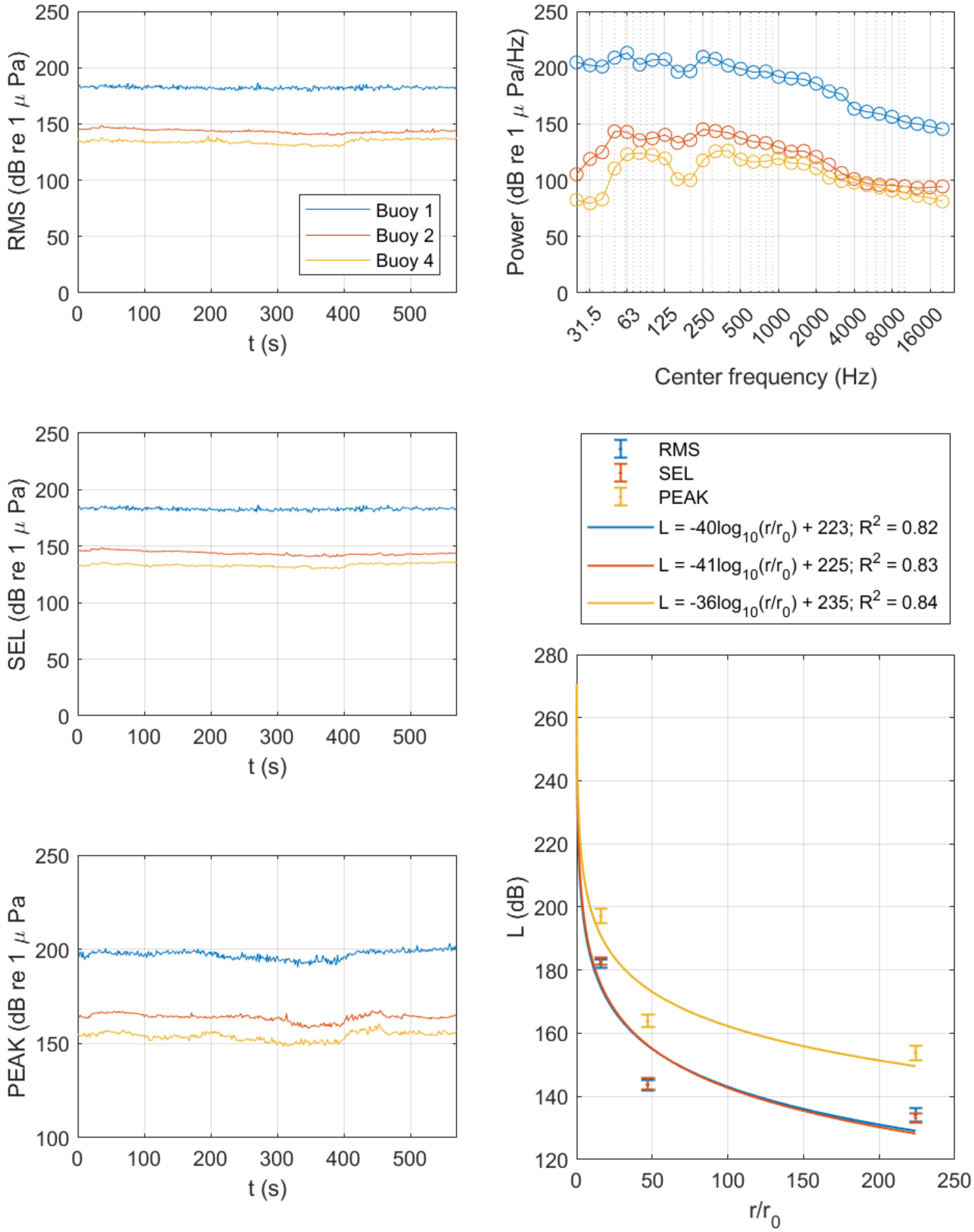


RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -38log10(r/r0) + 240; R2 = 0.99
L = -43log10(r/r0) + 241; R2 = 0.93
L = -42log10(r/r0) + 262; R2 = 0.94
L (dB)
r/r0

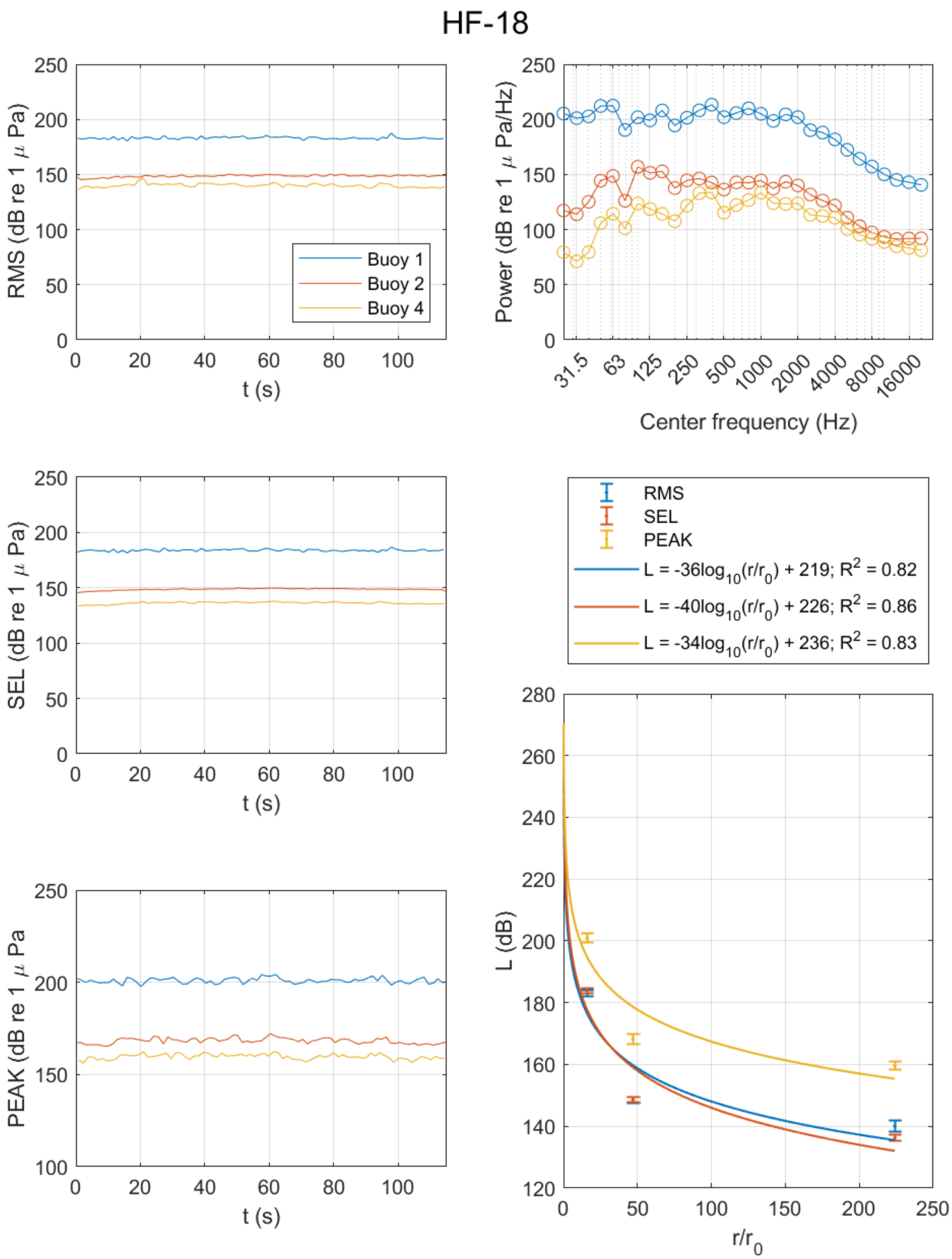
HF-16


RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 4
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
RMS
SEL
PEAK
L = -38log10(r/r0) + 221; R2 = 0.8
L = -41log10(r/r0) + 226; R2 = 0.84
L = -35log10(r/r0) + 234; R2 = 0.83
PEAK (dB re 1 μ Pa
L (dB)
r/r0

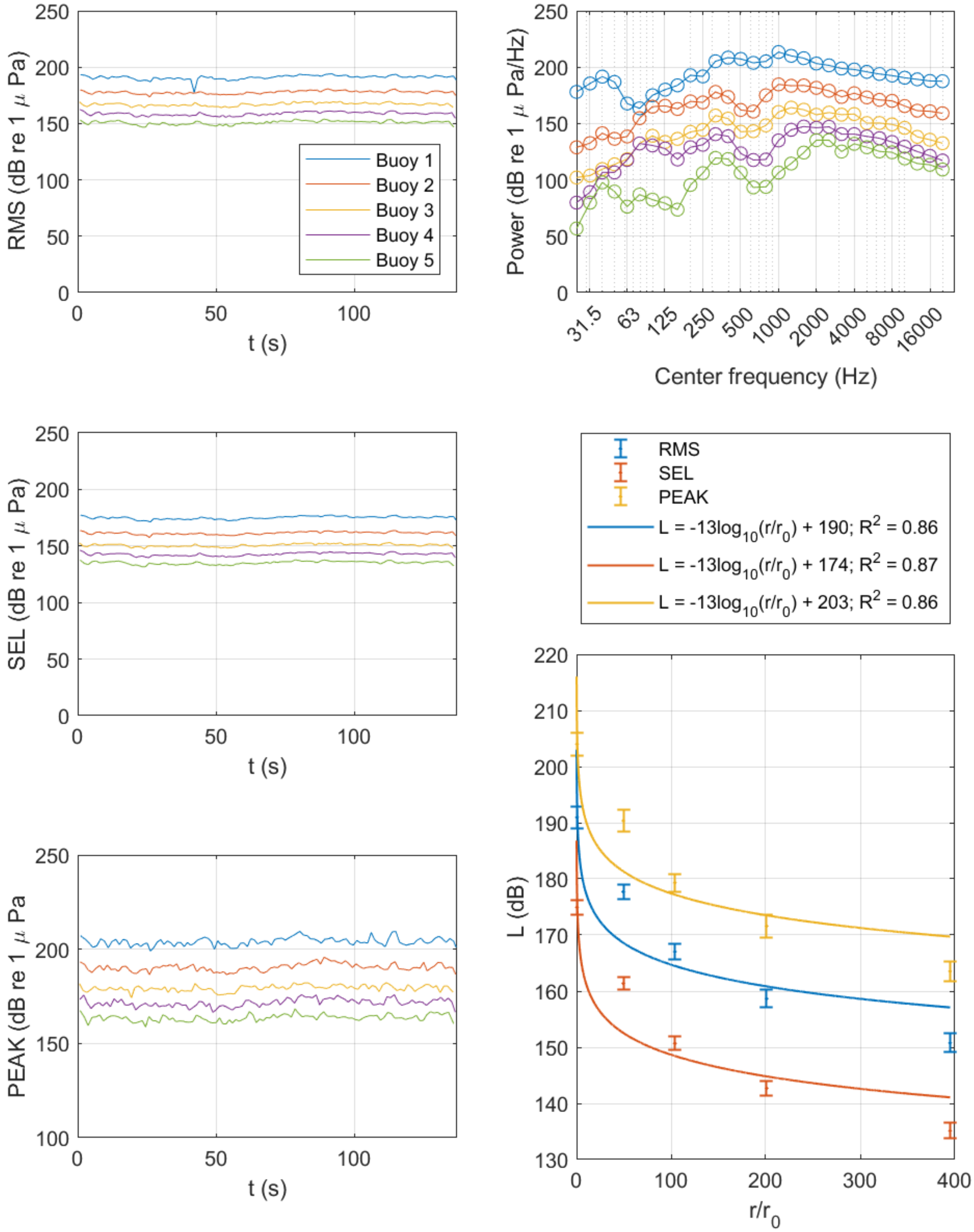
HF-17



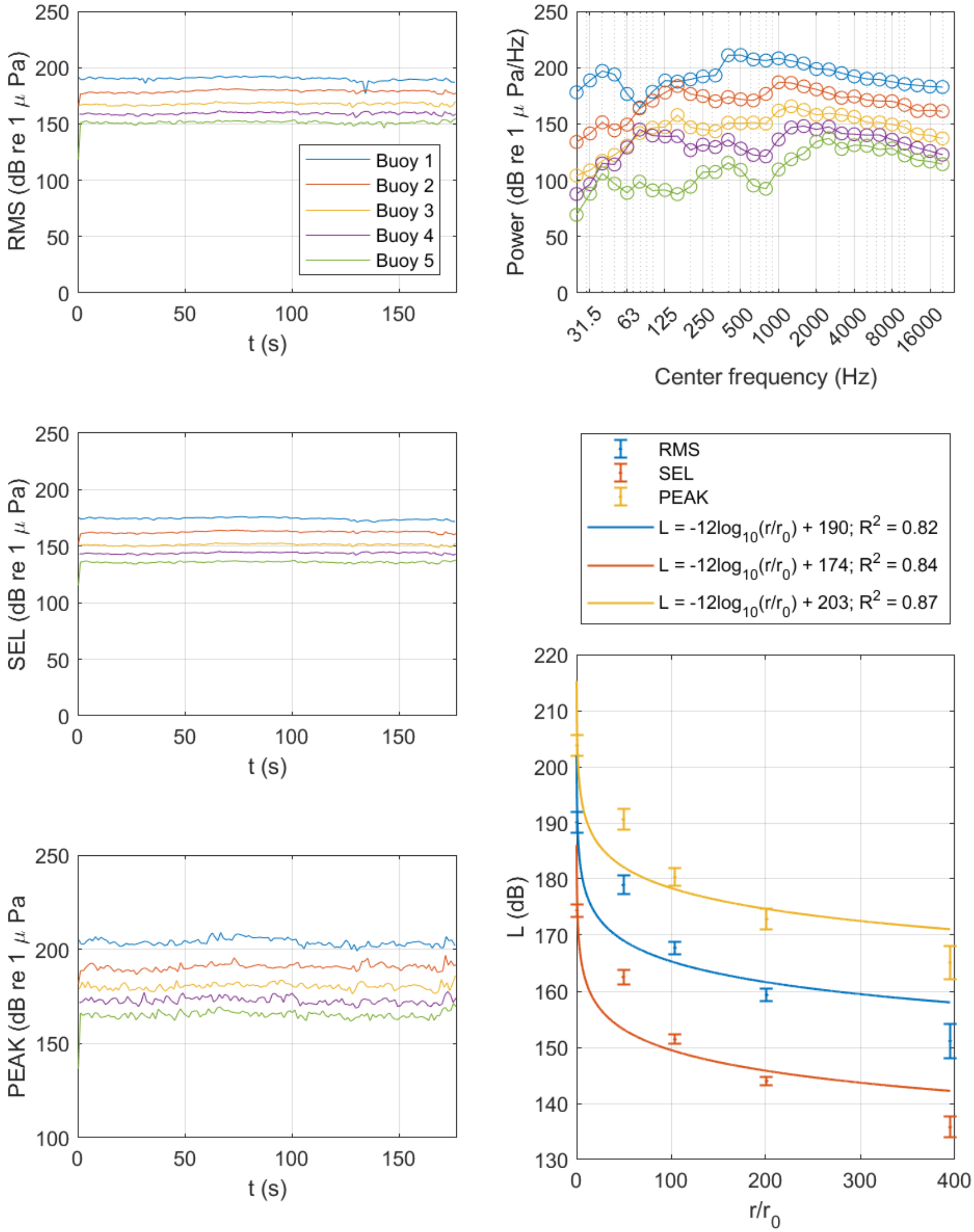
RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 4
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -40log10(r/r0) + 223; R2 = 0.82
L = -41log10(r/r0) + 225; R2 = 0.83
L = -36log10(r/r0) + 235; R2 = 0.84
L (dB)
r/r0


HF-18
RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 4
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -36log10(r/r0) + 219; R2 = 0.82
L = -40log10(r/r0) + 226; R2 = 0.86
L = -34log10(r/r0) + 236; R2 = 0.83
L (dB)
r/r0

HF-19

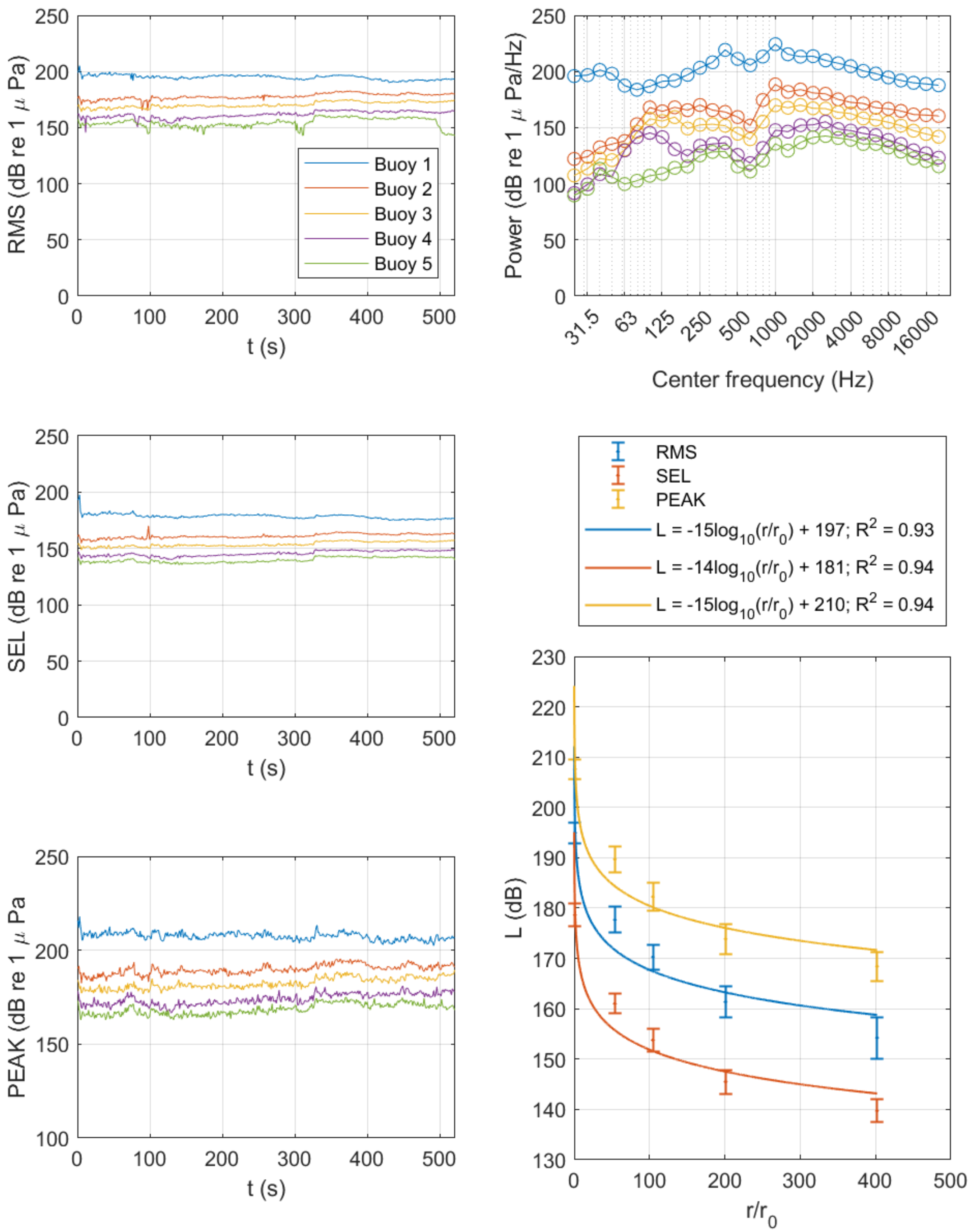

RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -13log10(r/r0) + 190; R2 = 0.86
L = -13log10(r/r0) + 174; R2 = 0.87
L = -13log10(r/r0) + 203; R2 = 0.86
L (dB)
r/r0

HF-20



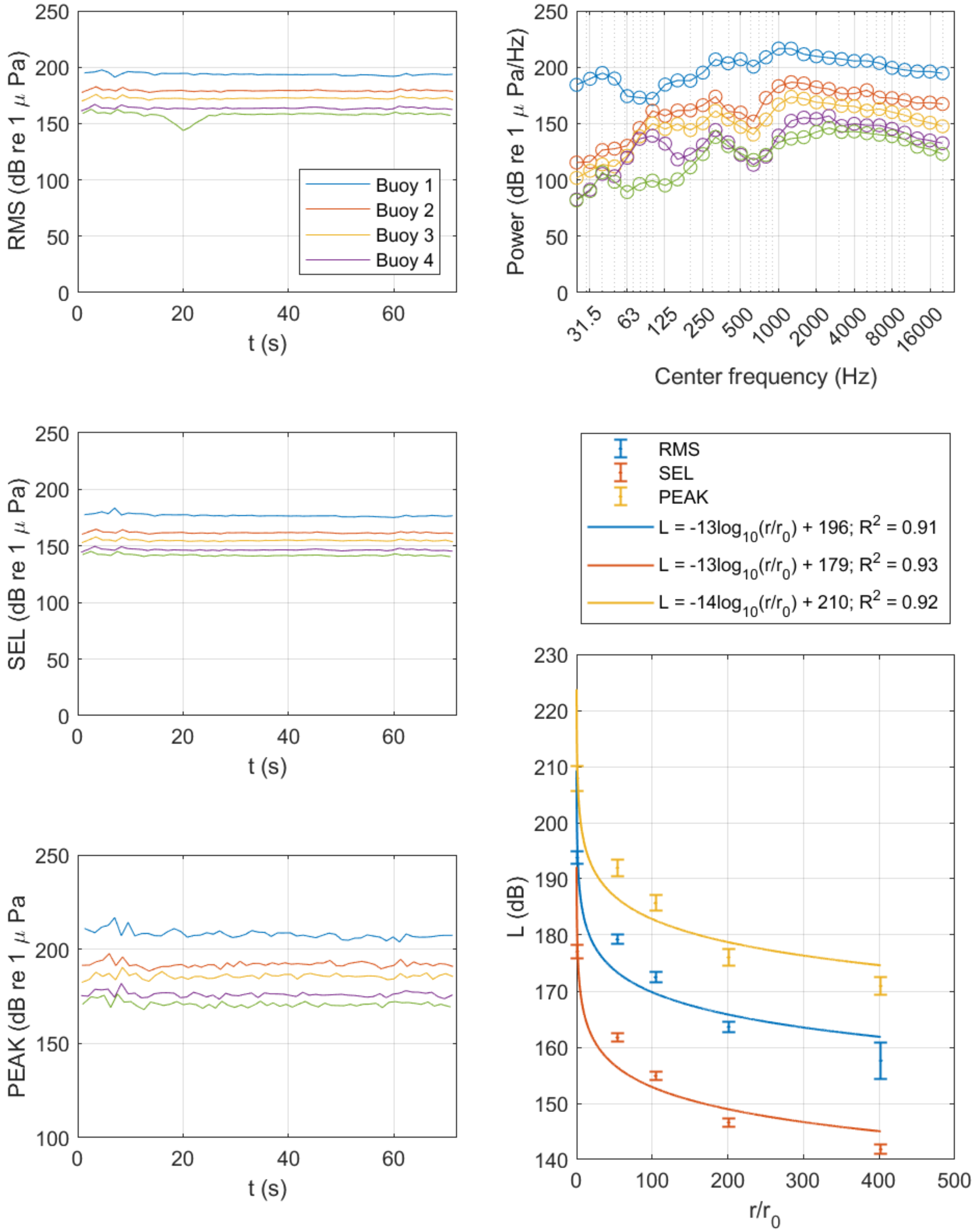
RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -12log10(r/r0) + 190; R2 = 0.82
L = -12log10(r/r0) + 174; R2 = 0.84
L = -12log10(r/r0) + 203; R2 = 0.87
L (dB)
r/r0

HF-21



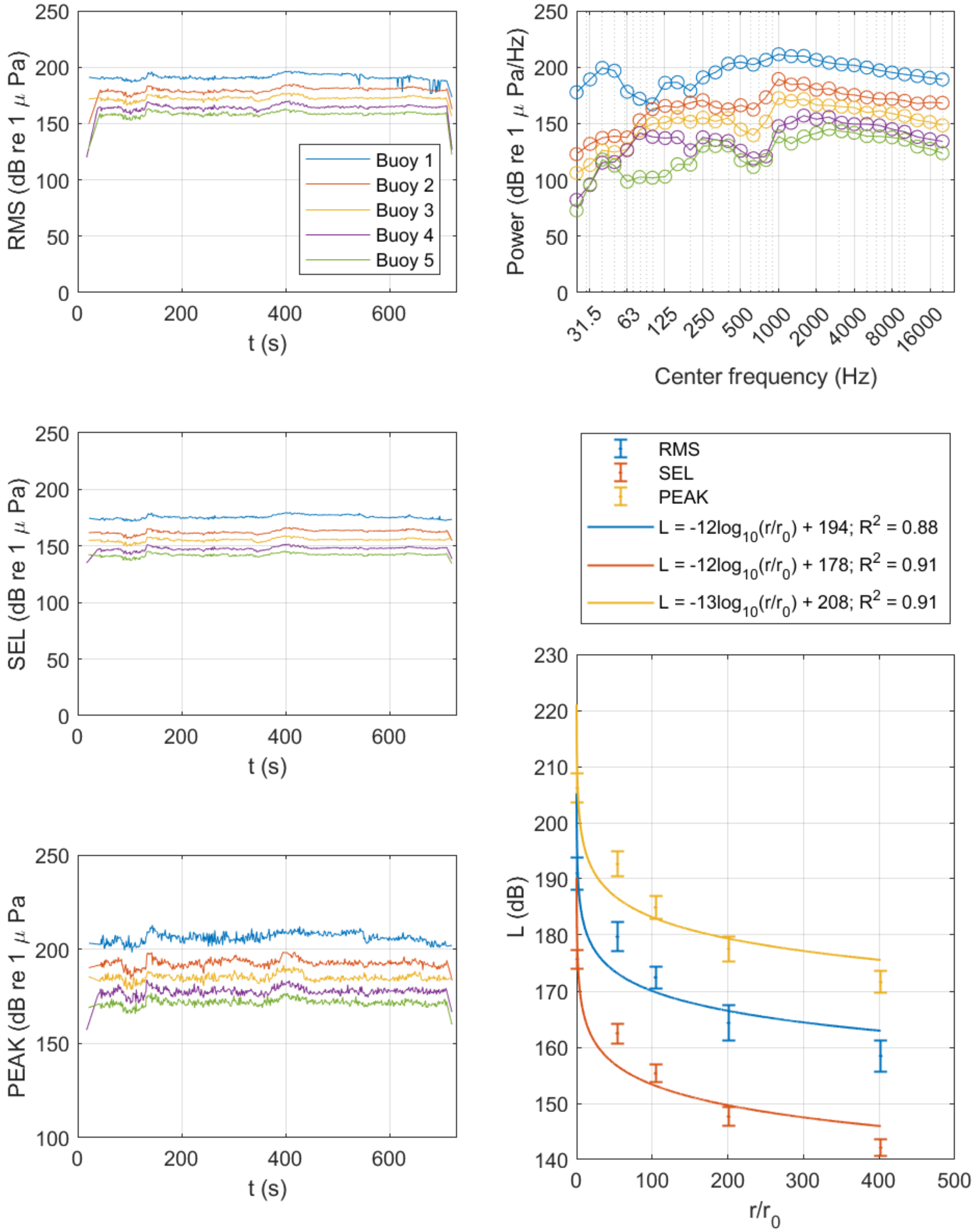
RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
SEL (dB re 1 μ Pa)
RMS
SEL
PEAK
L = -15log10(r/r0) + 197; R2 = 0.93
L = -14log10(r/r0) + 181; R2 = 0.94
L = -15log10(r/r0) + 210; R2 = 0.94
PEAK (dB re 1 μ Pa
L (dB)
r/r0

HF-22



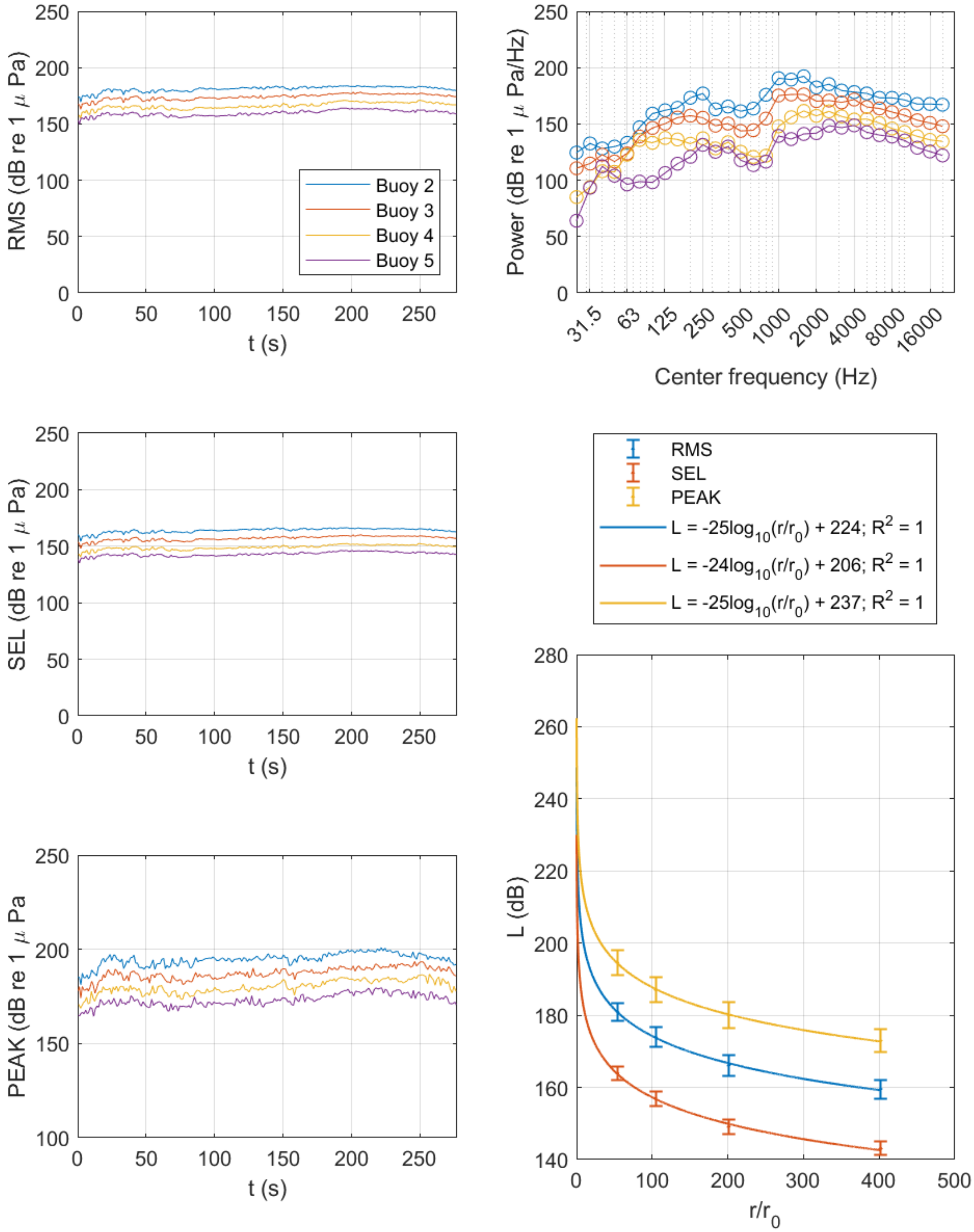
RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -13log10(r/r0) + 196; R2 = 0.91
L = -13log10(r/r0) + 179; R2 = 0.93
L = -14log10(r/r0) + 210; R2 = 0.92
L (dB)
r/r0

HF-23



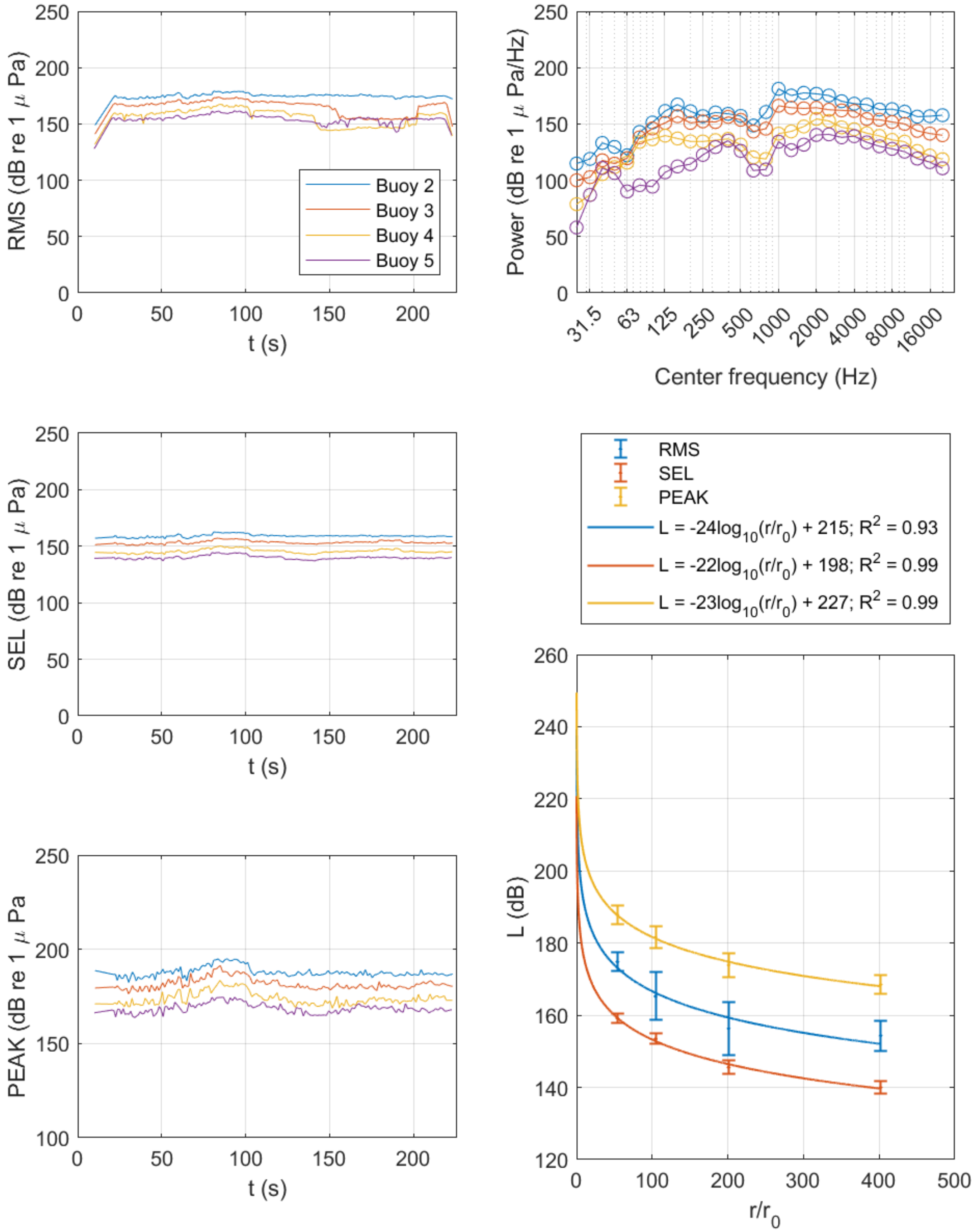
RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -12log10(r/r0) + 194; R2 = 0.88
L = -12log10(r/r0) + 178; R2 = 0.91
L = -13log10(r/r0) + 208; R2 = 0.91
L (dB)
r/r0

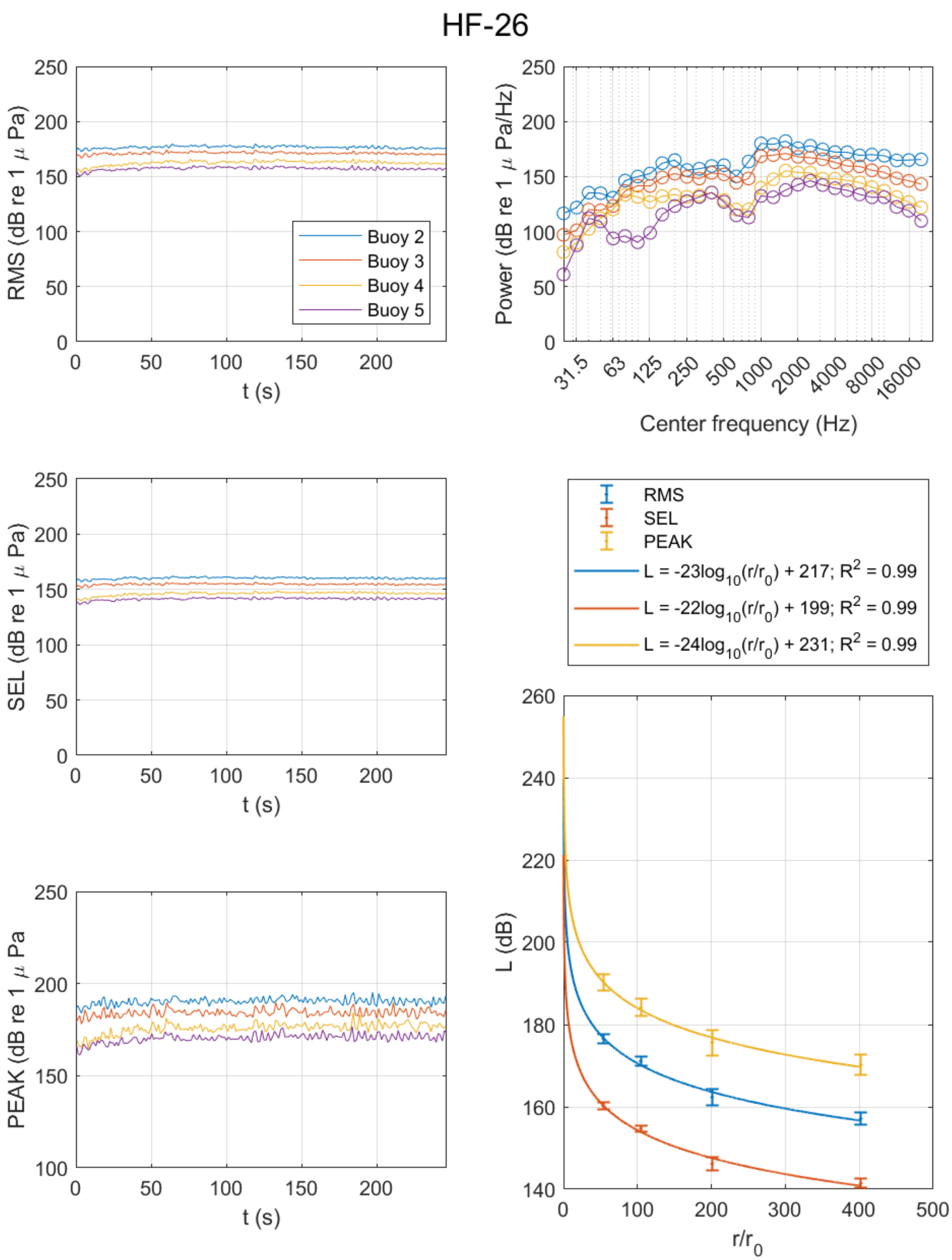
HF-24



RMS (dB re 1 μ Pa)
t (s)
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -25log10(r/r0) + 224; R2 = 1
L = -24log10(r/r0) + 206; R2 = 1
L = -25log10(r/r0) + 237; R2 = 1
L (dB)
r/r0

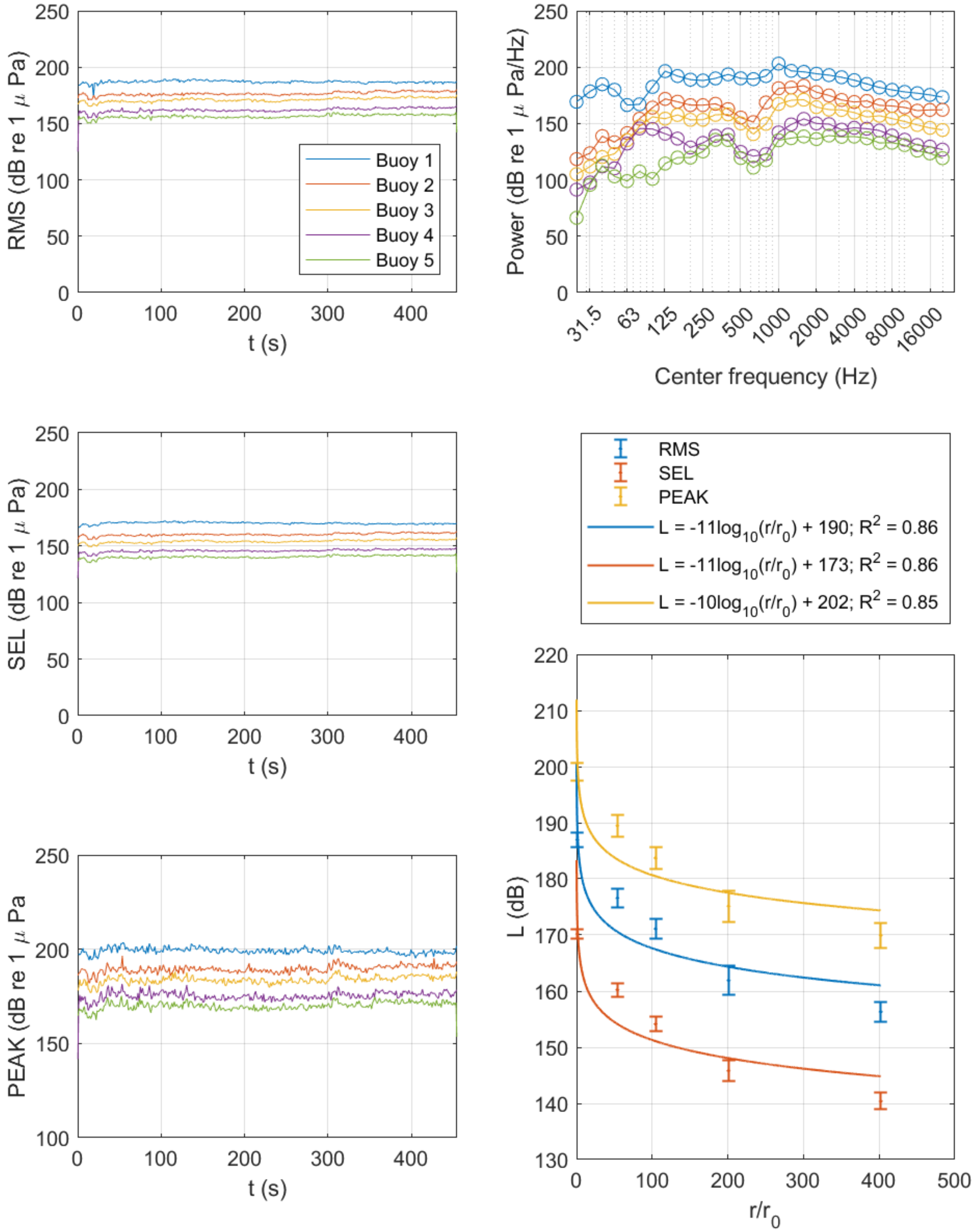
HF-25


RMS (dB re 1 μ Pa)
t (s)
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
SEL (dB re 1 μ Pa)
t (s)
PEAK (dB re 1 μ Pa
t (s)
RMS
SEL
PEAK
L = -24log10(r/r0) + 215; R2 = 0.93
L = -22log10(r/r0) + 198; R2 = 0.99
L = -23log10(r/r0) + 227; R2 = 0.99
L (dB)
r/r0

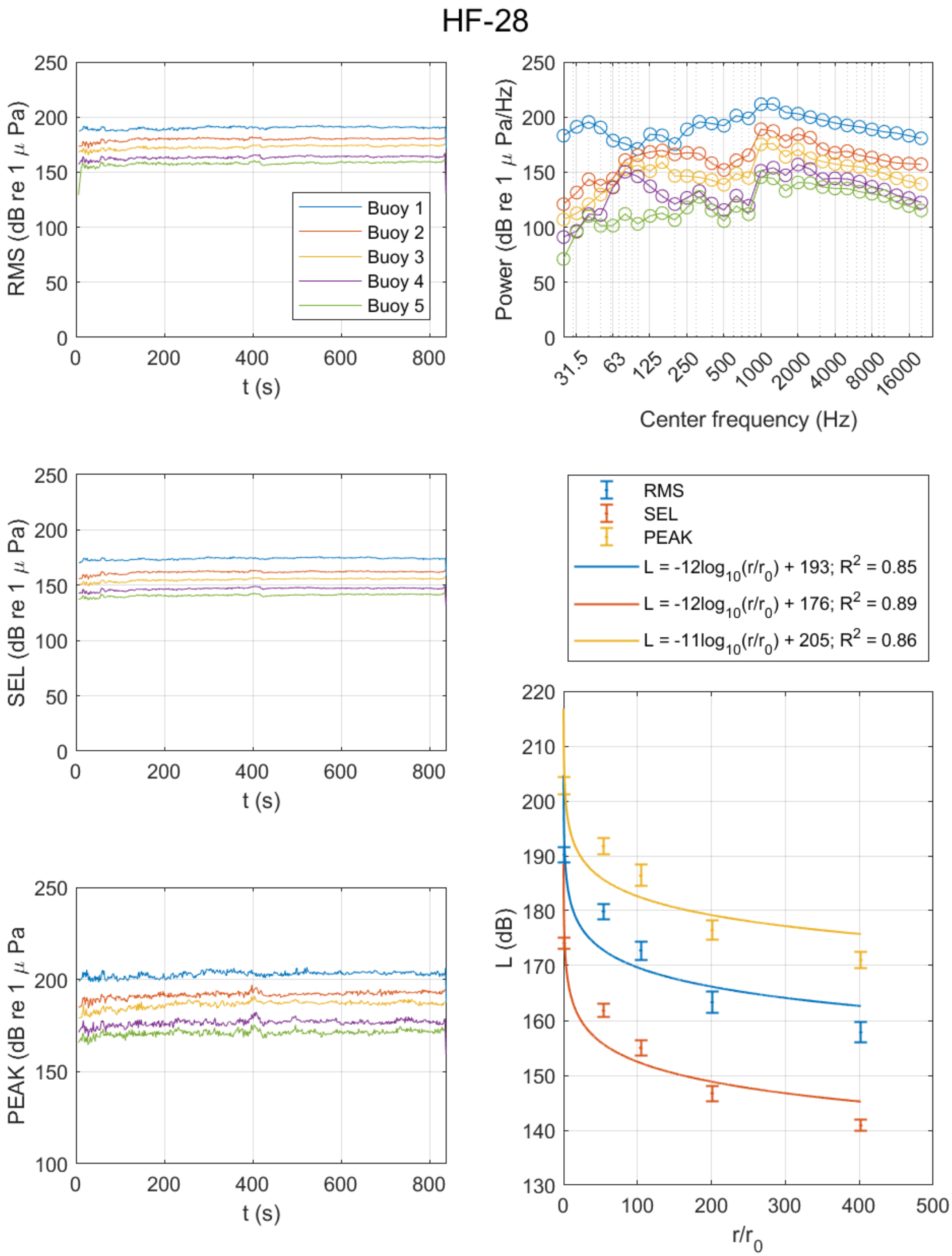


HF-26
RMS (dB re 1 μ Pa)
t (s)
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -23log10(r/r0) + 217; R2 = 0.99
L = -22log10(r/r0) + 199; R2 = 0.99
L = -24log10(r/r0) + 231; R2 = 0.99
L (dB)
r/r0

HF-27

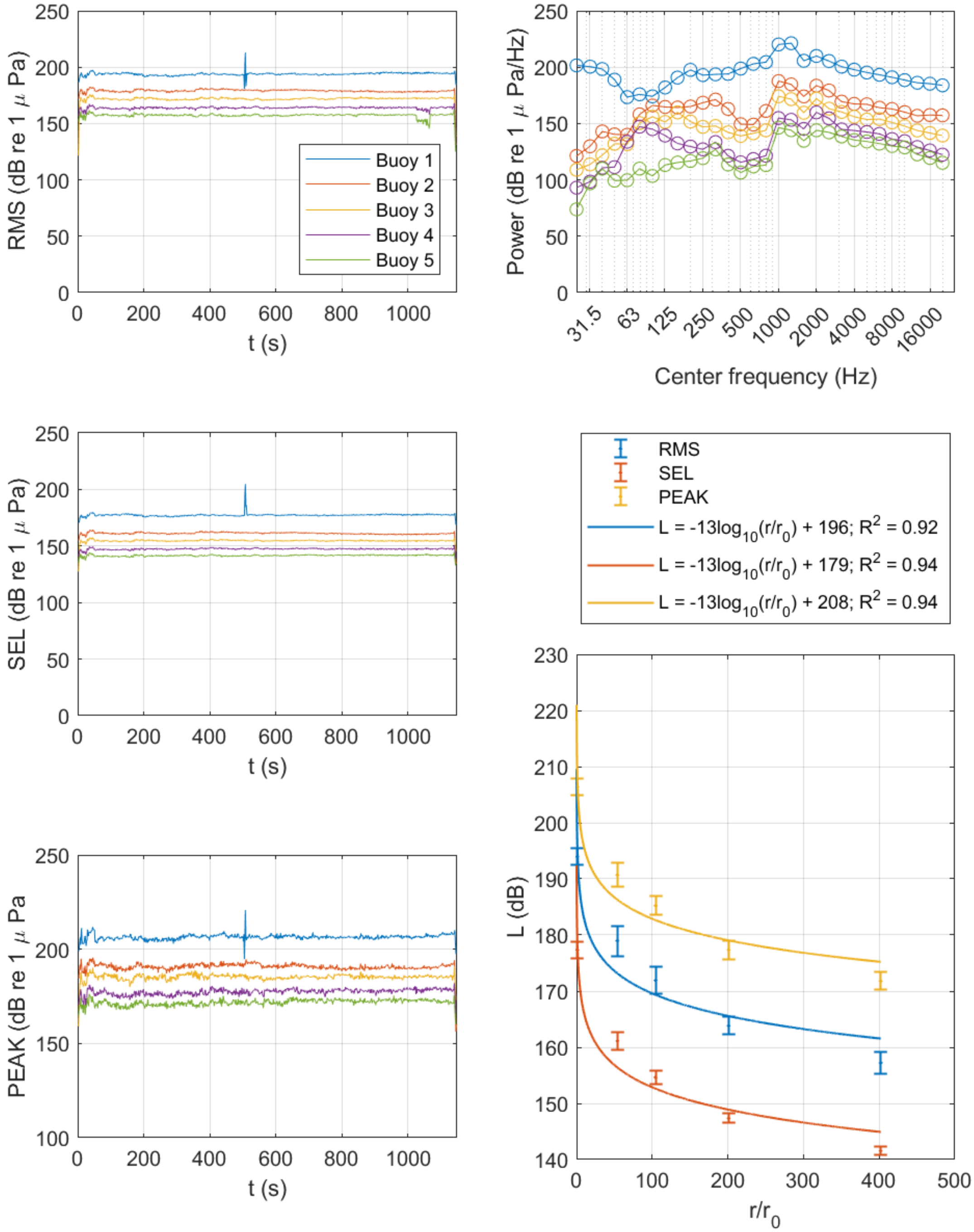


RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
SEL (dB re 1 μ Pa)
t (s)
RMS
SEL
PEAK
L = -11log10(r/r0) + 190; R2 = 0.86
L = -11log10(r/r0) + 173; R2 = 0.86
L = -10log10(r/r0) + 202; R2 = 0.85
L (dB)
r/r0
PEAK (dB re 1 μ Pa
t (s)



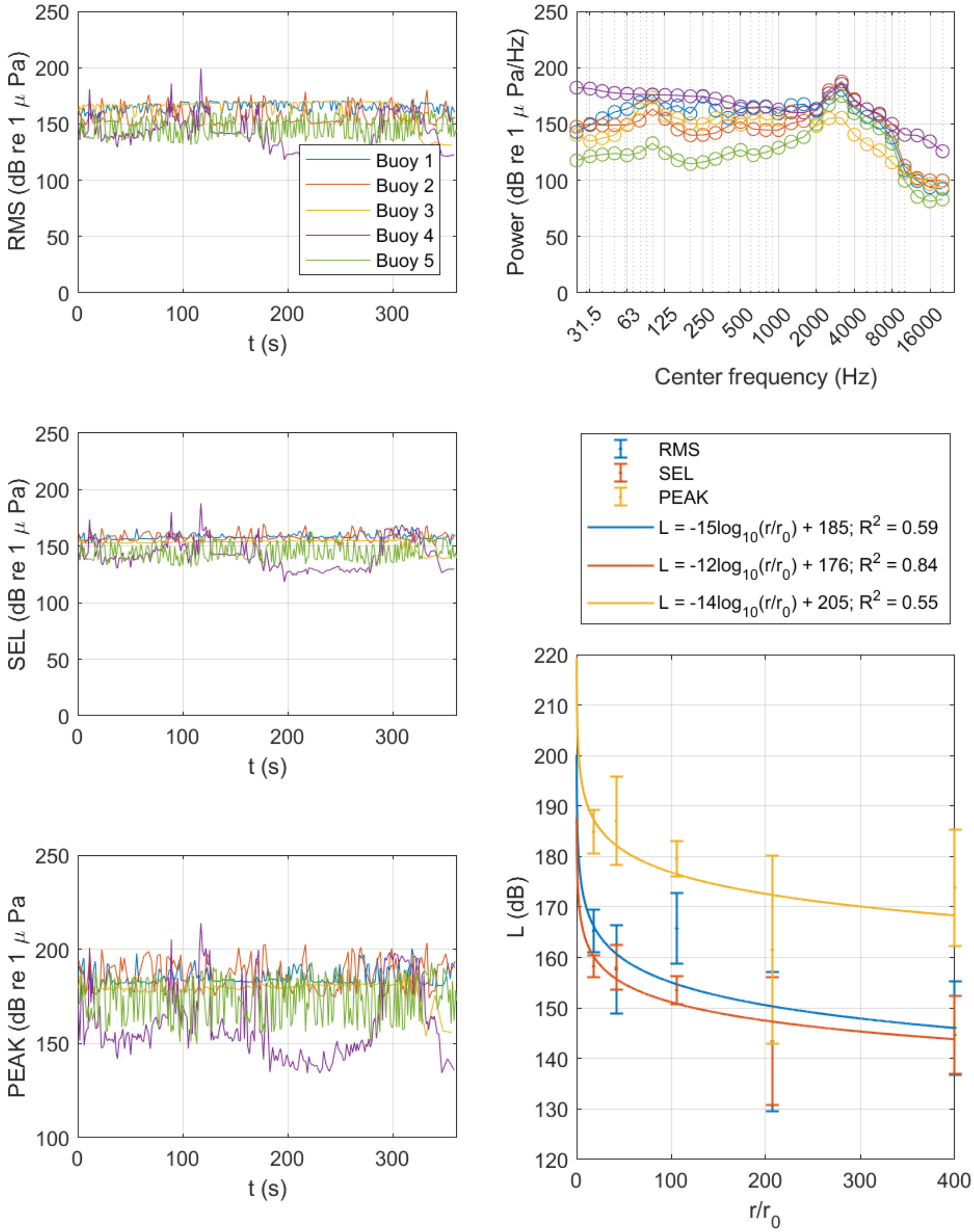
HF-28
RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -12log10(r/r0) + 193; R2 = 0.85
L = -12log10(r/r0) + 176; R2 = 0.89
L = -11log10(r/r0) + 205; R2 = 0.86
L (dB)
r/r0

HF-29

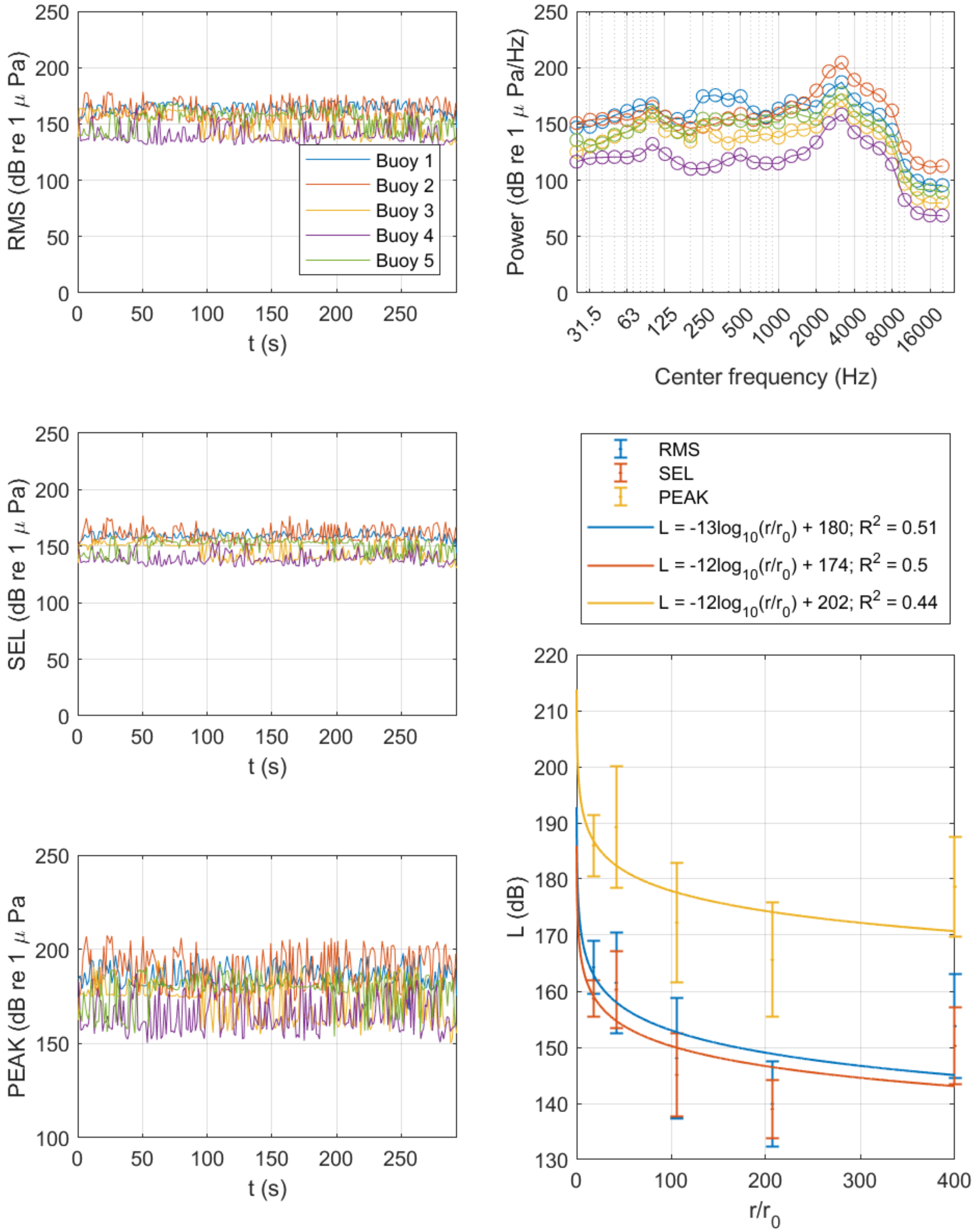


RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -13log10(r/r0) + 196; R2 = 0.92
L = -13log10(r/r0) + 179; R2 = 0.94
L = -13log10(r/r0) + 208; R2 = 0.94
L (dB)
r/r0

HF-30

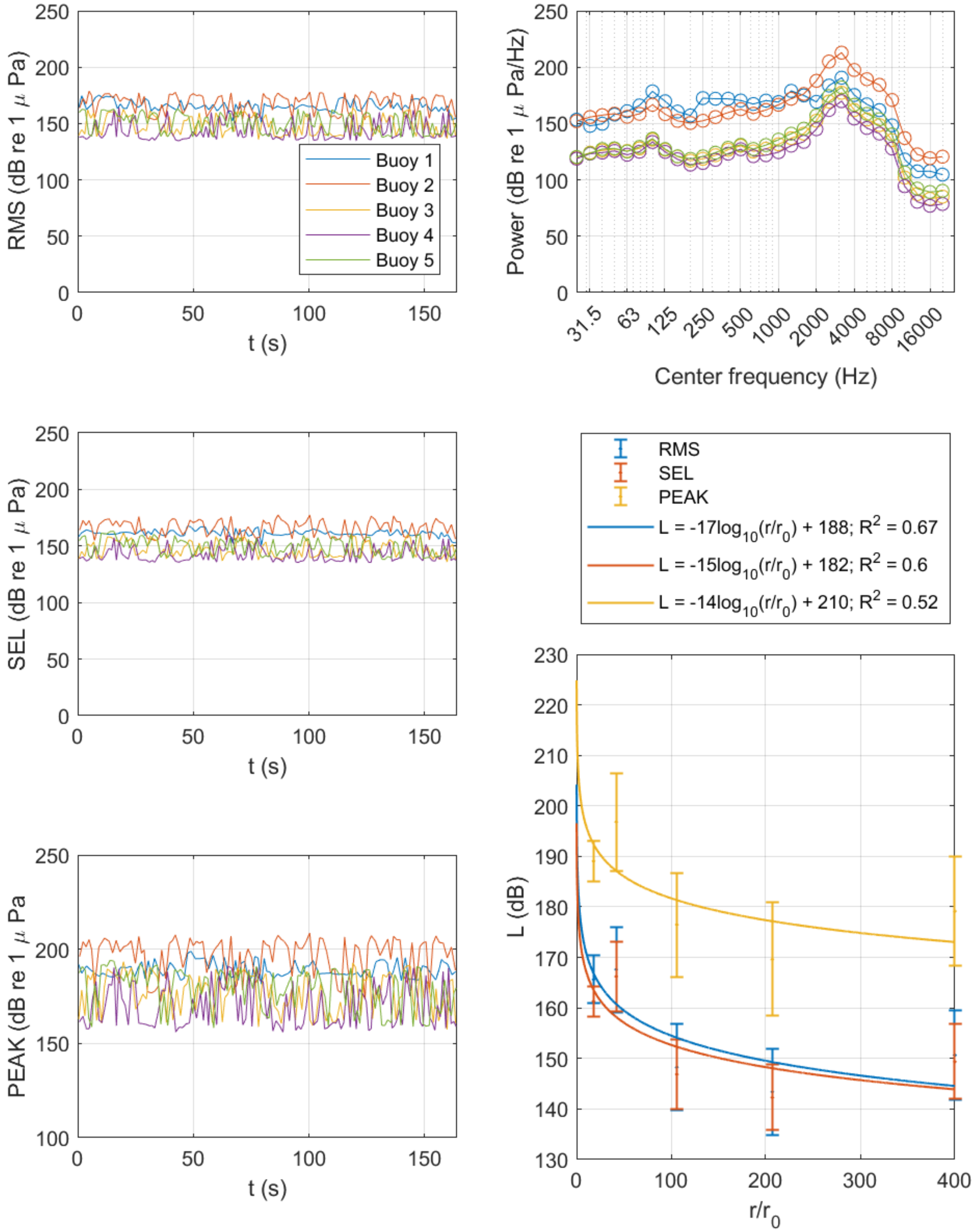

RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -15log10(r/r0) + 185; R2 = 0.59
L = -12log10(r/r0) + 176; R2 = 0.84
L = -14log10(r/r0) + 205; R2 = 0.55
L (dB)
r/r0

HF-31



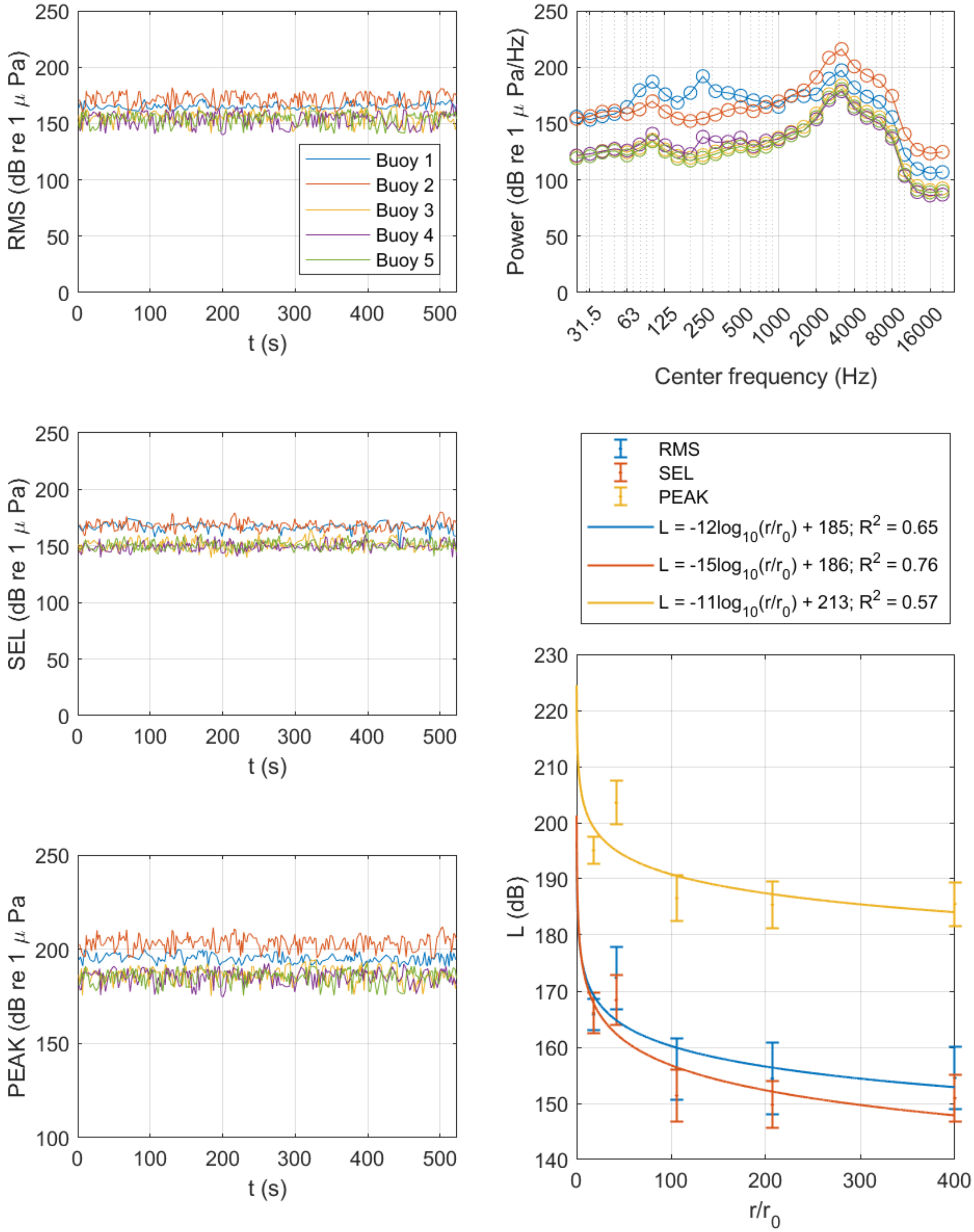
RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
t (s)
PEAK (dB re 1 μ Pa
t (s)
RMS
SEL
PEAK
L = -13log$_{10}$(r/r$_0$) + 180; R^2 = 0.51
L = -12log$_{10}$(r/r$_0$) + 174; R^2 = 0.5
L = -12log$_{10}$(r/r$_0$) + 202; R^2 = 0.44
L (dB)
r/r$_0$

HF-32



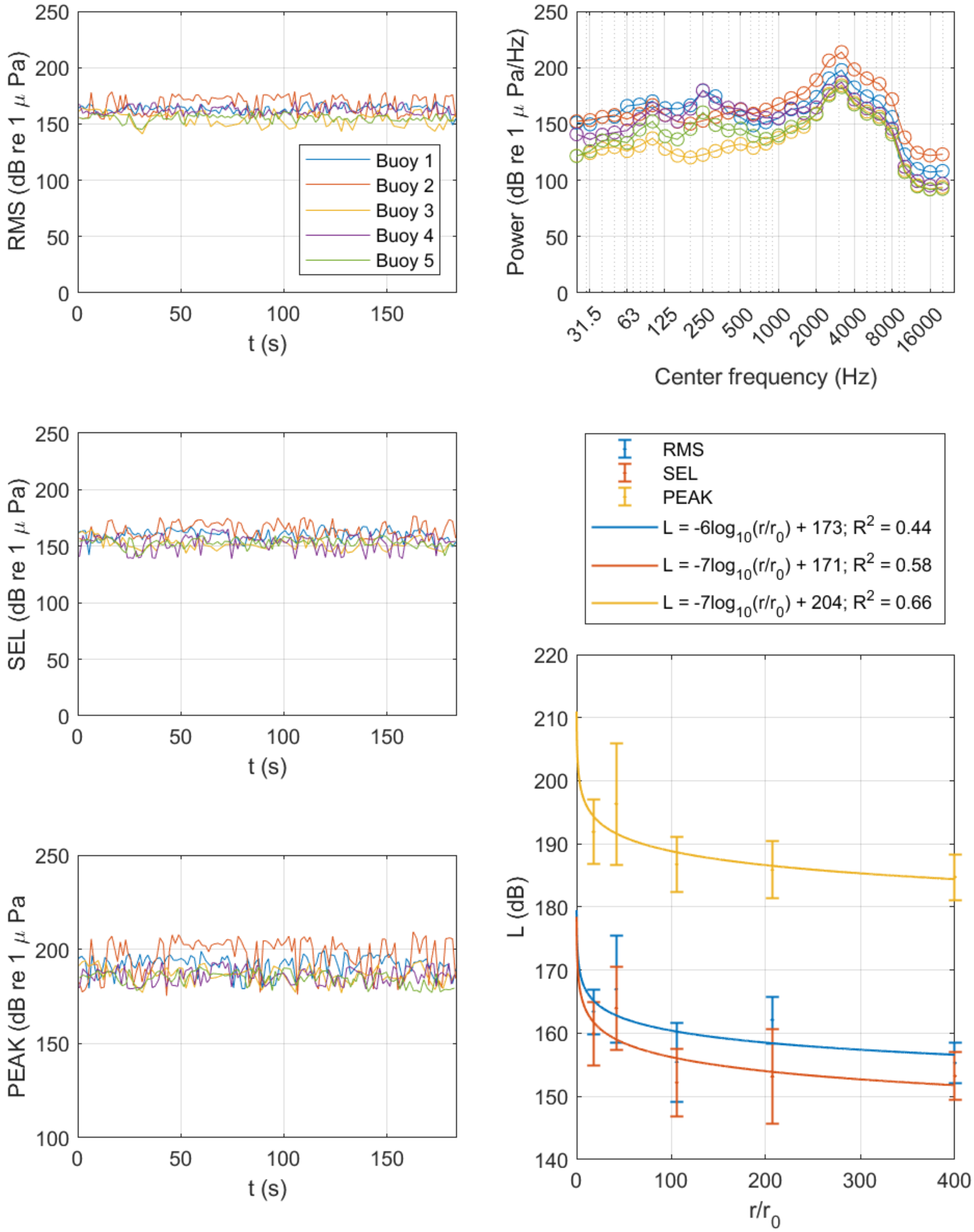
RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -17log10(r/r0) + 188; R2 = 0.67
L = -15log10(r/r0) + 182; R2 = 0.6
L = -14log10(r/r0) + 210; R2 = 0.52
L (dB)
r/r0

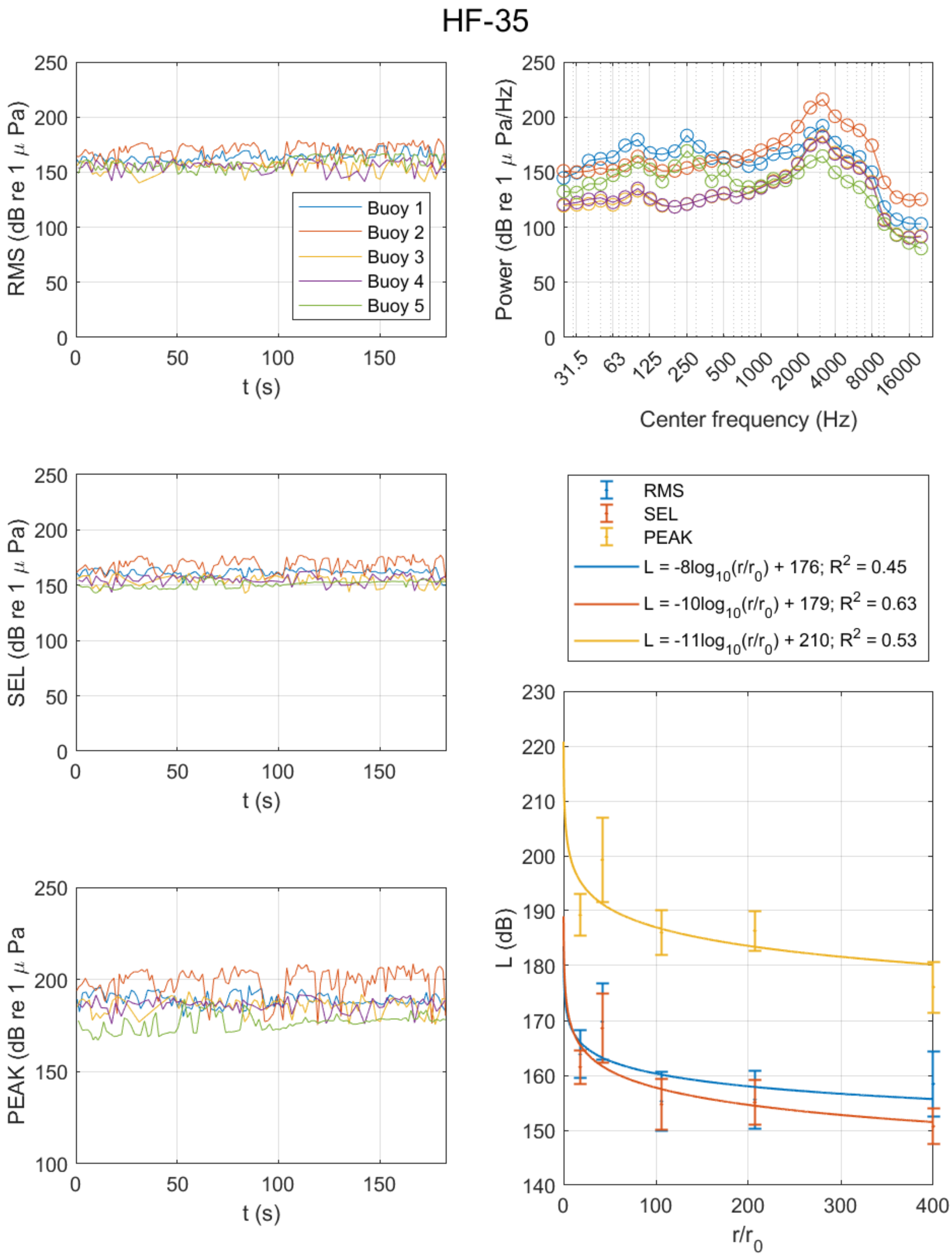
HF-33



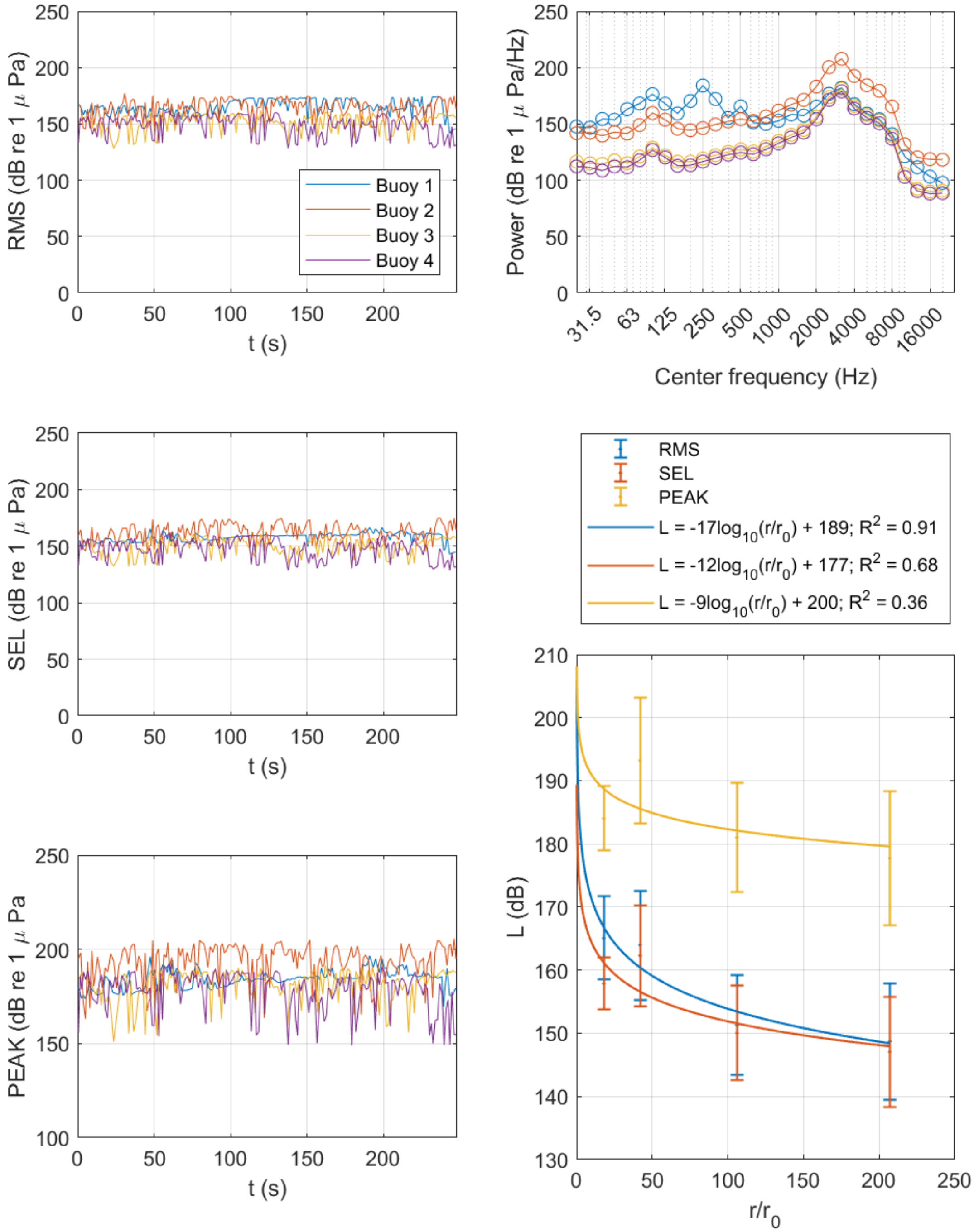
RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -12log10(r/r0) + 185; R2 = 0.65
L = -15log10(r/r0) + 186; R2 = 0.76
L = -11log10(r/r0) + 213; R2 = 0.57
L (dB)
r/r0

HF-34

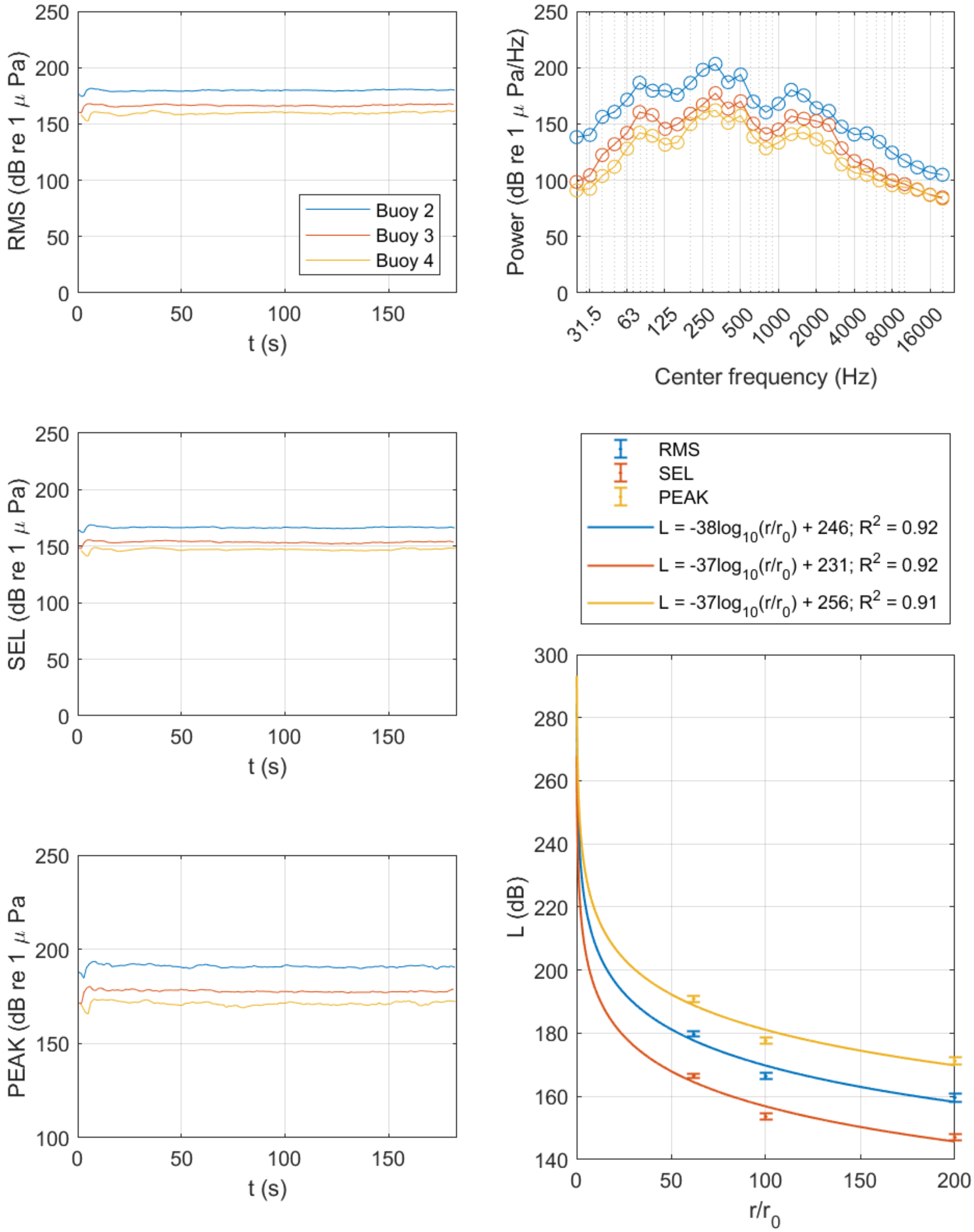

RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -6log10(r/r0) + 173; R2 = 0.44
L = -7log10(r/r0) + 171; R2 = 0.58
L = -7log10(r/r0) + 204; R2 = 0.66
L (dB)
r/r0


HF-35
RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -8log10(r/r0) + 176; R2 = 0.45
L = -10log10(r/r0) + 179; R2 = 0.63
L = -11log10(r/r0) + 210; R2 = 0.53
L (dB)
r/r0

HF-36

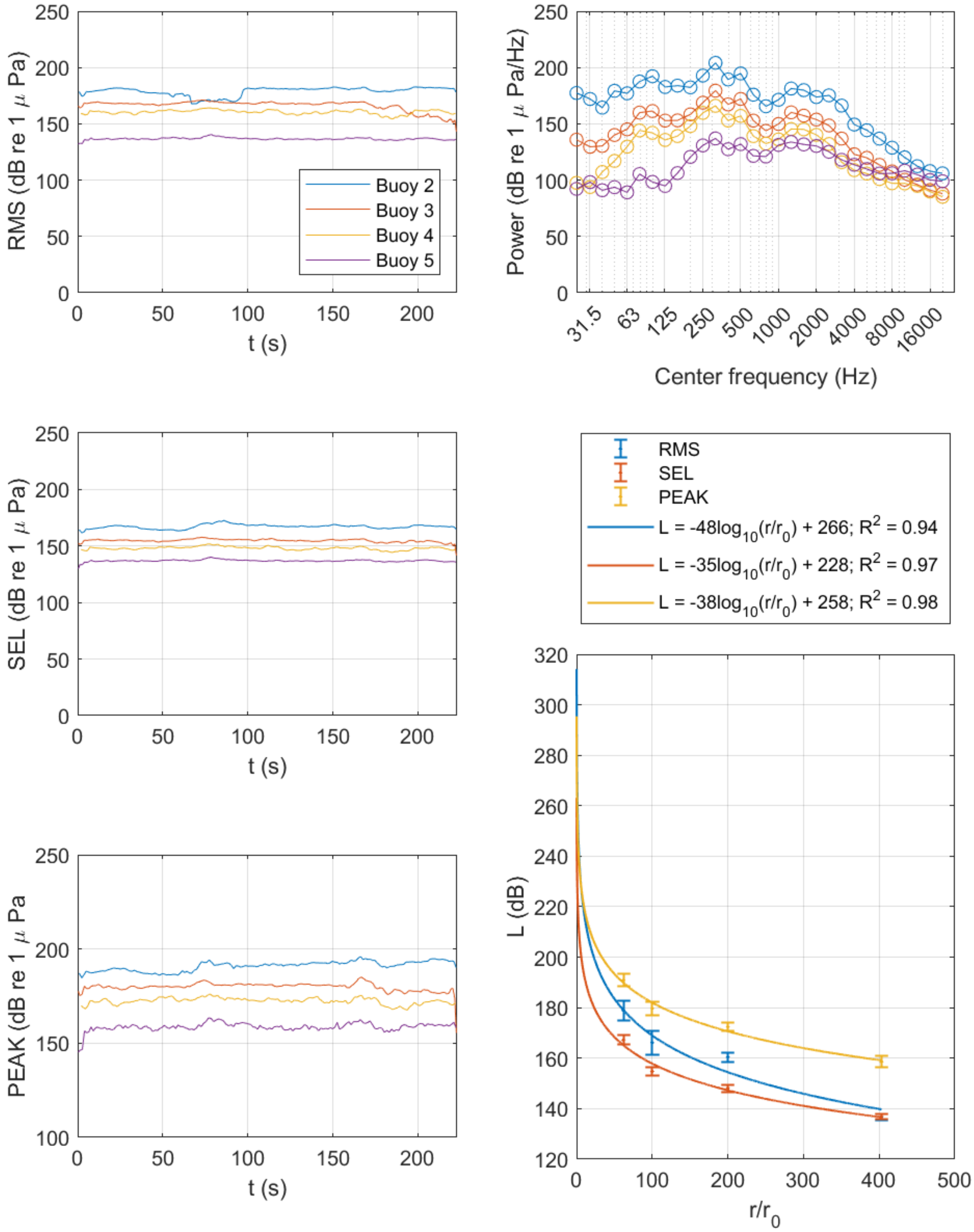

RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 3
Buoy 4
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
$L = -17\log_{10}(r/r_0) + 189$; $R^2 = 0.91$
$L = -12\log_{10}(r/r_0) + 177$; $R^2 = 0.68$
$L = -9\log_{10}(r/r_0) + 200$; $R^2 = 0.36$
L (dB)
r/r_0

HF-37



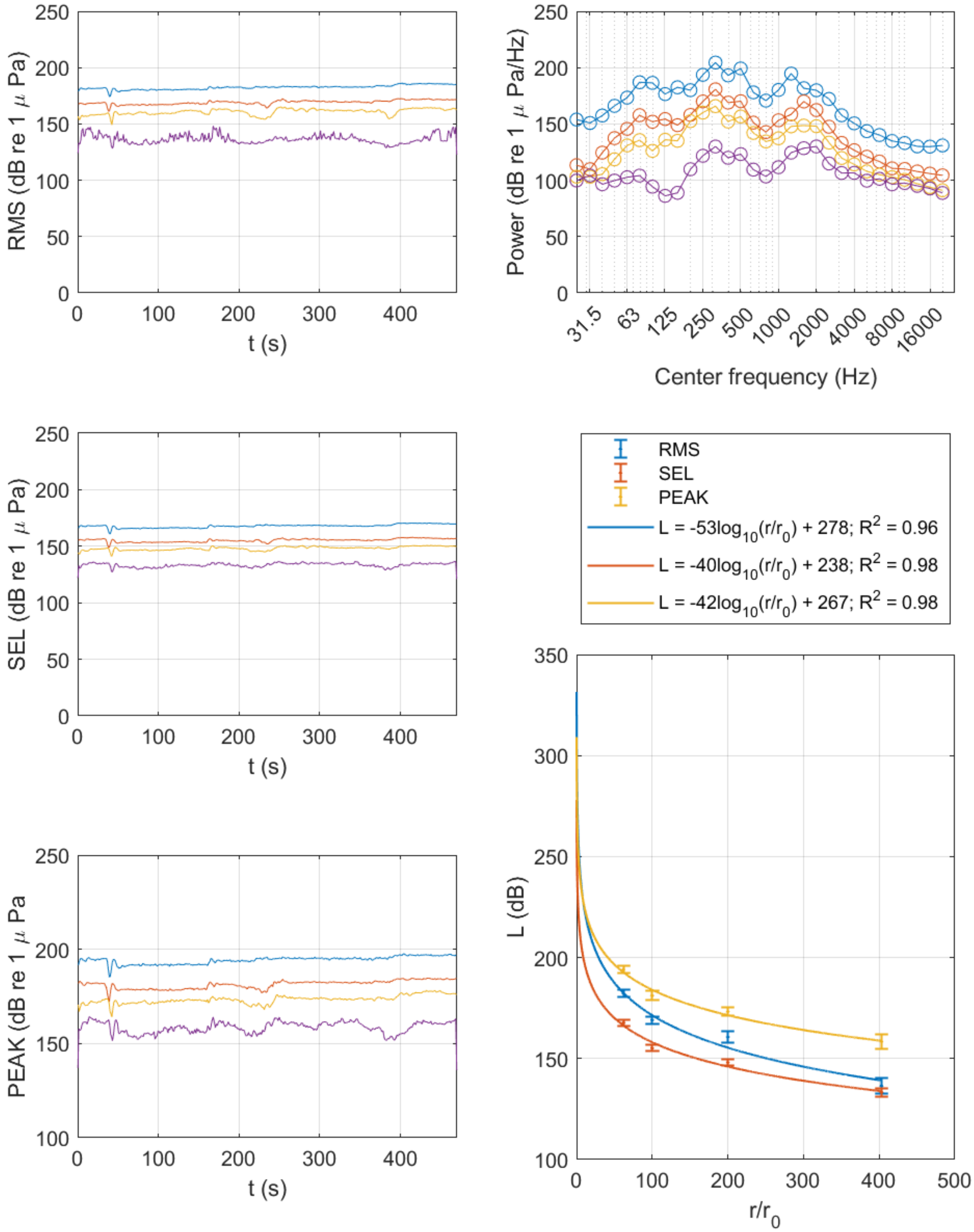
RMS (dB re 1 μ Pa)
t (s)
Buoy 2
Buoy 3
Buoy 4
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -38log10(r/r0) + 246; R2 = 0.92
L = -37log10(r/r0) + 231; R2 = 0.92
L = -37log10(r/r0) + 256; R2 = 0.91
L (dB)
r/r0

HF-38

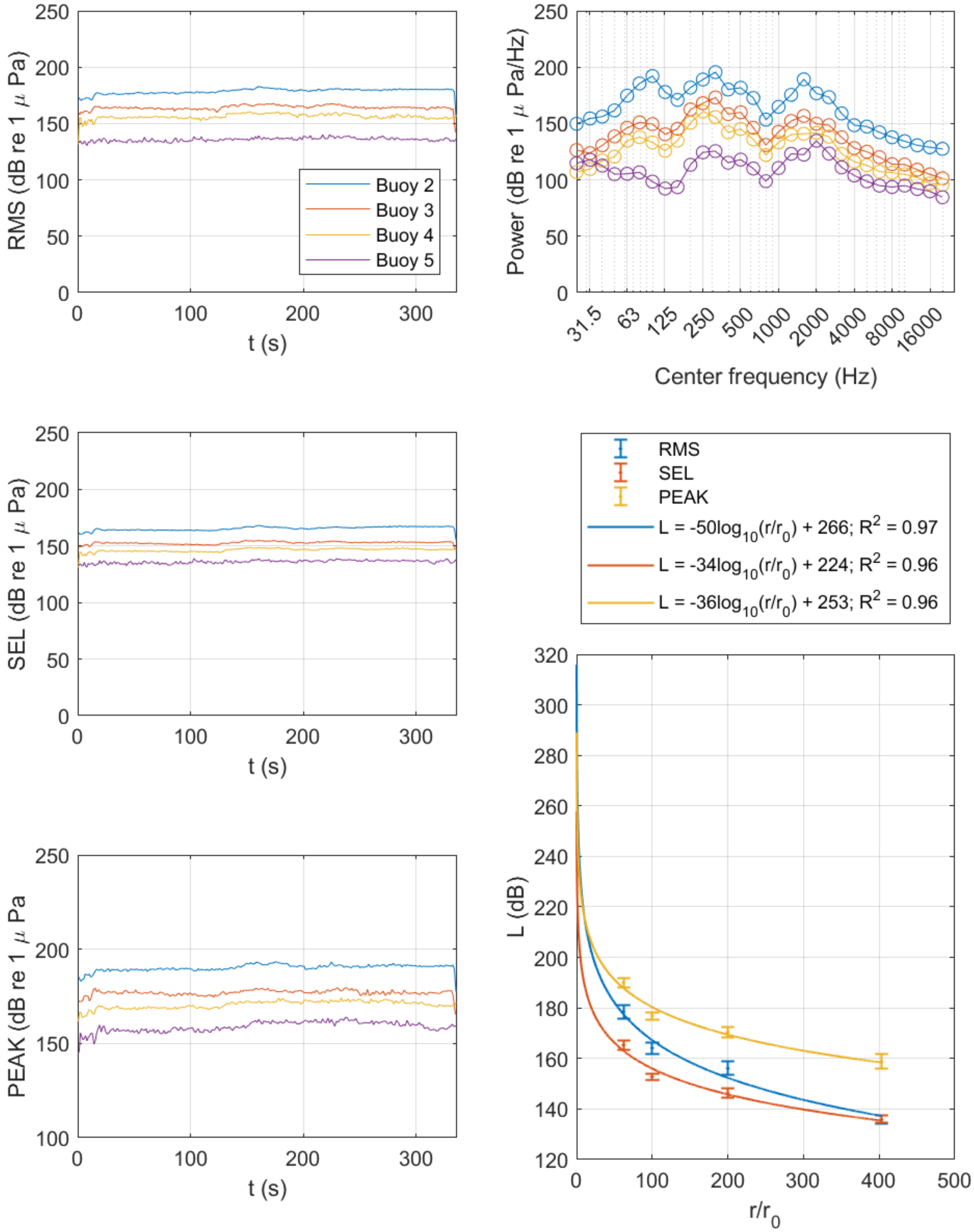


RMS (dB re 1 μ Pa)
t (s)
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
t (s)
PEAK (dB re 1 μ Pa
t (s)
RMS
SEL
PEAK
L = -48log10(r/r0) + 266; R2 = 0.94
L = -35log10(r/r0) + 228; R2 = 0.97
L = -38log10(r/r0) + 258; R2 = 0.98
L (dB)
r/r0

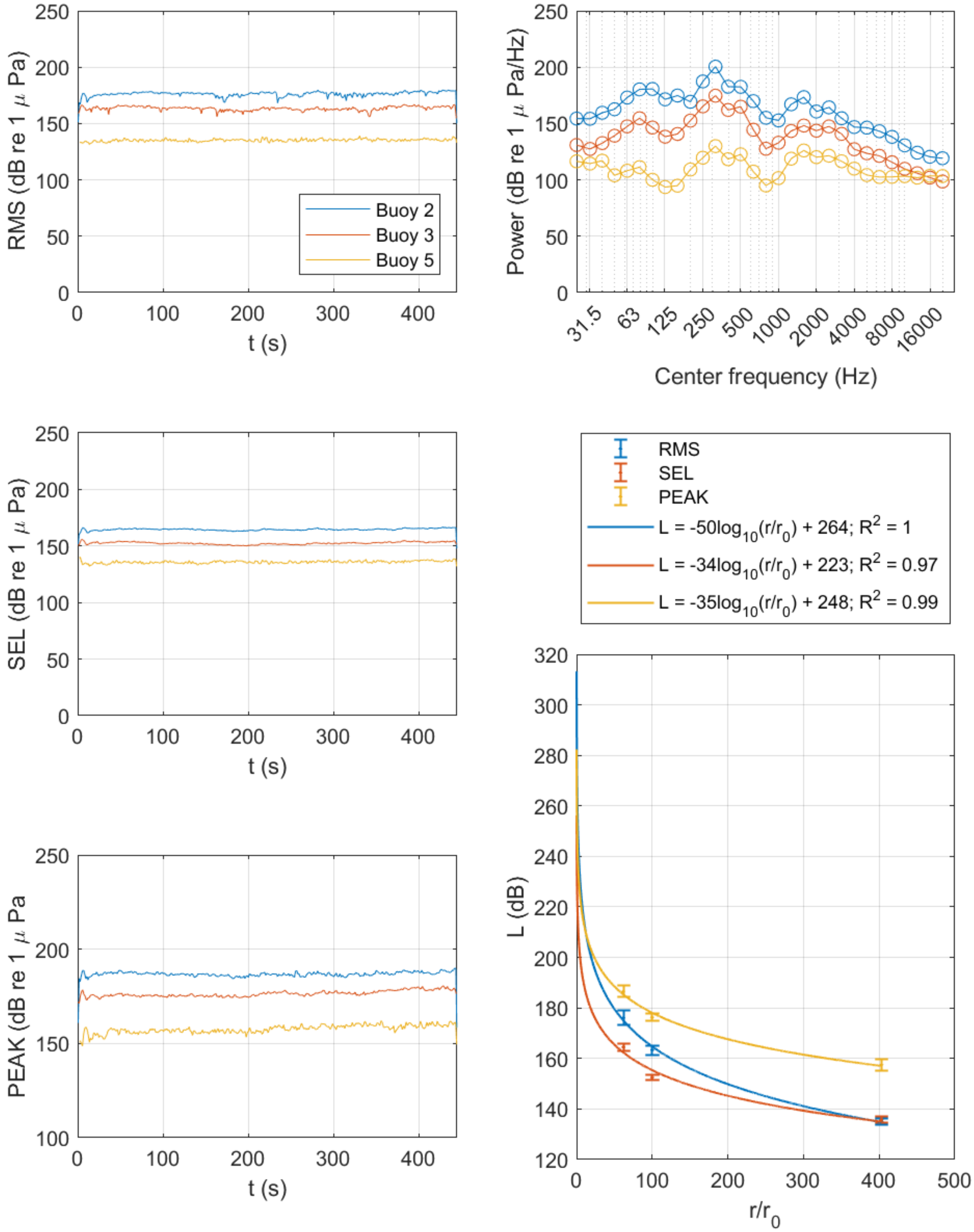
HF-39


RMS (dB re 1 μ Pa)
t (s)
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
RMS
SEL
PEAK
L = -53log10(r/r0) + 278; R2 = 0.96
L = -40log10(r/r0) + 238; R2 = 0.98
L = -42log10(r/r0) + 267; R2 = 0.98
PEAK (dB re 1 μ Pa
L (dB)
r/r0

HF-40

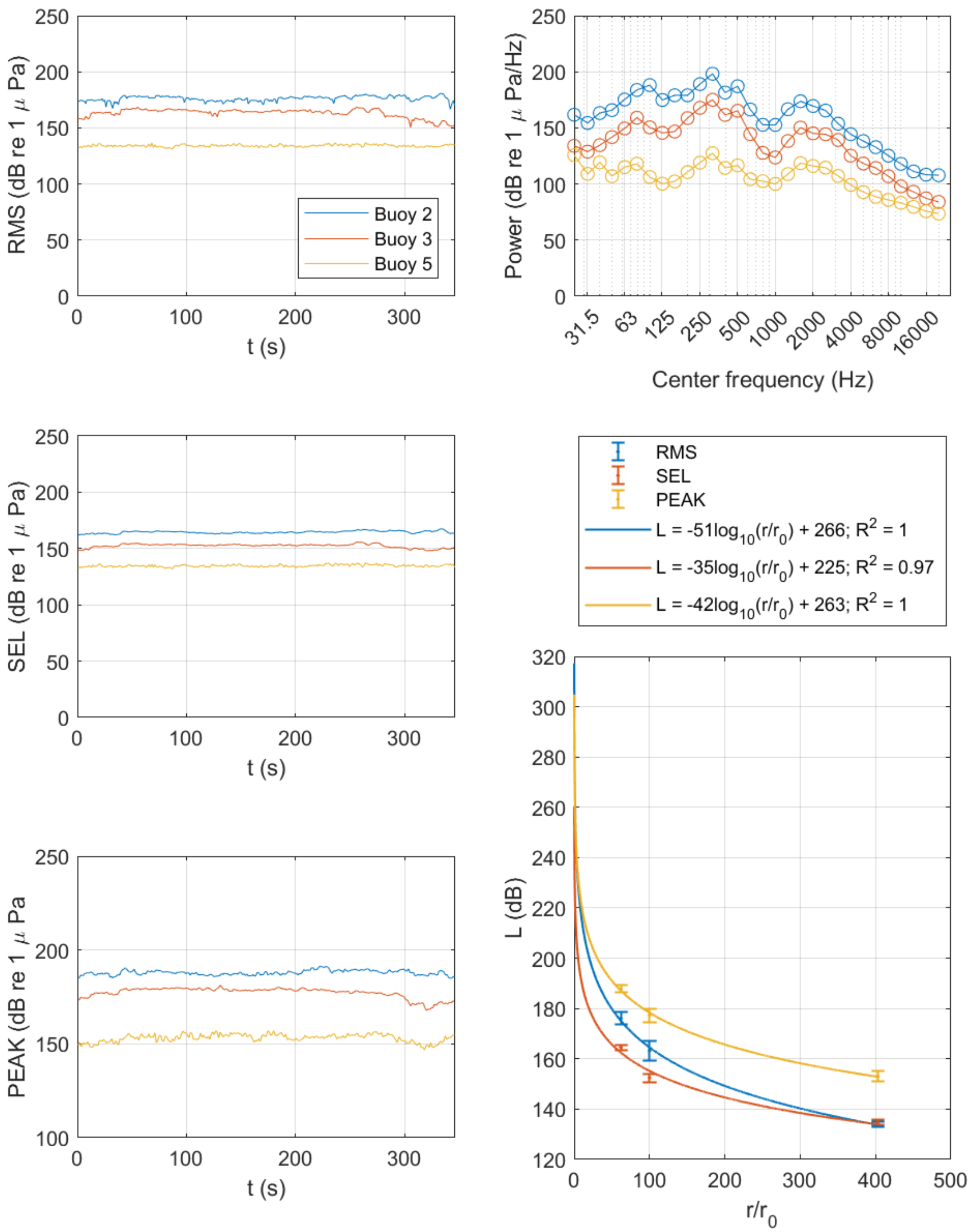

RMS (dB re 1 μ Pa)
t (s)
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -50log$_{10}$(r/r$_0$) + 266; R^2 = 0.97
L = -34log$_{10}$(r/r$_0$) + 224; R^2 = 0.96
L = -36log$_{10}$(r/r$_0$) + 253; R^2 = 0.96
L (dB)
r/r$_0$

HF-41



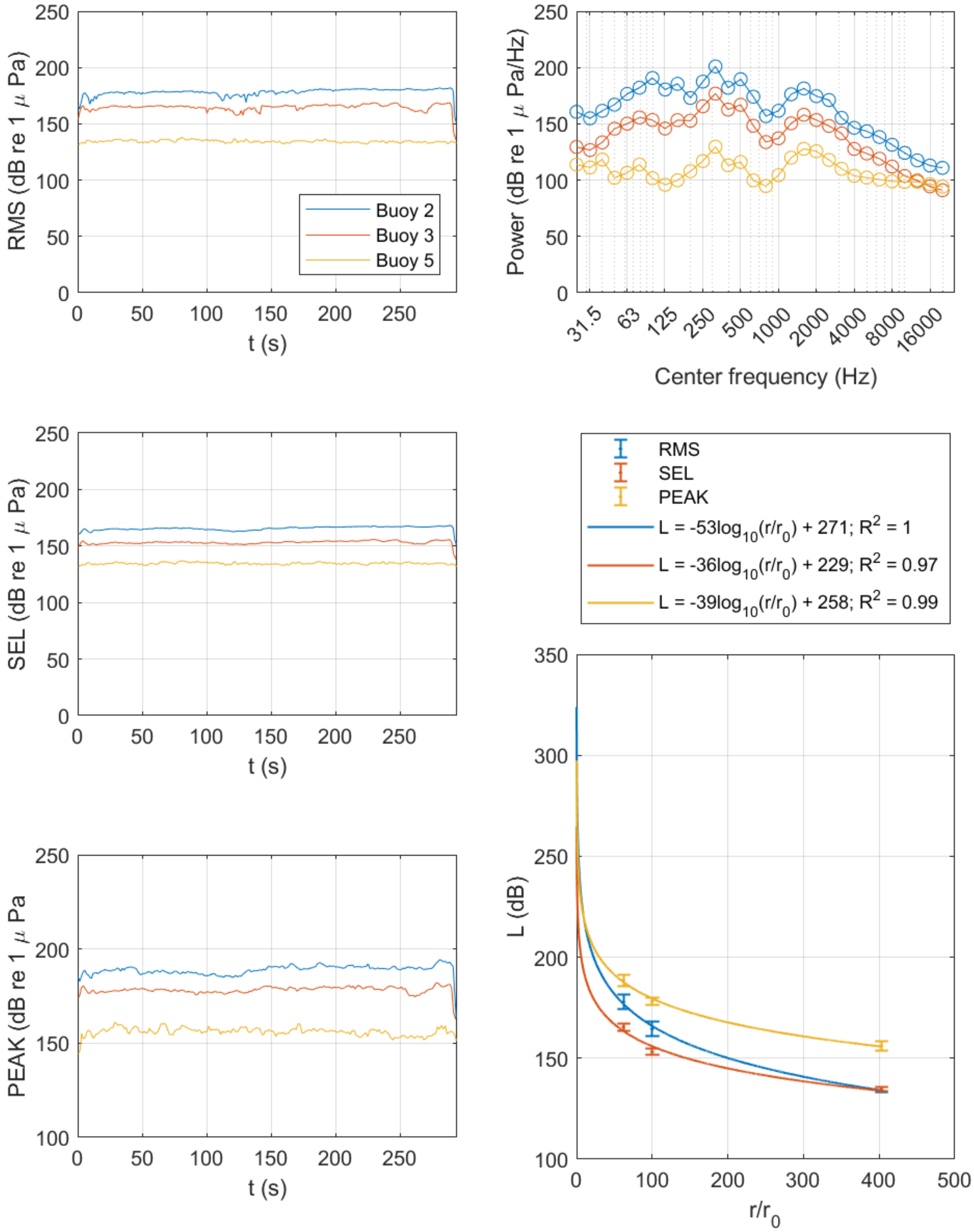
RMS (dB re 1 μ Pa)
t (s)
Buoy 2
Buoy 3
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
RMS
SEL
PEAK
L = -50log$_{10}$(r/r$_0$) + 264; R^2 = 1
L = -34log$_{10}$(r/r$_0$) + 223; R^2 = 0.97
L = -35log$_{10}$(r/r$_0$) + 248; R^2 = 0.99
L (dB)
r/r$_0$
PEAK (dB re 1 μ Pa

HF-42



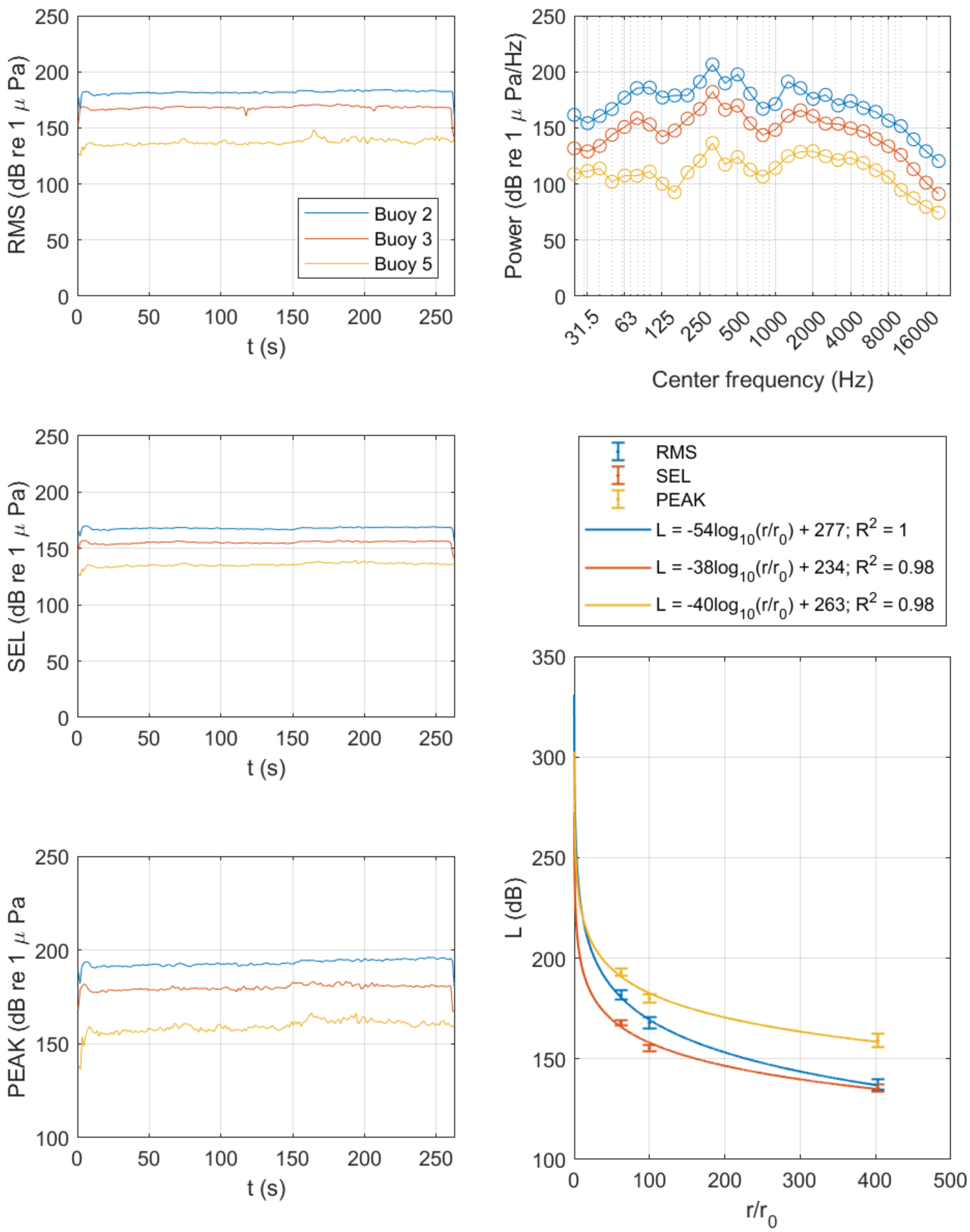
RMS (dB re 1 μ Pa)
t (s)
Buoy 2
Buoy 3
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -51log10(r/r0) + 266; R2 = 1
L = -35log10(r/r0) + 225; R2 = 0.97
L = -42log10(r/r0) + 263; R2 = 1
L (dB)
r/r0

HF-43

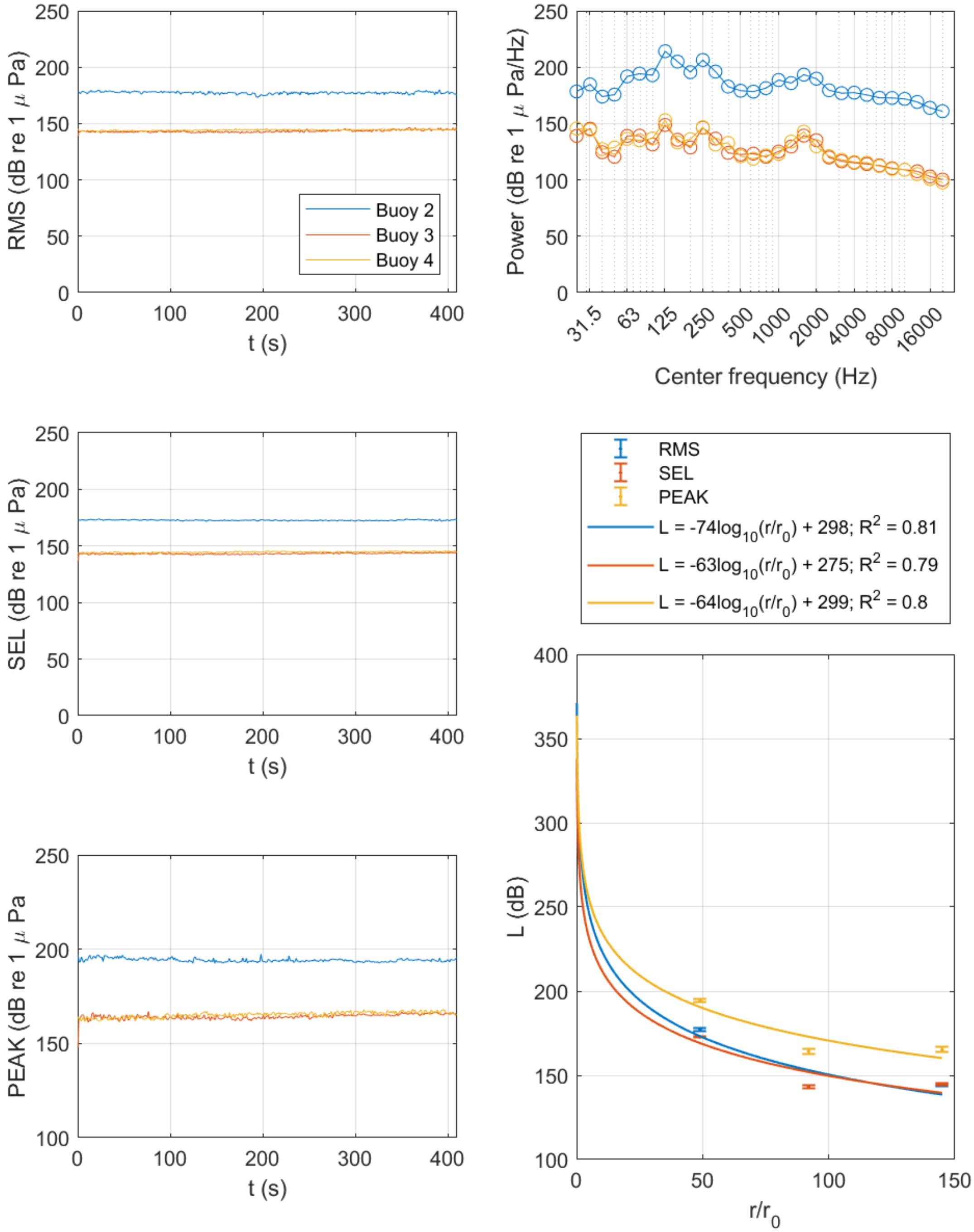


RMS (dB re 1 μ Pa)
t (s)
Buoy 2
Buoy 3
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -53log10(r/r0) + 271; R2 = 1
L = -36log10(r/r0) + 229; R2 = 0.97
L = -39log10(r/r0) + 258; R2 = 0.99
L (dB)
r/r0

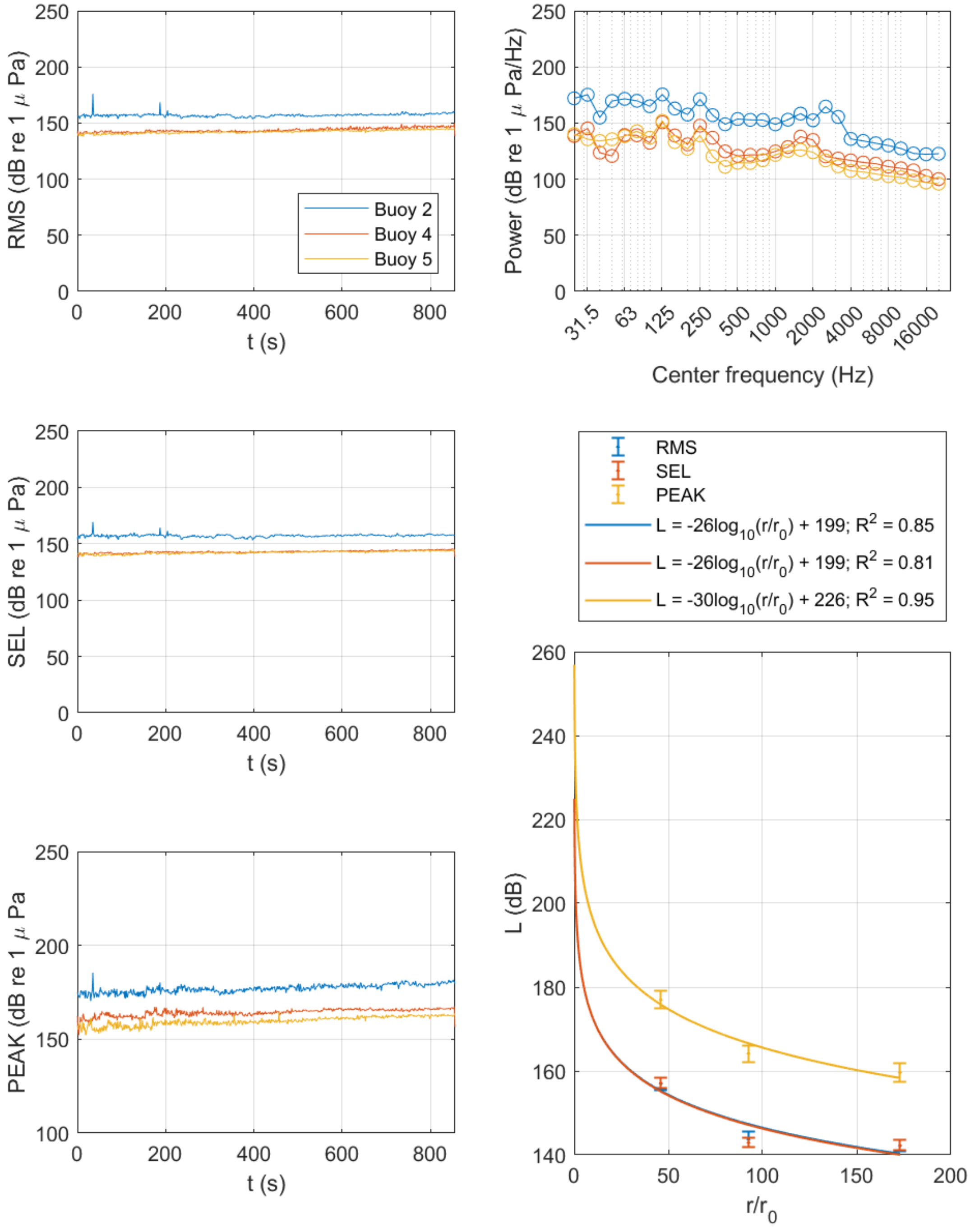
HF-44


RMS (dB re 1 μ Pa)
Buoy 2
Buoy 3
Buoy 5
t (s)
Power (dB re 1 μ Pa/Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
Center frequency (Hz)
SEL (dB re 1 μ Pa)
RMS
SEL
PEAK
L = -54log10(r/r0) + 277; R2 = 1
L = -38log10(r/r0) + 234; R2 = 0.98
L = -40log10(r/r0) + 263; R2 = 0.98
L (dB)
r/r0
PEAK (dB re 1 μ Pa

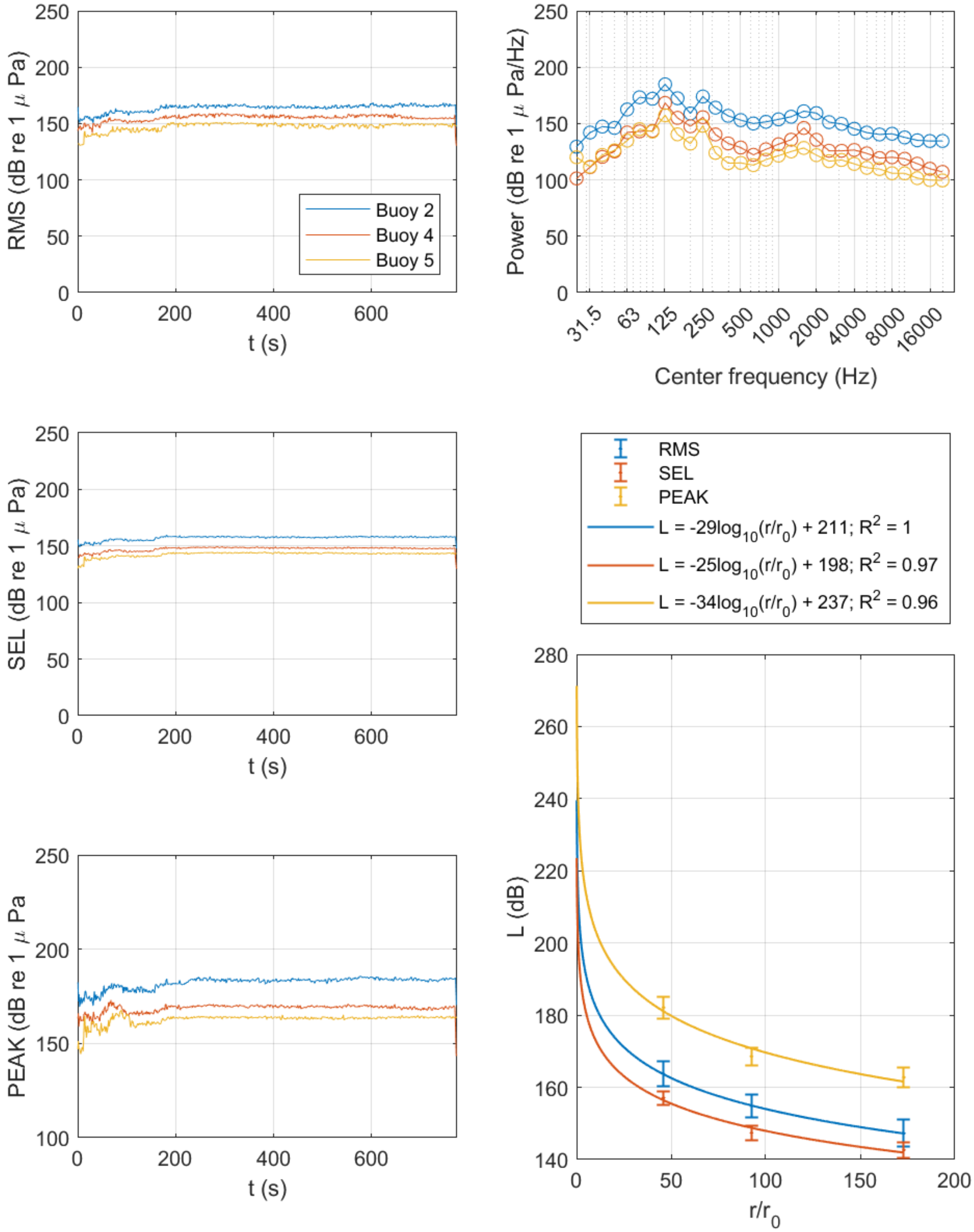
Simpsons Creek-1



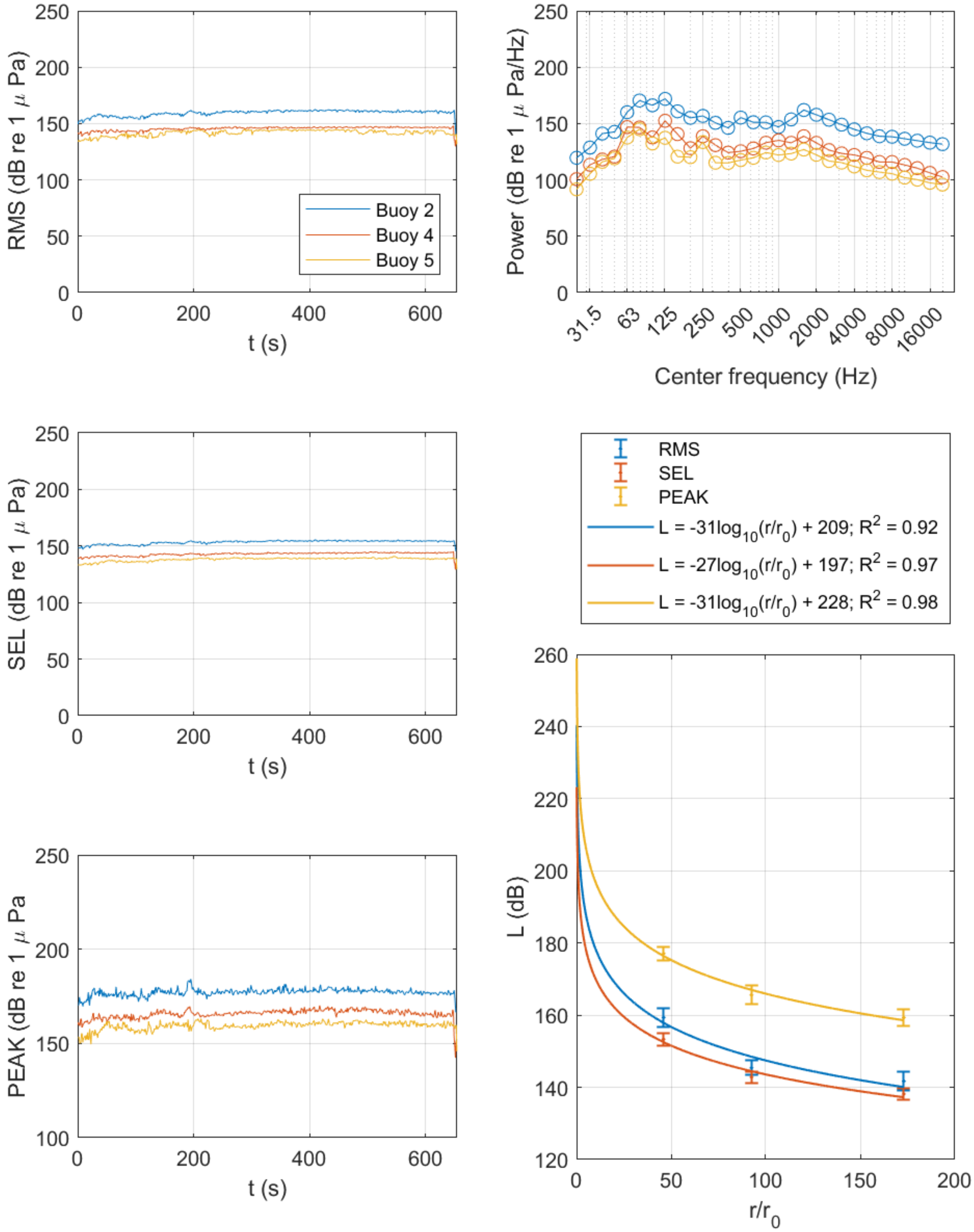
Loxahatchee-1

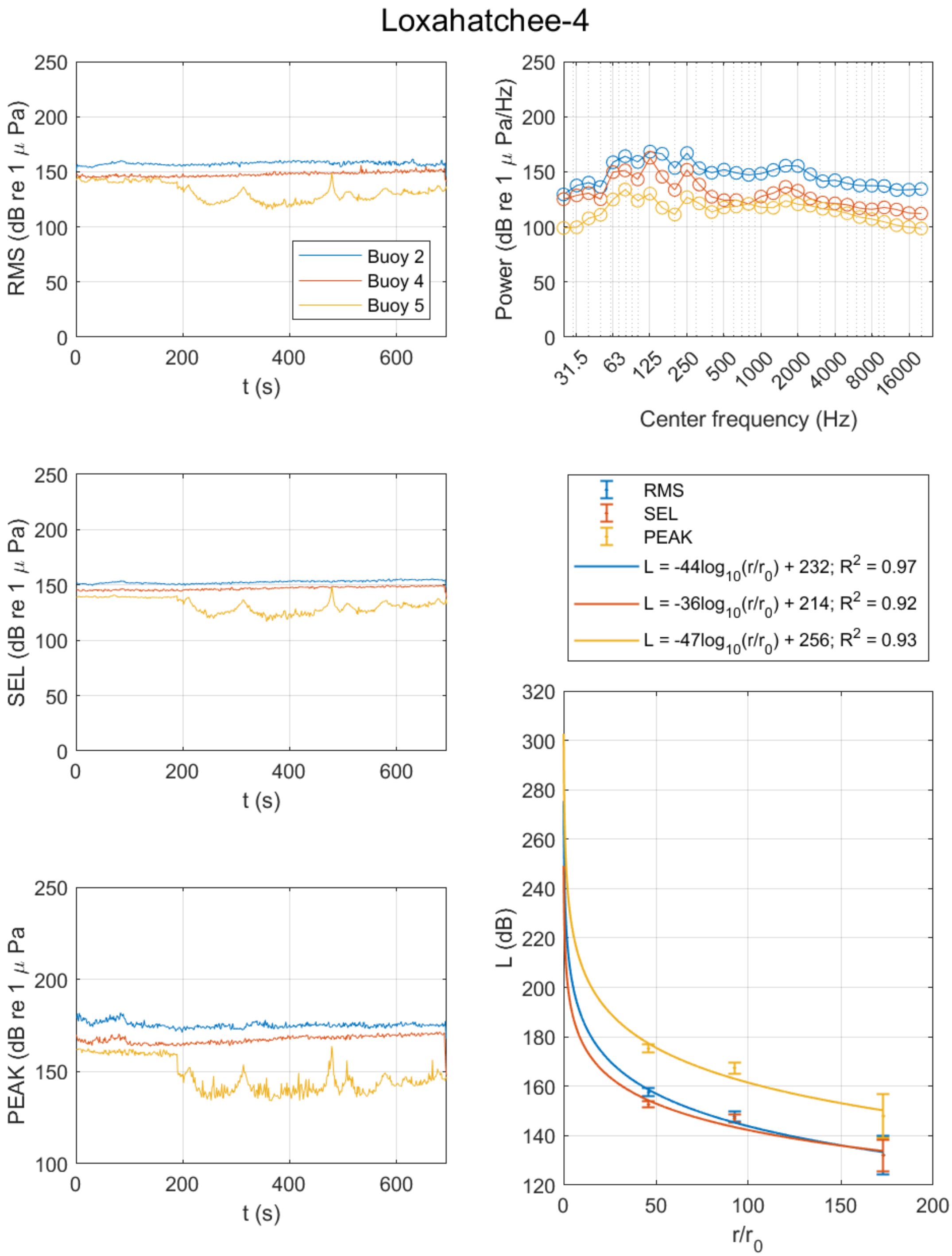


Loxahatchee-2

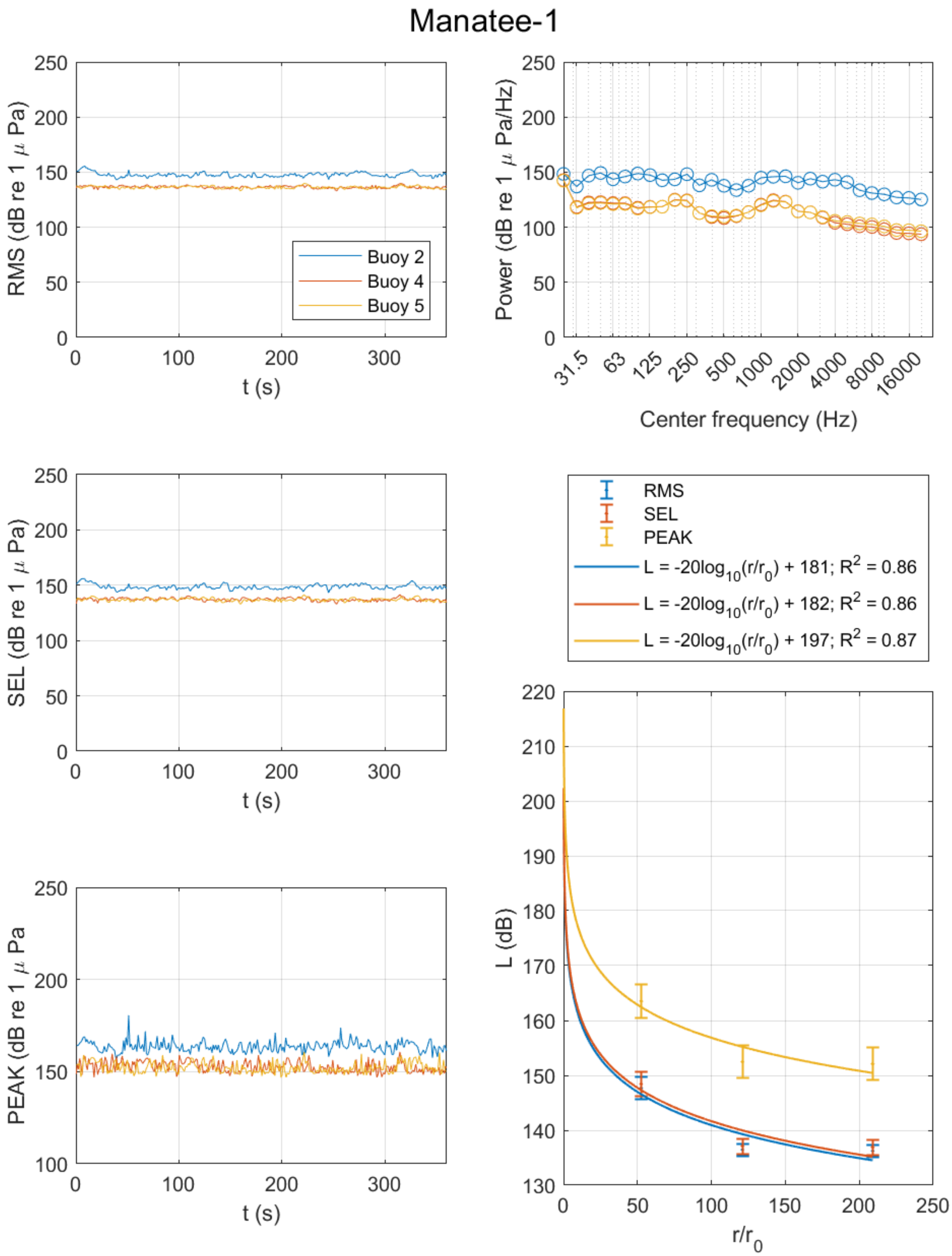


Loxahatchee-3

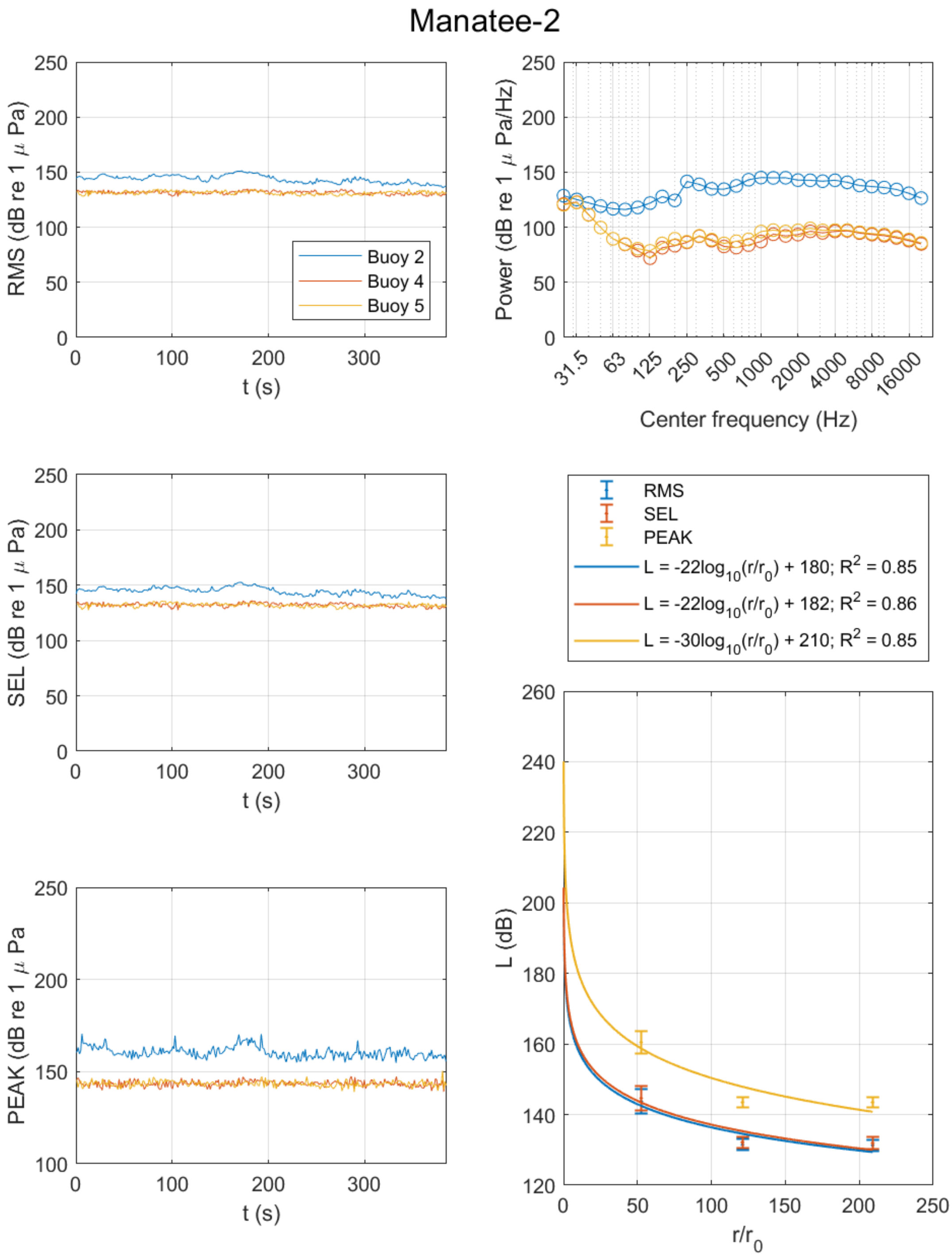




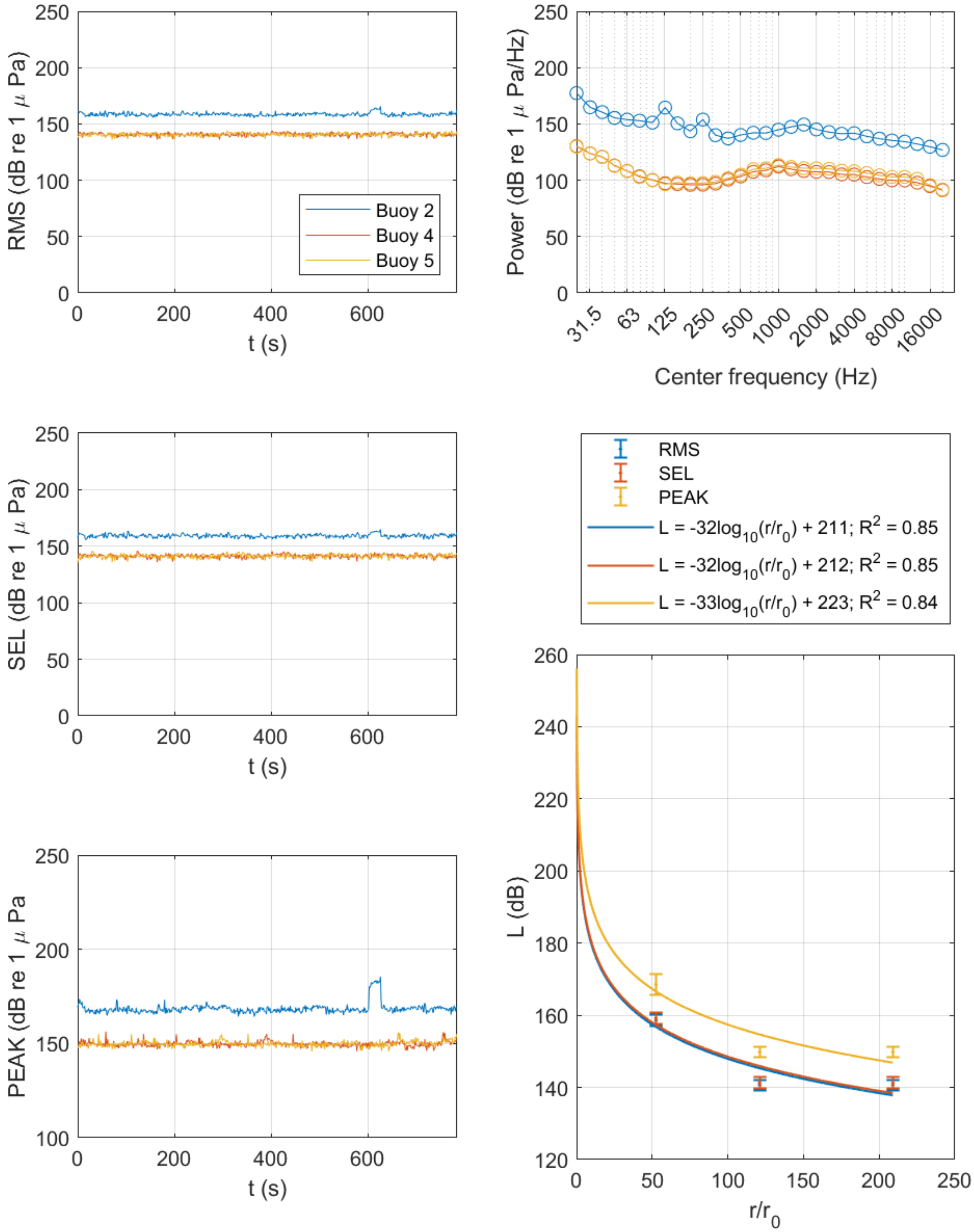
Loxahatchee-4
RMS (dB re 1 μ Pa)
t (s)
Buoy 2
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -44log10(r/r0) + 232; R2 = 0.97
L = -36log10(r/r0) + 214; R2 = 0.92
L = -47log10(r/r0) + 256; R2 = 0.93
L (dB)
r/r0



Manatee-1
RMS (dB re 1 μ Pa)
t (s)
Buoy 2
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
SEL (dB re 1 μ Pa)
t (s)
RMS
SEL
PEAK
L = -20log10(r/r0) + 181; R2 = 0.86
L = -20log10(r/r0) + 182; R2 = 0.86
L = -20log10(r/r0) + 197; R2 = 0.87
PEAK (dB re 1 μ Pa
t (s)
L (dB)
r/r0


Manatee-2
RMS (dB re 1 μ Pa)
t (s)
Buoy 2
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -22log10(r/r0) + 180; R2 = 0.85
L = -22log10(r/r0) + 182; R2 = 0.86
L = -30log10(r/r0) + 210; R2 = 0.85
L (dB)
r/r0

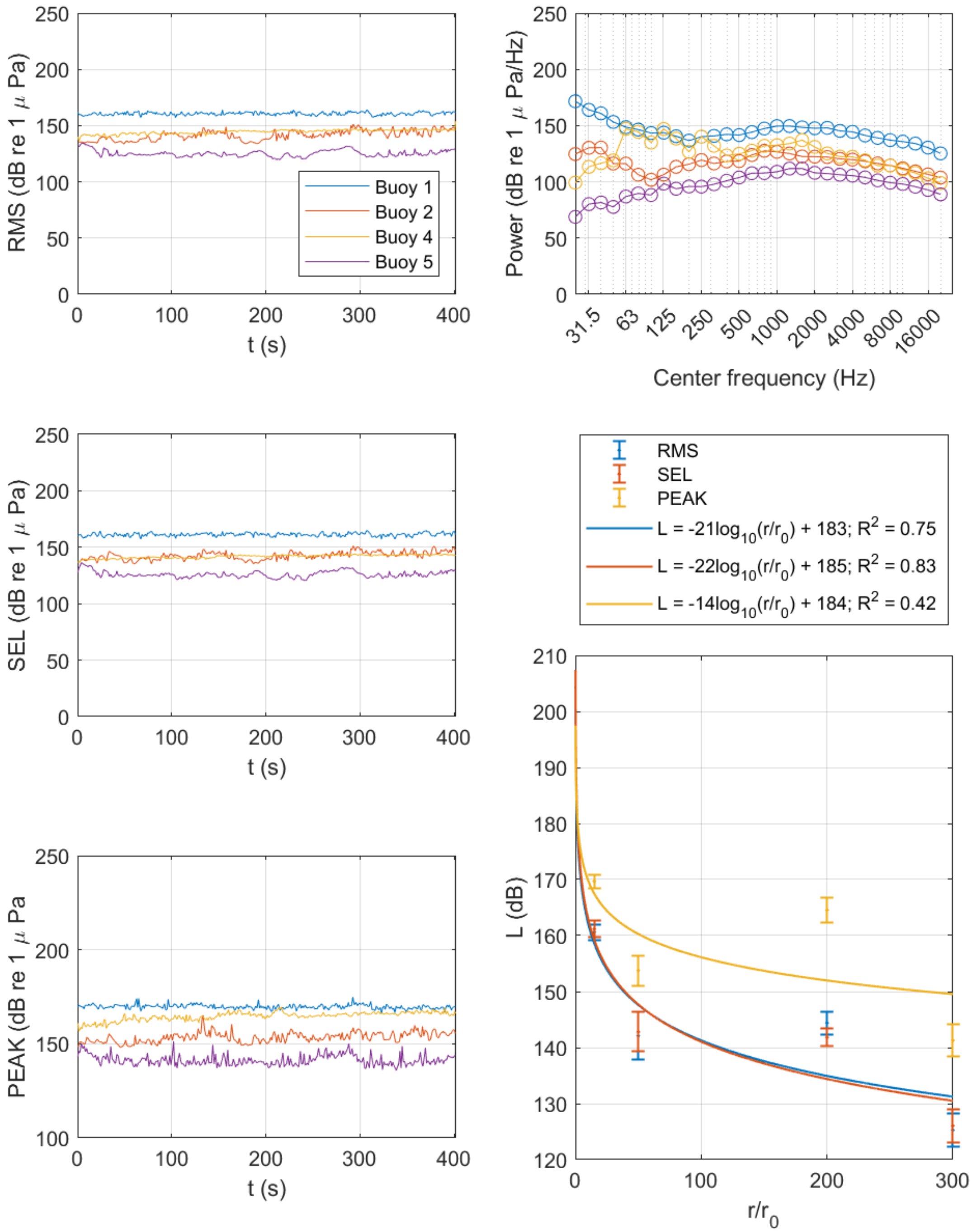
Manatee-3



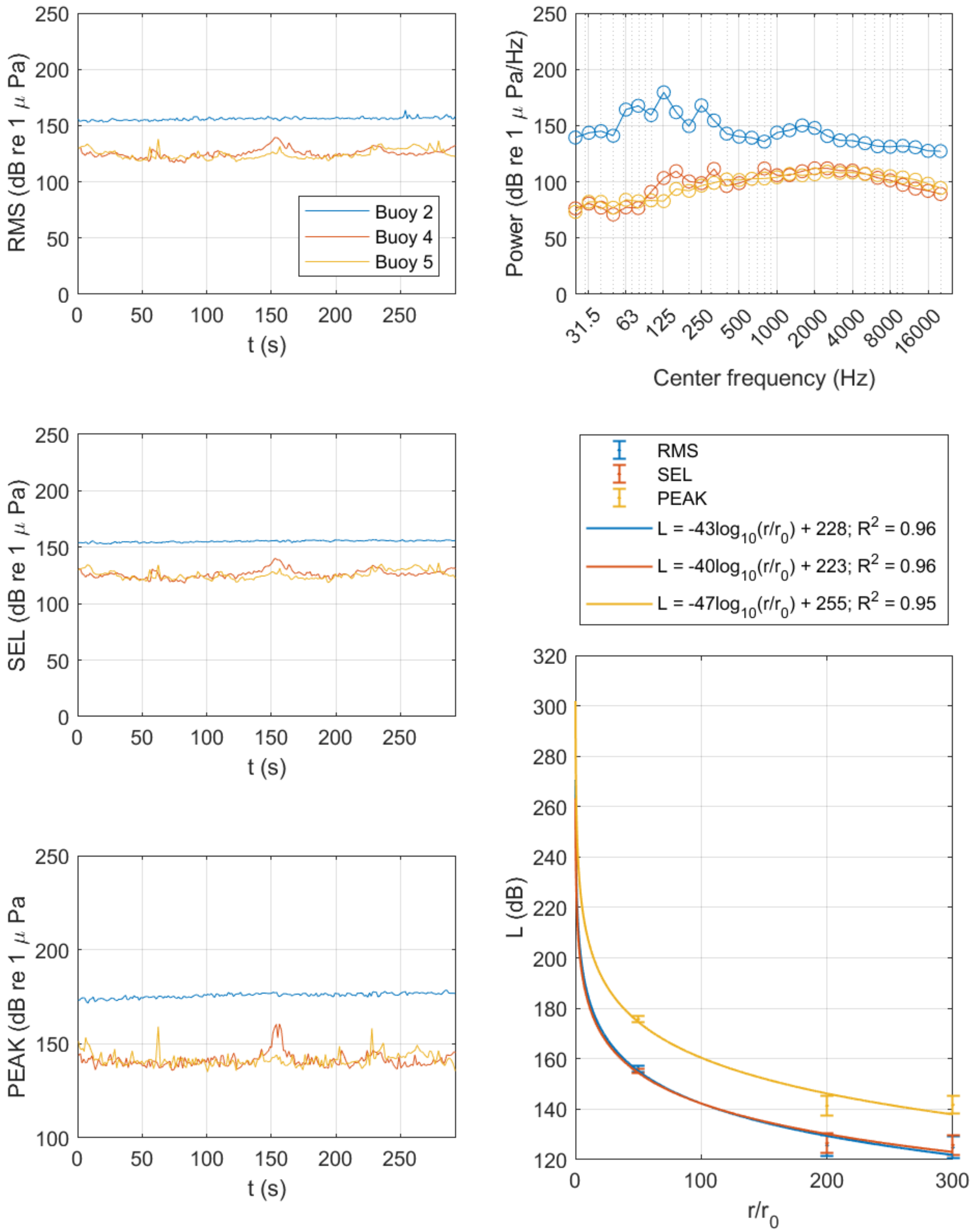
RMS (dB re 1 μ Pa)
t (s)
Buoy 2
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -32log10(r/r0) + 211; R2 = 0.85
L = -32log10(r/r0) + 212; R2 = 0.85
L = -33log10(r/r0) + 223; R2 = 0.84
L (dB)
r/r0

-

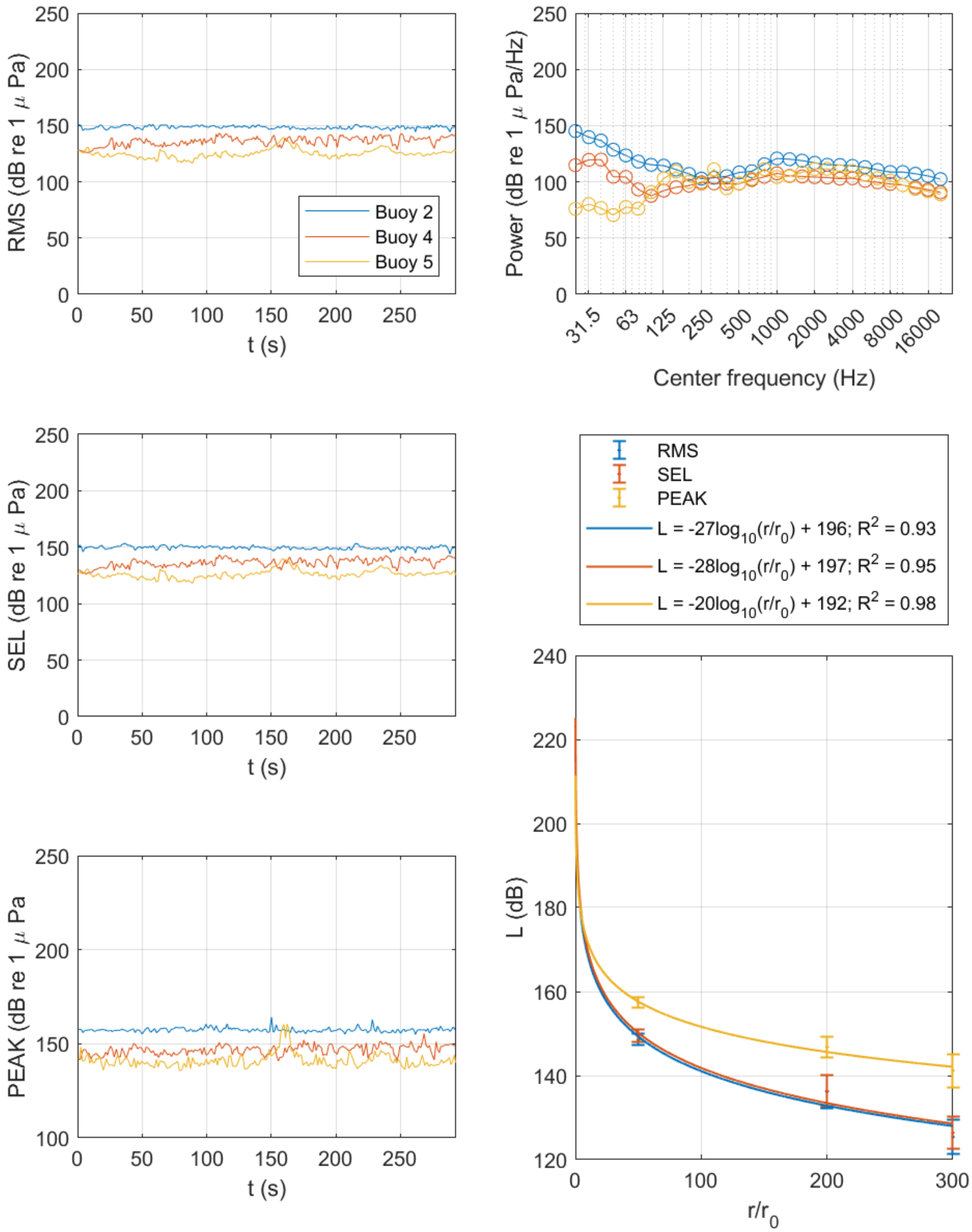
NASA-1


RMS (dB re 1 μ Pa)
t (s)
Buoy 1
Buoy 2
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
RMS
SEL
PEAK
L = -21log10(r/r0) + 183; R2 = 0.75
L = -22log10(r/r0) + 185; R2 = 0.83
L = -14log10(r/r0) + 184; R2 = 0.42
PEAK (dB re 1 μ Pa
L (dB)
r/r0

NASA-2

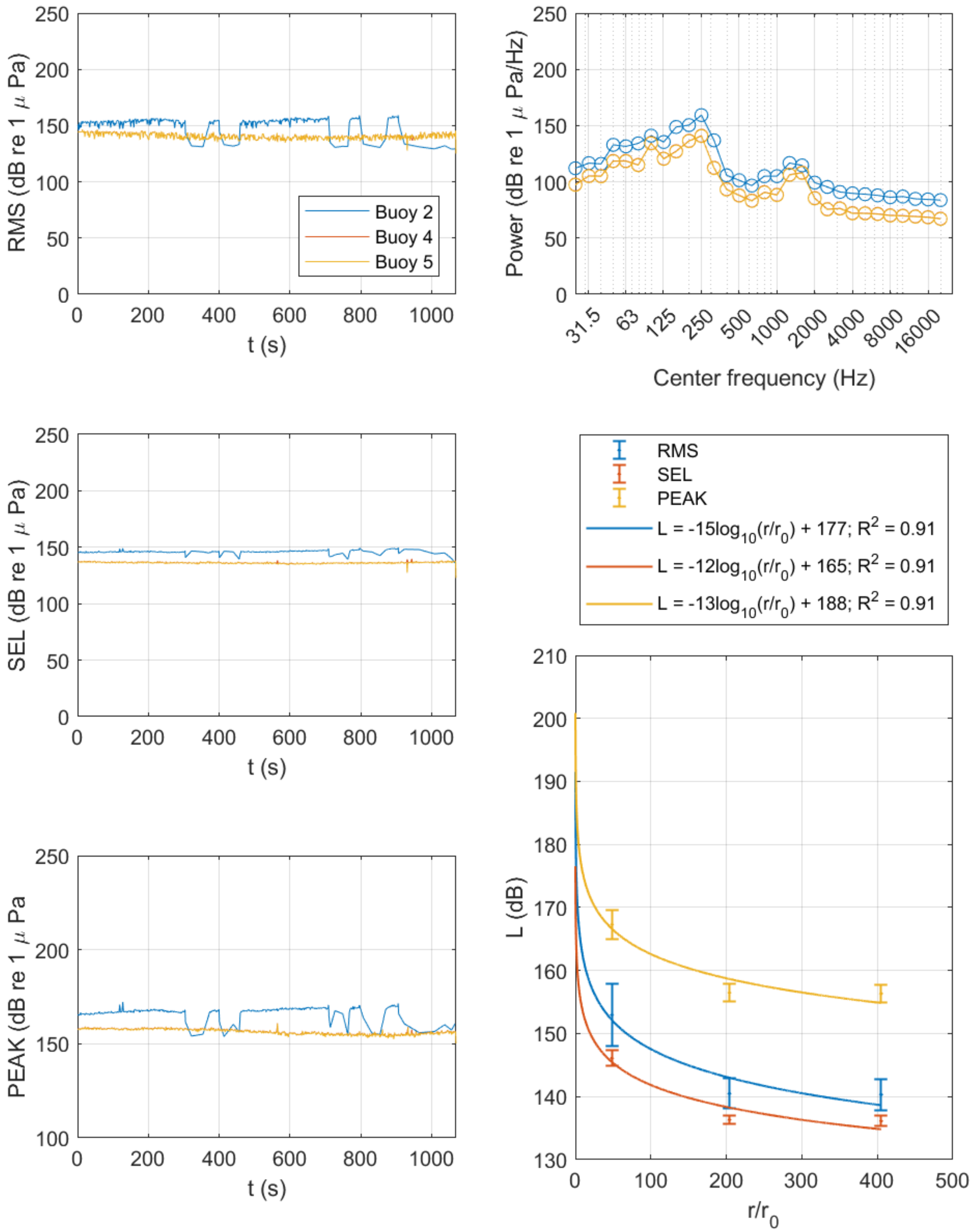

RMS (dB re 1 μ Pa)
t (s)
Buoy 2
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
t (s)
PEAK (dB re 1 μ Pa
t (s)
RMS
SEL
PEAK
L = -43log10(r/r0) + 228; R2 = 0.96
L = -40log10(r/r0) + 223; R2 = 0.96
L = -47log10(r/r0) + 255; R2 = 0.95
L (dB)
r/r0

NASA-3



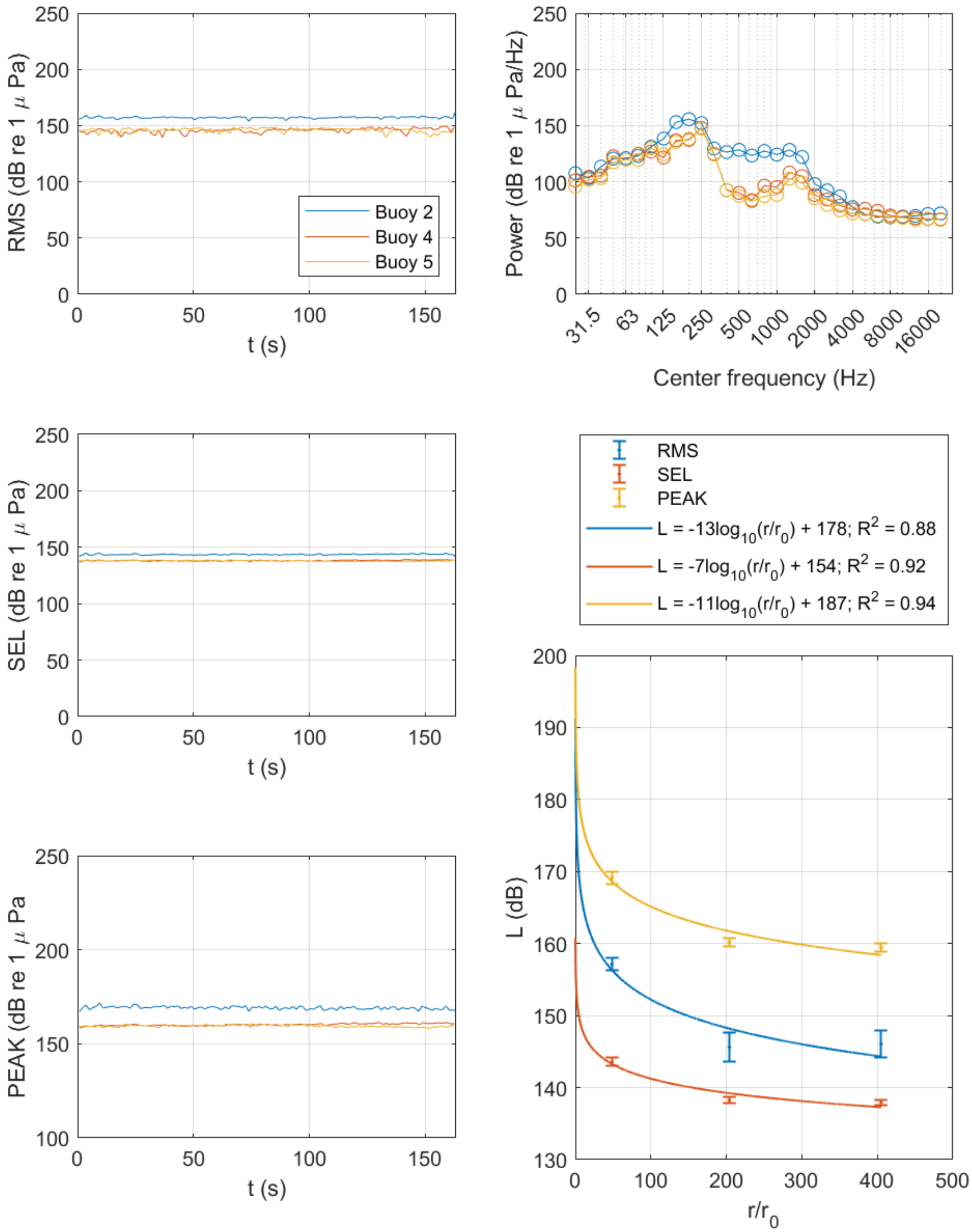
RMS (dB re 1 μ Pa)
t (s)
Buoy 2
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -27log10(r/r0) + 196; R2 = 0.93
L = -28log10(r/r0) + 197; R2 = 0.95
L = -20log10(r/r0) + 192; R2 = 0.98
L (dB)
r/r0

NASA-4

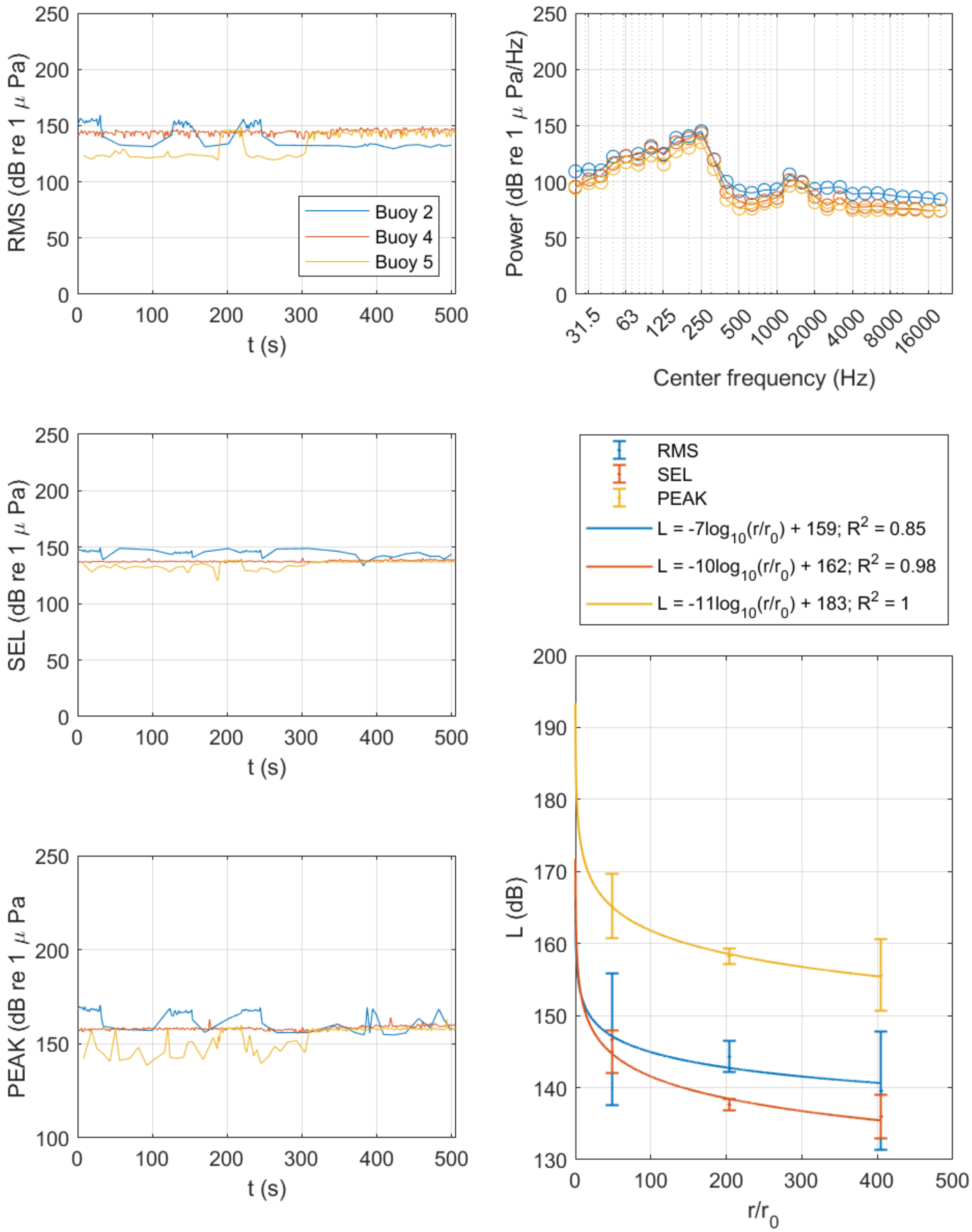


RMS (dB re 1 μ Pa)
t (s)
Buoy 2
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -15log10(r/r0) + 177; R2 = 0.91
L = -12log10(r/r0) + 165; R2 = 0.91
L = -13log10(r/r0) + 188; R2 = 0.91
L (dB)
r/r0

NASA-5

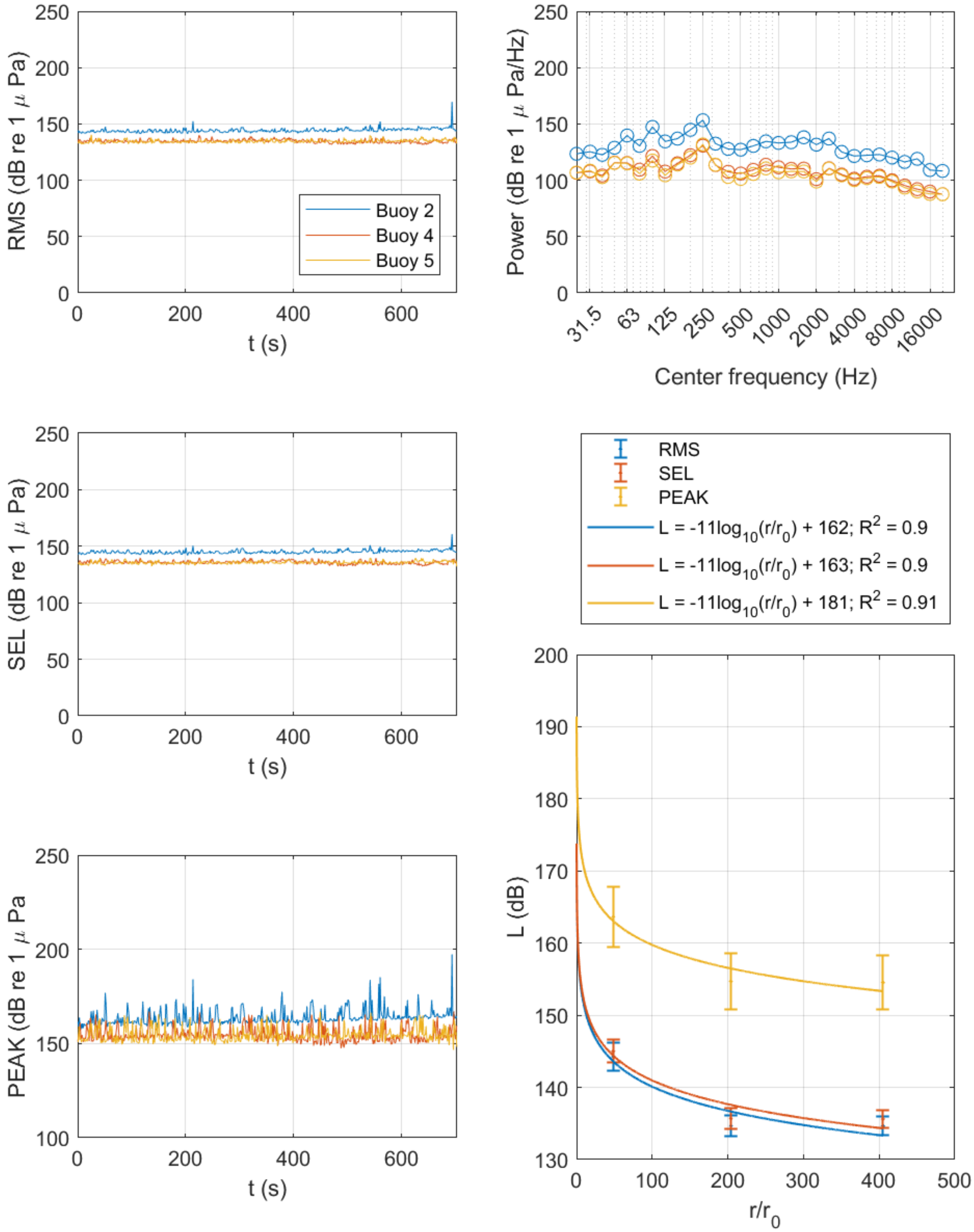

RMS (dB re 1 μ Pa)
t (s)
Buoy 2
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -13log10(r/r0) + 178; R2 = 0.88
L = -7log10(r/r0) + 154; R2 = 0.92
L = -11log10(r/r0) + 187; R2 = 0.94
L (dB)
r/r0

NASA-6



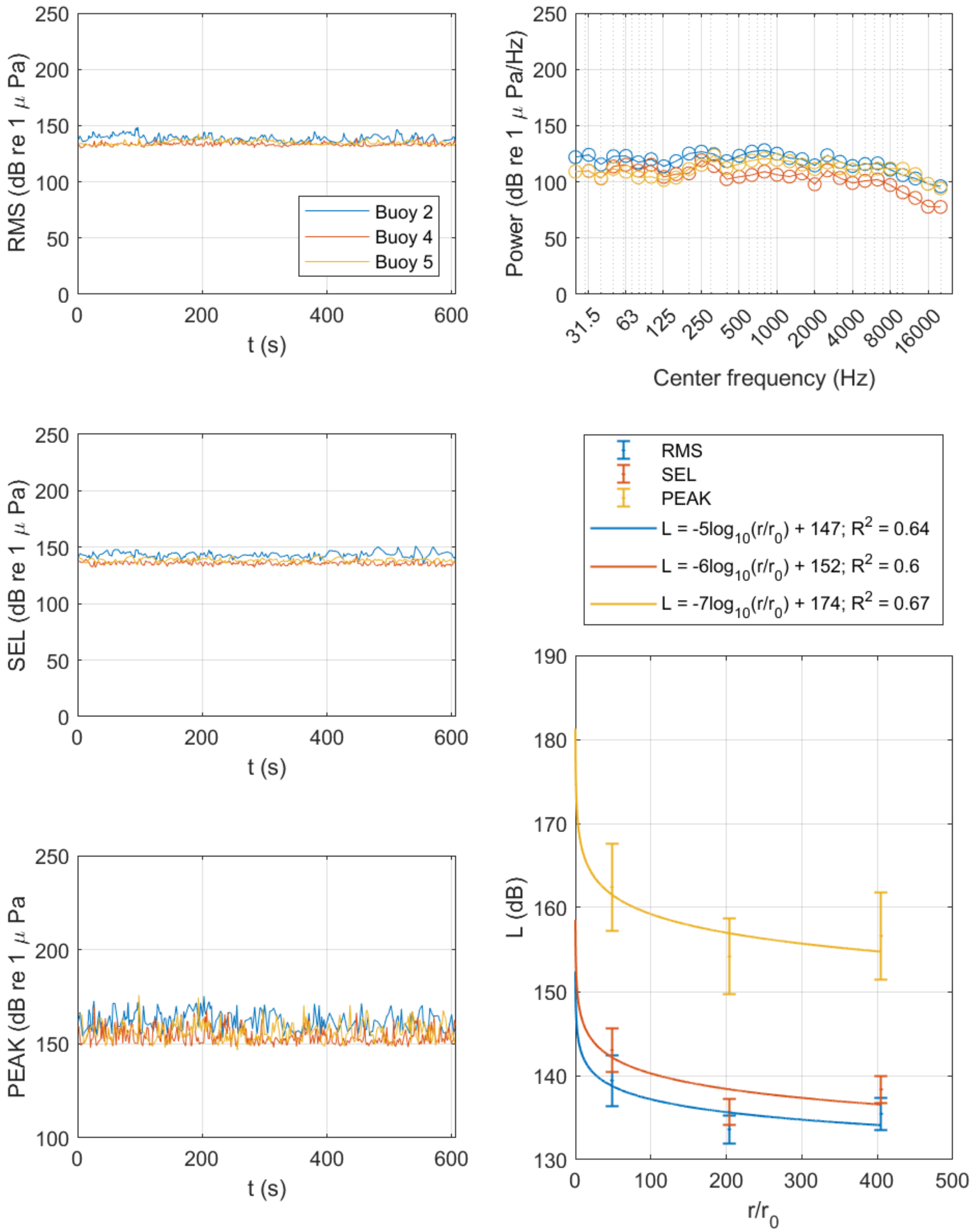
RMS (dB re 1 μ Pa)
t (s)
Buoy 2
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -7log10(r/r0) + 159; R2 = 0.85
L = -10log10(r/r0) + 162; R2 = 0.98
L = -11log10(r/r0) + 183; R2 = 1
L (dB)
r/r0

NASA-7



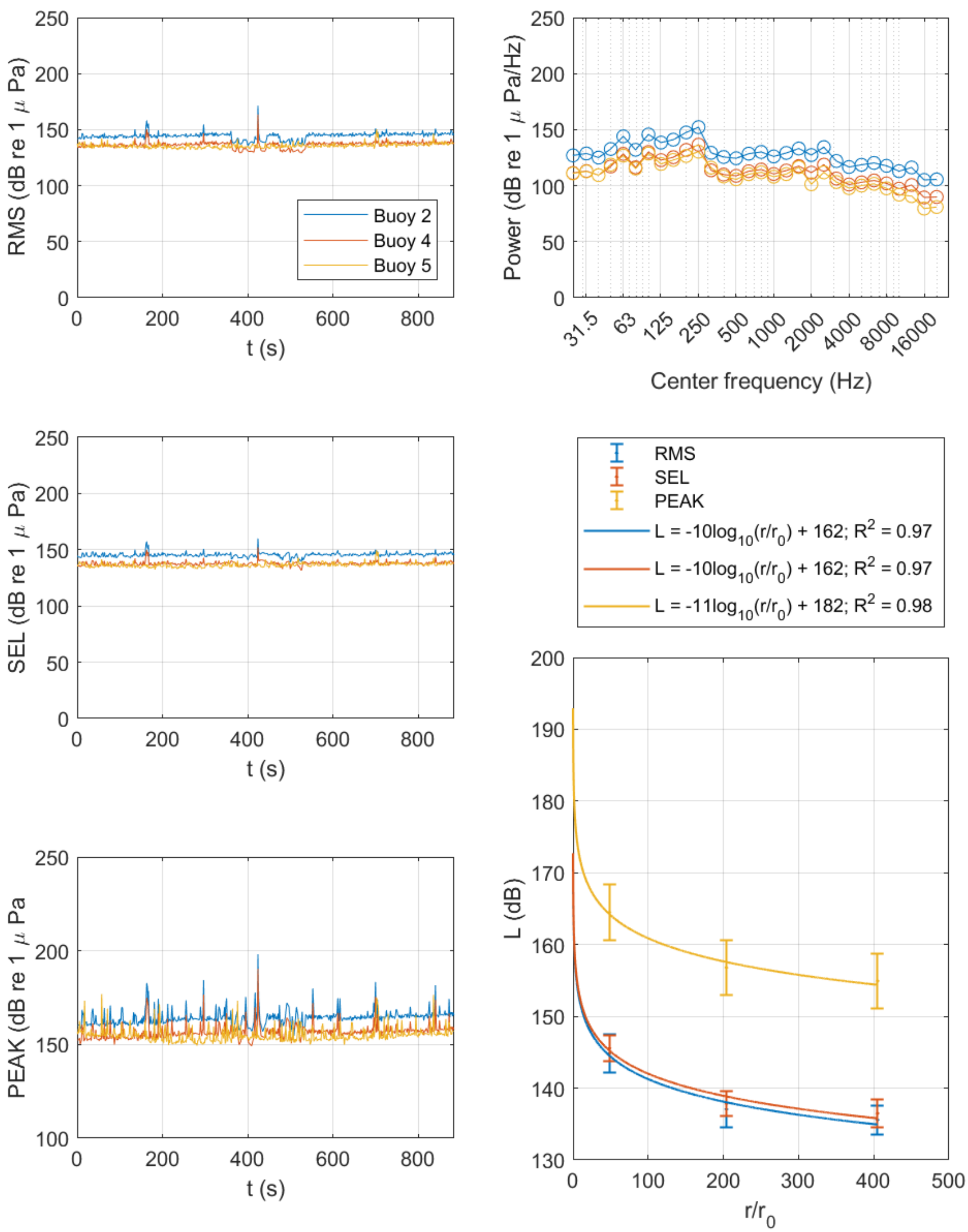
RMS (dB re 1 μ Pa)
t (s)
Buoy 2
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -11log10(r/r0) + 162; R2 = 0.9
L = -11log10(r/r0) + 163; R2 = 0.9
L = -11log10(r/r0) + 181; R2 = 0.91
L (dB)
r/r0

NASA-8

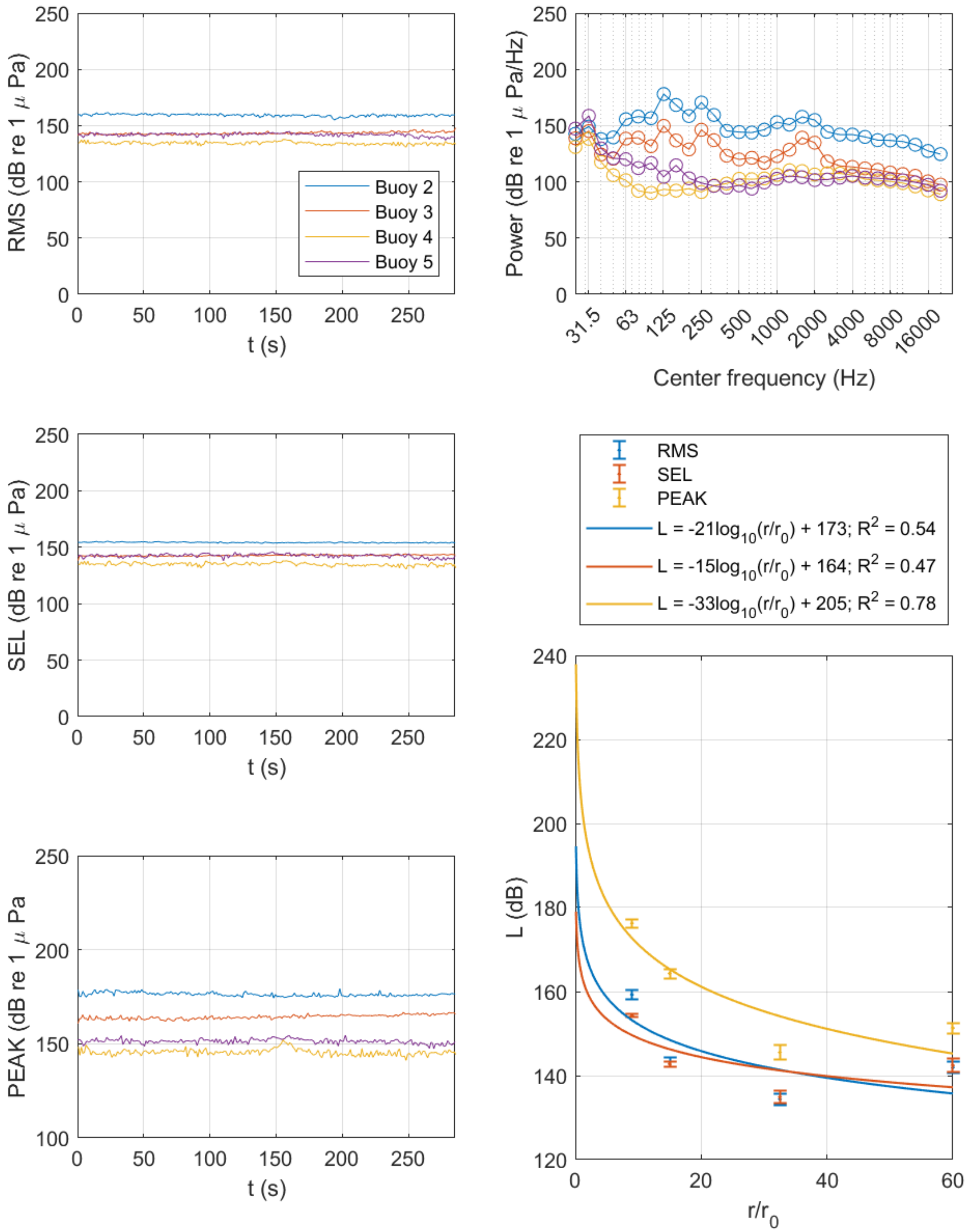


RMS (dB re 1 μ Pa)
t (s)
Buoy 2
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -5log10(r/r0) + 147; R2 = 0.64
L = -6log10(r/r0) + 152; R2 = 0.6
L = -7log10(r/r0) + 174; R2 = 0.67
L (dB)
r/r0

NASA-9

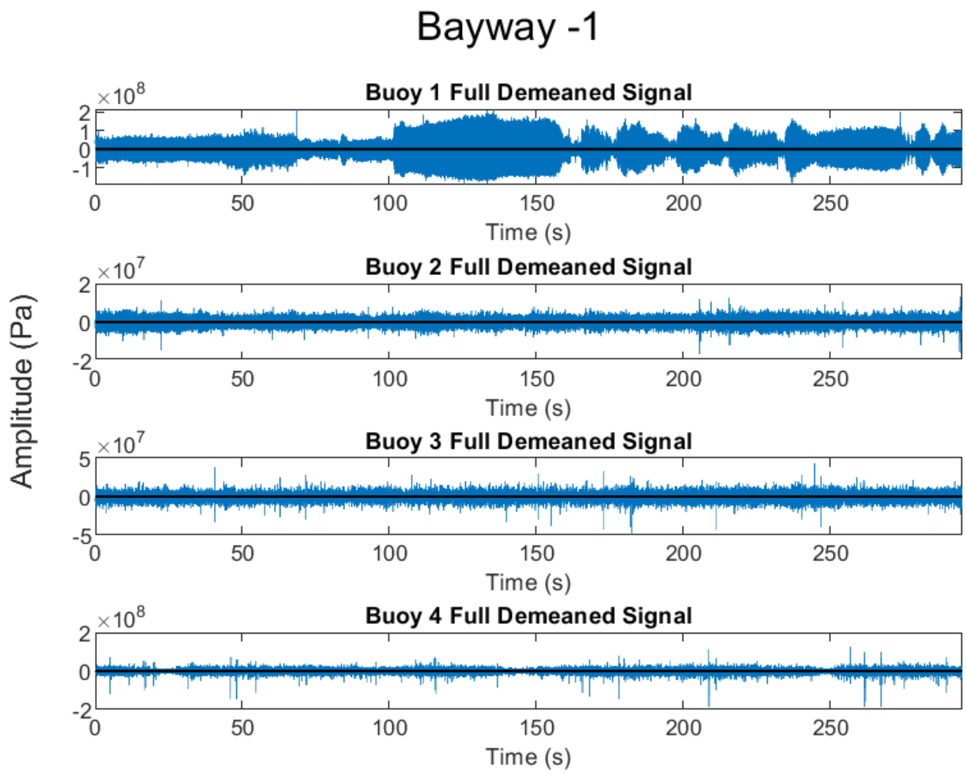

RMS (dB re 1 μ Pa)
t (s)
Buoy 2
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
Center frequency (Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
L = -10log$_{10}$(r/r$_0$) + 162; R^2 = 0.97
L = -10log$_{10}$(r/r$_0$) + 162; R^2 = 0.97
L = -11log$_{10}$(r/r$_0$) + 182; R^2 = 0.98
L (dB)
r/r$_0$

Broward-1

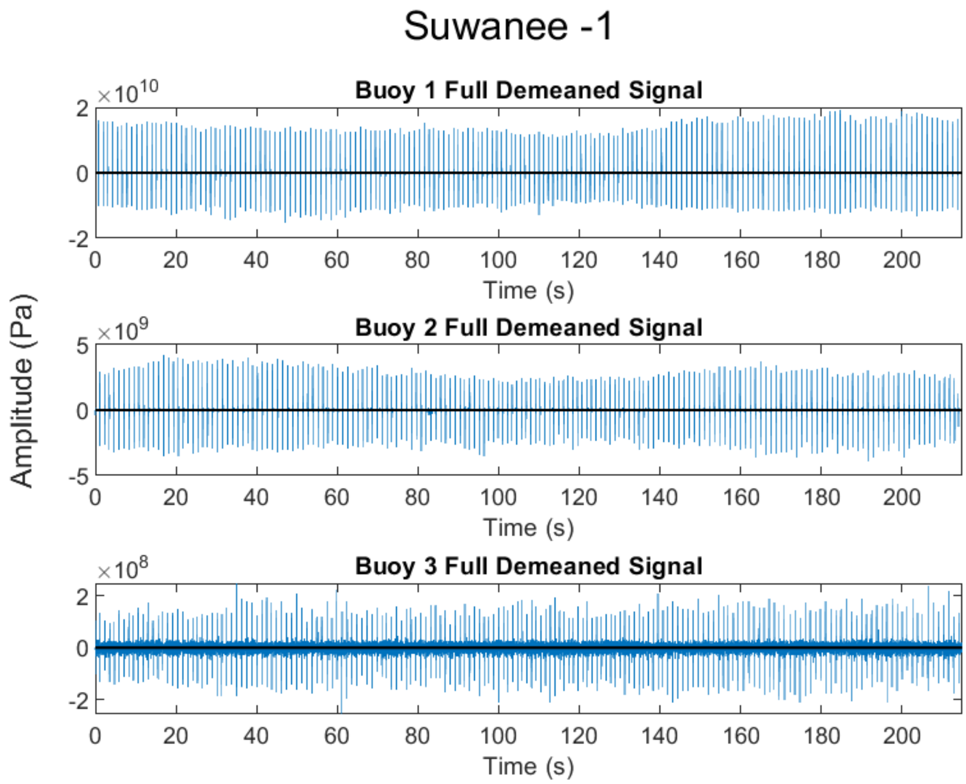


RMS (dB re 1 μ Pa)
t (s)
Buoy 2
Buoy 3
Buoy 4
Buoy 5
Power (dB re 1 μ Pa/Hz)
31.5
63
125
250
500
1000
2000
4000
8000
16000
Center frequency (Hz)
SEL (dB re 1 μ Pa)
PEAK (dB re 1 μ Pa
RMS
SEL
PEAK
$L = -21\log_{10}(r/r_0) + 173$; $R^2 = 0.54$
$L = -15\log_{10}(r/r_0) + 164$; $R^2 = 0.47$
$L = -33\log_{10}(r/r_0) + 205$; $R^2 = 0.78$
L (dB)
r/r_0

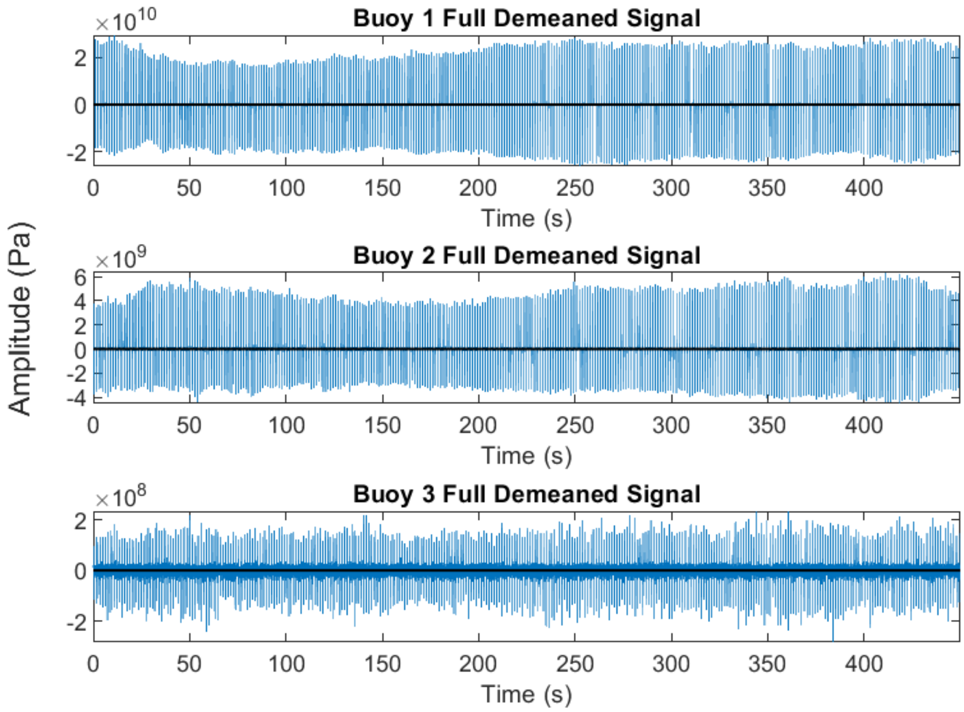
APPENDIX D
FULL DEMEANED SIGNALS



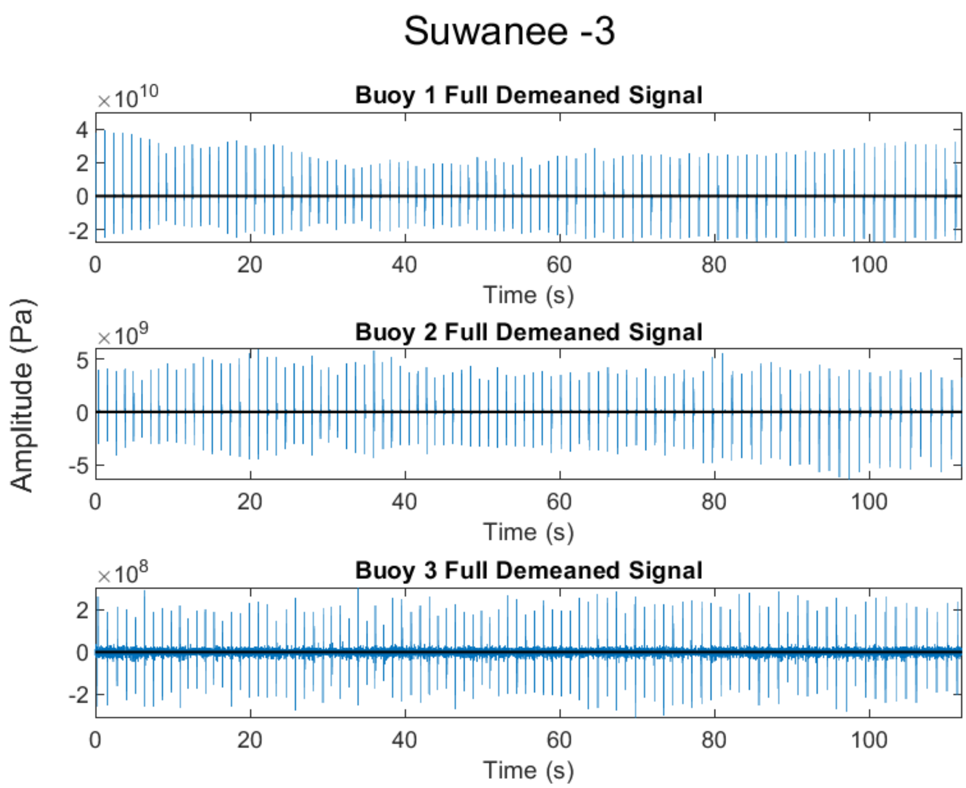
Bayway -1
Buoy 1 Full Demeaned Signal
×10^8
2
1
0
-1
0
50
100
150
200
250
Time (s)
Buoy 2 Full Demeaned Signal
×10^7
2
0
-2
Time (s)
Buoy 3 Full Demeaned Signal
×10^7
5
0
-5
Time (s)
Buoy 4 Full Demeaned Signal
×10^8
2
0
-2
Time (s)
Amplitude (Pa)

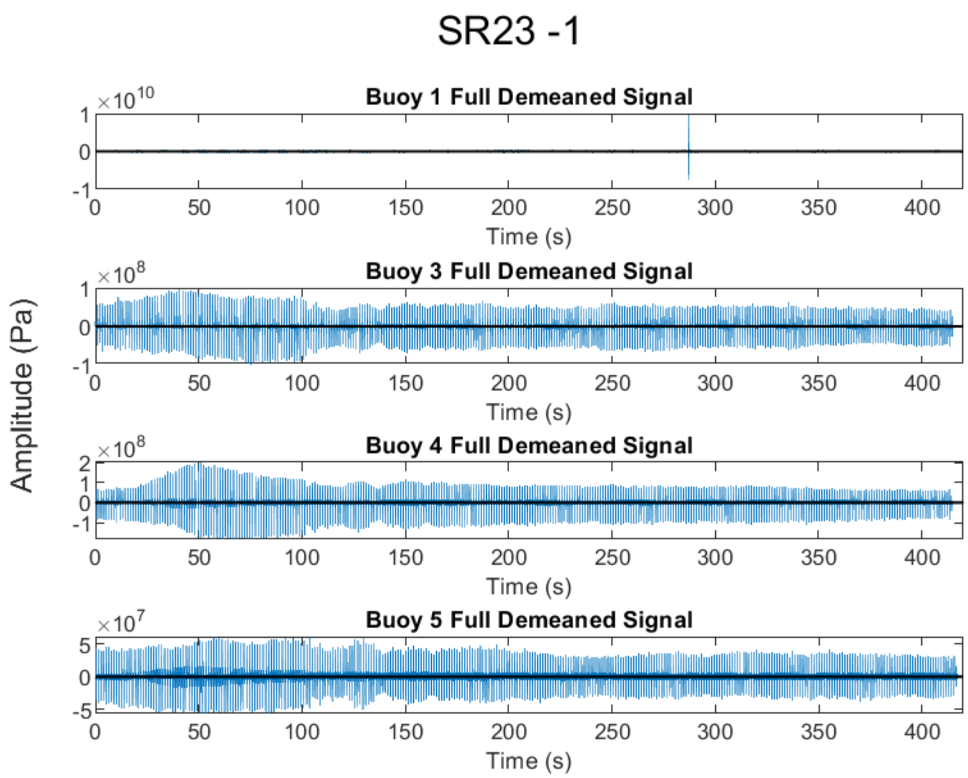

Suwanee -1
Buoy 1 Full Demeaned Signal
×10^10
2
0
-2
0 20 40 60 80 100 120 140 160 180 200
Time (s)
Amplitude (Pa)
Buoy 2 Full Demeaned Signal
×10^9
5
0
-5
0 20 40 60 80 100 120 140 160 180 200
Time (s)
Buoy 3 Full Demeaned Signal
×10^8
2
0
-2
0 20 40 60 80 100 120 140 160 180 200
Time (s)

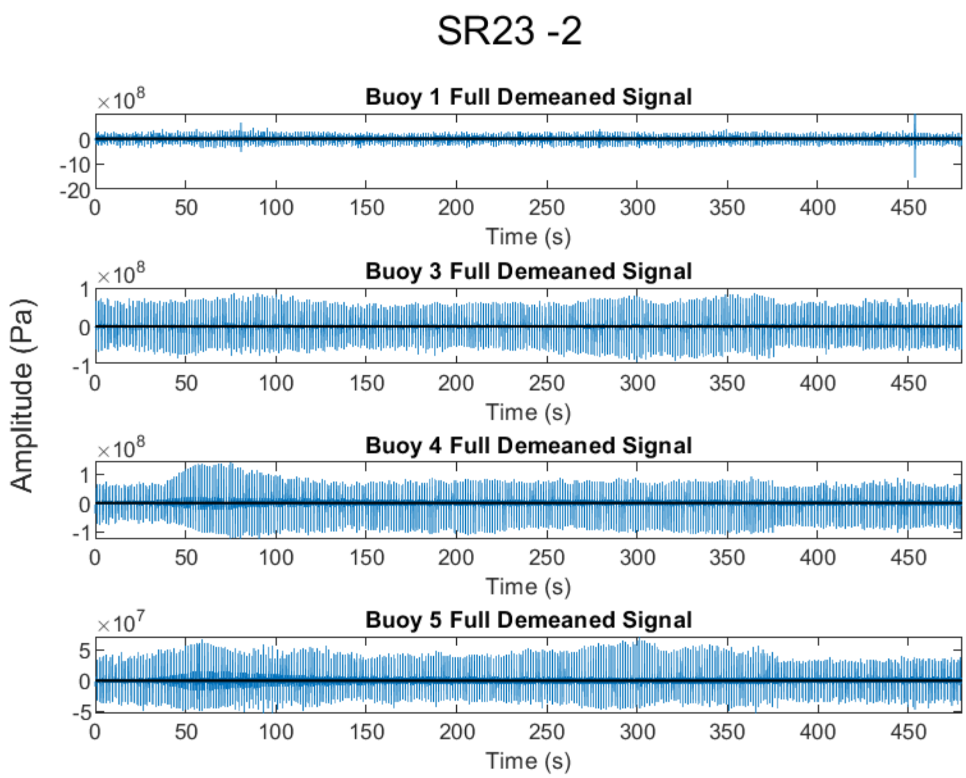
Suwanee -2



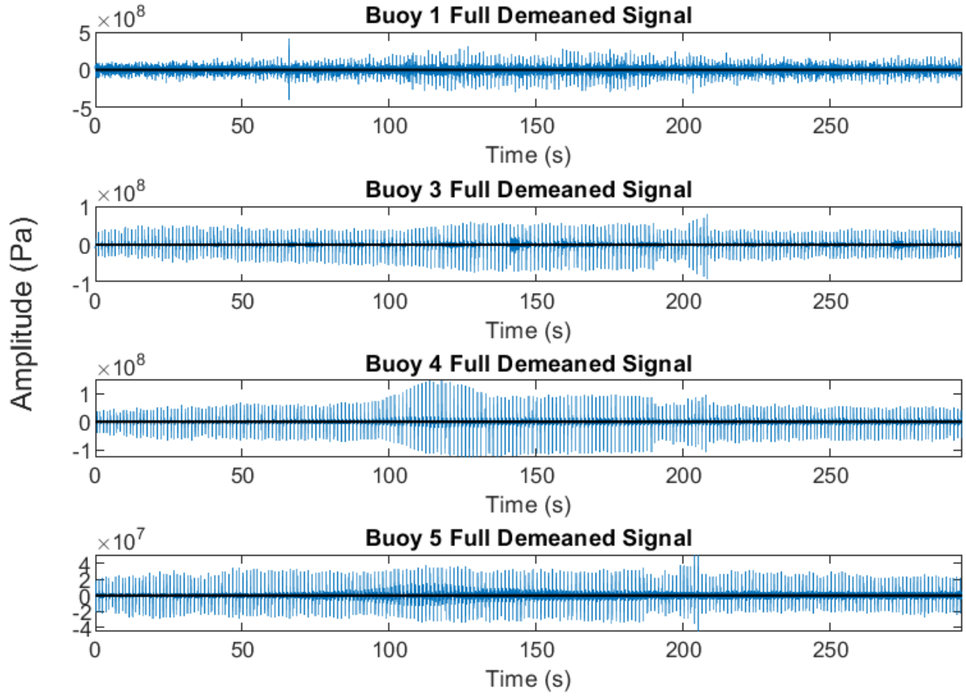
Buoy 1 Full Demeaned Signal
×10^10
2
0
-2
0 50 100 150 200 250 300 350 400
Time (s)
Amplitude (Pa)
Buoy 2 Full Demeaned Signal
×10^9
6
4
2
0
-2
-4
0 50 100 150 200 250 300 350 400
Time (s)
Buoy 3 Full Demeaned Signal
×10^8
2
0
-2
0 50 100 150 200 250 300 350 400
Time (s)


Suwanee -3
Buoy 1 Full Demeaned Signal
×10^10
4
2
0
-2
0
20
40
60
80
100
Time (s)
Amplitude (Pa)
Buoy 2 Full Demeaned Signal
×10^9
5
0
-5
0
20
40
60
80
100
Time (s)
Buoy 3 Full Demeaned Signal
×10^8
2
0
-2
0
20
40
60
80
100
Time (s)


SR23 -1
Buoy 1 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)

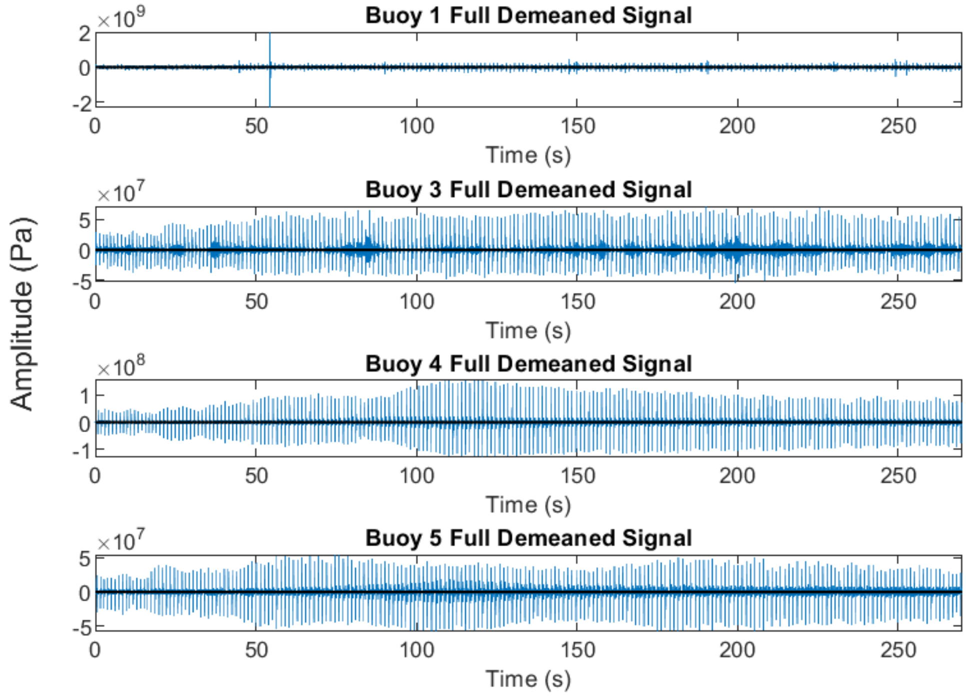

SR23 -2
Amplitude (Pa)
Buoy 1 Full Demeaned Signal
×10^8
0
-10
-20
Buoy 3 Full Demeaned Signal
×10^8
1
0
-1
Buoy 4 Full Demeaned Signal
×10^8
1
0
-1
Buoy 5 Full Demeaned Signal
×10^7
5
0
-5
0 50 100 150 200 250 300 350 400 450
Time (s)

SR23 -3

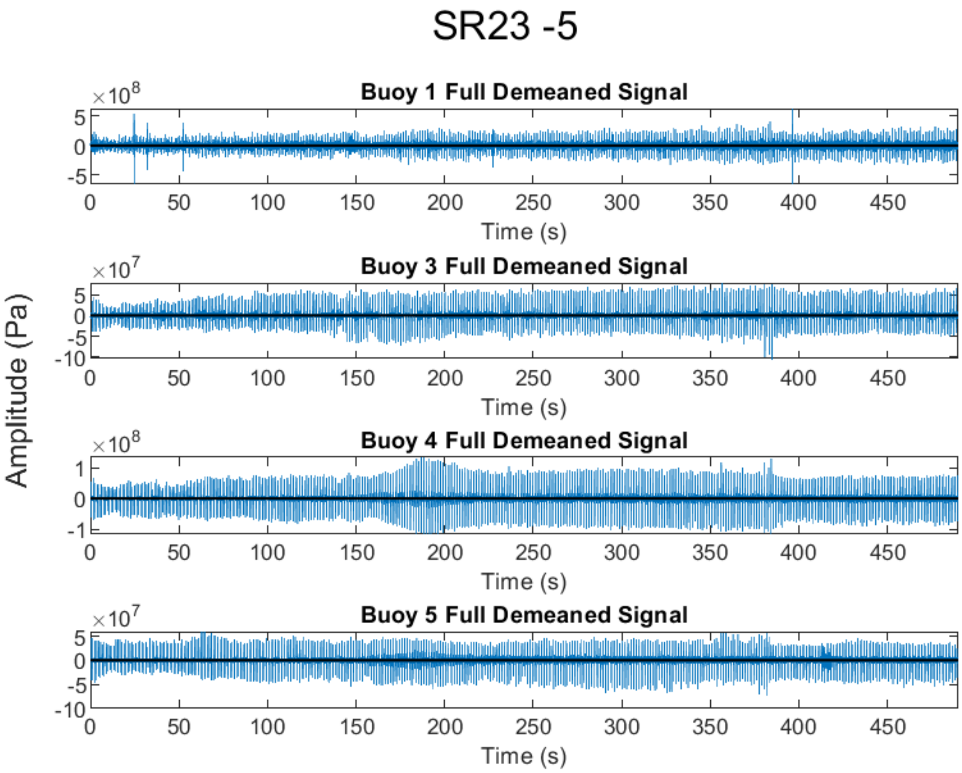


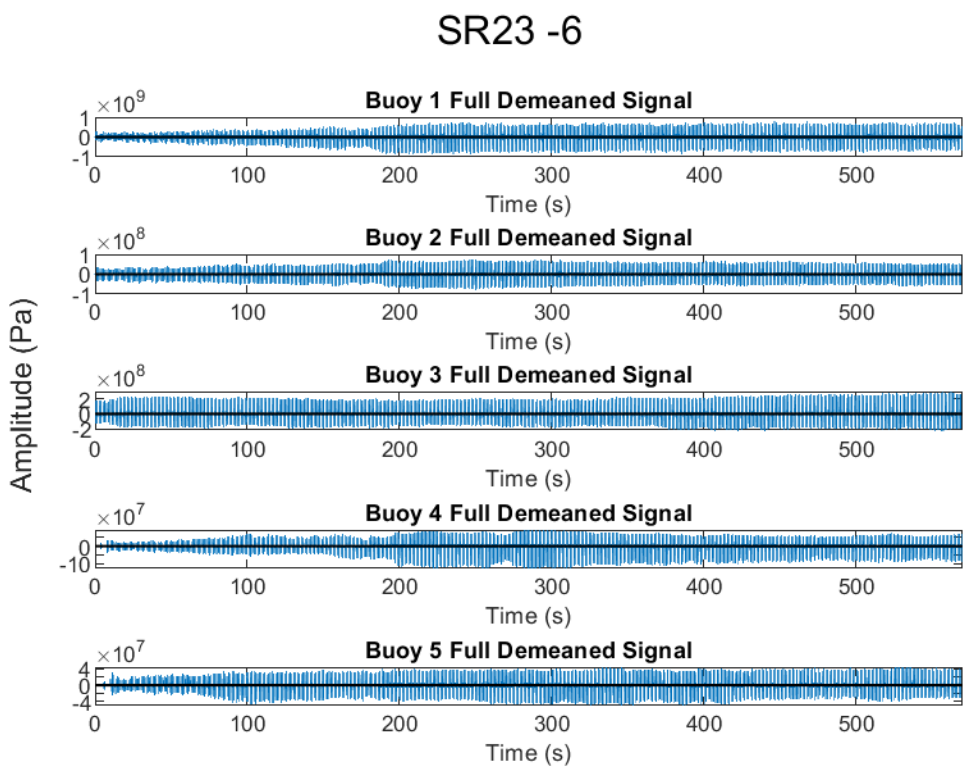
Buoy 1 Full Demeaned Signal
×10^8
5
0
-5
0
50
100
150
200
250
Time (s)
Buoy 3 Full Demeaned Signal
×10^8
1
0
-1
Amplitude (Pa)
Buoy 4 Full Demeaned Signal
×10^8
Buoy 5 Full Demeaned Signal
×10^7
4
2
-2
-4

SR23 -4

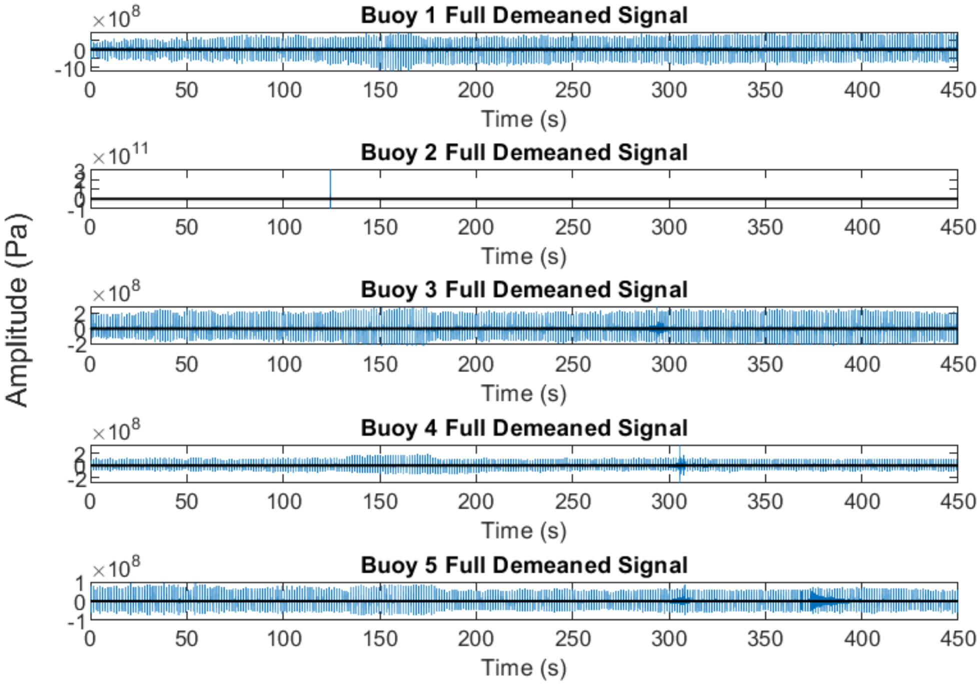


Buoy 1 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)

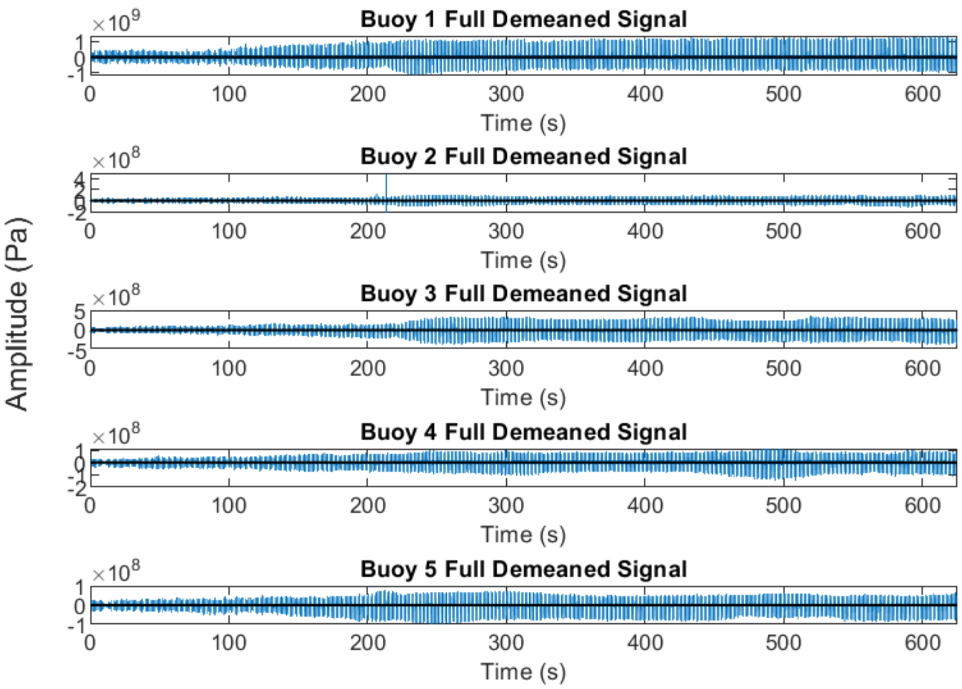

SR23 -5
Buoy 1 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)


SR23 -6
Buoy 1 Full Demeaned Signal
Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)

SR23 -7

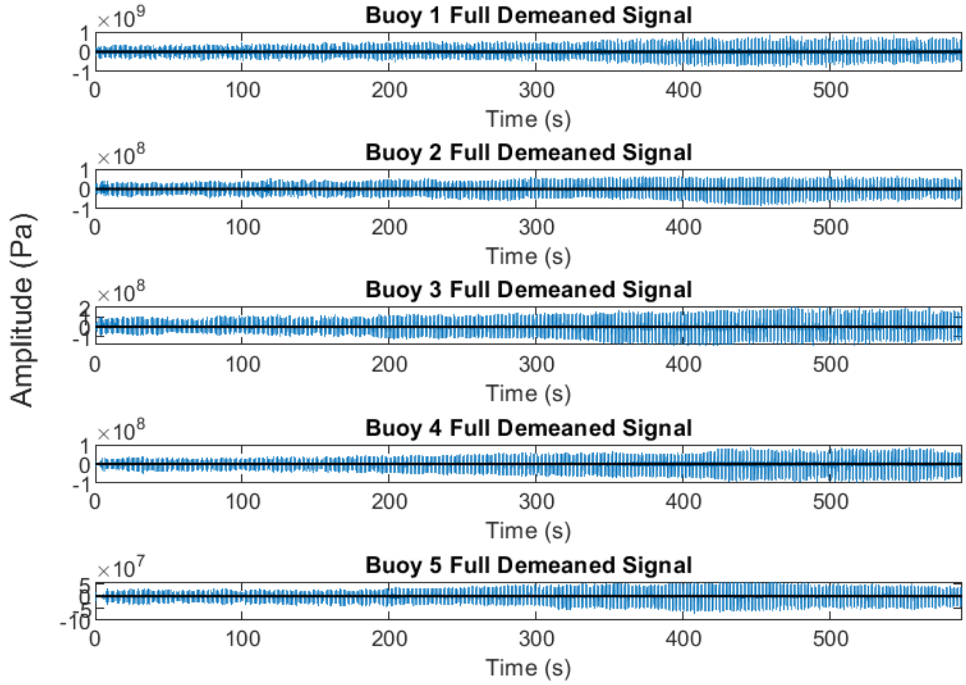

Buoy 1 Full Demeaned Signal
Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)

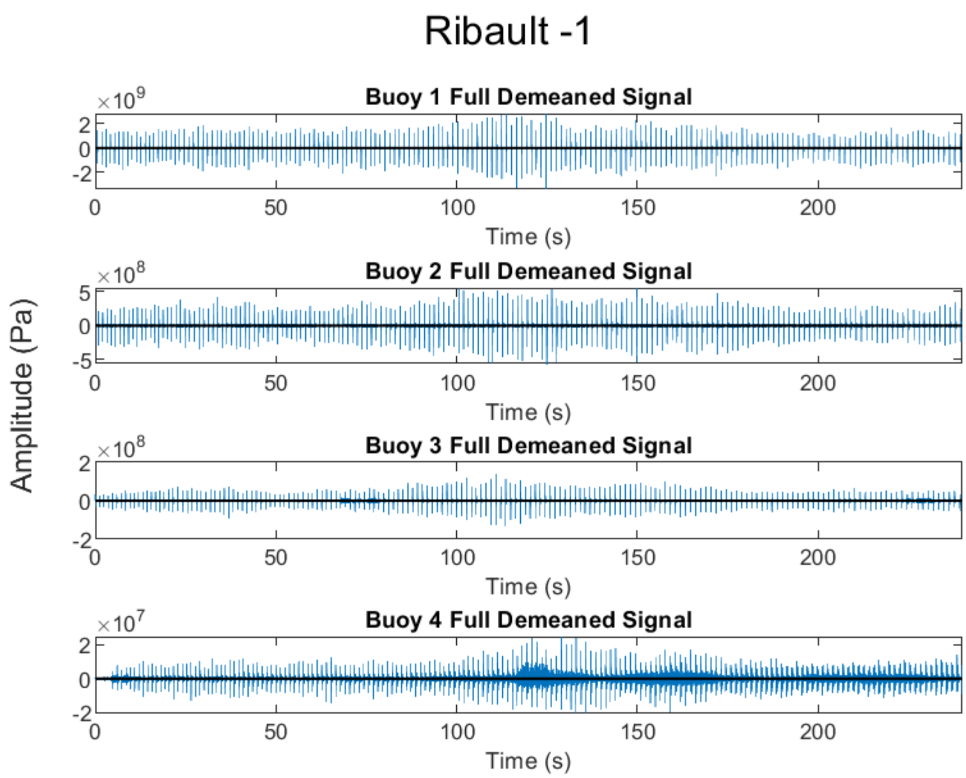
SR23 -8



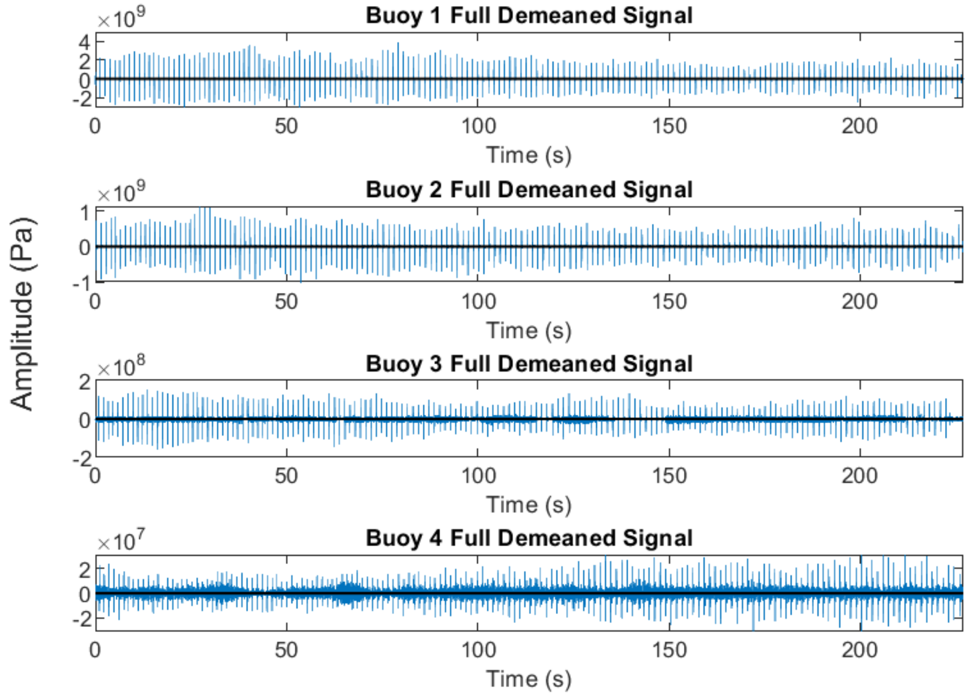
Buoy 1 Full Demeaned Signal
×10^9
Buoy 2 Full Demeaned Signal
×10^8
Buoy 3 Full Demeaned Signal
×10^8
Buoy 4 Full Demeaned Signal
×10^8
Buoy 5 Full Demeaned Signal
×10^8
Amplitude (Pa)
Time (s)
0
100
200
300
400
500
600

SR23 -9

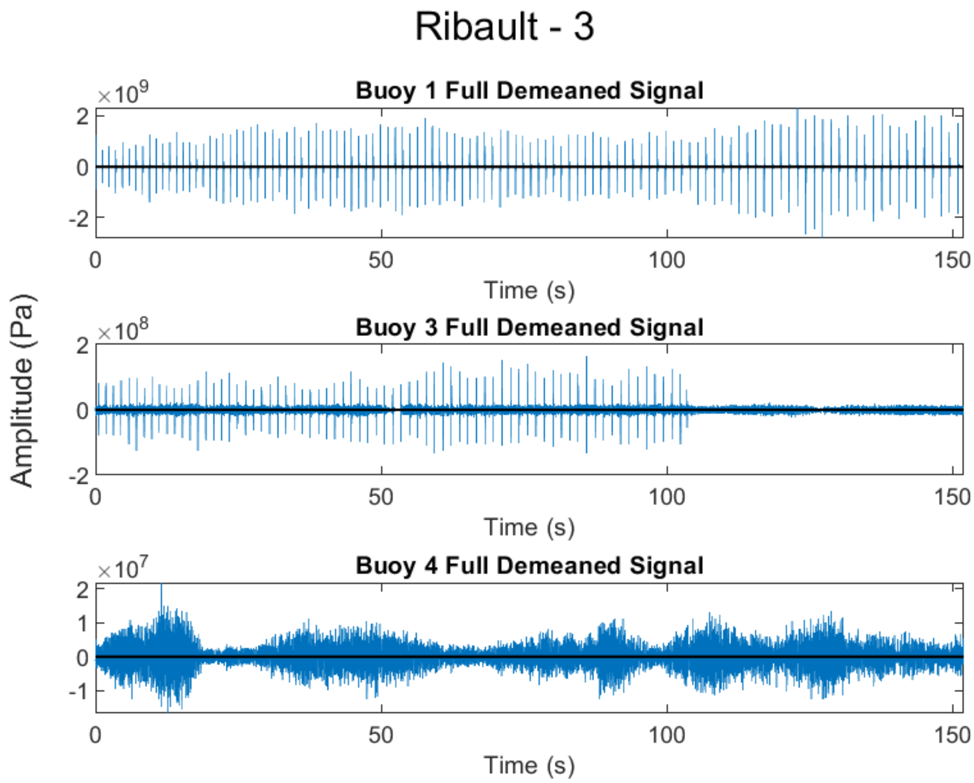

Buoy 1 Full Demeaned Signal
Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)
×10^9
×10^8
×10^7
0
100
200
300
400
500


Ribault -1
Buoy 1 Full Demeaned Signal
Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Amplitude (Pa)
Time (s)

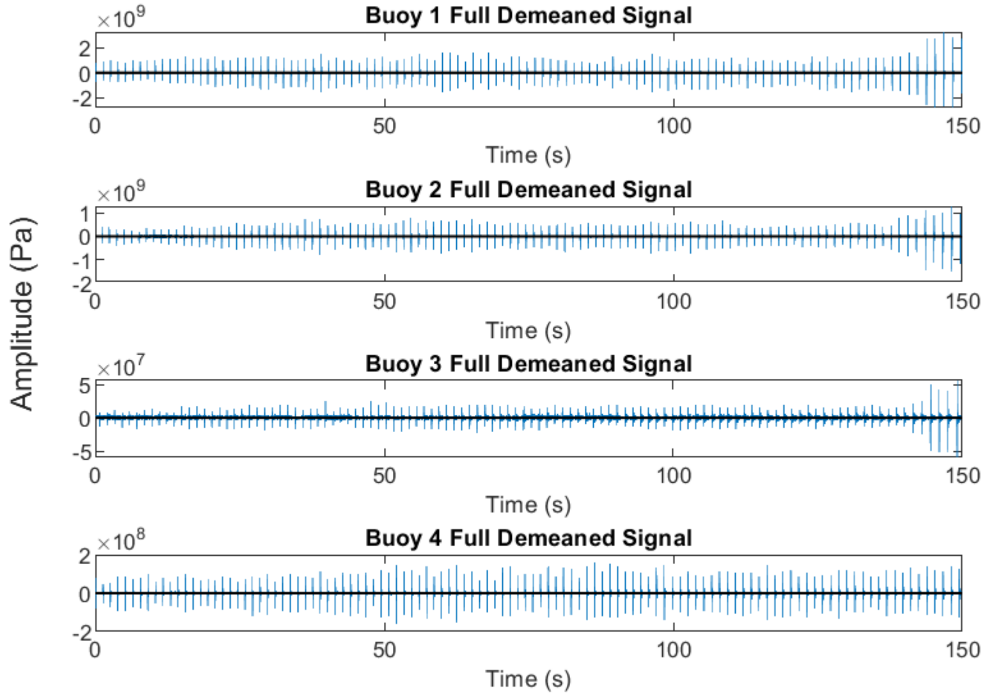
Ribault -2

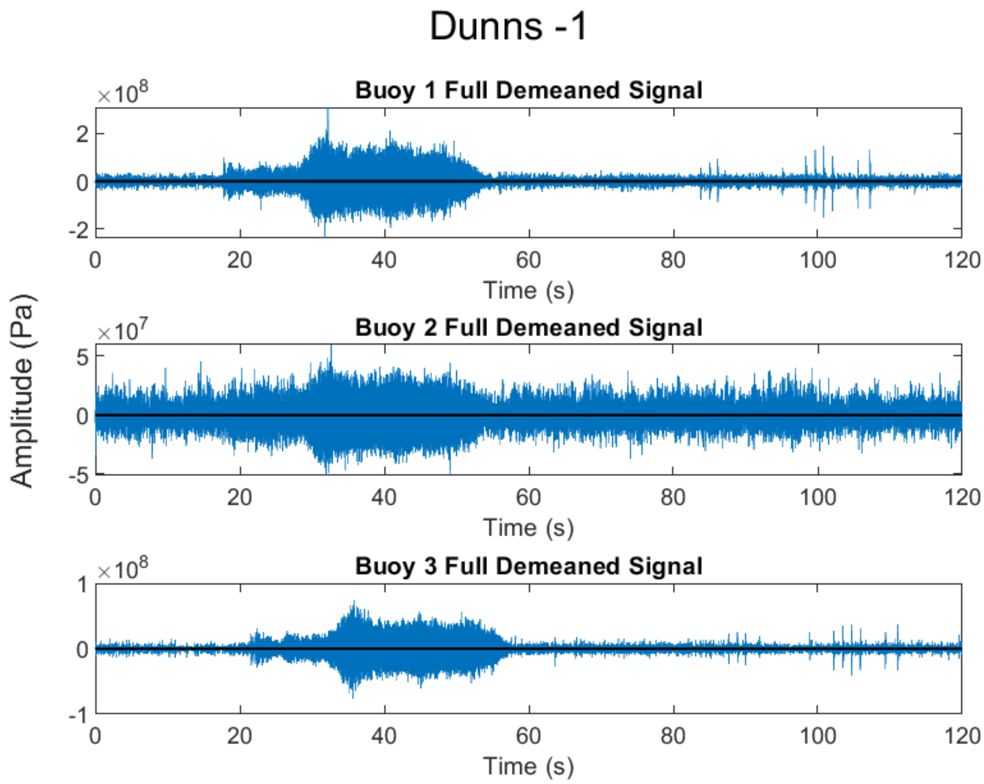


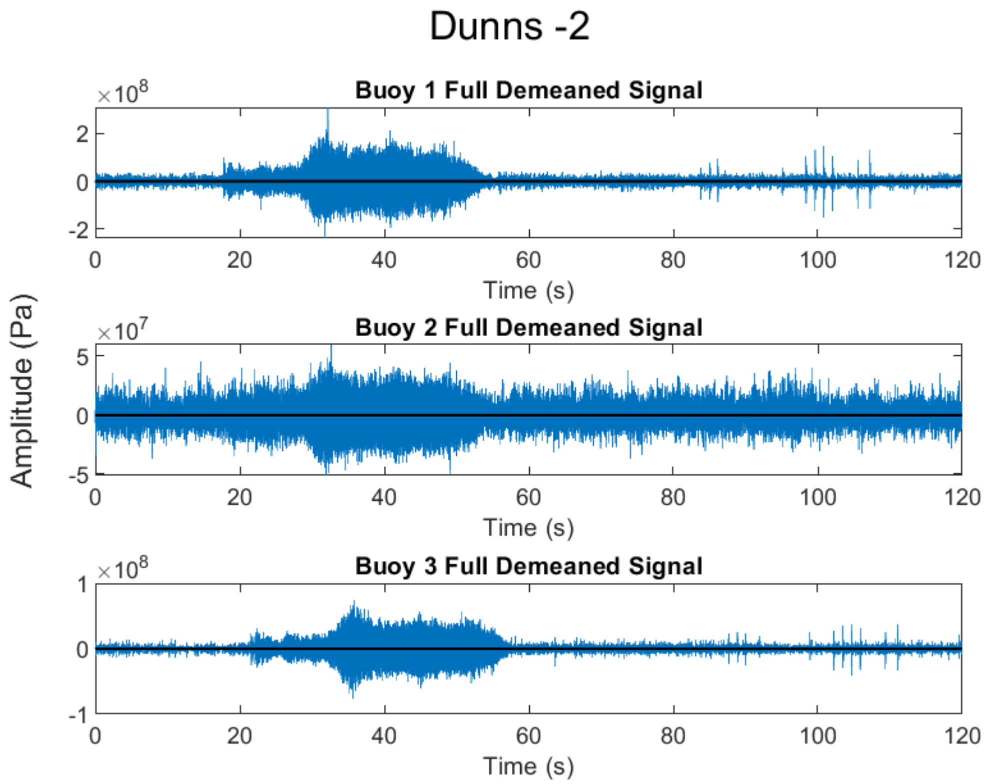
Amplitude (Pa)
Buoy 1 Full Demeaned Signal
×10^9
4
2
0
-2
Buoy 2 Full Demeaned Signal
×10^9
1
0
-1
Buoy 3 Full Demeaned Signal
×10^8
2
0
-2
Buoy 4 Full Demeaned Signal
×10^7
2
0
-2
0
50
100
150
200
Time (s)

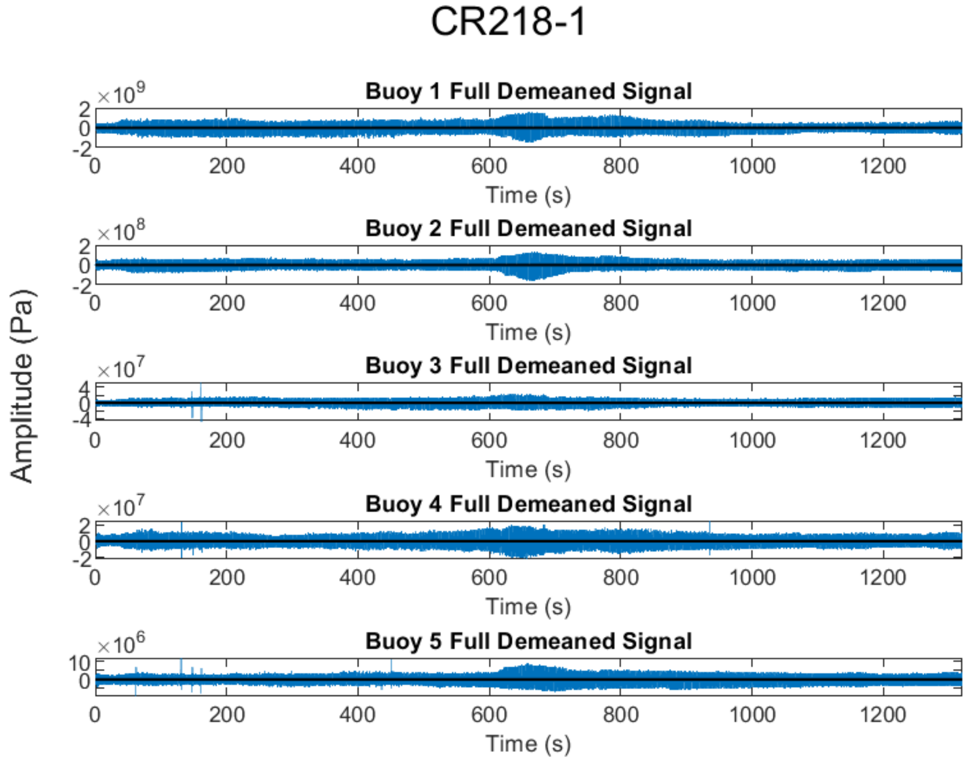

Ribault - 3
Buoy 1 Full Demeaned Signal
×10^9
2
0
-2
0
50
100
150
Time (s)
Amplitude (Pa)
Buoy 3 Full Demeaned Signal
×10^8
2
0
-2
0
50
100
150
Time (s)
Buoy 4 Full Demeaned Signal
×10^7
2
1
0
-1
0
50
100
150
Time (s)

Ribault -4

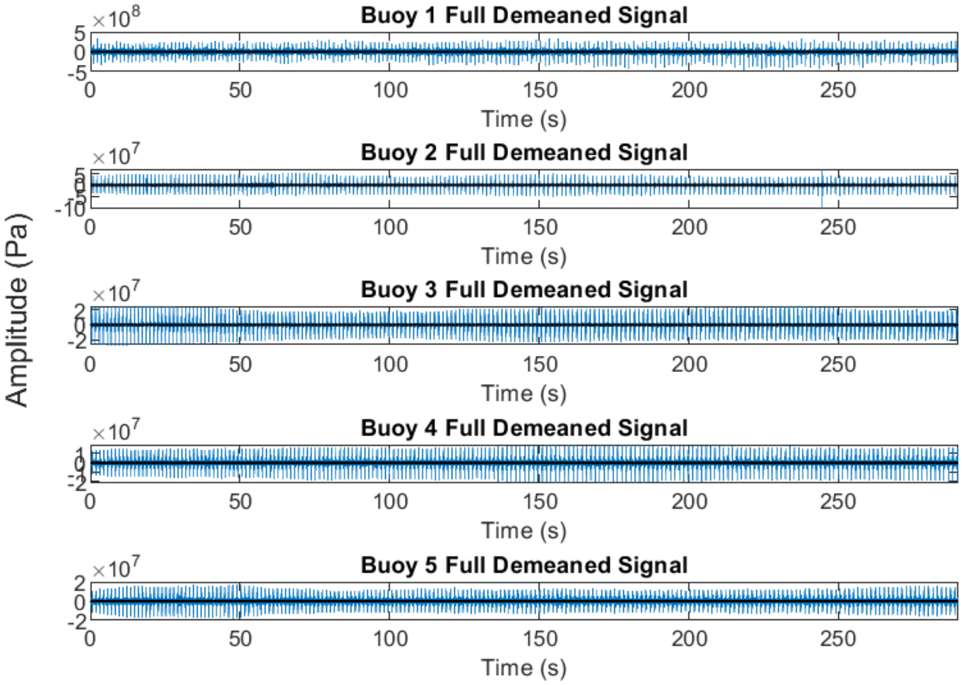

Buoy 1 Full Demeaned Signal
Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Amplitude (Pa)
Time (s)
$\times 10^9$
$\times 10^7$
$\times 10^8$


Dunns -1
Buoy 1 Full Demeaned Signal
×10^8
2
0
-2
0
20
40
60
80
100
120
Time (s)
Amplitude (Pa)
Buoy 2 Full Demeaned Signal
×10^7
5
0
-5
0
20
40
60
80
100
120
Time (s)
Buoy 3 Full Demeaned Signal
×10^8
1
0
-1
0
20
40
60
80
100
120
Time (s)


Dunns -2
Buoy 1 Full Demeaned Signal
×10^8
2
0
-2
0
20
40
60
80
100
120
Time (s)
Amplitude (Pa)
Buoy 2 Full Demeaned Signal
×10^7
5
0
-5
Time (s)
Buoy 3 Full Demeaned Signal
×10^8
1
0
-1
Time (s)

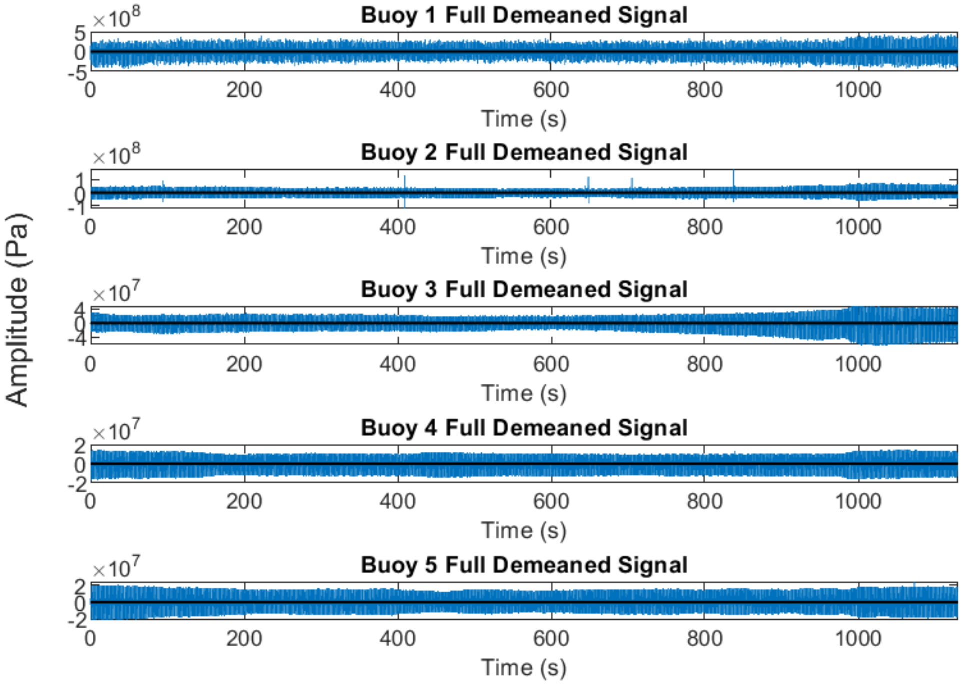

CR218-1
Buoy 1 Full Demeaned Signal
Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)

CR218-2

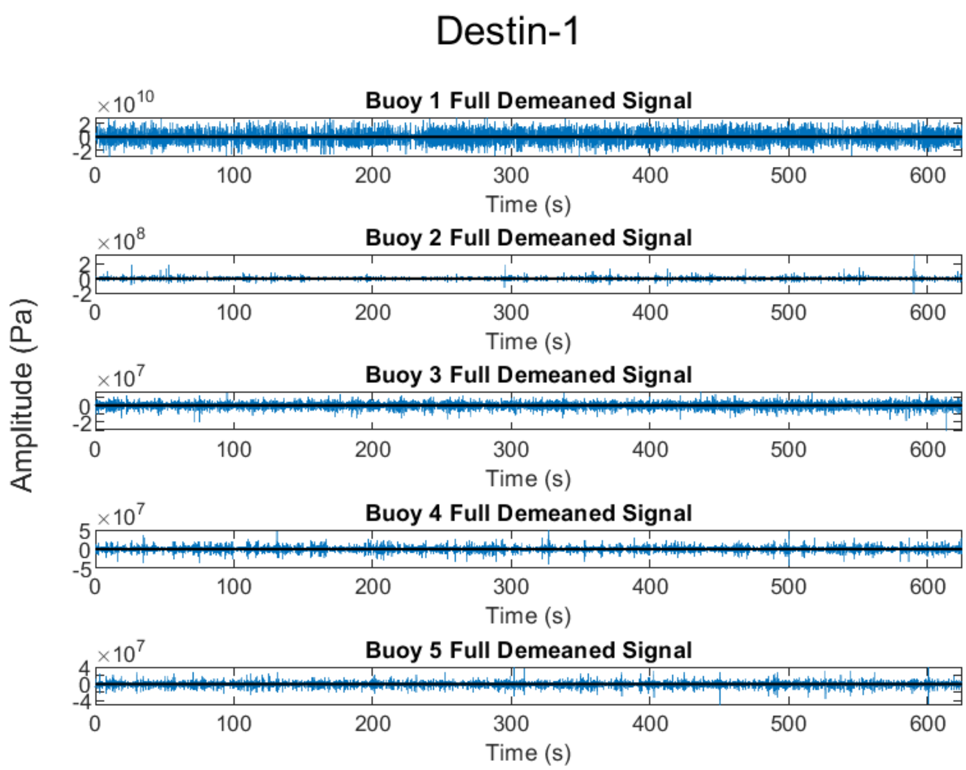


Buoy 1 Full Demeaned Signal
Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)

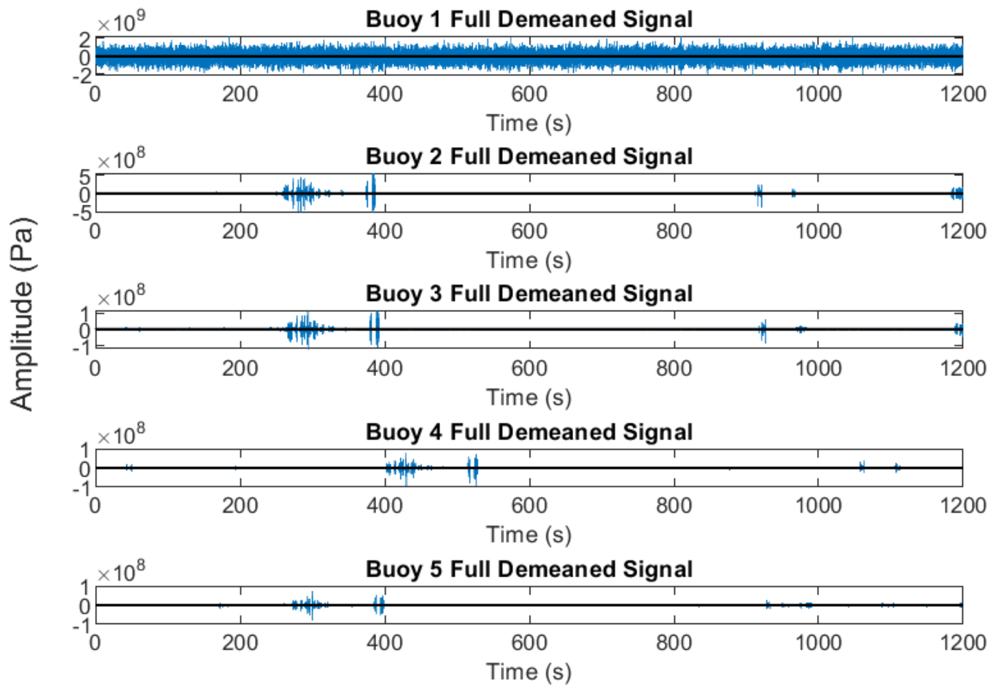
CR218-3



Buoy 1 Full Demeaned Signal
Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)

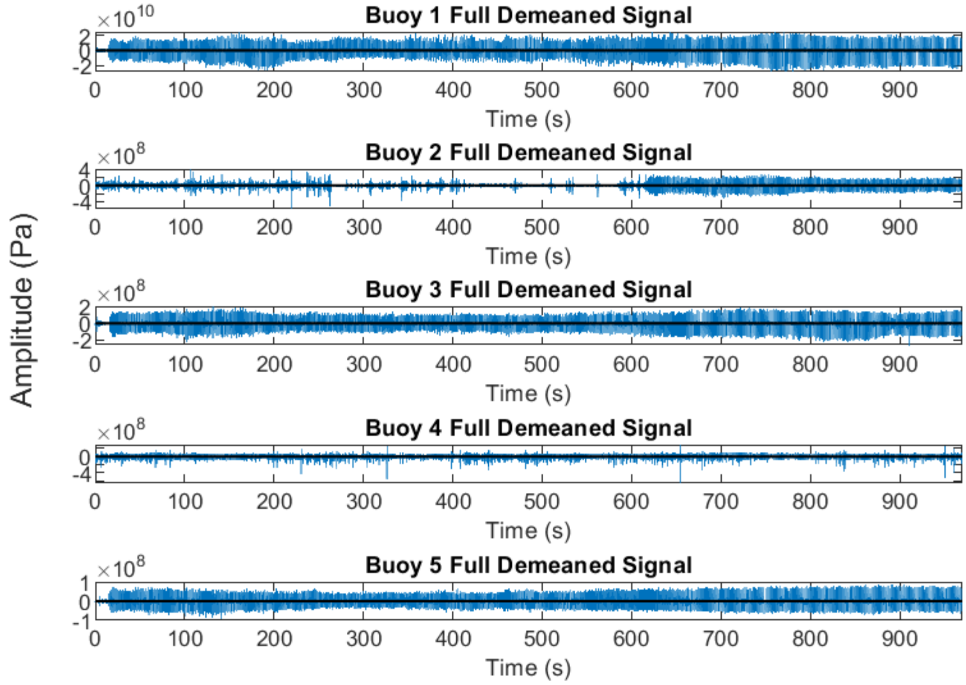

Destin-1
Buoy 1 Full Demeaned Signal
Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)

Destin-2

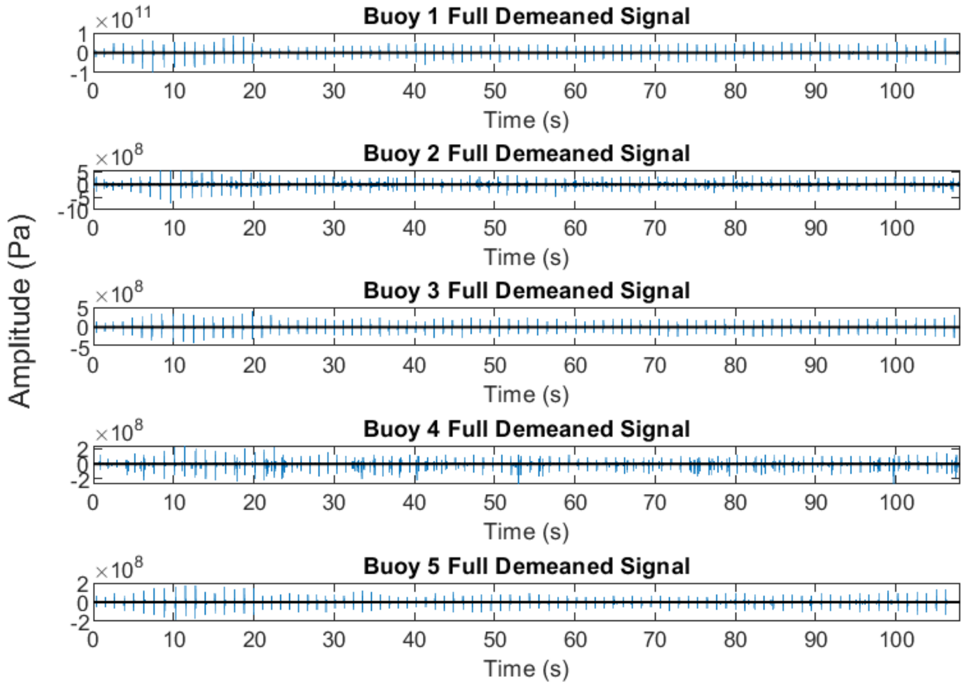


Buoy 1 Full Demeaned Signal
Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)

HF-1

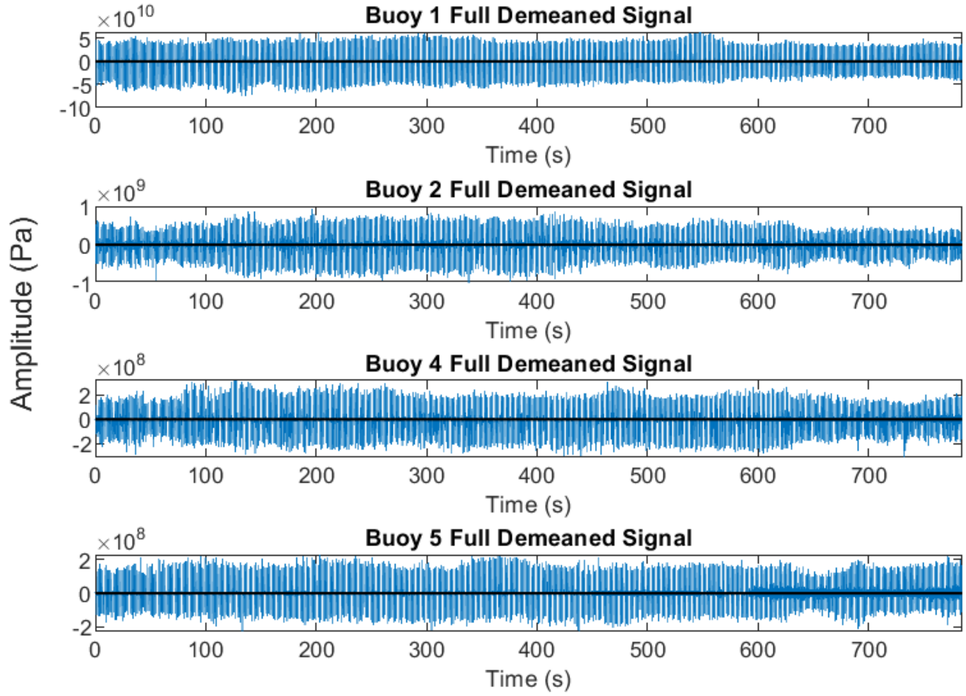

Buoy 1 Full Demeaned Signal
×10^10
Buoy 2 Full Demeaned Signal
×10^8
Buoy 3 Full Demeaned Signal
×10^8
Buoy 4 Full Demeaned Signal
×10^8
Buoy 5 Full Demeaned Signal
×10^8
Amplitude (Pa)
Time (s)

HF-2

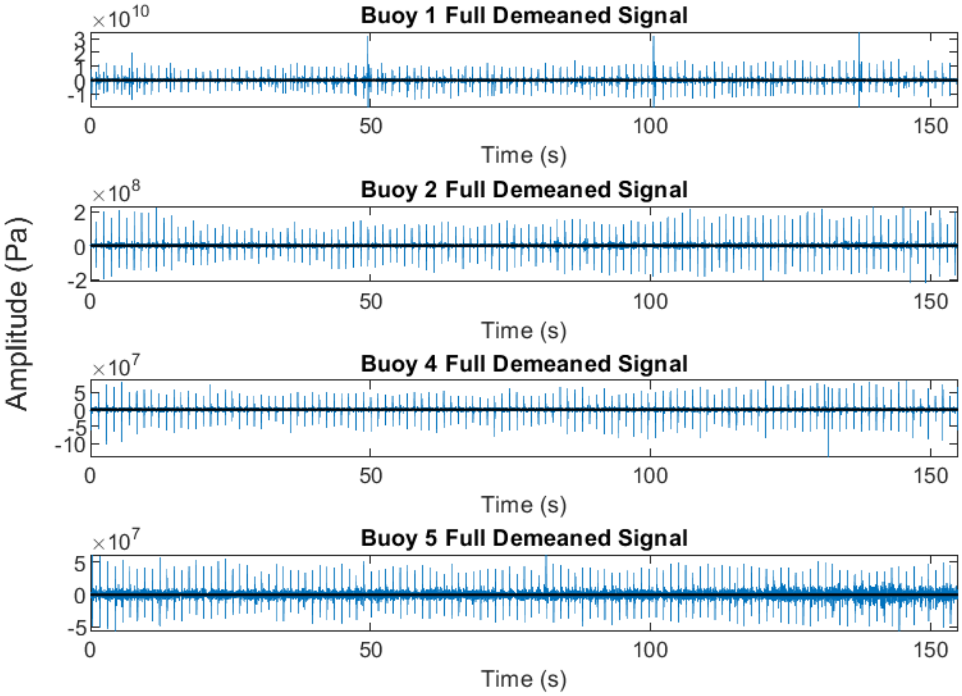


Buoy 1 Full Demeaned Signal
Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)

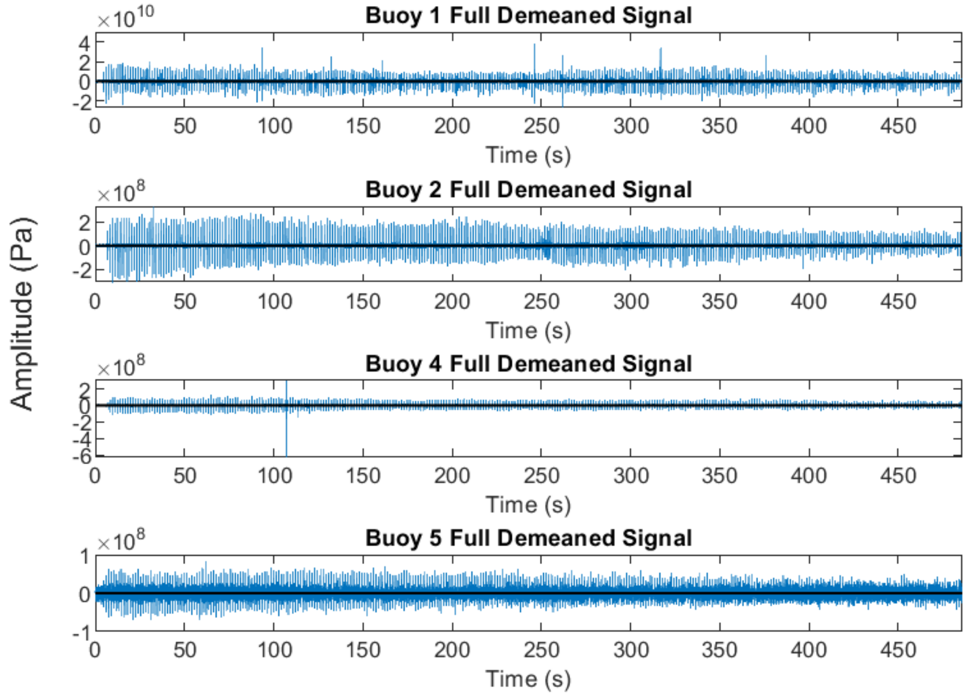
HF-3


Buoy 1 Full Demeaned Signal
×10^10
5
0
-5
-10
Buoy 2 Full Demeaned Signal
×10^9
1
0
-1
Buoy 4 Full Demeaned Signal
×10^8
2
0
-2
Buoy 5 Full Demeaned Signal
×10^8
2
0
-2
0 100 200 300 400 500 600 700
Time (s)
Amplitude (Pa)

HF-4

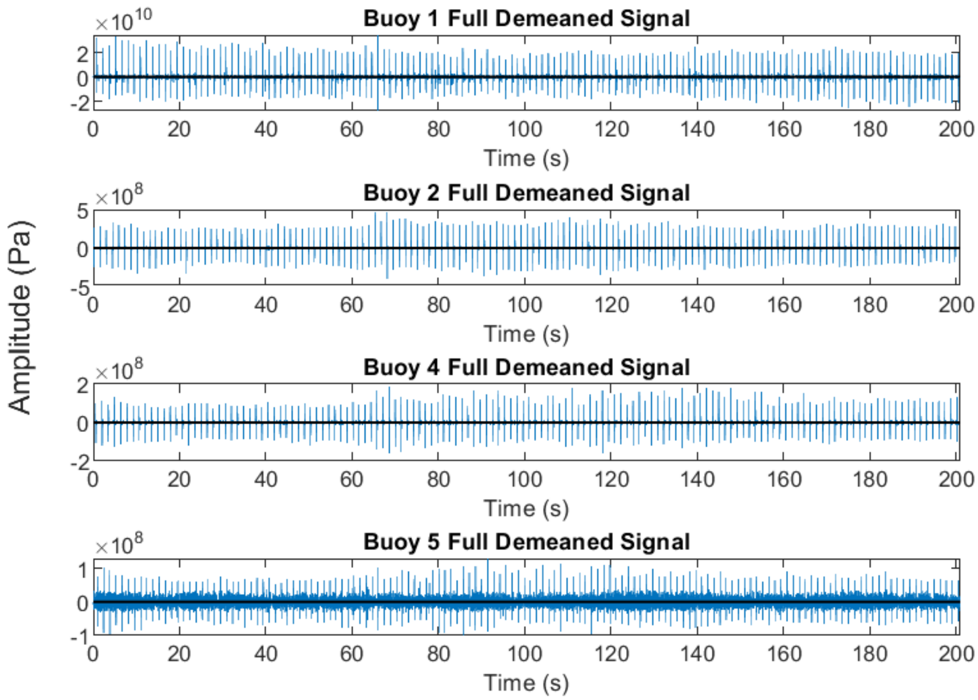

Buoy 1 Full Demeaned Signal
$\times 10^{10}$
3
2
1
0
-1
0
50
100
150
Time (s)
Buoy 2 Full Demeaned Signal
$\times 10^{8}$
2
0
-2
0
50
100
150
Time (s)
Buoy 4 Full Demeaned Signal
$\times 10^{7}$
5
0
-5
-10
0
50
100
150
Time (s)
Buoy 5 Full Demeaned Signal
$\times 10^{7}$
5
0
-5
0
50
100
150
Time (s)
Amplitude (Pa)

HF-5



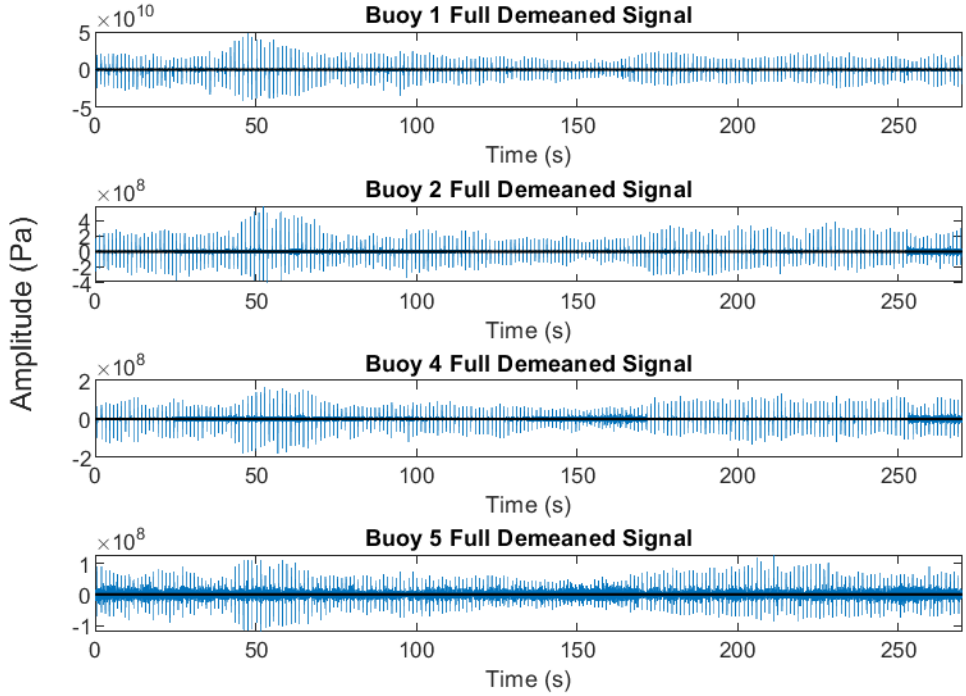
Buoy 1 Full Demeaned Signal
×10^10
Buoy 2 Full Demeaned Signal
×10^8
Buoy 4 Full Demeaned Signal
×10^8
Buoy 5 Full Demeaned Signal
×10^8
Amplitude (Pa)
Time (s)

HF-6



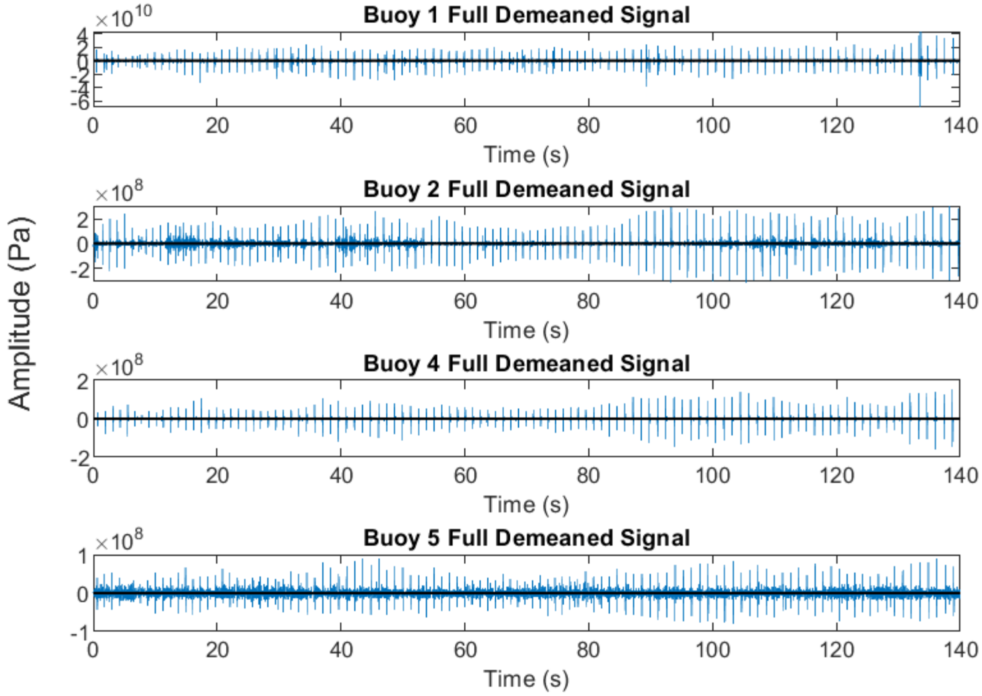
Amplitude (Pa)
×10^10
Buoy 1 Full Demeaned Signal
2
0
-2
0 20 40 60 80 100 120 140 160 180 200
Time (s)
×10^8
Buoy 2 Full Demeaned Signal
5
0
-5
0 20 40 60 80 100 120 140 160 180 200
Time (s)
×10^8
Buoy 4 Full Demeaned Signal
2
0
-2
0 20 40 60 80 100 120 140 160 180 200
Time (s)
×10^8
Buoy 5 Full Demeaned Signal
1
0
-1
0 20 40 60 80 100 120 140 160 180 200
Time (s)

HF-7

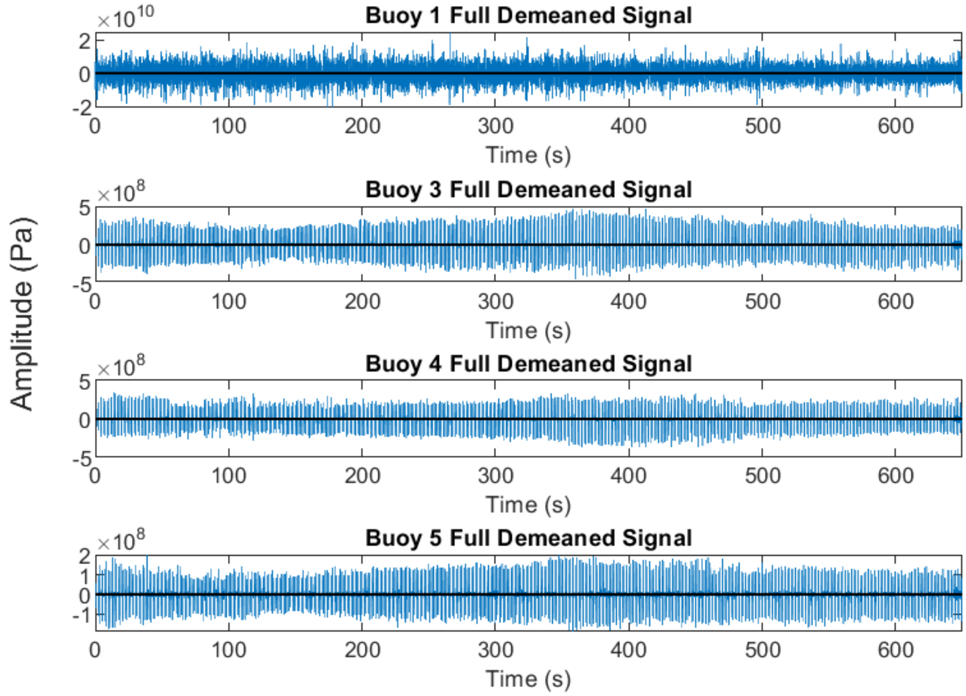


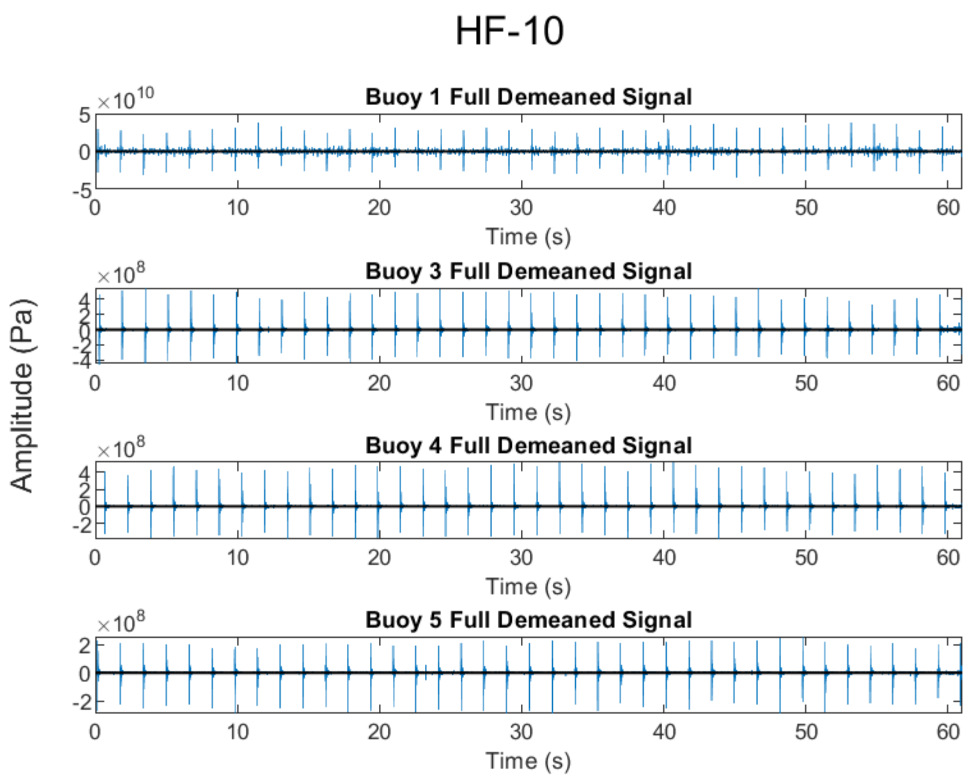
Buoy 1 Full Demeaned Signal
×10^10
5
0
-5
0
50
100
150
200
250
Time (s)
Buoy 2 Full Demeaned Signal
×10^8
4
2
0
-2
-4
Time (s)
Amplitude (Pa)
Buoy 4 Full Demeaned Signal
×10^8
2
0
-2
Time (s)
Buoy 5 Full Demeaned Signal
×10^8
1
0
-1
Time (s)

HF-8

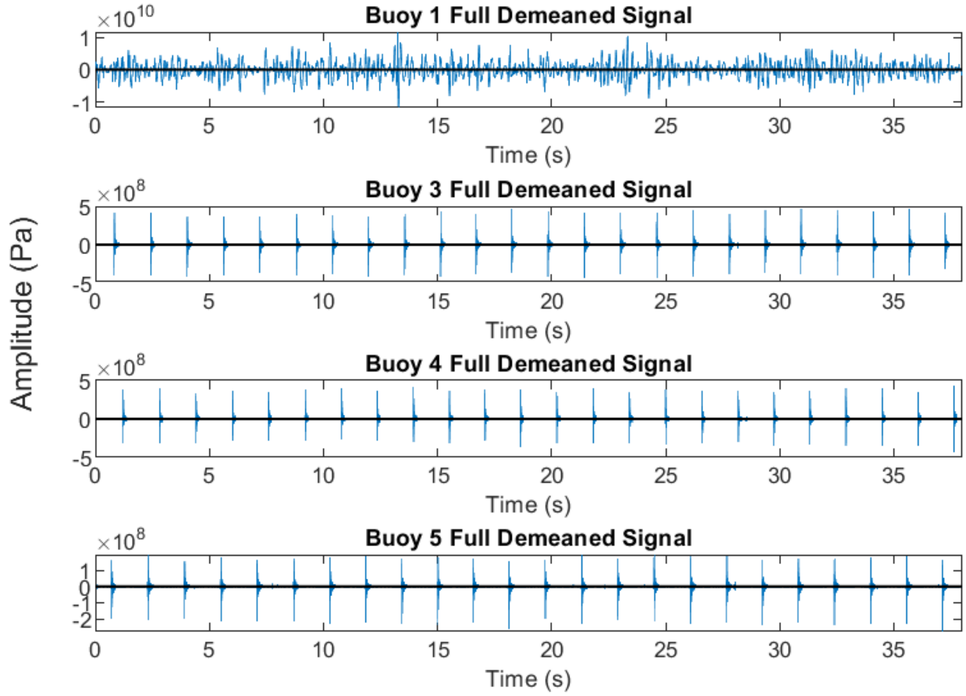

Buoy 1 Full Demeaned Signal
Buoy 2 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)

HF-9

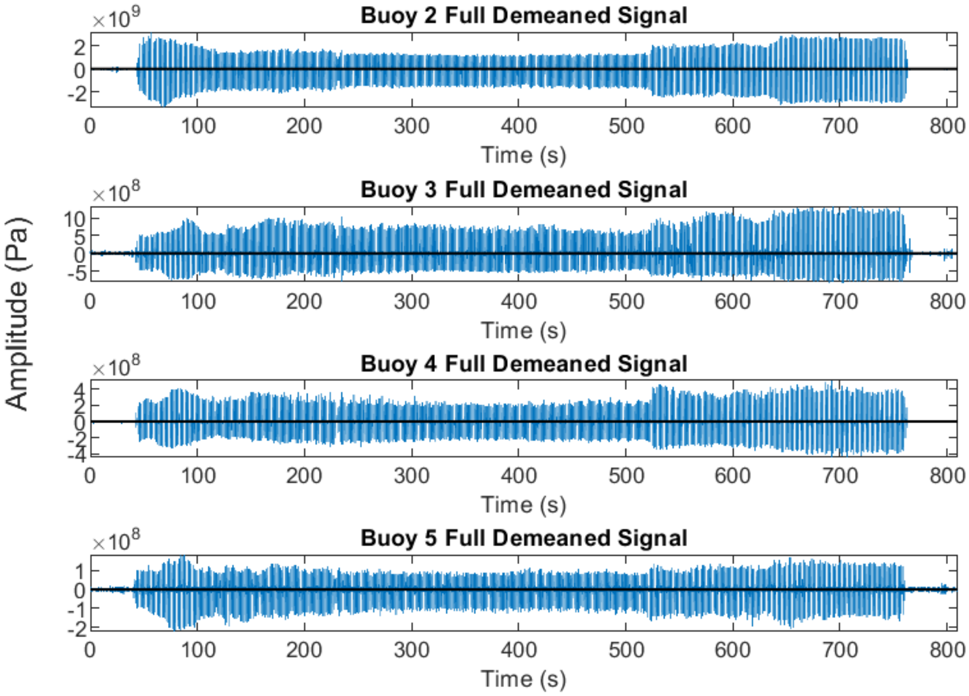

Amplitude (Pa)
Buoy 1 Full Demeaned Signal
×10^10
Time (s)
Buoy 3 Full Demeaned Signal
×10^8
Time (s)
Buoy 4 Full Demeaned Signal
×10^8
Time (s)
Buoy 5 Full Demeaned Signal
×10^8
Time (s)


HF-10
Buoy 1 Full Demeaned Signal
×10^10
5
0
-5
0
10
20
30
40
50
60
Time (s)
Buoy 3 Full Demeaned Signal
×10^8
4
2
0
-2
-4
Time (s)
Buoy 4 Full Demeaned Signal
×10^8
Time (s)
Buoy 5 Full Demeaned Signal
×10^8
Time (s)
Amplitude (Pa)

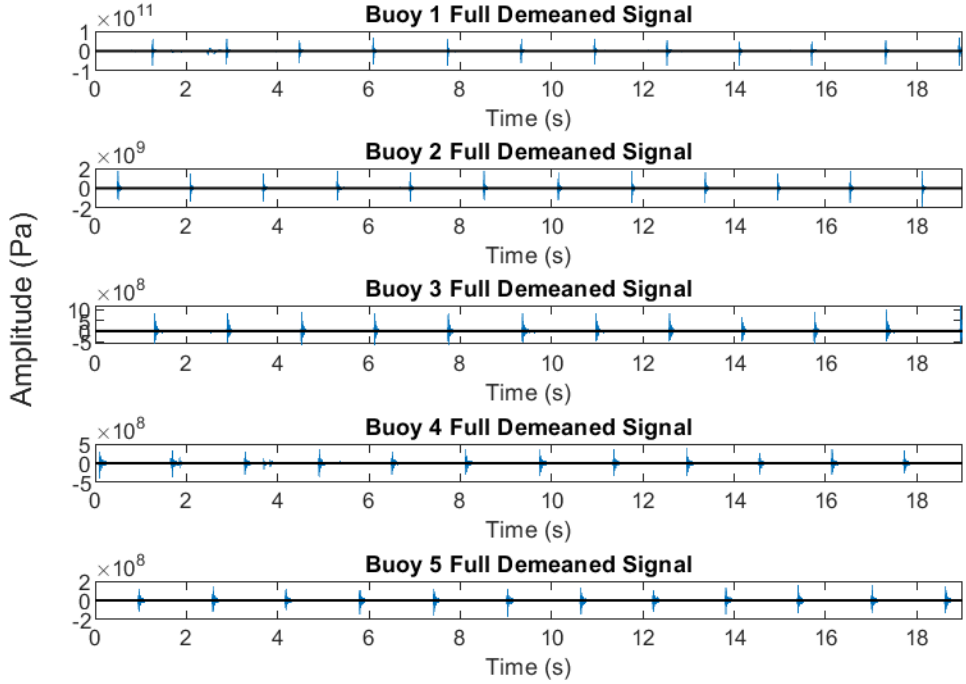
HF-11

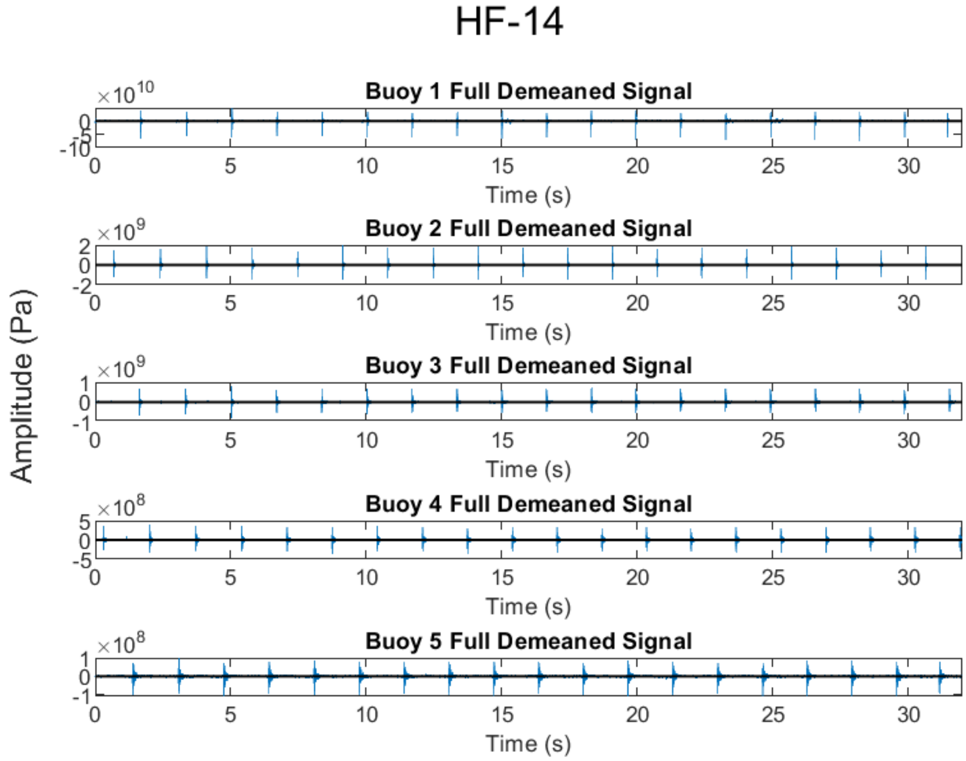

Amplitude (Pa)
Buoy 1 Full Demeaned Signal
×10^10
1
0
-1
0 5 10 15 20 25 30 35
Time (s)
Buoy 3 Full Demeaned Signal
×10^8
5
0
-5
0 5 10 15 20 25 30 35
Time (s)
Buoy 4 Full Demeaned Signal
×10^8
5
0
-5
0 5 10 15 20 25 30 35
Time (s)
Buoy 5 Full Demeaned Signal
×10^8
1
0
-1
-2
0 5 10 15 20 25 30 35
Time (s)

HF-12

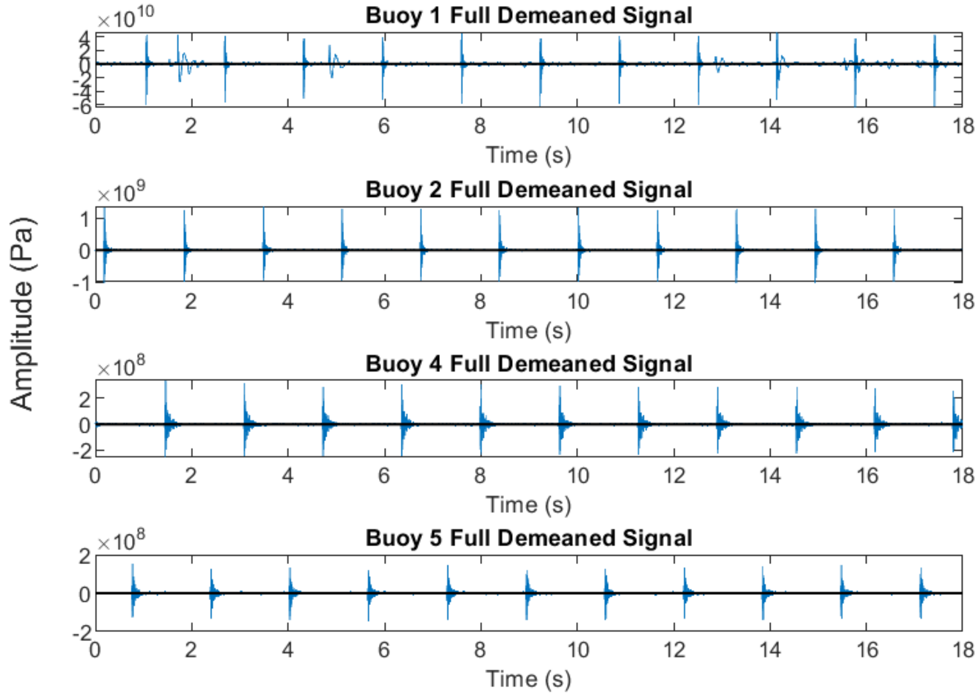

Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)

HF-13


Buoy 1 Full Demeaned Signal
Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)

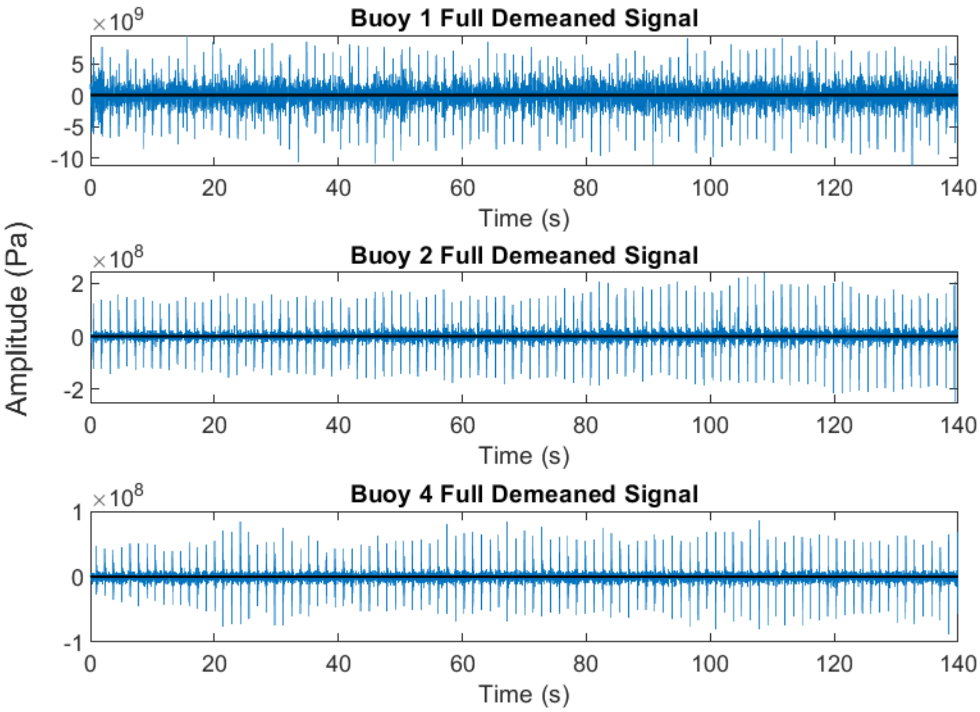

HF-14
Buoy 1 Full Demeaned Signal
Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)

HF-15

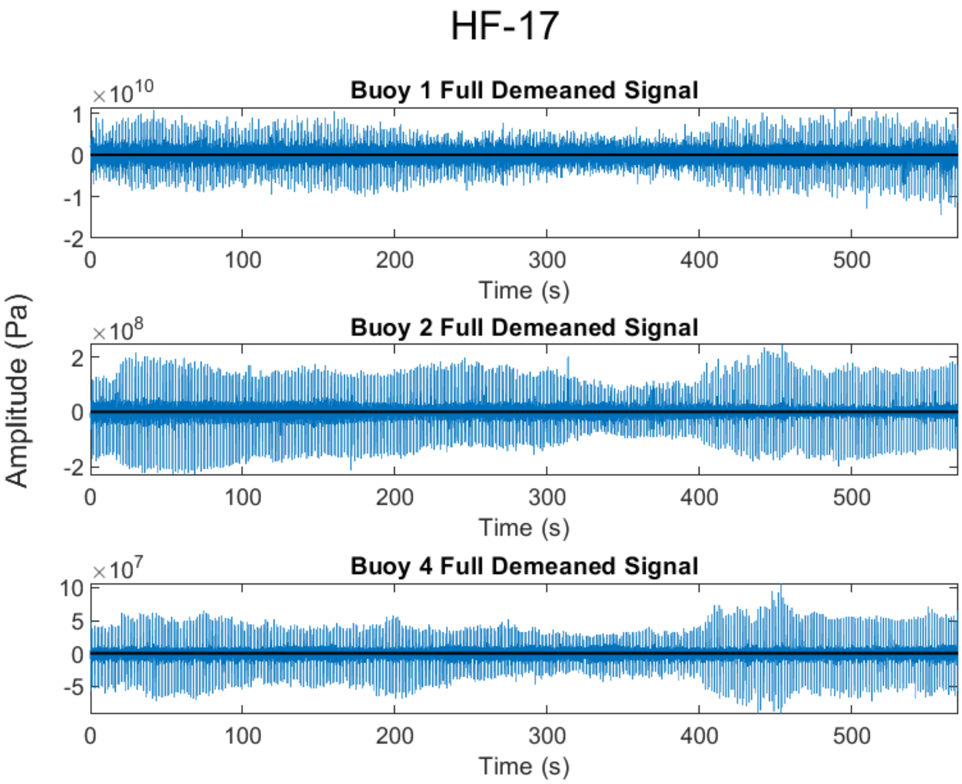


Buoy 1 Full Demeaned Signal
×10^10
Buoy 2 Full Demeaned Signal
×10^9
Buoy 4 Full Demeaned Signal
×10^8
Buoy 5 Full Demeaned Signal
×10^8
Amplitude (Pa)
Time (s)

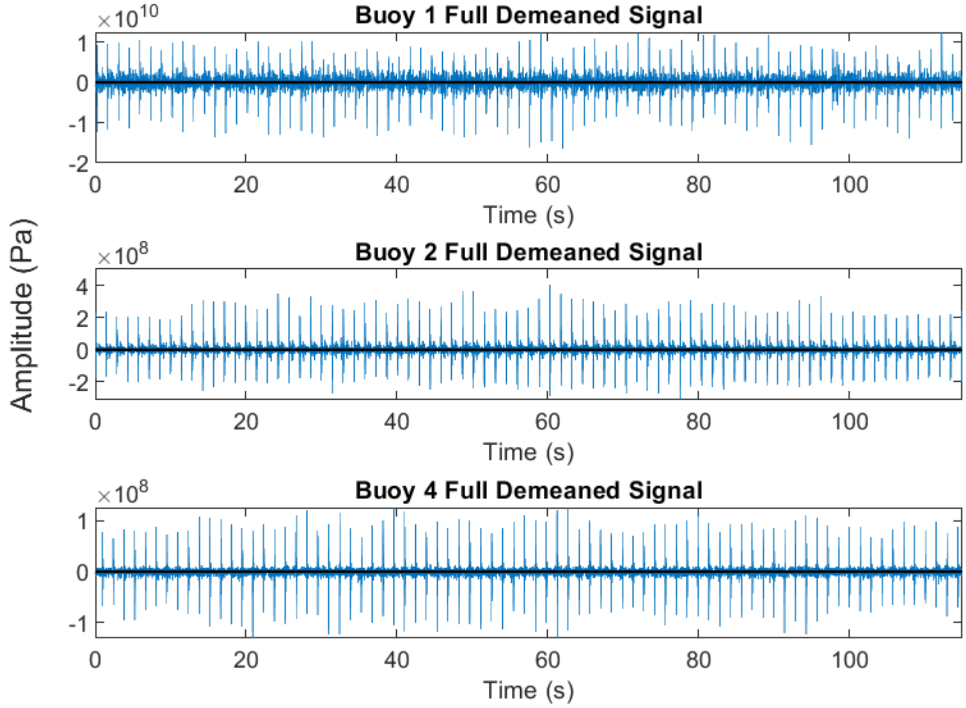
HF-16



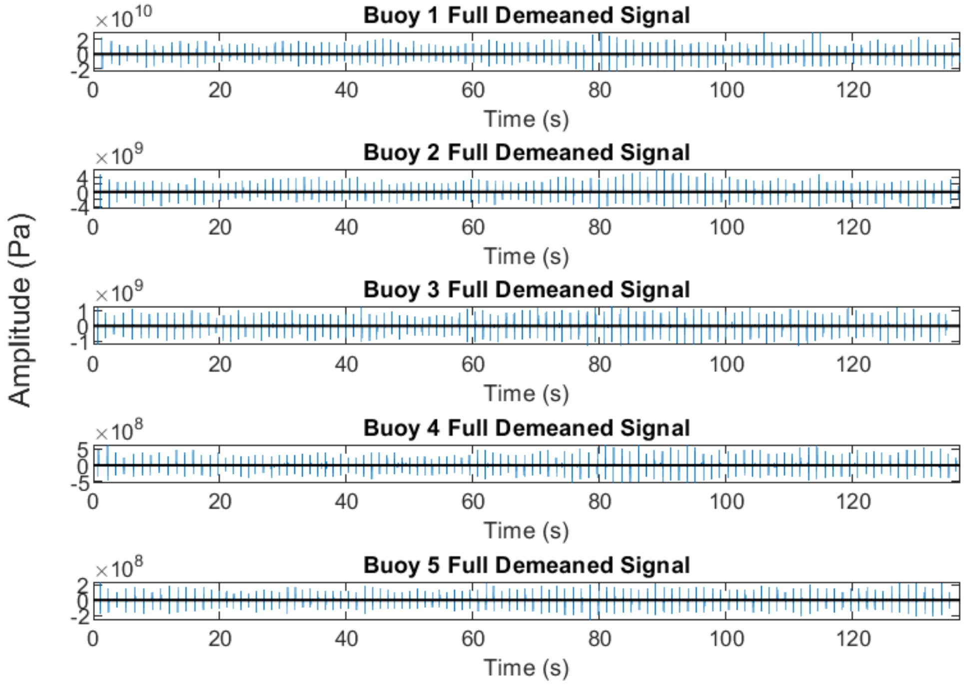
Buoy 1 Full Demeaned Signal
×10^9
5
0
-5
-10
0
20
40
60
80
100
120
140
Time (s)
Amplitude (Pa)
Buoy 2 Full Demeaned Signal
×10^8
2
0
-2
0
20
40
60
80
100
120
140
Time (s)
Buoy 4 Full Demeaned Signal
×10^8
1
0
-1
0
20
40
60
80
100
120
140
Time (s)


HF-17
Buoy 1 Full Demeaned Signal
×10^10
1
0
-1
-2
0
100
200
300
400
500
Time (s)
Amplitude (Pa)
Buoy 2 Full Demeaned Signal
×10^8
2
0
-2
0
100
200
300
400
500
Time (s)
Buoy 4 Full Demeaned Signal
×10^7
10
5
0
-5
0
100
200
300
400
500
Time (s)

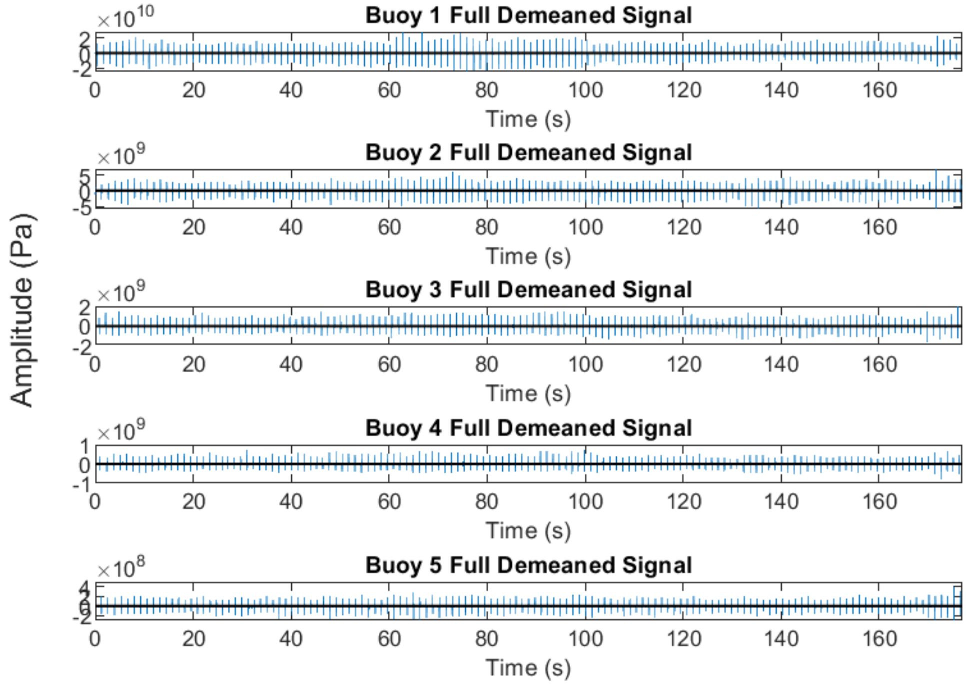
HF-18


Buoy 1 Full Demeaned Signal
Buoy 2 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Amplitude (Pa)
Time (s)
×10^10
×10^8

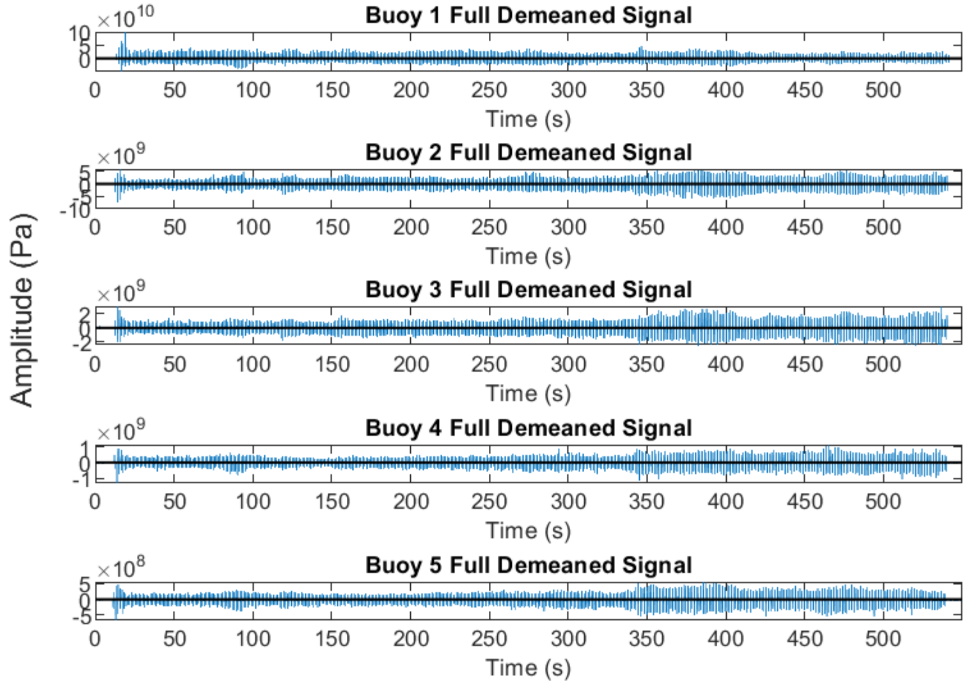
HF-19


Amplitude (Pa)
Buoy 1 Full Demeaned Signal
×10^10
Buoy 2 Full Demeaned Signal
×10^9
Buoy 3 Full Demeaned Signal
×10^9
Buoy 4 Full Demeaned Signal
×10^8
Buoy 5 Full Demeaned Signal
×10^8
Time (s)

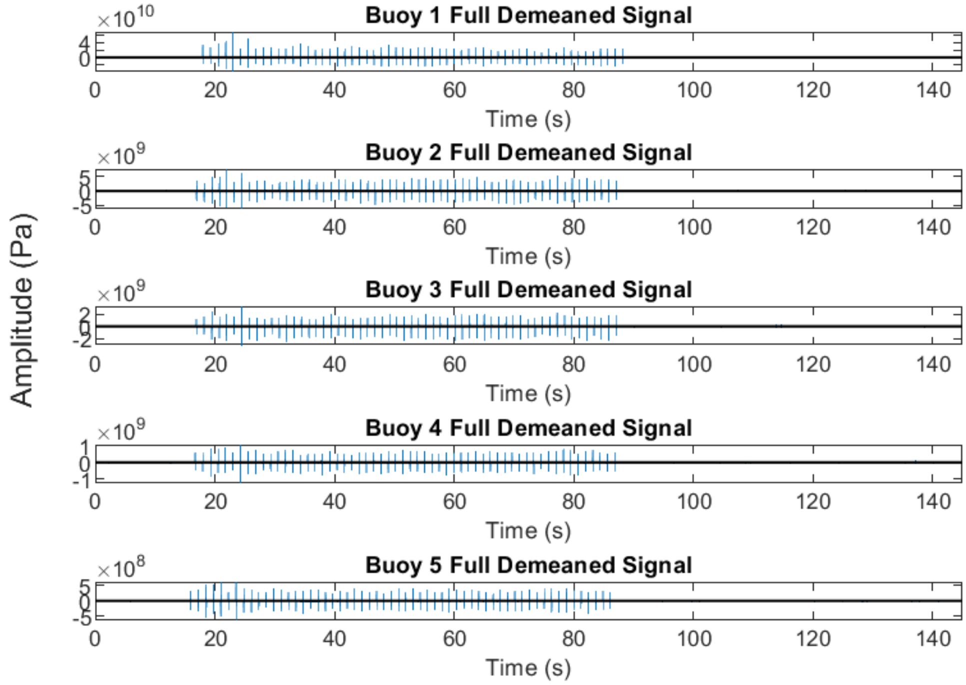
HF-20


Buoy 1 Full Demeaned Signal
Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)

HF-21

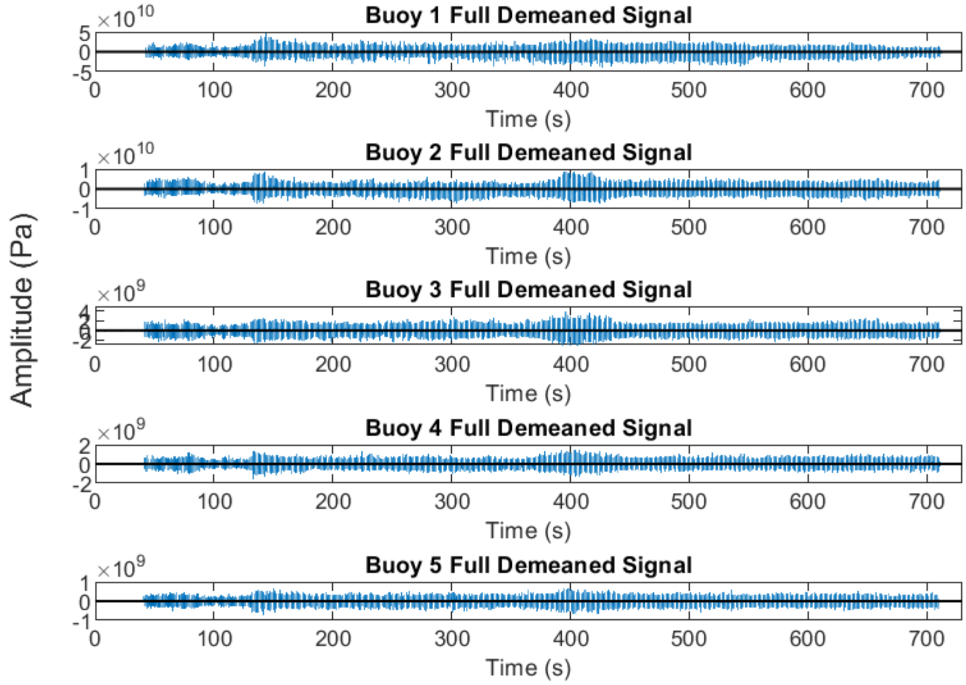

Buoy 1 Full Demeaned Signal
Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)

HF-22



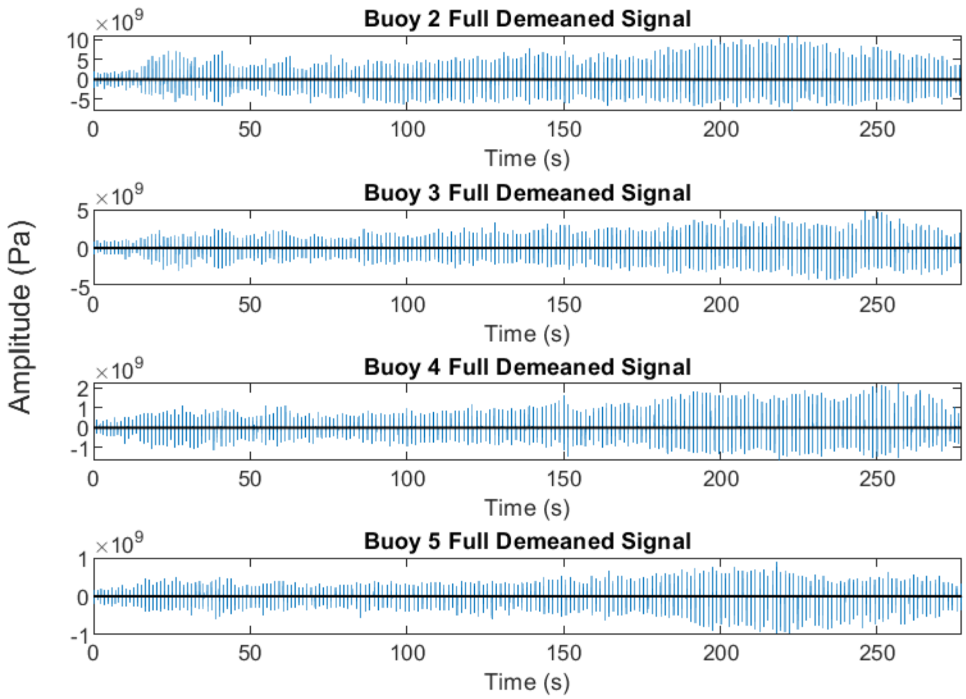
Amplitude (Pa)
×10^10
Buoy 1 Full Demeaned Signal
4
0
0
20
40
60
80
100
120
140
Time (s)
×10^9
Buoy 2 Full Demeaned Signal
5
0
-5
Time (s)
×10^9
Buoy 3 Full Demeaned Signal
2
0
-2
Time (s)
×10^9
Buoy 4 Full Demeaned Signal
1
0
-1
Time (s)
×10^8
Buoy 5 Full Demeaned Signal
5
0
-5
Time (s)

HF-23



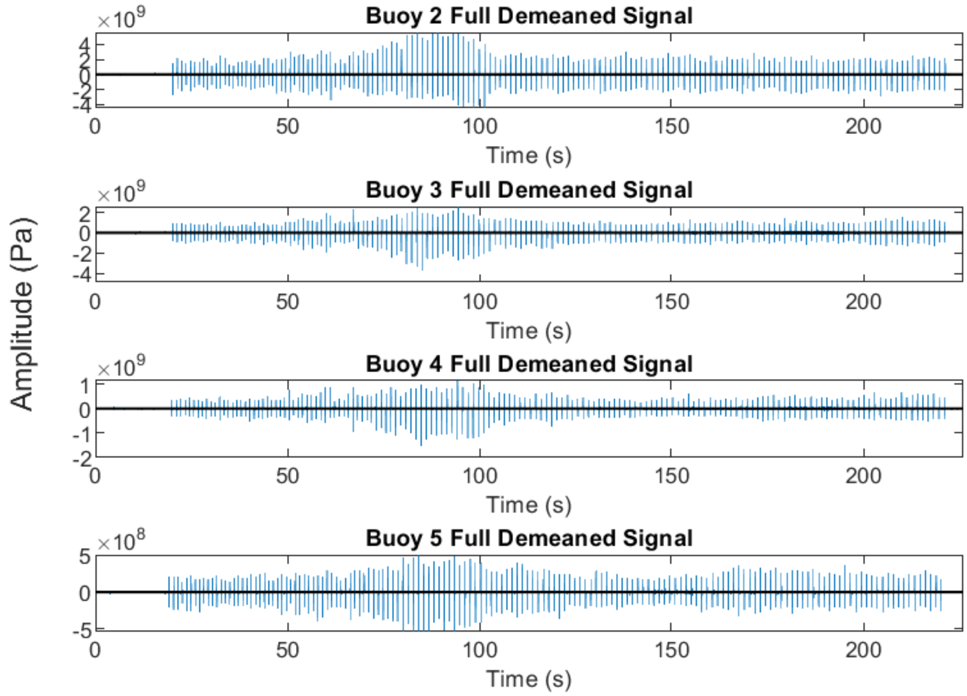
Amplitude (Pa)
Buoy 1 Full Demeaned Signal
×10^10
5
0
-5
Buoy 2 Full Demeaned Signal
×10^10
1
0
-1
Buoy 3 Full Demeaned Signal
×10^9
4
2
0
-2
Buoy 4 Full Demeaned Signal
×10^9
2
0
-2
Buoy 5 Full Demeaned Signal
×10^9
1
0
-1
0
100
200
300
400
500
600
700
Time (s)

HF - 24



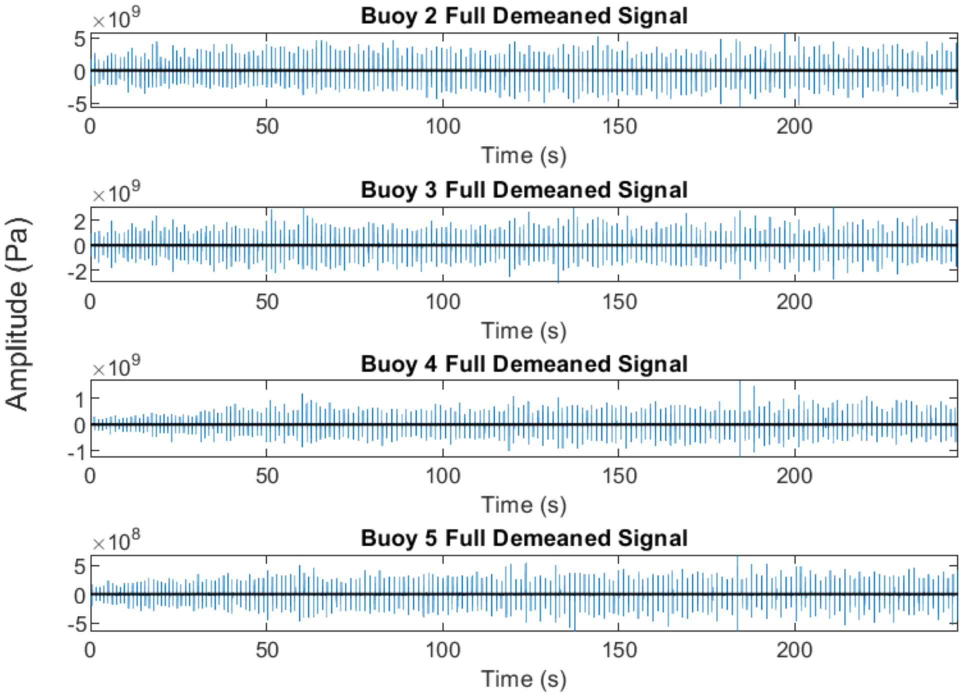
Amplitude (Pa)
Buoy 2 Full Demeaned Signal
×10^9
10
5
0
-5
0
50
100
150
200
250
Time (s)
Buoy 3 Full Demeaned Signal
×10^9
5
0
-5
Time (s)
Buoy 4 Full Demeaned Signal
×10^9
2
1
0
-1
Time (s)
Buoy 5 Full Demeaned Signal
×10^9
1
0
-1
Time (s)

HF - 25



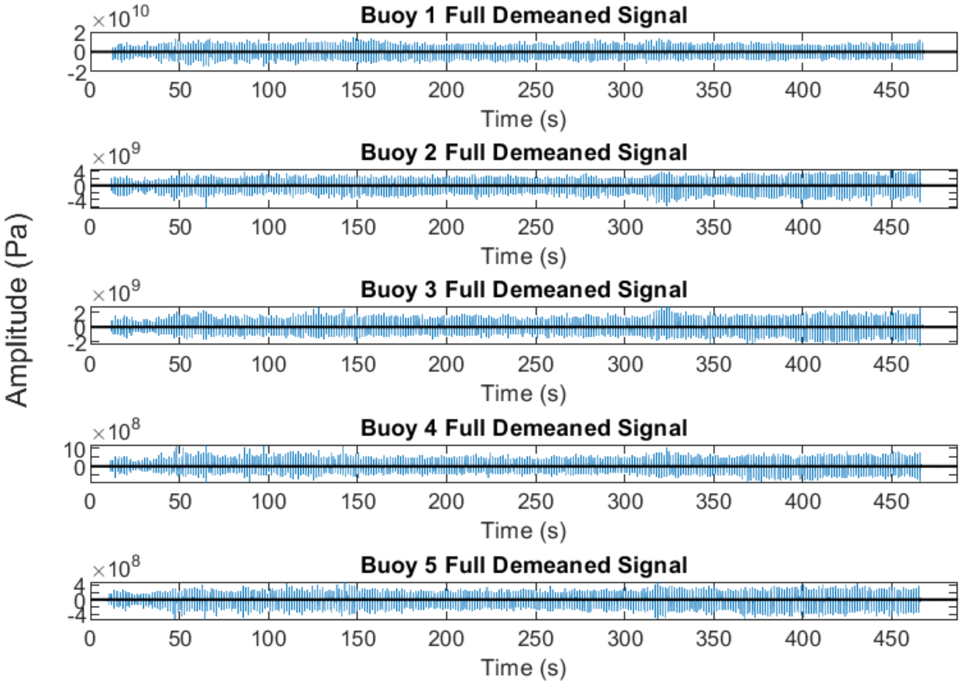
Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)
×10^9
×10^8

HF - 26

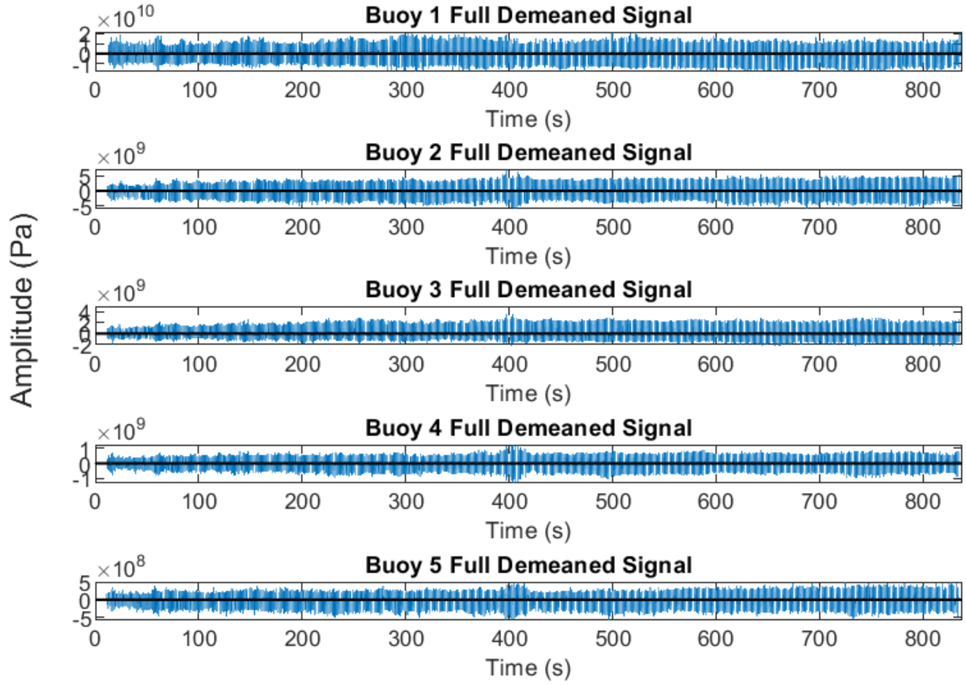


Amplitude (Pa)
×10^9
Buoy 2 Full Demeaned Signal
5
0
-5
0
50
100
150
200
Time (s)
×10^9
Buoy 3 Full Demeaned Signal
2
0
-2
0
50
100
150
200
Time (s)
×10^9
Buoy 4 Full Demeaned Signal
1
0
-1
0
50
100
150
200
Time (s)
×10^8
Buoy 5 Full Demeaned Signal
5
0
-5
0
50
100
150
200
Time (s)

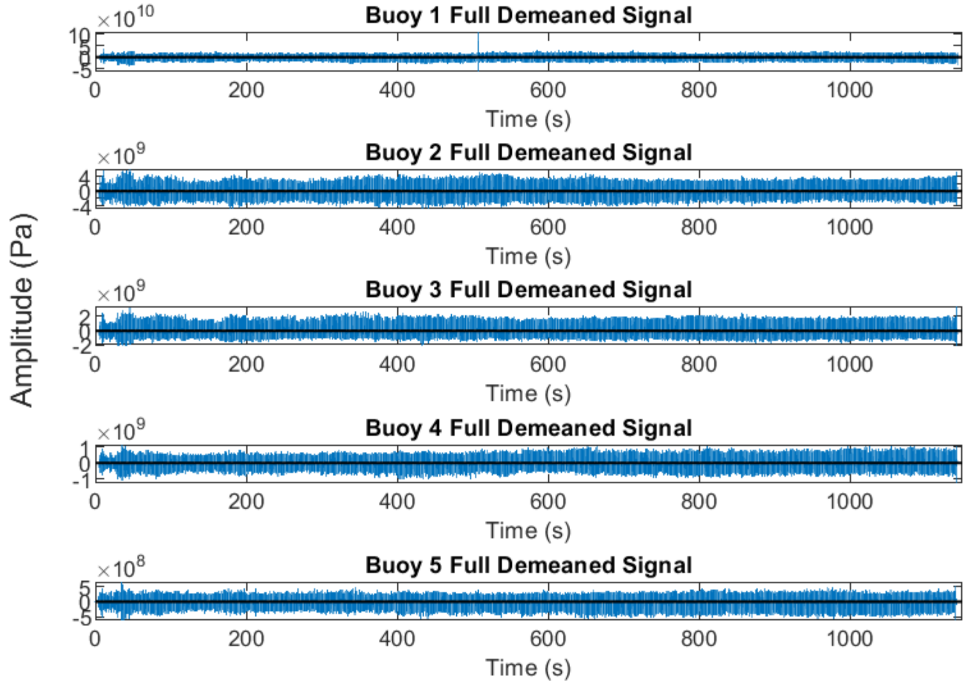
HF-27


Buoy 1 Full Demeaned Signal
Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)

HF-28

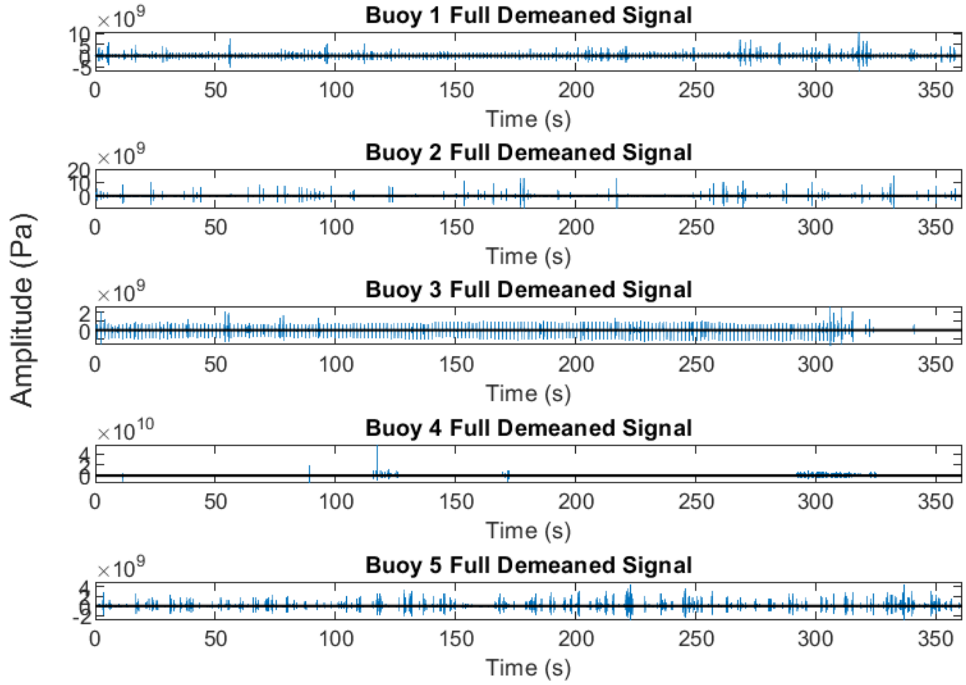

Buoy 1 Full Demeaned Signal
Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)

HF-29

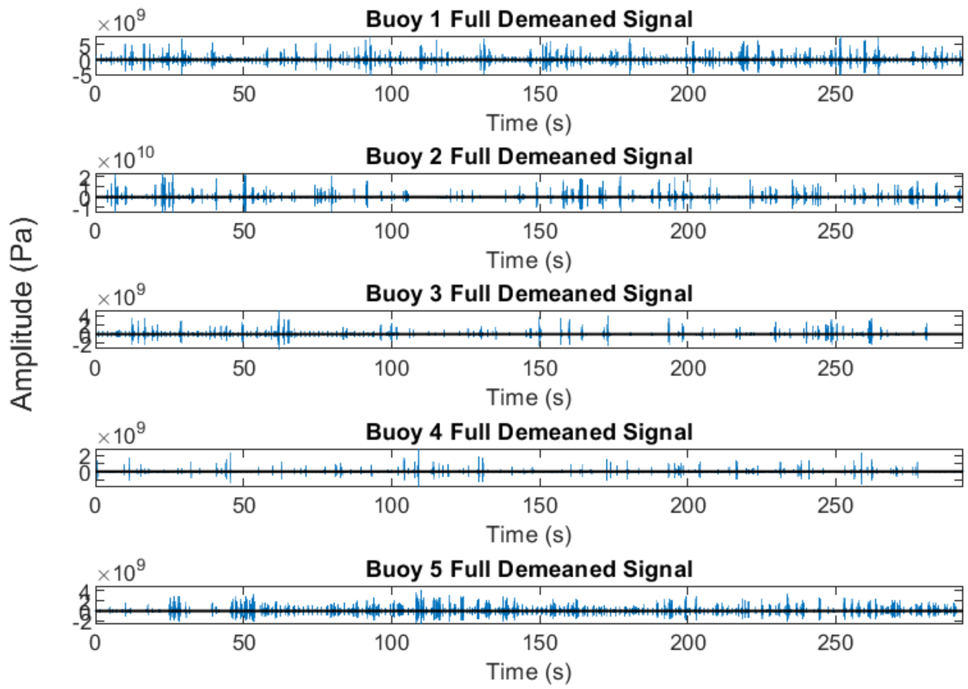


×10^10
Buoy 1 Full Demeaned Signal
10
5
0
-5
0
200
400
600
800
1000
Time (s)
×10^9
Buoy 2 Full Demeaned Signal
4
0
-4
Time (s)
×10^9
Buoy 3 Full Demeaned Signal
2
0
-2
Time (s)
×10^9
Buoy 4 Full Demeaned Signal
1
0
-1
Time (s)
×10^8
Buoy 5 Full Demeaned Signal
5
0
-5
Time (s)
Amplitude (Pa)

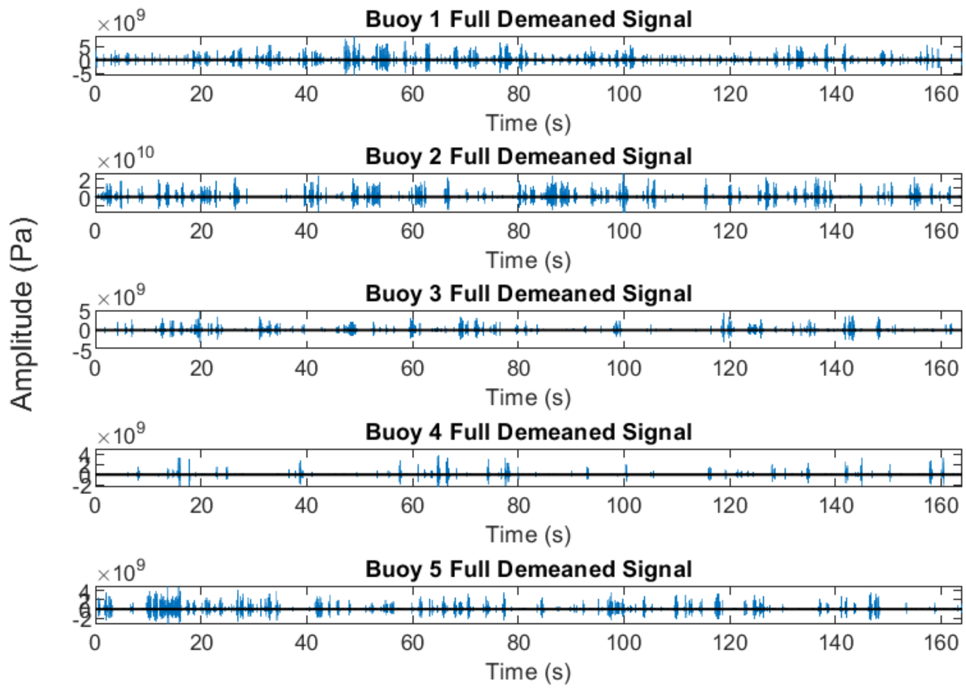
HF-30


Buoy 1 Full Demeaned Signal
Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)

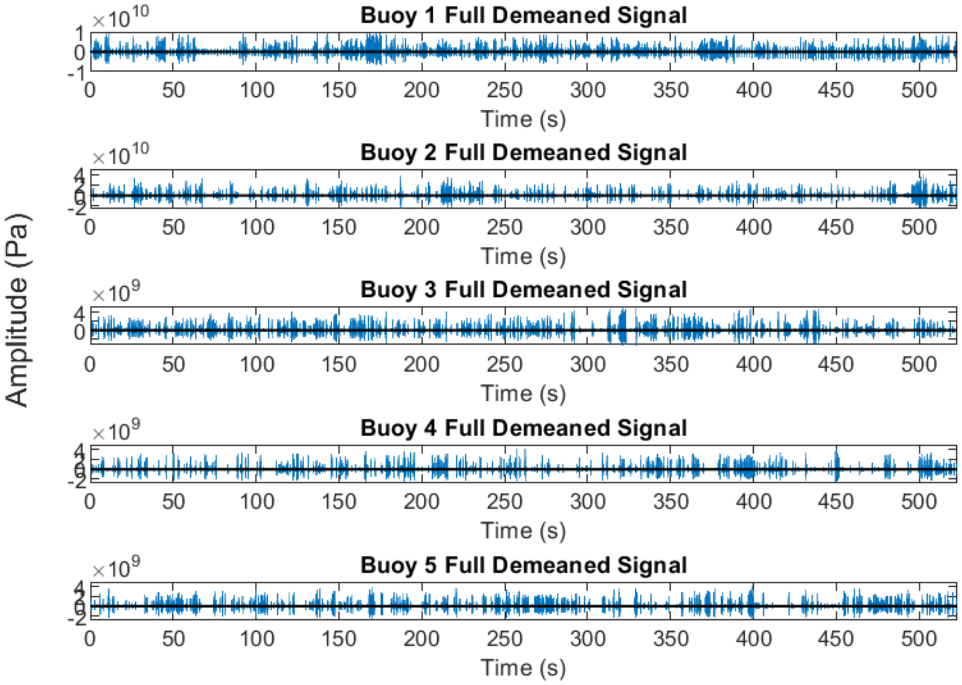
HF-31


Buoy 1 Full Demeaned Signal
Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)

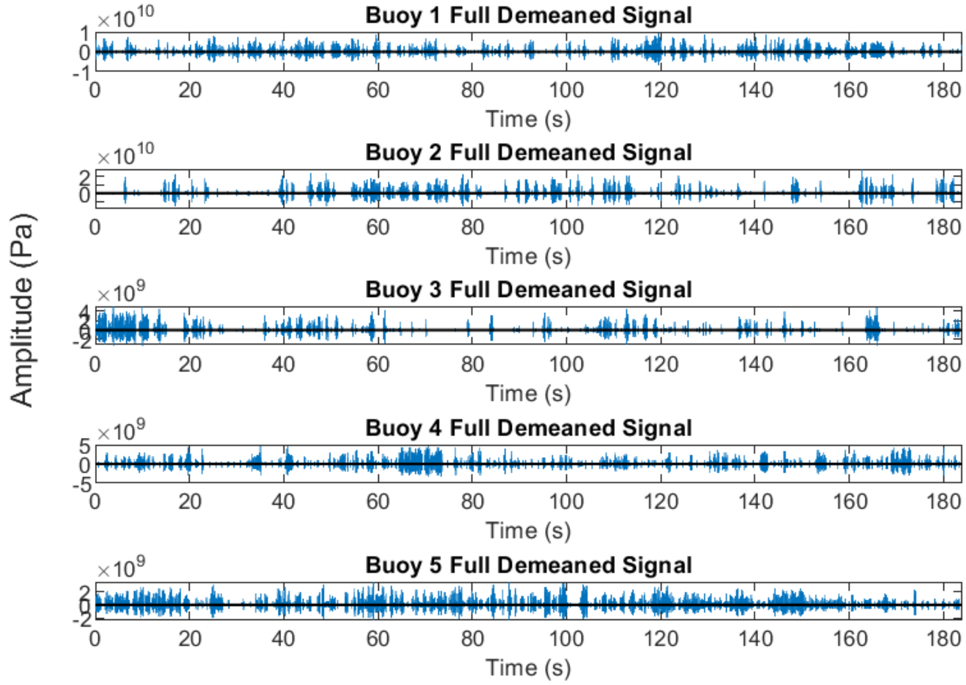
HF-32


Buoy 1 Full Demeaned Signal
Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)

HF-33

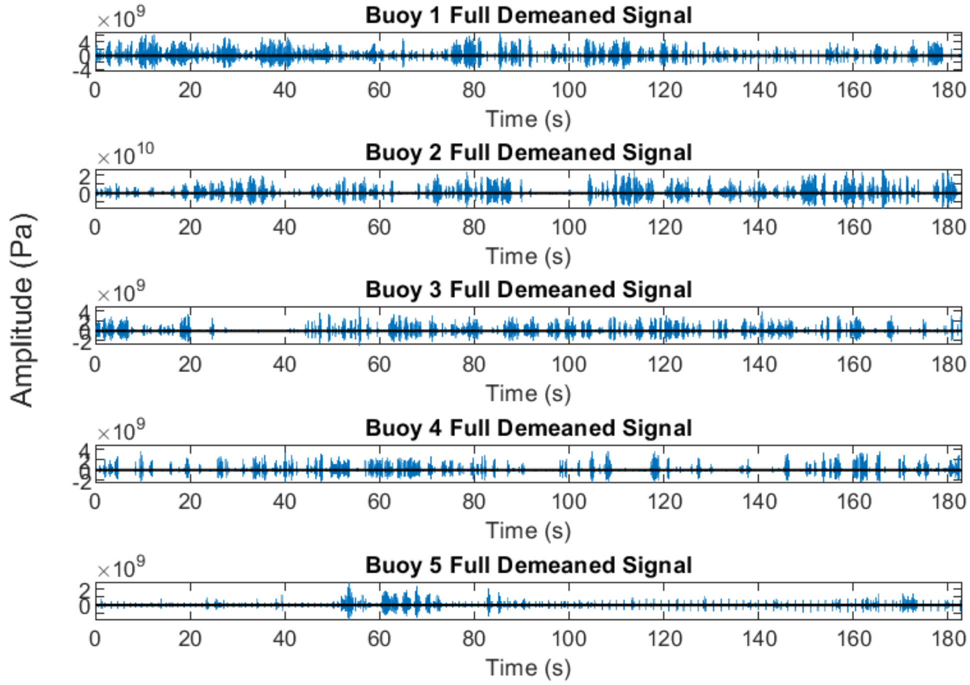

Buoy 1 Full Demeaned Signal
Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)

HF-34



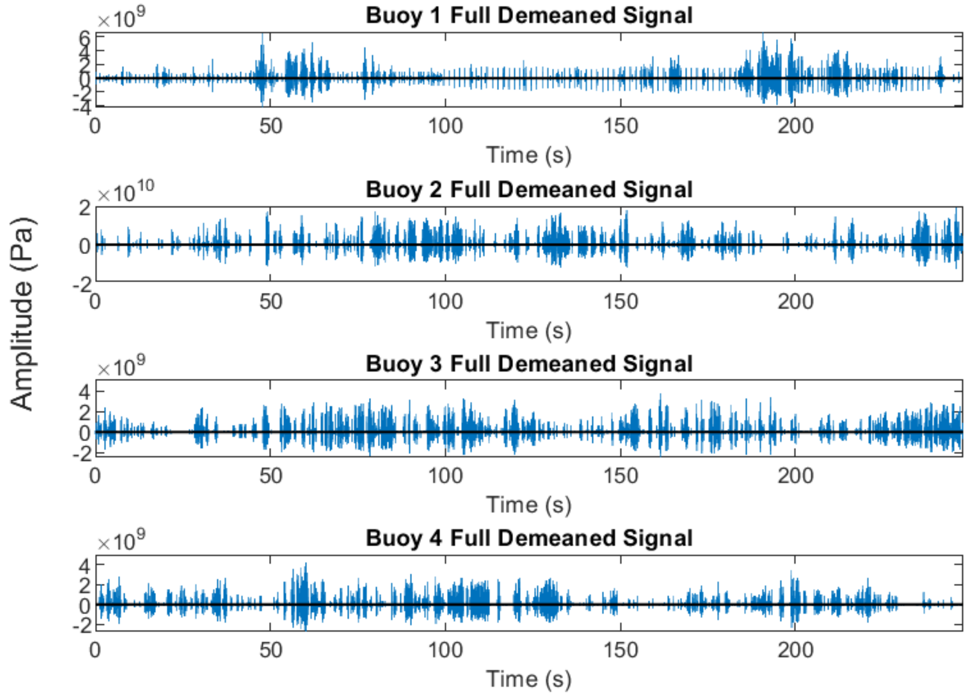
Buoy 1 Full Demeaned Signal
Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)

HF-35

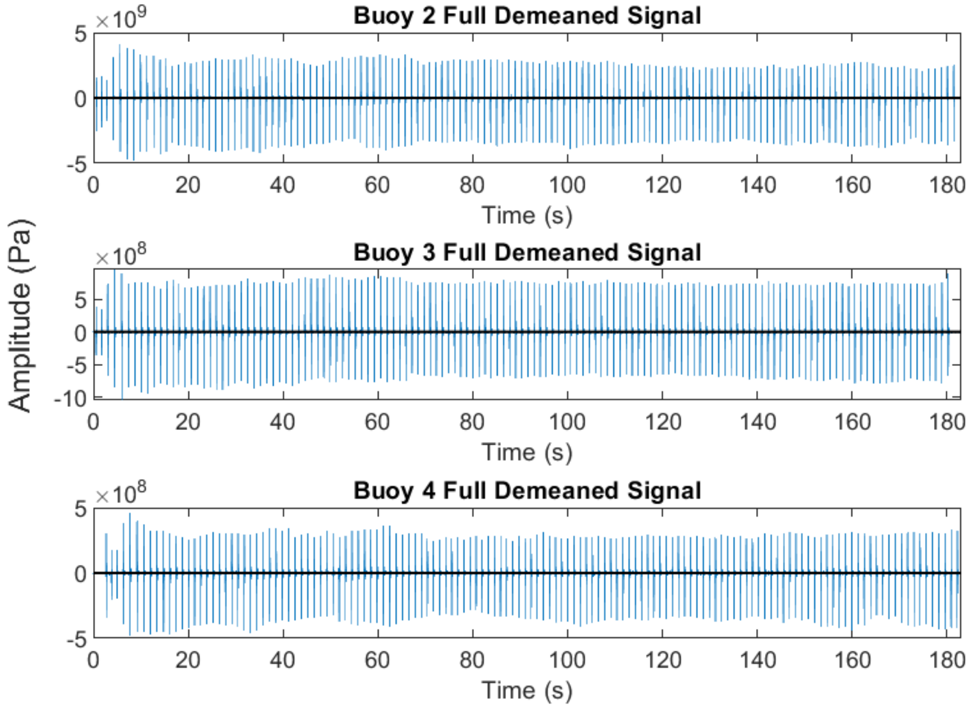


Buoy 1 Full Demeaned Signal
Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)

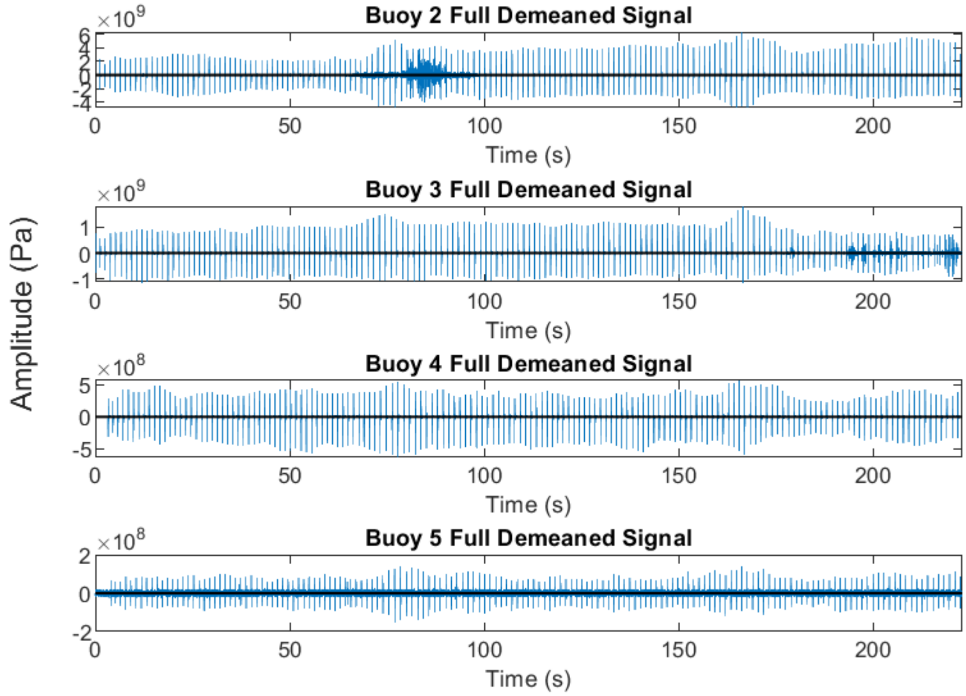
HF - 36


Buoy 1 Full Demeaned Signal
$\times 10^9$
6
4
2
0
-2
-4
0
50
100
150
200
Time (s)
Buoy 2 Full Demeaned Signal
$\times 10^{10}$
2
0
-2
Time (s)
Buoy 3 Full Demeaned Signal
$\times 10^9$
4
2
0
-2
Time (s)
Buoy 4 Full Demeaned Signal
$\times 10^9$
Time (s)
Amplitude (Pa)

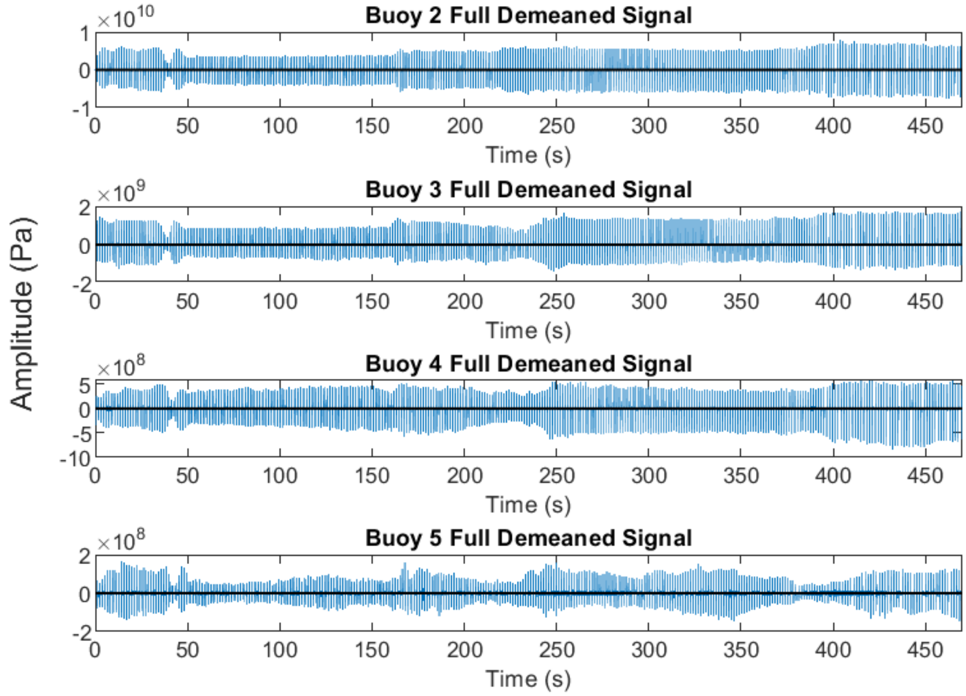
HF - 37


Buoy 2 Full Demeaned Signal
×10^9
5
0
-5
0
20
40
60
80
100
120
140
160
180
Time (s)
Amplitude (Pa)
Buoy 3 Full Demeaned Signal
×10^8
5
0
-5
-10
0
20
40
60
80
100
120
140
160
180
Time (s)
Buoy 4 Full Demeaned Signal
×10^8
5
0
-5
0
20
40
60
80
100
120
140
160
180
Time (s)

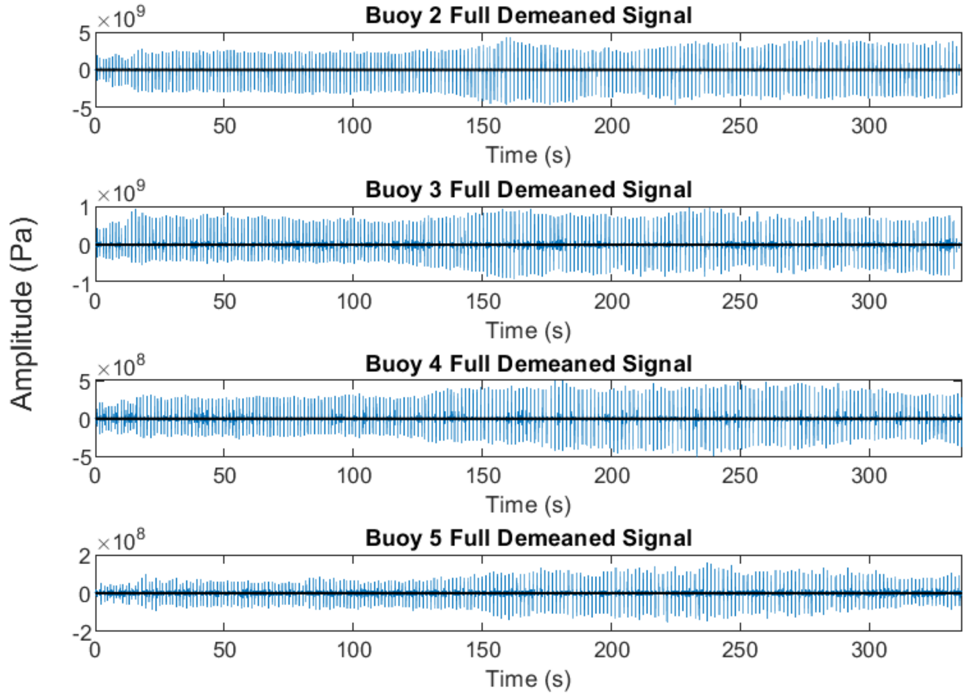
HF-38


Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)

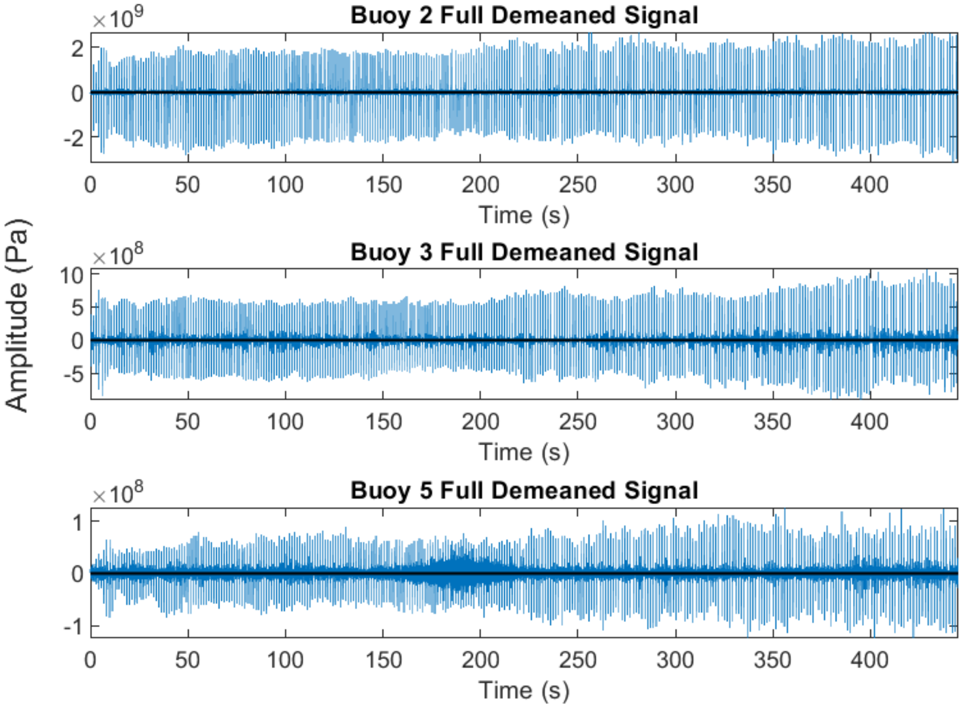
HF-39


Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)
×10^10
×10^9
×10^8
0
50
100
150
200
250
300
350
400
450

HF-40

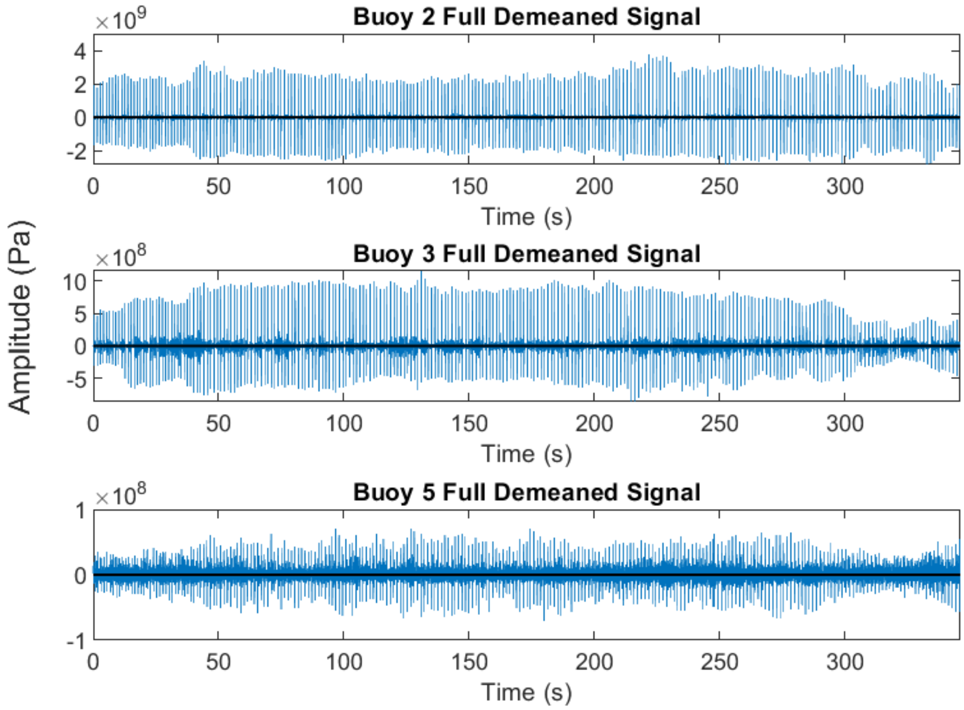

Buoy 2 Full Demeaned Signal
Buoy 3 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)
×10^9
×10^8

HF-41



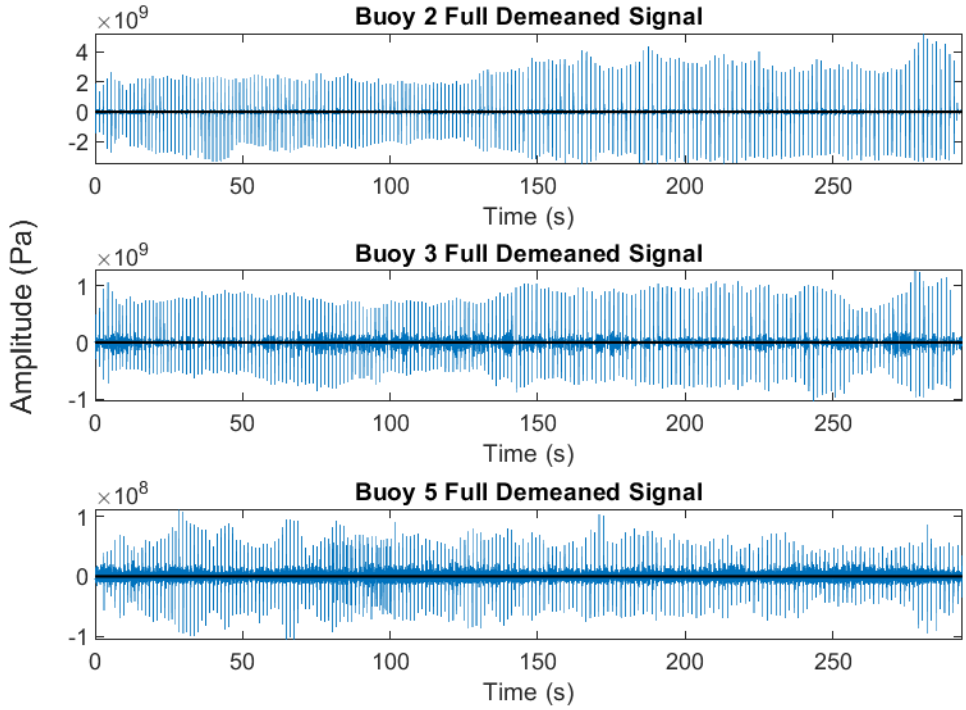
Amplitude (Pa)
Buoy 2 Full Demeaned Signal
×10^9
2
0
-2
0
50
100
150
200
250
300
350
400
Time (s)
Buoy 3 Full Demeaned Signal
×10^8
10
5
0
-5
0
50
100
150
200
250
300
350
400
Time (s)
Buoy 5 Full Demeaned Signal
×10^8
1
0
-1
0
50
100
150
200
250
300
350
400
Time (s)

HF-42

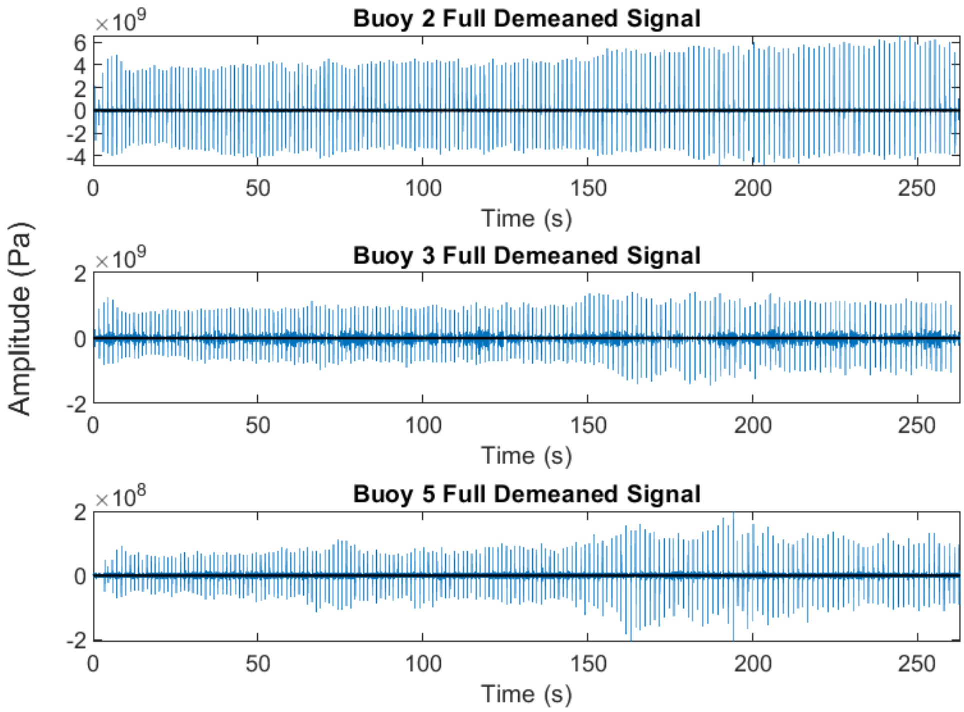


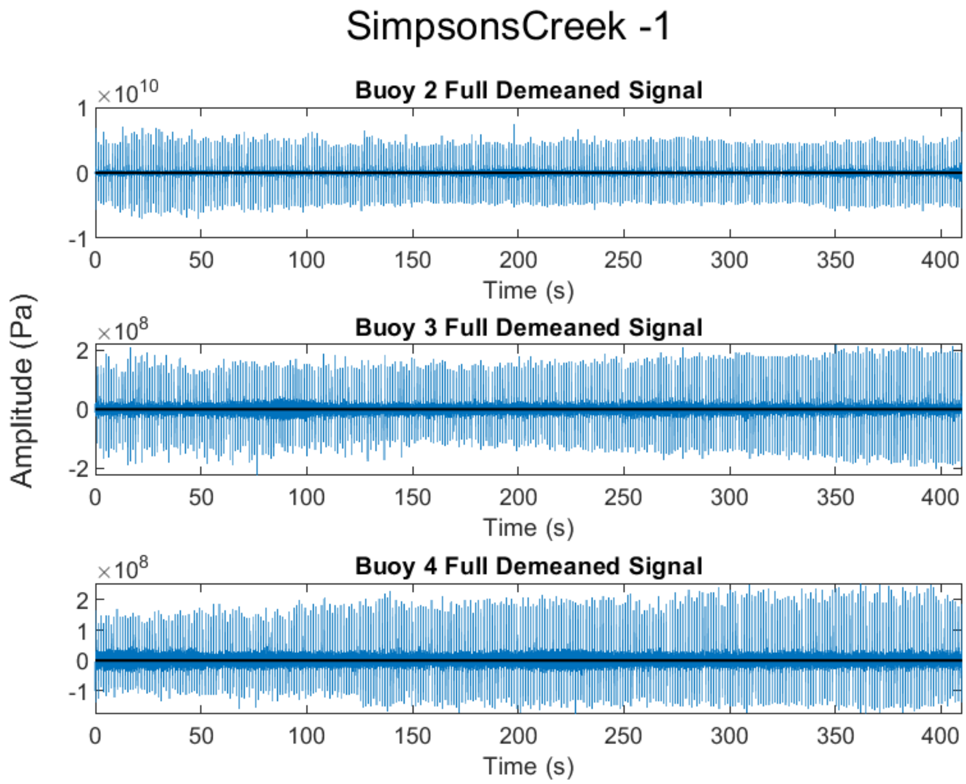
Buoy 2 Full Demeaned Signal
×10^9
4
2
0
-2
0
50
100
150
200
250
300
Time (s)
Amplitude (Pa)
Buoy 3 Full Demeaned Signal
×10^8
10
5
0
-5
Time (s)
Buoy 5 Full Demeaned Signal
×10^8
1
0
-1
Time (s)

HF-43

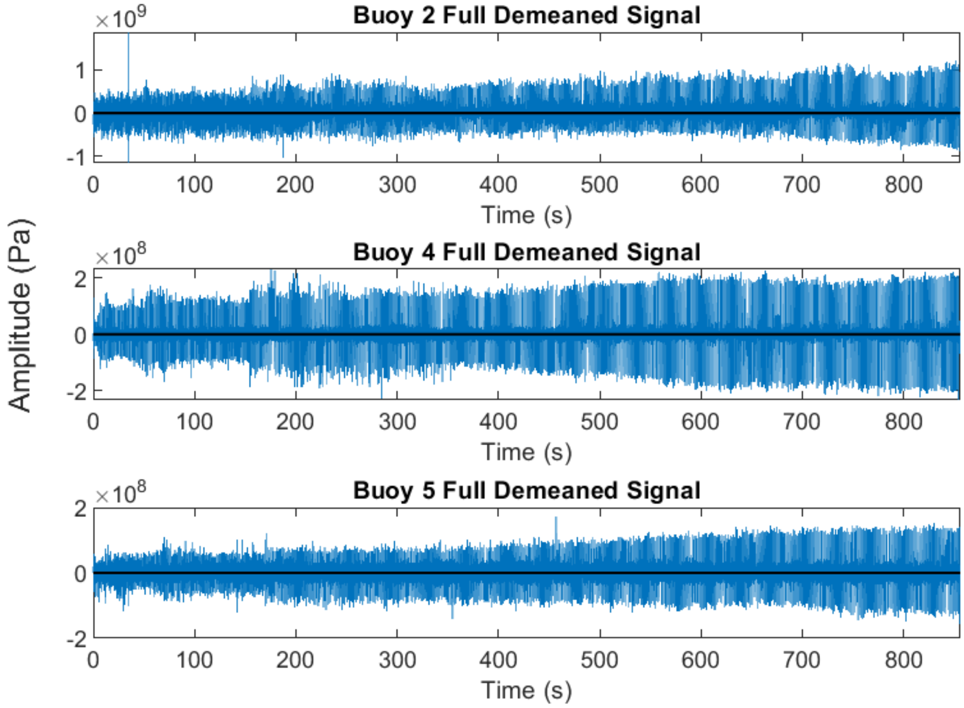

Buoy 2 Full Demeaned Signal
×10^9
4
2
0
-2
0
50
100
150
200
250
Time (s)
Amplitude (Pa)
Buoy 3 Full Demeaned Signal
×10^9
1
0
-1
0
50
100
150
200
250
Time (s)
Buoy 5 Full Demeaned Signal
×10^8
1
0
-1
0
50
100
150
200
250
Time (s)

HF-44

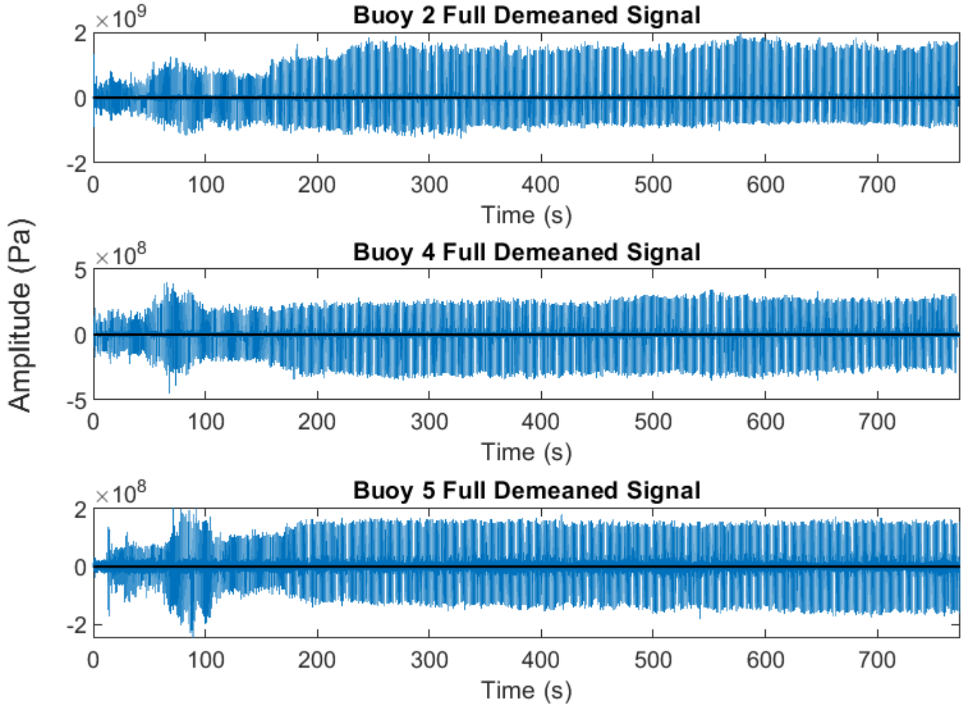

Buoy 2 Full Demeaned Signal
×10^9
6
4
2
0
-2
-4
0
50
100
150
200
250
Time (s)
Amplitude (Pa)
Buoy 3 Full Demeaned Signal
×10^9
2
0
-2
0
50
100
150
200
250
Time (s)
Buoy 5 Full Demeaned Signal
×10^8
2
0
-2
0
50
100
150
200
250
Time (s)


SimpsonsCreek -1
Buoy 2 Full Demeaned Signal
×10^10
1
0
-1
0
50
100
150
200
250
300
350
400
Time (s)
Amplitude (Pa)
Buoy 3 Full Demeaned Signal
×10^8
2
0
-2
0
50
100
150
200
250
300
350
400
Time (s)
Buoy 4 Full Demeaned Signal
×10^8
2
1
0
-1
0
50
100
150
200
250
300
350
400
Time (s)

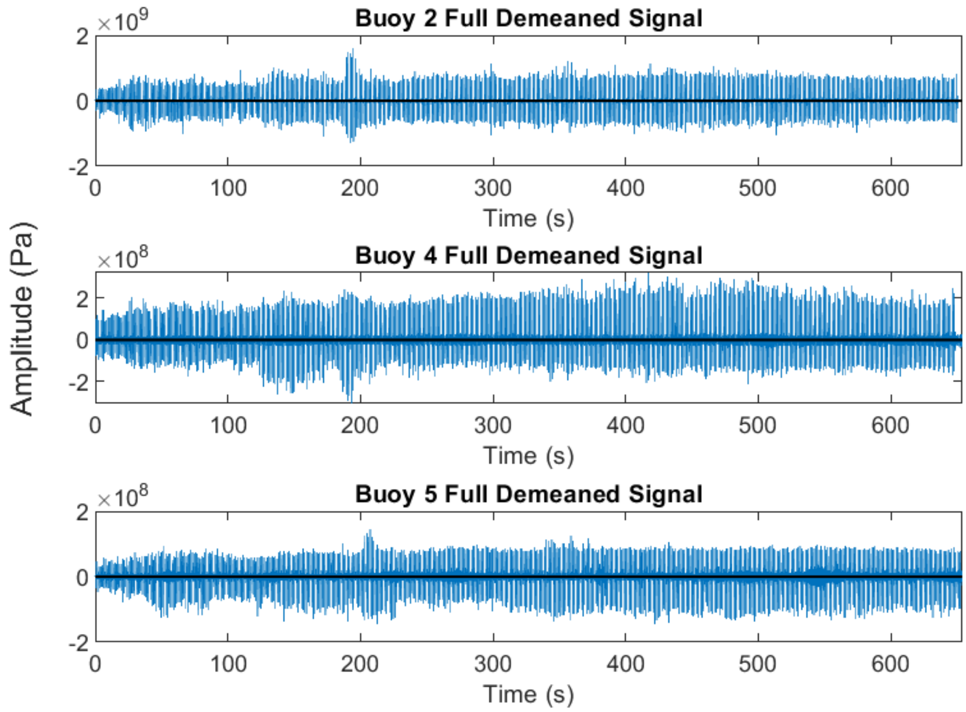
Loxahatchee -1

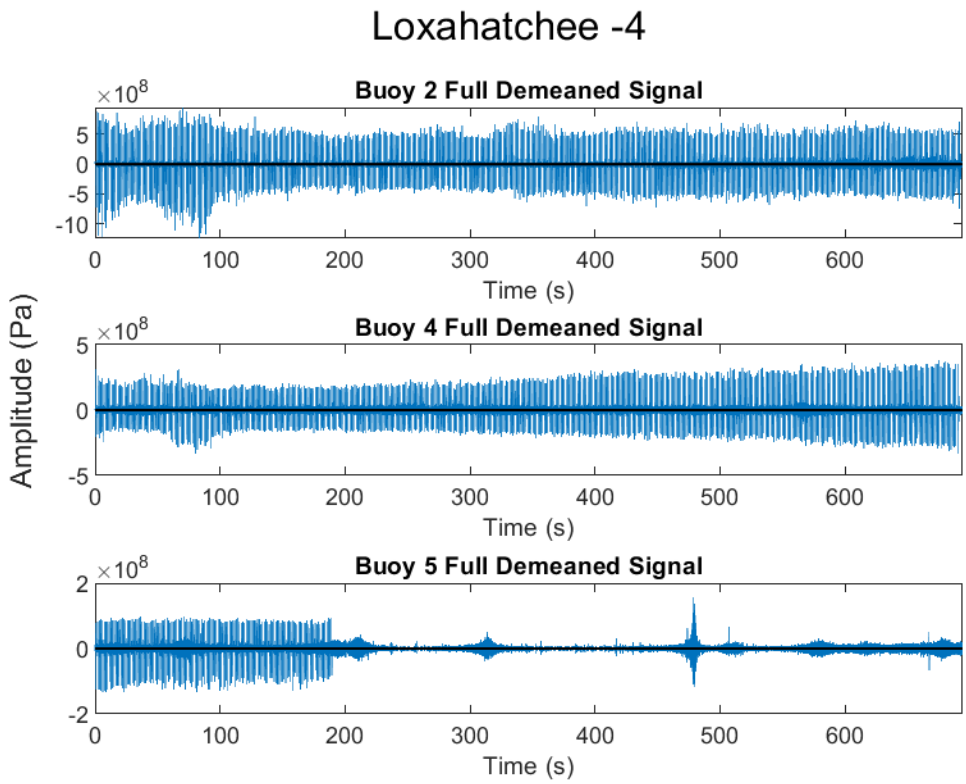


Loxahatchee -2

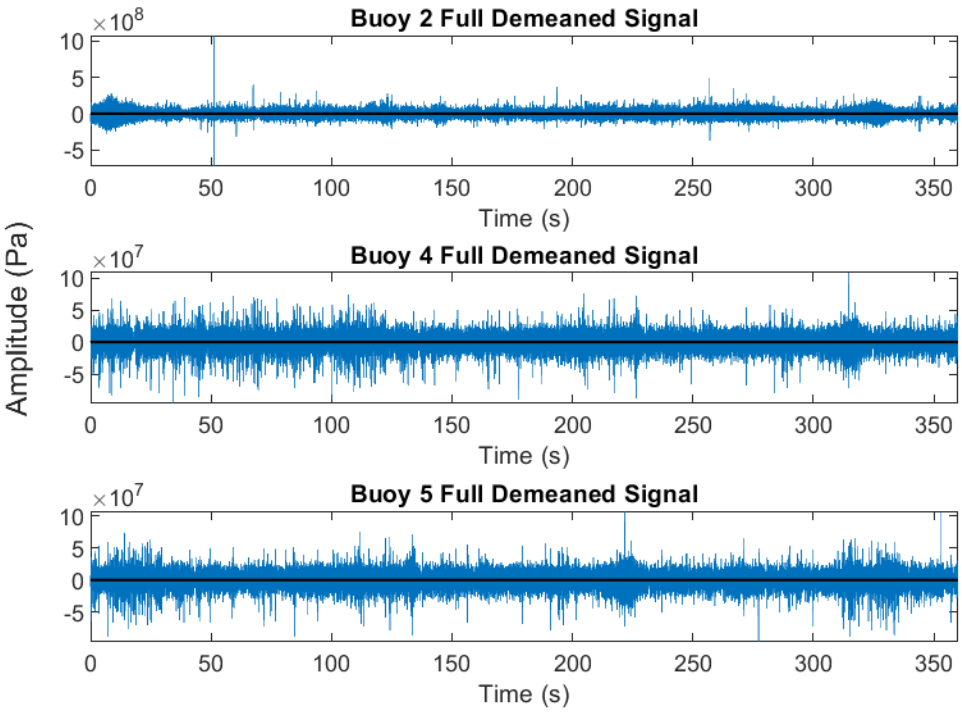


Loxahatchee -3

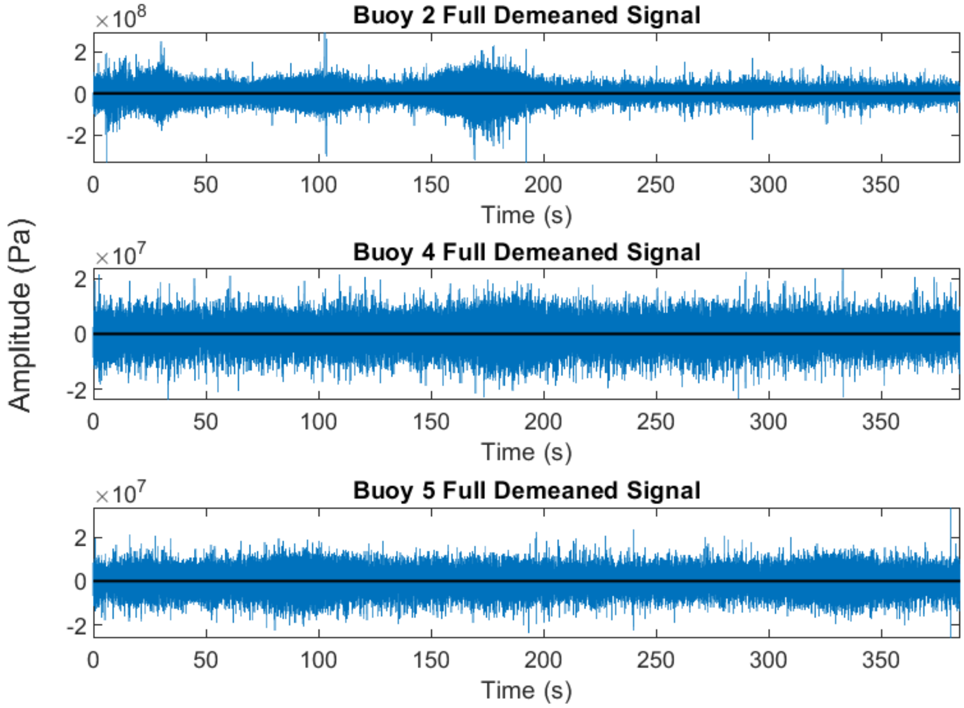



Loxahatchee -4
Buoy 2 Full Demeaned Signal
×10^8
5
0
-5
-10
0
100
200
300
400
500
600
Time (s)
Amplitude (Pa)
Buoy 4 Full Demeaned Signal
×10^8
5
0
-5
0
100
200
300
400
500
600
Time (s)
Buoy 5 Full Demeaned Signal
×10^8
2
0
-2
0
100
200
300
400
500
600
Time (s)

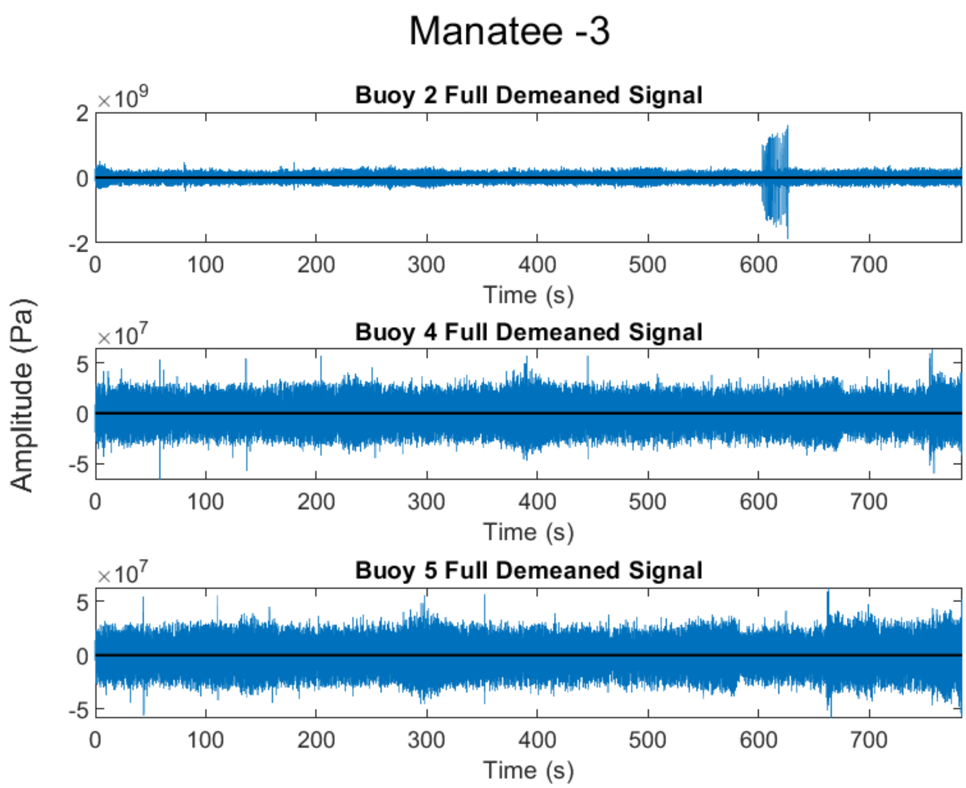
Manatee -1


Buoy 2 Full Demeaned Signal
×10^8
10
5
0
-5
0
50
100
150
200
250
300
350
Time (s)
Amplitude (Pa)
Buoy 4 Full Demeaned Signal
×10^7
Buoy 5 Full Demeaned Signal
×10^7

Manatee -2

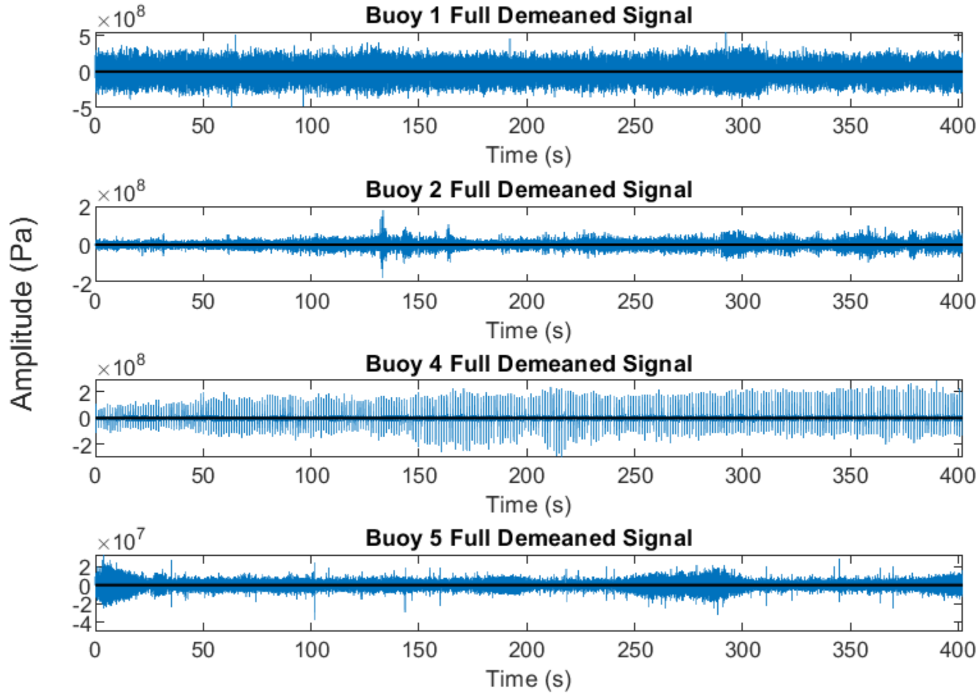


Buoy 2 Full Demeaned Signal
×10^8
2
0
-2
0
50
100
150
200
250
300
350
Time (s)
Amplitude (Pa)
Buoy 4 Full Demeaned Signal
×10^7
Buoy 5 Full Demeaned Signal
×10^7

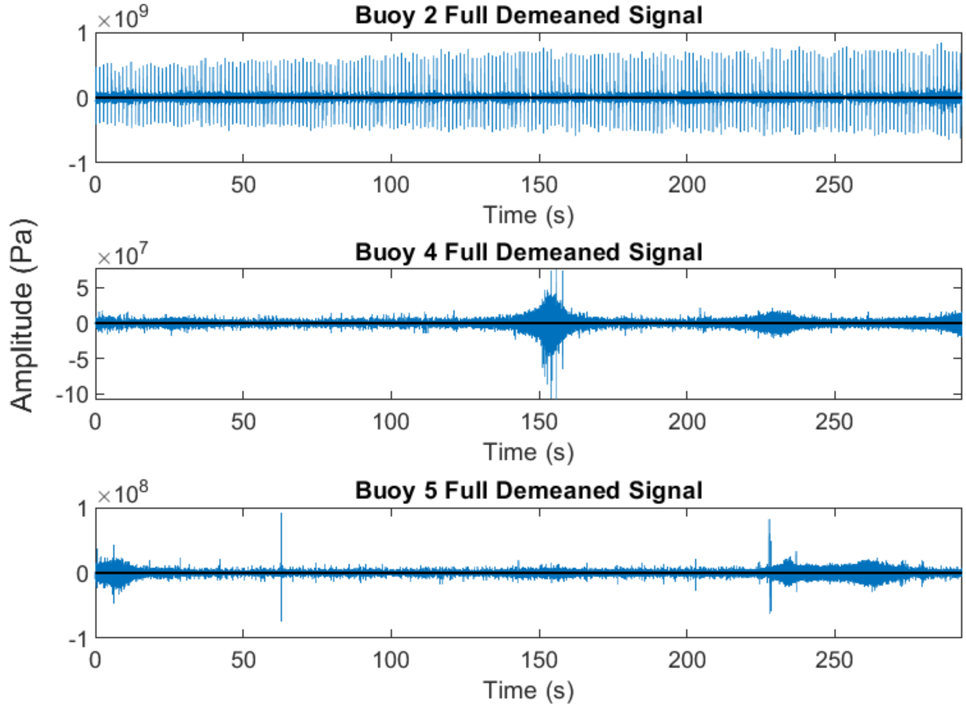


Manatee -3
Buoy 2 Full Demeaned Signal
×10^9
2
0
-2
0
100
200
300
400
500
600
700
Time (s)
Amplitude (Pa)
Buoy 4 Full Demeaned Signal
×10^7
5
0
-5
Buoy 5 Full Demeaned Signal

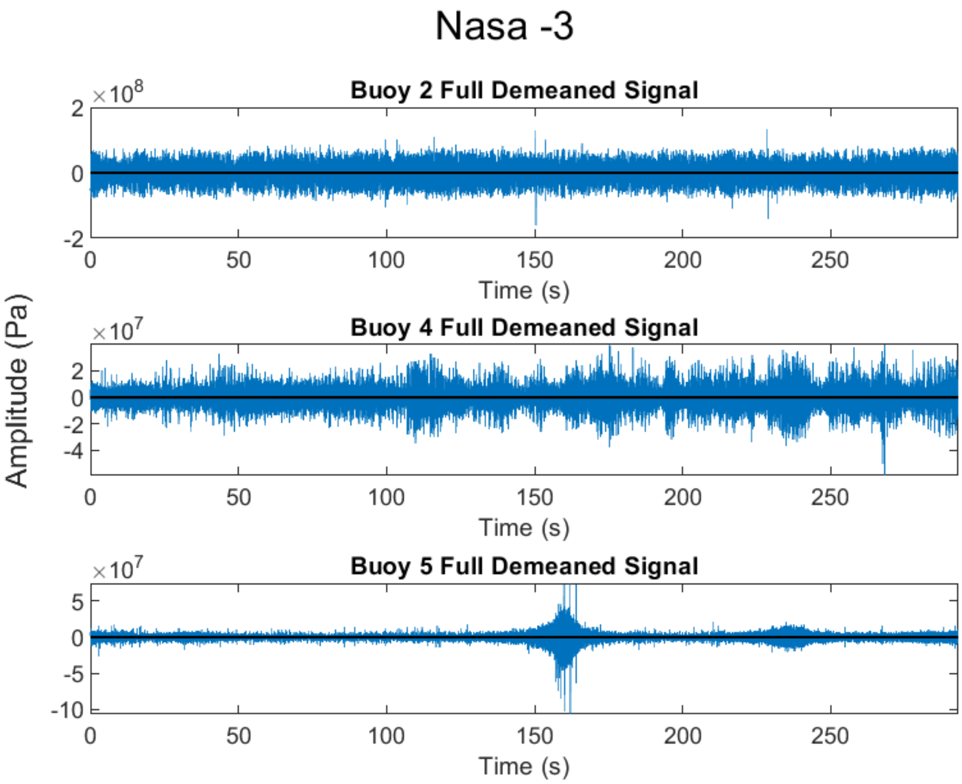
Nasa -1


Buoy 1 Full Demeaned Signal
Buoy 2 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)

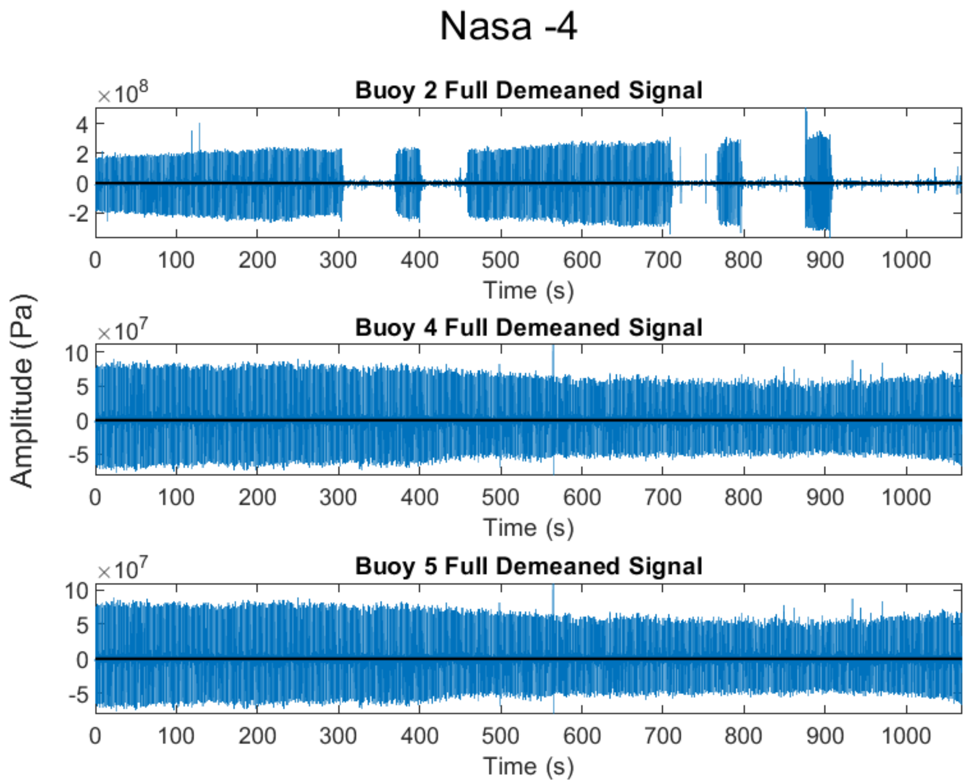
Nasa -2



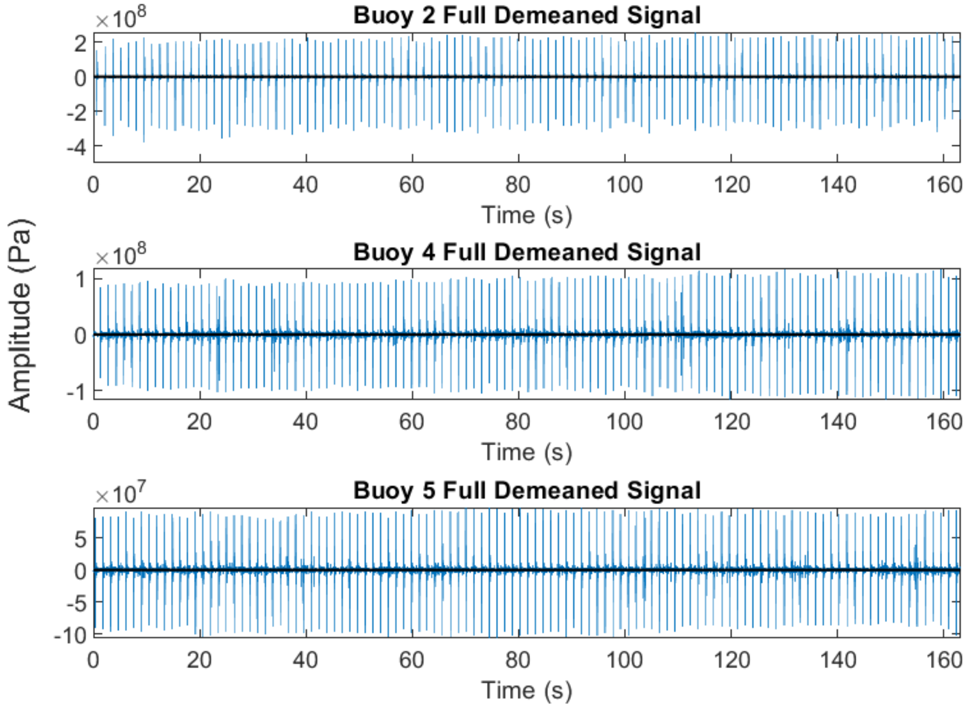
Buoy 2 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)



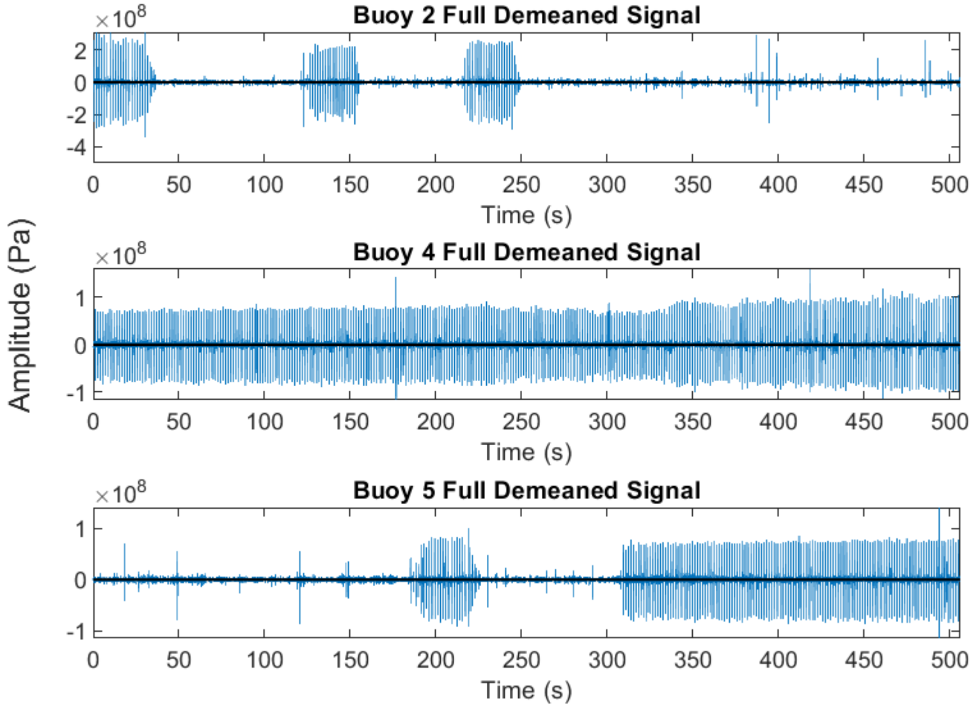
Nasa -3
Buoy 2 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)
$\times 10^8$
$\times 10^7$


Nasa -4
Buoy 2 Full Demeaned Signal
×10^8
4
2
0
-2
0
100
200
300
400
500
600
700
800
900
1000
Time (s)
Amplitude (Pa)
Buoy 4 Full Demeaned Signal
×10^7
10
5
0
-5
Time (s)
Buoy 5 Full Demeaned Signal
×10^7
10
5
0
-5
Time (s)

Nasa -5

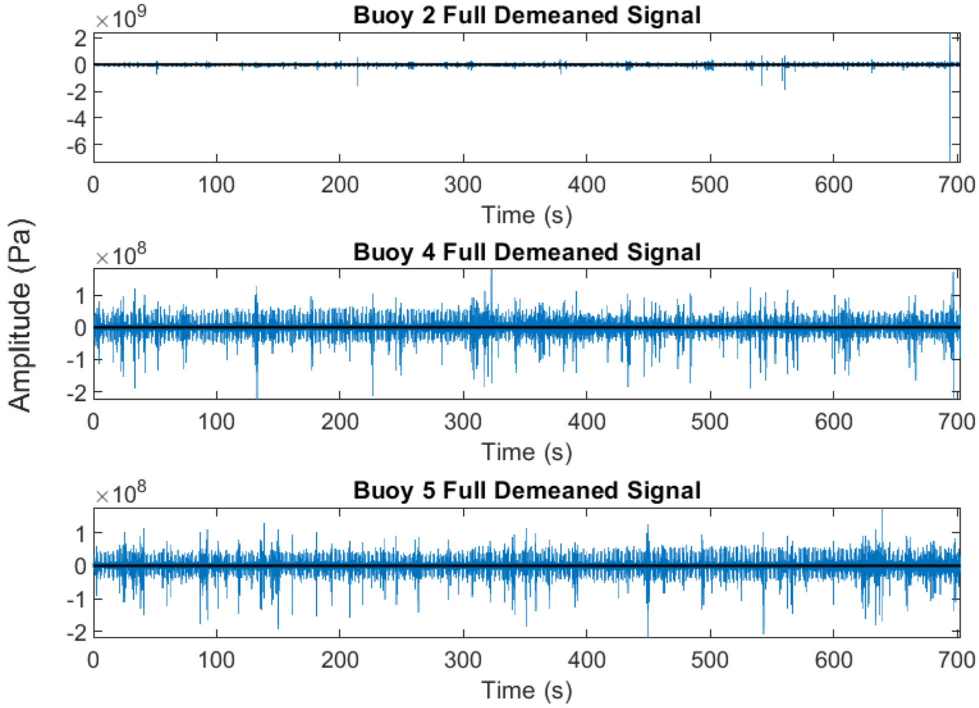

Buoy 2 Full Demeaned Signal
×10^8
2
0
-2
-4
0 20 40 60 80 100 120 140 160
Time (s)
Buoy 4 Full Demeaned Signal
×10^8
1
0
-1
0 20 40 60 80 100 120 140 160
Time (s)
Buoy 5 Full Demeaned Signal
×10^7
5
0
-5
-10
0 20 40 60 80 100 120 140 160
Time (s)
Amplitude (Pa)

Nasa -6



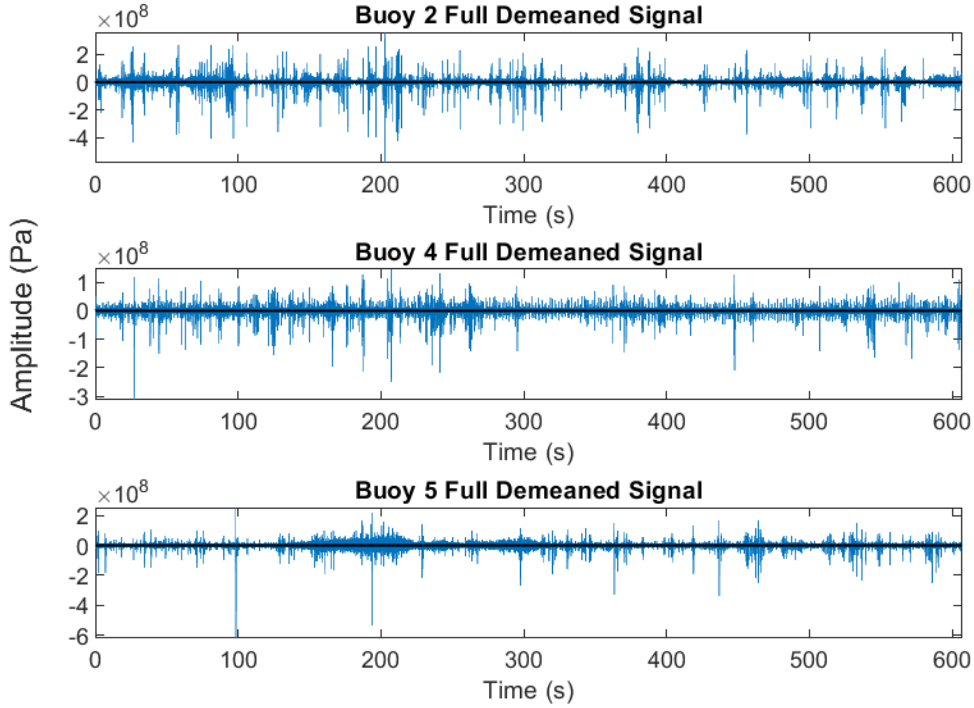
Buoy 2 Full Demeaned Signal
×10^8
2
0
-2
-4
0
50
100
150
200
250
300
350
400
450
500
Time (s)
Amplitude (Pa)
Buoy 4 Full Demeaned Signal
×10^8
1
0
-1
0
50
100
150
200
250
300
350
400
450
500
Time (s)
Buoy 5 Full Demeaned Signal
×10^8
1
0
-1
0
50
100
150
200
250
300
350
400
450
500
Time (s)

Nasa -7

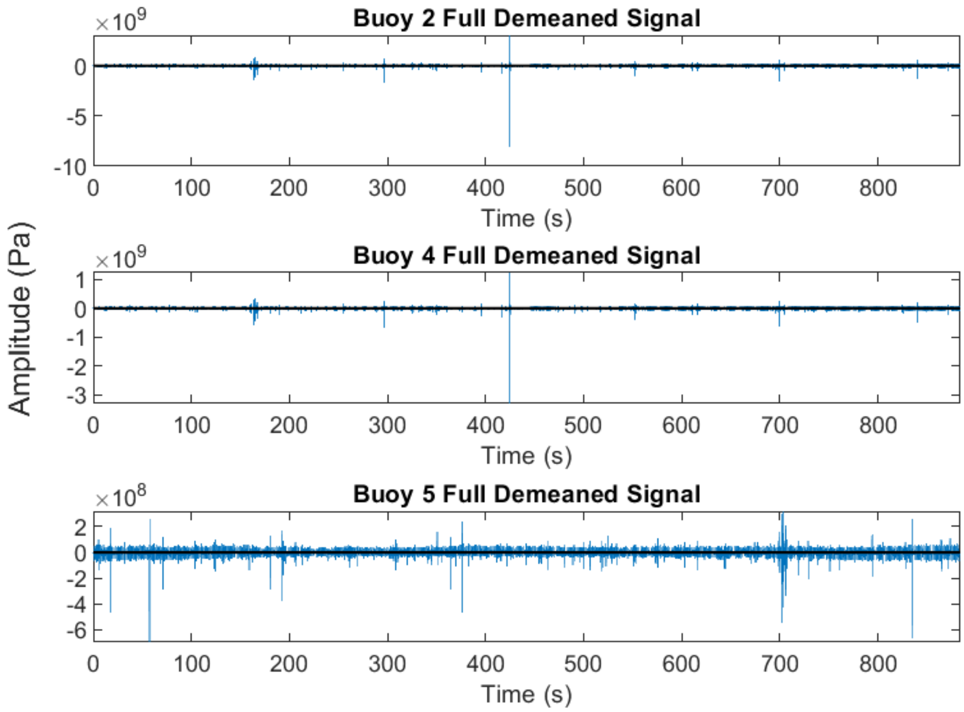


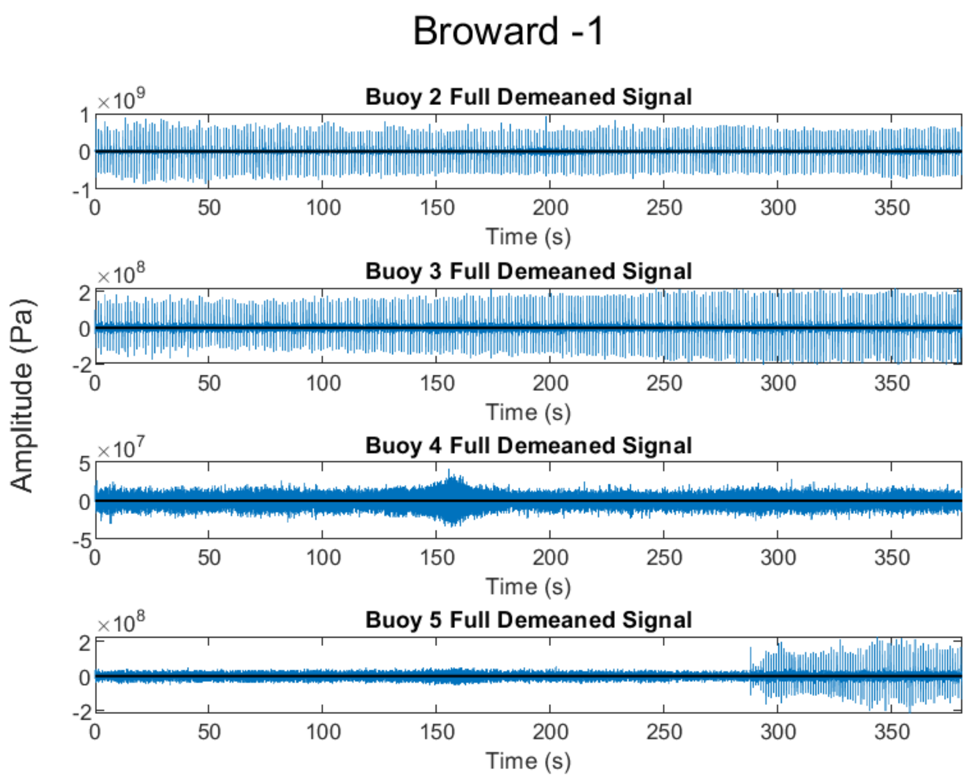
Buoy 2 Full Demeaned Signal
×10^9
2
0
-2
-4
-6
0
100
200
300
400
500
600
700
Time (s)
Amplitude (Pa)
Buoy 4 Full Demeaned Signal
×10^8
1
0
-1
-2
Time (s)
Buoy 5 Full Demeaned Signal
×10^8
1
0
-1
-2
Time (s)

Nasa -8

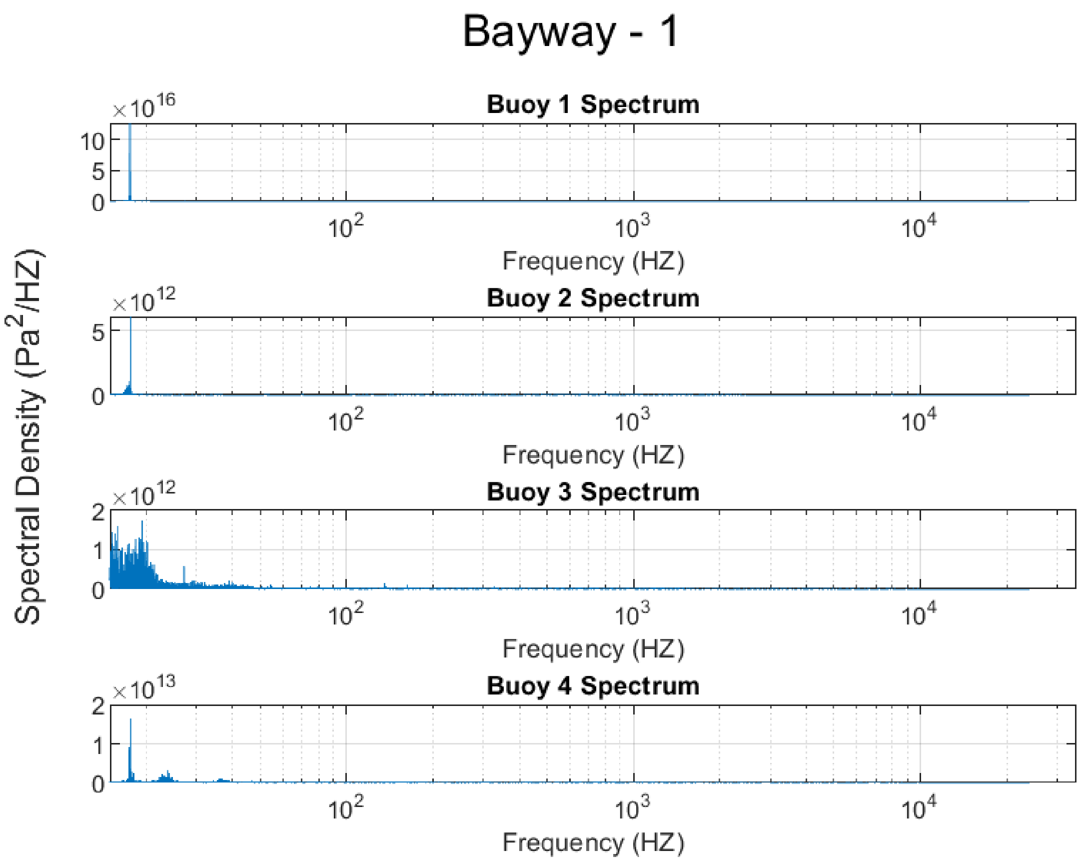

Buoy 2 Full Demeaned Signal
Buoy 4 Full Demeaned Signal
Buoy 5 Full Demeaned Signal
Amplitude (Pa)
Time (s)
×10^8

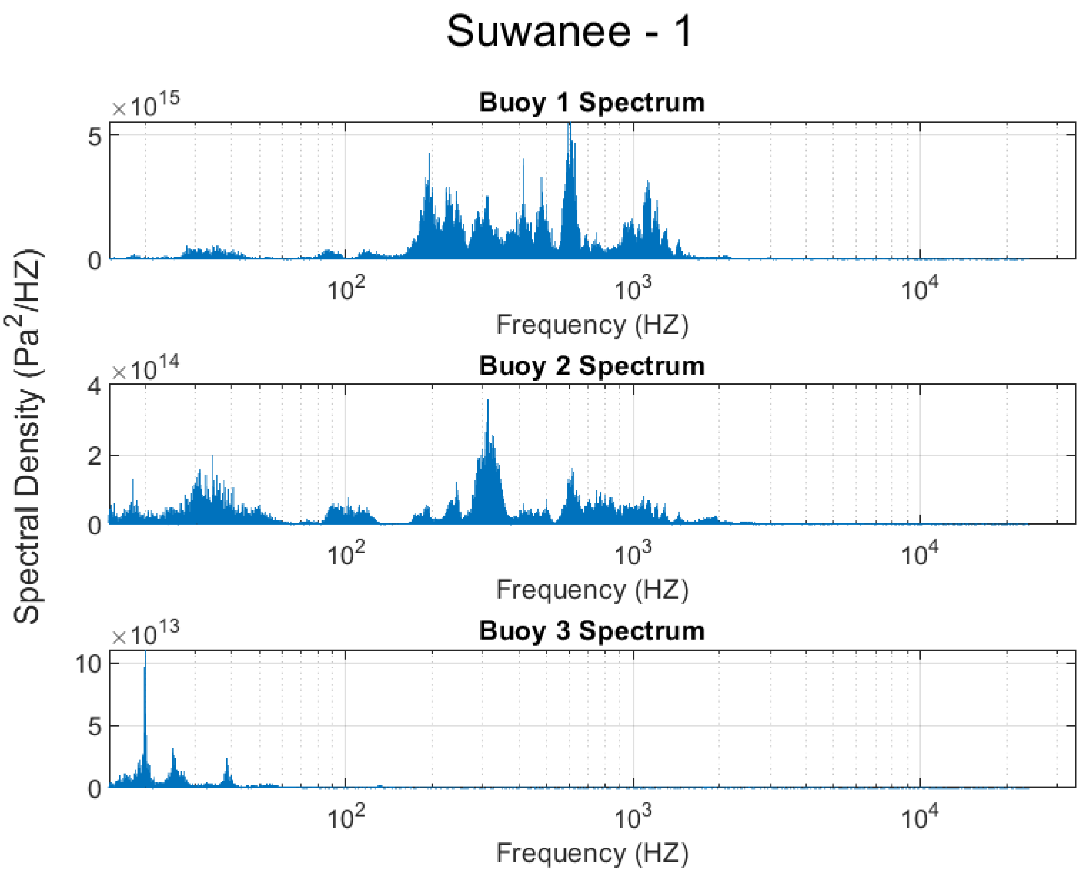
Nasa -9

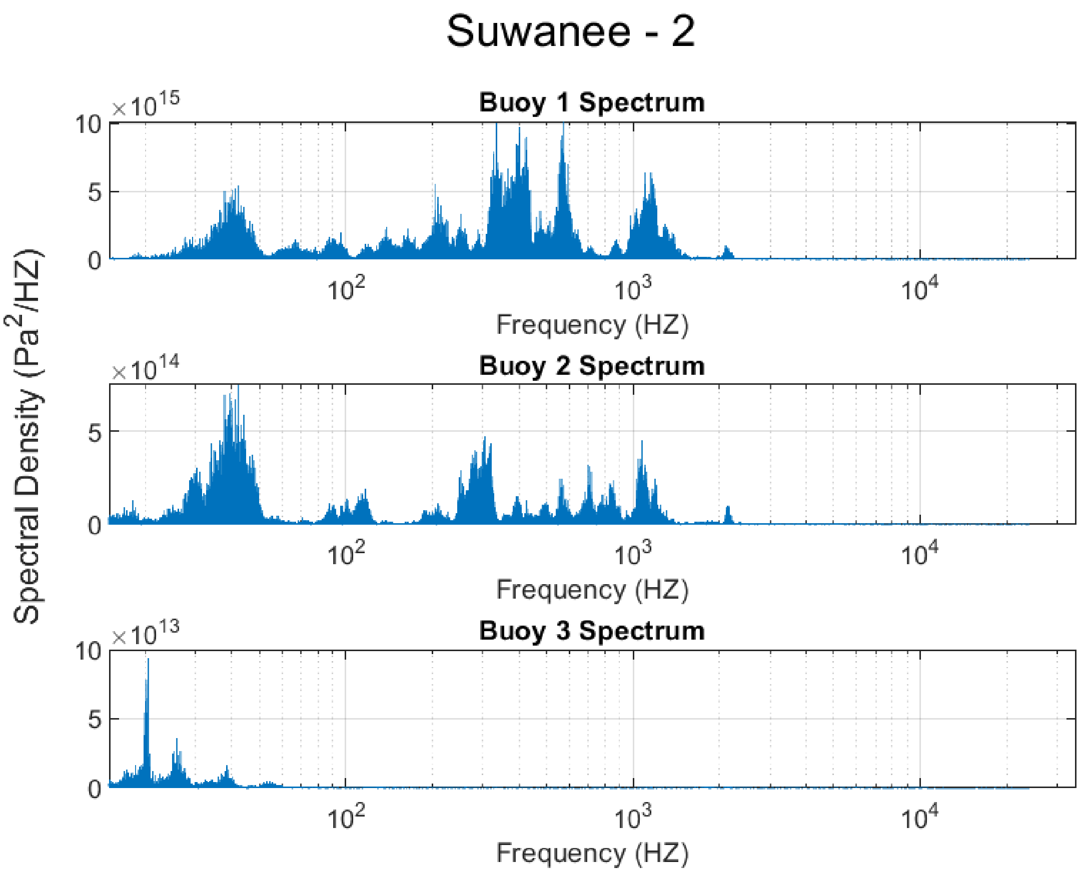

Buoy 2 Full Demeaned Signal
×10^9
0
-5
-10
0
100
200
300
400
500
600
700
800
Time (s)
Buoy 4 Full Demeaned Signal
×10^9
1
0
-1
-2
-3
Amplitude (Pa)
Buoy 5 Full Demeaned Signal
×10^8
2
0
-2
-4
-6


Broward -1
Amplitude (Pa)
Buoy 2 Full Demeaned Signal
×10^9
1
0
-1
Buoy 3 Full Demeaned Signal
×10^8
2
0
-2
Buoy 4 Full Demeaned Signal
×10^7
5
0
-5
Buoy 5 Full Demeaned Signal
×10^8
2
0
-2
0 50 100 150 200 250 300 350
Time (s)

APPENDIX E
FULL SPECTRA

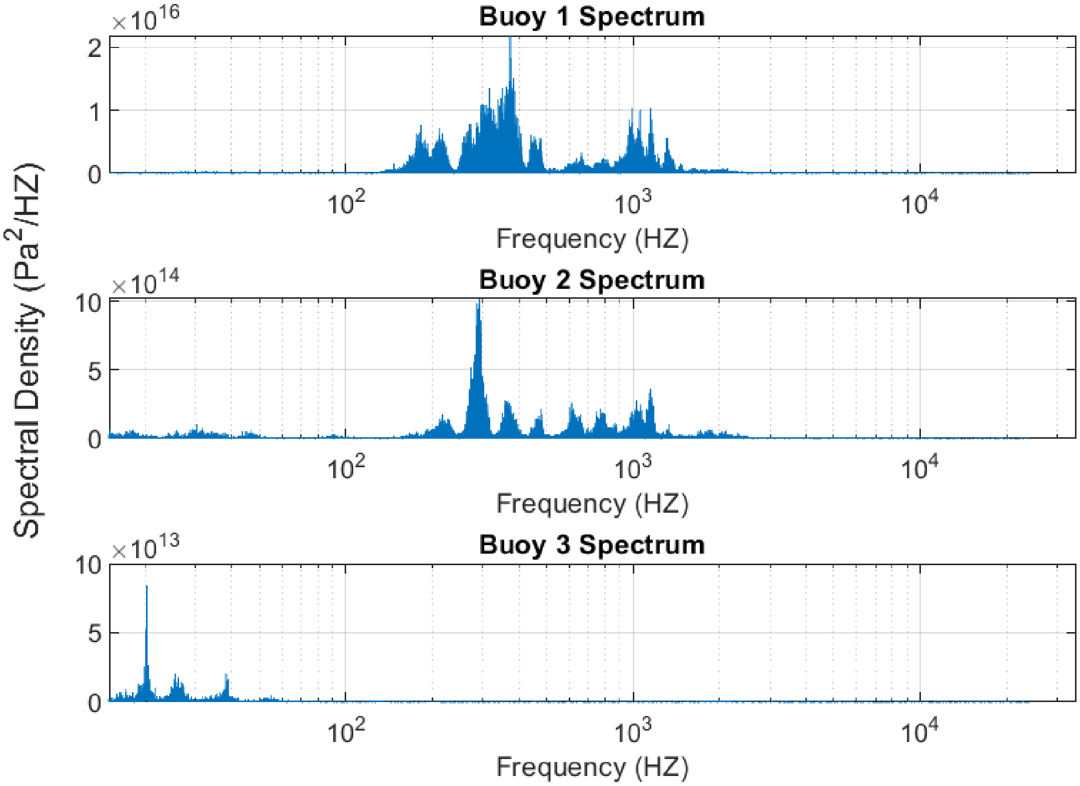

Bayway - 1
Buoy 1 Spectrum
Buoy 2 Spectrum
Buoy 3 Spectrum
Buoy 4 Spectrum
Spectral Density (Pa^2/HZ)
Frequency (HZ)
$\times 10^{16}$
$\times 10^{12}$
$\times 10^{13}$
10^2
10^3
10^4

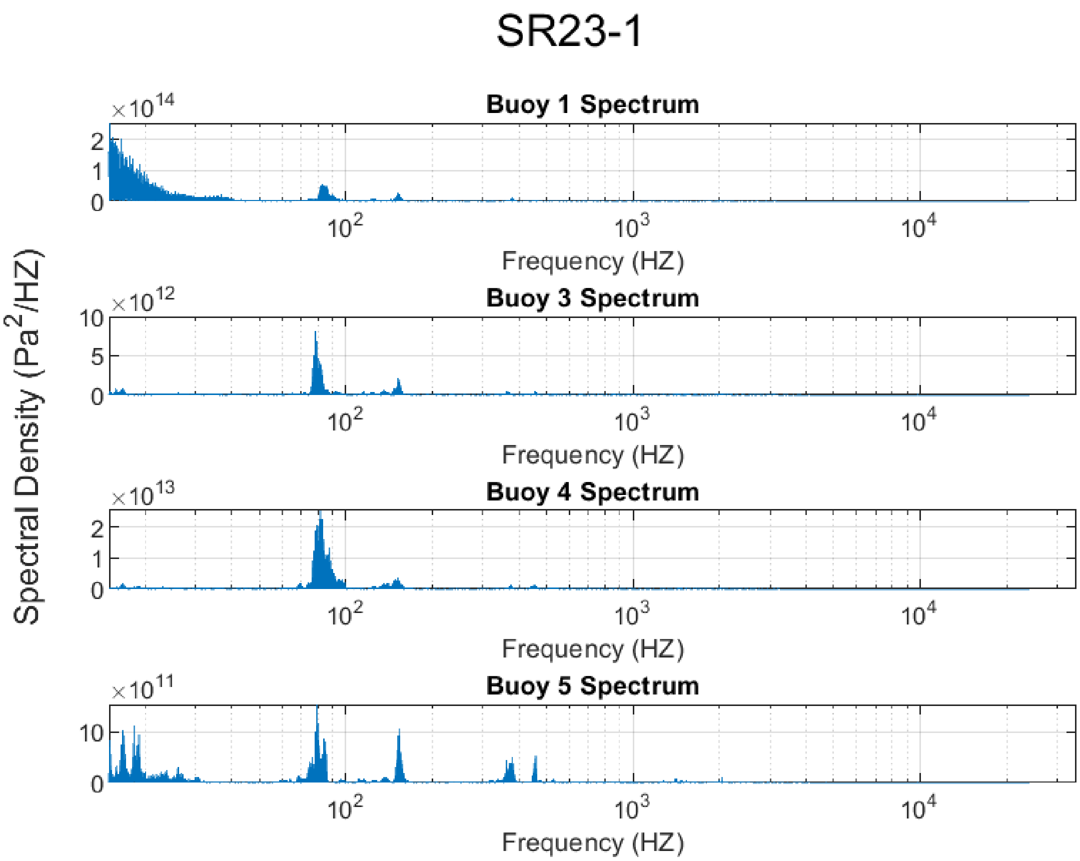

Suwanee - 1
Buoy 1 Spectrum
×10^15
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
×10^14
4
2
0
Spectral Density (Pa^2/HZ)
Buoy 3 Spectrum
×10^13
10
5
0

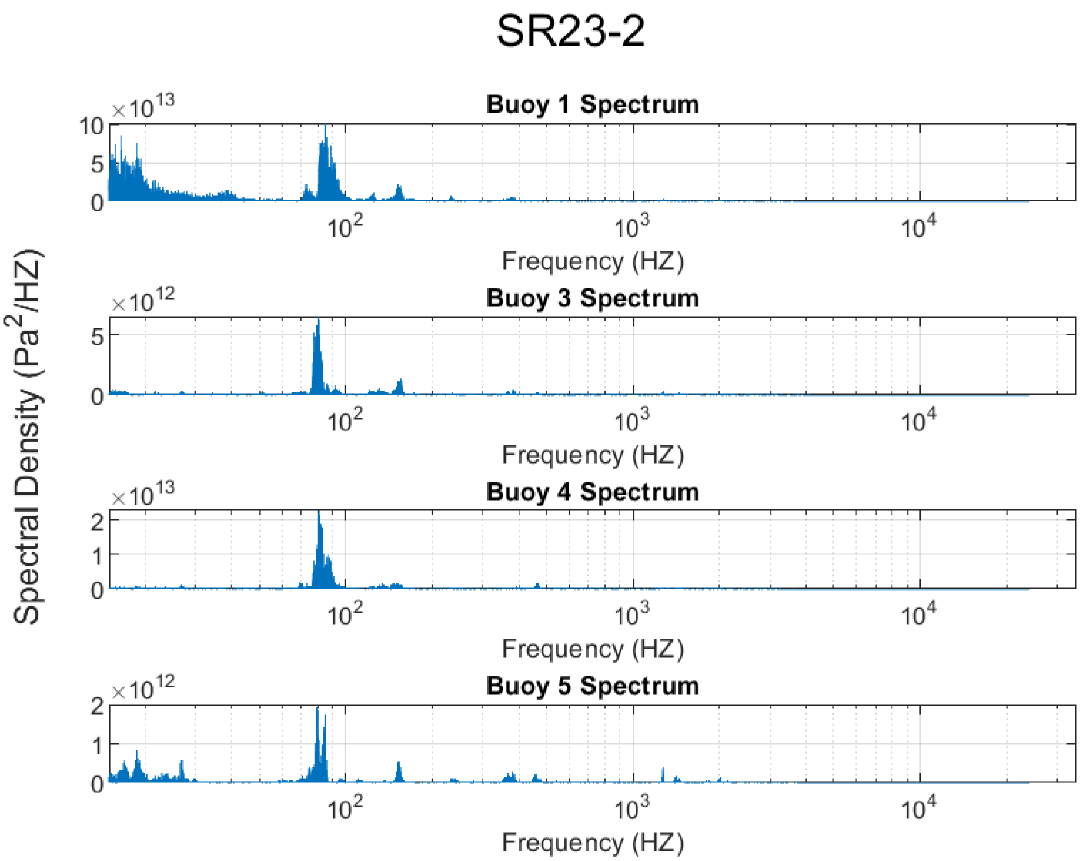


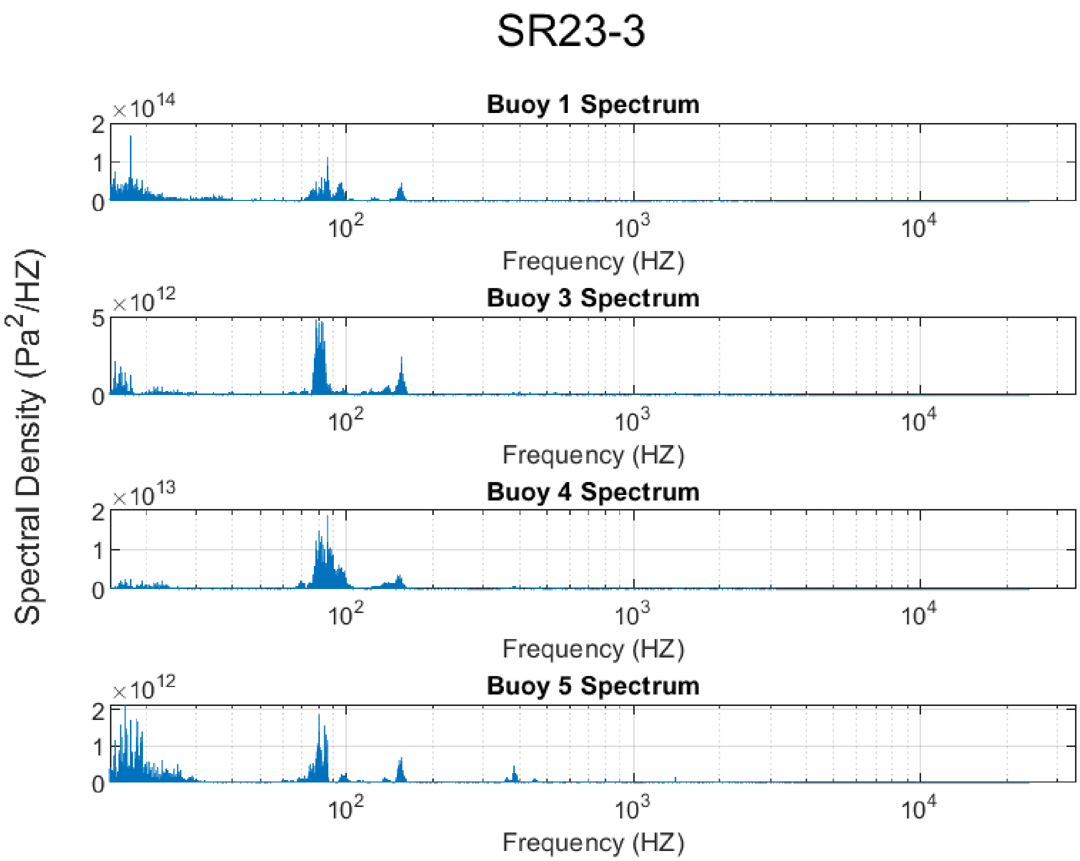
Suwanee - 2
Buoy 1 Spectrum
×10^15
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
×10^14
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
×10^13
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

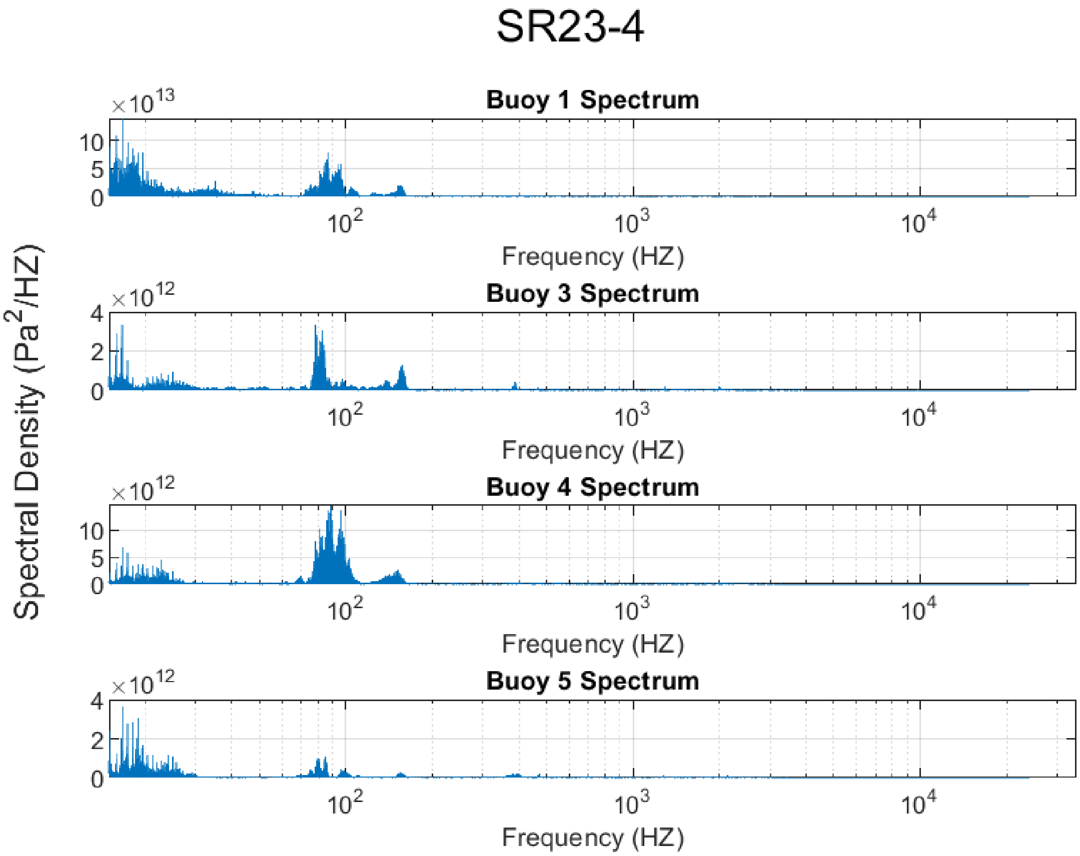
Suwanee - 3


Buoy 1 Spectrum
×10^16
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
×10^14
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
×10^13
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

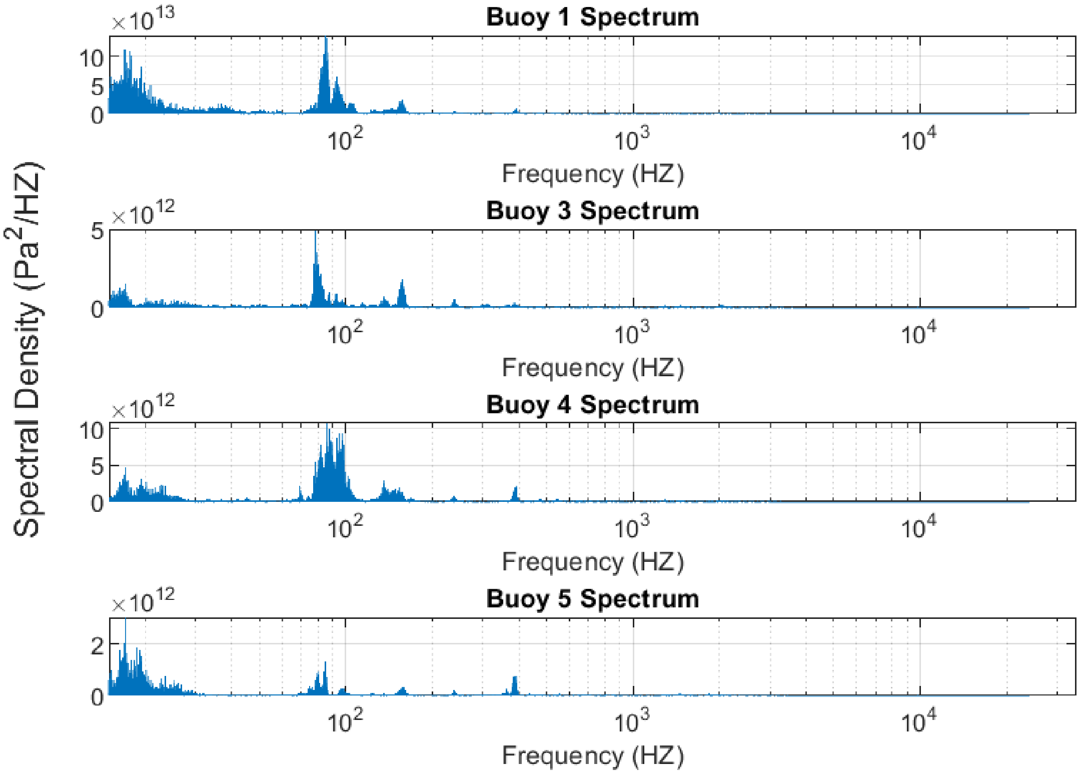

SR23-1
Buoy 1 Spectrum
Buoy 3 Spectrum
Buoy 4 Spectrum
Buoy 5 Spectrum
Spectral Density (Pa^2/HZ)
Frequency (HZ)
$\times 10^{14}$
$\times 10^{12}$
$\times 10^{13}$
$\times 10^{11}$
10^2
10^3
10^4

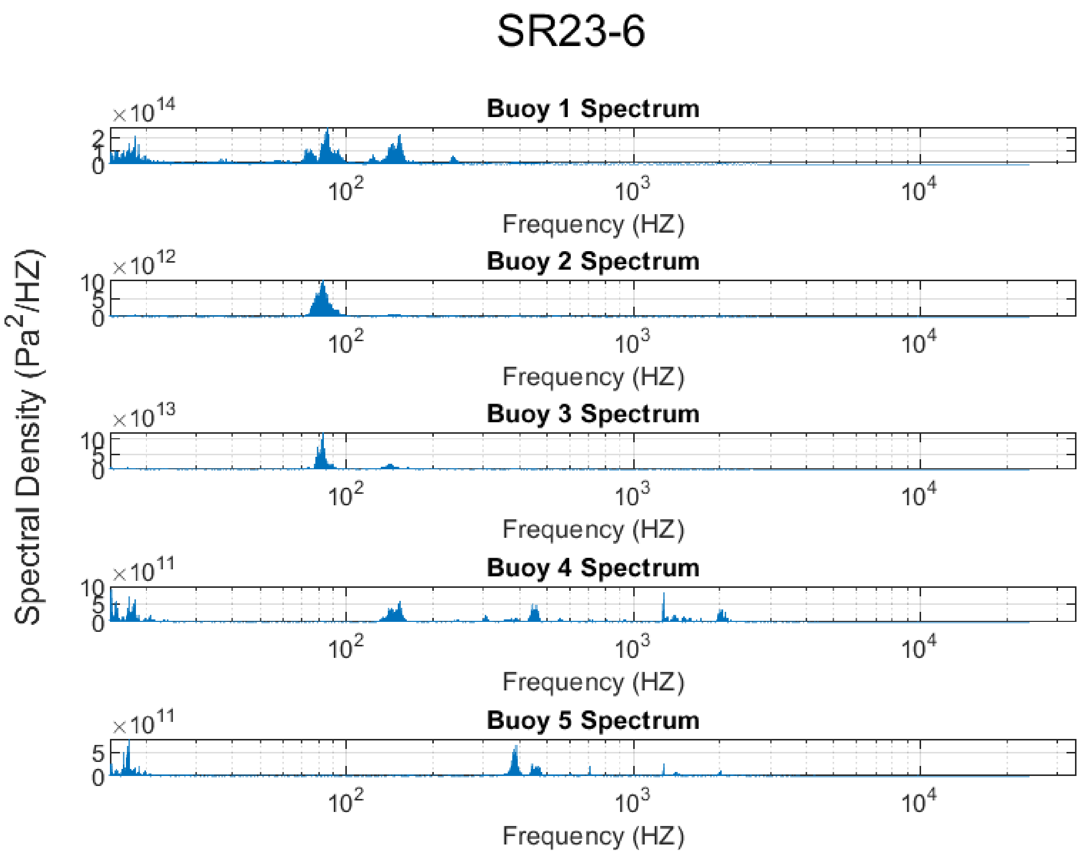

SR23-2
Buoy 1 Spectrum
Buoy 3 Spectrum
Buoy 4 Spectrum
Buoy 5 Spectrum
Spectral Density (Pa^2/HZ)
Frequency (HZ)
$\times 10^{13}$
$\times 10^{12}$
10^2
10^3
10^4

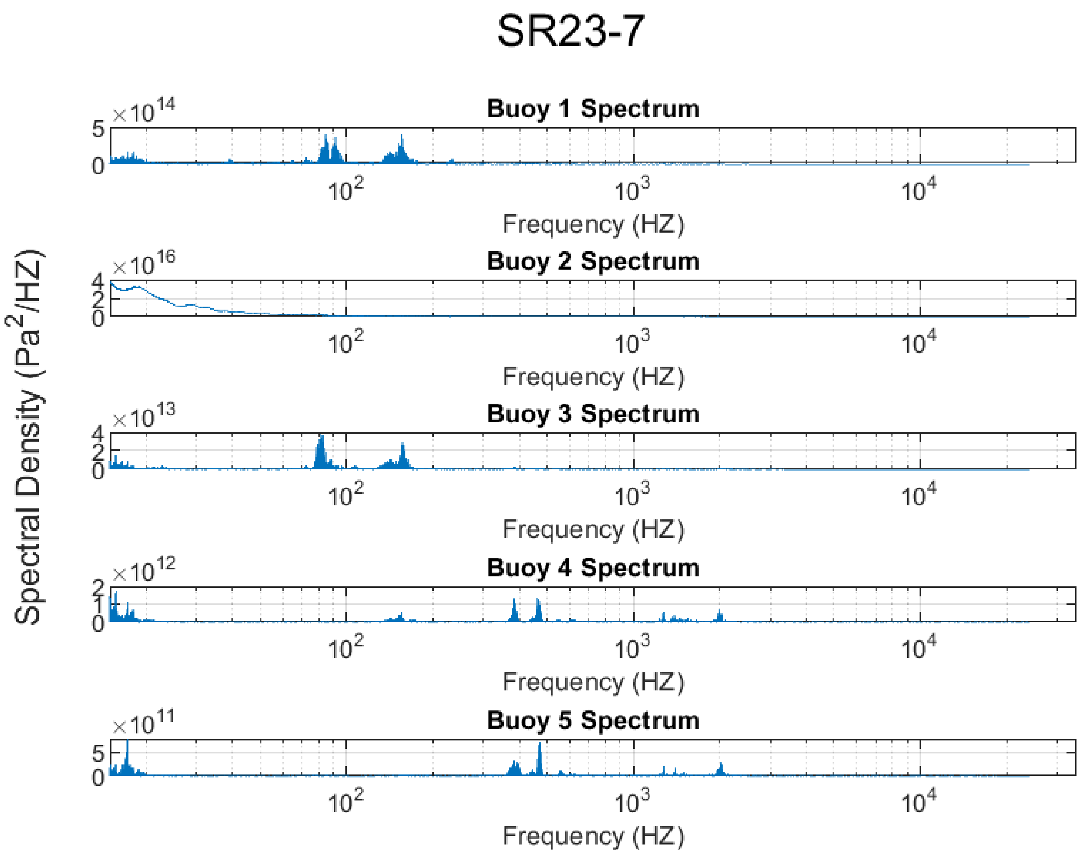

SR23-3
Buoy 1 Spectrum
×10^14
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
×10^12
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^13
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^12
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

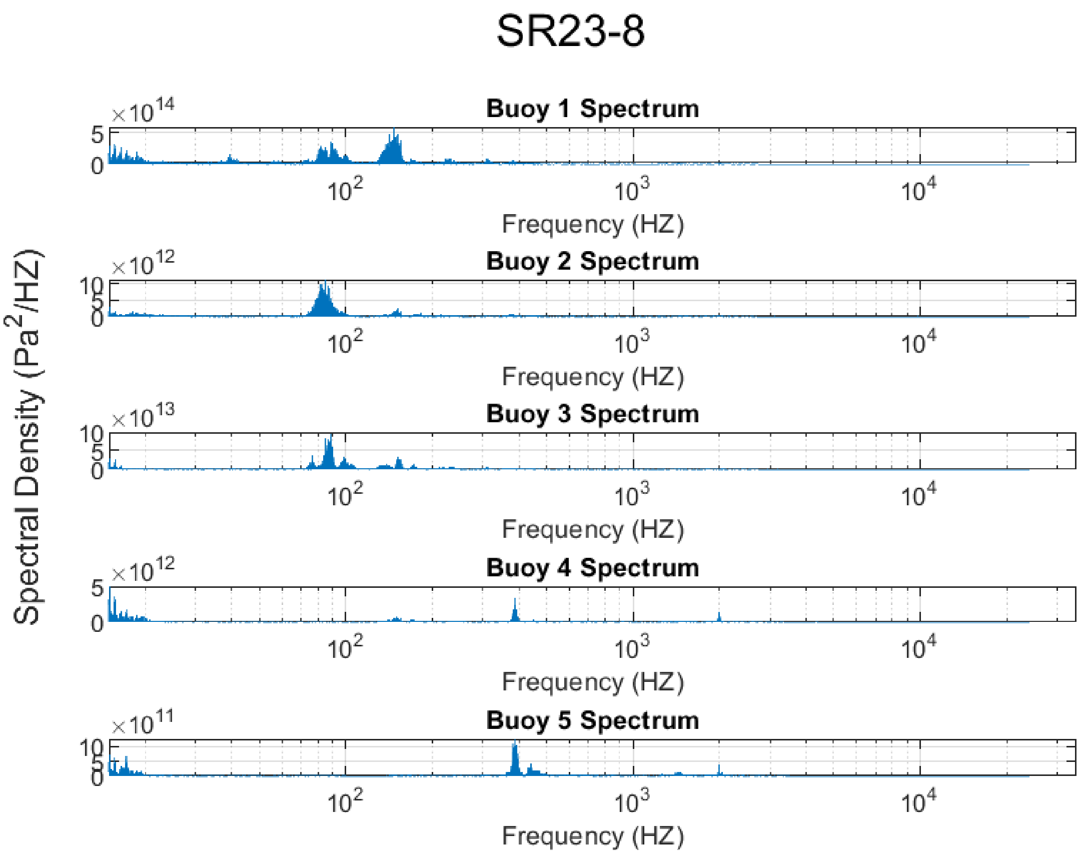

SR23-4
Buoy 1 Spectrum
Buoy 3 Spectrum
Buoy 4 Spectrum
Buoy 5 Spectrum
Spectral Density (Pa^2/HZ)
Frequency (HZ)
$\times 10^{13}$
$\times 10^{12}$
10^2
10^3
10^4

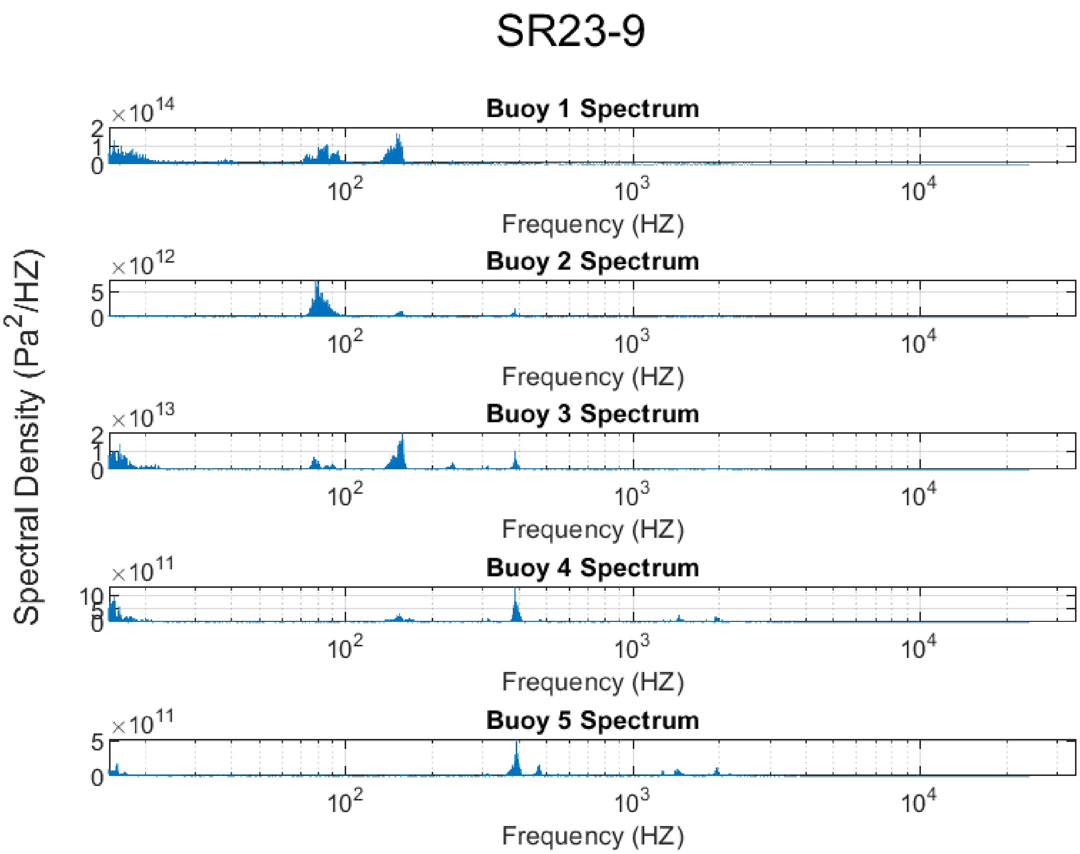
SR23-5


Spectral Density (Pa²/HZ)
Buoy 1 Spectrum
×10^13
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
×10^12
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^12
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^12
2
0
10^2
10^3
10^4
Frequency (HZ)

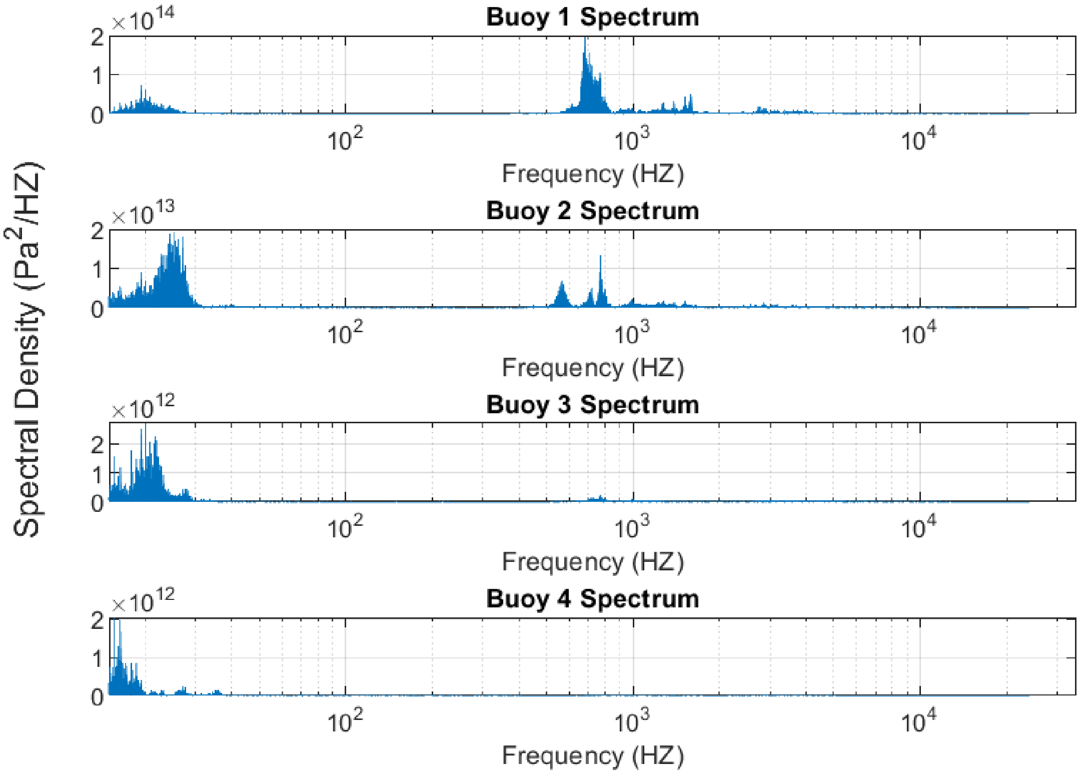

SR23-6
Spectral Density (Pa^2/HZ)
Buoy 1 Spectrum
×10^14
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
×10^12
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
×10^13
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^11
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^11
5
0
10^2
10^3
10^4
Frequency (HZ)


SR23-7
Spectral Density (Pa^2/HZ)
Buoy 1 Spectrum
×10^14
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
×10^16
4
2
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
×10^13
4
2
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^12
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^11
5
0
10^2
10^3
10^4
Frequency (HZ)

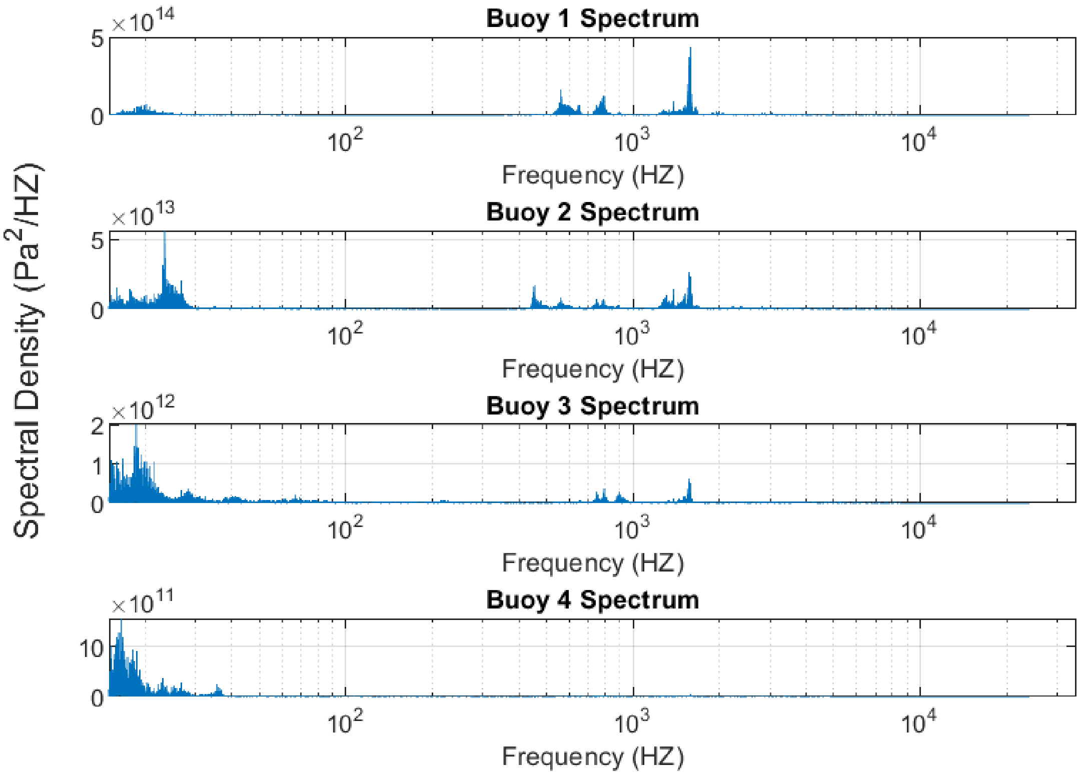

SR23-8
Spectral Density (Pa²/HZ)
×10¹⁴
Buoy 1 Spectrum
5
0
10²
10³
10⁴
Frequency (HZ)
×10¹²
Buoy 2 Spectrum
10
5
0
10²
10³
10⁴
Frequency (HZ)
×10¹³
Buoy 3 Spectrum
10
5
0
10²
10³
10⁴
Frequency (HZ)
×10¹²
Buoy 4 Spectrum
5
0
10²
10³
10⁴
Frequency (HZ)
×10¹¹
Buoy 5 Spectrum
10
5
0
10²
10³
10⁴
Frequency (HZ)


SR23-9
Buoy 1 Spectrum
Buoy 2 Spectrum
Buoy 3 Spectrum
Buoy 4 Spectrum
Buoy 5 Spectrum
Frequency (HZ)
Spectral Density (Pa^2/HZ)

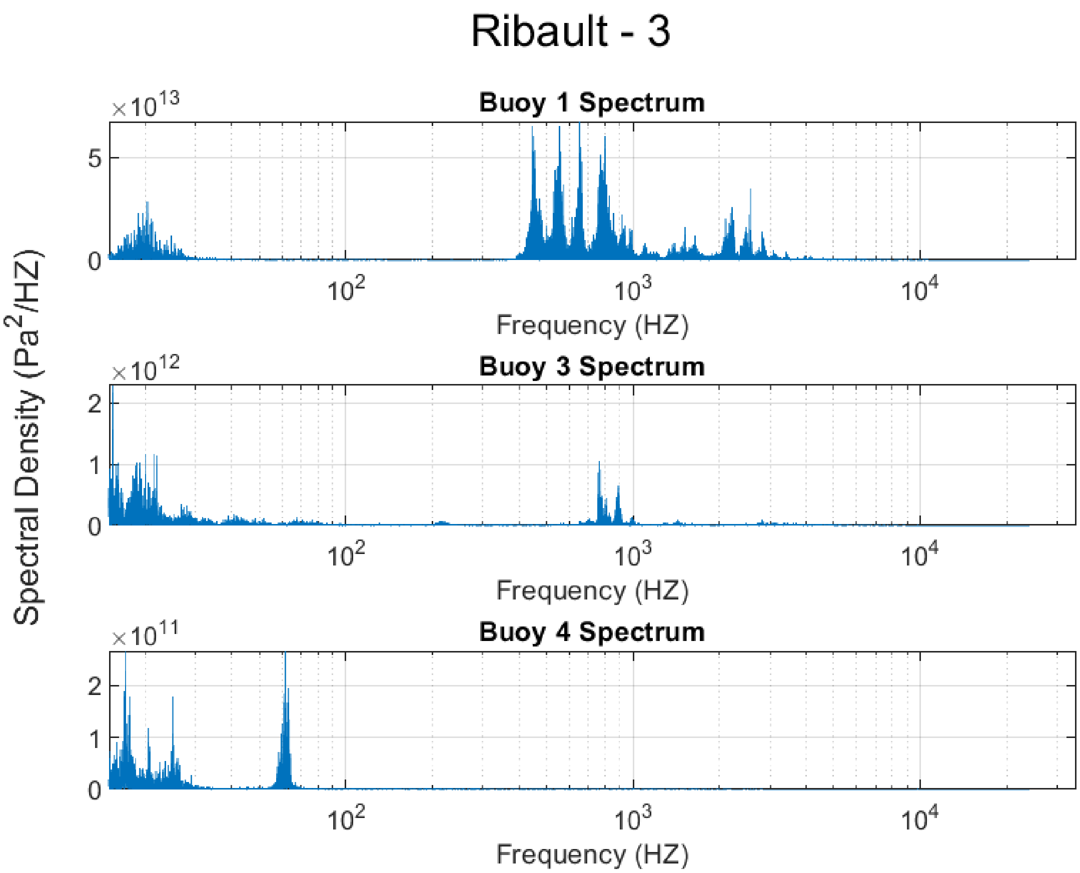
Ribault - 1

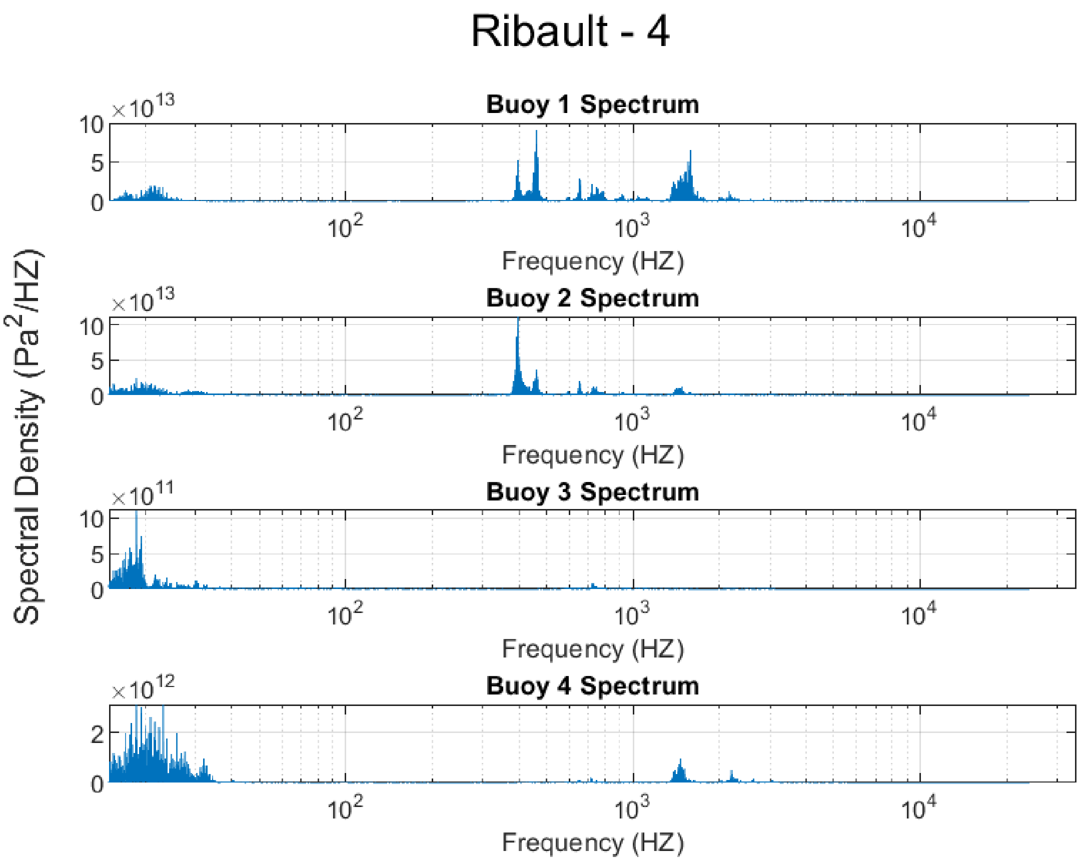

Buoy 1 Spectrum
Buoy 2 Spectrum
Buoy 3 Spectrum
Buoy 4 Spectrum
Spectral Density (Pa^2/HZ)
Frequency (HZ)
$\times 10^{14}$
$\times 10^{13}$
$\times 10^{12}$
10^2
10^3
10^4

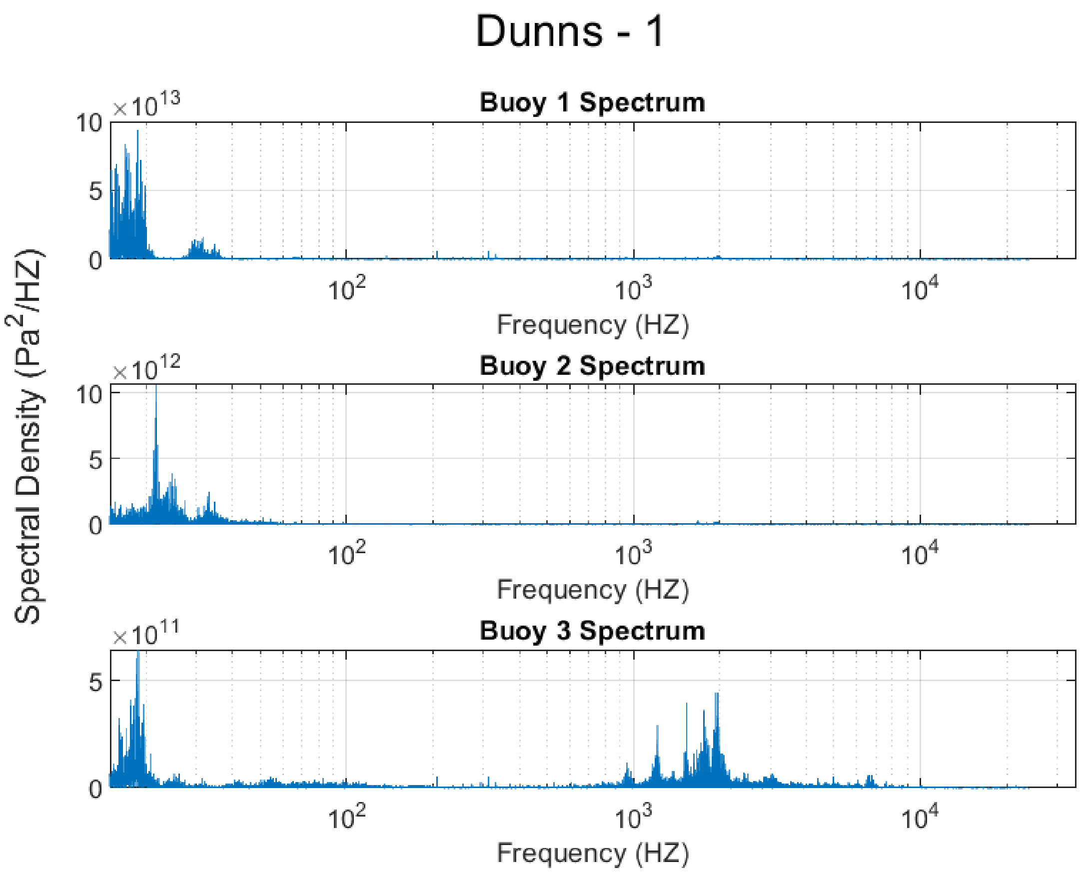
Ribault - 2



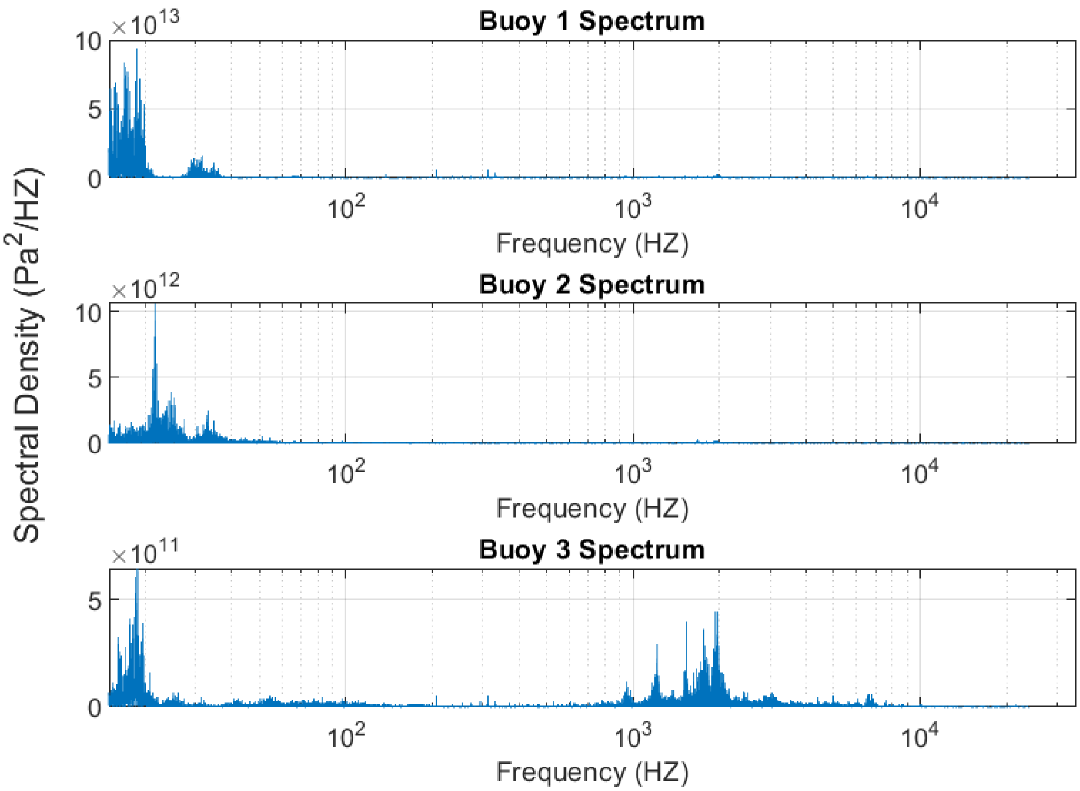
Spectral Density (Pa²/HZ)
Buoy 1 Spectrum
×10^14
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
×10^13
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
×10^12
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^11
10
0
10^2
10^3
10^4
Frequency (HZ)


Ribault - 3
Buoy 1 Spectrum
×10^13
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
×10^12
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^11
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)


Ribault - 4
Buoy 1 Spectrum
×10^13
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
×10^13
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
×10^11
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^12
2
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

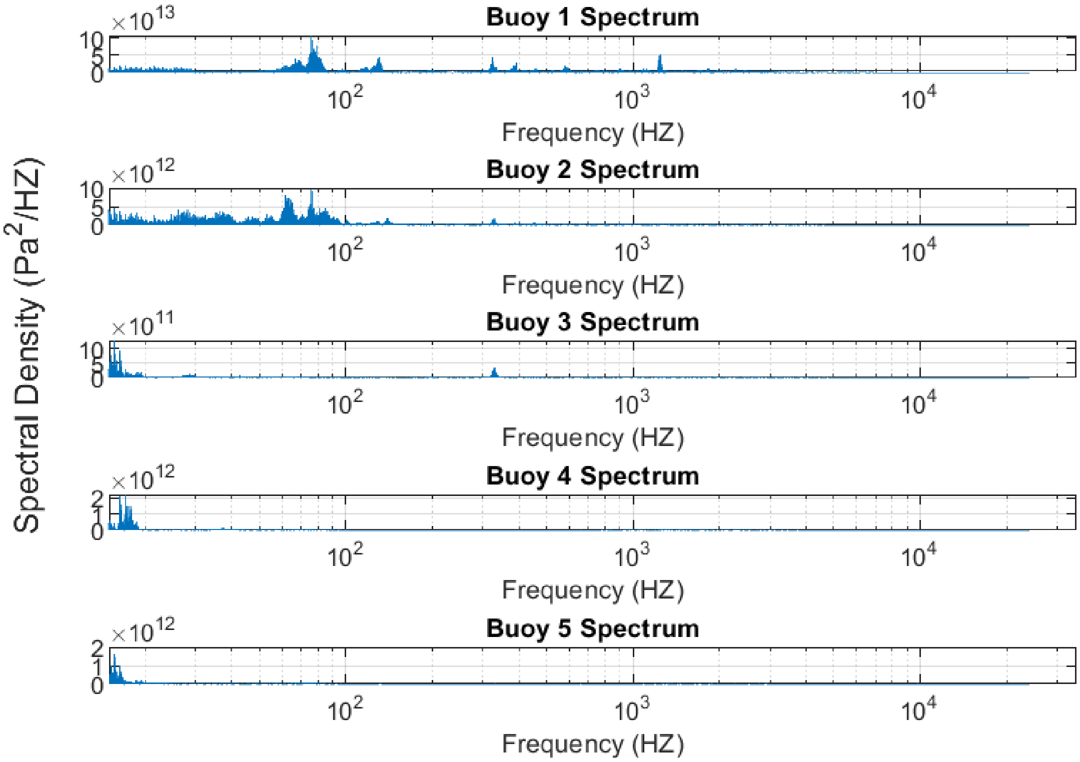

Dunns - 1
Buoy 1 Spectrum
×10^13
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
×10^12
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
×10^11
5
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

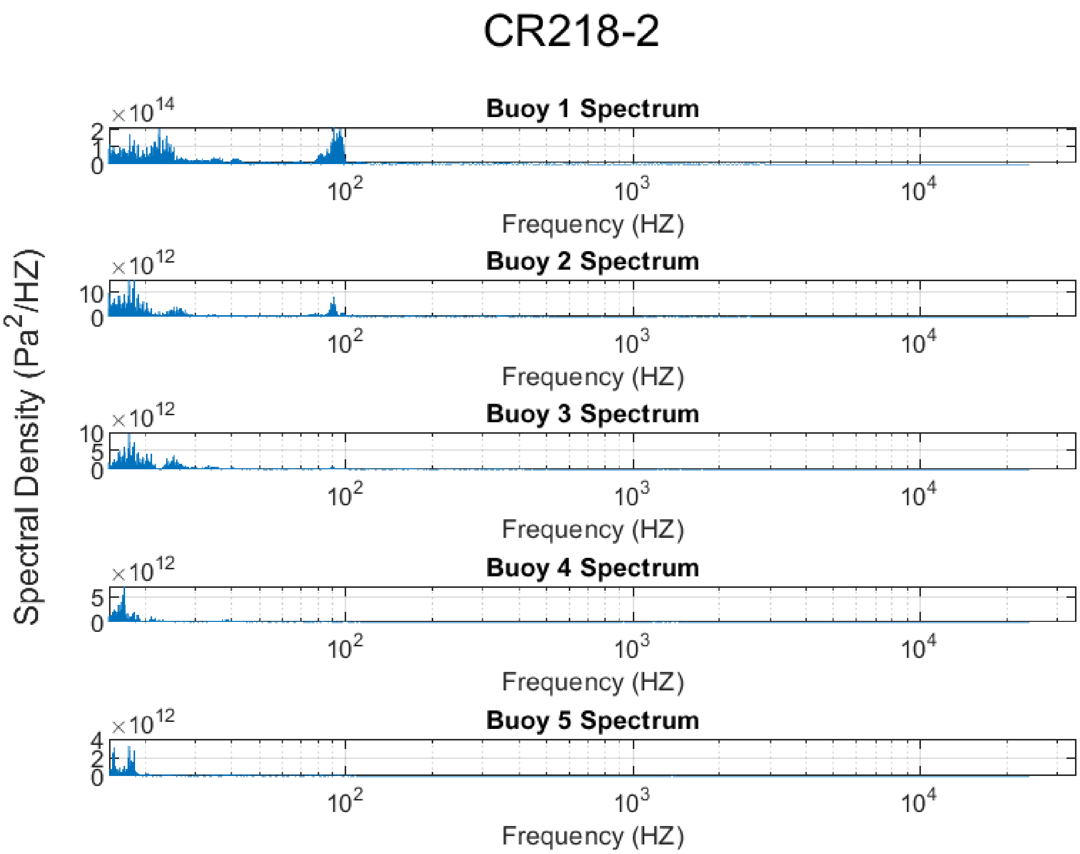
Dunns - 2



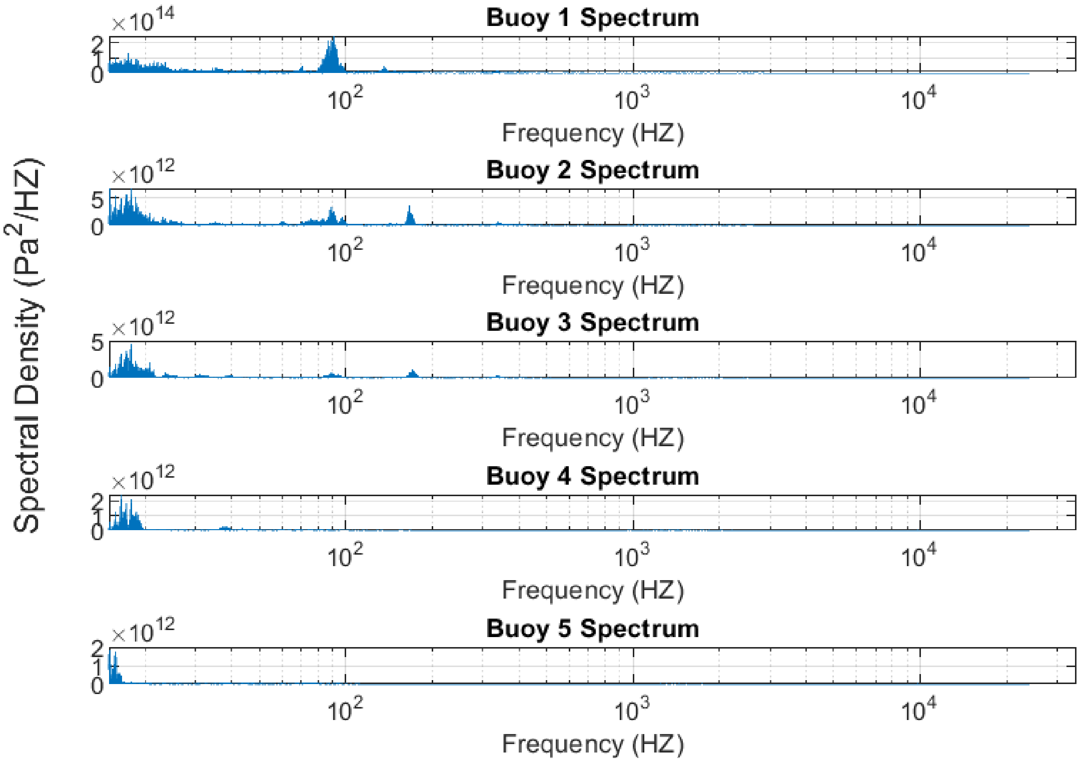
Buoy 1 Spectrum
×10^13
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
×10^12
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
×10^11
5
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

CR218-1

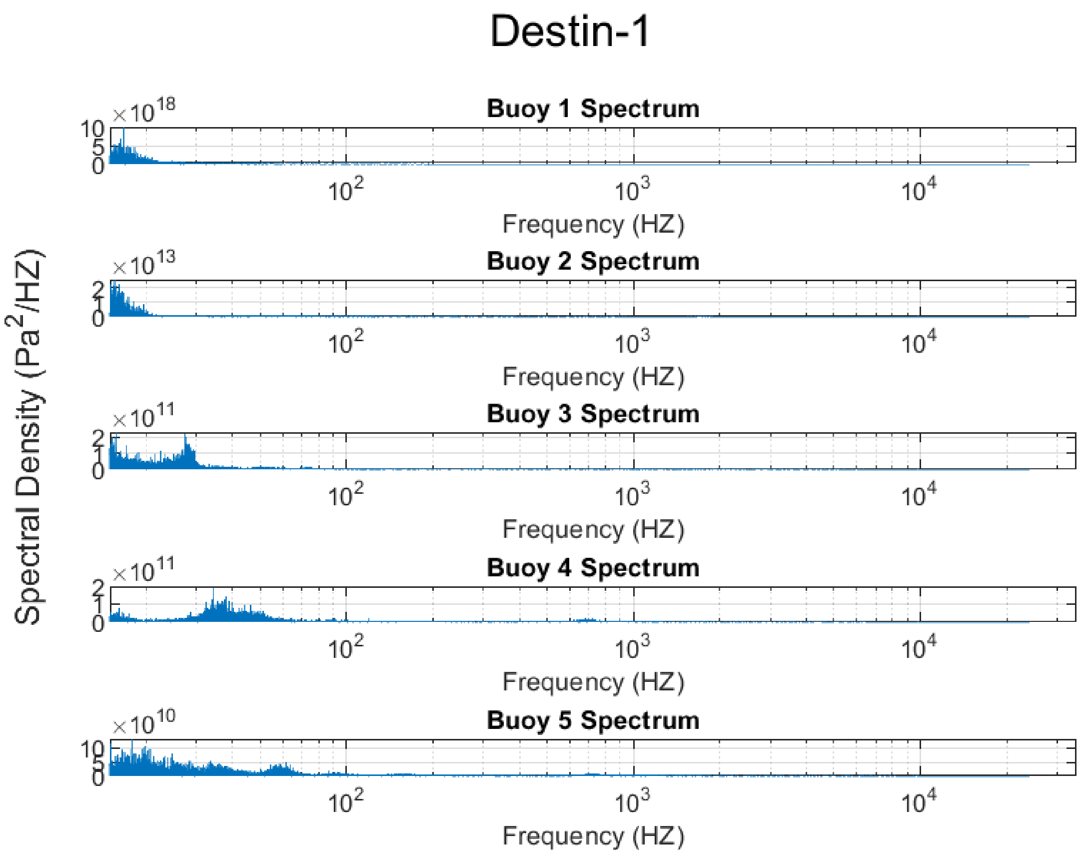

Spectral Density (Pa^2/HZ)
×10^{13}
Buoy 1 Spectrum
10
5
0
10^2
10^3
10^4
Frequency (HZ)
×10^{12}
Buoy 2 Spectrum
10
5
0
10^2
10^3
10^4
Frequency (HZ)
×10^{11}
Buoy 3 Spectrum
10
5
0
10^2
10^3
10^4
Frequency (HZ)
×10^{12}
Buoy 4 Spectrum
2
1
0
10^2
10^3
10^4
Frequency (HZ)
×10^{12}
Buoy 5 Spectrum
2
1
0
10^2
10^3
10^4
Frequency (HZ)

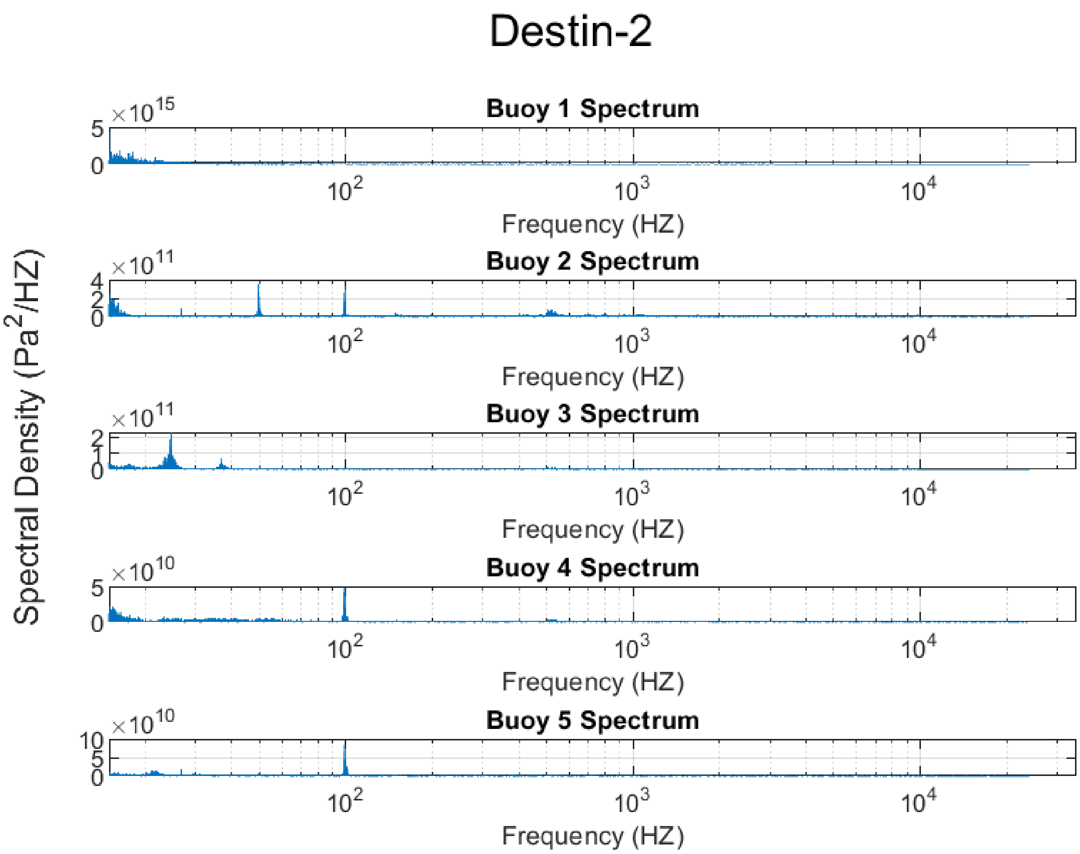

CR218-2
Spectral Density (Pa²/HZ)
Buoy 1 Spectrum
×10^14
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
×10^12
10
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
×10^12
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^12
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^12
4
2
0
10^2
10^3
10^4
Frequency (HZ)

CR218-3



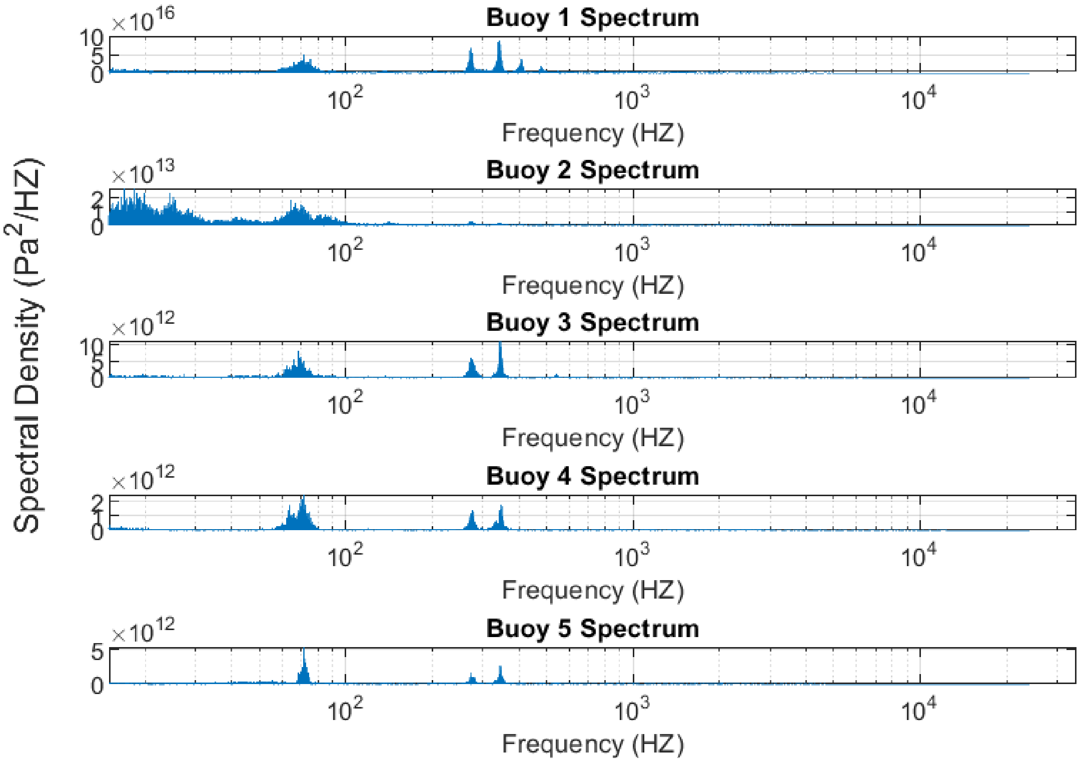
Buoy 1 Spectrum
×10^14
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
×10^12
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
×10^12
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^12
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^12
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)


Destin-1
Buoy 1 Spectrum
×10^18
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
×10^13
2
1
0
Frequency (HZ)
Buoy 3 Spectrum
×10^11
Frequency (HZ)
Buoy 4 Spectrum
×10^11
Frequency (HZ)
Buoy 5 Spectrum
×10^10
Frequency (HZ)
Spectral Density (Pa^2/HZ)

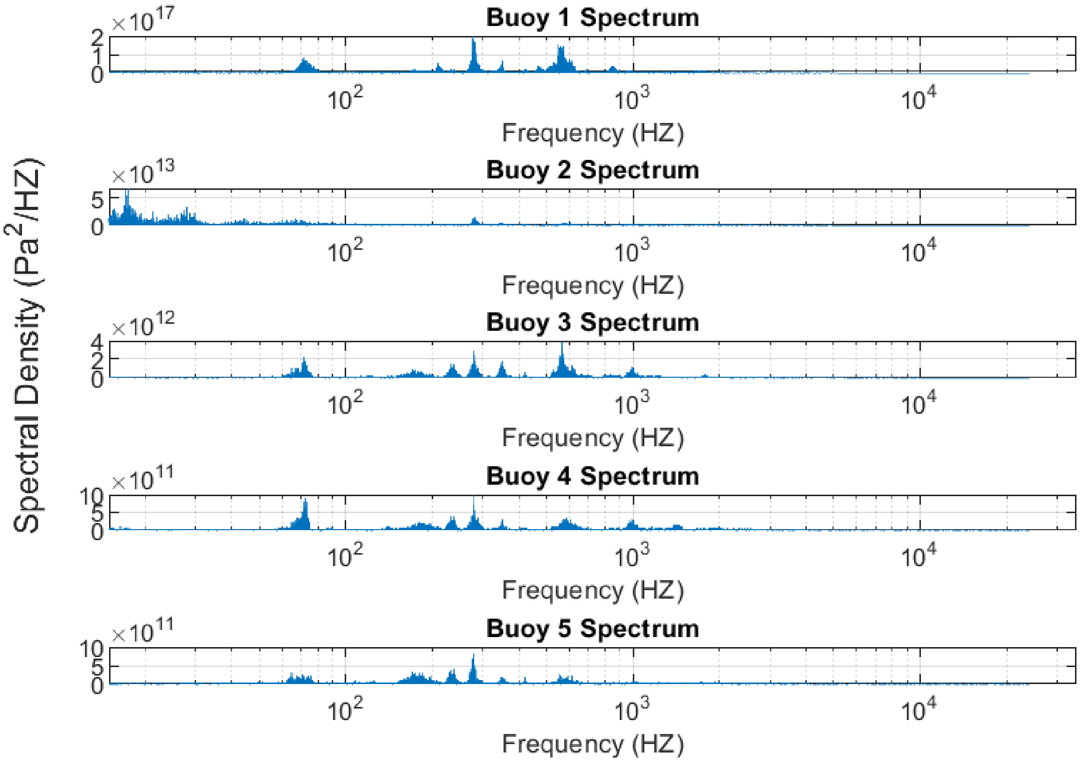


Destin-2
Buoy 1 Spectrum
×10^15
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
×10^11
4
2
0
Frequency (HZ)
Buoy 3 Spectrum
×10^11
2
1
0
Frequency (HZ)
Buoy 4 Spectrum
×10^10
5
0
Frequency (HZ)
Buoy 5 Spectrum
×10^10
10
5
0
Frequency (HZ)
Spectral Density (Pa^2/HZ)

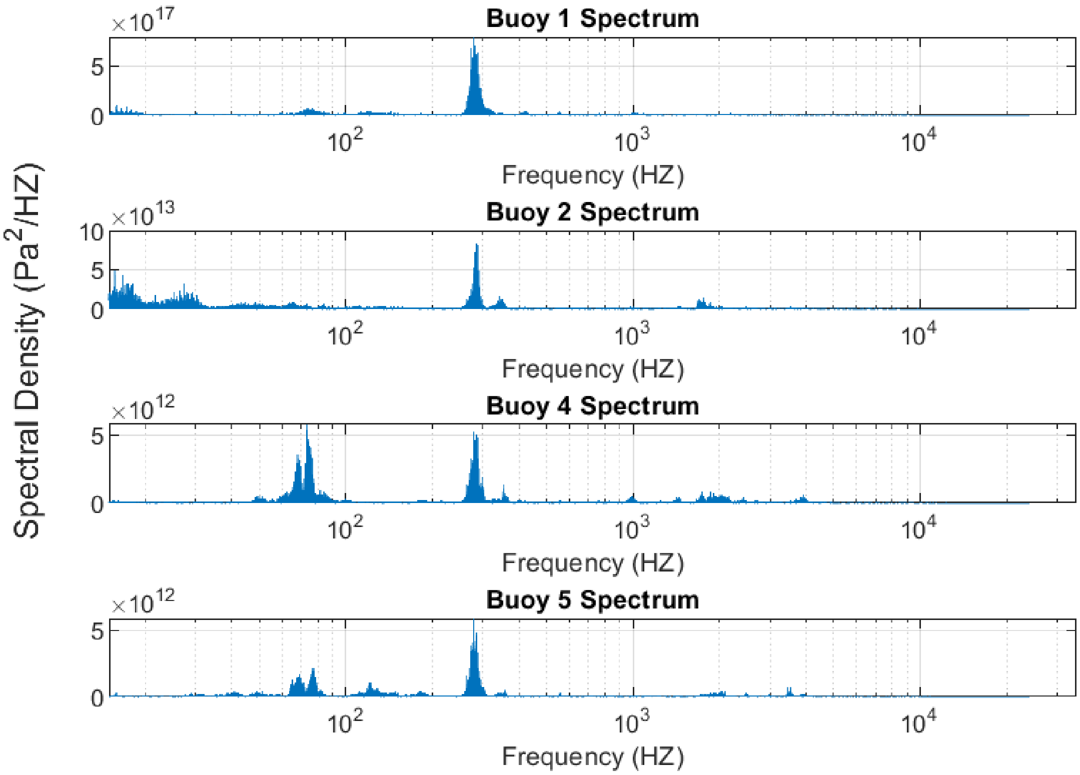
HF-1


Spectral Density (Pa^2/HZ)
Buoy 1 Spectrum
×10^{16}
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
×10^{13}
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
×10^{12}
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^{12}
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^{12}
5
0
10^2
10^3
10^4
Frequency (HZ)

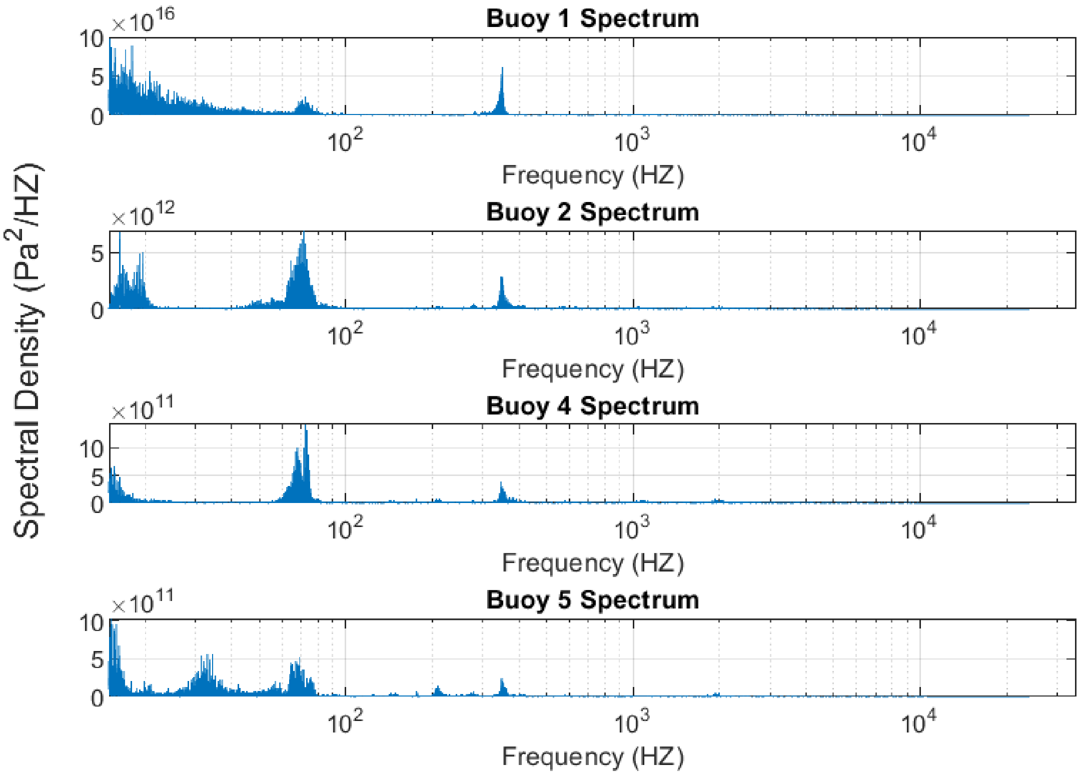
HF-2


Buoy 1 Spectrum
Buoy 2 Spectrum
Buoy 3 Spectrum
Buoy 4 Spectrum
Buoy 5 Spectrum
Spectral Density (Pa²/HZ)
Frequency (HZ)
$\times 10^{17}$
$\times 10^{13}$
$\times 10^{12}$
$\times 10^{11}$
10^2
10^3
10^4

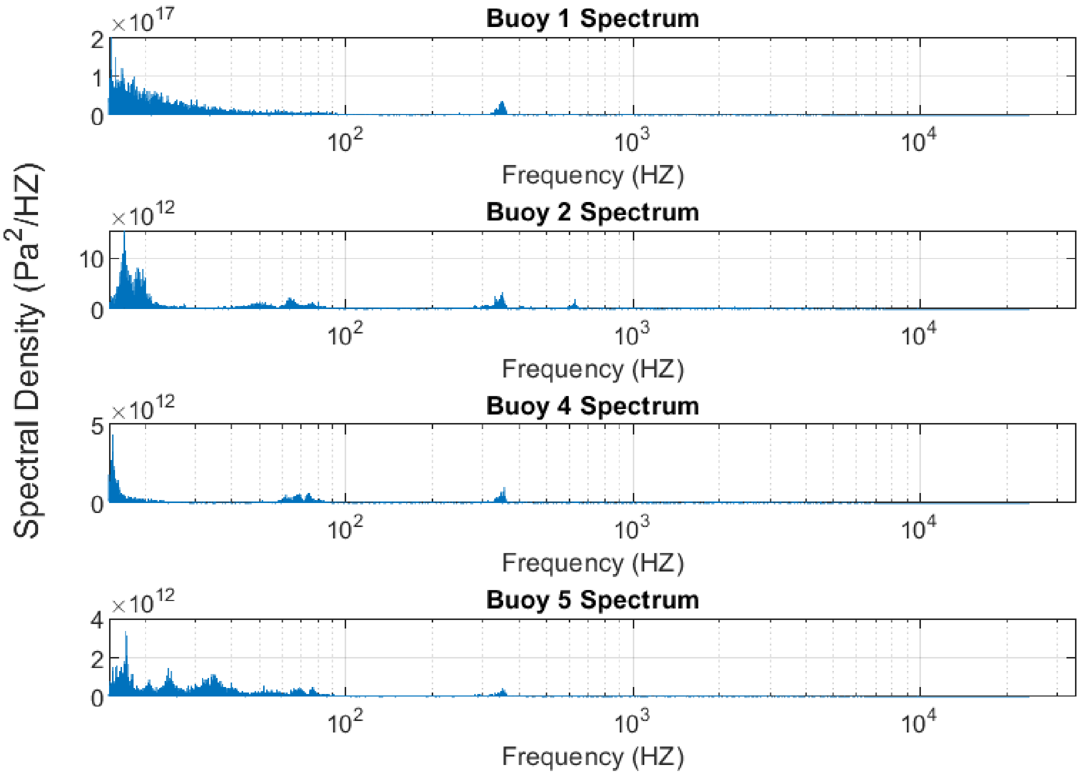
HF-3


Buoy 1 Spectrum
Buoy 2 Spectrum
Buoy 4 Spectrum
Buoy 5 Spectrum
Spectral Density (Pa²/HZ)
Frequency (HZ)
×10^17
×10^13
×10^12
10^2
10^3
10^4

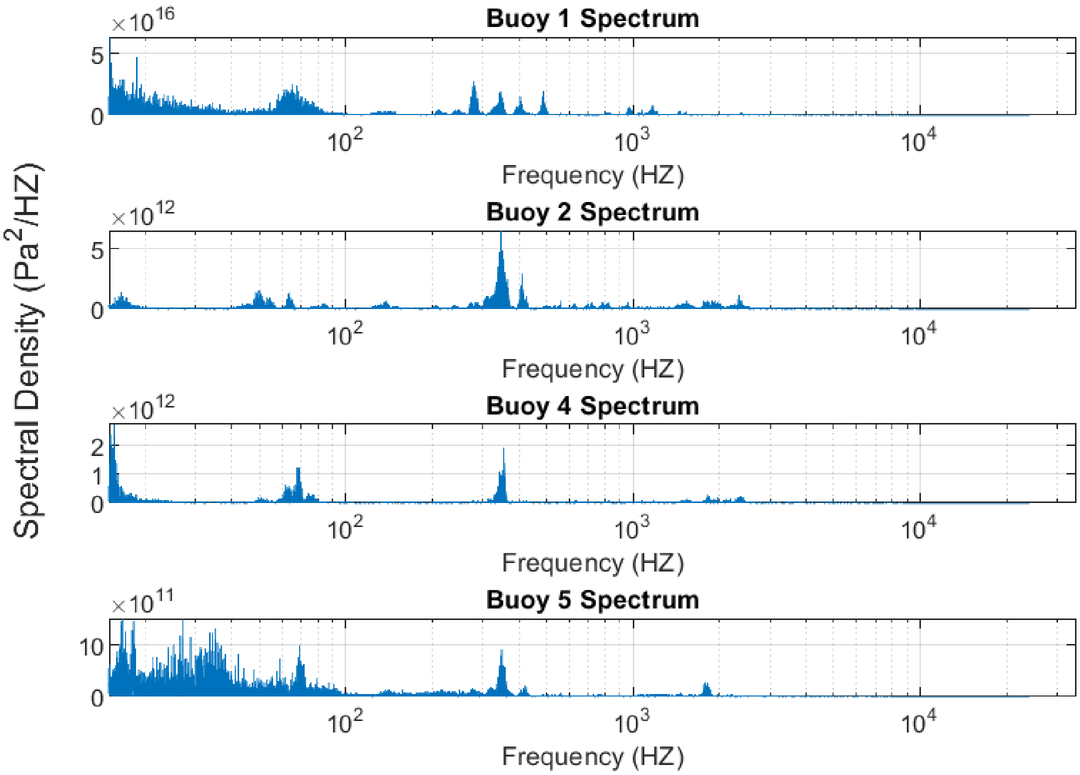
HF-4


Buoy 1 Spectrum
×10^16
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
×10^12
5
0
Frequency (HZ)
Buoy 4 Spectrum
×10^11
10
5
0
Frequency (HZ)
Buoy 5 Spectrum
×10^11
10
5
0
Frequency (HZ)
Spectral Density (Pa^2/HZ)

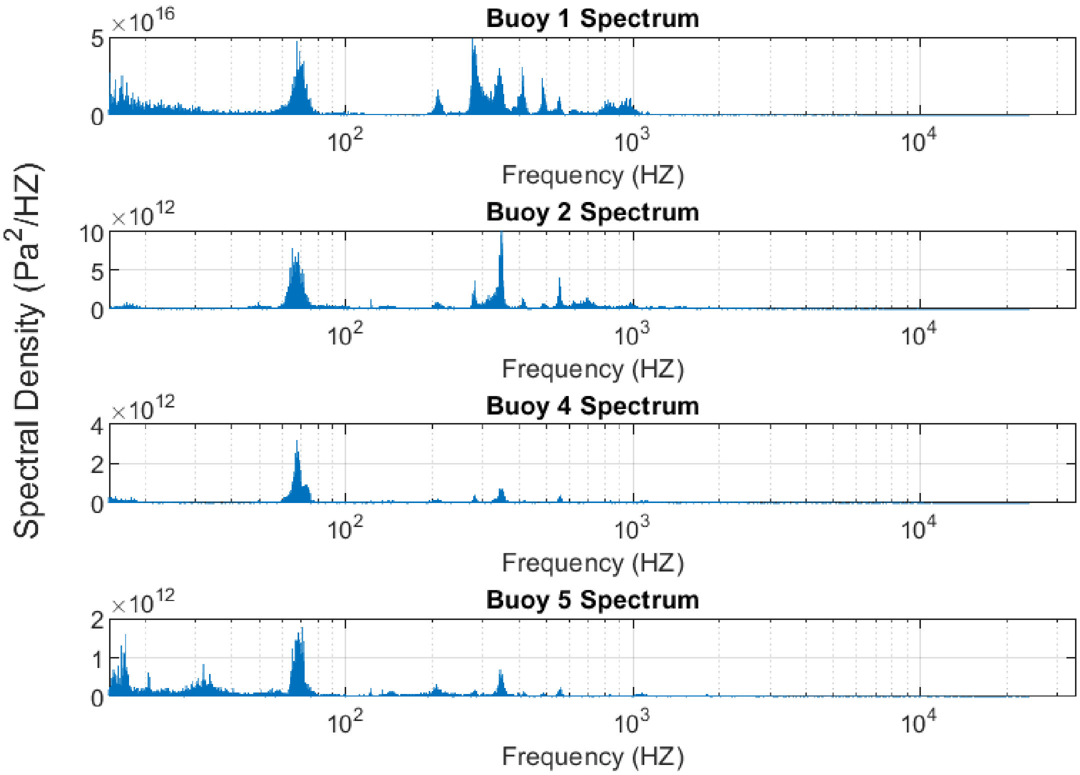
HF-5


Buoy 1 Spectrum
×10^17
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
×10^12
10
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^12
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^12
4
2
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

HF-6

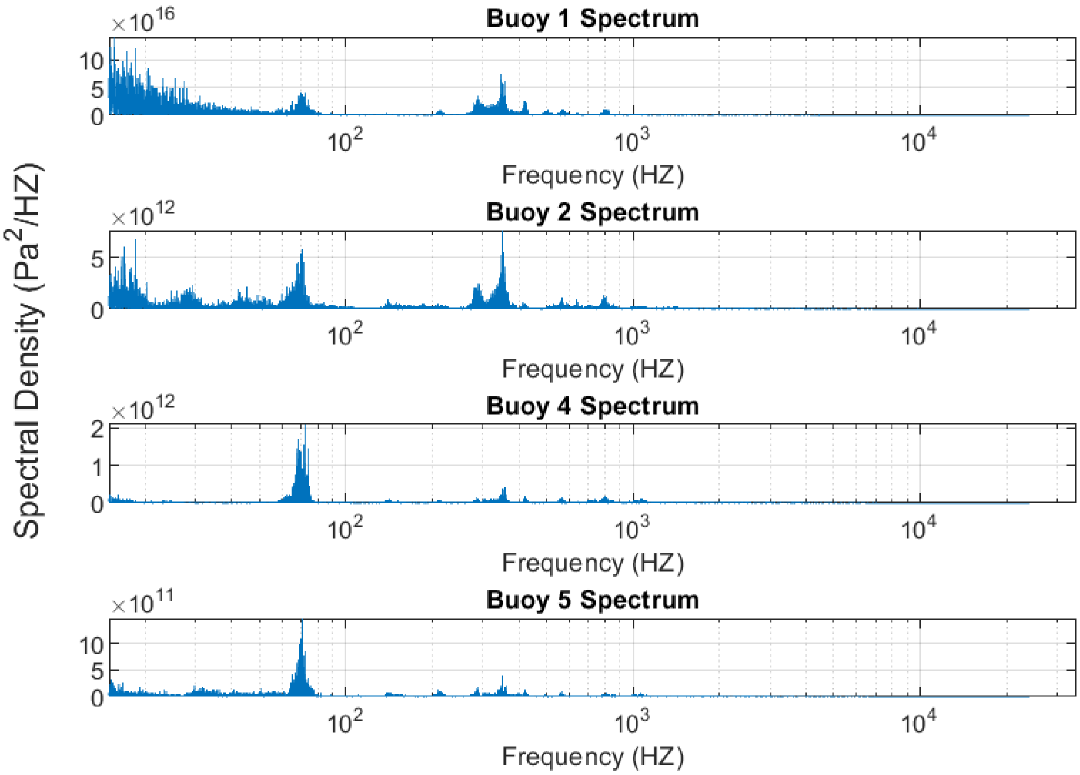

Buoy 1 Spectrum
×10^16
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
×10^12
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^12
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^11
10
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

HF-7



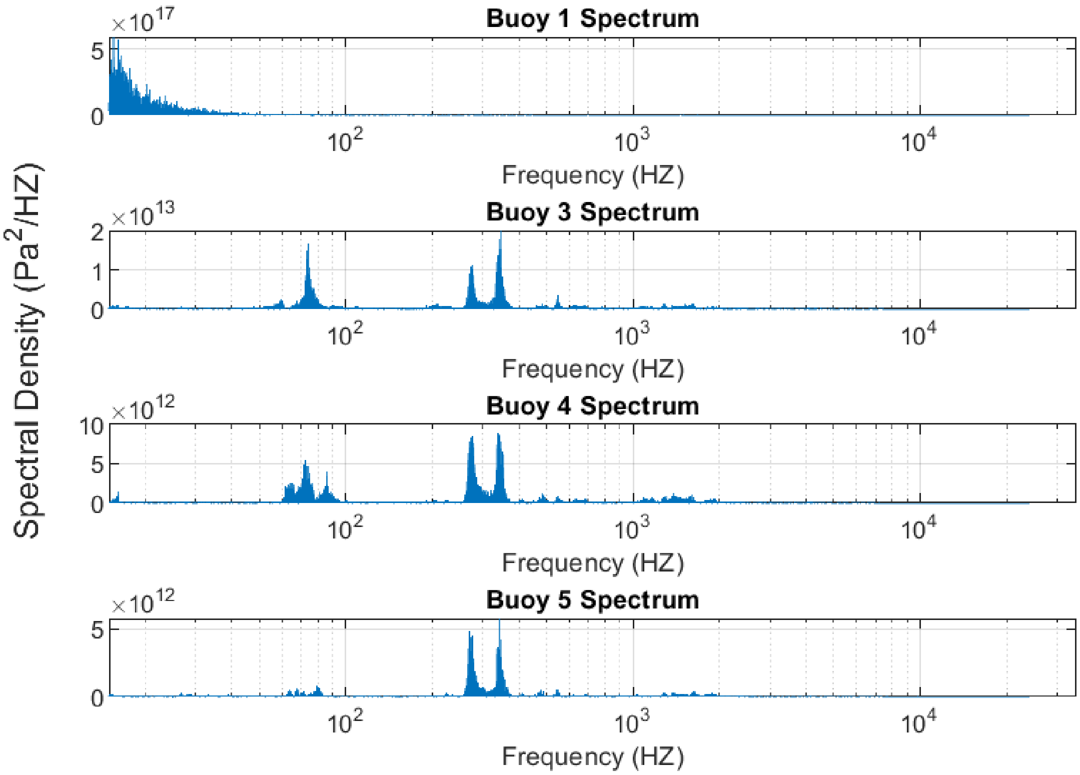
Buoy 1 Spectrum
Buoy 2 Spectrum
Buoy 4 Spectrum
Buoy 5 Spectrum
Spectral Density (Pa^2/HZ)
Frequency (HZ)

HF-8

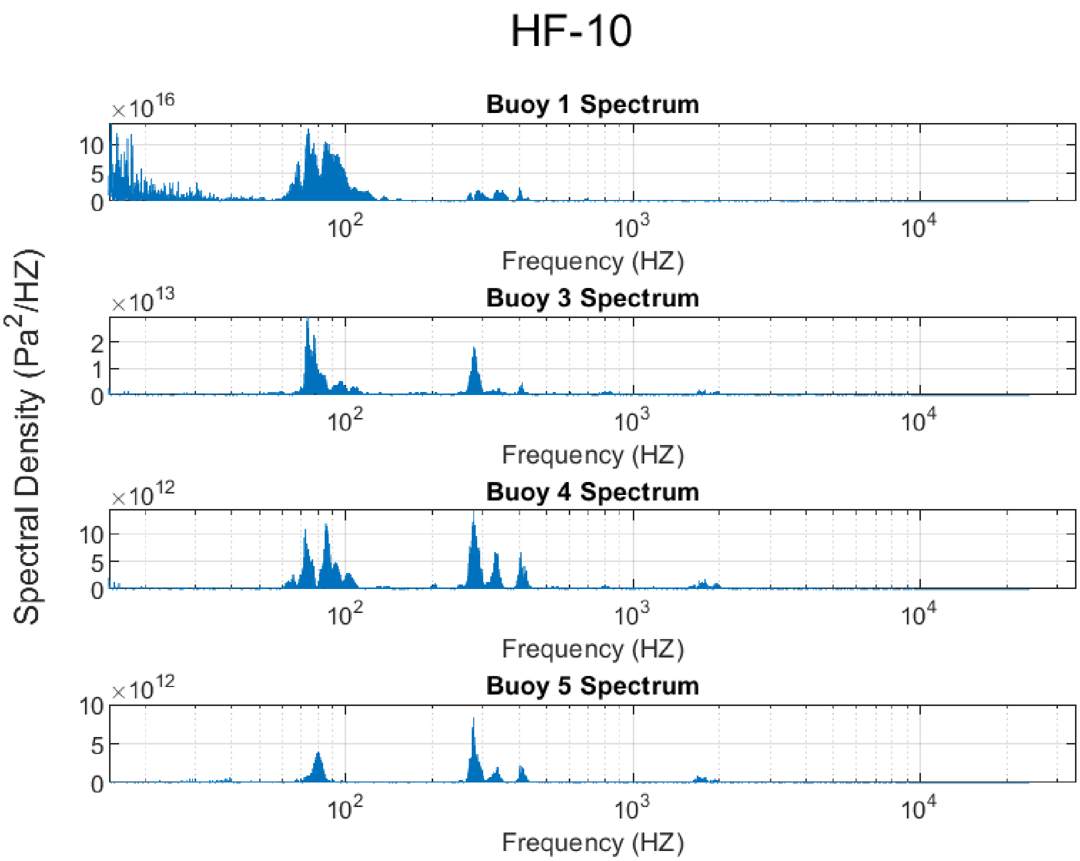


Buoy 1 Spectrum
×10^16
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
×10^12
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^12
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^11
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

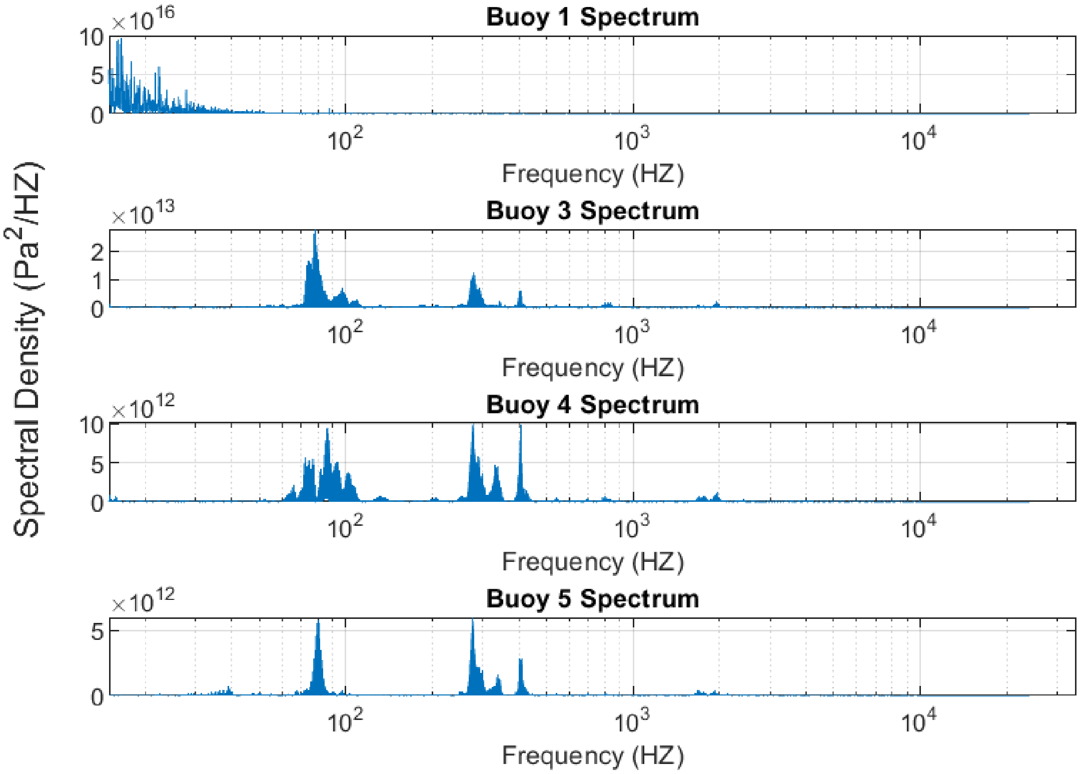
HF-9



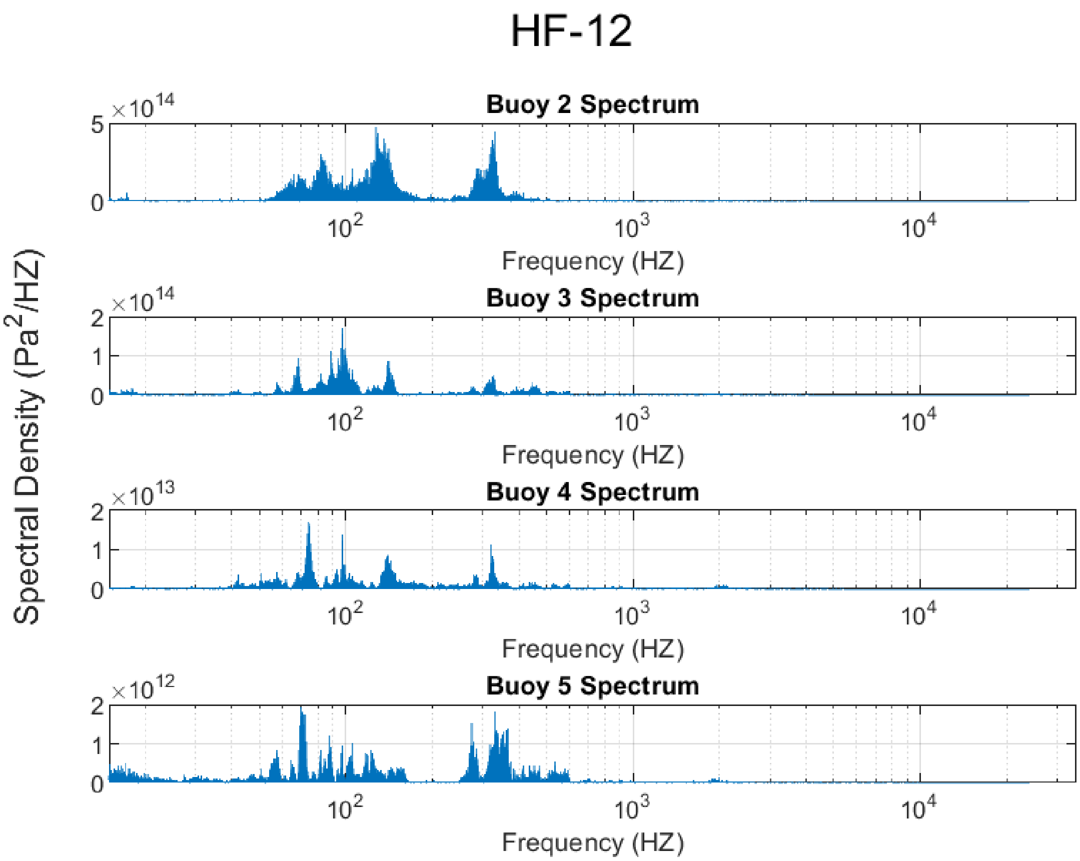
Spectral Density (Pa^2/HZ)
Buoy 1 Spectrum
$\times 10^{17}$
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
$\times 10^{13}$
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
$\times 10^{12}$
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
$\times 10^{12}$
5
0
10^2
10^3
10^4
Frequency (HZ)

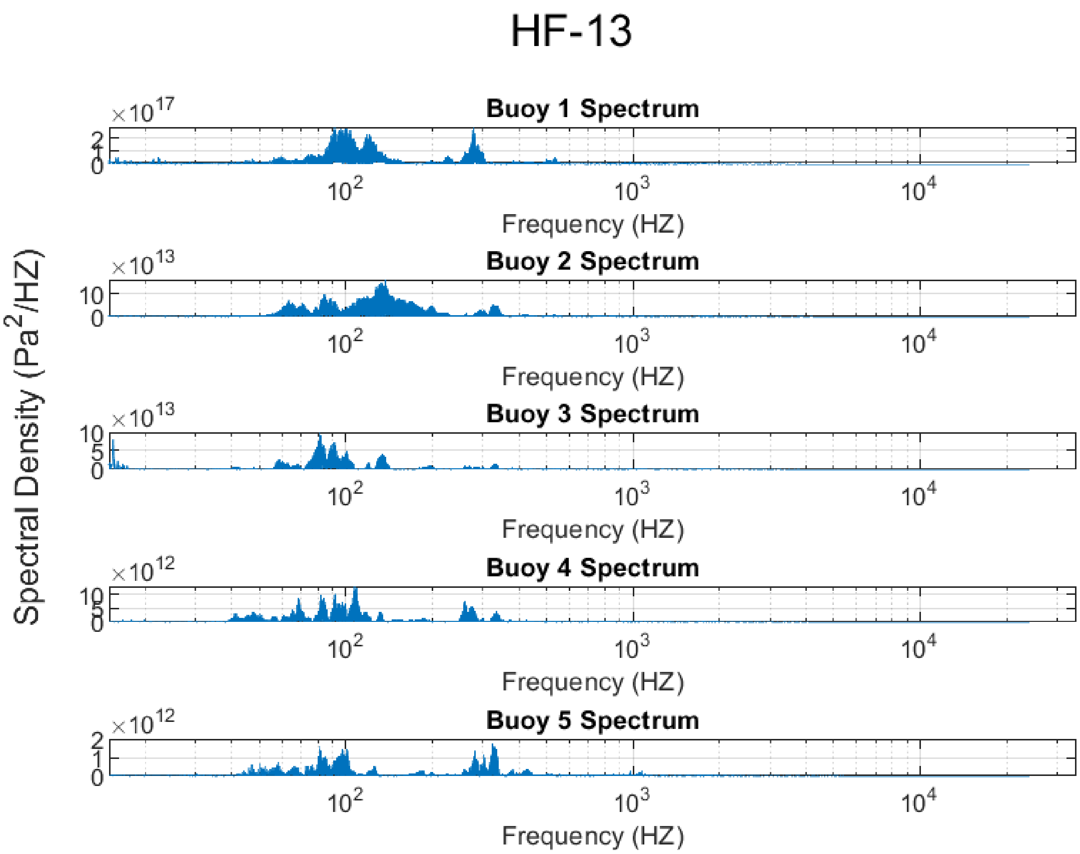

HF-10
Buoy 1 Spectrum
Buoy 3 Spectrum
Buoy 4 Spectrum
Buoy 5 Spectrum
Spectral Density (Pa^2/HZ)
Frequency (HZ)

HF-11

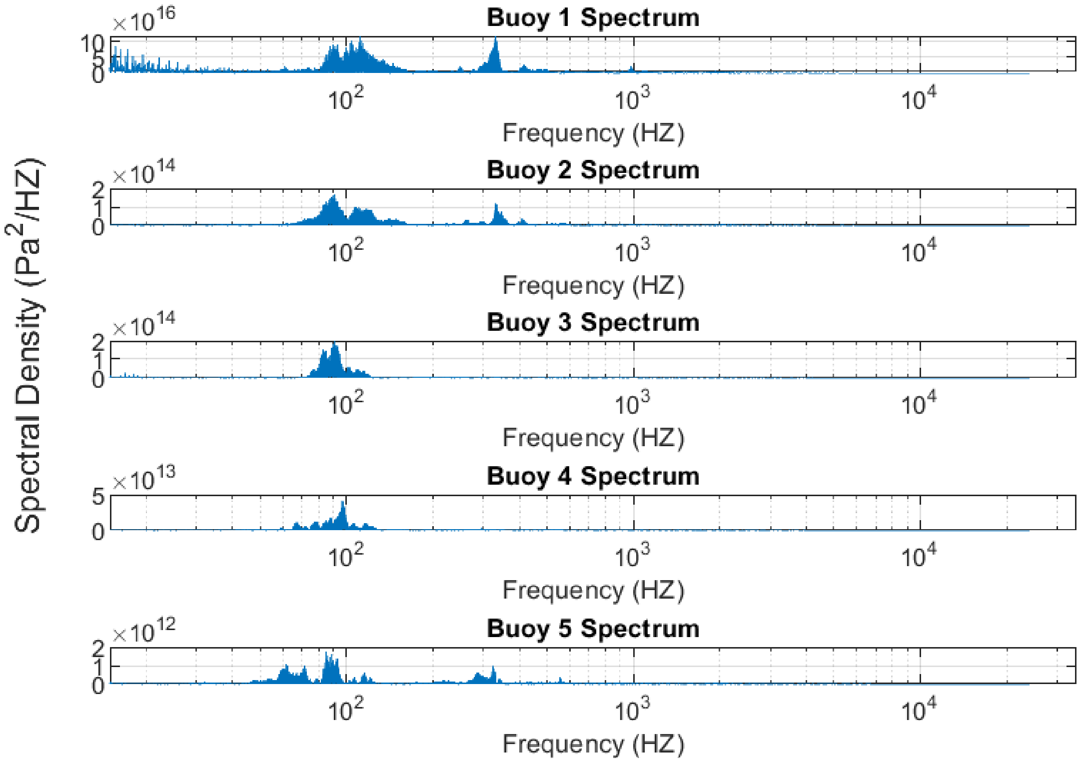


Buoy 1 Spectrum
Buoy 3 Spectrum
Buoy 4 Spectrum
Buoy 5 Spectrum
Spectral Density (Pa²/HZ)
Frequency (HZ)

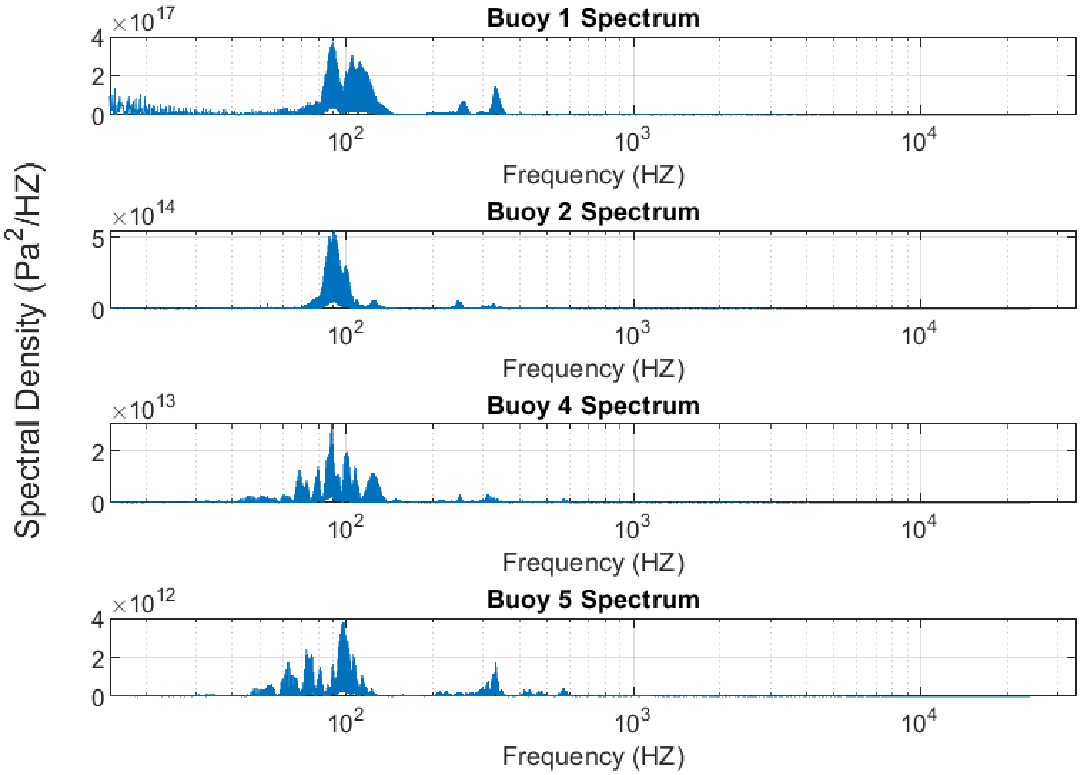

HF-12
Spectral Density (Pa²/HZ)
Buoy 2 Spectrum
×10^14
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
×10^14
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^13
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^12
2
1
0
10^2
10^3
10^4
Frequency (HZ)


HF-13
Spectral Density (Pa^2/HZ)
Buoy 1 Spectrum
$\times 10^{17}$
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
$\times 10^{13}$
10
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
$\times 10^{13}$
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
$\times 10^{12}$
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
$\times 10^{12}$
2
1
0
10^2
10^3
10^4
Frequency (HZ)

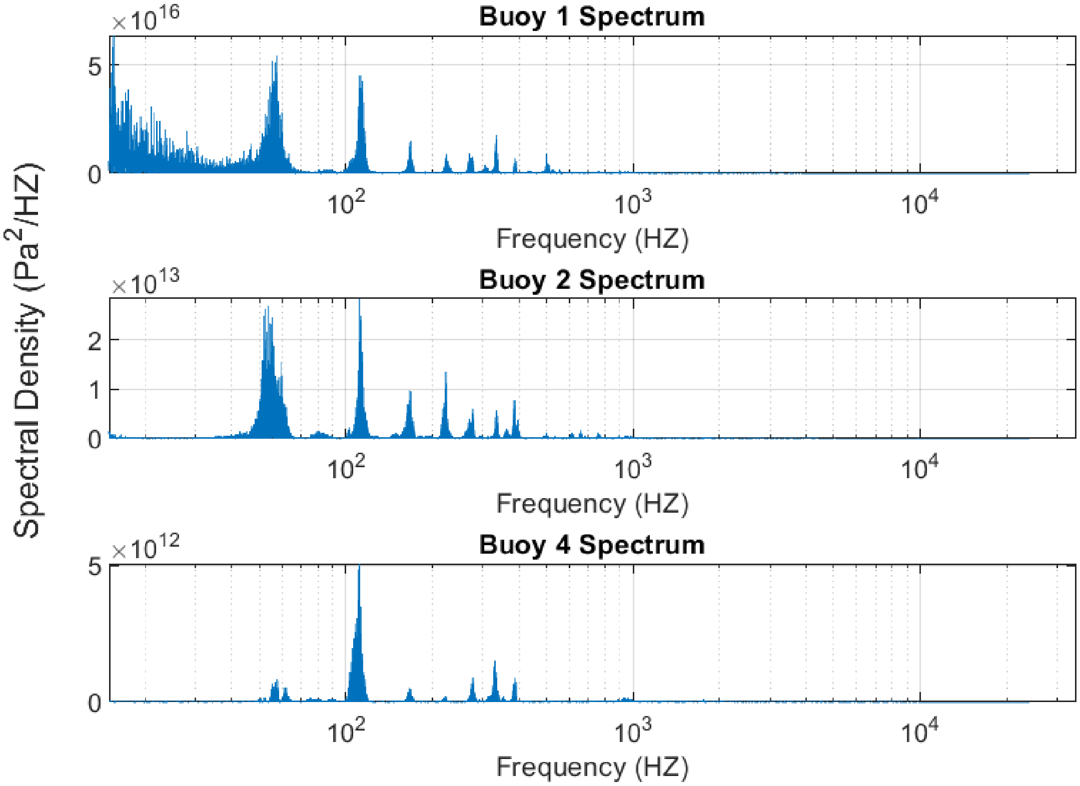
HF-14


Buoy 1 Spectrum
×10^16
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
×10^14
2
1
0
Buoy 3 Spectrum
×10^14
Buoy 4 Spectrum
×10^13
5
Buoy 5 Spectrum
×10^12
Spectral Density (Pa^2/HZ)

HF-15

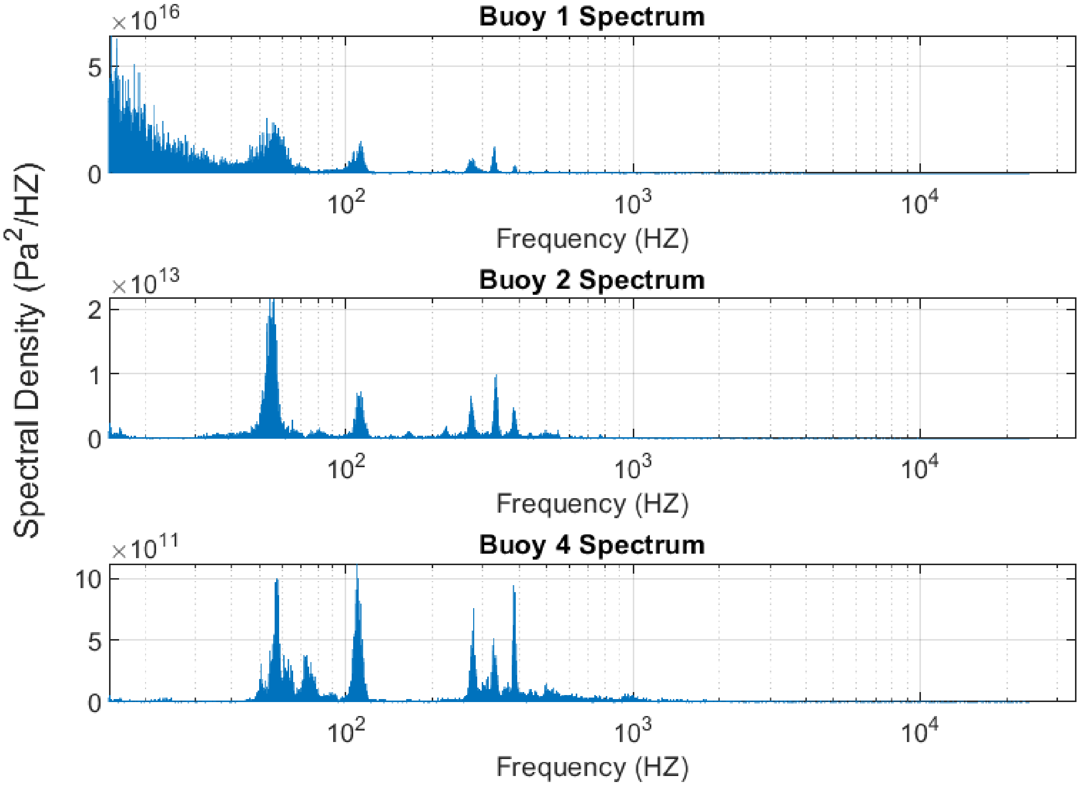

Buoy 1 Spectrum
×10^17
4
2
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
×10^14
5
0
Frequency (HZ)
Buoy 4 Spectrum
×10^13
2
0
Frequency (HZ)
Buoy 5 Spectrum
×10^12
4
2
0
Frequency (HZ)
Spectral Density (Pa^2/HZ)

HF-16



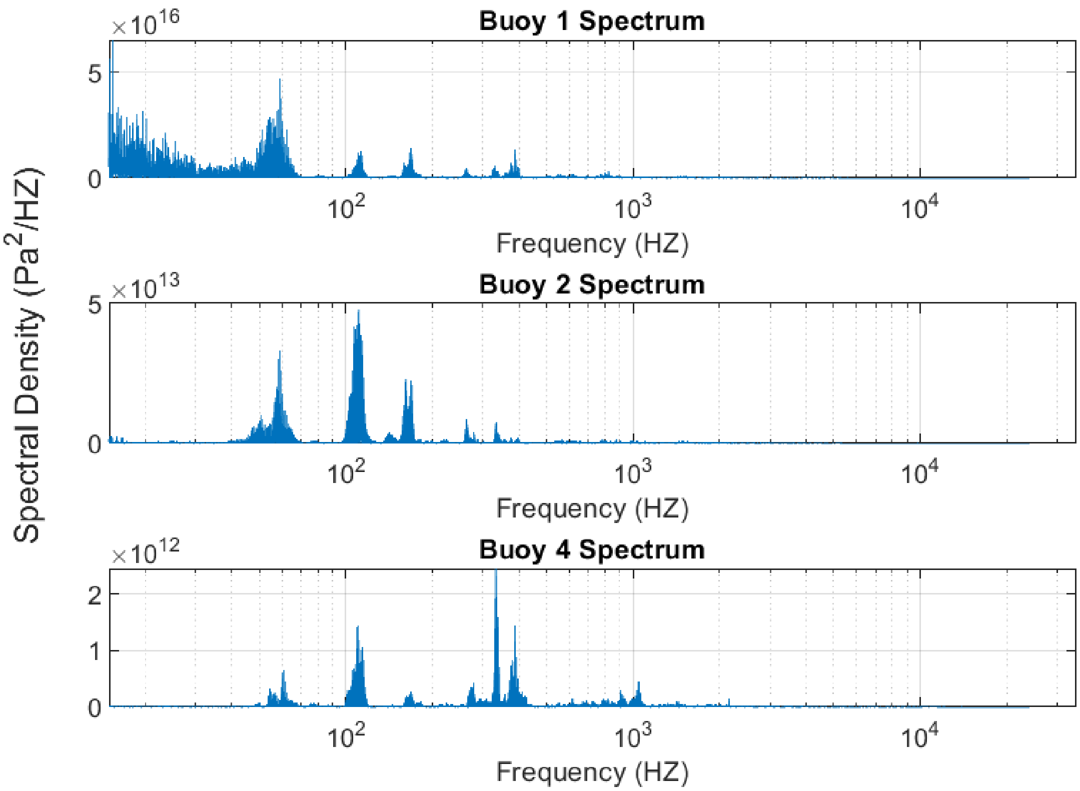
Buoy 1 Spectrum
×10^16
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
×10^13
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^12
5
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

HF-17

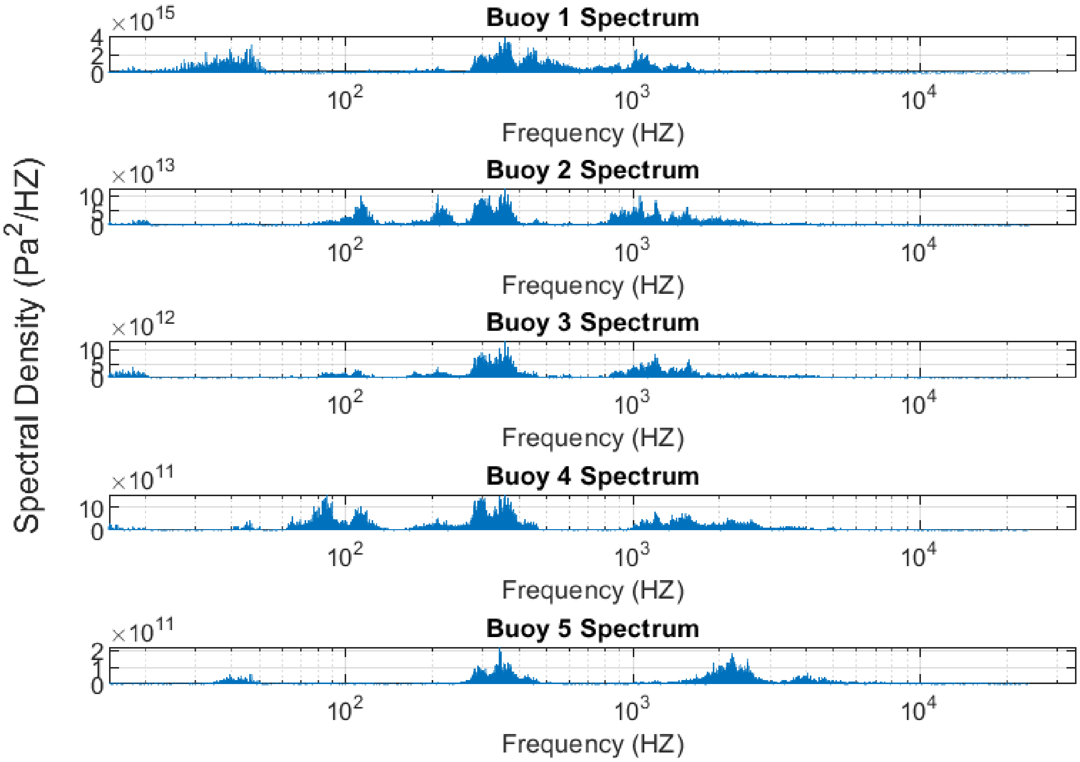


Buoy 1 Spectrum
×10^16
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
×10^13
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^11
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

HF-18

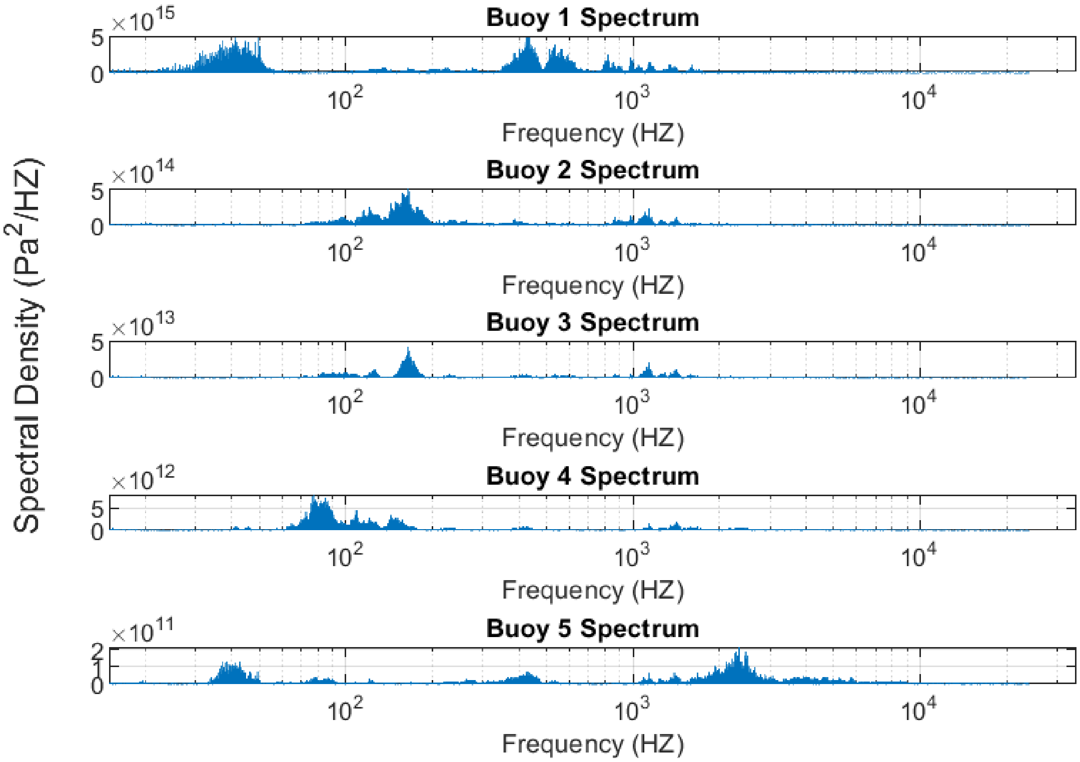

Buoy 1 Spectrum
×10^16
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
×10^13
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^12
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

HF-19

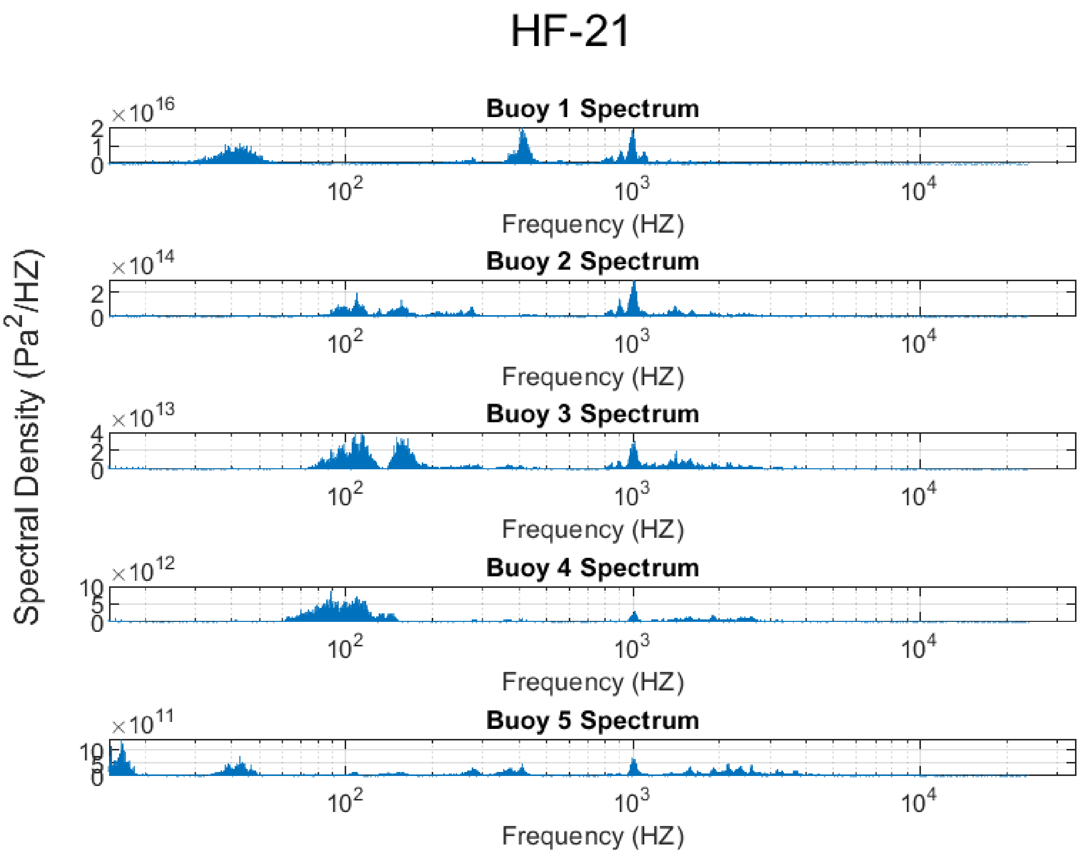


Spectral Density (Pa^2/HZ)
Buoy 1 Spectrum
×10^15
Buoy 2 Spectrum
×10^13
Buoy 3 Spectrum
×10^12
Buoy 4 Spectrum
×10^11
Buoy 5 Spectrum
×10^11
Frequency (HZ)

HF-20

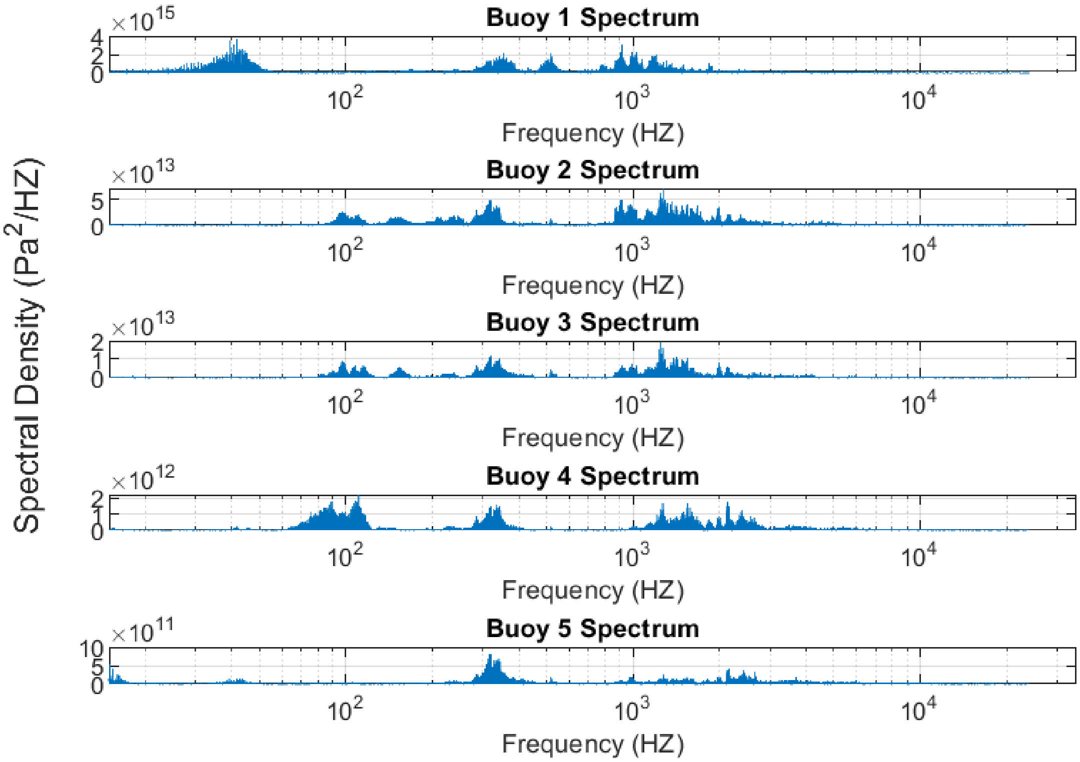


Buoy 1 Spectrum
×10^15
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
×10^14
Buoy 3 Spectrum
×10^13
Buoy 4 Spectrum
×10^12
Buoy 5 Spectrum
×10^11
2
1
Spectral Density (Pa^2/HZ)



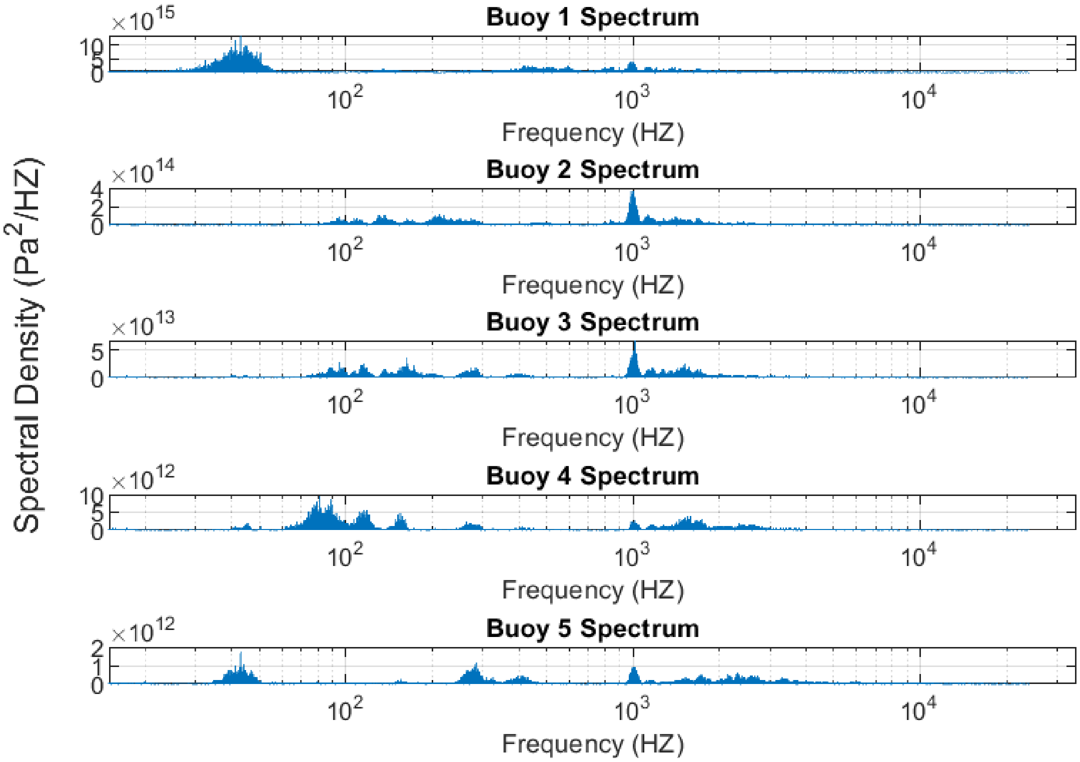
HF-21
Buoy 1 Spectrum
Buoy 2 Spectrum
Buoy 3 Spectrum
Buoy 4 Spectrum
Buoy 5 Spectrum
Spectral Density (Pa^2/HZ)
Frequency (HZ)

HF-22



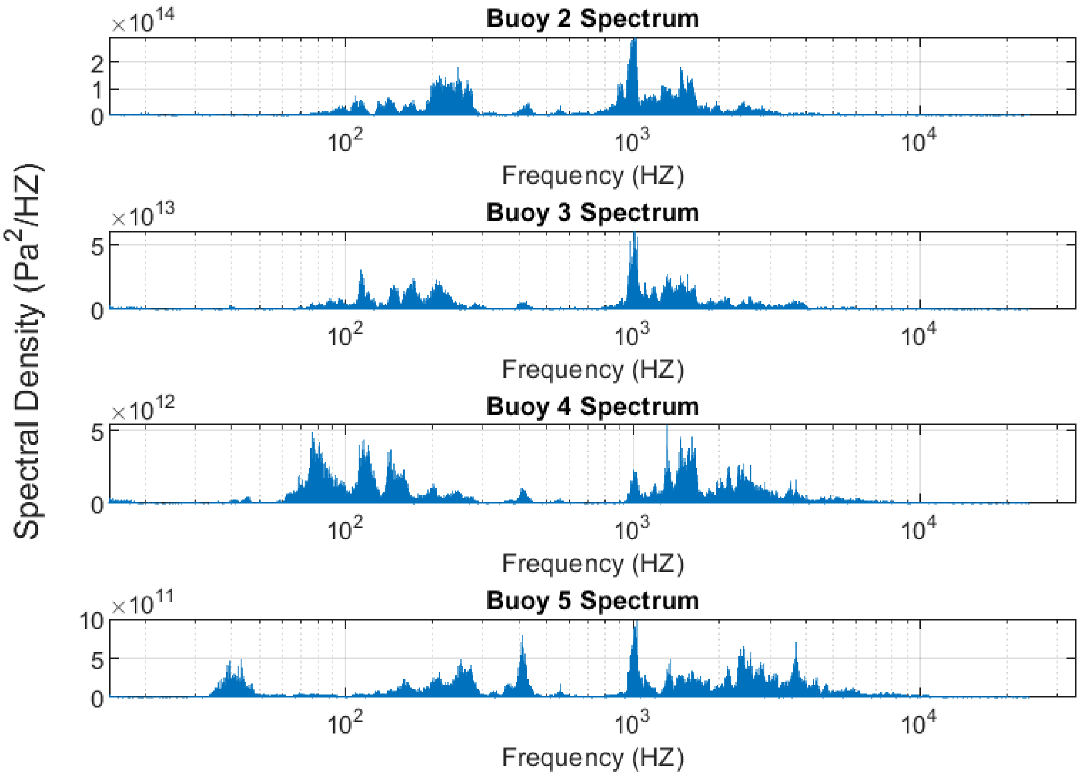
Buoy 1 Spectrum
Buoy 2 Spectrum
Buoy 3 Spectrum
Buoy 4 Spectrum
Buoy 5 Spectrum
Spectral Density (Pa²/HZ)
Frequency (HZ)

HF-23



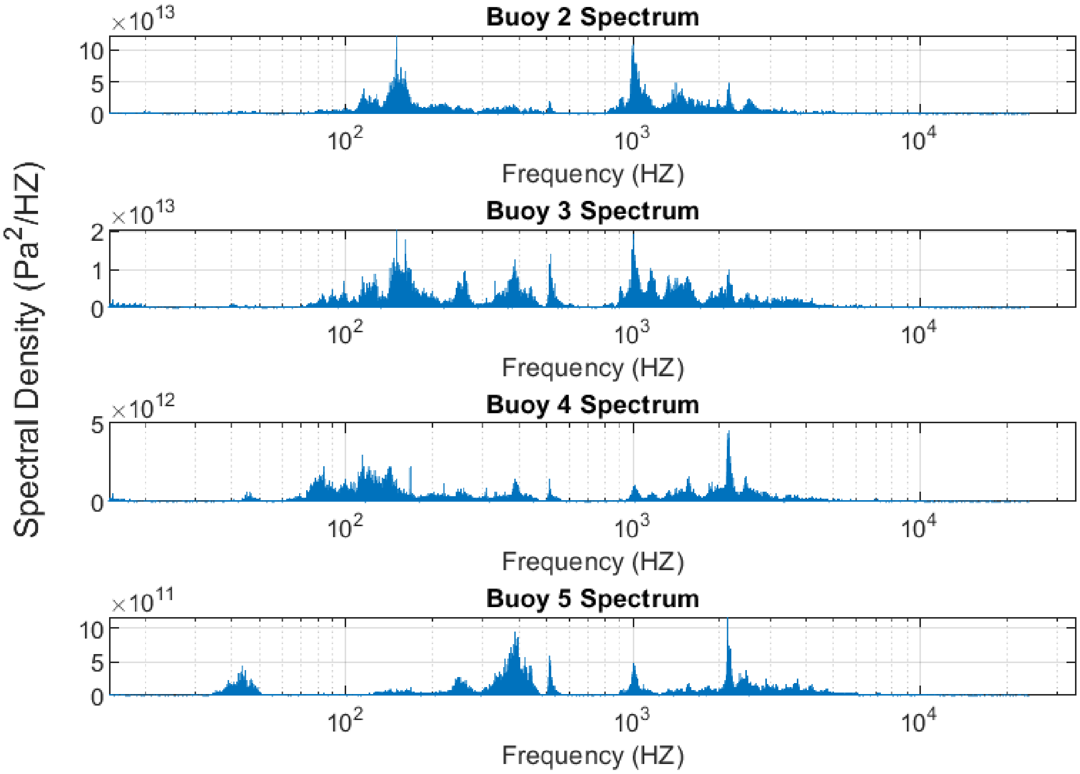
Buoy 1 Spectrum
×10^15
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
×10^14
4
2
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
×10^13
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^12
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^12
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

HF - 24

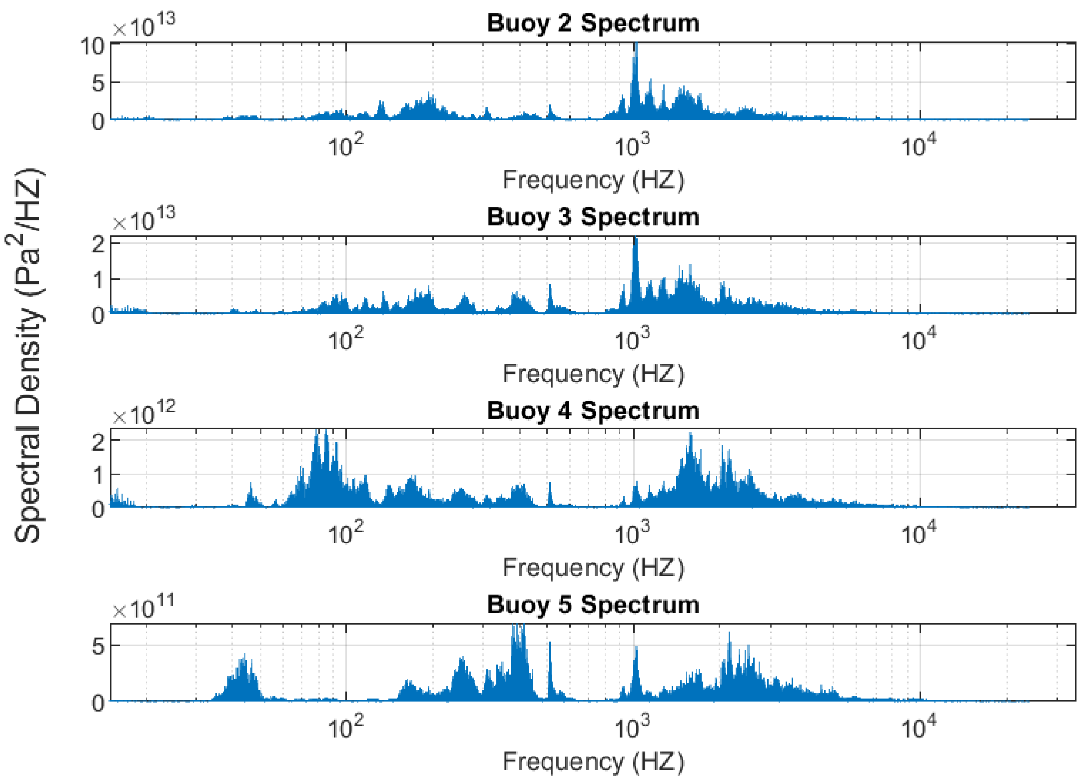


Spectral Density (Pa^2/HZ)
Buoy 2 Spectrum
$\times10^{14}$
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
$\times10^{13}$
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
$\times10^{12}$
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
$\times10^{11}$
10
5
0
10^2
10^3
10^4
Frequency (HZ)

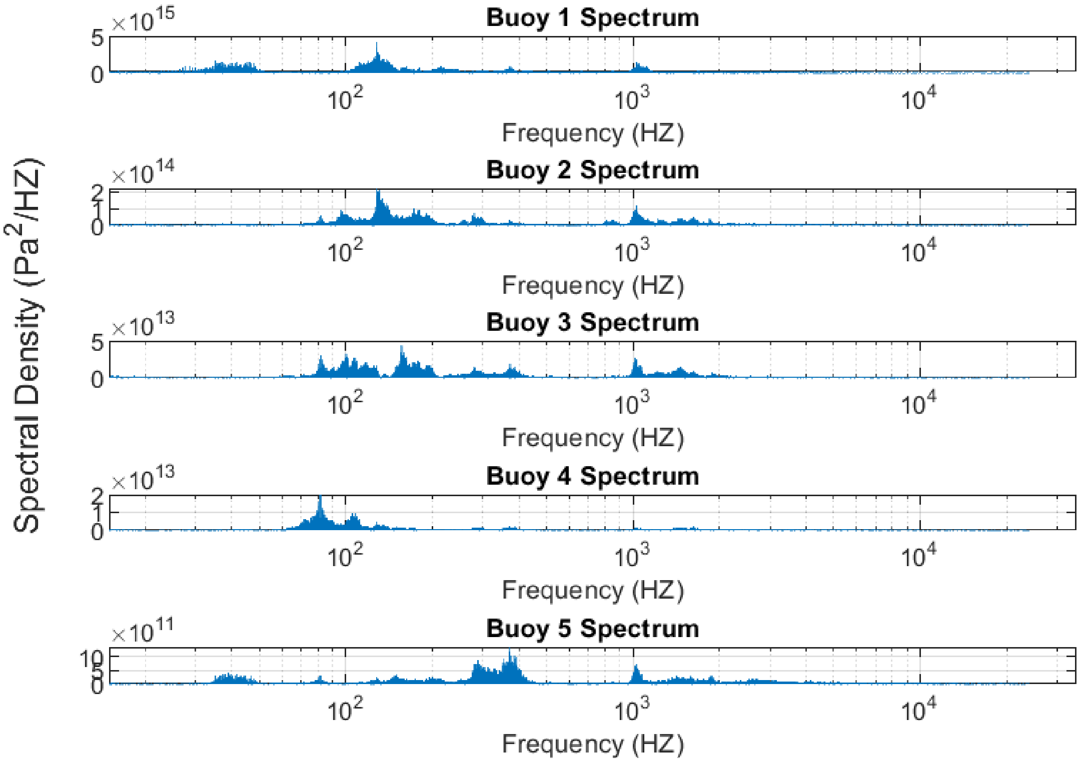
HF - 25


Spectral Density (Pa^2/HZ)
Buoy 2 Spectrum
$\times 10^{13}$
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
$\times 10^{13}$
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
$\times 10^{12}$
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
$\times 10^{11}$
10
5
0
10^2
10^3
10^4
Frequency (HZ)

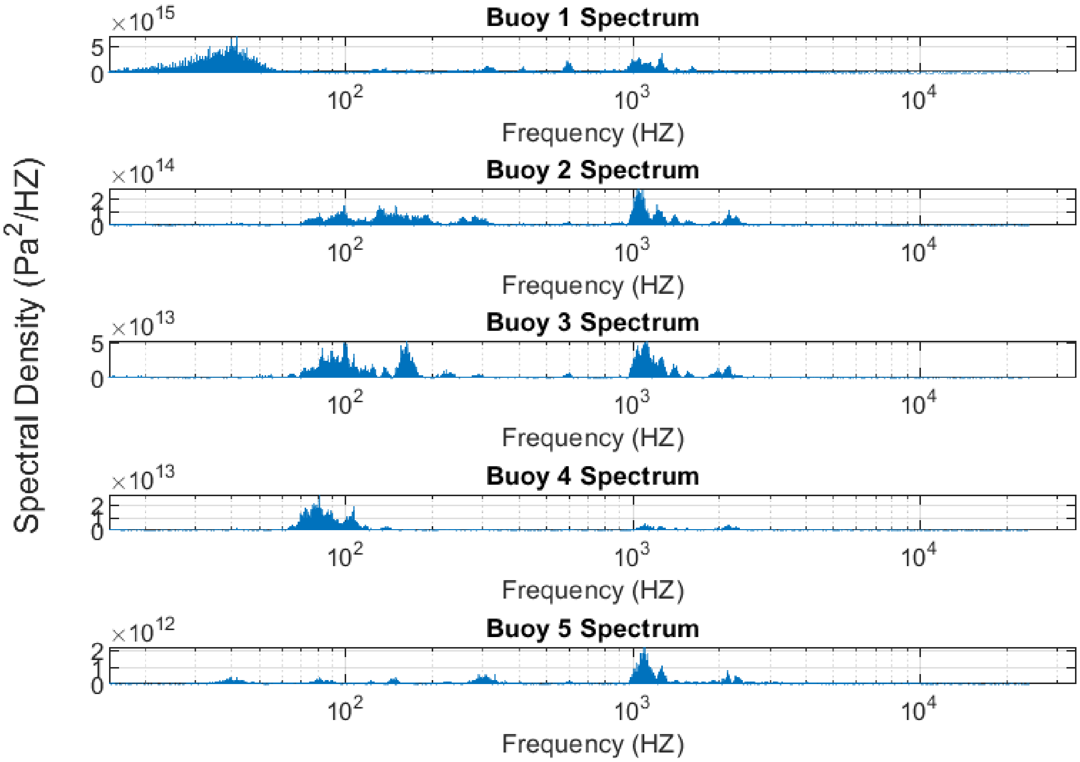
HF - 26


Buoy 2 Spectrum
×10^13
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
×10^13
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^12
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^11
5
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

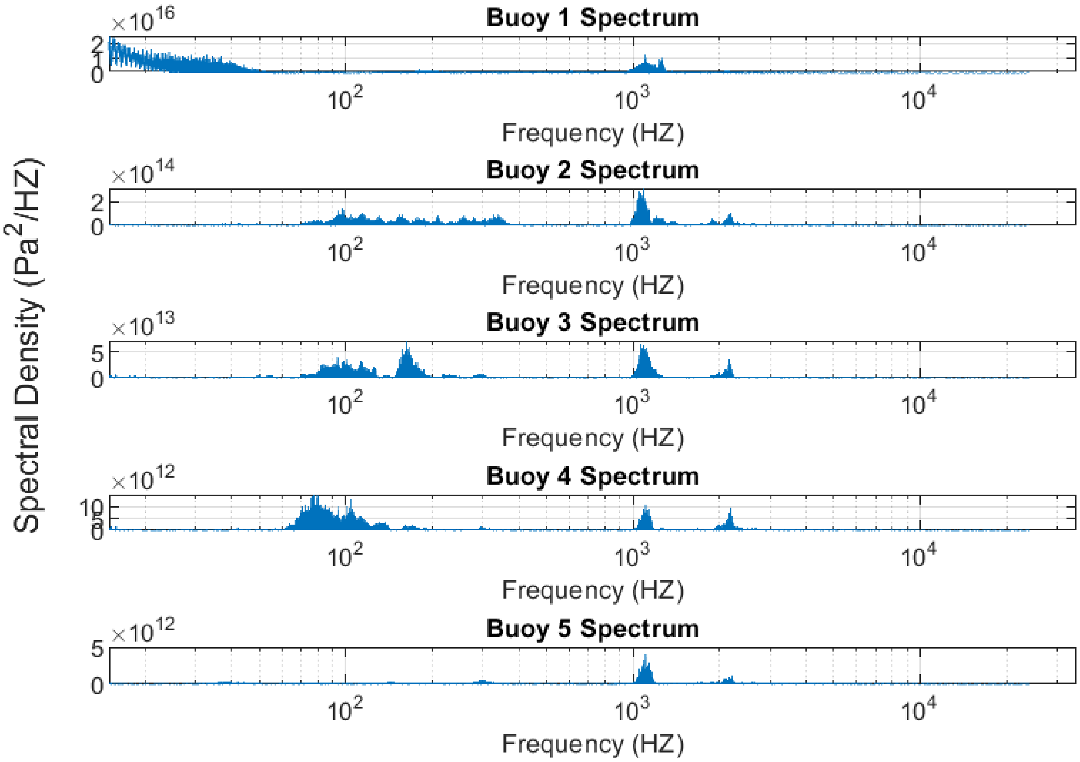
HF-27

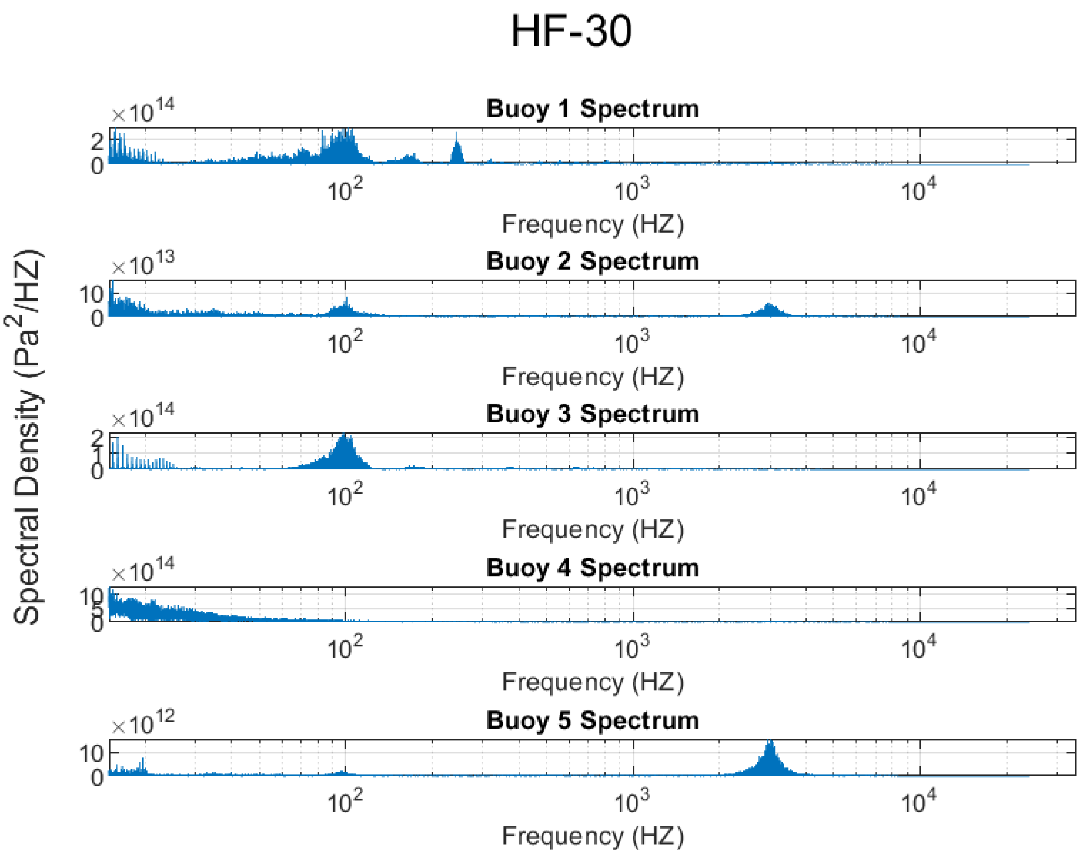

Buoy 1 Spectrum
Buoy 2 Spectrum
Buoy 3 Spectrum
Buoy 4 Spectrum
Buoy 5 Spectrum
Spectral Density (Pa^2/HZ)
Frequency (HZ)
×10^15
×10^14
×10^13
×10^13
×10^11
10^2
10^3
10^4

HF-28

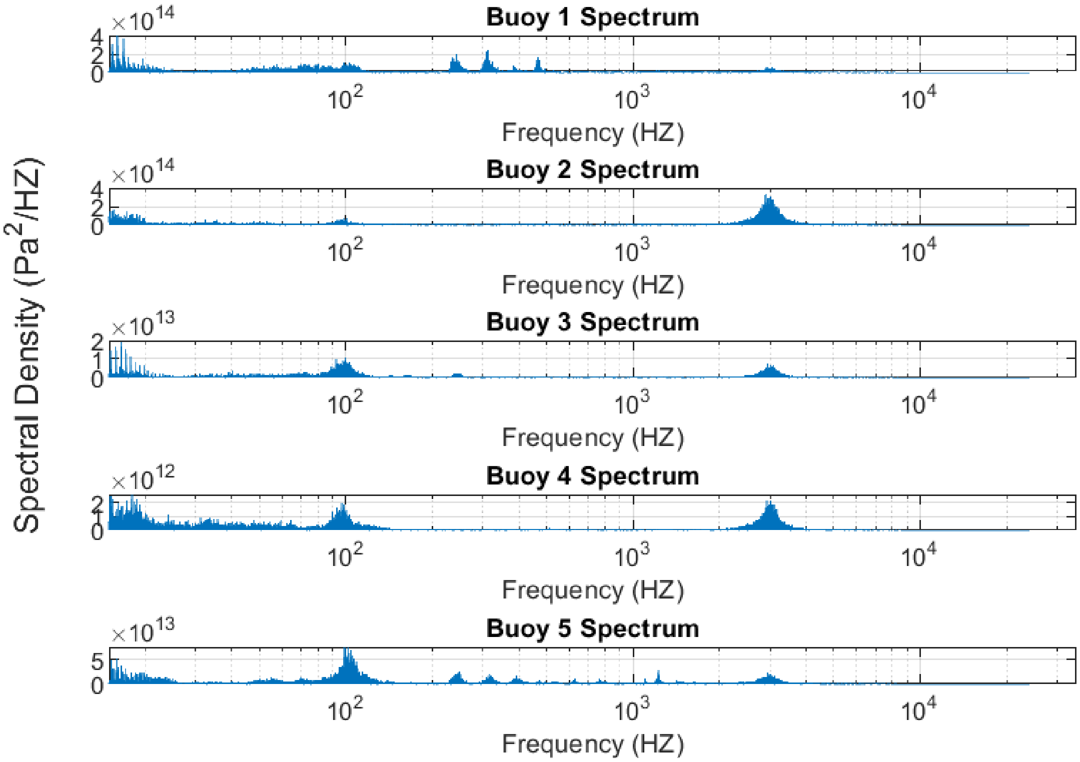

Spectral Density (Pa²/HZ)
×10¹⁵
Buoy 1 Spectrum
5
0
10²
10³
10⁴
Frequency (HZ)
×10¹⁴
Buoy 2 Spectrum
2
1
0
10²
10³
10⁴
Frequency (HZ)
×10¹³
Buoy 3 Spectrum
5
0
10²
10³
10⁴
Frequency (HZ)
×10¹³
Buoy 4 Spectrum
2
1
0
10²
10³
10⁴
Frequency (HZ)
×10¹²
Buoy 5 Spectrum
2
1
0
10²
10³
10⁴
Frequency (HZ)

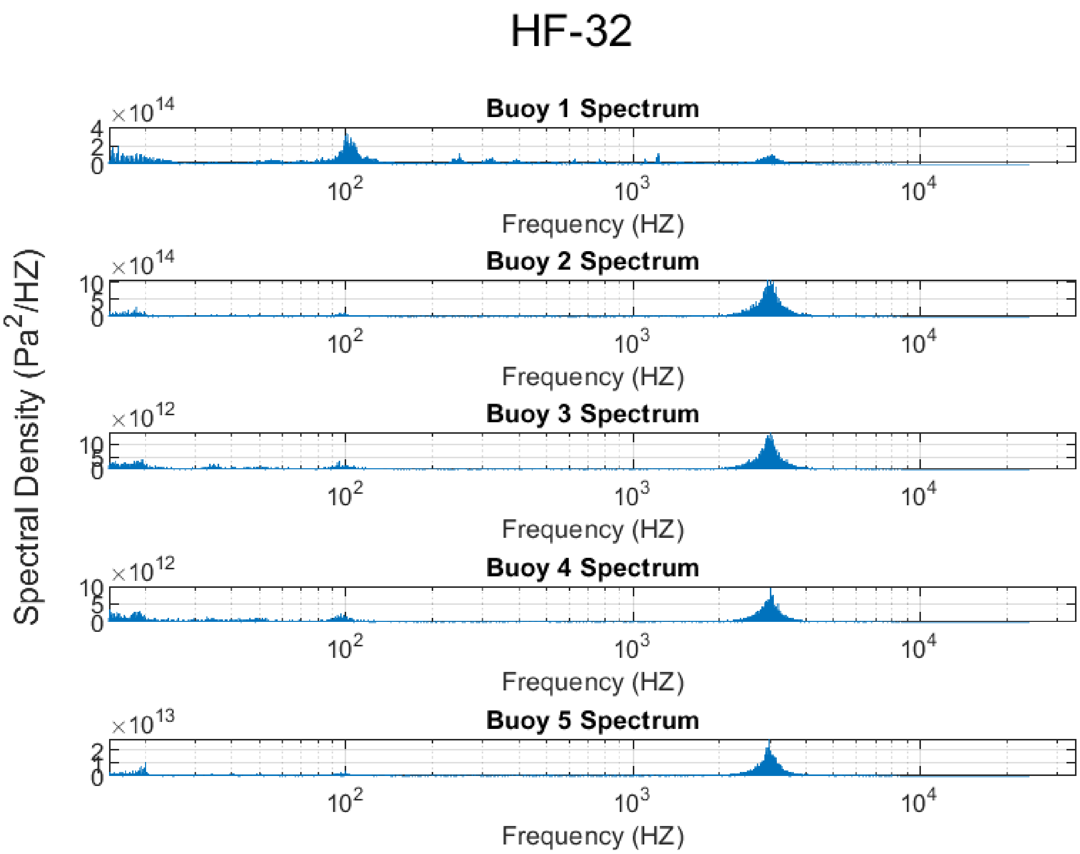
HF-29


Buoy 1 Spectrum
Buoy 2 Spectrum
Buoy 3 Spectrum
Buoy 4 Spectrum
Buoy 5 Spectrum
Spectral Density (Pa²/HZ)
Frequency (HZ)

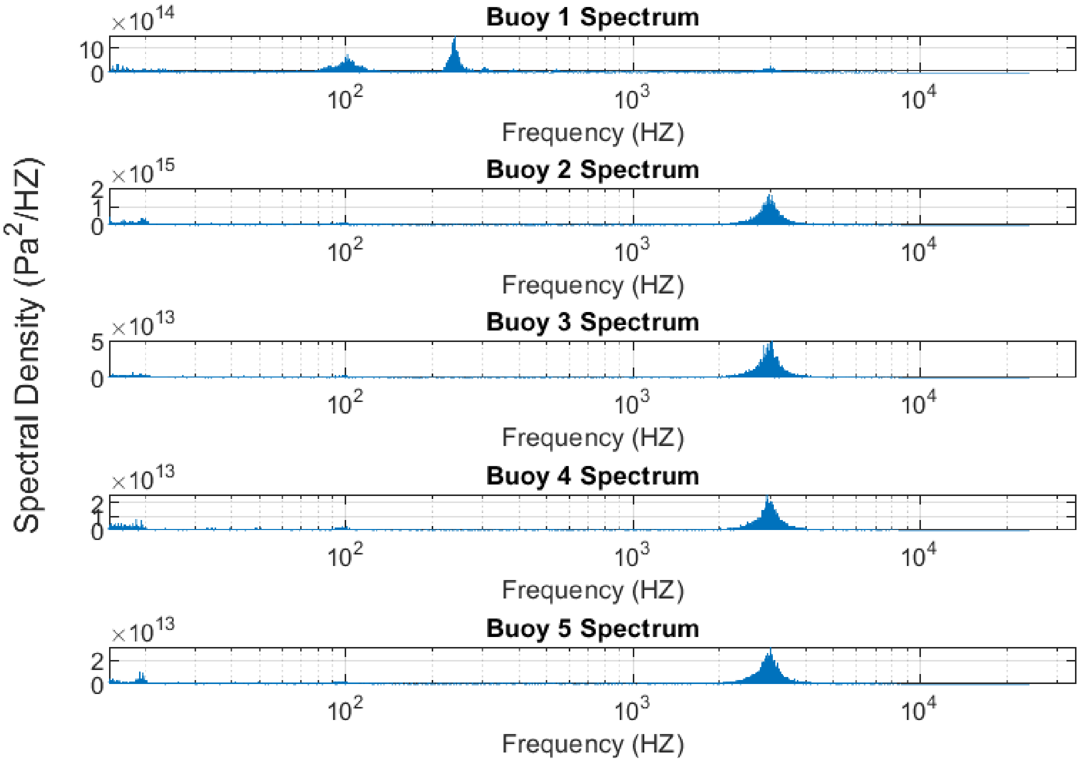

HF-30
Spectral Density (Pa^2/HZ)
Buoy 1 Spectrum
×10^14
2
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
×10^13
10
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
×10^14
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^14
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^12
10
0
10^2
10^3
10^4
Frequency (HZ)

HF-31


Spectral Density (Pa^2/HZ)
Buoy 1 Spectrum
$\times 10^{14}$
4
2
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
$\times 10^{14}$
4
2
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
$\times 10^{13}$
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
$\times 10^{12}$
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
$\times 10^{13}$
5
0
10^2
10^3
10^4
Frequency (HZ)

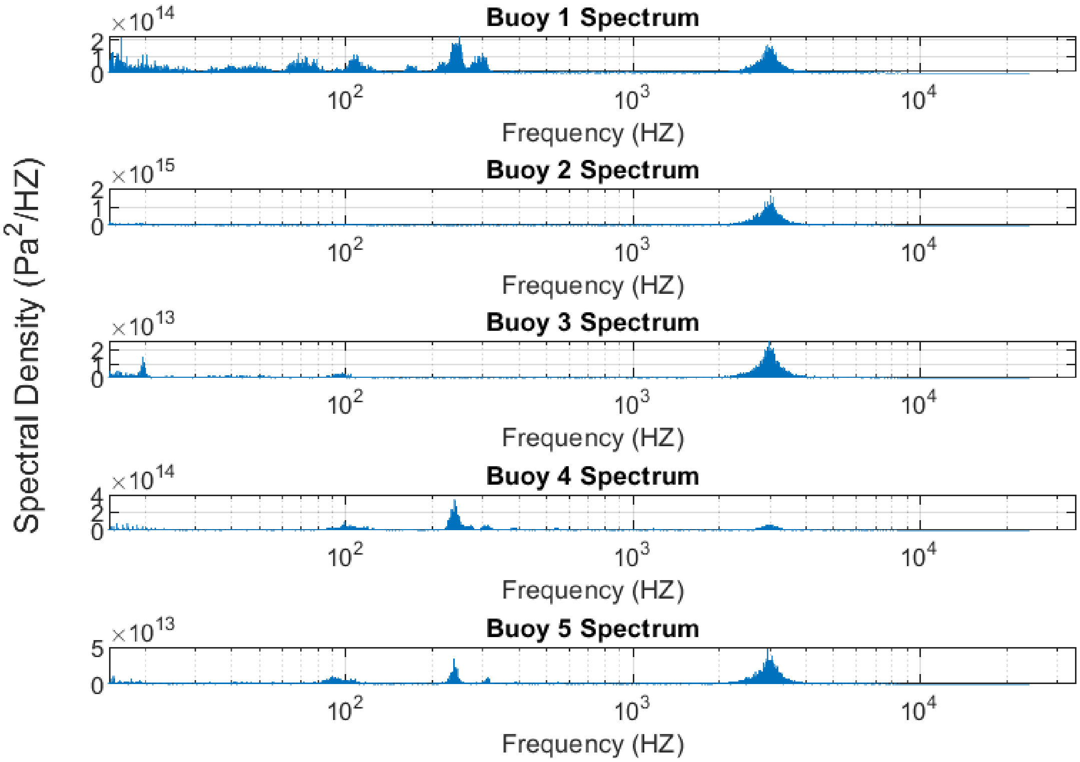

HF-32
Buoy 1 Spectrum
Buoy 2 Spectrum
Buoy 3 Spectrum
Buoy 4 Spectrum
Buoy 5 Spectrum
Spectral Density (Pa^2/HZ)
Frequency (HZ)
$\times 10^{14}$
$\times 10^{12}$
$\times 10^{13}$
10^2
10^3
10^4

HF-33

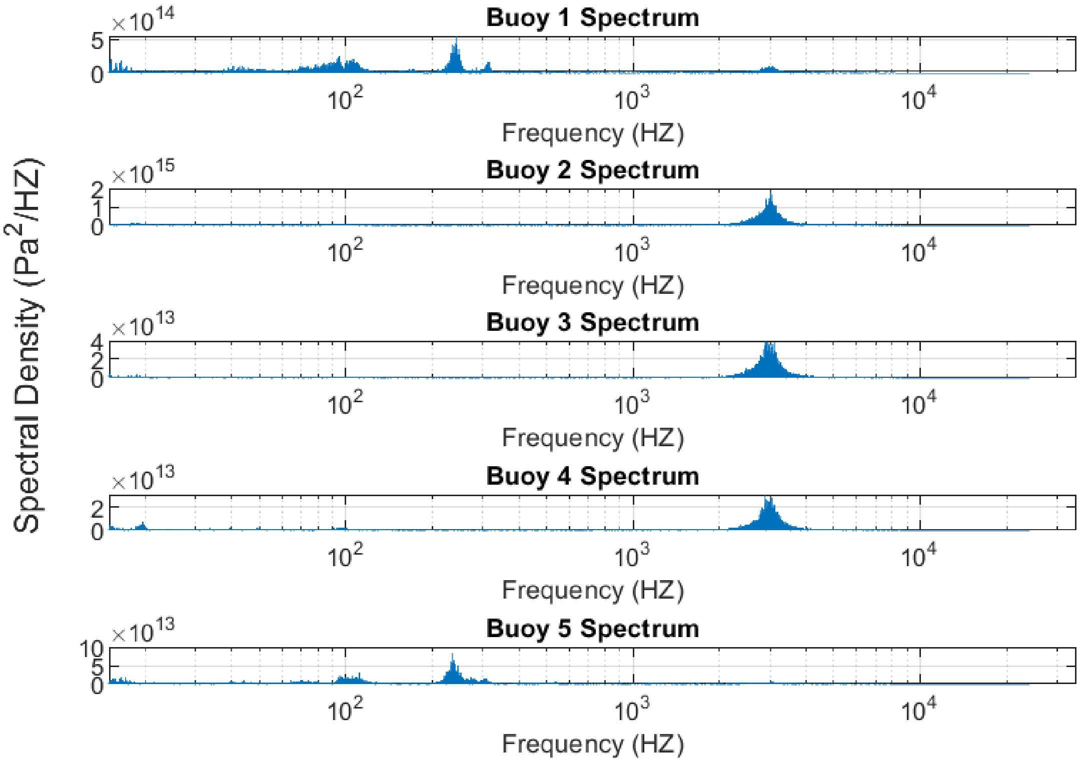


Spectral Density (Pa^2/HZ)
Buoy 1 Spectrum
$\times 10^{14}$
10
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
$\times 10^{15}$
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
$\times 10^{13}$
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
$\times 10^{13}$
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
$\times 10^{13}$
2
0
10^2
10^3
10^4
Frequency (HZ)

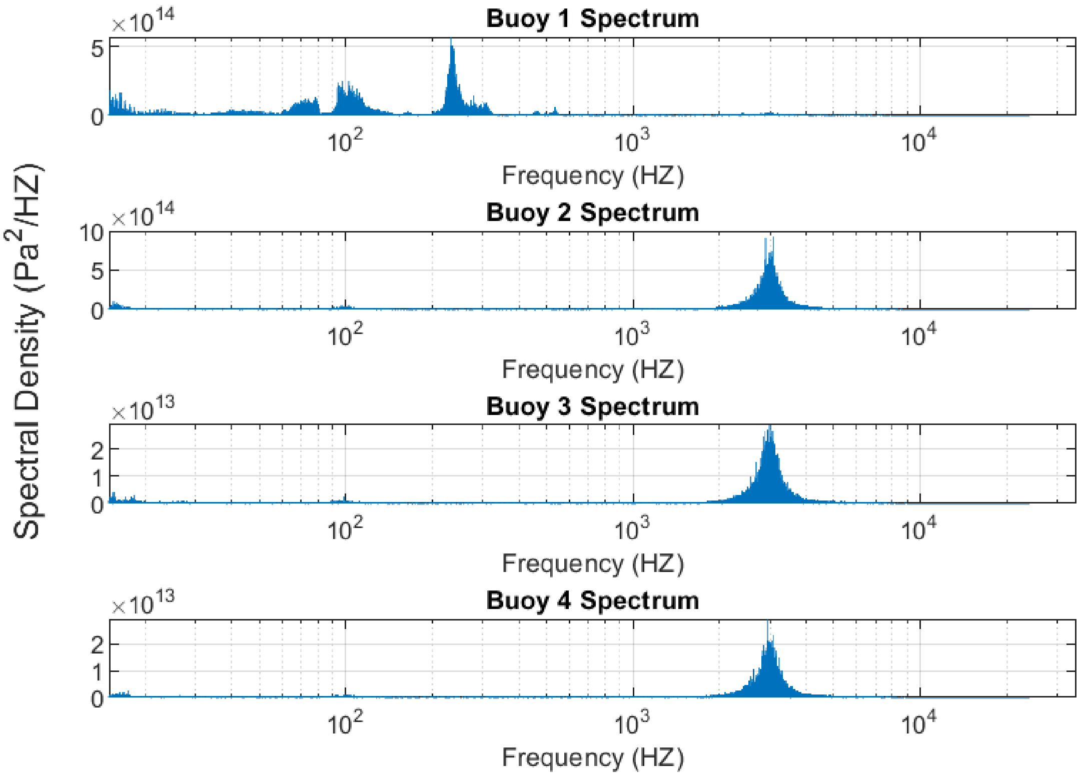
HF-34


Buoy 1 Spectrum
Buoy 2 Spectrum
Buoy 3 Spectrum
Buoy 4 Spectrum
Buoy 5 Spectrum
Spectral Density (Pa²/HZ)
Frequency (HZ)
×10^14
×10^15
×10^13
×10^14
×10^13
10^2
10^3
10^4

HF-35

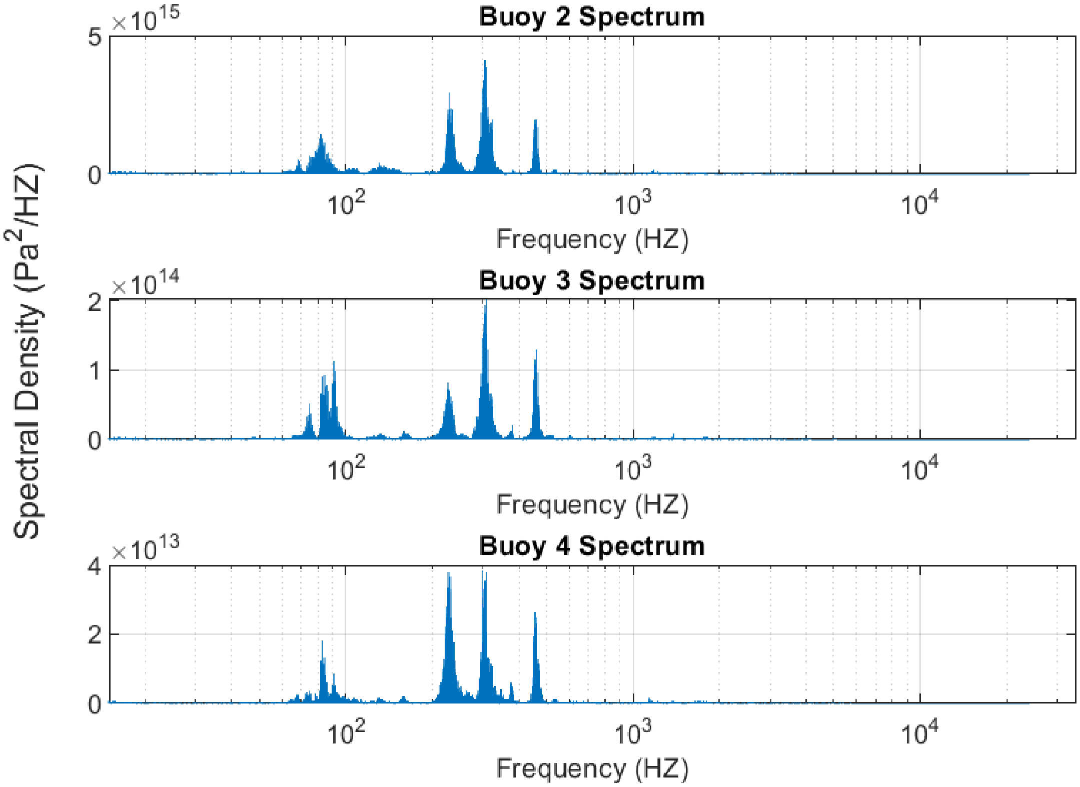

Buoy 1 Spectrum
Buoy 2 Spectrum
Buoy 3 Spectrum
Buoy 4 Spectrum
Buoy 5 Spectrum
Spectral Density (Pa^2/HZ)
Frequency (HZ)
$\times 10^{14}$
$\times 10^{15}$
$\times 10^{13}$
10^2
10^3
10^4

HF - 36

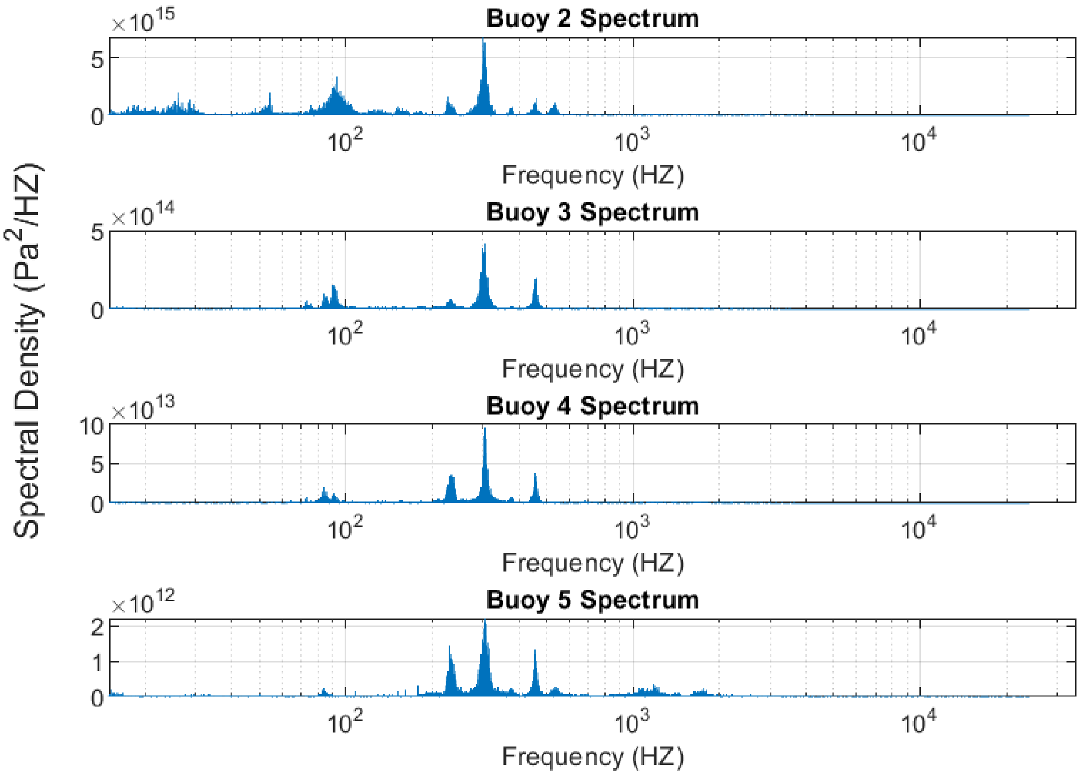


Buoy 1 Spectrum
×10^14
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 2 Spectrum
×10^14
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
×10^13
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^13
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

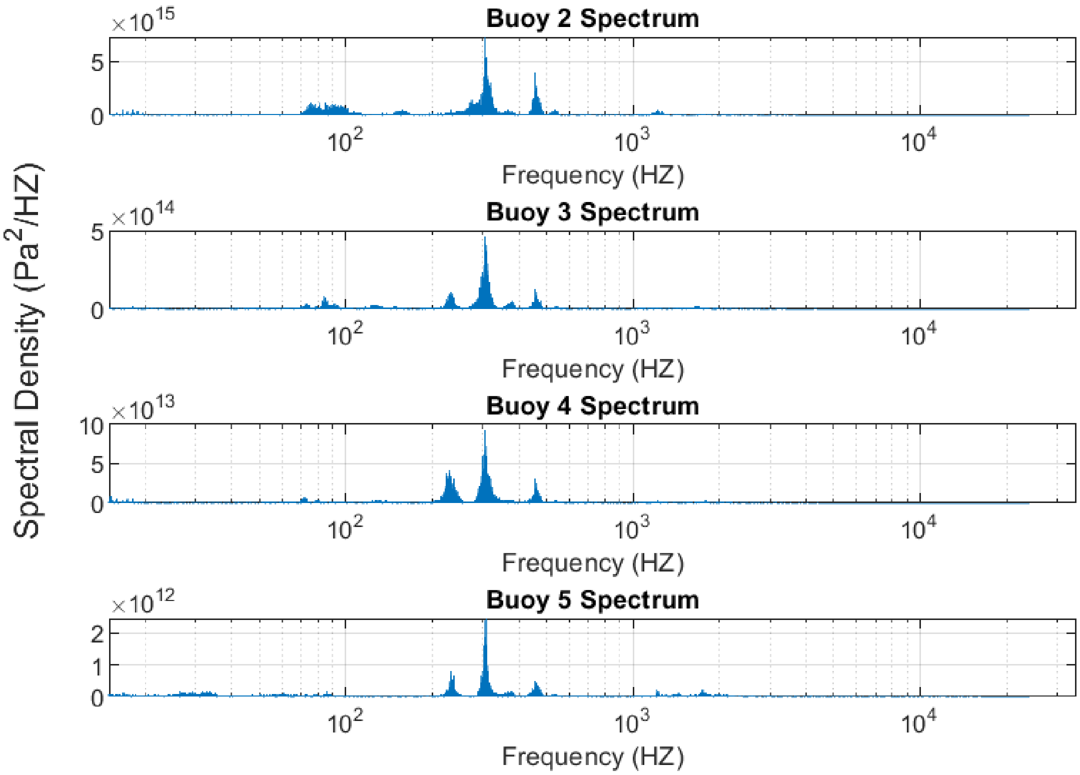
HF - 37

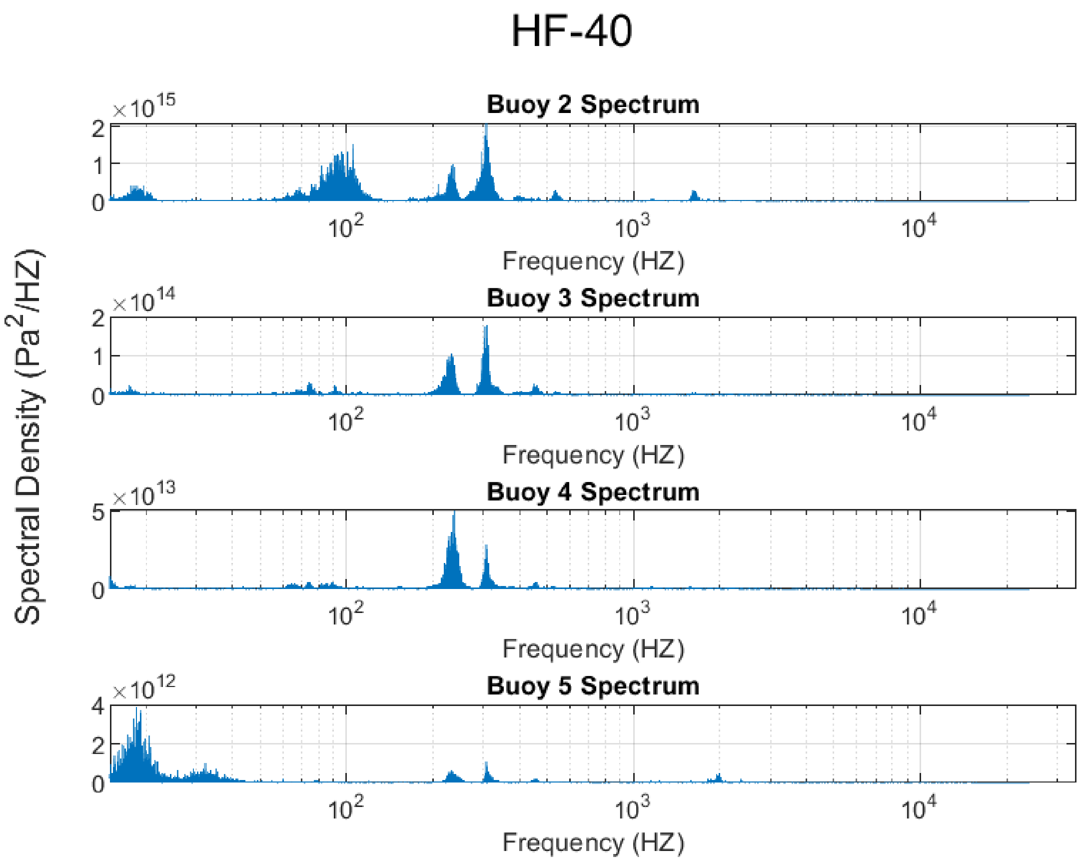

Buoy 2 Spectrum
Buoy 3 Spectrum
Buoy 4 Spectrum
Spectral Density (Pa²/HZ)
Frequency (HZ)
×10^15
×10^14
×10^13
10^2
10^3
10^4

HF-38

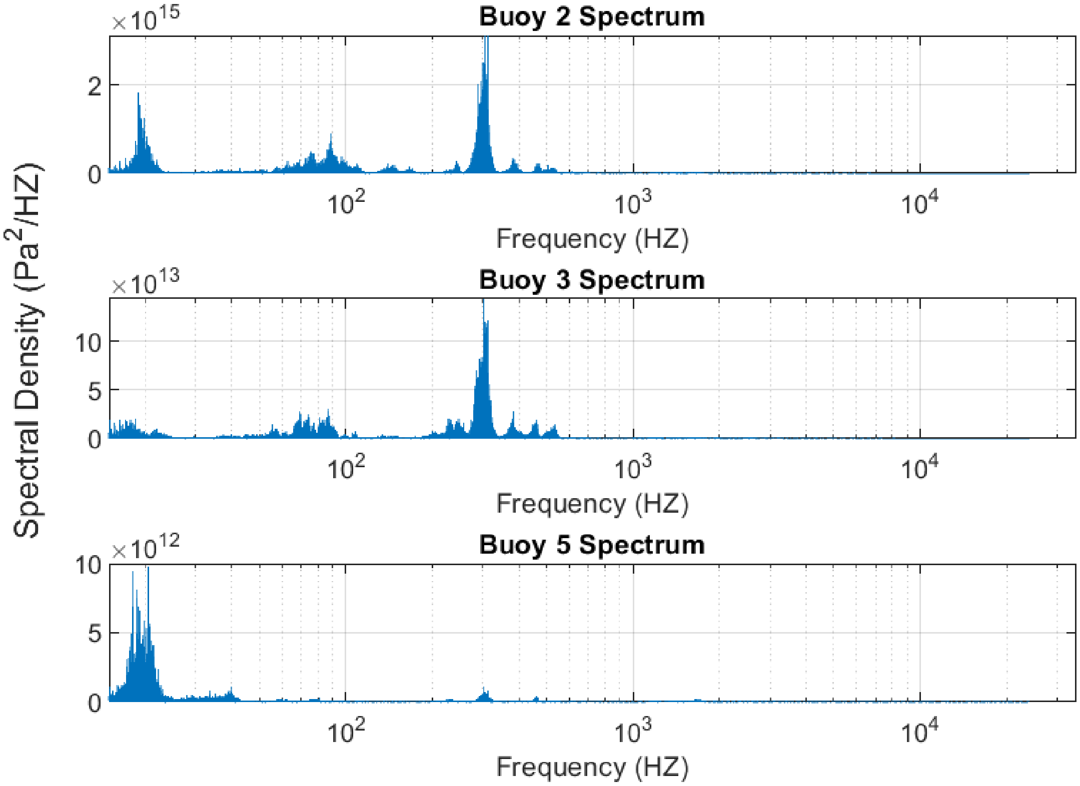

Buoy 2 Spectrum
×10^15
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
×10^14
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^13
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^12
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

HF- 39

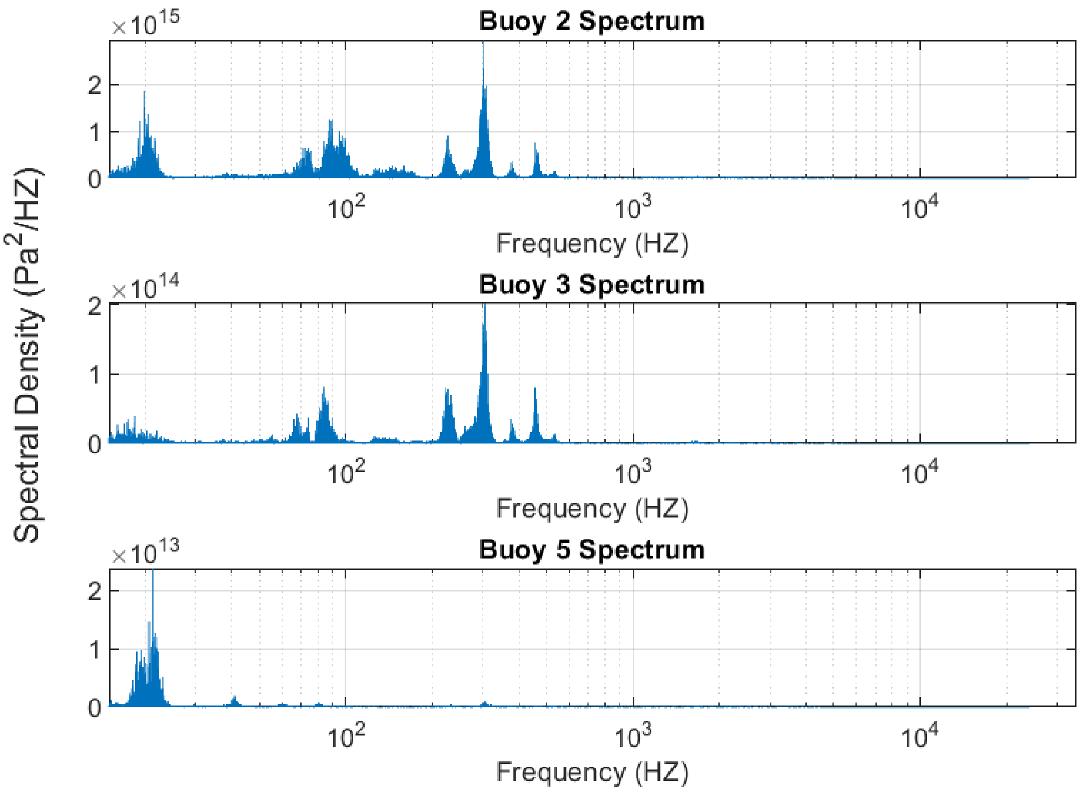

Buoy 2 Spectrum
Buoy 3 Spectrum
Buoy 4 Spectrum
Buoy 5 Spectrum
Spectral Density (Pa²/HZ)
Frequency (HZ)
×10^15
×10^14
×10^13
×10^12
10^2
10^3
10^4


HF-40
Buoy 2 Spectrum
Buoy 3 Spectrum
Buoy 4 Spectrum
Buoy 5 Spectrum
Frequency (HZ)
Spectral Density (Pa²/HZ)

HF- 41

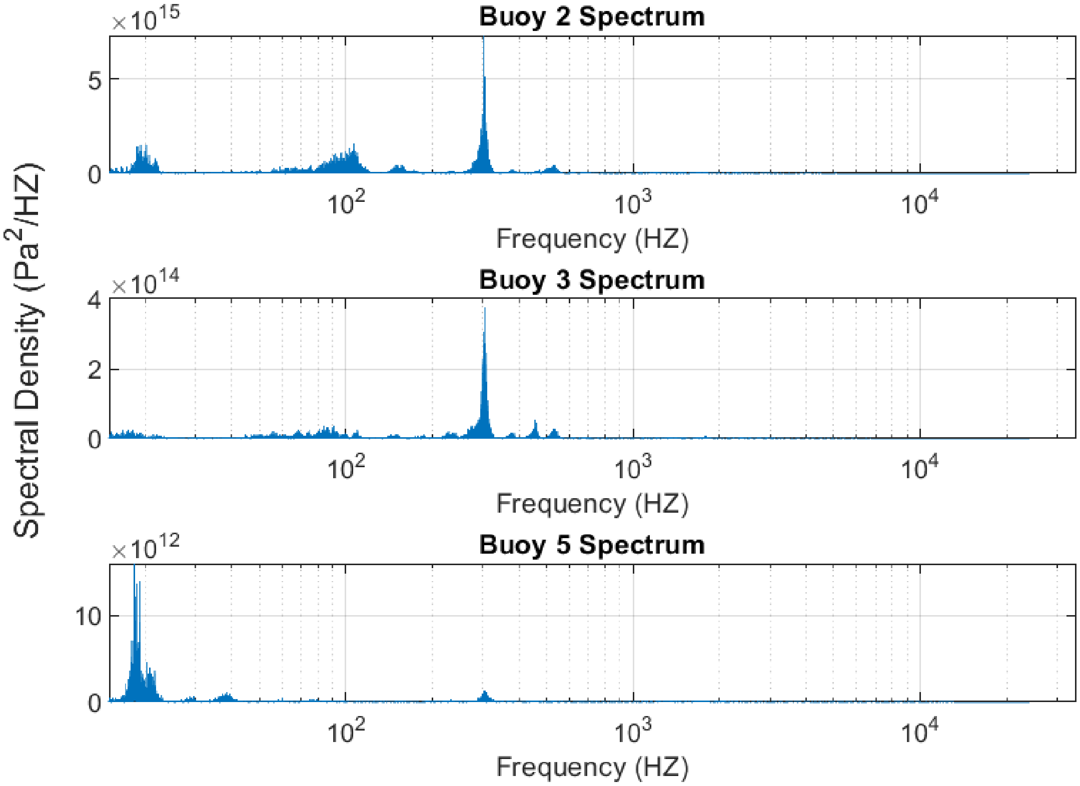

Buoy 2 Spectrum
$\times 10^{15}$
2
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
$\times 10^{13}$
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
$\times 10^{12}$
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

HF- 42

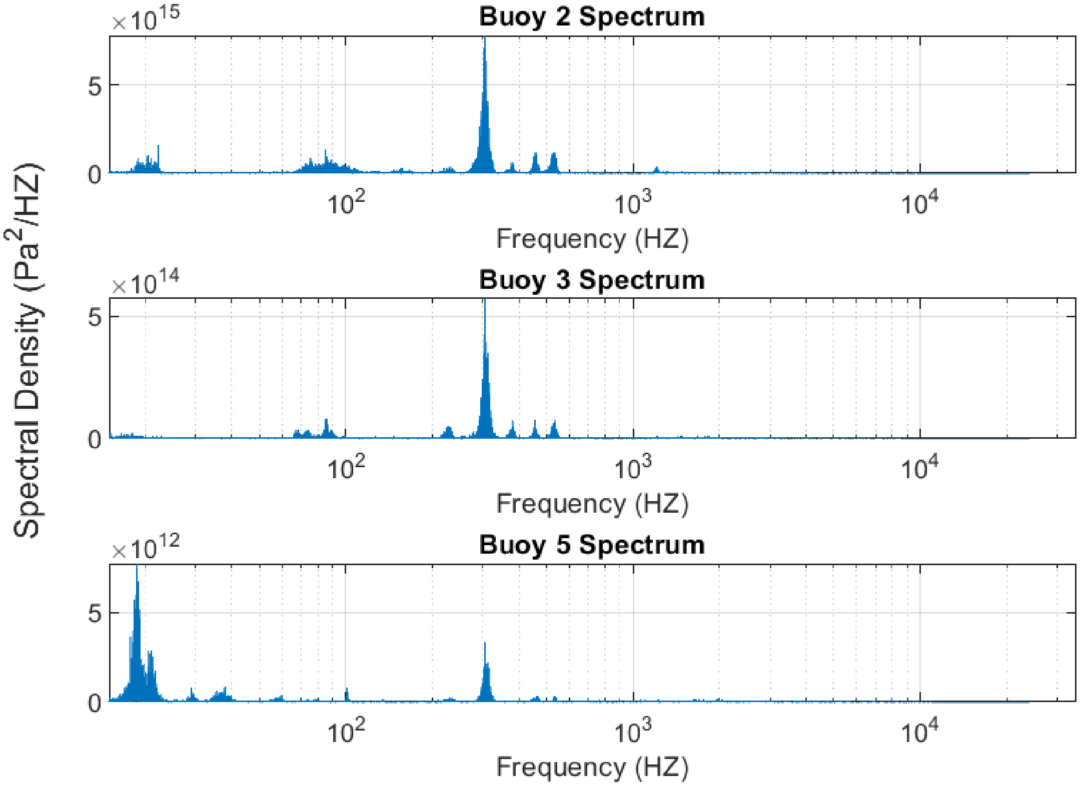


Buoy 2 Spectrum
$\times 10^{15}$
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
$\times 10^{14}$
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
$\times 10^{13}$
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

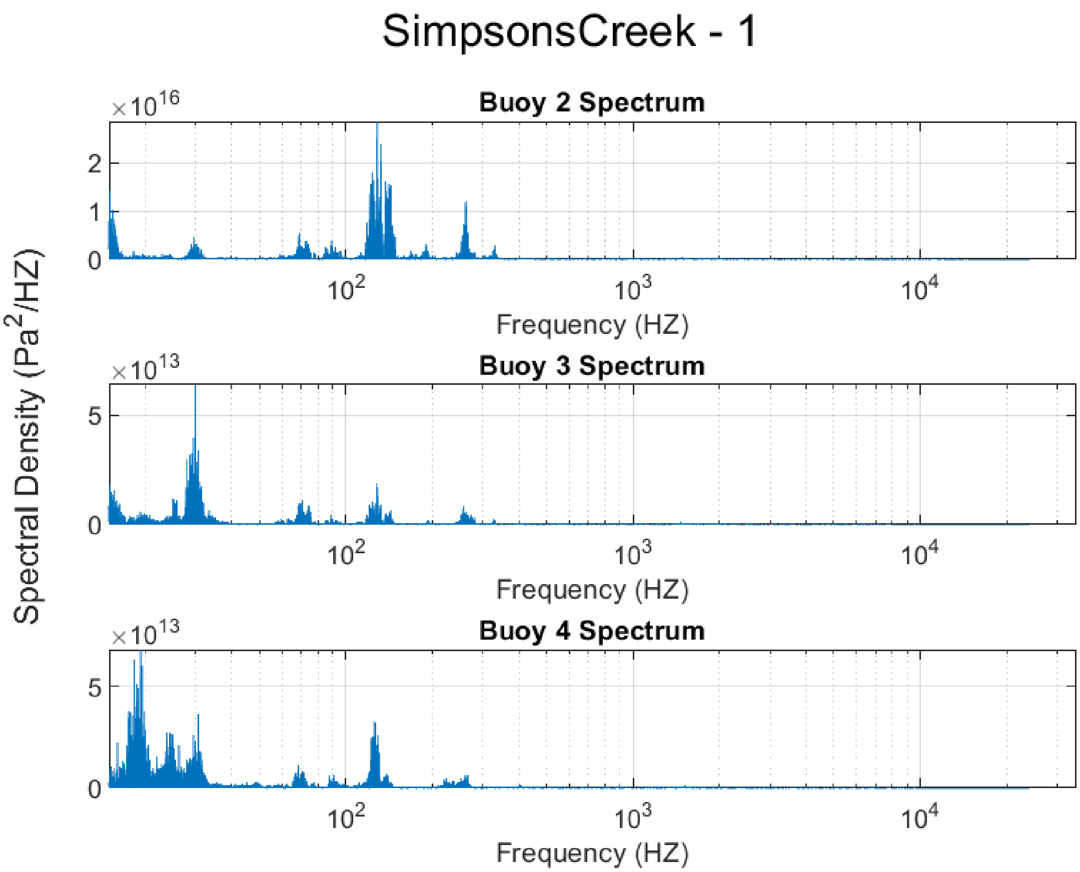
HF- 43

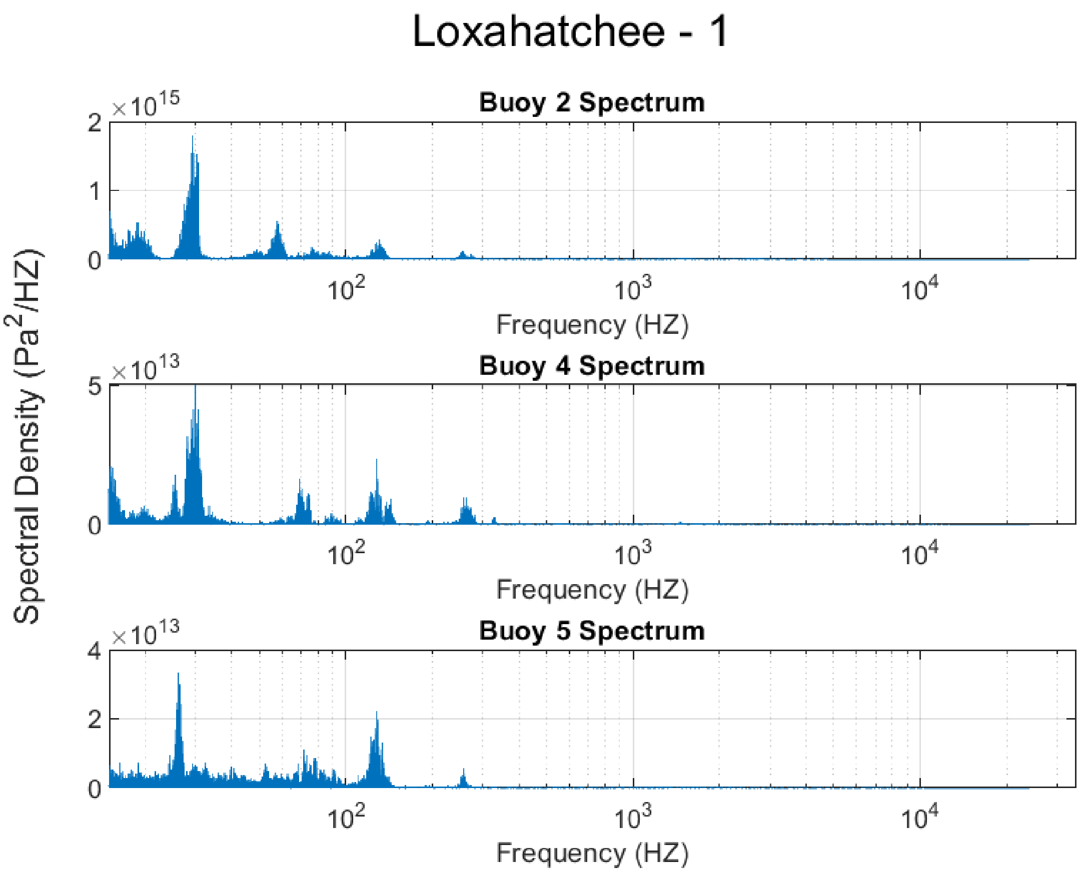

Buoy 2 Spectrum
×10^15
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
×10^14
4
2
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^12
10
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

HF- 44



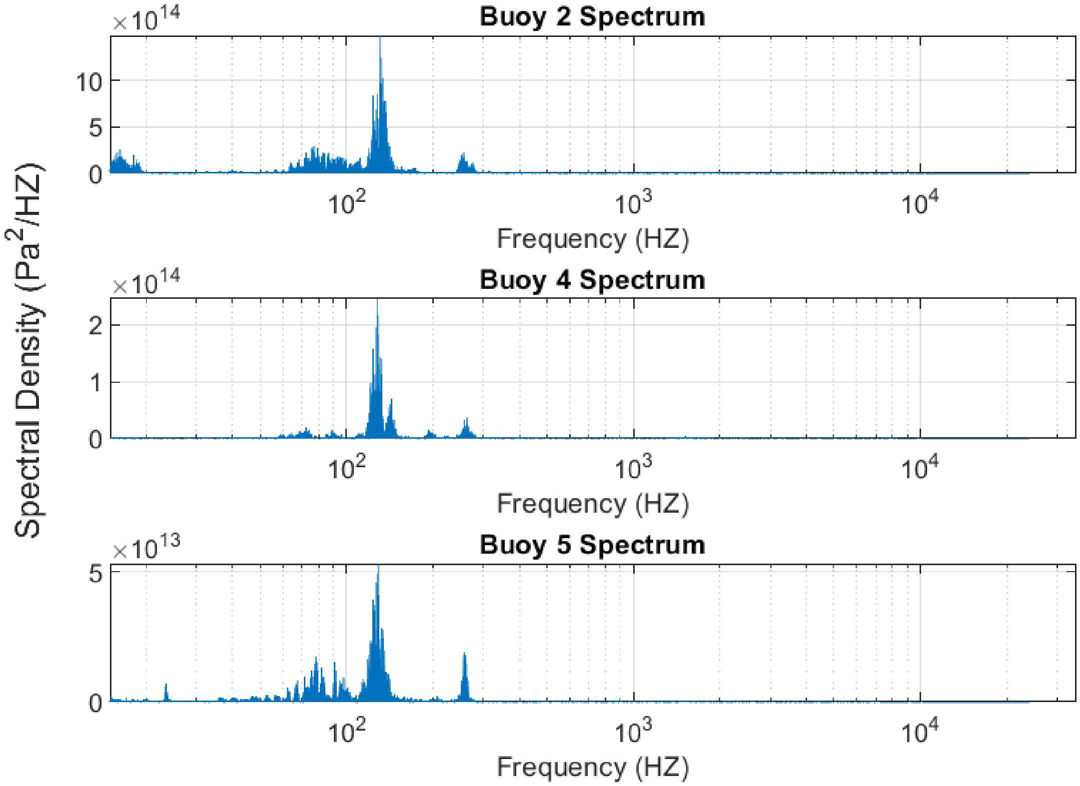
Buoy 2 Spectrum
×10^15
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
×10^14
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^12
5
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

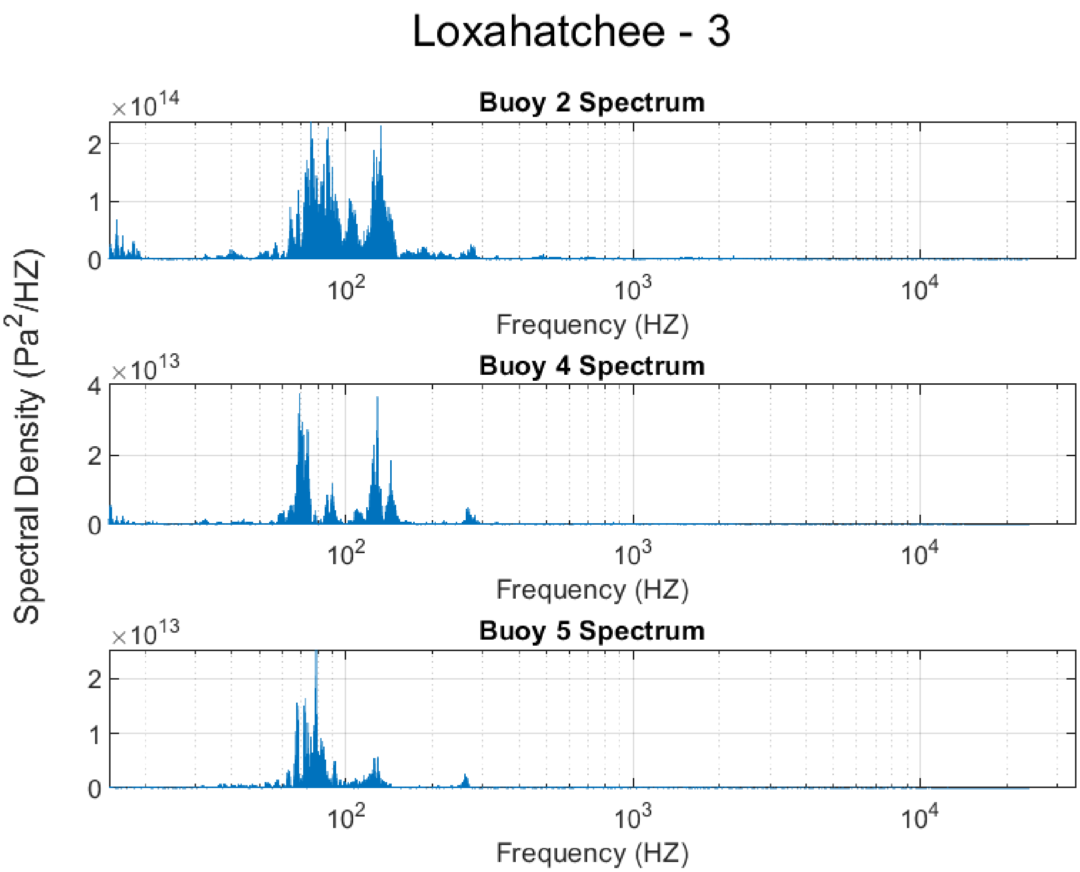

SimpsonsCreek - 1
Buoy 2 Spectrum
×10^16
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 3 Spectrum
×10^13
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^13
5
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)



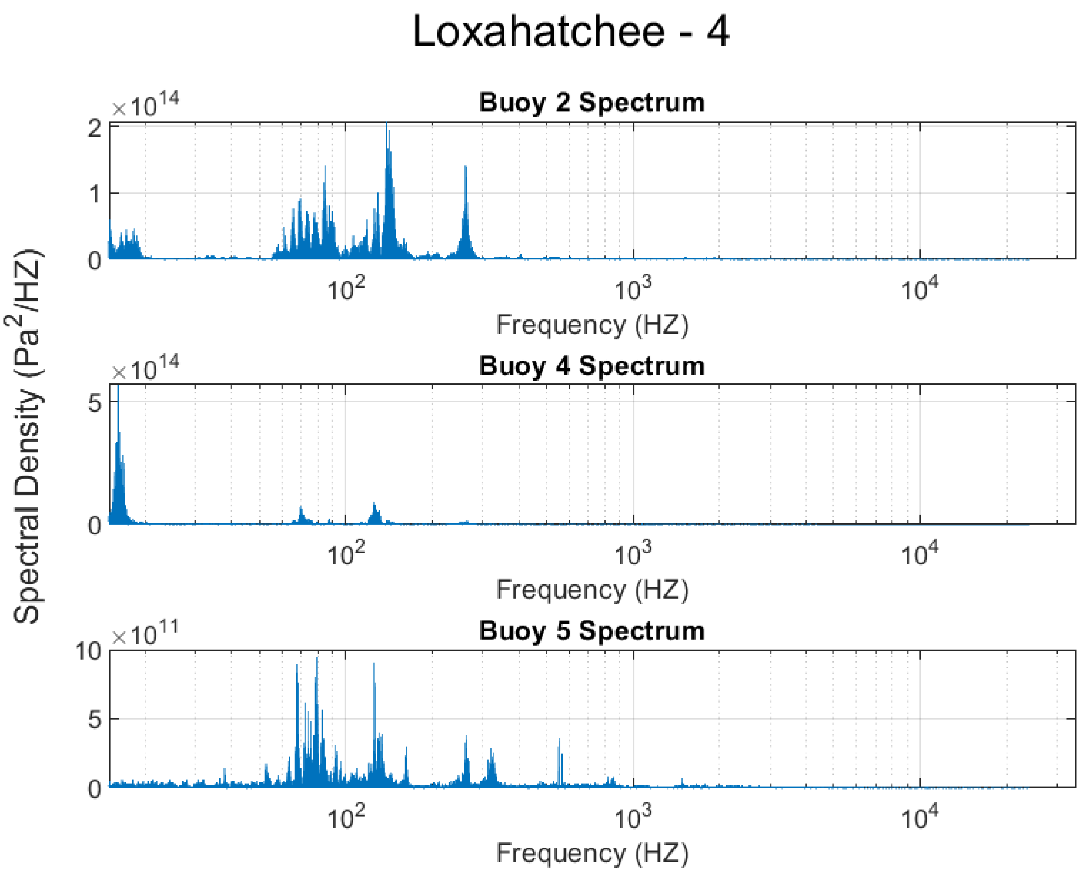
Loxahatchee - 1
Buoy 2 Spectrum
×10^15
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^13
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^13
4
2
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

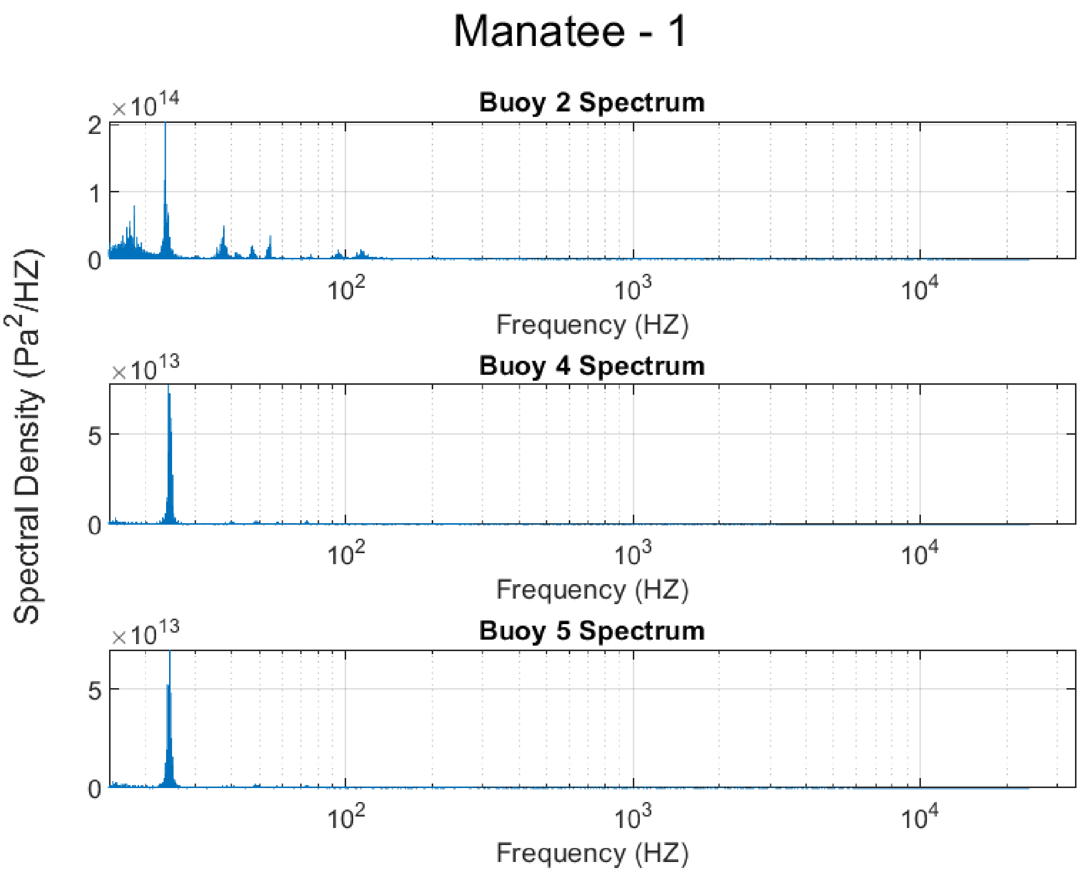
Loxahatchee - 2

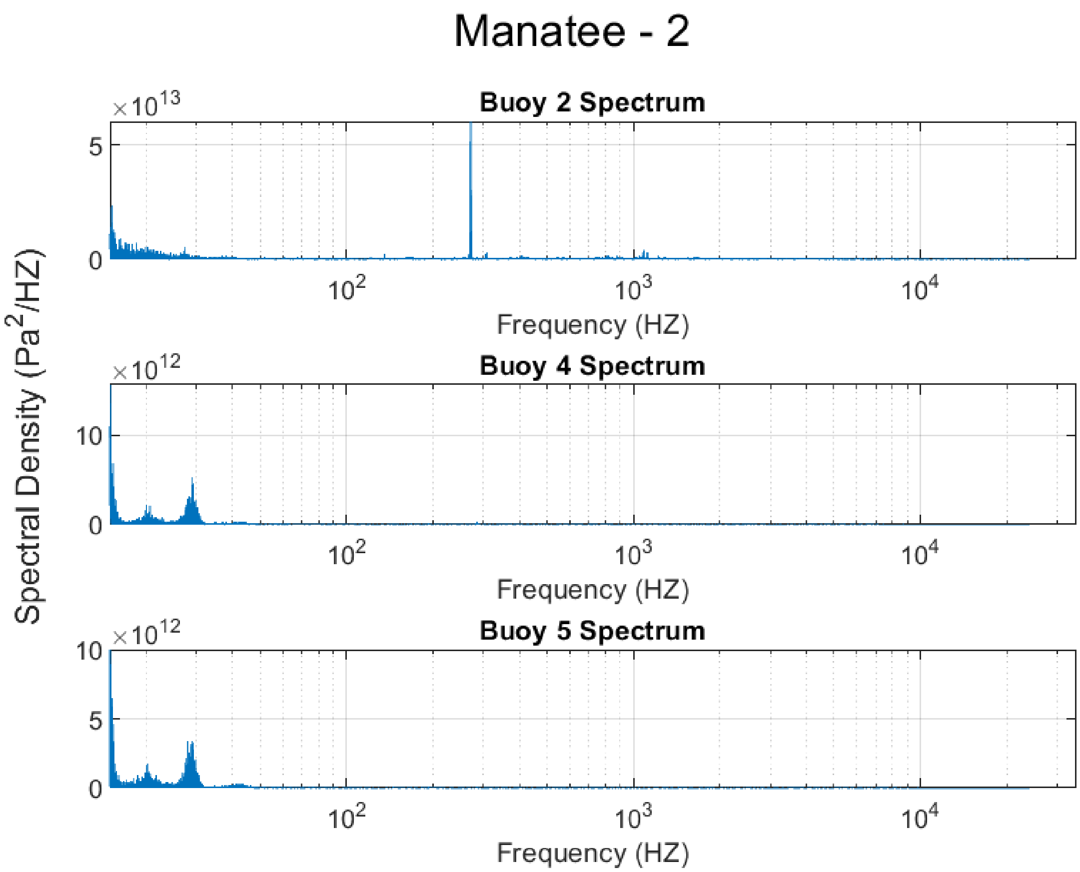




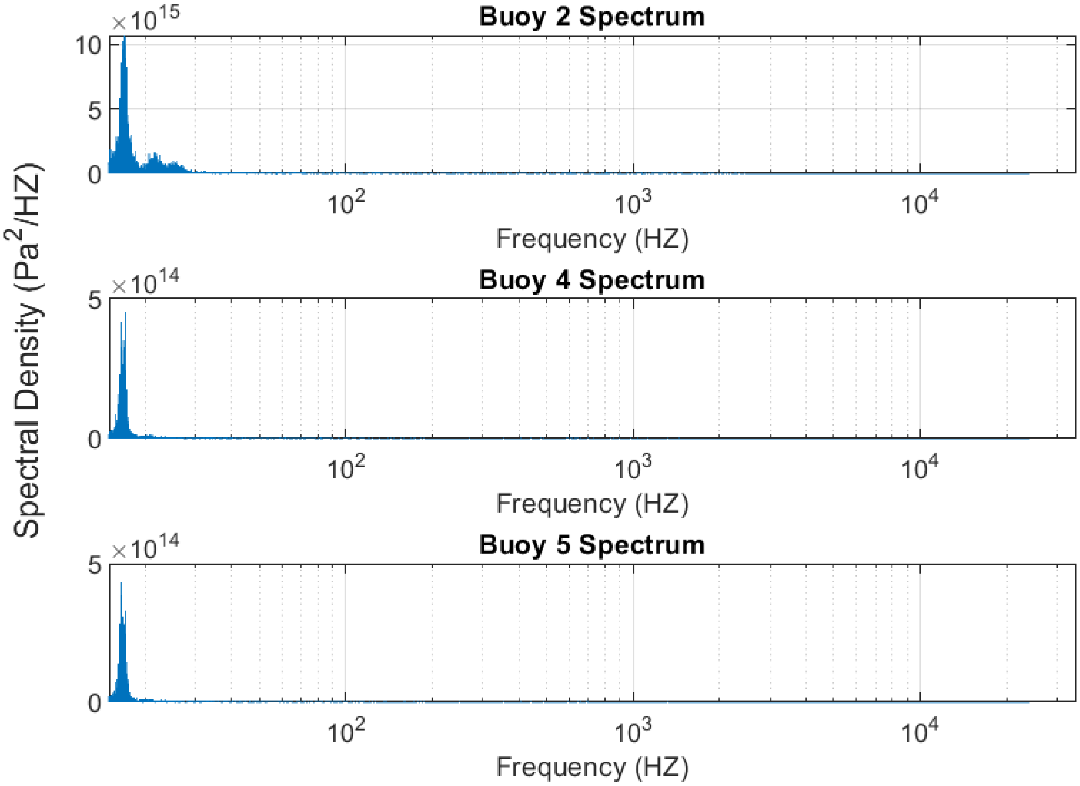
Loxahatchee - 3
Spectral Density (Pa^2/HZ)
Buoy 2 Spectrum
×10^14
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^13
4
2
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^13
2
1
0
10^2
10^3
10^4
Frequency (HZ)


Loxahatchee - 4
Buoy 2 Spectrum
×10^14
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^14
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^11
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

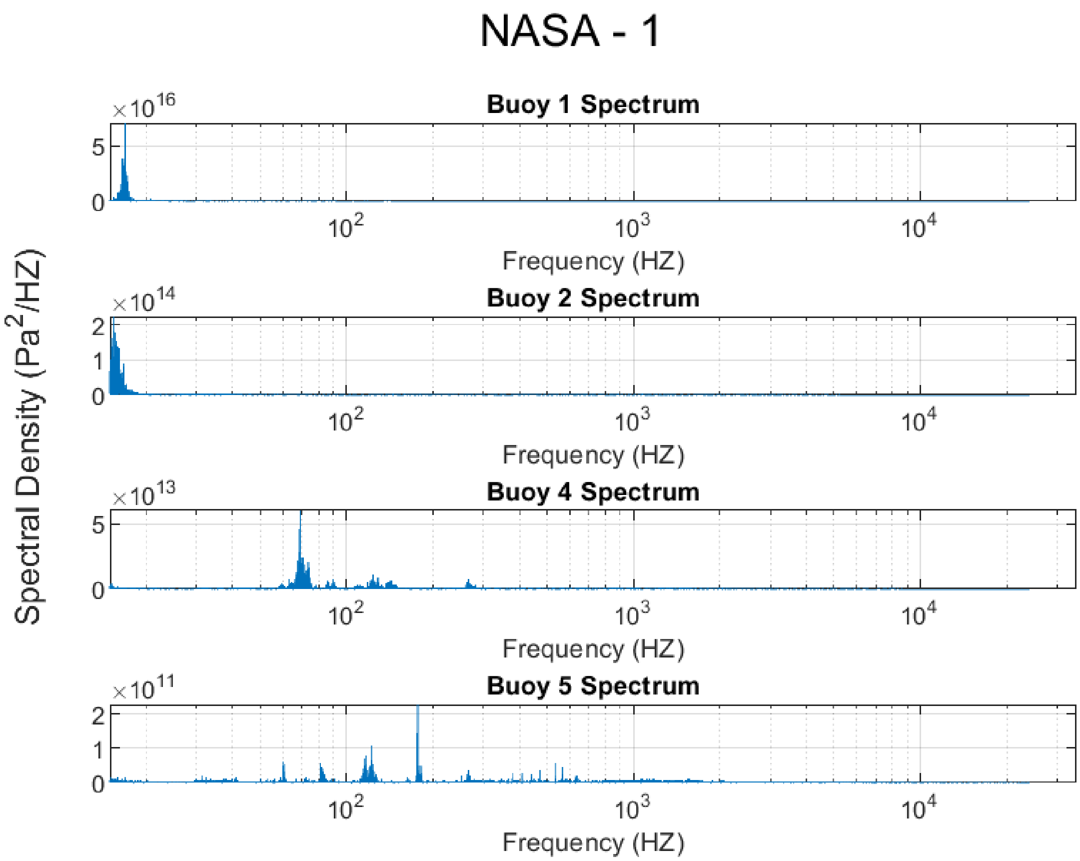

Manatee - 1
Buoy 2 Spectrum
×10^14
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^13
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^13
5
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)


Manatee - 2
Buoy 2 Spectrum
×10^13
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^12
10
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^12
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

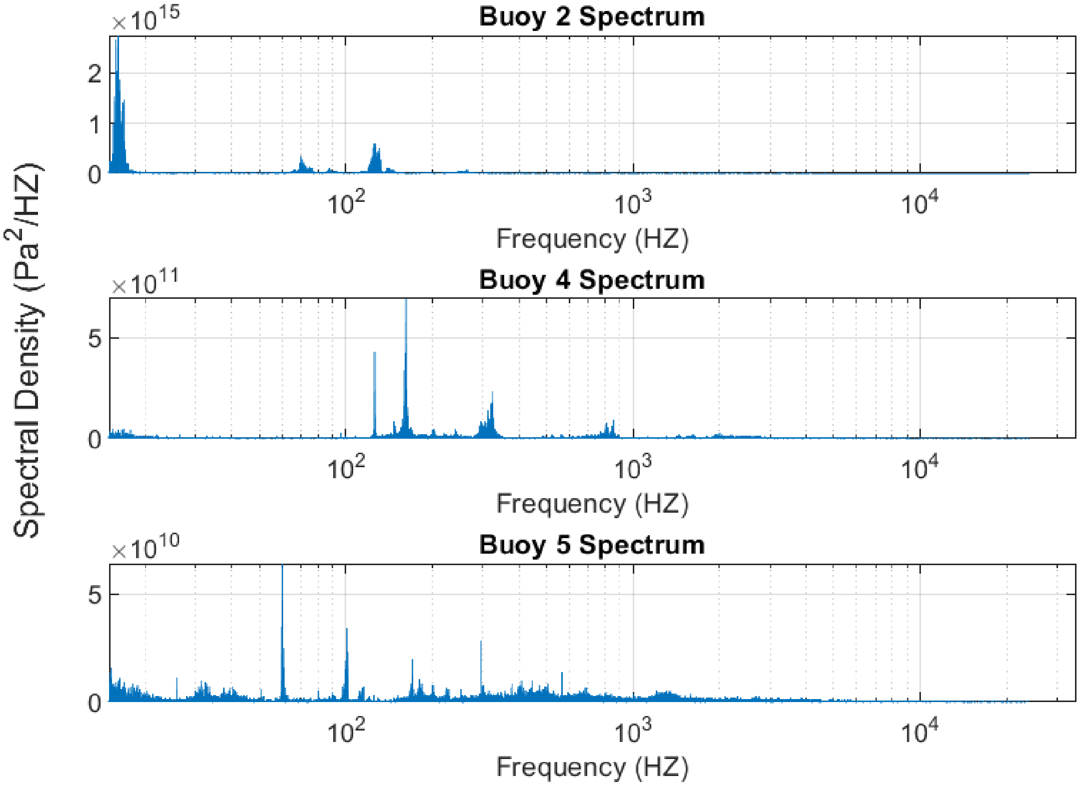
Manatee - 3



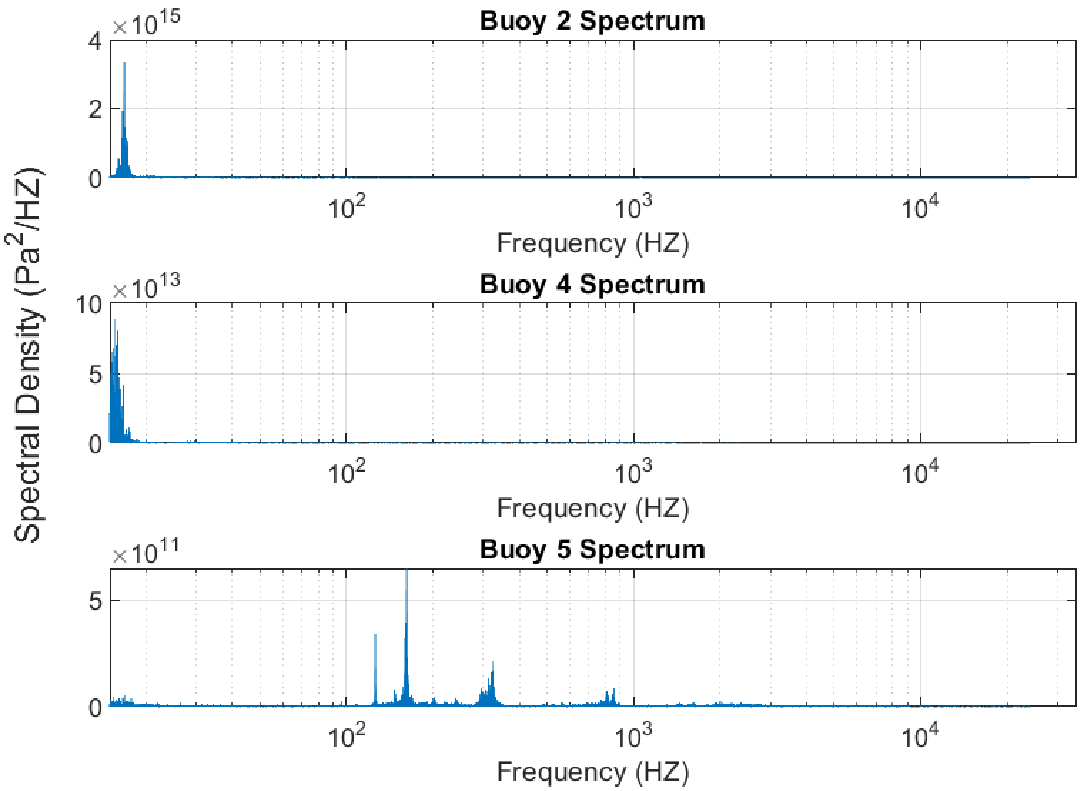
Buoy 2 Spectrum
×10^15
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^14
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^14
5
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

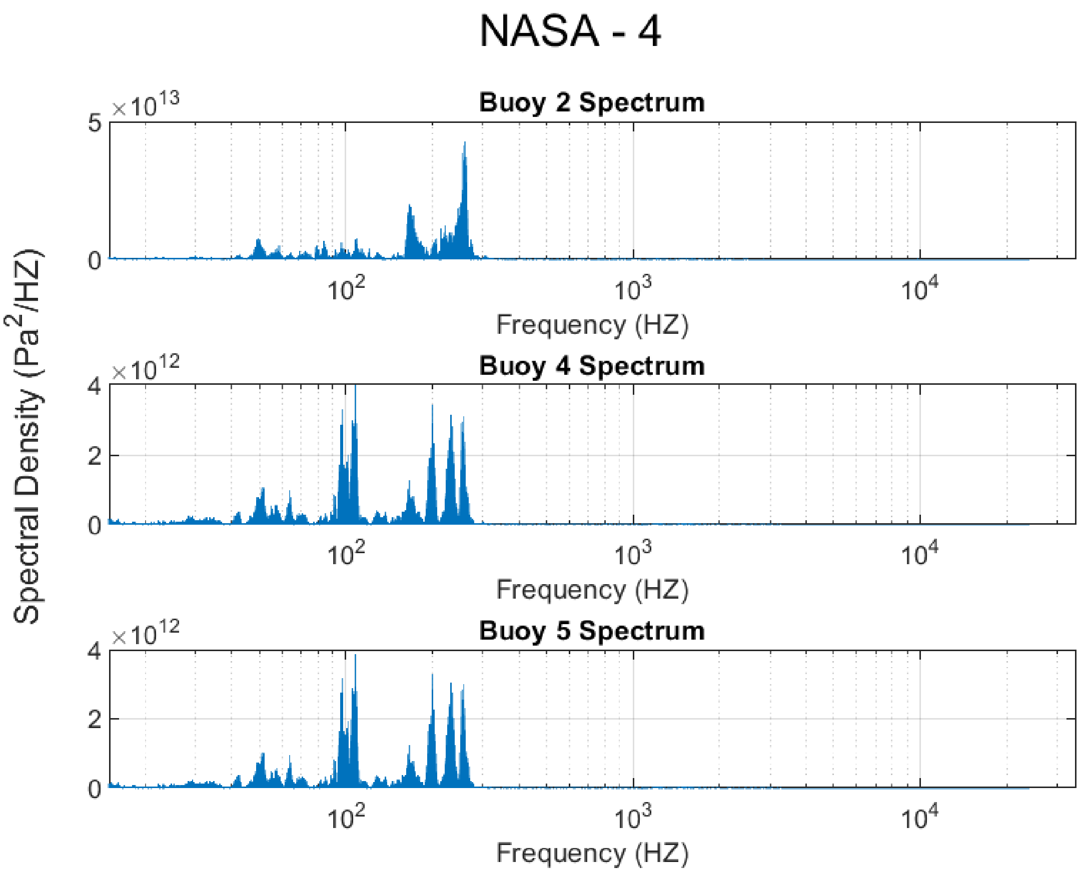

NASA - 1
Buoy 1 Spectrum
Buoy 2 Spectrum
Buoy 4 Spectrum
Buoy 5 Spectrum
Spectral Density (Pa^2/HZ)
Frequency (HZ)

NASA - 2

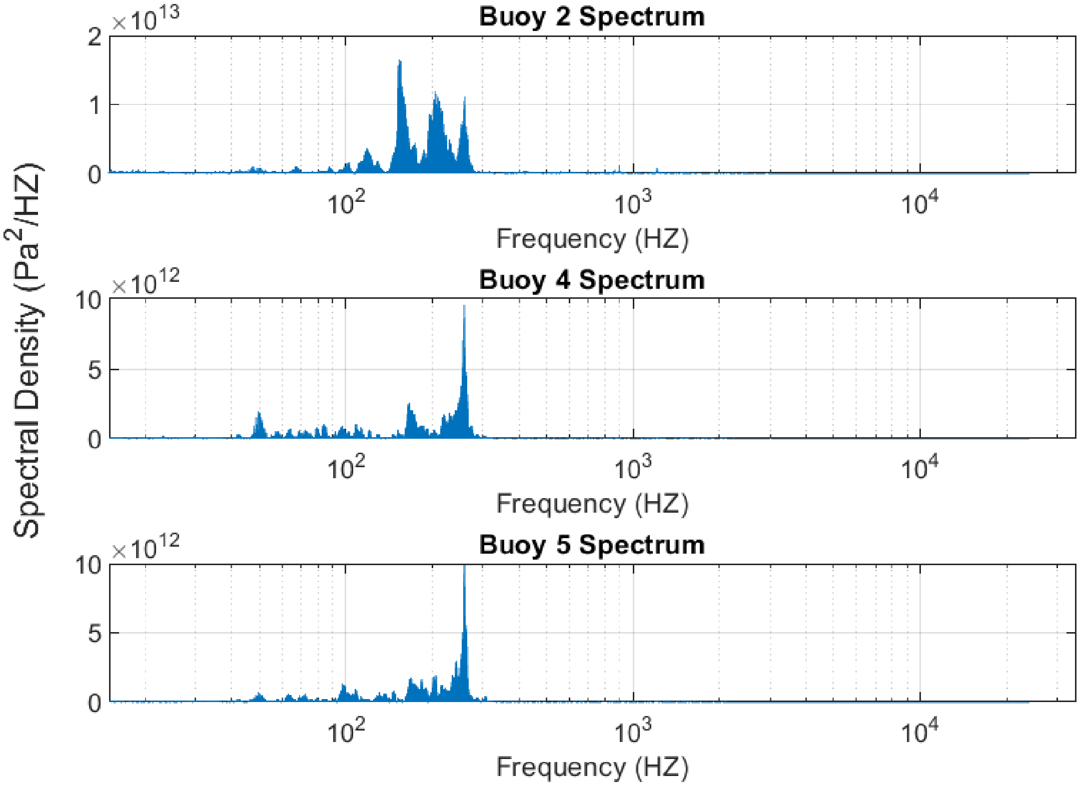

Buoy 2 Spectrum
×10^15
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)
Buoy 4 Spectrum
×10^11
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^10
5
0
10^2
10^3
10^4
Frequency (HZ)

NASA - 3


Buoy 2 Spectrum
×10^15
4
2
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^13
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^11
5
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

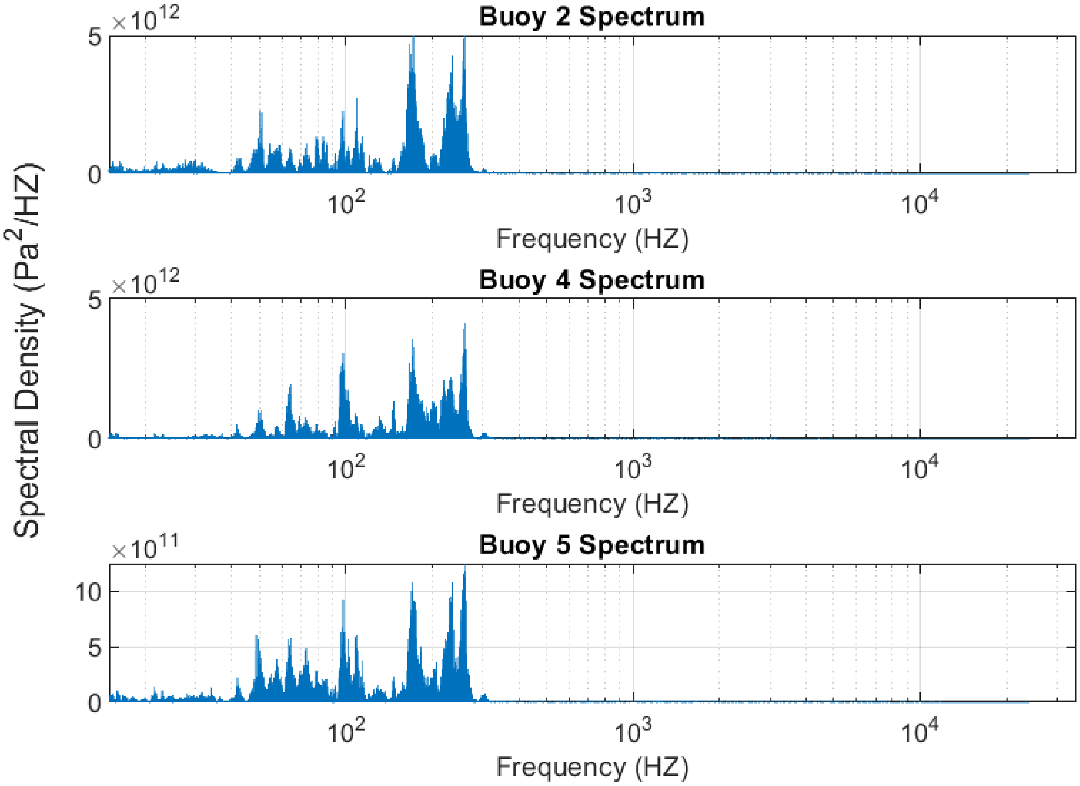

NASA - 4
Buoy 2 Spectrum
×10^13
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^12
4
2
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^12
4
2
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

NASA - 5

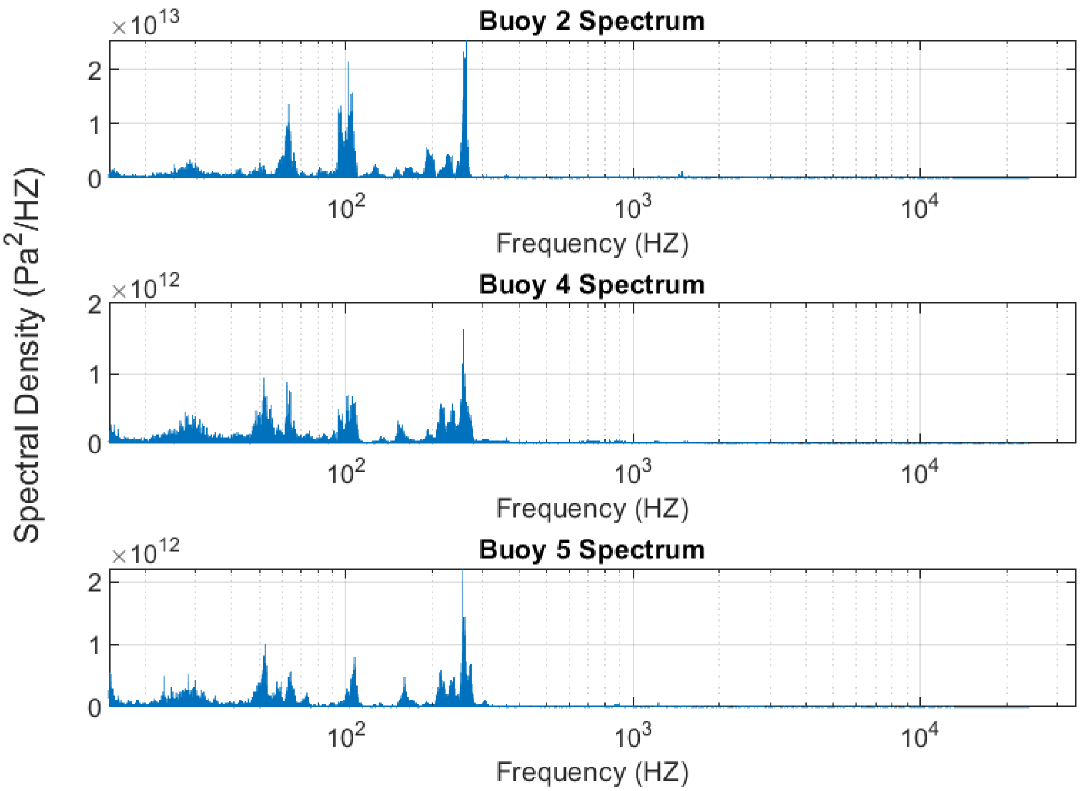


Buoy 2 Spectrum
Buoy 4 Spectrum
Buoy 5 Spectrum
Spectral Density (Pa^2/HZ)
Frequency (HZ)

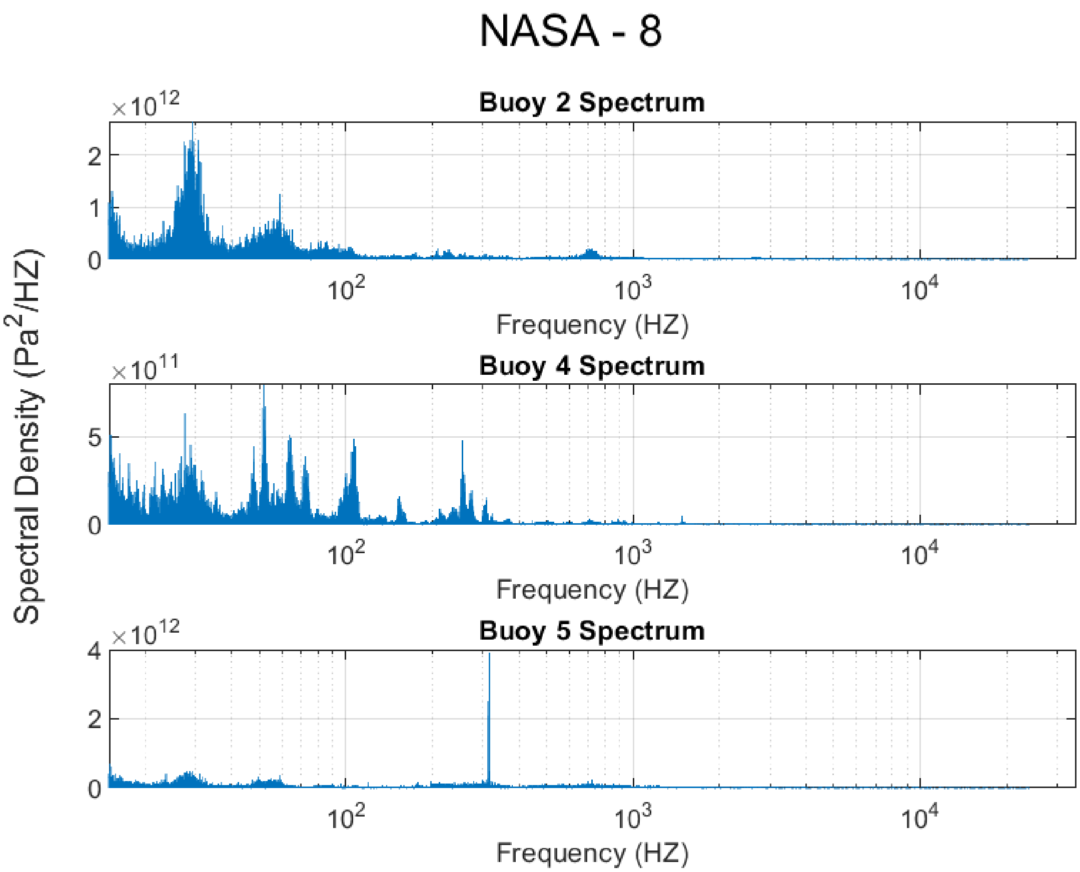
NASA - 6


Buoy 2 Spectrum
×10^12
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^12
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^11
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

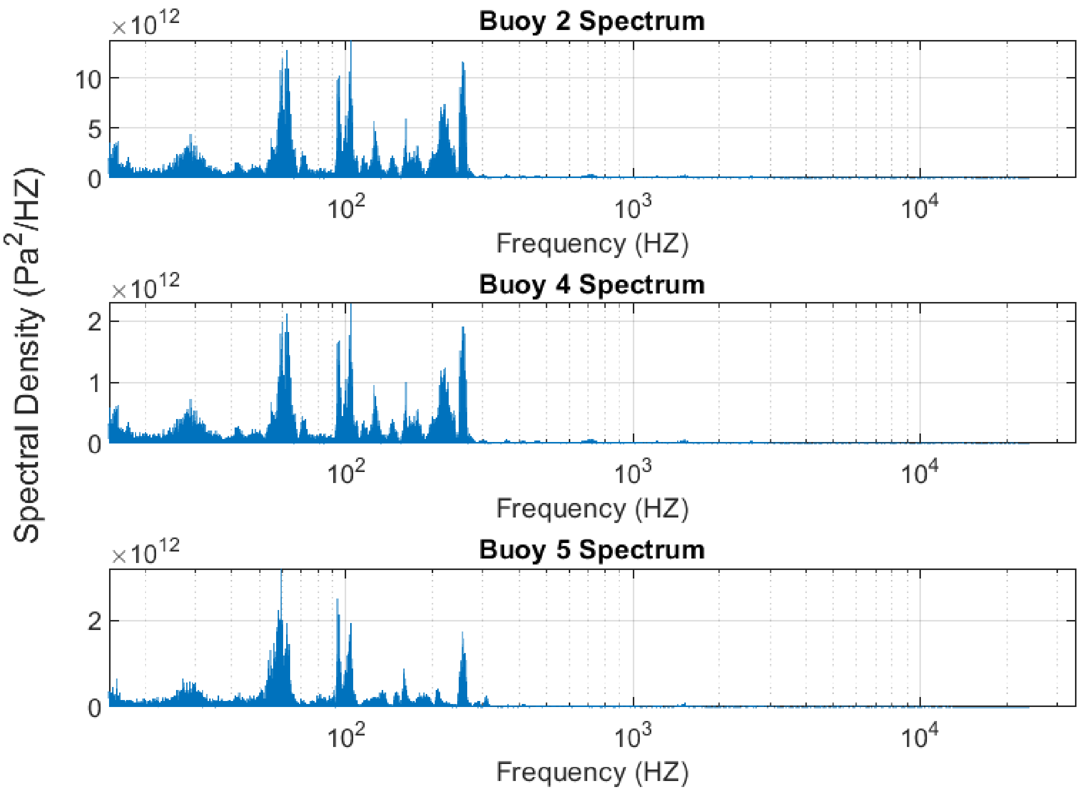
NASA - 7



Buoy 2 Spectrum
×10^13
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^12
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^12
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

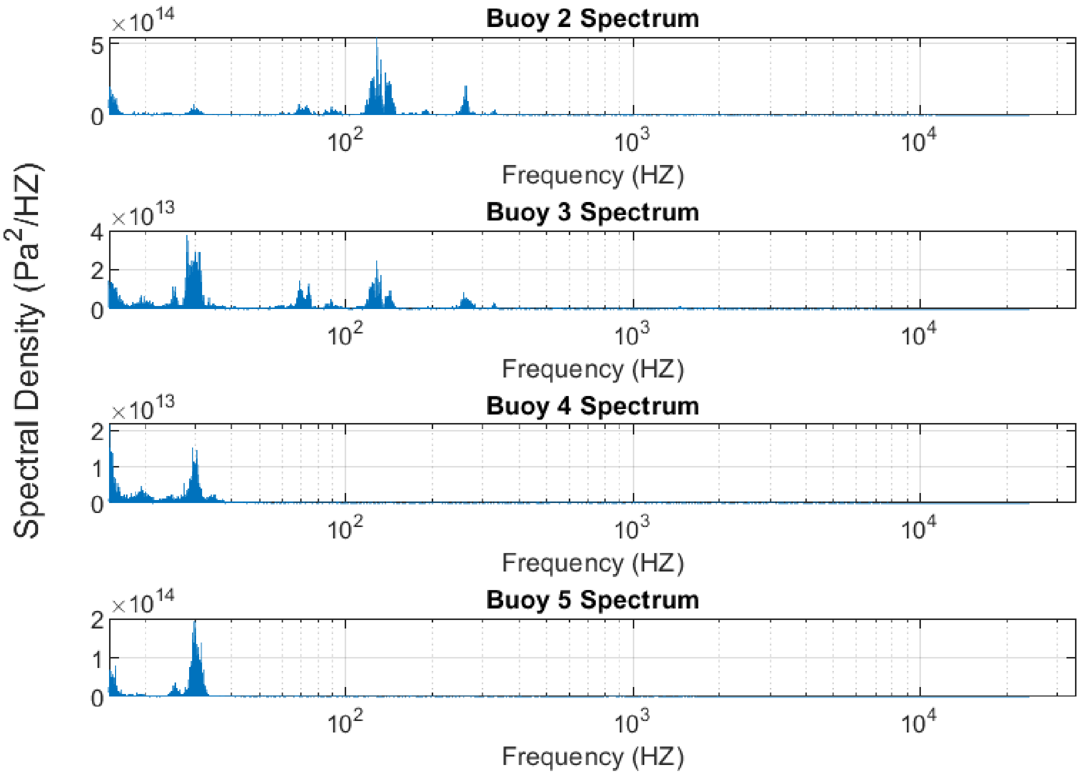

NASA - 8
Buoy 2 Spectrum
Buoy 4 Spectrum
Buoy 5 Spectrum
Spectral Density (Pa^2/HZ)
Frequency (HZ)

NASA - 9



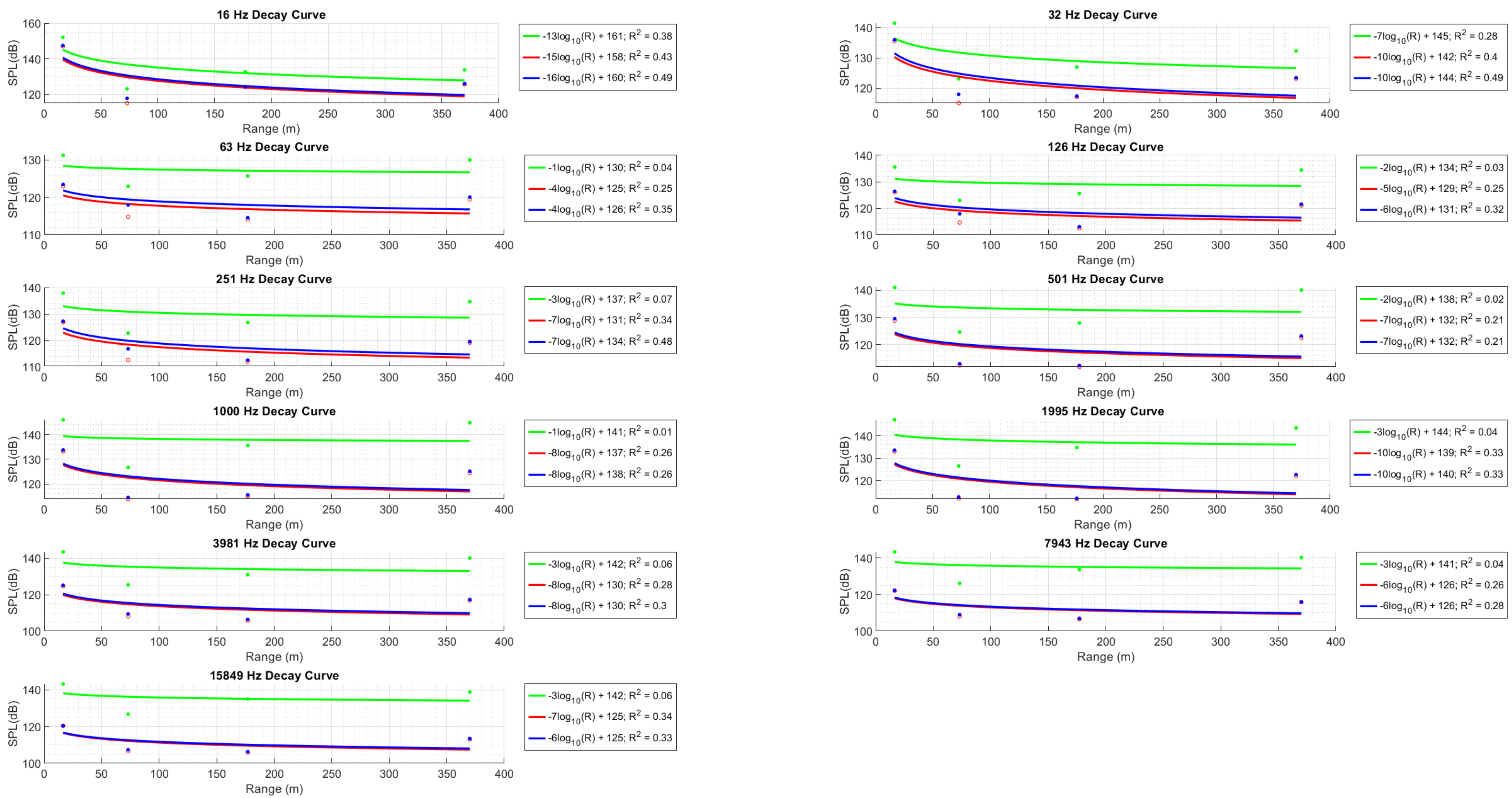
Buoy 2 Spectrum
×10^12
10
5
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 4 Spectrum
×10^12
2
1
0
10^2
10^3
10^4
Frequency (HZ)
Buoy 5 Spectrum
×10^12
2
0
10^2
10^3
10^4
Frequency (HZ)
Spectral Density (Pa^2/HZ)

Broward - 1

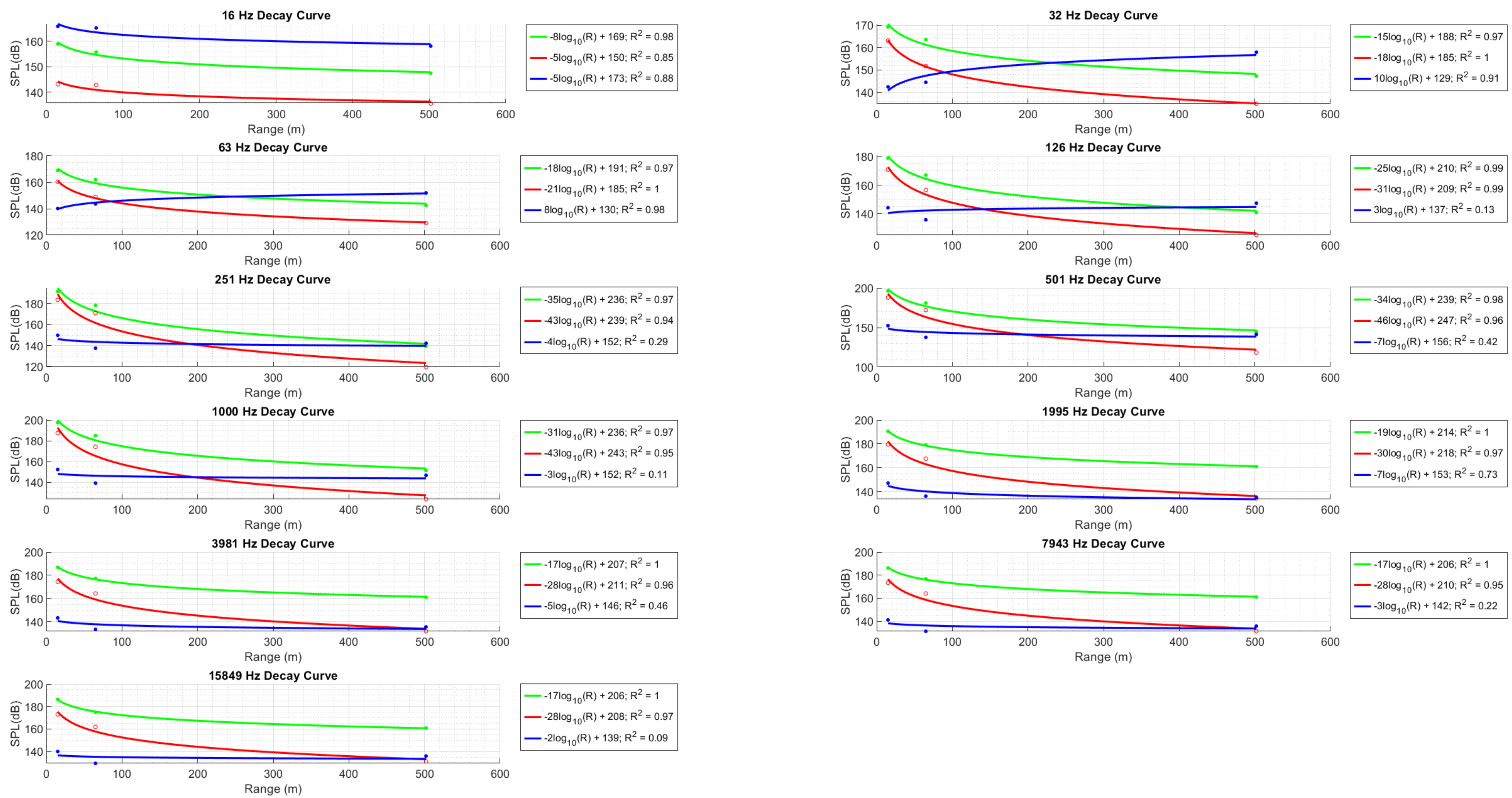

Buoy 2 Spectrum
Buoy 3 Spectrum
Buoy 4 Spectrum
Buoy 5 Spectrum
Spectral Density (Pa^2/HZ)
Frequency (HZ)

APPENDIX F
FREQUENCY DECAY CURVES

Bayway - 1

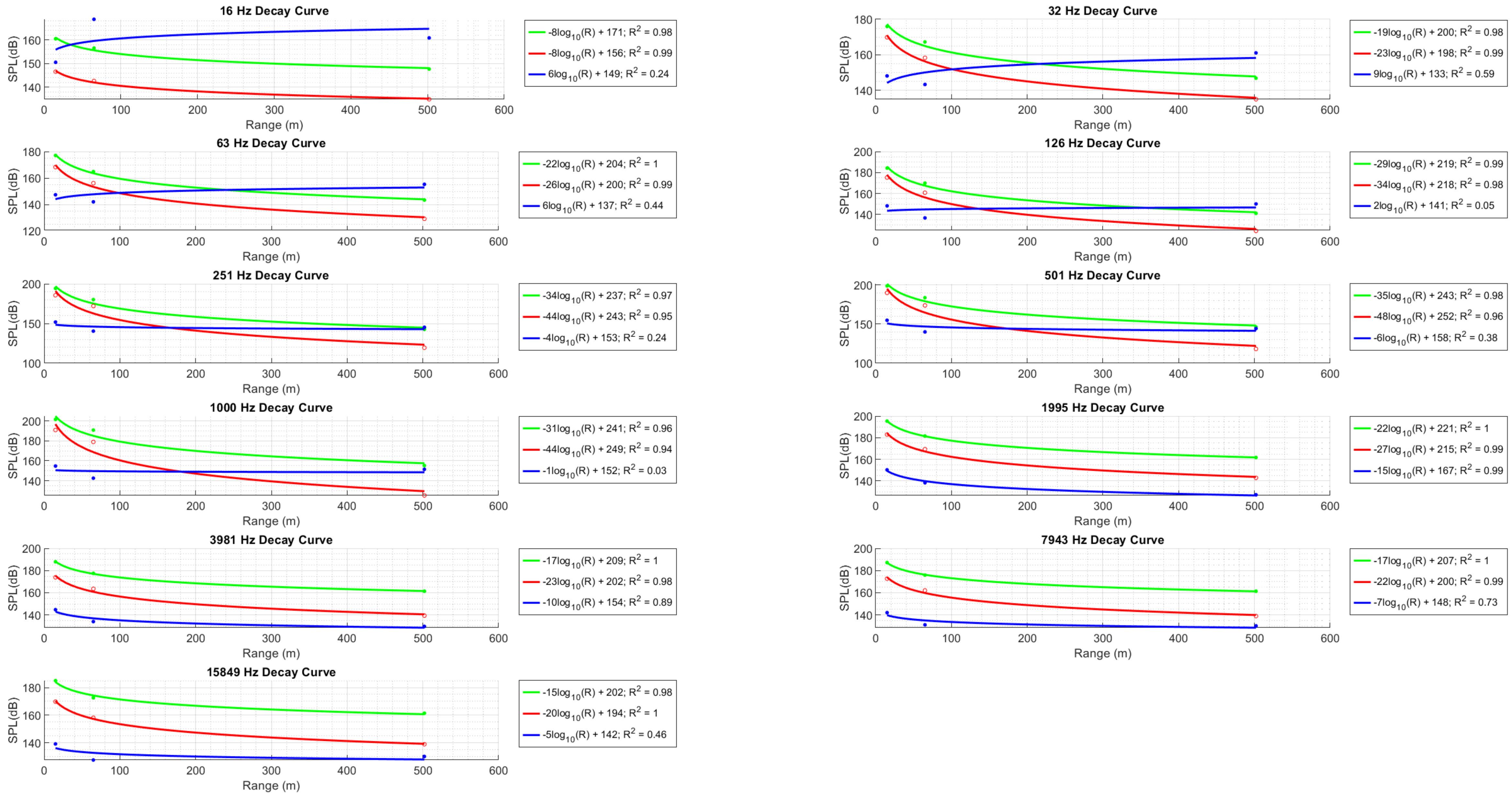

16 Hz Decay Curve
-13log10(R) + 161; R2 = 0.38
-15log10(R) + 158; R2 = 0.43
-16log10(R) + 160; R2 = 0.49
32 Hz Decay Curve
-7log10(R) + 145; R2 = 0.28
-10log10(R) + 142; R2 = 0.4
-10log10(R) + 144; R2 = 0.49
63 Hz Decay Curve
-1log10(R) + 130; R2 = 0.04
-4log10(R) + 125; R2 = 0.25
-4log10(R) + 126; R2 = 0.35
126 Hz Decay Curve
-2log10(R) + 134; R2 = 0.03
-5log10(R) + 129; R2 = 0.25
-6log10(R) + 131; R2 = 0.32
251 Hz Decay Curve
-3log10(R) + 137; R2 = 0.07
-7log10(R) + 131; R2 = 0.34
-7log10(R) + 134; R2 = 0.48
501 Hz Decay Curve
-2log10(R) + 138; R2 = 0.02
-7log10(R) + 132; R2 = 0.21
-7log10(R) + 132; R2 = 0.21
1000 Hz Decay Curve
-1log10(R) + 141; R2 = 0.01
-8log10(R) + 137; R2 = 0.26
-8log10(R) + 138; R2 = 0.26
1995 Hz Decay Curve
-3log10(R) + 144; R2 = 0.04
-10log10(R) + 139; R2 = 0.33
-10log10(R) + 140; R2 = 0.33
3981 Hz Decay Curve
-3log10(R) + 142; R2 = 0.06
-8log10(R) + 130; R2 = 0.28
-8log10(R) + 130; R2 = 0.3
7943 Hz Decay Curve
-3log10(R) + 141; R2 = 0.04
-6log10(R) + 126; R2 = 0.26
-6log10(R) + 126; R2 = 0.28
15849 Hz Decay Curve
-3log10(R) + 142; R2 = 0.06
-7log10(R) + 125; R2 = 0.34
-6log10(R) + 125; R2 = 0.33
SPL(dB)
Range (m)

Suwanee - 1

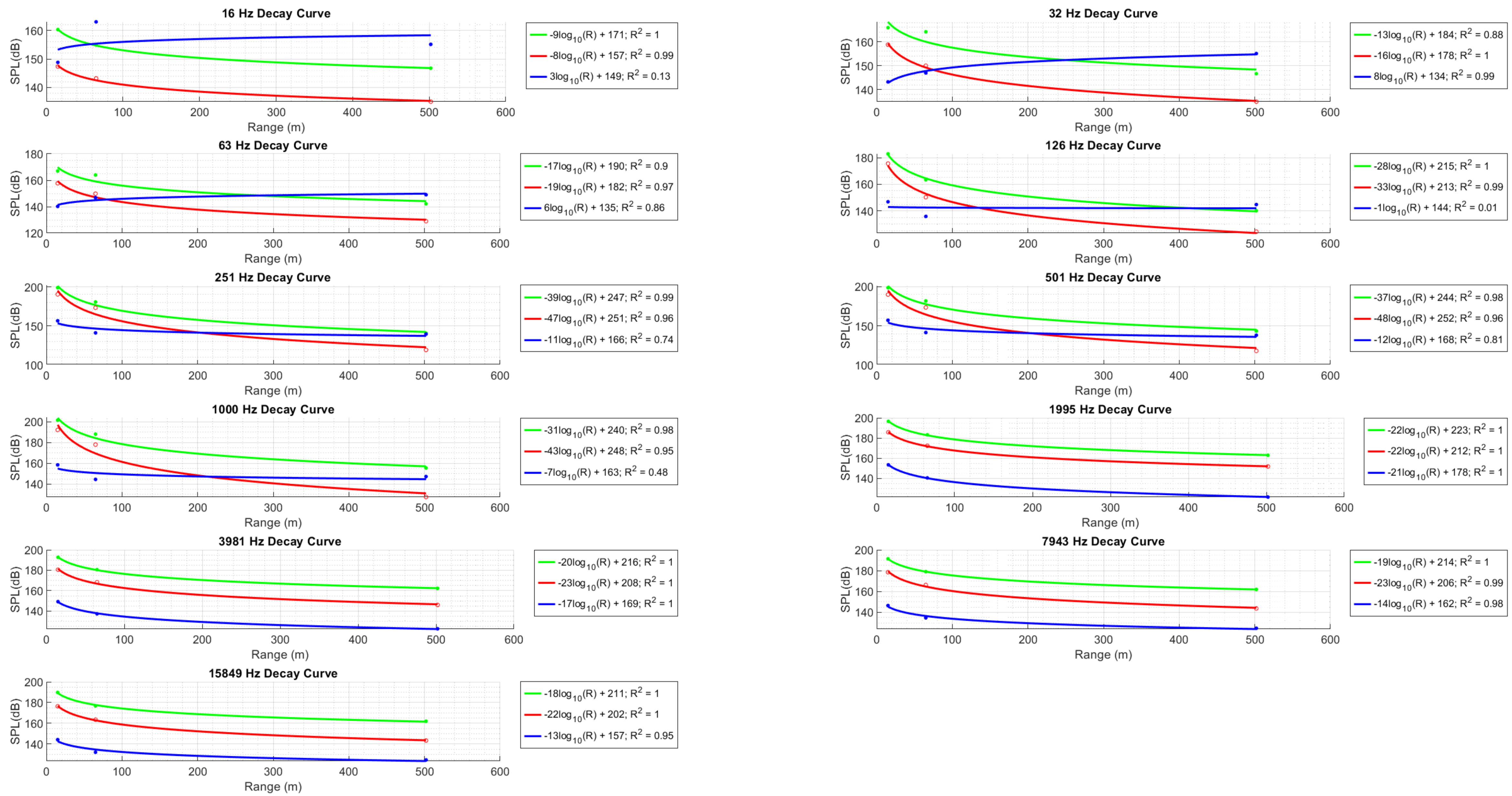


16 Hz Decay Curve
-8log10(R) + 169; R2 = 0.98
-5log10(R) + 150; R2 = 0.85
-5log10(R) + 173; R2 = 0.88
32 Hz Decay Curve
-15log10(R) + 188; R2 = 0.97
-18log10(R) + 185; R2 = 1
10log10(R) + 129; R2 = 0.91
63 Hz Decay Curve
-18log10(R) + 191; R2 = 0.97
-21log10(R) + 185; R2 = 1
8log10(R) + 130; R2 = 0.98
126 Hz Decay Curve
-25log10(R) + 210; R2 = 0.99
-31log10(R) + 209; R2 = 0.99
3log10(R) + 137; R2 = 0.13
251 Hz Decay Curve
-35log10(R) + 236; R2 = 0.97
-43log10(R) + 239; R2 = 0.94
-4log10(R) + 152; R2 = 0.29
501 Hz Decay Curve
-34log10(R) + 239; R2 = 0.98
-46log10(R) + 247; R2 = 0.96
-7log10(R) + 156; R2 = 0.42
1000 Hz Decay Curve
-31log10(R) + 236; R2 = 0.97
-43log10(R) + 243; R2 = 0.95
-3log10(R) + 152; R2 = 0.11
1995 Hz Decay Curve
-19log10(R) + 214; R2 = 1
-30log10(R) + 218; R2 = 0.97
-7log10(R) + 153; R2 = 0.73
3981 Hz Decay Curve
-17log10(R) + 207; R2 = 1
-28log10(R) + 211; R2 = 0.96
-5log10(R) + 146; R2 = 0.46
7943 Hz Decay Curve
-17log10(R) + 206; R2 = 1
-28log10(R) + 210; R2 = 0.95
-3log10(R) + 142; R2 = 0.22
15849 Hz Decay Curve
-17log10(R) + 206; R2 = 1
-28log10(R) + 208; R2 = 0.97
-2log10(R) + 139; R2 = 0.09
SPL(dB)
Range (m)

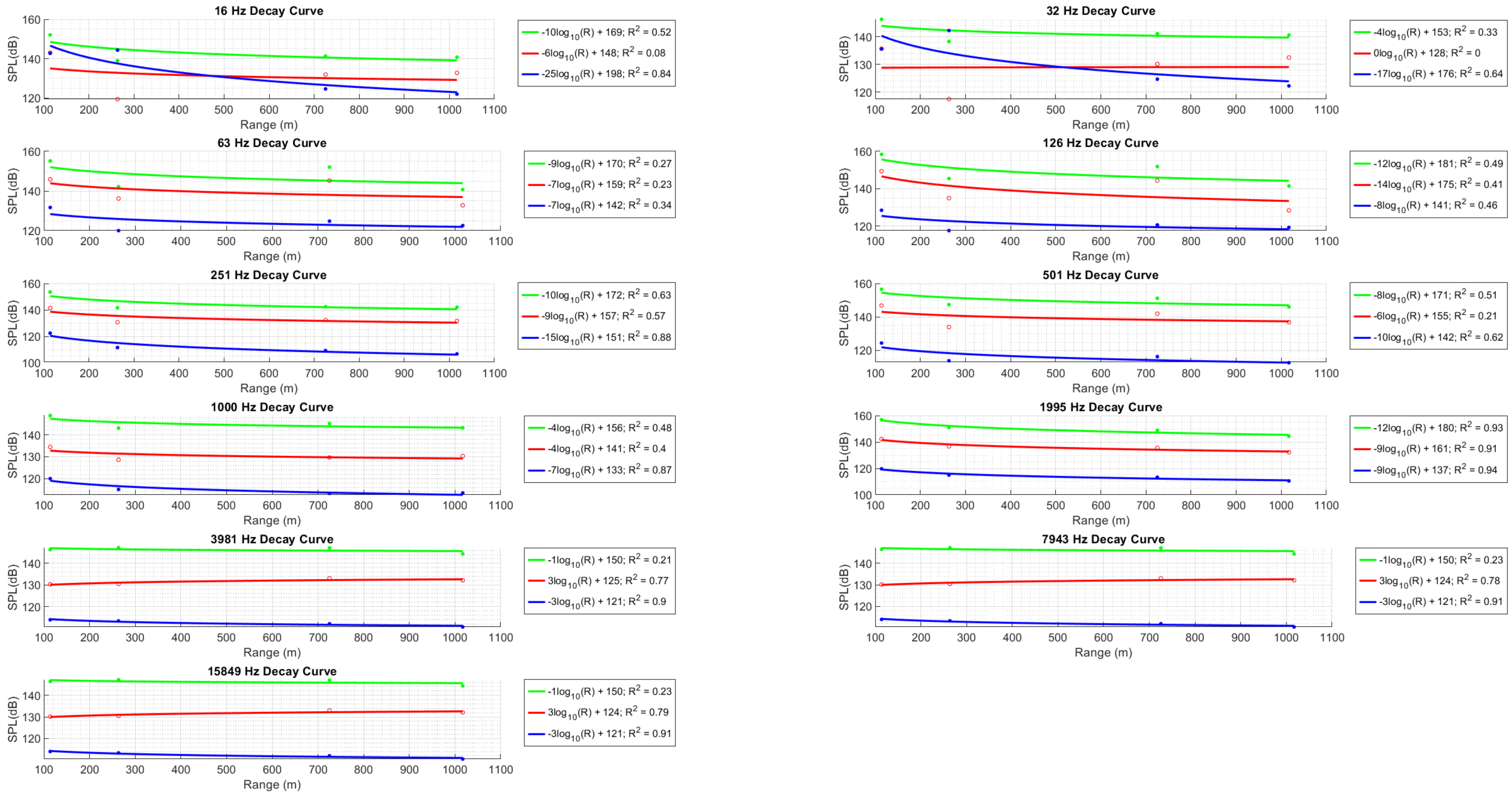
Suwanee - 2


16 Hz Decay Curve
-8log10(R) + 171; R2 = 0.98
-8log10(R) + 156; R2 = 0.99
6log10(R) + 149; R2 = 0.24
32 Hz Decay Curve
-19log10(R) + 200; R2 = 0.98
-23log10(R) + 198; R2 = 0.99
9log10(R) + 133; R2 = 0.59
63 Hz Decay Curve
-22log10(R) + 204; R2 = 1
-26log10(R) + 200; R2 = 0.99
6log10(R) + 137; R2 = 0.44
126 Hz Decay Curve
-29log10(R) + 219; R2 = 0.99
-34log10(R) + 218; R2 = 0.98
2log10(R) + 141; R2 = 0.05
251 Hz Decay Curve
-34log10(R) + 237; R2 = 0.97
-44log10(R) + 243; R2 = 0.95
-4log10(R) + 153; R2 = 0.24
501 Hz Decay Curve
-35log10(R) + 243; R2 = 0.98
-48log10(R) + 252; R2 = 0.96
-6log10(R) + 158; R2 = 0.38
1000 Hz Decay Curve
-31log10(R) + 241; R2 = 0.96
-44log10(R) + 249; R2 = 0.94
-1log10(R) + 152; R2 = 0.03
1995 Hz Decay Curve
-22log10(R) + 221; R2 = 1
-27log10(R) + 215; R2 = 0.99
-15log10(R) + 167; R2 = 0.99
3981 Hz Decay Curve
-17log10(R) + 209; R2 = 1
-23log10(R) + 202; R2 = 0.98
-10log10(R) + 154; R2 = 0.89
7943 Hz Decay Curve
-17log10(R) + 207; R2 = 1
-22log10(R) + 200; R2 = 0.99
-7log10(R) + 148; R2 = 0.73
15849 Hz Decay Curve
-15log10(R) + 202; R2 = 0.98
-20log10(R) + 194; R2 = 1
-5log10(R) + 142; R2 = 0.46
SPL(dB)
Range (m)

Suwanee - 3

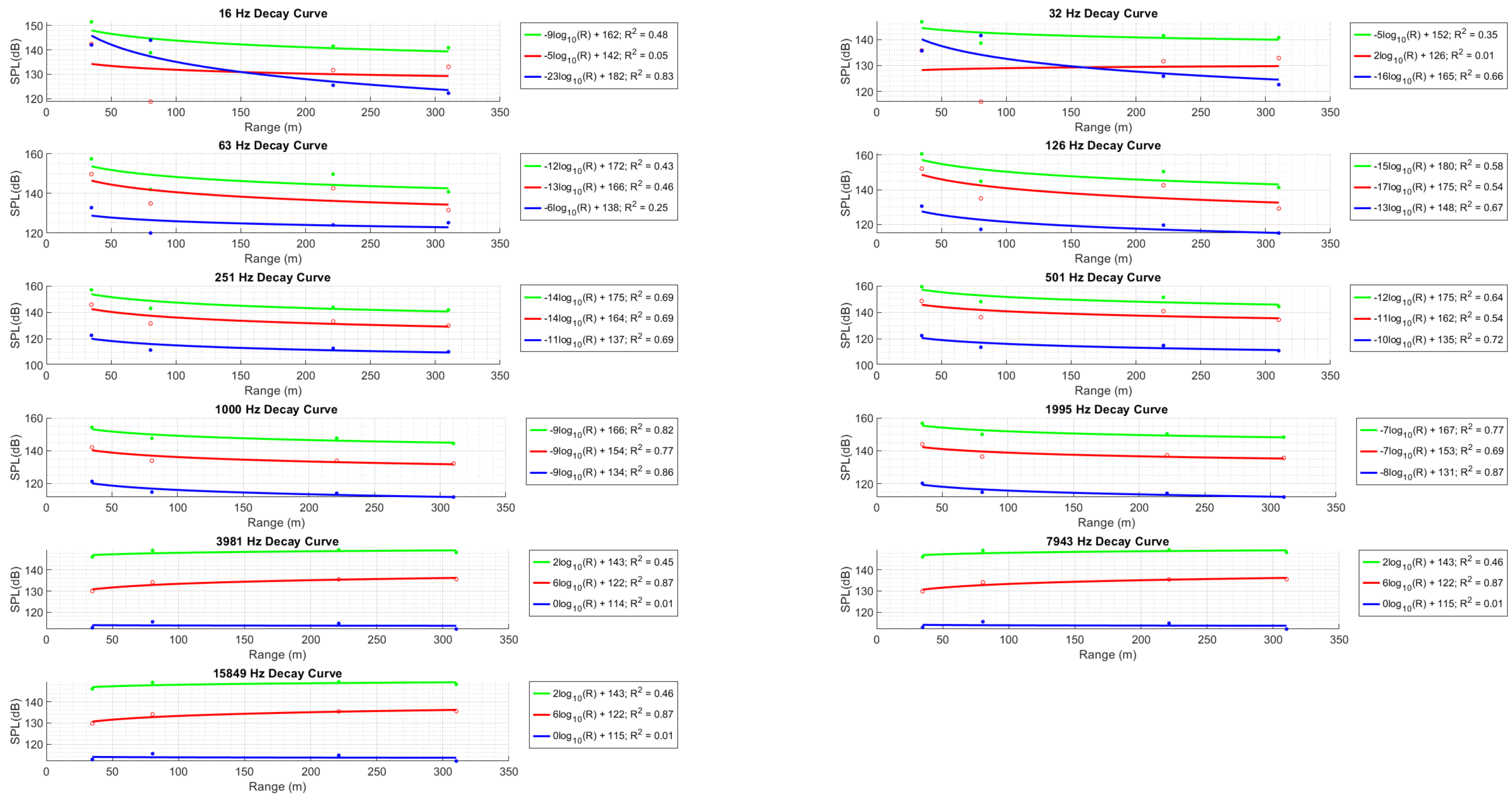

16 Hz Decay Curve
-9log10(R) + 171; R2 = 1
-8log10(R) + 157; R2 = 0.99
3log10(R) + 149; R2 = 0.13
32 Hz Decay Curve
-13log10(R) + 184; R2 = 0.88
-16log10(R) + 178; R2 = 1
8log10(R) + 134; R2 = 0.99
63 Hz Decay Curve
-17log10(R) + 190; R2 = 0.9
-19log10(R) + 182; R2 = 0.97
6log10(R) + 135; R2 = 0.86
126 Hz Decay Curve
-28log10(R) + 215; R2 = 1
-33log10(R) + 213; R2 = 0.99
-1log10(R) + 144; R2 = 0.01
251 Hz Decay Curve
-39log10(R) + 247; R2 = 0.99
-47log10(R) + 251; R2 = 0.96
-11log10(R) + 166; R2 = 0.74
501 Hz Decay Curve
-37log10(R) + 244; R2 = 0.98
-48log10(R) + 252; R2 = 0.96
-12log10(R) + 168; R2 = 0.81
1000 Hz Decay Curve
-31log10(R) + 240; R2 = 0.98
-43log10(R) + 248; R2 = 0.95
-7log10(R) + 163; R2 = 0.48
1995 Hz Decay Curve
-22log10(R) + 223; R2 = 1
-22log10(R) + 212; R2 = 1
-21log10(R) + 178; R2 = 1
3981 Hz Decay Curve
-20log10(R) + 216; R2 = 1
-23log10(R) + 208; R2 = 1
-17log10(R) + 169; R2 = 1
7943 Hz Decay Curve
-19log10(R) + 214; R2 = 1
-23log10(R) + 206; R2 = 0.99
-14log10(R) + 162; R2 = 0.98
15849 Hz Decay Curve
-18log10(R) + 211; R2 = 1
-22log10(R) + 202; R2 = 1
-13log10(R) + 157; R2 = 0.95
SPL(dB)
Range (m)

SR23 - 1

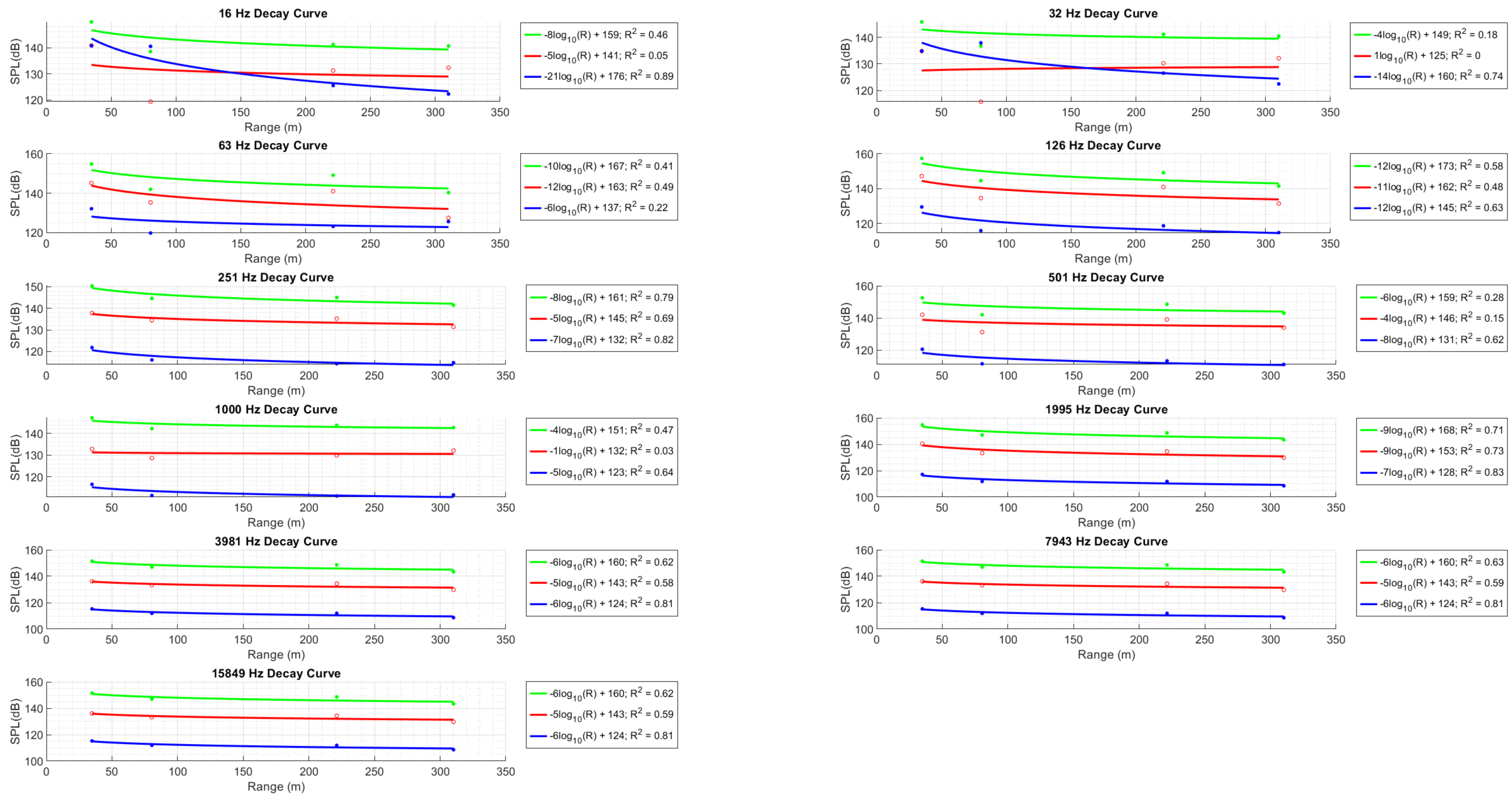


16 Hz Decay Curve
-10log10(R) + 169; R2 = 0.52
-6log10(R) + 148; R2 = 0.08
-25log10(R) + 198; R2 = 0.84
32 Hz Decay Curve
-4log10(R) + 153; R2 = 0.33
0log10(R) + 128; R2 = 0
-17log10(R) + 176; R2 = 0.64
63 Hz Decay Curve
-9log10(R) + 170; R2 = 0.27
-7log10(R) + 159; R2 = 0.23
-7log10(R) + 142; R2 = 0.34
126 Hz Decay Curve
-12log10(R) + 181; R2 = 0.49
-14log10(R) + 175; R2 = 0.41
-8log10(R) + 141; R2 = 0.46
251 Hz Decay Curve
-10log10(R) + 172; R2 = 0.63
-9log10(R) + 157; R2 = 0.57
-15log10(R) + 151; R2 = 0.88
501 Hz Decay Curve
-8log10(R) + 171; R2 = 0.51
-6log10(R) + 155; R2 = 0.21
-10log10(R) + 142; R2 = 0.62
1000 Hz Decay Curve
-4log10(R) + 156; R2 = 0.48
-4log10(R) + 141; R2 = 0.4
-7log10(R) + 133; R2 = 0.87
1995 Hz Decay Curve
-12log10(R) + 180; R2 = 0.93
-9log10(R) + 161; R2 = 0.91
-9log10(R) + 137; R2 = 0.94
3981 Hz Decay Curve
-1log10(R) + 150; R2 = 0.21
3log10(R) + 125; R2 = 0.77
-3log10(R) + 121; R2 = 0.9
7943 Hz Decay Curve
-1log10(R) + 150; R2 = 0.23
3log10(R) + 124; R2 = 0.78
-3log10(R) + 121; R2 = 0.91
15849 Hz Decay Curve
-1log10(R) + 150; R2 = 0.23
3log10(R) + 124; R2 = 0.79
-3log10(R) + 121; R2 = 0.91
SPL(dB)
Range (m)

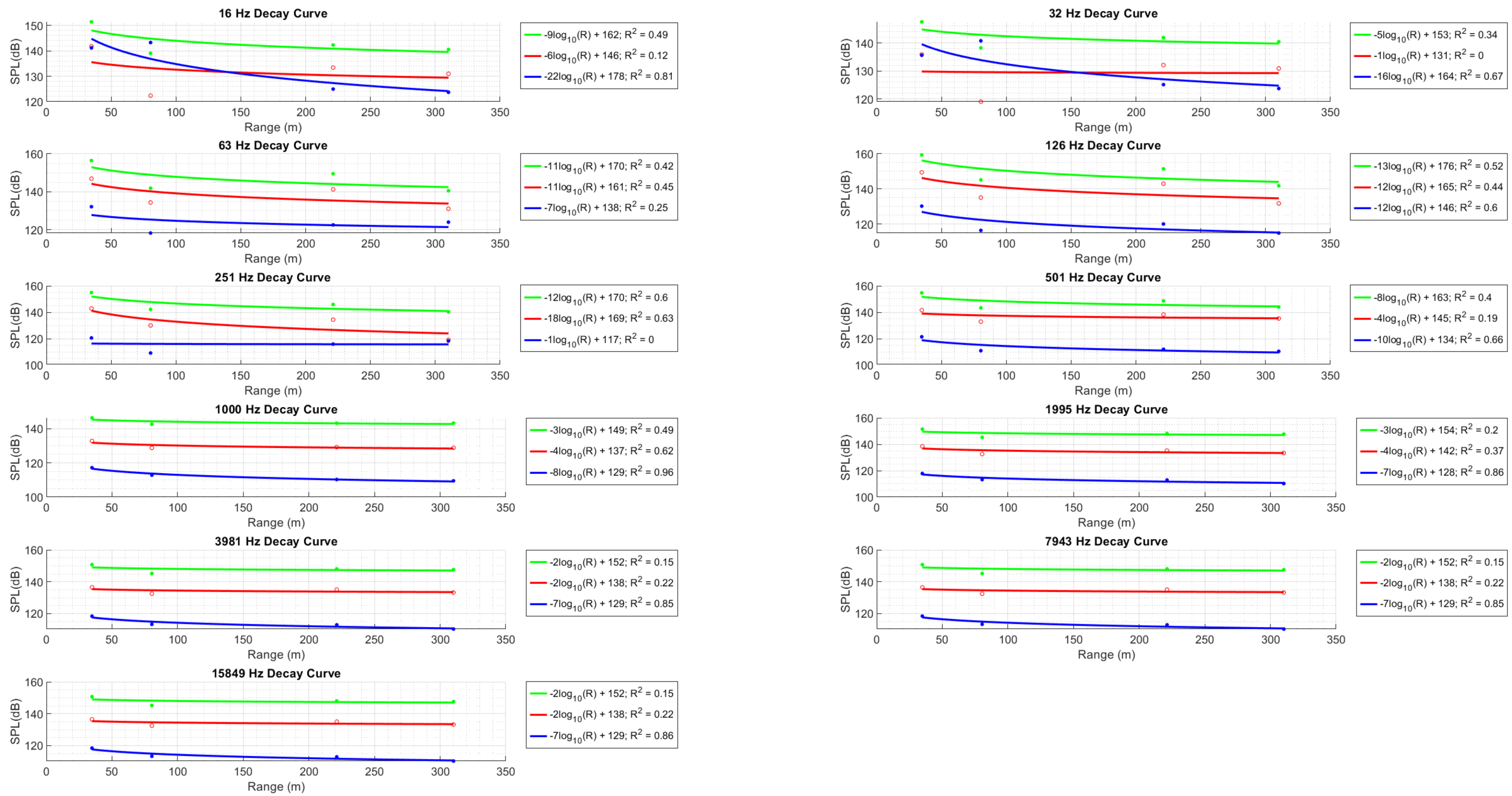
SR23 - 2


16 Hz Decay Curve
-9log10(R) + 162; R2 = 0.48
-5log10(R) + 142; R2 = 0.05
-23log10(R) + 182; R2 = 0.83
32 Hz Decay Curve
-5log10(R) + 152; R2 = 0.35
2log10(R) + 126; R2 = 0.01
-16log10(R) + 165; R2 = 0.66
63 Hz Decay Curve
-12log10(R) + 172; R2 = 0.43
-13log10(R) + 166; R2 = 0.46
-6log10(R) + 138; R2 = 0.25
126 Hz Decay Curve
-15log10(R) + 180; R2 = 0.58
-17log10(R) + 175; R2 = 0.54
-13log10(R) + 148; R2 = 0.67
251 Hz Decay Curve
-14log10(R) + 175; R2 = 0.69
-14log10(R) + 164; R2 = 0.69
-11log10(R) + 137; R2 = 0.69
501 Hz Decay Curve
-12log10(R) + 175; R2 = 0.64
-11log10(R) + 162; R2 = 0.54
-10log10(R) + 135; R2 = 0.72
1000 Hz Decay Curve
-9log10(R) + 166; R2 = 0.82
-9log10(R) + 154; R2 = 0.77
-9log10(R) + 134; R2 = 0.86
1995 Hz Decay Curve
-7log10(R) + 167; R2 = 0.77
-7log10(R) + 153; R2 = 0.69
-8log10(R) + 131; R2 = 0.87
3981 Hz Decay Curve
2log10(R) + 143; R2 = 0.45
6log10(R) + 122; R2 = 0.87
0log10(R) + 114; R2 = 0.01
7943 Hz Decay Curve
2log10(R) + 143; R2 = 0.46
6log10(R) + 122; R2 = 0.87
0log10(R) + 115; R2 = 0.01
15849 Hz Decay Curve
2log10(R) + 143; R2 = 0.46
6log10(R) + 122; R2 = 0.87
0log10(R) + 115; R2 = 0.01
SPL(dB)
Range (m)

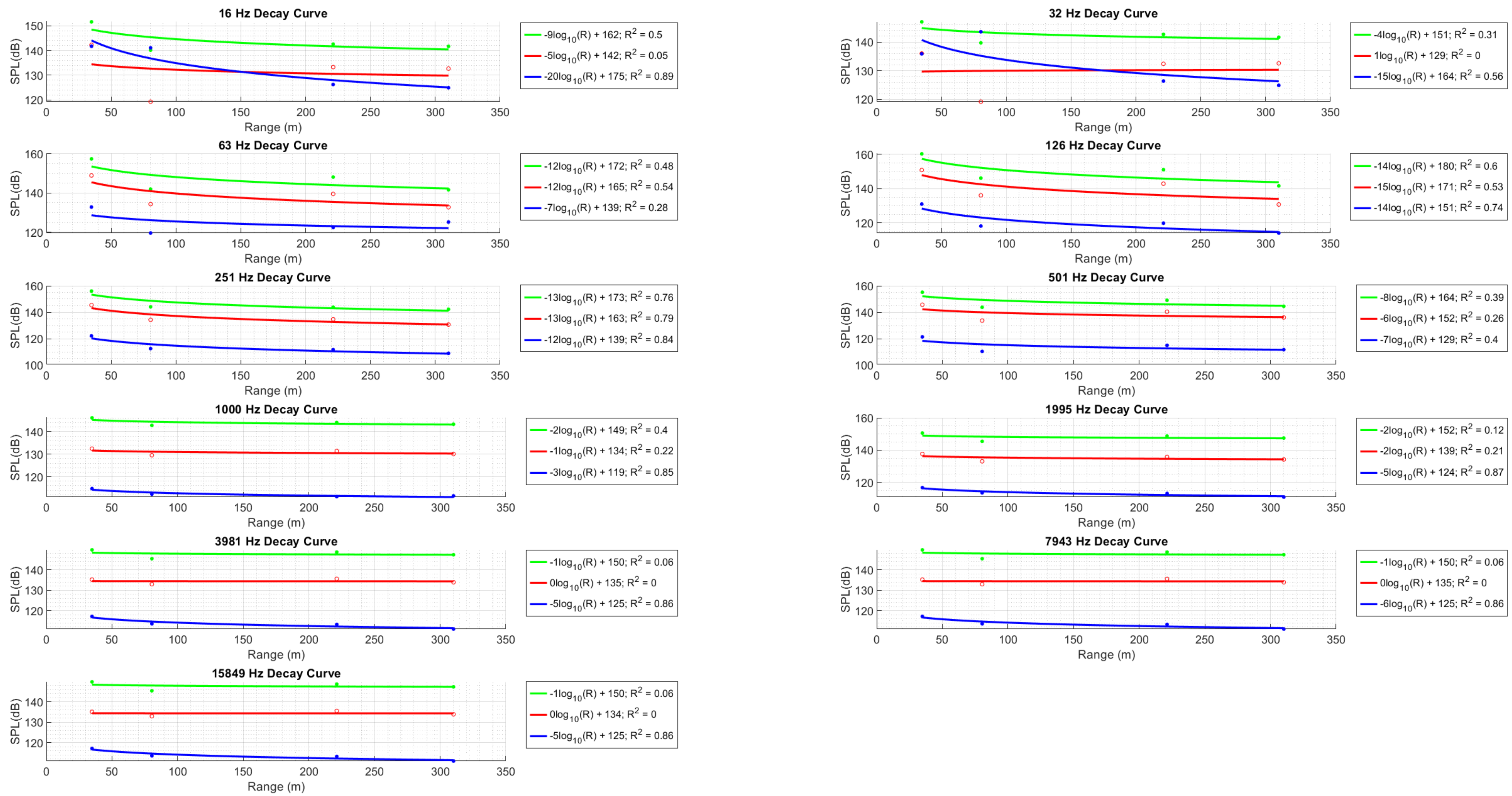
SR23 - 3


16 Hz Decay Curve
$-8\log_{10}(R) + 159$; $R^2 = 0.46$
$-5\log_{10}(R) + 141$; $R^2 = 0.05$
$-21\log_{10}(R) + 176$; $R^2 = 0.89$
32 Hz Decay Curve
$-4\log_{10}(R) + 149$; $R^2 = 0.18$
$1\log_{10}(R) + 125$; $R^2 = 0$
$-14\log_{10}(R) + 160$; $R^2 = 0.74$
63 Hz Decay Curve
$-10\log_{10}(R) + 167$; $R^2 = 0.41$
$-12\log_{10}(R) + 163$; $R^2 = 0.49$
$-6\log_{10}(R) + 137$; $R^2 = 0.22$
126 Hz Decay Curve
$-12\log_{10}(R) + 173$; $R^2 = 0.58$
$-11\log_{10}(R) + 162$; $R^2 = 0.48$
$-12\log_{10}(R) + 145$; $R^2 = 0.63$
251 Hz Decay Curve
$-8\log_{10}(R) + 161$; $R^2 = 0.79$
$-5\log_{10}(R) + 145$; $R^2 = 0.69$
$-7\log_{10}(R) + 132$; $R^2 = 0.82$
501 Hz Decay Curve
$-6\log_{10}(R) + 159$; $R^2 = 0.28$
$-4\log_{10}(R) + 146$; $R^2 = 0.15$
$-8\log_{10}(R) + 131$; $R^2 = 0.62$
1000 Hz Decay Curve
$-4\log_{10}(R) + 151$; $R^2 = 0.47$
$-1\log_{10}(R) + 132$; $R^2 = 0.03$
$-5\log_{10}(R) + 123$; $R^2 = 0.64$
1995 Hz Decay Curve
$-9\log_{10}(R) + 168$; $R^2 = 0.71$
$-9\log_{10}(R) + 153$; $R^2 = 0.73$
$-7\log_{10}(R) + 128$; $R^2 = 0.83$
3981 Hz Decay Curve
$-6\log_{10}(R) + 160$; $R^2 = 0.62$
$-5\log_{10}(R) + 143$; $R^2 = 0.58$
$-6\log_{10}(R) + 124$; $R^2 = 0.81$
7943 Hz Decay Curve
$-6\log_{10}(R) + 160$; $R^2 = 0.63$
$-5\log_{10}(R) + 143$; $R^2 = 0.59$
$-6\log_{10}(R) + 124$; $R^2 = 0.81$
15849 Hz Decay Curve
$-6\log_{10}(R) + 160$; $R^2 = 0.62$
$-5\log_{10}(R) + 143$; $R^2 = 0.59$
$-6\log_{10}(R) + 124$; $R^2 = 0.81$
SPL(dB)
Range (m)

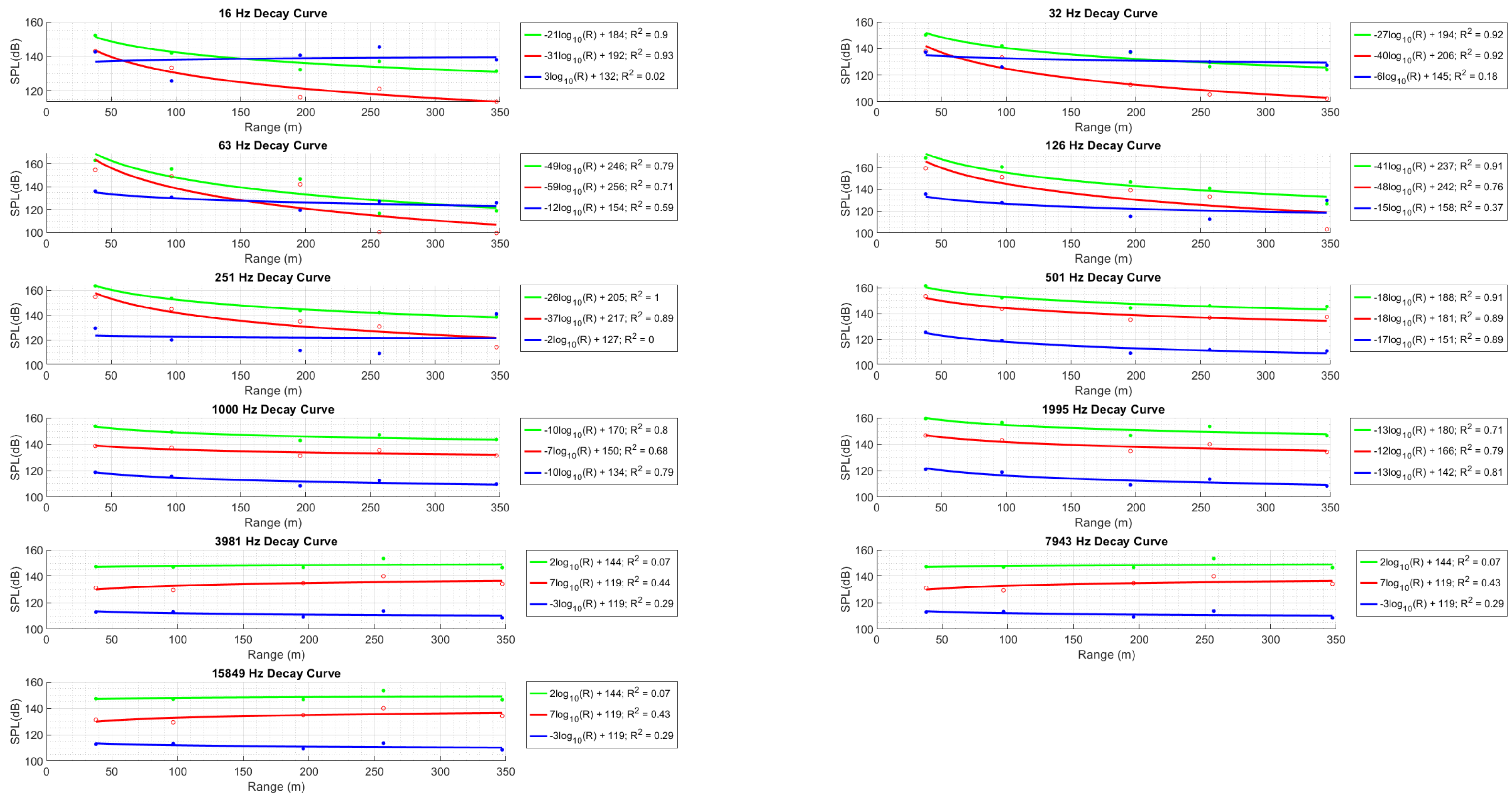
SR23 - 4


16 Hz Decay Curve
-9log10(R) + 162; R2 = 0.49
-6log10(R) + 146; R2 = 0.12
-22log10(R) + 178; R2 = 0.81
32 Hz Decay Curve
-5log10(R) + 153; R2 = 0.34
-1log10(R) + 131; R2 = 0
-16log10(R) + 164; R2 = 0.67
63 Hz Decay Curve
-11log10(R) + 170; R2 = 0.42
-11log10(R) + 161; R2 = 0.45
-7log10(R) + 138; R2 = 0.25
126 Hz Decay Curve
-13log10(R) + 176; R2 = 0.52
-12log10(R) + 165; R2 = 0.44
-12log10(R) + 146; R2 = 0.6
251 Hz Decay Curve
-12log10(R) + 170; R2 = 0.6
-18log10(R) + 169; R2 = 0.63
-1log10(R) + 117; R2 = 0
501 Hz Decay Curve
-8log10(R) + 163; R2 = 0.4
-4log10(R) + 145; R2 = 0.19
-10log10(R) + 134; R2 = 0.66
1000 Hz Decay Curve
-3log10(R) + 149; R2 = 0.49
-4log10(R) + 137; R2 = 0.62
-8log10(R) + 129; R2 = 0.96
1995 Hz Decay Curve
-3log10(R) + 154; R2 = 0.2
-4log10(R) + 142; R2 = 0.37
-7log10(R) + 128; R2 = 0.86
3981 Hz Decay Curve
-2log10(R) + 152; R2 = 0.15
-2log10(R) + 138; R2 = 0.22
-7log10(R) + 129; R2 = 0.85
7943 Hz Decay Curve
-2log10(R) + 152; R2 = 0.15
-2log10(R) + 138; R2 = 0.22
-7log10(R) + 129; R2 = 0.85
15849 Hz Decay Curve
-2log10(R) + 152; R2 = 0.15
-2log10(R) + 138; R2 = 0.22
-7log10(R) + 129; R2 = 0.86
SPL(dB)
Range (m)

SR23 - 5

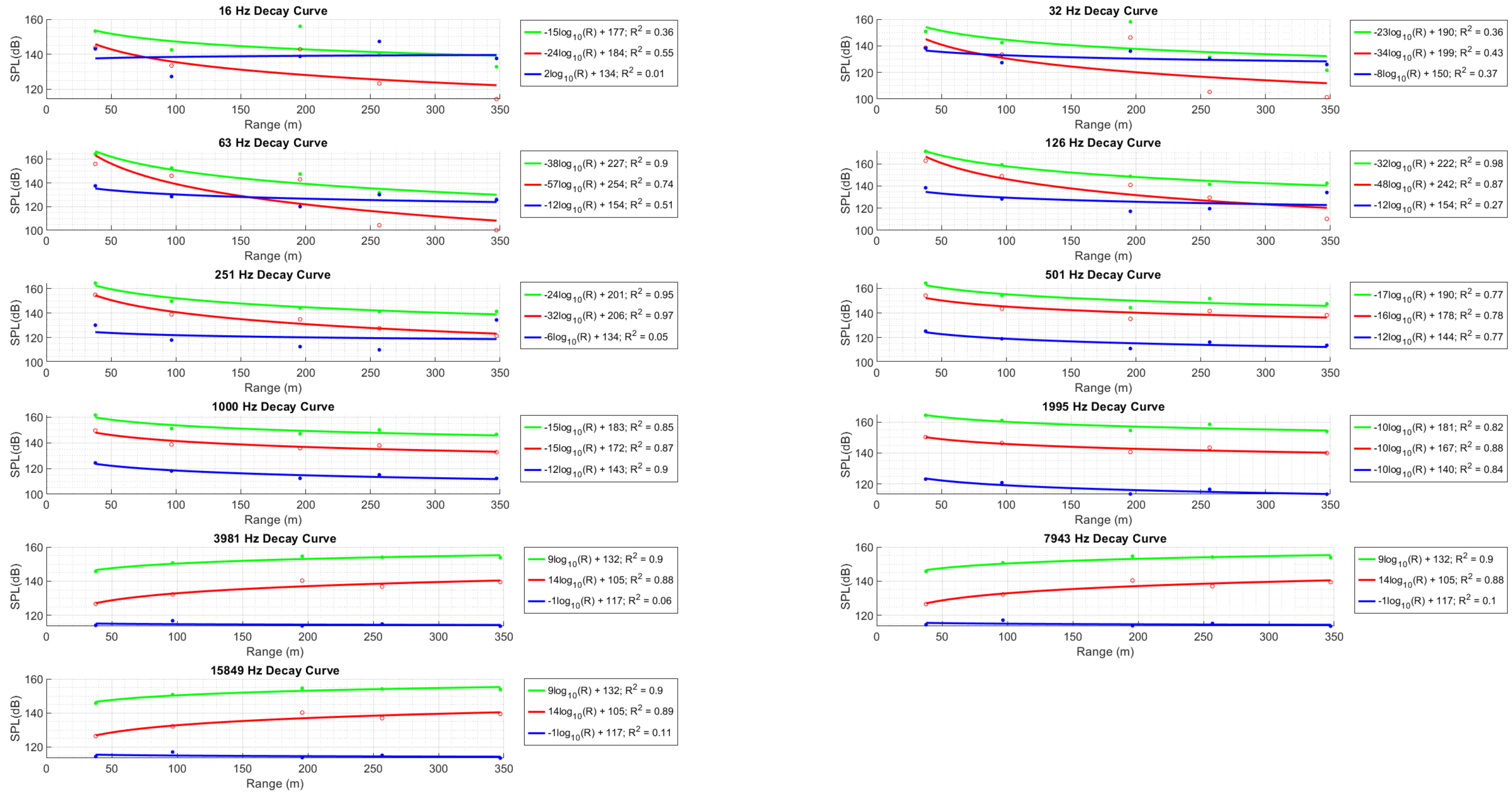

16 Hz Decay Curve
-9log10(R) + 162; R2 = 0.5
-5log10(R) + 142; R2 = 0.05
-20log10(R) + 175; R2 = 0.89
32 Hz Decay Curve
-4log10(R) + 151; R2 = 0.31
1log10(R) + 129; R2 = 0
-15log10(R) + 164; R2 = 0.56
63 Hz Decay Curve
-12log10(R) + 172; R2 = 0.48
-12log10(R) + 165; R2 = 0.54
-7log10(R) + 139; R2 = 0.28
126 Hz Decay Curve
-14log10(R) + 180; R2 = 0.6
-15log10(R) + 171; R2 = 0.53
-14log10(R) + 151; R2 = 0.74
251 Hz Decay Curve
-13log10(R) + 173; R2 = 0.76
-13log10(R) + 163; R2 = 0.79
-12log10(R) + 139; R2 = 0.84
501 Hz Decay Curve
-8log10(R) + 164; R2 = 0.39
-6log10(R) + 152; R2 = 0.26
-7log10(R) + 129; R2 = 0.4
1000 Hz Decay Curve
-2log10(R) + 149; R2 = 0.4
-1log10(R) + 134; R2 = 0.22
-3log10(R) + 119; R2 = 0.85
1995 Hz Decay Curve
-2log10(R) + 152; R2 = 0.12
-2log10(R) + 139; R2 = 0.21
-5log10(R) + 124; R2 = 0.87
3981 Hz Decay Curve
-1log10(R) + 150; R2 = 0.06
0log10(R) + 135; R2 = 0
-5log10(R) + 125; R2 = 0.86
7943 Hz Decay Curve
-1log10(R) + 150; R2 = 0.06
0log10(R) + 135; R2 = 0
-6log10(R) + 125; R2 = 0.86
15849 Hz Decay Curve
-1log10(R) + 150; R2 = 0.06
0log10(R) + 134; R2 = 0
-5log10(R) + 125; R2 = 0.86
SPL(dB)
Range (m)

SR23 - 6



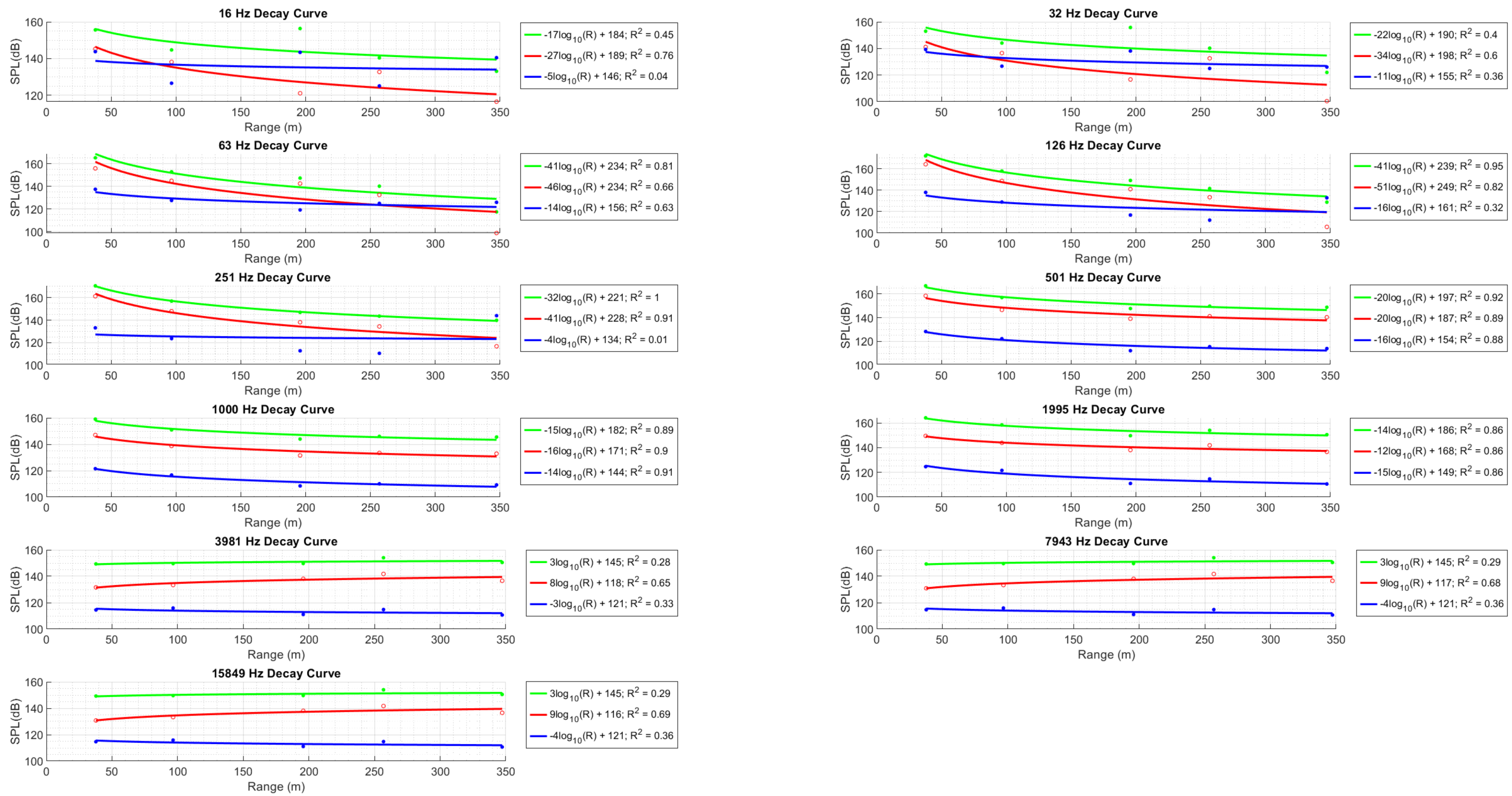
16 Hz Decay Curve
-21log10(R) + 184; R2 = 0.9
-31log10(R) + 192; R2 = 0.93
3log10(R) + 132; R2 = 0.02
32 Hz Decay Curve
-27log10(R) + 194; R2 = 0.92
-40log10(R) + 206; R2 = 0.92
-6log10(R) + 145; R2 = 0.18
63 Hz Decay Curve
-49log10(R) + 246; R2 = 0.79
-59log10(R) + 256; R2 = 0.71
-12log10(R) + 154; R2 = 0.59
126 Hz Decay Curve
-41log10(R) + 237; R2 = 0.91
-48log10(R) + 242; R2 = 0.76
-15log10(R) + 158; R2 = 0.37
251 Hz Decay Curve
-26log10(R) + 205; R2 = 1
-37log10(R) + 217; R2 = 0.89
-2log10(R) + 127; R2 = 0
501 Hz Decay Curve
-18log10(R) + 188; R2 = 0.91
-18log10(R) + 181; R2 = 0.89
-17log10(R) + 151; R2 = 0.89
1000 Hz Decay Curve
-10log10(R) + 170; R2 = 0.8
-7log10(R) + 150; R2 = 0.68
-10log10(R) + 134; R2 = 0.79
1995 Hz Decay Curve
-13log10(R) + 180; R2 = 0.71
-12log10(R) + 166; R2 = 0.79
-13log10(R) + 142; R2 = 0.81
3981 Hz Decay Curve
2log10(R) + 144; R2 = 0.07
7log10(R) + 119; R2 = 0.44
-3log10(R) + 119; R2 = 0.29
7943 Hz Decay Curve
2log10(R) + 144; R2 = 0.07
7log10(R) + 119; R2 = 0.43
-3log10(R) + 119; R2 = 0.29
15849 Hz Decay Curve
2log10(R) + 144; R2 = 0.07
7log10(R) + 119; R2 = 0.43
-3log10(R) + 119; R2 = 0.29
SPL(dB)
Range (m)

SR23 - 7

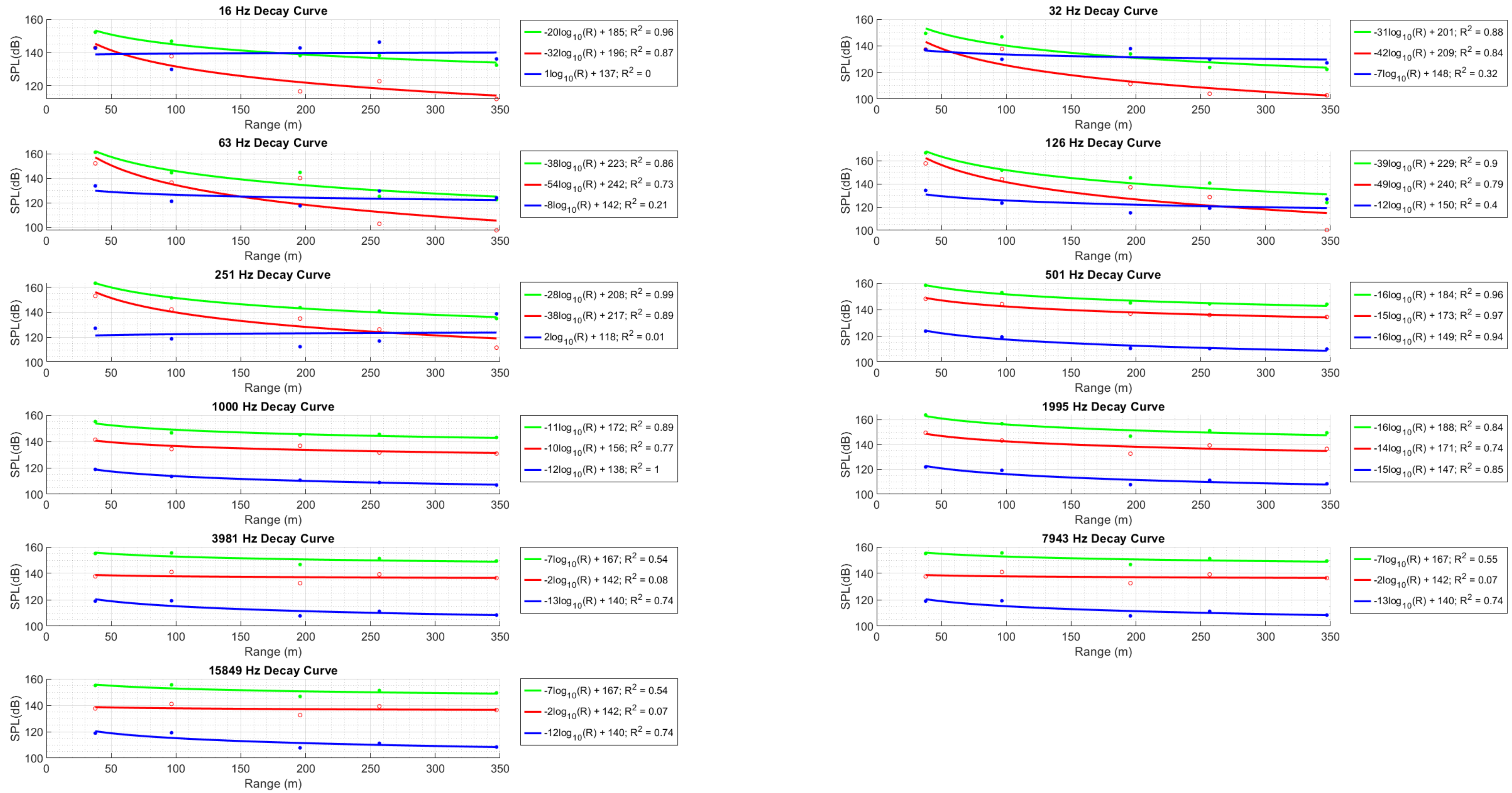


16 Hz Decay Curve
$-15\log_{10}(R) + 177; R^2 = 0.36$
$-24\log_{10}(R) + 184; R^2 = 0.55$
$2\log_{10}(R) + 134; R^2 = 0.01$
32 Hz Decay Curve
$-23\log_{10}(R) + 190; R^2 = 0.36$
$-34\log_{10}(R) + 199; R^2 = 0.43$
$-8\log_{10}(R) + 150; R^2 = 0.37$
63 Hz Decay Curve
$-38\log_{10}(R) + 227; R^2 = 0.9$
$-57\log_{10}(R) + 254; R^2 = 0.74$
$-12\log_{10}(R) + 154; R^2 = 0.51$
126 Hz Decay Curve
$-32\log_{10}(R) + 222; R^2 = 0.98$
$-48\log_{10}(R) + 242; R^2 = 0.87$
$-12\log_{10}(R) + 154; R^2 = 0.27$
251 Hz Decay Curve
$-24\log_{10}(R) + 201; R^2 = 0.95$
$-32\log_{10}(R) + 206; R^2 = 0.97$
$-6\log_{10}(R) + 134; R^2 = 0.05$
501 Hz Decay Curve
$-17\log_{10}(R) + 190; R^2 = 0.77$
$-16\log_{10}(R) + 178; R^2 = 0.78$
$-12\log_{10}(R) + 144; R^2 = 0.77$
1000 Hz Decay Curve
$-15\log_{10}(R) + 183; R^2 = 0.85$
$-15\log_{10}(R) + 172; R^2 = 0.87$
$-12\log_{10}(R) + 143; R^2 = 0.9$
1995 Hz Decay Curve
$-10\log_{10}(R) + 181; R^2 = 0.82$
$-10\log_{10}(R) + 167; R^2 = 0.88$
$-10\log_{10}(R) + 140; R^2 = 0.84$
3981 Hz Decay Curve
$9\log_{10}(R) + 132; R^2 = 0.9$
$14\log_{10}(R) + 105; R^2 = 0.88$
$-1\log_{10}(R) + 117; R^2 = 0.06$
7943 Hz Decay Curve
$9\log_{10}(R) + 132; R^2 = 0.9$
$14\log_{10}(R) + 105; R^2 = 0.88$
$-1\log_{10}(R) + 117; R^2 = 0.1$
15849 Hz Decay Curve
$9\log_{10}(R) + 132; R^2 = 0.9$
$14\log_{10}(R) + 105; R^2 = 0.89$
$-1\log_{10}(R) + 117; R^2 = 0.11$
SPL(dB)
Range (m)

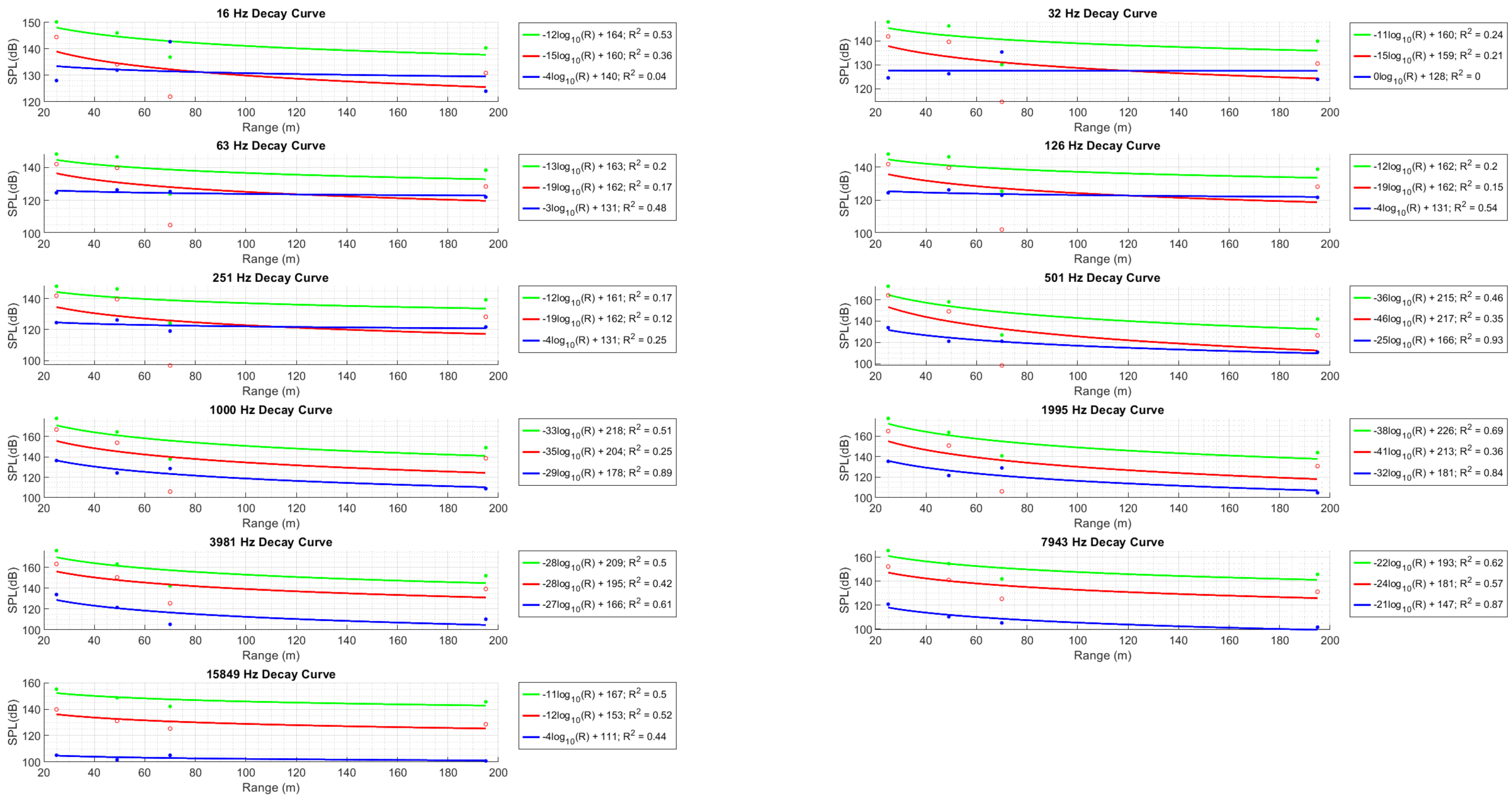
SR23 - 8


16 Hz Decay Curve
-17log10(R) + 184; R2 = 0.45
-27log10(R) + 189; R2 = 0.76
-5log10(R) + 146; R2 = 0.04
32 Hz Decay Curve
-22log10(R) + 190; R2 = 0.4
-34log10(R) + 198; R2 = 0.6
-11log10(R) + 155; R2 = 0.36
63 Hz Decay Curve
-41log10(R) + 234; R2 = 0.81
-46log10(R) + 234; R2 = 0.66
-14log10(R) + 156; R2 = 0.63
126 Hz Decay Curve
-41log10(R) + 239; R2 = 0.95
-51log10(R) + 249; R2 = 0.82
-16log10(R) + 161; R2 = 0.32
251 Hz Decay Curve
-32log10(R) + 221; R2 = 1
-41log10(R) + 228; R2 = 0.91
-4log10(R) + 134; R2 = 0.01
501 Hz Decay Curve
-20log10(R) + 197; R2 = 0.92
-20log10(R) + 187; R2 = 0.89
-16log10(R) + 154; R2 = 0.88
1000 Hz Decay Curve
-15log10(R) + 182; R2 = 0.89
-16log10(R) + 171; R2 = 0.9
-14log10(R) + 144; R2 = 0.91
1995 Hz Decay Curve
-14log10(R) + 186; R2 = 0.86
-12log10(R) + 168; R2 = 0.86
-15log10(R) + 149; R2 = 0.86
3981 Hz Decay Curve
3log10(R) + 145; R2 = 0.28
8log10(R) + 118; R2 = 0.65
-3log10(R) + 121; R2 = 0.33
7943 Hz Decay Curve
3log10(R) + 145; R2 = 0.29
9log10(R) + 117; R2 = 0.68
-4log10(R) + 121; R2 = 0.36
15849 Hz Decay Curve
3log10(R) + 145; R2 = 0.29
9log10(R) + 116; R2 = 0.69
-4log10(R) + 121; R2 = 0.36
SPL(dB)
Range (m)

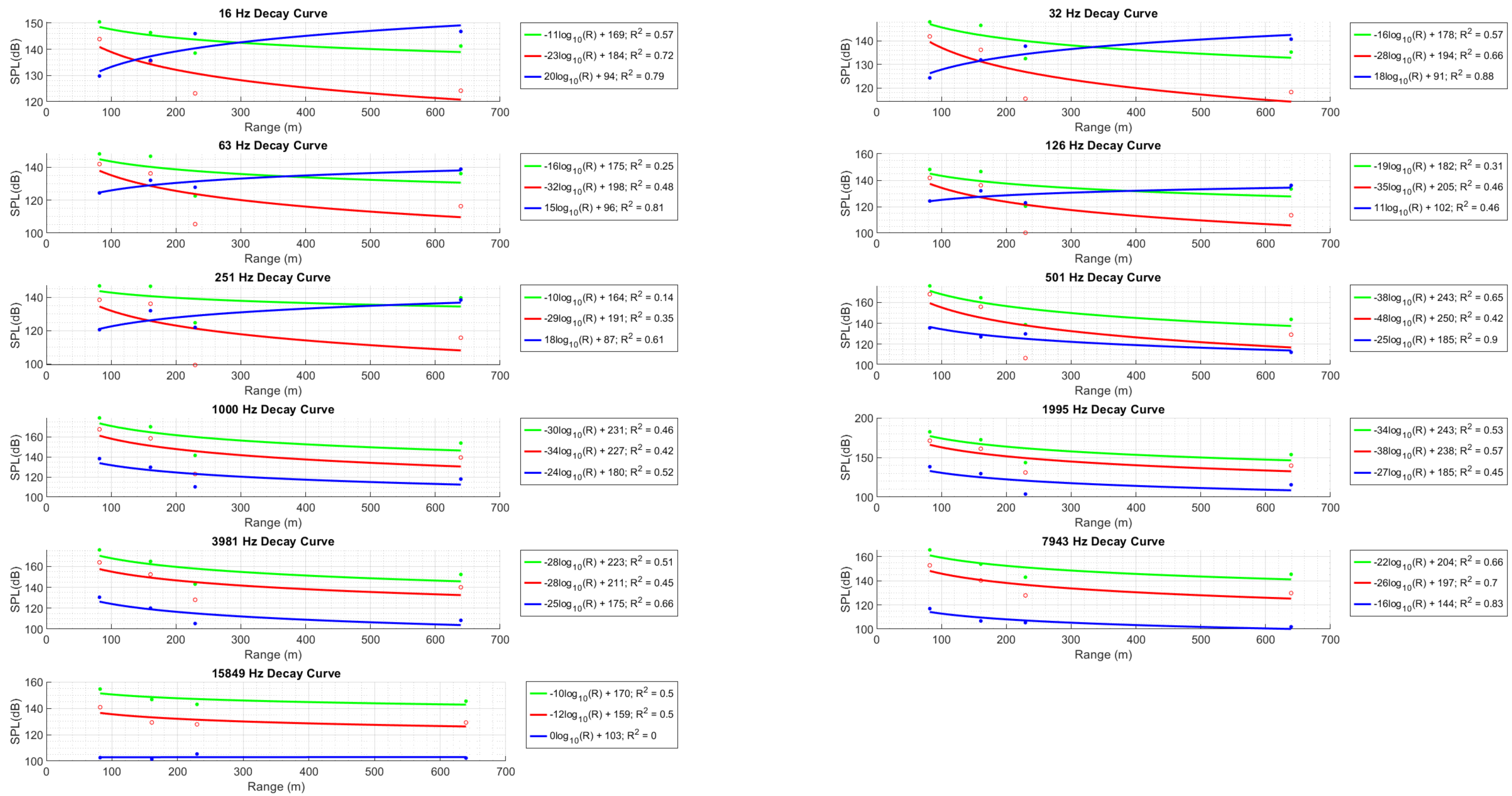
SR23 - 9


16 Hz Decay Curve
$-20\log_{10}(R) + 185$; $R^2 = 0.96$
$-32\log_{10}(R) + 196$; $R^2 = 0.87$
$1\log_{10}(R) + 137$; $R^2 = 0$
32 Hz Decay Curve
$-31\log_{10}(R) + 201$; $R^2 = 0.88$
$-42\log_{10}(R) + 209$; $R^2 = 0.84$
$-7\log_{10}(R) + 148$; $R^2 = 0.32$
63 Hz Decay Curve
$-38\log_{10}(R) + 223$; $R^2 = 0.86$
$-54\log_{10}(R) + 242$; $R^2 = 0.73$
$-8\log_{10}(R) + 142$; $R^2 = 0.21$
126 Hz Decay Curve
$-39\log_{10}(R) + 229$; $R^2 = 0.9$
$-49\log_{10}(R) + 240$; $R^2 = 0.79$
$-12\log_{10}(R) + 150$; $R^2 = 0.4$
251 Hz Decay Curve
$-28\log_{10}(R) + 208$; $R^2 = 0.99$
$-38\log_{10}(R) + 217$; $R^2 = 0.89$
$2\log_{10}(R) + 118$; $R^2 = 0.01$
501 Hz Decay Curve
$-16\log_{10}(R) + 184$; $R^2 = 0.96$
$-15\log_{10}(R) + 173$; $R^2 = 0.97$
$-16\log_{10}(R) + 149$; $R^2 = 0.94$
1000 Hz Decay Curve
$-11\log_{10}(R) + 172$; $R^2 = 0.89$
$-10\log_{10}(R) + 156$; $R^2 = 0.77$
$-12\log_{10}(R) + 138$; $R^2 = 1$
1995 Hz Decay Curve
$-16\log_{10}(R) + 188$; $R^2 = 0.84$
$-14\log_{10}(R) + 171$; $R^2 = 0.74$
$-15\log_{10}(R) + 147$; $R^2 = 0.85$
3981 Hz Decay Curve
$-7\log_{10}(R) + 167$; $R^2 = 0.54$
$-2\log_{10}(R) + 142$; $R^2 = 0.08$
$-13\log_{10}(R) + 140$; $R^2 = 0.74$
7943 Hz Decay Curve
$-7\log_{10}(R) + 167$; $R^2 = 0.55$
$-2\log_{10}(R) + 142$; $R^2 = 0.07$
$-13\log_{10}(R) + 140$; $R^2 = 0.74$
15849 Hz Decay Curve
$-7\log_{10}(R) + 167$; $R^2 = 0.54$
$-2\log_{10}(R) + 142$; $R^2 = 0.07$
$-12\log_{10}(R) + 140$; $R^2 = 0.74$
SPL(dB)
Range (m)

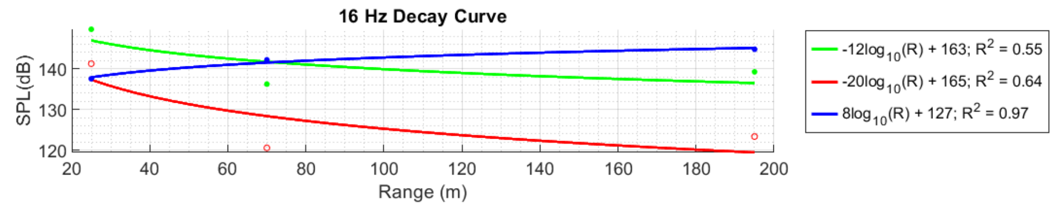
Ribault - 1

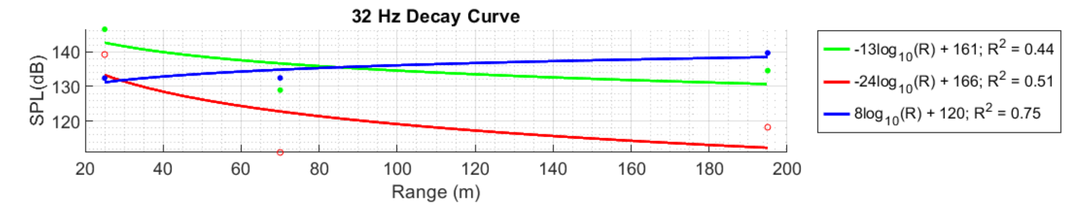

16 Hz Decay Curve
-12log10(R) + 164; R2 = 0.53
-15log10(R) + 160; R2 = 0.36
-4log10(R) + 140; R2 = 0.04
32 Hz Decay Curve
-11log10(R) + 160; R2 = 0.24
-15log10(R) + 159; R2 = 0.21
0log10(R) + 128; R2 = 0
63 Hz Decay Curve
-13log10(R) + 163; R2 = 0.2
-19log10(R) + 162; R2 = 0.17
-3log10(R) + 131; R2 = 0.48
126 Hz Decay Curve
-12log10(R) + 162; R2 = 0.2
-19log10(R) + 162; R2 = 0.15
-4log10(R) + 131; R2 = 0.54
251 Hz Decay Curve
-12log10(R) + 161; R2 = 0.17
-19log10(R) + 162; R2 = 0.12
-4log10(R) + 131; R2 = 0.25
501 Hz Decay Curve
-36log10(R) + 215; R2 = 0.46
-46log10(R) + 217; R2 = 0.35
-25log10(R) + 166; R2 = 0.93
1000 Hz Decay Curve
-33log10(R) + 218; R2 = 0.51
-35log10(R) + 204; R2 = 0.25
-29log10(R) + 178; R2 = 0.89
1995 Hz Decay Curve
-38log10(R) + 226; R2 = 0.69
-41log10(R) + 213; R2 = 0.36
-32log10(R) + 181; R2 = 0.84
3981 Hz Decay Curve
-28log10(R) + 209; R2 = 0.5
-28log10(R) + 195; R2 = 0.42
-27log10(R) + 166; R2 = 0.61
7943 Hz Decay Curve
-22log10(R) + 193; R2 = 0.62
-24log10(R) + 181; R2 = 0.57
-21log10(R) + 147; R2 = 0.87
15849 Hz Decay Curve
-11log10(R) + 167; R2 = 0.5
-12log10(R) + 153; R2 = 0.52
-4log10(R) + 111; R2 = 0.44
SPL(dB)
Range (m)

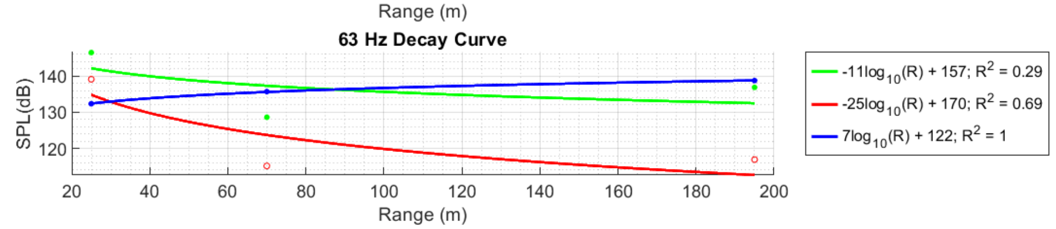
Ribault - 2

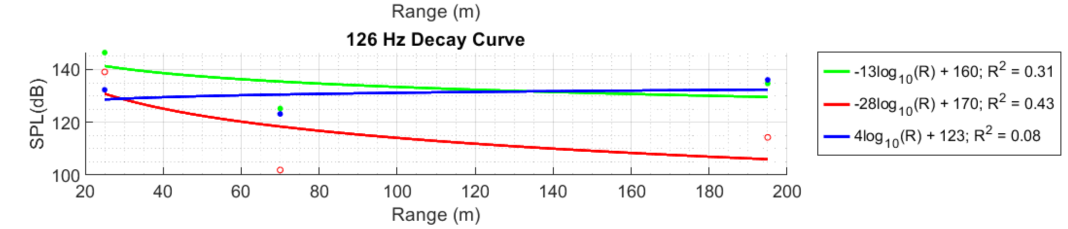

16 Hz Decay Curve
$-11\log_{10}(R) + 169$; $R^2 = 0.57$
$-23\log_{10}(R) + 184$; $R^2 = 0.72$
$20\log_{10}(R) + 94$; $R^2 = 0.79$
32 Hz Decay Curve
$-16\log_{10}(R) + 178$; $R^2 = 0.57$
$-28\log_{10}(R) + 194$; $R^2 = 0.66$
$18\log_{10}(R) + 91$; $R^2 = 0.88$
63 Hz Decay Curve
$-16\log_{10}(R) + 175$; $R^2 = 0.25$
$-32\log_{10}(R) + 198$; $R^2 = 0.48$
$15\log_{10}(R) + 96$; $R^2 = 0.81$
126 Hz Decay Curve
$-19\log_{10}(R) + 182$; $R^2 = 0.31$
$-35\log_{10}(R) + 205$; $R^2 = 0.46$
$11\log_{10}(R) + 102$; $R^2 = 0.46$
251 Hz Decay Curve
$-10\log_{10}(R) + 164$; $R^2 = 0.14$
$-29\log_{10}(R) + 191$; $R^2 = 0.35$
$18\log_{10}(R) + 87$; $R^2 = 0.61$
501 Hz Decay Curve
$-38\log_{10}(R) + 243$; $R^2 = 0.65$
$-48\log_{10}(R) + 250$; $R^2 = 0.42$
$-25\log_{10}(R) + 185$; $R^2 = 0.9$
1000 Hz Decay Curve
$-30\log_{10}(R) + 231$; $R^2 = 0.46$
$-34\log_{10}(R) + 227$; $R^2 = 0.42$
$-24\log_{10}(R) + 180$; $R^2 = 0.52$
1995 Hz Decay Curve
$-34\log_{10}(R) + 243$; $R^2 = 0.53$
$-38\log_{10}(R) + 238$; $R^2 = 0.57$
$-27\log_{10}(R) + 185$; $R^2 = 0.45$
3981 Hz Decay Curve
$-28\log_{10}(R) + 223$; $R^2 = 0.51$
$-28\log_{10}(R) + 211$; $R^2 = 0.45$
$-25\log_{10}(R) + 175$; $R^2 = 0.66$
7943 Hz Decay Curve
$-22\log_{10}(R) + 204$; $R^2 = 0.66$
$-26\log_{10}(R) + 197$; $R^2 = 0.7$
$-16\log_{10}(R) + 144$; $R^2 = 0.83$
15849 Hz Decay Curve
$-10\log_{10}(R) + 170$; $R^2 = 0.5$
$-12\log_{10}(R) + 159$; $R^2 = 0.5$
$0\log_{10}(R) + 103$; $R^2 = 0$
SPL(dB)
Range (m)

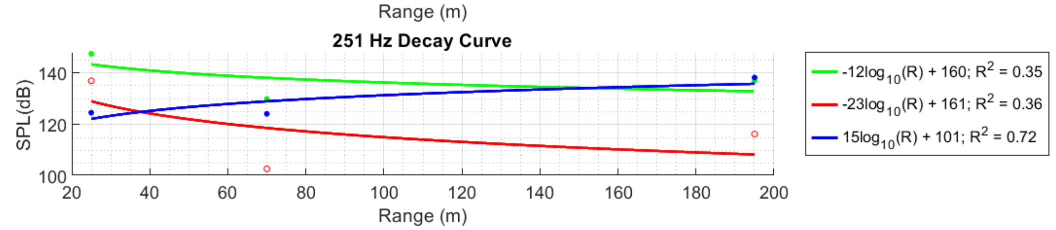
Ribault- 3

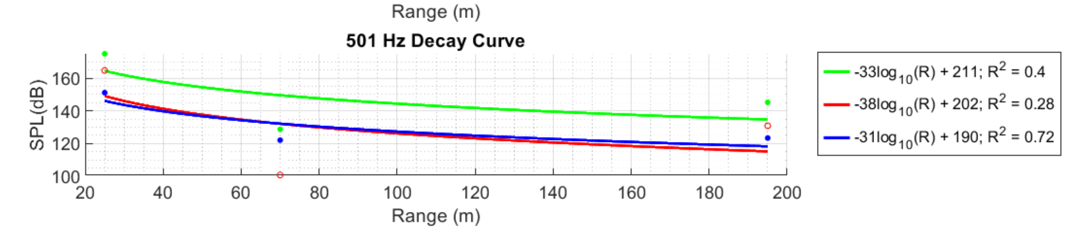

16 Hz Decay Curve
SPL(dB)
Range (m)
-12log10(R) + 163; R2 = 0.55
-20log10(R) + 165; R2 = 0.64
8log10(R) + 127; R2 = 0.97

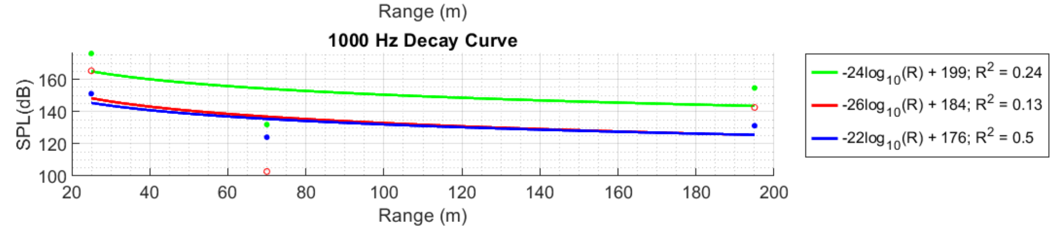

32 Hz Decay Curve
SPL(dB)
Range (m)
-13log10(R) + 161; R2 = 0.44
-24log10(R) + 166; R2 = 0.51
8log10(R) + 120; R2 = 0.75

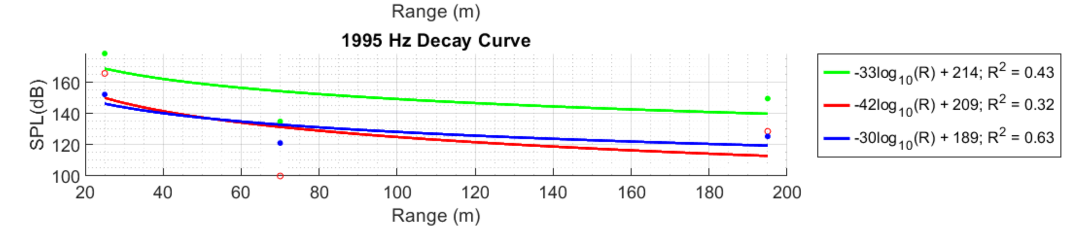

63 Hz Decay Curve
SPL(dB)
Range (m)
-11log10(R) + 157; R2 = 0.29
-25log10(R) + 170; R2 = 0.69
7log10(R) + 122; R2 = 1

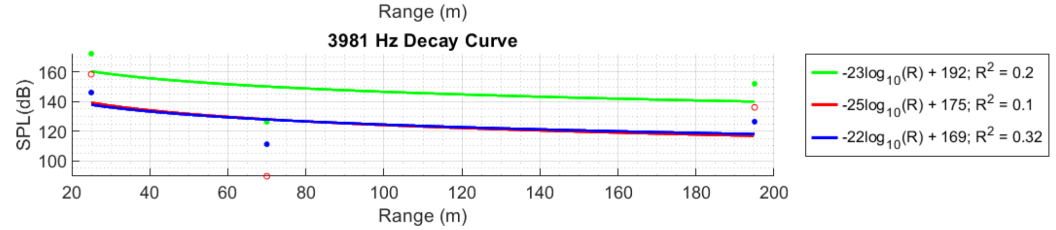

126 Hz Decay Curve
SPL(dB)
Range (m)
-13log10(R) + 160; R2 = 0.31
-28log10(R) + 170; R2 = 0.43
4log10(R) + 123; R2 = 0.08

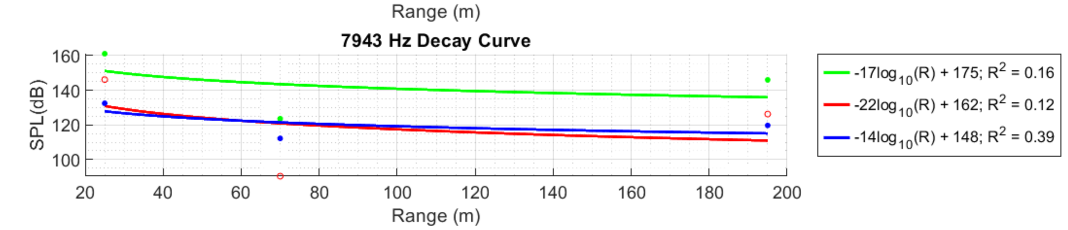

251 Hz Decay Curve
SPL(dB)
Range (m)
-12log10(R) + 160; R2 = 0.35
-23log10(R) + 161; R2 = 0.36
15log10(R) + 101; R2 = 0.72

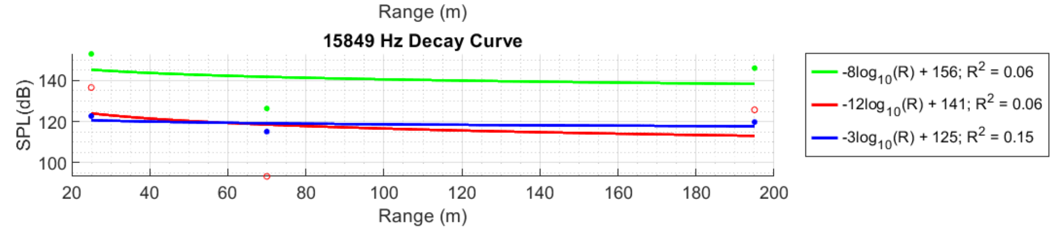

501 Hz Decay Curve
SPL(dB)
Range (m)
-33log10(R) + 211; R2 = 0.4
-38log10(R) + 202; R2 = 0.28
-31log10(R) + 190; R2 = 0.72


1000 Hz Decay Curve
SPL(dB)
Range (m)
-24log10(R) + 199; R2 = 0.24
-26log10(R) + 184; R2 = 0.13
-22log10(R) + 176; R2 = 0.5

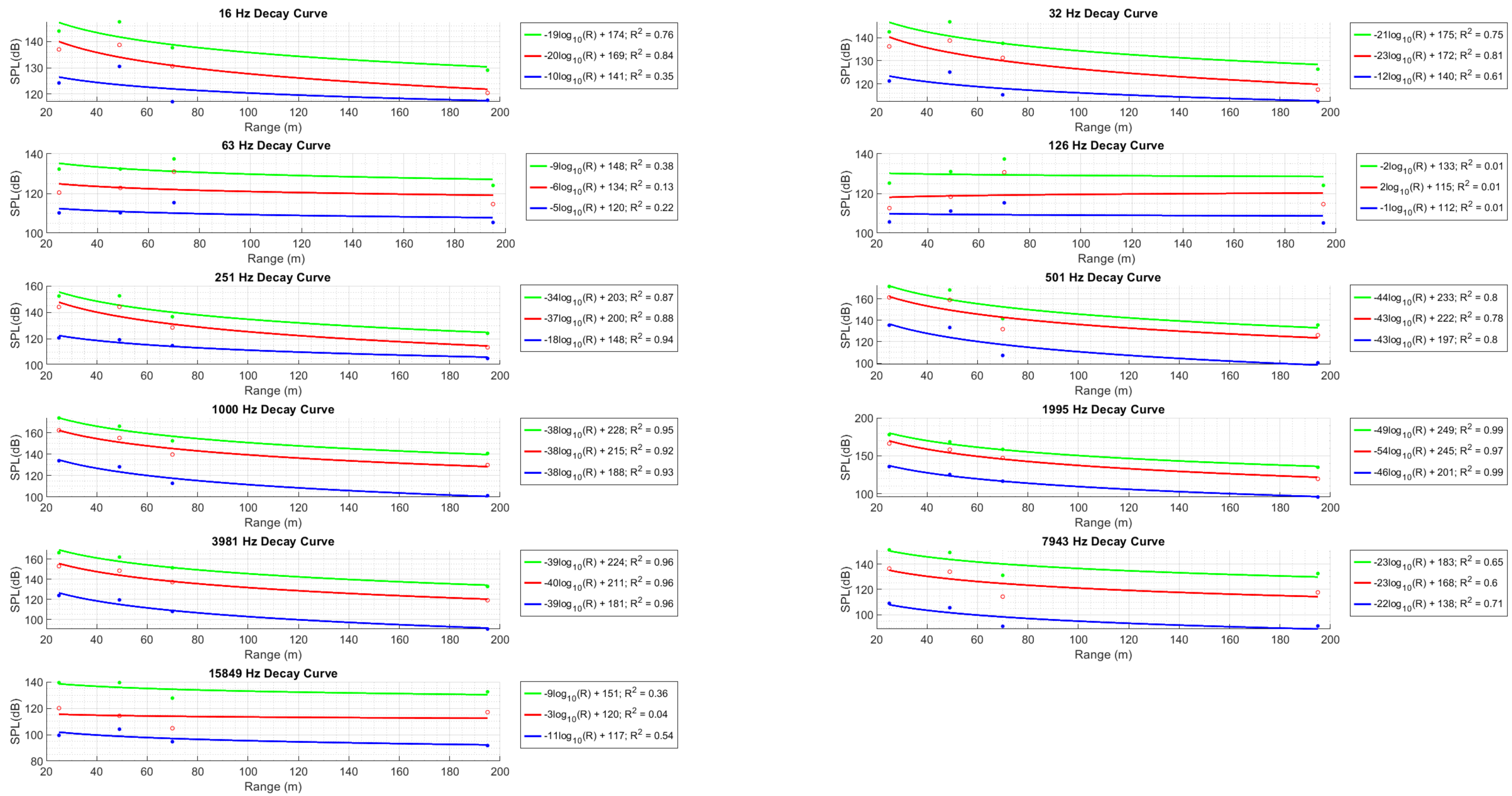

1995 Hz Decay Curve
SPL(dB)
Range (m)
-33log10(R) + 214; R2 = 0.43
-42log10(R) + 209; R2 = 0.32
-30log10(R) + 189; R2 = 0.63


3981 Hz Decay Curve
SPL(dB)
Range (m)
-23log10(R) + 192; R2 = 0.2
-25log10(R) + 175; R2 = 0.1
-22log10(R) + 169; R2 = 0.32

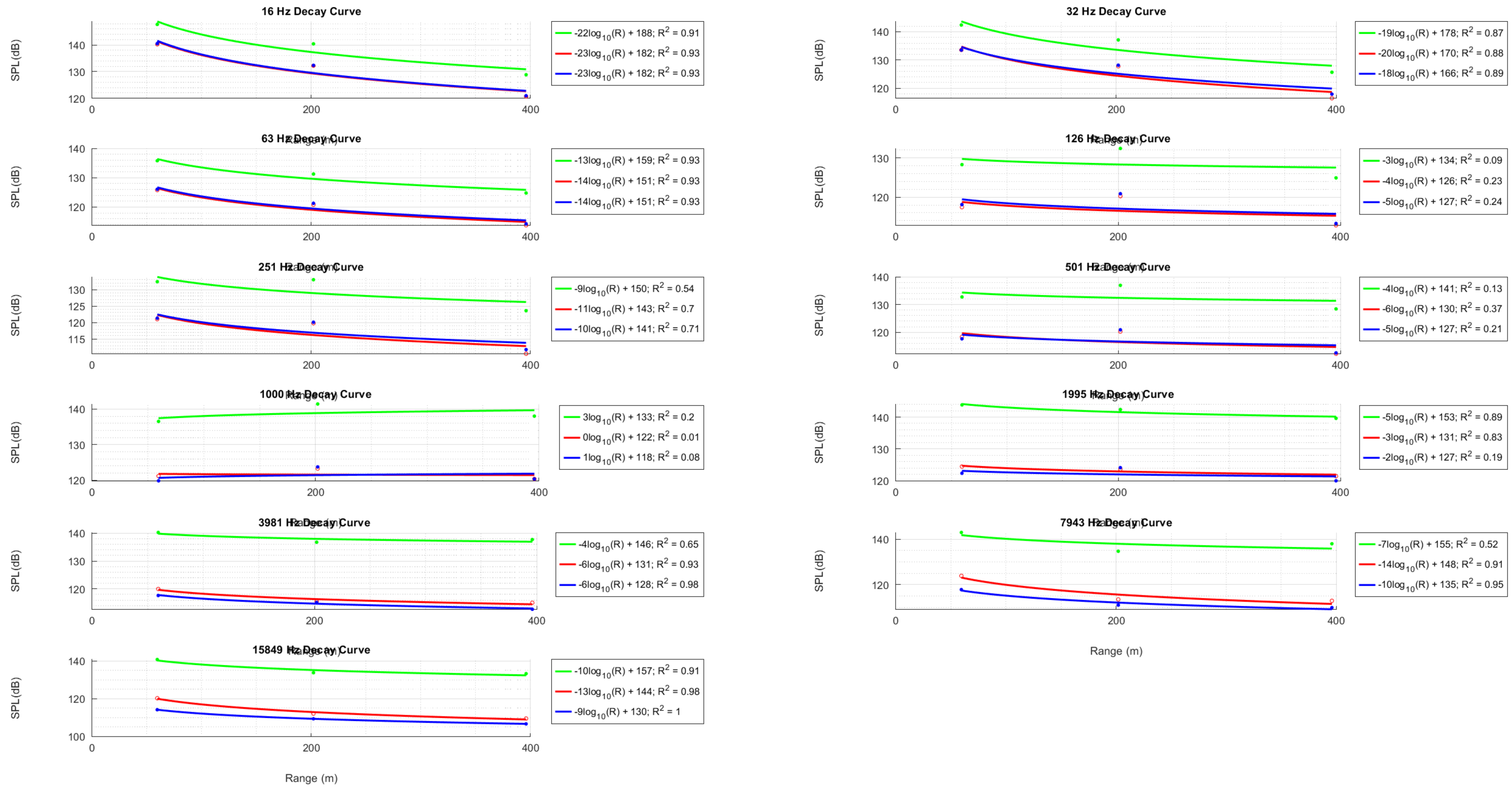

7943 Hz Decay Curve
SPL(dB)
Range (m)
-17log10(R) + 175; R2 = 0.16
-22log10(R) + 162; R2 = 0.12
-14log10(R) + 148; R2 = 0.39


15849 Hz Decay Curve
SPL(dB)
Range (m)
-8log10(R) + 156; R2 = 0.06
-12log10(R) + 141; R2 = 0.06
-3log10(R) + 125; R2 = 0.15

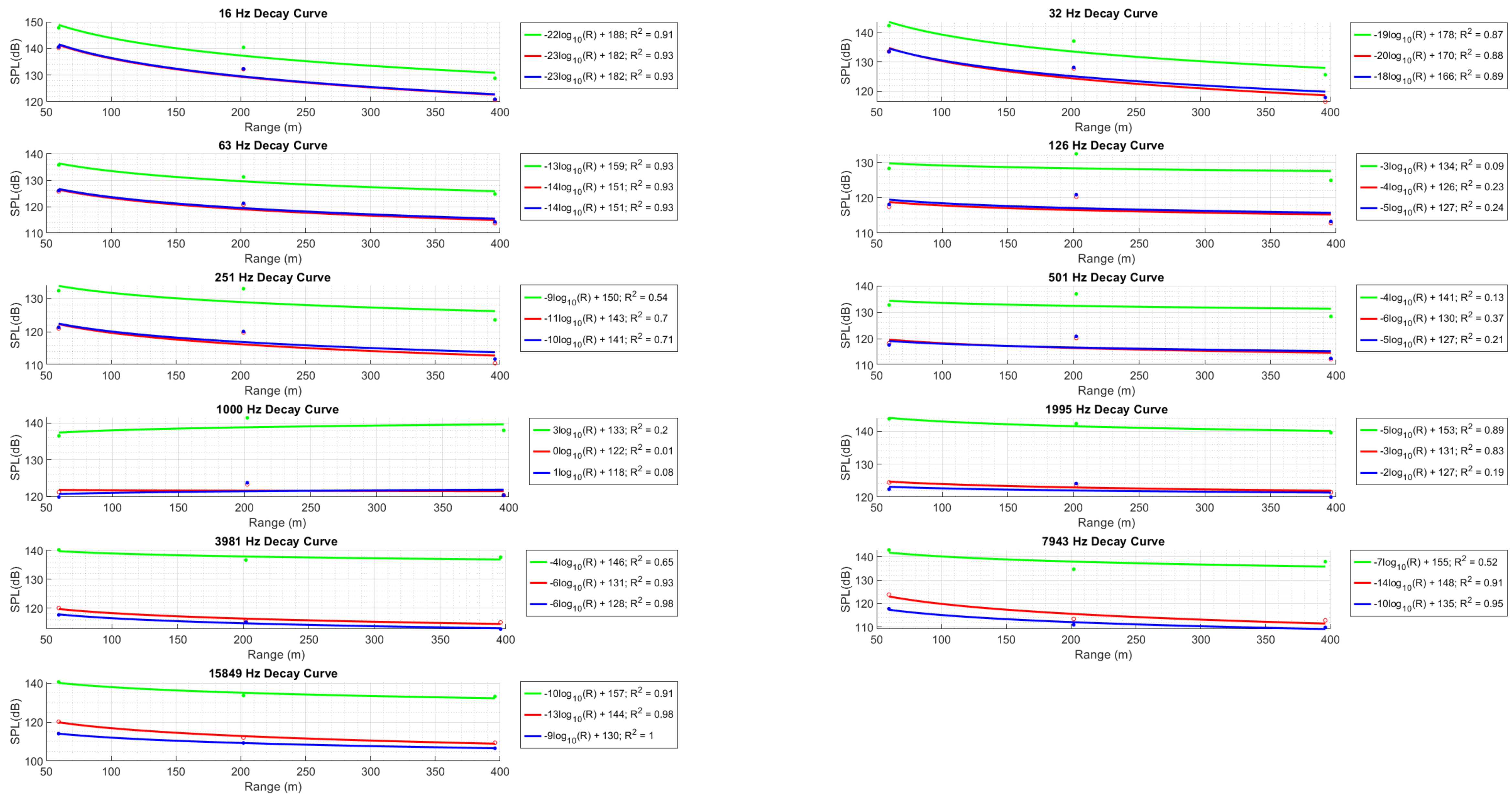
Ribault - 4


16 Hz Decay Curve
-19log10(R) + 174; R2 = 0.76
-20log10(R) + 169; R2 = 0.84
-10log10(R) + 141; R2 = 0.35
32 Hz Decay Curve
-21log10(R) + 175; R2 = 0.75
-23log10(R) + 172; R2 = 0.81
-12log10(R) + 140; R2 = 0.61
63 Hz Decay Curve
-9log10(R) + 148; R2 = 0.38
-6log10(R) + 134; R2 = 0.13
-5log10(R) + 120; R2 = 0.22
126 Hz Decay Curve
-2log10(R) + 133; R2 = 0.01
2log10(R) + 115; R2 = 0.01
-1log10(R) + 112; R2 = 0.01
251 Hz Decay Curve
-34log10(R) + 203; R2 = 0.87
-37log10(R) + 200; R2 = 0.88
-18log10(R) + 148; R2 = 0.94
501 Hz Decay Curve
-44log10(R) + 233; R2 = 0.8
-43log10(R) + 222; R2 = 0.78
-43log10(R) + 197; R2 = 0.8
1000 Hz Decay Curve
-38log10(R) + 228; R2 = 0.95
-38log10(R) + 215; R2 = 0.92
-38log10(R) + 188; R2 = 0.93
1995 Hz Decay Curve
-49log10(R) + 249; R2 = 0.99
-54log10(R) + 245; R2 = 0.97
-46log10(R) + 201; R2 = 0.99
3981 Hz Decay Curve
-39log10(R) + 224; R2 = 0.96
-40log10(R) + 211; R2 = 0.96
-39log10(R) + 181; R2 = 0.96
7943 Hz Decay Curve
-23log10(R) + 183; R2 = 0.65
-23log10(R) + 168; R2 = 0.6
-22log10(R) + 138; R2 = 0.71
15849 Hz Decay Curve
-9log10(R) + 151; R2 = 0.36
-3log10(R) + 120; R2 = 0.04
-11log10(R) + 117; R2 = 0.54
SPL(dB)
Range (m)

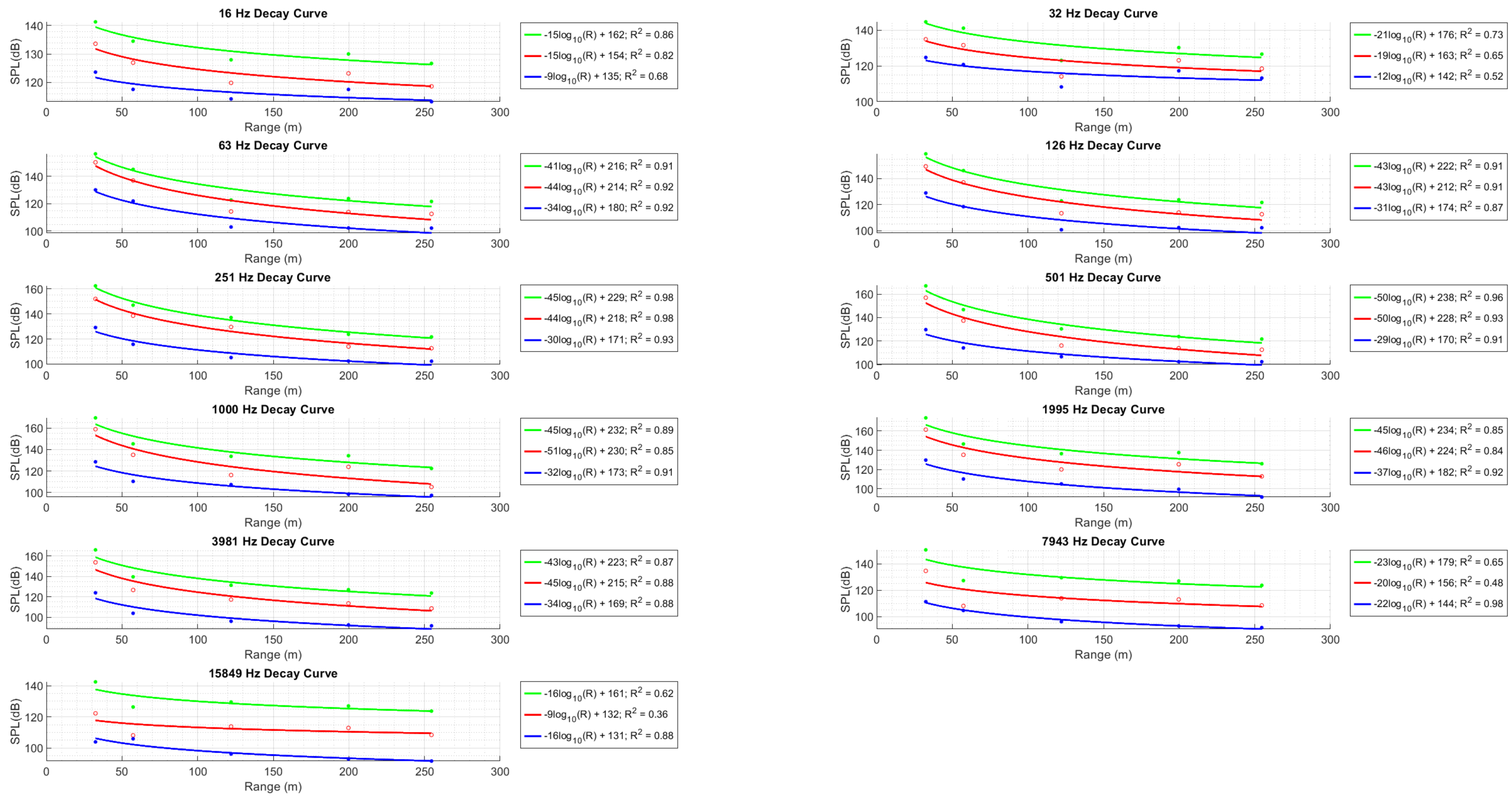
Dunns - 1


16 Hz Decay Curve
-22log10(R) + 188; R2 = 0.91
-23log10(R) + 182; R2 = 0.93
-23log10(R) + 182; R2 = 0.93
32 Hz Decay Curve
-19log10(R) + 178; R2 = 0.87
-20log10(R) + 170; R2 = 0.88
-18log10(R) + 166; R2 = 0.89
63 Hz Decay Curve
-13log10(R) + 159; R2 = 0.93
-14log10(R) + 151; R2 = 0.93
-14log10(R) + 151; R2 = 0.93
126 Hz Decay Curve
-3log10(R) + 134; R2 = 0.09
-4log10(R) + 126; R2 = 0.23
-5log10(R) + 127; R2 = 0.24
251 Hz Decay Curve
-9log10(R) + 150; R2 = 0.54
-11log10(R) + 143; R2 = 0.7
-10log10(R) + 141; R2 = 0.71
501 Hz Decay Curve
-4log10(R) + 141; R2 = 0.13
-6log10(R) + 130; R2 = 0.37
-5log10(R) + 127; R2 = 0.21
1000 Hz Decay Curve
3log10(R) + 133; R2 = 0.2
0log10(R) + 122; R2 = 0.01
1log10(R) + 118; R2 = 0.08
1995 Hz Decay Curve
-5log10(R) + 153; R2 = 0.89
-3log10(R) + 131; R2 = 0.83
-2log10(R) + 127; R2 = 0.19
3981 Hz Decay Curve
-4log10(R) + 146; R2 = 0.65
-6log10(R) + 131; R2 = 0.93
-6log10(R) + 128; R2 = 0.98
7943 Hz Decay Curve
-7log10(R) + 155; R2 = 0.52
-14log10(R) + 148; R2 = 0.91
-10log10(R) + 135; R2 = 0.95
15849 Hz Decay Curve
-10log10(R) + 157; R2 = 0.91
-13log10(R) + 144; R2 = 0.98
-9log10(R) + 130; R2 = 1
SPL(dB)
Range (m)

Dunns - 2

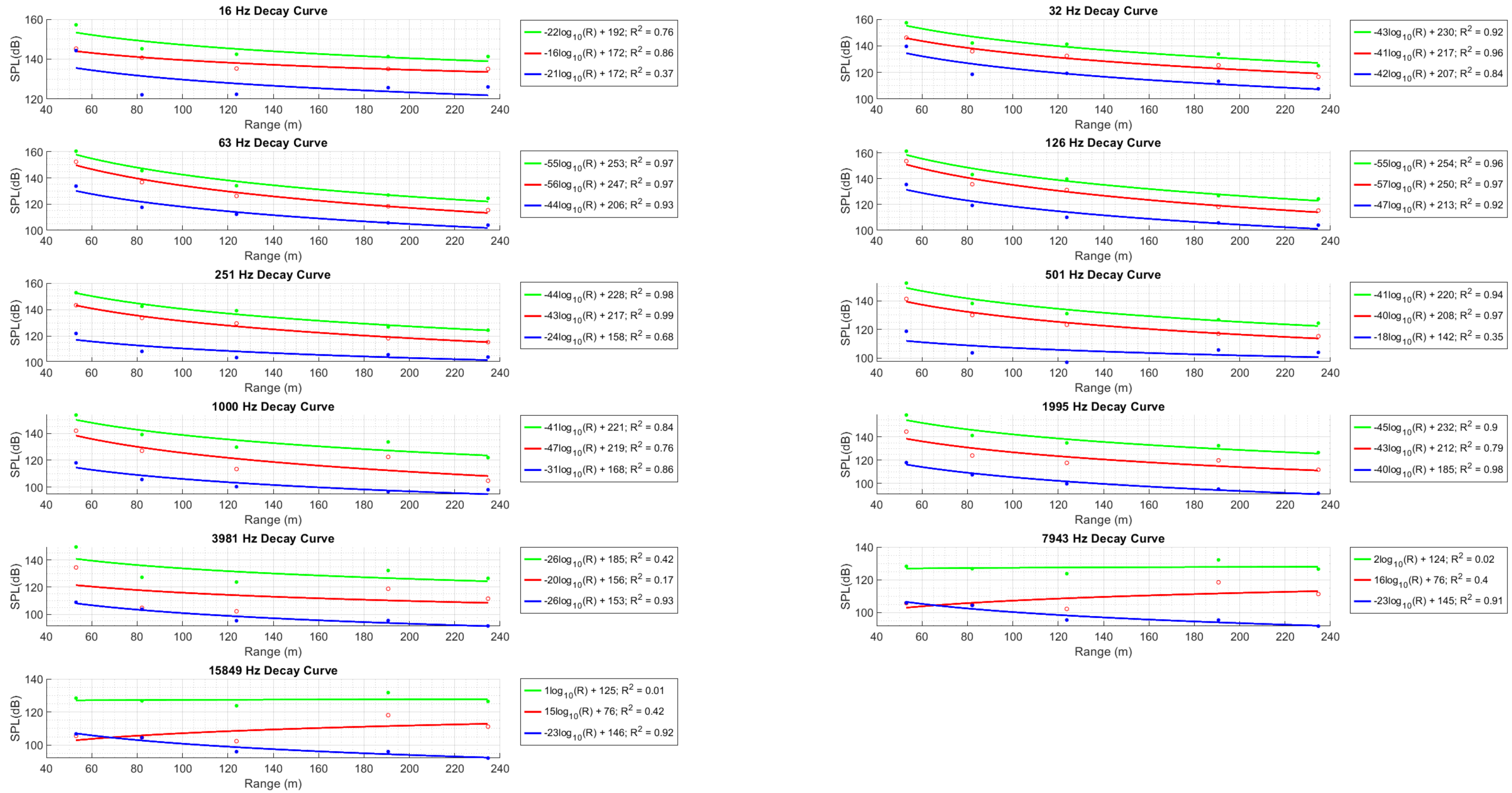

16 Hz Decay Curve
-22log10(R) + 188; R2 = 0.91
-23log10(R) + 182; R2 = 0.93
-23log10(R) + 182; R2 = 0.93
32 Hz Decay Curve
-19log10(R) + 178; R2 = 0.87
-20log10(R) + 170; R2 = 0.88
-18log10(R) + 166; R2 = 0.89
63 Hz Decay Curve
-13log10(R) + 159; R2 = 0.93
-14log10(R) + 151; R2 = 0.93
-14log10(R) + 151; R2 = 0.93
126 Hz Decay Curve
-3log10(R) + 134; R2 = 0.09
-4log10(R) + 126; R2 = 0.23
-5log10(R) + 127; R2 = 0.24
251 Hz Decay Curve
-9log10(R) + 150; R2 = 0.54
-11log10(R) + 143; R2 = 0.7
-10log10(R) + 141; R2 = 0.71
501 Hz Decay Curve
-4log10(R) + 141; R2 = 0.13
-6log10(R) + 130; R2 = 0.37
-5log10(R) + 127; R2 = 0.21
1000 Hz Decay Curve
3log10(R) + 133; R2 = 0.2
0log10(R) + 122; R2 = 0.01
1log10(R) + 118; R2 = 0.08
1995 Hz Decay Curve
-5log10(R) + 153; R2 = 0.89
-3log10(R) + 131; R2 = 0.83
-2log10(R) + 127; R2 = 0.19
3981 Hz Decay Curve
-4log10(R) + 146; R2 = 0.65
-6log10(R) + 131; R2 = 0.93
-6log10(R) + 128; R2 = 0.98
7943 Hz Decay Curve
-7log10(R) + 155; R2 = 0.52
-14log10(R) + 148; R2 = 0.91
-10log10(R) + 135; R2 = 0.95
15849 Hz Decay Curve
-10log10(R) + 157; R2 = 0.91
-13log10(R) + 144; R2 = 0.98
-9log10(R) + 130; R2 = 1
SPL(dB)
Range (m)

CR218 - 1

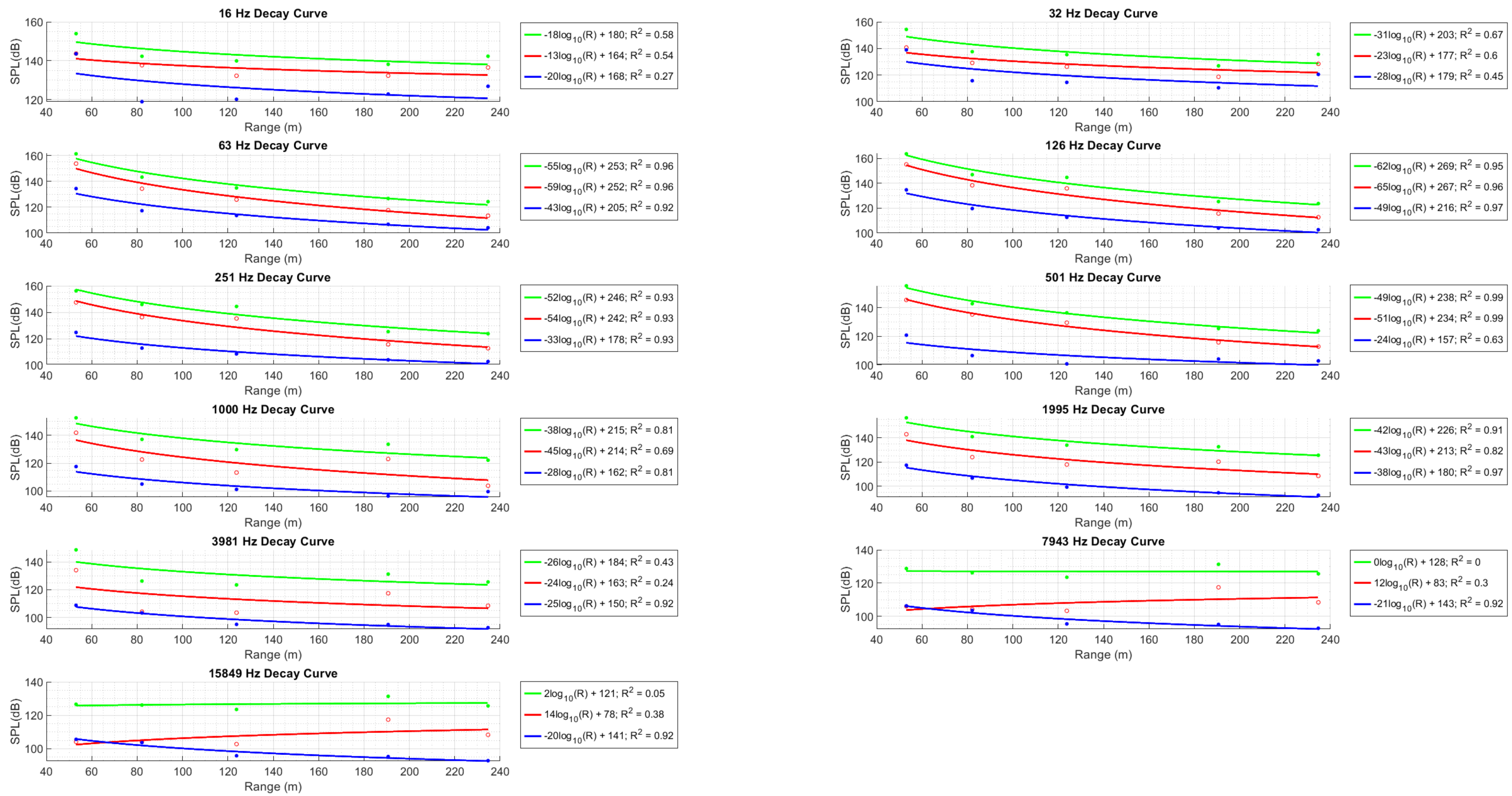


16 Hz Decay Curve
-15log10(R) + 162; R2 = 0.86
-15log10(R) + 154; R2 = 0.82
-9log10(R) + 135; R2 = 0.68
32 Hz Decay Curve
-21log10(R) + 176; R2 = 0.73
-19log10(R) + 163; R2 = 0.65
-12log10(R) + 142; R2 = 0.52
63 Hz Decay Curve
-41log10(R) + 216; R2 = 0.91
-44log10(R) + 214; R2 = 0.92
-34log10(R) + 180; R2 = 0.92
126 Hz Decay Curve
-43log10(R) + 222; R2 = 0.91
-43log10(R) + 212; R2 = 0.91
-31log10(R) + 174; R2 = 0.87
251 Hz Decay Curve
-45log10(R) + 229; R2 = 0.98
-44log10(R) + 218; R2 = 0.98
-30log10(R) + 171; R2 = 0.93
501 Hz Decay Curve
-50log10(R) + 238; R2 = 0.96
-50log10(R) + 228; R2 = 0.93
-29log10(R) + 170; R2 = 0.91
1000 Hz Decay Curve
-45log10(R) + 232; R2 = 0.89
-51log10(R) + 230; R2 = 0.85
-32log10(R) + 173; R2 = 0.91
1995 Hz Decay Curve
-45log10(R) + 234; R2 = 0.85
-46log10(R) + 224; R2 = 0.84
-37log10(R) + 182; R2 = 0.92
3981 Hz Decay Curve
-43log10(R) + 223; R2 = 0.87
-45log10(R) + 215; R2 = 0.88
-34log10(R) + 169; R2 = 0.88
7943 Hz Decay Curve
-23log10(R) + 179; R2 = 0.65
-20log10(R) + 156; R2 = 0.48
-22log10(R) + 144; R2 = 0.98
15849 Hz Decay Curve
-16log10(R) + 161; R2 = 0.62
-9log10(R) + 132; R2 = 0.36
-16log10(R) + 131; R2 = 0.88
SPL(dB)
Range (m)

CR218 - 2

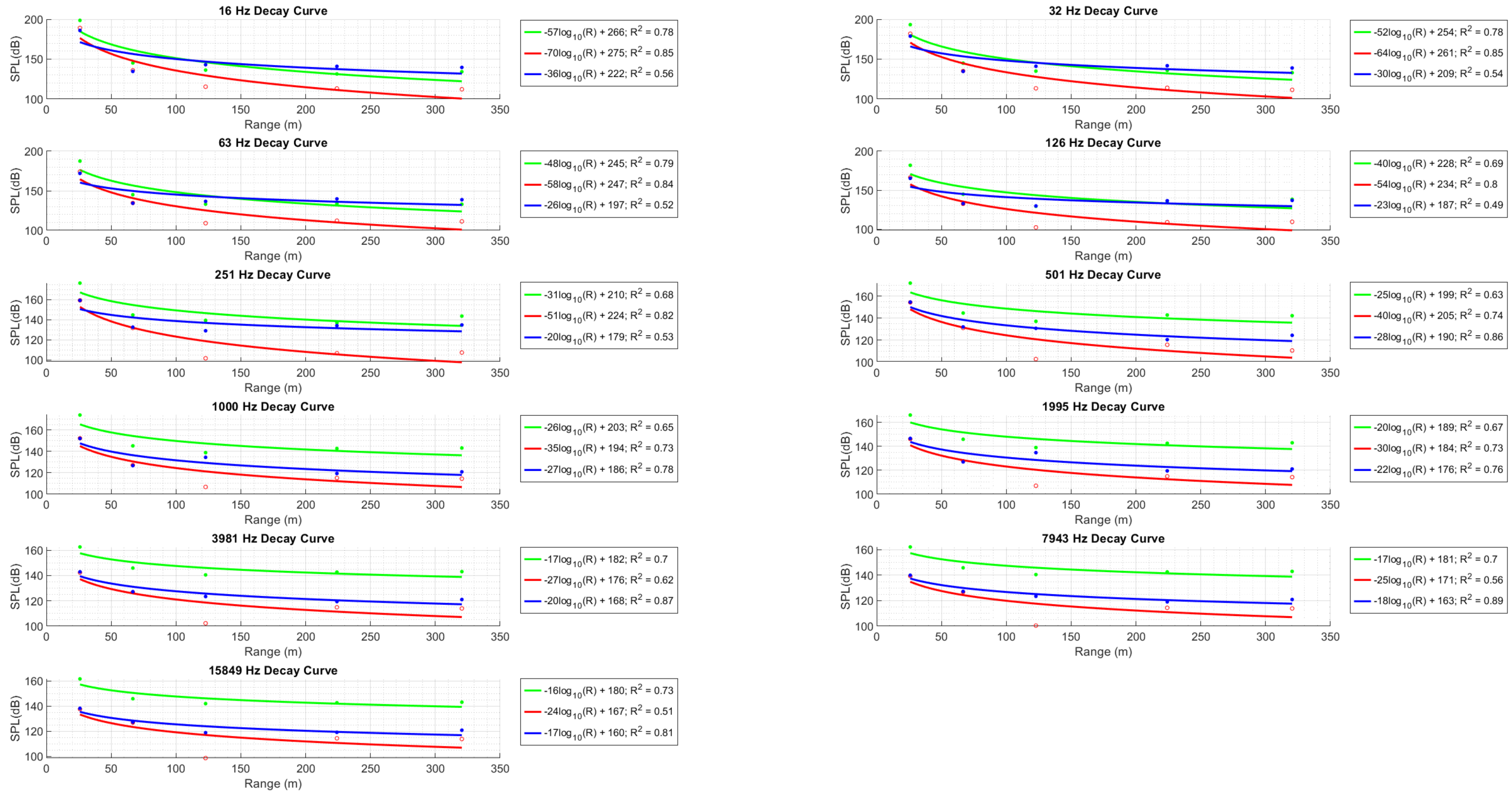

16 Hz Decay Curve
-22log10(R) + 192; R2 = 0.76
-16log10(R) + 172; R2 = 0.86
-21log10(R) + 172; R2 = 0.37
32 Hz Decay Curve
-43log10(R) + 230; R2 = 0.92
-41log10(R) + 217; R2 = 0.96
-42log10(R) + 207; R2 = 0.84
63 Hz Decay Curve
-55log10(R) + 253; R2 = 0.97
-56log10(R) + 247; R2 = 0.97
-44log10(R) + 206; R2 = 0.93
126 Hz Decay Curve
-55log10(R) + 254; R2 = 0.96
-57log10(R) + 250; R2 = 0.97
-47log10(R) + 213; R2 = 0.92
251 Hz Decay Curve
-44log10(R) + 228; R2 = 0.98
-43log10(R) + 217; R2 = 0.99
-24log10(R) + 158; R2 = 0.68
501 Hz Decay Curve
-41log10(R) + 220; R2 = 0.94
-40log10(R) + 208; R2 = 0.97
-18log10(R) + 142; R2 = 0.35
1000 Hz Decay Curve
-41log10(R) + 221; R2 = 0.84
-47log10(R) + 219; R2 = 0.76
-31log10(R) + 168; R2 = 0.86
1995 Hz Decay Curve
-45log10(R) + 232; R2 = 0.9
-43log10(R) + 212; R2 = 0.79
-40log10(R) + 185; R2 = 0.98
3981 Hz Decay Curve
-26log10(R) + 185; R2 = 0.42
-20log10(R) + 156; R2 = 0.17
-26log10(R) + 153; R2 = 0.93
7943 Hz Decay Curve
2log10(R) + 124; R2 = 0.02
16log10(R) + 76; R2 = 0.4
-23log10(R) + 145; R2 = 0.91
15849 Hz Decay Curve
1log10(R) + 125; R2 = 0.01
15log10(R) + 76; R2 = 0.42
-23log10(R) + 146; R2 = 0.92
SPL(dB)
Range (m)

CR218 - 3

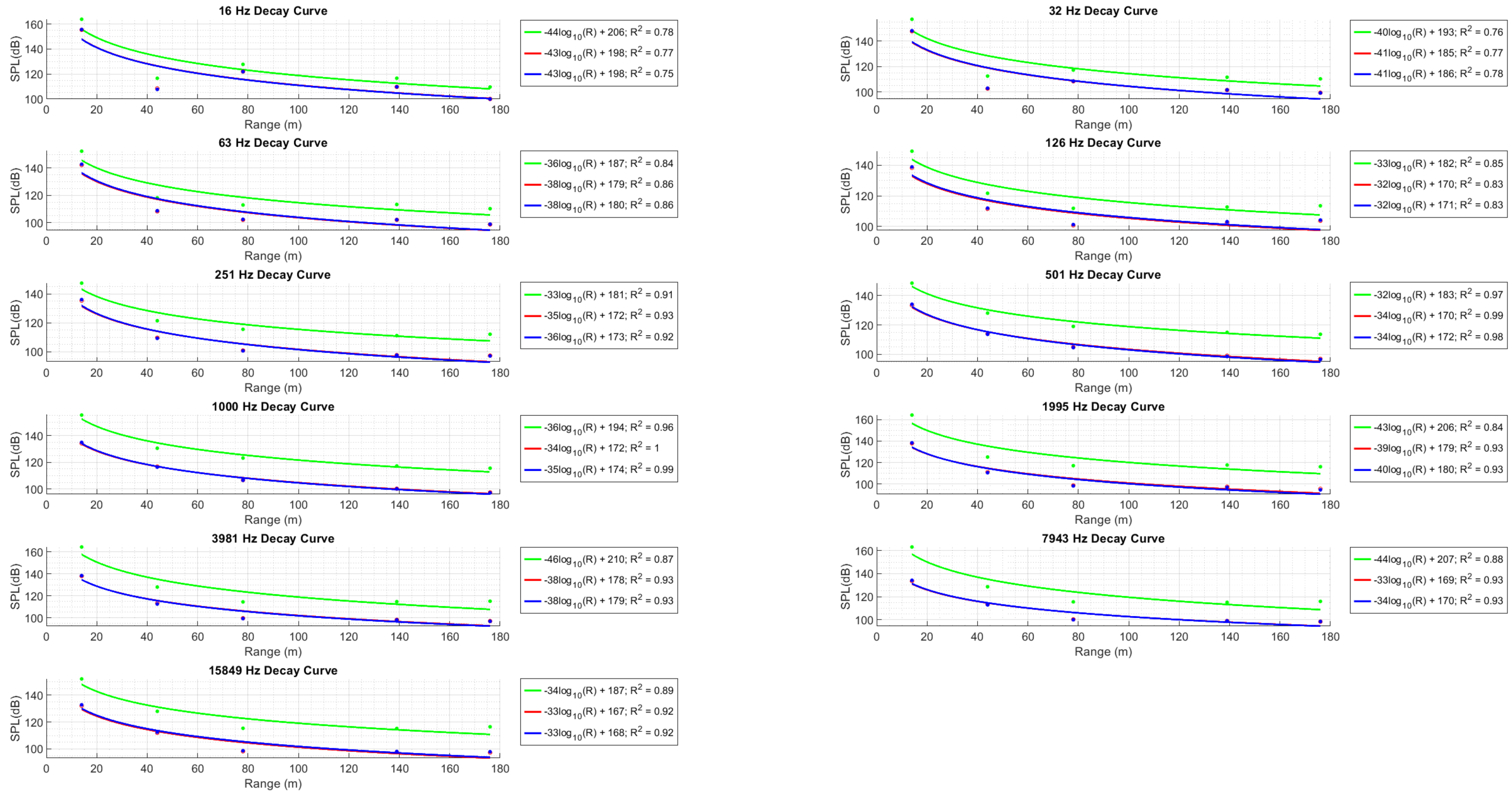


16 Hz Decay Curve
-18log10(R) + 180; R2 = 0.58
-13log10(R) + 164; R2 = 0.54
-20log10(R) + 168; R2 = 0.27
32 Hz Decay Curve
-31log10(R) + 203; R2 = 0.67
-23log10(R) + 177; R2 = 0.6
-28log10(R) + 179; R2 = 0.45
63 Hz Decay Curve
-55log10(R) + 253; R2 = 0.96
-59log10(R) + 252; R2 = 0.96
-43log10(R) + 205; R2 = 0.92
126 Hz Decay Curve
-62log10(R) + 269; R2 = 0.95
-65log10(R) + 267; R2 = 0.96
-49log10(R) + 216; R2 = 0.97
251 Hz Decay Curve
-52log10(R) + 246; R2 = 0.93
-54log10(R) + 242; R2 = 0.93
-33log10(R) + 178; R2 = 0.93
501 Hz Decay Curve
-49log10(R) + 238; R2 = 0.99
-51log10(R) + 234; R2 = 0.99
-24log10(R) + 157; R2 = 0.63
1000 Hz Decay Curve
-38log10(R) + 215; R2 = 0.81
-45log10(R) + 214; R2 = 0.69
-28log10(R) + 162; R2 = 0.81
1995 Hz Decay Curve
-42log10(R) + 226; R2 = 0.91
-43log10(R) + 213; R2 = 0.82
-38log10(R) + 180; R2 = 0.97
3981 Hz Decay Curve
-26log10(R) + 184; R2 = 0.43
-24log10(R) + 163; R2 = 0.24
-25log10(R) + 150; R2 = 0.92
7943 Hz Decay Curve
0log10(R) + 128; R2 = 0
12log10(R) + 83; R2 = 0.3
-21log10(R) + 143; R2 = 0.92
15849 Hz Decay Curve
2log10(R) + 121; R2 = 0.05
14log10(R) + 78; R2 = 0.38
-20log10(R) + 141; R2 = 0.92
SPL(dB)
Range (m)

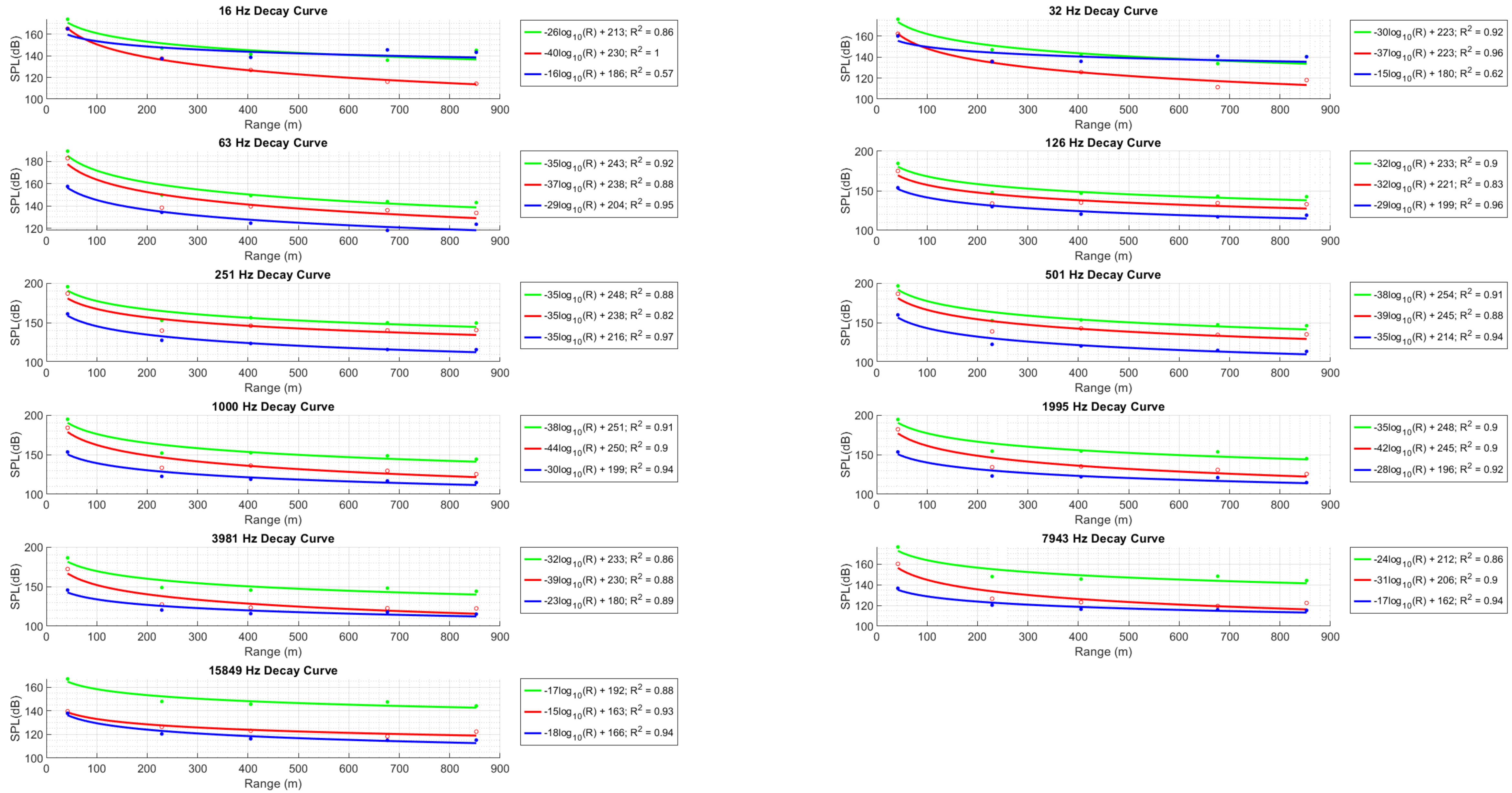
Destin - 1


16 Hz Decay Curve
-57log10(R) + 266; R2 = 0.78
-70log10(R) + 275; R2 = 0.85
-36log10(R) + 222; R2 = 0.56
32 Hz Decay Curve
-52log10(R) + 254; R2 = 0.78
-64log10(R) + 261; R2 = 0.85
-30log10(R) + 209; R2 = 0.54
63 Hz Decay Curve
-48log10(R) + 245; R2 = 0.79
-58log10(R) + 247; R2 = 0.84
-26log10(R) + 197; R2 = 0.52
126 Hz Decay Curve
-40log10(R) + 228; R2 = 0.69
-54log10(R) + 234; R2 = 0.8
-23log10(R) + 187; R2 = 0.49
251 Hz Decay Curve
-31log10(R) + 210; R2 = 0.68
-51log10(R) + 224; R2 = 0.82
-20log10(R) + 179; R2 = 0.53
501 Hz Decay Curve
-25log10(R) + 199; R2 = 0.63
-40log10(R) + 205; R2 = 0.74
-28log10(R) + 190; R2 = 0.86
1000 Hz Decay Curve
-26log10(R) + 203; R2 = 0.65
-35log10(R) + 194; R2 = 0.73
-27log10(R) + 186; R2 = 0.78
1995 Hz Decay Curve
-20log10(R) + 189; R2 = 0.67
-30log10(R) + 184; R2 = 0.73
-22log10(R) + 176; R2 = 0.76
3981 Hz Decay Curve
-17log10(R) + 182; R2 = 0.7
-27log10(R) + 176; R2 = 0.62
-20log10(R) + 168; R2 = 0.87
7943 Hz Decay Curve
-17log10(R) + 181; R2 = 0.7
-25log10(R) + 171; R2 = 0.56
-18log10(R) + 163; R2 = 0.89
15849 Hz Decay Curve
-16log10(R) + 180; R2 = 0.73
-24log10(R) + 167; R2 = 0.51
-17log10(R) + 160; R2 = 0.81
SPL(dB)
Range (m)

Destin - 2

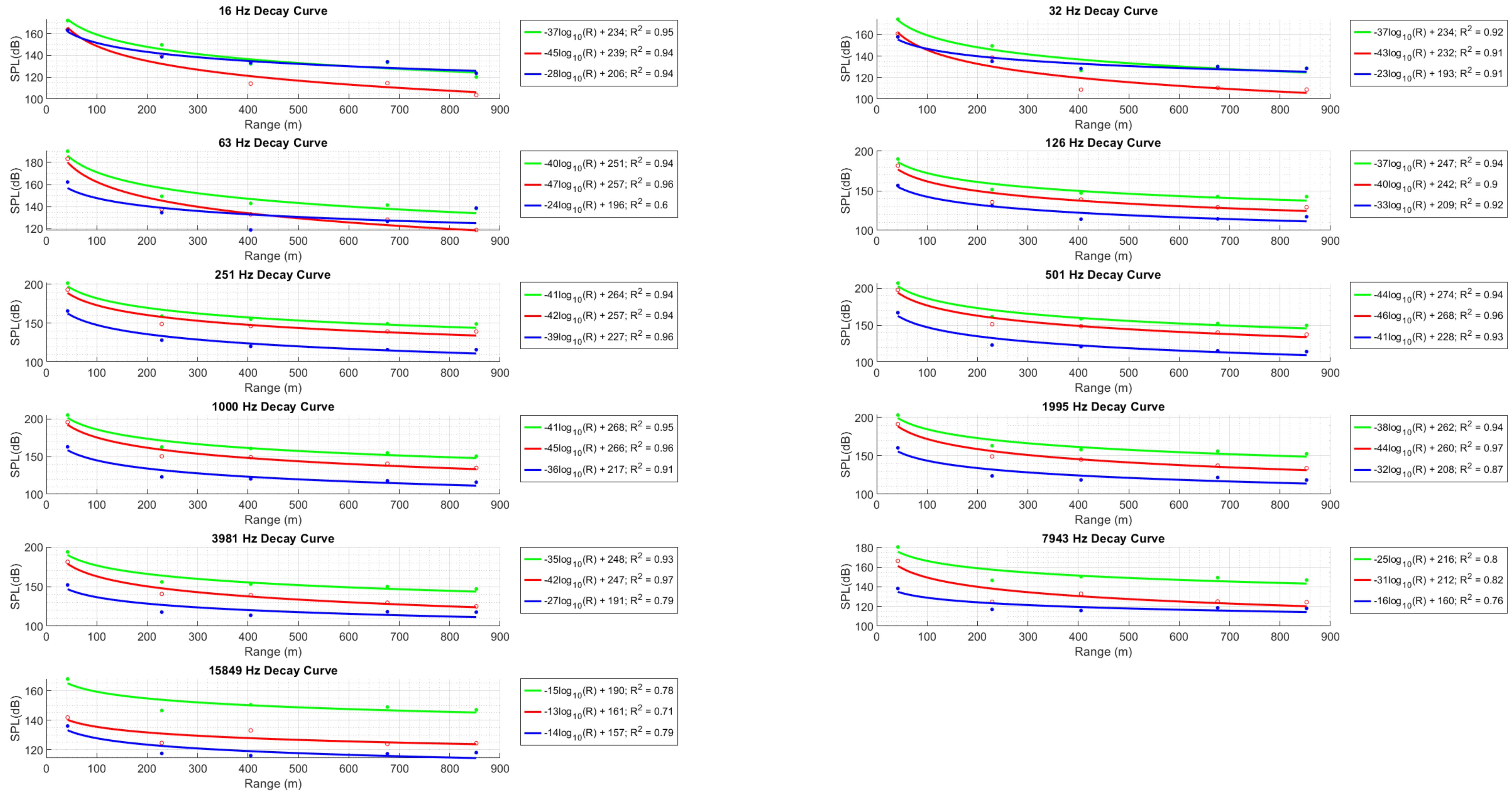

16 Hz Decay Curve
-44log10(R) + 206; R2 = 0.78
-43log10(R) + 198; R2 = 0.77
-43log10(R) + 198; R2 = 0.75
32 Hz Decay Curve
-40log10(R) + 193; R2 = 0.76
-41log10(R) + 185; R2 = 0.77
-41log10(R) + 186; R2 = 0.78
63 Hz Decay Curve
-36log10(R) + 187; R2 = 0.84
-38log10(R) + 179; R2 = 0.86
-38log10(R) + 180; R2 = 0.86
126 Hz Decay Curve
-33log10(R) + 182; R2 = 0.85
-32log10(R) + 170; R2 = 0.83
-32log10(R) + 171; R2 = 0.83
251 Hz Decay Curve
-33log10(R) + 181; R2 = 0.91
-35log10(R) + 172; R2 = 0.93
-36log10(R) + 173; R2 = 0.92
501 Hz Decay Curve
-32log10(R) + 183; R2 = 0.97
-34log10(R) + 170; R2 = 0.99
-34log10(R) + 172; R2 = 0.98
1000 Hz Decay Curve
-36log10(R) + 194; R2 = 0.96
-34log10(R) + 172; R2 = 1
-35log10(R) + 174; R2 = 0.99
1995 Hz Decay Curve
-43log10(R) + 206; R2 = 0.84
-39log10(R) + 179; R2 = 0.93
-40log10(R) + 180; R2 = 0.93
3981 Hz Decay Curve
-46log10(R) + 210; R2 = 0.87
-38log10(R) + 178; R2 = 0.93
-38log10(R) + 179; R2 = 0.93
7943 Hz Decay Curve
-44log10(R) + 207; R2 = 0.88
-33log10(R) + 169; R2 = 0.93
-34log10(R) + 170; R2 = 0.93
15849 Hz Decay Curve
-34log10(R) + 187; R2 = 0.89
-33log10(R) + 167; R2 = 0.92
-33log10(R) + 168; R2 = 0.92
SPL(dB)
Range (m)

HF - 1

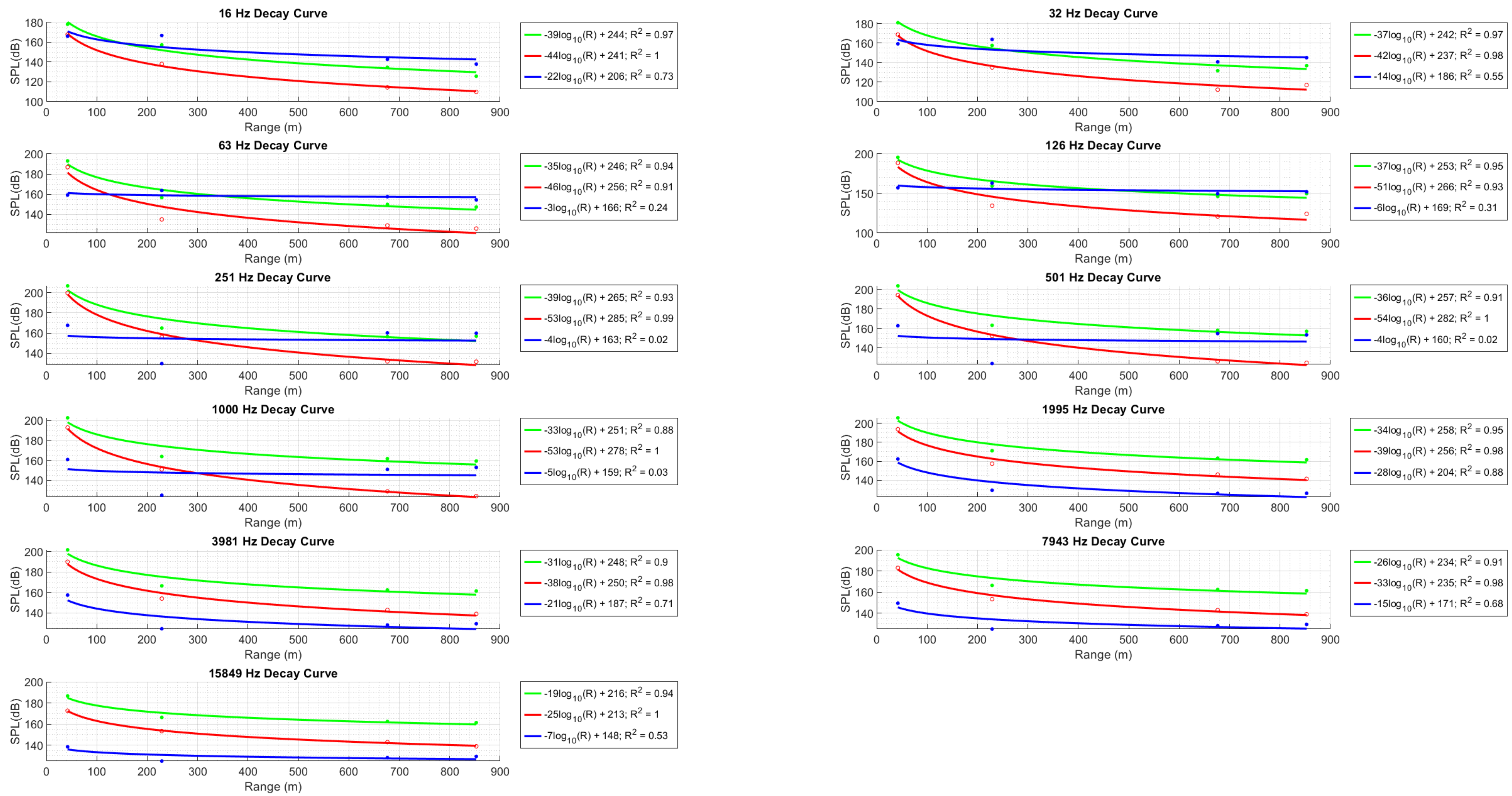


16 Hz Decay Curve
-26log10(R) + 213; R2 = 0.86
-40log10(R) + 230; R2 = 1
-16log10(R) + 186; R2 = 0.57
32 Hz Decay Curve
-30log10(R) + 223; R2 = 0.92
-37log10(R) + 223; R2 = 0.96
-15log10(R) + 180; R2 = 0.62
63 Hz Decay Curve
-35log10(R) + 243; R2 = 0.92
-37log10(R) + 238; R2 = 0.88
-29log10(R) + 204; R2 = 0.95
126 Hz Decay Curve
-32log10(R) + 233; R2 = 0.9
-32log10(R) + 221; R2 = 0.83
-29log10(R) + 199; R2 = 0.96
251 Hz Decay Curve
-35log10(R) + 248; R2 = 0.88
-35log10(R) + 238; R2 = 0.82
-35log10(R) + 216; R2 = 0.97
501 Hz Decay Curve
-38log10(R) + 254; R2 = 0.91
-39log10(R) + 245; R2 = 0.88
-35log10(R) + 214; R2 = 0.94
1000 Hz Decay Curve
-38log10(R) + 251; R2 = 0.91
-44log10(R) + 250; R2 = 0.9
-30log10(R) + 199; R2 = 0.94
1995 Hz Decay Curve
-35log10(R) + 248; R2 = 0.9
-42log10(R) + 245; R2 = 0.9
-28log10(R) + 196; R2 = 0.92
3981 Hz Decay Curve
-32log10(R) + 233; R2 = 0.86
-39log10(R) + 230; R2 = 0.88
-23log10(R) + 180; R2 = 0.89
7943 Hz Decay Curve
-24log10(R) + 212; R2 = 0.86
-31log10(R) + 206; R2 = 0.9
-17log10(R) + 162; R2 = 0.94
15849 Hz Decay Curve
-17log10(R) + 192; R2 = 0.88
-15log10(R) + 163; R2 = 0.93
-18log10(R) + 166; R2 = 0.94
SPL(dB)
Range (m)

HF - 2

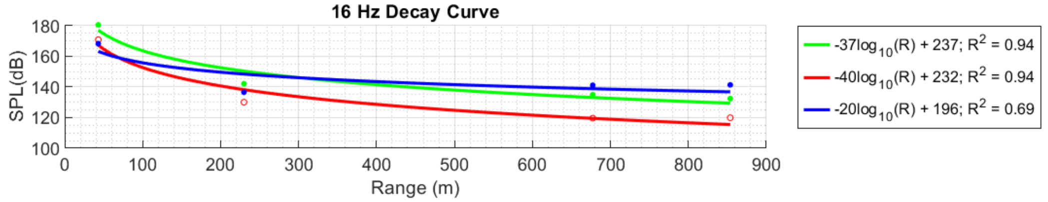

16 Hz Decay Curve
-37log10(R) + 234; R2 = 0.95
-45log10(R) + 239; R2 = 0.94
-28log10(R) + 206; R2 = 0.94
32 Hz Decay Curve
-37log10(R) + 234; R2 = 0.92
-43log10(R) + 232; R2 = 0.91
-23log10(R) + 193; R2 = 0.91
63 Hz Decay Curve
-40log10(R) + 251; R2 = 0.94
-47log10(R) + 257; R2 = 0.96
-24log10(R) + 196; R2 = 0.6
126 Hz Decay Curve
-37log10(R) + 247; R2 = 0.94
-40log10(R) + 242; R2 = 0.9
-33log10(R) + 209; R2 = 0.92
251 Hz Decay Curve
-41log10(R) + 264; R2 = 0.94
-42log10(R) + 257; R2 = 0.94
-39log10(R) + 227; R2 = 0.96
501 Hz Decay Curve
-44log10(R) + 274; R2 = 0.94
-46log10(R) + 268; R2 = 0.96
-41log10(R) + 228; R2 = 0.93
1000 Hz Decay Curve
-41log10(R) + 268; R2 = 0.95
-45log10(R) + 266; R2 = 0.96
-36log10(R) + 217; R2 = 0.91
1995 Hz Decay Curve
-38log10(R) + 262; R2 = 0.94
-44log10(R) + 260; R2 = 0.97
-32log10(R) + 208; R2 = 0.87
3981 Hz Decay Curve
-35log10(R) + 248; R2 = 0.93
-42log10(R) + 247; R2 = 0.97
-27log10(R) + 191; R2 = 0.79
7943 Hz Decay Curve
-25log10(R) + 216; R2 = 0.8
-31log10(R) + 212; R2 = 0.82
-16log10(R) + 160; R2 = 0.76
15849 Hz Decay Curve
-15log10(R) + 190; R2 = 0.78
-13log10(R) + 161; R2 = 0.71
-14log10(R) + 157; R2 = 0.79
SPL(dB)
Range (m)

HF - 3

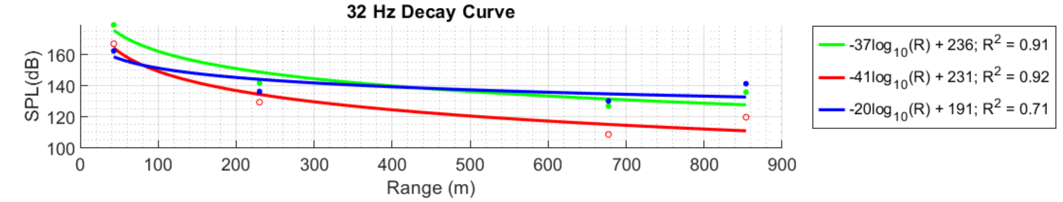

16 Hz Decay Curve
-39log10(R) + 244; R2 = 0.97
-44log10(R) + 241; R2 = 1
-22log10(R) + 206; R2 = 0.73
32 Hz Decay Curve
-37log10(R) + 242; R2 = 0.97
-42log10(R) + 237; R2 = 0.98
-14log10(R) + 186; R2 = 0.55
63 Hz Decay Curve
-35log10(R) + 246; R2 = 0.94
-46log10(R) + 256; R2 = 0.91
-3log10(R) + 166; R2 = 0.24
126 Hz Decay Curve
-37log10(R) + 253; R2 = 0.95
-51log10(R) + 266; R2 = 0.93
-6log10(R) + 169; R2 = 0.31
251 Hz Decay Curve
-39log10(R) + 265; R2 = 0.93
-53log10(R) + 285; R2 = 0.99
-4log10(R) + 163; R2 = 0.02
501 Hz Decay Curve
-36log10(R) + 257; R2 = 0.91
-54log10(R) + 282; R2 = 1
-4log10(R) + 160; R2 = 0.02
1000 Hz Decay Curve
-33log10(R) + 251; R2 = 0.88
-53log10(R) + 278; R2 = 1
-5log10(R) + 159; R2 = 0.03
1995 Hz Decay Curve
-34log10(R) + 258; R2 = 0.95
-39log10(R) + 256; R2 = 0.98
-28log10(R) + 204; R2 = 0.88
3981 Hz Decay Curve
-31log10(R) + 248; R2 = 0.9
-38log10(R) + 250; R2 = 0.98
-21log10(R) + 187; R2 = 0.71
7943 Hz Decay Curve
-26log10(R) + 234; R2 = 0.91
-33log10(R) + 235; R2 = 0.98
-15log10(R) + 171; R2 = 0.68
15849 Hz Decay Curve
-19log10(R) + 216; R2 = 0.94
-25log10(R) + 213; R2 = 1
-7log10(R) + 148; R2 = 0.53
SPL(dB)
Range (m)

HF - 4

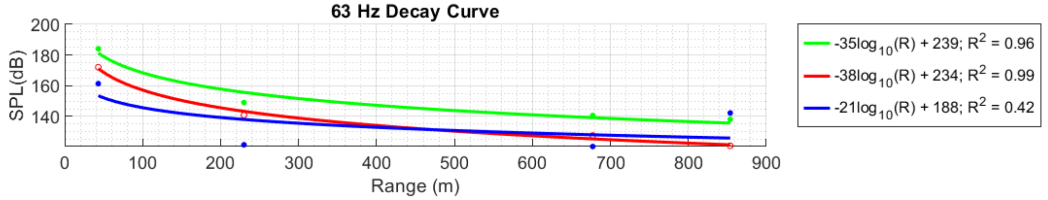
16 Hz Decay Curve



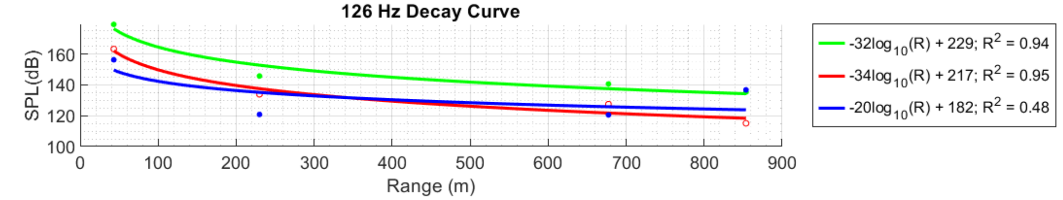
32 Hz Decay Curve



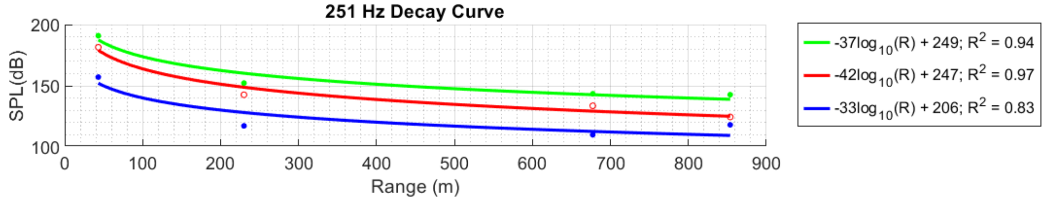
63 Hz Decay Curve



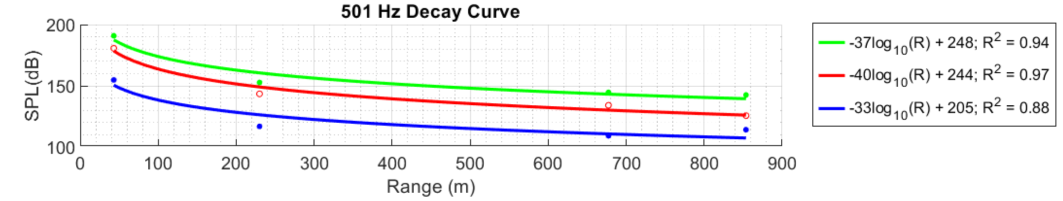
126 Hz Decay Curve



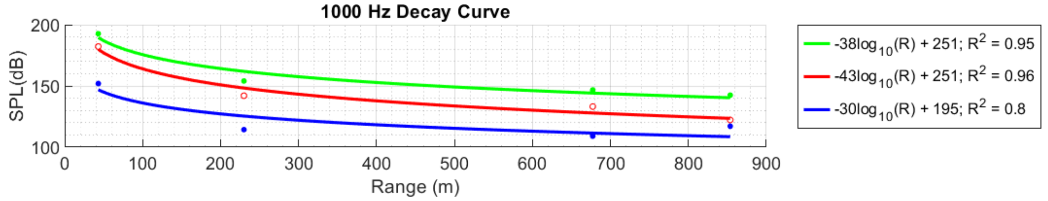
251 Hz Decay Curve



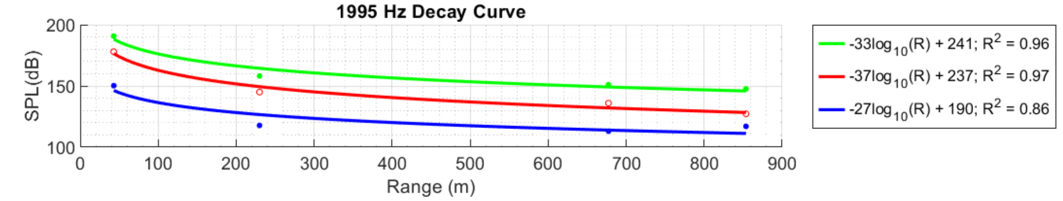
501 Hz Decay Curve



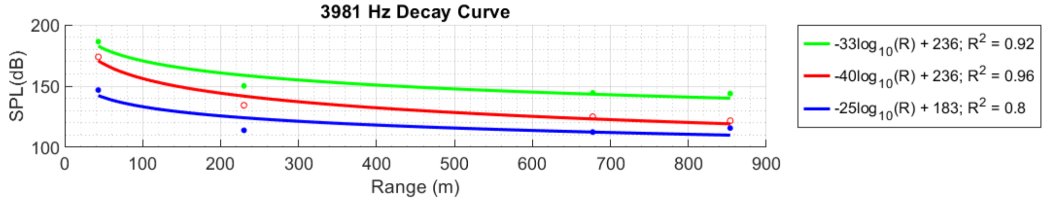
1000 Hz Decay Curve



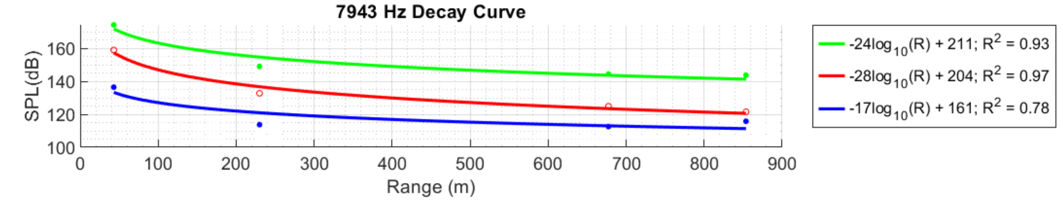
1995 Hz Decay Curve



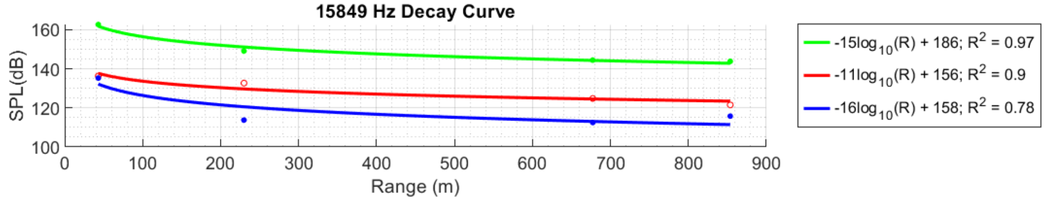
3981 Hz Decay Curve



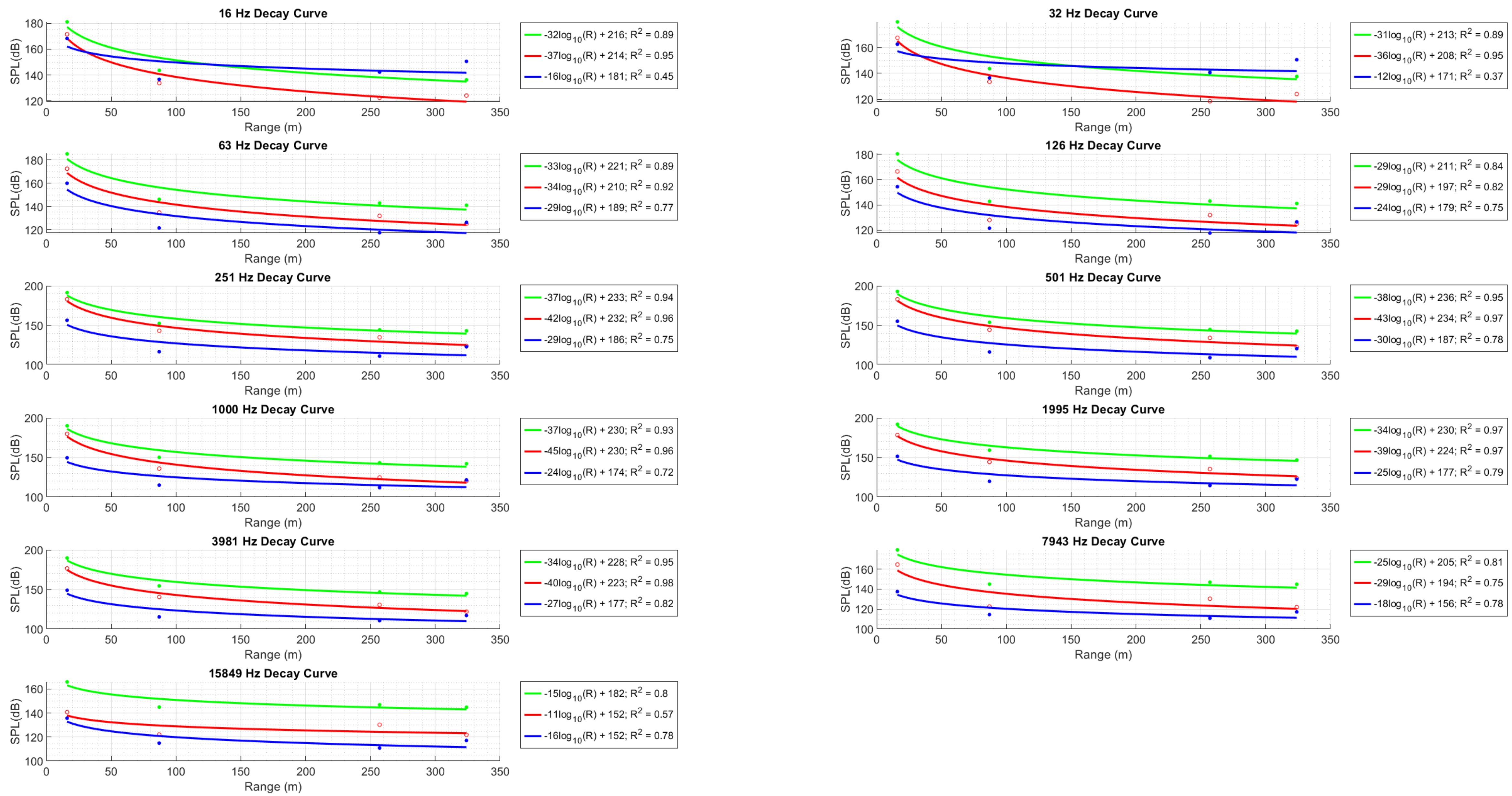
7943 Hz Decay Curve



15849 Hz Decay Curve

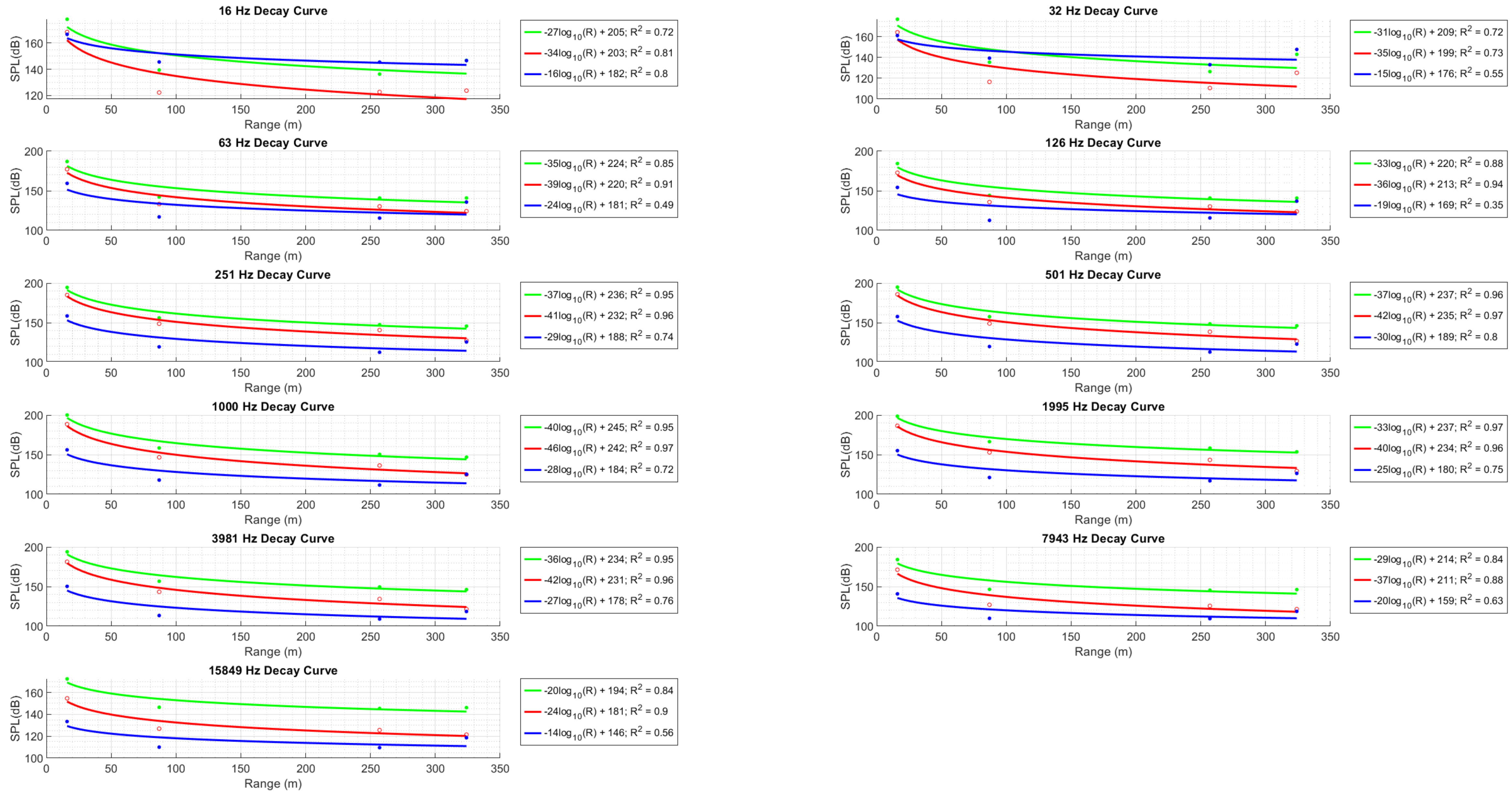


HF - 5



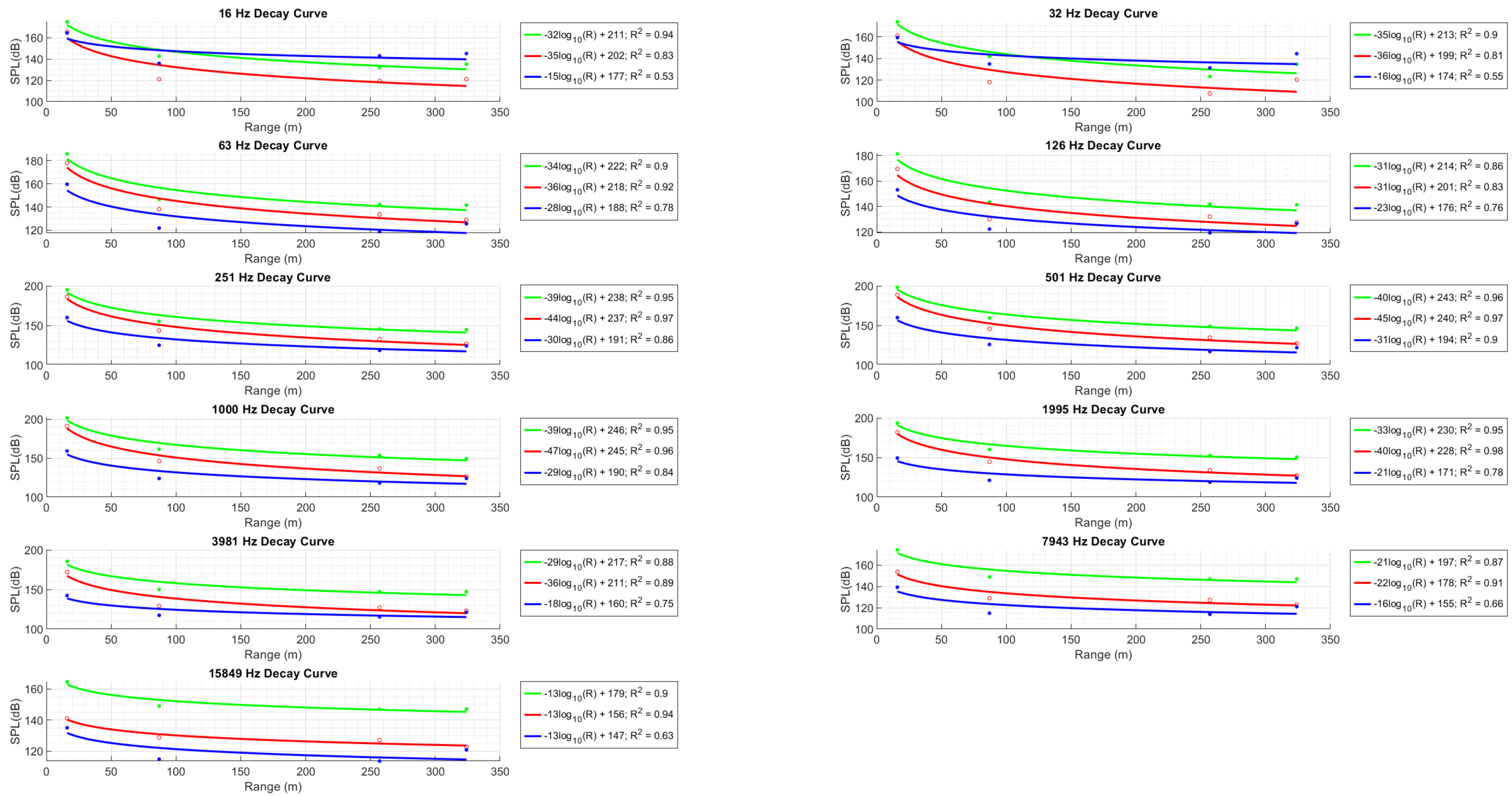
16 Hz Decay Curve
-32log10(R) + 216; R2 = 0.89
-37log10(R) + 214; R2 = 0.95
-16log10(R) + 181; R2 = 0.45
32 Hz Decay Curve
-31log10(R) + 213; R2 = 0.89
-36log10(R) + 208; R2 = 0.95
-12log10(R) + 171; R2 = 0.37
63 Hz Decay Curve
-33log10(R) + 221; R2 = 0.89
-34log10(R) + 210; R2 = 0.92
-29log10(R) + 189; R2 = 0.77
126 Hz Decay Curve
-29log10(R) + 211; R2 = 0.84
-29log10(R) + 197; R2 = 0.82
-24log10(R) + 179; R2 = 0.75
251 Hz Decay Curve
-37log10(R) + 233; R2 = 0.94
-42log10(R) + 232; R2 = 0.96
-29log10(R) + 186; R2 = 0.75
501 Hz Decay Curve
-38log10(R) + 236; R2 = 0.95
-43log10(R) + 234; R2 = 0.97
-30log10(R) + 187; R2 = 0.78
1000 Hz Decay Curve
-37log10(R) + 230; R2 = 0.93
-45log10(R) + 230; R2 = 0.96
-24log10(R) + 174; R2 = 0.72
1995 Hz Decay Curve
-34log10(R) + 230; R2 = 0.97
-39log10(R) + 224; R2 = 0.97
-25log10(R) + 177; R2 = 0.79
3981 Hz Decay Curve
-34log10(R) + 228; R2 = 0.95
-40log10(R) + 223; R2 = 0.98
-27log10(R) + 177; R2 = 0.82
7943 Hz Decay Curve
-25log10(R) + 205; R2 = 0.81
-29log10(R) + 194; R2 = 0.75
-18log10(R) + 156; R2 = 0.78
15849 Hz Decay Curve
-15log10(R) + 182; R2 = 0.8
-11log10(R) + 152; R2 = 0.57
-16log10(R) + 152; R2 = 0.78
SPL(dB)
Range (m)

HF - 6

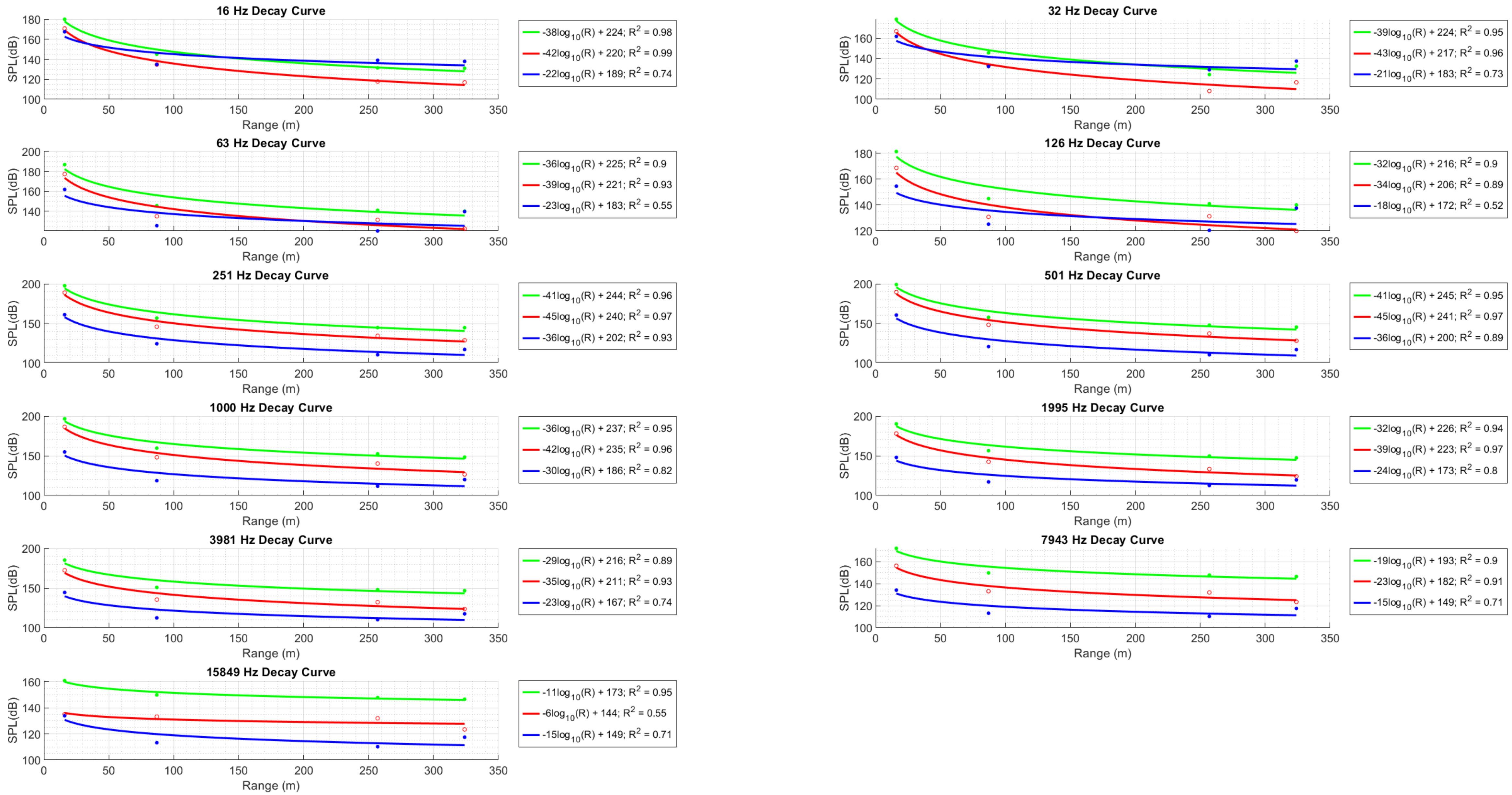


16 Hz Decay Curve
-27log10(R) + 205; R2 = 0.72
-34log10(R) + 203; R2 = 0.81
-16log10(R) + 182; R2 = 0.8
32 Hz Decay Curve
-31log10(R) + 209; R2 = 0.72
-35log10(R) + 199; R2 = 0.73
-15log10(R) + 176; R2 = 0.55
63 Hz Decay Curve
-35log10(R) + 224; R2 = 0.85
-39log10(R) + 220; R2 = 0.91
-24log10(R) + 181; R2 = 0.49
126 Hz Decay Curve
-33log10(R) + 220; R2 = 0.88
-36log10(R) + 213; R2 = 0.94
-19log10(R) + 169; R2 = 0.35
251 Hz Decay Curve
-37log10(R) + 236; R2 = 0.95
-41log10(R) + 232; R2 = 0.96
-29log10(R) + 188; R2 = 0.74
501 Hz Decay Curve
-37log10(R) + 237; R2 = 0.96
-42log10(R) + 235; R2 = 0.97
-30log10(R) + 189; R2 = 0.8
1000 Hz Decay Curve
-40log10(R) + 245; R2 = 0.95
-46log10(R) + 242; R2 = 0.97
-28log10(R) + 184; R2 = 0.72
1995 Hz Decay Curve
-33log10(R) + 237; R2 = 0.97
-40log10(R) + 234; R2 = 0.96
-25log10(R) + 180; R2 = 0.75
3981 Hz Decay Curve
-36log10(R) + 234; R2 = 0.95
-42log10(R) + 231; R2 = 0.96
-27log10(R) + 178; R2 = 0.76
7943 Hz Decay Curve
-29log10(R) + 214; R2 = 0.84
-37log10(R) + 211; R2 = 0.88
-20log10(R) + 159; R2 = 0.63
15849 Hz Decay Curve
-20log10(R) + 194; R2 = 0.84
-24log10(R) + 181; R2 = 0.9
-14log10(R) + 146; R2 = 0.56
SPL(dB)
Range (m)

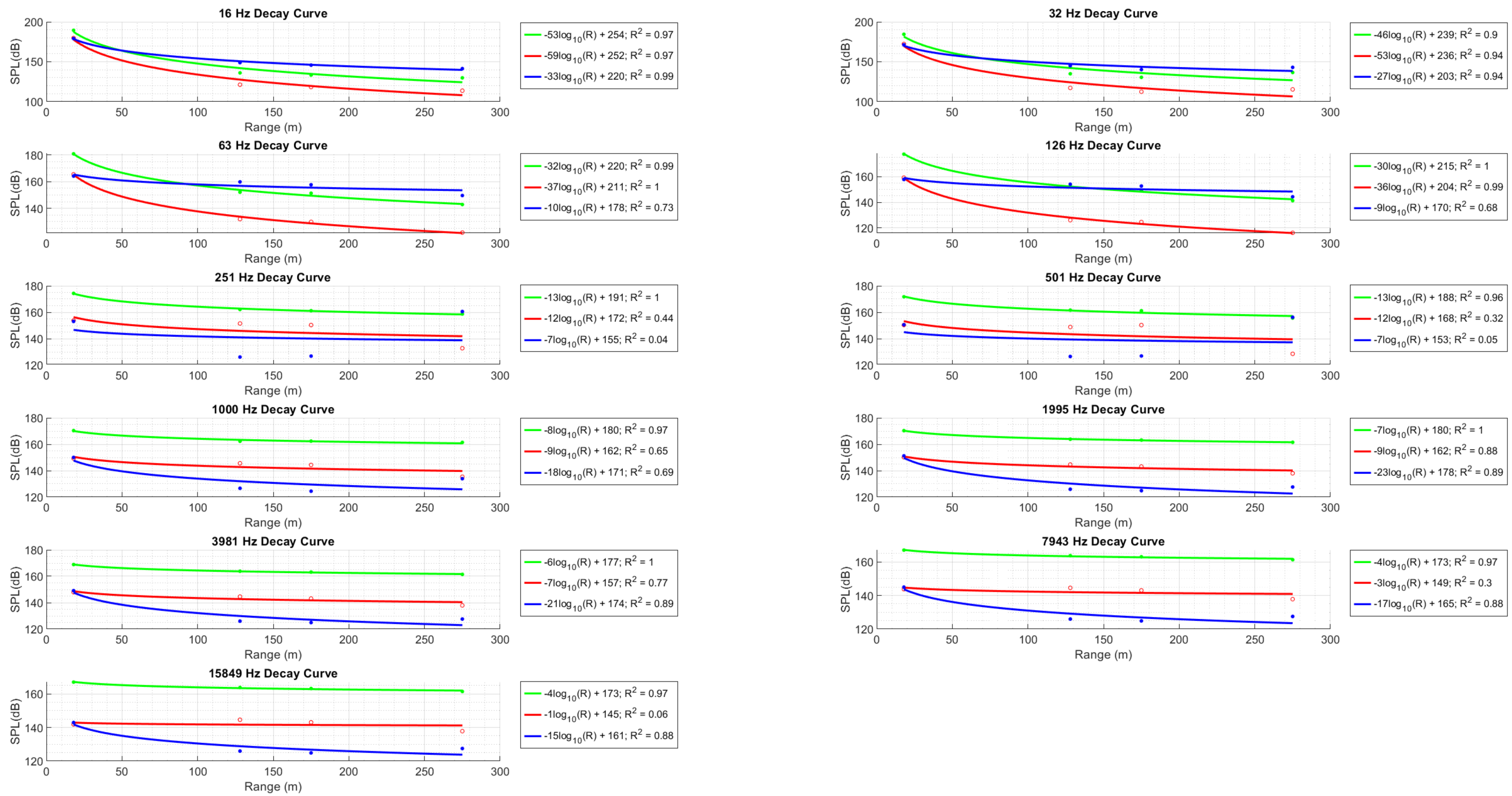
HF - 7


16 Hz Decay Curve
$-32\log_{10}(R) + 211; R^2 = 0.94$
$-35\log_{10}(R) + 202; R^2 = 0.83$
$-15\log_{10}(R) + 177; R^2 = 0.53$
32 Hz Decay Curve
$-35\log_{10}(R) + 213; R^2 = 0.9$
$-36\log_{10}(R) + 199; R^2 = 0.81$
$-16\log_{10}(R) + 174; R^2 = 0.55$
63 Hz Decay Curve
$-34\log_{10}(R) + 222; R^2 = 0.9$
$-36\log_{10}(R) + 218; R^2 = 0.92$
$-28\log_{10}(R) + 188; R^2 = 0.78$
126 Hz Decay Curve
$-31\log_{10}(R) + 214; R^2 = 0.86$
$-31\log_{10}(R) + 201; R^2 = 0.83$
$-23\log_{10}(R) + 176; R^2 = 0.76$
251 Hz Decay Curve
$-39\log_{10}(R) + 238; R^2 = 0.95$
$-44\log_{10}(R) + 237; R^2 = 0.97$
$-30\log_{10}(R) + 191; R^2 = 0.86$
501 Hz Decay Curve
$-40\log_{10}(R) + 243; R^2 = 0.96$
$-45\log_{10}(R) + 240; R^2 = 0.97$
$-31\log_{10}(R) + 194; R^2 = 0.9$
1000 Hz Decay Curve
$-39\log_{10}(R) + 246; R^2 = 0.95$
$-47\log_{10}(R) + 245; R^2 = 0.96$
$-29\log_{10}(R) + 190; R^2 = 0.84$
1995 Hz Decay Curve
$-33\log_{10}(R) + 230; R^2 = 0.95$
$-40\log_{10}(R) + 228; R^2 = 0.98$
$-21\log_{10}(R) + 171; R^2 = 0.78$
3981 Hz Decay Curve
$-29\log_{10}(R) + 217; R^2 = 0.88$
$-36\log_{10}(R) + 211; R^2 = 0.89$
$-18\log_{10}(R) + 160; R^2 = 0.75$
7943 Hz Decay Curve
$-21\log_{10}(R) + 197; R^2 = 0.87$
$-22\log_{10}(R) + 178; R^2 = 0.91$
$-16\log_{10}(R) + 155; R^2 = 0.66$
15849 Hz Decay Curve
$-13\log_{10}(R) + 179; R^2 = 0.9$
$-13\log_{10}(R) + 156; R^2 = 0.94$
$-13\log_{10}(R) + 147; R^2 = 0.63$
SPL(dB)
Range (m)

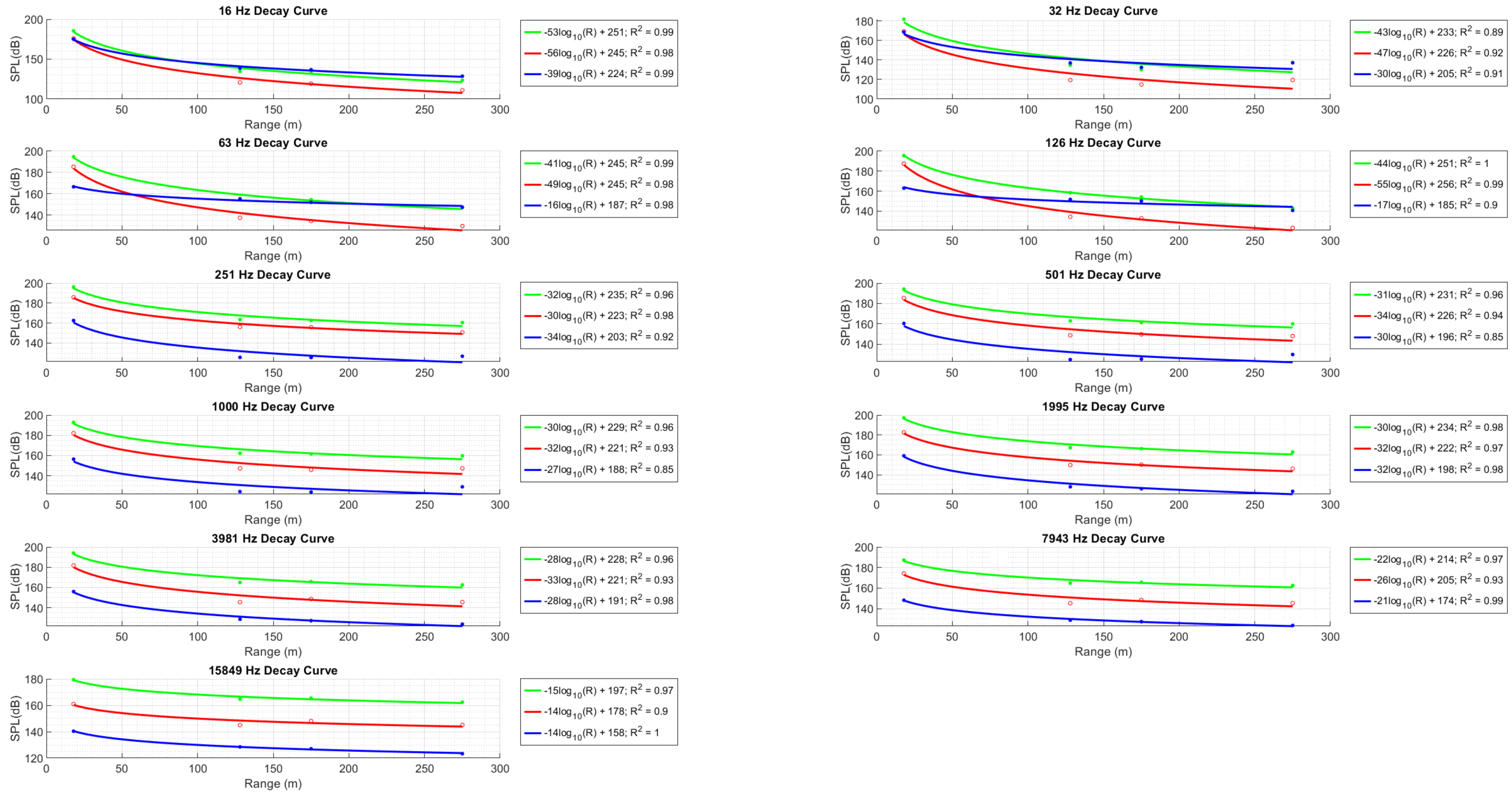
HF - 8


16 Hz Decay Curve
-38log10(R) + 224; R2 = 0.98
-42log10(R) + 220; R2 = 0.99
-22log10(R) + 189; R2 = 0.74
32 Hz Decay Curve
-39log10(R) + 224; R2 = 0.95
-43log10(R) + 217; R2 = 0.96
-21log10(R) + 183; R2 = 0.73
63 Hz Decay Curve
-36log10(R) + 225; R2 = 0.9
-39log10(R) + 221; R2 = 0.93
-23log10(R) + 183; R2 = 0.55
126 Hz Decay Curve
-32log10(R) + 216; R2 = 0.9
-34log10(R) + 206; R2 = 0.89
-18log10(R) + 172; R2 = 0.52
251 Hz Decay Curve
-41log10(R) + 244; R2 = 0.96
-45log10(R) + 240; R2 = 0.97
-36log10(R) + 202; R2 = 0.93
501 Hz Decay Curve
-41log10(R) + 245; R2 = 0.95
-45log10(R) + 241; R2 = 0.97
-36log10(R) + 200; R2 = 0.89
1000 Hz Decay Curve
-36log10(R) + 237; R2 = 0.95
-42log10(R) + 235; R2 = 0.96
-30log10(R) + 186; R2 = 0.82
1995 Hz Decay Curve
-32log10(R) + 226; R2 = 0.94
-39log10(R) + 223; R2 = 0.97
-24log10(R) + 173; R2 = 0.8
3981 Hz Decay Curve
-29log10(R) + 216; R2 = 0.89
-35log10(R) + 211; R2 = 0.93
-23log10(R) + 167; R2 = 0.74
7943 Hz Decay Curve
-19log10(R) + 193; R2 = 0.9
-23log10(R) + 182; R2 = 0.91
-15log10(R) + 149; R2 = 0.71
15849 Hz Decay Curve
-11log10(R) + 173; R2 = 0.95
-6log10(R) + 144; R2 = 0.55
-15log10(R) + 149; R2 = 0.71
SPL(dB)
Range (m)

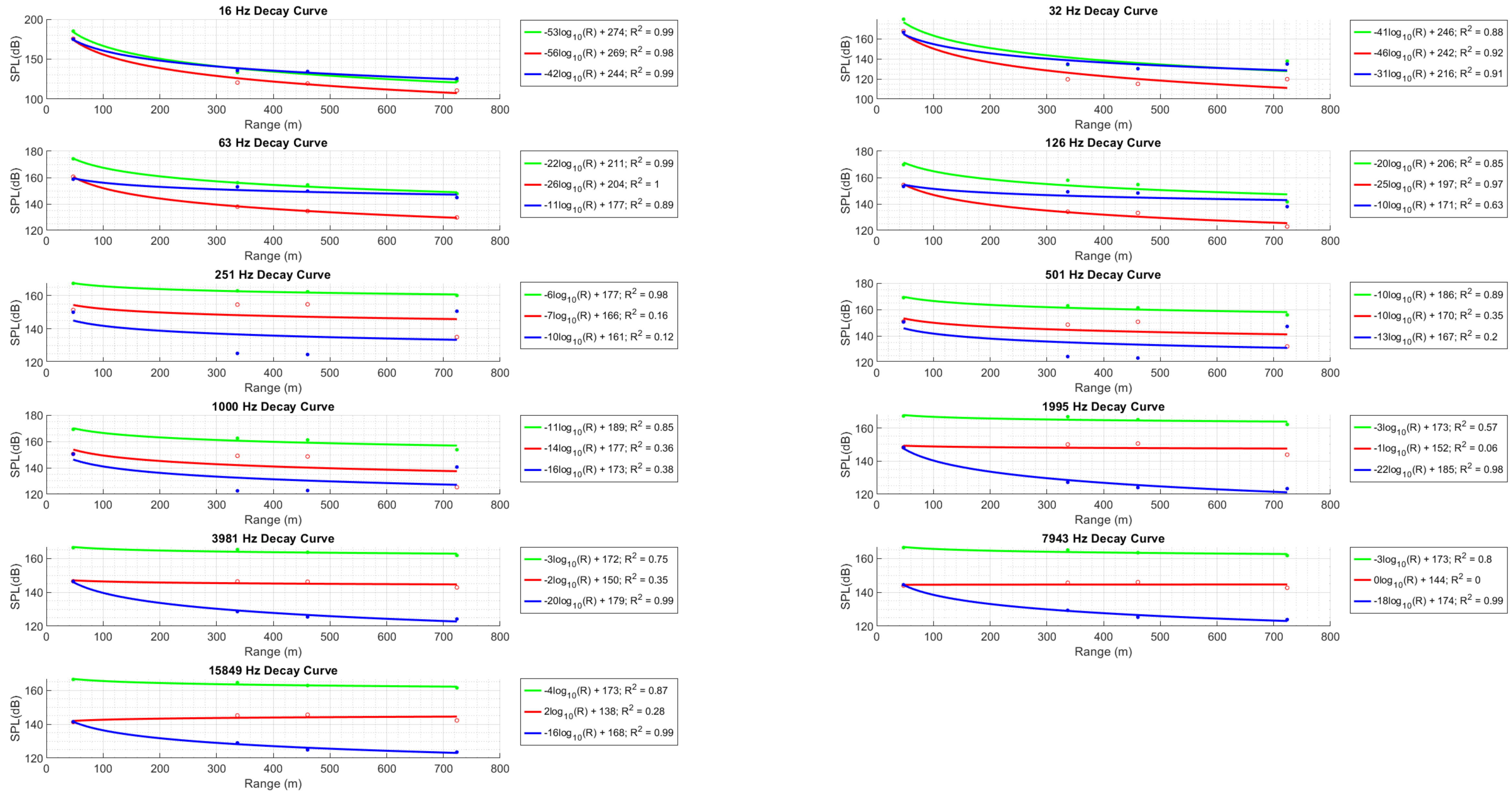
HF - 9


16 Hz Decay Curve
-53log10(R) + 254; R2 = 0.97
-59log10(R) + 252; R2 = 0.97
-33log10(R) + 220; R2 = 0.99
32 Hz Decay Curve
-46log10(R) + 239; R2 = 0.9
-53log10(R) + 236; R2 = 0.94
-27log10(R) + 203; R2 = 0.94
63 Hz Decay Curve
-32log10(R) + 220; R2 = 0.99
-37log10(R) + 211; R2 = 1
-10log10(R) + 178; R2 = 0.73
126 Hz Decay Curve
-30log10(R) + 215; R2 = 1
-36log10(R) + 204; R2 = 0.99
-9log10(R) + 170; R2 = 0.68
251 Hz Decay Curve
-13log10(R) + 191; R2 = 1
-12log10(R) + 172; R2 = 0.44
-7log10(R) + 155; R2 = 0.04
501 Hz Decay Curve
-13log10(R) + 188; R2 = 0.96
-12log10(R) + 168; R2 = 0.32
-7log10(R) + 153; R2 = 0.05
1000 Hz Decay Curve
-8log10(R) + 180; R2 = 0.97
-9log10(R) + 162; R2 = 0.65
-18log10(R) + 171; R2 = 0.69
1995 Hz Decay Curve
-7log10(R) + 180; R2 = 1
-9log10(R) + 162; R2 = 0.88
-23log10(R) + 178; R2 = 0.89
3981 Hz Decay Curve
-6log10(R) + 177; R2 = 1
-7log10(R) + 157; R2 = 0.77
-21log10(R) + 174; R2 = 0.89
7943 Hz Decay Curve
-4log10(R) + 173; R2 = 0.97
-3log10(R) + 149; R2 = 0.3
-17log10(R) + 165; R2 = 0.88
15849 Hz Decay Curve
-4log10(R) + 173; R2 = 0.97
-1log10(R) + 145; R2 = 0.06
-15log10(R) + 161; R2 = 0.88
SPL(dB)
Range (m)

HF - 10

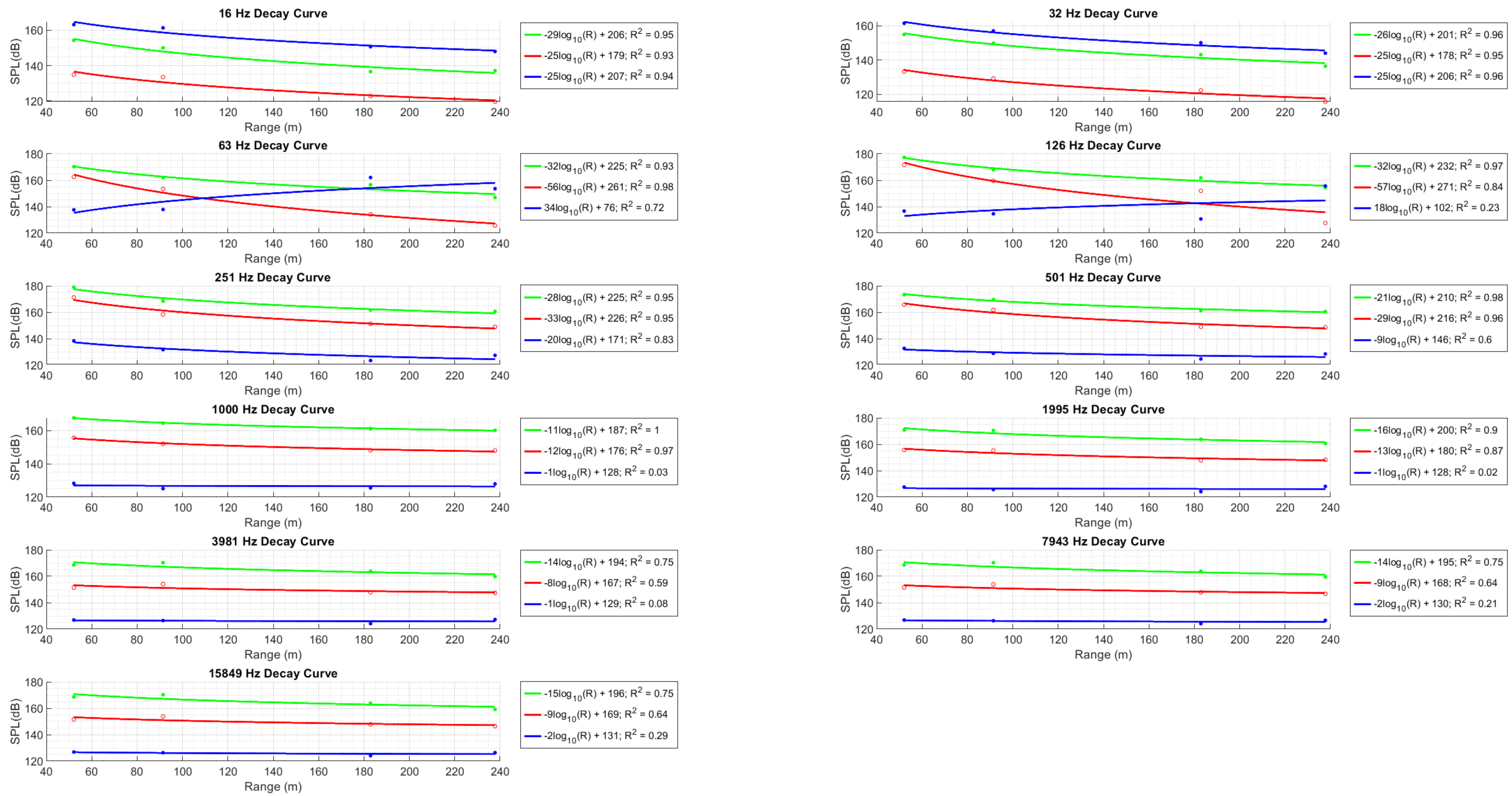

16 Hz Decay Curve
-53log10(R) + 251; R2 = 0.99
-56log10(R) + 245; R2 = 0.98
-39log10(R) + 224; R2 = 0.99
32 Hz Decay Curve
-43log10(R) + 233; R2 = 0.89
-47log10(R) + 226; R2 = 0.92
-30log10(R) + 205; R2 = 0.91
63 Hz Decay Curve
-41log10(R) + 245; R2 = 0.99
-49log10(R) + 245; R2 = 0.98
-16log10(R) + 187; R2 = 0.98
126 Hz Decay Curve
-44log10(R) + 251; R2 = 1
-55log10(R) + 256; R2 = 0.99
-17log10(R) + 185; R2 = 0.9
251 Hz Decay Curve
-32log10(R) + 235; R2 = 0.96
-30log10(R) + 223; R2 = 0.98
-34log10(R) + 203; R2 = 0.92
501 Hz Decay Curve
-31log10(R) + 231; R2 = 0.96
-34log10(R) + 226; R2 = 0.94
-30log10(R) + 196; R2 = 0.85
1000 Hz Decay Curve
-30log10(R) + 229; R2 = 0.96
-32log10(R) + 221; R2 = 0.93
-27log10(R) + 188; R2 = 0.85
1995 Hz Decay Curve
-30log10(R) + 234; R2 = 0.98
-32log10(R) + 222; R2 = 0.97
-32log10(R) + 198; R2 = 0.98
3981 Hz Decay Curve
-28log10(R) + 228; R2 = 0.96
-33log10(R) + 221; R2 = 0.93
-28log10(R) + 191; R2 = 0.98
7943 Hz Decay Curve
-22log10(R) + 214; R2 = 0.97
-26log10(R) + 205; R2 = 0.93
-21log10(R) + 174; R2 = 0.99
15849 Hz Decay Curve
-15log10(R) + 197; R2 = 0.97
-14log10(R) + 178; R2 = 0.9
-14log10(R) + 158; R2 = 1
SPL(dB)
Range (m)

HF - 11



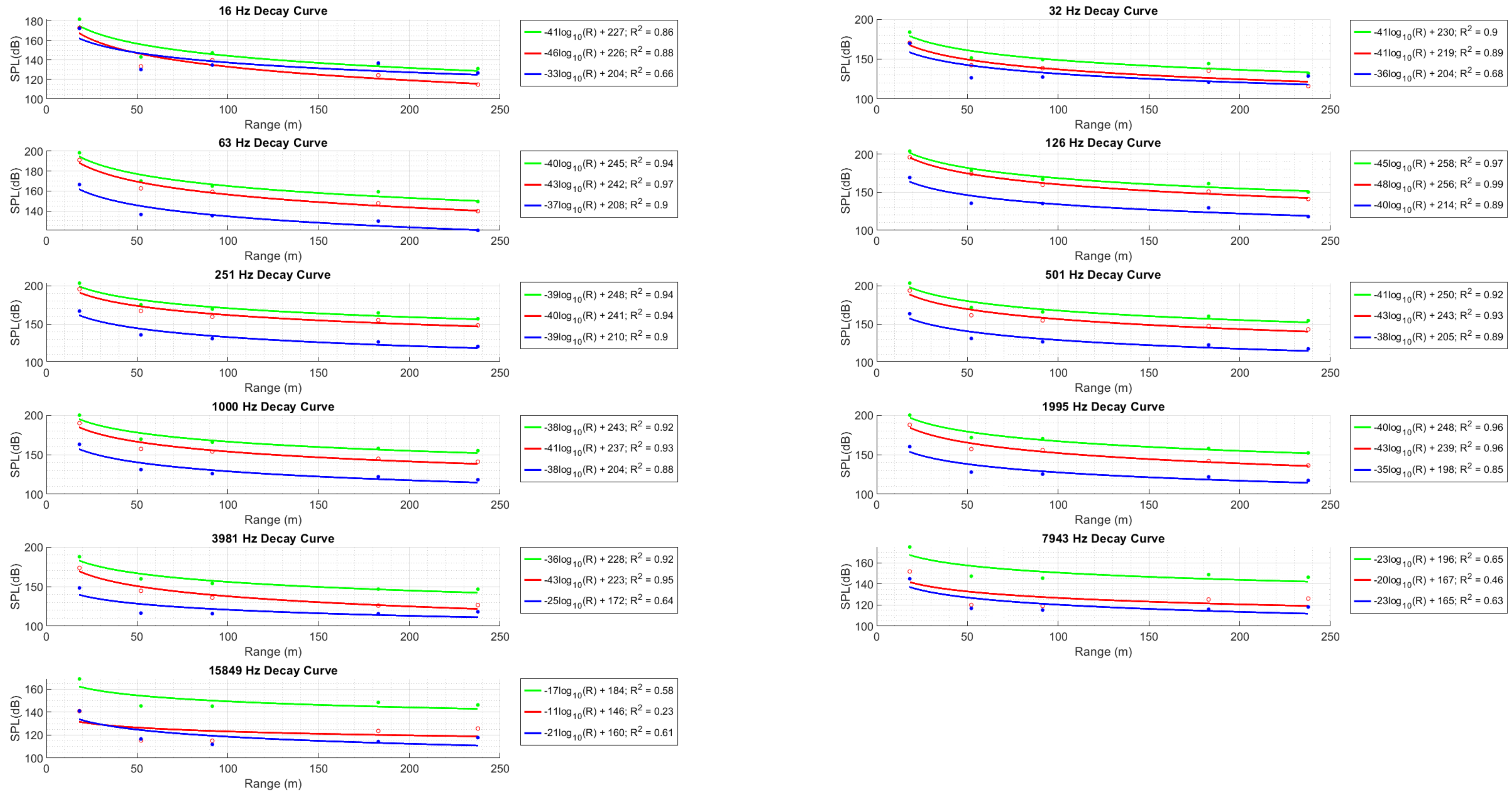
16 Hz Decay Curve
-53log10(R) + 274; R2 = 0.99
-56log10(R) + 269; R2 = 0.98
-42log10(R) + 244; R2 = 0.99
32 Hz Decay Curve
-41log10(R) + 246; R2 = 0.88
-46log10(R) + 242; R2 = 0.92
-31log10(R) + 216; R2 = 0.91
63 Hz Decay Curve
-22log10(R) + 211; R2 = 0.99
-26log10(R) + 204; R2 = 1
-11log10(R) + 177; R2 = 0.89
126 Hz Decay Curve
-20log10(R) + 206; R2 = 0.85
-25log10(R) + 197; R2 = 0.97
-10log10(R) + 171; R2 = 0.63
251 Hz Decay Curve
-6log10(R) + 177; R2 = 0.98
-7log10(R) + 166; R2 = 0.16
-10log10(R) + 161; R2 = 0.12
501 Hz Decay Curve
-10log10(R) + 186; R2 = 0.89
-10log10(R) + 170; R2 = 0.35
-13log10(R) + 167; R2 = 0.2
1000 Hz Decay Curve
-11log10(R) + 189; R2 = 0.85
-14log10(R) + 177; R2 = 0.36
-16log10(R) + 173; R2 = 0.38
1995 Hz Decay Curve
-3log10(R) + 173; R2 = 0.57
-1log10(R) + 152; R2 = 0.06
-22log10(R) + 185; R2 = 0.98
3981 Hz Decay Curve
-3log10(R) + 172; R2 = 0.75
-2log10(R) + 150; R2 = 0.35
-20log10(R) + 179; R2 = 0.99
7943 Hz Decay Curve
-3log10(R) + 173; R2 = 0.8
0log10(R) + 144; R2 = 0
-18log10(R) + 174; R2 = 0.99
15849 Hz Decay Curve
-4log10(R) + 173; R2 = 0.87
2log10(R) + 138; R2 = 0.28
-16log10(R) + 168; R2 = 0.99
SPL(dB)
Range (m)

HF - 12

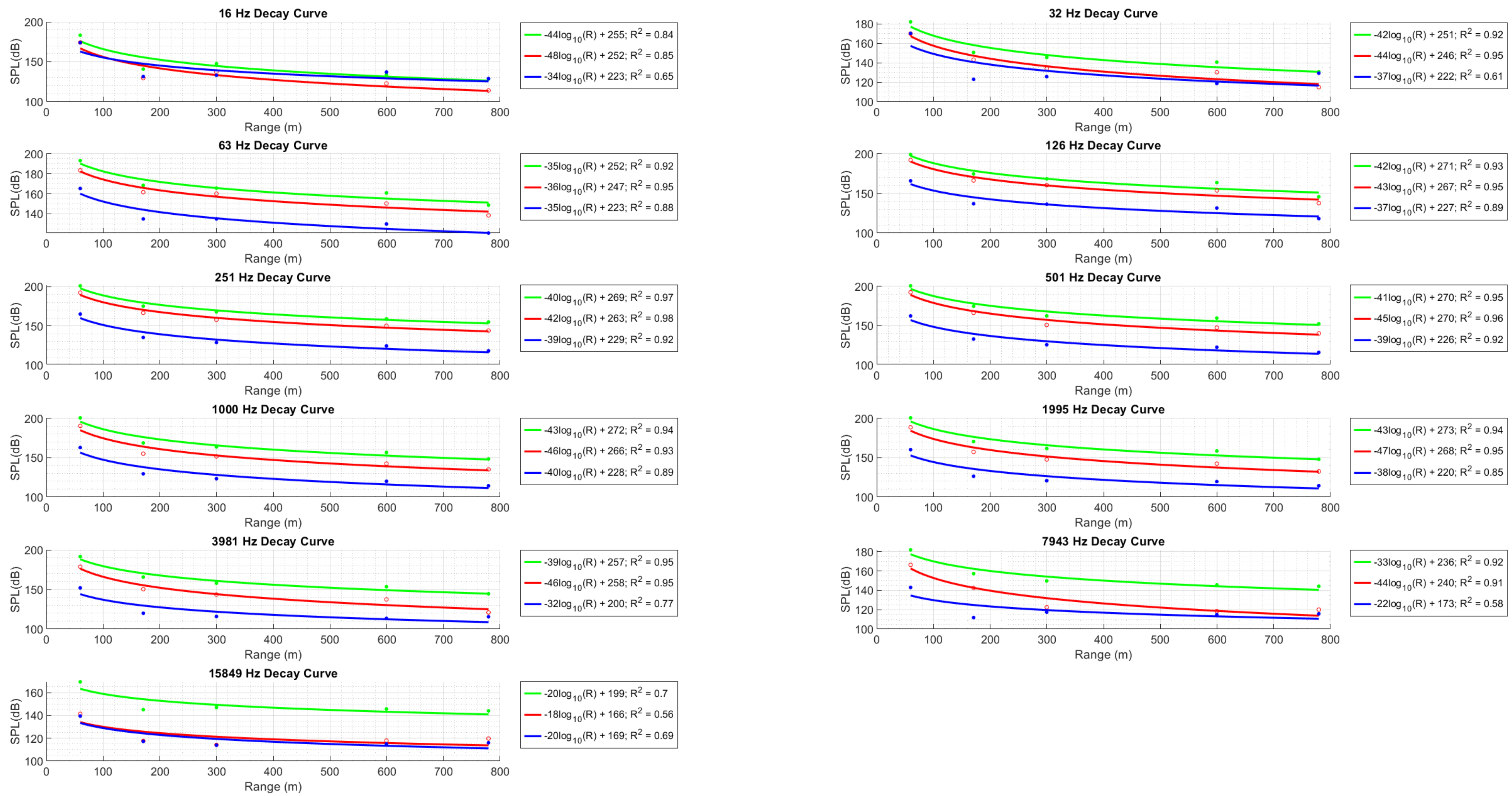


16 Hz Decay Curve
-29log10(R) + 206; R2 = 0.95
-25log10(R) + 179; R2 = 0.93
-25log10(R) + 207; R2 = 0.94
32 Hz Decay Curve
-26log10(R) + 201; R2 = 0.96
-25log10(R) + 178; R2 = 0.95
-25log10(R) + 206; R2 = 0.96
63 Hz Decay Curve
-32log10(R) + 225; R2 = 0.93
-56log10(R) + 261; R2 = 0.98
34log10(R) + 76; R2 = 0.72
126 Hz Decay Curve
-32log10(R) + 232; R2 = 0.97
-57log10(R) + 271; R2 = 0.84
18log10(R) + 102; R2 = 0.23
251 Hz Decay Curve
-28log10(R) + 225; R2 = 0.95
-33log10(R) + 226; R2 = 0.95
-20log10(R) + 171; R2 = 0.83
501 Hz Decay Curve
-21log10(R) + 210; R2 = 0.98
-29log10(R) + 216; R2 = 0.96
-9log10(R) + 146; R2 = 0.6
1000 Hz Decay Curve
-11log10(R) + 187; R2 = 1
-12log10(R) + 176; R2 = 0.97
-1log10(R) + 128; R2 = 0.03
1995 Hz Decay Curve
-16log10(R) + 200; R2 = 0.9
-13log10(R) + 180; R2 = 0.87
-1log10(R) + 128; R2 = 0.02
3981 Hz Decay Curve
-14log10(R) + 194; R2 = 0.75
-8log10(R) + 167; R2 = 0.59
-1log10(R) + 129; R2 = 0.08
7943 Hz Decay Curve
-14log10(R) + 195; R2 = 0.75
-9log10(R) + 168; R2 = 0.64
-2log10(R) + 130; R2 = 0.21
15849 Hz Decay Curve
-15log10(R) + 196; R2 = 0.75
-9log10(R) + 169; R2 = 0.64
-2log10(R) + 131; R2 = 0.29
SPL(dB)
Range (m)

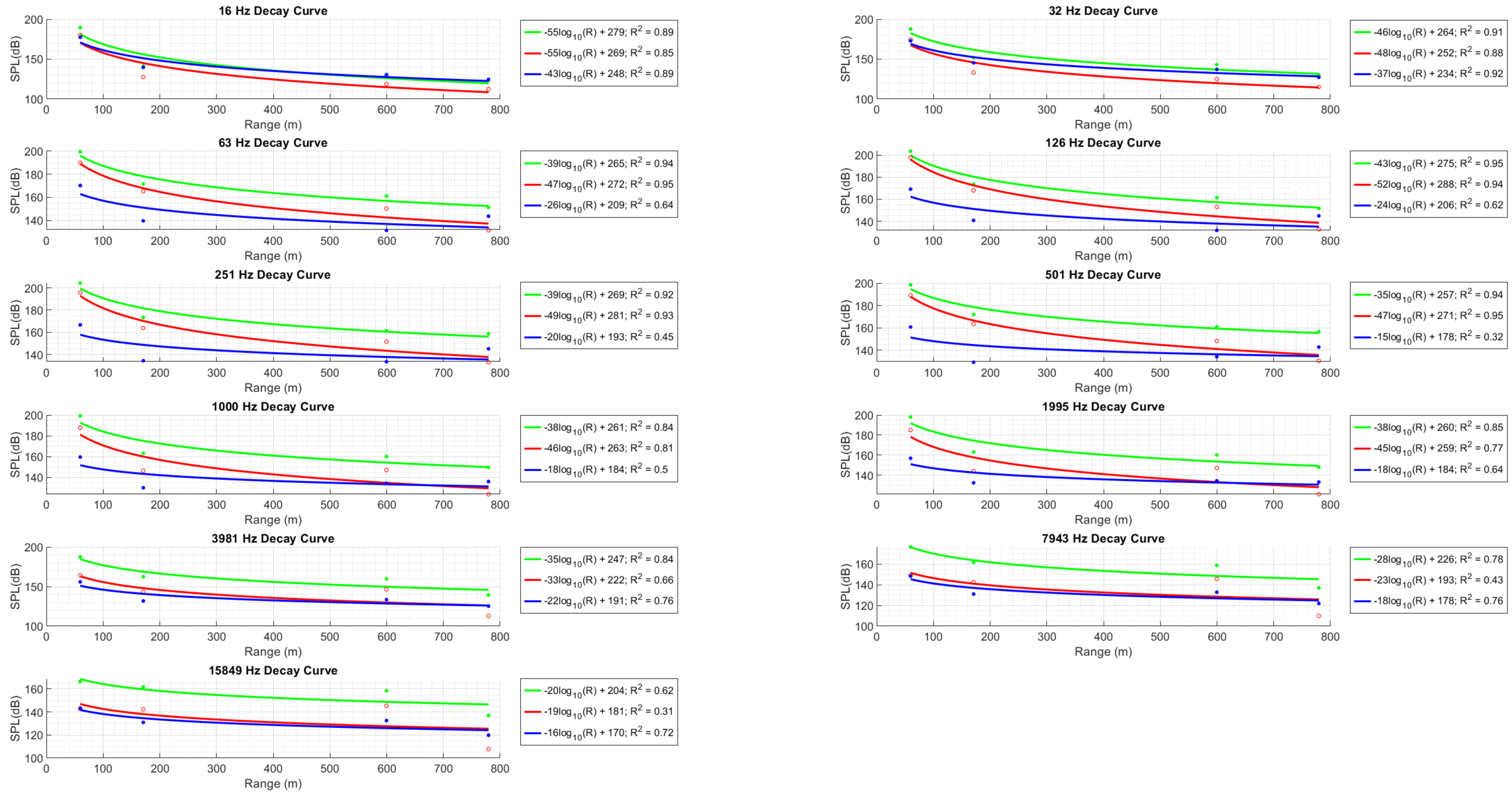
HF - 13


16 Hz Decay Curve
-41log10(R) + 227; R2 = 0.86
-46log10(R) + 226; R2 = 0.88
-33log10(R) + 204; R2 = 0.66
32 Hz Decay Curve
-41log10(R) + 230; R2 = 0.9
-41log10(R) + 219; R2 = 0.89
-36log10(R) + 204; R2 = 0.68
63 Hz Decay Curve
-40log10(R) + 245; R2 = 0.94
-43log10(R) + 242; R2 = 0.97
-37log10(R) + 208; R2 = 0.9
126 Hz Decay Curve
-45log10(R) + 258; R2 = 0.97
-48log10(R) + 256; R2 = 0.99
-40log10(R) + 214; R2 = 0.89
251 Hz Decay Curve
-39log10(R) + 248; R2 = 0.94
-40log10(R) + 241; R2 = 0.94
-39log10(R) + 210; R2 = 0.9
501 Hz Decay Curve
-41log10(R) + 250; R2 = 0.92
-43log10(R) + 243; R2 = 0.93
-38log10(R) + 205; R2 = 0.89
1000 Hz Decay Curve
-38log10(R) + 243; R2 = 0.92
-41log10(R) + 237; R2 = 0.93
-38log10(R) + 204; R2 = 0.88
1995 Hz Decay Curve
-40log10(R) + 248; R2 = 0.96
-43log10(R) + 239; R2 = 0.96
-35log10(R) + 198; R2 = 0.85
3981 Hz Decay Curve
-36log10(R) + 228; R2 = 0.92
-43log10(R) + 223; R2 = 0.95
-25log10(R) + 172; R2 = 0.64
7943 Hz Decay Curve
-23log10(R) + 196; R2 = 0.65
-20log10(R) + 167; R2 = 0.46
-23log10(R) + 165; R2 = 0.63
15849 Hz Decay Curve
-17log10(R) + 184; R2 = 0.58
-11log10(R) + 146; R2 = 0.23
-21log10(R) + 160; R2 = 0.61
SPL(dB)
Range (m)

HF - 14

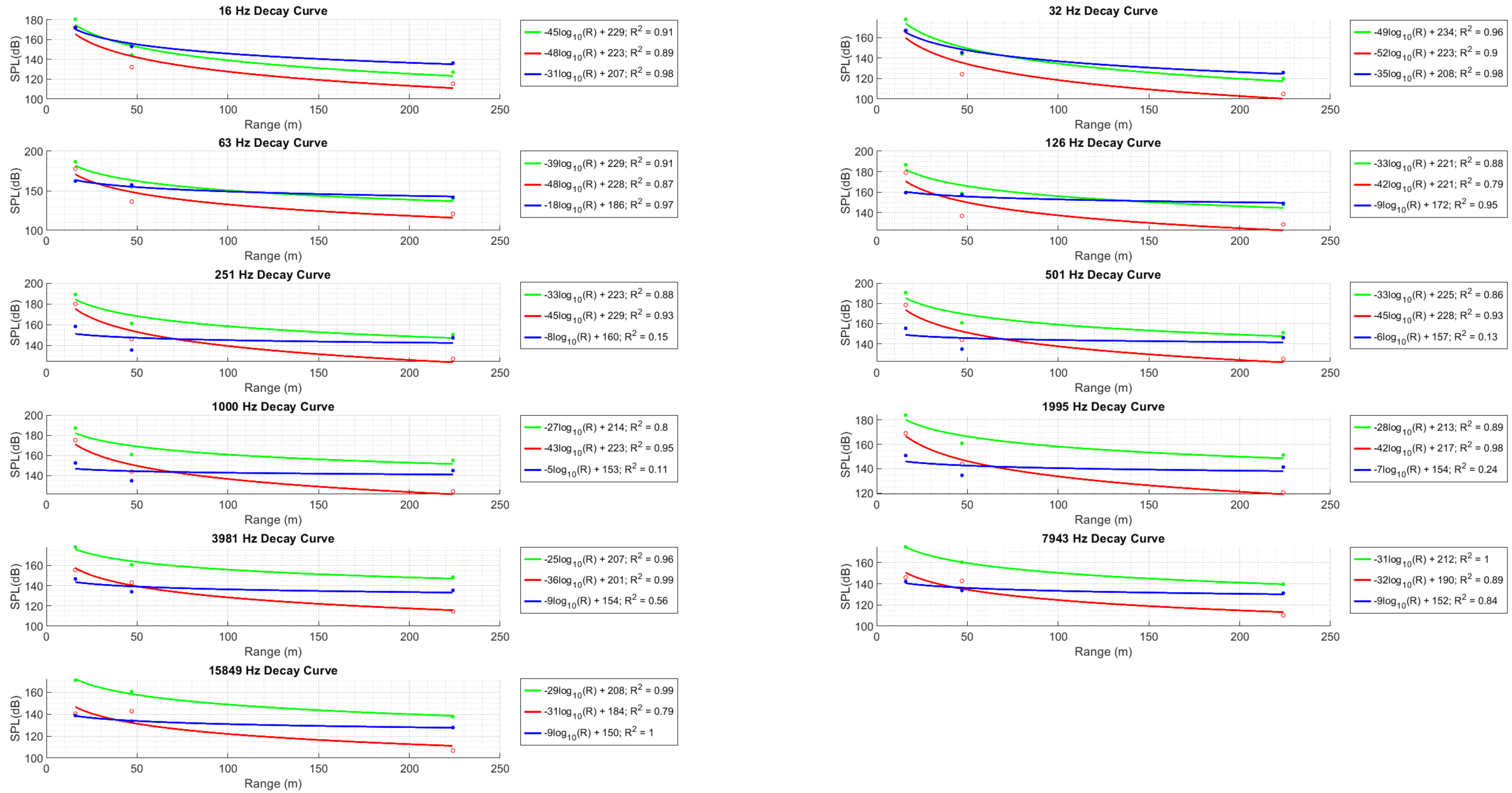

16 Hz Decay Curve
-44log10(R) + 255; R2 = 0.84
-48log10(R) + 252; R2 = 0.85
-34log10(R) + 223; R2 = 0.65
32 Hz Decay Curve
-42log10(R) + 251; R2 = 0.92
-44log10(R) + 246; R2 = 0.95
-37log10(R) + 222; R2 = 0.61
63 Hz Decay Curve
-35log10(R) + 252; R2 = 0.92
-36log10(R) + 247; R2 = 0.95
-35log10(R) + 223; R2 = 0.88
126 Hz Decay Curve
-42log10(R) + 271; R2 = 0.93
-43log10(R) + 267; R2 = 0.95
-37log10(R) + 227; R2 = 0.89
251 Hz Decay Curve
-40log10(R) + 269; R2 = 0.97
-42log10(R) + 263; R2 = 0.98
-39log10(R) + 229; R2 = 0.92
501 Hz Decay Curve
-41log10(R) + 270; R2 = 0.95
-45log10(R) + 270; R2 = 0.96
-39log10(R) + 226; R2 = 0.92
1000 Hz Decay Curve
-43log10(R) + 272; R2 = 0.94
-46log10(R) + 266; R2 = 0.93
-40log10(R) + 228; R2 = 0.89
1995 Hz Decay Curve
-43log10(R) + 273; R2 = 0.94
-47log10(R) + 268; R2 = 0.95
-38log10(R) + 220; R2 = 0.85
3981 Hz Decay Curve
-39log10(R) + 257; R2 = 0.95
-46log10(R) + 258; R2 = 0.95
-32log10(R) + 200; R2 = 0.77
7943 Hz Decay Curve
-33log10(R) + 236; R2 = 0.92
-44log10(R) + 240; R2 = 0.91
-22log10(R) + 173; R2 = 0.58
15849 Hz Decay Curve
-20log10(R) + 199; R2 = 0.7
-18log10(R) + 166; R2 = 0.56
-20log10(R) + 169; R2 = 0.69
SPL(dB)
Range (m)

HF - 15

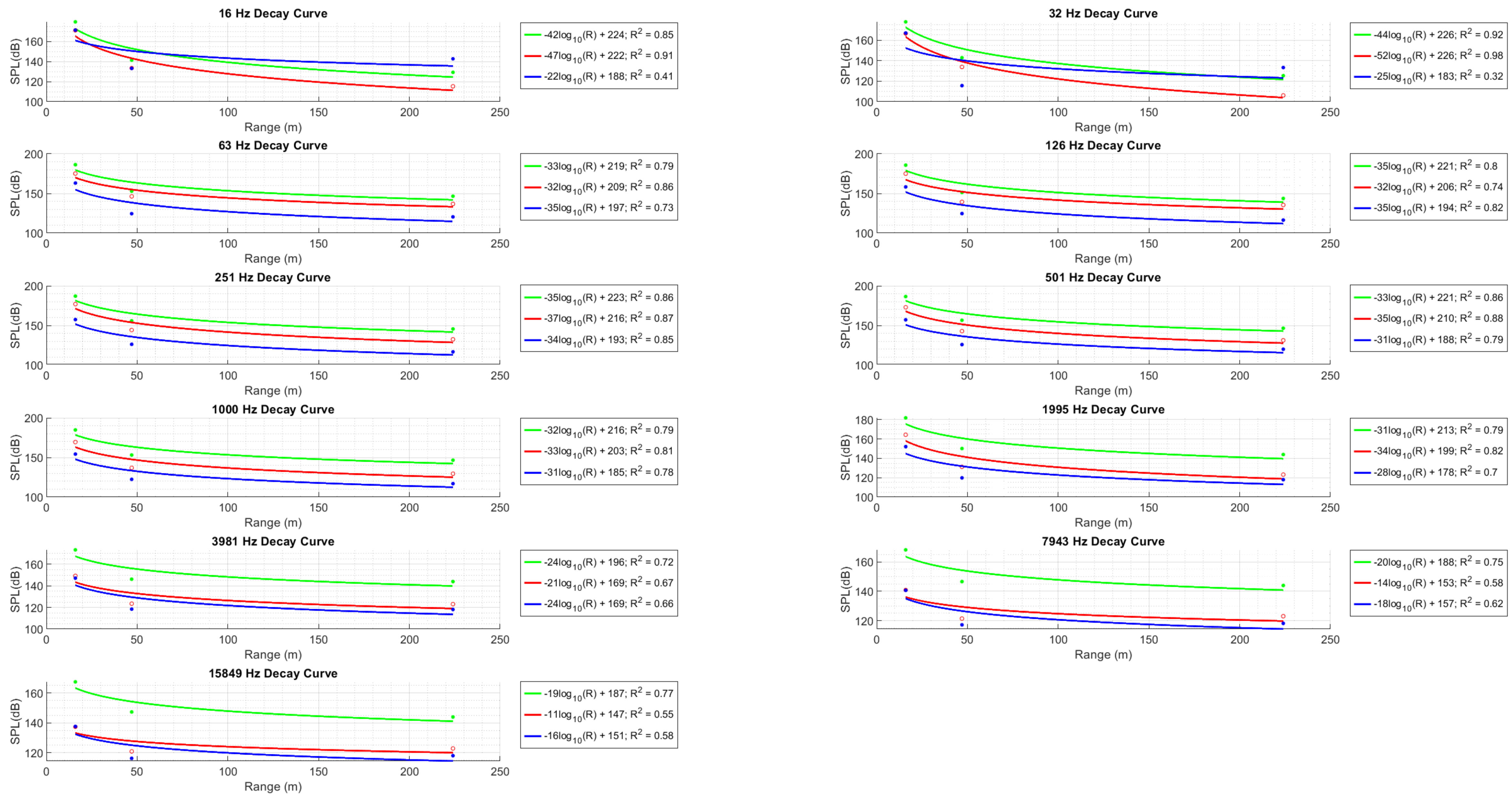


16 Hz Decay Curve
-55log10(R) + 279; R2 = 0.89
-55log10(R) + 269; R2 = 0.85
-43log10(R) + 248; R2 = 0.89
32 Hz Decay Curve
-46log10(R) + 264; R2 = 0.91
-48log10(R) + 252; R2 = 0.88
-37log10(R) + 234; R2 = 0.92
63 Hz Decay Curve
-39log10(R) + 265; R2 = 0.94
-47log10(R) + 272; R2 = 0.95
-26log10(R) + 209; R2 = 0.64
126 Hz Decay Curve
-43log10(R) + 275; R2 = 0.95
-52log10(R) + 288; R2 = 0.94
-24log10(R) + 206; R2 = 0.62
251 Hz Decay Curve
-39log10(R) + 269; R2 = 0.92
-49log10(R) + 281; R2 = 0.93
-20log10(R) + 193; R2 = 0.45
501 Hz Decay Curve
-35log10(R) + 257; R2 = 0.94
-47log10(R) + 271; R2 = 0.95
-15log10(R) + 178; R2 = 0.32
1000 Hz Decay Curve
-38log10(R) + 261; R2 = 0.84
-46log10(R) + 263; R2 = 0.81
-18log10(R) + 184; R2 = 0.5
1995 Hz Decay Curve
-38log10(R) + 260; R2 = 0.85
-45log10(R) + 259; R2 = 0.77
-18log10(R) + 184; R2 = 0.64
3981 Hz Decay Curve
-35log10(R) + 247; R2 = 0.84
-33log10(R) + 222; R2 = 0.66
-22log10(R) + 191; R2 = 0.76
7943 Hz Decay Curve
-28log10(R) + 226; R2 = 0.78
-23log10(R) + 193; R2 = 0.43
-18log10(R) + 178; R2 = 0.76
15849 Hz Decay Curve
-20log10(R) + 204; R2 = 0.62
-19log10(R) + 181; R2 = 0.31
-16log10(R) + 170; R2 = 0.72
SPL(dB)
Range (m)

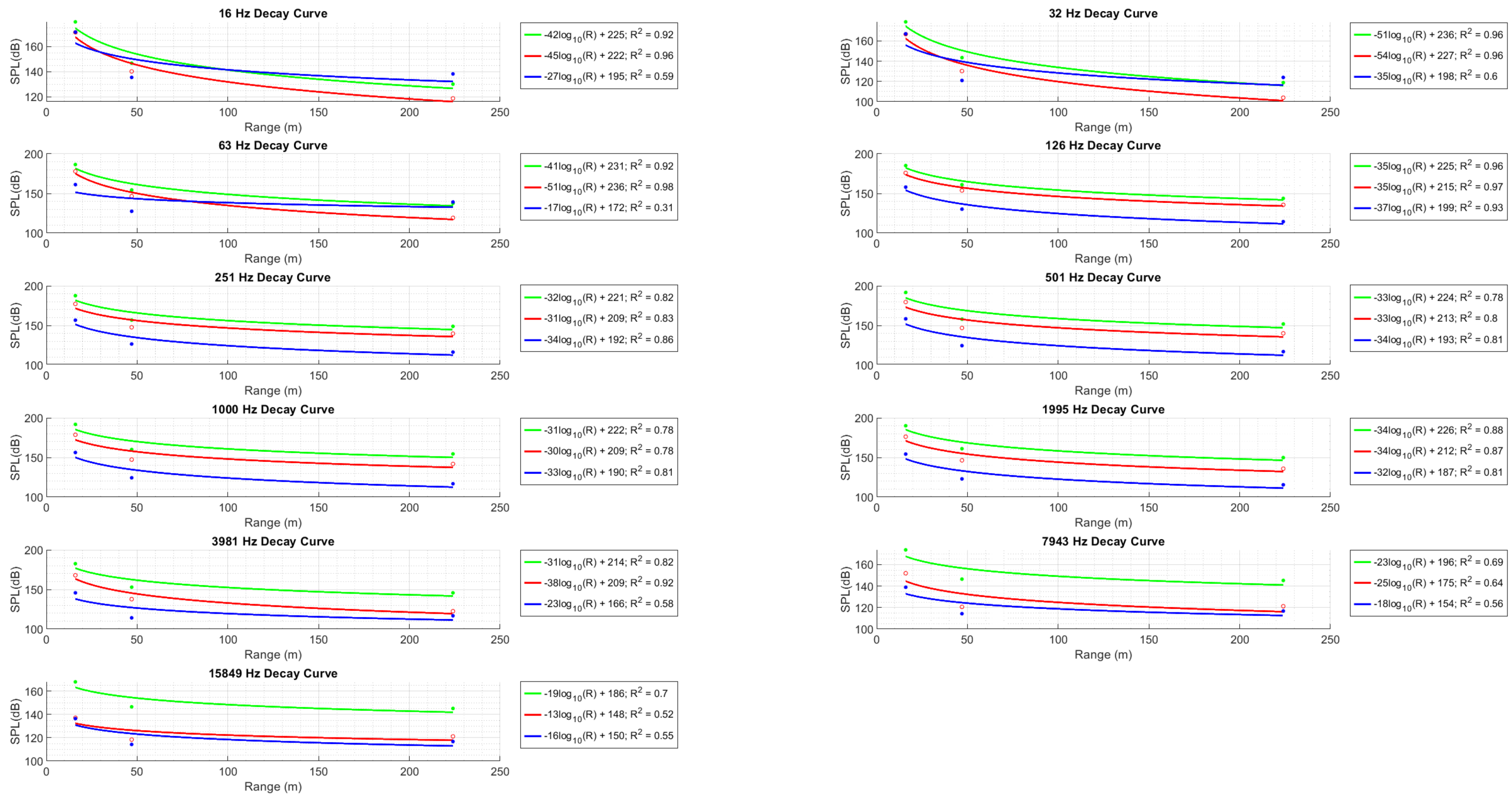
HF - 16


16 Hz Decay Curve
$-45\log_{10}(R) + 229$; $R^2 = 0.91$
$-48\log_{10}(R) + 223$; $R^2 = 0.89$
$-31\log_{10}(R) + 207$; $R^2 = 0.98$
32 Hz Decay Curve
$-49\log_{10}(R) + 234$; $R^2 = 0.96$
$-52\log_{10}(R) + 223$; $R^2 = 0.9$
$-35\log_{10}(R) + 208$; $R^2 = 0.98$
63 Hz Decay Curve
$-39\log_{10}(R) + 229$; $R^2 = 0.91$
$-48\log_{10}(R) + 228$; $R^2 = 0.87$
$-18\log_{10}(R) + 186$; $R^2 = 0.97$
126 Hz Decay Curve
$-33\log_{10}(R) + 221$; $R^2 = 0.88$
$-42\log_{10}(R) + 221$; $R^2 = 0.79$
$-9\log_{10}(R) + 172$; $R^2 = 0.95$
251 Hz Decay Curve
$-33\log_{10}(R) + 223$; $R^2 = 0.88$
$-45\log_{10}(R) + 229$; $R^2 = 0.93$
$-8\log_{10}(R) + 160$; $R^2 = 0.15$
501 Hz Decay Curve
$-33\log_{10}(R) + 225$; $R^2 = 0.86$
$-45\log_{10}(R) + 228$; $R^2 = 0.93$
$-6\log_{10}(R) + 157$; $R^2 = 0.13$
1000 Hz Decay Curve
$-27\log_{10}(R) + 214$; $R^2 = 0.8$
$-43\log_{10}(R) + 223$; $R^2 = 0.95$
$-5\log_{10}(R) + 153$; $R^2 = 0.11$
1995 Hz Decay Curve
$-28\log_{10}(R) + 213$; $R^2 = 0.89$
$-42\log_{10}(R) + 217$; $R^2 = 0.98$
$-7\log_{10}(R) + 154$; $R^2 = 0.24$
3981 Hz Decay Curve
$-25\log_{10}(R) + 207$; $R^2 = 0.96$
$-36\log_{10}(R) + 201$; $R^2 = 0.99$
$-9\log_{10}(R) + 154$; $R^2 = 0.56$
7943 Hz Decay Curve
$-31\log_{10}(R) + 212$; $R^2 = 1$
$-32\log_{10}(R) + 190$; $R^2 = 0.89$
$-9\log_{10}(R) + 152$; $R^2 = 0.84$
15849 Hz Decay Curve
$-29\log_{10}(R) + 208$; $R^2 = 0.99$
$-31\log_{10}(R) + 184$; $R^2 = 0.79$
$-9\log_{10}(R) + 150$; $R^2 = 1$
SPL(dB)
Range (m)

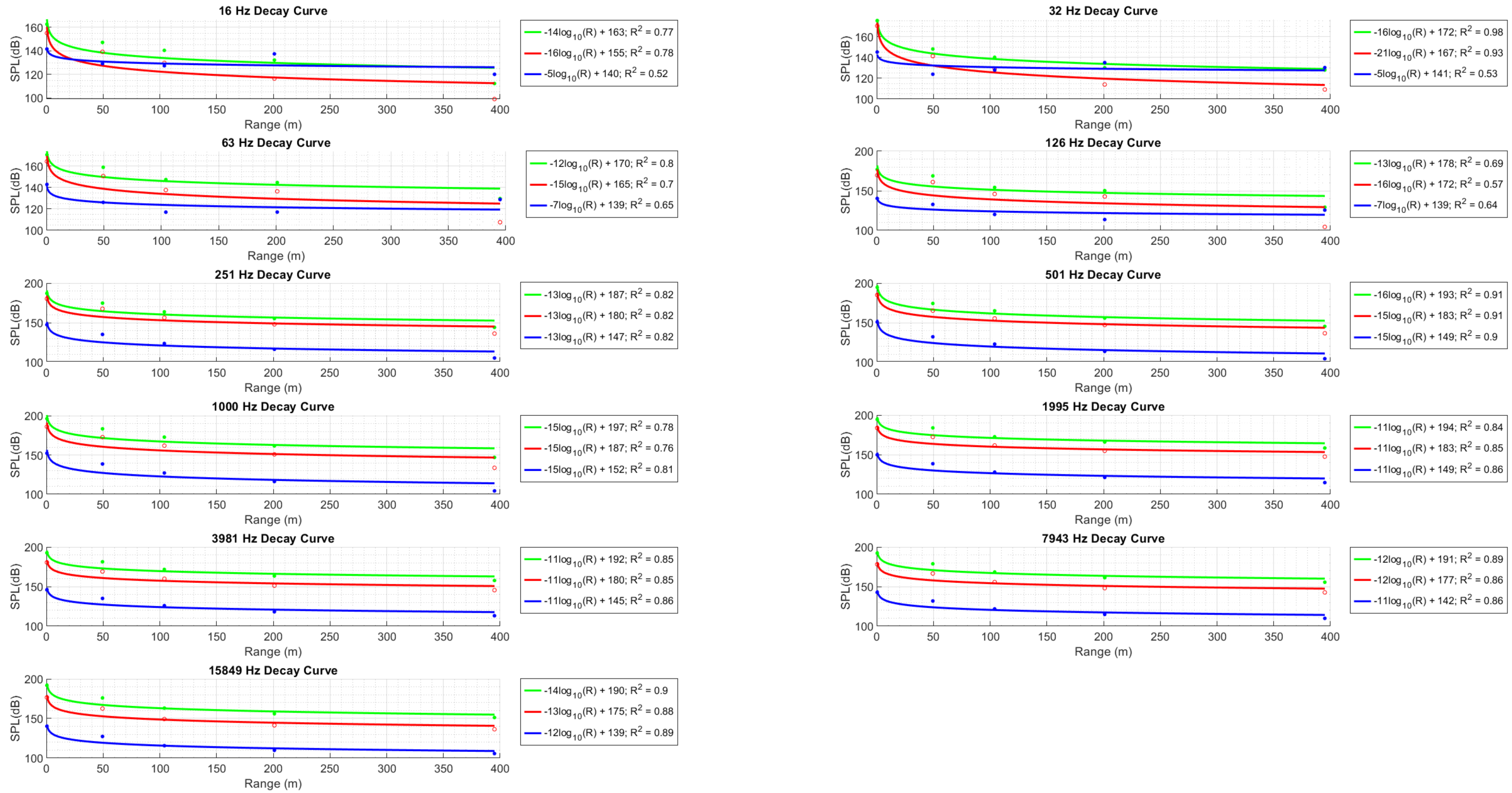
HF - 17


16 Hz Decay Curve
-42log$_{10}$(R) + 224; R^2 = 0.85
-47log$_{10}$(R) + 222; R^2 = 0.91
-22log$_{10}$(R) + 188; R^2 = 0.41
32 Hz Decay Curve
-44log$_{10}$(R) + 226; R^2 = 0.92
-52log$_{10}$(R) + 226; R^2 = 0.98
-25log$_{10}$(R) + 183; R^2 = 0.32
63 Hz Decay Curve
-33log$_{10}$(R) + 219; R^2 = 0.79
-32log$_{10}$(R) + 209; R^2 = 0.86
-35log$_{10}$(R) + 197; R^2 = 0.73
126 Hz Decay Curve
-35log$_{10}$(R) + 221; R^2 = 0.8
-32log$_{10}$(R) + 206; R^2 = 0.74
-35log$_{10}$(R) + 194; R^2 = 0.82
251 Hz Decay Curve
-35log$_{10}$(R) + 223; R^2 = 0.86
-37log$_{10}$(R) + 216; R^2 = 0.87
-34log$_{10}$(R) + 193; R^2 = 0.85
501 Hz Decay Curve
-33log$_{10}$(R) + 221; R^2 = 0.86
-35log$_{10}$(R) + 210; R^2 = 0.88
-31log$_{10}$(R) + 188; R^2 = 0.79
1000 Hz Decay Curve
-32log$_{10}$(R) + 216; R^2 = 0.79
-33log$_{10}$(R) + 203; R^2 = 0.81
-31log$_{10}$(R) + 185; R^2 = 0.78
1995 Hz Decay Curve
-31log$_{10}$(R) + 213; R^2 = 0.79
-34log$_{10}$(R) + 199; R^2 = 0.82
-28log$_{10}$(R) + 178; R^2 = 0.7
3981 Hz Decay Curve
-24log$_{10}$(R) + 196; R^2 = 0.72
-21log$_{10}$(R) + 169; R^2 = 0.67
-24log$_{10}$(R) + 169; R^2 = 0.66
7943 Hz Decay Curve
-20log$_{10}$(R) + 188; R^2 = 0.75
-14log$_{10}$(R) + 153; R^2 = 0.58
-18log$_{10}$(R) + 157; R^2 = 0.62
15849 Hz Decay Curve
-19log$_{10}$(R) + 187; R^2 = 0.77
-11log$_{10}$(R) + 147; R^2 = 0.55
-16log$_{10}$(R) + 151; R^2 = 0.58
SPL(dB)
Range (m)

HF - 18

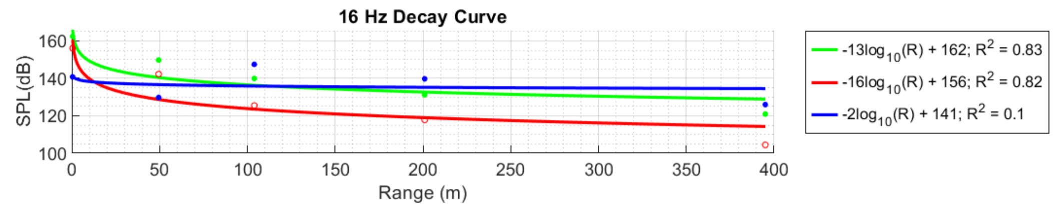

16 Hz Decay Curve
-42log10(R) + 225; R2 = 0.92
-45log10(R) + 222; R2 = 0.96
-27log10(R) + 195; R2 = 0.59
32 Hz Decay Curve
-51log10(R) + 236; R2 = 0.96
-54log10(R) + 227; R2 = 0.96
-35log10(R) + 198; R2 = 0.6
63 Hz Decay Curve
-41log10(R) + 231; R2 = 0.92
-51log10(R) + 236; R2 = 0.98
-17log10(R) + 172; R2 = 0.31
126 Hz Decay Curve
-35log10(R) + 225; R2 = 0.96
-35log10(R) + 215; R2 = 0.97
-37log10(R) + 199; R2 = 0.93
251 Hz Decay Curve
-32log10(R) + 221; R2 = 0.82
-31log10(R) + 209; R2 = 0.83
-34log10(R) + 192; R2 = 0.86
501 Hz Decay Curve
-33log10(R) + 224; R2 = 0.78
-33log10(R) + 213; R2 = 0.8
-34log10(R) + 193; R2 = 0.81
1000 Hz Decay Curve
-31log10(R) + 222; R2 = 0.78
-30log10(R) + 209; R2 = 0.78
-33log10(R) + 190; R2 = 0.81
1995 Hz Decay Curve
-34log10(R) + 226; R2 = 0.88
-34log10(R) + 212; R2 = 0.87
-32log10(R) + 187; R2 = 0.81
3981 Hz Decay Curve
-31log10(R) + 214; R2 = 0.82
-38log10(R) + 209; R2 = 0.92
-23log10(R) + 166; R2 = 0.58
7943 Hz Decay Curve
-23log10(R) + 196; R2 = 0.69
-25log10(R) + 175; R2 = 0.64
-18log10(R) + 154; R2 = 0.56
15849 Hz Decay Curve
-19log10(R) + 186; R2 = 0.7
-13log10(R) + 148; R2 = 0.52
-16log10(R) + 150; R2 = 0.55
SPL(dB)
Range (m)

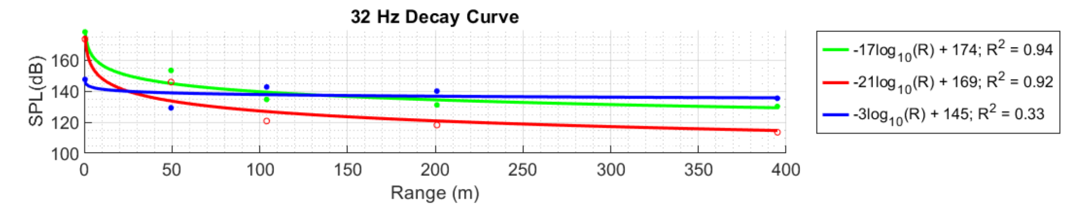
HF - 19

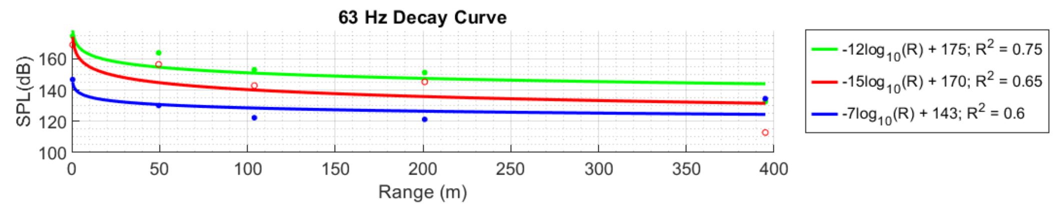


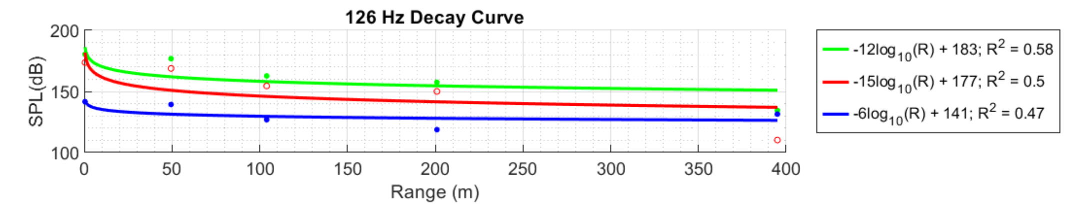
16 Hz Decay Curve
-14log10(R) + 163; R2 = 0.77
-16log10(R) + 155; R2 = 0.78
-5log10(R) + 140; R2 = 0.52
32 Hz Decay Curve
-16log10(R) + 172; R2 = 0.98
-21log10(R) + 167; R2 = 0.93
-5log10(R) + 141; R2 = 0.53
63 Hz Decay Curve
-12log10(R) + 170; R2 = 0.8
-15log10(R) + 165; R2 = 0.7
-7log10(R) + 139; R2 = 0.65
126 Hz Decay Curve
-13log10(R) + 178; R2 = 0.69
-16log10(R) + 172; R2 = 0.57
-7log10(R) + 139; R2 = 0.64
251 Hz Decay Curve
-13log10(R) + 187; R2 = 0.82
-13log10(R) + 180; R2 = 0.82
-13log10(R) + 147; R2 = 0.82
501 Hz Decay Curve
-16log10(R) + 193; R2 = 0.91
-15log10(R) + 183; R2 = 0.91
-15log10(R) + 149; R2 = 0.9
1000 Hz Decay Curve
-15log10(R) + 197; R2 = 0.78
-15log10(R) + 187; R2 = 0.76
-15log10(R) + 152; R2 = 0.81
1995 Hz Decay Curve
-11log10(R) + 194; R2 = 0.84
-11log10(R) + 183; R2 = 0.85
-11log10(R) + 149; R2 = 0.86
3981 Hz Decay Curve
-11log10(R) + 192; R2 = 0.85
-11log10(R) + 180; R2 = 0.85
-11log10(R) + 145; R2 = 0.86
7943 Hz Decay Curve
-12log10(R) + 191; R2 = 0.89
-12log10(R) + 177; R2 = 0.86
-11log10(R) + 142; R2 = 0.86
15849 Hz Decay Curve
-14log10(R) + 190; R2 = 0.9
-13log10(R) + 175; R2 = 0.88
-12log10(R) + 139; R2 = 0.89
SPL(dB)
Range (m)

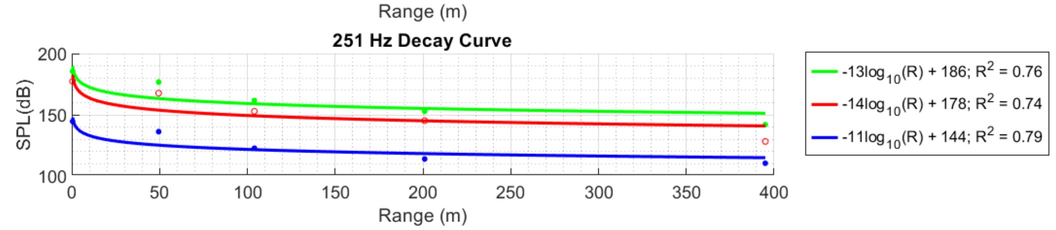
HF - 20

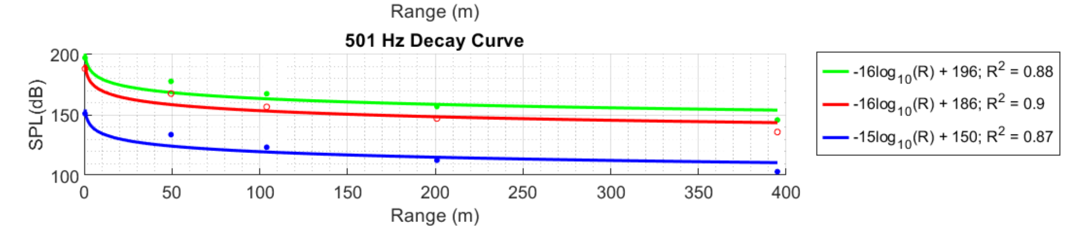

16 Hz Decay Curve
SPL(dB)
Range (m)
$-13\log_{10}(R) + 162;\ R^2 = 0.83$
$-16\log_{10}(R) + 156;\ R^2 = 0.82$
$-2\log_{10}(R) + 141;\ R^2 = 0.1$

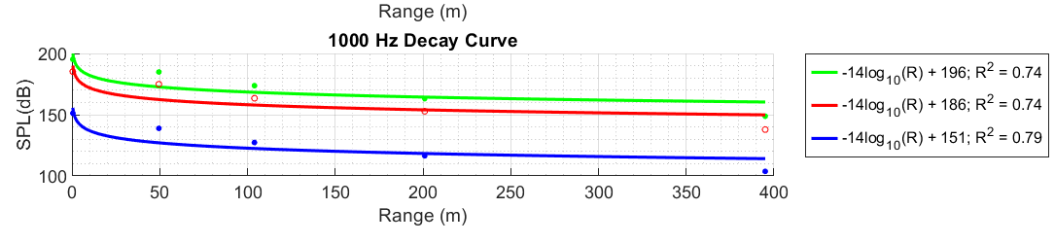

32 Hz Decay Curve
SPL(dB)
Range (m)
$-17\log_{10}(R) + 174;\ R^2 = 0.94$
$-21\log_{10}(R) + 169;\ R^2 = 0.92$
$-3\log_{10}(R) + 145;\ R^2 = 0.33$

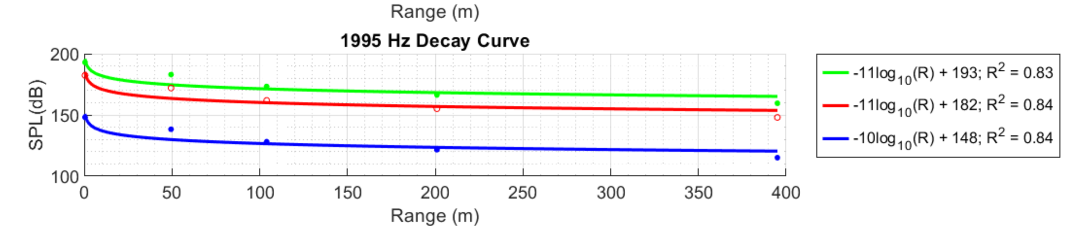

63 Hz Decay Curve
SPL(dB)
Range (m)
$-12\log_{10}(R) + 175;\ R^2 = 0.75$
$-15\log_{10}(R) + 170;\ R^2 = 0.65$
$-7\log_{10}(R) + 143;\ R^2 = 0.6$

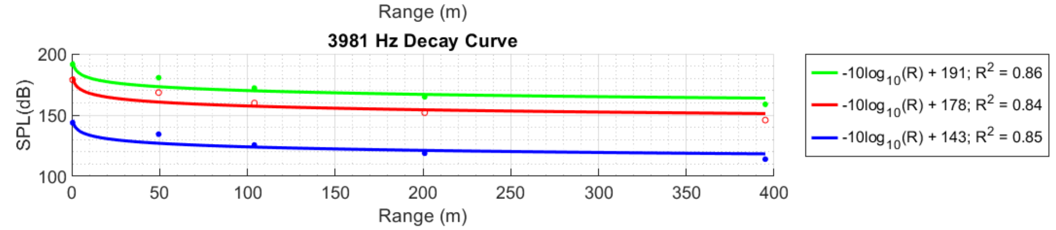

126 Hz Decay Curve
SPL(dB)
Range (m)
$-12\log_{10}(R) + 183;\ R^2 = 0.58$
$-15\log_{10}(R) + 177;\ R^2 = 0.5$
$-6\log_{10}(R) + 141;\ R^2 = 0.47$

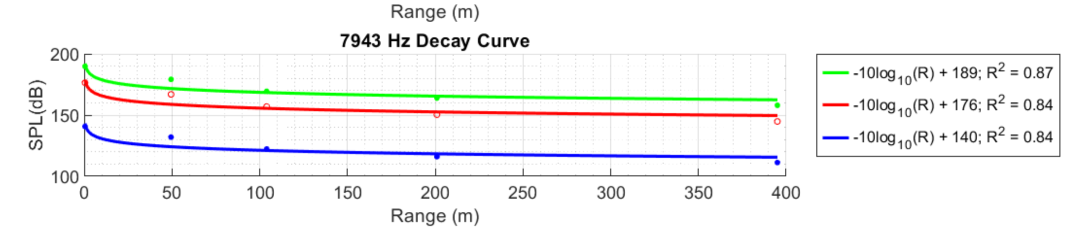

251 Hz Decay Curve
SPL(dB)
Range (m)
$-13\log_{10}(R) + 186;\ R^2 = 0.76$
$-14\log_{10}(R) + 178;\ R^2 = 0.74$
$-11\log_{10}(R) + 144;\ R^2 = 0.79$

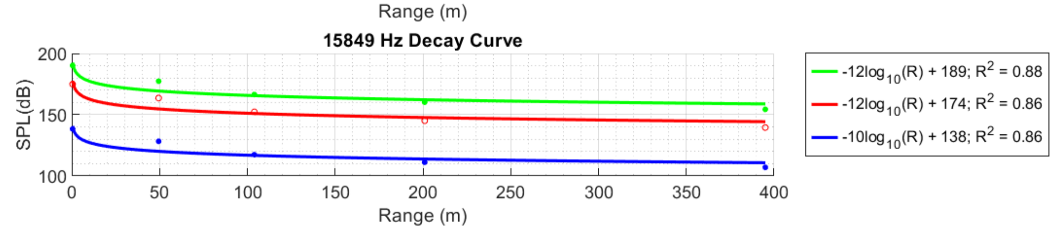

501 Hz Decay Curve
SPL(dB)
Range (m)
$-16\log_{10}(R) + 196;\ R^2 = 0.88$
$-16\log_{10}(R) + 186;\ R^2 = 0.9$
$-15\log_{10}(R) + 150;\ R^2 = 0.87$


1000 Hz Decay Curve
SPL(dB)
Range (m)
$-14\log_{10}(R) + 196;\ R^2 = 0.74$
$-14\log_{10}(R) + 186;\ R^2 = 0.74$
$-14\log_{10}(R) + 151;\ R^2 = 0.79$

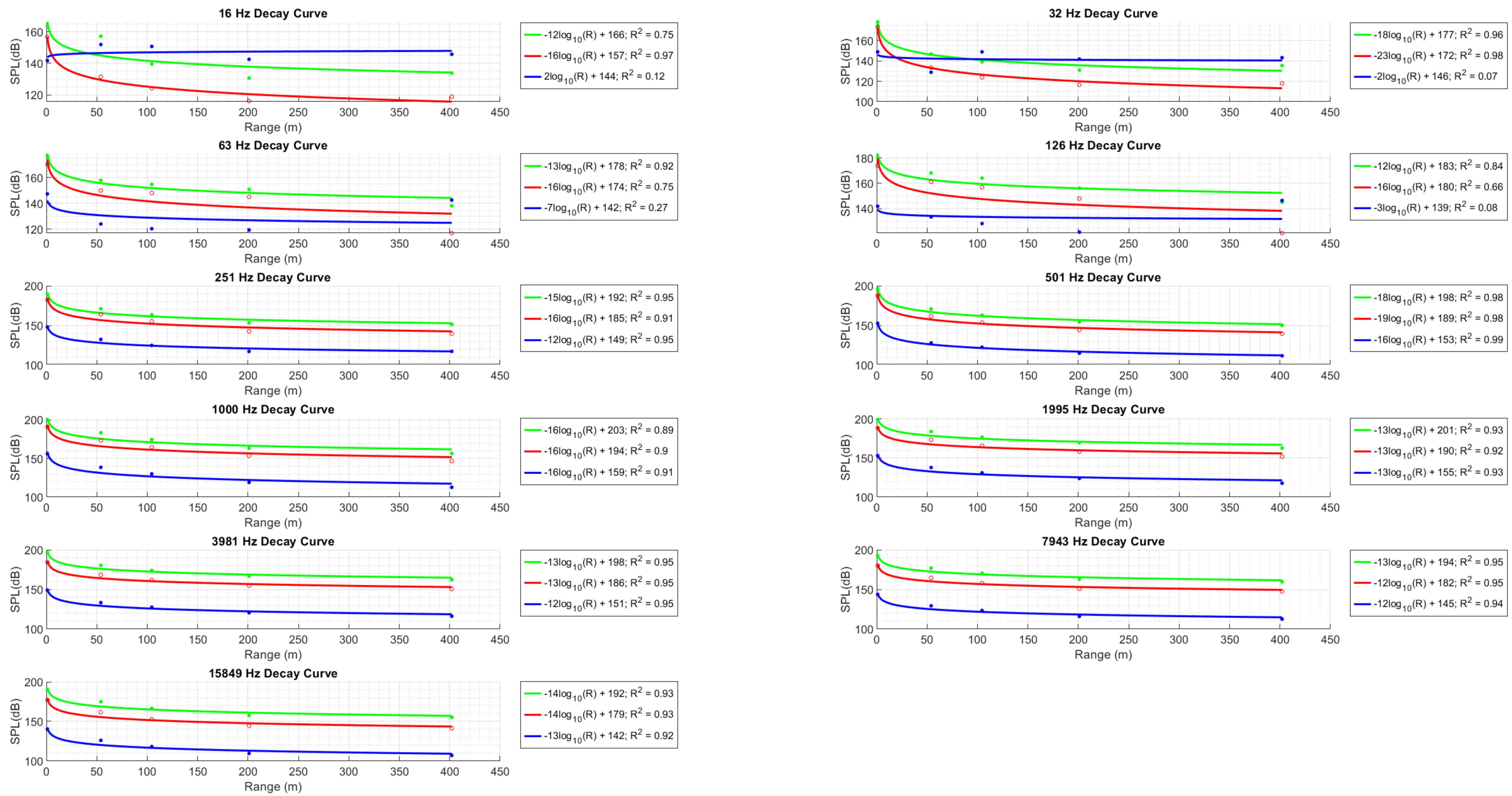

1995 Hz Decay Curve
SPL(dB)
Range (m)
$-11\log_{10}(R) + 193;\ R^2 = 0.83$
$-11\log_{10}(R) + 182;\ R^2 = 0.84$
$-10\log_{10}(R) + 148;\ R^2 = 0.84$


3981 Hz Decay Curve
SPL(dB)
Range (m)
$-10\log_{10}(R) + 191;\ R^2 = 0.86$
$-10\log_{10}(R) + 178;\ R^2 = 0.84$
$-10\log_{10}(R) + 143;\ R^2 = 0.85$

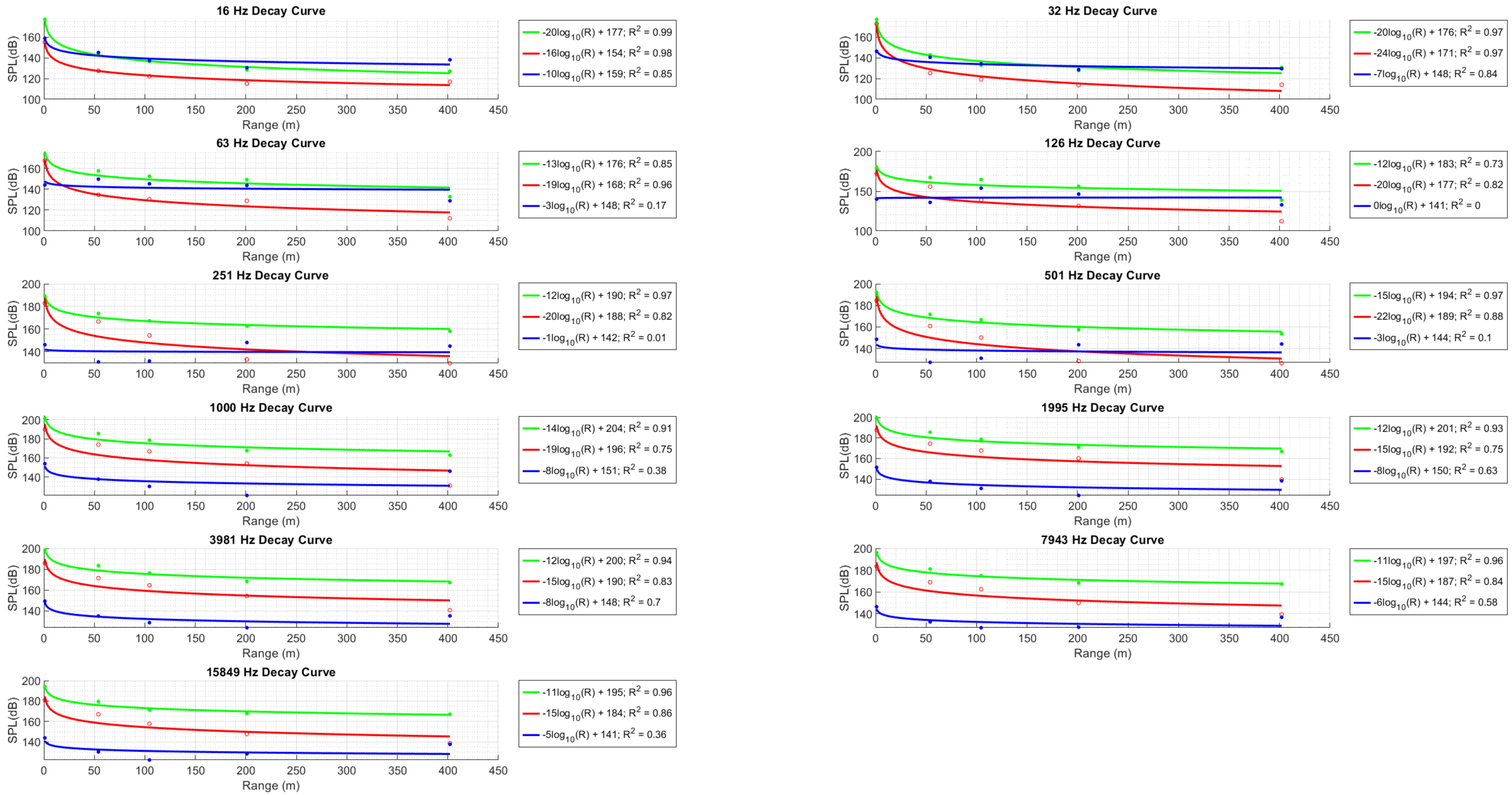

7943 Hz Decay Curve
SPL(dB)
Range (m)
$-10\log_{10}(R) + 189;\ R^2 = 0.87$
$-10\log_{10}(R) + 176;\ R^2 = 0.84$
$-10\log_{10}(R) + 140;\ R^2 = 0.84$


15849 Hz Decay Curve
SPL(dB)
Range (m)
$-12\log_{10}(R) + 189;\ R^2 = 0.88$
$-12\log_{10}(R) + 174;\ R^2 = 0.86$
$-10\log_{10}(R) + 138;\ R^2 = 0.86$

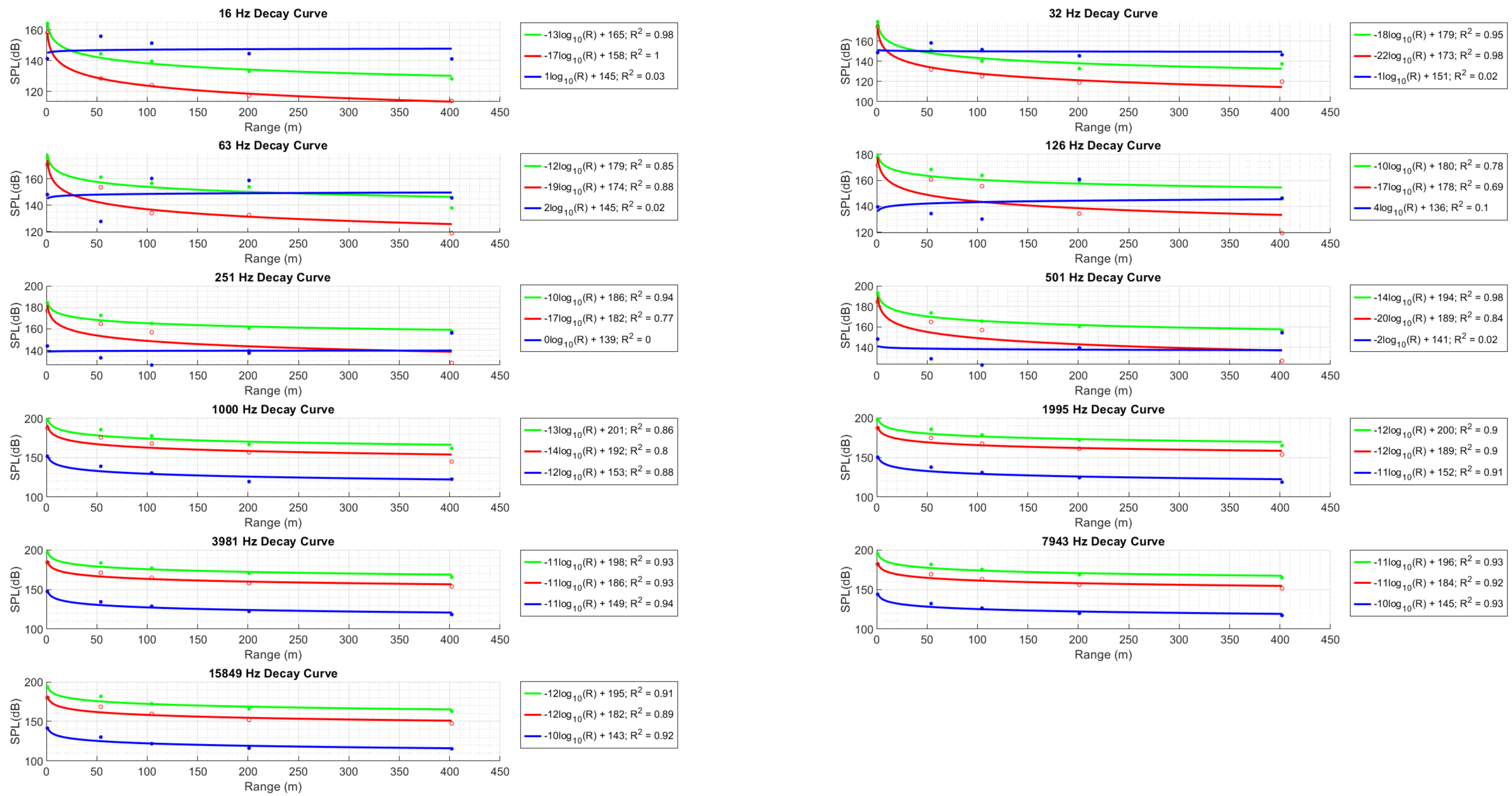
HF - 21

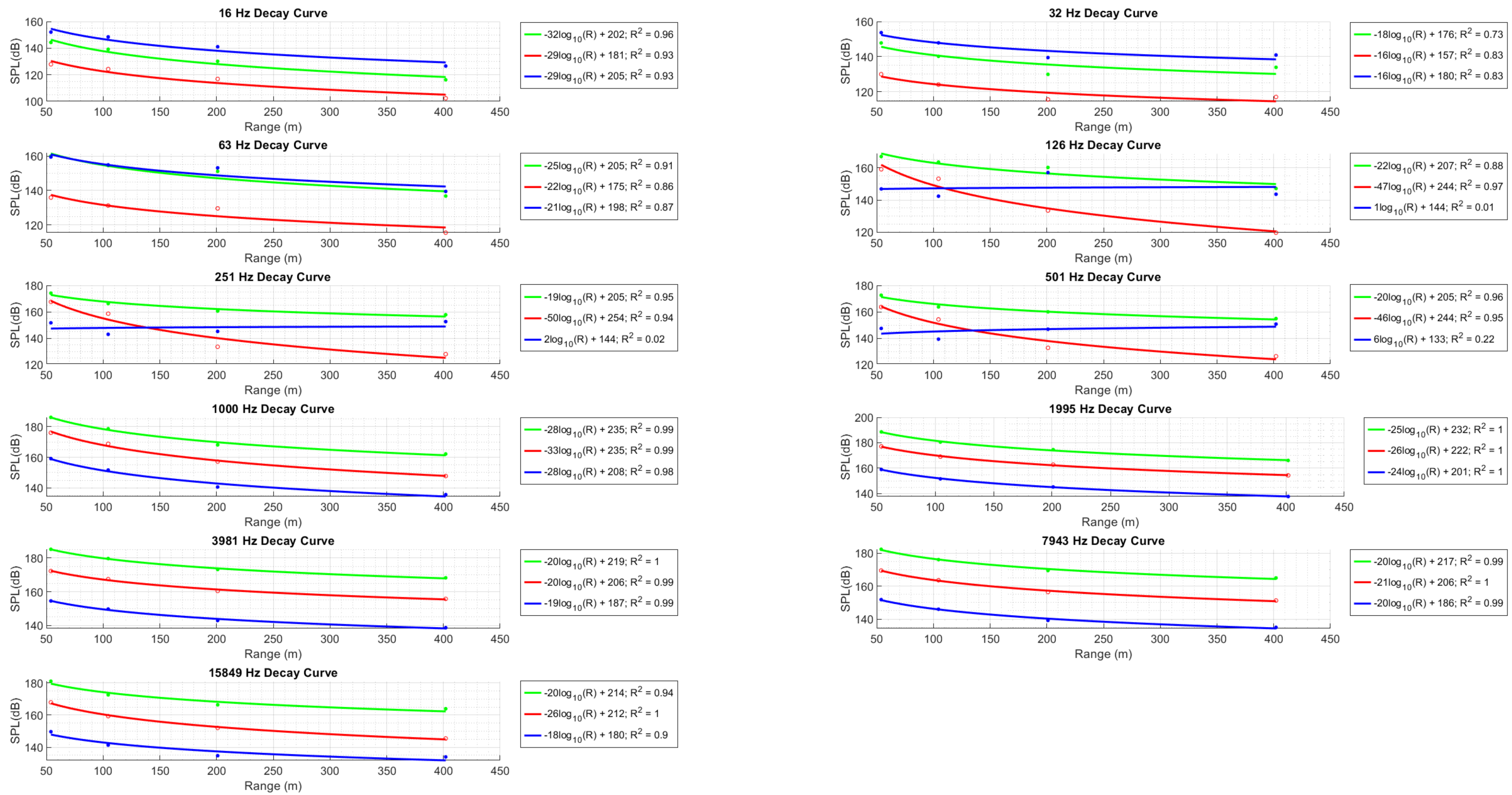

16 Hz Decay Curve
-12log10(R) + 166; R2 = 0.75
-16log10(R) + 157; R2 = 0.97
2log10(R) + 144; R2 = 0.12
32 Hz Decay Curve
-18log10(R) + 177; R2 = 0.96
-23log10(R) + 172; R2 = 0.98
-2log10(R) + 146; R2 = 0.07
63 Hz Decay Curve
-13log10(R) + 178; R2 = 0.92
-16log10(R) + 174; R2 = 0.75
-7log10(R) + 142; R2 = 0.27
126 Hz Decay Curve
-12log10(R) + 183; R2 = 0.84
-16log10(R) + 180; R2 = 0.66
-3log10(R) + 139; R2 = 0.08
251 Hz Decay Curve
-15log10(R) + 192; R2 = 0.95
-16log10(R) + 185; R2 = 0.91
-12log10(R) + 149; R2 = 0.95
501 Hz Decay Curve
-18log10(R) + 198; R2 = 0.98
-19log10(R) + 189; R2 = 0.98
-16log10(R) + 153; R2 = 0.99
1000 Hz Decay Curve
-16log10(R) + 203; R2 = 0.89
-16log10(R) + 194; R2 = 0.9
-16log10(R) + 159; R2 = 0.91
1995 Hz Decay Curve
-13log10(R) + 201; R2 = 0.93
-13log10(R) + 190; R2 = 0.92
-13log10(R) + 155; R2 = 0.93
3981 Hz Decay Curve
-13log10(R) + 198; R2 = 0.95
-13log10(R) + 186; R2 = 0.95
-12log10(R) + 151; R2 = 0.95
7943 Hz Decay Curve
-13log10(R) + 194; R2 = 0.95
-12log10(R) + 182; R2 = 0.95
-12log10(R) + 145; R2 = 0.94
15849 Hz Decay Curve
-14log10(R) + 192; R2 = 0.93
-14log10(R) + 179; R2 = 0.93
-13log10(R) + 142; R2 = 0.92
SPL(dB)
Range (m)

HF - 22

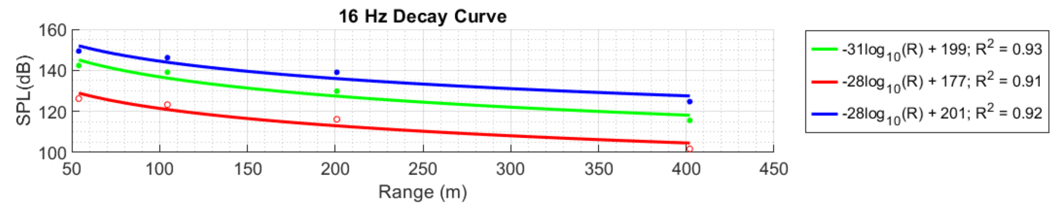

16 Hz Decay Curve
-20log10(R) + 177; R2 = 0.99
-16log10(R) + 154; R2 = 0.98
-10log10(R) + 159; R2 = 0.85
32 Hz Decay Curve
-20log10(R) + 176; R2 = 0.97
-24log10(R) + 171; R2 = 0.97
-7log10(R) + 148; R2 = 0.84
63 Hz Decay Curve
-13log10(R) + 176; R2 = 0.85
-19log10(R) + 168; R2 = 0.96
-3log10(R) + 148; R2 = 0.17
126 Hz Decay Curve
-12log10(R) + 183; R2 = 0.73
-20log10(R) + 177; R2 = 0.82
0log10(R) + 141; R2 = 0
251 Hz Decay Curve
-12log10(R) + 190; R2 = 0.97
-20log10(R) + 188; R2 = 0.82
-1log10(R) + 142; R2 = 0.01
501 Hz Decay Curve
-15log10(R) + 194; R2 = 0.97
-22log10(R) + 189; R2 = 0.88
-3log10(R) + 144; R2 = 0.1
1000 Hz Decay Curve
-14log10(R) + 204; R2 = 0.91
-19log10(R) + 196; R2 = 0.75
-8log10(R) + 151; R2 = 0.38
1995 Hz Decay Curve
-12log10(R) + 201; R2 = 0.93
-15log10(R) + 192; R2 = 0.75
-8log10(R) + 150; R2 = 0.63
3981 Hz Decay Curve
-12log10(R) + 200; R2 = 0.94
-15log10(R) + 190; R2 = 0.83
-8log10(R) + 148; R2 = 0.7
7943 Hz Decay Curve
-11log10(R) + 197; R2 = 0.96
-15log10(R) + 187; R2 = 0.84
-6log10(R) + 144; R2 = 0.58
15849 Hz Decay Curve
-11log10(R) + 195; R2 = 0.96
-15log10(R) + 184; R2 = 0.86
-5log10(R) + 141; R2 = 0.36
SPL(dB)
Range (m)

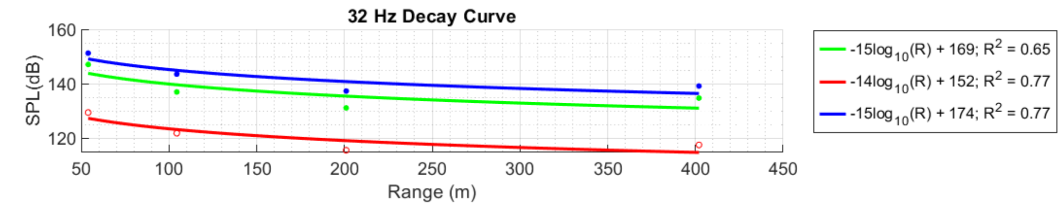
HF - 23

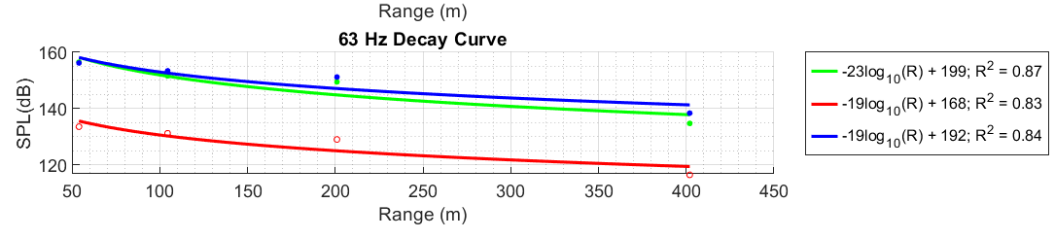

16 Hz Decay Curve
-13log10(R) + 165; R2 = 0.98
-17log10(R) + 158; R2 = 1
1log10(R) + 145; R2 = 0.03
32 Hz Decay Curve
-18log10(R) + 179; R2 = 0.95
-22log10(R) + 173; R2 = 0.98
-1log10(R) + 151; R2 = 0.02
63 Hz Decay Curve
-12log10(R) + 179; R2 = 0.85
-19log10(R) + 174; R2 = 0.88
2log10(R) + 145; R2 = 0.02
126 Hz Decay Curve
-10log10(R) + 180; R2 = 0.78
-17log10(R) + 178; R2 = 0.69
4log10(R) + 136; R2 = 0.1
251 Hz Decay Curve
-10log10(R) + 186; R2 = 0.94
-17log10(R) + 182; R2 = 0.77
0log10(R) + 139; R2 = 0
501 Hz Decay Curve
-14log10(R) + 194; R2 = 0.98
-20log10(R) + 189; R2 = 0.84
-2log10(R) + 141; R2 = 0.02
1000 Hz Decay Curve
-13log10(R) + 201; R2 = 0.86
-14log10(R) + 192; R2 = 0.8
-12log10(R) + 153; R2 = 0.88
1995 Hz Decay Curve
-12log10(R) + 200; R2 = 0.9
-12log10(R) + 189; R2 = 0.9
-11log10(R) + 152; R2 = 0.91
3981 Hz Decay Curve
-11log10(R) + 198; R2 = 0.93
-11log10(R) + 186; R2 = 0.93
-11log10(R) + 149; R2 = 0.94
7943 Hz Decay Curve
-11log10(R) + 196; R2 = 0.93
-11log10(R) + 184; R2 = 0.92
-10log10(R) + 145; R2 = 0.93
15849 Hz Decay Curve
-12log10(R) + 195; R2 = 0.91
-12log10(R) + 182; R2 = 0.89
-10log10(R) + 143; R2 = 0.92
SPL(dB)
Range (m)

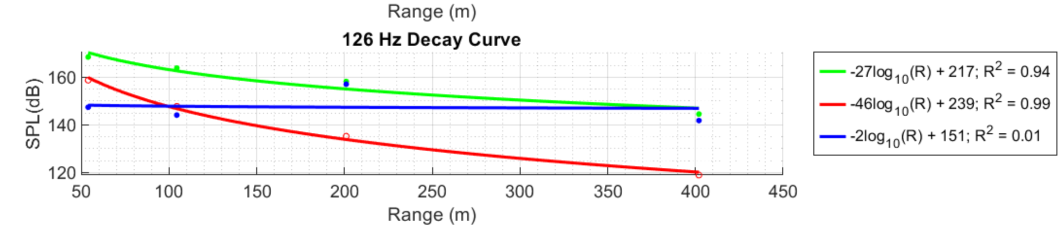

16 Hz Decay Curve
-32log10(R) + 202; R2 = 0.96
-29log10(R) + 181; R2 = 0.93
-29log10(R) + 205; R2 = 0.93
32 Hz Decay Curve
-18log10(R) + 176; R2 = 0.73
-16log10(R) + 157; R2 = 0.83
-16log10(R) + 180; R2 = 0.83
63 Hz Decay Curve
-25log10(R) + 205; R2 = 0.91
-22log10(R) + 175; R2 = 0.86
-21log10(R) + 198; R2 = 0.87
126 Hz Decay Curve
-22log10(R) + 207; R2 = 0.88
-47log10(R) + 244; R2 = 0.97
1log10(R) + 144; R2 = 0.01
251 Hz Decay Curve
-19log10(R) + 205; R2 = 0.95
-50log10(R) + 254; R2 = 0.94
2log10(R) + 144; R2 = 0.02
501 Hz Decay Curve
-20log10(R) + 205; R2 = 0.96
-46log10(R) + 244; R2 = 0.95
6log10(R) + 133; R2 = 0.22
1000 Hz Decay Curve
-28log10(R) + 235; R2 = 0.99
-33log10(R) + 235; R2 = 0.99
-28log10(R) + 208; R2 = 0.98
1995 Hz Decay Curve
-25log10(R) + 232; R2 = 1
-26log10(R) + 222; R2 = 1
-24log10(R) + 201; R2 = 1
3981 Hz Decay Curve
-20log10(R) + 219; R2 = 1
-20log10(R) + 206; R2 = 0.99
-19log10(R) + 187; R2 = 0.99
7943 Hz Decay Curve
-20log10(R) + 217; R2 = 0.99
-21log10(R) + 206; R2 = 1
-20log10(R) + 186; R2 = 0.99
15849 Hz Decay Curve
-20log10(R) + 214; R2 = 0.94
-26log10(R) + 212; R2 = 1
-18log10(R) + 180; R2 = 0.9
SPL(dB)
Range (m)

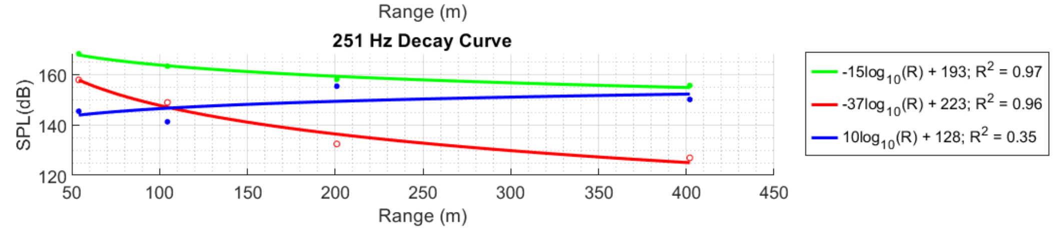
HF - 25

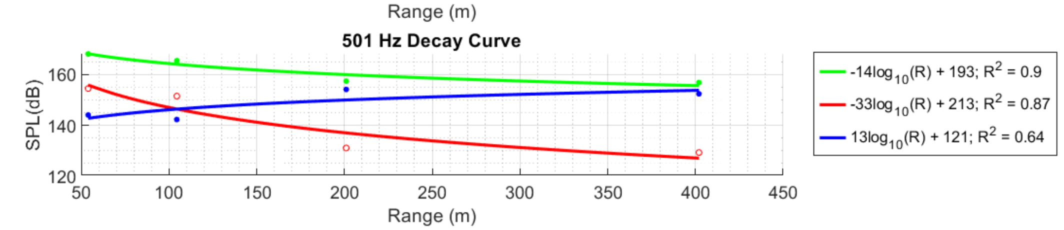

16 Hz Decay Curve
SPL(dB)
Range (m)
-31log$_{10}$(R) + 199; R^2 = 0.93
-28log$_{10}$(R) + 177; R^2 = 0.91
-28log$_{10}$(R) + 201; R^2 = 0.92

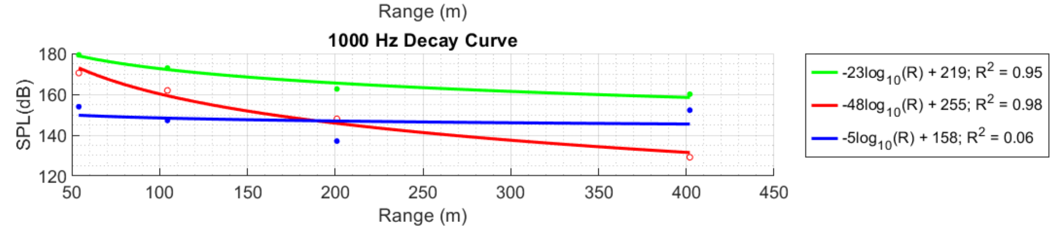

32 Hz Decay Curve
SPL(dB)
Range (m)
-15log$_{10}$(R) + 169; R^2 = 0.65
-14log$_{10}$(R) + 152; R^2 = 0.77
-15log$_{10}$(R) + 174; R^2 = 0.77

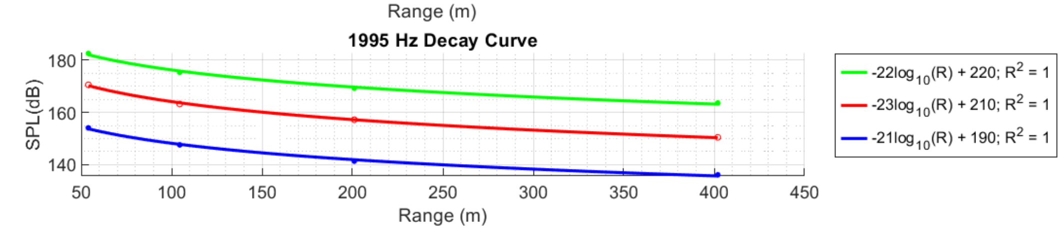

63 Hz Decay Curve
SPL(dB)
Range (m)
-23log$_{10}$(R) + 199; R^2 = 0.87
-19log$_{10}$(R) + 168; R^2 = 0.83
-19log$_{10}$(R) + 192; R^2 = 0.84

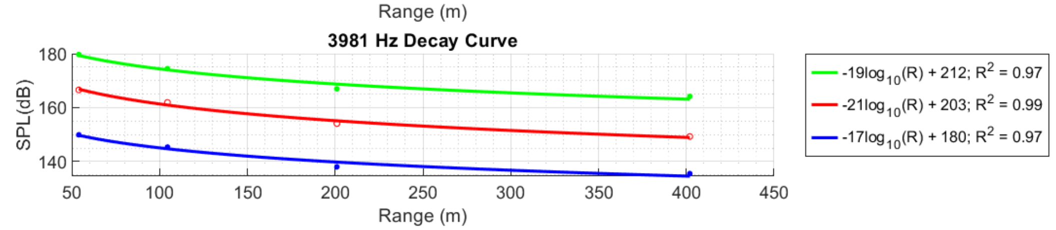

126 Hz Decay Curve
SPL(dB)
Range (m)
-27log$_{10}$(R) + 217; R^2 = 0.94
-46log$_{10}$(R) + 239; R^2 = 0.99
-2log$_{10}$(R) + 151; R^2 = 0.01

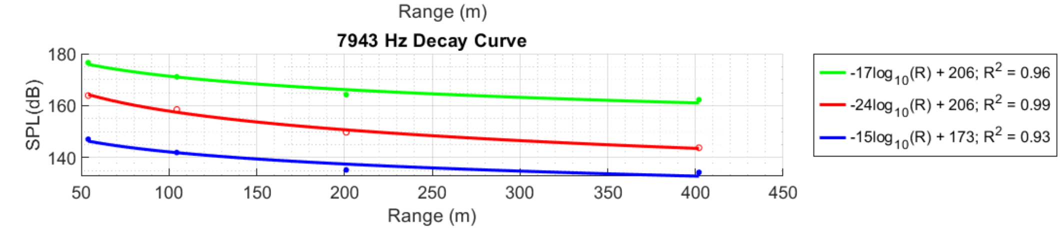

251 Hz Decay Curve
SPL(dB)
Range (m)
-15log$_{10}$(R) + 193; R^2 = 0.97
-37log$_{10}$(R) + 223; R^2 = 0.96
10log$_{10}$(R) + 128; R^2 = 0.35

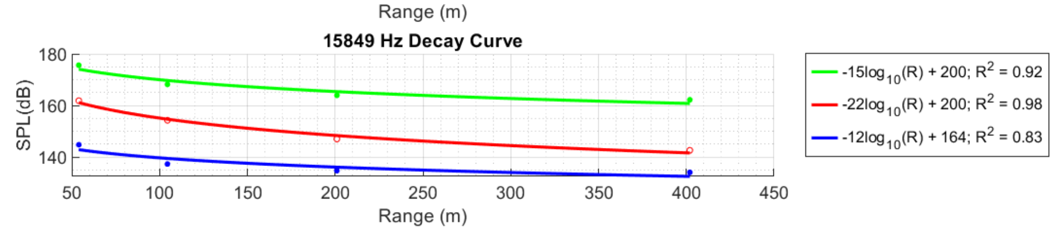

501 Hz Decay Curve
SPL(dB)
Range (m)
-14log$_{10}$(R) + 193; R^2 = 0.9
-33log$_{10}$(R) + 213; R^2 = 0.87
13log$_{10}$(R) + 121; R^2 = 0.64


1000 Hz Decay Curve
SPL(dB)
Range (m)
-23log$_{10}$(R) + 219; R^2 = 0.95
-48log$_{10}$(R) + 255; R^2 = 0.98
-5log$_{10}$(R) + 158; R^2 = 0.06

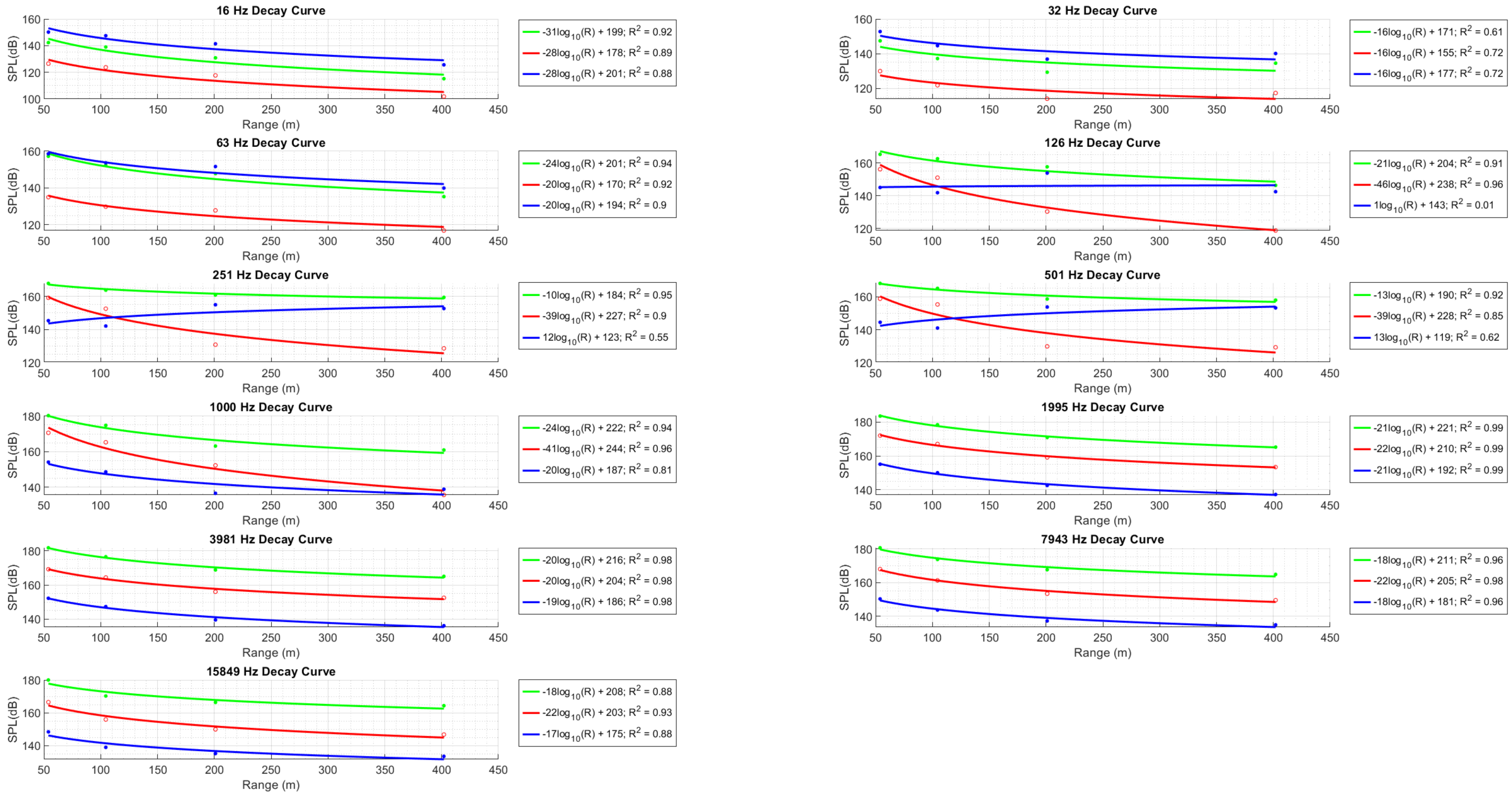

1995 Hz Decay Curve
SPL(dB)
Range (m)
-22log$_{10}$(R) + 220; R^2 = 1
-23log$_{10}$(R) + 210; R^2 = 1
-21log$_{10}$(R) + 190; R^2 = 1


3981 Hz Decay Curve
SPL(dB)
Range (m)
-19log$_{10}$(R) + 212; R^2 = 0.97
-21log$_{10}$(R) + 203; R^2 = 0.99
-17log$_{10}$(R) + 180; R^2 = 0.97

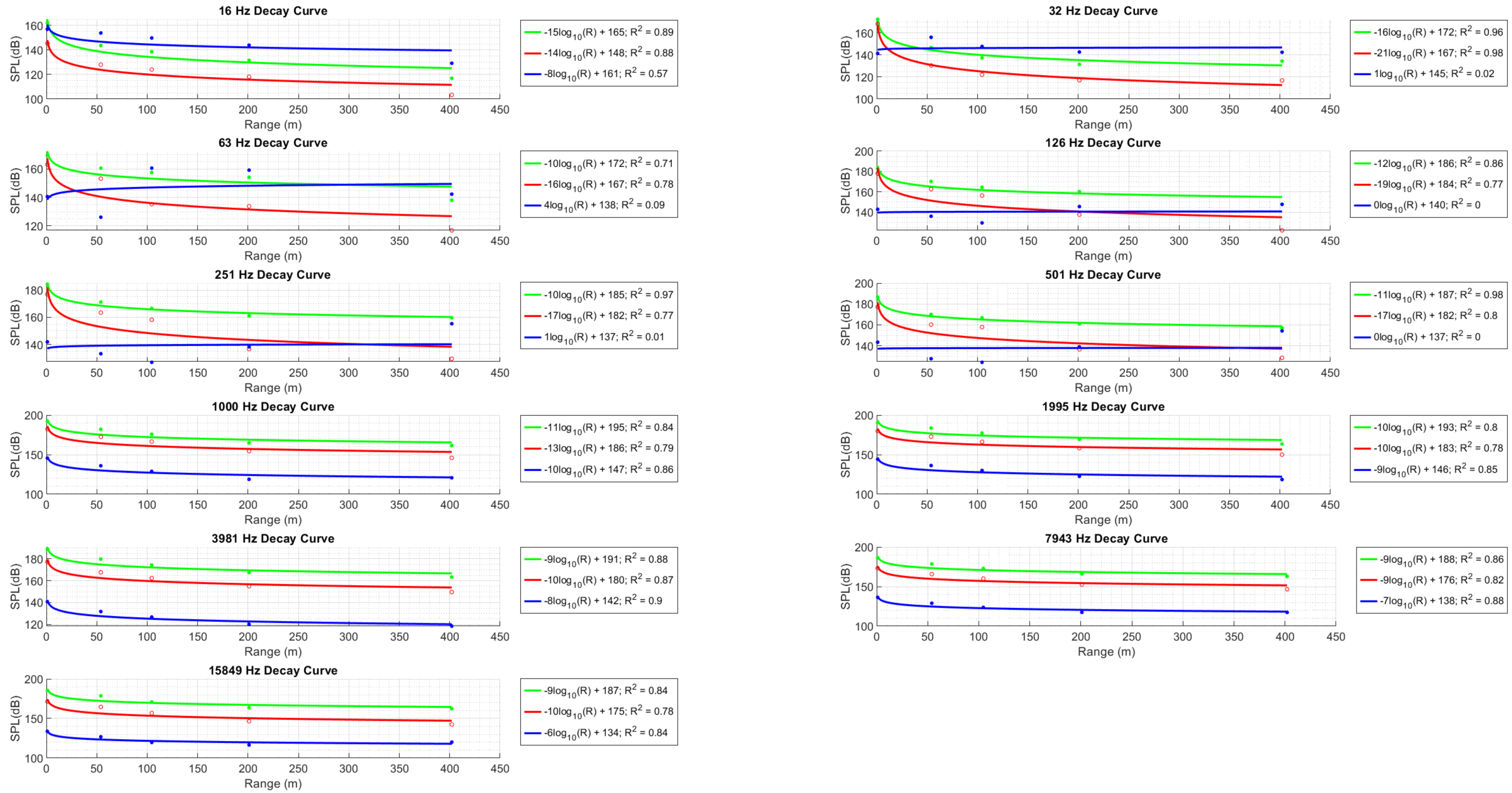

7943 Hz Decay Curve
SPL(dB)
Range (m)
-17log$_{10}$(R) + 206; R^2 = 0.96
-24log$_{10}$(R) + 206; R^2 = 0.99
-15log$_{10}$(R) + 173; R^2 = 0.93


15849 Hz Decay Curve
SPL(dB)
Range (m)
-15log$_{10}$(R) + 200; R^2 = 0.92
-22log$_{10}$(R) + 200; R^2 = 0.98
-12log$_{10}$(R) + 164; R^2 = 0.83

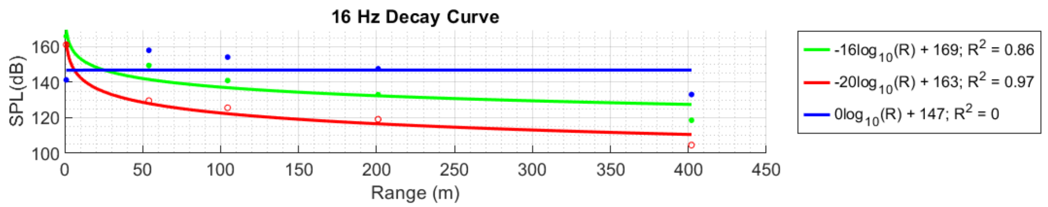
HF - 26

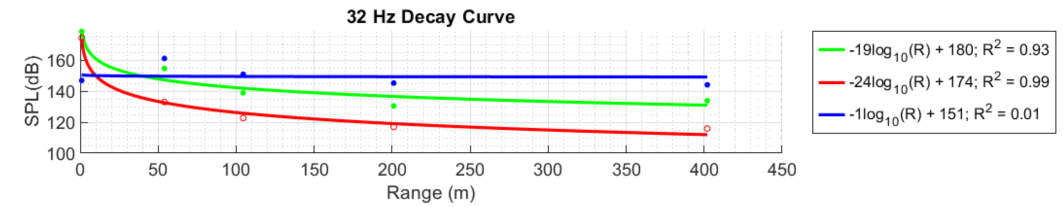

16 Hz Decay Curve
-31log10(R) + 199; R2 = 0.92
-28log10(R) + 178; R2 = 0.89
-28log10(R) + 201; R2 = 0.88
32 Hz Decay Curve
-16log10(R) + 171; R2 = 0.61
-16log10(R) + 155; R2 = 0.72
-16log10(R) + 177; R2 = 0.72
63 Hz Decay Curve
-24log10(R) + 201; R2 = 0.94
-20log10(R) + 170; R2 = 0.92
-20log10(R) + 194; R2 = 0.9
126 Hz Decay Curve
-21log10(R) + 204; R2 = 0.91
-46log10(R) + 238; R2 = 0.96
1log10(R) + 143; R2 = 0.01
251 Hz Decay Curve
-10log10(R) + 184; R2 = 0.95
-39log10(R) + 227; R2 = 0.9
12log10(R) + 123; R2 = 0.55
501 Hz Decay Curve
-13log10(R) + 190; R2 = 0.92
-39log10(R) + 228; R2 = 0.85
13log10(R) + 119; R2 = 0.62
1000 Hz Decay Curve
-24log10(R) + 222; R2 = 0.94
-41log10(R) + 244; R2 = 0.96
-20log10(R) + 187; R2 = 0.81
1995 Hz Decay Curve
-21log10(R) + 221; R2 = 0.99
-22log10(R) + 210; R2 = 0.99
-21log10(R) + 192; R2 = 0.99
3981 Hz Decay Curve
-20log10(R) + 216; R2 = 0.98
-20log10(R) + 204; R2 = 0.98
-19log10(R) + 186; R2 = 0.98
7943 Hz Decay Curve
-18log10(R) + 211; R2 = 0.96
-22log10(R) + 205; R2 = 0.98
-18log10(R) + 181; R2 = 0.96
15849 Hz Decay Curve
-18log10(R) + 208; R2 = 0.88
-22log10(R) + 203; R2 = 0.93
-17log10(R) + 175; R2 = 0.88
SPL(dB)
Range (m)

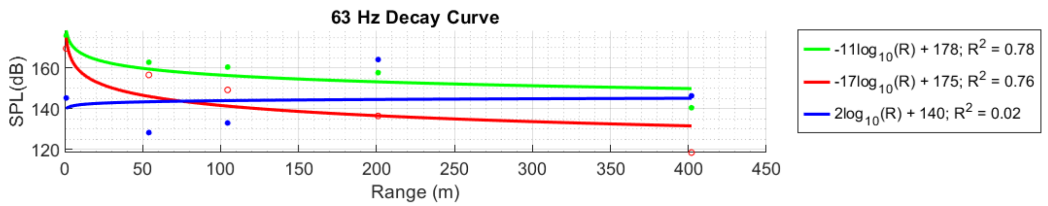
HF - 27

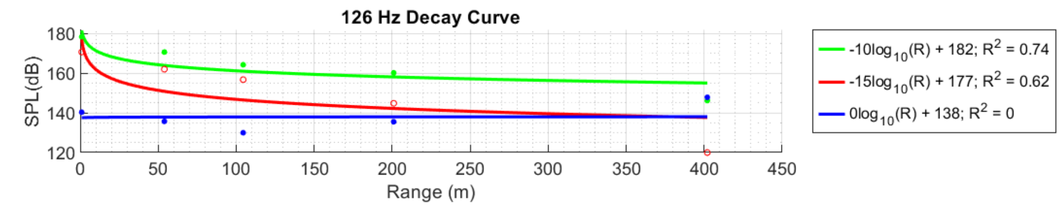


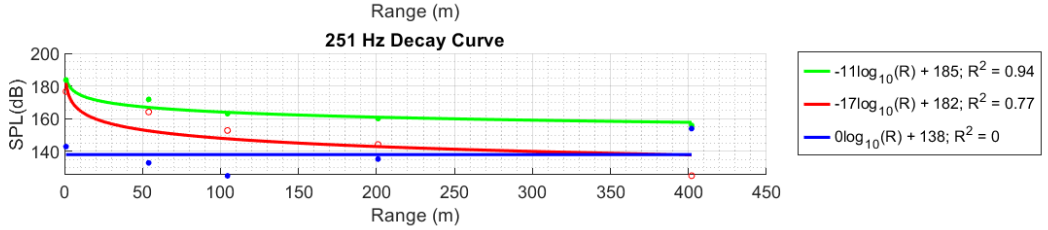
16 Hz Decay Curve
$-15\log_{10}(R) + 165$; $R^2 = 0.89$
$-14\log_{10}(R) + 148$; $R^2 = 0.88$
$-8\log_{10}(R) + 161$; $R^2 = 0.57$
32 Hz Decay Curve
$-16\log_{10}(R) + 172$; $R^2 = 0.96$
$-21\log_{10}(R) + 167$; $R^2 = 0.98$
$1\log_{10}(R) + 145$; $R^2 = 0.02$
63 Hz Decay Curve
$-10\log_{10}(R) + 172$; $R^2 = 0.71$
$-16\log_{10}(R) + 167$; $R^2 = 0.78$
$4\log_{10}(R) + 138$; $R^2 = 0.09$
126 Hz Decay Curve
$-12\log_{10}(R) + 186$; $R^2 = 0.86$
$-19\log_{10}(R) + 184$; $R^2 = 0.77$
$0\log_{10}(R) + 140$; $R^2 = 0$
251 Hz Decay Curve
$-10\log_{10}(R) + 185$; $R^2 = 0.97$
$-17\log_{10}(R) + 182$; $R^2 = 0.77$
$1\log_{10}(R) + 137$; $R^2 = 0.01$
501 Hz Decay Curve
$-11\log_{10}(R) + 187$; $R^2 = 0.98$
$-17\log_{10}(R) + 182$; $R^2 = 0.8$
$0\log_{10}(R) + 137$; $R^2 = 0$
1000 Hz Decay Curve
$-11\log_{10}(R) + 195$; $R^2 = 0.84$
$-13\log_{10}(R) + 186$; $R^2 = 0.79$
$-10\log_{10}(R) + 147$; $R^2 = 0.86$
1995 Hz Decay Curve
$-10\log_{10}(R) + 193$; $R^2 = 0.8$
$-10\log_{10}(R) + 183$; $R^2 = 0.78$
$-9\log_{10}(R) + 146$; $R^2 = 0.85$
3981 Hz Decay Curve
$-9\log_{10}(R) + 191$; $R^2 = 0.88$
$-10\log_{10}(R) + 180$; $R^2 = 0.87$
$-8\log_{10}(R) + 142$; $R^2 = 0.9$
7943 Hz Decay Curve
$-9\log_{10}(R) + 188$; $R^2 = 0.86$
$-9\log_{10}(R) + 176$; $R^2 = 0.82$
$-7\log_{10}(R) + 138$; $R^2 = 0.88$
15849 Hz Decay Curve
$-9\log_{10}(R) + 187$; $R^2 = 0.84$
$-10\log_{10}(R) + 175$; $R^2 = 0.78$
$-6\log_{10}(R) + 134$; $R^2 = 0.84$
SPL(dB)
Range (m)

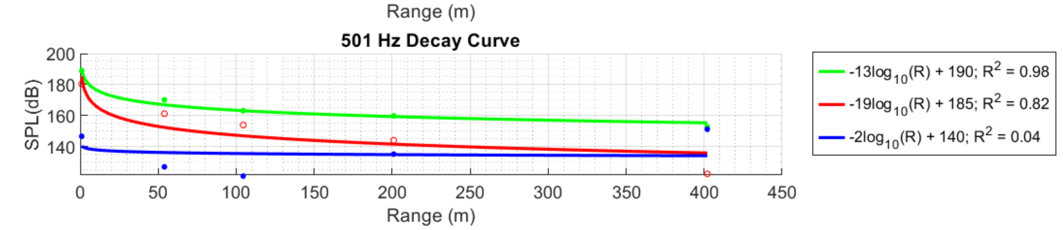

16 Hz Decay Curve
SPL(dB)
Range (m)
-16log10(R) + 169; R2 = 0.86
-20log10(R) + 163; R2 = 0.97
0log10(R) + 147; R2 = 0

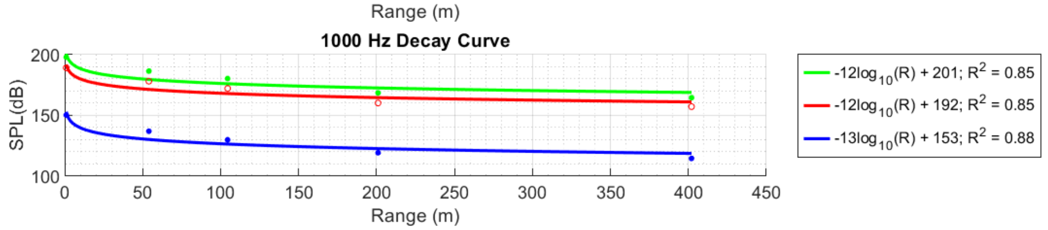

32 Hz Decay Curve
SPL(dB)
Range (m)
-19log10(R) + 180; R2 = 0.93
-24log10(R) + 174; R2 = 0.99
-1log10(R) + 151; R2 = 0.01

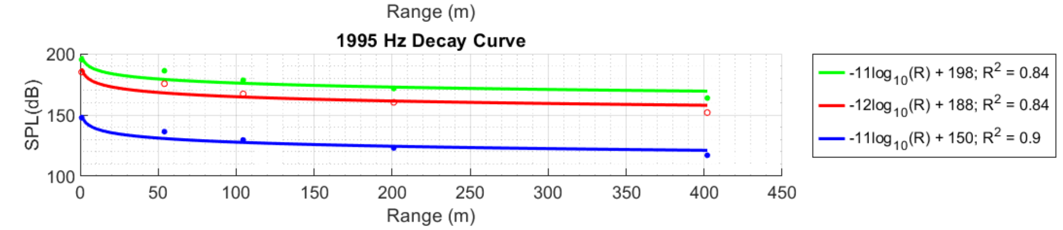

63 Hz Decay Curve
SPL(dB)
Range (m)
-11log10(R) + 178; R2 = 0.78
-17log10(R) + 175; R2 = 0.76
2log10(R) + 140; R2 = 0.02

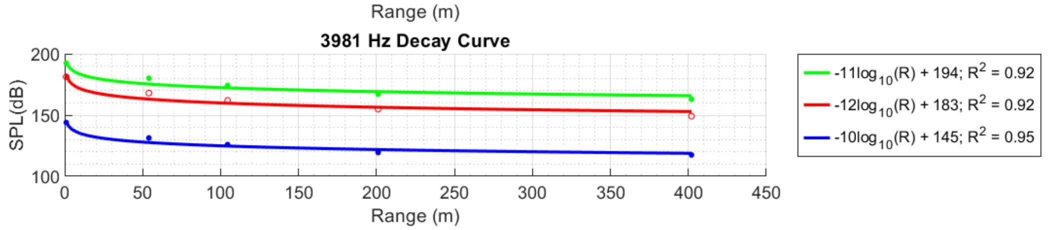

126 Hz Decay Curve
SPL(dB)
Range (m)
-10log10(R) + 182; R2 = 0.74
-15log10(R) + 177; R2 = 0.62
0log10(R) + 138; R2 = 0

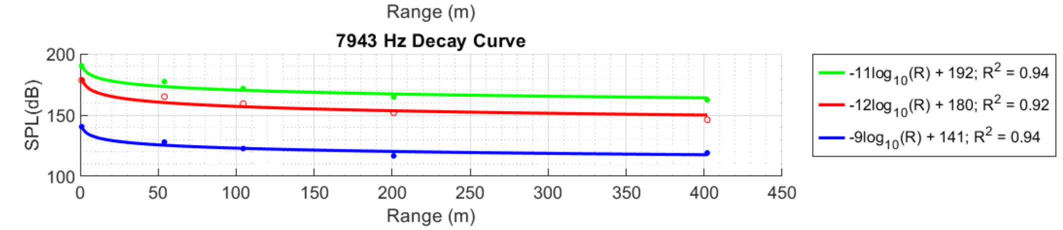

251 Hz Decay Curve
SPL(dB)
Range (m)
-11log10(R) + 185; R2 = 0.94
-17log10(R) + 182; R2 = 0.77
0log10(R) + 138; R2 = 0

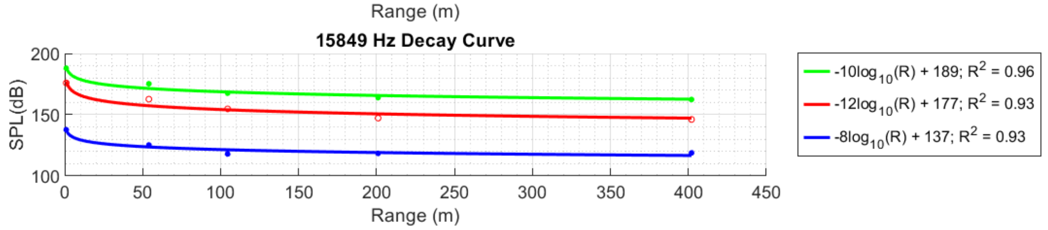

501 Hz Decay Curve
SPL(dB)
Range (m)
-13log10(R) + 190; R2 = 0.98
-19log10(R) + 185; R2 = 0.82
-2log10(R) + 140; R2 = 0.04


1000 Hz Decay Curve
SPL(dB)
Range (m)
-12log10(R) + 201; R2 = 0.85
-12log10(R) + 192; R2 = 0.85
-13log10(R) + 153; R2 = 0.88

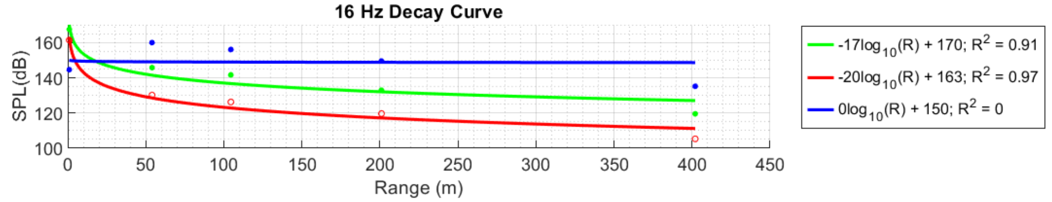

1995 Hz Decay Curve
SPL(dB)
Range (m)
-11log10(R) + 198; R2 = 0.84
-12log10(R) + 188; R2 = 0.84
-11log10(R) + 150; R2 = 0.9


3981 Hz Decay Curve
SPL(dB)
Range (m)
-11log10(R) + 194; R2 = 0.92
-12log10(R) + 183; R2 = 0.92
-10log10(R) + 145; R2 = 0.95

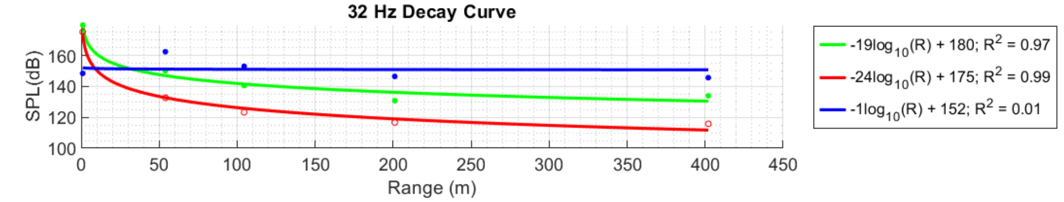

7943 Hz Decay Curve
SPL(dB)
Range (m)
-11log10(R) + 192; R2 = 0.94
-12log10(R) + 180; R2 = 0.92
-9log10(R) + 141; R2 = 0.94


15849 Hz Decay Curve
SPL(dB)
Range (m)
-10log10(R) + 189; R2 = 0.96
-12log10(R) + 177; R2 = 0.93
-8log10(R) + 137; R2 = 0.93

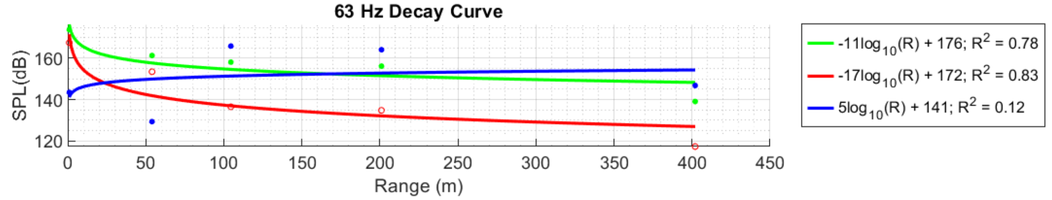
16 Hz Decay Curve



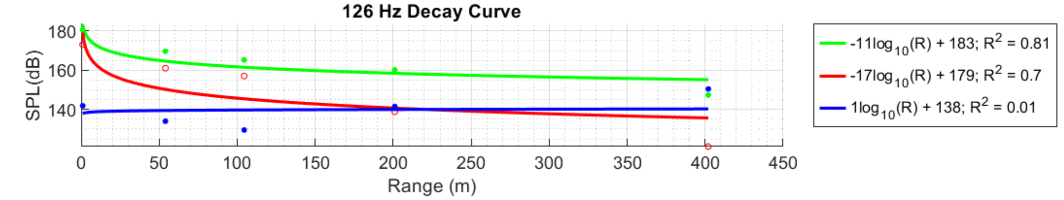
32 Hz Decay Curve



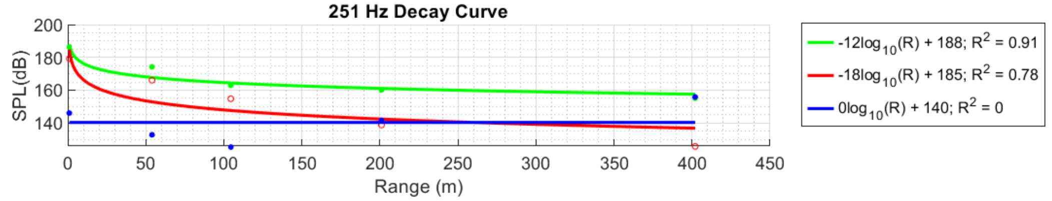
63 Hz Decay Curve



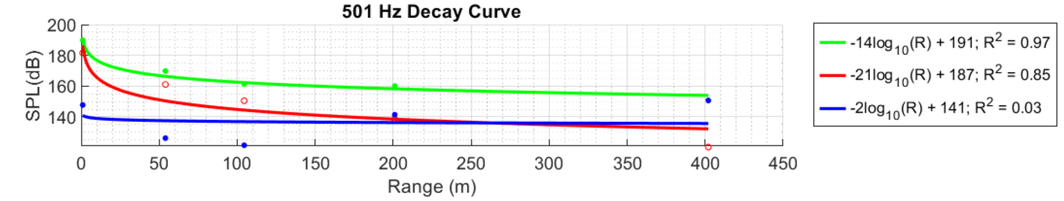
126 Hz Decay Curve



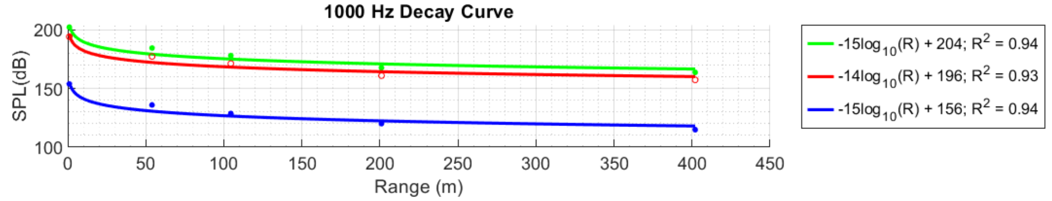
251 Hz Decay Curve



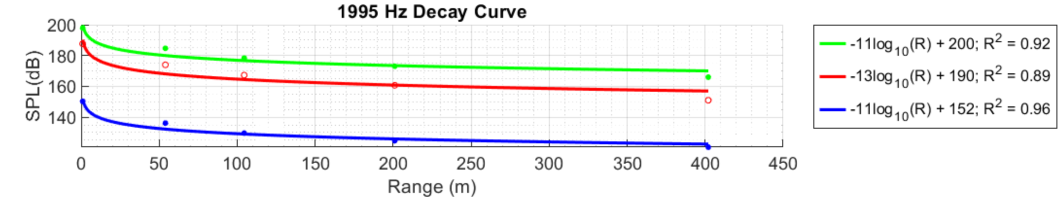
501 Hz Decay Curve



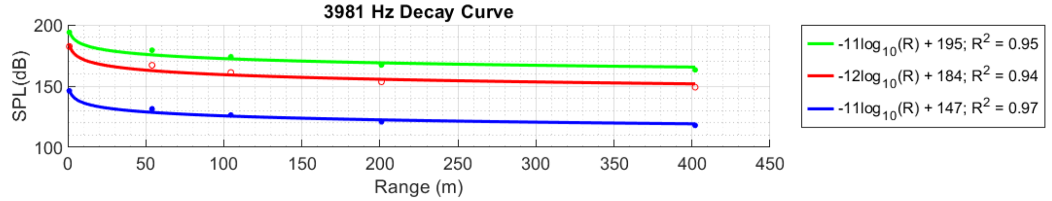
1000 Hz Decay Curve



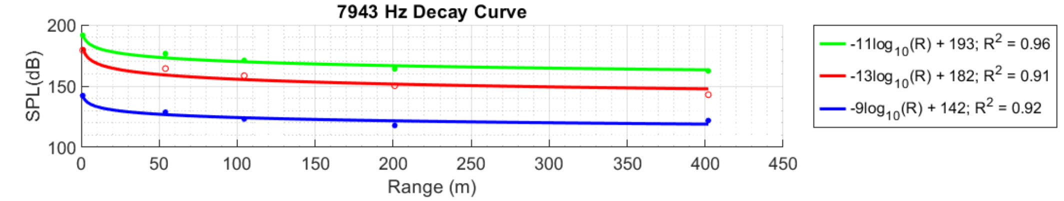
1995 Hz Decay Curve



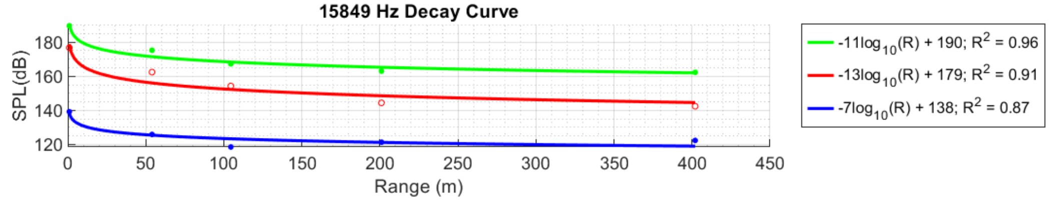
3981 Hz Decay Curve



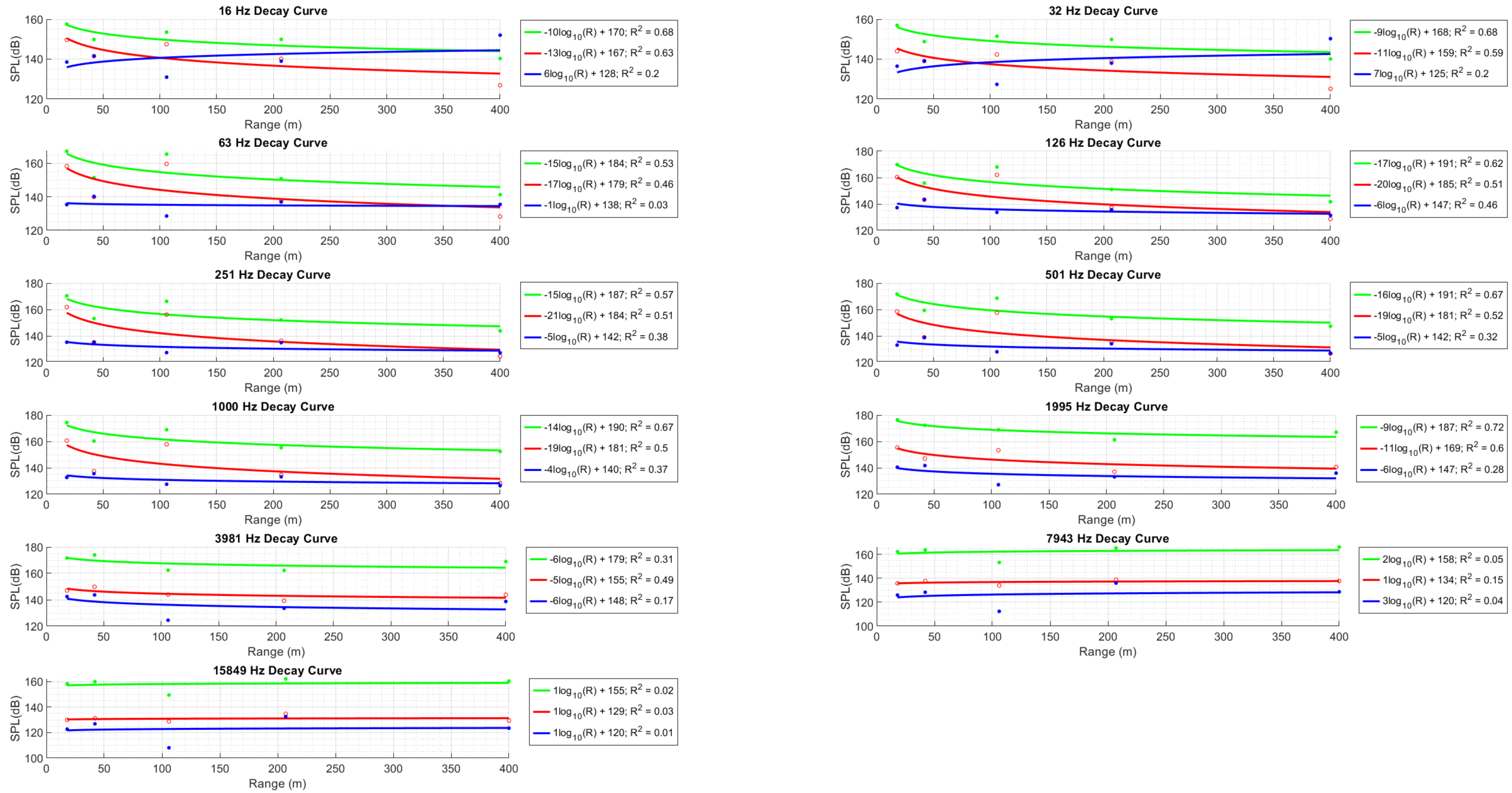
7943 Hz Decay Curve



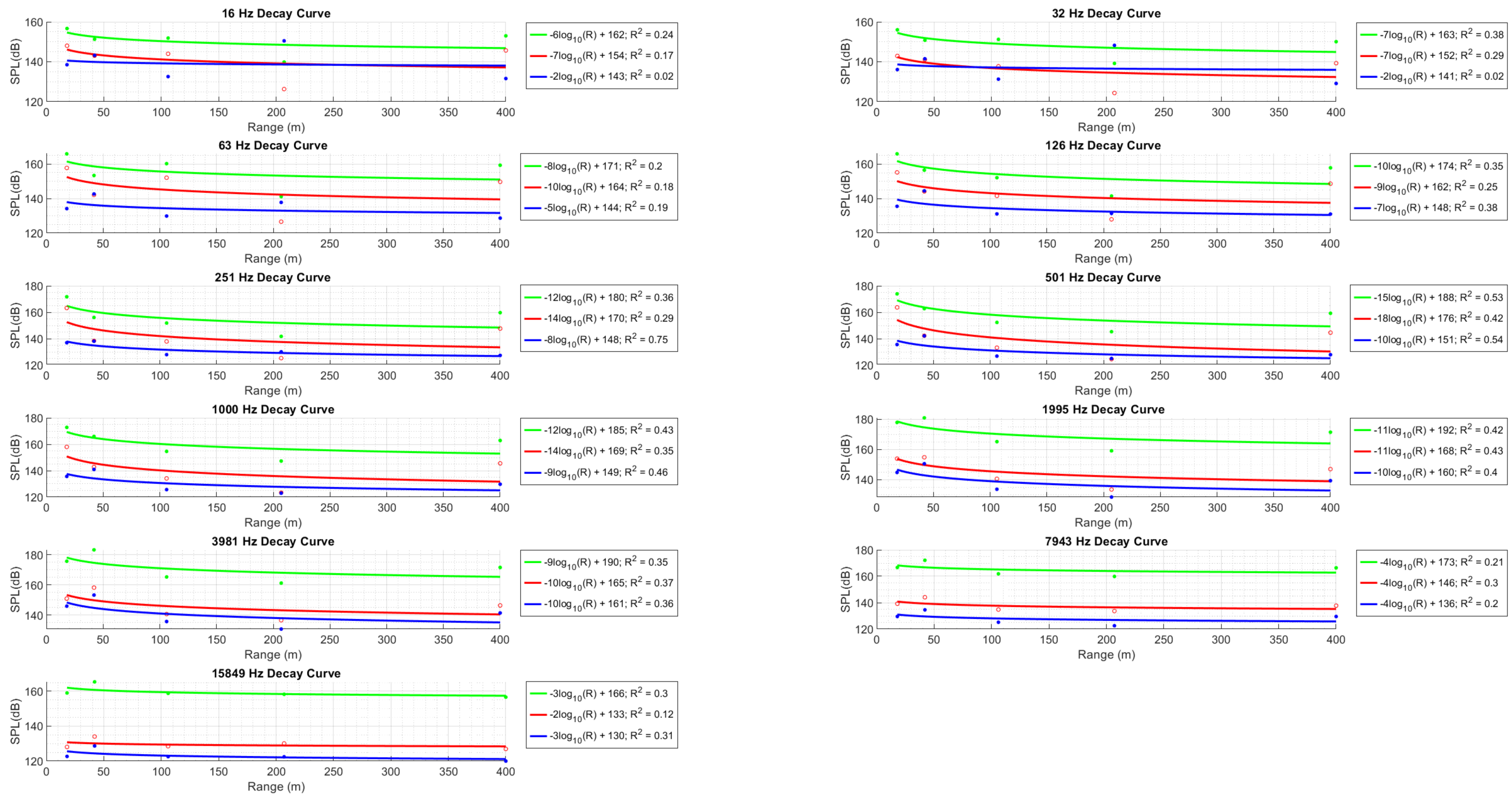
15849 Hz Decay Curve



HF - 30

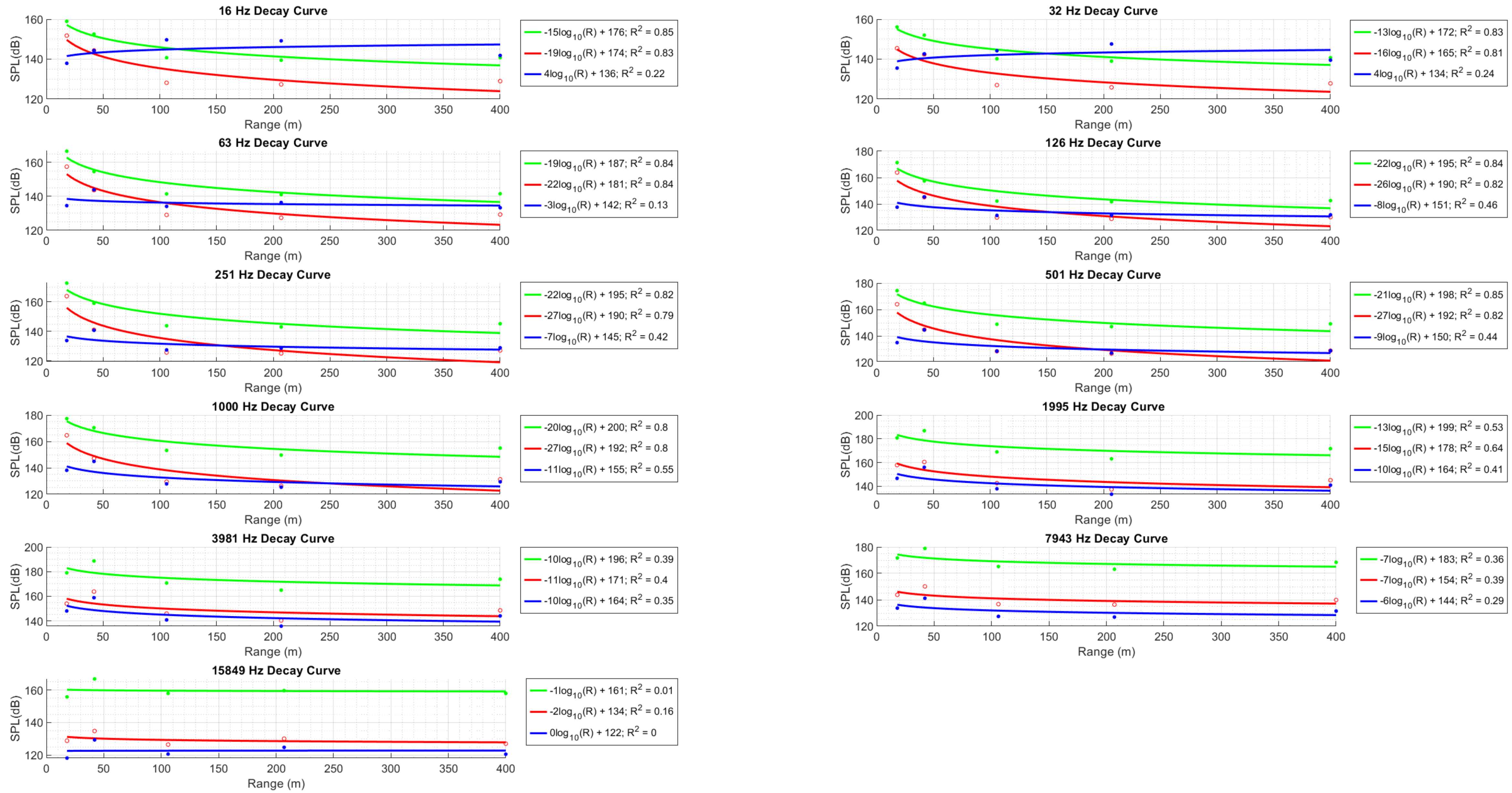

16 Hz Decay Curve
-10log10(R) + 170; R2 = 0.68
-13log10(R) + 167; R2 = 0.63
6log10(R) + 128; R2 = 0.2
32 Hz Decay Curve
-9log10(R) + 168; R2 = 0.68
-11log10(R) + 159; R2 = 0.59
7log10(R) + 125; R2 = 0.2
63 Hz Decay Curve
-15log10(R) + 184; R2 = 0.53
-17log10(R) + 179; R2 = 0.46
-1log10(R) + 138; R2 = 0.03
126 Hz Decay Curve
-17log10(R) + 191; R2 = 0.62
-20log10(R) + 185; R2 = 0.51
-6log10(R) + 147; R2 = 0.46
251 Hz Decay Curve
-15log10(R) + 187; R2 = 0.57
-21log10(R) + 184; R2 = 0.51
-5log10(R) + 142; R2 = 0.38
501 Hz Decay Curve
-16log10(R) + 191; R2 = 0.67
-19log10(R) + 181; R2 = 0.52
-5log10(R) + 142; R2 = 0.32
1000 Hz Decay Curve
-14log10(R) + 190; R2 = 0.67
-19log10(R) + 181; R2 = 0.5
-4log10(R) + 140; R2 = 0.37
1995 Hz Decay Curve
-9log10(R) + 187; R2 = 0.72
-11log10(R) + 169; R2 = 0.6
-6log10(R) + 147; R2 = 0.28
3981 Hz Decay Curve
-6log10(R) + 179; R2 = 0.31
-5log10(R) + 155; R2 = 0.49
-6log10(R) + 148; R2 = 0.17
7943 Hz Decay Curve
2log10(R) + 158; R2 = 0.05
1log10(R) + 134; R2 = 0.15
3log10(R) + 120; R2 = 0.04
15849 Hz Decay Curve
1log10(R) + 155; R2 = 0.02
1log10(R) + 129; R2 = 0.03
1log10(R) + 120; R2 = 0.01
SPL(dB)
Range (m)

HF - 31

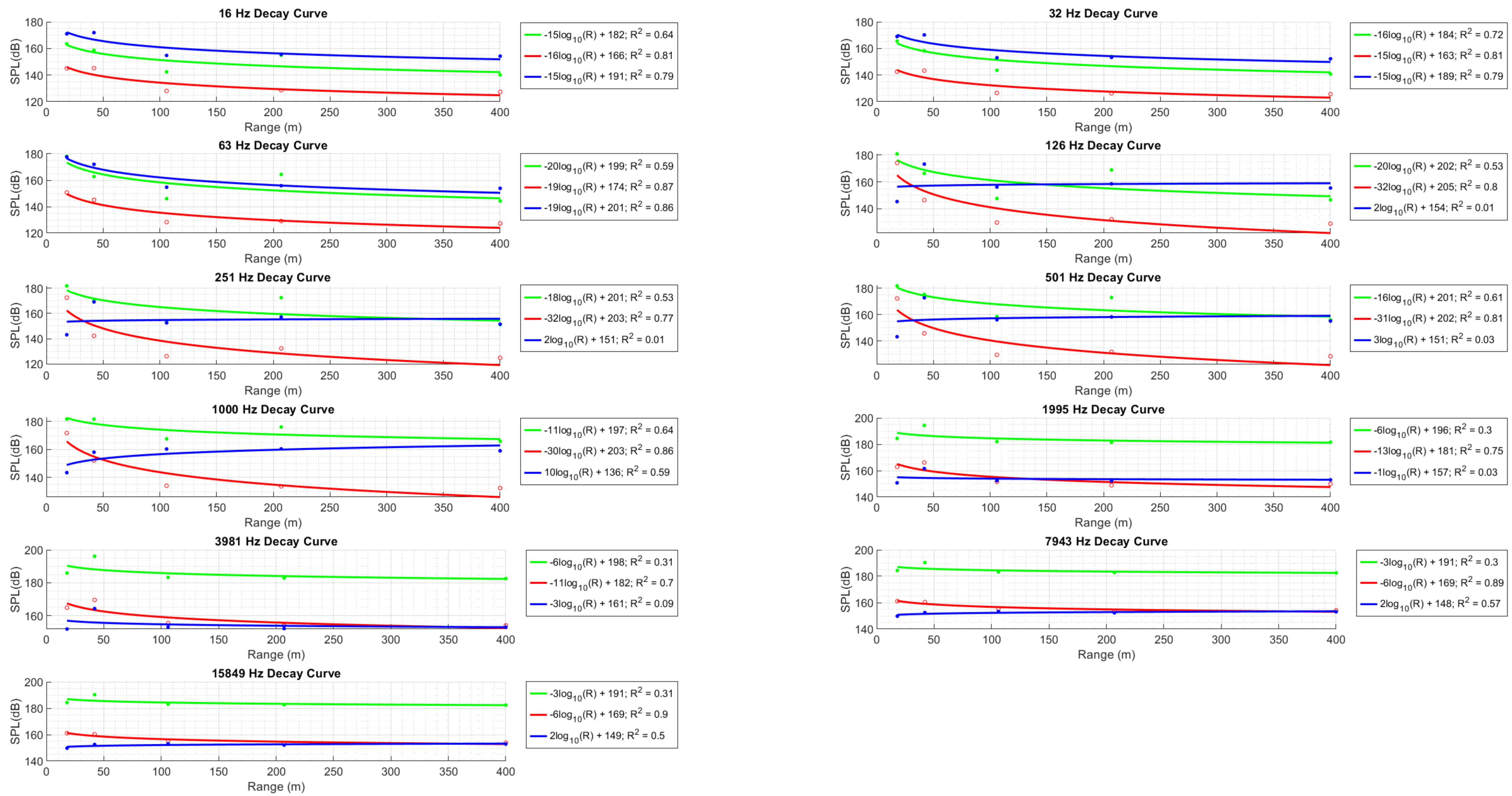


16 Hz Decay Curve
-6log10(R) + 162; R2 = 0.24
-7log10(R) + 154; R2 = 0.17
-2log10(R) + 143; R2 = 0.02
32 Hz Decay Curve
-7log10(R) + 163; R2 = 0.38
-7log10(R) + 152; R2 = 0.29
-2log10(R) + 141; R2 = 0.02
63 Hz Decay Curve
-8log10(R) + 171; R2 = 0.2
-10log10(R) + 164; R2 = 0.18
-5log10(R) + 144; R2 = 0.19
126 Hz Decay Curve
-10log10(R) + 174; R2 = 0.35
-9log10(R) + 162; R2 = 0.25
-7log10(R) + 148; R2 = 0.38
251 Hz Decay Curve
-12log10(R) + 180; R2 = 0.36
-14log10(R) + 170; R2 = 0.29
-8log10(R) + 148; R2 = 0.75
501 Hz Decay Curve
-15log10(R) + 188; R2 = 0.53
-18log10(R) + 176; R2 = 0.42
-10log10(R) + 151; R2 = 0.54
1000 Hz Decay Curve
-12log10(R) + 185; R2 = 0.43
-14log10(R) + 169; R2 = 0.35
-9log10(R) + 149; R2 = 0.46
1995 Hz Decay Curve
-11log10(R) + 192; R2 = 0.42
-11log10(R) + 168; R2 = 0.43
-10log10(R) + 160; R2 = 0.4
3981 Hz Decay Curve
-9log10(R) + 190; R2 = 0.35
-10log10(R) + 165; R2 = 0.37
-10log10(R) + 161; R2 = 0.36
7943 Hz Decay Curve
-4log10(R) + 173; R2 = 0.21
-4log10(R) + 146; R2 = 0.3
-4log10(R) + 136; R2 = 0.2
15849 Hz Decay Curve
-3log10(R) + 166; R2 = 0.3
-2log10(R) + 133; R2 = 0.12
-3log10(R) + 130; R2 = 0.31
SPL(dB)
Range (m)

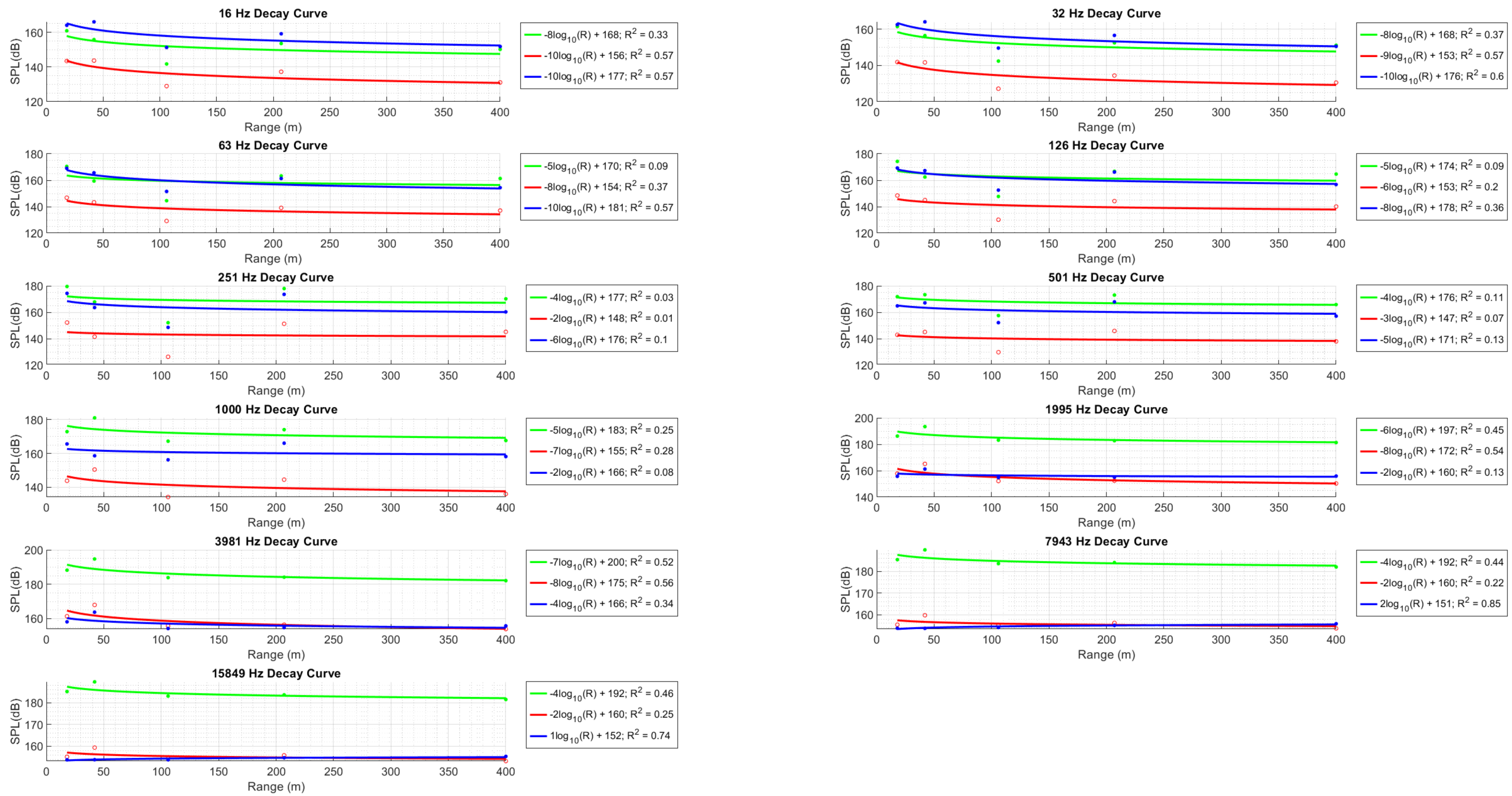
HF - 32


16 Hz Decay Curve
$-15\log_{10}(R) + 176$; $R^2 = 0.85$
$-19\log_{10}(R) + 174$; $R^2 = 0.83$
$4\log_{10}(R) + 136$; $R^2 = 0.22$
32 Hz Decay Curve
$-13\log_{10}(R) + 172$; $R^2 = 0.83$
$-16\log_{10}(R) + 165$; $R^2 = 0.81$
$4\log_{10}(R) + 134$; $R^2 = 0.24$
63 Hz Decay Curve
$-19\log_{10}(R) + 187$; $R^2 = 0.84$
$-22\log_{10}(R) + 181$; $R^2 = 0.84$
$-3\log_{10}(R) + 142$; $R^2 = 0.13$
126 Hz Decay Curve
$-22\log_{10}(R) + 195$; $R^2 = 0.84$
$-26\log_{10}(R) + 190$; $R^2 = 0.82$
$-8\log_{10}(R) + 151$; $R^2 = 0.46$
251 Hz Decay Curve
$-22\log_{10}(R) + 195$; $R^2 = 0.82$
$-27\log_{10}(R) + 190$; $R^2 = 0.79$
$-7\log_{10}(R) + 145$; $R^2 = 0.42$
501 Hz Decay Curve
$-21\log_{10}(R) + 198$; $R^2 = 0.85$
$-27\log_{10}(R) + 192$; $R^2 = 0.82$
$-9\log_{10}(R) + 150$; $R^2 = 0.44$
1000 Hz Decay Curve
$-20\log_{10}(R) + 200$; $R^2 = 0.8$
$-27\log_{10}(R) + 192$; $R^2 = 0.8$
$-11\log_{10}(R) + 155$; $R^2 = 0.55$
1995 Hz Decay Curve
$-13\log_{10}(R) + 199$; $R^2 = 0.53$
$-15\log_{10}(R) + 178$; $R^2 = 0.64$
$-10\log_{10}(R) + 164$; $R^2 = 0.41$
3981 Hz Decay Curve
$-10\log_{10}(R) + 196$; $R^2 = 0.39$
$-11\log_{10}(R) + 171$; $R^2 = 0.4$
$-10\log_{10}(R) + 164$; $R^2 = 0.35$
7943 Hz Decay Curve
$-7\log_{10}(R) + 183$; $R^2 = 0.36$
$-7\log_{10}(R) + 154$; $R^2 = 0.39$
$-6\log_{10}(R) + 144$; $R^2 = 0.29$
15849 Hz Decay Curve
$-1\log_{10}(R) + 161$; $R^2 = 0.01$
$-2\log_{10}(R) + 134$; $R^2 = 0.16$
$0\log_{10}(R) + 122$; $R^2 = 0$
SPL(dB)
Range (m)

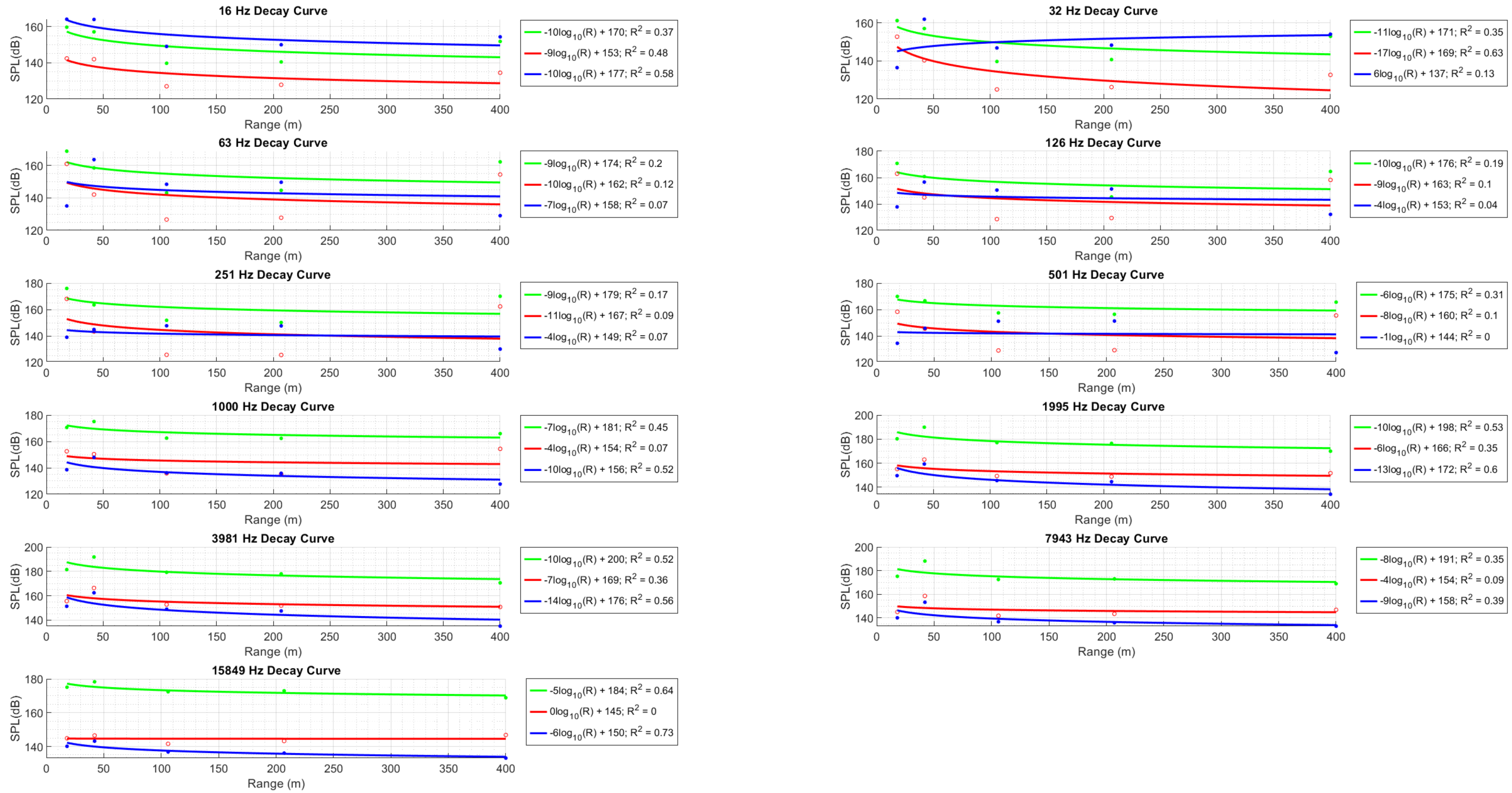
HF - 33


16 Hz Decay Curve
-15log10(R) + 182; R2 = 0.64
-16log10(R) + 166; R2 = 0.81
-15log10(R) + 191; R2 = 0.79
32 Hz Decay Curve
-16log10(R) + 184; R2 = 0.72
-15log10(R) + 163; R2 = 0.81
-15log10(R) + 189; R2 = 0.79
63 Hz Decay Curve
-20log10(R) + 199; R2 = 0.59
-19log10(R) + 174; R2 = 0.87
-19log10(R) + 201; R2 = 0.86
126 Hz Decay Curve
-20log10(R) + 202; R2 = 0.53
-32log10(R) + 205; R2 = 0.8
2log10(R) + 154; R2 = 0.01
251 Hz Decay Curve
-18log10(R) + 201; R2 = 0.53
-32log10(R) + 203; R2 = 0.77
2log10(R) + 151; R2 = 0.01
501 Hz Decay Curve
-16log10(R) + 201; R2 = 0.61
-31log10(R) + 202; R2 = 0.81
3log10(R) + 151; R2 = 0.03
1000 Hz Decay Curve
-11log10(R) + 197; R2 = 0.64
-30log10(R) + 203; R2 = 0.86
10log10(R) + 136; R2 = 0.59
1995 Hz Decay Curve
-6log10(R) + 196; R2 = 0.3
-13log10(R) + 181; R2 = 0.75
-1log10(R) + 157; R2 = 0.03
3981 Hz Decay Curve
-6log10(R) + 198; R2 = 0.31
-11log10(R) + 182; R2 = 0.7
-3log10(R) + 161; R2 = 0.09
7943 Hz Decay Curve
-3log10(R) + 191; R2 = 0.3
-6log10(R) + 169; R2 = 0.89
2log10(R) + 148; R2 = 0.57
15849 Hz Decay Curve
-3log10(R) + 191; R2 = 0.31
-6log10(R) + 169; R2 = 0.9
2log10(R) + 149; R2 = 0.5
SPL(dB)
Range (m)

HF - 34

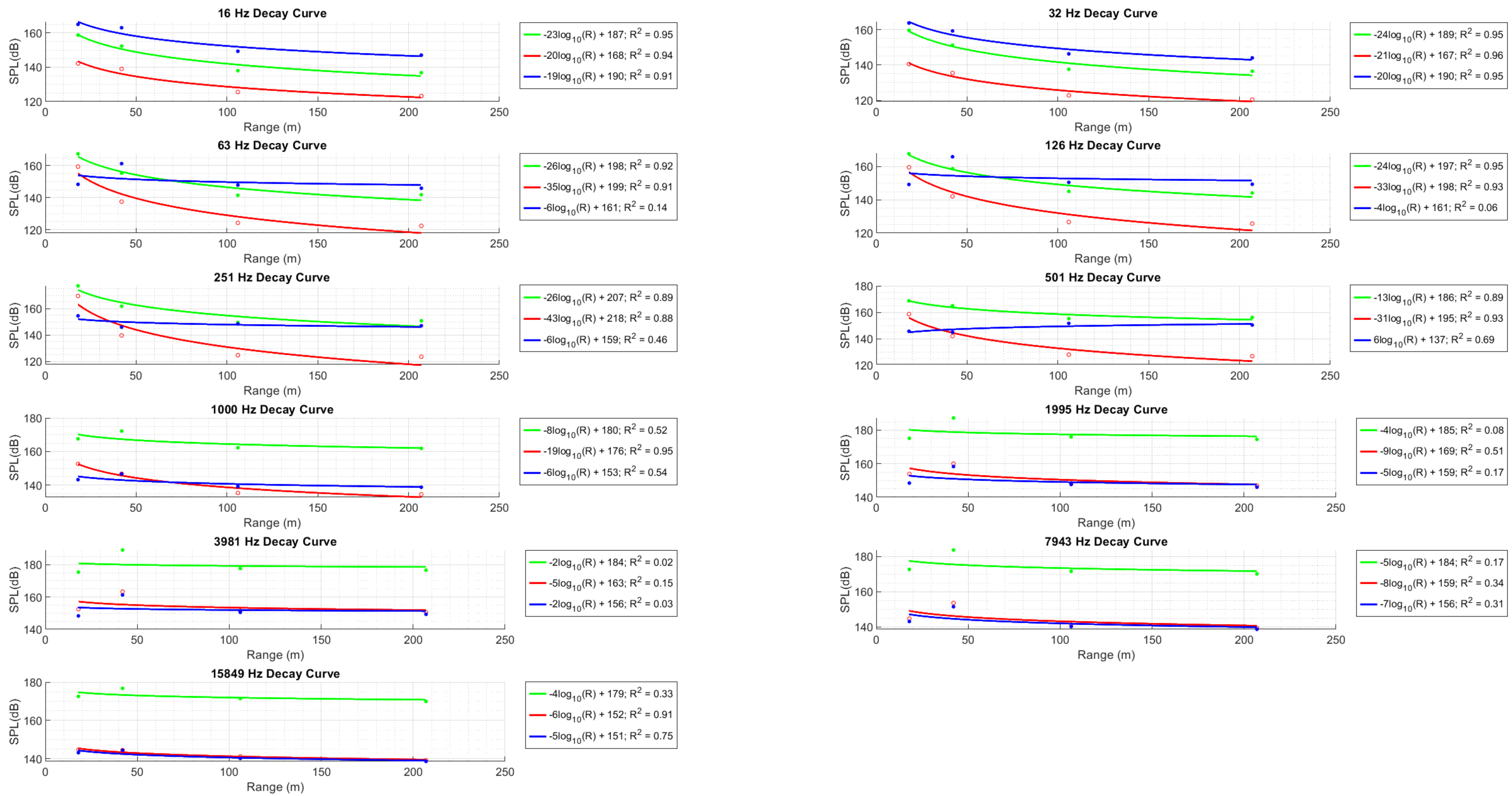

16 Hz Decay Curve
-8log10(R) + 168; R2 = 0.33
-10log10(R) + 156; R2 = 0.57
-10log10(R) + 177; R2 = 0.57
SPL(dB)
Range (m)
32 Hz Decay Curve
-8log10(R) + 168; R2 = 0.37
-9log10(R) + 153; R2 = 0.57
-10log10(R) + 176; R2 = 0.6
63 Hz Decay Curve
-5log10(R) + 170; R2 = 0.09
-8log10(R) + 154; R2 = 0.37
-10log10(R) + 181; R2 = 0.57
126 Hz Decay Curve
-5log10(R) + 174; R2 = 0.09
-6log10(R) + 153; R2 = 0.2
-8log10(R) + 178; R2 = 0.36
251 Hz Decay Curve
-4log10(R) + 177; R2 = 0.03
-2log10(R) + 148; R2 = 0.01
-6log10(R) + 176; R2 = 0.1
501 Hz Decay Curve
-4log10(R) + 176; R2 = 0.11
-3log10(R) + 147; R2 = 0.07
-5log10(R) + 171; R2 = 0.13
1000 Hz Decay Curve
-5log10(R) + 183; R2 = 0.25
-7log10(R) + 155; R2 = 0.28
-2log10(R) + 166; R2 = 0.08
1995 Hz Decay Curve
-6log10(R) + 197; R2 = 0.45
-8log10(R) + 172; R2 = 0.54
-2log10(R) + 160; R2 = 0.13
3981 Hz Decay Curve
-7log10(R) + 200; R2 = 0.52
-8log10(R) + 175; R2 = 0.56
-4log10(R) + 166; R2 = 0.34
7943 Hz Decay Curve
-4log10(R) + 192; R2 = 0.44
-2log10(R) + 160; R2 = 0.22
2log10(R) + 151; R2 = 0.85
15849 Hz Decay Curve
-4log10(R) + 192; R2 = 0.46
-2log10(R) + 160; R2 = 0.25
1log10(R) + 152; R2 = 0.74

HF - 35



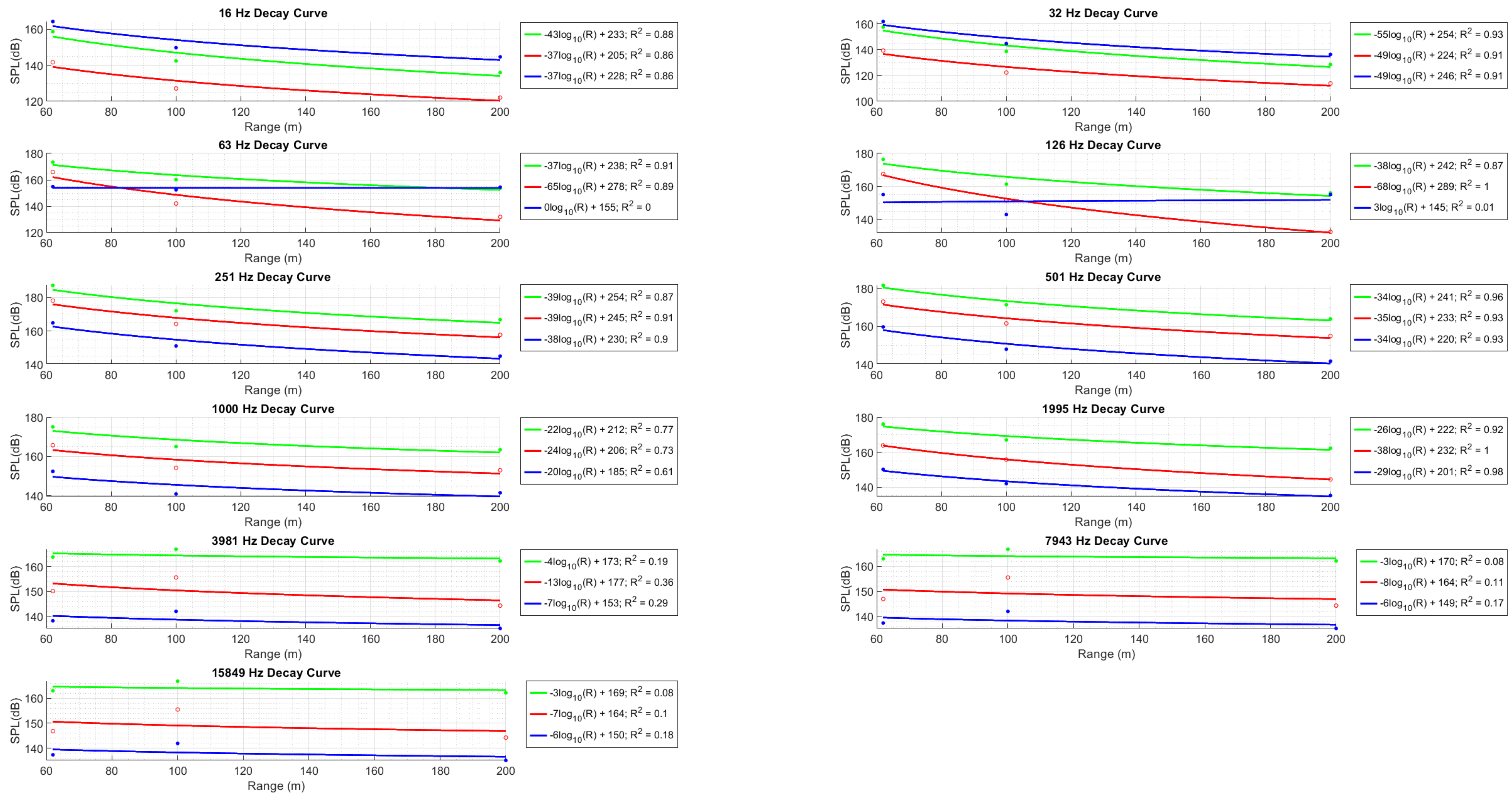
16 Hz Decay Curve
-10log10(R) + 170; R2 = 0.37
-9log10(R) + 153; R2 = 0.48
-10log10(R) + 177; R2 = 0.58
32 Hz Decay Curve
-11log10(R) + 171; R2 = 0.35
-17log10(R) + 169; R2 = 0.63
6log10(R) + 137; R2 = 0.13
63 Hz Decay Curve
-9log10(R) + 174; R2 = 0.2
-10log10(R) + 162; R2 = 0.12
-7log10(R) + 158; R2 = 0.07
126 Hz Decay Curve
-10log10(R) + 176; R2 = 0.19
-9log10(R) + 163; R2 = 0.1
-4log10(R) + 153; R2 = 0.04
251 Hz Decay Curve
-9log10(R) + 179; R2 = 0.17
-11log10(R) + 167; R2 = 0.09
-4log10(R) + 149; R2 = 0.07
501 Hz Decay Curve
-6log10(R) + 175; R2 = 0.31
-8log10(R) + 160; R2 = 0.1
-1log10(R) + 144; R2 = 0
1000 Hz Decay Curve
-7log10(R) + 181; R2 = 0.45
-4log10(R) + 154; R2 = 0.07
-10log10(R) + 156; R2 = 0.52
1995 Hz Decay Curve
-10log10(R) + 198; R2 = 0.53
-6log10(R) + 166; R2 = 0.35
-13log10(R) + 172; R2 = 0.6
3981 Hz Decay Curve
-10log10(R) + 200; R2 = 0.52
-7log10(R) + 169; R2 = 0.36
-14log10(R) + 176; R2 = 0.56
7943 Hz Decay Curve
-8log10(R) + 191; R2 = 0.35
-4log10(R) + 154; R2 = 0.09
-9log10(R) + 158; R2 = 0.39
15849 Hz Decay Curve
-5log10(R) + 184; R2 = 0.64
0log10(R) + 145; R2 = 0
-6log10(R) + 150; R2 = 0.73
SPL(dB)
Range (m)

HF - 36

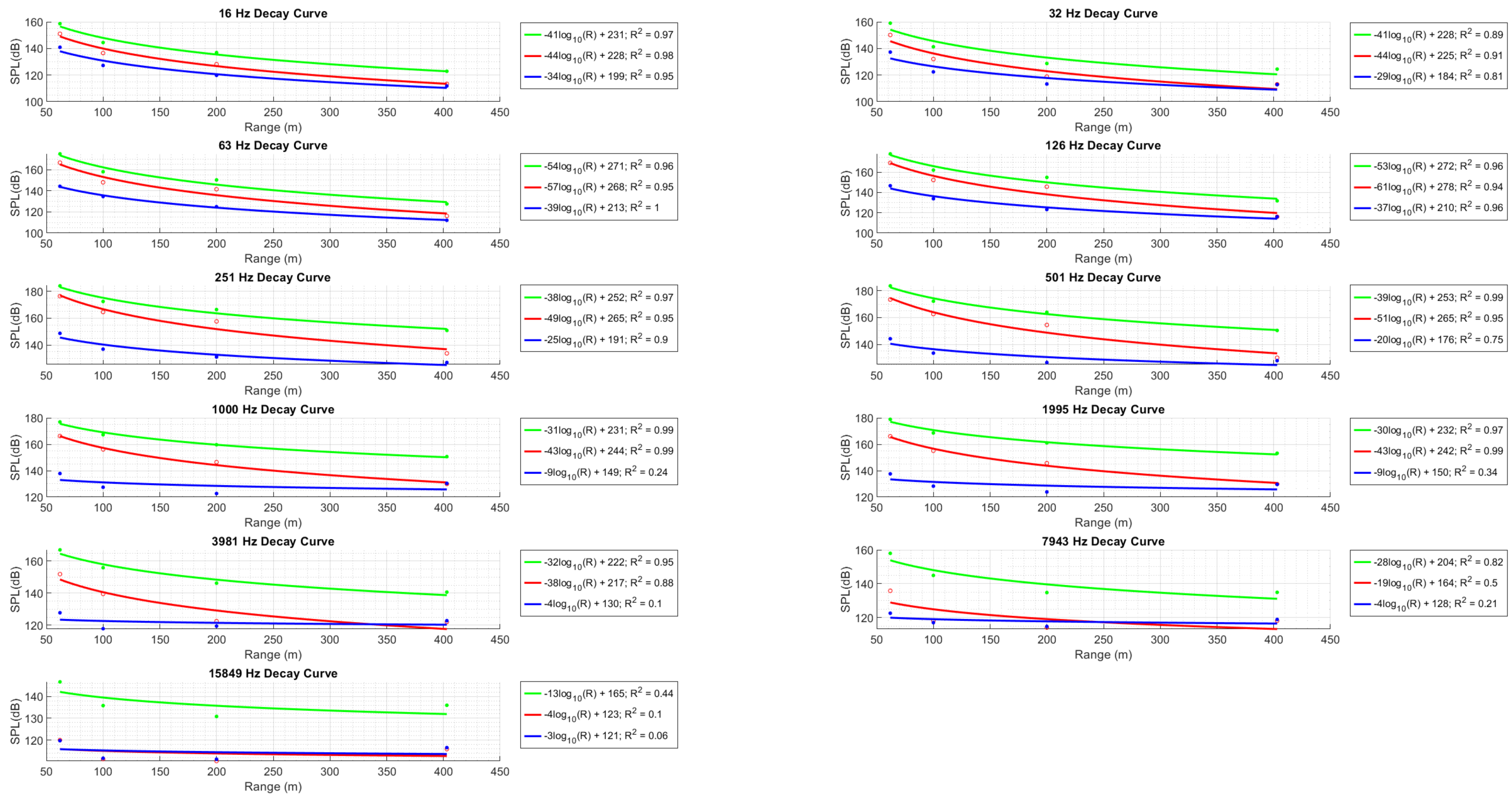


16 Hz Decay Curve
-23log$_{10}$(R) + 187; R^2 = 0.95
-20log$_{10}$(R) + 168; R^2 = 0.94
-19log$_{10}$(R) + 190; R^2 = 0.91
32 Hz Decay Curve
-24log$_{10}$(R) + 189; R^2 = 0.95
-21log$_{10}$(R) + 167; R^2 = 0.96
-20log$_{10}$(R) + 190; R^2 = 0.95
63 Hz Decay Curve
-26log$_{10}$(R) + 198; R^2 = 0.92
-35log$_{10}$(R) + 199; R^2 = 0.91
-6log$_{10}$(R) + 161; R^2 = 0.14
126 Hz Decay Curve
-24log$_{10}$(R) + 197; R^2 = 0.95
-33log$_{10}$(R) + 198; R^2 = 0.93
-4log$_{10}$(R) + 161; R^2 = 0.06
251 Hz Decay Curve
-26log$_{10}$(R) + 207; R^2 = 0.89
-43log$_{10}$(R) + 218; R^2 = 0.88
-6log$_{10}$(R) + 159; R^2 = 0.46
501 Hz Decay Curve
-13log$_{10}$(R) + 186; R^2 = 0.89
-31log$_{10}$(R) + 195; R^2 = 0.93
6log$_{10}$(R) + 137; R^2 = 0.69
1000 Hz Decay Curve
-8log$_{10}$(R) + 180; R^2 = 0.52
-19log$_{10}$(R) + 176; R^2 = 0.95
-6log$_{10}$(R) + 153; R^2 = 0.54
1995 Hz Decay Curve
-4log$_{10}$(R) + 185; R^2 = 0.08
-9log$_{10}$(R) + 169; R^2 = 0.51
-5log$_{10}$(R) + 159; R^2 = 0.17
3981 Hz Decay Curve
-2log$_{10}$(R) + 184; R^2 = 0.02
-5log$_{10}$(R) + 163; R^2 = 0.15
-2log$_{10}$(R) + 156; R^2 = 0.03
7943 Hz Decay Curve
-5log$_{10}$(R) + 184; R^2 = 0.17
-8log$_{10}$(R) + 159; R^2 = 0.34
-7log$_{10}$(R) + 156; R^2 = 0.31
15849 Hz Decay Curve
-4log$_{10}$(R) + 179; R^2 = 0.33
-6log$_{10}$(R) + 152; R^2 = 0.91
-5log$_{10}$(R) + 151; R^2 = 0.75
SPL(dB)
Range (m)

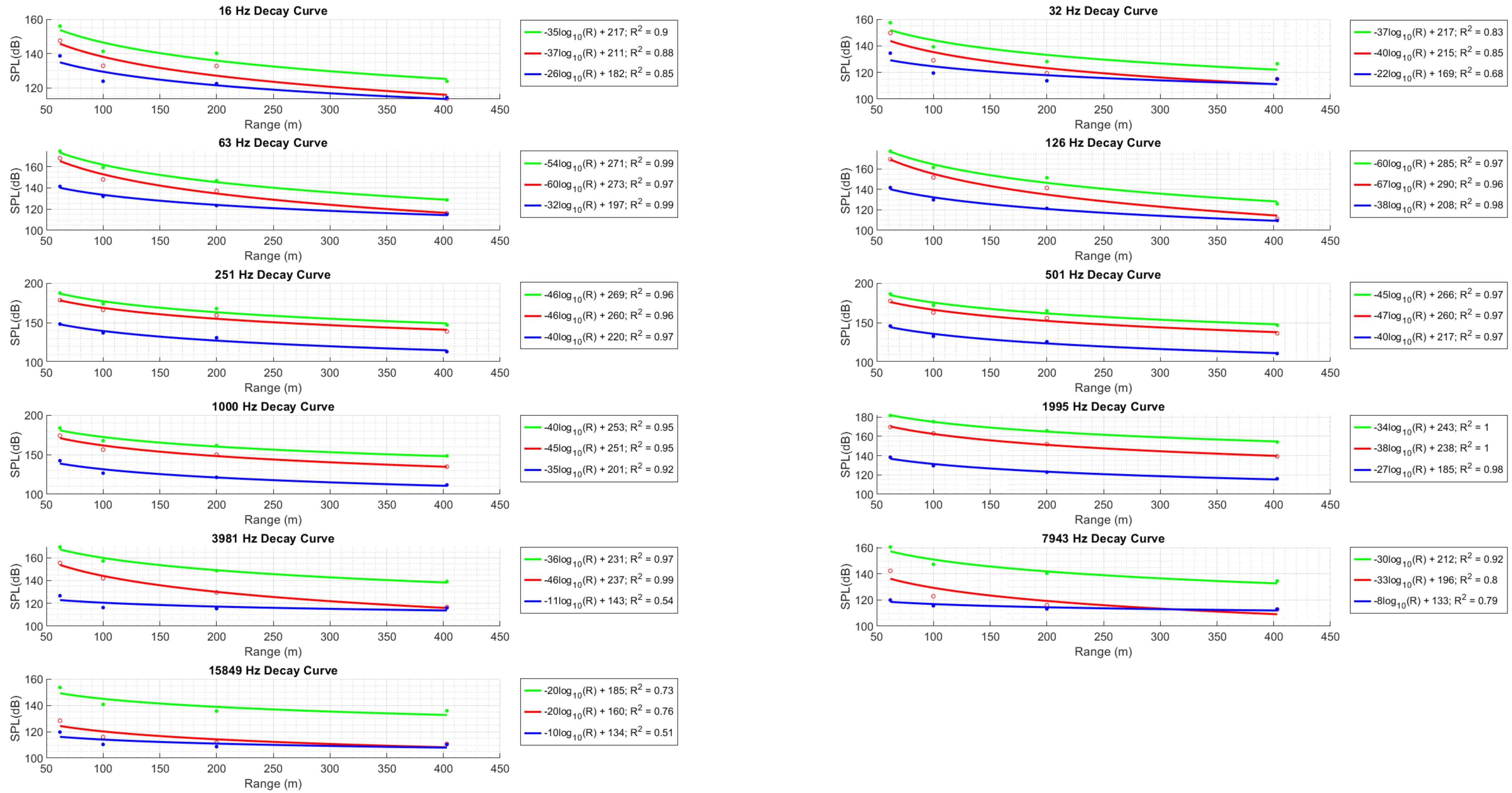
HF - 37


16 Hz Decay Curve
-43log10(R) + 233; R2 = 0.88
-37log10(R) + 205; R2 = 0.86
-37log10(R) + 228; R2 = 0.86
32 Hz Decay Curve
-55log10(R) + 254; R2 = 0.93
-49log10(R) + 224; R2 = 0.91
-49log10(R) + 246; R2 = 0.91
63 Hz Decay Curve
-37log10(R) + 238; R2 = 0.91
-65log10(R) + 278; R2 = 0.89
0log10(R) + 155; R2 = 0
126 Hz Decay Curve
-38log10(R) + 242; R2 = 0.87
-68log10(R) + 289; R2 = 1
3log10(R) + 145; R2 = 0.01
251 Hz Decay Curve
-39log10(R) + 254; R2 = 0.87
-39log10(R) + 245; R2 = 0.91
-38log10(R) + 230; R2 = 0.9
501 Hz Decay Curve
-34log10(R) + 241; R2 = 0.96
-35log10(R) + 233; R2 = 0.93
-34log10(R) + 220; R2 = 0.93
1000 Hz Decay Curve
-22log10(R) + 212; R2 = 0.77
-24log10(R) + 206; R2 = 0.73
-20log10(R) + 185; R2 = 0.61
1995 Hz Decay Curve
-26log10(R) + 222; R2 = 0.92
-38log10(R) + 232; R2 = 1
-29log10(R) + 201; R2 = 0.98
3981 Hz Decay Curve
-4log10(R) + 173; R2 = 0.19
-13log10(R) + 177; R2 = 0.36
-7log10(R) + 153; R2 = 0.29
7943 Hz Decay Curve
-3log10(R) + 170; R2 = 0.08
-8log10(R) + 164; R2 = 0.11
-6log10(R) + 149; R2 = 0.17
15849 Hz Decay Curve
-3log10(R) + 169; R2 = 0.08
-7log10(R) + 164; R2 = 0.1
-6log10(R) + 150; R2 = 0.18
SPL(dB)
Range (m)

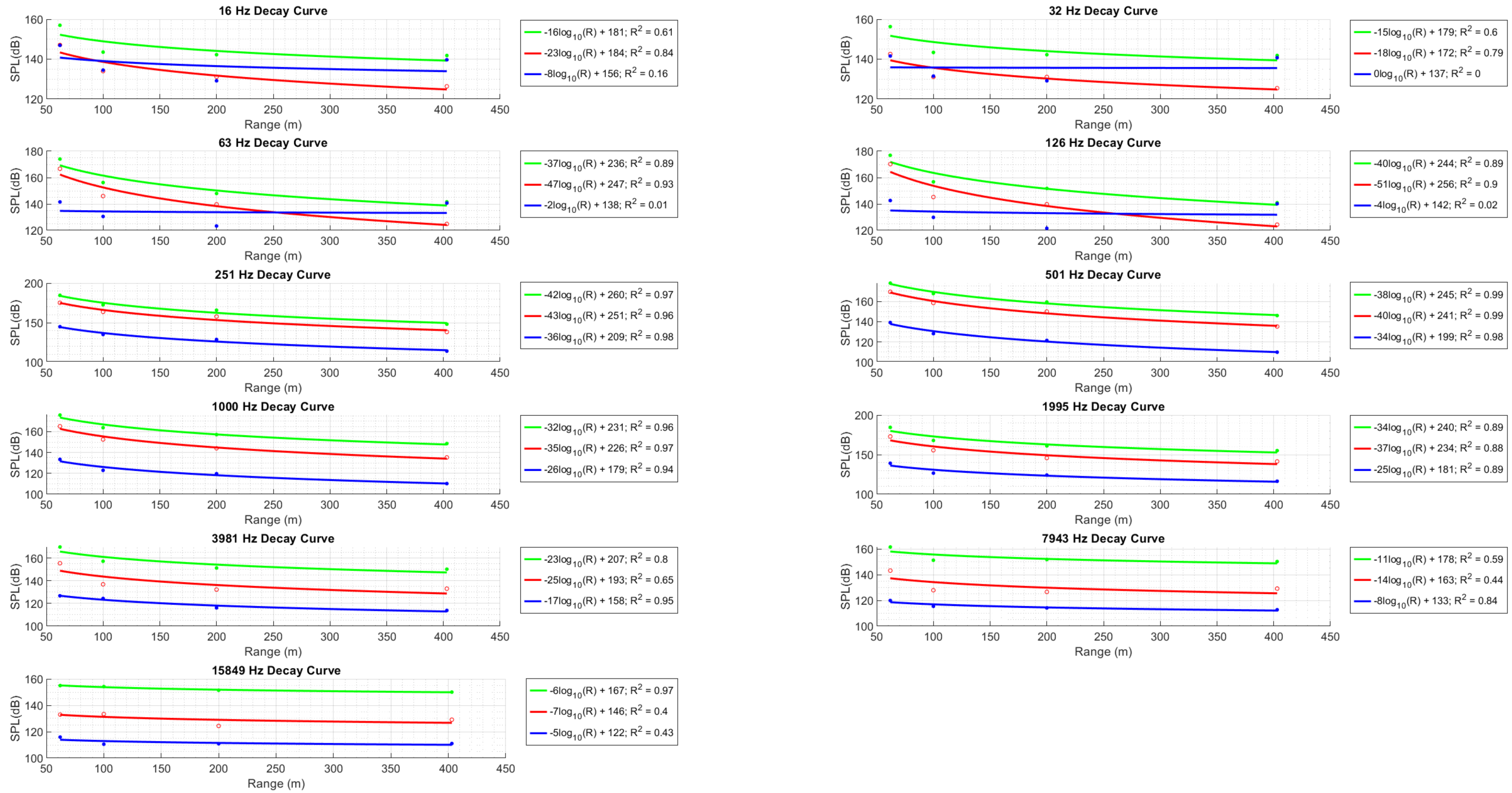
HF - 38


16 Hz Decay Curve
-41log10(R) + 231; R2 = 0.97
-44log10(R) + 228; R2 = 0.98
-34log10(R) + 199; R2 = 0.95
32 Hz Decay Curve
-41log10(R) + 228; R2 = 0.89
-44log10(R) + 225; R2 = 0.91
-29log10(R) + 184; R2 = 0.81
63 Hz Decay Curve
-54log10(R) + 271; R2 = 0.96
-57log10(R) + 268; R2 = 0.95
-39log10(R) + 213; R2 = 1
126 Hz Decay Curve
-53log10(R) + 272; R2 = 0.96
-61log10(R) + 278; R2 = 0.94
-37log10(R) + 210; R2 = 0.96
251 Hz Decay Curve
-38log10(R) + 252; R2 = 0.97
-49log10(R) + 265; R2 = 0.95
-25log10(R) + 191; R2 = 0.9
501 Hz Decay Curve
-39log10(R) + 253; R2 = 0.99
-51log10(R) + 265; R2 = 0.95
-20log10(R) + 176; R2 = 0.75
1000 Hz Decay Curve
-31log10(R) + 231; R2 = 0.99
-43log10(R) + 244; R2 = 0.99
-9log10(R) + 149; R2 = 0.24
1995 Hz Decay Curve
-30log10(R) + 232; R2 = 0.97
-43log10(R) + 242; R2 = 0.99
-9log10(R) + 150; R2 = 0.34
3981 Hz Decay Curve
-32log10(R) + 222; R2 = 0.95
-38log10(R) + 217; R2 = 0.88
-4log10(R) + 130; R2 = 0.1
7943 Hz Decay Curve
-28log10(R) + 204; R2 = 0.82
-19log10(R) + 164; R2 = 0.5
-4log10(R) + 128; R2 = 0.21
15849 Hz Decay Curve
-13log10(R) + 165; R2 = 0.44
-4log10(R) + 123; R2 = 0.1
-3log10(R) + 121; R2 = 0.06
SPL(dB)
Range (m)

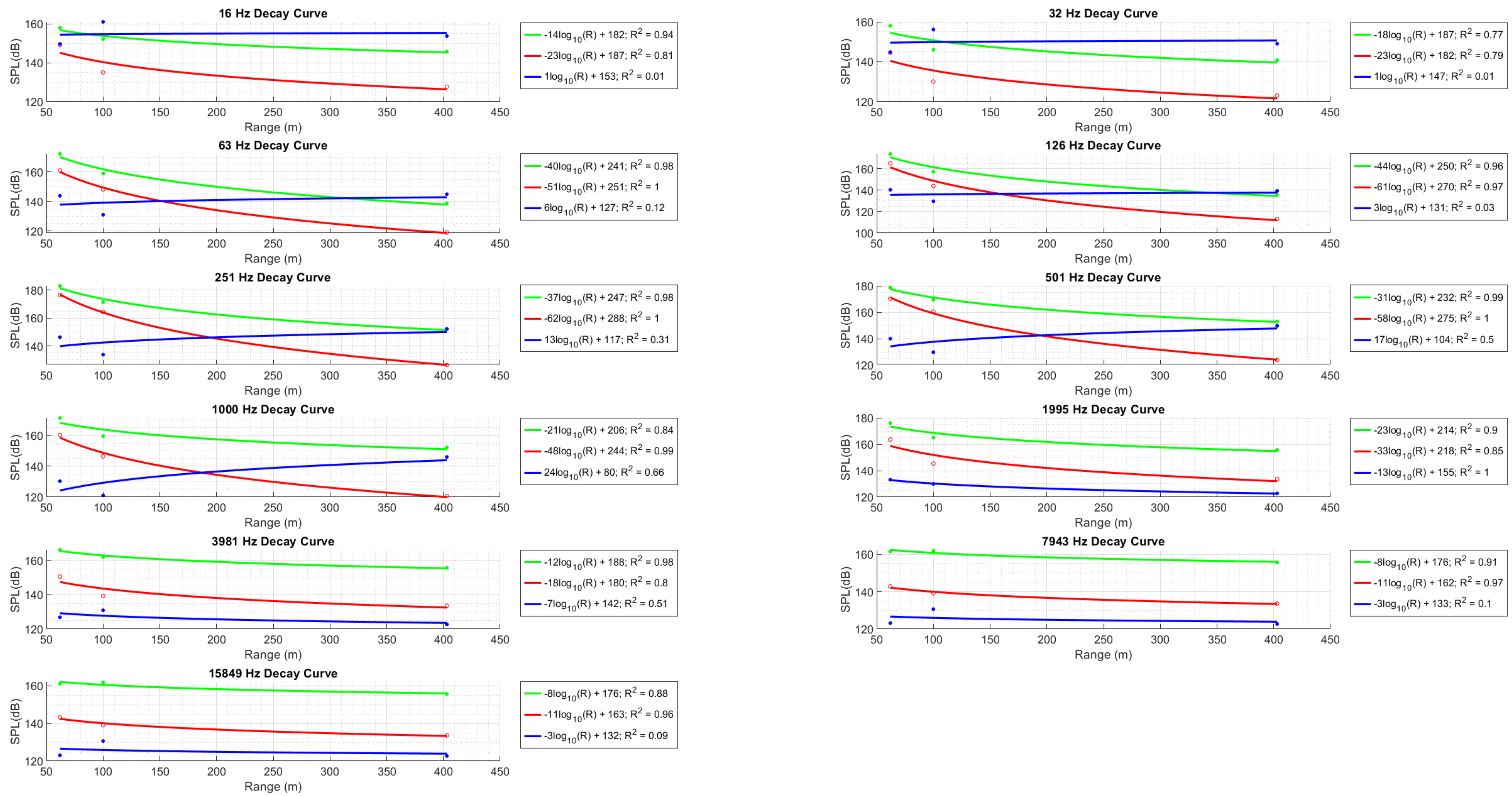
HF - 39


16 Hz Decay Curve
-35log10(R) + 217; R2 = 0.9
-37log10(R) + 211; R2 = 0.88
-26log10(R) + 182; R2 = 0.85
32 Hz Decay Curve
-37log10(R) + 217; R2 = 0.83
-40log10(R) + 215; R2 = 0.85
-22log10(R) + 169; R2 = 0.68
63 Hz Decay Curve
-54log10(R) + 271; R2 = 0.99
-60log10(R) + 273; R2 = 0.97
-32log10(R) + 197; R2 = 0.99
126 Hz Decay Curve
-60log10(R) + 285; R2 = 0.97
-67log10(R) + 290; R2 = 0.96
-38log10(R) + 208; R2 = 0.98
251 Hz Decay Curve
-46log10(R) + 269; R2 = 0.96
-46log10(R) + 260; R2 = 0.96
-40log10(R) + 220; R2 = 0.97
501 Hz Decay Curve
-45log10(R) + 266; R2 = 0.97
-47log10(R) + 260; R2 = 0.97
-40log10(R) + 217; R2 = 0.97
1000 Hz Decay Curve
-40log10(R) + 253; R2 = 0.95
-45log10(R) + 251; R2 = 0.95
-35log10(R) + 201; R2 = 0.92
1995 Hz Decay Curve
-34log10(R) + 243; R2 = 1
-38log10(R) + 238; R2 = 1
-27log10(R) + 185; R2 = 0.98
3981 Hz Decay Curve
-36log10(R) + 231; R2 = 0.97
-46log10(R) + 237; R2 = 0.99
-11log10(R) + 143; R2 = 0.54
7943 Hz Decay Curve
-30log10(R) + 212; R2 = 0.92
-33log10(R) + 196; R2 = 0.8
-8log10(R) + 133; R2 = 0.79
15849 Hz Decay Curve
-20log10(R) + 185; R2 = 0.73
-20log10(R) + 160; R2 = 0.76
-10log10(R) + 134; R2 = 0.51
SPL(dB)
Range (m)

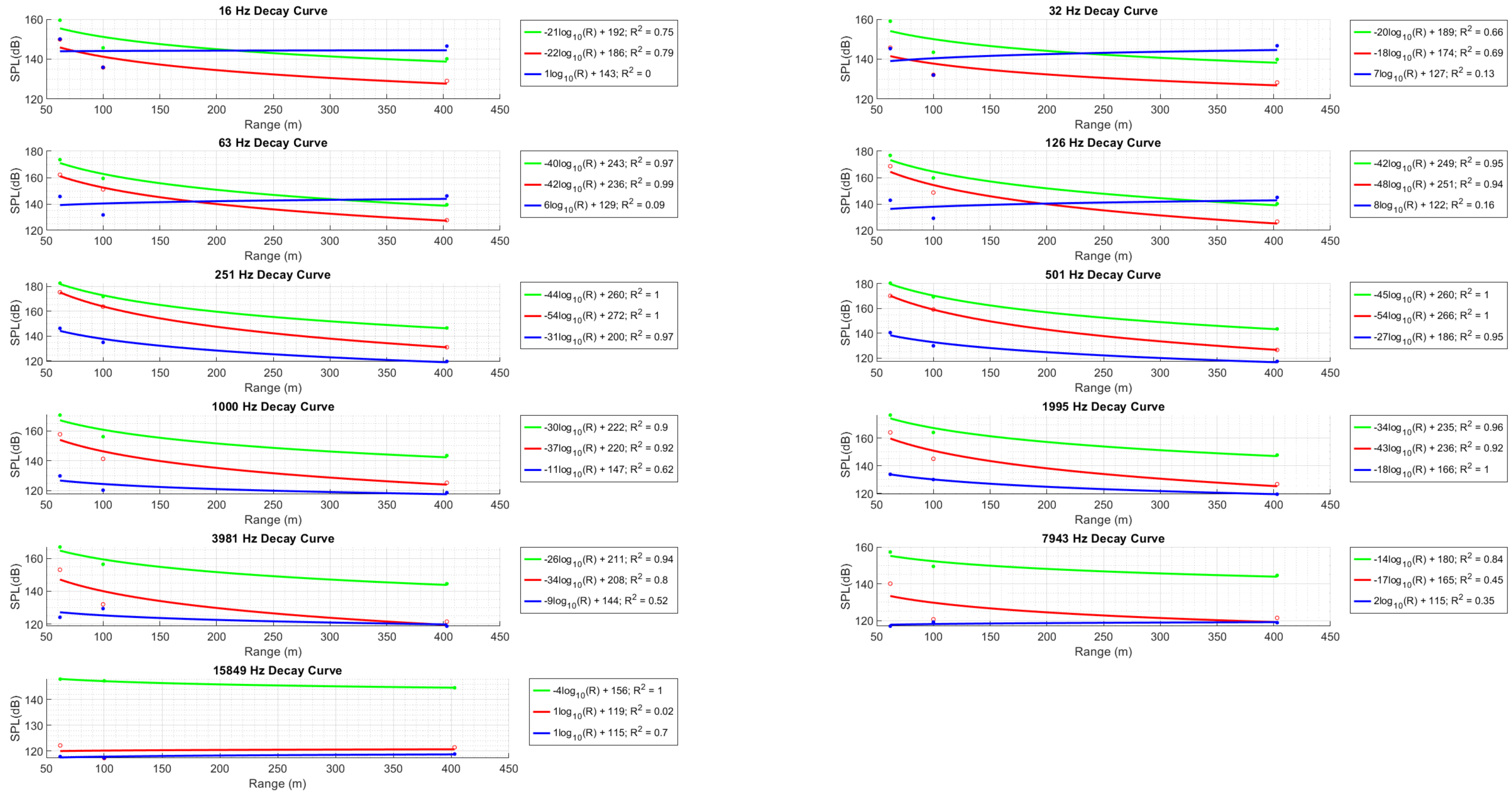
HF - 40


16 Hz Decay Curve
-16log10(R) + 181; R2 = 0.61
-23log10(R) + 184; R2 = 0.84
-8log10(R) + 156; R2 = 0.16
32 Hz Decay Curve
-15log10(R) + 179; R2 = 0.6
-18log10(R) + 172; R2 = 0.79
0log10(R) + 137; R2 = 0
63 Hz Decay Curve
-37log10(R) + 236; R2 = 0.89
-47log10(R) + 247; R2 = 0.93
-2log10(R) + 138; R2 = 0.01
126 Hz Decay Curve
-40log10(R) + 244; R2 = 0.89
-51log10(R) + 256; R2 = 0.9
-4log10(R) + 142; R2 = 0.02
251 Hz Decay Curve
-42log10(R) + 260; R2 = 0.97
-43log10(R) + 251; R2 = 0.96
-36log10(R) + 209; R2 = 0.98
501 Hz Decay Curve
-38log10(R) + 245; R2 = 0.99
-40log10(R) + 241; R2 = 0.99
-34log10(R) + 199; R2 = 0.98
1000 Hz Decay Curve
-32log10(R) + 231; R2 = 0.96
-35log10(R) + 226; R2 = 0.97
-26log10(R) + 179; R2 = 0.94
1995 Hz Decay Curve
-34log10(R) + 240; R2 = 0.89
-37log10(R) + 234; R2 = 0.88
-25log10(R) + 181; R2 = 0.89
3981 Hz Decay Curve
-23log10(R) + 207; R2 = 0.8
-25log10(R) + 193; R2 = 0.65
-17log10(R) + 158; R2 = 0.95
7943 Hz Decay Curve
-11log10(R) + 178; R2 = 0.59
-14log10(R) + 163; R2 = 0.44
-8log10(R) + 133; R2 = 0.84
15849 Hz Decay Curve
-6log10(R) + 167; R2 = 0.97
-7log10(R) + 146; R2 = 0.4
-5log10(R) + 122; R2 = 0.43
SPL(dB)
Range (m)

HF - 41

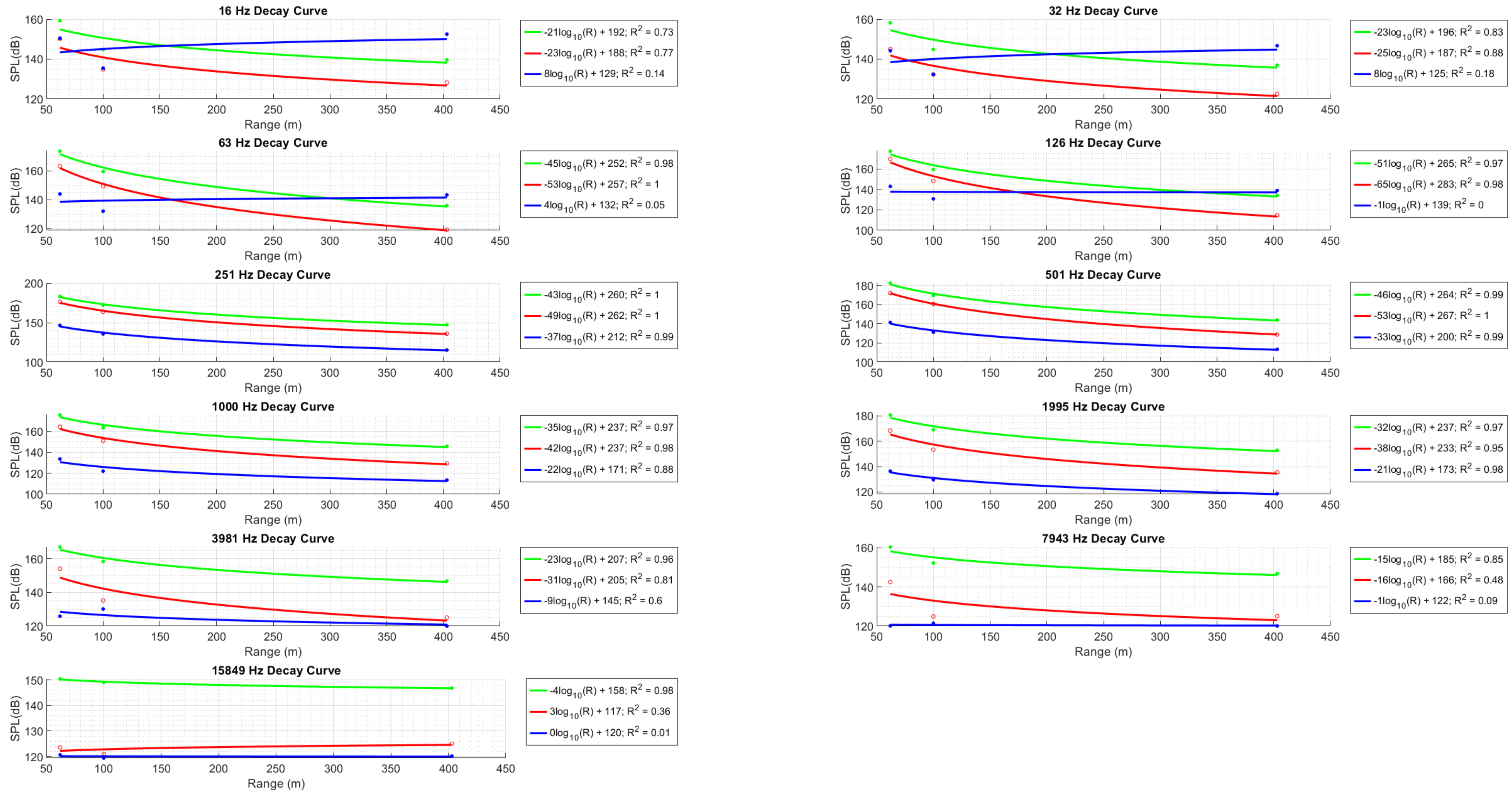

16 Hz Decay Curve
-14log10(R) + 182; R2 = 0.94
-23log10(R) + 187; R2 = 0.81
1log10(R) + 153; R2 = 0.01
32 Hz Decay Curve
-18log10(R) + 187; R2 = 0.77
-23log10(R) + 182; R2 = 0.79
1log10(R) + 147; R2 = 0.01
63 Hz Decay Curve
-40log10(R) + 241; R2 = 0.98
-51log10(R) + 251; R2 = 1
6log10(R) + 127; R2 = 0.12
126 Hz Decay Curve
-44log10(R) + 250; R2 = 0.96
-61log10(R) + 270; R2 = 0.97
3log10(R) + 131; R2 = 0.03
251 Hz Decay Curve
-37log10(R) + 247; R2 = 0.98
-62log10(R) + 288; R2 = 1
13log10(R) + 117; R2 = 0.31
501 Hz Decay Curve
-31log10(R) + 232; R2 = 0.99
-58log10(R) + 275; R2 = 1
17log10(R) + 104; R2 = 0.5
1000 Hz Decay Curve
-21log10(R) + 206; R2 = 0.84
-48log10(R) + 244; R2 = 0.99
24log10(R) + 80; R2 = 0.66
1995 Hz Decay Curve
-23log10(R) + 214; R2 = 0.9
-33log10(R) + 218; R2 = 0.85
-13log10(R) + 155; R2 = 1
3981 Hz Decay Curve
-12log10(R) + 188; R2 = 0.98
-18log10(R) + 180; R2 = 0.8
-7log10(R) + 142; R2 = 0.51
7943 Hz Decay Curve
-8log10(R) + 176; R2 = 0.91
-11log10(R) + 162; R2 = 0.97
-3log10(R) + 133; R2 = 0.1
15849 Hz Decay Curve
-8log10(R) + 176; R2 = 0.88
-11log10(R) + 163; R2 = 0.96
-3log10(R) + 132; R2 = 0.09
SPL(dB)
Range (m)

HF - 42

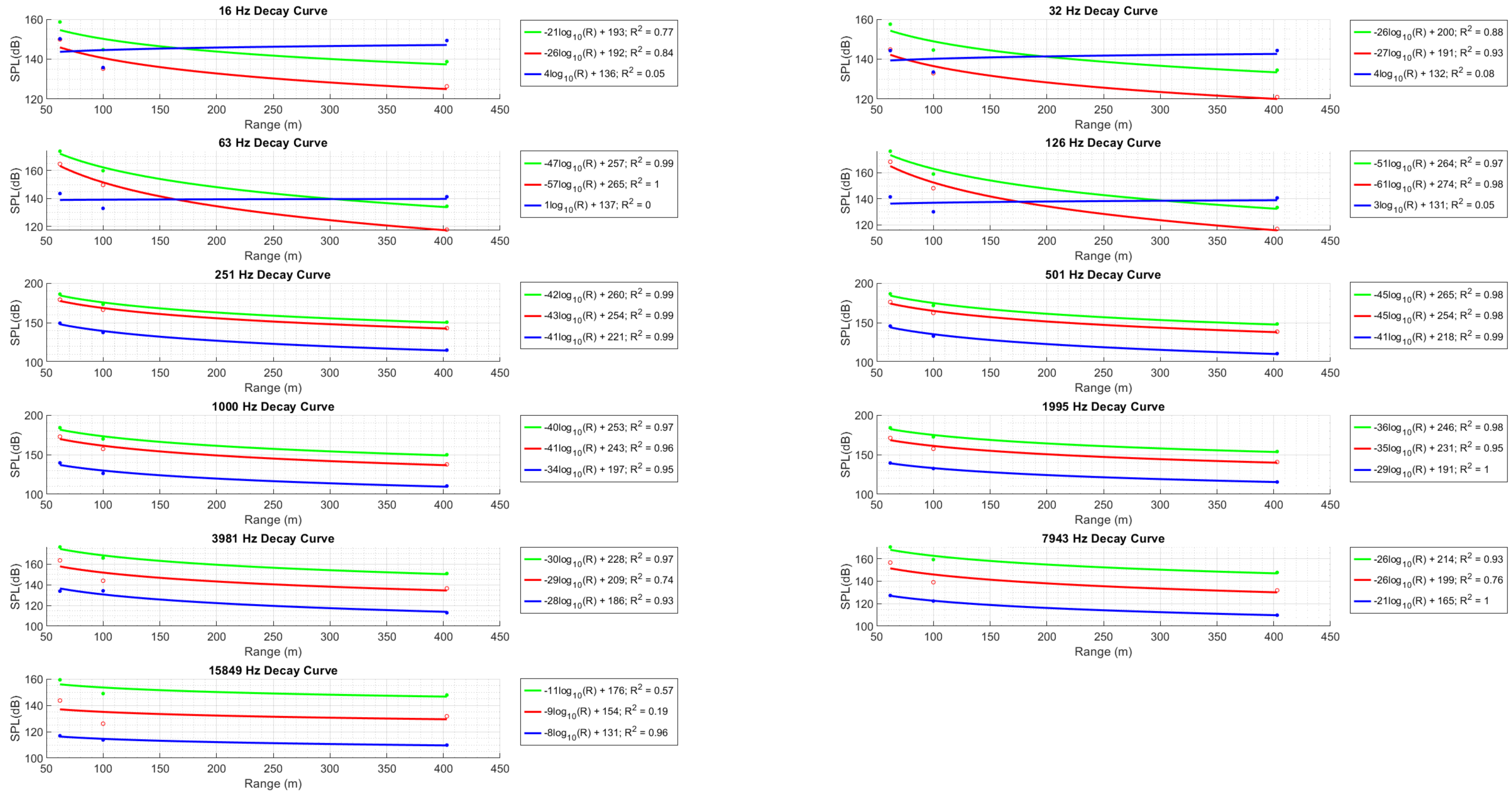


16 Hz Decay Curve
-21log10(R) + 192; R2 = 0.75
-22log10(R) + 186; R2 = 0.79
1log10(R) + 143; R2 = 0
32 Hz Decay Curve
-20log10(R) + 189; R2 = 0.66
-18log10(R) + 174; R2 = 0.69
7log10(R) + 127; R2 = 0.13
63 Hz Decay Curve
-40log10(R) + 243; R2 = 0.97
-42log10(R) + 236; R2 = 0.99
6log10(R) + 129; R2 = 0.09
126 Hz Decay Curve
-42log10(R) + 249; R2 = 0.95
-48log10(R) + 251; R2 = 0.94
8log10(R) + 122; R2 = 0.16
251 Hz Decay Curve
-44log10(R) + 260; R2 = 1
-54log10(R) + 272; R2 = 1
-31log10(R) + 200; R2 = 0.97
501 Hz Decay Curve
-45log10(R) + 260; R2 = 1
-54log10(R) + 266; R2 = 1
-27log10(R) + 186; R2 = 0.95
1000 Hz Decay Curve
-30log10(R) + 222; R2 = 0.9
-37log10(R) + 220; R2 = 0.92
-11log10(R) + 147; R2 = 0.62
1995 Hz Decay Curve
-34log10(R) + 235; R2 = 0.96
-43log10(R) + 236; R2 = 0.92
-18log10(R) + 166; R2 = 1
3981 Hz Decay Curve
-26log10(R) + 211; R2 = 0.94
-34log10(R) + 208; R2 = 0.8
-9log10(R) + 144; R2 = 0.52
7943 Hz Decay Curve
-14log10(R) + 180; R2 = 0.84
-17log10(R) + 165; R2 = 0.45
2log10(R) + 115; R2 = 0.35
15849 Hz Decay Curve
-4log10(R) + 156; R2 = 1
1log10(R) + 119; R2 = 0.02
1log10(R) + 115; R2 = 0.7
SPL(dB)
Range (m)

HF - 43

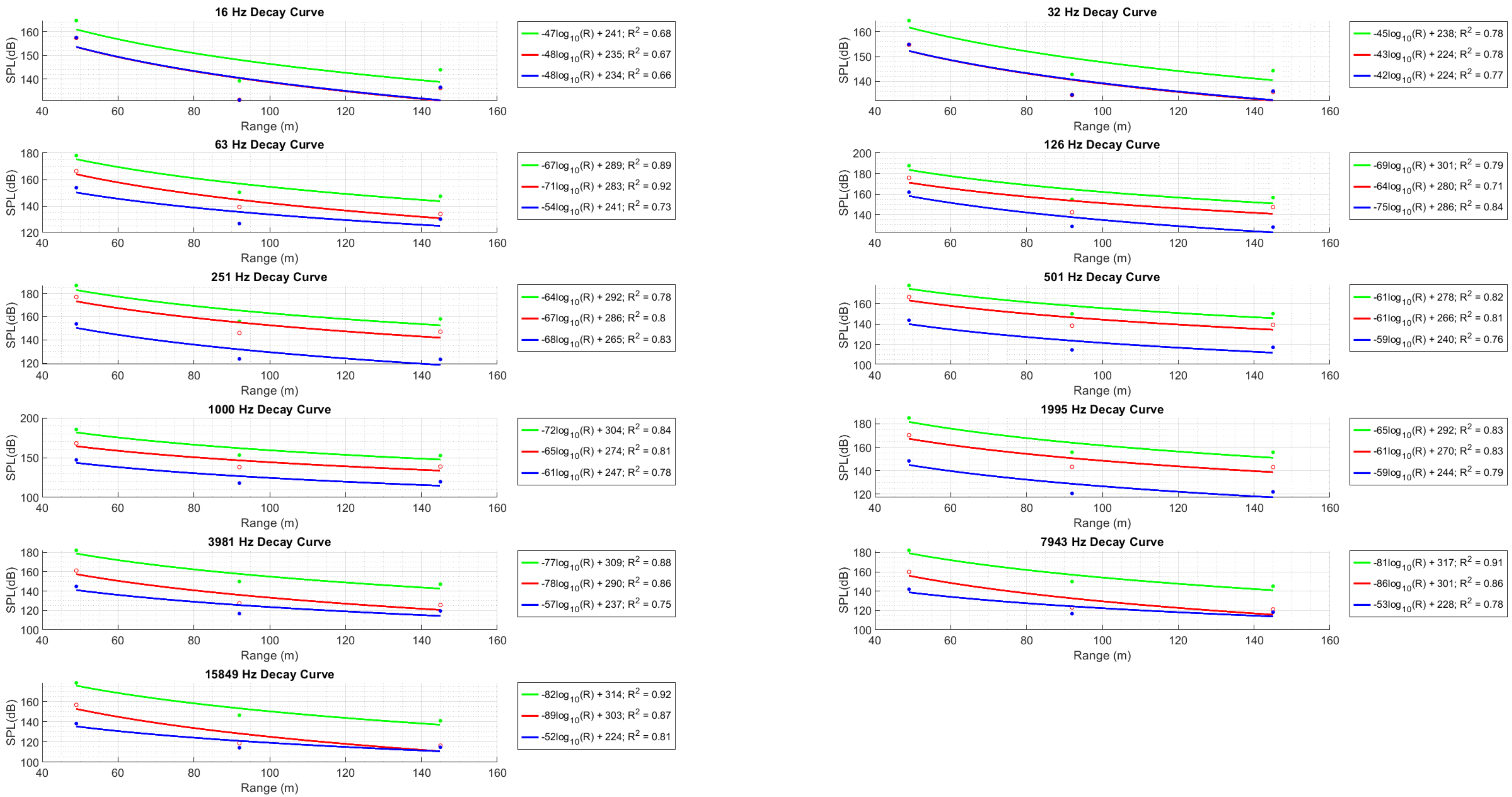

16 Hz Decay Curve
-21log10(R) + 192; R2 = 0.73
-23log10(R) + 188; R2 = 0.77
8log10(R) + 129; R2 = 0.14
32 Hz Decay Curve
-23log10(R) + 196; R2 = 0.83
-25log10(R) + 187; R2 = 0.88
8log10(R) + 125; R2 = 0.18
63 Hz Decay Curve
-45log10(R) + 252; R2 = 0.98
-53log10(R) + 257; R2 = 1
4log10(R) + 132; R2 = 0.05
126 Hz Decay Curve
-51log10(R) + 265; R2 = 0.97
-65log10(R) + 283; R2 = 0.98
-1log10(R) + 139; R2 = 0
251 Hz Decay Curve
-43log10(R) + 260; R2 = 1
-49log10(R) + 262; R2 = 1
-37log10(R) + 212; R2 = 0.99
501 Hz Decay Curve
-46log10(R) + 264; R2 = 0.99
-53log10(R) + 267; R2 = 1
-33log10(R) + 200; R2 = 0.99
1000 Hz Decay Curve
-35log10(R) + 237; R2 = 0.97
-42log10(R) + 237; R2 = 0.98
-22log10(R) + 171; R2 = 0.88
1995 Hz Decay Curve
-32log10(R) + 237; R2 = 0.97
-38log10(R) + 233; R2 = 0.95
-21log10(R) + 173; R2 = 0.98
3981 Hz Decay Curve
-23log10(R) + 207; R2 = 0.96
-31log10(R) + 205; R2 = 0.81
-9log10(R) + 145; R2 = 0.6
7943 Hz Decay Curve
-15log10(R) + 185; R2 = 0.85
-16log10(R) + 166; R2 = 0.48
-1log10(R) + 122; R2 = 0.09
15849 Hz Decay Curve
-4log10(R) + 158; R2 = 0.98
3log10(R) + 117; R2 = 0.36
0log10(R) + 120; R2 = 0.01
SPL(dB)
Range (m)

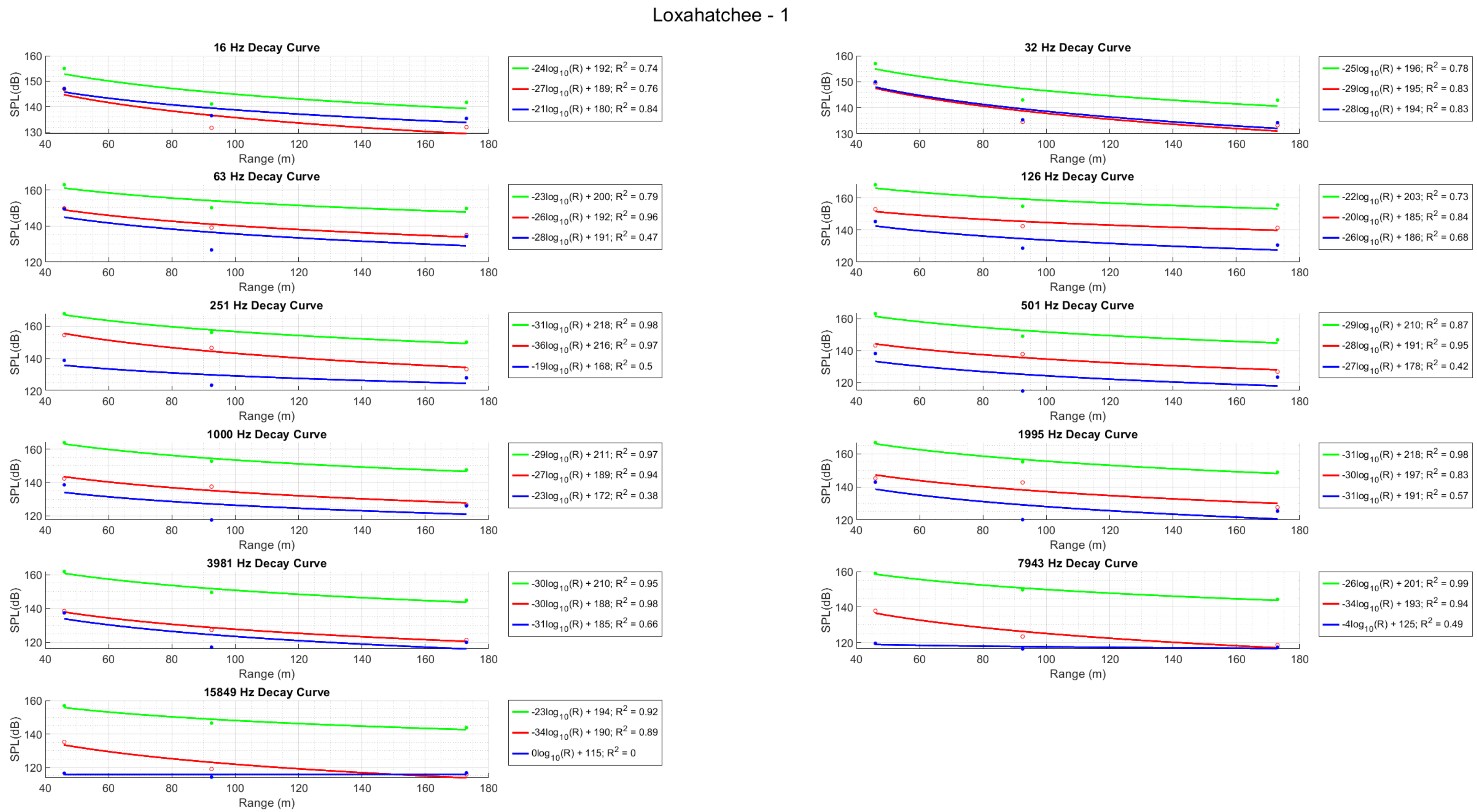
HF - 44



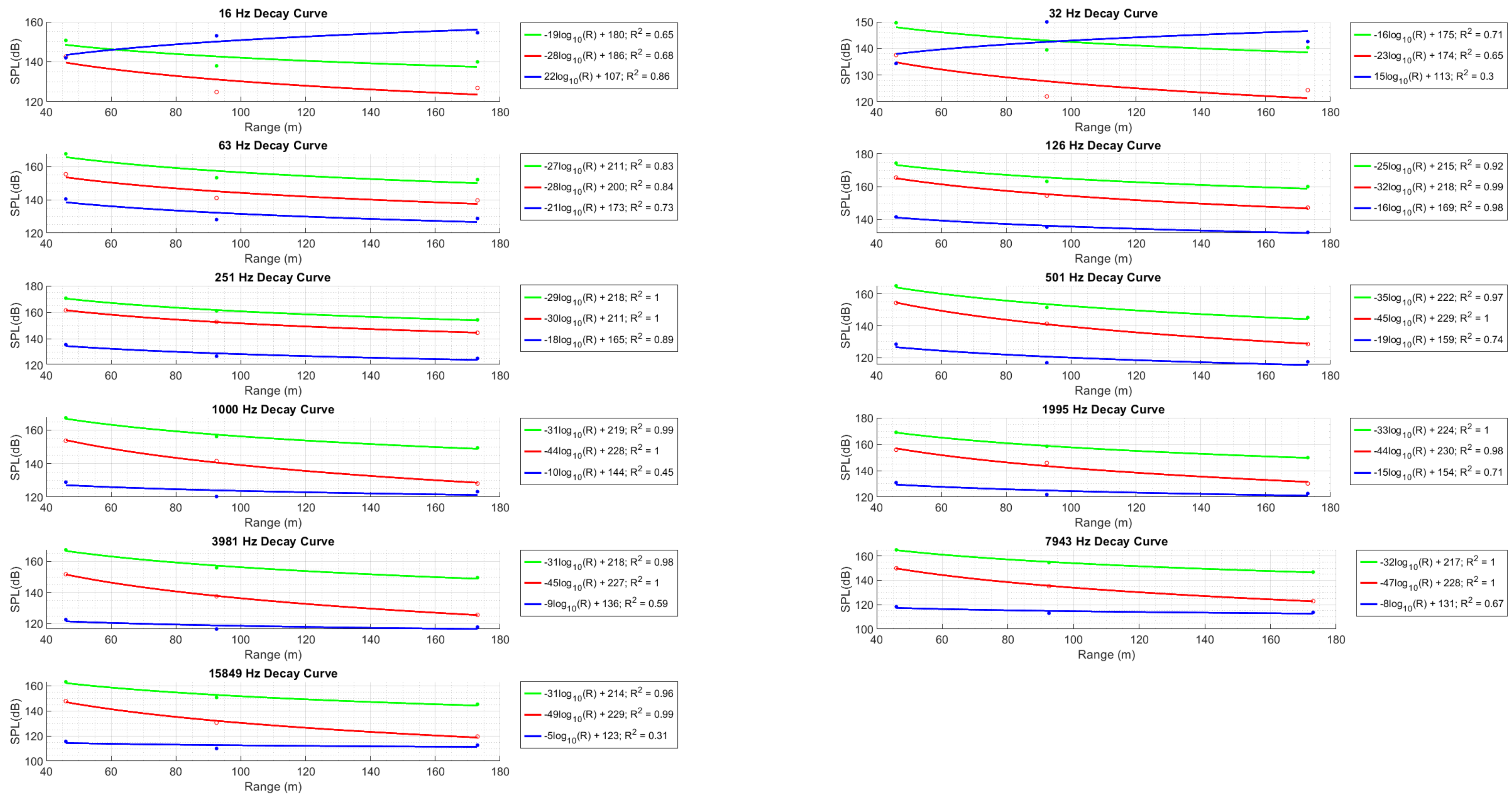
16 Hz Decay Curve
-21log10(R) + 193; R2 = 0.77
-26log10(R) + 192; R2 = 0.84
4log10(R) + 136; R2 = 0.05
32 Hz Decay Curve
-26log10(R) + 200; R2 = 0.88
-27log10(R) + 191; R2 = 0.93
4log10(R) + 132; R2 = 0.08
63 Hz Decay Curve
-47log10(R) + 257; R2 = 0.99
-57log10(R) + 265; R2 = 1
1log10(R) + 137; R2 = 0
126 Hz Decay Curve
-51log10(R) + 264; R2 = 0.97
-61log10(R) + 274; R2 = 0.98
3log10(R) + 131; R2 = 0.05
251 Hz Decay Curve
-42log10(R) + 260; R2 = 0.99
-43log10(R) + 254; R2 = 0.99
-41log10(R) + 221; R2 = 0.99
501 Hz Decay Curve
-45log10(R) + 265; R2 = 0.98
-45log10(R) + 254; R2 = 0.98
-41log10(R) + 218; R2 = 0.99
1000 Hz Decay Curve
-40log10(R) + 253; R2 = 0.97
-41log10(R) + 243; R2 = 0.96
-34log10(R) + 197; R2 = 0.95
1995 Hz Decay Curve
-36log10(R) + 246; R2 = 0.98
-35log10(R) + 231; R2 = 0.95
-29log10(R) + 191; R2 = 1
3981 Hz Decay Curve
-30log10(R) + 228; R2 = 0.97
-29log10(R) + 209; R2 = 0.74
-28log10(R) + 186; R2 = 0.93
7943 Hz Decay Curve
-26log10(R) + 214; R2 = 0.93
-26log10(R) + 199; R2 = 0.76
-21log10(R) + 165; R2 = 1
15849 Hz Decay Curve
-11log10(R) + 176; R2 = 0.57
-9log10(R) + 154; R2 = 0.19
-8log10(R) + 131; R2 = 0.96
SPL(dB)
Range (m)

SimpsonsCreek - 1

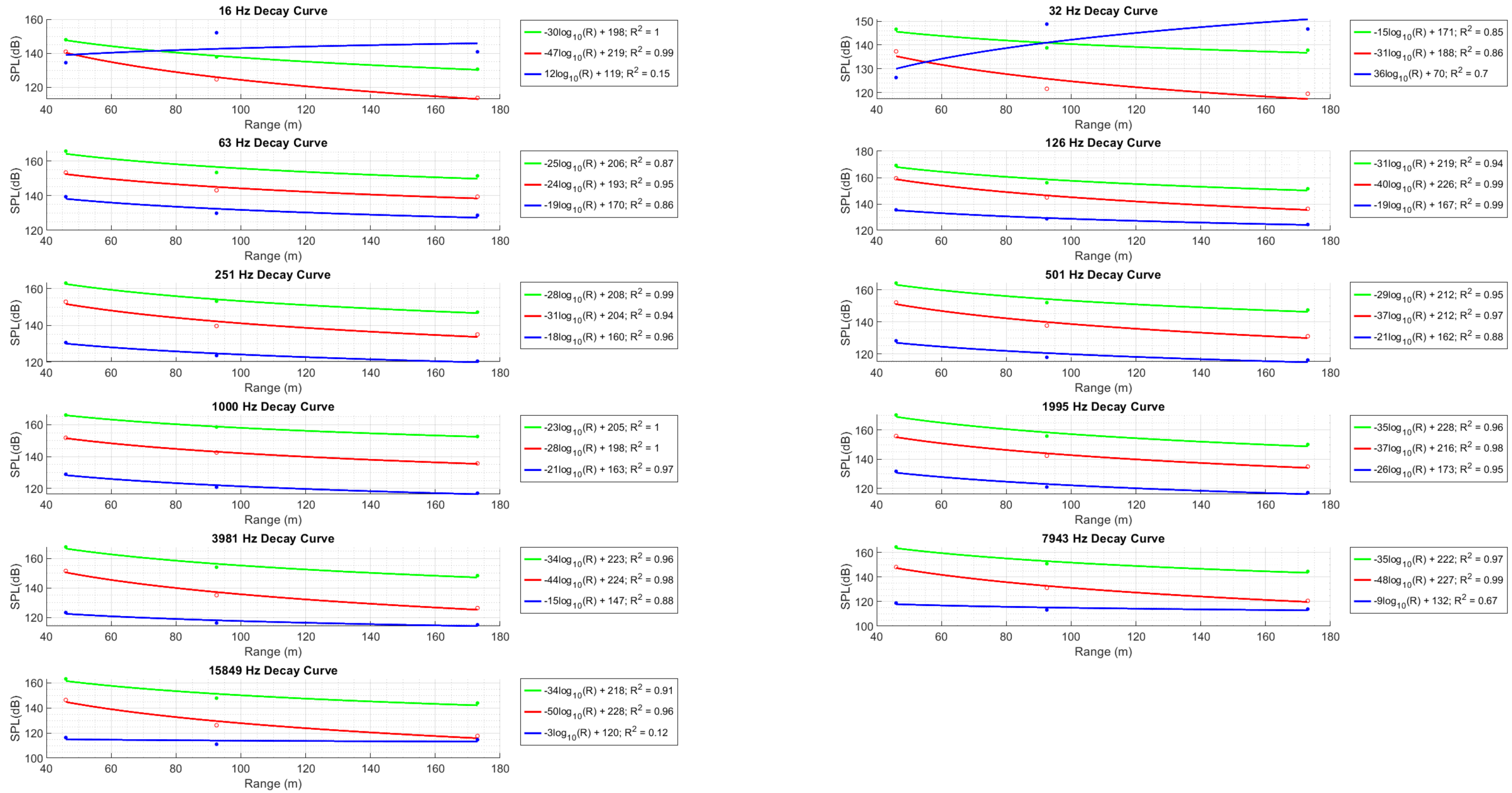



Loxahatchee - 1
16 Hz Decay Curve
SPL(dB)
Range (m)
-24log10(R) + 192; R2 = 0.74
-27log10(R) + 189; R2 = 0.76
-21log10(R) + 180; R2 = 0.84
32 Hz Decay Curve
-25log10(R) + 196; R2 = 0.78
-29log10(R) + 195; R2 = 0.83
-28log10(R) + 194; R2 = 0.83
63 Hz Decay Curve
-23log10(R) + 200; R2 = 0.79
-26log10(R) + 192; R2 = 0.96
-28log10(R) + 191; R2 = 0.47
126 Hz Decay Curve
-22log10(R) + 203; R2 = 0.73
-20log10(R) + 185; R2 = 0.84
-26log10(R) + 186; R2 = 0.68
251 Hz Decay Curve
-31log10(R) + 218; R2 = 0.98
-36log10(R) + 216; R2 = 0.97
-19log10(R) + 168; R2 = 0.5
501 Hz Decay Curve
-29log10(R) + 210; R2 = 0.87
-28log10(R) + 191; R2 = 0.95
-27log10(R) + 178; R2 = 0.42
1000 Hz Decay Curve
-29log10(R) + 211; R2 = 0.97
-27log10(R) + 189; R2 = 0.94
-23log10(R) + 172; R2 = 0.38
1995 Hz Decay Curve
-31log10(R) + 218; R2 = 0.98
-30log10(R) + 197; R2 = 0.83
-31log10(R) + 191; R2 = 0.57
3981 Hz Decay Curve
-30log10(R) + 210; R2 = 0.95
-30log10(R) + 188; R2 = 0.98
-31log10(R) + 185; R2 = 0.66
7943 Hz Decay Curve
-26log10(R) + 201; R2 = 0.99
-34log10(R) + 193; R2 = 0.94
-4log10(R) + 125; R2 = 0.49
15849 Hz Decay Curve
-23log10(R) + 194; R2 = 0.92
-34log10(R) + 190; R2 = 0.89
0log10(R) + 115; R2 = 0

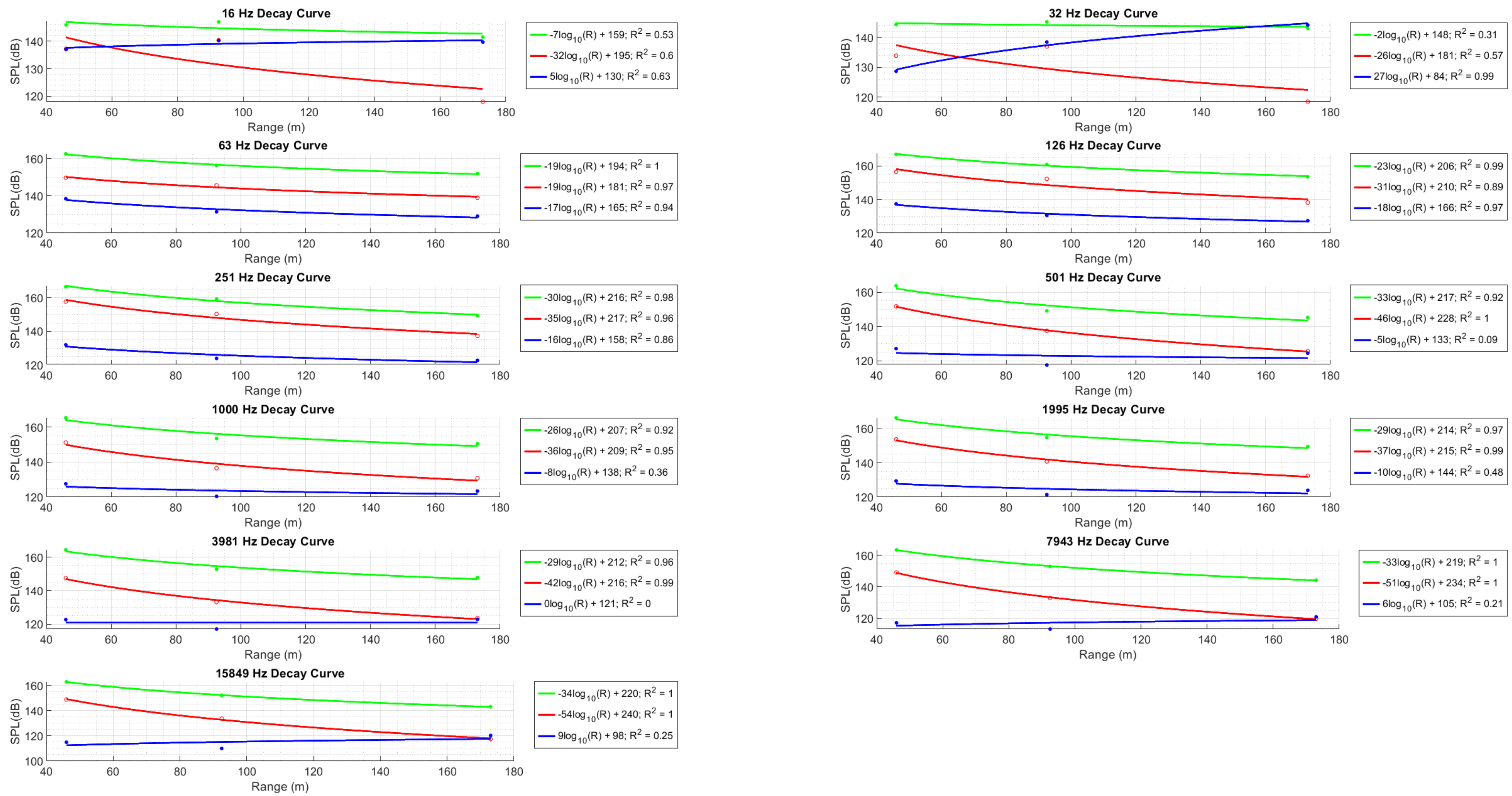
Loxahatchee - 2



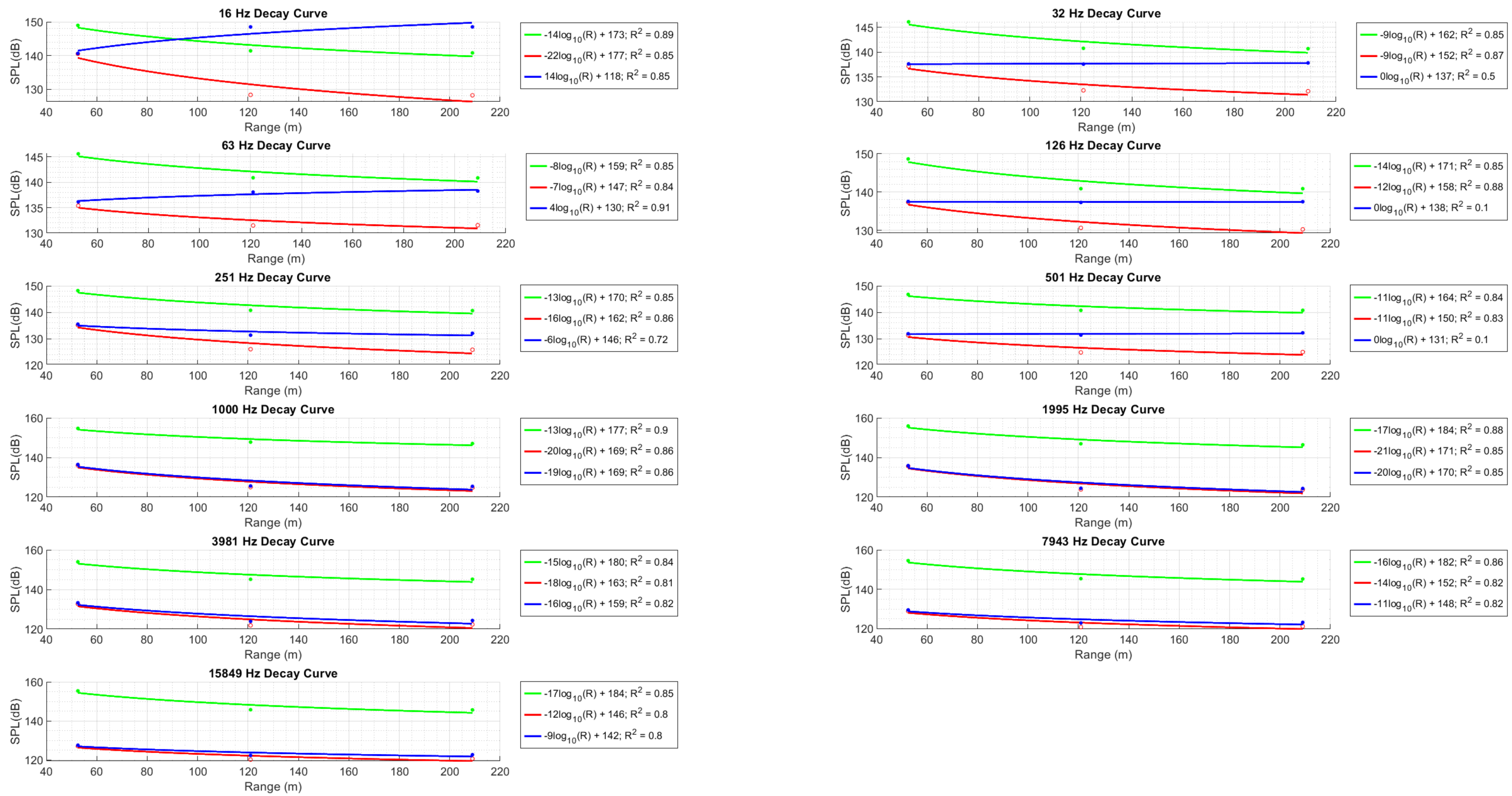
Loxahatchee - 3



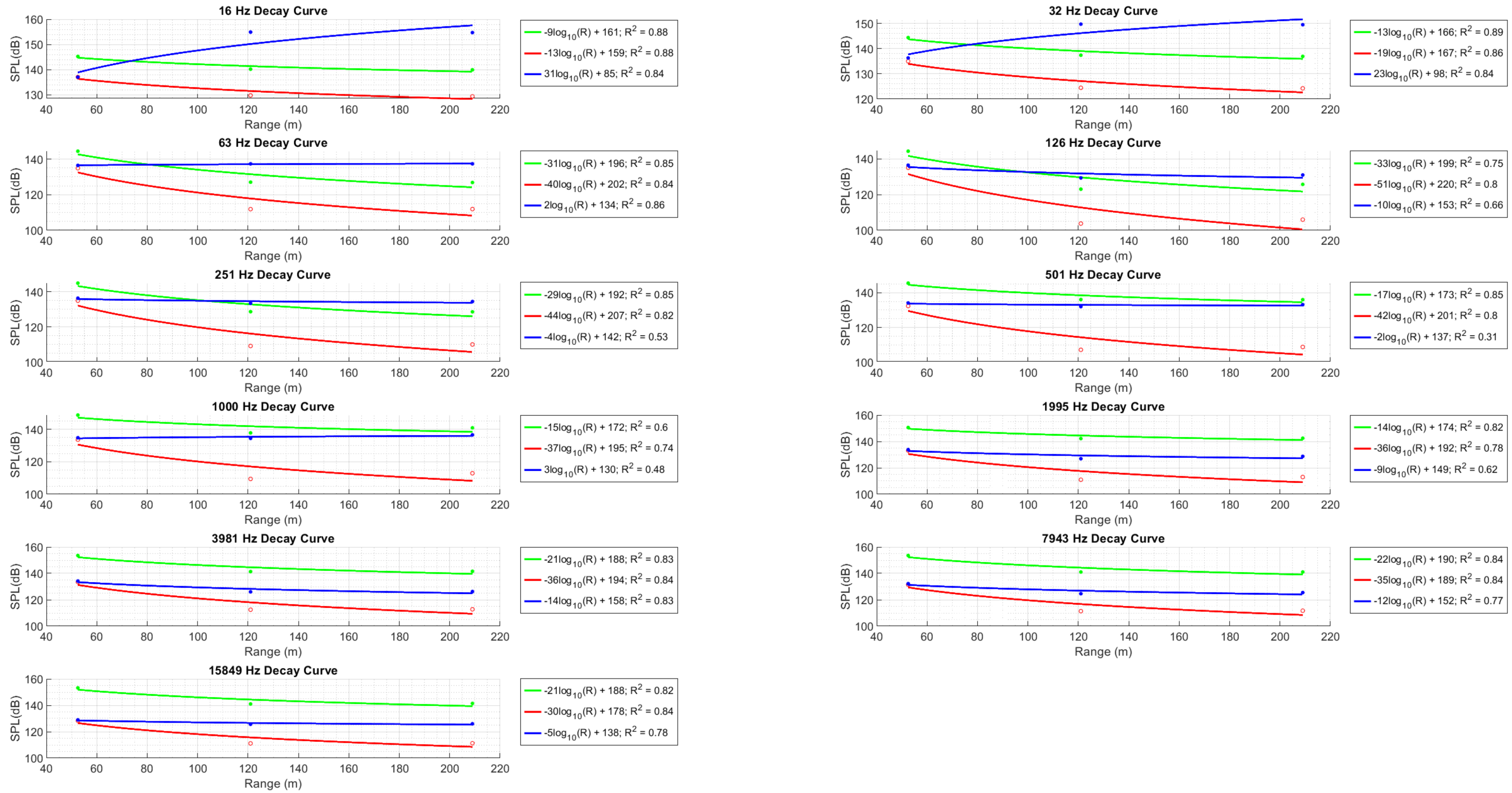
Loxahatchee - 4



Manatee - 1

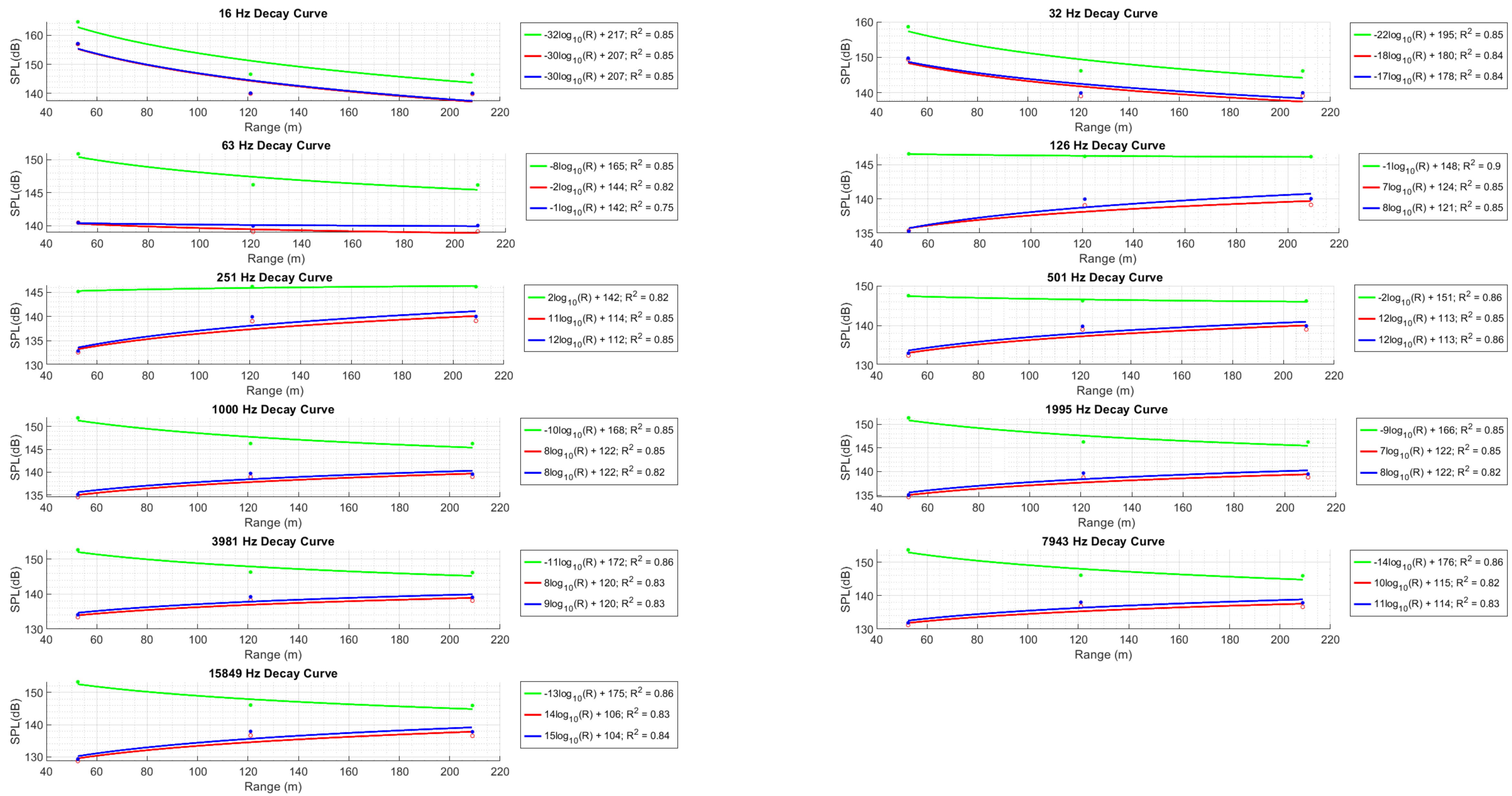

16 Hz Decay Curve
-14log10(R) + 173; R2 = 0.89
-22log10(R) + 177; R2 = 0.85
14log10(R) + 118; R2 = 0.85
32 Hz Decay Curve
-9log10(R) + 162; R2 = 0.85
-9log10(R) + 152; R2 = 0.87
0log10(R) + 137; R2 = 0.5
63 Hz Decay Curve
-8log10(R) + 159; R2 = 0.85
-7log10(R) + 147; R2 = 0.84
4log10(R) + 130; R2 = 0.91
126 Hz Decay Curve
-14log10(R) + 171; R2 = 0.85
-12log10(R) + 158; R2 = 0.88
0log10(R) + 138; R2 = 0.1
251 Hz Decay Curve
-13log10(R) + 170; R2 = 0.85
-16log10(R) + 162; R2 = 0.86
-6log10(R) + 146; R2 = 0.72
501 Hz Decay Curve
-11log10(R) + 164; R2 = 0.84
-11log10(R) + 150; R2 = 0.83
0log10(R) + 131; R2 = 0.1
1000 Hz Decay Curve
-13log10(R) + 177; R2 = 0.9
-20log10(R) + 169; R2 = 0.86
-19log10(R) + 169; R2 = 0.86
1995 Hz Decay Curve
-17log10(R) + 184; R2 = 0.88
-21log10(R) + 171; R2 = 0.85
-20log10(R) + 170; R2 = 0.85
3981 Hz Decay Curve
-15log10(R) + 180; R2 = 0.84
-18log10(R) + 163; R2 = 0.81
-16log10(R) + 159; R2 = 0.82
7943 Hz Decay Curve
-16log10(R) + 182; R2 = 0.86
-14log10(R) + 152; R2 = 0.82
-11log10(R) + 148; R2 = 0.82
15849 Hz Decay Curve
-17log10(R) + 184; R2 = 0.85
-12log10(R) + 146; R2 = 0.8
-9log10(R) + 142; R2 = 0.8
SPL(dB)
Range (m)

Manatee - 2

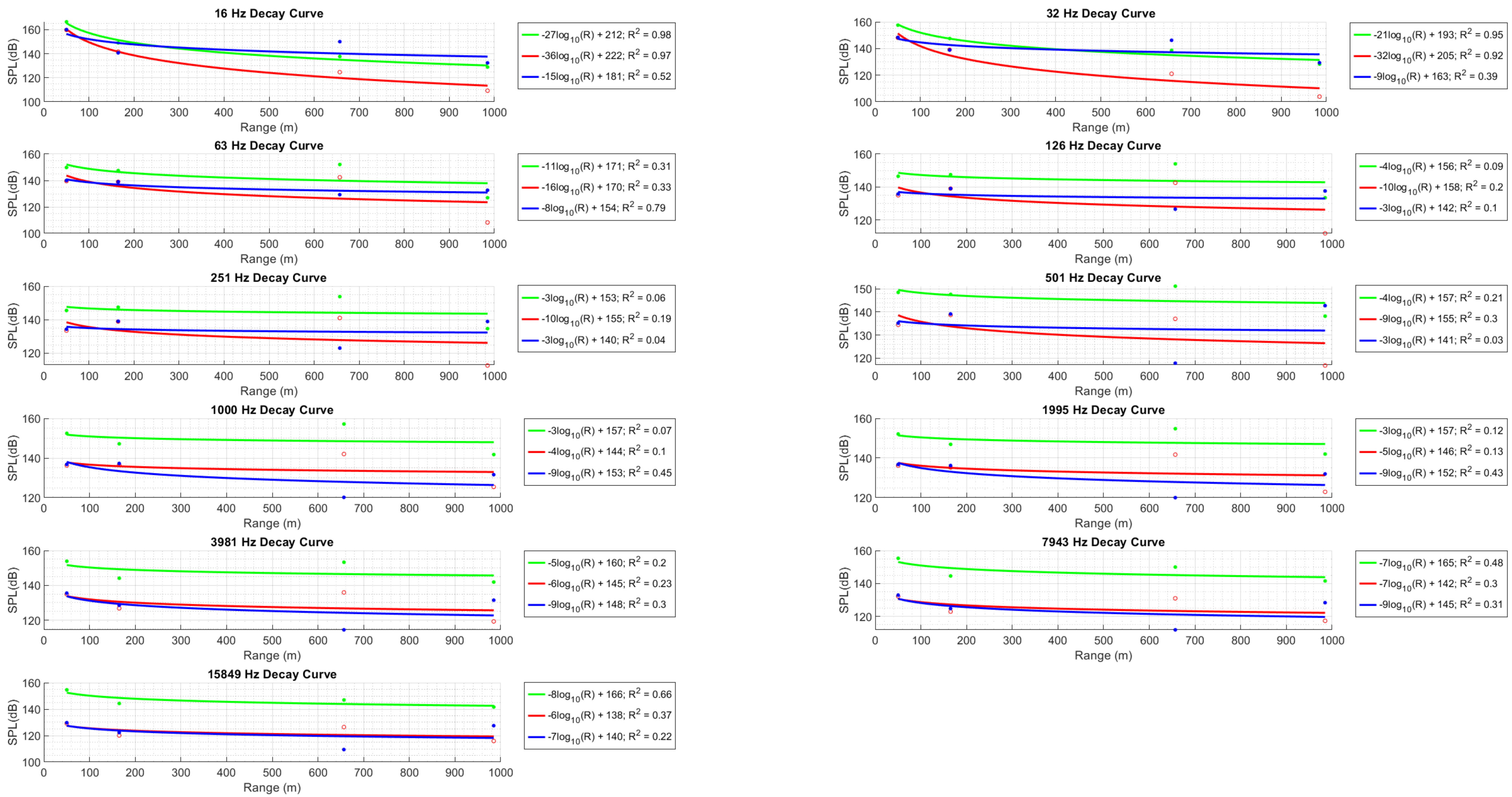


16 Hz Decay Curve
-9log10(R) + 161; R2 = 0.88
-13log10(R) + 159; R2 = 0.88
31log10(R) + 85; R2 = 0.84
32 Hz Decay Curve
-13log10(R) + 166; R2 = 0.89
-19log10(R) + 167; R2 = 0.86
23log10(R) + 98; R2 = 0.84
63 Hz Decay Curve
-31log10(R) + 196; R2 = 0.85
-40log10(R) + 202; R2 = 0.84
2log10(R) + 134; R2 = 0.86
126 Hz Decay Curve
-33log10(R) + 199; R2 = 0.75
-51log10(R) + 220; R2 = 0.8
-10log10(R) + 153; R2 = 0.66
251 Hz Decay Curve
-29log10(R) + 192; R2 = 0.85
-44log10(R) + 207; R2 = 0.82
-4log10(R) + 142; R2 = 0.53
501 Hz Decay Curve
-17log10(R) + 173; R2 = 0.85
-42log10(R) + 201; R2 = 0.8
-2log10(R) + 137; R2 = 0.31
1000 Hz Decay Curve
-15log10(R) + 172; R2 = 0.6
-37log10(R) + 195; R2 = 0.74
3log10(R) + 130; R2 = 0.48
1995 Hz Decay Curve
-14log10(R) + 174; R2 = 0.82
-36log10(R) + 192; R2 = 0.78
-9log10(R) + 149; R2 = 0.62
3981 Hz Decay Curve
-21log10(R) + 188; R2 = 0.83
-36log10(R) + 194; R2 = 0.84
-14log10(R) + 158; R2 = 0.83
7943 Hz Decay Curve
-22log10(R) + 190; R2 = 0.84
-35log10(R) + 189; R2 = 0.84
-12log10(R) + 152; R2 = 0.77
15849 Hz Decay Curve
-21log10(R) + 188; R2 = 0.82
-30log10(R) + 178; R2 = 0.84
-5log10(R) + 138; R2 = 0.78
SPL(dB)
Range (m)

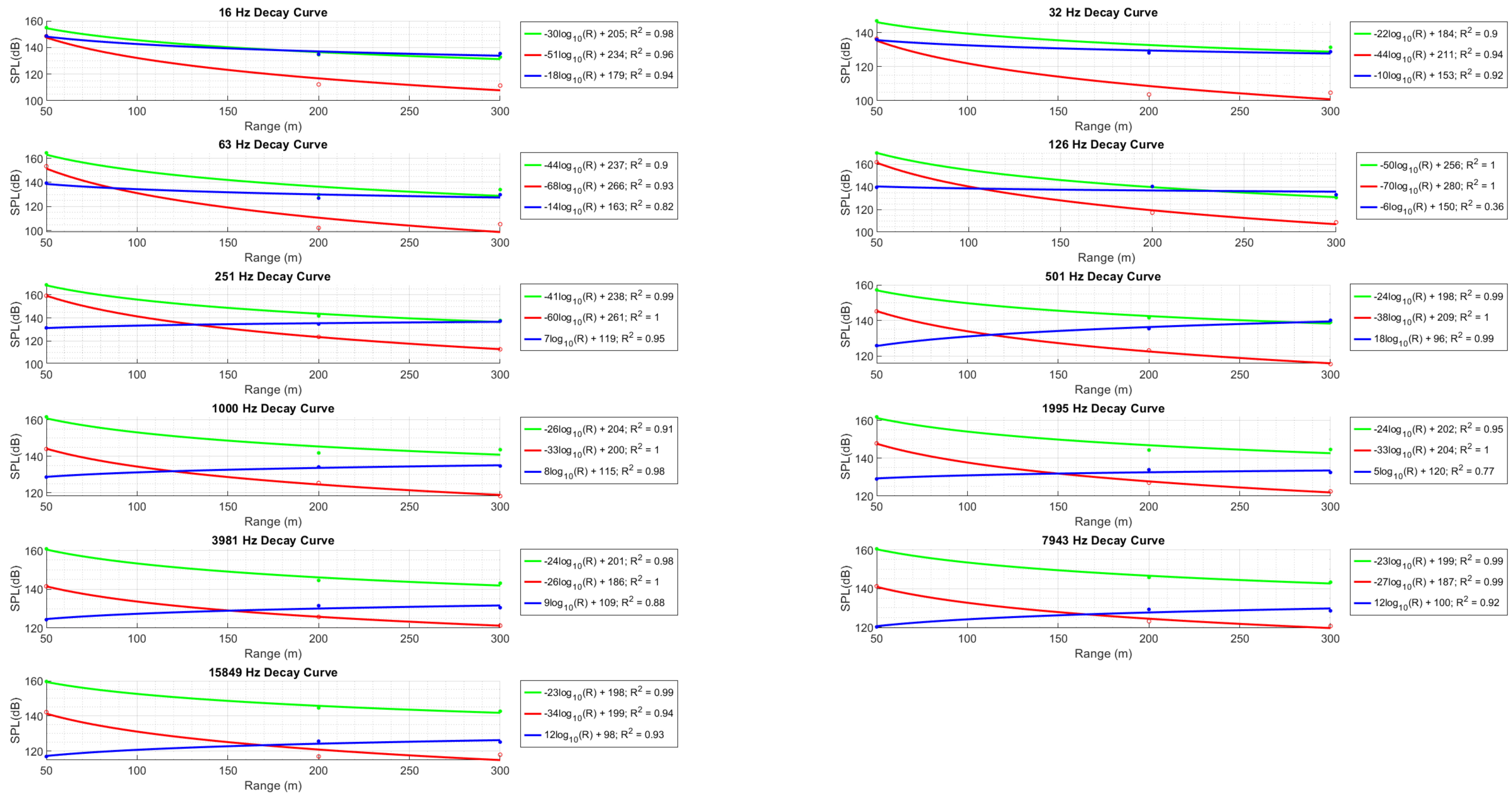
Manatee - 3


16 Hz Decay Curve
-32log10(R) + 217; R2 = 0.85
-30log10(R) + 207; R2 = 0.85
-30log10(R) + 207; R2 = 0.85
32 Hz Decay Curve
-22log10(R) + 195; R2 = 0.85
-18log10(R) + 180; R2 = 0.84
-17log10(R) + 178; R2 = 0.84
63 Hz Decay Curve
-8log10(R) + 165; R2 = 0.85
-2log10(R) + 144; R2 = 0.82
-1log10(R) + 142; R2 = 0.75
126 Hz Decay Curve
-1log10(R) + 148; R2 = 0.9
7log10(R) + 124; R2 = 0.85
8log10(R) + 121; R2 = 0.85
251 Hz Decay Curve
2log10(R) + 142; R2 = 0.82
11log10(R) + 114; R2 = 0.85
12log10(R) + 112; R2 = 0.85
501 Hz Decay Curve
-2log10(R) + 151; R2 = 0.86
12log10(R) + 113; R2 = 0.85
12log10(R) + 113; R2 = 0.86
1000 Hz Decay Curve
-10log10(R) + 168; R2 = 0.85
8log10(R) + 122; R2 = 0.85
8log10(R) + 122; R2 = 0.82
1995 Hz Decay Curve
-9log10(R) + 166; R2 = 0.85
7log10(R) + 122; R2 = 0.85
8log10(R) + 122; R2 = 0.82
3981 Hz Decay Curve
-11log10(R) + 172; R2 = 0.86
8log10(R) + 120; R2 = 0.83
9log10(R) + 120; R2 = 0.83
7943 Hz Decay Curve
-14log10(R) + 176; R2 = 0.86
10log10(R) + 115; R2 = 0.82
11log10(R) + 114; R2 = 0.83
15849 Hz Decay Curve
-13log10(R) + 175; R2 = 0.86
14log10(R) + 106; R2 = 0.83
15log10(R) + 104; R2 = 0.84
SPL(dB)
Range (m)

NASA - 1

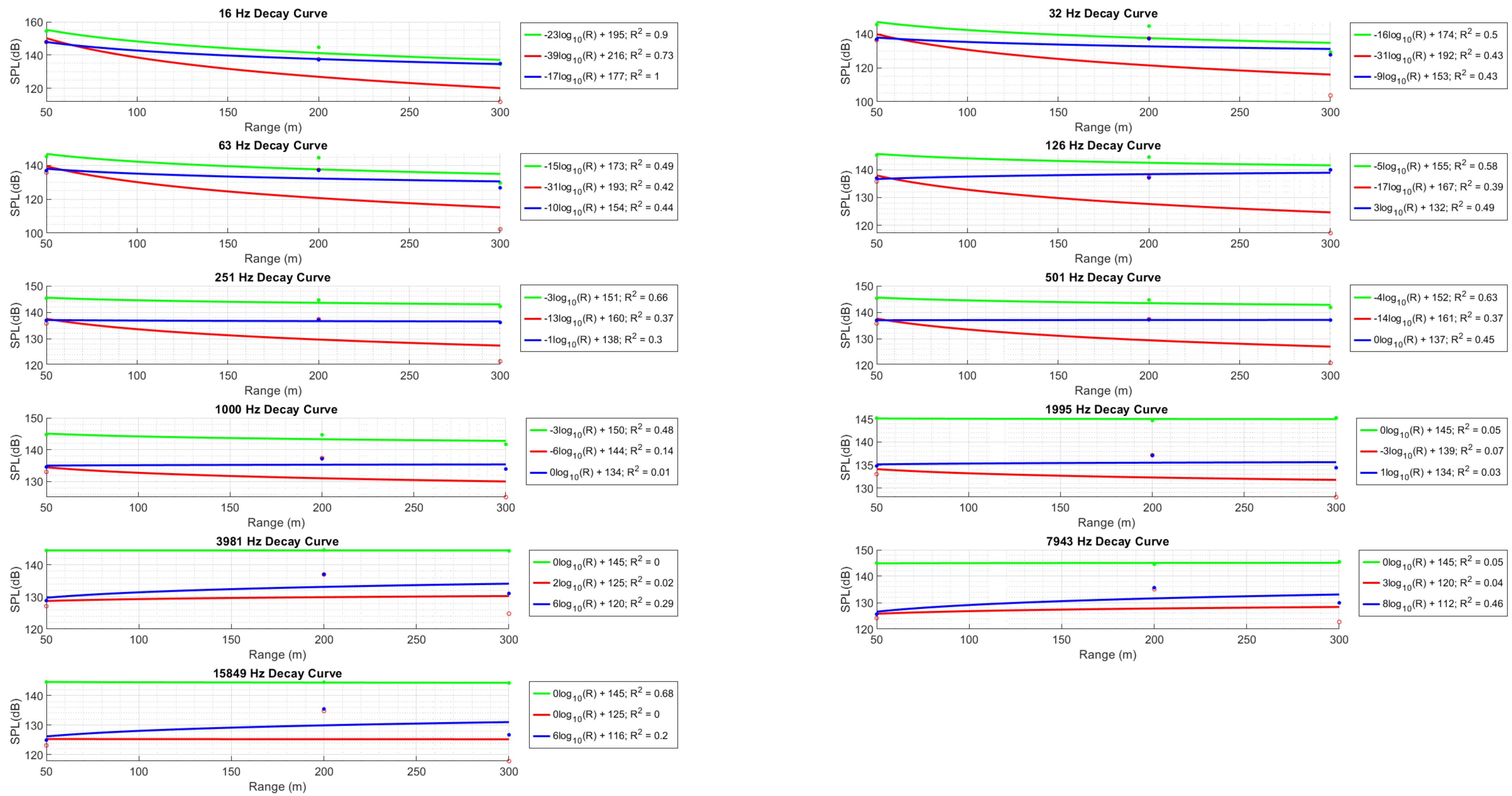

16 Hz Decay Curve
-27log10(R) + 212; R2 = 0.98
-36log10(R) + 222; R2 = 0.97
-15log10(R) + 181; R2 = 0.52
32 Hz Decay Curve
-21log10(R) + 193; R2 = 0.95
-32log10(R) + 205; R2 = 0.92
-9log10(R) + 163; R2 = 0.39
63 Hz Decay Curve
-11log10(R) + 171; R2 = 0.31
-16log10(R) + 170; R2 = 0.33
-8log10(R) + 154; R2 = 0.79
126 Hz Decay Curve
-4log10(R) + 156; R2 = 0.09
-10log10(R) + 158; R2 = 0.2
-3log10(R) + 142; R2 = 0.1
251 Hz Decay Curve
-3log10(R) + 153; R2 = 0.06
-10log10(R) + 155; R2 = 0.19
-3log10(R) + 140; R2 = 0.04
501 Hz Decay Curve
-4log10(R) + 157; R2 = 0.21
-9log10(R) + 155; R2 = 0.3
-3log10(R) + 141; R2 = 0.03
1000 Hz Decay Curve
-3log10(R) + 157; R2 = 0.07
-4log10(R) + 144; R2 = 0.1
-9log10(R) + 153; R2 = 0.45
1995 Hz Decay Curve
-3log10(R) + 157; R2 = 0.12
-5log10(R) + 146; R2 = 0.13
-9log10(R) + 152; R2 = 0.43
3981 Hz Decay Curve
-5log10(R) + 160; R2 = 0.2
-6log10(R) + 145; R2 = 0.23
-9log10(R) + 148; R2 = 0.3
7943 Hz Decay Curve
-7log10(R) + 165; R2 = 0.48
-7log10(R) + 142; R2 = 0.3
-9log10(R) + 145; R2 = 0.31
15849 Hz Decay Curve
-8log10(R) + 166; R2 = 0.66
-6log10(R) + 138; R2 = 0.37
-7log10(R) + 140; R2 = 0.22
SPL(dB)
Range (m)

NASA - 2

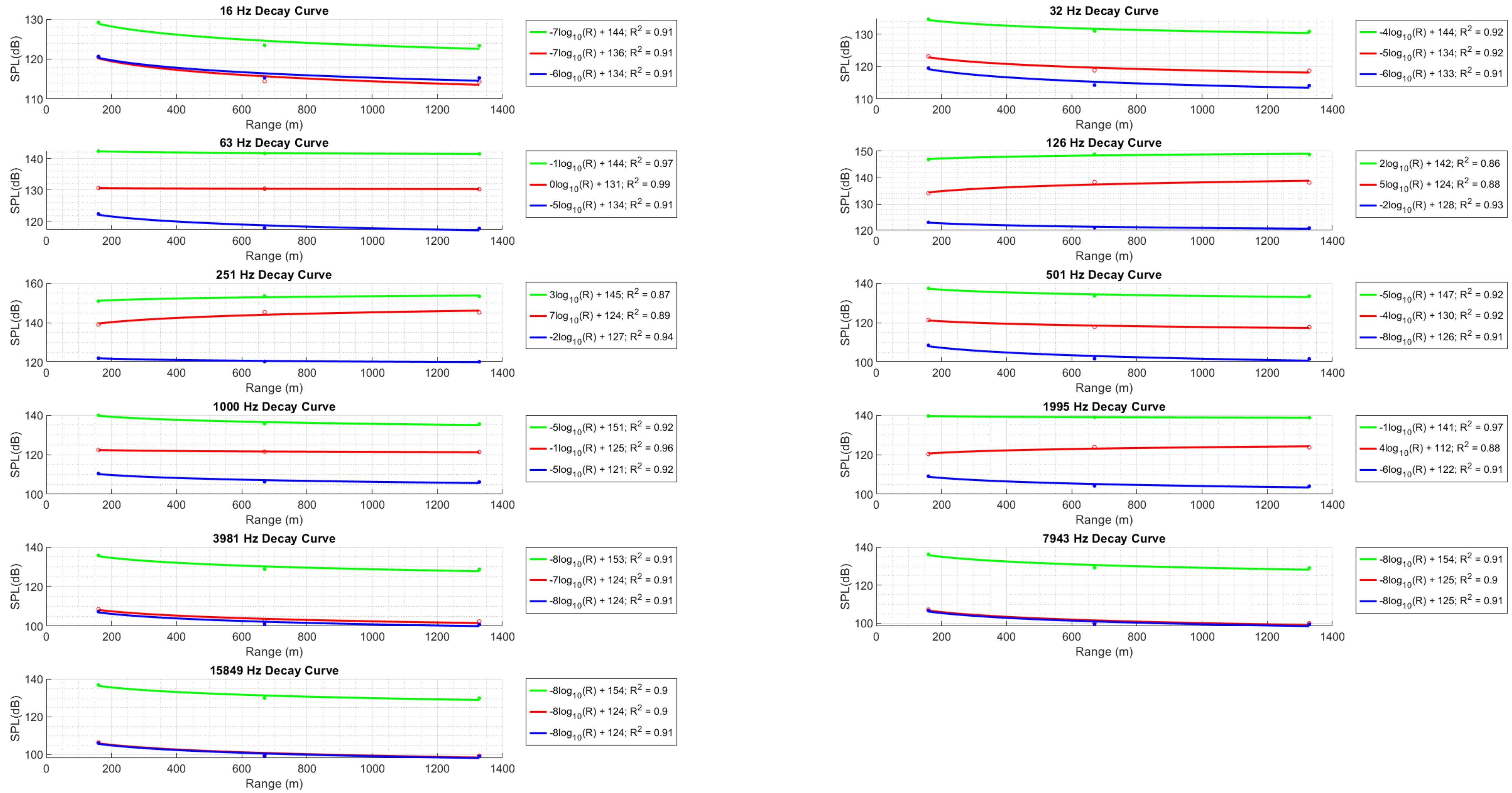


16 Hz Decay Curve
$-30\log_{10}(R) + 205$; $R^2 = 0.98$
$-51\log_{10}(R) + 234$; $R^2 = 0.96$
$-18\log_{10}(R) + 179$; $R^2 = 0.94$
32 Hz Decay Curve
$-22\log_{10}(R) + 184$; $R^2 = 0.9$
$-44\log_{10}(R) + 211$; $R^2 = 0.94$
$-10\log_{10}(R) + 153$; $R^2 = 0.92$
63 Hz Decay Curve
$-44\log_{10}(R) + 237$; $R^2 = 0.9$
$-68\log_{10}(R) + 266$; $R^2 = 0.93$
$-14\log_{10}(R) + 163$; $R^2 = 0.82$
126 Hz Decay Curve
$-50\log_{10}(R) + 256$; $R^2 = 1$
$-70\log_{10}(R) + 280$; $R^2 = 1$
$-6\log_{10}(R) + 150$; $R^2 = 0.36$
251 Hz Decay Curve
$-41\log_{10}(R) + 238$; $R^2 = 0.99$
$-60\log_{10}(R) + 261$; $R^2 = 1$
$7\log_{10}(R) + 119$; $R^2 = 0.95$
501 Hz Decay Curve
$-24\log_{10}(R) + 198$; $R^2 = 0.99$
$-38\log_{10}(R) + 209$; $R^2 = 1$
$18\log_{10}(R) + 96$; $R^2 = 0.99$
1000 Hz Decay Curve
$-26\log_{10}(R) + 204$; $R^2 = 0.91$
$-33\log_{10}(R) + 200$; $R^2 = 1$
$8\log_{10}(R) + 115$; $R^2 = 0.98$
1995 Hz Decay Curve
$-24\log_{10}(R) + 202$; $R^2 = 0.95$
$-33\log_{10}(R) + 204$; $R^2 = 1$
$5\log_{10}(R) + 120$; $R^2 = 0.77$
3981 Hz Decay Curve
$-24\log_{10}(R) + 201$; $R^2 = 0.98$
$-26\log_{10}(R) + 186$; $R^2 = 1$
$9\log_{10}(R) + 109$; $R^2 = 0.88$
7943 Hz Decay Curve
$-23\log_{10}(R) + 199$; $R^2 = 0.99$
$-27\log_{10}(R) + 187$; $R^2 = 0.99$
$12\log_{10}(R) + 100$; $R^2 = 0.92$
15849 Hz Decay Curve
$-23\log_{10}(R) + 198$; $R^2 = 0.99$
$-34\log_{10}(R) + 199$; $R^2 = 0.94$
$12\log_{10}(R) + 98$; $R^2 = 0.93$
SPL(dB)
Range (m)

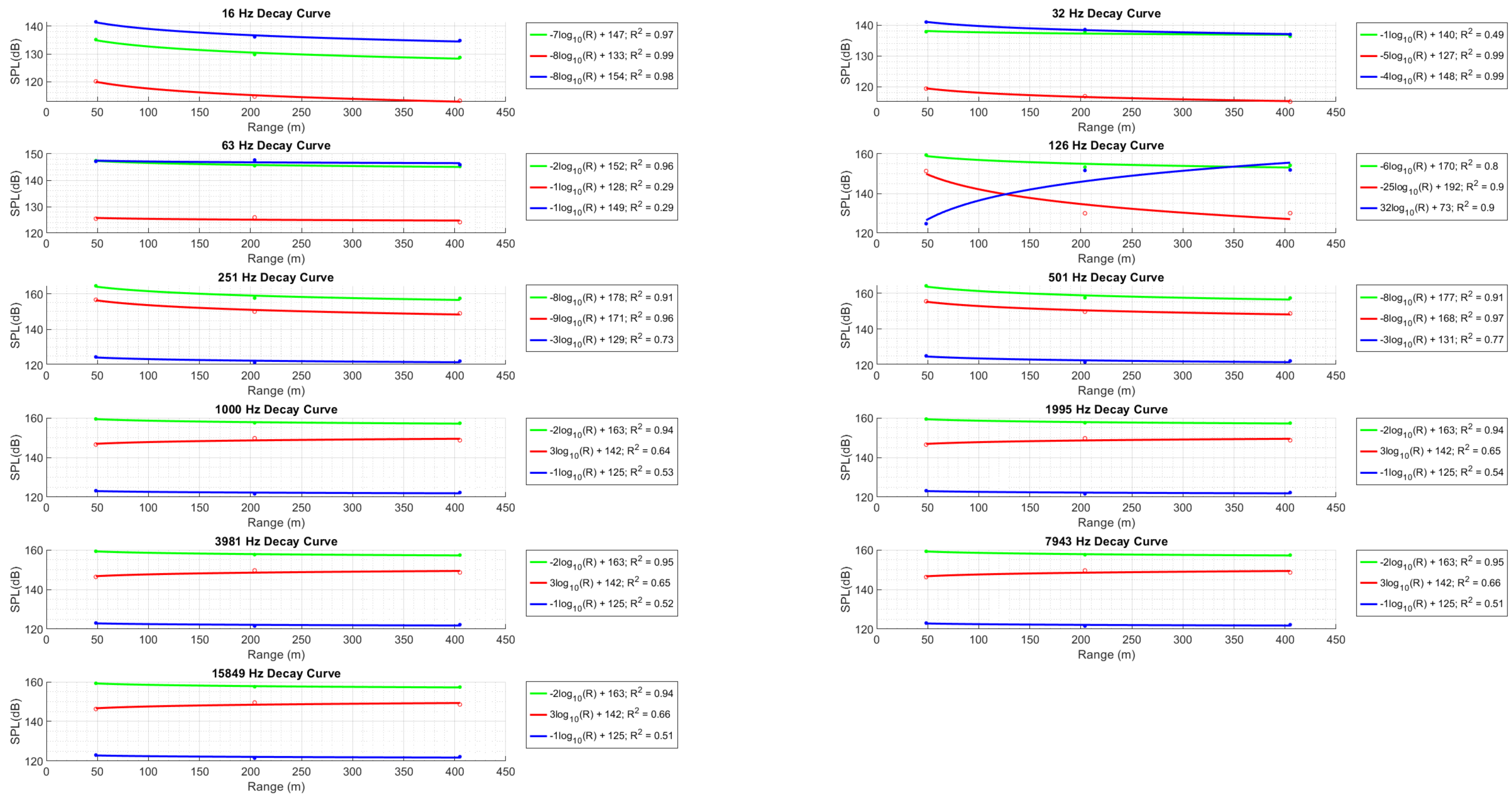
NASA - 3


16 Hz Decay Curve
-23log10(R) + 195; R2 = 0.9
-39log10(R) + 216; R2 = 0.73
-17log10(R) + 177; R2 = 1
32 Hz Decay Curve
-16log10(R) + 174; R2 = 0.5
-31log10(R) + 192; R2 = 0.43
-9log10(R) + 153; R2 = 0.43
63 Hz Decay Curve
-15log10(R) + 173; R2 = 0.49
-31log10(R) + 193; R2 = 0.42
-10log10(R) + 154; R2 = 0.44
126 Hz Decay Curve
-5log10(R) + 155; R2 = 0.58
-17log10(R) + 167; R2 = 0.39
3log10(R) + 132; R2 = 0.49
251 Hz Decay Curve
-3log10(R) + 151; R2 = 0.66
-13log10(R) + 160; R2 = 0.37
-1log10(R) + 138; R2 = 0.3
501 Hz Decay Curve
-4log10(R) + 152; R2 = 0.63
-14log10(R) + 161; R2 = 0.37
0log10(R) + 137; R2 = 0.45
1000 Hz Decay Curve
-3log10(R) + 150; R2 = 0.48
-6log10(R) + 144; R2 = 0.14
0log10(R) + 134; R2 = 0.01
1995 Hz Decay Curve
0log10(R) + 145; R2 = 0.05
-3log10(R) + 139; R2 = 0.07
1log10(R) + 134; R2 = 0.03
3981 Hz Decay Curve
0log10(R) + 145; R2 = 0
2log10(R) + 125; R2 = 0.02
6log10(R) + 120; R2 = 0.29
7943 Hz Decay Curve
0log10(R) + 145; R2 = 0.05
3log10(R) + 120; R2 = 0.04
8log10(R) + 112; R2 = 0.46
15849 Hz Decay Curve
0log10(R) + 145; R2 = 0.68
0log10(R) + 125; R2 = 0
6log10(R) + 116; R2 = 0.2
SPL(dB)
Range (m)

NASA - 4

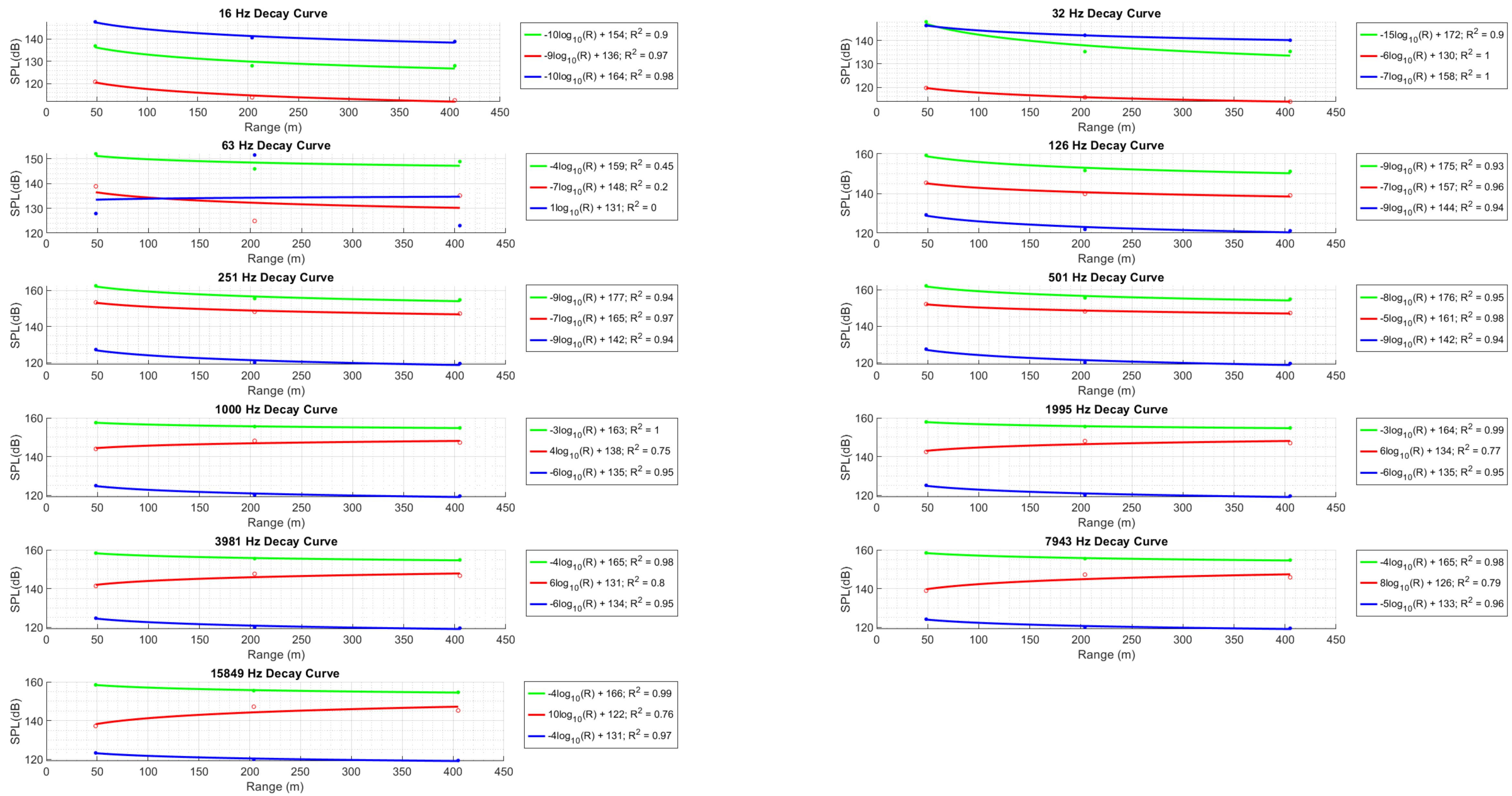

16 Hz Decay Curve
-7log10(R) + 144; R2 = 0.91
-7log10(R) + 136; R2 = 0.91
-6log10(R) + 134; R2 = 0.91
32 Hz Decay Curve
-4log10(R) + 144; R2 = 0.92
-5log10(R) + 134; R2 = 0.92
-6log10(R) + 133; R2 = 0.91
63 Hz Decay Curve
-1log10(R) + 144; R2 = 0.97
0log10(R) + 131; R2 = 0.99
-5log10(R) + 134; R2 = 0.91
126 Hz Decay Curve
2log10(R) + 142; R2 = 0.86
5log10(R) + 124; R2 = 0.88
-2log10(R) + 128; R2 = 0.93
251 Hz Decay Curve
3log10(R) + 145; R2 = 0.87
7log10(R) + 124; R2 = 0.89
-2log10(R) + 127; R2 = 0.94
501 Hz Decay Curve
-5log10(R) + 147; R2 = 0.92
-4log10(R) + 130; R2 = 0.92
-8log10(R) + 126; R2 = 0.91
1000 Hz Decay Curve
-5log10(R) + 151; R2 = 0.92
-1log10(R) + 125; R2 = 0.96
-5log10(R) + 121; R2 = 0.92
1995 Hz Decay Curve
-1log10(R) + 141; R2 = 0.97
4log10(R) + 112; R2 = 0.88
-6log10(R) + 122; R2 = 0.91
3981 Hz Decay Curve
-8log10(R) + 153; R2 = 0.91
-7log10(R) + 124; R2 = 0.91
-8log10(R) + 124; R2 = 0.91
7943 Hz Decay Curve
-8log10(R) + 154; R2 = 0.91
-8log10(R) + 125; R2 = 0.9
-8log10(R) + 125; R2 = 0.91
15849 Hz Decay Curve
-8log10(R) + 154; R2 = 0.9
-8log10(R) + 124; R2 = 0.9
-8log10(R) + 124; R2 = 0.91
SPL(dB)
Range (m)

NASA - 5

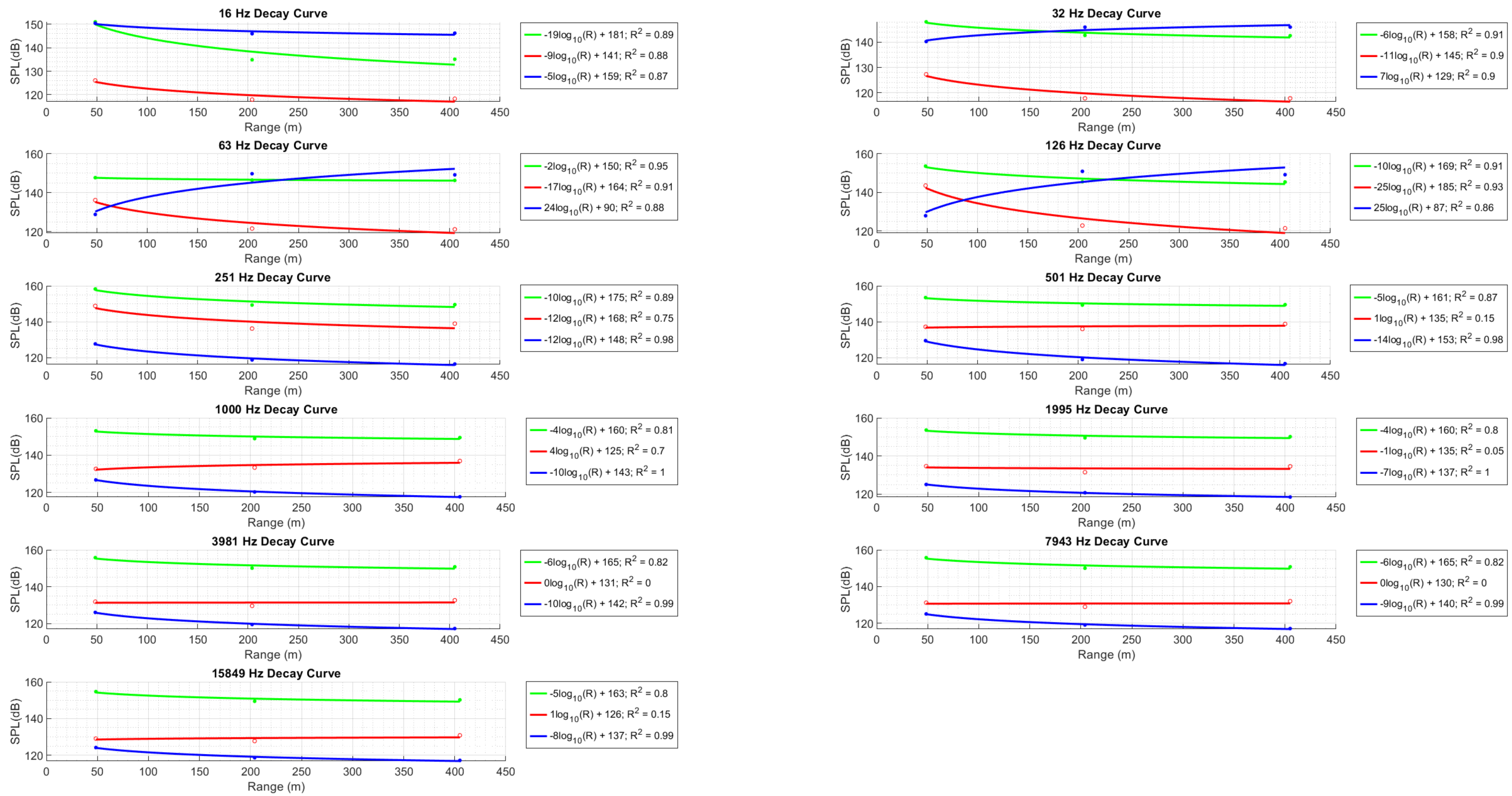


16 Hz Decay Curve
-7log10(R) + 147; R2 = 0.97
-8log10(R) + 133; R2 = 0.99
-8log10(R) + 154; R2 = 0.98
32 Hz Decay Curve
-1log10(R) + 140; R2 = 0.49
-5log10(R) + 127; R2 = 0.99
-4log10(R) + 148; R2 = 0.99
63 Hz Decay Curve
-2log10(R) + 152; R2 = 0.96
-1log10(R) + 128; R2 = 0.29
-1log10(R) + 149; R2 = 0.29
126 Hz Decay Curve
-6log10(R) + 170; R2 = 0.8
-25log10(R) + 192; R2 = 0.9
32log10(R) + 73; R2 = 0.9
251 Hz Decay Curve
-8log10(R) + 178; R2 = 0.91
-9log10(R) + 171; R2 = 0.96
-3log10(R) + 129; R2 = 0.73
501 Hz Decay Curve
-8log10(R) + 177; R2 = 0.91
-8log10(R) + 168; R2 = 0.97
-3log10(R) + 131; R2 = 0.77
1000 Hz Decay Curve
-2log10(R) + 163; R2 = 0.94
3log10(R) + 142; R2 = 0.64
-1log10(R) + 125; R2 = 0.53
1995 Hz Decay Curve
-2log10(R) + 163; R2 = 0.94
3log10(R) + 142; R2 = 0.65
-1log10(R) + 125; R2 = 0.54
3981 Hz Decay Curve
-2log10(R) + 163; R2 = 0.95
3log10(R) + 142; R2 = 0.65
-1log10(R) + 125; R2 = 0.52
7943 Hz Decay Curve
-2log10(R) + 163; R2 = 0.95
3log10(R) + 142; R2 = 0.66
-1log10(R) + 125; R2 = 0.51
15849 Hz Decay Curve
-2log10(R) + 163; R2 = 0.94
3log10(R) + 142; R2 = 0.66
-1log10(R) + 125; R2 = 0.51
SPL(dB)
Range (m)

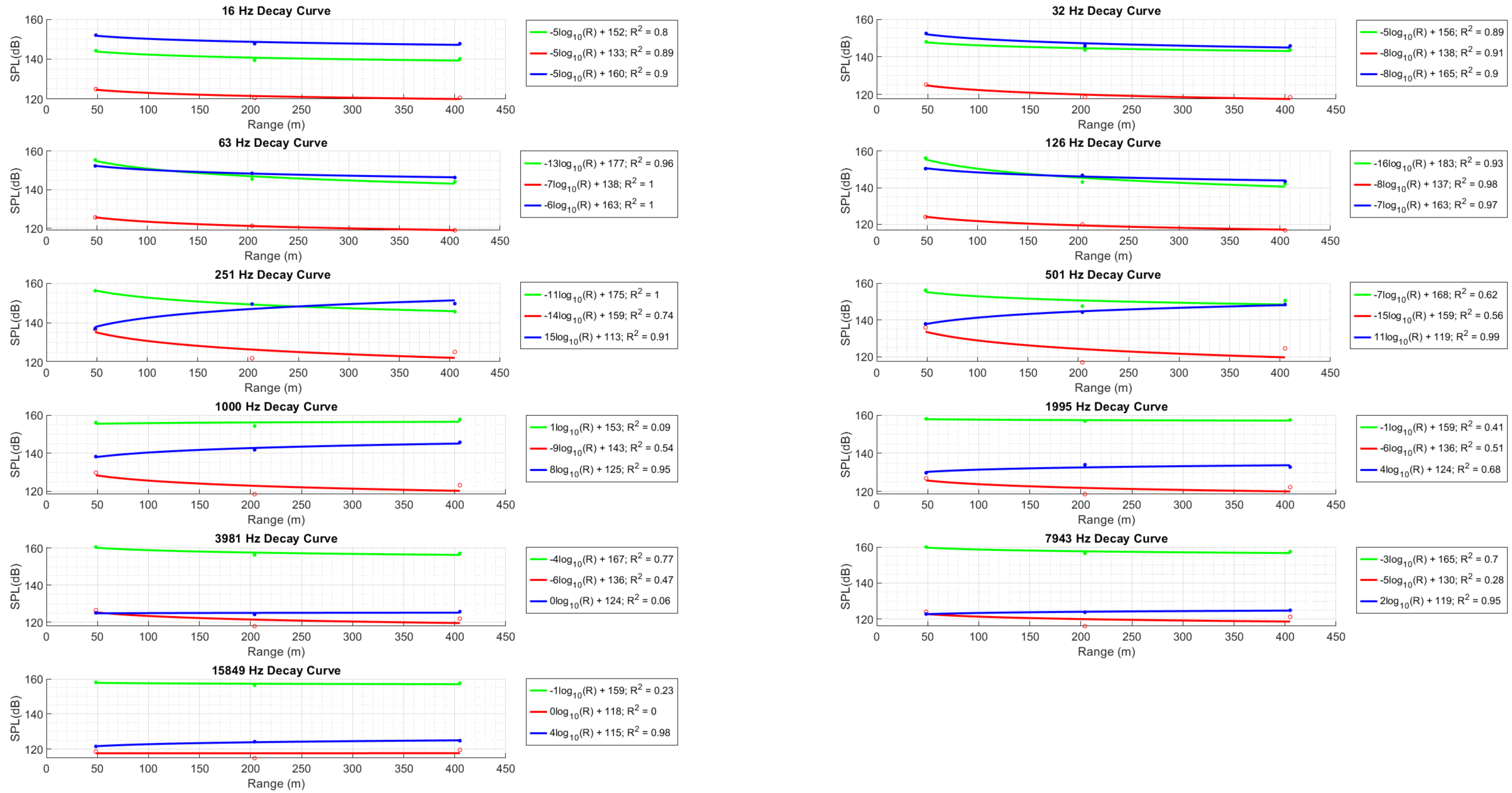
NASA - 6


16 Hz Decay Curve
$-10\log_{10}(R) + 154;\ R^2 = 0.9$
$-9\log_{10}(R) + 136;\ R^2 = 0.97$
$-10\log_{10}(R) + 164;\ R^2 = 0.98$
32 Hz Decay Curve
$-15\log_{10}(R) + 172;\ R^2 = 0.9$
$-6\log_{10}(R) + 130;\ R^2 = 1$
$-7\log_{10}(R) + 158;\ R^2 = 1$
63 Hz Decay Curve
$-4\log_{10}(R) + 159;\ R^2 = 0.45$
$-7\log_{10}(R) + 148;\ R^2 = 0.2$
$1\log_{10}(R) + 131;\ R^2 = 0$
126 Hz Decay Curve
$-9\log_{10}(R) + 175;\ R^2 = 0.93$
$-7\log_{10}(R) + 157;\ R^2 = 0.96$
$-9\log_{10}(R) + 144;\ R^2 = 0.94$
251 Hz Decay Curve
$-9\log_{10}(R) + 177;\ R^2 = 0.94$
$-7\log_{10}(R) + 165;\ R^2 = 0.97$
$-9\log_{10}(R) + 142;\ R^2 = 0.94$
501 Hz Decay Curve
$-8\log_{10}(R) + 176;\ R^2 = 0.95$
$-5\log_{10}(R) + 161;\ R^2 = 0.98$
$-9\log_{10}(R) + 142;\ R^2 = 0.94$
1000 Hz Decay Curve
$-3\log_{10}(R) + 163;\ R^2 = 1$
$4\log_{10}(R) + 138;\ R^2 = 0.75$
$-6\log_{10}(R) + 135;\ R^2 = 0.95$
1995 Hz Decay Curve
$-3\log_{10}(R) + 164;\ R^2 = 0.99$
$6\log_{10}(R) + 134;\ R^2 = 0.77$
$-6\log_{10}(R) + 135;\ R^2 = 0.95$
3981 Hz Decay Curve
$-4\log_{10}(R) + 165;\ R^2 = 0.98$
$6\log_{10}(R) + 131;\ R^2 = 0.8$
$-6\log_{10}(R) + 134;\ R^2 = 0.95$
7943 Hz Decay Curve
$-4\log_{10}(R) + 165;\ R^2 = 0.98$
$8\log_{10}(R) + 126;\ R^2 = 0.79$
$-5\log_{10}(R) + 133;\ R^2 = 0.96$
15849 Hz Decay Curve
$-4\log_{10}(R) + 166;\ R^2 = 0.99$
$10\log_{10}(R) + 122;\ R^2 = 0.76$
$-4\log_{10}(R) + 131;\ R^2 = 0.97$
SPL(dB)
Range (m)

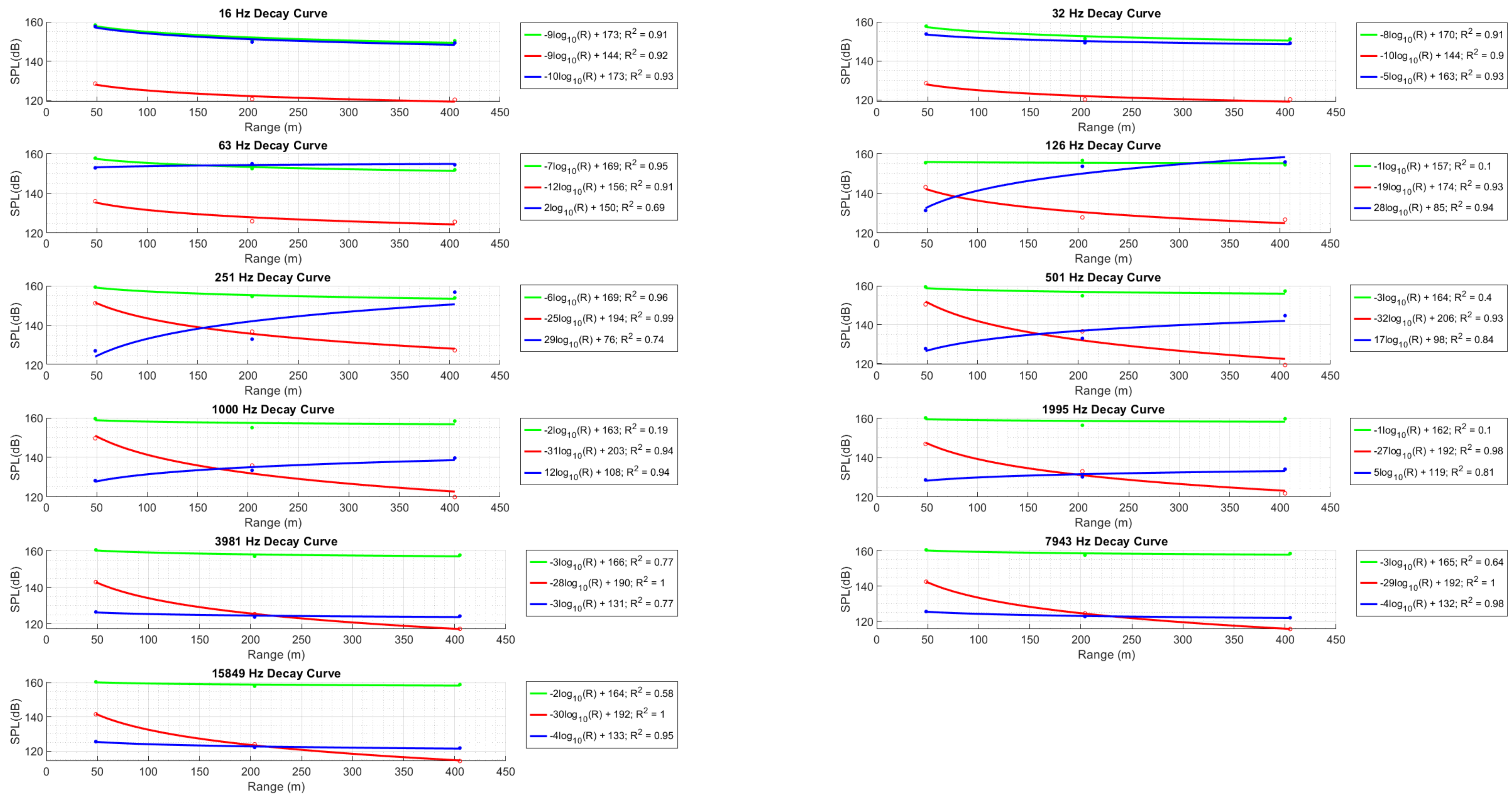
NASA - 7


16 Hz Decay Curve
-19log10(R) + 181; R2 = 0.89
-9log10(R) + 141; R2 = 0.88
-5log10(R) + 159; R2 = 0.87
32 Hz Decay Curve
-6log10(R) + 158; R2 = 0.91
-11log10(R) + 145; R2 = 0.9
7log10(R) + 129; R2 = 0.9
63 Hz Decay Curve
-2log10(R) + 150; R2 = 0.95
-17log10(R) + 164; R2 = 0.91
24log10(R) + 90; R2 = 0.88
126 Hz Decay Curve
-10log10(R) + 169; R2 = 0.91
-25log10(R) + 185; R2 = 0.93
25log10(R) + 87; R2 = 0.86
251 Hz Decay Curve
-10log10(R) + 175; R2 = 0.89
-12log10(R) + 168; R2 = 0.75
-12log10(R) + 148; R2 = 0.98
501 Hz Decay Curve
-5log10(R) + 161; R2 = 0.87
1log10(R) + 135; R2 = 0.15
-14log10(R) + 153; R2 = 0.98
1000 Hz Decay Curve
-4log10(R) + 160; R2 = 0.81
4log10(R) + 125; R2 = 0.7
-10log10(R) + 143; R2 = 1
1995 Hz Decay Curve
-4log10(R) + 160; R2 = 0.8
-1log10(R) + 135; R2 = 0.05
-7log10(R) + 137; R2 = 1
3981 Hz Decay Curve
-6log10(R) + 165; R2 = 0.82
0log10(R) + 131; R2 = 0
-10log10(R) + 142; R2 = 0.99
7943 Hz Decay Curve
-6log10(R) + 165; R2 = 0.82
0log10(R) + 130; R2 = 0
-9log10(R) + 140; R2 = 0.99
15849 Hz Decay Curve
-5log10(R) + 163; R2 = 0.8
1log10(R) + 126; R2 = 0.15
-8log10(R) + 137; R2 = 0.99
SPL(dB)
Range (m)

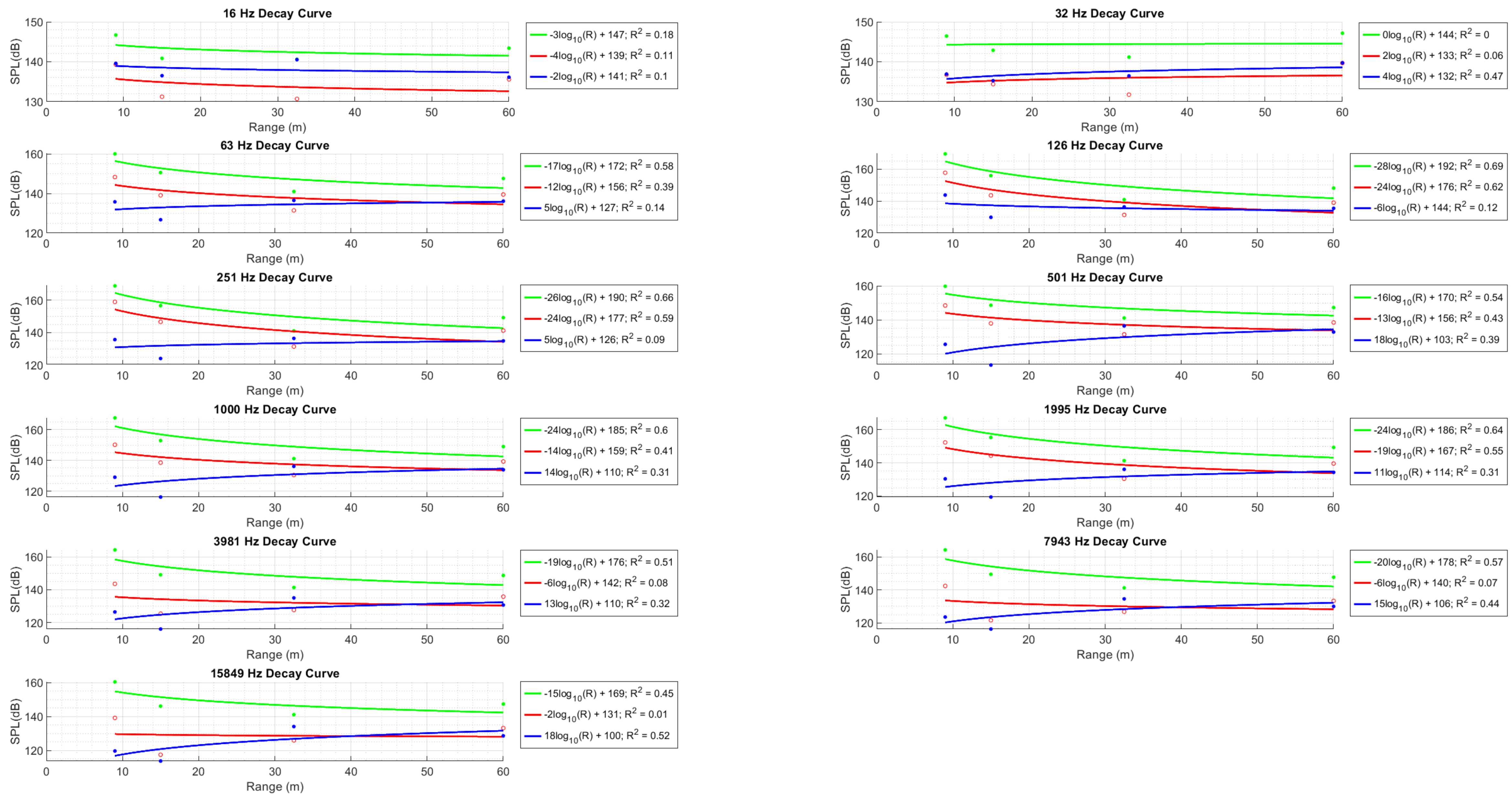
NASA - 8


16 Hz Decay Curve
-5log10(R) + 152; R2 = 0.8
-5log10(R) + 133; R2 = 0.89
-5log10(R) + 160; R2 = 0.9
32 Hz Decay Curve
-5log10(R) + 156; R2 = 0.89
-8log10(R) + 138; R2 = 0.91
-8log10(R) + 165; R2 = 0.9
63 Hz Decay Curve
-13log10(R) + 177; R2 = 0.96
-7log10(R) + 138; R2 = 1
-6log10(R) + 163; R2 = 1
126 Hz Decay Curve
-16log10(R) + 183; R2 = 0.93
-8log10(R) + 137; R2 = 0.98
-7log10(R) + 163; R2 = 0.97
251 Hz Decay Curve
-11log10(R) + 175; R2 = 1
-14log10(R) + 159; R2 = 0.74
15log10(R) + 113; R2 = 0.91
501 Hz Decay Curve
-7log10(R) + 168; R2 = 0.62
-15log10(R) + 159; R2 = 0.56
11log10(R) + 119; R2 = 0.99
1000 Hz Decay Curve
1log10(R) + 153; R2 = 0.09
-9log10(R) + 143; R2 = 0.54
8log10(R) + 125; R2 = 0.95
1995 Hz Decay Curve
-1log10(R) + 159; R2 = 0.41
-6log10(R) + 136; R2 = 0.51
4log10(R) + 124; R2 = 0.68
3981 Hz Decay Curve
-4log10(R) + 167; R2 = 0.77
-6log10(R) + 136; R2 = 0.47
0log10(R) + 124; R2 = 0.06
7943 Hz Decay Curve
-3log10(R) + 165; R2 = 0.7
-5log10(R) + 130; R2 = 0.28
2log10(R) + 119; R2 = 0.95
15849 Hz Decay Curve
-1log10(R) + 159; R2 = 0.23
0log10(R) + 118; R2 = 0
4log10(R) + 115; R2 = 0.98
SPL(dB)
Range (m)

NASA - 9

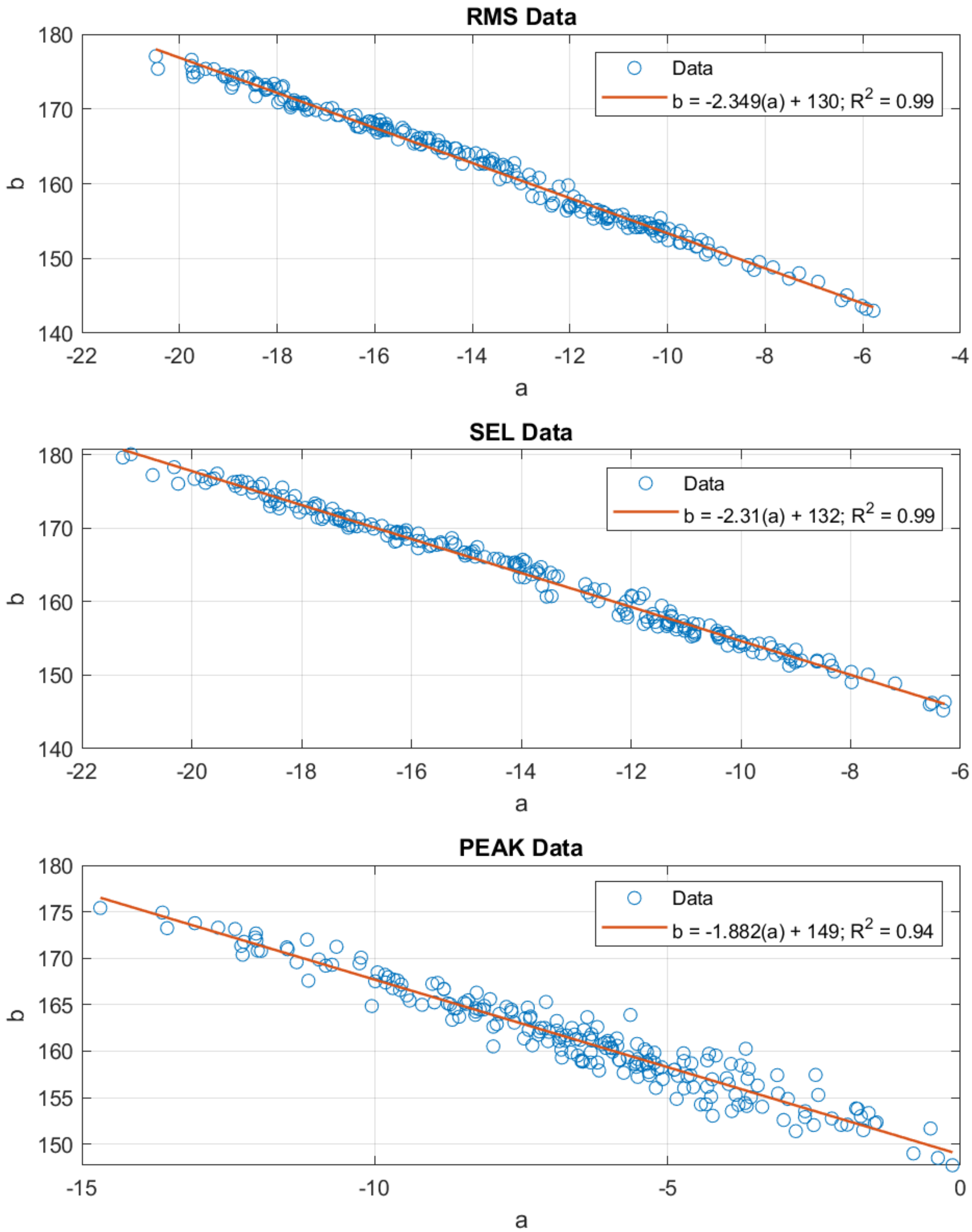

16 Hz Decay Curve
-9log10(R) + 173; R2 = 0.91
-9log10(R) + 144; R2 = 0.92
-10log10(R) + 173; R2 = 0.93
32 Hz Decay Curve
-8log10(R) + 170; R2 = 0.91
-10log10(R) + 144; R2 = 0.9
-5log10(R) + 163; R2 = 0.93
63 Hz Decay Curve
-7log10(R) + 169; R2 = 0.95
-12log10(R) + 156; R2 = 0.91
2log10(R) + 150; R2 = 0.69
126 Hz Decay Curve
-1log10(R) + 157; R2 = 0.1
-19log10(R) + 174; R2 = 0.93
28log10(R) + 85; R2 = 0.94
251 Hz Decay Curve
-6log10(R) + 169; R2 = 0.96
-25log10(R) + 194; R2 = 0.99
29log10(R) + 76; R2 = 0.74
501 Hz Decay Curve
-3log10(R) + 164; R2 = 0.4
-32log10(R) + 206; R2 = 0.93
17log10(R) + 98; R2 = 0.84
1000 Hz Decay Curve
-2log10(R) + 163; R2 = 0.19
-31log10(R) + 203; R2 = 0.94
12log10(R) + 108; R2 = 0.94
1995 Hz Decay Curve
-1log10(R) + 162; R2 = 0.1
-27log10(R) + 192; R2 = 0.98
5log10(R) + 119; R2 = 0.81
3981 Hz Decay Curve
-3log10(R) + 166; R2 = 0.77
-28log10(R) + 190; R2 = 1
-3log10(R) + 131; R2 = 0.77
7943 Hz Decay Curve
-3log10(R) + 165; R2 = 0.64
-29log10(R) + 192; R2 = 1
-4log10(R) + 132; R2 = 0.98
15849 Hz Decay Curve
-2log10(R) + 164; R2 = 0.58
-30log10(R) + 192; R2 = 1
-4log10(R) + 133; R2 = 0.95
SPL(dB)
Range (m)

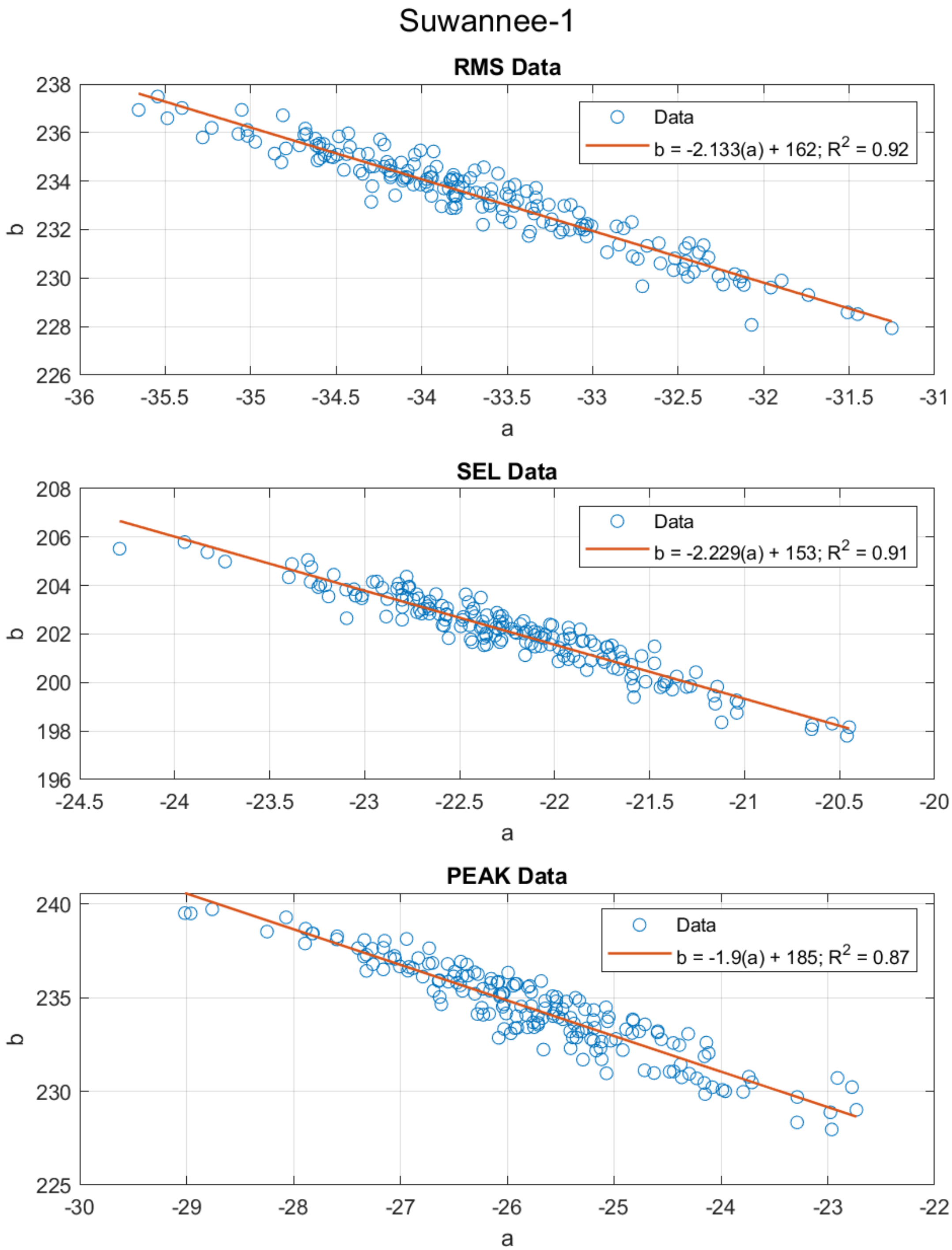
Broward - 1


16 Hz Decay Curve
$-3\log_{10}(R) + 147$; $R^2 = 0.18$
$-4\log_{10}(R) + 139$; $R^2 = 0.11$
$-2\log_{10}(R) + 141$; $R^2 = 0.1$
32 Hz Decay Curve
$0\log_{10}(R) + 144$; $R^2 = 0$
$2\log_{10}(R) + 133$; $R^2 = 0.06$
$4\log_{10}(R) + 132$; $R^2 = 0.47$
63 Hz Decay Curve
$-17\log_{10}(R) + 172$; $R^2 = 0.58$
$-12\log_{10}(R) + 156$; $R^2 = 0.39$
$5\log_{10}(R) + 127$; $R^2 = 0.14$
126 Hz Decay Curve
$-28\log_{10}(R) + 192$; $R^2 = 0.69$
$-24\log_{10}(R) + 176$; $R^2 = 0.62$
$-6\log_{10}(R) + 144$; $R^2 = 0.12$
251 Hz Decay Curve
$-26\log_{10}(R) + 190$; $R^2 = 0.66$
$-24\log_{10}(R) + 177$; $R^2 = 0.59$
$5\log_{10}(R) + 126$; $R^2 = 0.09$
501 Hz Decay Curve
$-16\log_{10}(R) + 170$; $R^2 = 0.54$
$-13\log_{10}(R) + 156$; $R^2 = 0.43$
$18\log_{10}(R) + 103$; $R^2 = 0.39$
1000 Hz Decay Curve
$-24\log_{10}(R) + 185$; $R^2 = 0.6$
$-14\log_{10}(R) + 159$; $R^2 = 0.41$
$14\log_{10}(R) + 110$; $R^2 = 0.31$
1995 Hz Decay Curve
$-24\log_{10}(R) + 186$; $R^2 = 0.64$
$-19\log_{10}(R) + 167$; $R^2 = 0.55$
$11\log_{10}(R) + 114$; $R^2 = 0.31$
3981 Hz Decay Curve
$-19\log_{10}(R) + 176$; $R^2 = 0.51$
$-6\log_{10}(R) + 142$; $R^2 = 0.08$
$13\log_{10}(R) + 110$; $R^2 = 0.32$
7943 Hz Decay Curve
$-20\log_{10}(R) + 178$; $R^2 = 0.57$
$-6\log_{10}(R) + 140$; $R^2 = 0.07$
$15\log_{10}(R) + 106$; $R^2 = 0.44$
15849 Hz Decay Curve
$-15\log_{10}(R) + 169$; $R^2 = 0.45$
$-2\log_{10}(R) + 131$; $R^2 = 0.01$
$18\log_{10}(R) + 100$; $R^2 = 0.52$
SPL(dB)
Range (m)

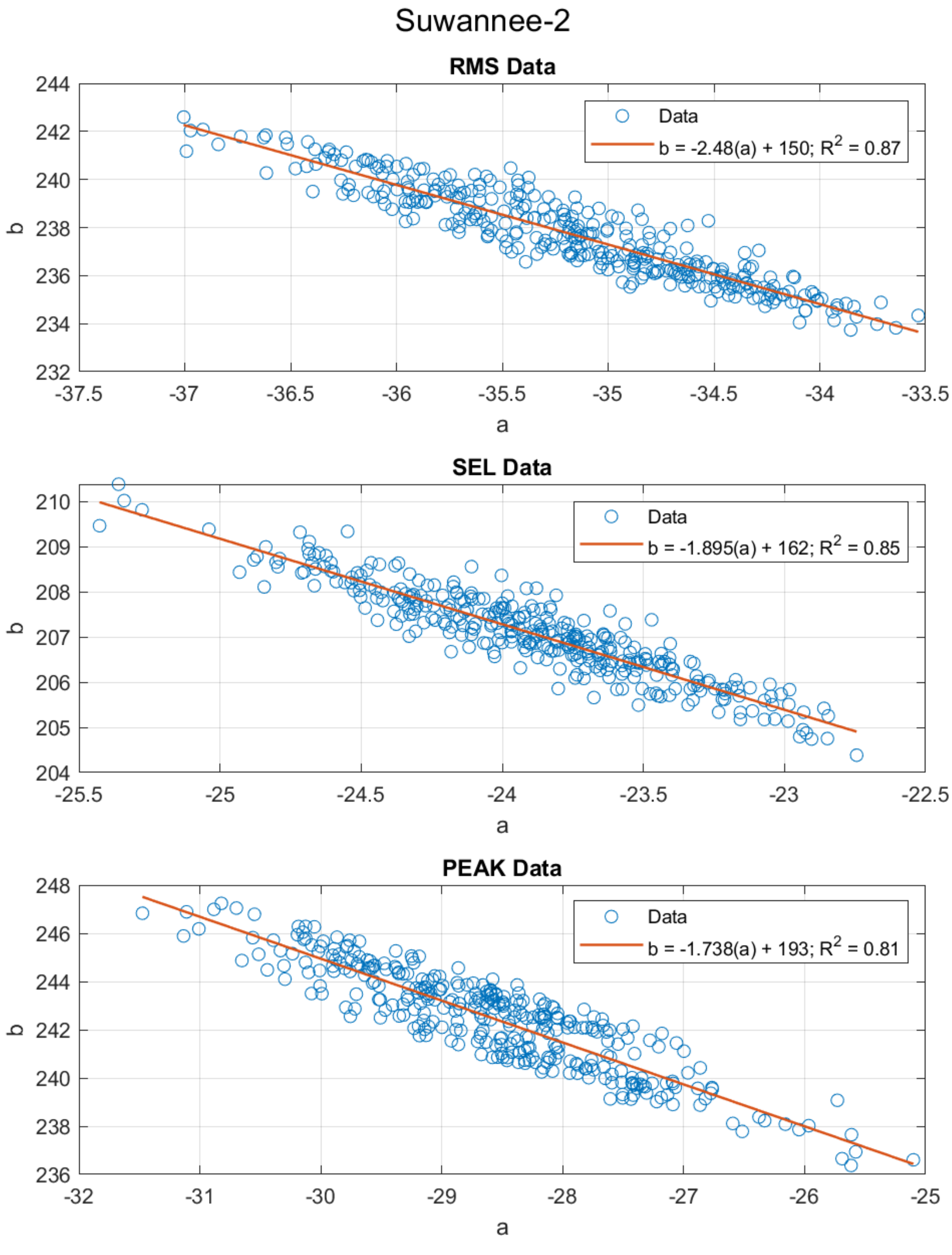
APPENDIX G
BLOW-BY-BLOW TL COEFFICIENTS PLOTS

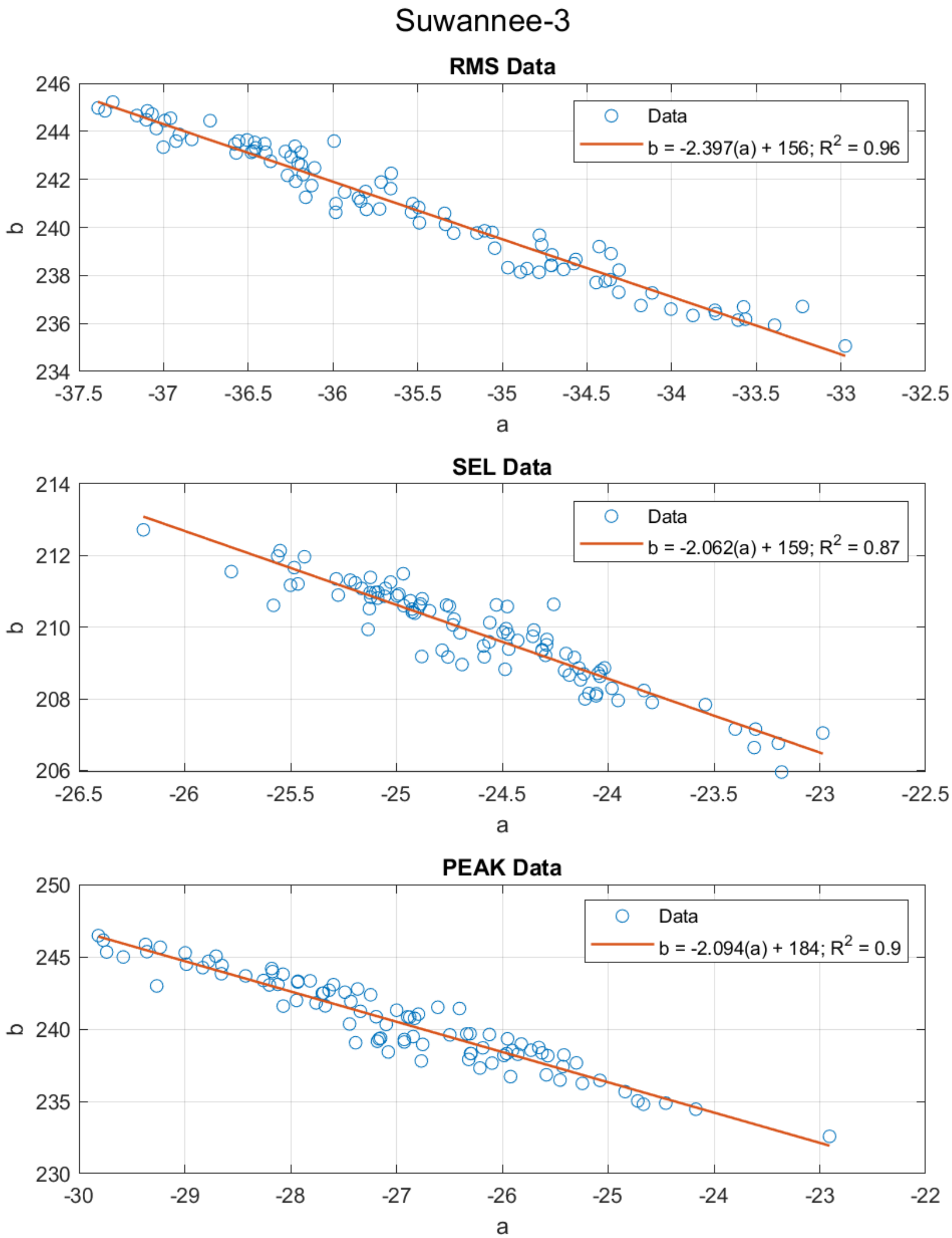
Bayway-1

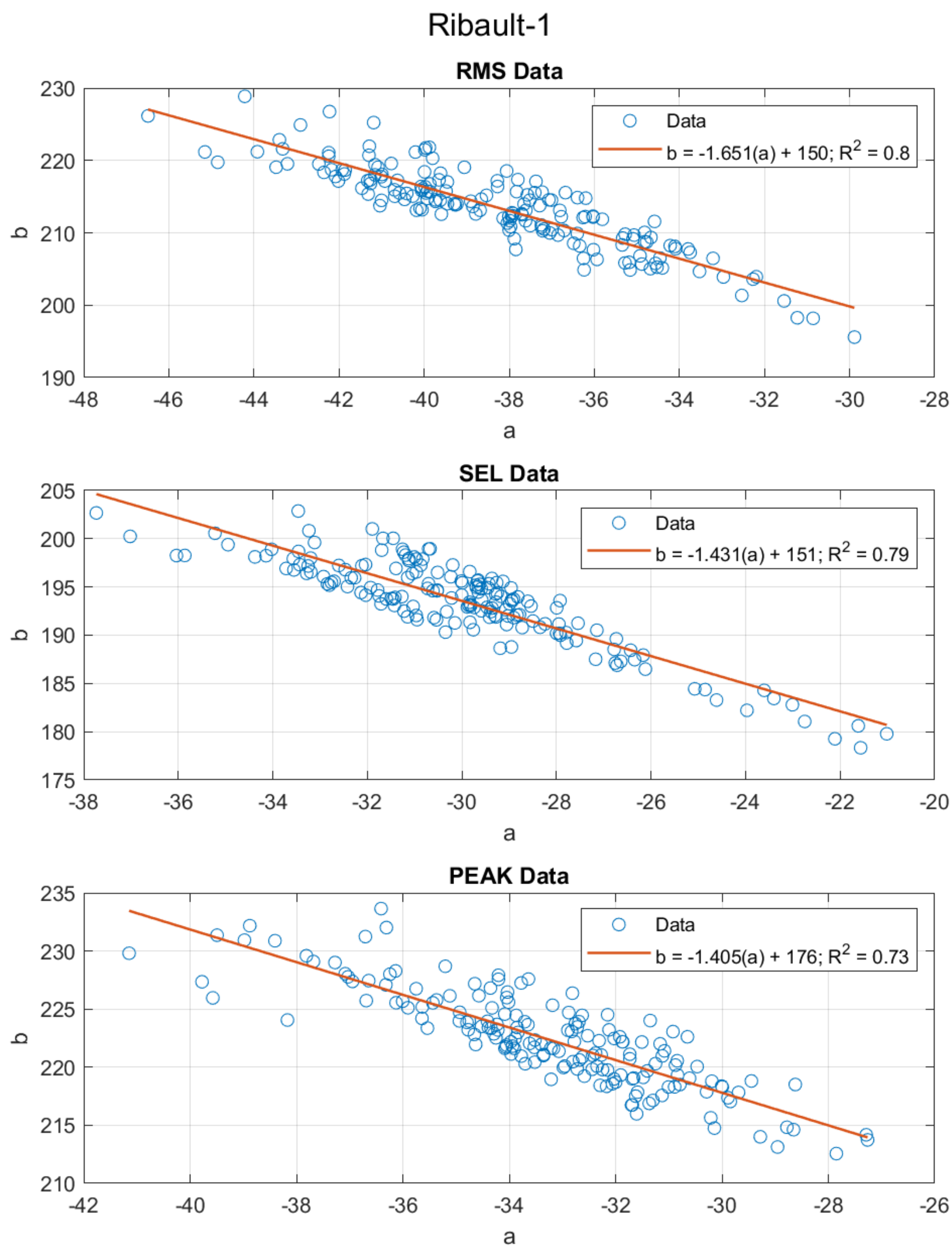

RMS Data
Data
b = -2.349(a) + 130; R2 = 0.99
b
a
SEL Data
Data
b = -2.31(a) + 132; R2 = 0.99
b
a
PEAK Data
Data
b = -1.882(a) + 149; R2 = 0.94
b
a



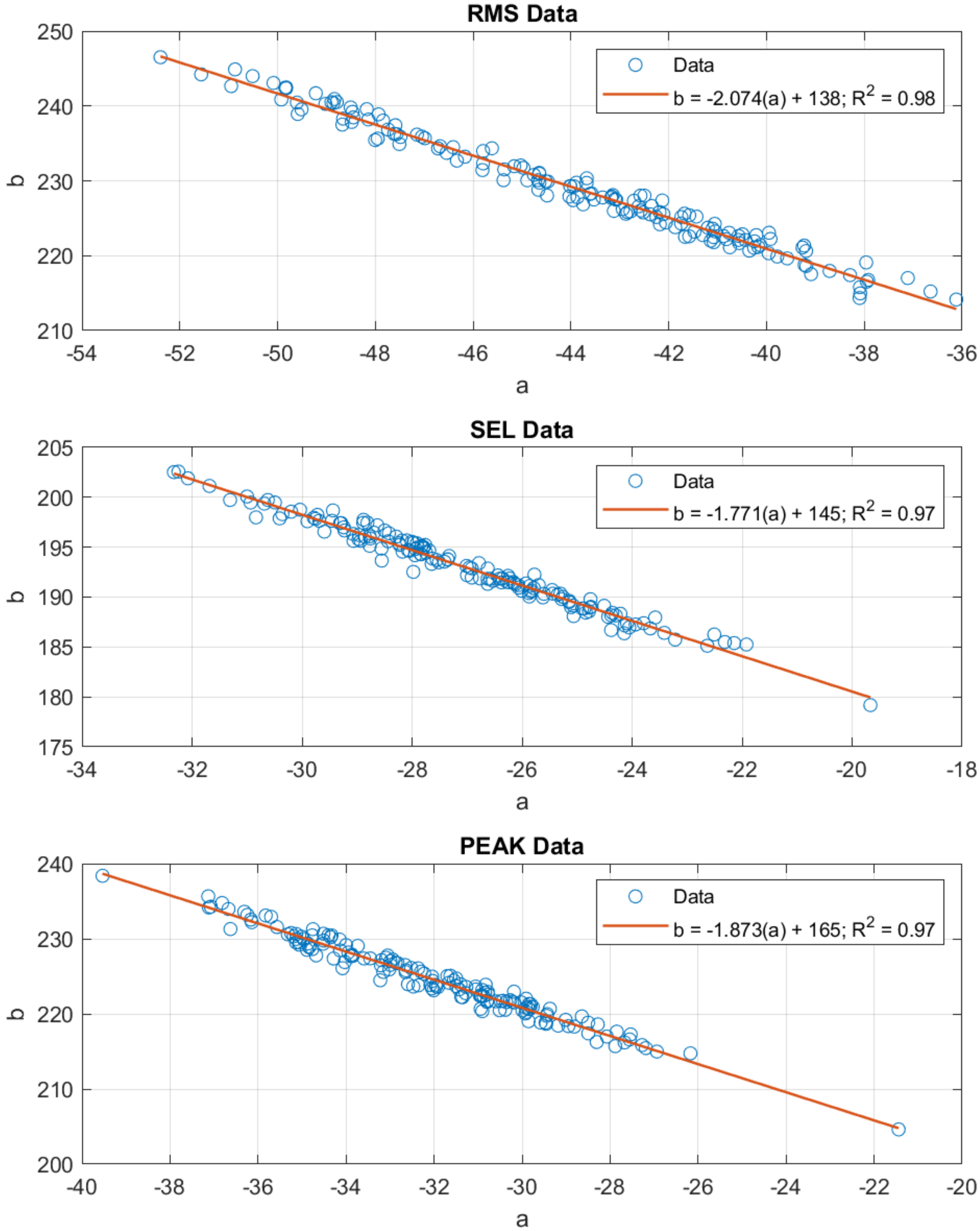
Suwannee-1
RMS Data
Data
b = -2.133(a) + 162; R2 = 0.92
b
a
SEL Data
Data
b = -2.229(a) + 153; R2 = 0.91
b
a
PEAK Data
Data
b = -1.9(a) + 185; R2 = 0.87
b
a


Suwannee-2
RMS Data
Data
b = -2.48(a) + 150; R^2 = 0.87
SEL Data
Data
b = -1.895(a) + 162; R^2 = 0.85
PEAK Data
Data
b = -1.738(a) + 193; R^2 = 0.81
a
b

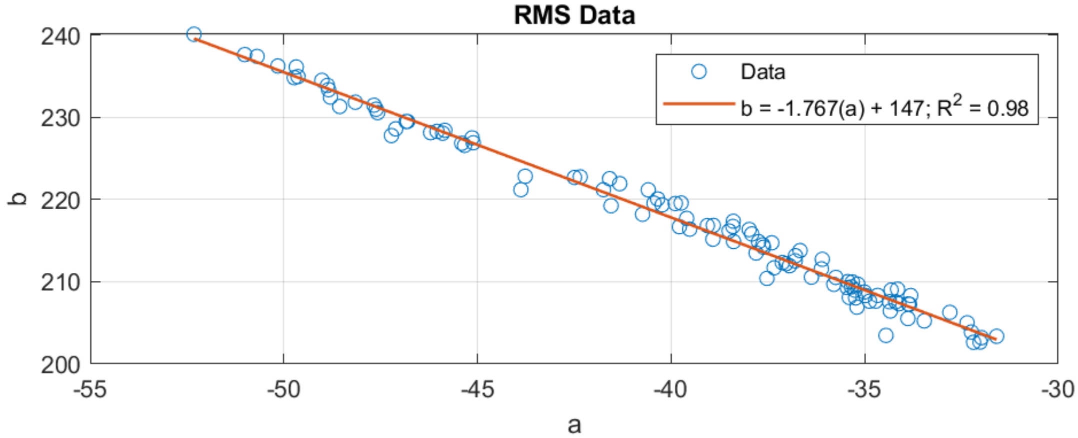

Suwannee-3
RMS Data
Data
b = -2.397(a) + 156; R^2 = 0.96
b
a
SEL Data
Data
b = -2.062(a) + 159; R^2 = 0.87
b
a
PEAK Data
Data
b = -2.094(a) + 184; R^2 = 0.9
b
a

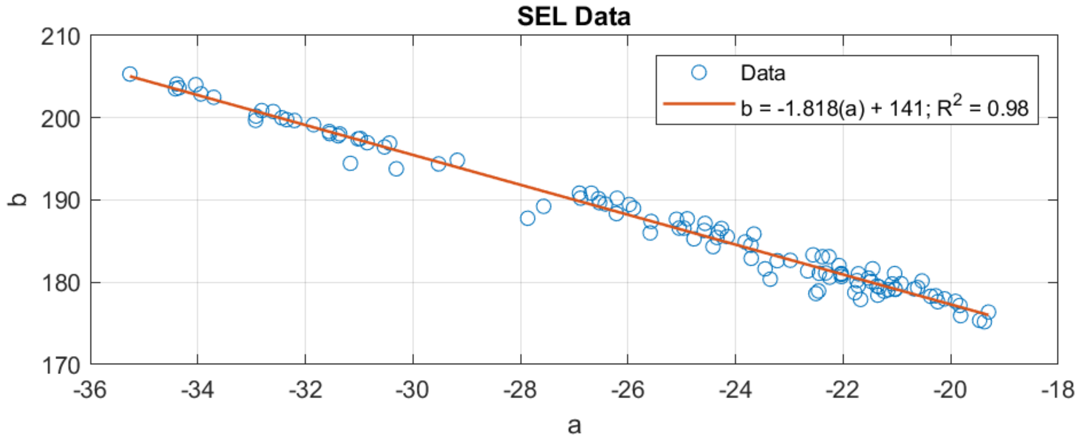

Ribault-1
RMS Data
Data
b = -1.651(a) + 150; R2 = 0.8
b
a
SEL Data
Data
b = -1.431(a) + 151; R2 = 0.79
b
a
PEAK Data
Data
b = -1.405(a) + 176; R2 = 0.73
b
a

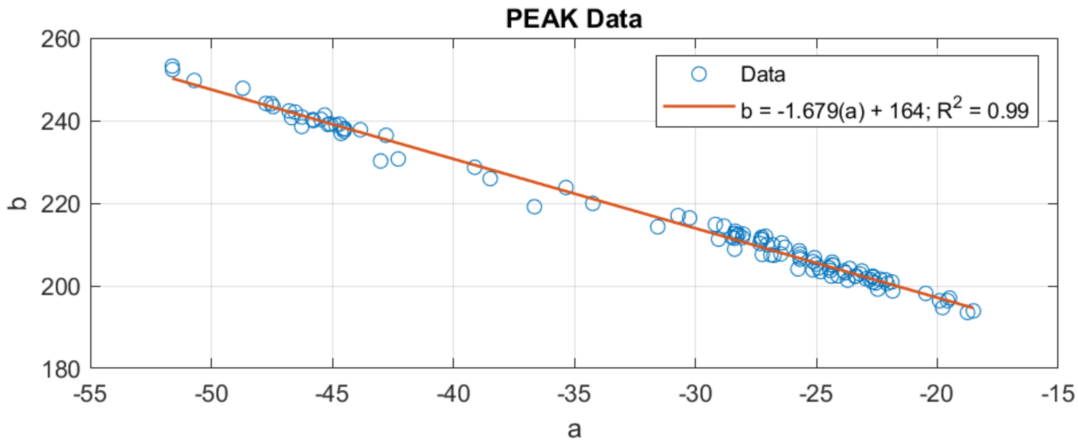
Ribault-2

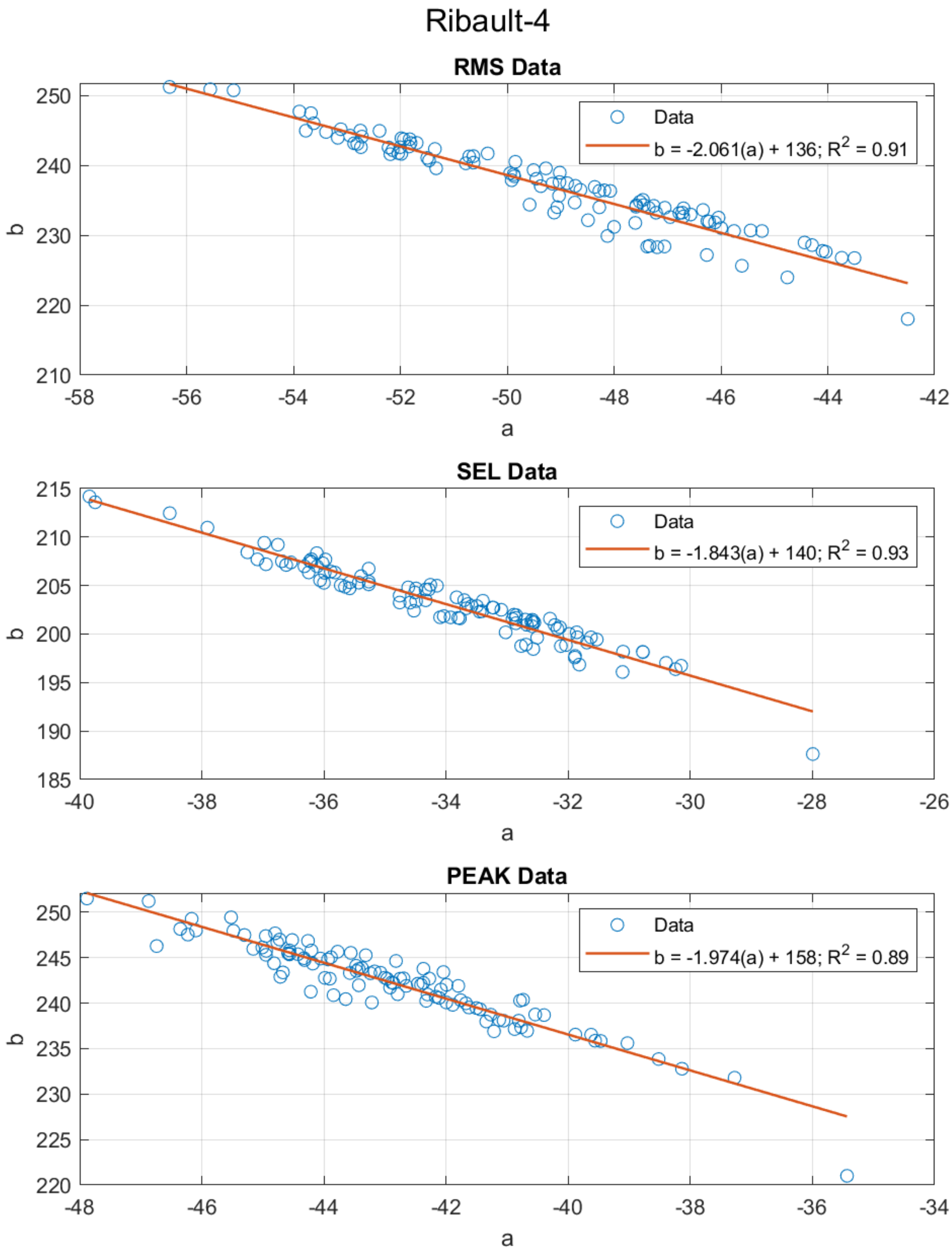

RMS Data
Data
b = -2.074(a) + 138; R2 = 0.98
b
a
SEL Data
Data
b = -1.771(a) + 145; R2 = 0.97
b
a
PEAK Data
Data
b = -1.873(a) + 165; R2 = 0.97
b
a

Ribault-3

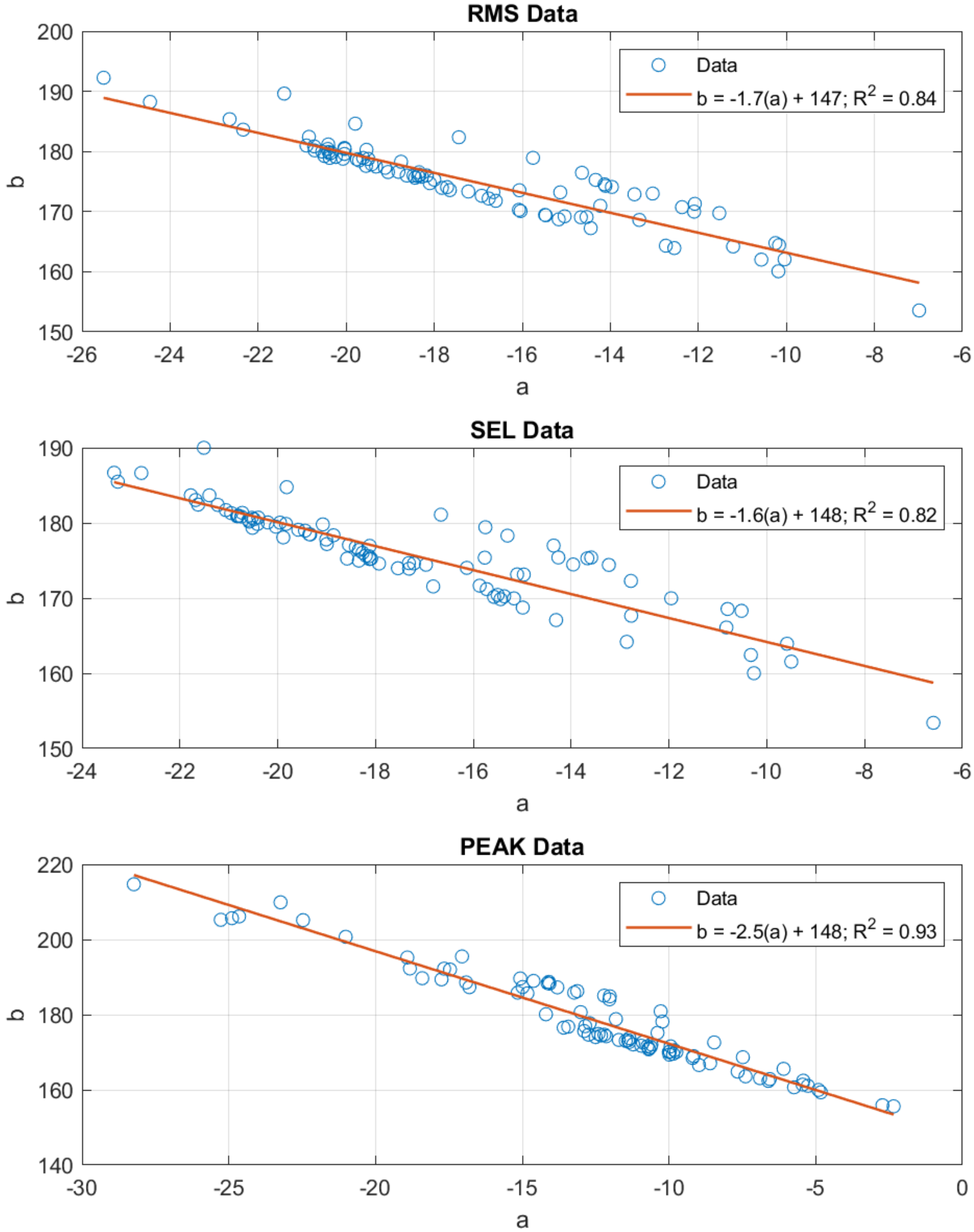

RMS Data
Data
b = -1.767(a) + 147; R^2 = 0.98
b
a
240
230
220
210
200
-55
-50
-45
-40
-35
-30


SEL Data
Data
b = -1.818(a) + 141; R^2 = 0.98
b
a
210
200
190
180
170
-36
-34
-32
-30
-28
-26
-24
-22
-20
-18

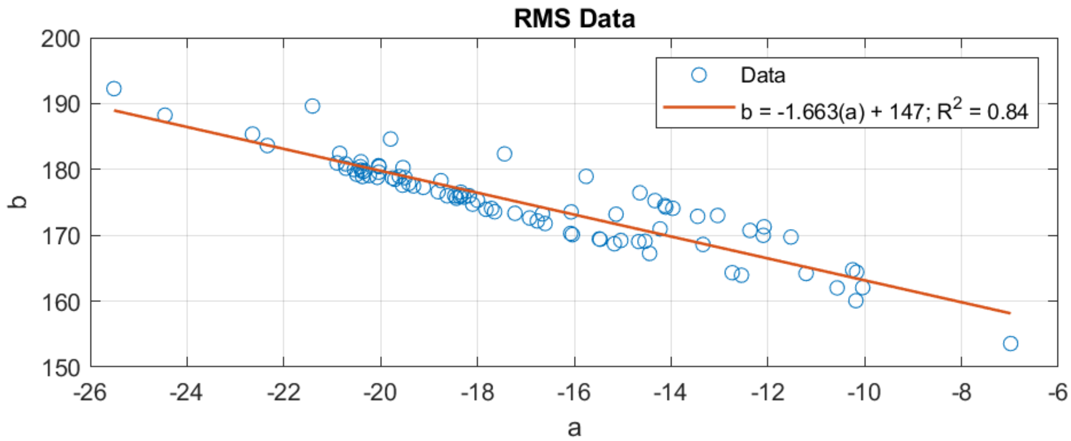

PEAK Data
Data
b = -1.679(a) + 164; R^2 = 0.99
b
a
260
240
220
200
180
-55
-50
-45
-40
-35
-30
-25
-20
-15


Ribault-4
RMS Data
Data
b = -2.061(a) + 136; R2 = 0.91
b
a
250
240
230
220
210
-58
-56
-54
-52
-50
-48
-46
-44
-42
SEL Data
Data
b = -1.843(a) + 140; R2 = 0.93
b
a
215
210
205
200
195
190
185
-40
-38
-36
-34
-32
-30
-28
-26
PEAK Data
Data
b = -1.974(a) + 158; R2 = 0.89
b
a
250
245
240
235
230
225
220
-48
-46
-44
-42
-40
-38
-36
-34

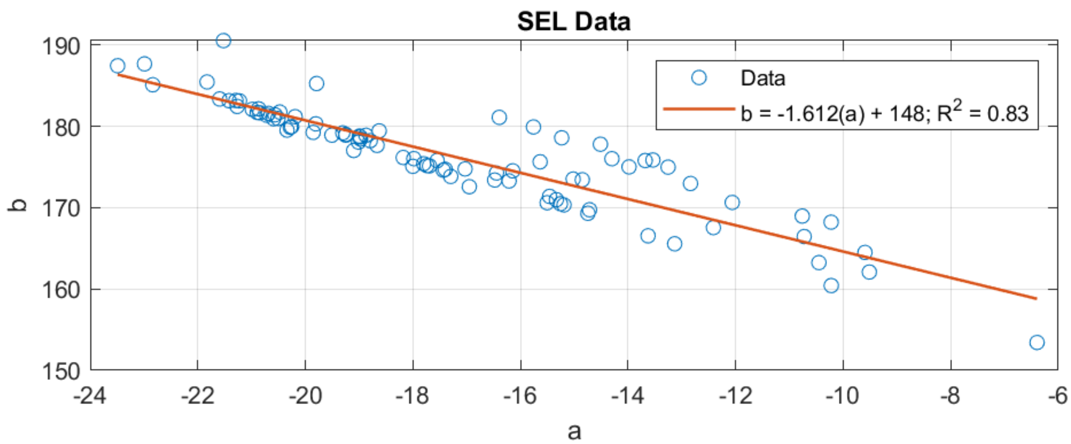
Dunns-1


RMS Data
Data
b = -1.7(a) + 147; R2 = 0.84
b
a
SEL Data
Data
b = -1.6(a) + 148; R2 = 0.82
b
a
PEAK Data
Data
b = -2.5(a) + 148; R2 = 0.93
b
a

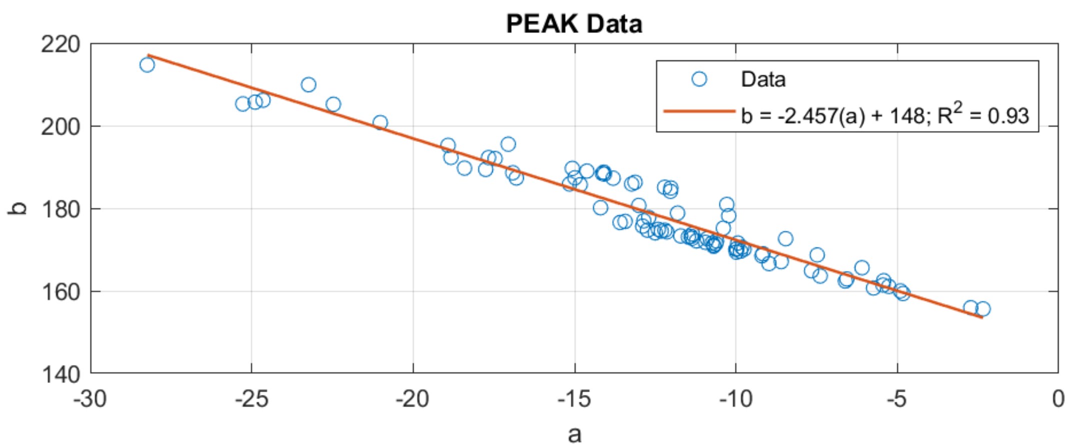
Dunns-2



RMS Data
Data
b = -1.663(a) + 147; R^2 = 0.84
b
a

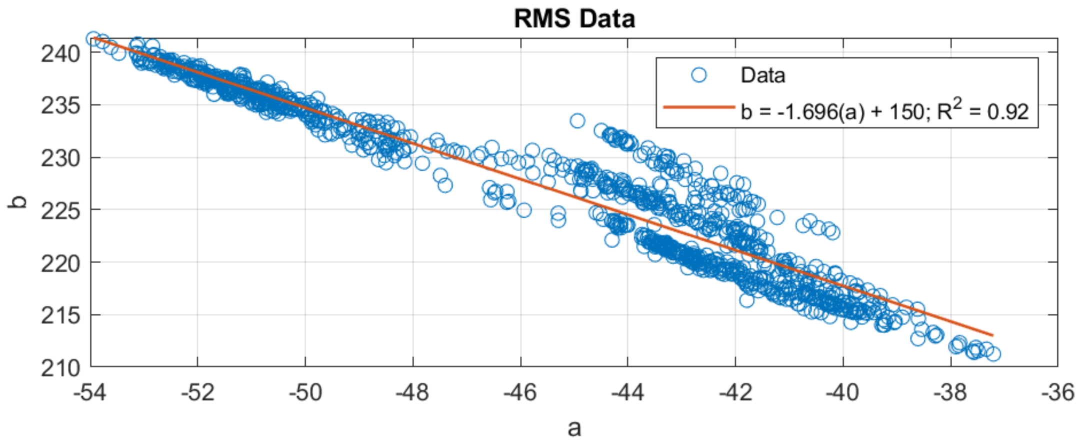


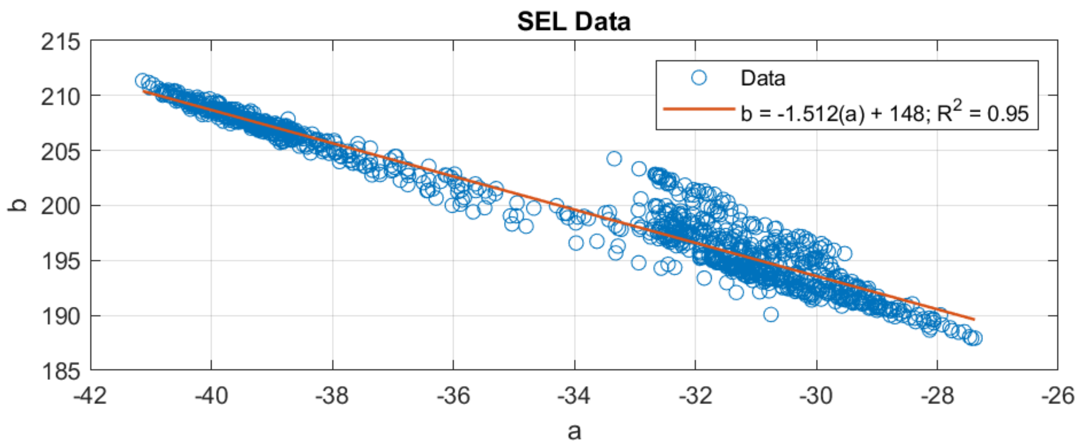
SEL Data
Data
b = -1.612(a) + 148; R^2 = 0.83
b
a

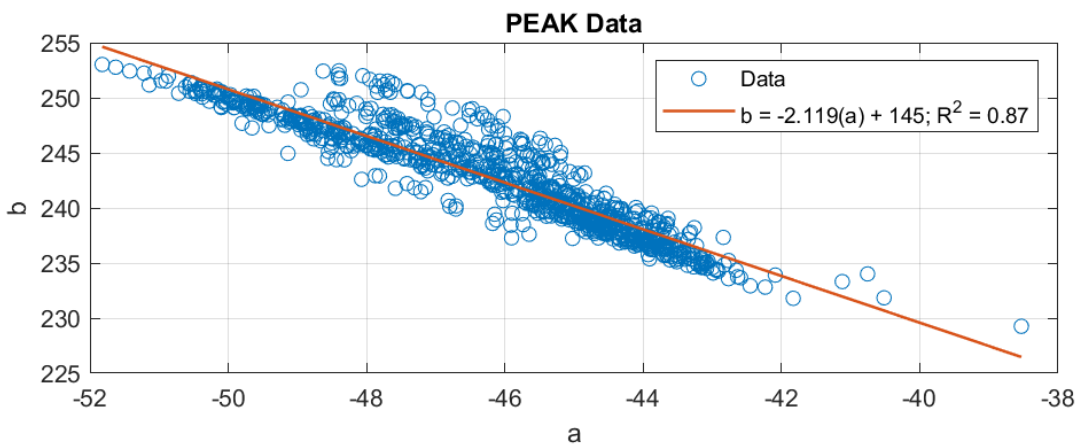


PEAK Data
Data
b = -2.457(a) + 148; R^2 = 0.93
b
a

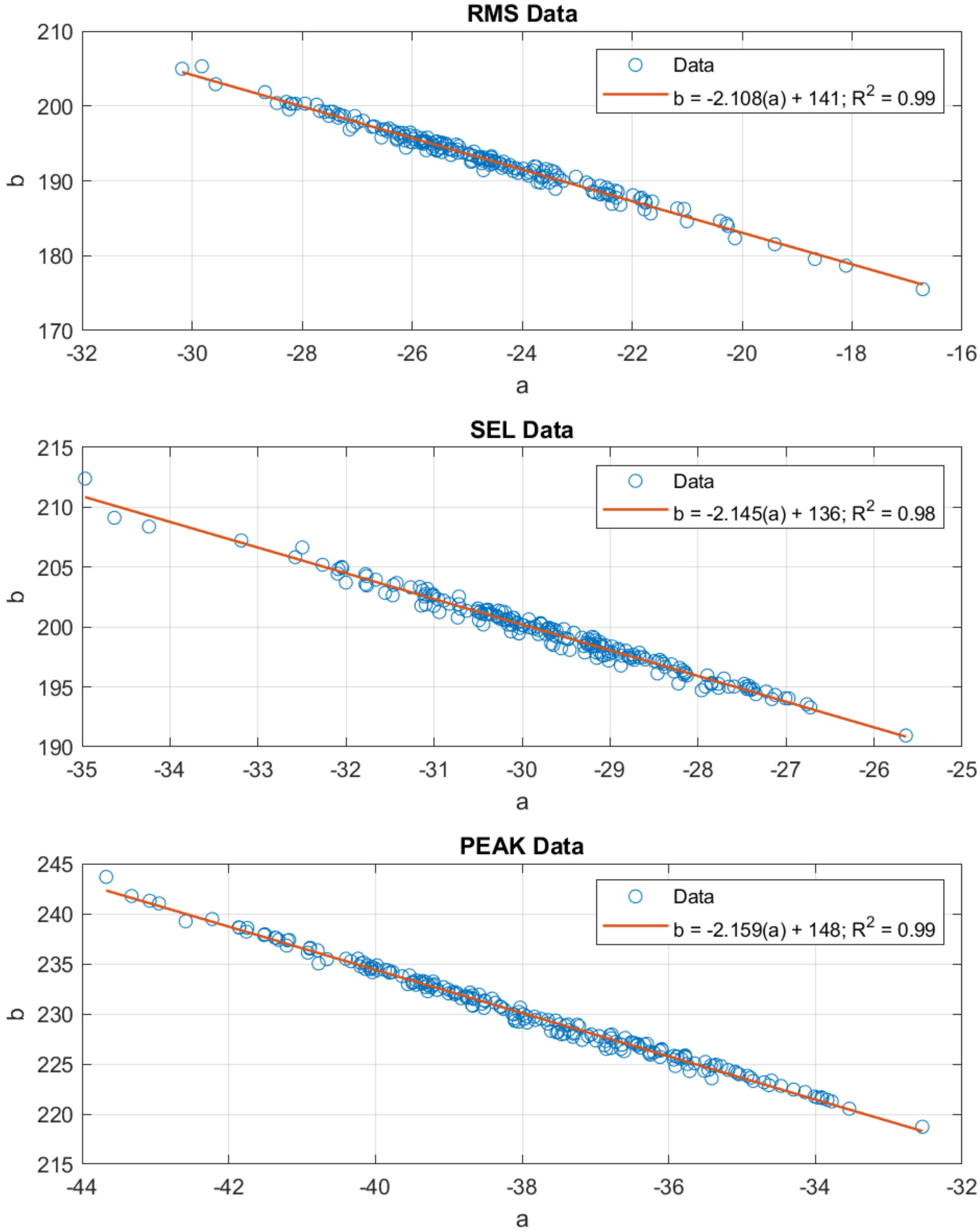
CR218-1

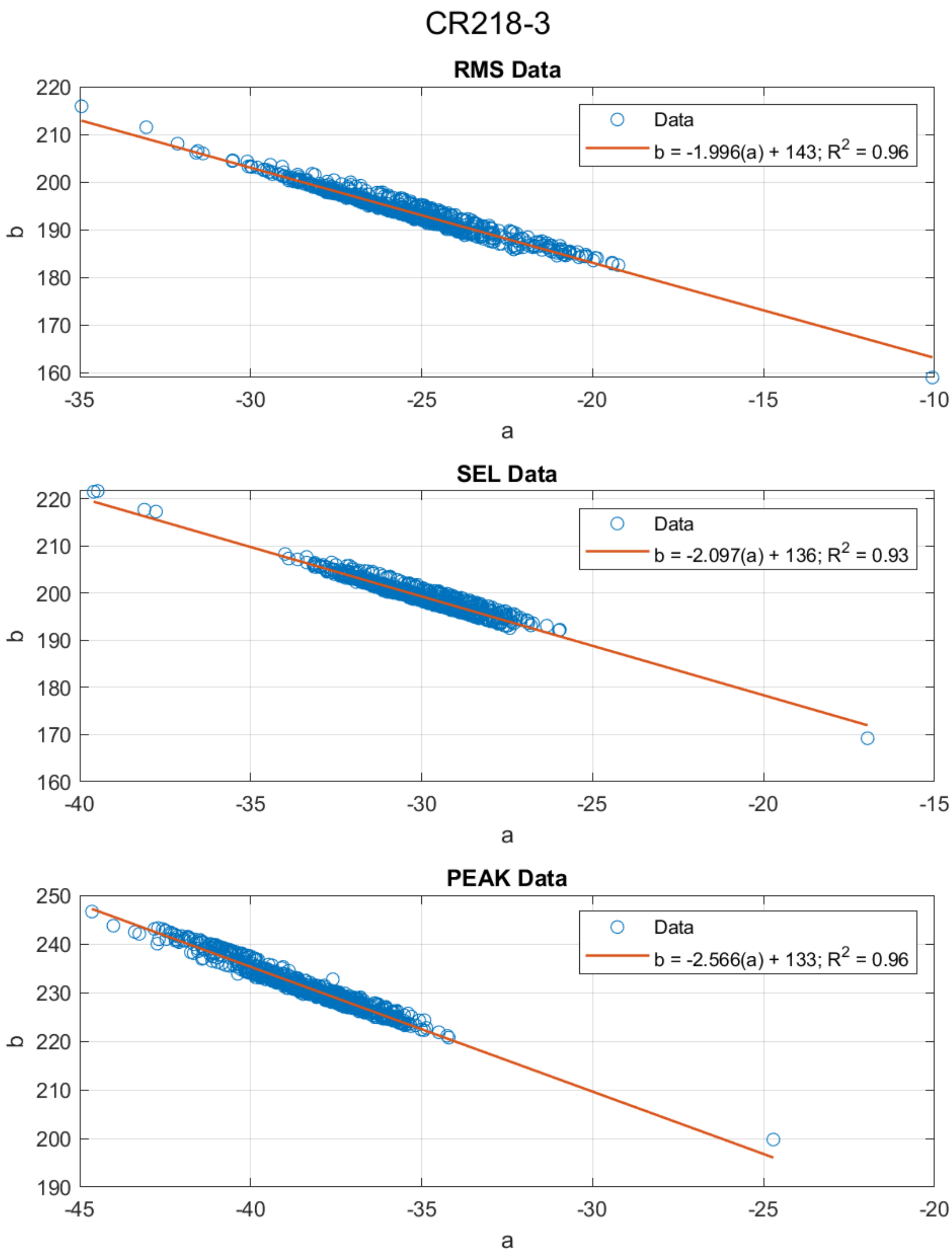

RMS Data
Data
b = -1.696(a) + 150; R^2 = 0.92
b
a
240
235
230
225
220
215
210
-54
-52
-50
-48
-46
-44
-42
-40
-38
-36


SEL Data
Data
b = -1.512(a) + 148; R^2 = 0.95
b
a
215
210
205
200
195
190
185
-42
-40
-38
-36
-34
-32
-30
-28
-26

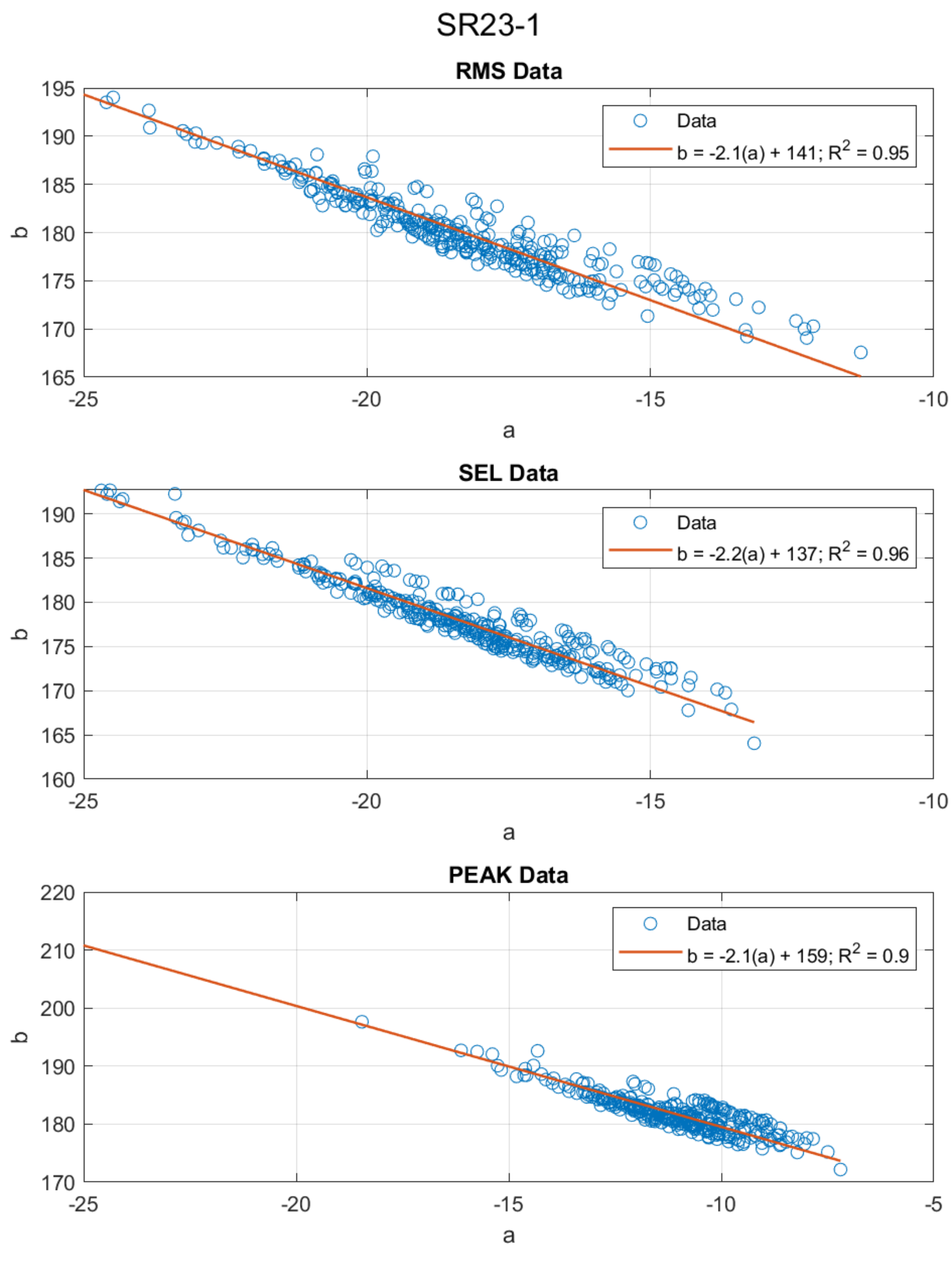

PEAK Data
Data
b = -2.119(a) + 145; R^2 = 0.87
b
a
255
250
245
240
235
230
225
-52
-50
-48
-46
-44
-42
-40
-38

CR218-2

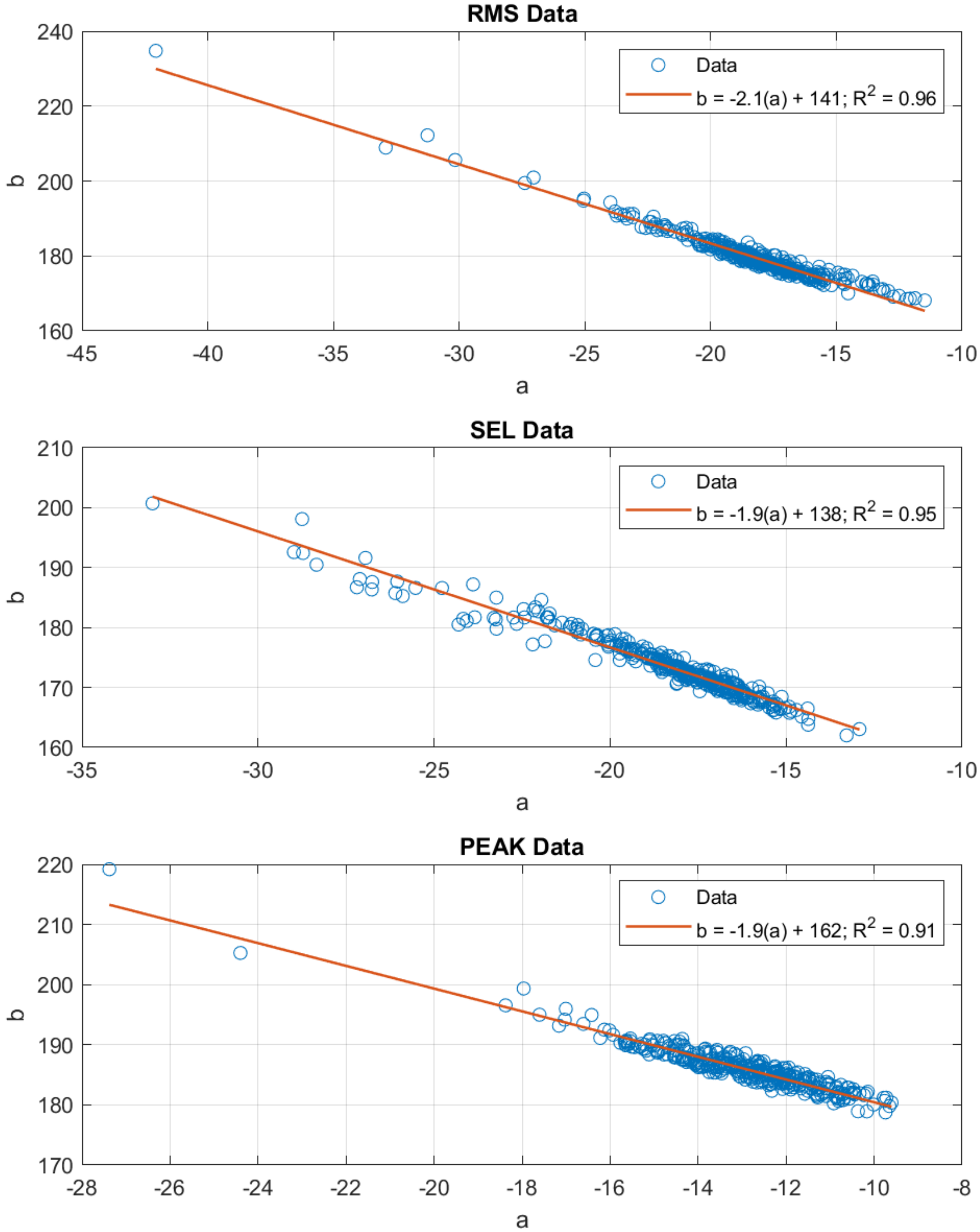

RMS Data
Data
b = -2.108(a) + 141; R2 = 0.99
b
a
SEL Data
Data
b = -2.145(a) + 136; R2 = 0.98
b
a
PEAK Data
Data
b = -2.159(a) + 148; R2 = 0.99
b
a



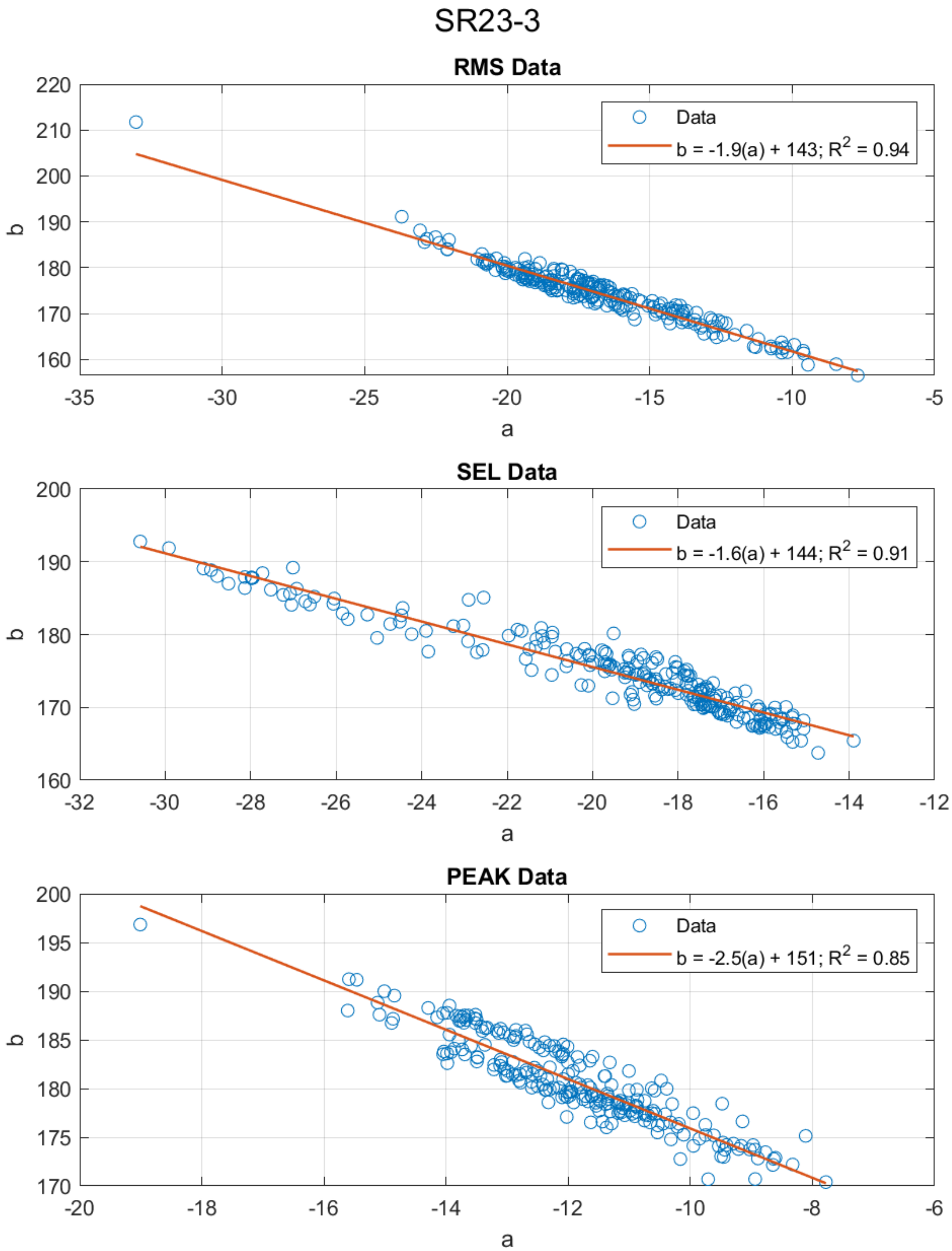
CR218-3
RMS Data
Data
b = -1.996(a) + 143; R2 = 0.96
b
a
SEL Data
Data
b = -2.097(a) + 136; R2 = 0.93
b
a
PEAK Data
Data
b = -2.566(a) + 133; R2 = 0.96
b
a


SR23-1
RMS Data
Data
b = -2.1(a) + 141; R2 = 0.95
b
a
SEL Data
Data
b = -2.2(a) + 137; R2 = 0.96
b
a
PEAK Data
Data
b = -2.1(a) + 159; R2 = 0.9
b
a

SR23-2

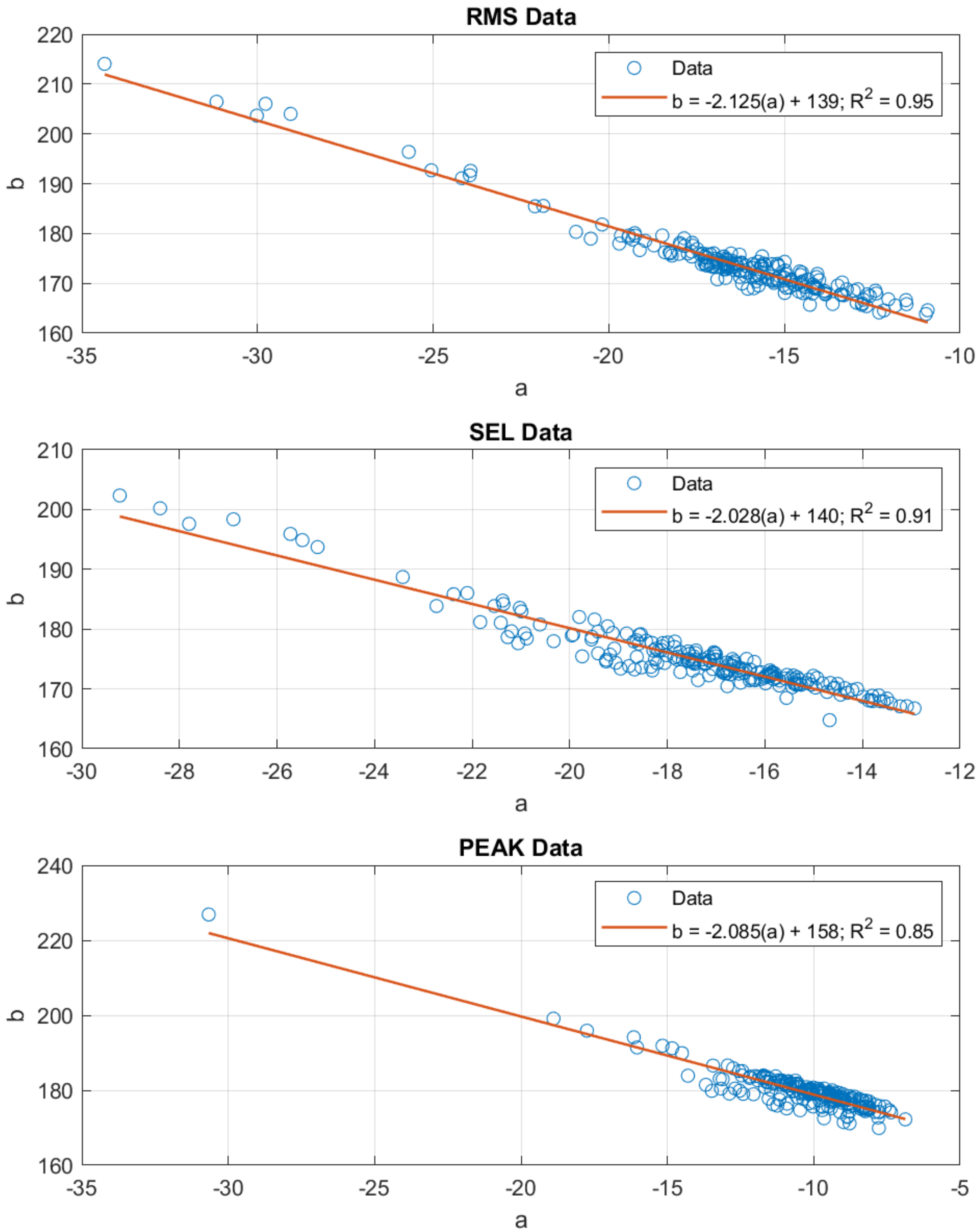


RMS Data
Data
b = -2.1(a) + 141; R^2 = 0.96
SEL Data
Data
b = -1.9(a) + 138; R^2 = 0.95
PEAK Data
Data
b = -1.9(a) + 162; R^2 = 0.91
a
b

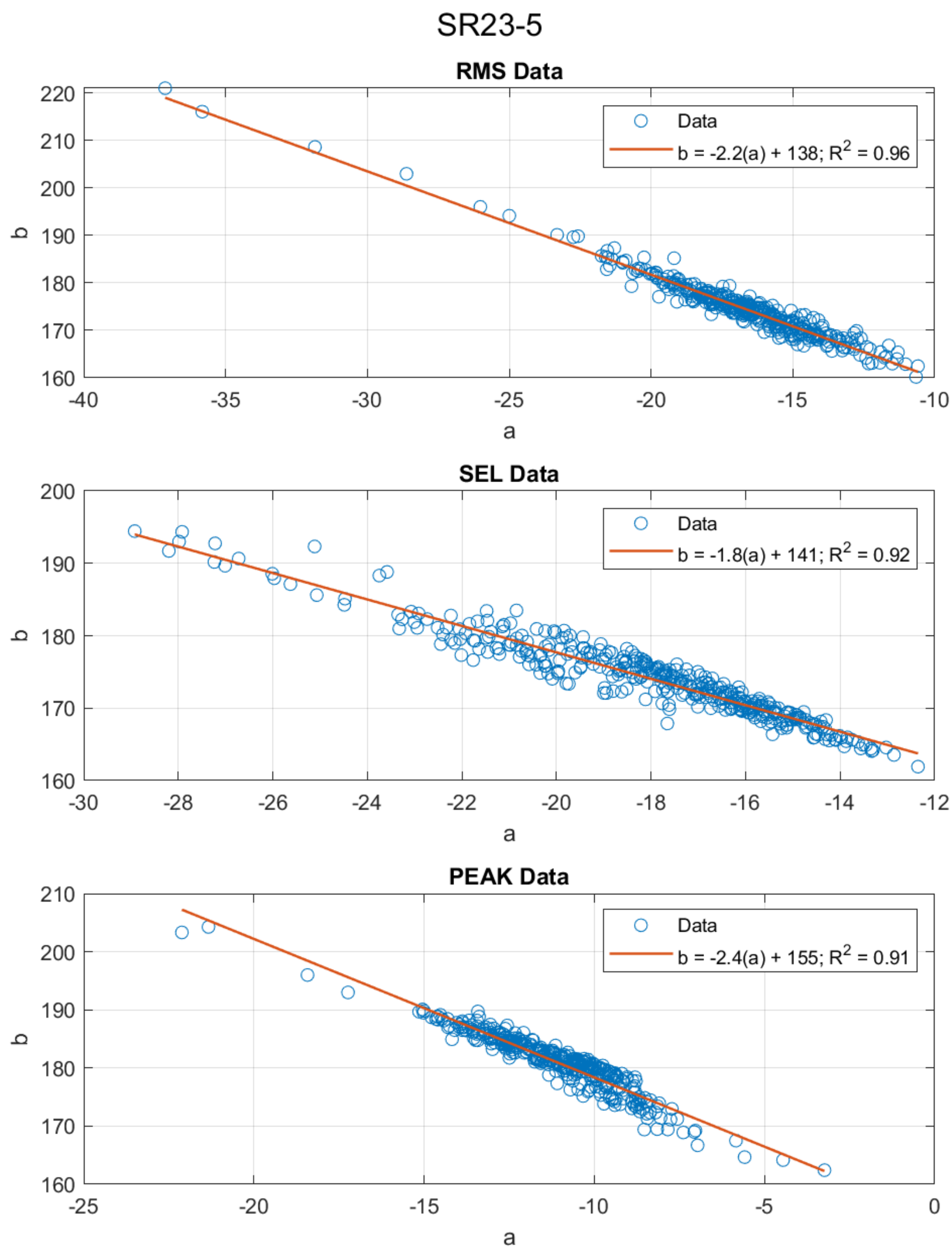


SR23-3
RMS Data
Data
b = -1.9(a) + 143; R^2 = 0.94
b
a
SEL Data
Data
b = -1.6(a) + 144; R^2 = 0.91
b
a
PEAK Data
Data
b = -2.5(a) + 151; R^2 = 0.85
b
a

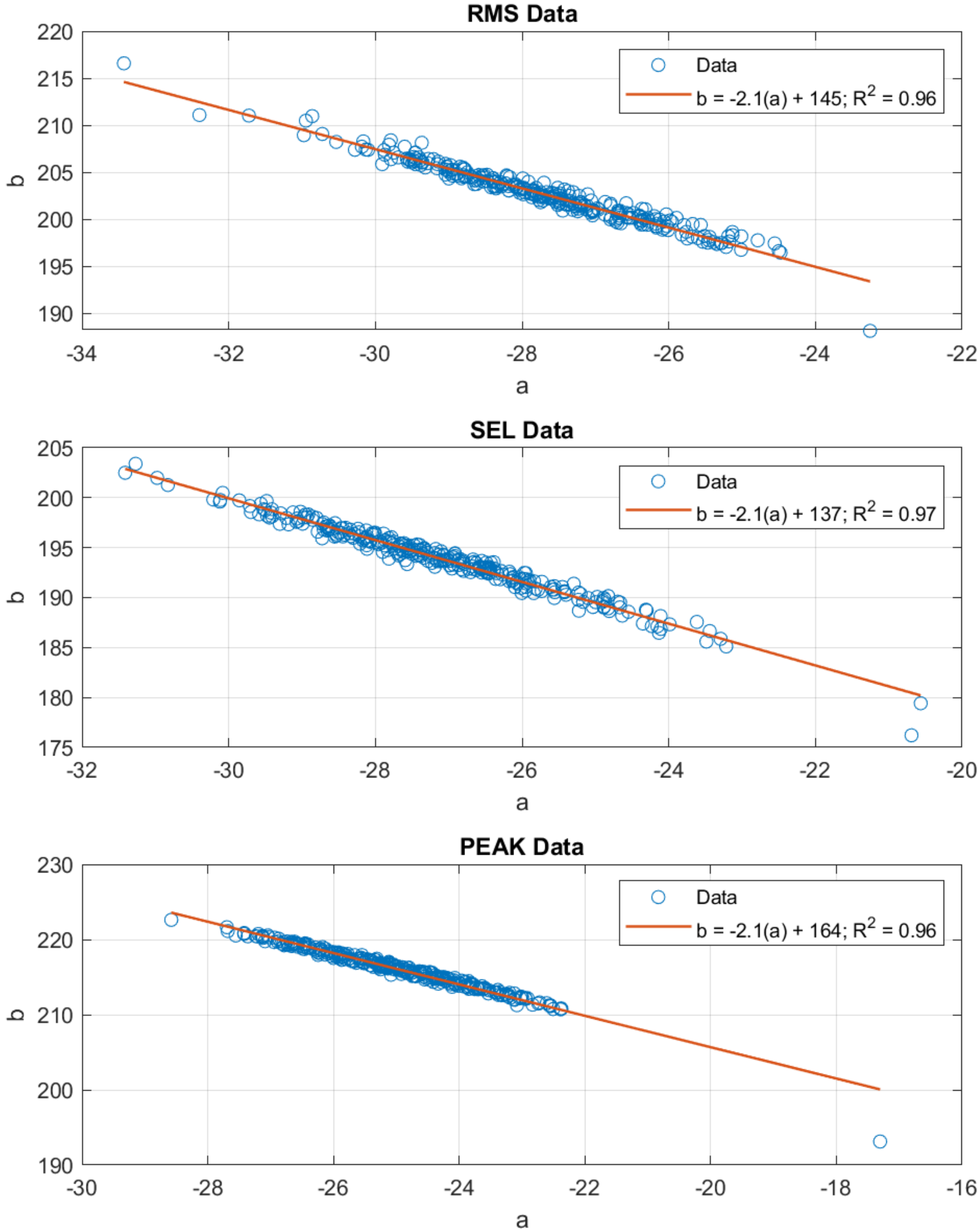
SR23-4



RMS Data
Data
b = -2.125(a) + 139; R^2 = 0.95
b
a
SEL Data
Data
b = -2.028(a) + 140; R^2 = 0.91
b
a
PEAK Data
Data
b = -2.085(a) + 158; R^2 = 0.85
b
a

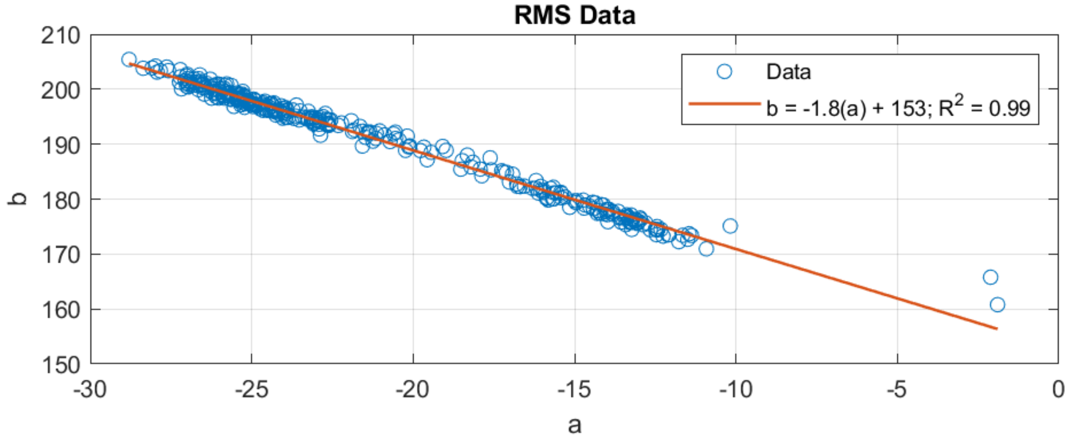

SR23-5
RMS Data
Data
b = -2.2(a) + 138; R2 = 0.96
b
a
SEL Data
Data
b = -1.8(a) + 141; R2 = 0.92
b
a
PEAK Data
Data
b = -2.4(a) + 155; R2 = 0.91
b
a

SR23-6

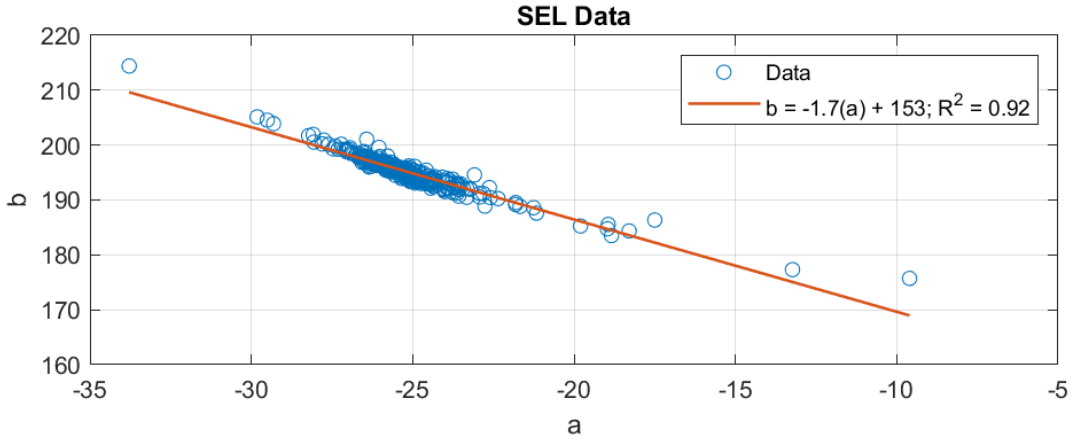


RMS Data
Data
b = -2.1(a) + 145; R2 = 0.96
b
a
SEL Data
Data
b = -2.1(a) + 137; R2 = 0.97
b
a
PEAK Data
Data
b = -2.1(a) + 164; R2 = 0.96
b
a

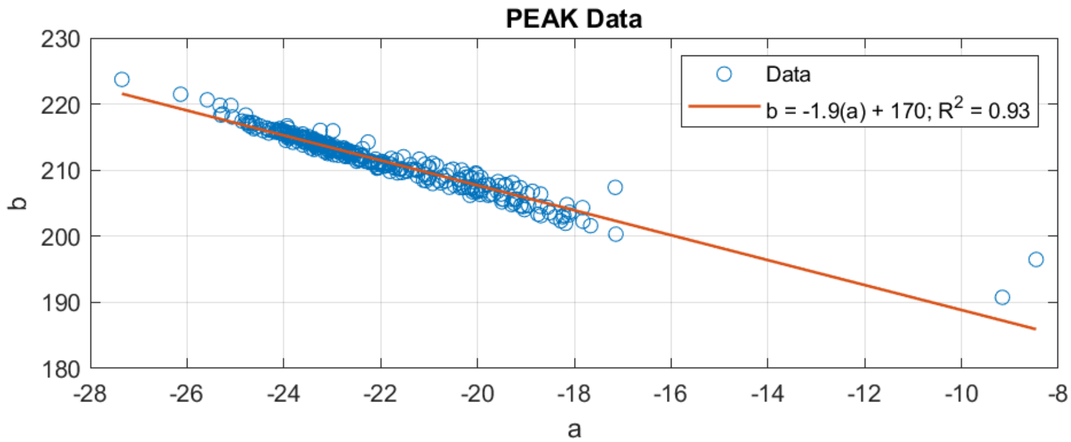
SR23-7



RMS Data
Data
b = -1.8(a) + 153; R2 = 0.99
b
a

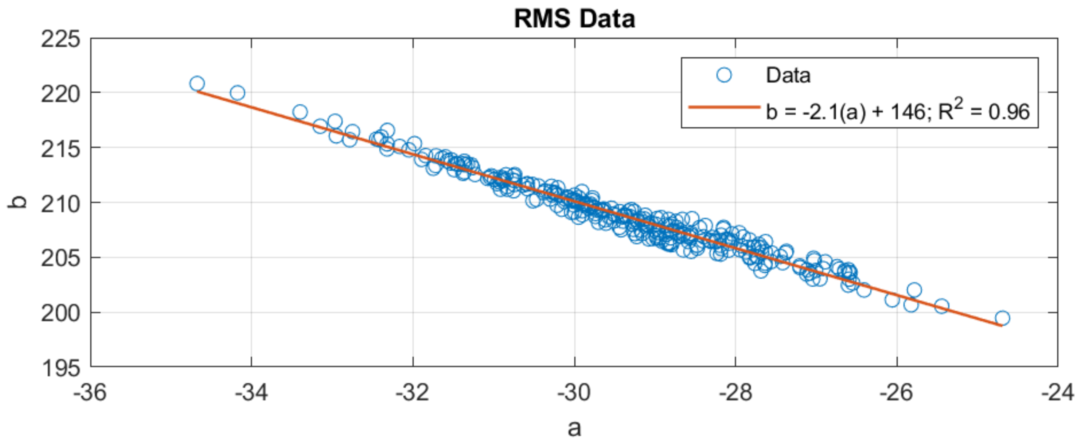


SEL Data
Data
b = -1.7(a) + 153; R2 = 0.92
b
a

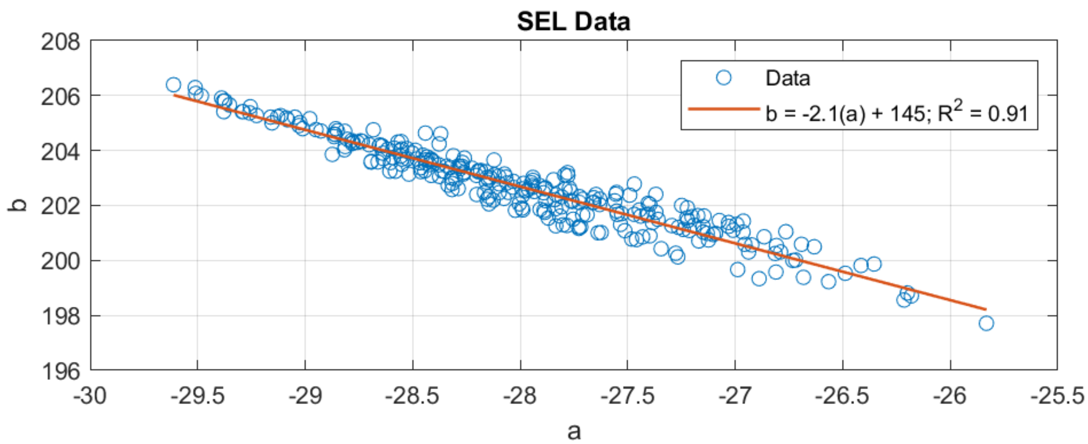


PEAK Data
Data
b = -1.9(a) + 170; R2 = 0.93
b
a

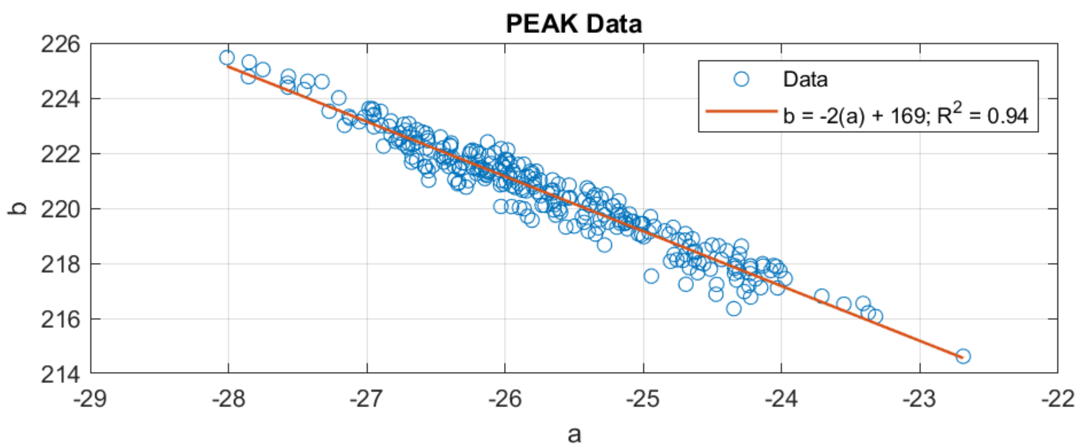
SR23-8



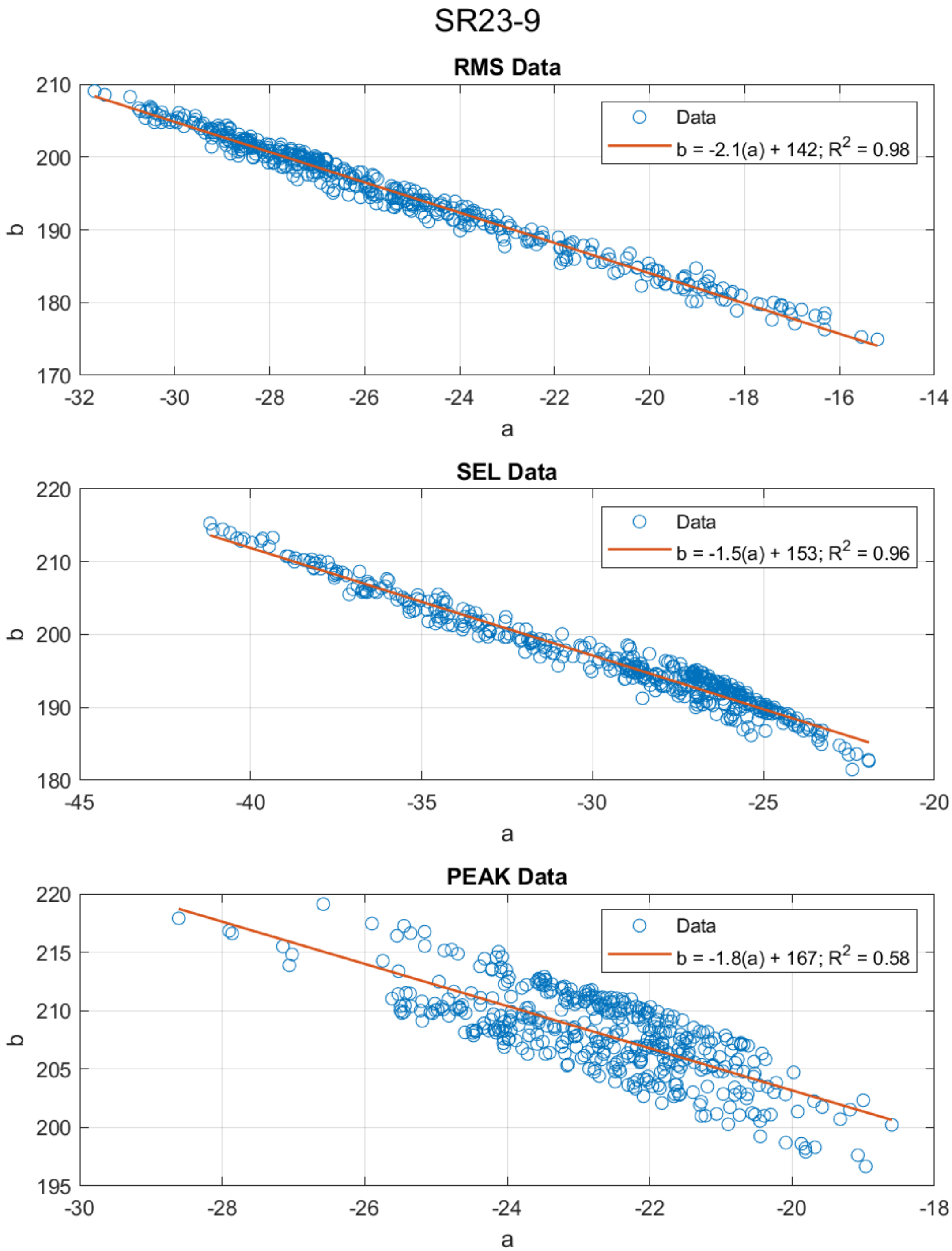
RMS Data
Data
b = -2.1(a) + 146; R^2 = 0.96
225
220
215
210
205
200
195
-36
-34
-32
-30
-28
-26
-24
a
b



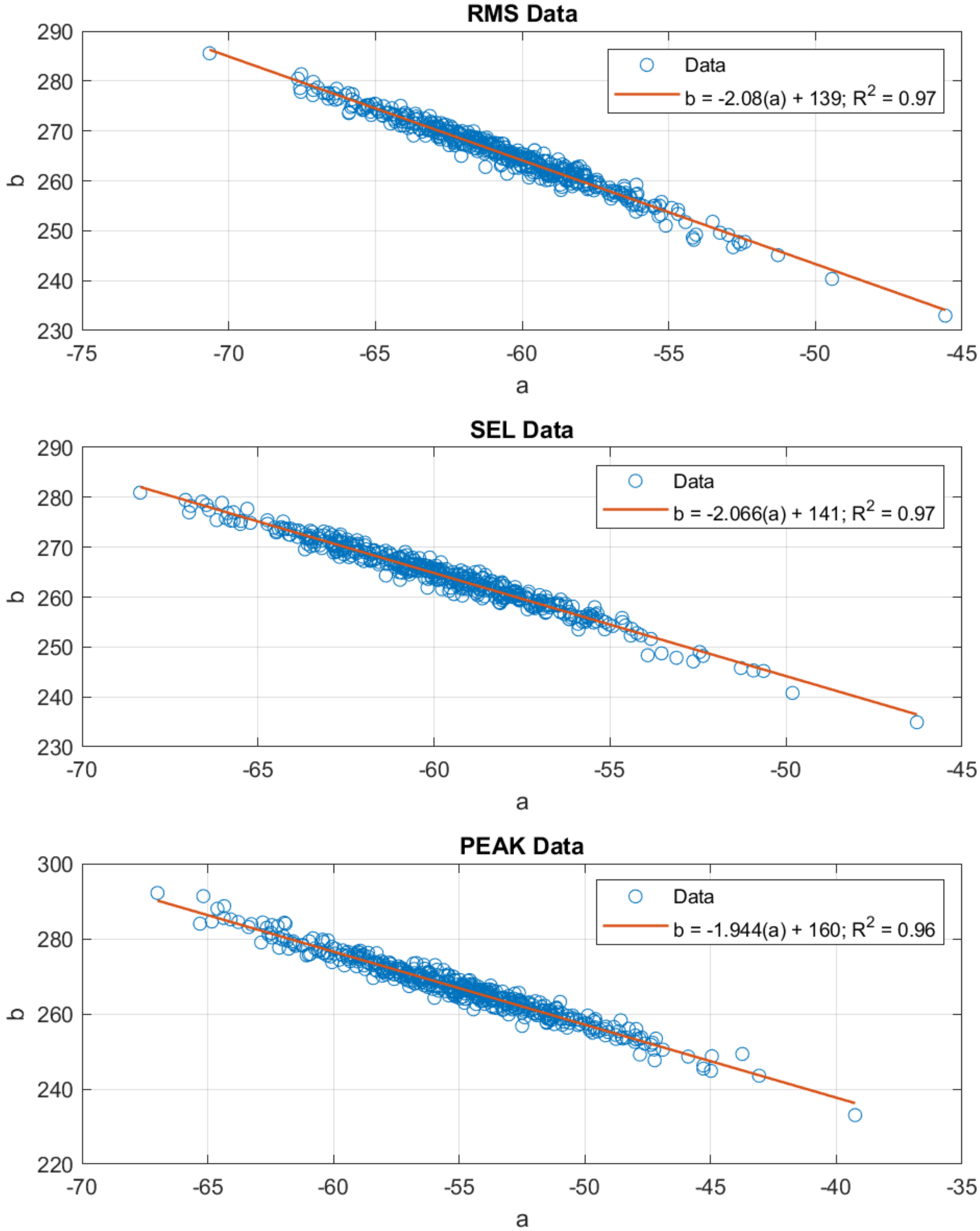
SEL Data
Data
b = -2.1(a) + 145; R^2 = 0.91
208
206
204
202
200
198
196
-30
-29.5
-29
-28.5
-28
-27.5
-27
-26.5
-26
-25.5
a
b



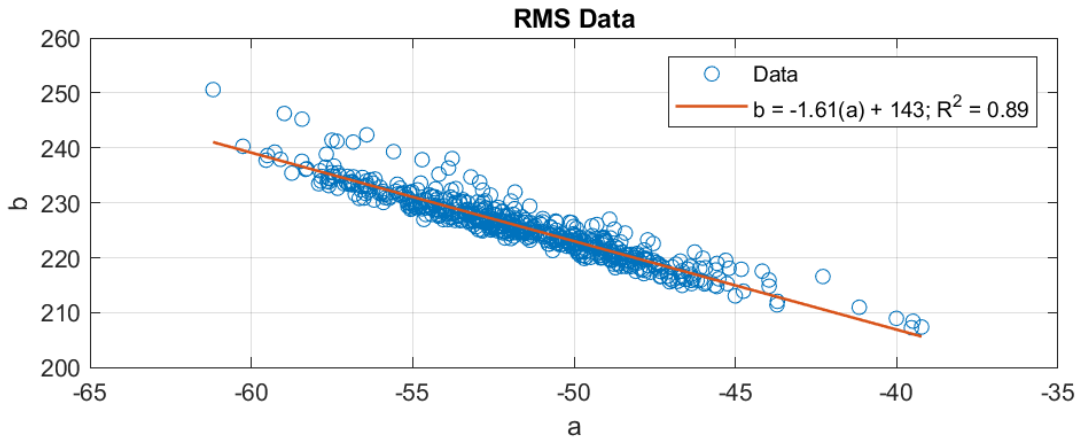
PEAK Data
Data
b = -2(a) + 169; R^2 = 0.94
226
224
222
220
218
216
214
-29
-28
-27
-26
-25
-24
-23
-22
a
b


SR23-9
RMS Data
Data
b = -2.1(a) + 142; R2 = 0.98
b
a
SEL Data
Data
b = -1.5(a) + 153; R2 = 0.96
b
a
PEAK Data
Data
b = -1.8(a) + 167; R2 = 0.58
b
a

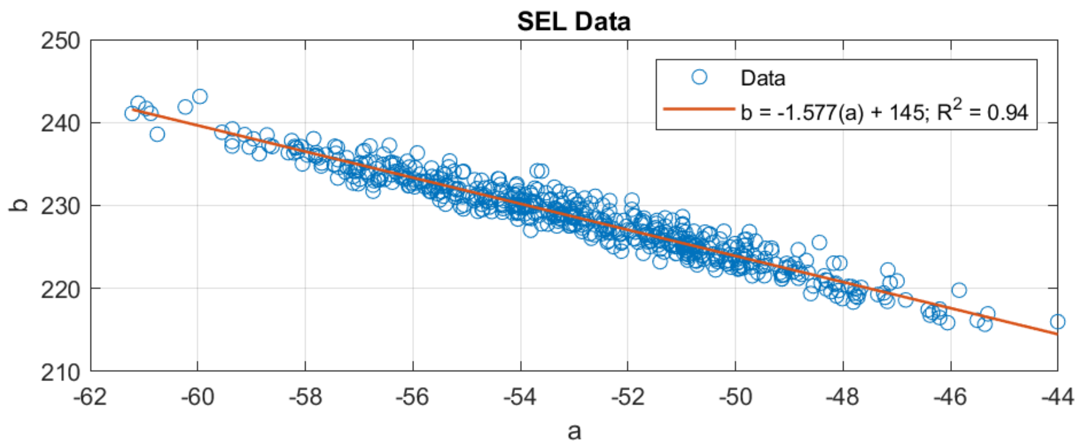
Destin-1


RMS Data
Data
b = -2.08(a) + 139; R^2 = 0.97
b
a
SEL Data
Data
b = -2.066(a) + 141; R^2 = 0.97
b
a
PEAK Data
Data
b = -1.944(a) + 160; R^2 = 0.96
b
a

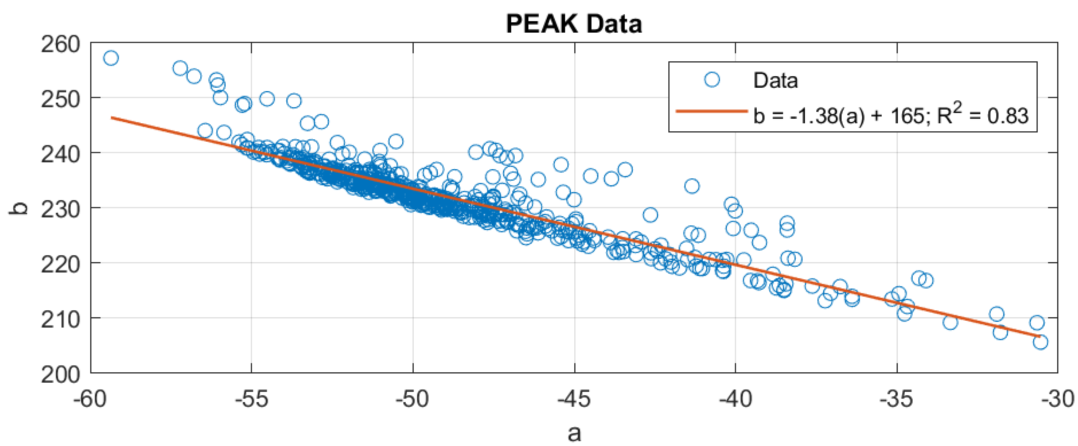
Destin-2



RMS Data
Data
b = -1.61(a) + 143; R^2 = 0.89
b
a

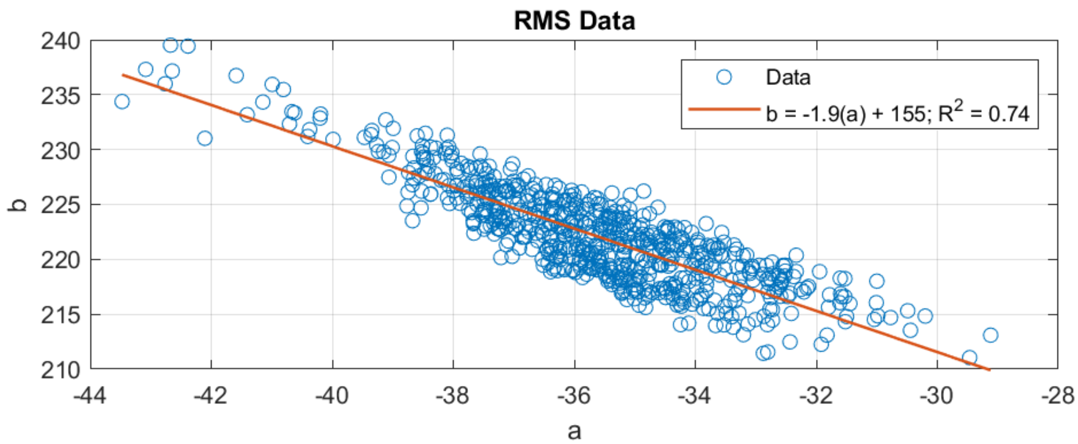


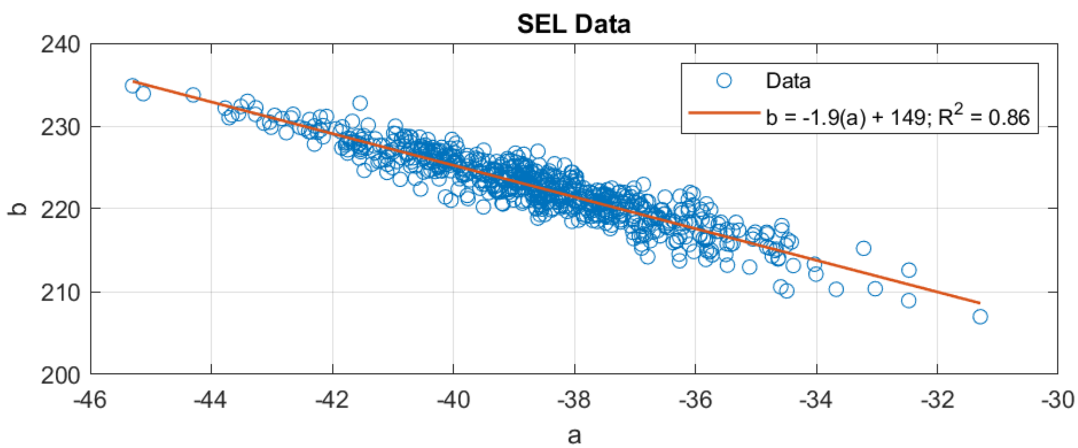
SEL Data
Data
b = -1.577(a) + 145; R^2 = 0.94
b
a

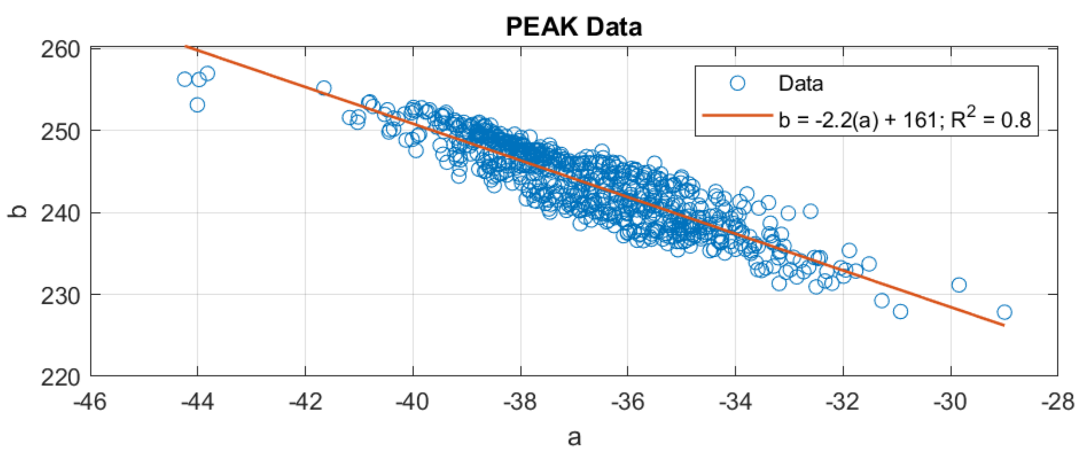


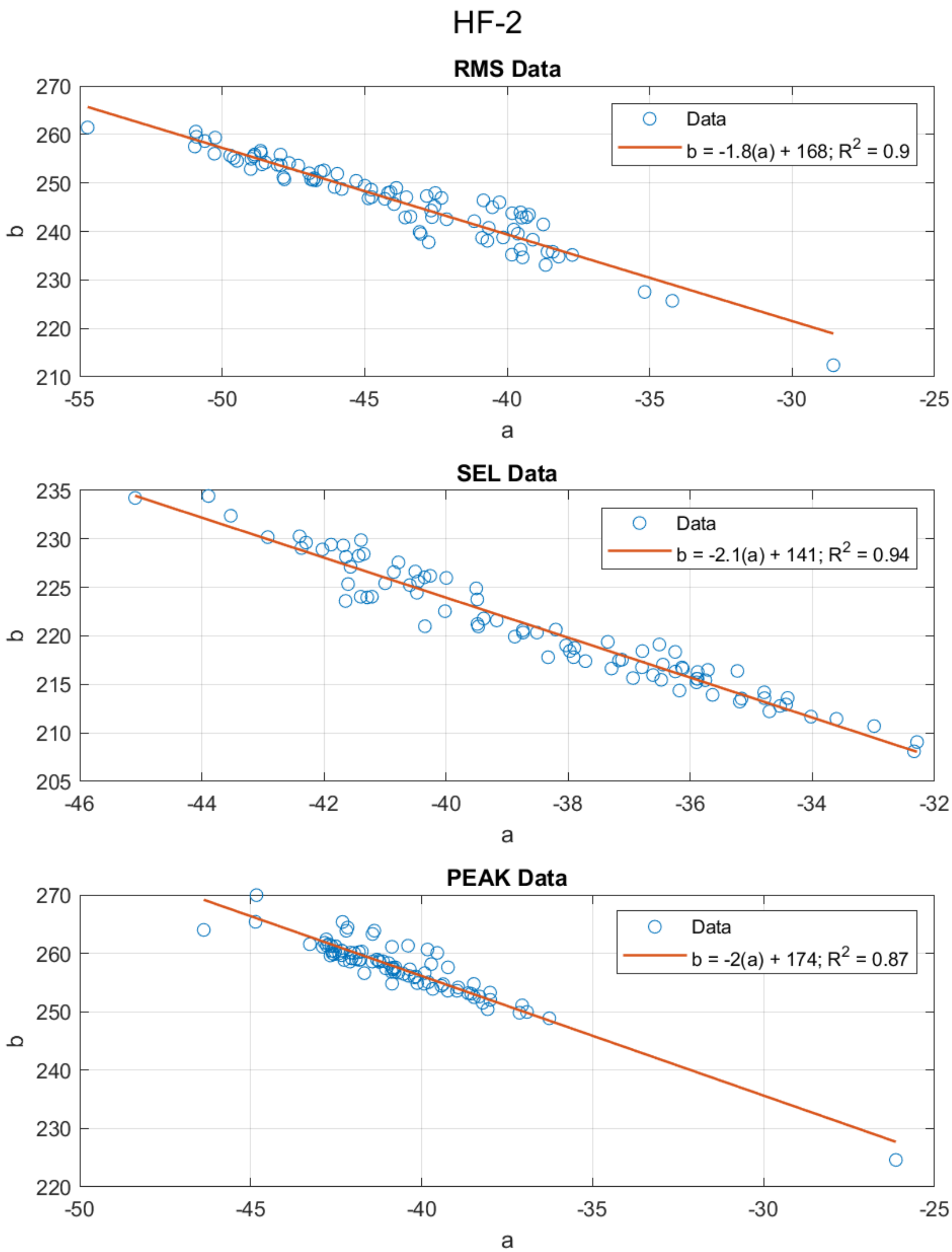
PEAK Data
Data
b = -1.38(a) + 165; R^2 = 0.83
b
a

HF-1

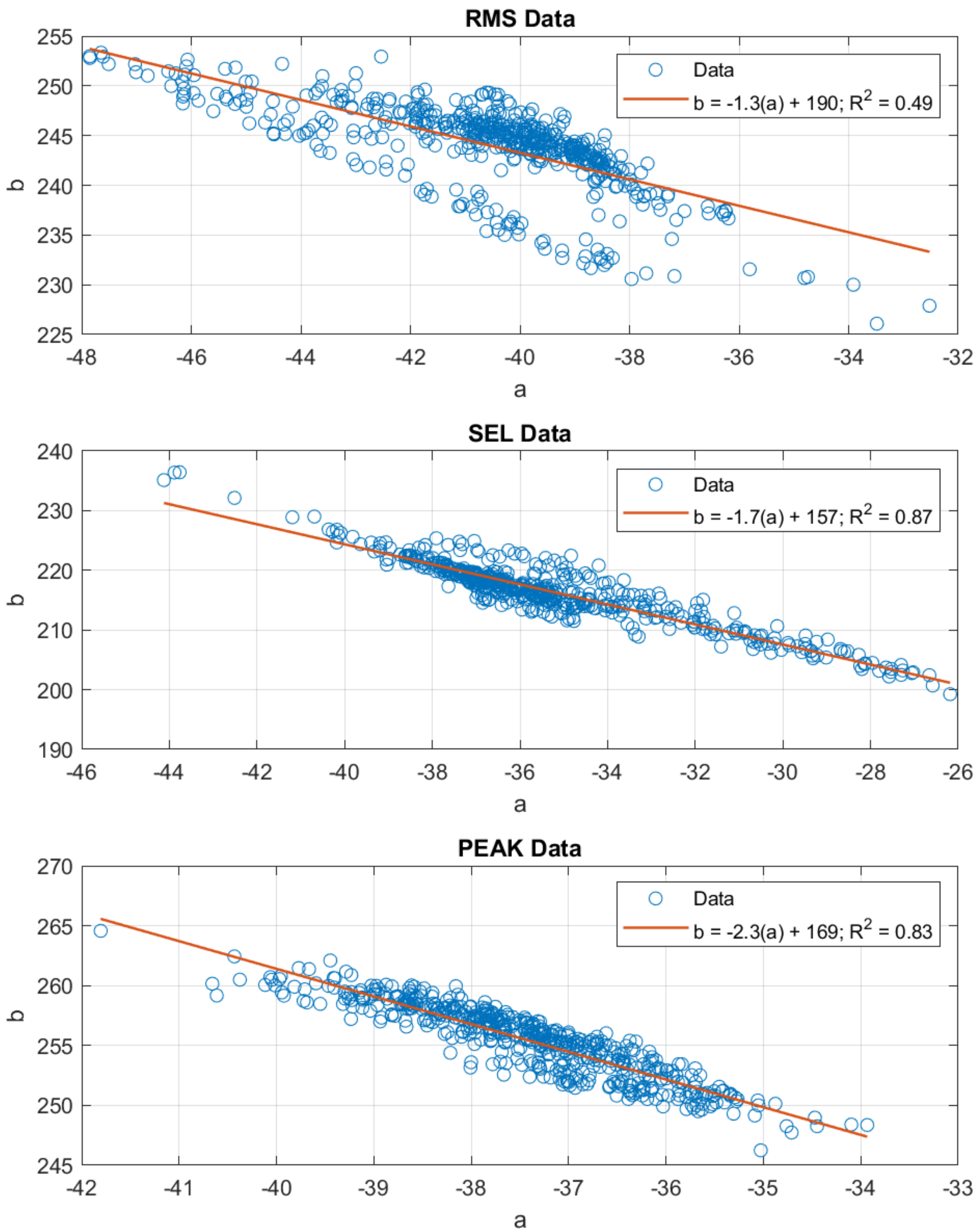

RMS Data
Data
b = -1.9(a) + 155; R^2 = 0.74
b
a


SEL Data
Data
b = -1.9(a) + 149; R^2 = 0.86
b
a

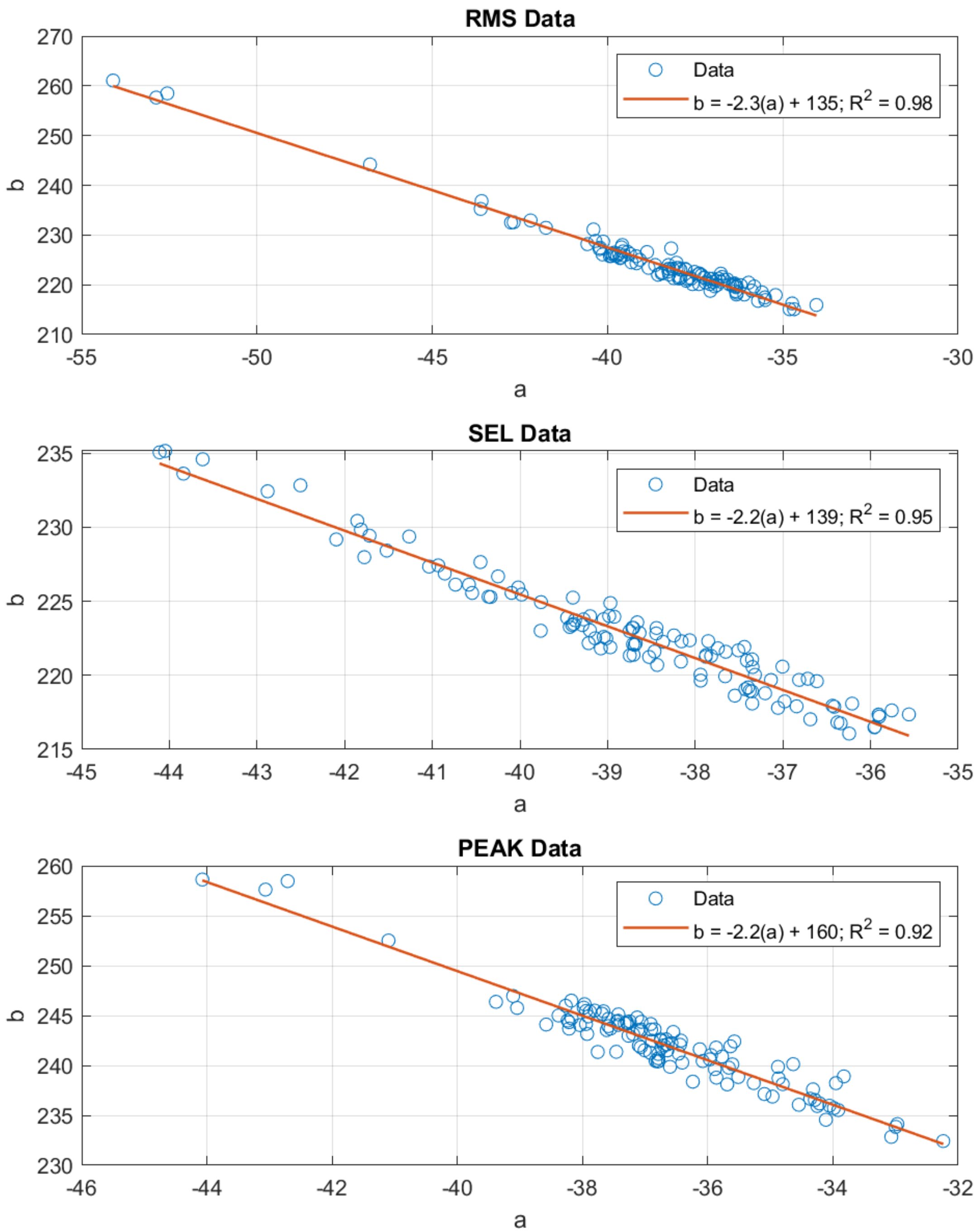

PEAK Data
Data
b = -2.2(a) + 161; R^2 = 0.8
b
a


HF-2
RMS Data
Data
b = -1.8(a) + 168; R2 = 0.9
270
260
250
240
230
220
210
-55
-50
-45
-40
-35
-30
-25
a
b
SEL Data
Data
b = -2.1(a) + 141; R2 = 0.94
235
230
225
220
215
210
205
-46
-44
-42
-40
-38
-36
-34
-32
a
b
PEAK Data
Data
b = -2(a) + 174; R2 = 0.87
270
260
250
240
230
220
-50
-45
-40
-35
-30
-25
a
b

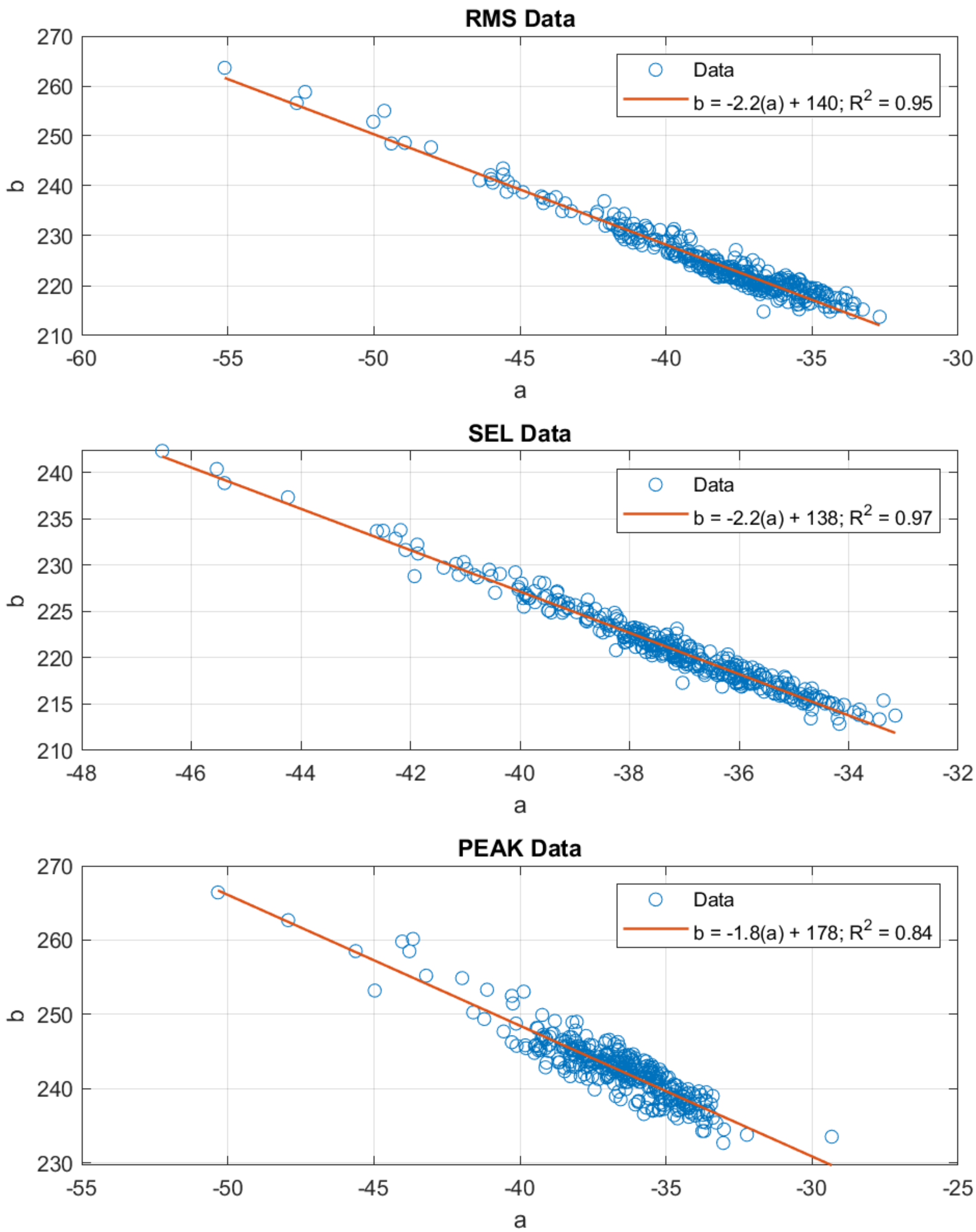
HF-3

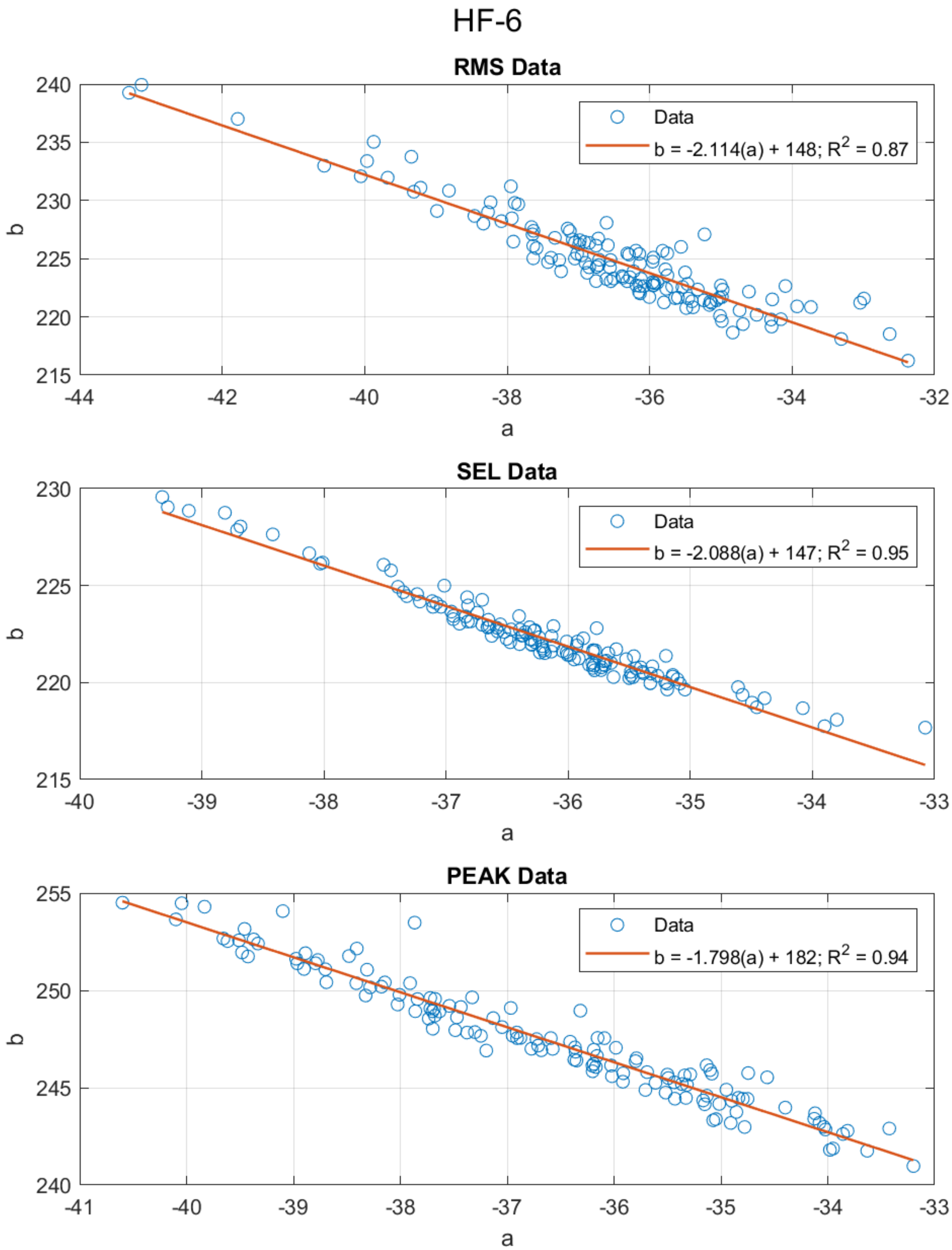

RMS Data
Data
b = -1.3(a) + 190; R^2 = 0.49
b
a
SEL Data
Data
b = -1.7(a) + 157; R^2 = 0.87
b
a
PEAK Data
Data
b = -2.3(a) + 169; R^2 = 0.83
b
a

HF-4

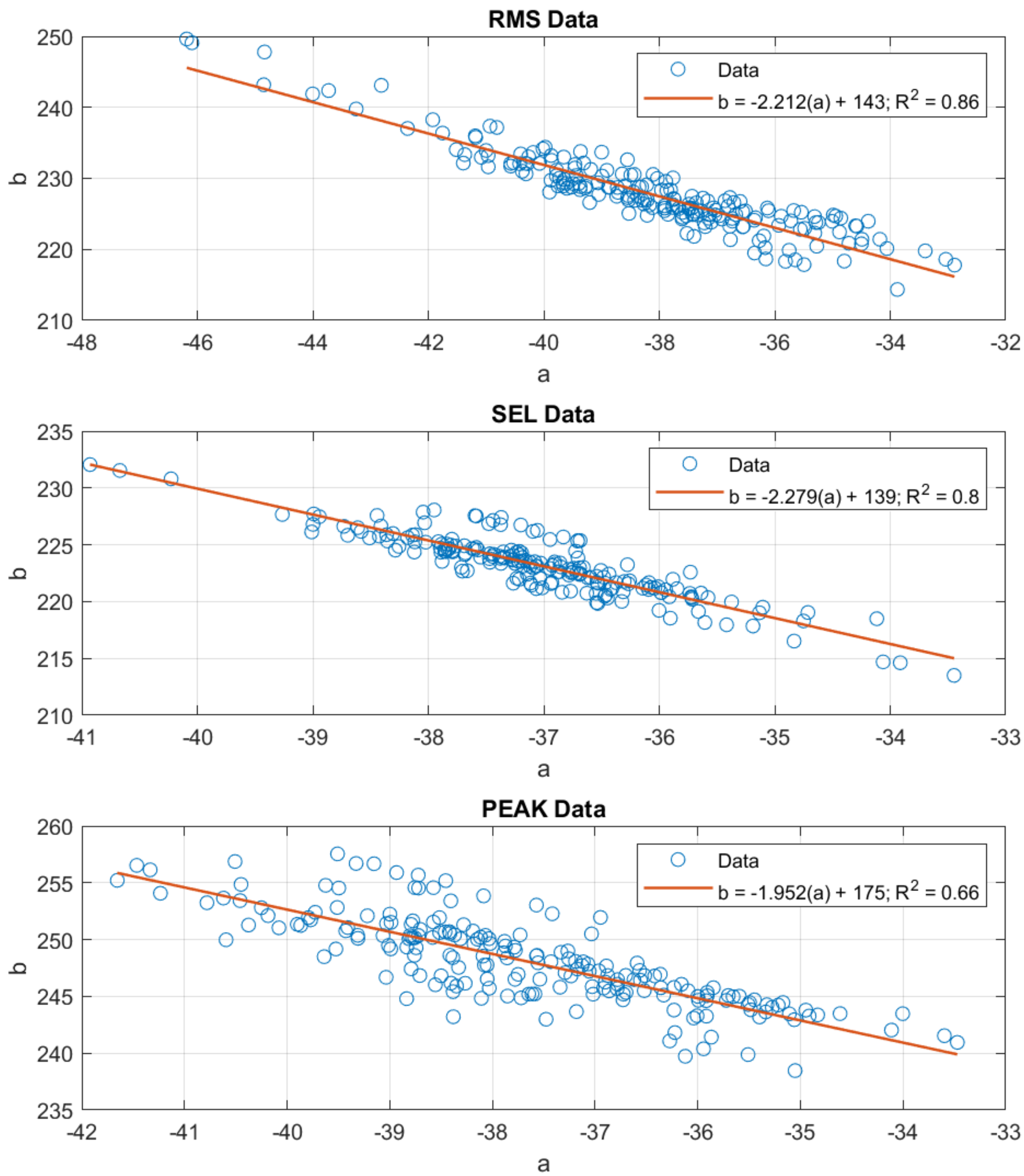

RMS Data
Data
b = -2.3(a) + 135; R2 = 0.98
b
a
SEL Data
Data
b = -2.2(a) + 139; R2 = 0.95
b
a
PEAK Data
Data
b = -2.2(a) + 160; R2 = 0.92
b
a

HF-5

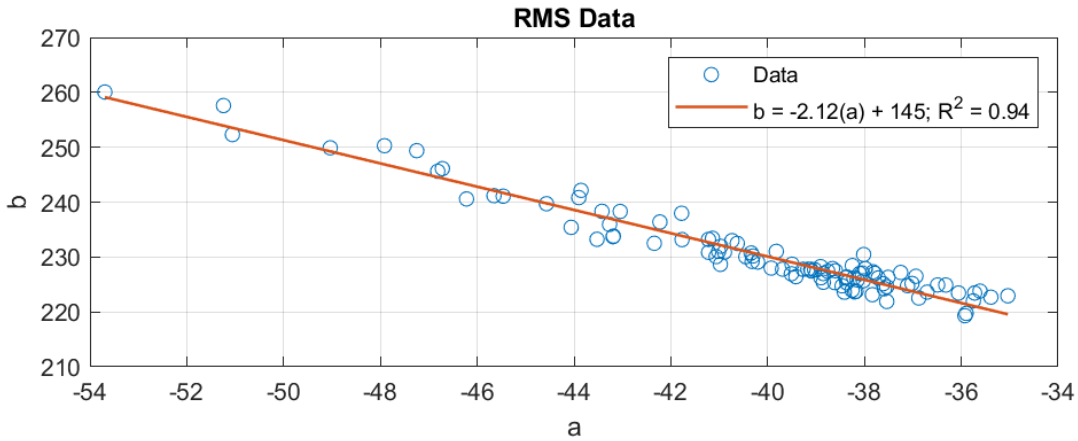

RMS Data
Data
b = -2.2(a) + 140; R^2 = 0.95
b
a
SEL Data
Data
b = -2.2(a) + 138; R^2 = 0.97
b
a
PEAK Data
Data
b = -1.8(a) + 178; R^2 = 0.84
b
a

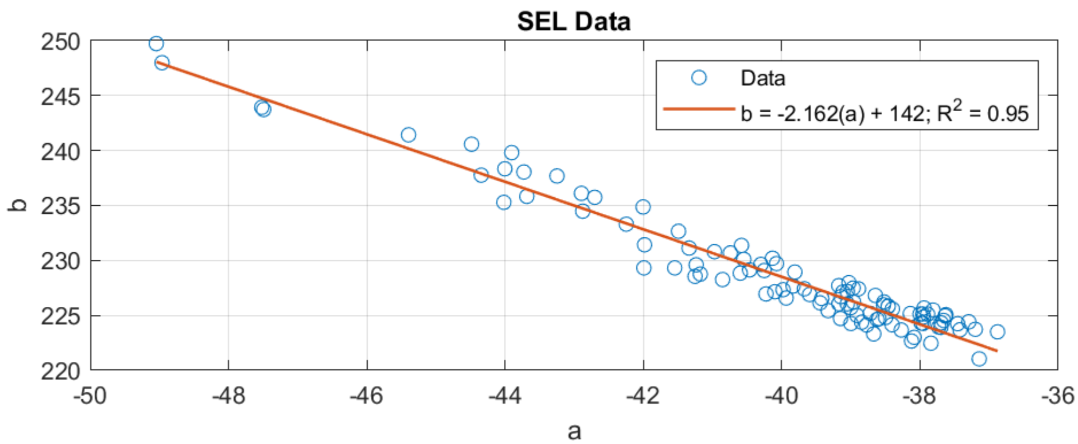

HF-6
RMS Data
Data
b = -2.114(a) + 148; R2 = 0.87
b
a
SEL Data
Data
b = -2.088(a) + 147; R2 = 0.95
b
a
PEAK Data
Data
b = -1.798(a) + 182; R2 = 0.94
b
a

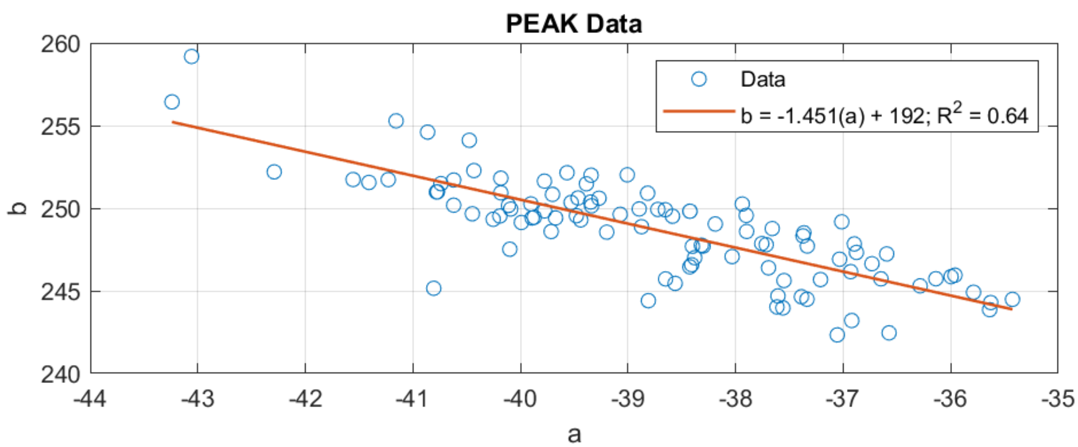
HF-7


RMS Data
Data
b = -2.212(a) + 143; R2 = 0.86
b
a
SEL Data
Data
b = -2.279(a) + 139; R2 = 0.8
b
a
PEAK Data
Data
b = -1.952(a) + 175; R2 = 0.66
b
a

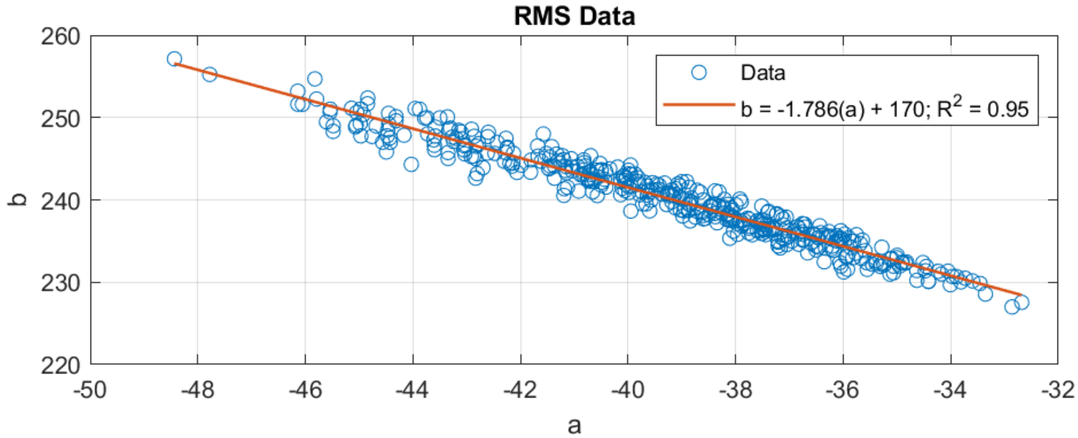
HF-8

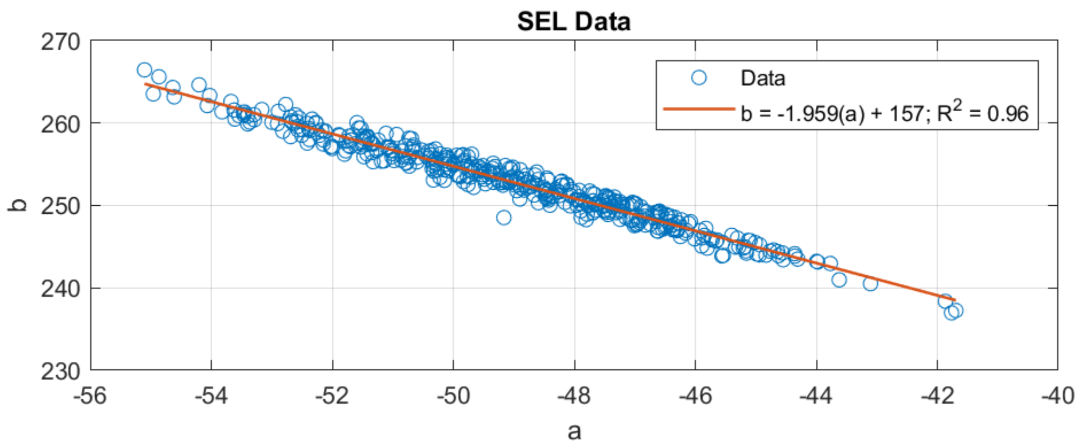

RMS Data
Data
b = -2.12(a) + 145; R2 = 0.94
b
a
270
260
250
240
230
220
210
-54
-52
-50
-48
-46
-44
-42
-40
-38
-36
-34

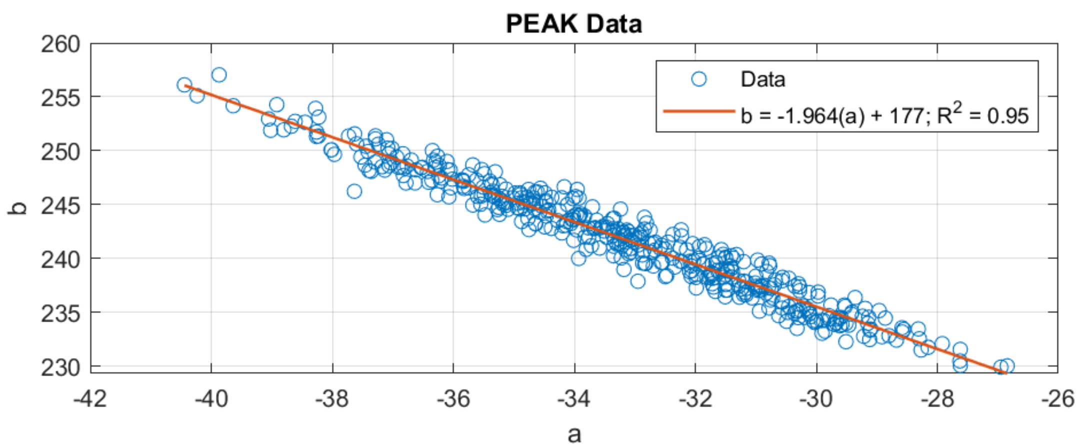

SEL Data
Data
b = -2.162(a) + 142; R2 = 0.95
b
a
250
245
240
235
230
225
220
-50
-48
-46
-44
-42
-40
-38
-36


PEAK Data
Data
b = -1.451(a) + 192; R2 = 0.64
b
a
260
255
250
245
240
-44
-43
-42
-41
-40
-39
-38
-37
-36
-35

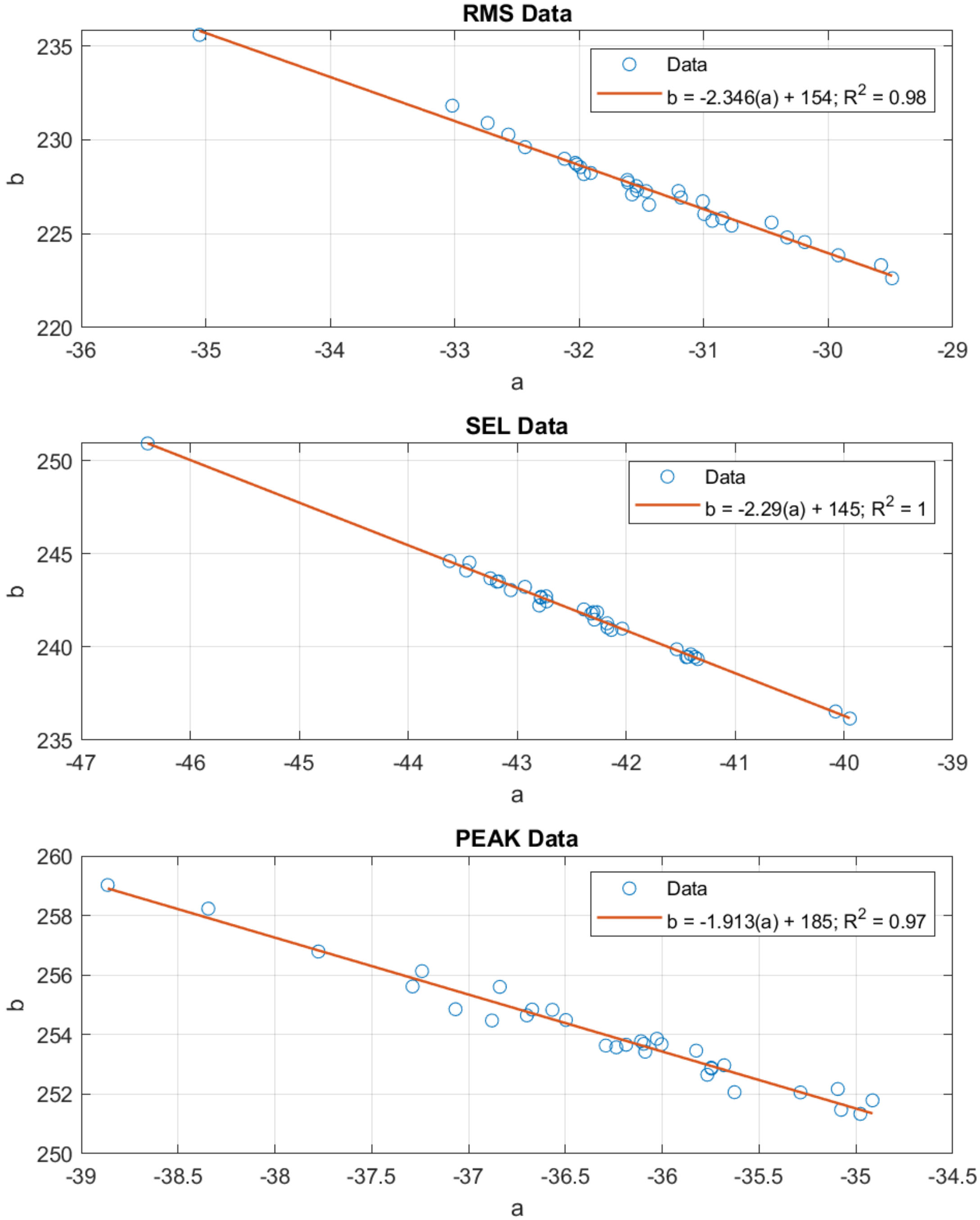
HF-9


RMS Data
Data
b = -1.786(a) + 170; R2 = 0.95
b
a

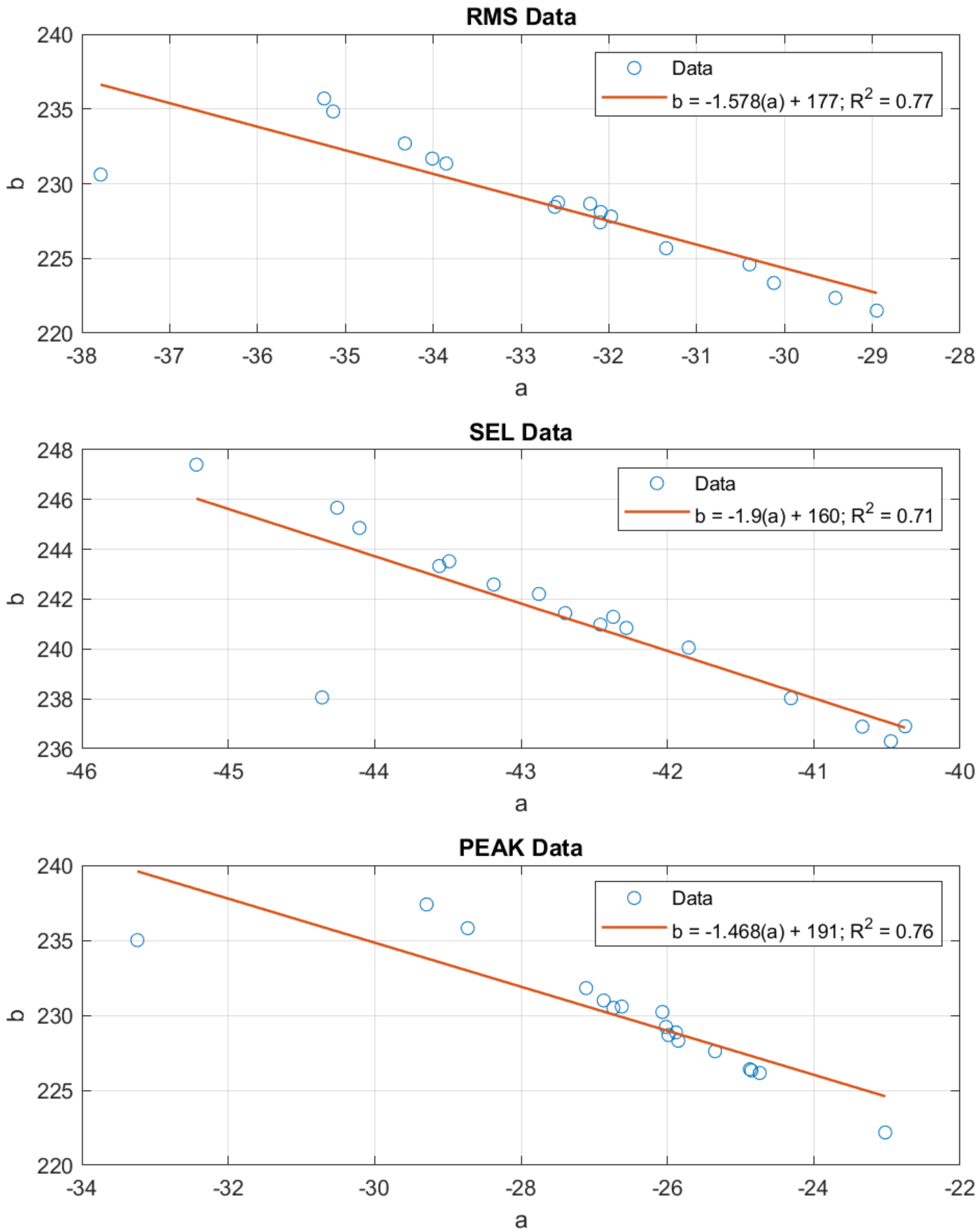

SEL Data
Data
b = -1.959(a) + 157; R2 = 0.96
b
a


PEAK Data
Data
b = -1.964(a) + 177; R2 = 0.95
b
a

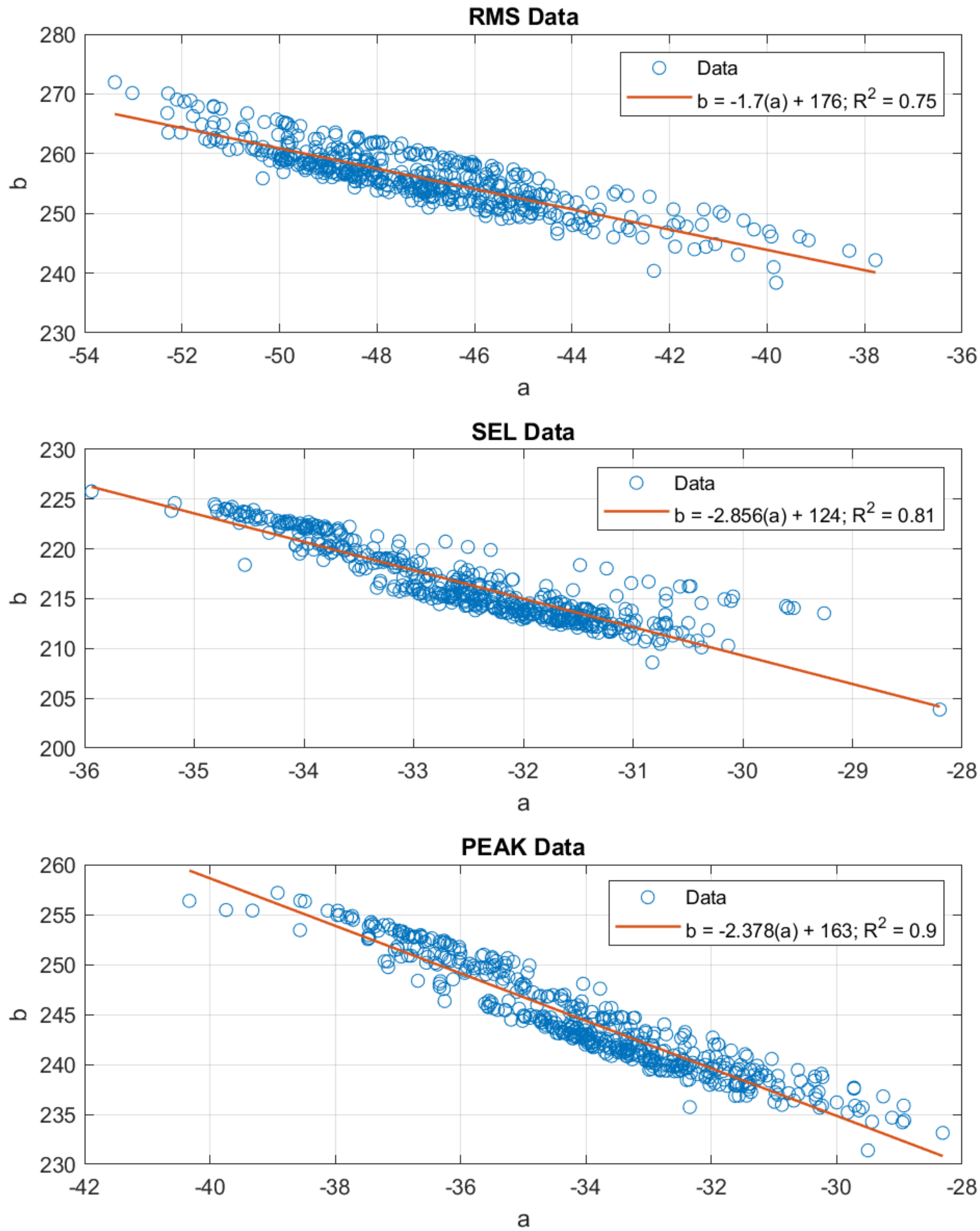
HF-10


RMS Data
Data
b = -2.346(a) + 154; R^2 = 0.98
235
230
225
220
-36
-35
-34
-33
-32
-31
-30
-29
a
b
SEL Data
Data
b = -2.29(a) + 145; R^2 = 1
250
245
240
235
-47
-46
-45
-44
-43
-42
-41
-40
-39
a
b
PEAK Data
Data
b = -1.913(a) + 185; R^2 = 0.97
260
258
256
254
252
250
-39
-38.5
-38
-37.5
-37
-36.5
-36
-35.5
-35
-34.5
a
b

HF-11

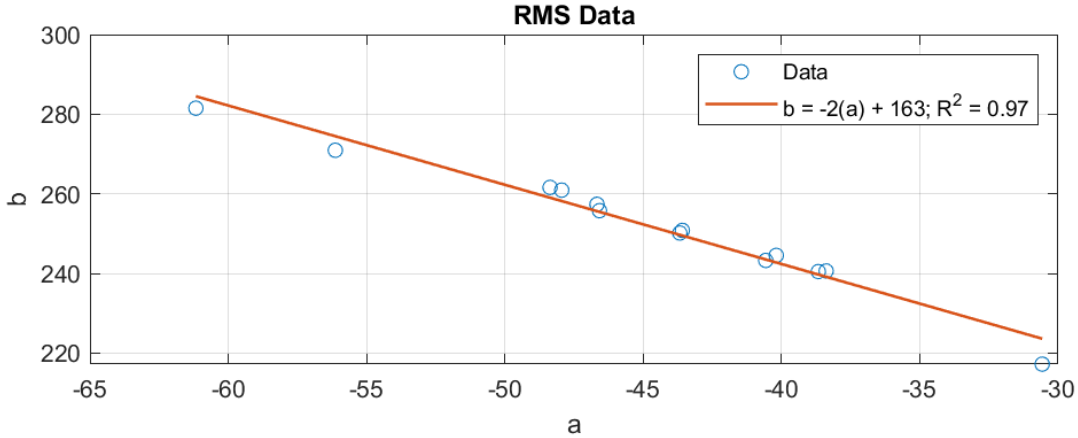

RMS Data
Data
b = -1.578(a) + 177; R^2 = 0.77
240
235
230
225
220
-38
-37
-36
-35
-34
-33
-32
-31
-30
-29
-28
a
b
SEL Data
Data
b = -1.9(a) + 160; R^2 = 0.71
248
246
244
242
240
238
236
-46
-45
-44
-43
-42
-41
-40
a
b
PEAK Data
Data
b = -1.468(a) + 191; R^2 = 0.76
240
235
230
225
220
-34
-32
-30
-28
-26
-24
-22
a
b

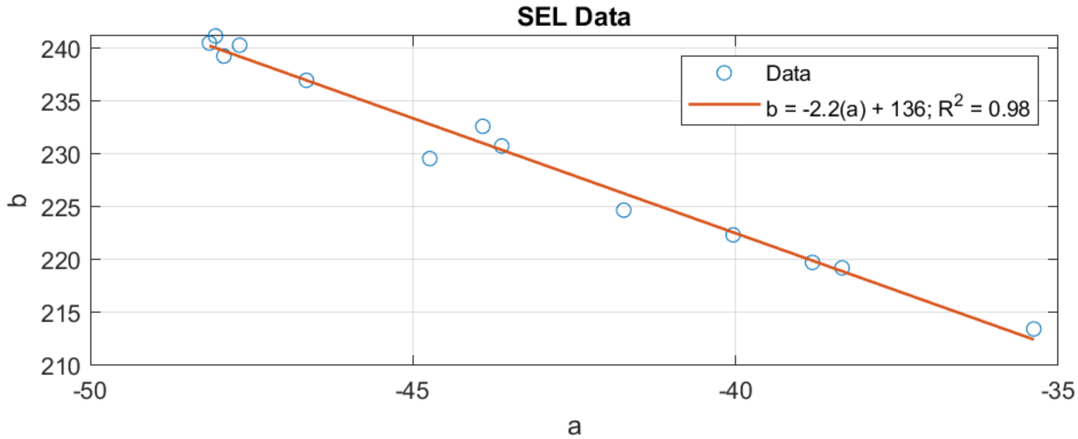
HF-12

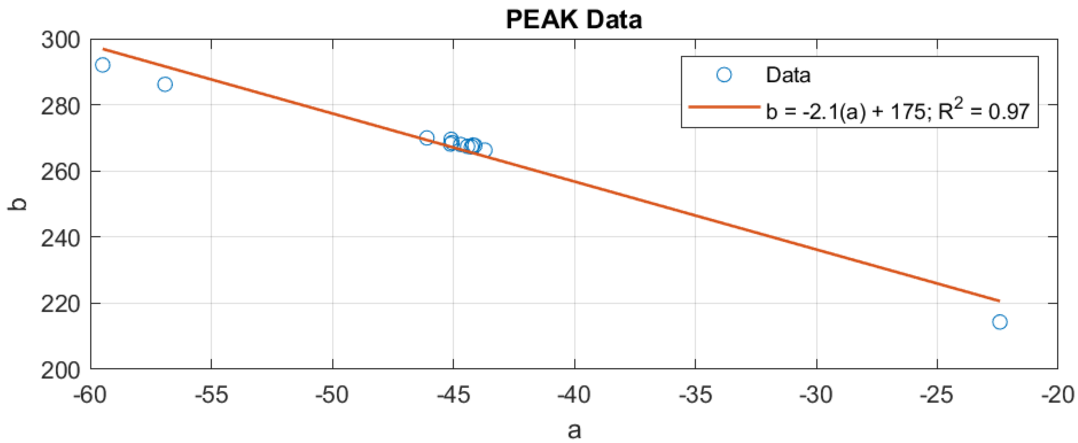


RMS Data
Data
b = -1.7(a) + 176; R2 = 0.75
b
a
SEL Data
Data
b = -2.856(a) + 124; R2 = 0.81
b
a
PEAK Data
Data
b = -2.378(a) + 163; R2 = 0.9
b
a

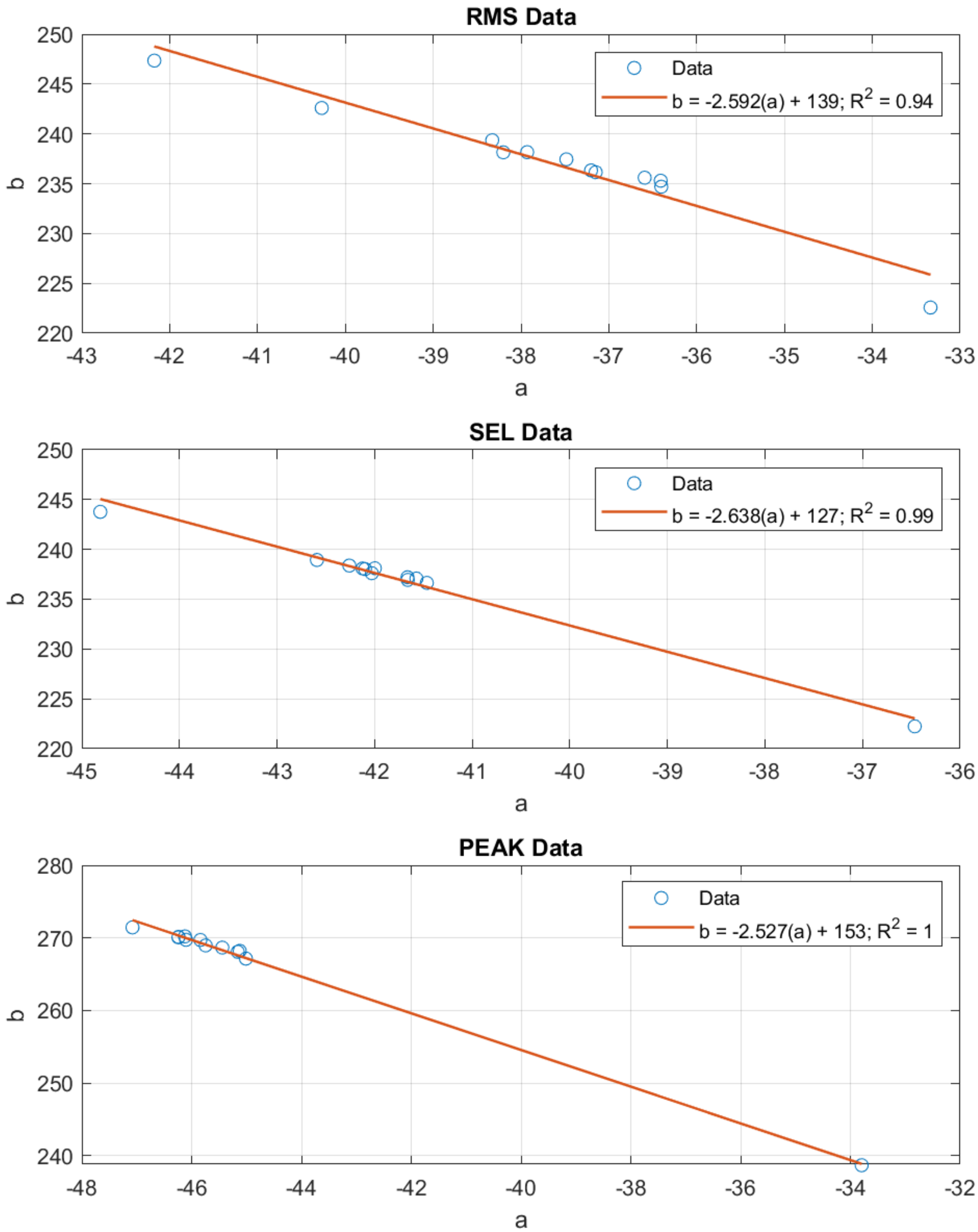
HF-13

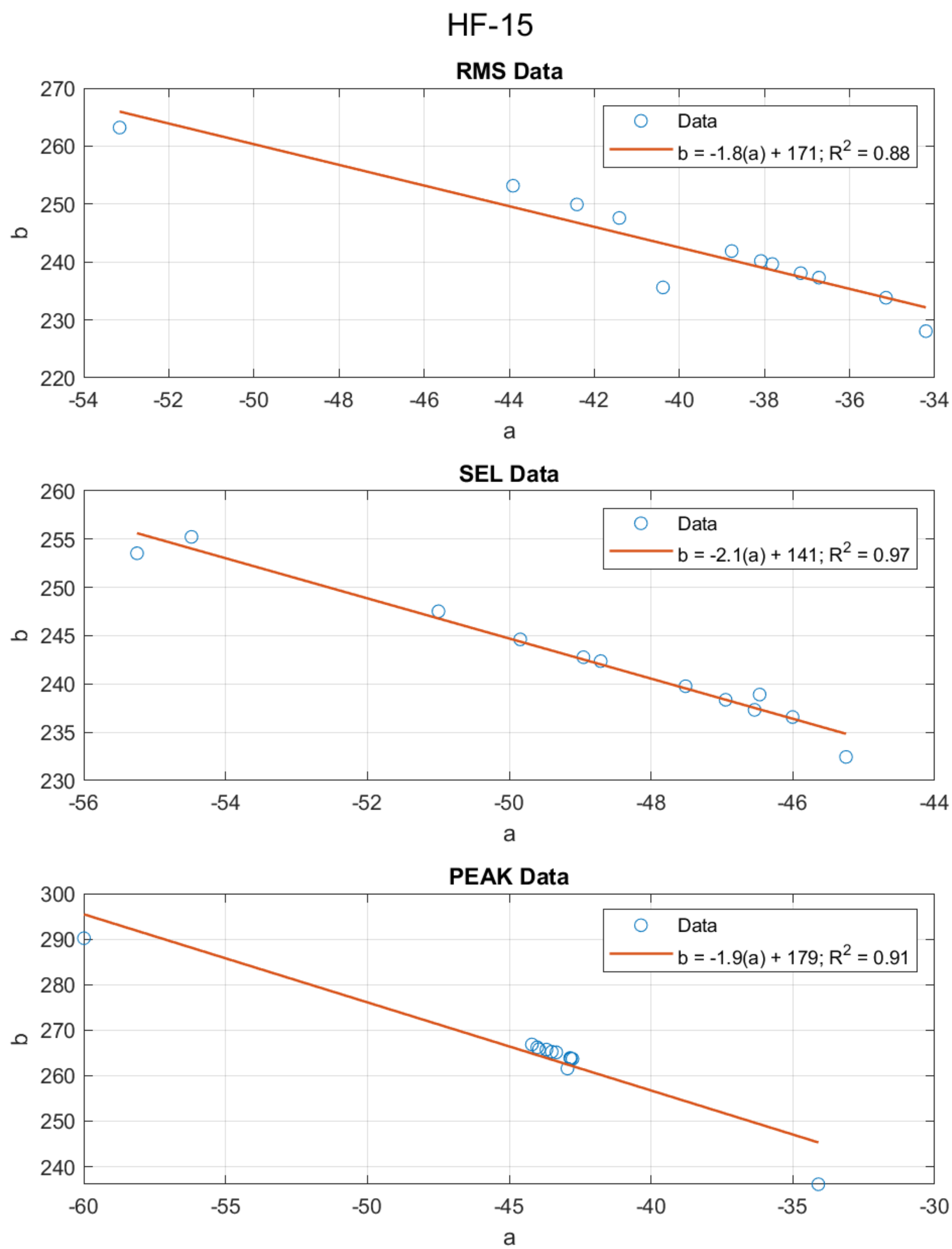

RMS Data
Data
b = -2(a) + 163; R2 = 0.97
a
b


SEL Data
Data
b = -2.2(a) + 136; R2 = 0.98
a
b


PEAK Data
Data
b = -2.1(a) + 175; R2 = 0.97
a
b

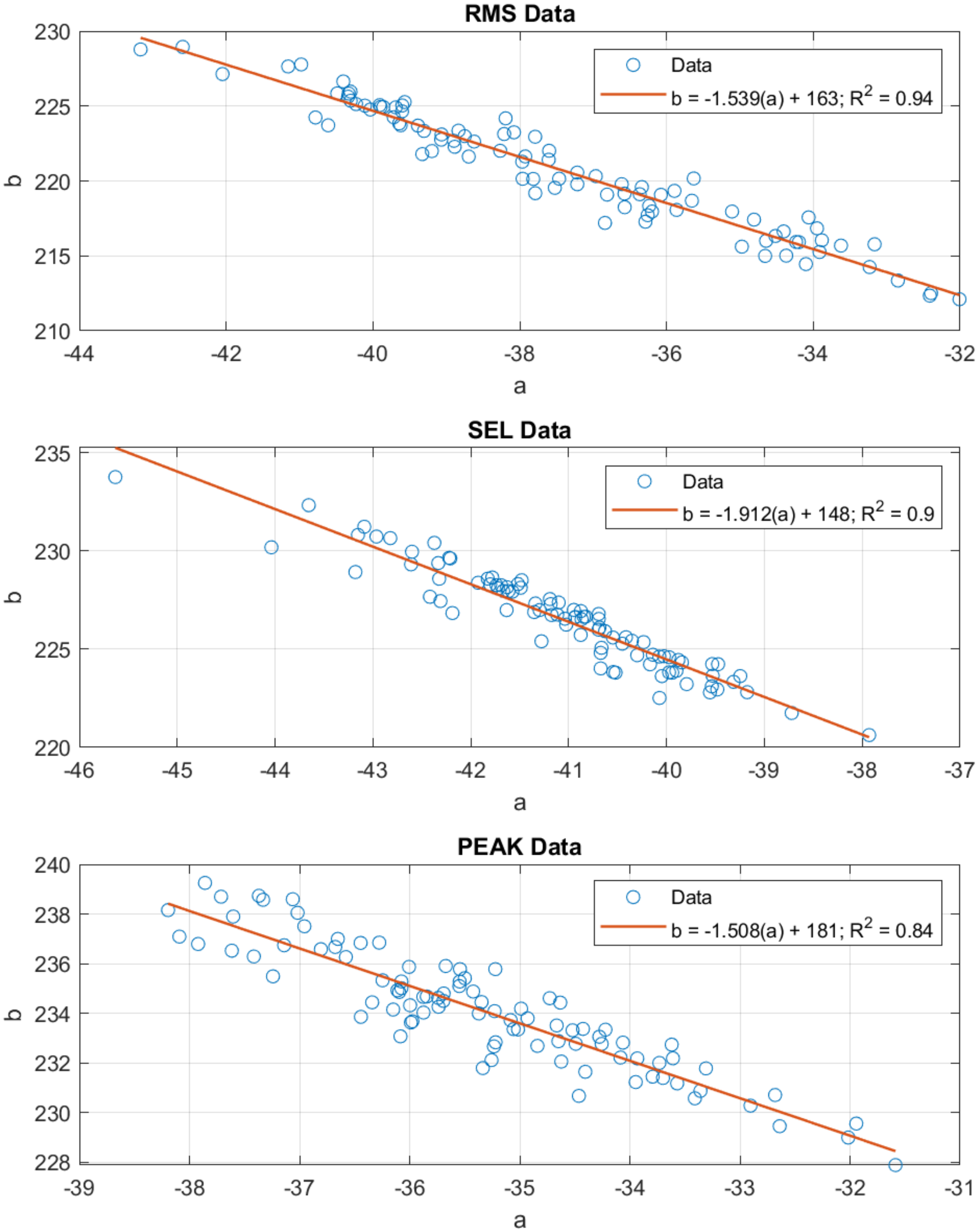
HF-14


RMS Data
Data
b = -2.592(a) + 139; R2 = 0.94
b
a
SEL Data
Data
b = -2.638(a) + 127; R2 = 0.99
b
a
PEAK Data
Data
b = -2.527(a) + 153; R2 = 1
b
a

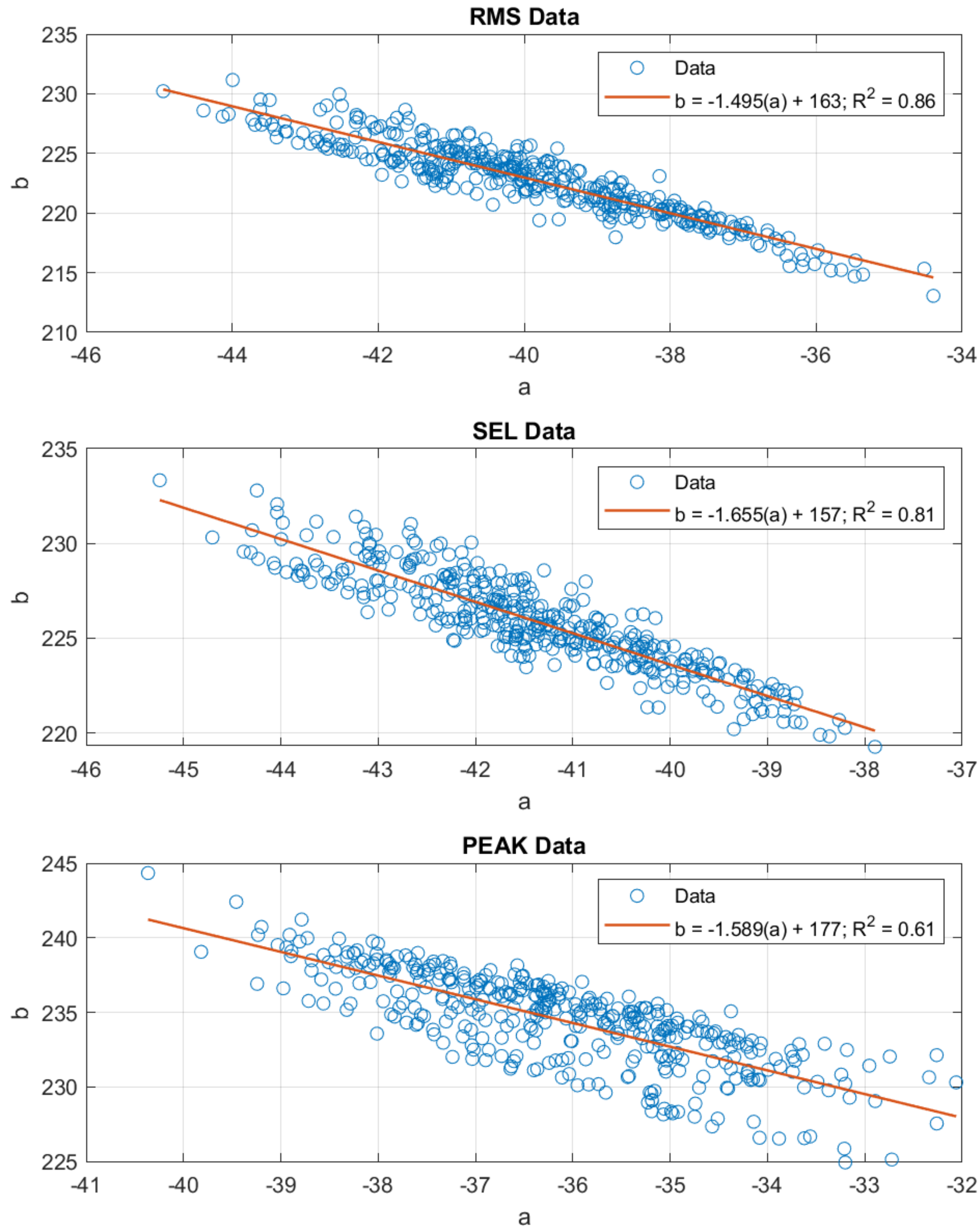


HF-15
RMS Data
Data
b = -1.8(a) + 171; R2 = 0.88
b
a
SEL Data
Data
b = -2.1(a) + 141; R2 = 0.97
b
a
PEAK Data
Data
b = -1.9(a) + 179; R2 = 0.91
b
a

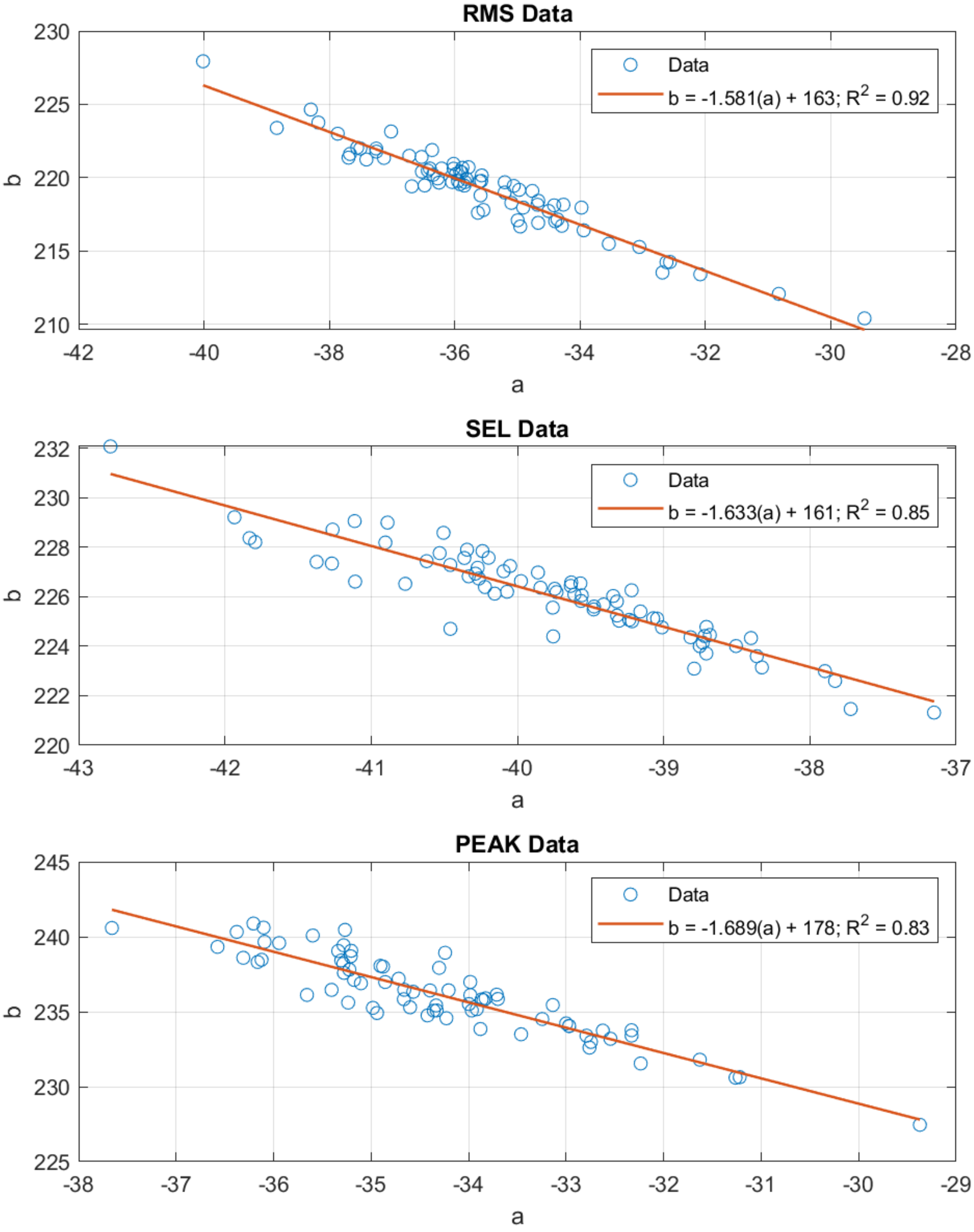
HF-16


RMS Data
Data
b = -1.539(a) + 163; R^2 = 0.94
b
a
SEL Data
Data
b = -1.912(a) + 148; R^2 = 0.9
b
a
PEAK Data
Data
b = -1.508(a) + 181; R^2 = 0.84
b
a

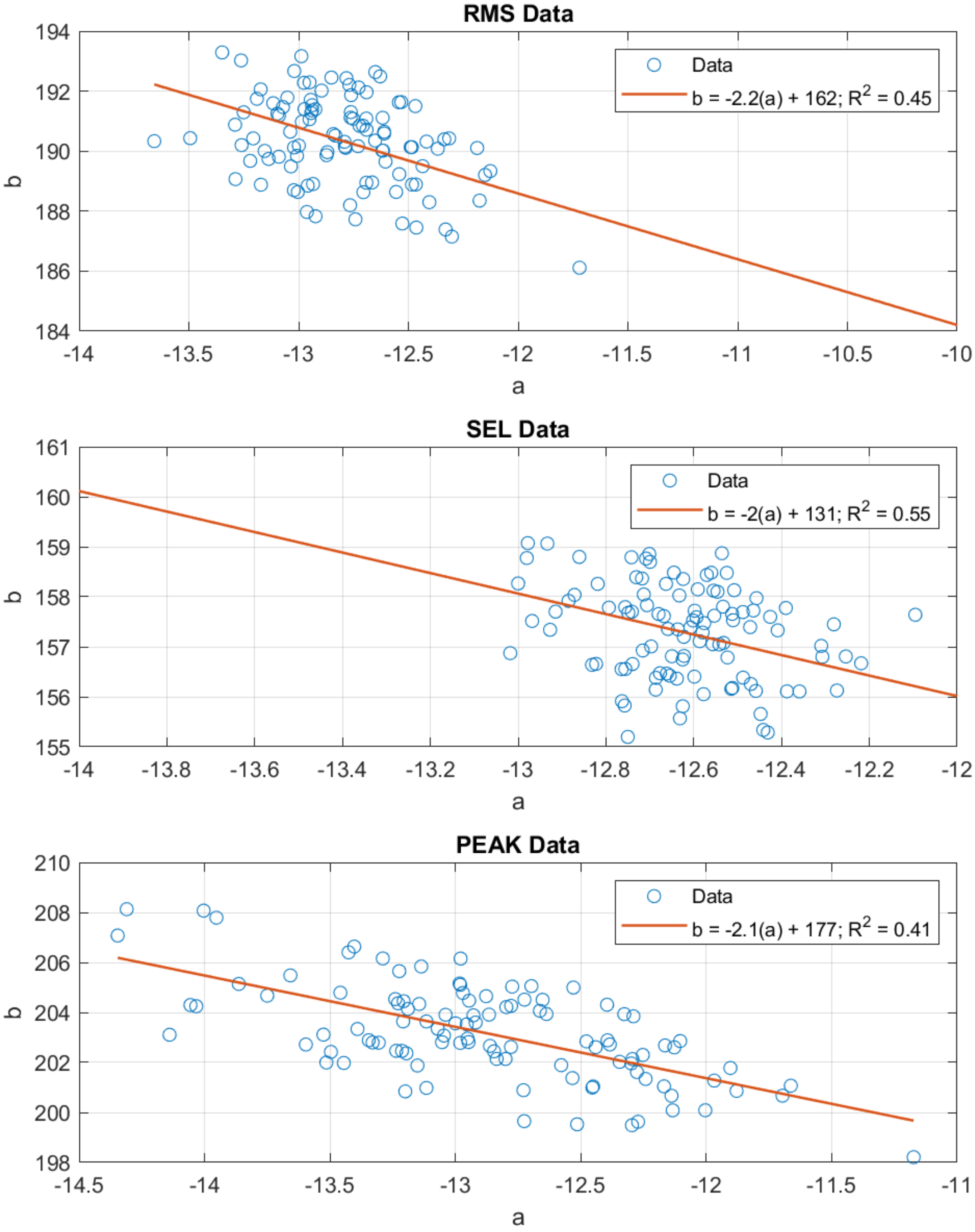
HF-17


RMS Data
Data
b = -1.495(a) + 163; R2 = 0.86
b
a
SEL Data
Data
b = -1.655(a) + 157; R2 = 0.81
b
a
PEAK Data
Data
b = -1.589(a) + 177; R2 = 0.61
b
a

HF-18

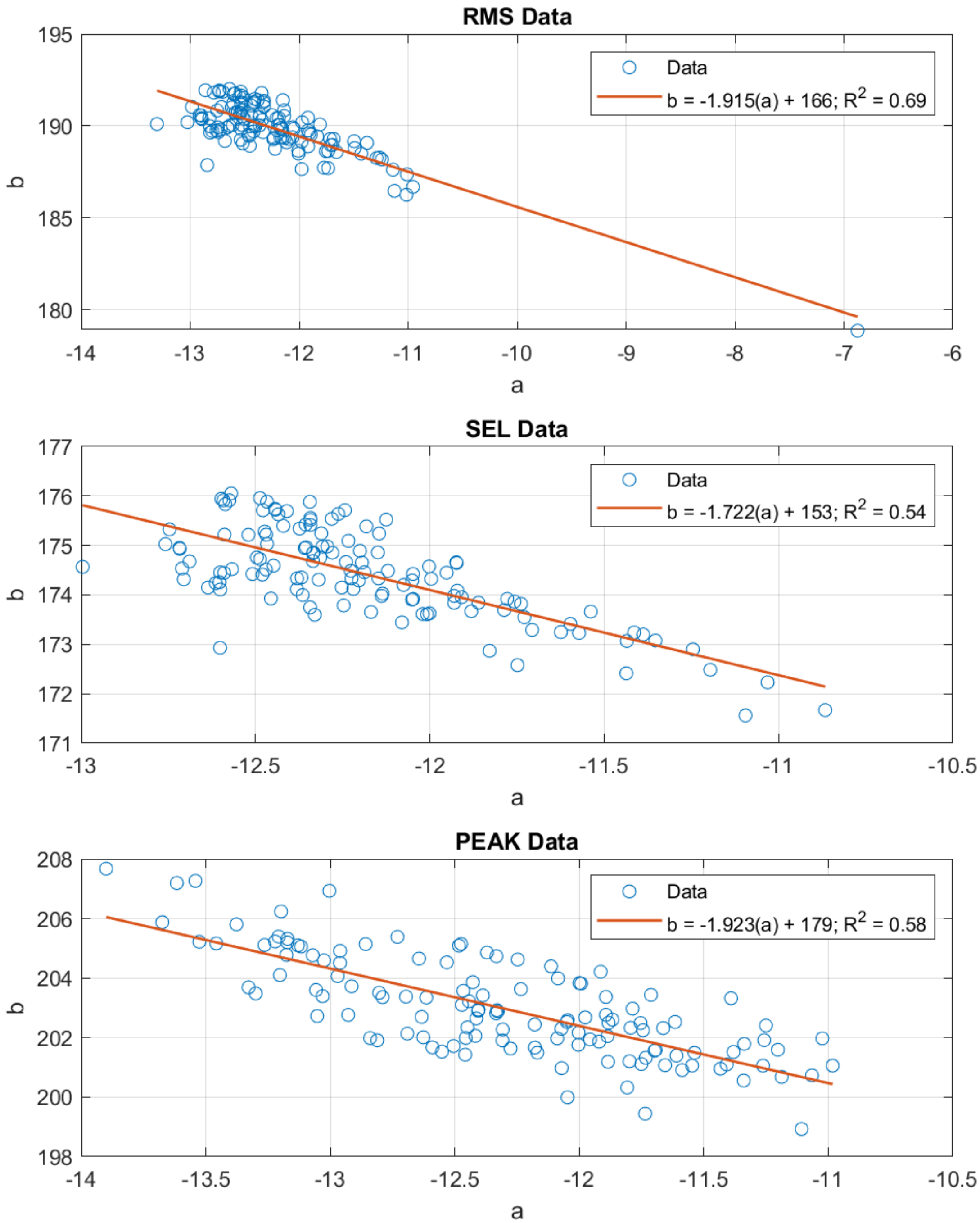

RMS Data
Data
b = -1.581(a) + 163; R2 = 0.92
b
a
SEL Data
Data
b = -1.633(a) + 161; R2 = 0.85
b
a
PEAK Data
Data
b = -1.689(a) + 178; R2 = 0.83
b
a

HF-19

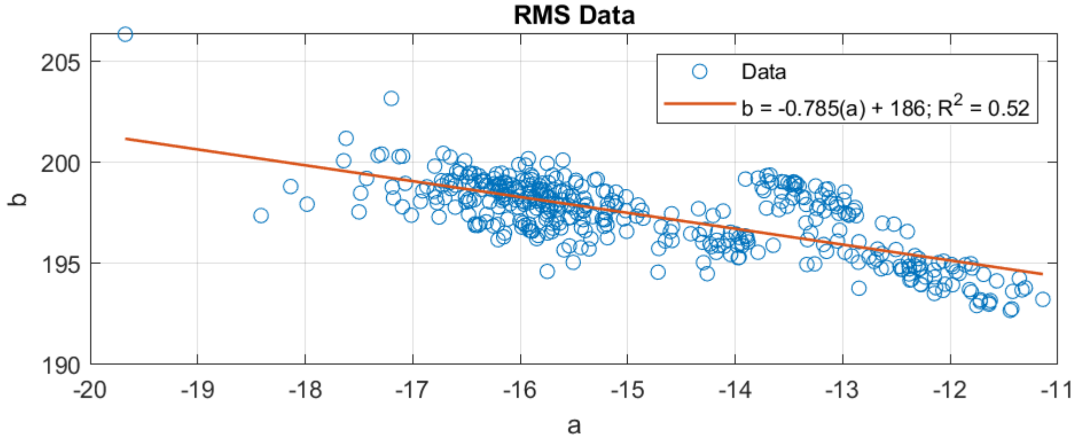


RMS Data
Data
b = -2.2(a) + 162; R2 = 0.45
b
a
SEL Data
Data
b = -2(a) + 131; R2 = 0.55
b
a
PEAK Data
Data
b = -2.1(a) + 177; R2 = 0.41
b
a

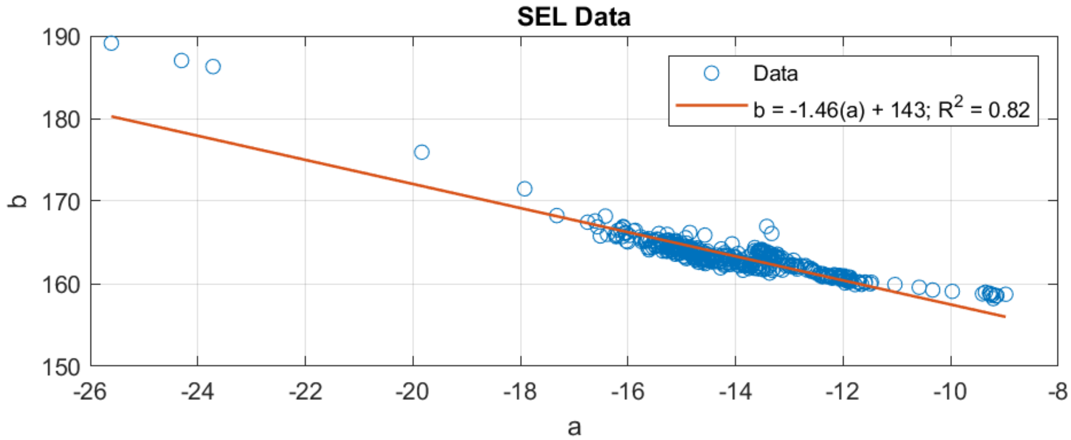
HF-20


RMS Data
Data
b = -1.915(a) + 166; R2 = 0.69
195
190
185
180
-14
-13
-12
-11
-10
-9
-8
-7
-6
a
b
SEL Data
Data
b = -1.722(a) + 153; R2 = 0.54
177
176
175
174
173
172
171
-13
-12.5
-12
-11.5
-11
-10.5
a
b
PEAK Data
Data
b = -1.923(a) + 179; R2 = 0.58
208
206
204
202
200
198
-14
-13.5
-13
-12.5
-12
-11.5
-11
-10.5
a
b

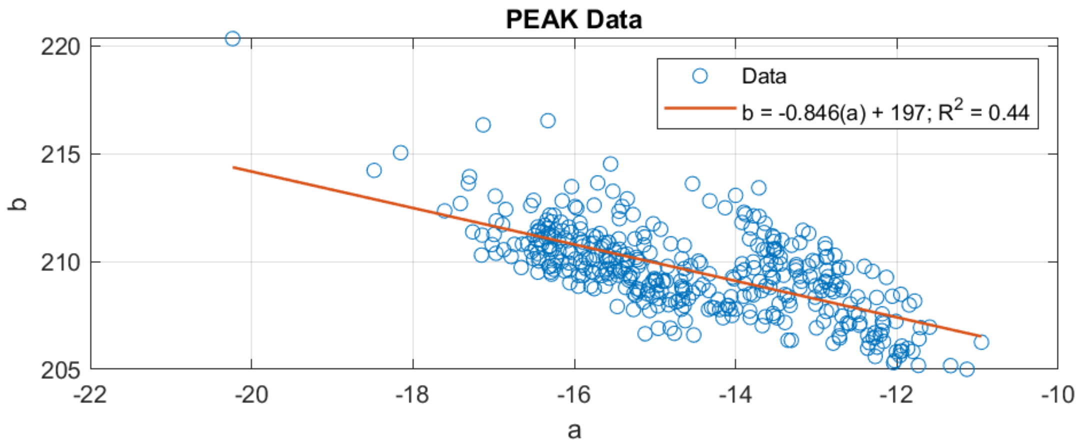
HF-21



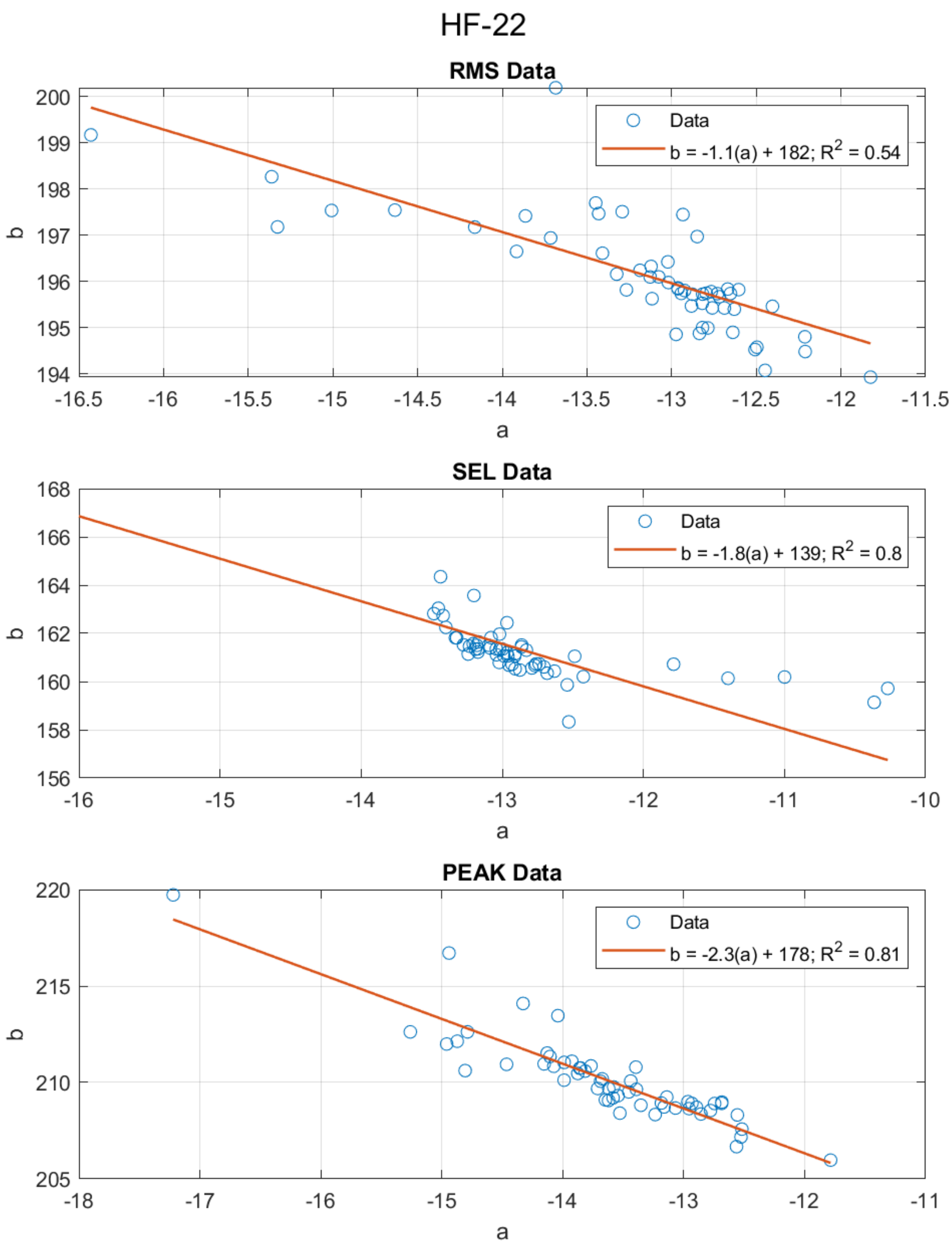
RMS Data
Data
b = -0.785(a) + 186; R2 = 0.52
b
a
205
200
195
190
-20
-19
-18
-17
-16
-15
-14
-13
-12
-11



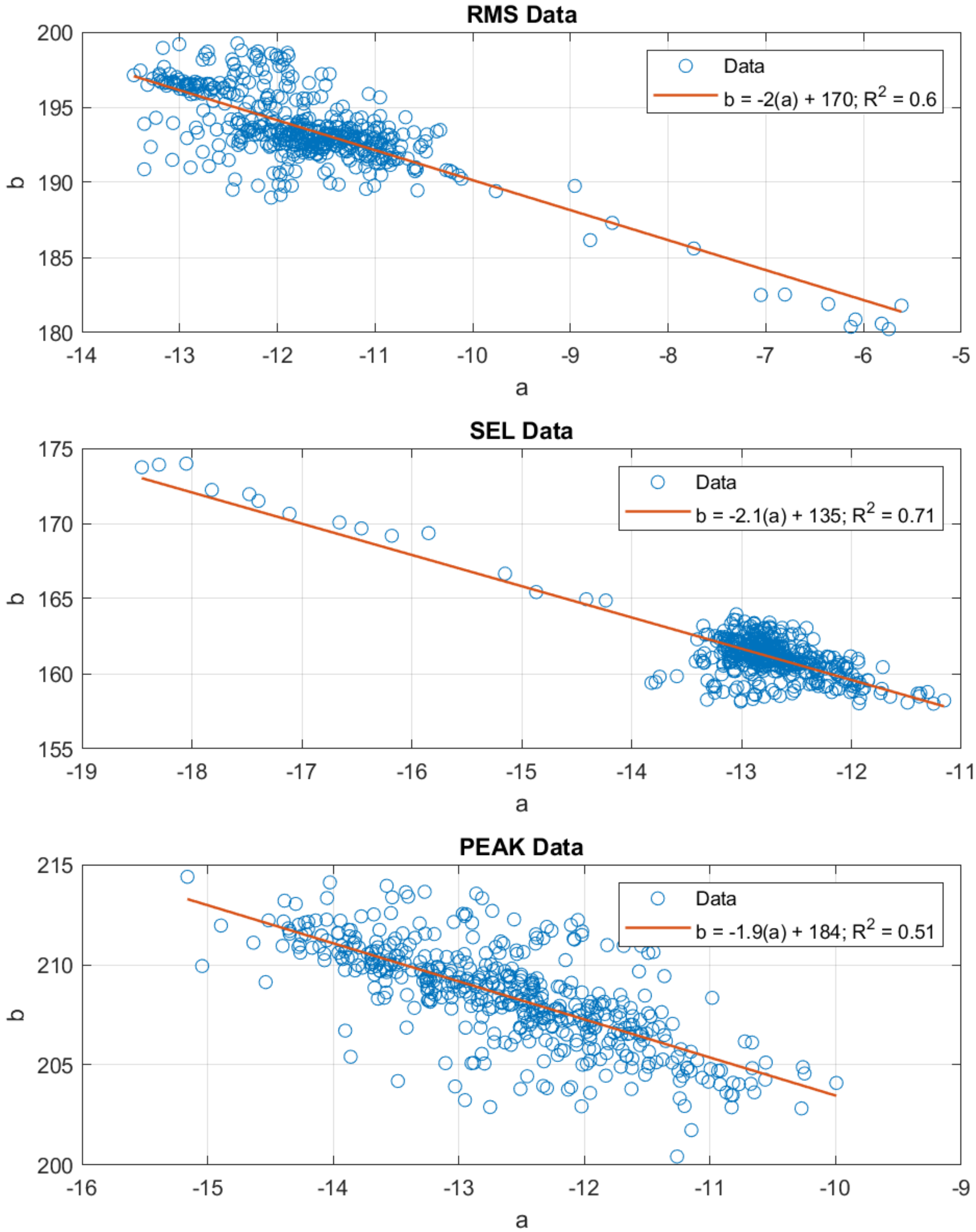
SEL Data
Data
b = -1.46(a) + 143; R2 = 0.82
b
a
190
180
170
160
150
-26
-24
-22
-20
-18
-16
-14
-12
-10
-8



PEAK Data
Data
b = -0.846(a) + 197; R2 = 0.44
b
a
220
215
210
205
-22
-20
-18
-16
-14
-12
-10

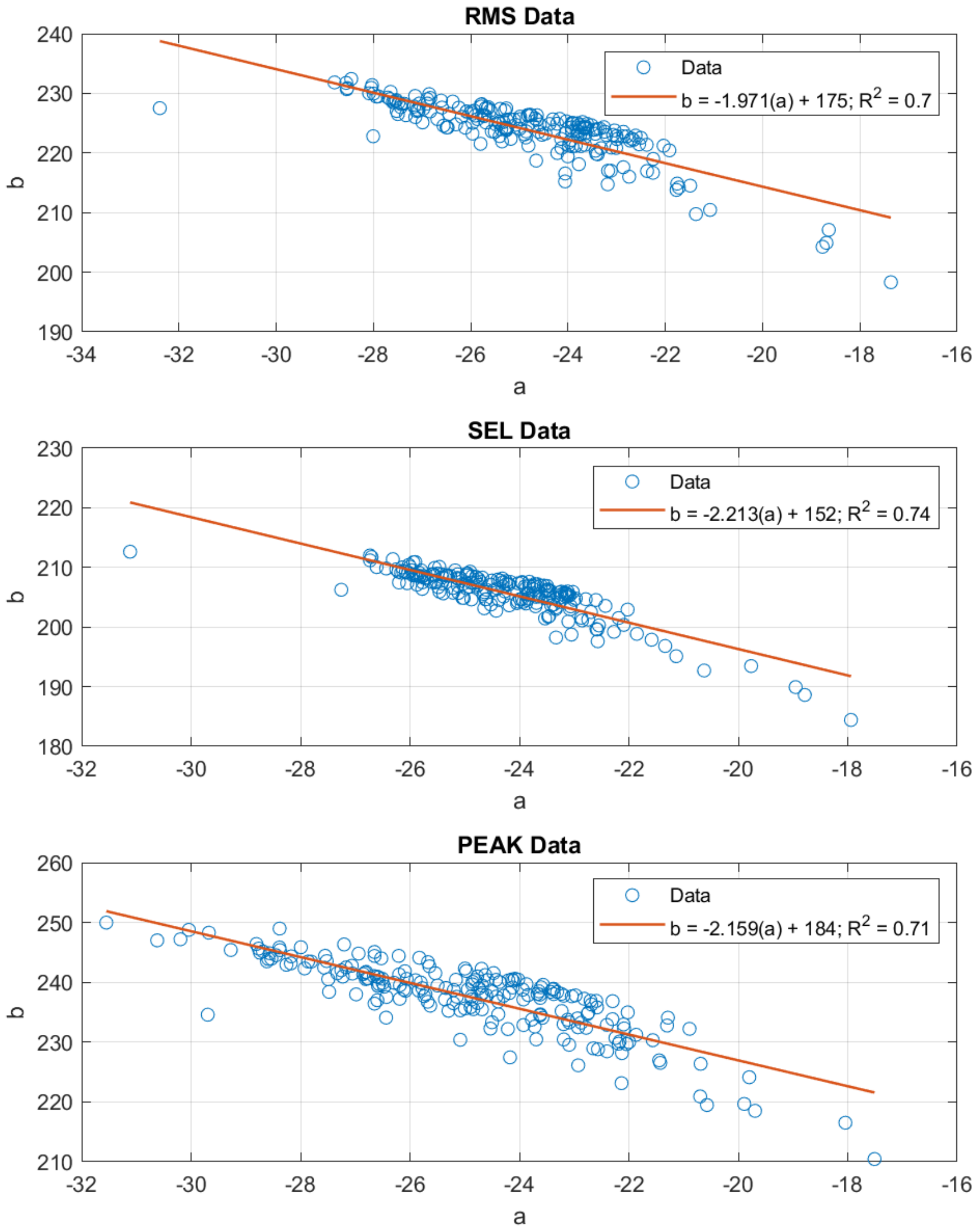

HF-22
RMS Data
Data
b = -1.1(a) + 182; R^2 = 0.54
b
a
SEL Data
Data
b = -1.8(a) + 139; R^2 = 0.8
b
a
PEAK Data
Data
b = -2.3(a) + 178; R^2 = 0.81
b
a

HF-23

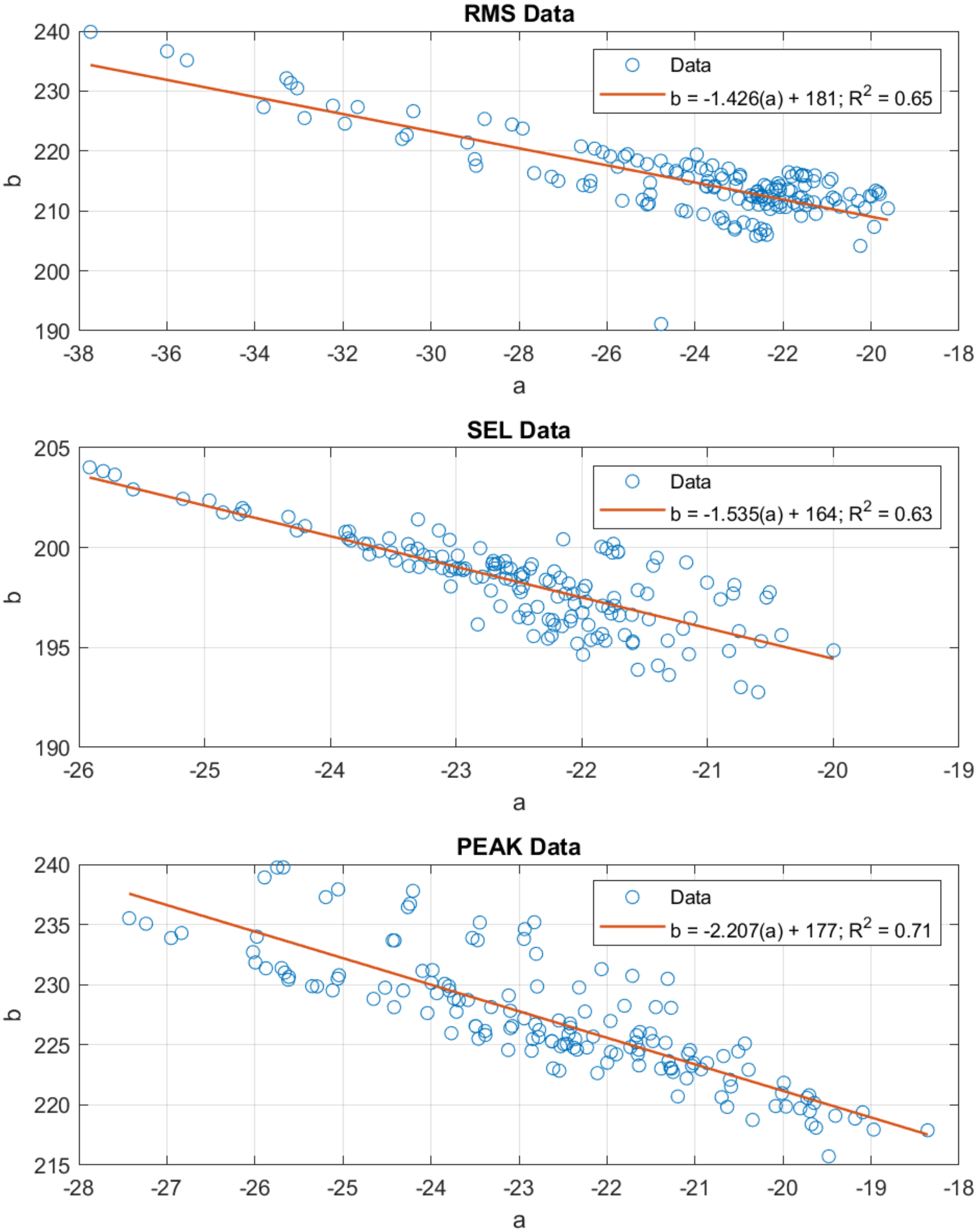


RMS Data
Data
b = -2(a) + 170; R^2 = 0.6
200
195
190
185
180
-14
-13
-12
-11
-10
-9
-8
-7
-6
-5
a
b
SEL Data
Data
b = -2.1(a) + 135; R^2 = 0.71
175
170
165
160
155
-19
-18
-17
-16
-15
-14
-13
-12
-11
a
b
PEAK Data
Data
b = -1.9(a) + 184; R^2 = 0.51
215
210
205
200
-16
-15
-14
-13
-12
-11
-10
-9
a
b

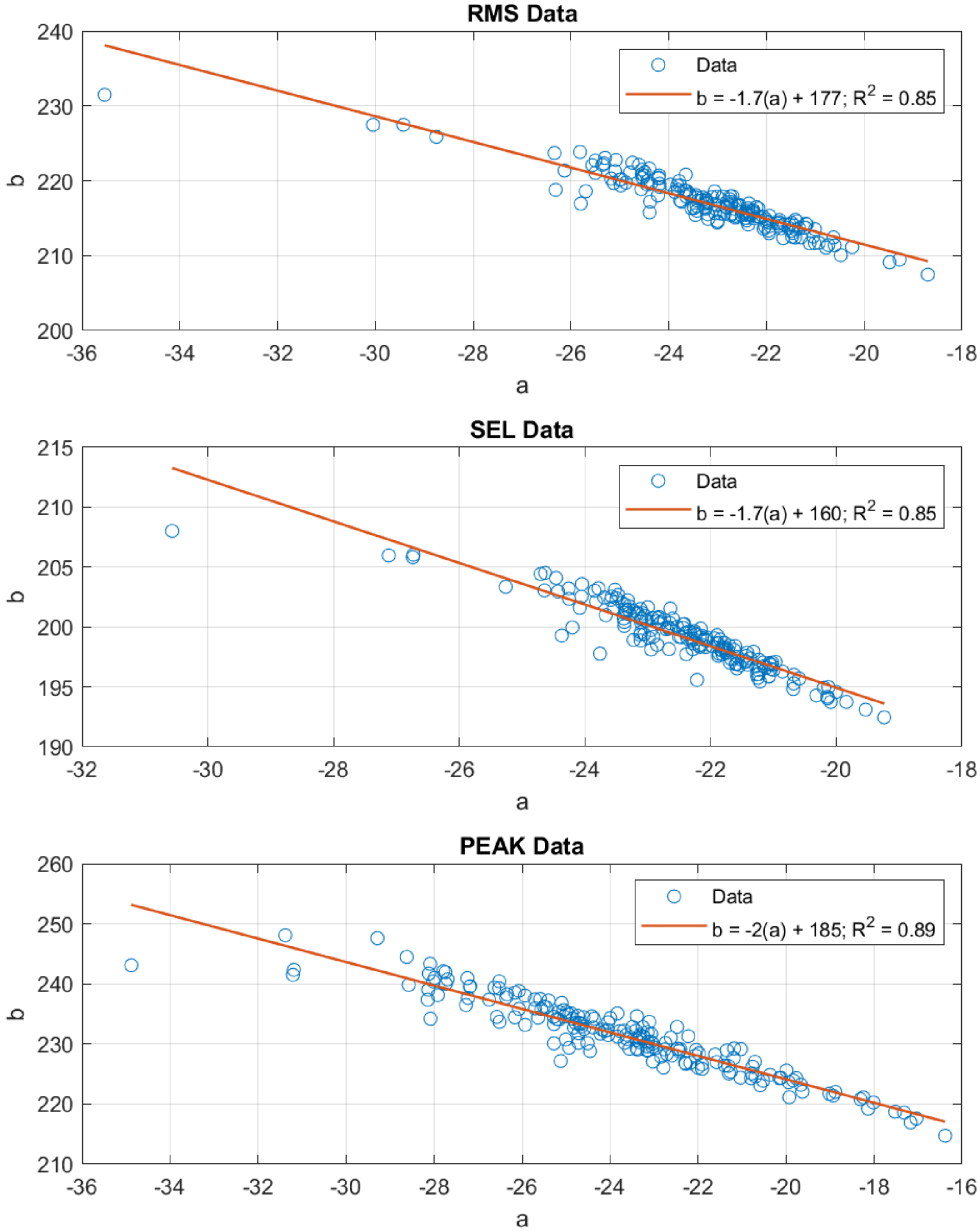
HF-24


RMS Data
Data
b = -1.971(a) + 175; R2 = 0.7
b
a
SEL Data
Data
b = -2.213(a) + 152; R2 = 0.74
b
a
PEAK Data
Data
b = -2.159(a) + 184; R2 = 0.71
b
a

HF-25

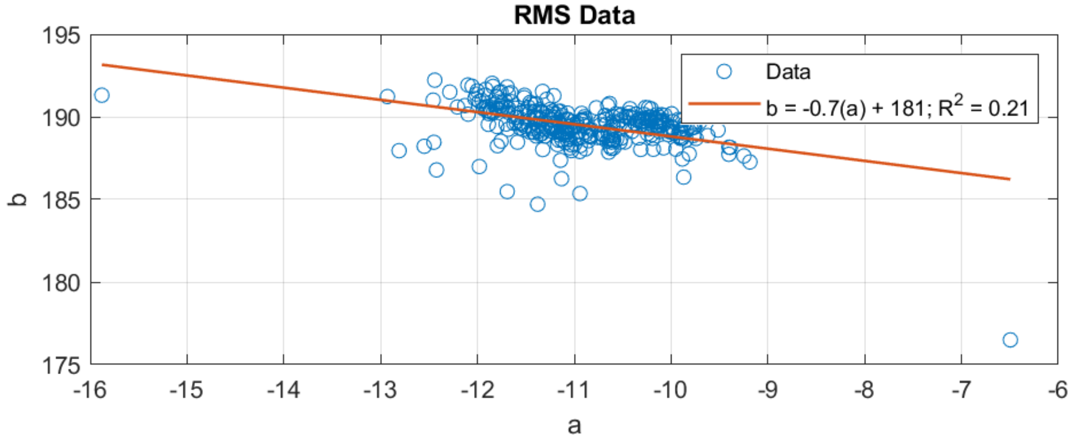

RMS Data
Data
b = -1.426(a) + 181; R2 = 0.65
b
a
SEL Data
Data
b = -1.535(a) + 164; R2 = 0.63
b
a
PEAK Data
Data
b = -2.207(a) + 177; R2 = 0.71
b
a

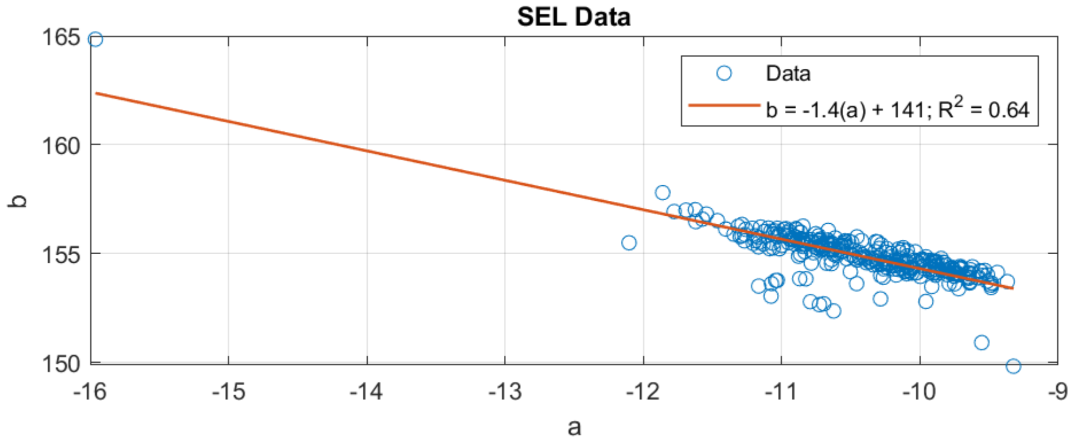
HF-26

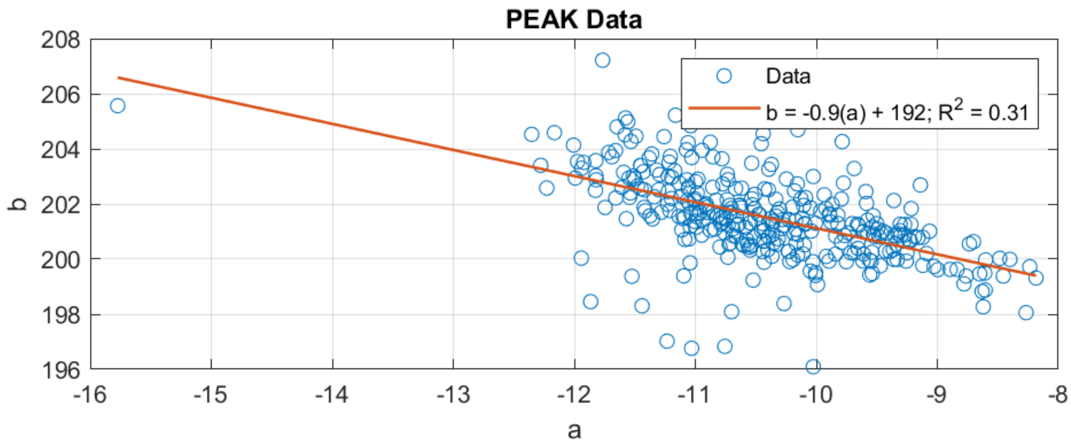


RMS Data
Data
b = -1.7(a) + 177; R^2 = 0.85
SEL Data
Data
b = -1.7(a) + 160; R^2 = 0.85
PEAK Data
Data
b = -2(a) + 185; R^2 = 0.89
a
b

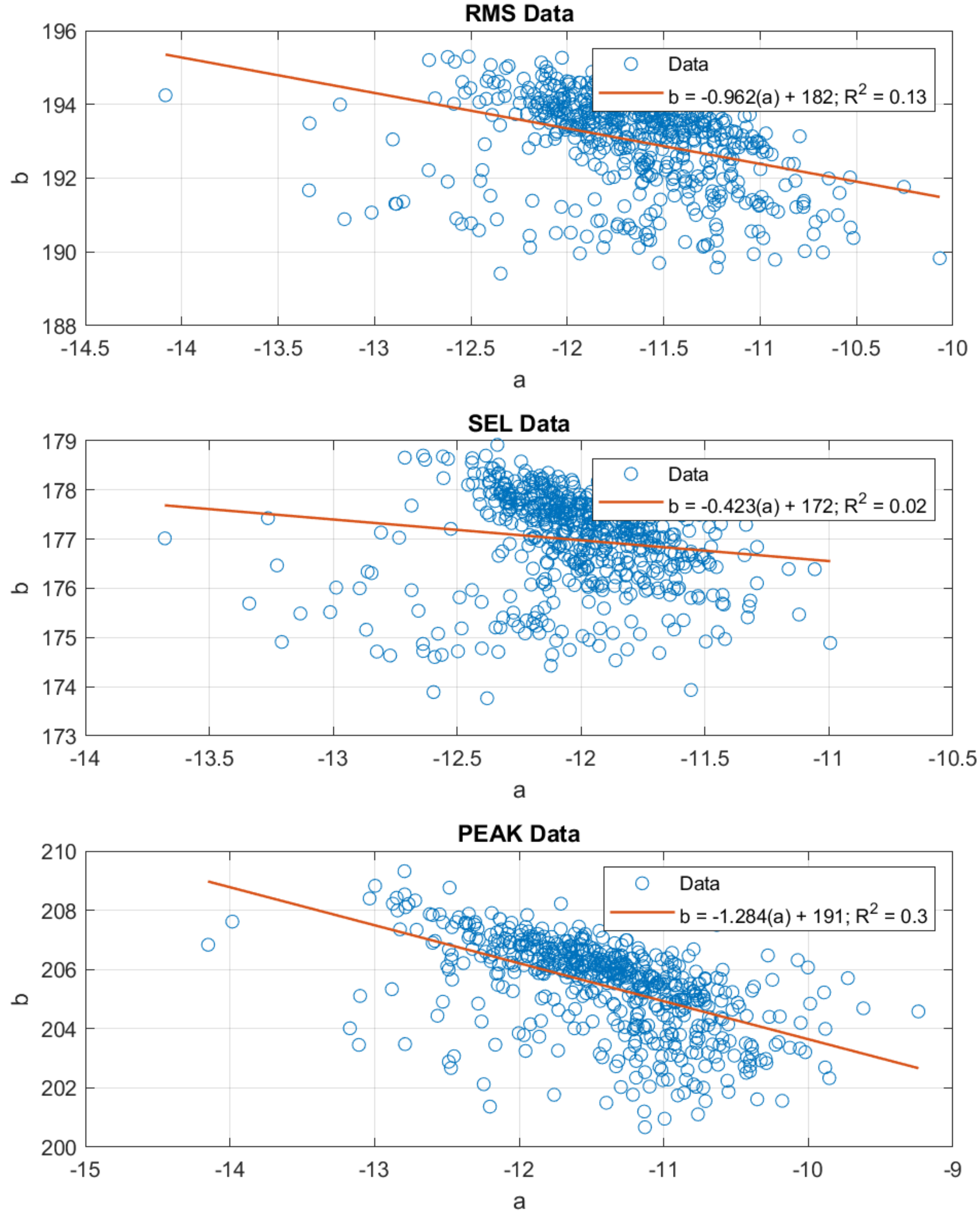
HF-27


RMS Data
Data
b = -0.7(a) + 181; R2 = 0.21
b
a

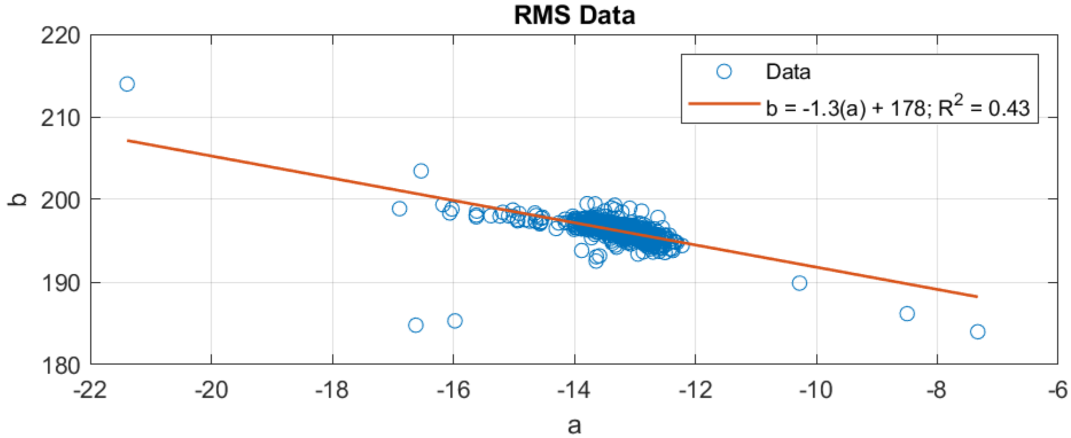

SEL Data
Data
b = -1.4(a) + 141; R2 = 0.64
b
a

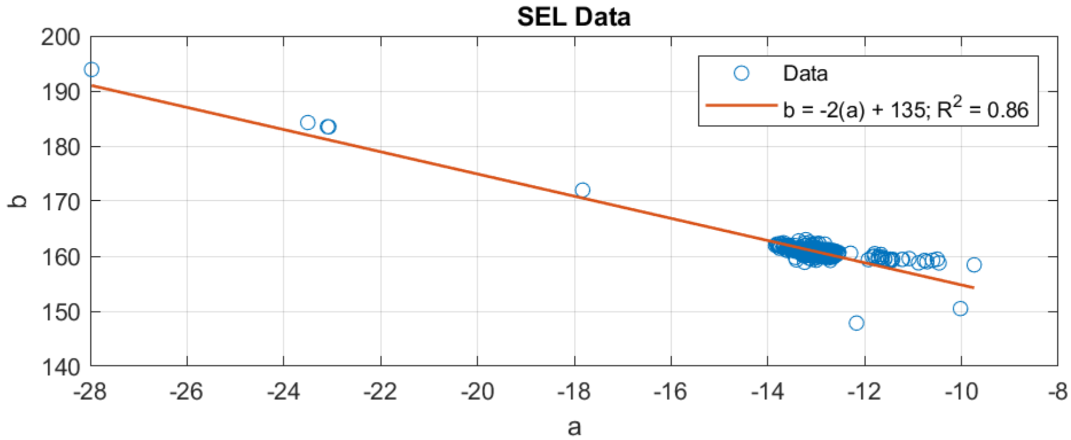

PEAK Data
Data
b = -0.9(a) + 192; R2 = 0.31
b
a

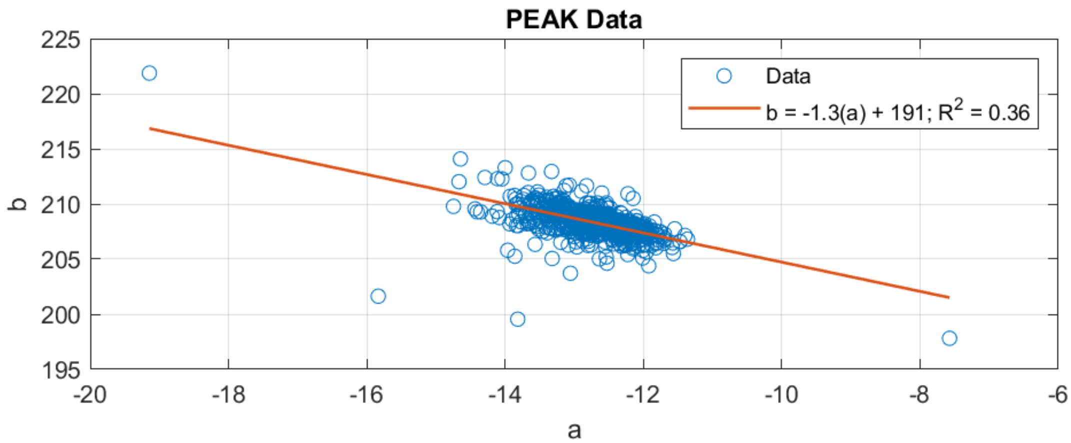
HF-28


RMS Data
Data
b = -0.962(a) + 182; R2 = 0.13
b
a
SEL Data
Data
b = -0.423(a) + 172; R2 = 0.02
b
a
PEAK Data
Data
b = -1.284(a) + 191; R2 = 0.3
b
a

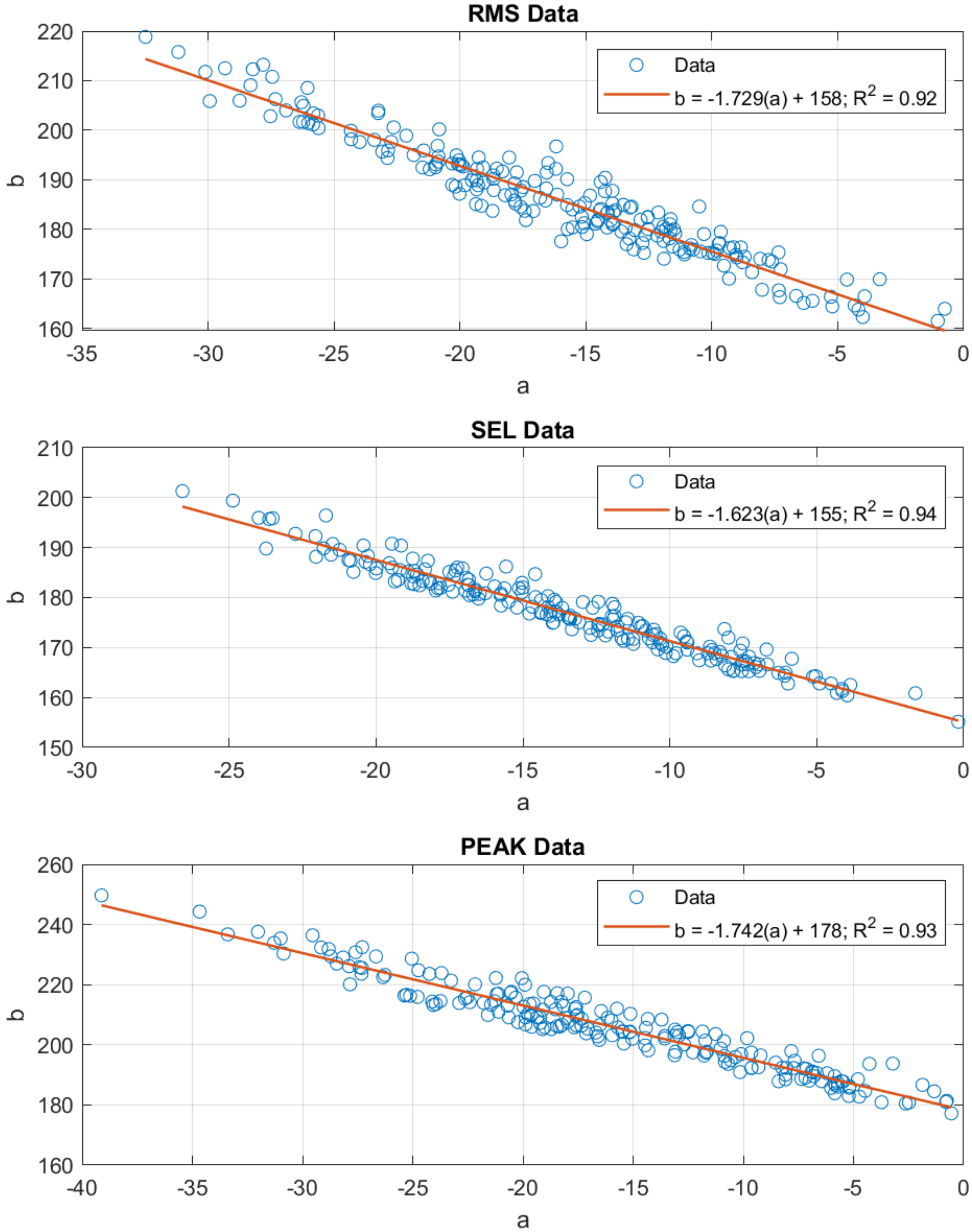
HF-29


RMS Data
Data
b = -1.3(a) + 178; R2 = 0.43
b
a
220
210
200
190
180
-22
-20
-18
-16
-14
-12
-10
-8
-6

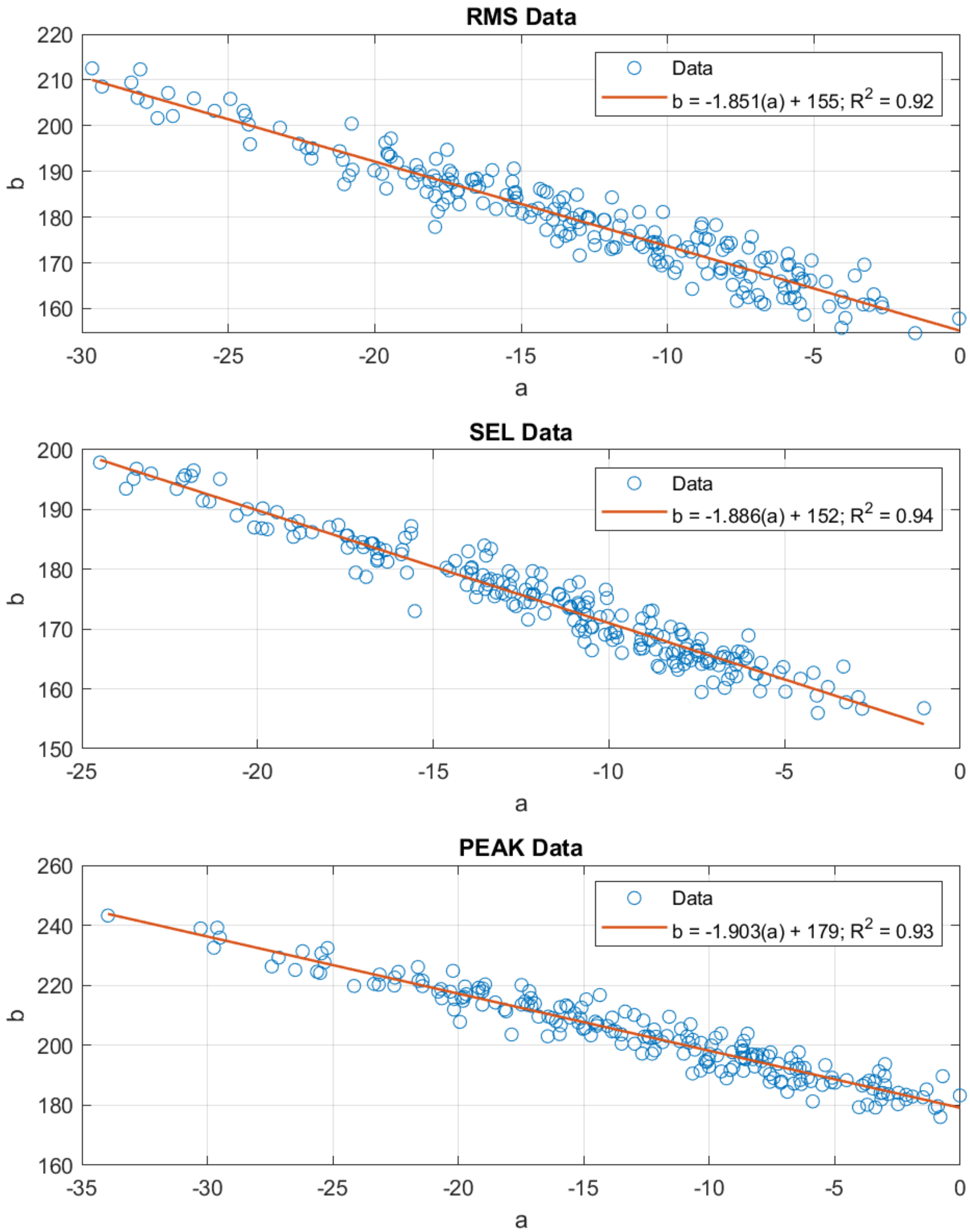

SEL Data
Data
b = -2(a) + 135; R2 = 0.86
b
a
200
190
180
170
160
150
140
-28
-26
-24
-22
-20
-18
-16
-14
-12
-10
-8


PEAK Data
Data
b = -1.3(a) + 191; R2 = 0.36
b
a
225
220
215
210
205
200
195
-20
-18
-16
-14
-12
-10
-8
-6

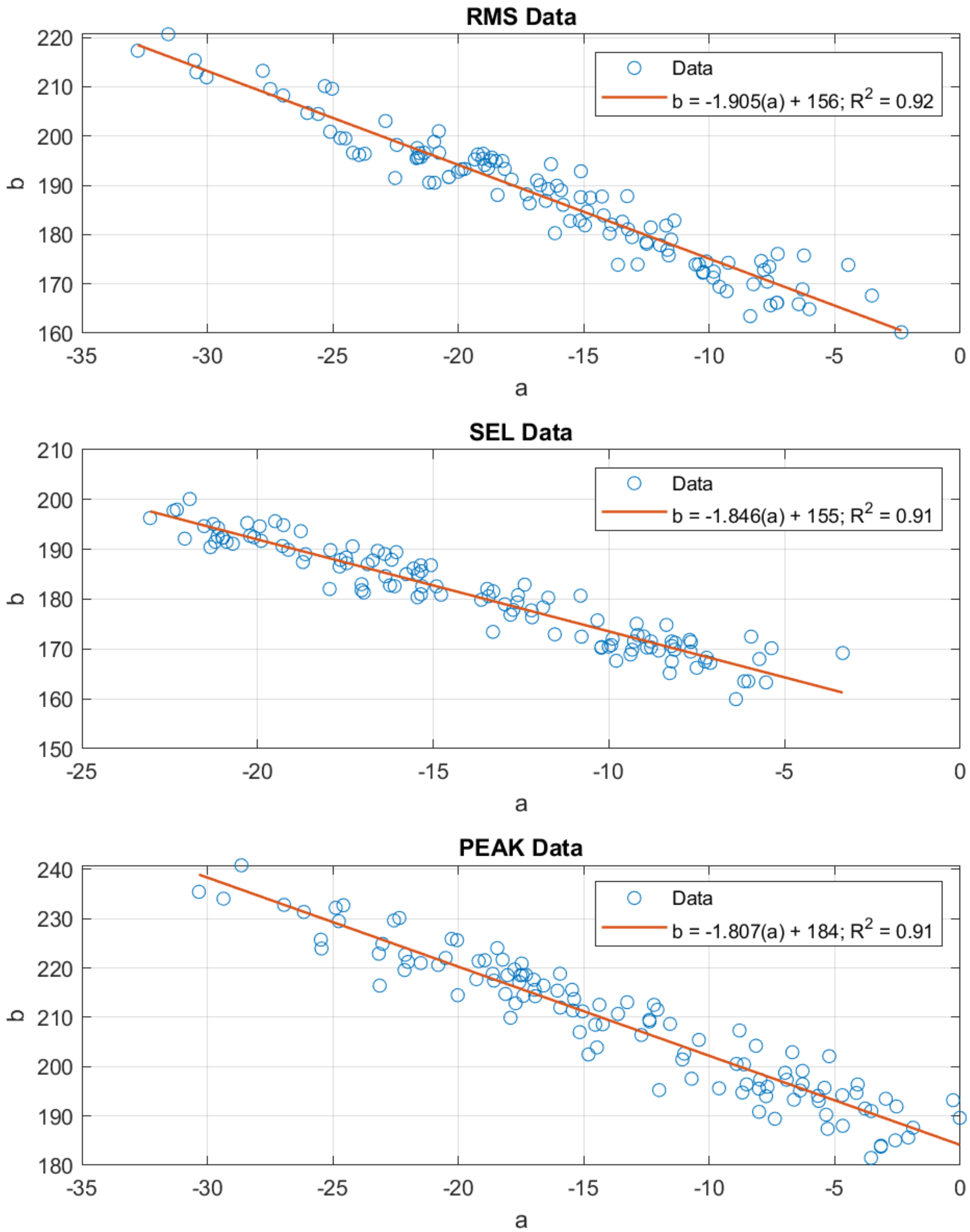
HF-30


RMS Data
Data
b = -1.729(a) + 158; R2 = 0.92
220
210
200
190
180
170
160
-35
-30
-25
-20
-15
-10
-5
0
a
b
SEL Data
Data
b = -1.623(a) + 155; R2 = 0.94
210
200
190
180
170
160
150
-30
-25
-20
-15
-10
-5
0
a
b
PEAK Data
Data
b = -1.742(a) + 178; R2 = 0.93
260
240
220
200
180
160
-40
-35
-30
-25
-20
-15
-10
-5
0
a
b

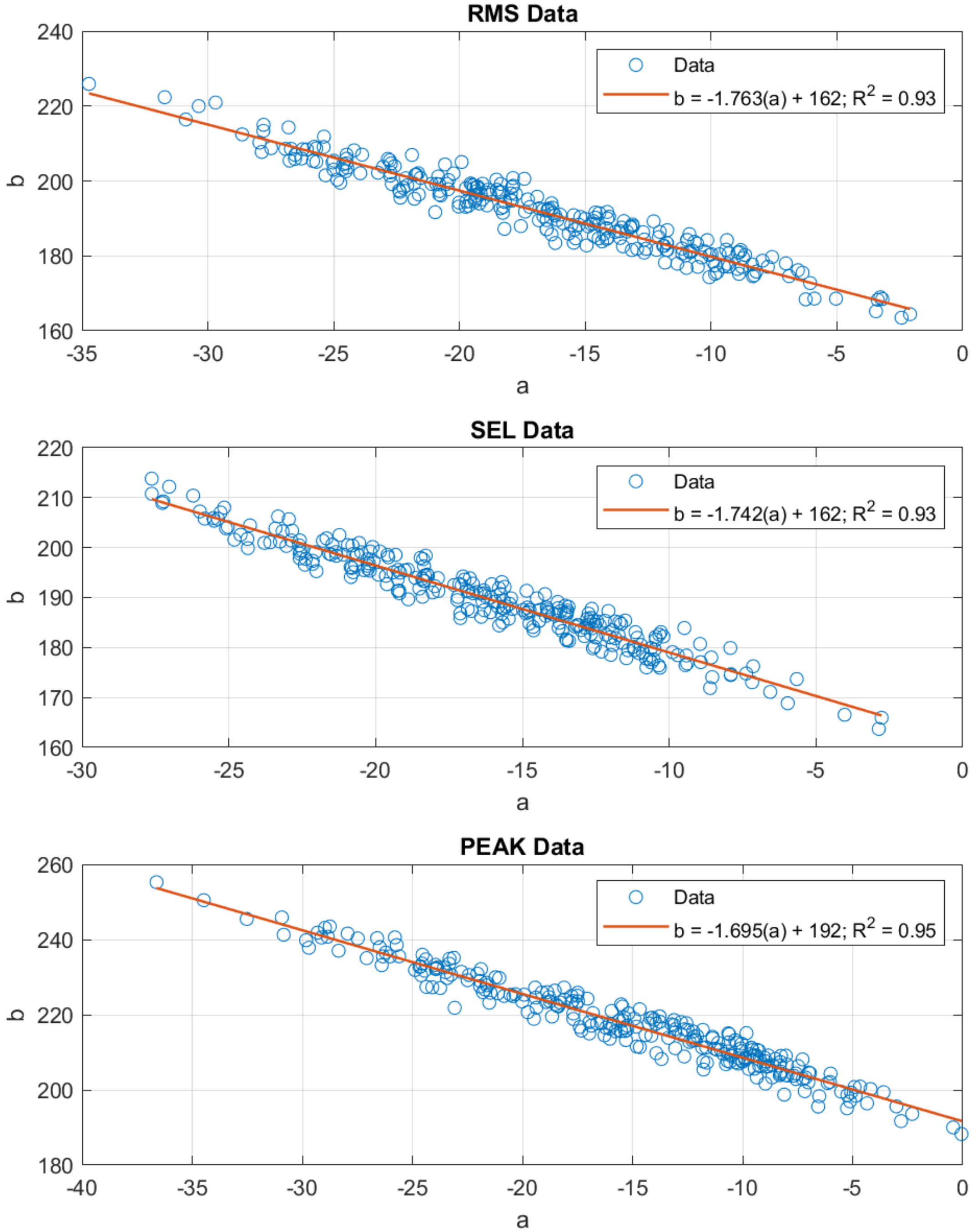
HF-31


RMS Data
Data
b = -1.851(a) + 155; R2 = 0.92
b
a
SEL Data
Data
b = -1.886(a) + 152; R2 = 0.94
b
a
PEAK Data
Data
b = -1.903(a) + 179; R2 = 0.93
b
a

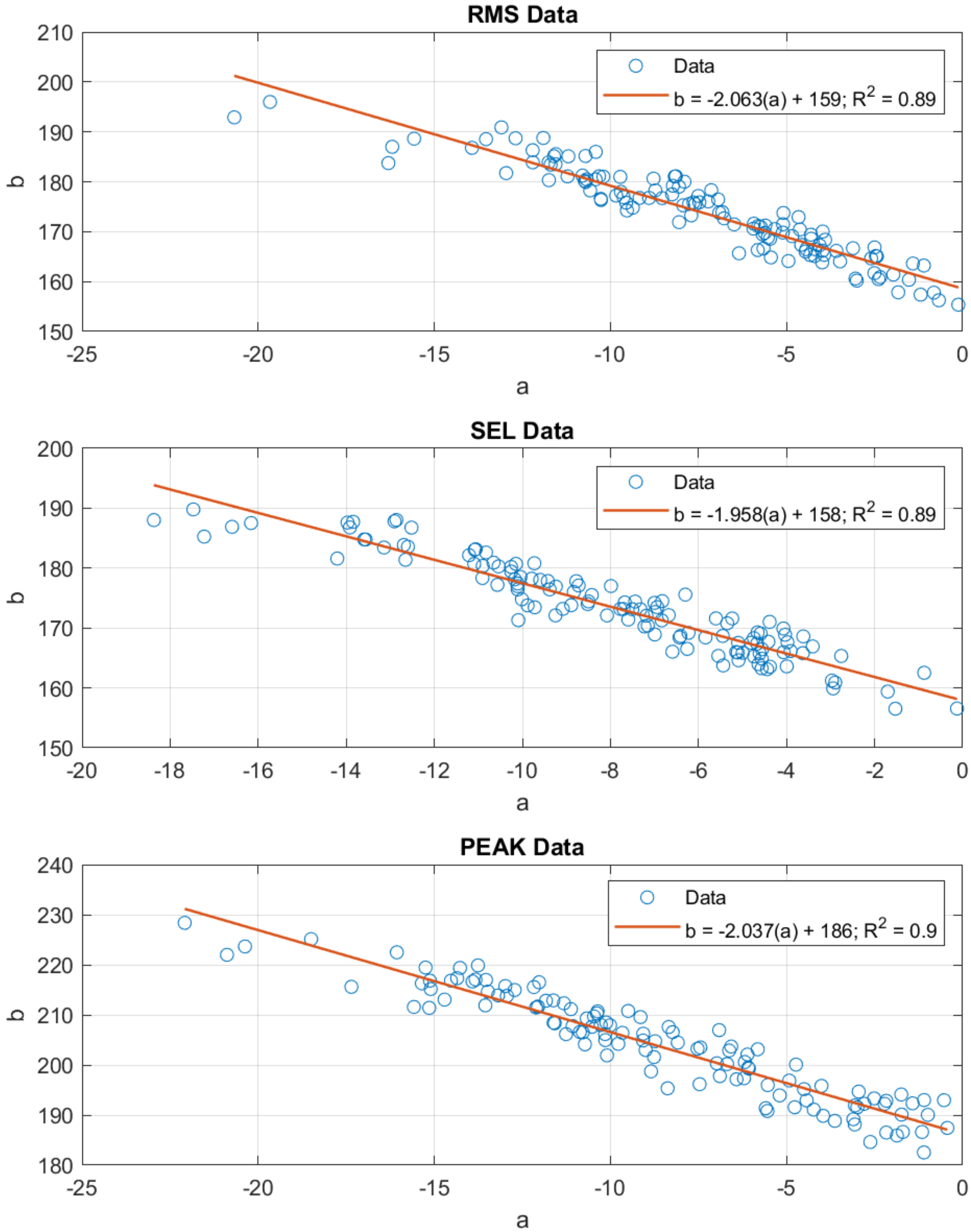
HF-32


RMS Data
Data
b = -1.905(a) + 156; R2 = 0.92
b
a
SEL Data
Data
b = -1.846(a) + 155; R2 = 0.91
b
a
PEAK Data
Data
b = -1.807(a) + 184; R2 = 0.91
b
a

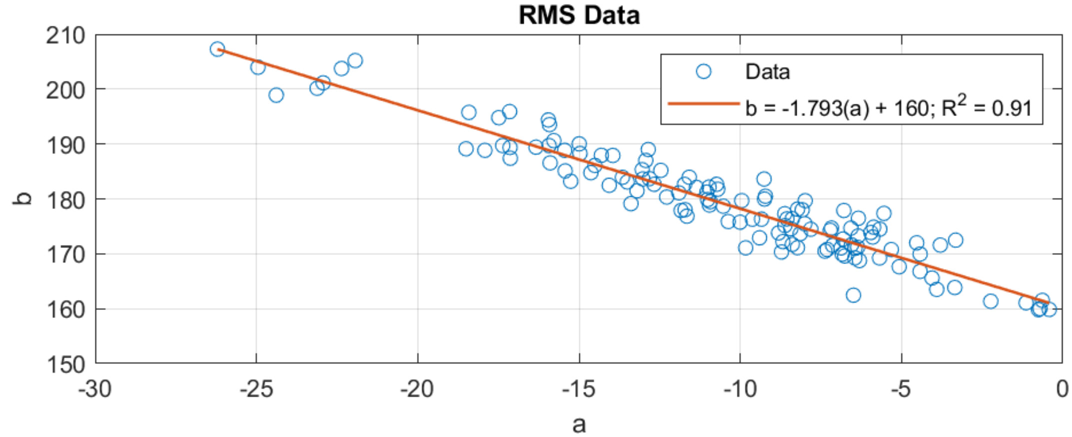
HF-33

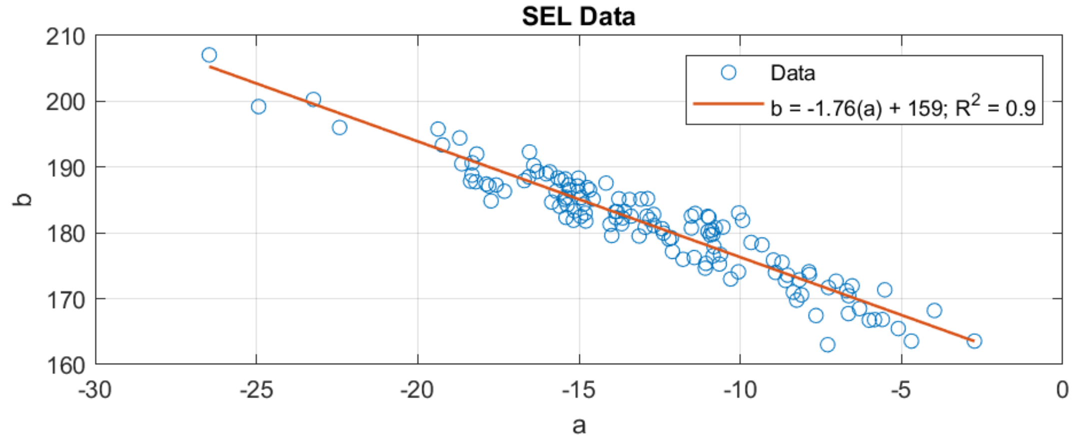

RMS Data
Data
b = -1.763(a) + 162; R2 = 0.93
b
a
240
220
200
180
160
-35
-30
-25
-20
-15
-10
-5
0
SEL Data
Data
b = -1.742(a) + 162; R2 = 0.93
b
a
220
210
200
190
180
170
160
-30
-25
-20
-15
-10
-5
0
PEAK Data
Data
b = -1.695(a) + 192; R2 = 0.95
b
a
260
240
220
200
180
-40
-35
-30
-25
-20
-15
-10
-5
0

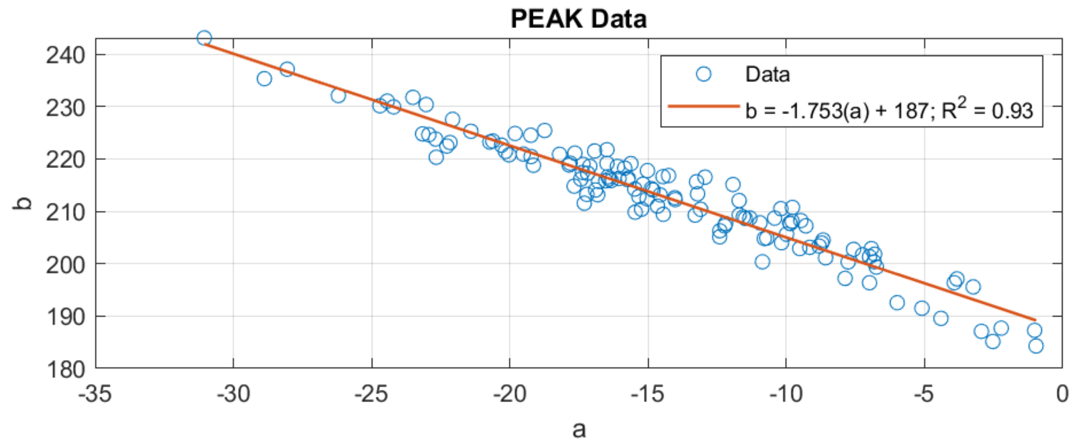
HF-34

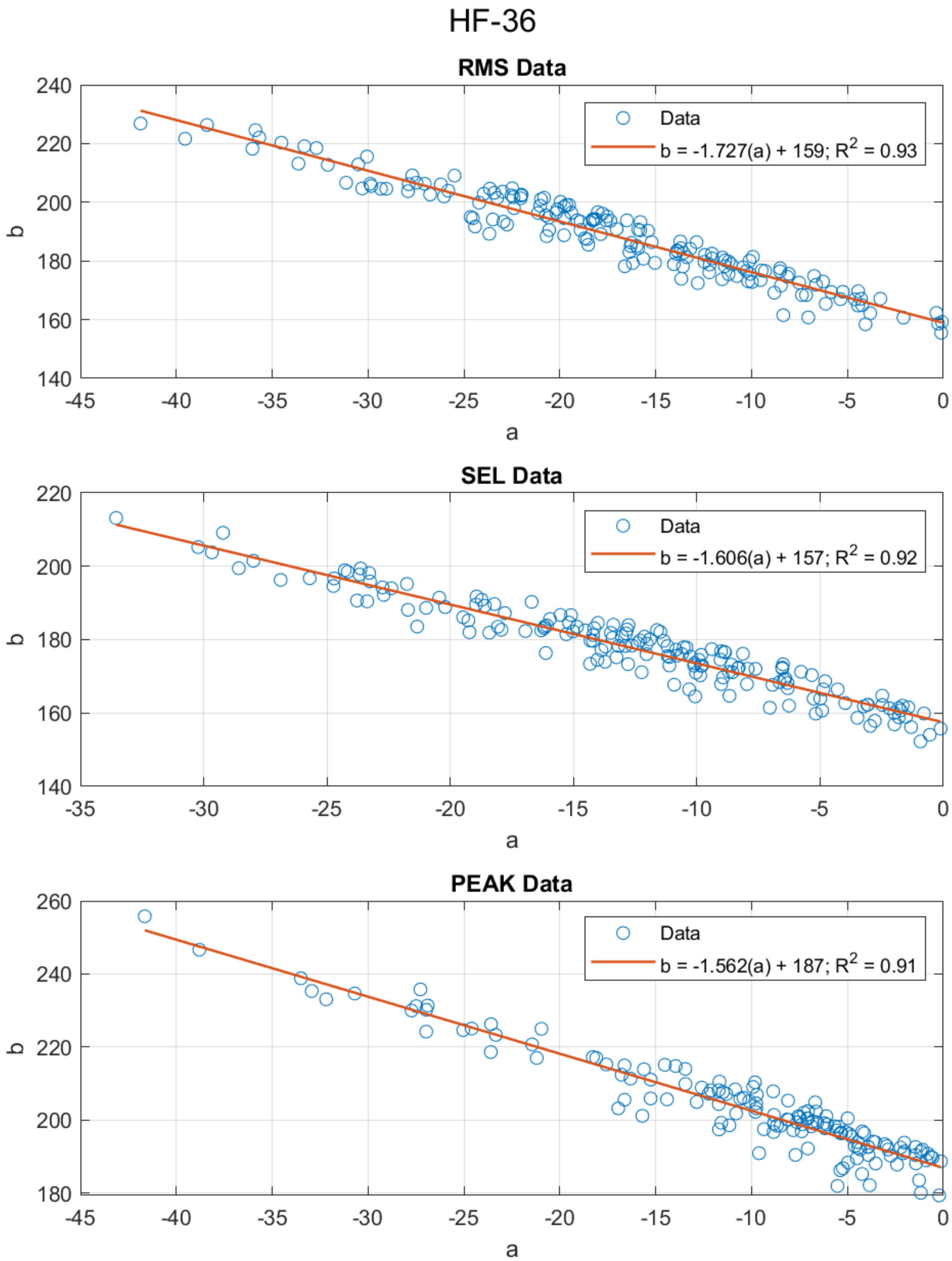

RMS Data
Data
b = -2.063(a) + 159; R2 = 0.89
b
a
SEL Data
Data
b = -1.958(a) + 158; R2 = 0.89
b
a
PEAK Data
Data
b = -2.037(a) + 186; R2 = 0.9
b
a

HF-35

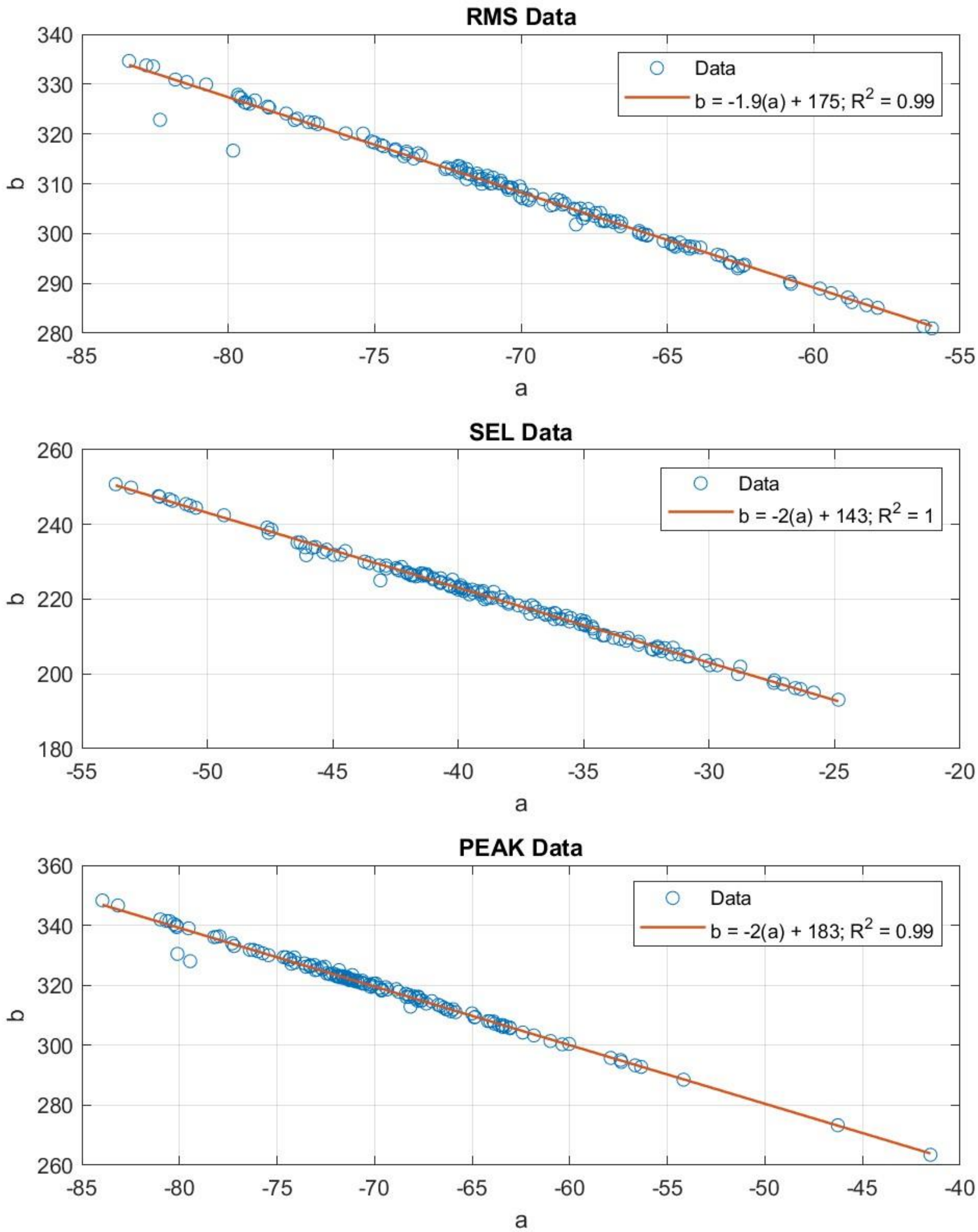

RMS Data
Data
b = -1.793(a) + 160; R^2 = 0.91
b
a

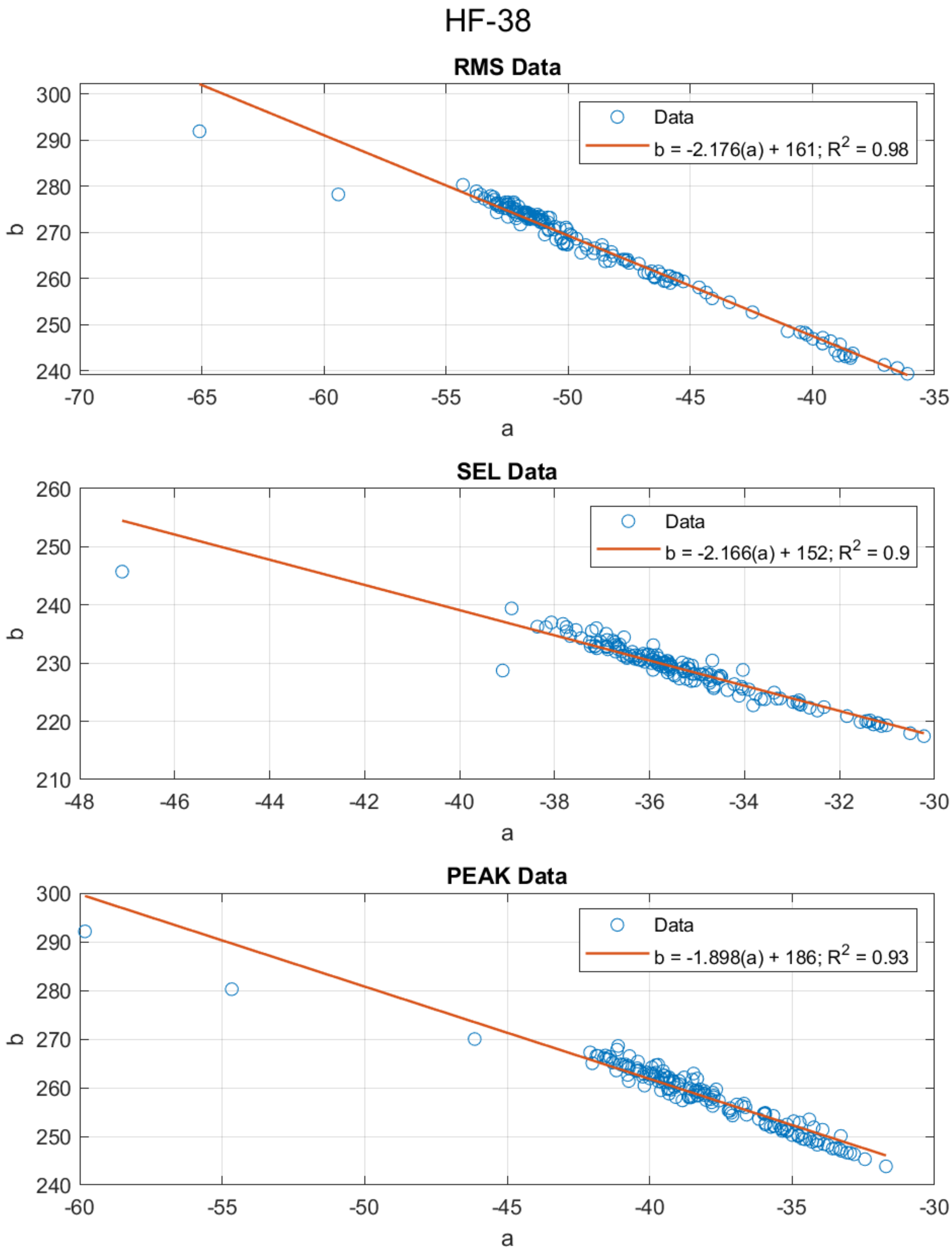

SEL Data
Data
b = -1.76(a) + 159; R^2 = 0.9
b
a


PEAK Data
Data
b = -1.753(a) + 187; R^2 = 0.93
b
a

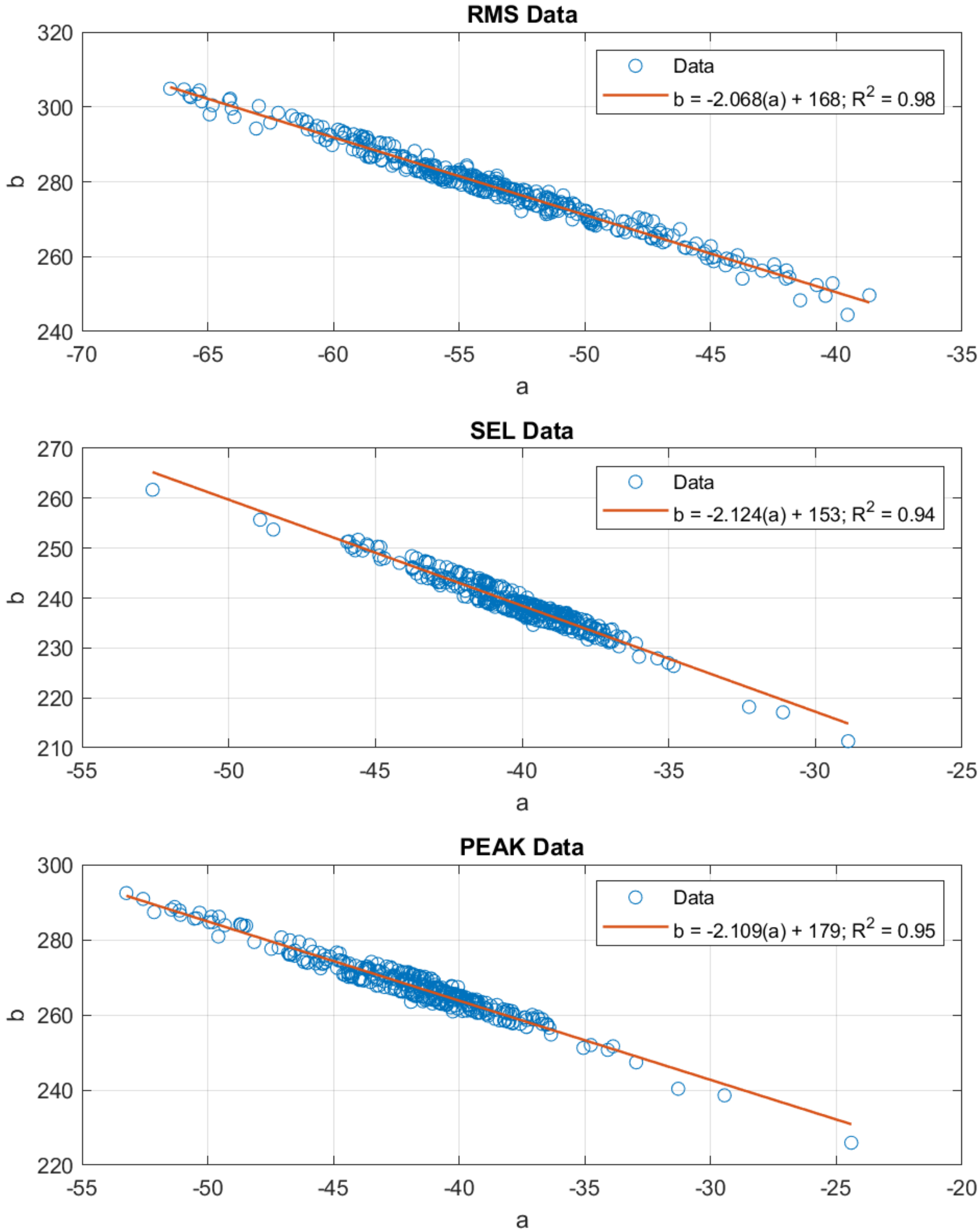

HF-36
RMS Data
Data
b = -1.727(a) + 159; R^2 = 0.93
SEL Data
Data
b = -1.606(a) + 157; R^2 = 0.92
PEAK Data
Data
b = -1.562(a) + 187; R^2 = 0.91
a
b

HF-37

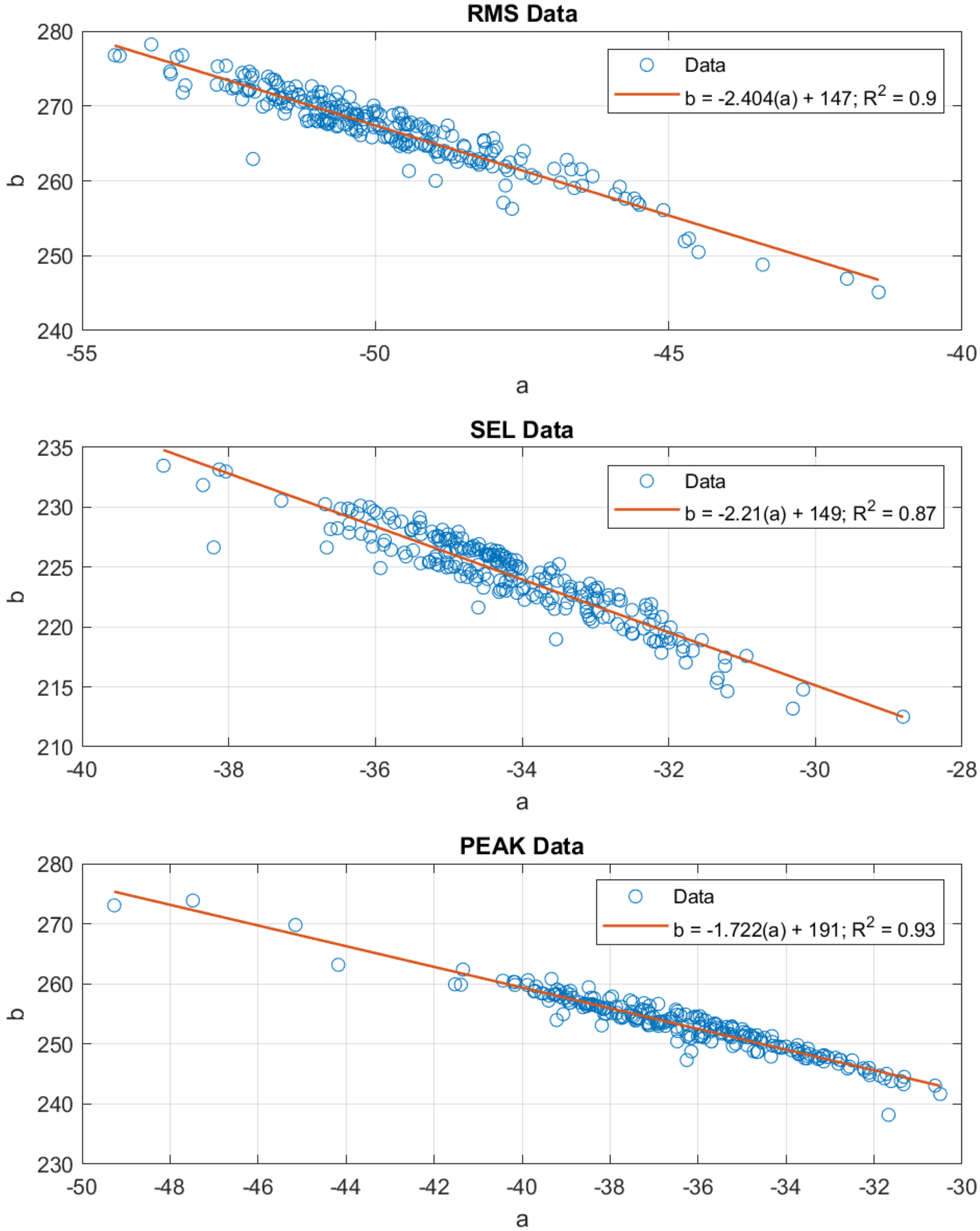

RMS Data
Data
b = -1.9(a) + 175; R^2 = 0.99
b
a
SEL Data
Data
b = -2(a) + 143; R^2 = 1
b
a
PEAK Data
Data
b = -2(a) + 183; R^2 = 0.99
b
a


HF-38
RMS Data
Data
b = -2.176(a) + 161; R2 = 0.98
SEL Data
Data
b = -2.166(a) + 152; R2 = 0.9
PEAK Data
Data
b = -1.898(a) + 186; R2 = 0.93
a
b

HF-39

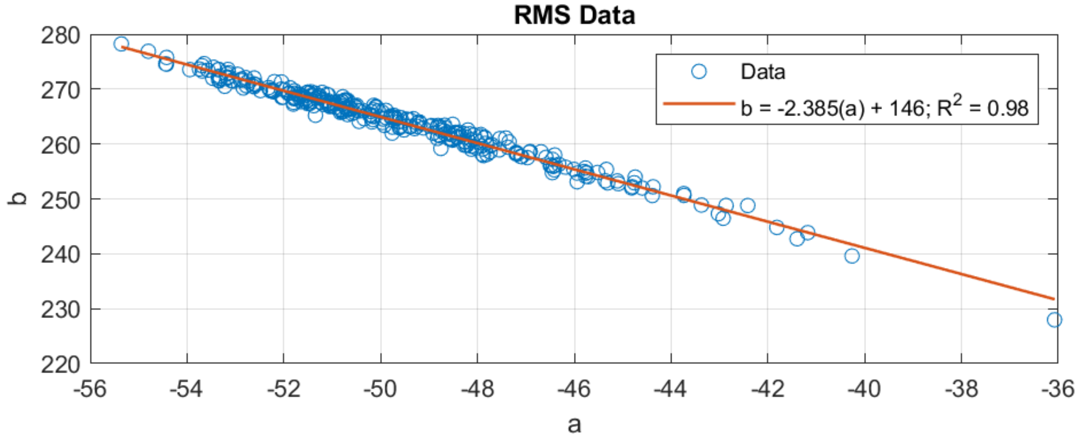

RMS Data
Data
b = -2.068(a) + 168; R^2 = 0.98
b
a
SEL Data
Data
b = -2.124(a) + 153; R^2 = 0.94
b
a
PEAK Data
Data
b = -2.109(a) + 179; R^2 = 0.95
b
a

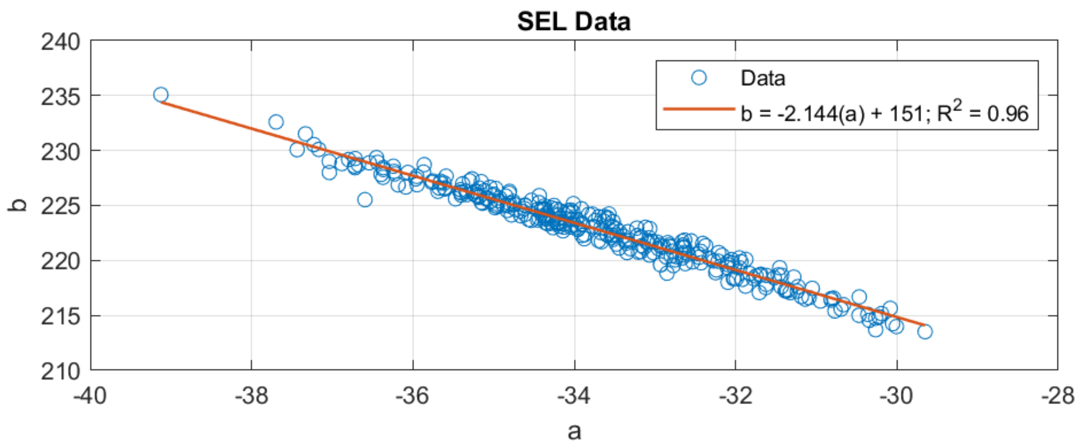
HF-40

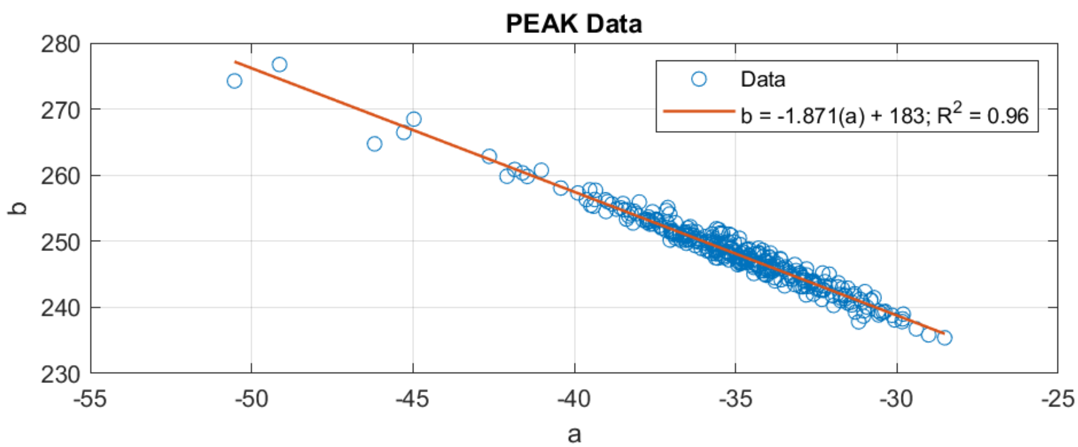


RMS Data
Data
b = -2.404(a) + 147; R^2 = 0.9
b
a
SEL Data
Data
b = -2.21(a) + 149; R^2 = 0.87
b
a
PEAK Data
Data
b = -1.722(a) + 191; R^2 = 0.93
b
a

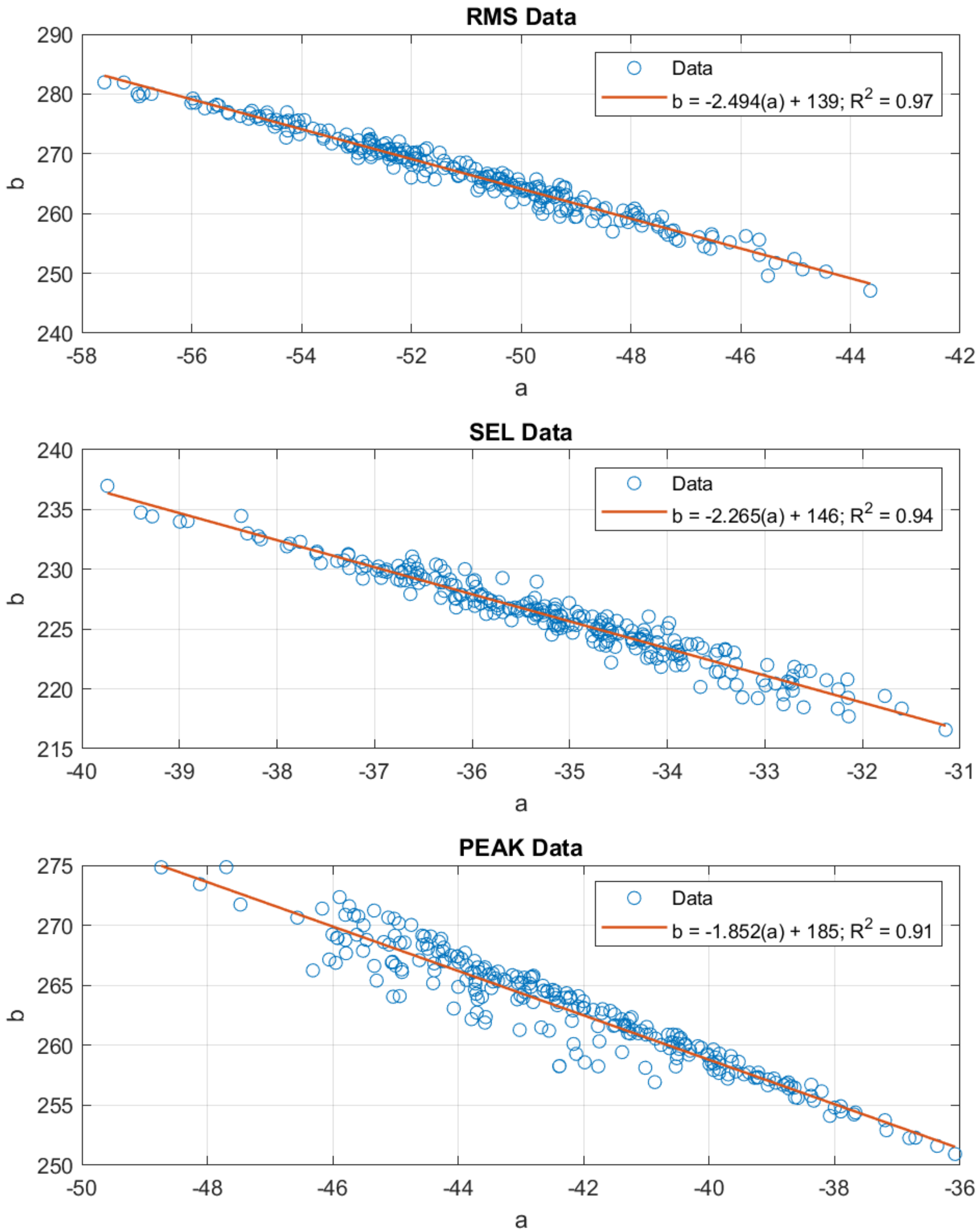
HF-41

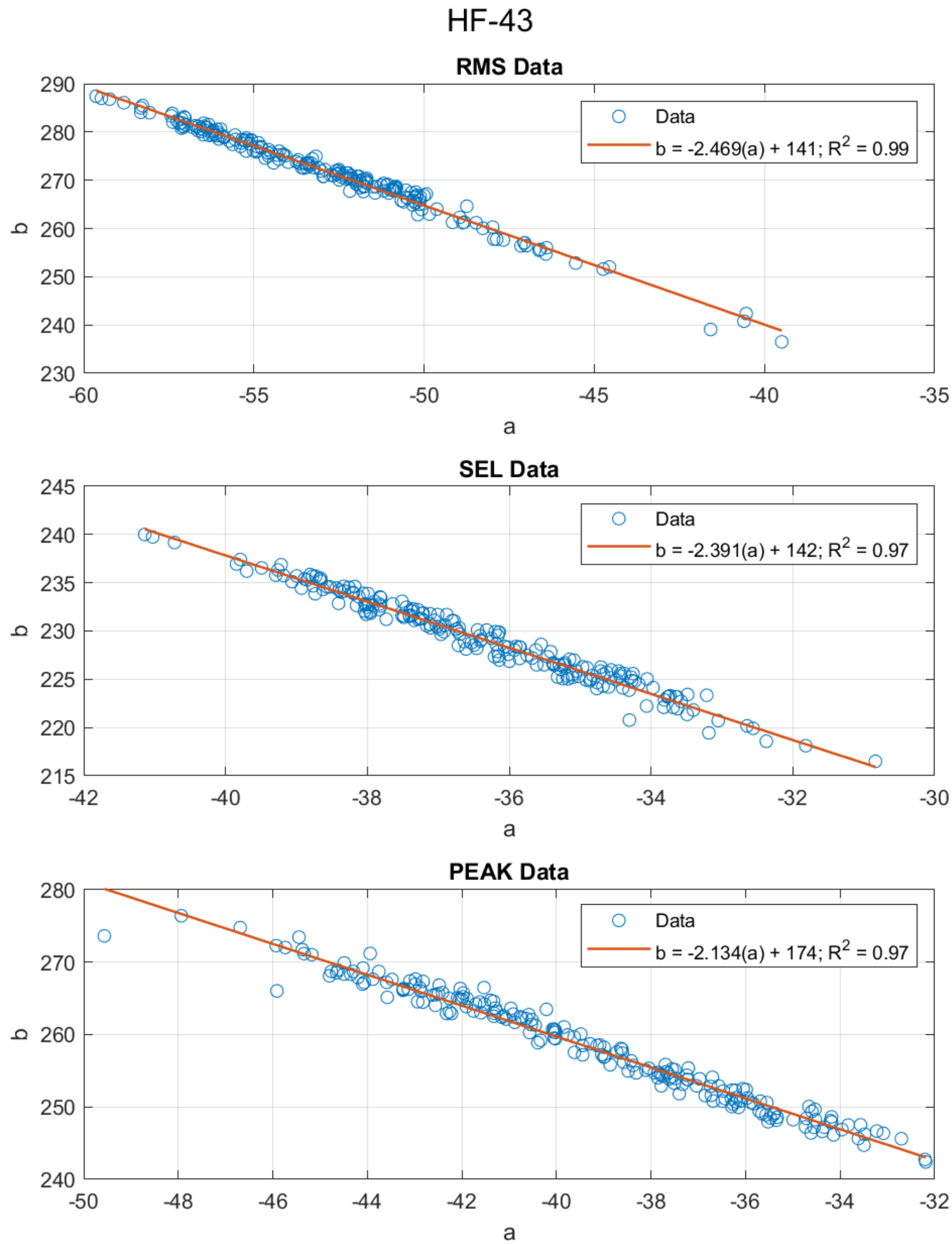

RMS Data
Data
b = -2.385(a) + 146; R^2 = 0.98
b
a
280
270
260
250
240
230
220
-56
-54
-52
-50
-48
-46
-44
-42
-40
-38
-36


SEL Data
Data
b = -2.144(a) + 151; R^2 = 0.96
b
a
240
235
230
225
220
215
210
-40
-38
-36
-34
-32
-30
-28

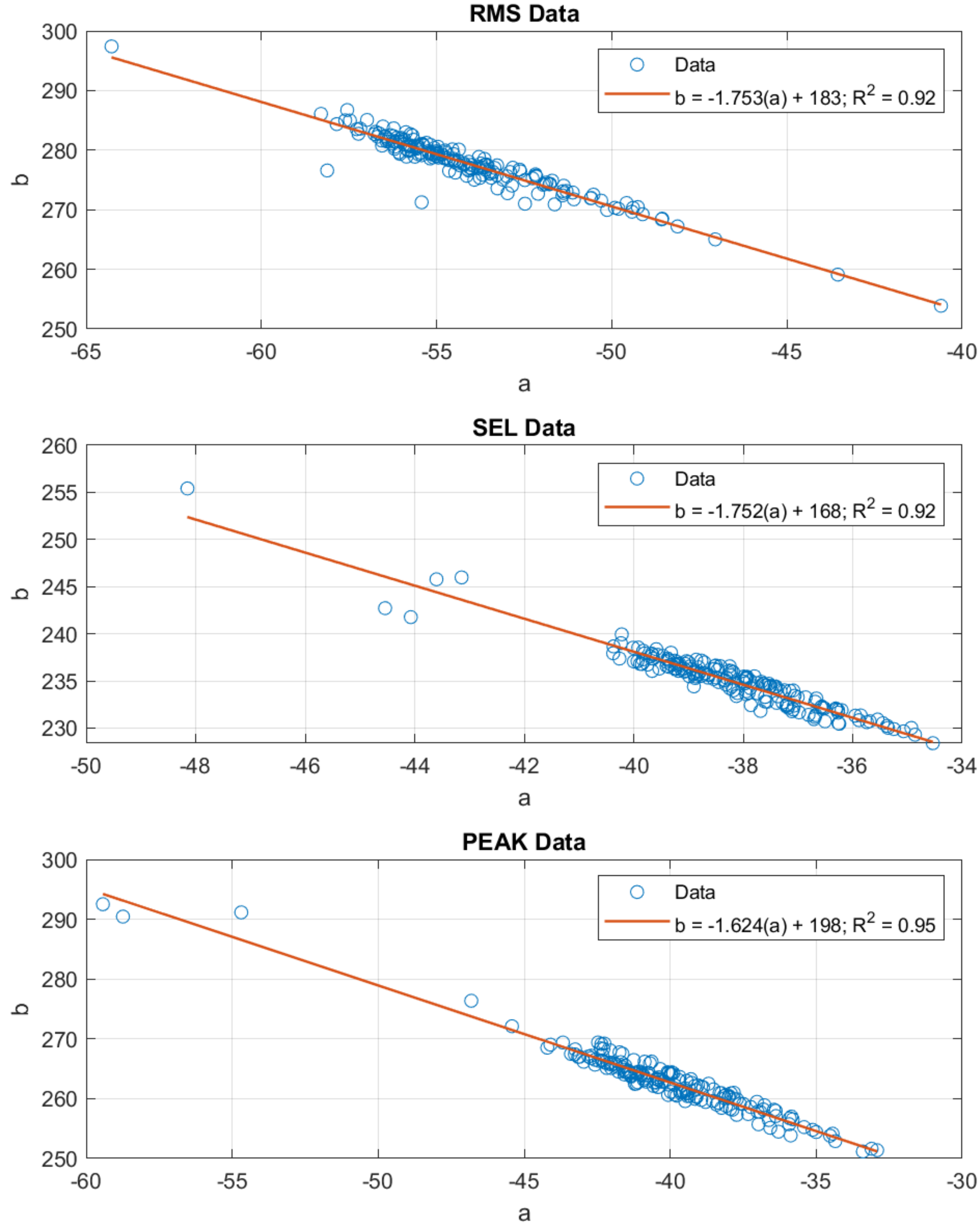

PEAK Data
Data
b = -1.871(a) + 183; R^2 = 0.96
b
a
280
270
260
250
240
230
-55
-50
-45
-40
-35
-30
-25

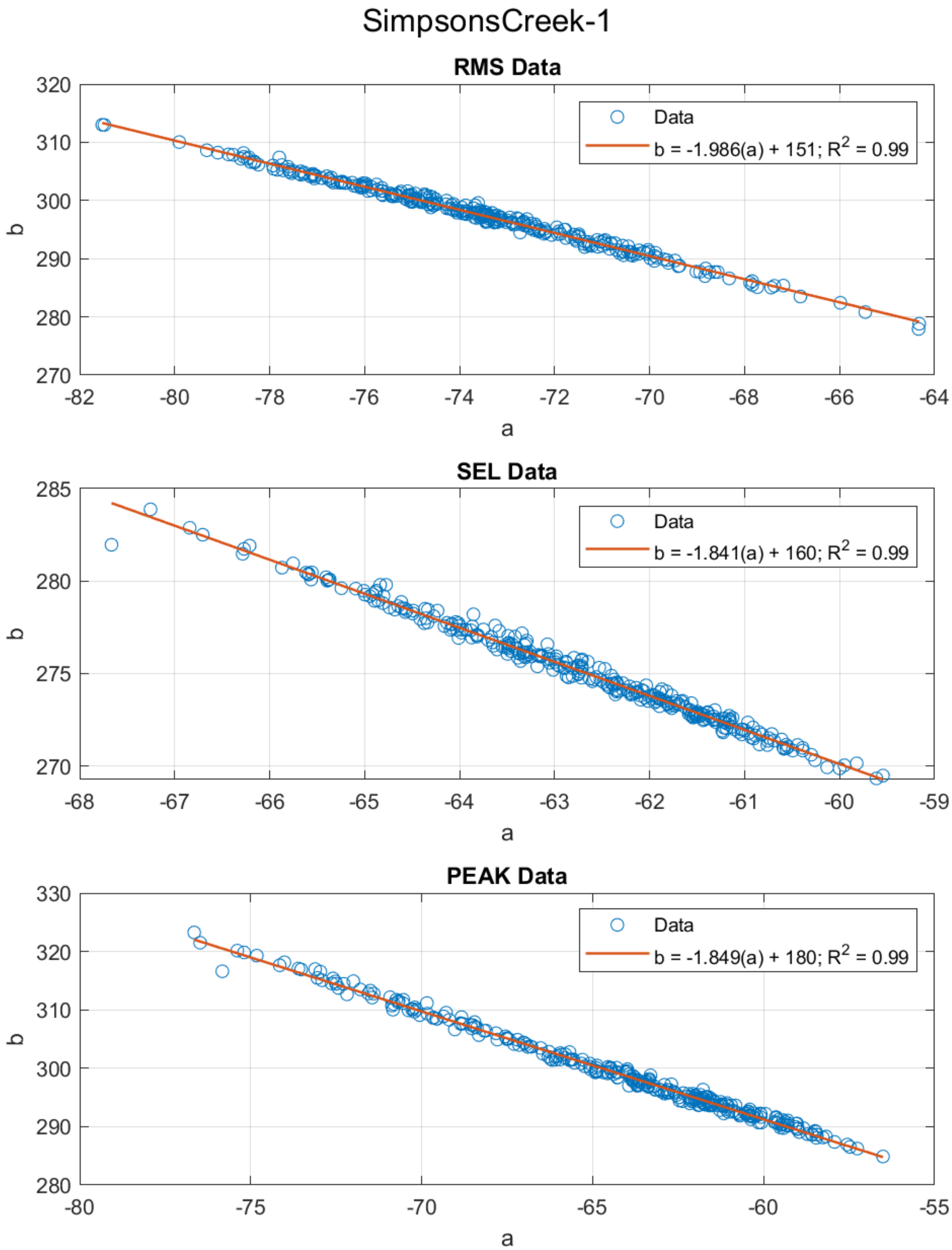
HF-42

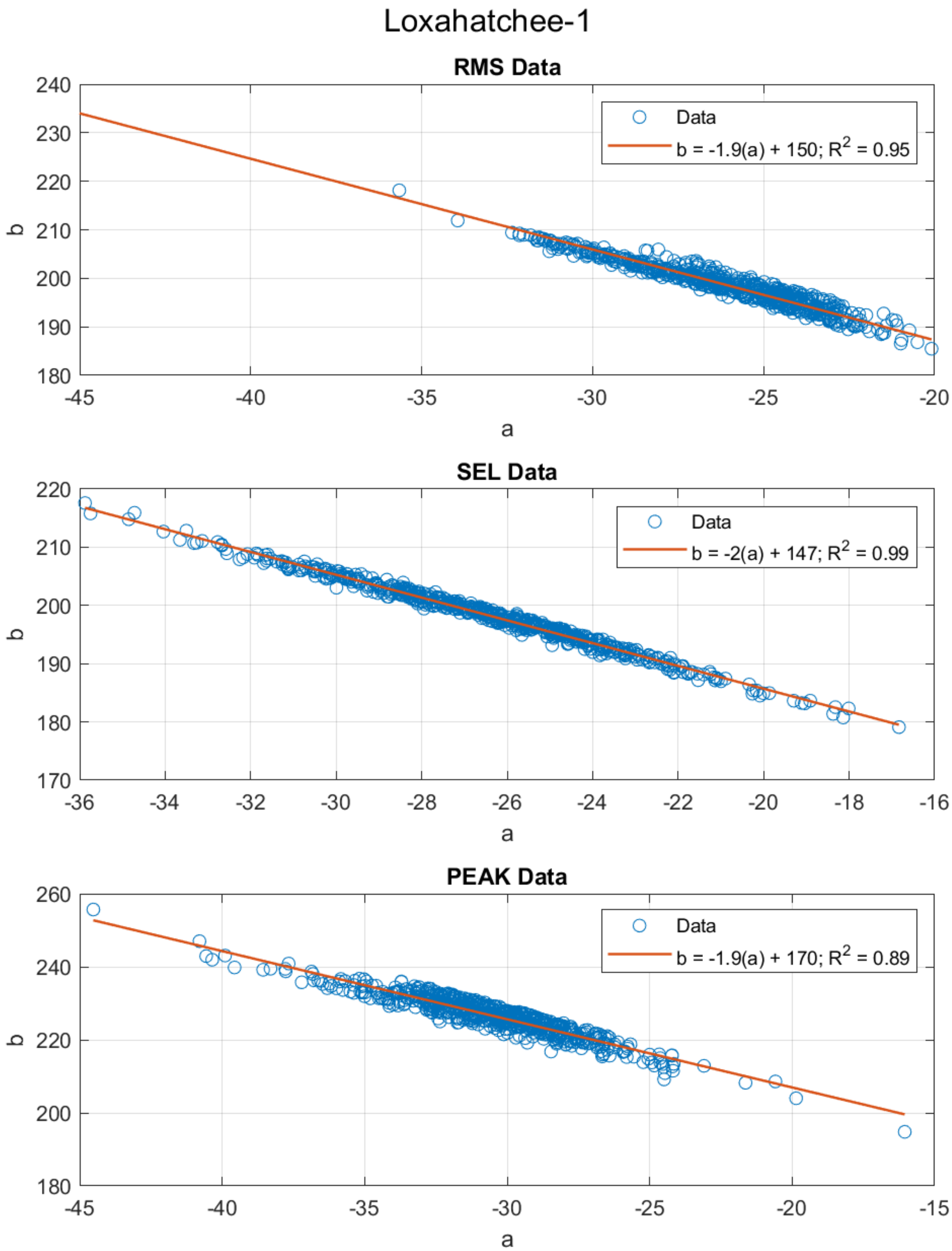

RMS Data
Data
b = -2.494(a) + 139; R^2 = 0.97
b
a
SEL Data
Data
b = -2.265(a) + 146; R^2 = 0.94
b
a
PEAK Data
Data
b = -1.852(a) + 185; R^2 = 0.91
b
a


HF-43
RMS Data
Data
b = -2.469(a) + 141; R2 = 0.99
b
a
SEL Data
Data
b = -2.391(a) + 142; R2 = 0.97
PEAK Data
Data
b = -2.134(a) + 174; R2 = 0.97

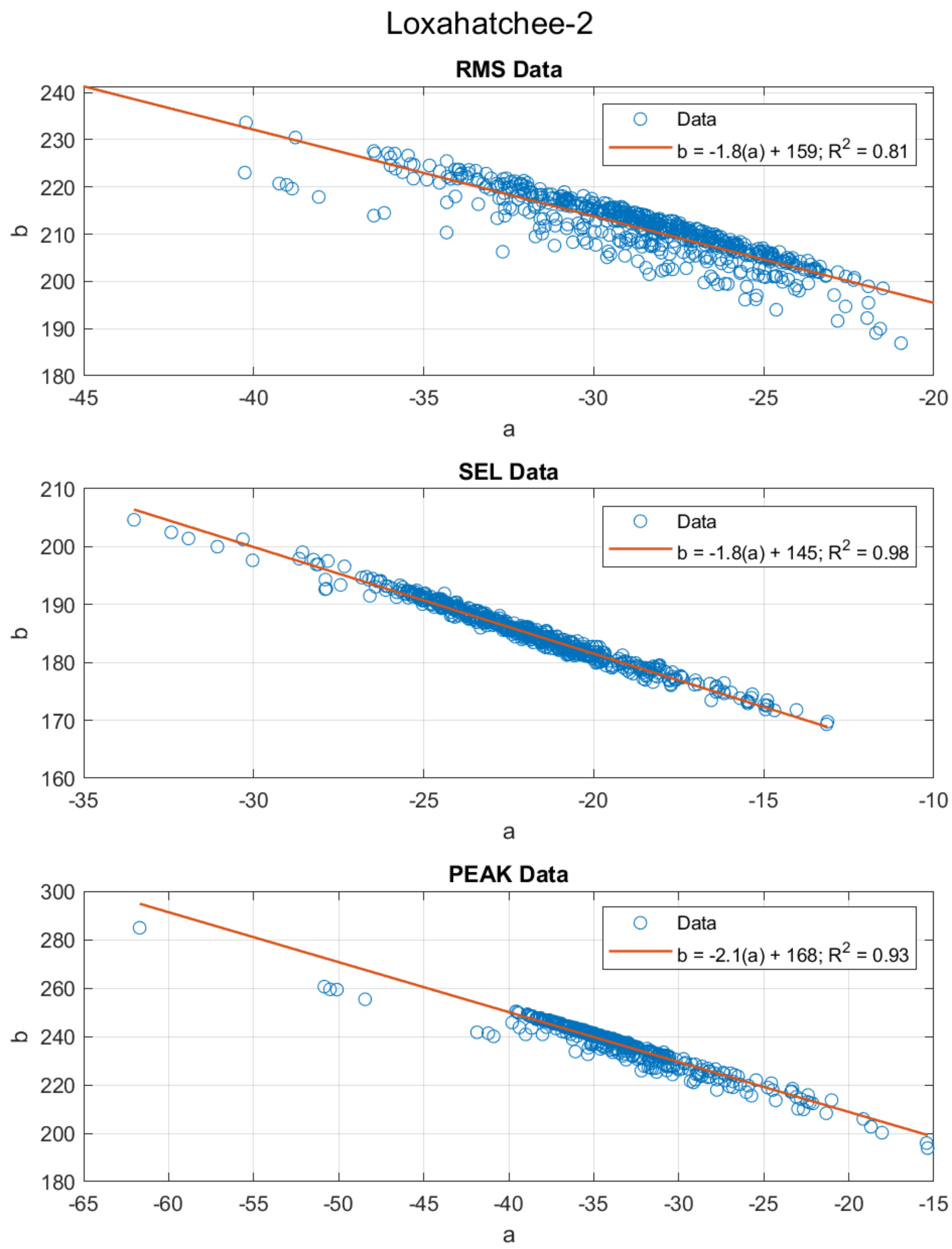
HF-44


RMS Data
Data
b = -1.753(a) + 183; R^2 = 0.92
300
290
280
270
260
250
-65
-60
-55
-50
-45
-40
a
b
SEL Data
Data
b = -1.752(a) + 168; R^2 = 0.92
260
255
250
245
240
235
230
-50
-48
-46
-44
-42
-40
-38
-36
-34
a
b
PEAK Data
Data
b = -1.624(a) + 198; R^2 = 0.95
300
290
280
270
260
250
-60
-55
-50
-45
-40
-35
-30
a
b


SimpsonsCreek-1
RMS Data
Data
b = -1.986(a) + 151; R^2 = 0.99
320
310
300
290
280
270
b
-82
-80
-78
-76
-74
-72
-70
-68
-66
-64
a
SEL Data
Data
b = -1.841(a) + 160; R^2 = 0.99
285
280
275
270
b
-68
-67
-66
-65
-64
-63
-62
-61
-60
-59
a
PEAK Data
Data
b = -1.849(a) + 180; R^2 = 0.99
330
320
310
300
290
280
b
-80
-75
-70
-65
-60
-55
a

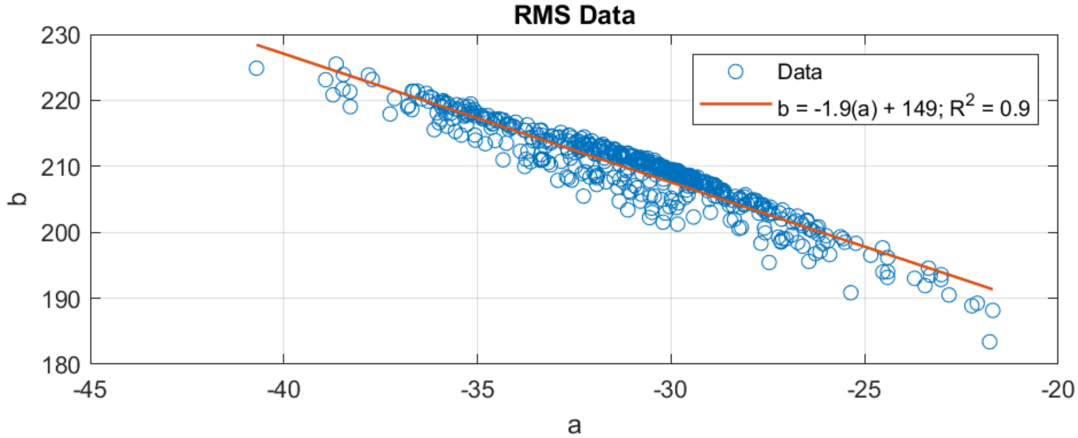


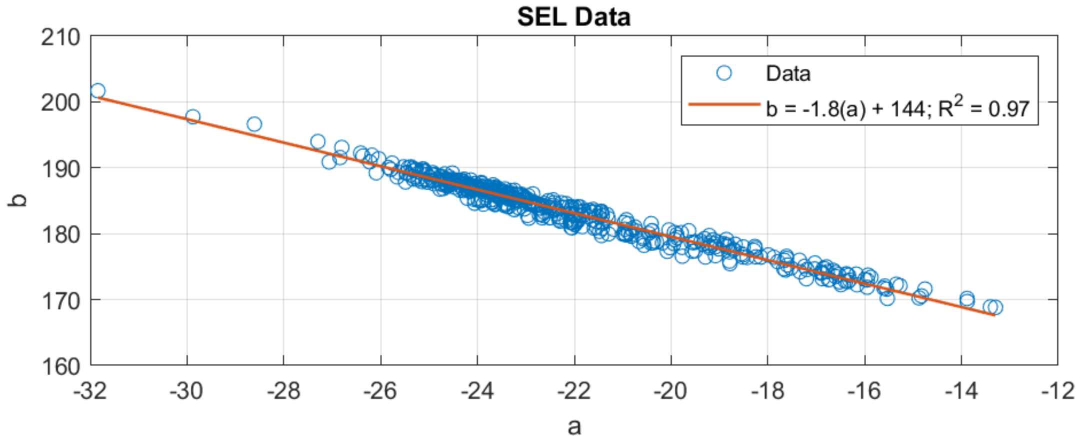
Loxahatchee-1
RMS Data
Data
b = -1.9(a) + 150; R2 = 0.95
b
a
240
230
220
210
200
190
180
-45
-40
-35
-30
-25
-20
SEL Data
Data
b = -2(a) + 147; R2 = 0.99
b
a
220
210
200
190
180
170
-36
-34
-32
-30
-28
-26
-24
-22
-20
-18
-16
PEAK Data
Data
b = -1.9(a) + 170; R2 = 0.89
b
a
260
240
220
200
180
-45
-40
-35
-30
-25
-20
-15

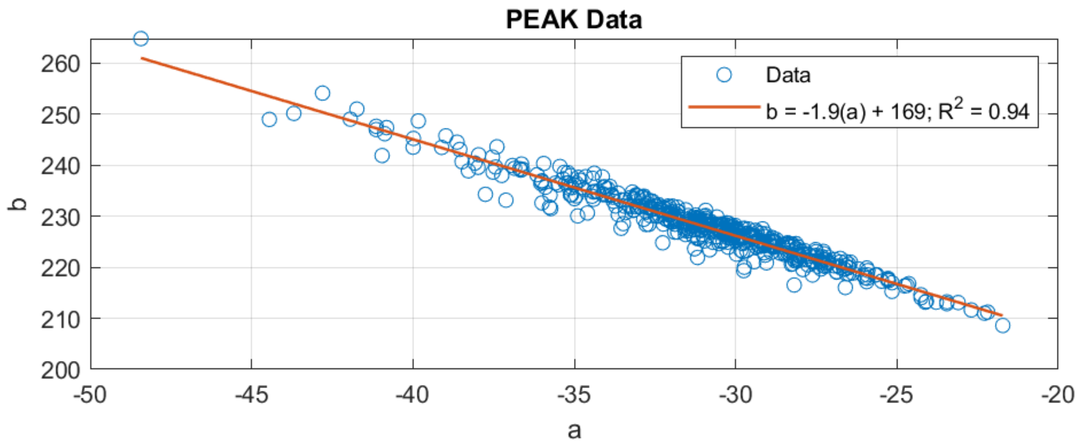


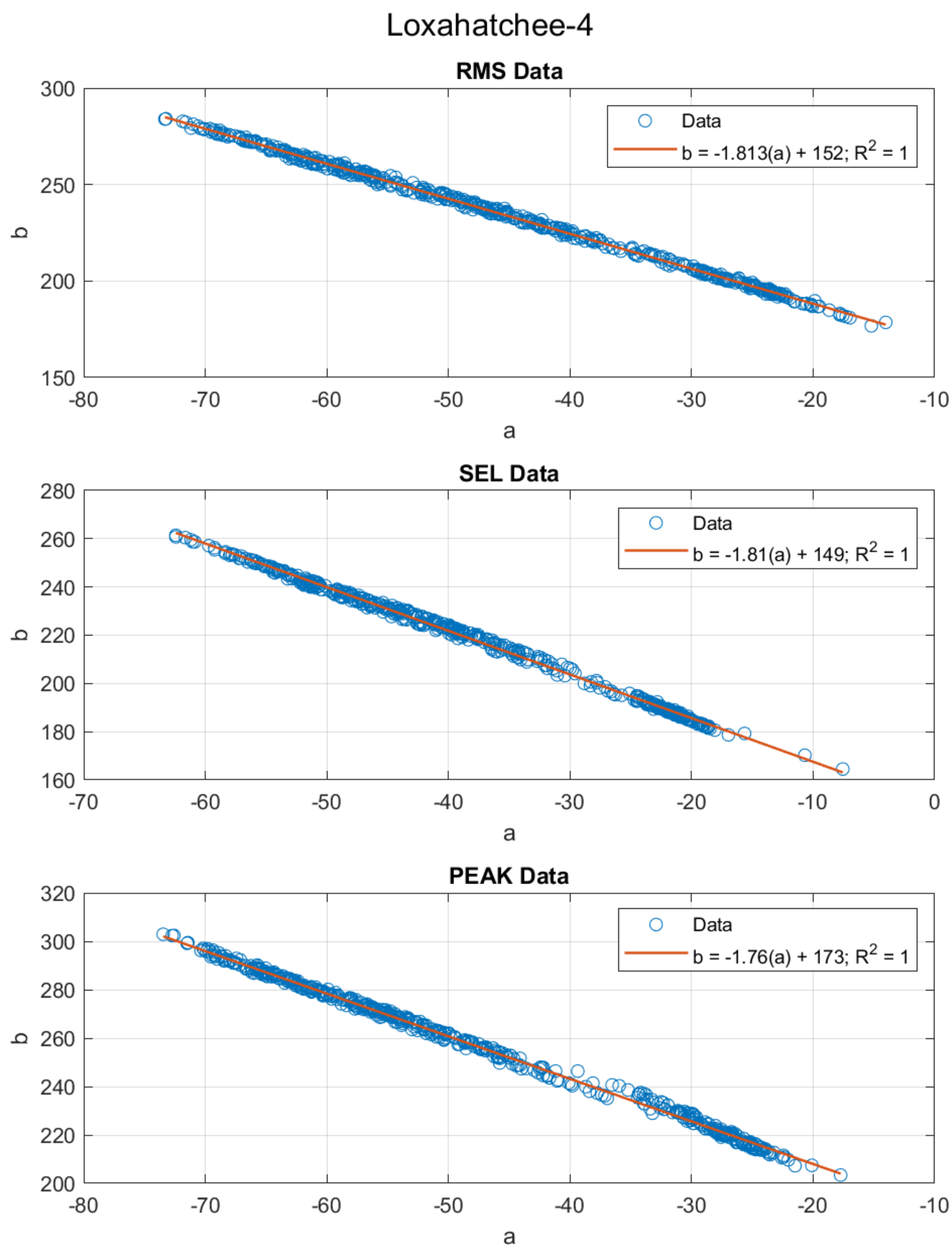
Loxahatchee-2
RMS Data
Data
b = -1.8(a) + 159; R2 = 0.81
b
a
240
230
220
210
200
190
180
-45
-40
-35
-30
-25
-20
SEL Data
Data
b = -1.8(a) + 145; R2 = 0.98
210
200
190
180
170
160
-35
-30
-25
-20
-15
-10
PEAK Data
Data
b = -2.1(a) + 168; R2 = 0.93
300
280
260
240
220
200
180
-65
-60
-55
-50
-45
-40
-35
-30
-25
-20
-15

Loxahatchee-3

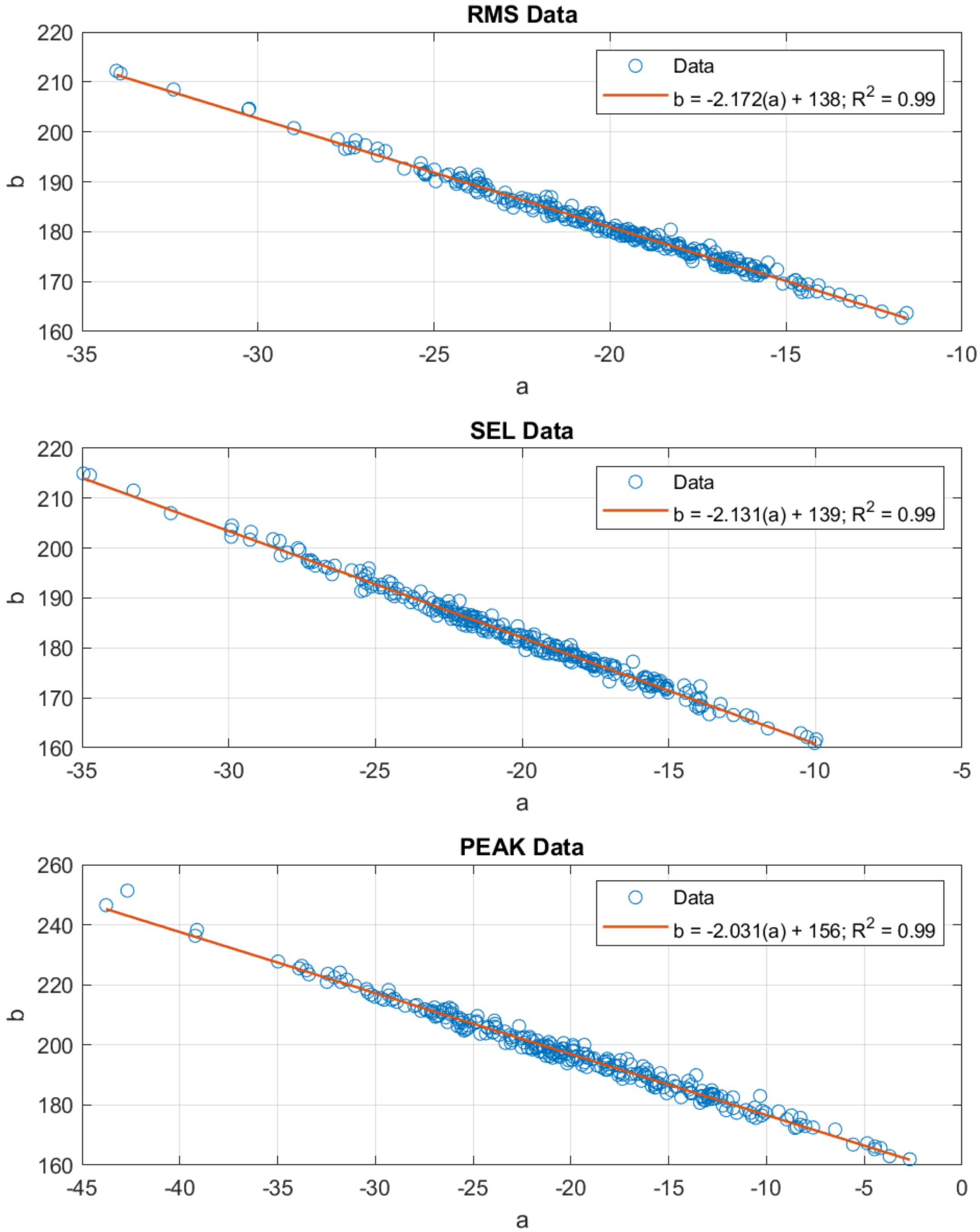






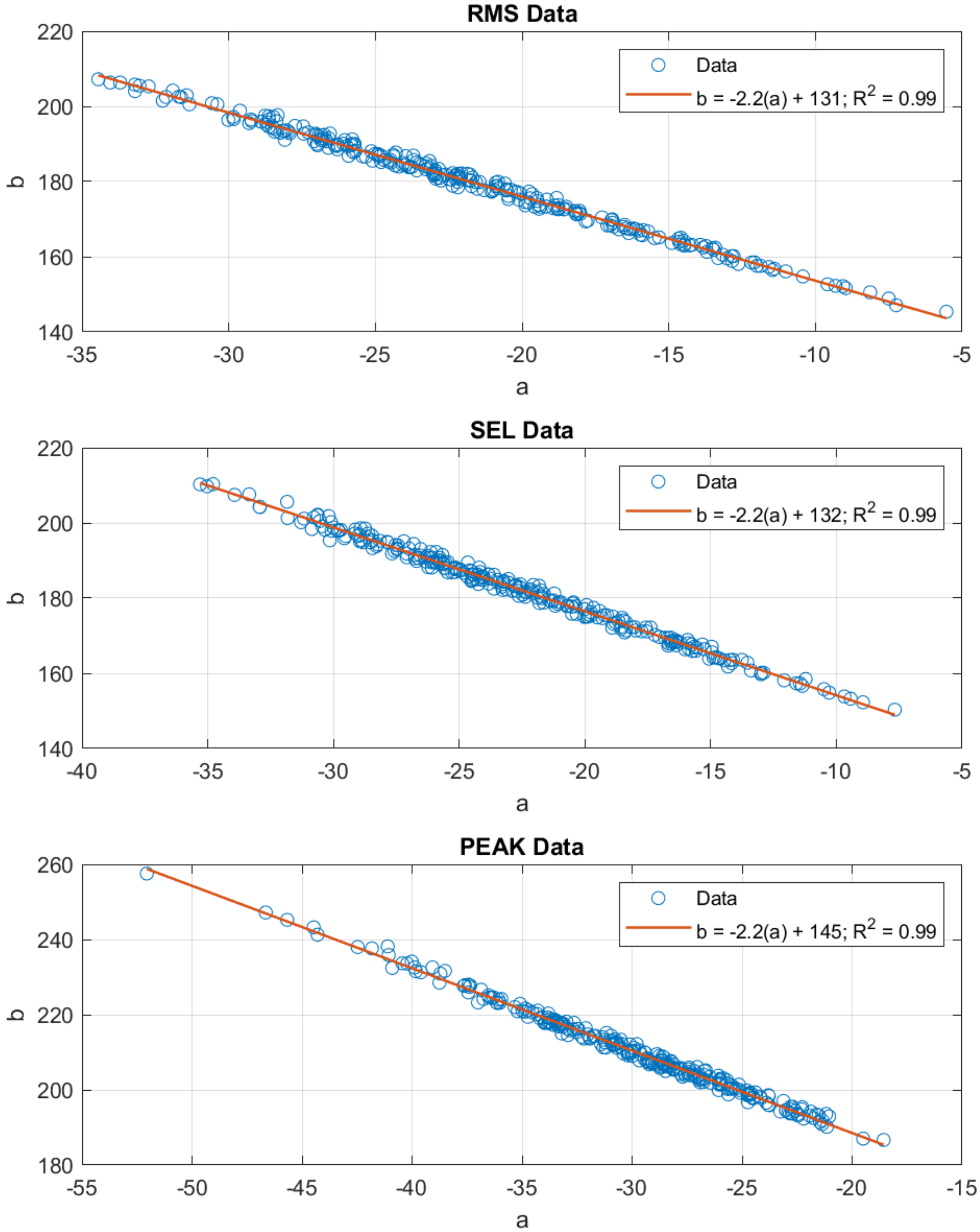

Loxahatchee-4
RMS Data
Data
b = -1.813(a) + 152; R2 = 1
b
a
SEL Data
Data
b = -1.81(a) + 149; R2 = 1
b
a
PEAK Data
Data
b = -1.76(a) + 173; R2 = 1
b
a

Manatee-1

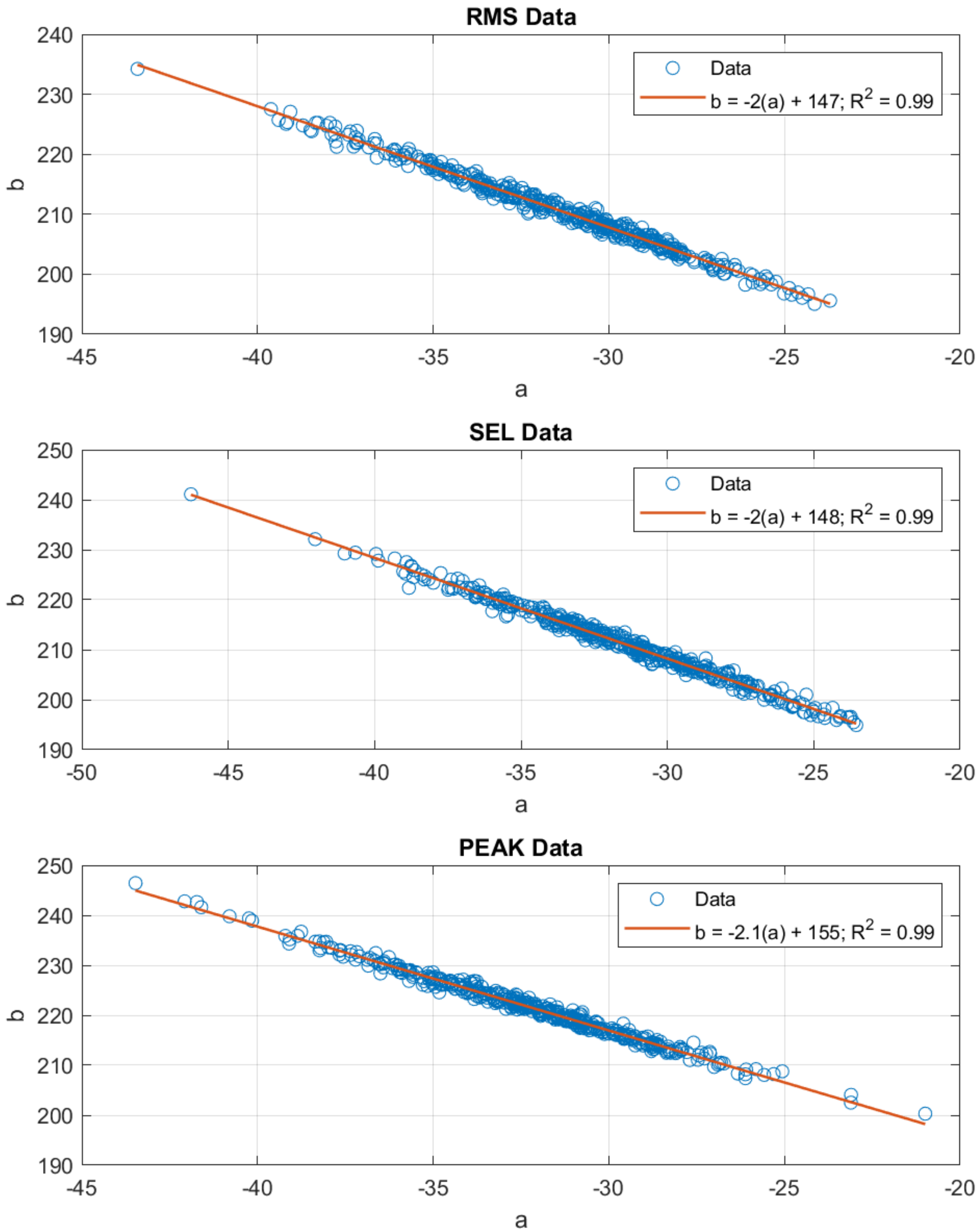


RMS Data
Data
b = -2.172(a) + 138; R2 = 0.99
b
a
SEL Data
Data
b = -2.131(a) + 139; R2 = 0.99
b
a
PEAK Data
Data
b = -2.031(a) + 156; R2 = 0.99
b
a

Manatee-2

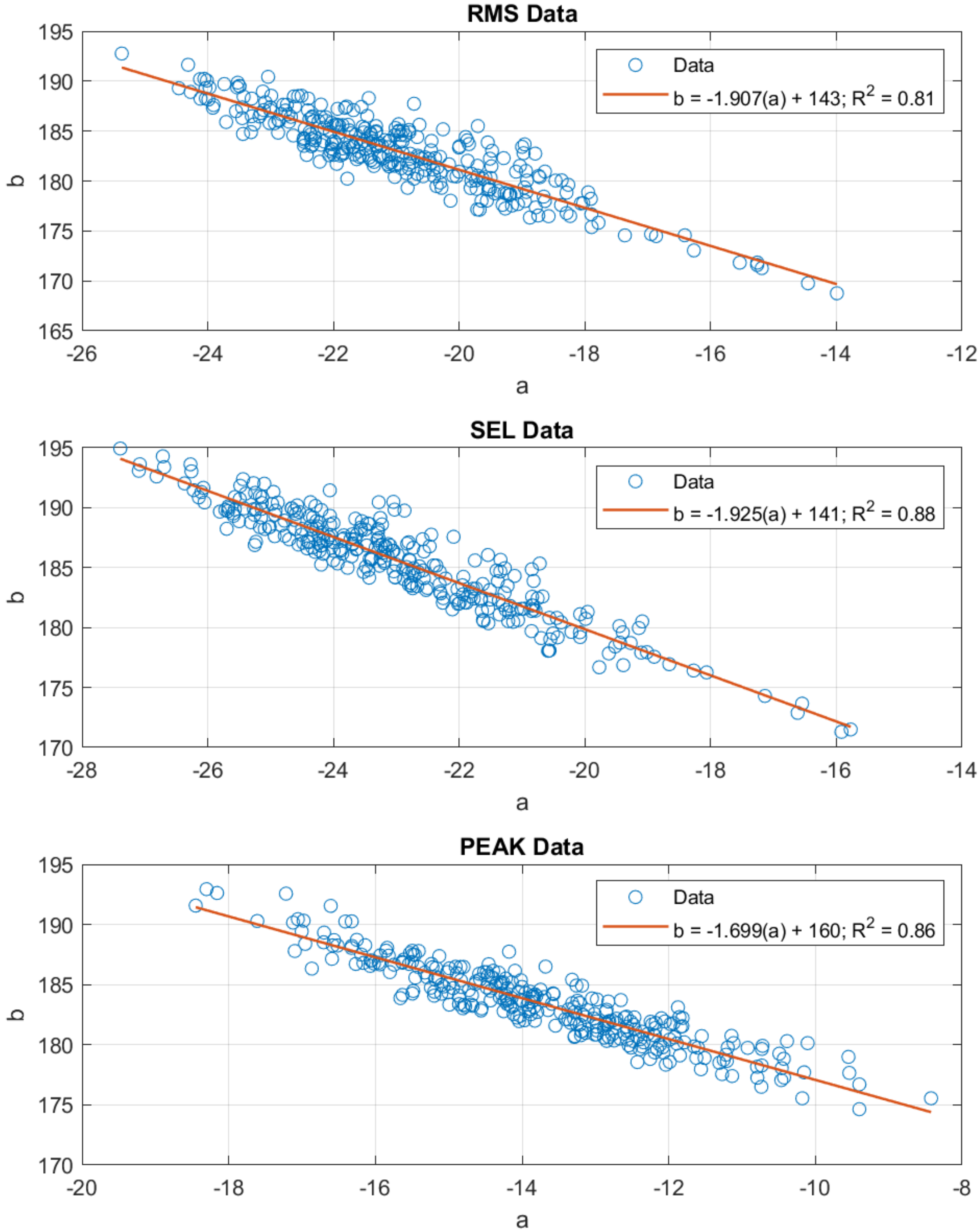

RMS Data
Data
b = -2.2(a) + 131; R2 = 0.99
b
a
SEL Data
Data
b = -2.2(a) + 132; R2 = 0.99
b
a
PEAK Data
Data
b = -2.2(a) + 145; R2 = 0.99
b
a

Manatee-3

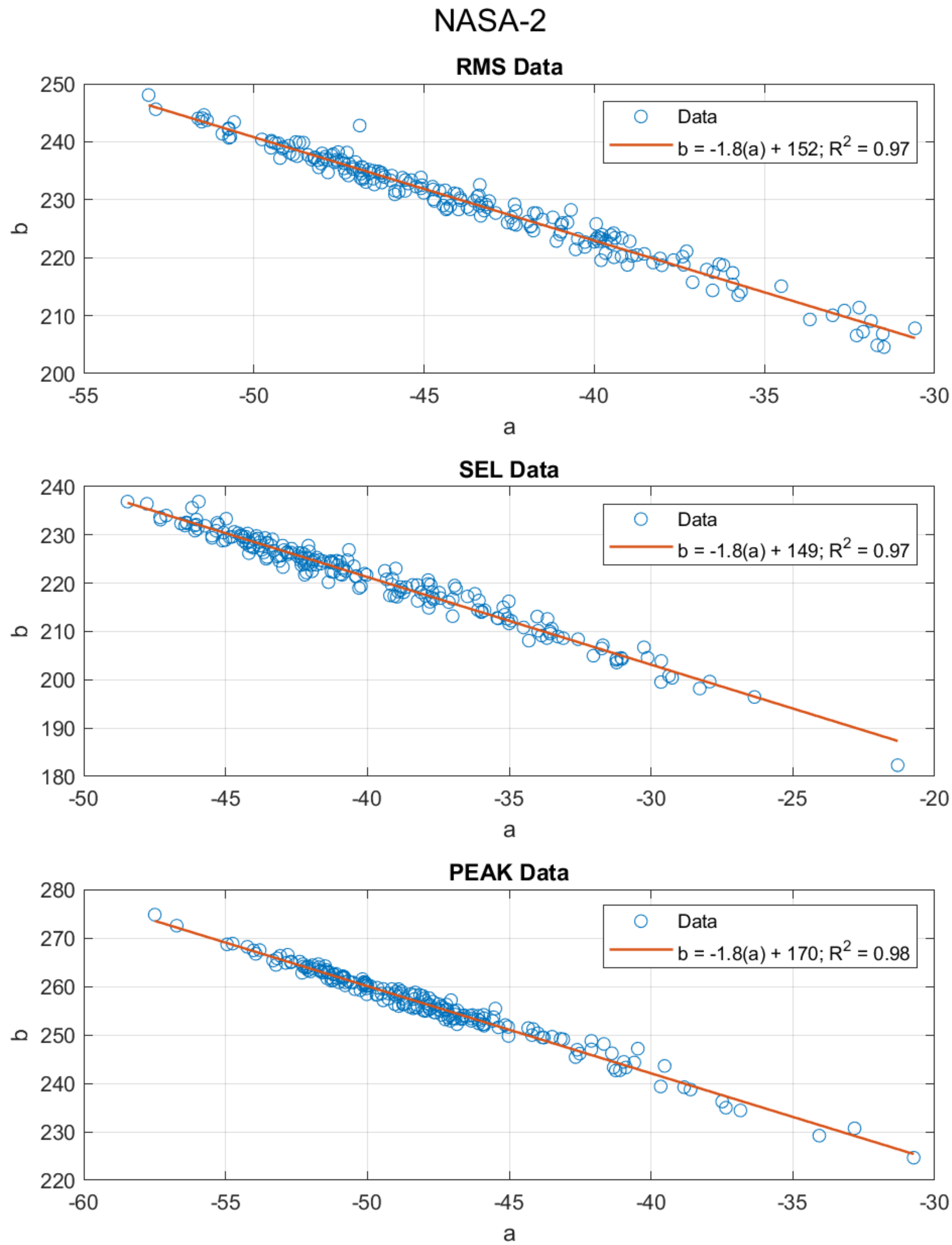


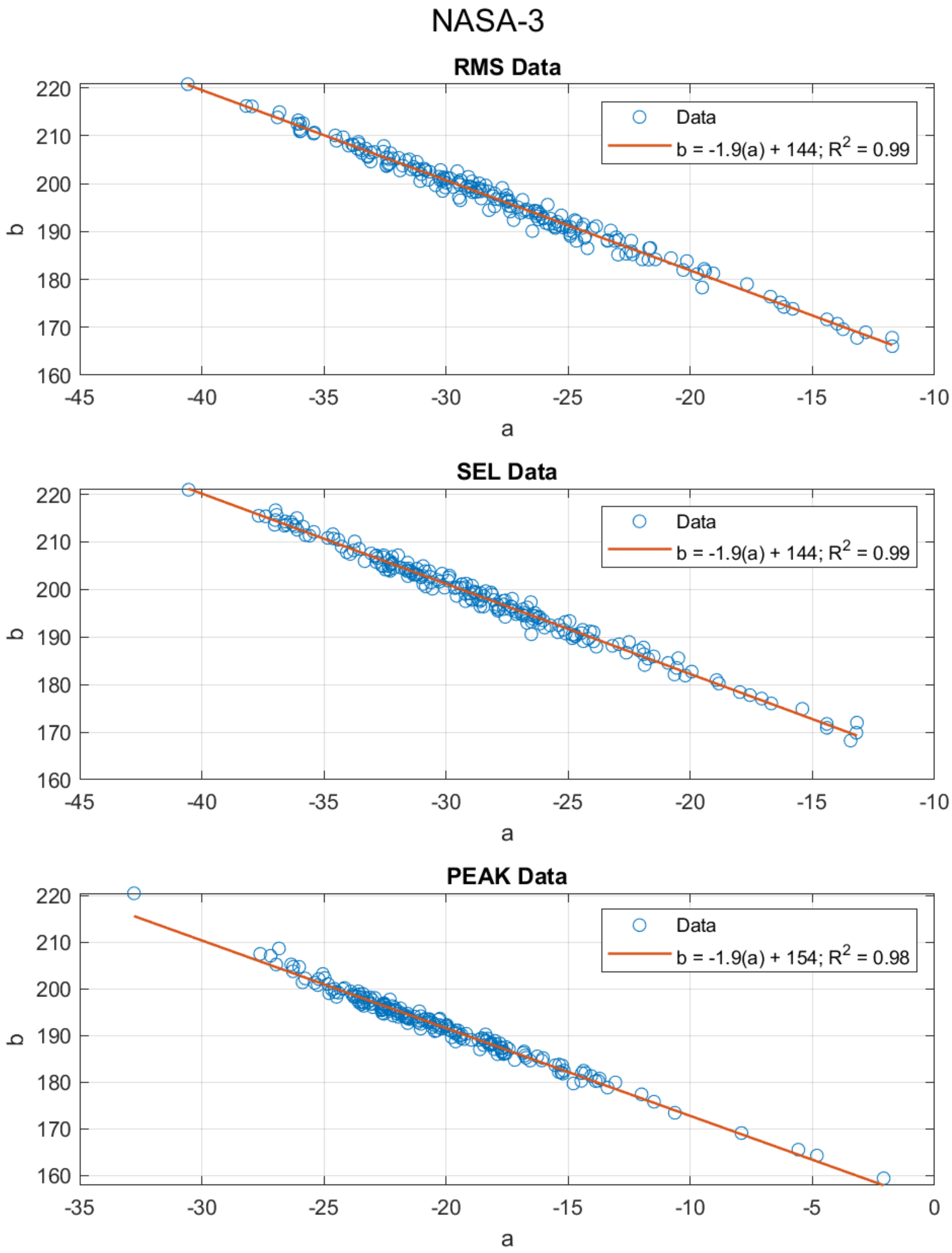
RMS Data
Data
b = -2(a) + 147; R2 = 0.99
b
a
SEL Data
Data
b = -2(a) + 148; R2 = 0.99
b
a
PEAK Data
Data
b = -2.1(a) + 155; R2 = 0.99
b
a

NASA-1



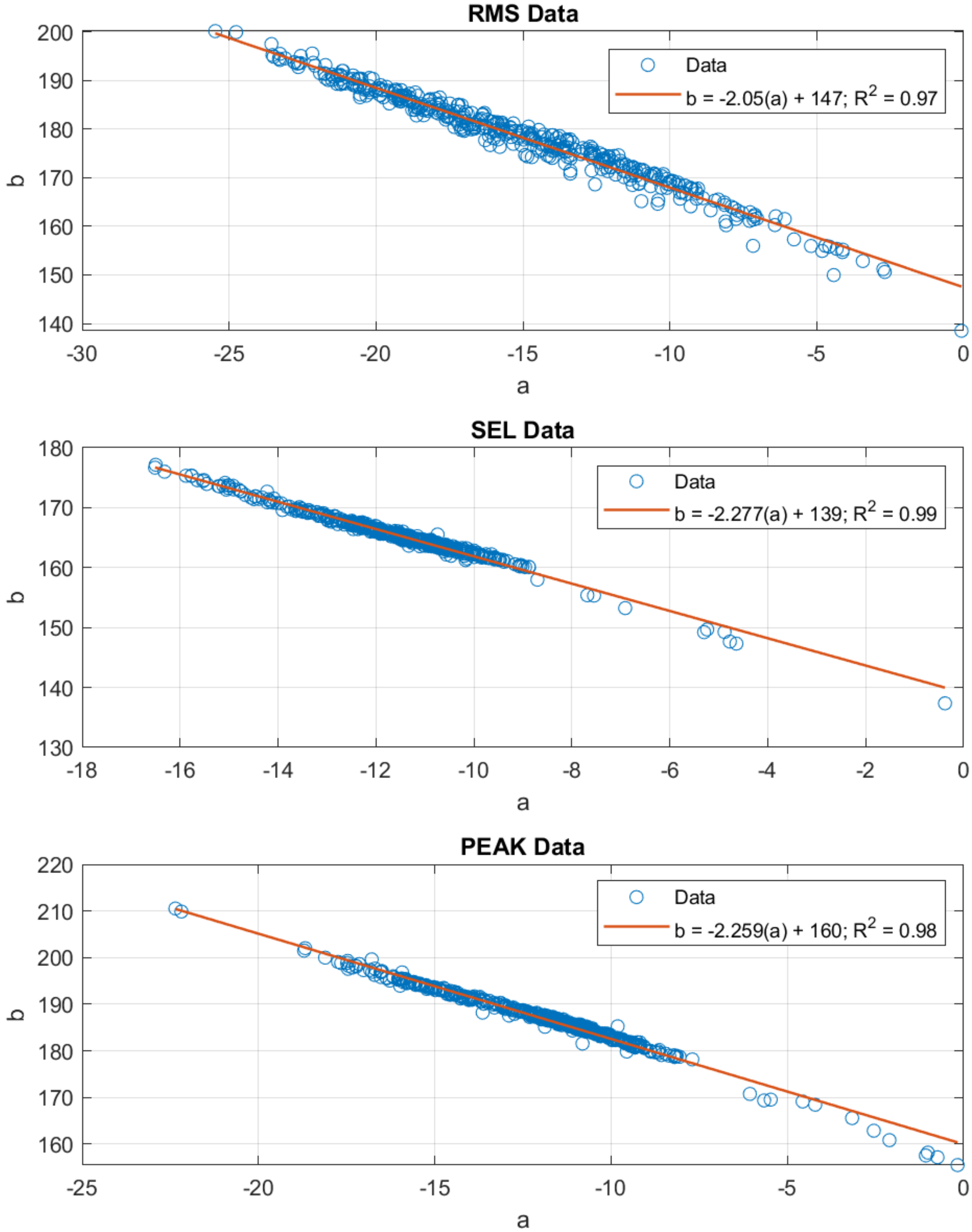
RMS Data
Data
b = -1.907(a) + 143; R2 = 0.81
b
a
SEL Data
Data
b = -1.925(a) + 141; R2 = 0.88
b
a
PEAK Data
Data
b = -1.699(a) + 160; R2 = 0.86
b
a


NASA-2
RMS Data
Data
b = -1.8(a) + 152; R2 = 0.97
b
a
250
240
230
220
210
200
-55
-50
-45
-40
-35
-30
SEL Data
Data
b = -1.8(a) + 149; R2 = 0.97
b
a
240
230
220
210
200
190
180
-50
-45
-40
-35
-30
-25
-20
PEAK Data
Data
b = -1.8(a) + 170; R2 = 0.98
b
a
280
270
260
250
240
230
220
-60
-55
-50
-45
-40
-35
-30

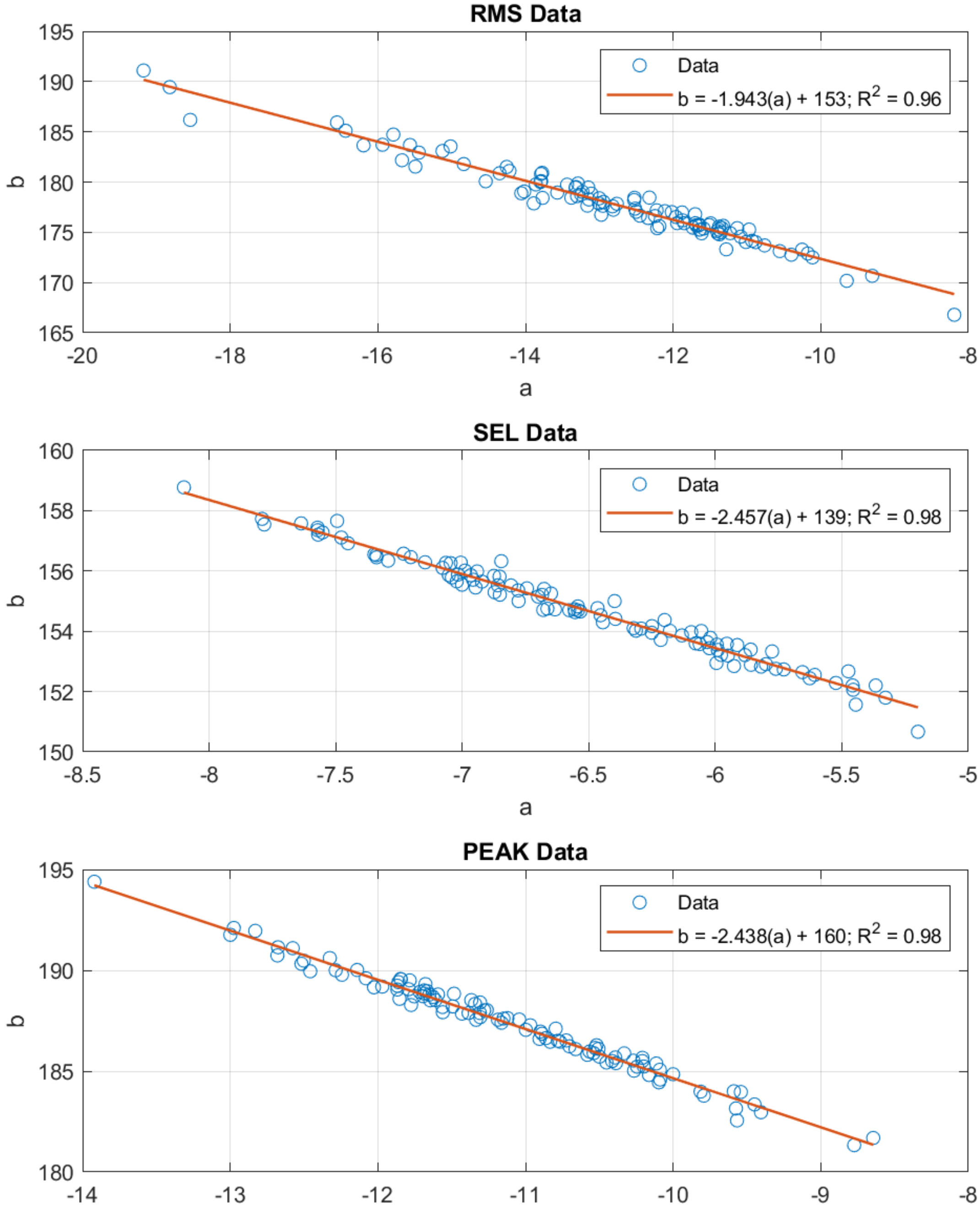


NASA-3
RMS Data
Data
b = -1.9(a) + 144; R2 = 0.99
b
a
SEL Data
Data
b = -1.9(a) + 144; R2 = 0.99
b
a
PEAK Data
Data
b = -1.9(a) + 154; R2 = 0.98
b
a

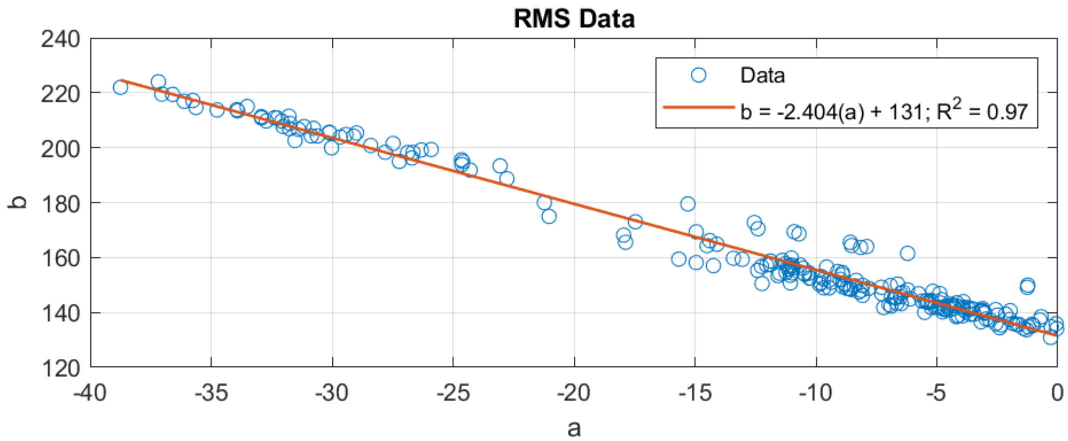
NASA-4


RMS Data
Data
b = -2.05(a) + 147; R^2 = 0.97
b
a
SEL Data
Data
b = -2.277(a) + 139; R^2 = 0.99
b
a
PEAK Data
Data
b = -2.259(a) + 160; R^2 = 0.98
b
a

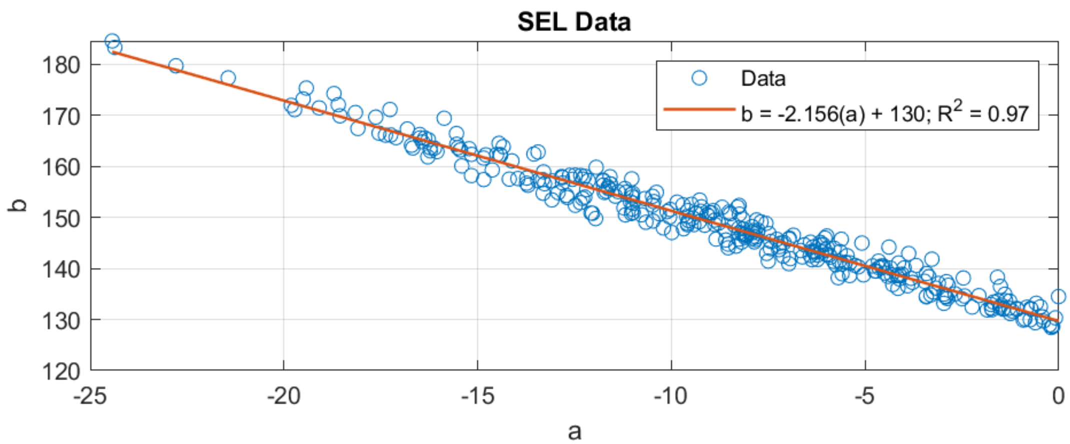
NASA-5


RMS Data
Data
b = -1.943(a) + 153; R2 = 0.96
b
a
SEL Data
Data
b = -2.457(a) + 139; R2 = 0.98
b
a
PEAK Data
Data
b = -2.438(a) + 160; R2 = 0.98
b
a

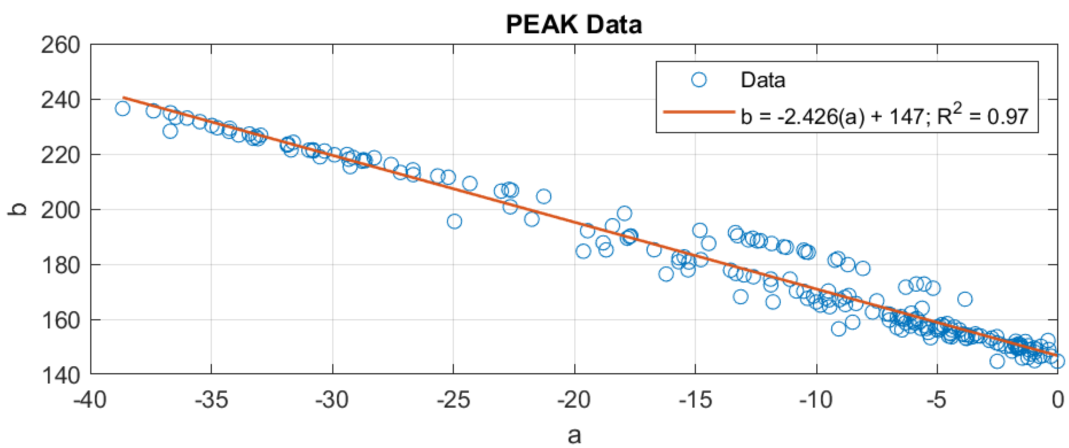
NASA-6



RMS Data
Data
b = -2.404(a) + 131; R2 = 0.97
b
a

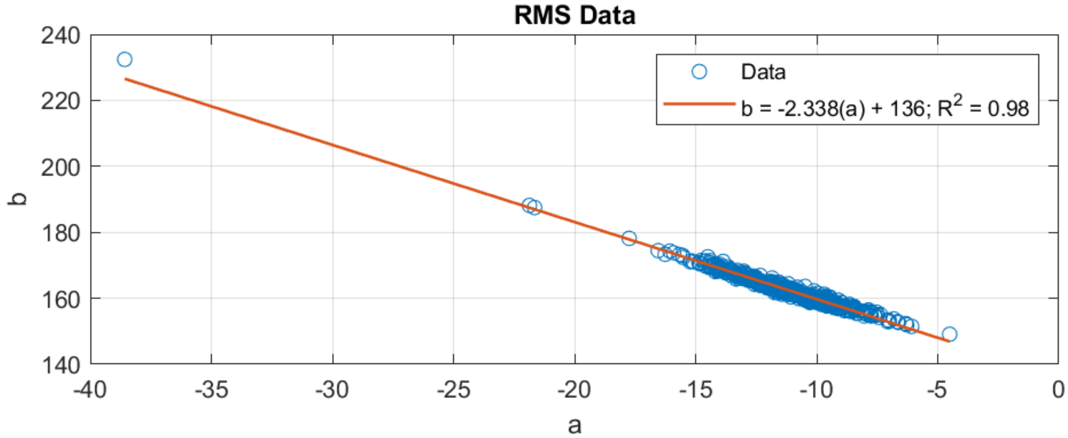


SEL Data
Data
b = -2.156(a) + 130; R2 = 0.97
b
a

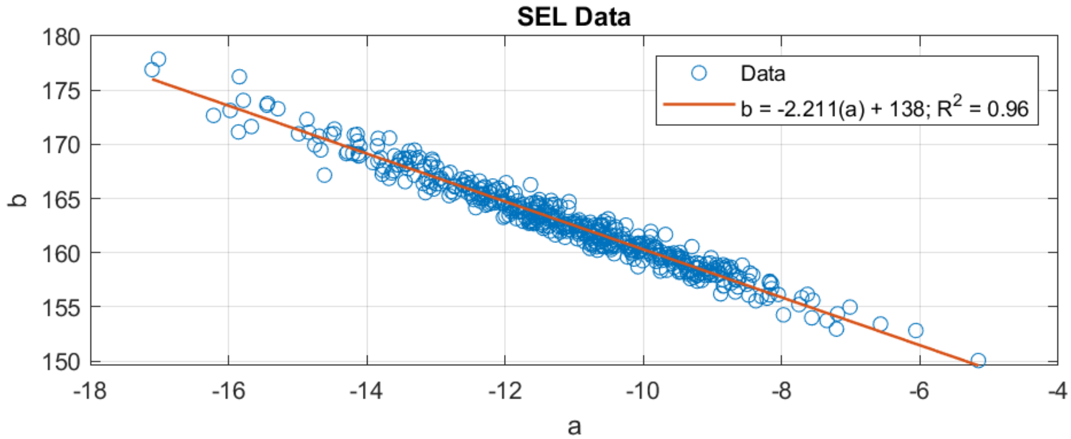


PEAK Data
Data
b = -2.426(a) + 147; R2 = 0.97
b
a

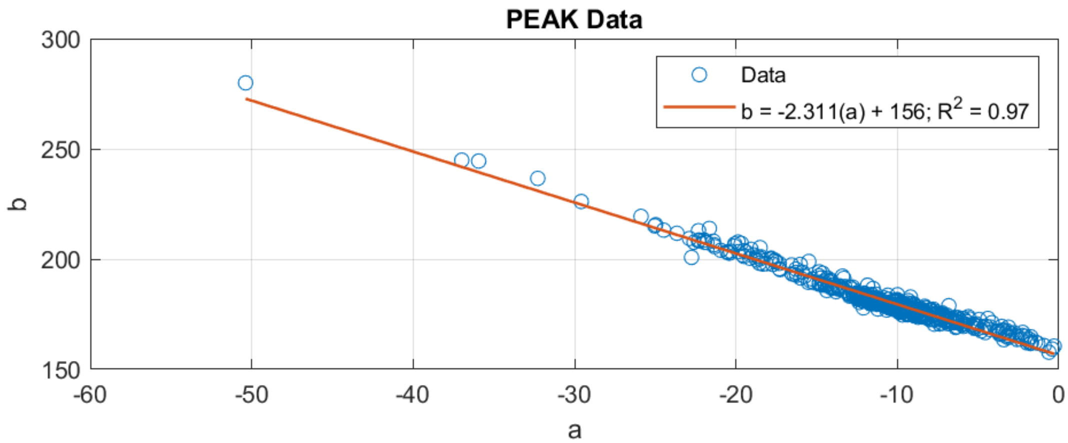
NASA-7



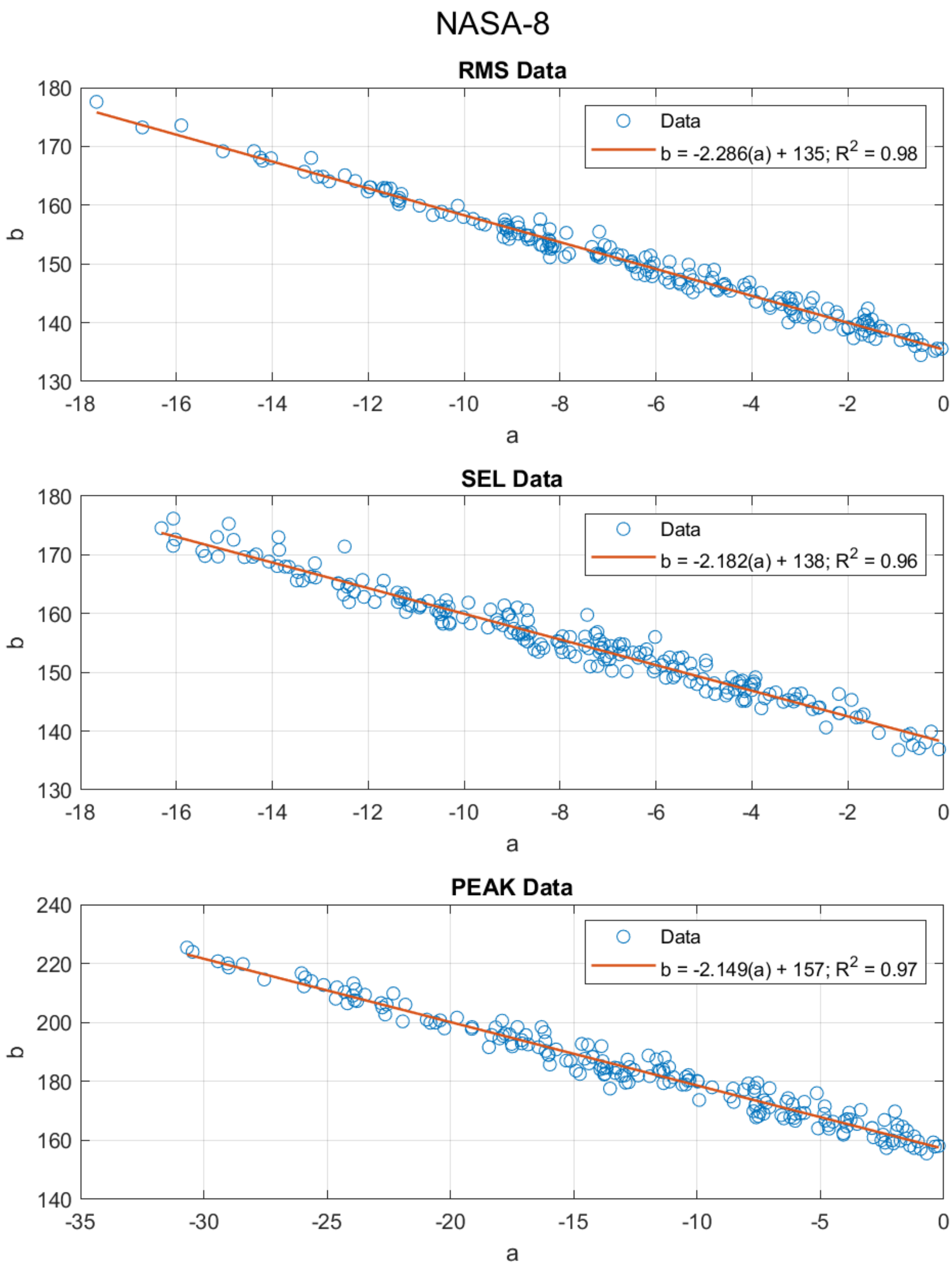
RMS Data
Data
b = -2.338(a) + 136; R^2 = 0.98
b
a
240
220
200
180
160
140
-40
-35
-30
-25
-20
-15
-10
-5
0

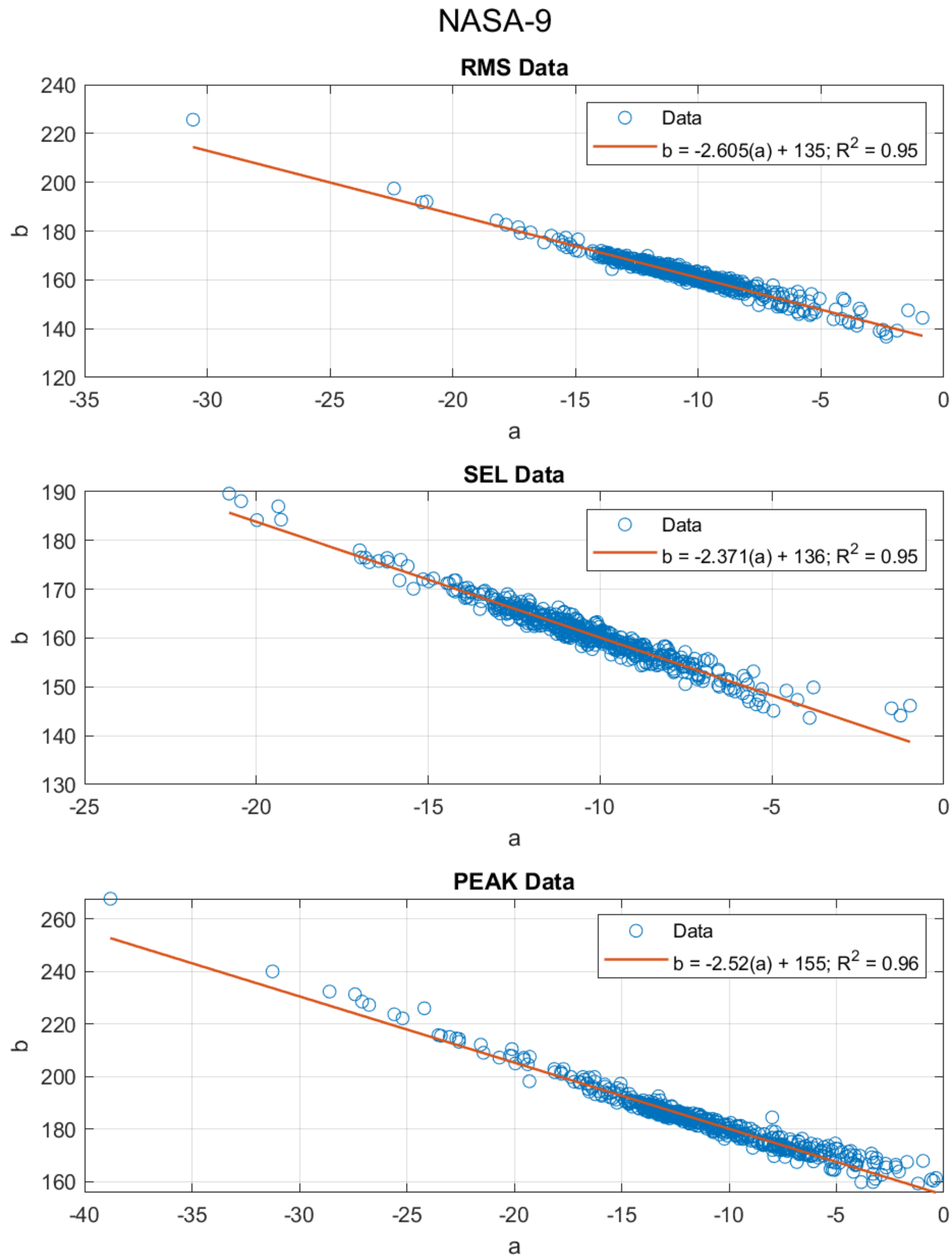


SEL Data
Data
b = -2.211(a) + 138; R^2 = 0.96
b
a
180
175
170
165
160
155
150
-18
-16
-14
-12
-10
-8
-6
-4

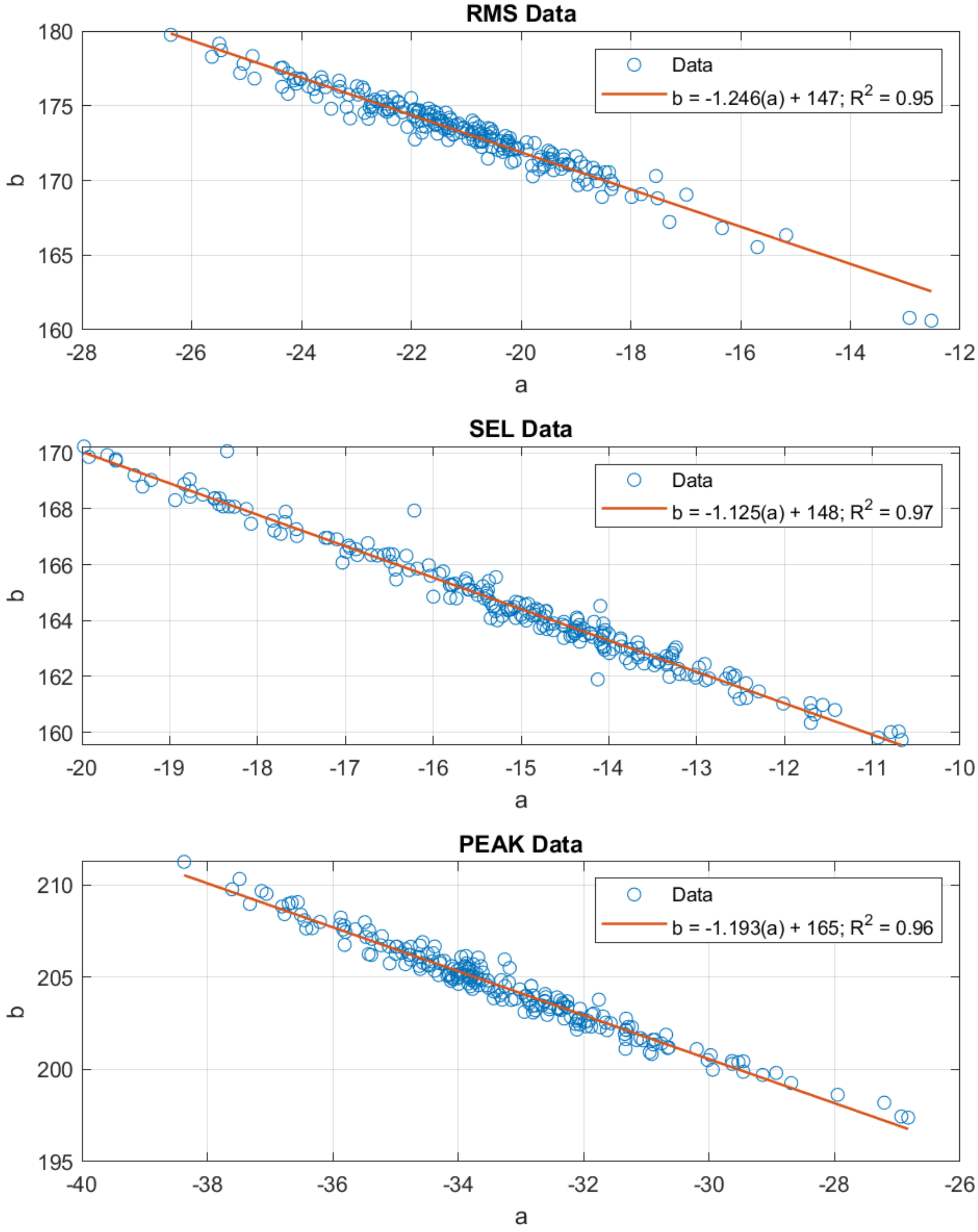


PEAK Data
Data
b = -2.311(a) + 156; R^2 = 0.97
b
a
300
250
200
150
-60
-50
-40
-30
-20
-10
0


NASA-8
RMS Data
Data
b = -2.286(a) + 135; R^2 = 0.98
180
170
160
150
140
130
-18
-16
-14
-12
-10
-8
-6
-4
-2
0
a
b
SEL Data
Data
b = -2.182(a) + 138; R^2 = 0.96
180
170
160
150
140
130
-18
-16
-14
-12
-10
-8
-6
-4
-2
0
a
b
PEAK Data
Data
b = -2.149(a) + 157; R^2 = 0.97
240
220
200
180
160
140
-35
-30
-25
-20
-15
-10
-5
0
a
b


NASA-9
RMS Data
Data
b = -2.605(a) + 135; R2 = 0.95
b
a
SEL Data
Data
b = -2.371(a) + 136; R2 = 0.95
b
a
PEAK Data
Data
b = -2.52(a) + 155; R2 = 0.96
b
a

Broward-1



RMS Data
Data
b = -1.246(a) + 147; R^2 = 0.95
180
175
170
165
160
-28
-26
-24
-22
-20
-18
-16
-14
-12
a
b
SEL Data
Data
b = -1.125(a) + 148; R^2 = 0.97
170
168
166
164
162
160
-20
-19
-18
-17
-16
-15
-14
-13
-12
-11
-10
a
b
PEAK Data
Data
b = -1.193(a) + 165; R^2 = 0.96
210
205
200
195
-40
-38
-36
-34
-32
-30
-28
-26
a
b

APPENDIX H
SOUND DECAY CURVES FROM BAYWAY AND RIBAULT CFD

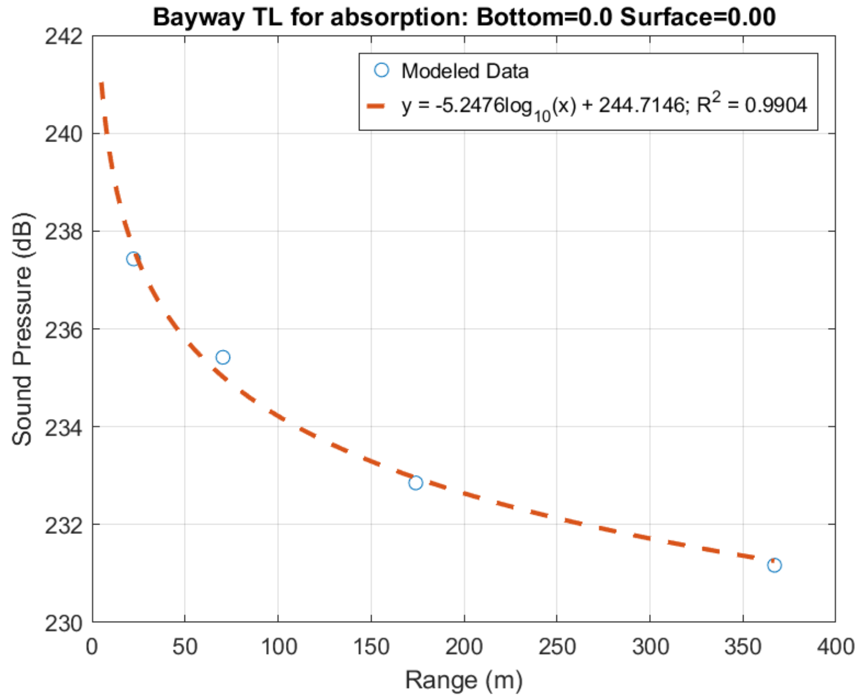


Figure H-1. Bayway TL curve for 0.0 Bottom-0.00 Surface Absorption

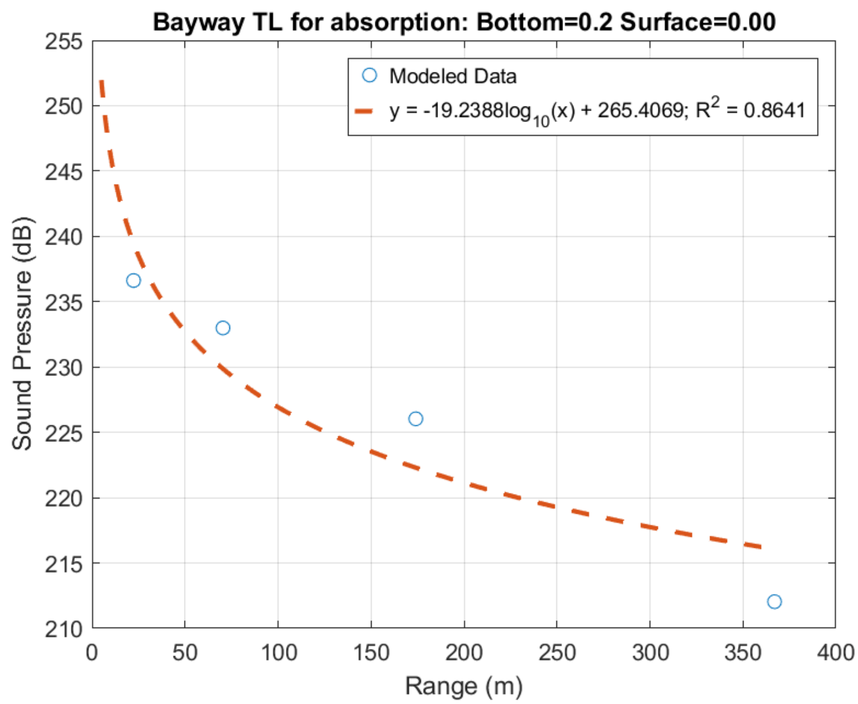


Figure H-2. Bayway TL curve for 0.2 Bottom-0.00 Surface Absorption

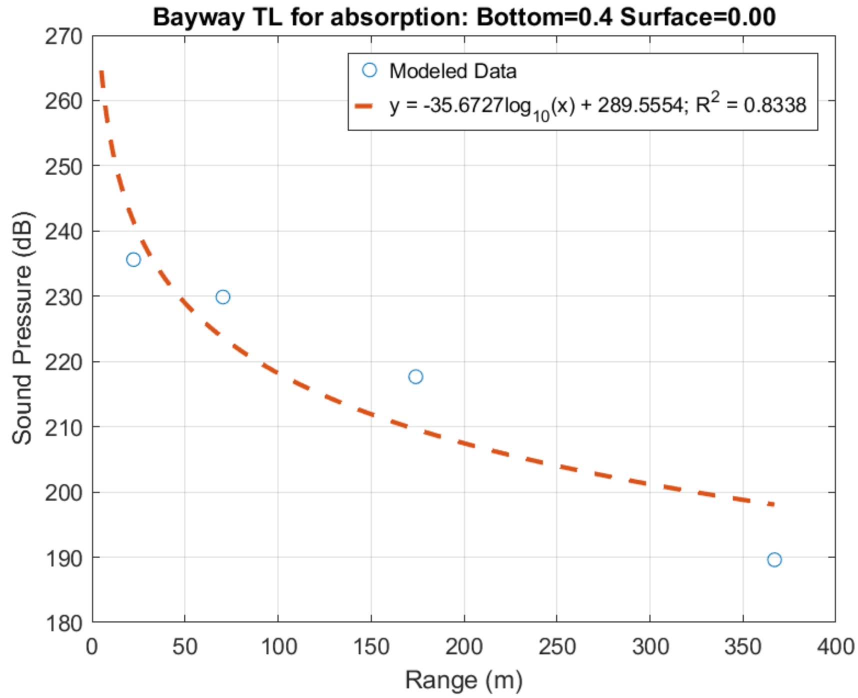


Figure H-3. Bayway TL curve for 0.4 Bottom-0.00 Surface Absorption

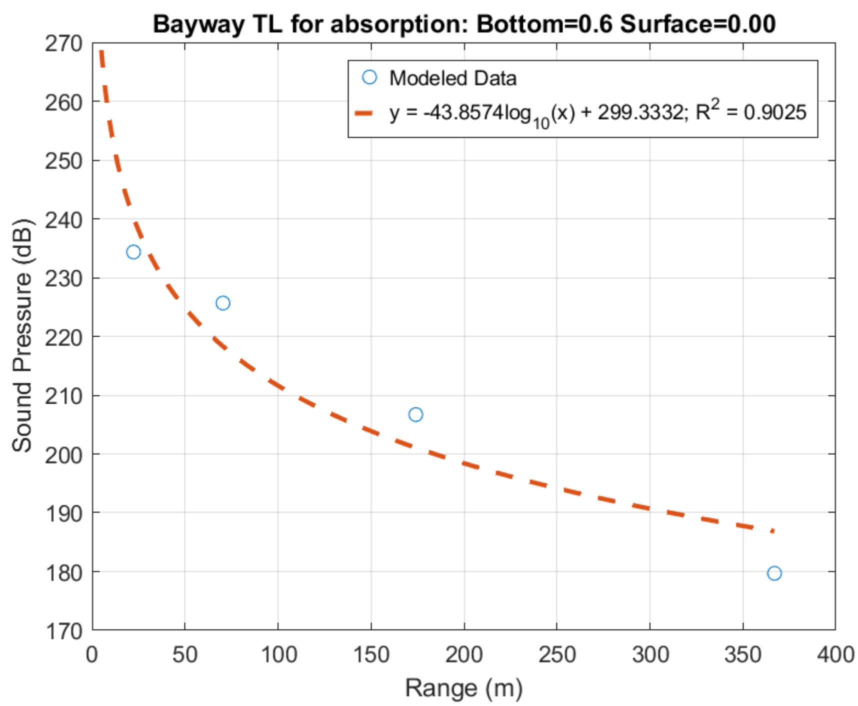


Figure H-4. Bayway TL curve for 0.6 Bottom-0.00 Surface Absorption

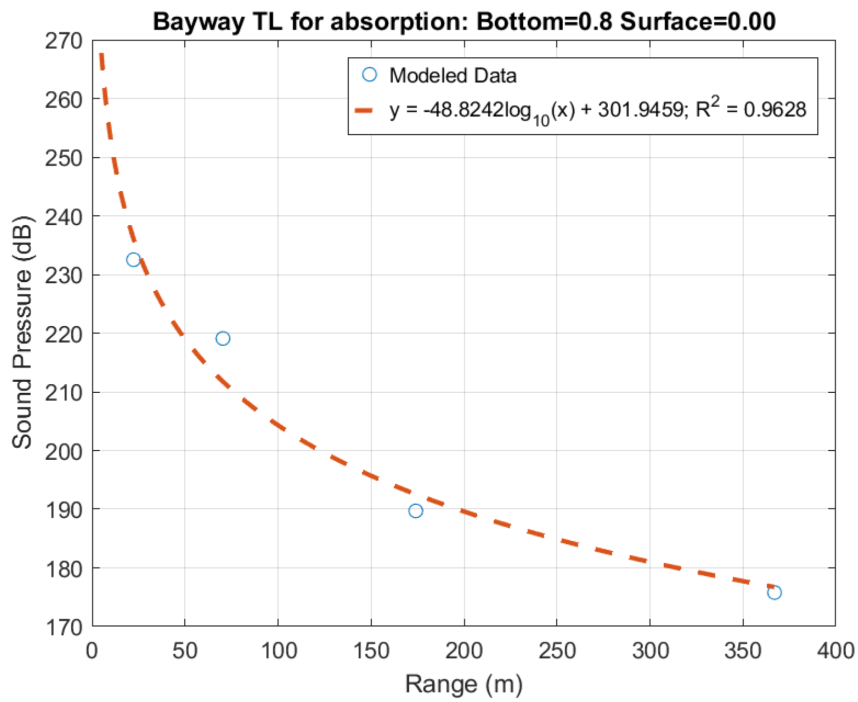


Figure H-5. Bayway TL curve for 0.8 Bottom-0.00 Surface Absorption

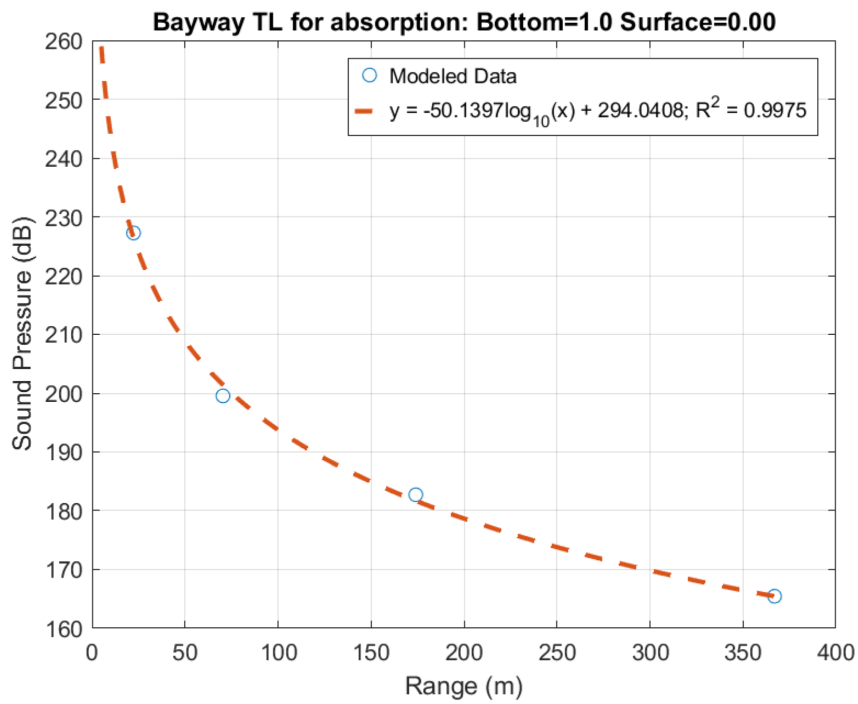


Figure H-6. Bayway TL curve for 1.0 Bottom-0.00 Surface Absorption

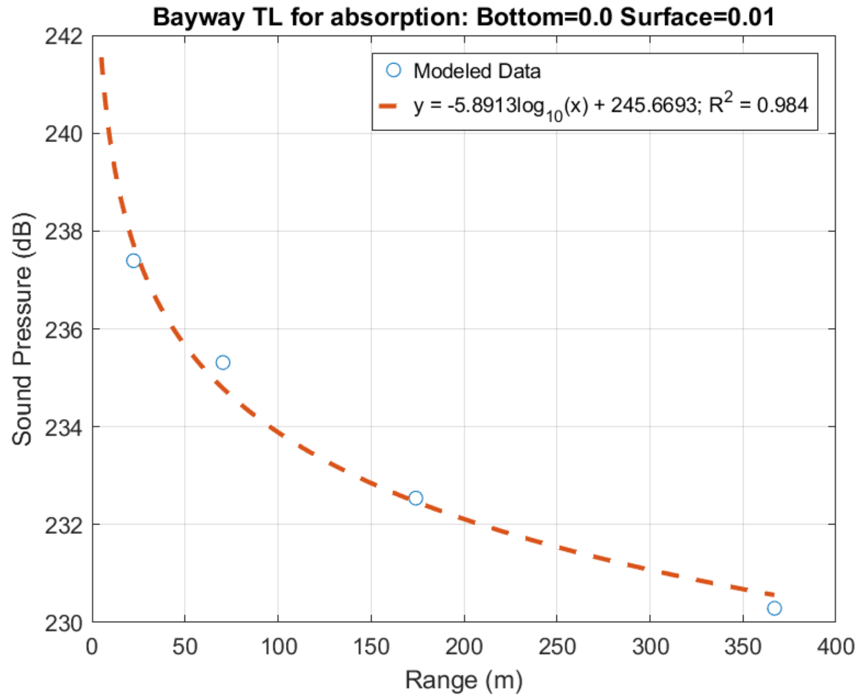


Figure H-7. Bayway TL curve for 0.0 Bottom-0.01 Surface Absorption

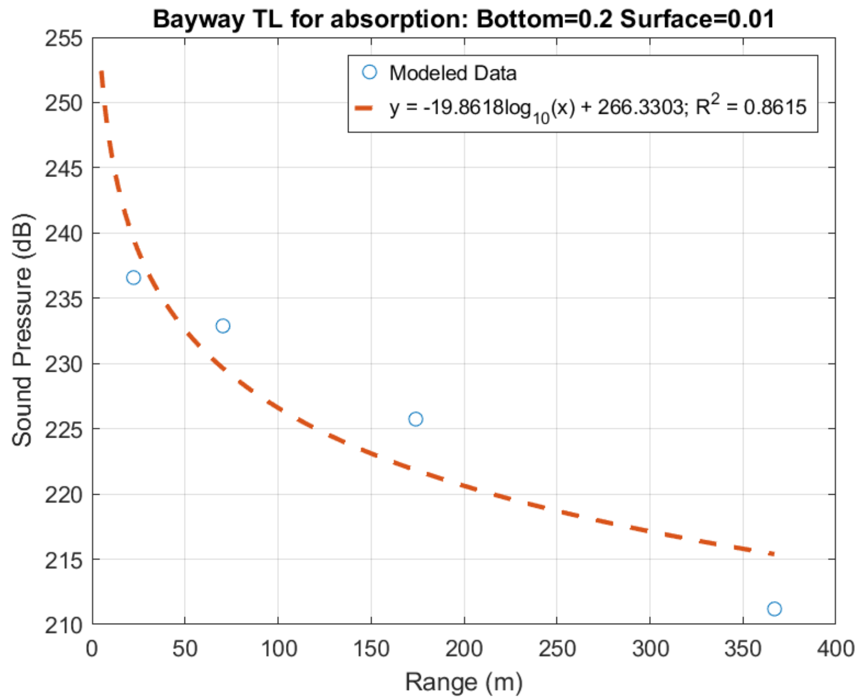


Figure H-8. Bayway TL curve for 0.2 Bottom-0.01 Surface Absorption

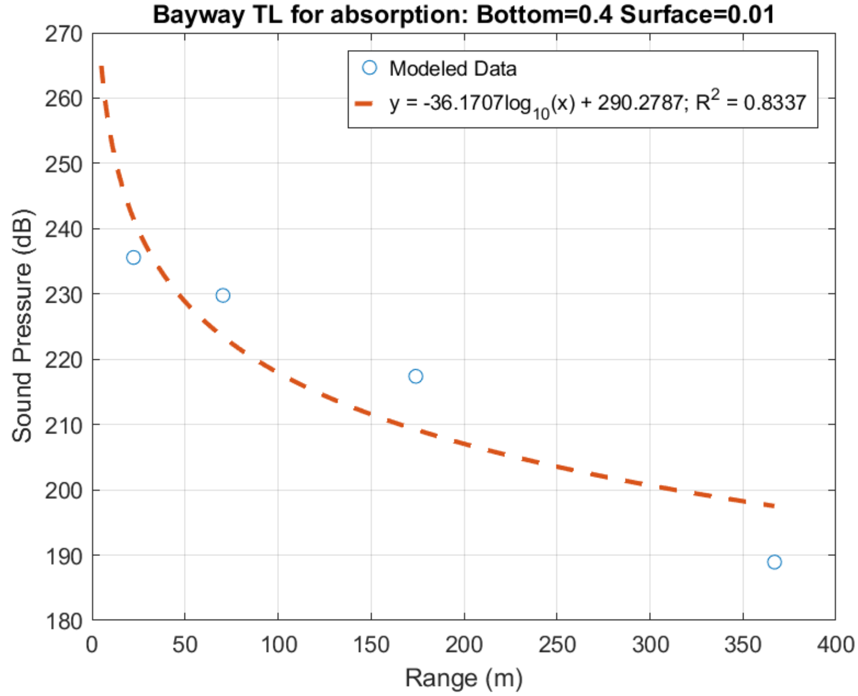


Figure H-9. Bayway TL curve for 0.4 Bottom-0.01 Surface Absorption

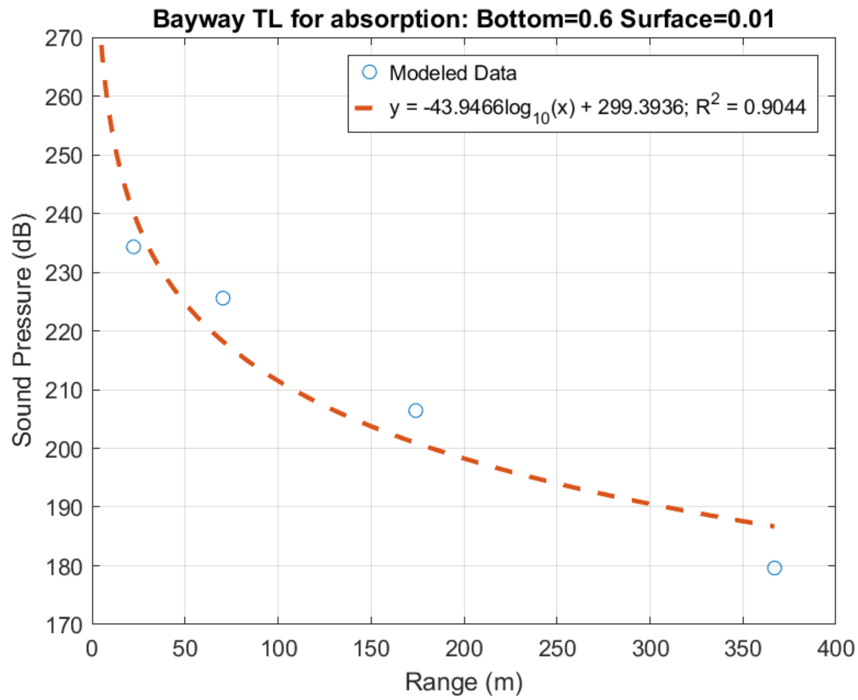


Figure H-10. Bayway TL curve for 0.6 Bottom-0.01 Surface Absorption

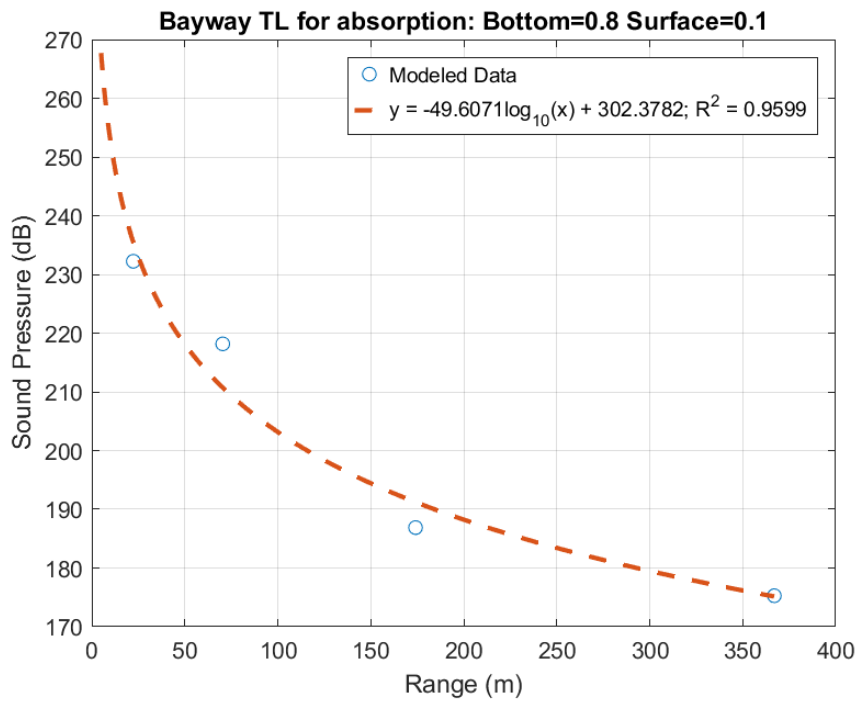


Figure H-11 Bayway TL curve for 0.8 Bottom-0.1 Surface Absorption

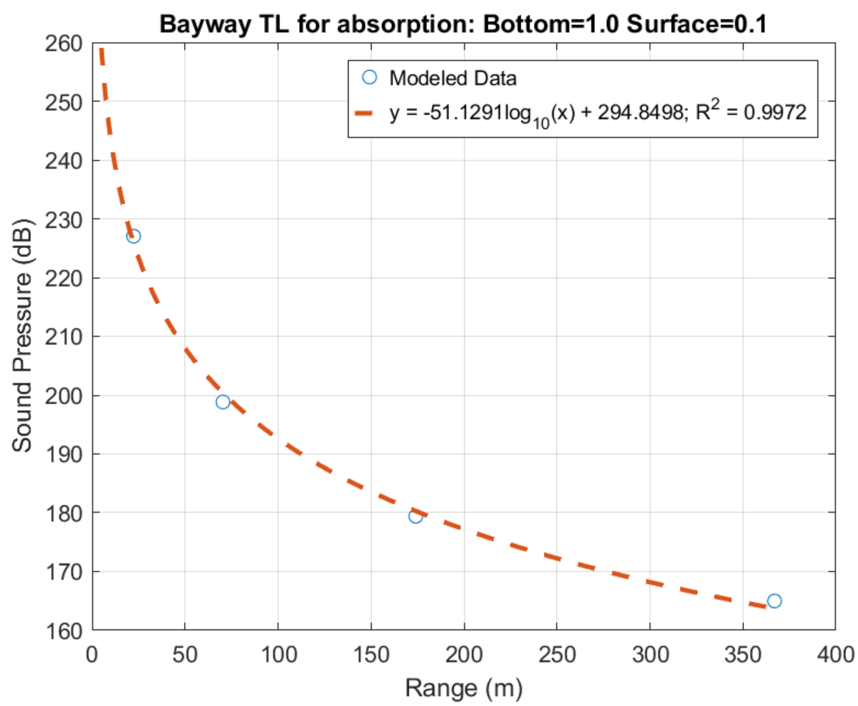


Figure H-12. Bayway TL curve for 1.0 Bottom-0.1 Surface Absorption

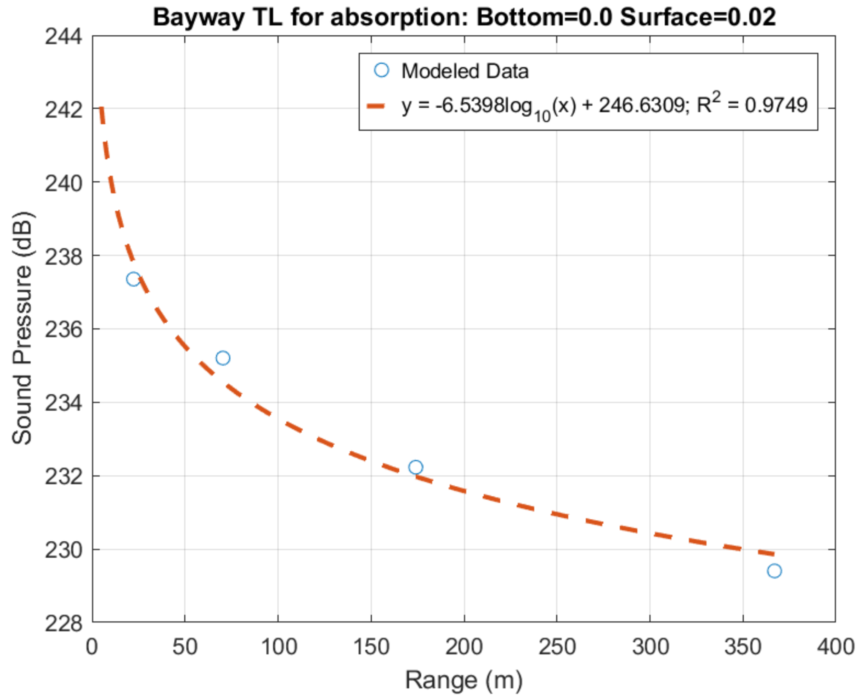


Figure H-13. Bayway TL curve for 0.0 Bottom-0.02 Surface Absorption

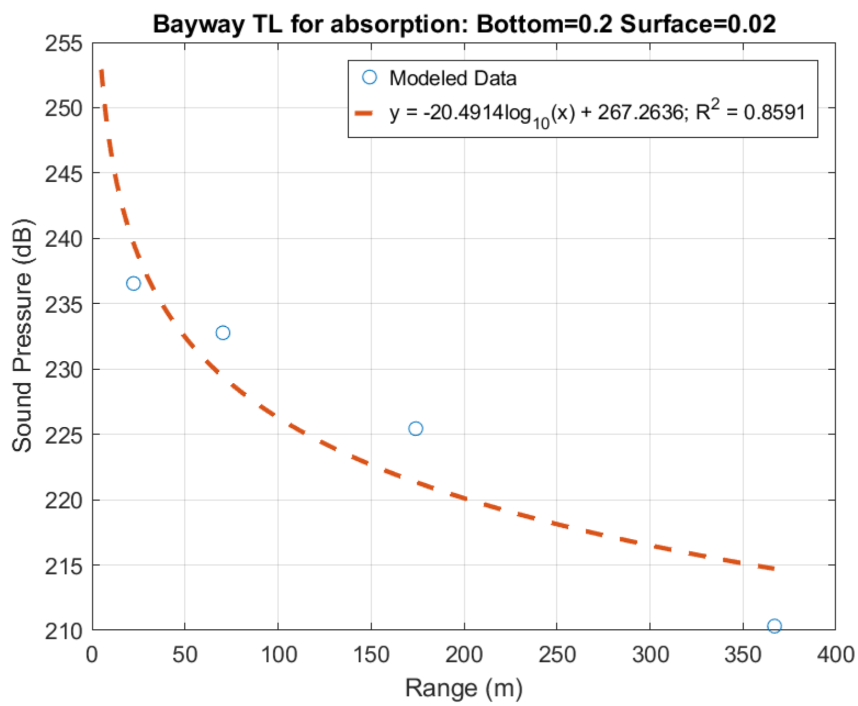


Figure H-14. Bayway TL curve for 0.2 Bottom-0.02 Surface Absorption

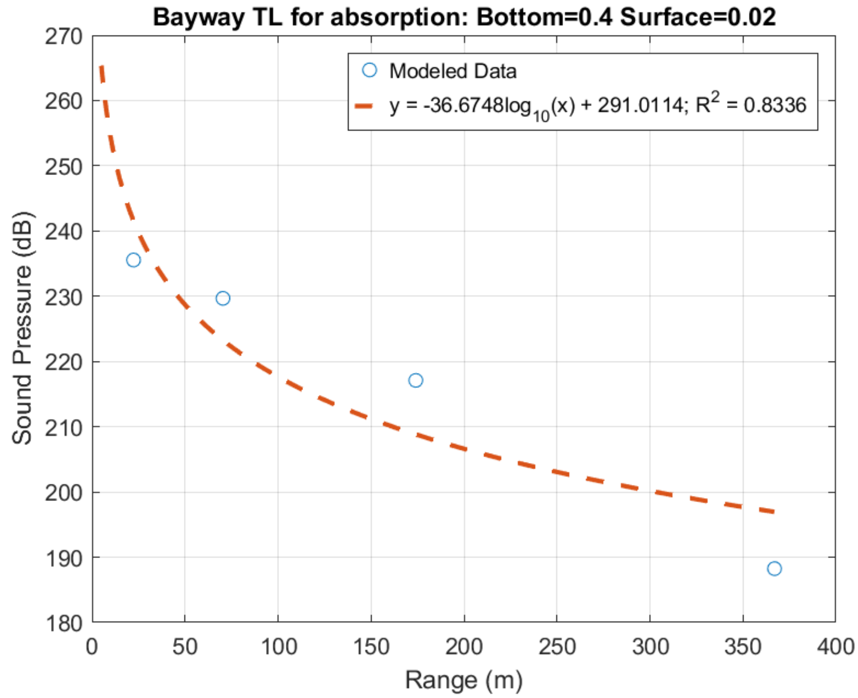


Figure H-15. Bayway TL curve for 0.4 Bottom-0.02 Surface Absorption

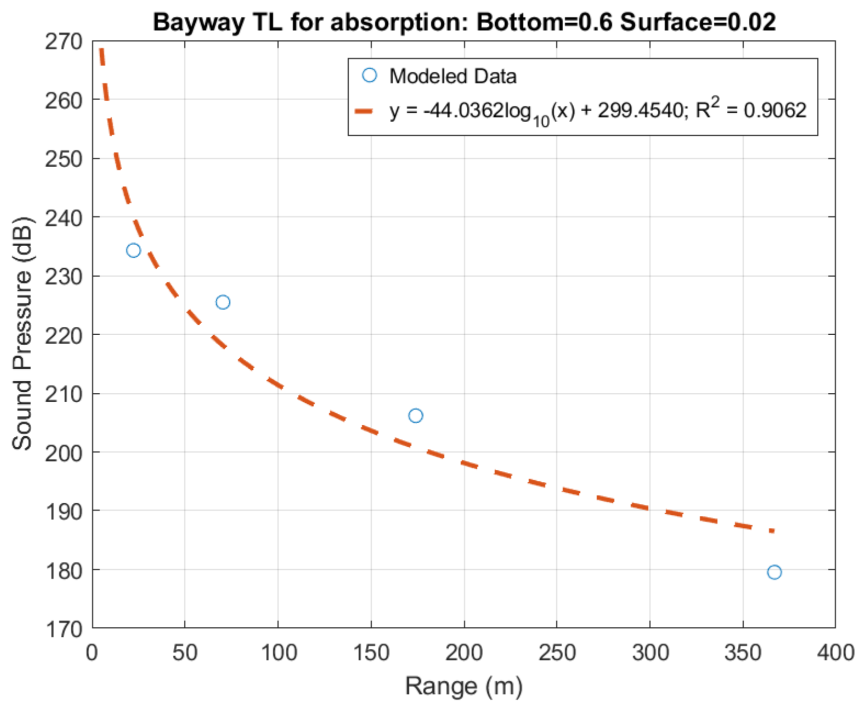


Figure H-16. Bayway TL curve for 0.6 Bottom-0.02 Surface Absorption

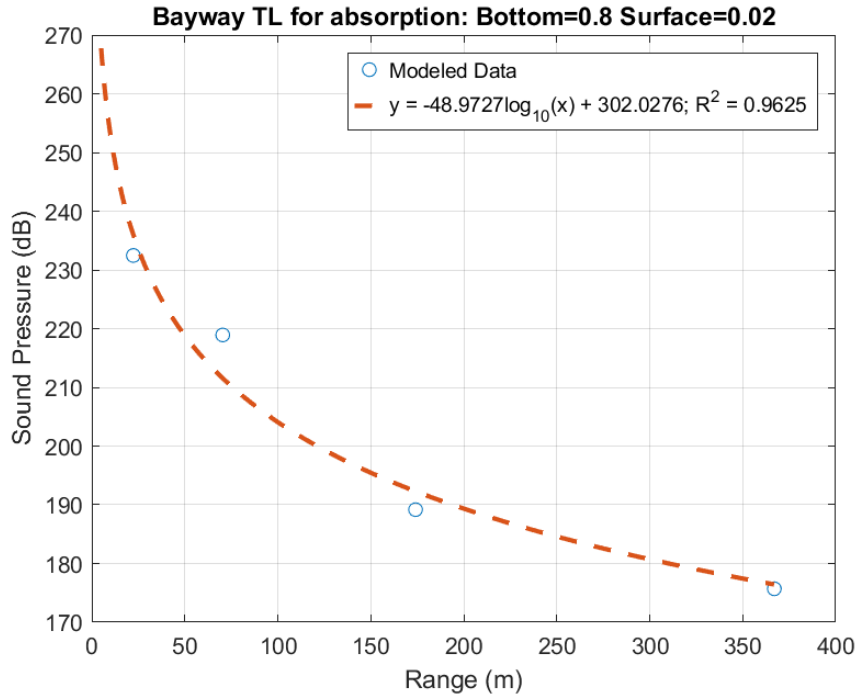


Figure H-17. Bayway TL curve for 0.8 Bottom-0.02 Surface Absorption

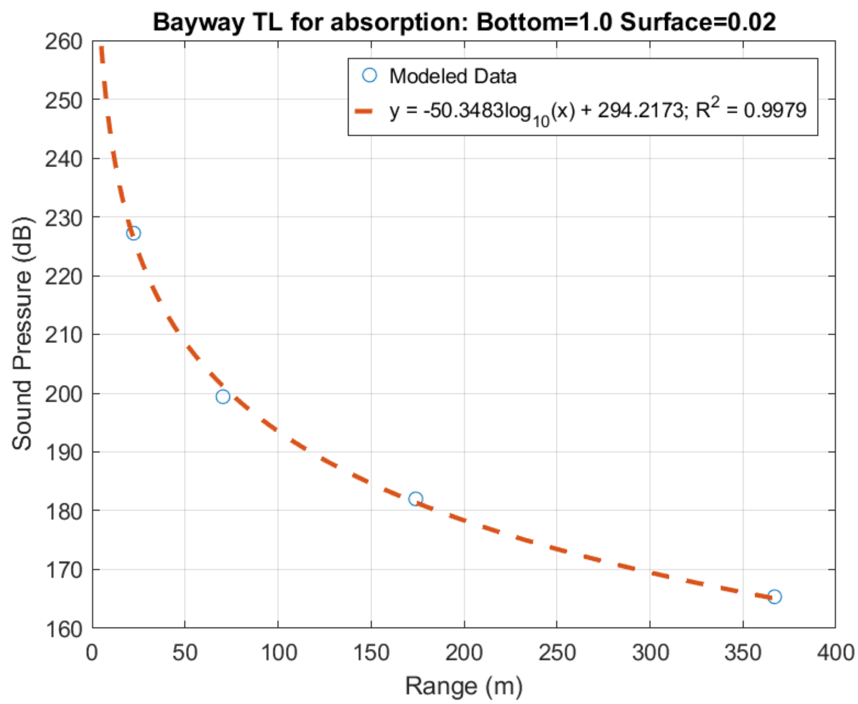


Figure H-18. Bayway TL curve for 1.0 Bottom-0.02 Surface Absorption

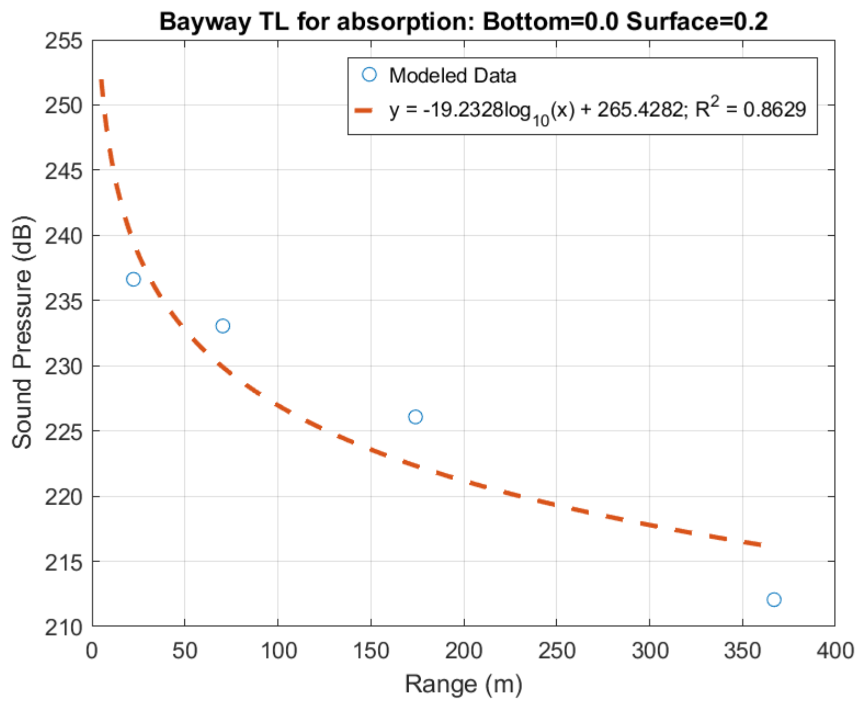


Figure H-19. Bayway TL curve for 0.0 Bottom-0.2 Surface Absorption

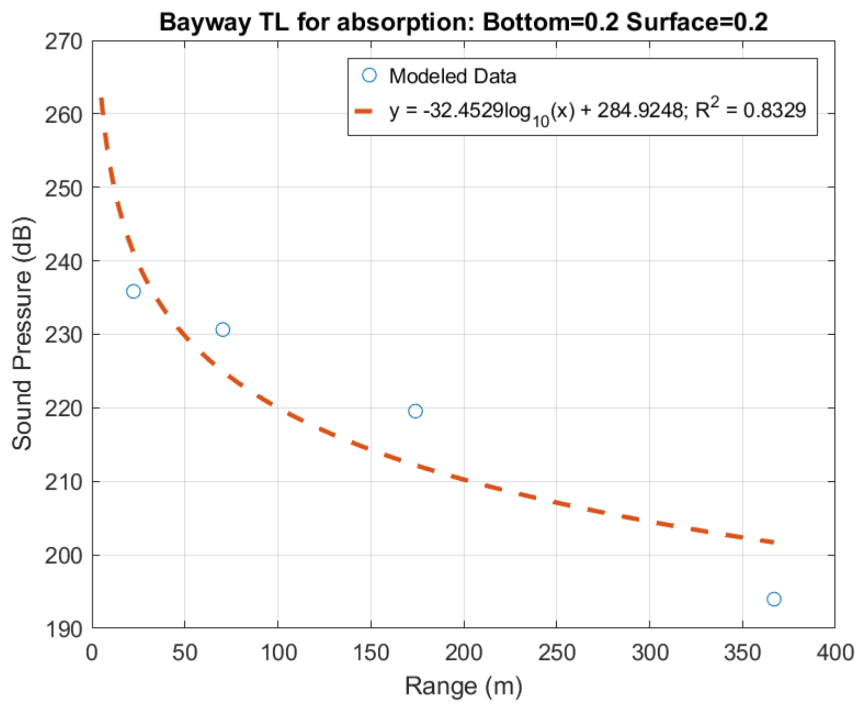


Figure H-20. Bayway TL curve for 0.2 Bottom-0.2 Surface Absorption

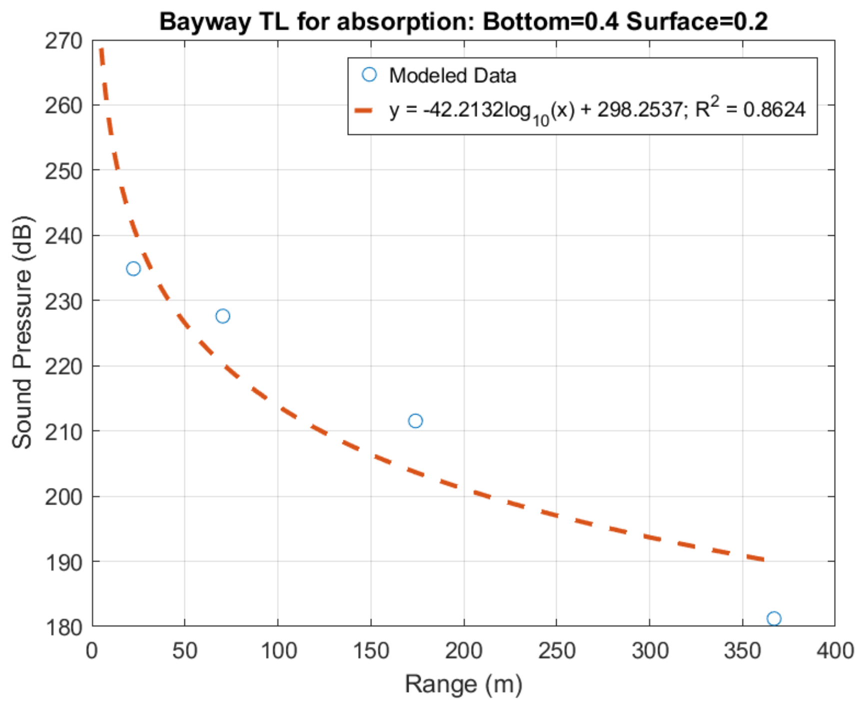


Figure H-21. Bayway TL curve for 0.4 Bottom-0.2 Surface Absorption

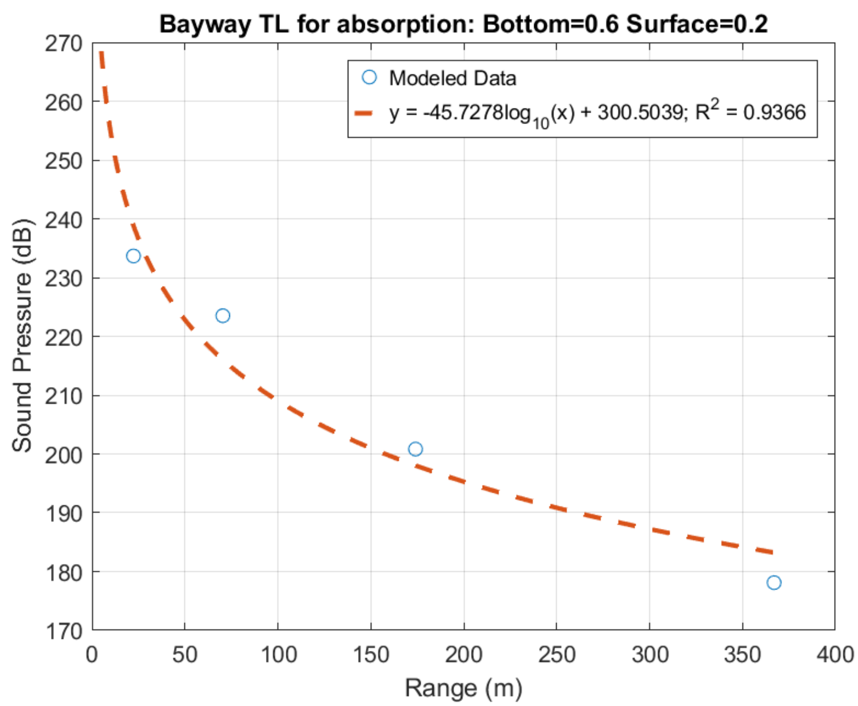


Figure H-22. Bayway TL curve for 0.6 Bottom-0.2 Surface Absorption

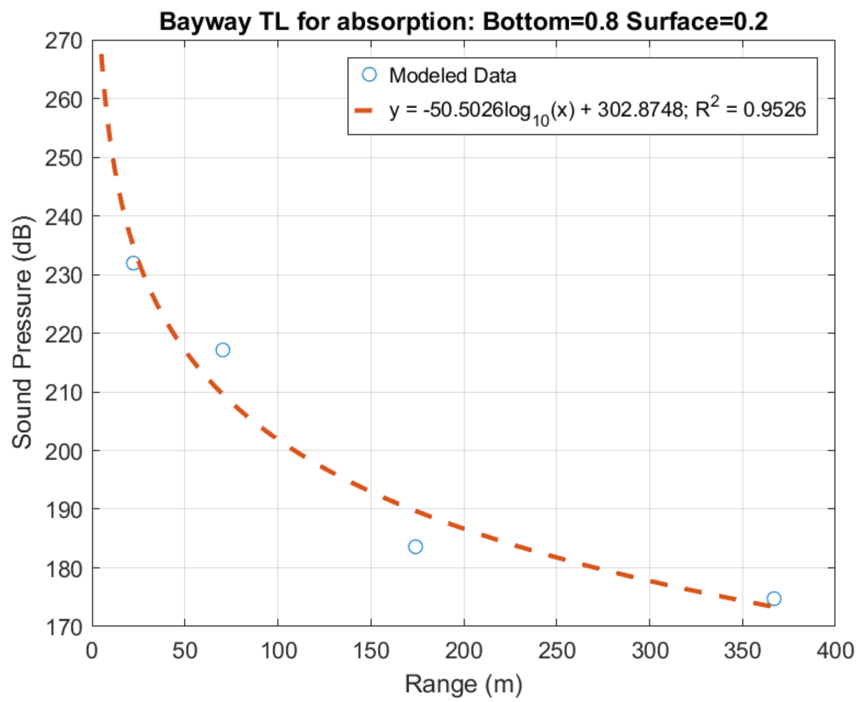


Figure H-23. Bayway TL curve for 0.8 Bottom-0.2 Surface Absorption

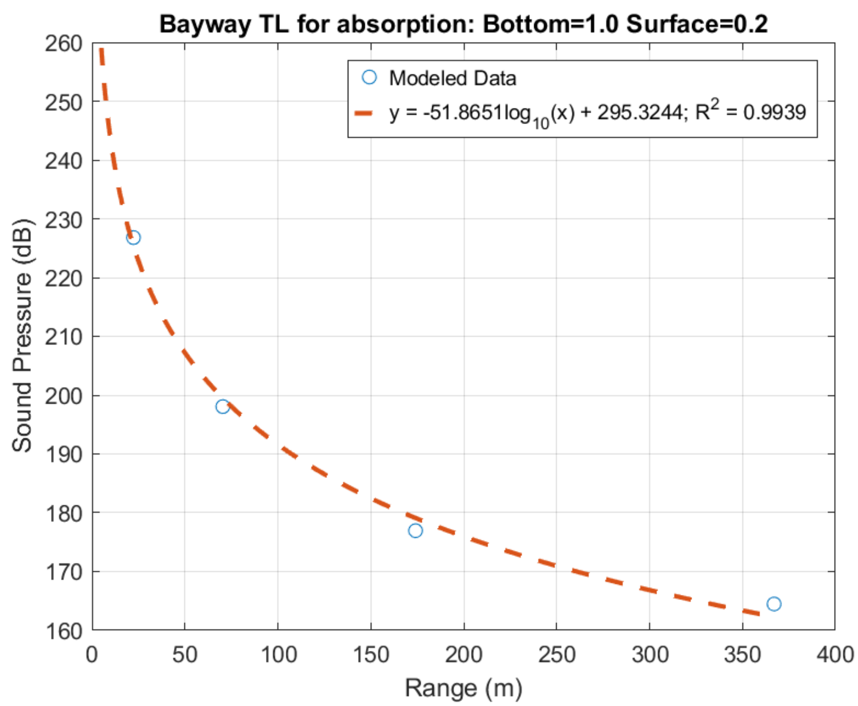


Figure H-24. Bayway TL curve for 1.0 Bottom-0.2 Surface Absorption

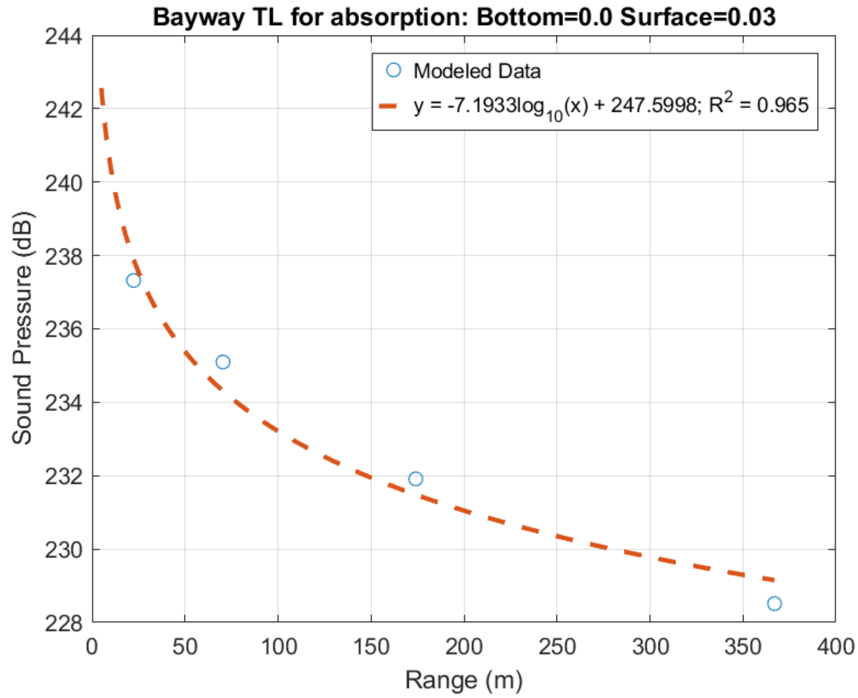


Figure H-25. Bayway TL curve for 0.0 Bottom-0.03 Surface Absorption

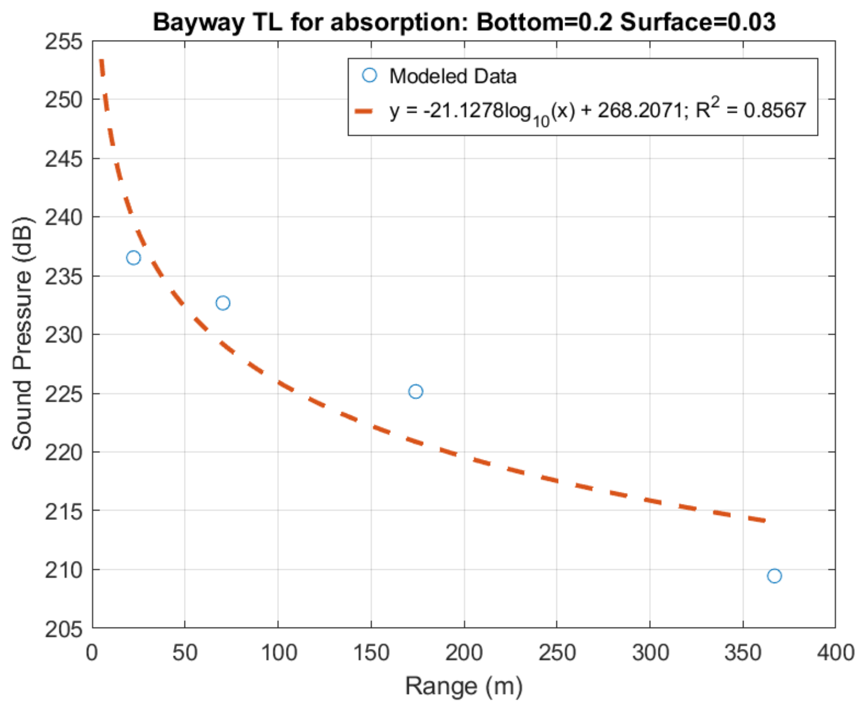


Figure H-26. Bayway TL curve for 0.2 Bottom-0.03 Surface Absorption

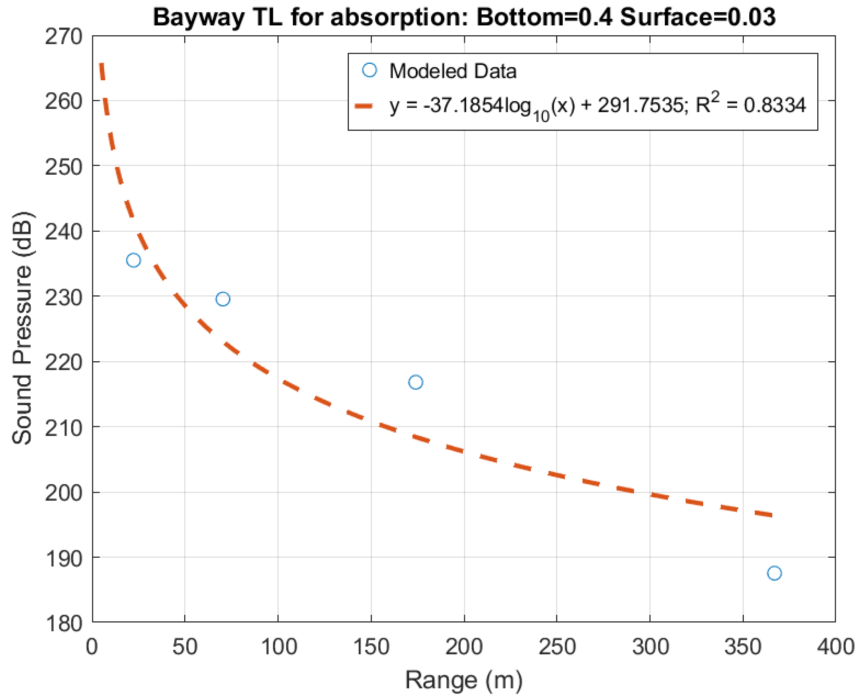


Figure H-27. Bayway TL curve for 0.4 Bottom-0.03 Surface Absorption

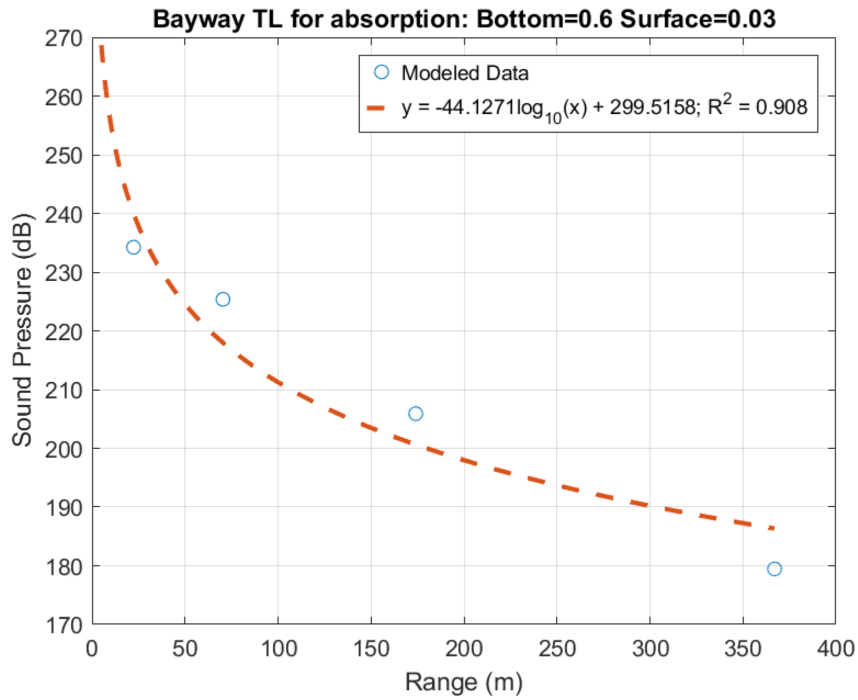


Figure H-28. Bayway TL curve for 0.6 Bottom-0.03 Surface Absorption

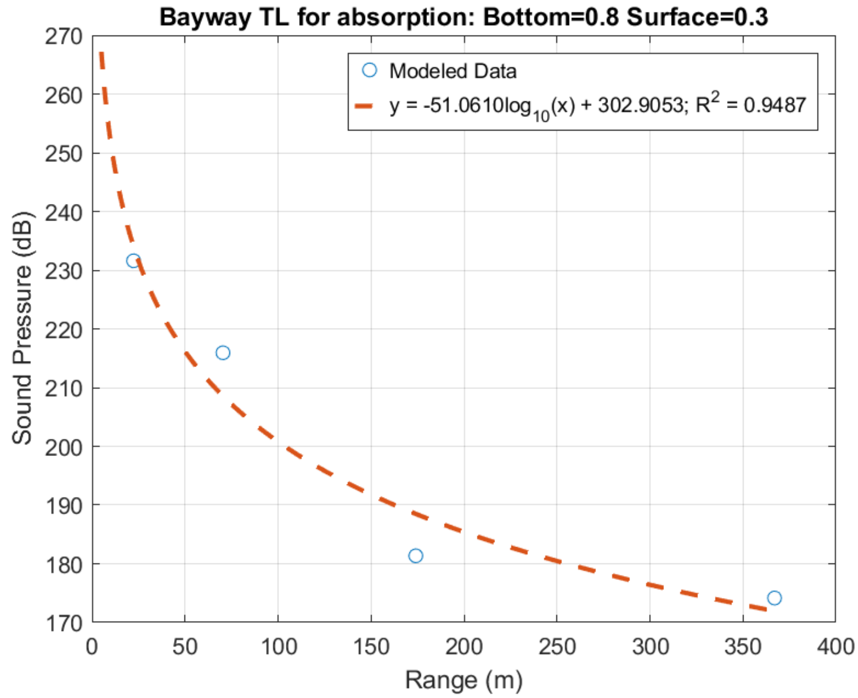


Figure H-29. Bayway TL curve for 0.8 Bottom-0.3 Surface Absorption

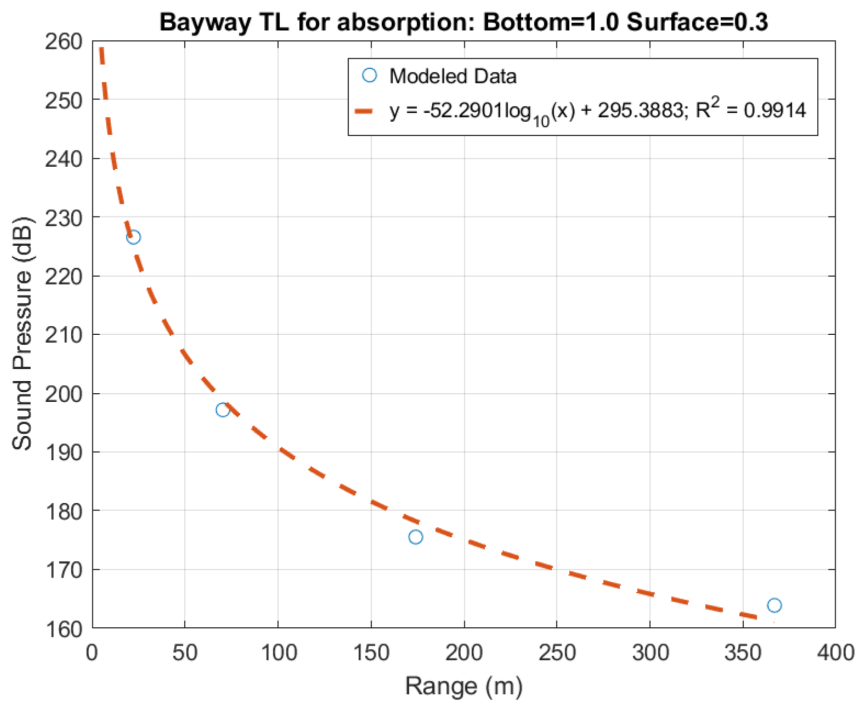


Figure H-30. Bayway TL curve for 1.0 Bottom-0.3 Surface Absorption

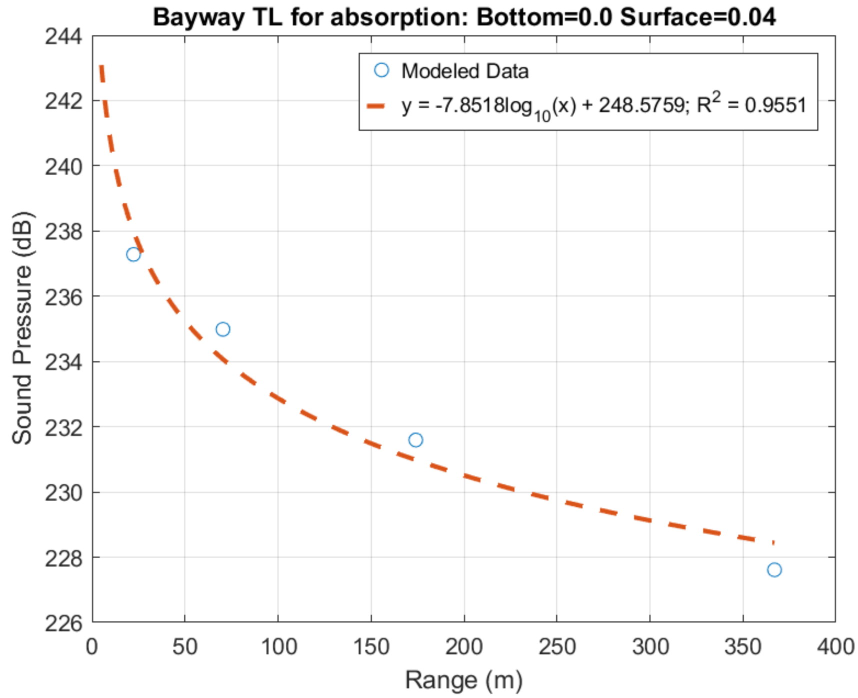


Figure H-31. Bayway TL curve for 0.0 Bottom-0.04 Surface Absorption

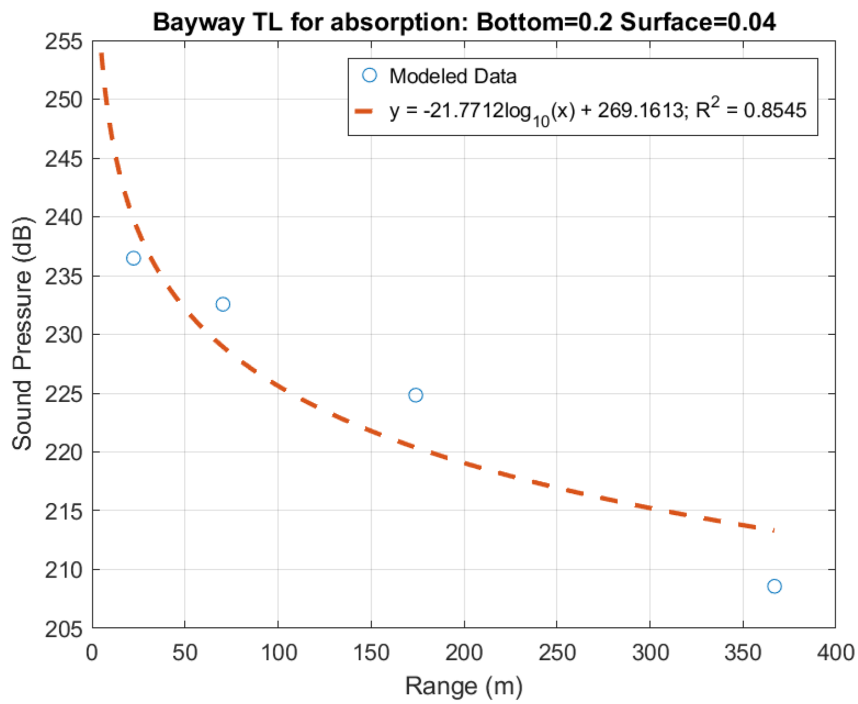


Figure H-32. Bayway TL curve for 0.2 Bottom-0.04 Surface Absorption

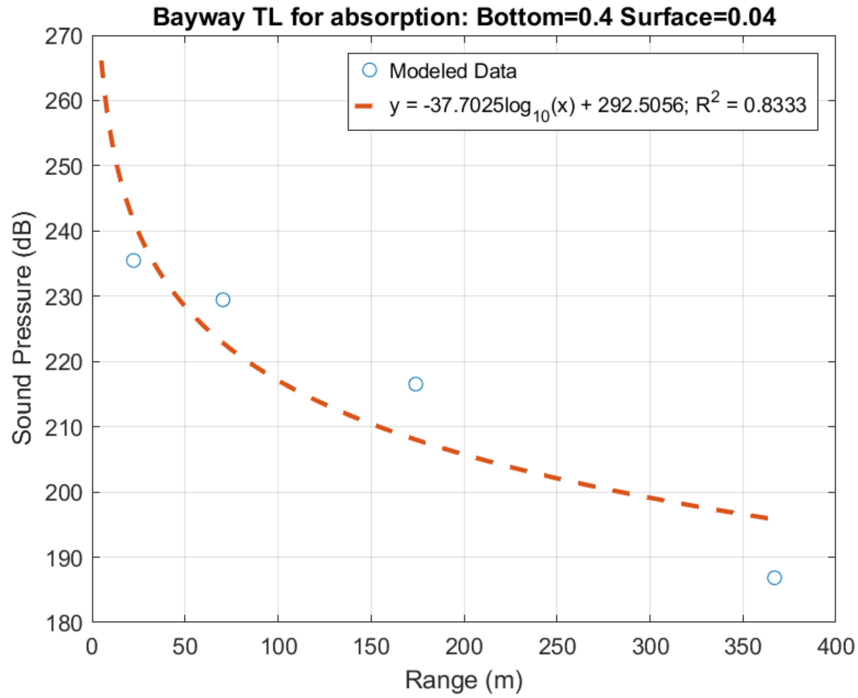


Figure H-33. Bayway TL curve for 0.4 Bottom-0.04 Surface Absorption

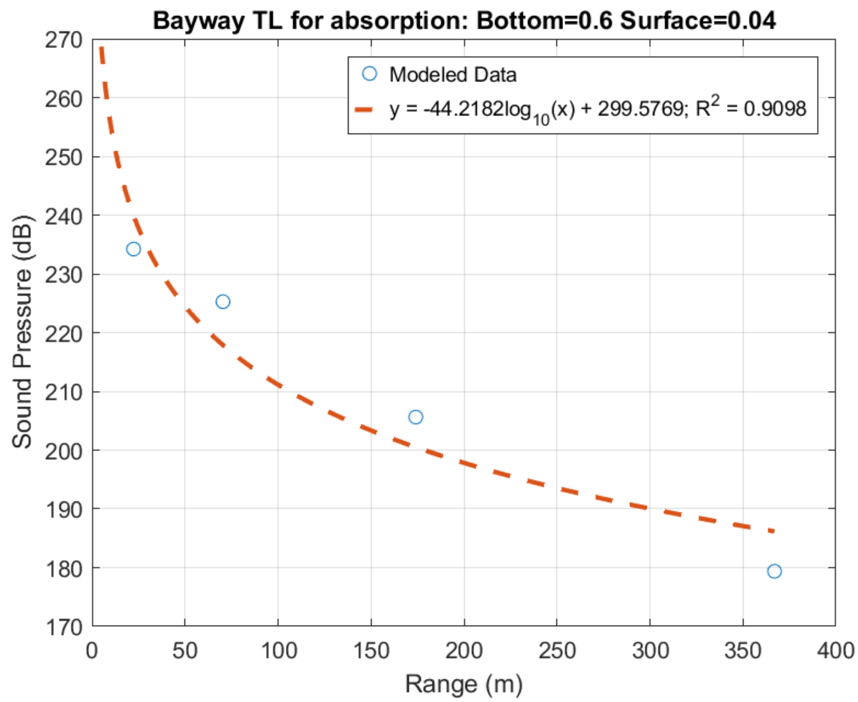


Figure H-34. Bayway TL curve for 0.6 Bottom-0.04 Surface Absorption

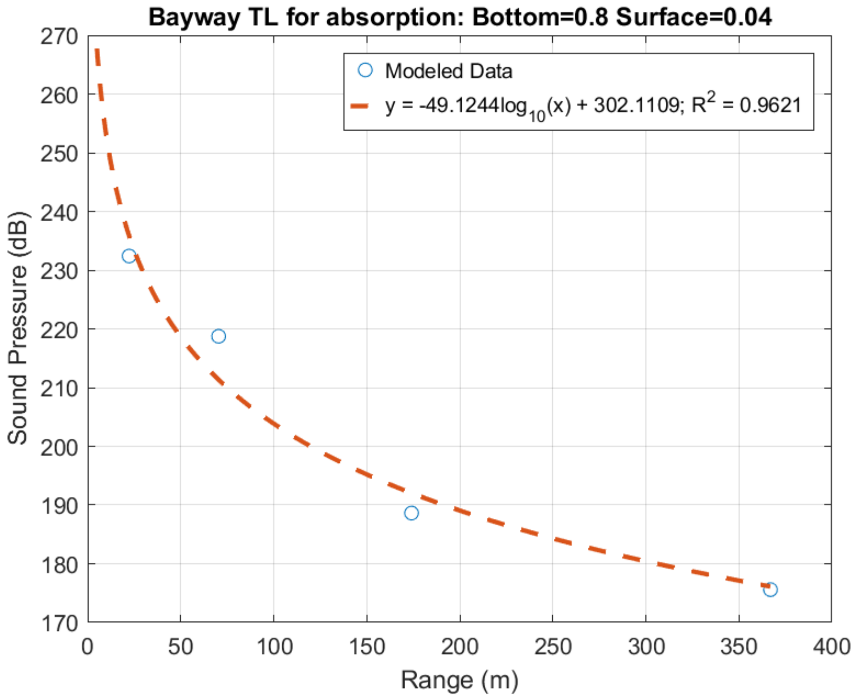


Figure H-35. Bayway TL curve for 0.8 Bottom-0.04 Surface Absorption

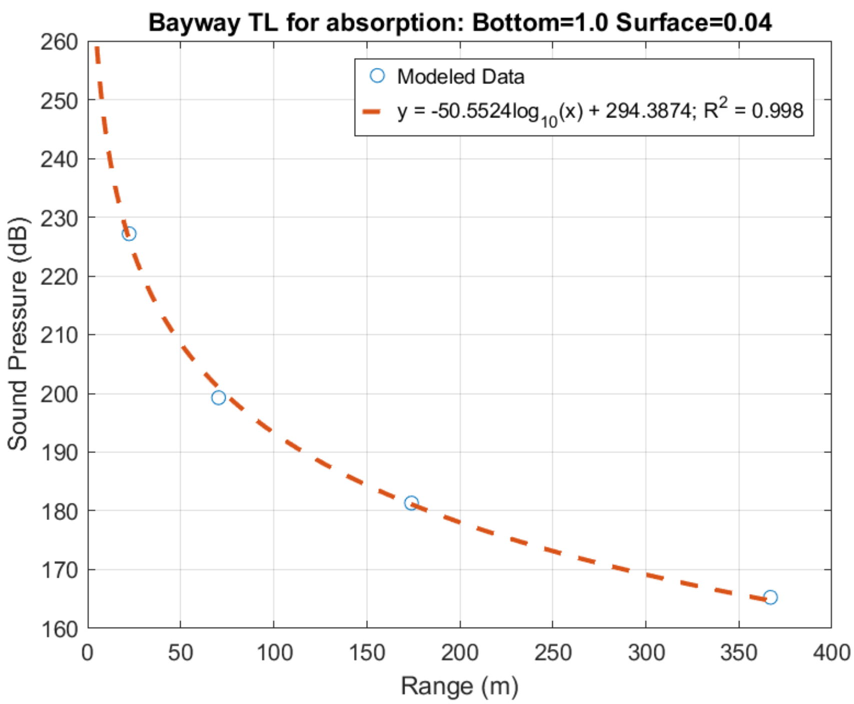


Figure H-36. Bayway TL curve for 1.0 Bottom-0.04 Surface Absorption

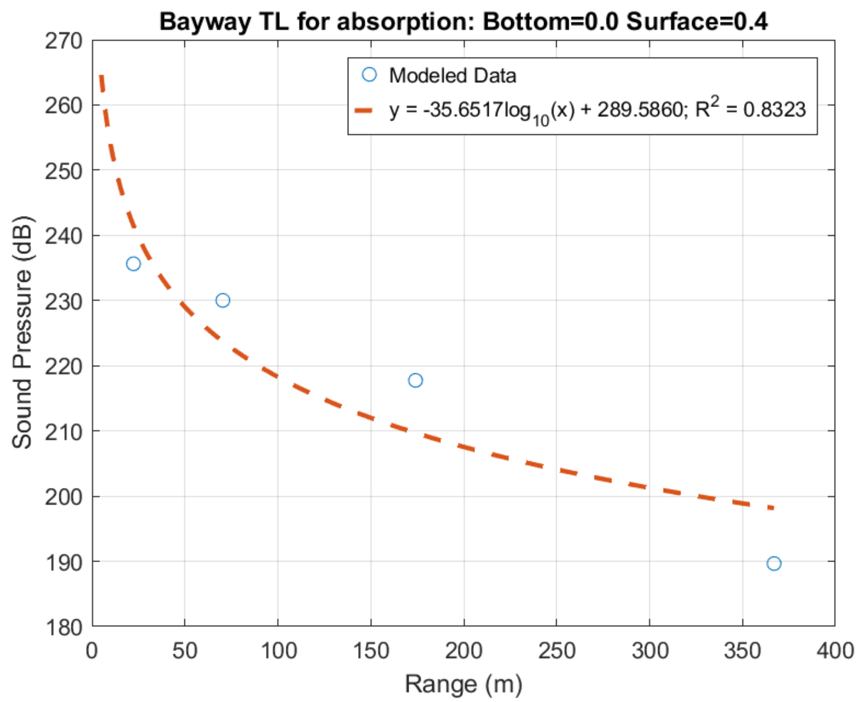


Figure H-37. Bayway TL curve for 0.0 Bottom-0.4 Surface Absorption

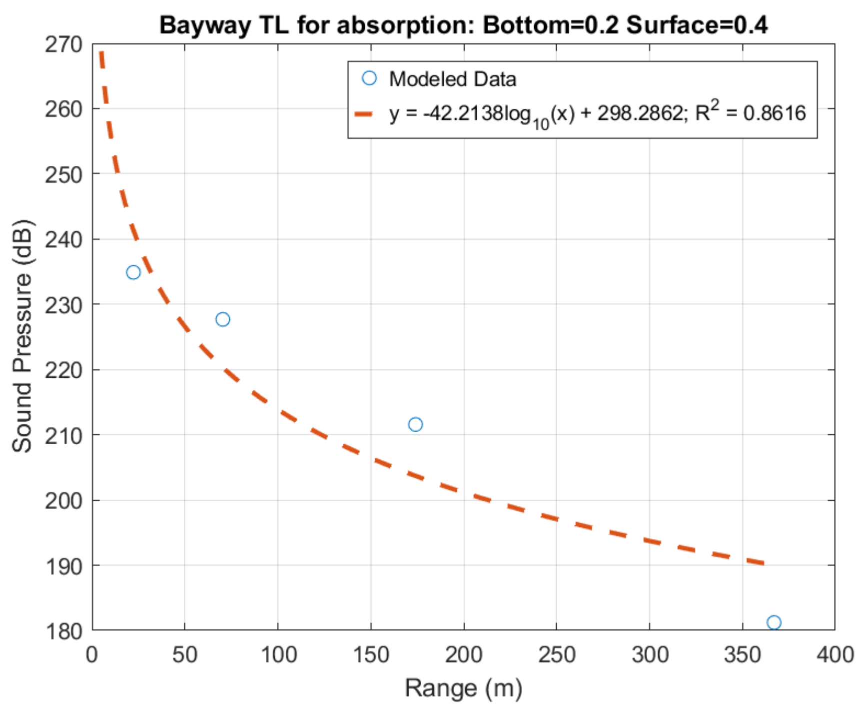


Figure H-38. Bayway TL curve for 0.2 Bottom-0.4 Surface Absorption

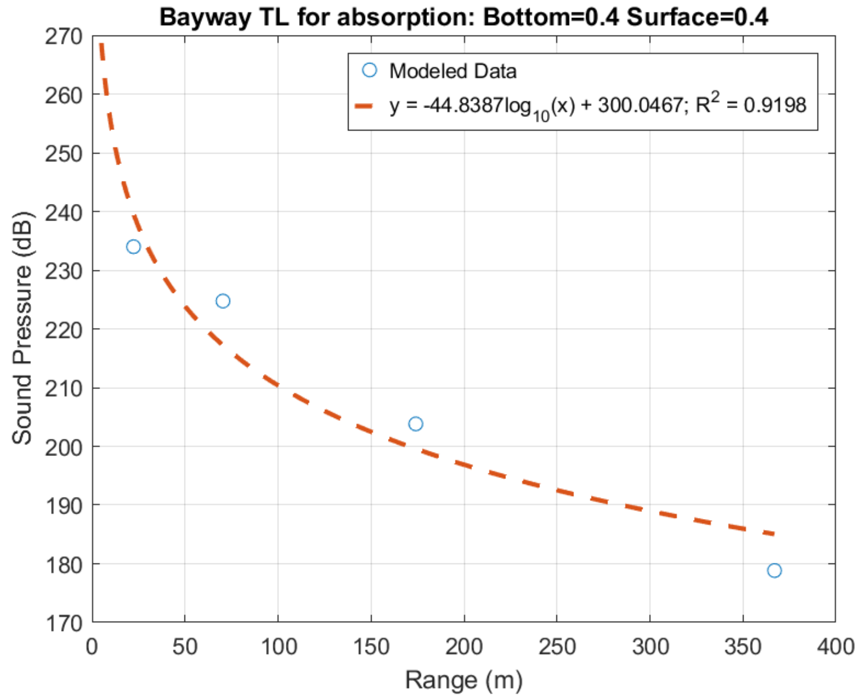


Figure H-39. Bayway TL curve for 0.4 Bottom-0.4 Surface Absorption

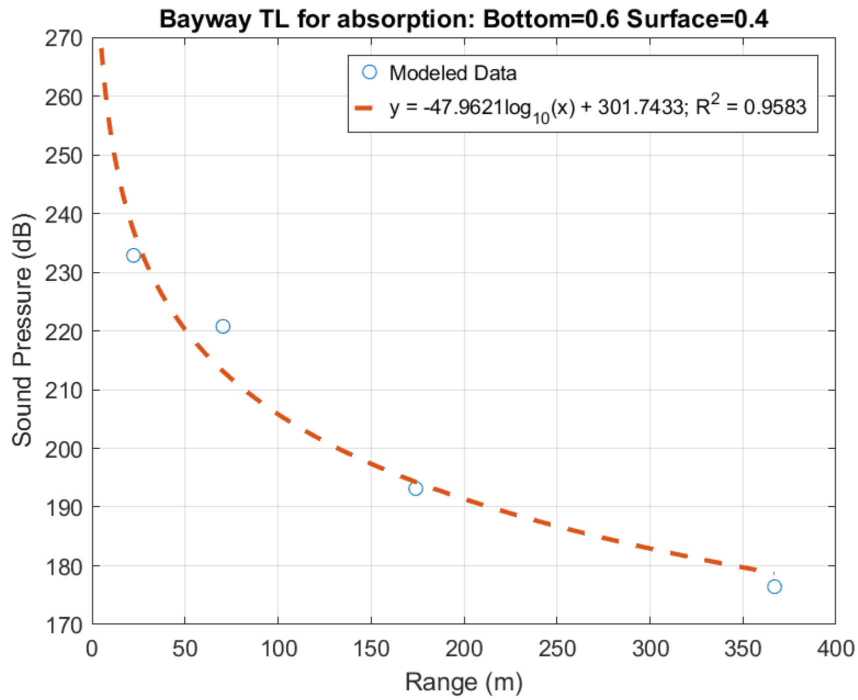


Figure H-40. Bayway TL curve for 0.6 Bottom-0.4 Surface Absorption

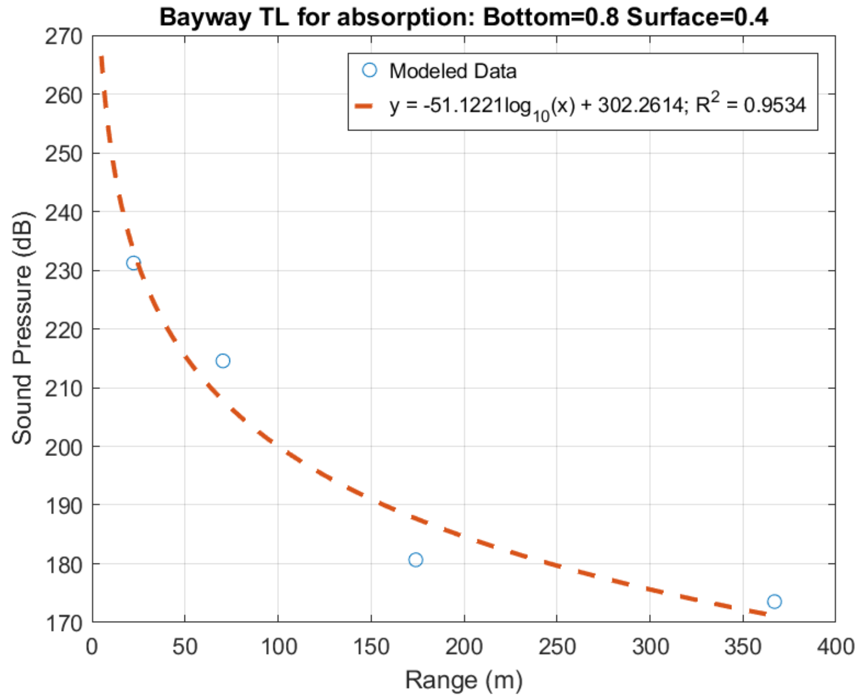


Figure H-41. Bayway TL curve for 0.8 Bottom-0.4 Surface Absorption

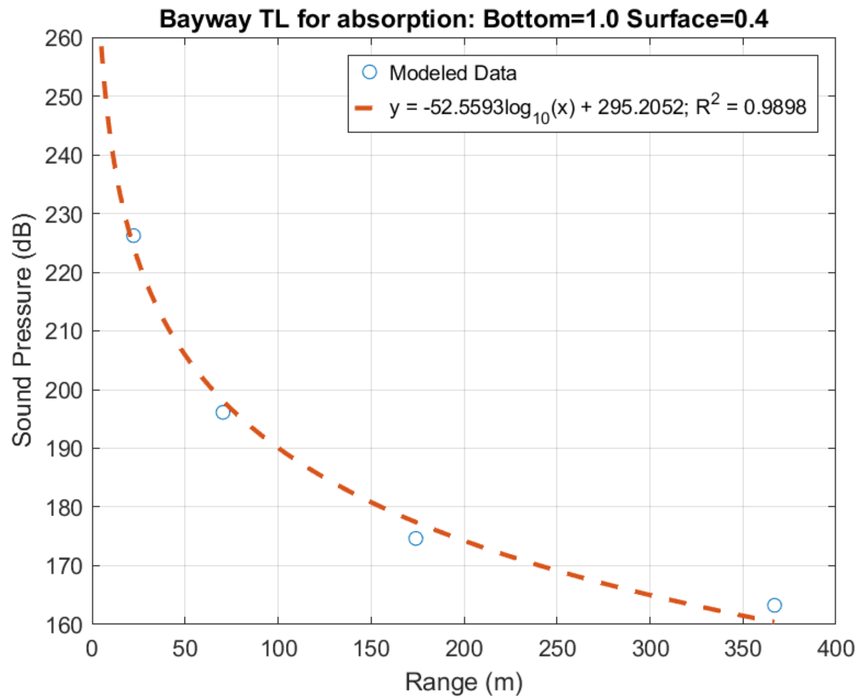


Figure H-42. Bayway TL curve for 1.0 Bottom-0.4 Surface Absorption

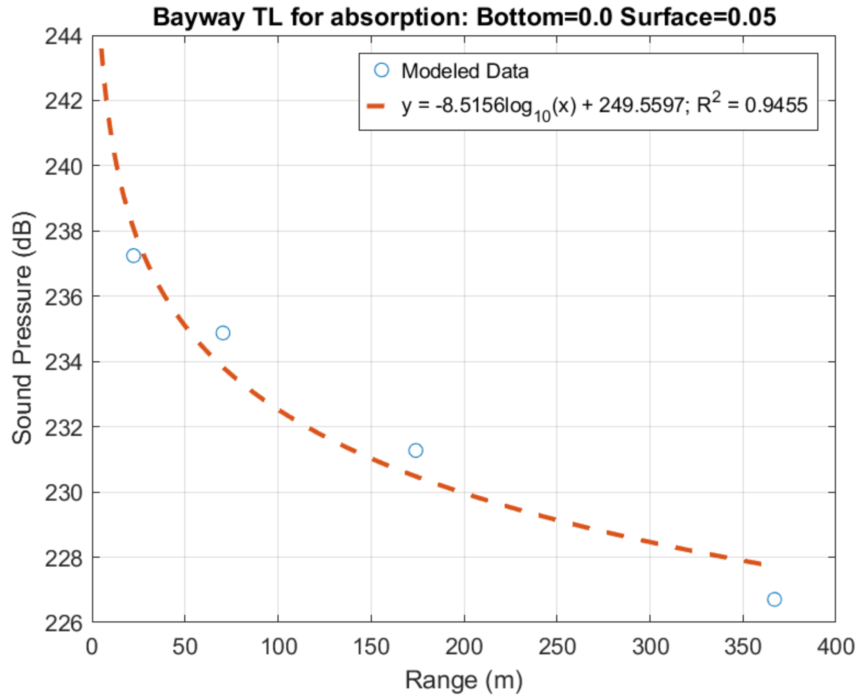


Figure H-43. Bayway TL curve for 0.0 Bottom-0.05 Surface Absorption

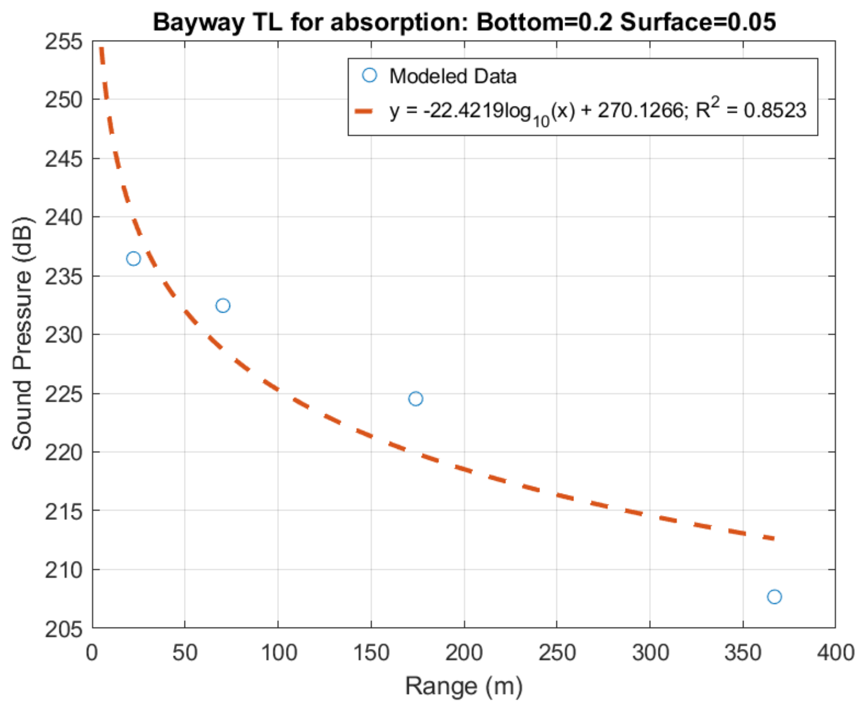


Figure H-44. Bayway TL curve for 0.2 Bottom-0.05 Surface Absorption

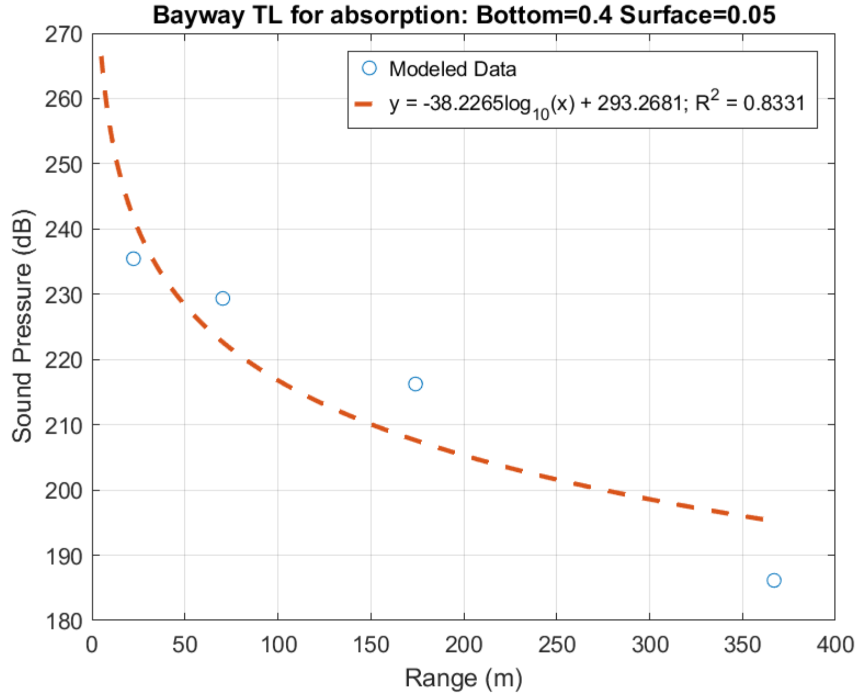


Figure H-45. Bayway TL curve for 0.4 Bottom-0.05 Surface Absorption

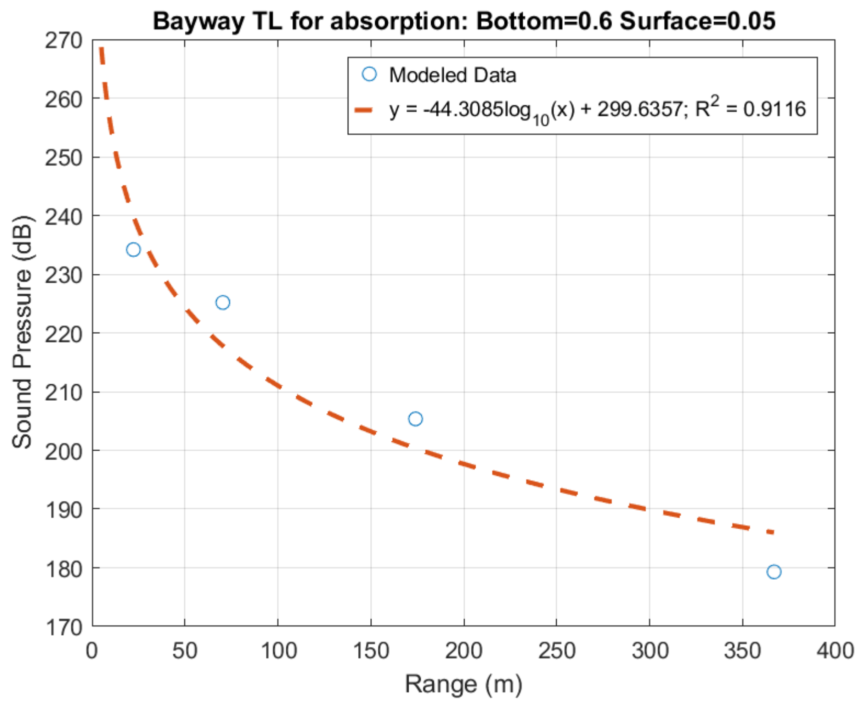


Figure H-46. Bayway TL curve for 0.6 Bottom-0.05 Surface Absorption

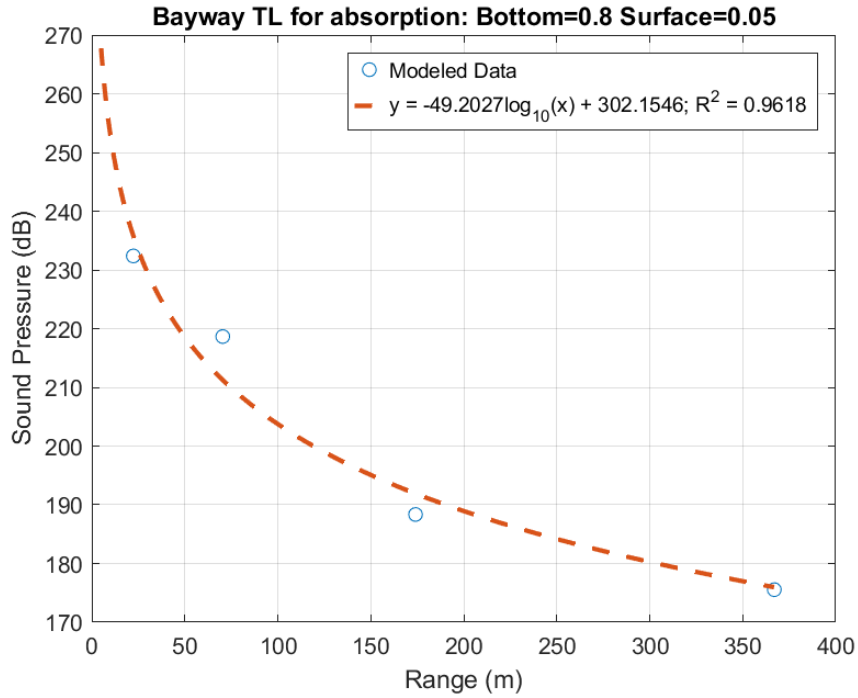


Figure H-47. Bayway TL curve for 0.8 Bottom-0.05 Surface Absorption

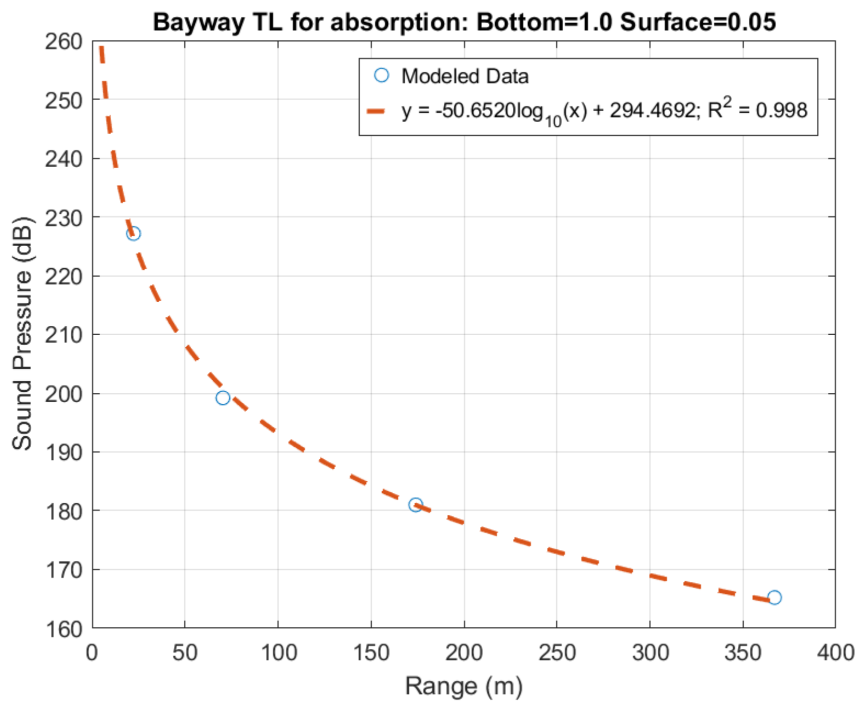


Figure H-48. Bayway TL curve for 1.0 Bottom-0.05 Surface Absorption

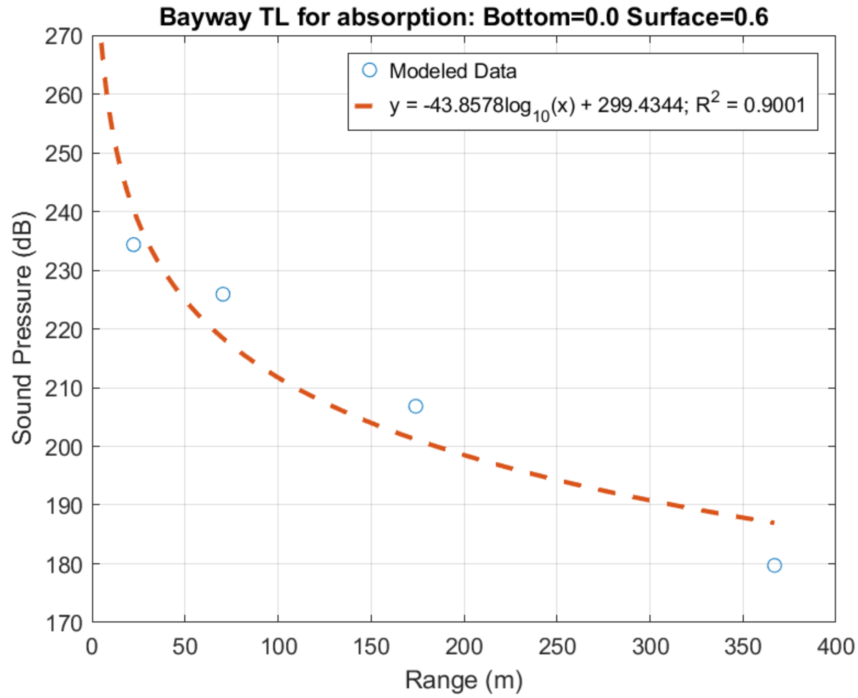


Figure H-49. Bayway TL curve for 0.0 Bottom-0.6 Surface Absorption

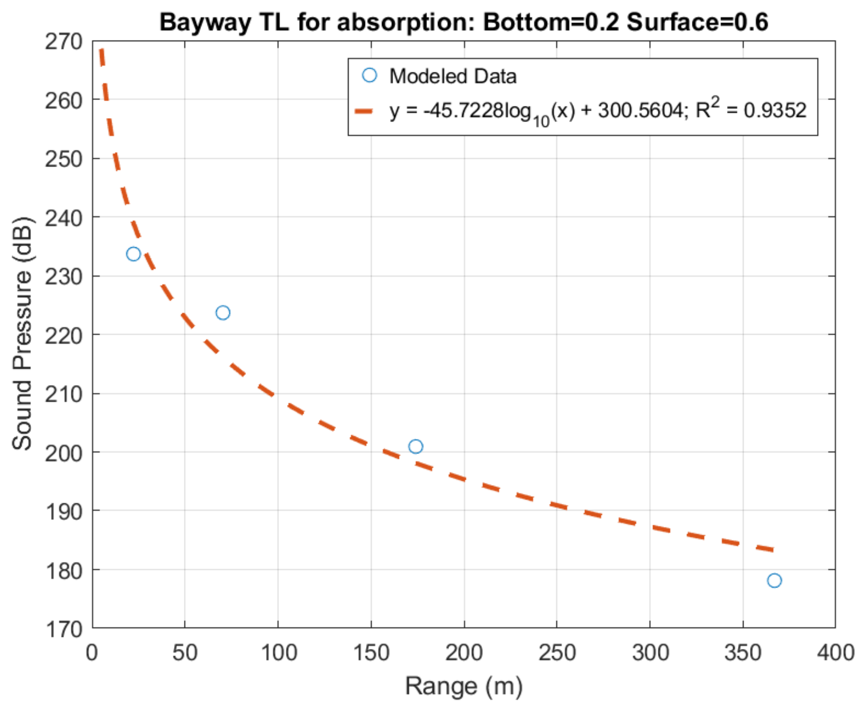


Figure H-50. Bayway TL curve for 0.2 Bottom-0.6 Surface Absorption

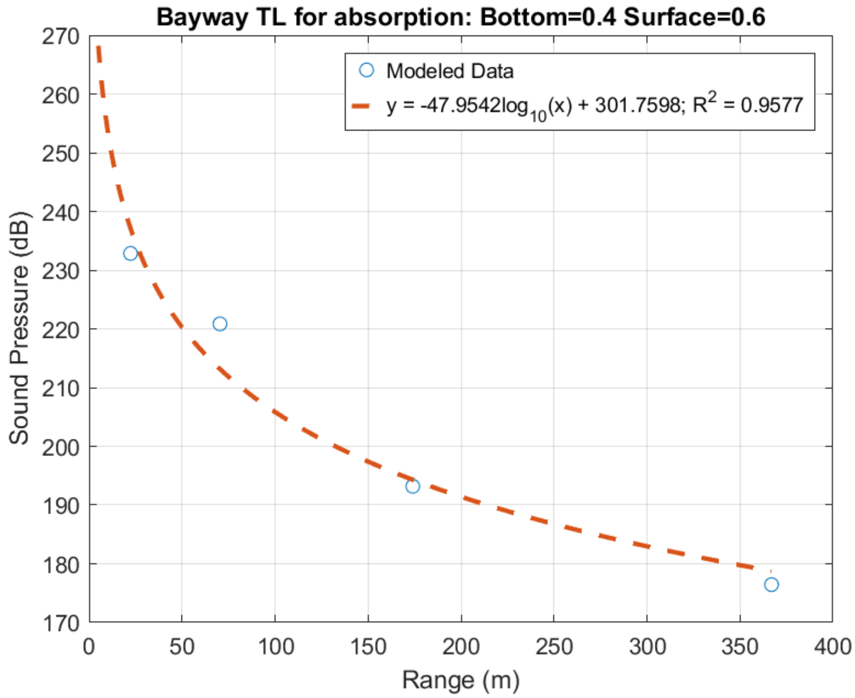


Figure H-51. Bayway TL curve for 0.4 Bottom-0.6 Surface Absorption

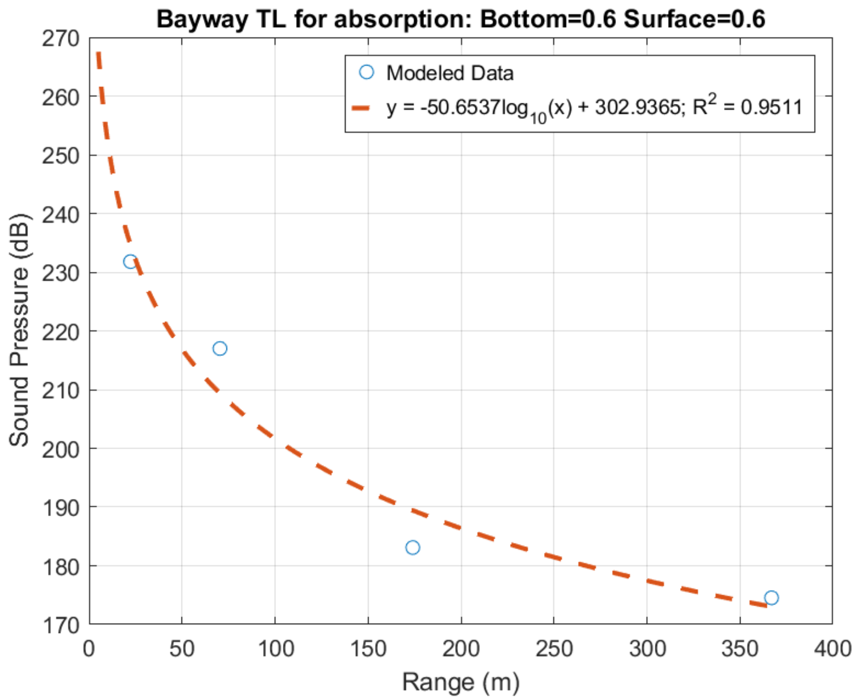


Figure H-52. Bayway TL curve for 0.6 Bottom-0.6 Surface Absorption

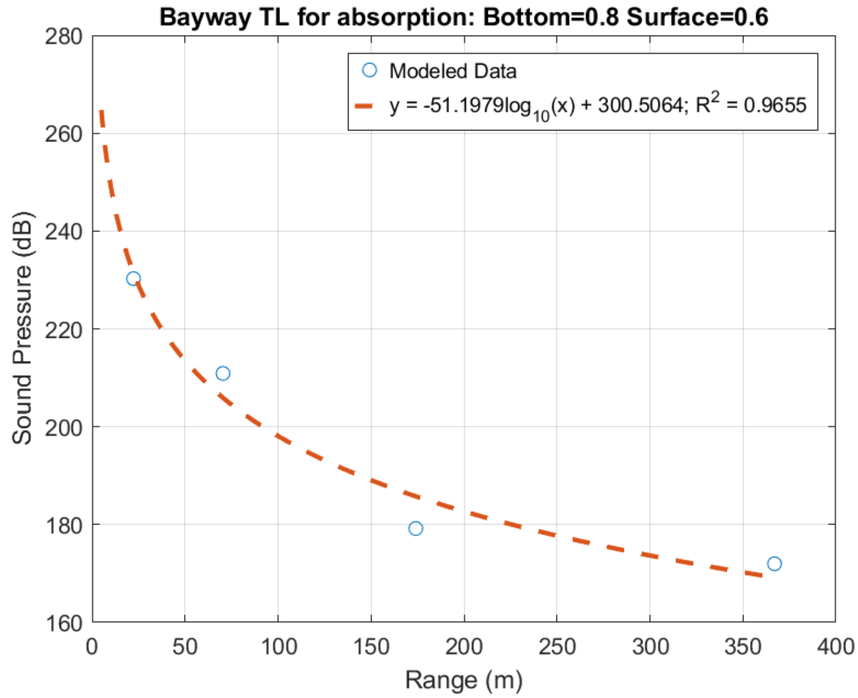


Figure H-53. Bayway TL curve for 0.8 Bottom-0.6 Surface Absorption

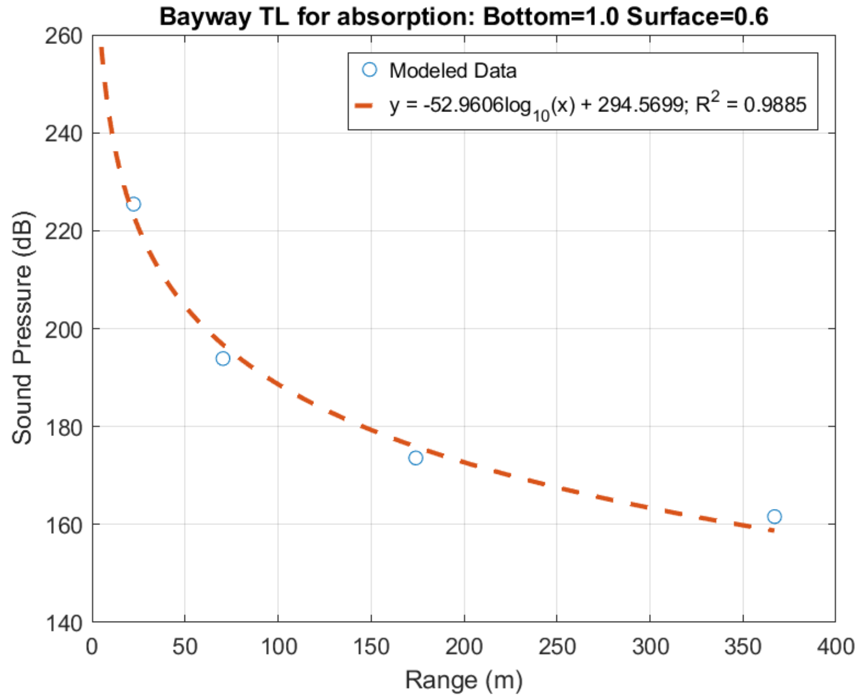


Figure H-54. Bayway TL curve for 1.0 Bottom-0.6 Surface Absorption

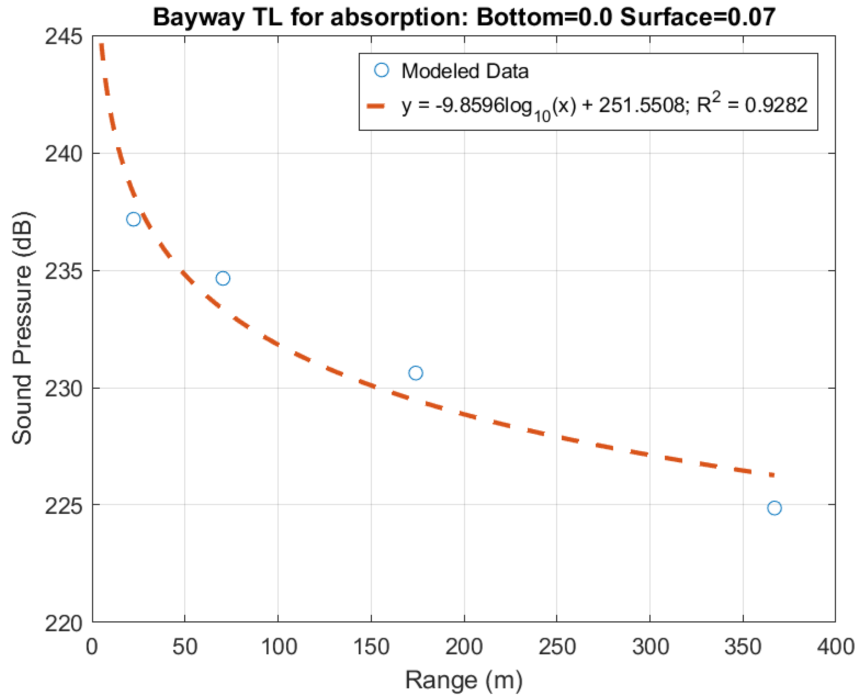


Figure H-55. Bayway TL curve for 0.0 Bottom-0.07 Surface Absorption

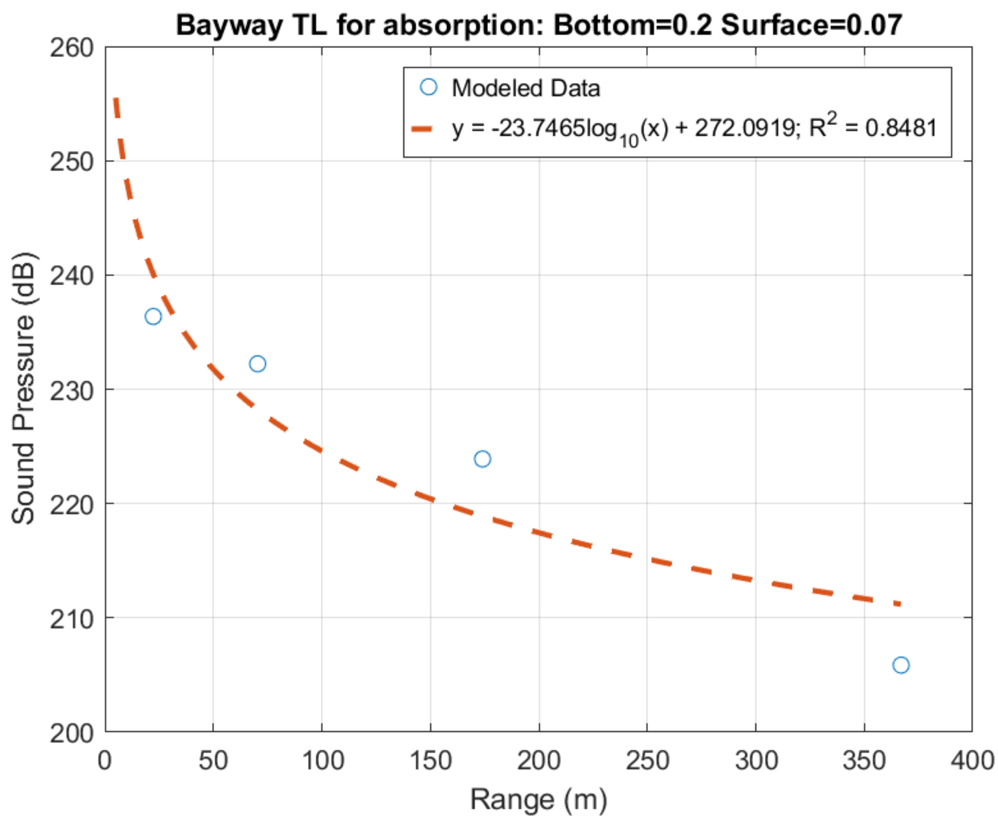


Figure H-56. Bayway TL curve for 0.2 Bottom-0.07 Surface Absorption

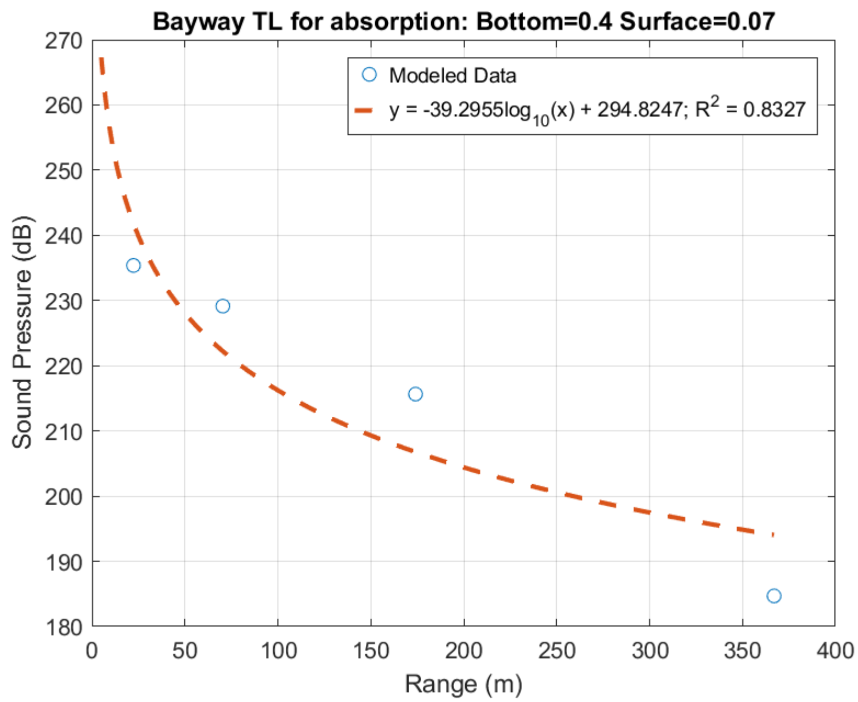


Figure H-57. Bayway TL curve for 0.4 Bottom-0.07 Surface Absorption

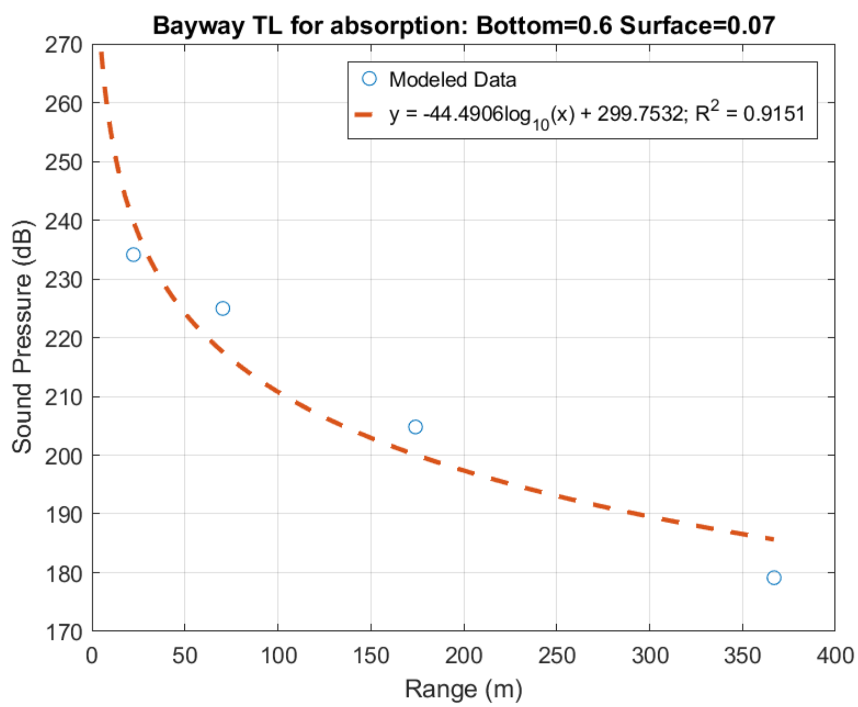


Figure H-58. Bayway TL curve for 0.6 Bottom-0.07 Surface Absorption

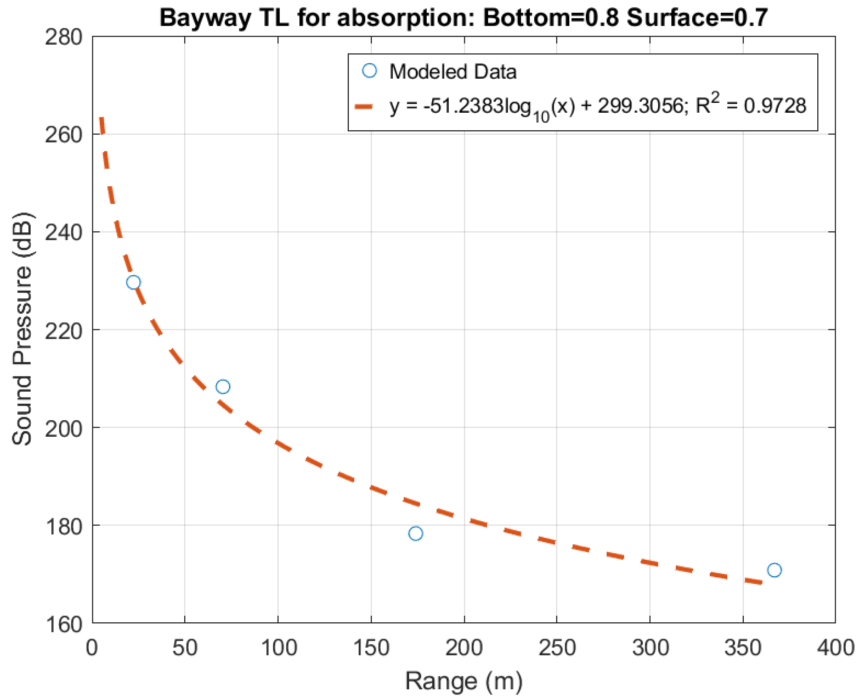


Figure H-59. Bayway TL curve for 0.8 Bottom-0.7 Surface Absorption

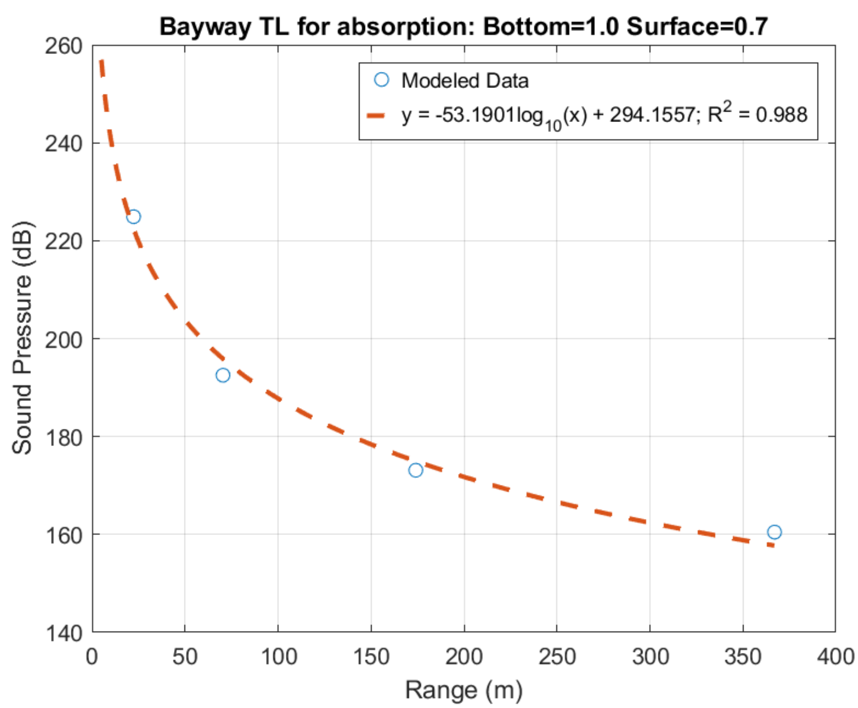


Figure H-60. Bayway TL curve for 1.0 Bottom-0.7 Surface Absorption

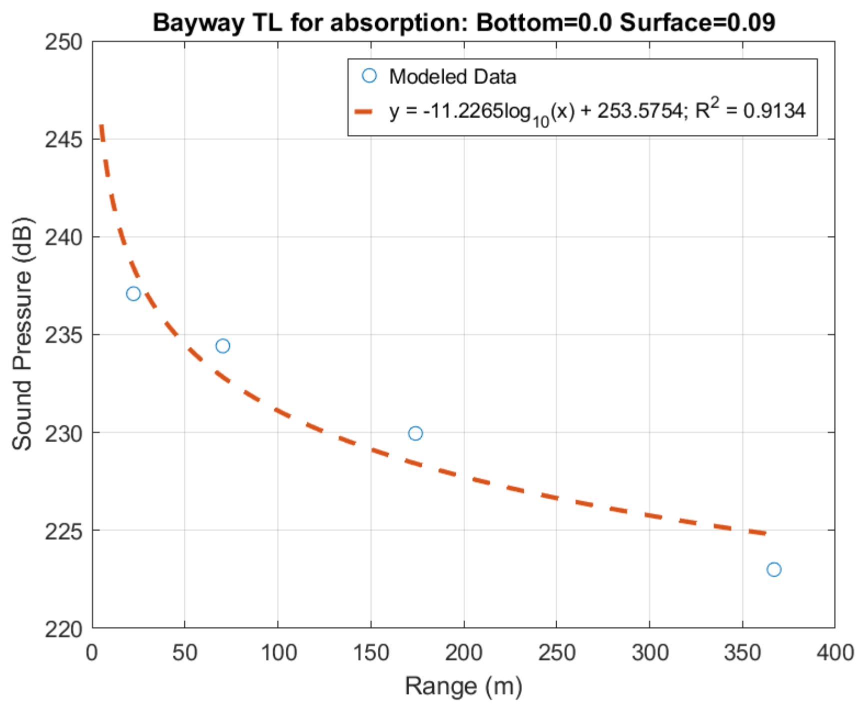


Figure H-61. Bayway TL curve for 0.0 Bottom-0.09 Surface Absorption

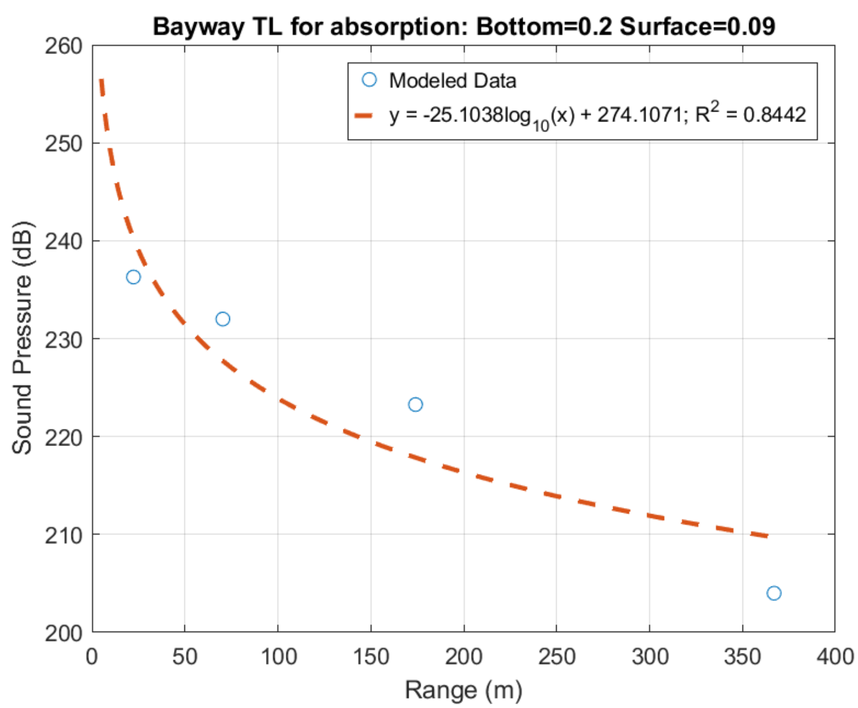


Figure H-62. Bayway TL curve for 0.2 Bottom-0.09 Surface Absorption

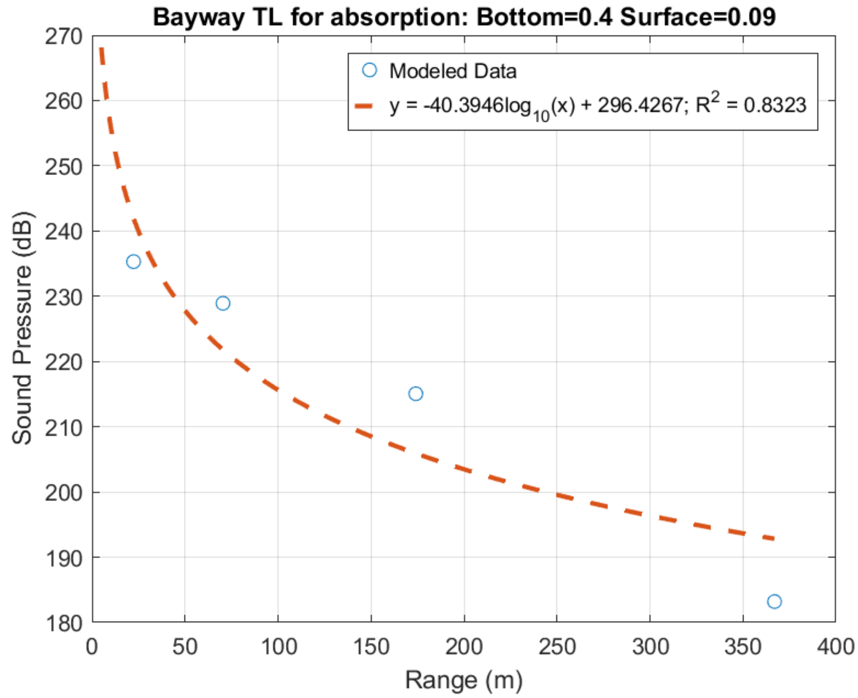


Figure H-63. Bayway TL curve for 0.4 Bottom-0.09 Surface Absorption

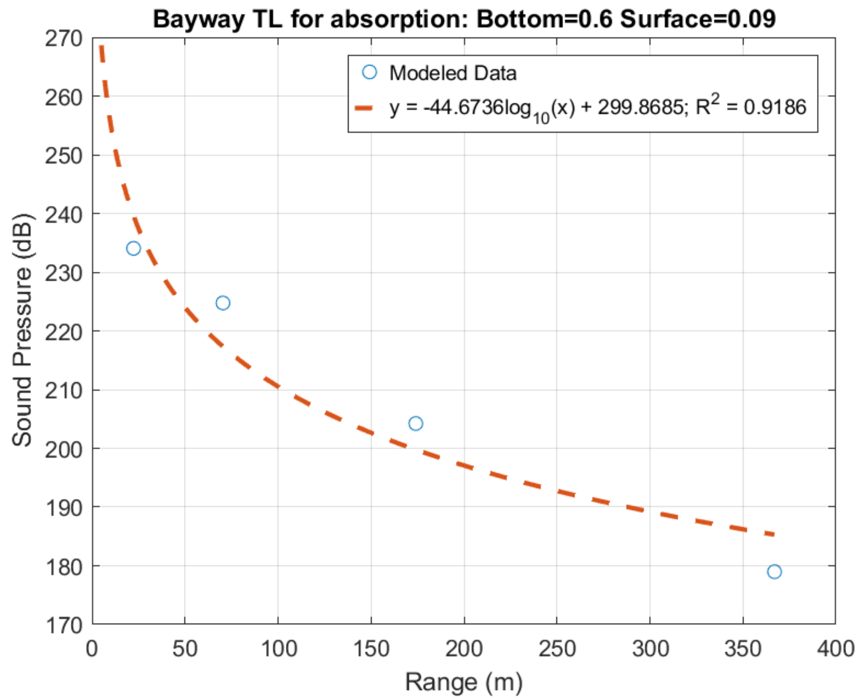


Figure H-64. Bayway TL curve for 0.6 Bottom-0.09 Surface Absorption

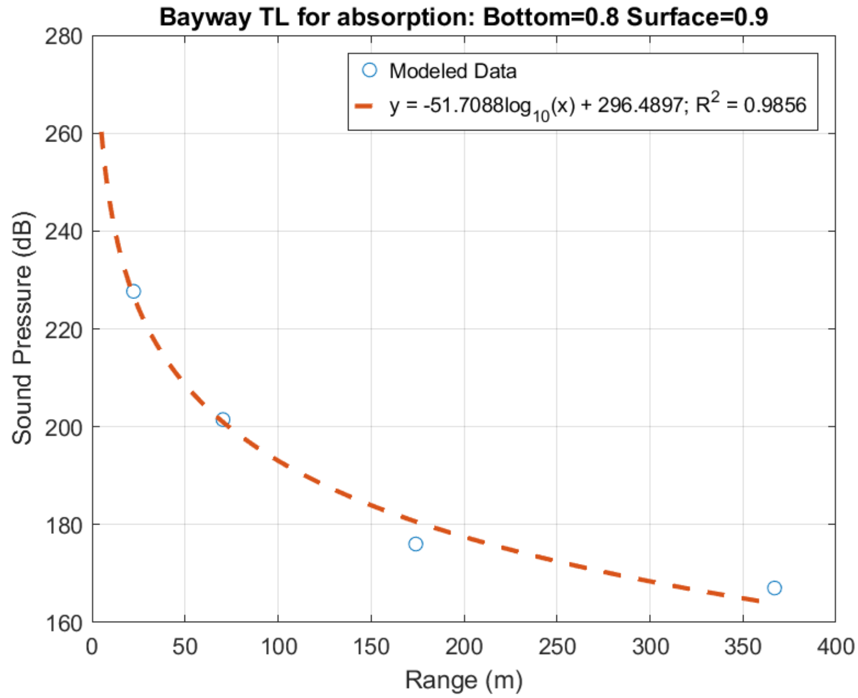


Figure H-65. Bayway TL curve for 0.8 Bottom-0.9 Surface Absorption

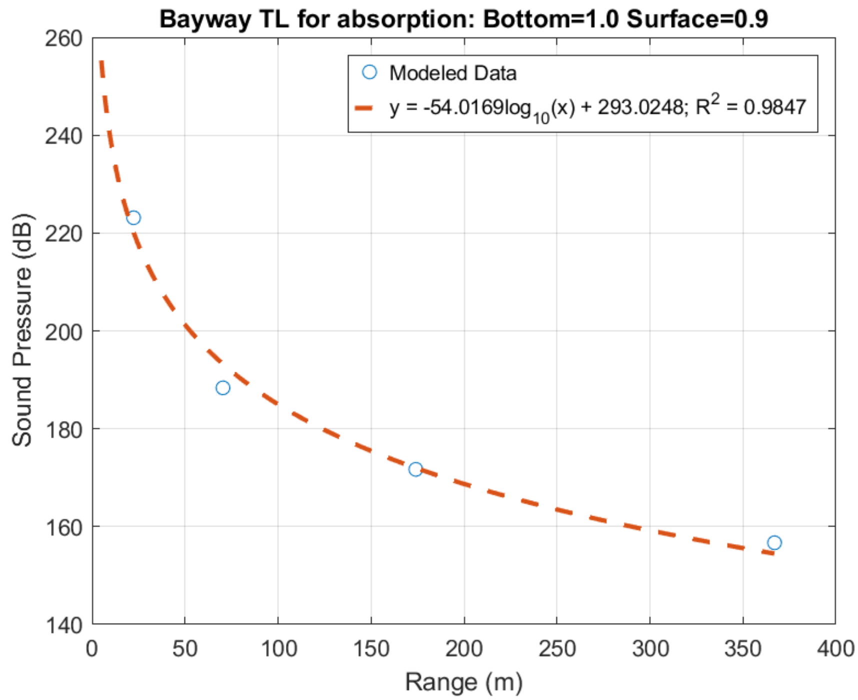


Figure H-66. Bayway TL curve for 1.0 Bottom-0.9 Surface Absorption

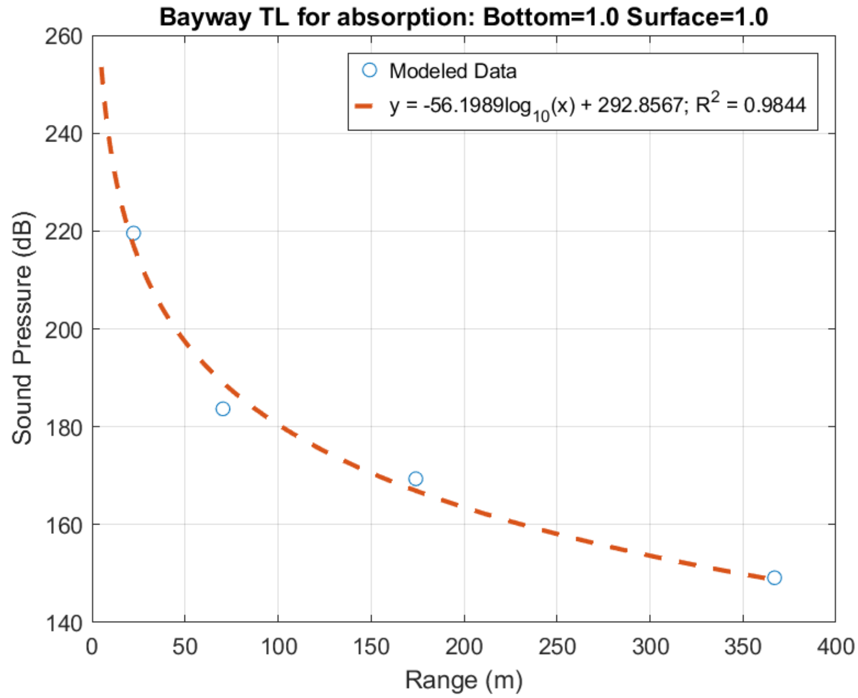


Figure H-67. Bayway TL curve for 1.0 Bottom-1.0 Surface Absorption

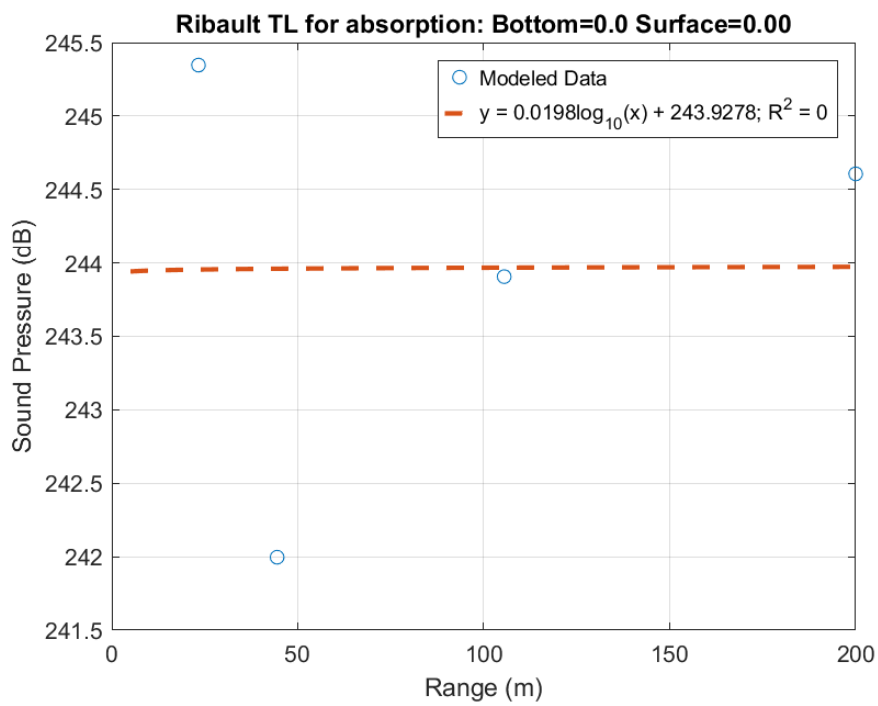


Figure H-68. Ribault TL curve for 0.0 Bottom-0.00 Surface Absorption

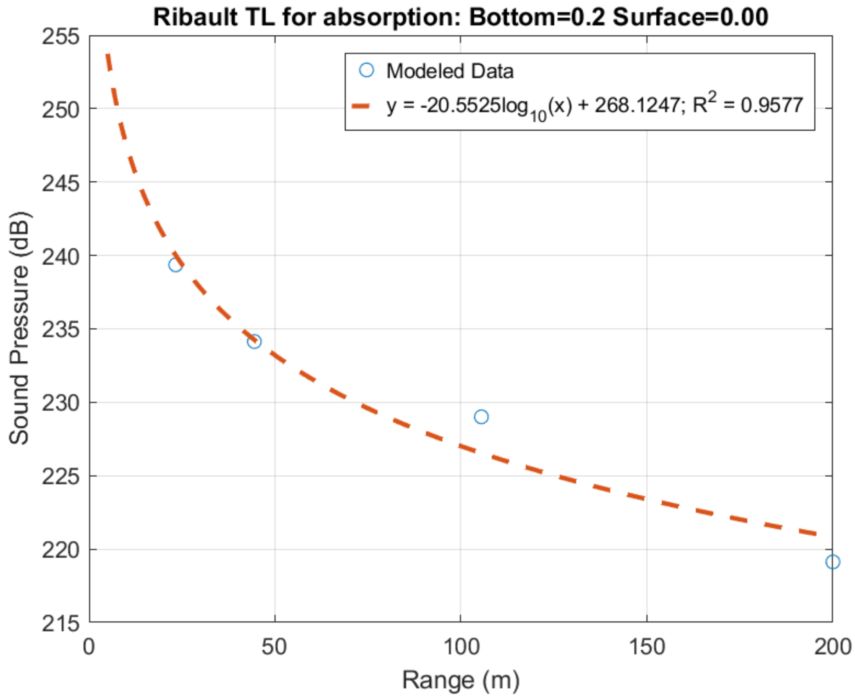


Figure H-69. Ribault TL curve for 0.2 Bottom-0.00 Surface Absorption

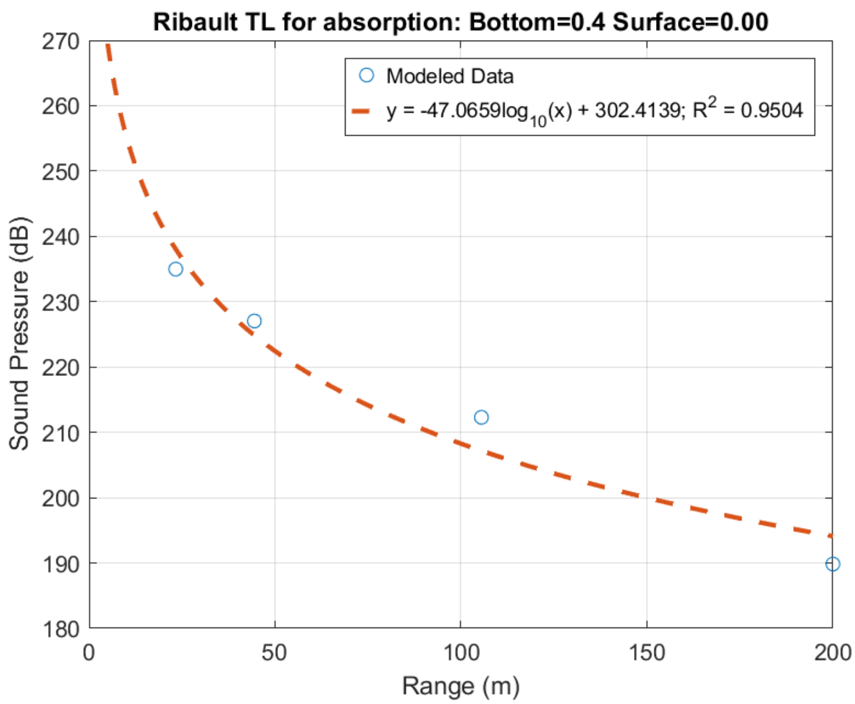


Figure H-70. Ribault TL curve for 0.4 Bottom-0.00 Surface Absorption

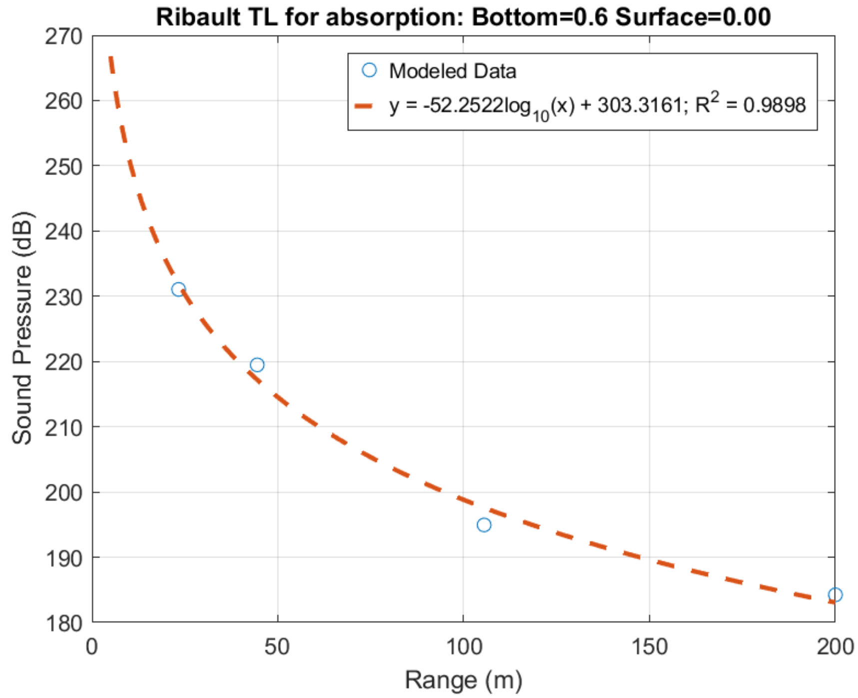


Figure H-71. Ribault TL curve for 0.6 Bottom-0.00 Surface Absorption

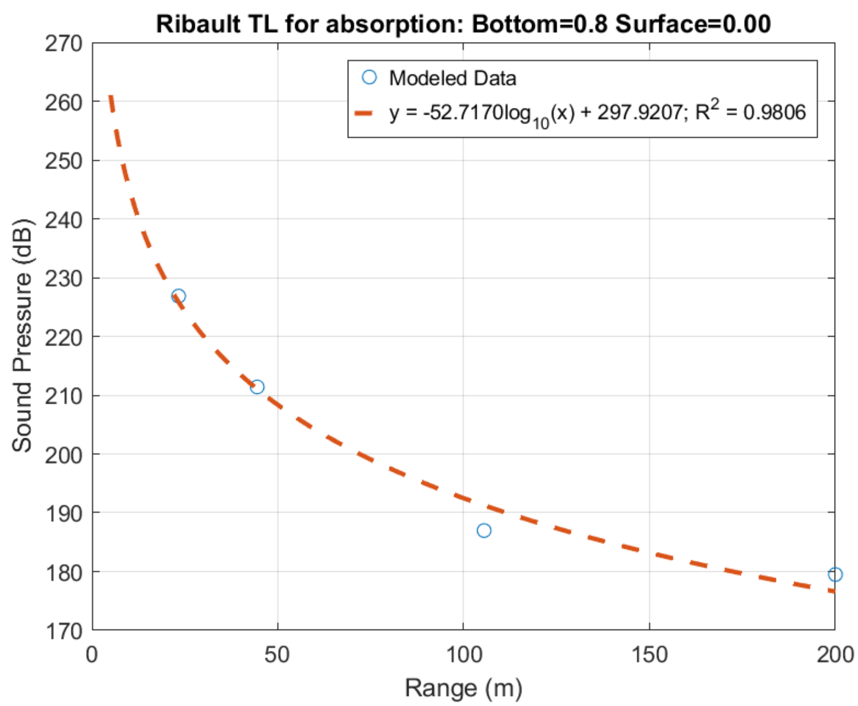


Figure H-72. Ribault TL curve for 0.8 Bottom-0.00 Surface Absorption

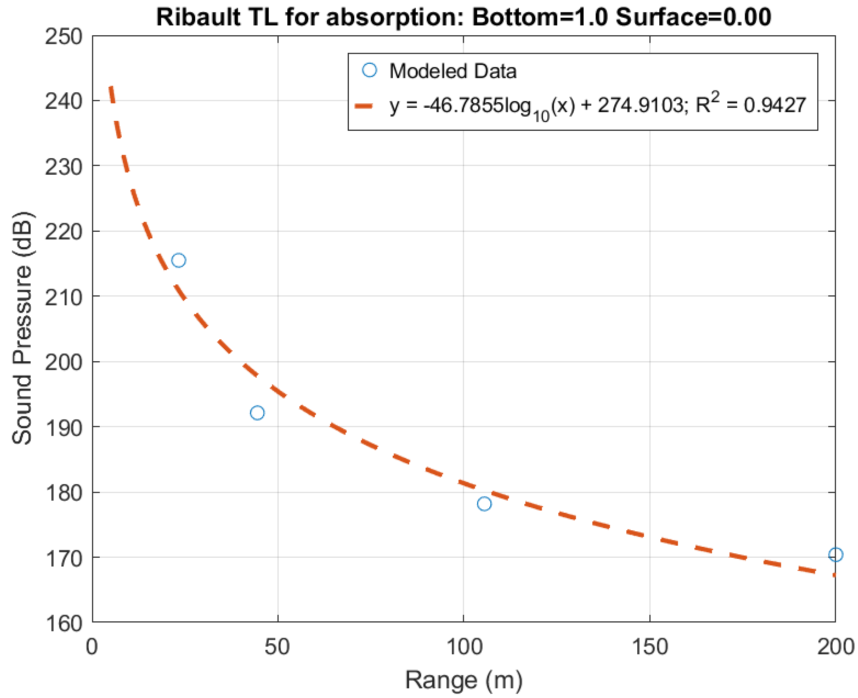


Figure H-73. Ribault TL curve for 1.0 Bottom-0.00 Surface Absorption

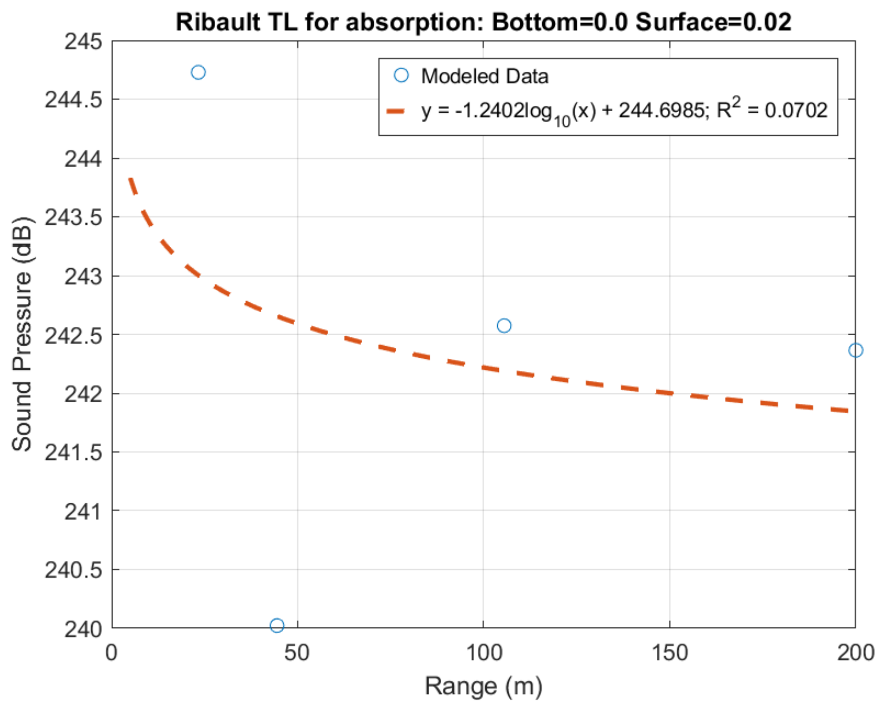


Figure H-74 Ribault TL curve for 0.0 Bottom-0.02 Surface Absorption

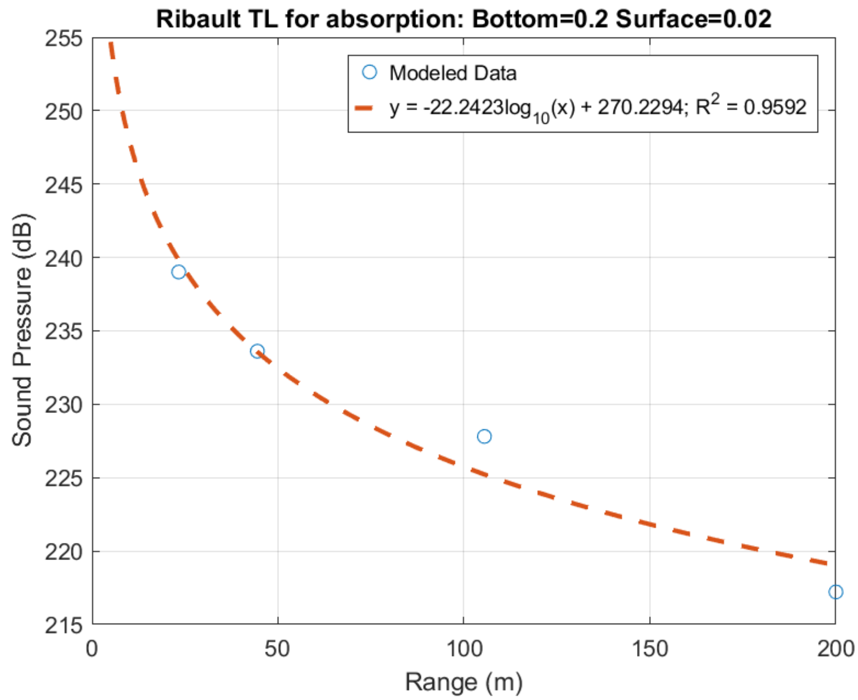


Figure H-75. Ribault TL curve for 0.2 Bottom-0.02 Surface Absorption

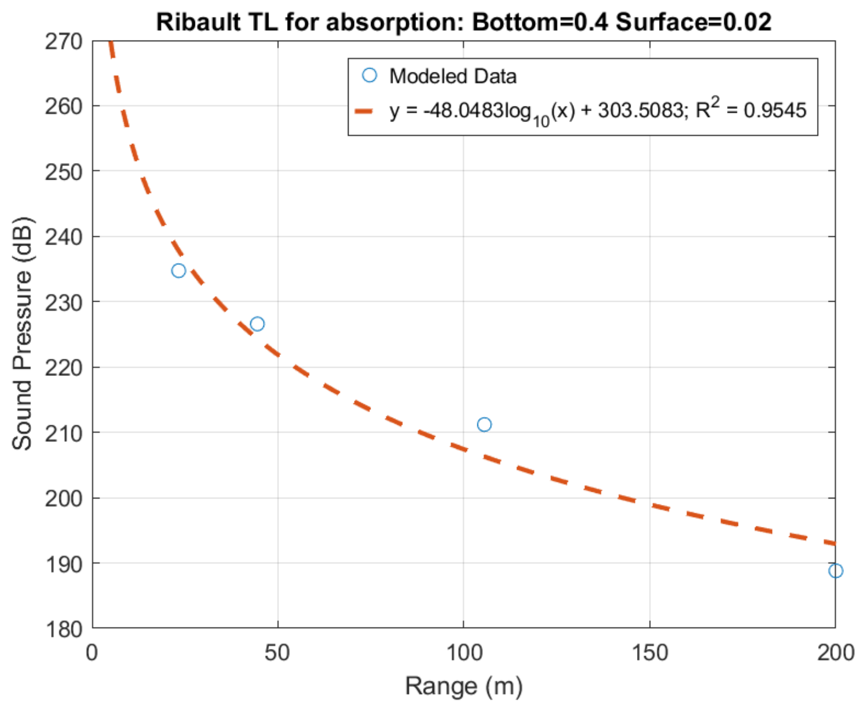


Figure H-76. Ribault TL curve for 0.4 Bottom-0.02 Surface Absorption

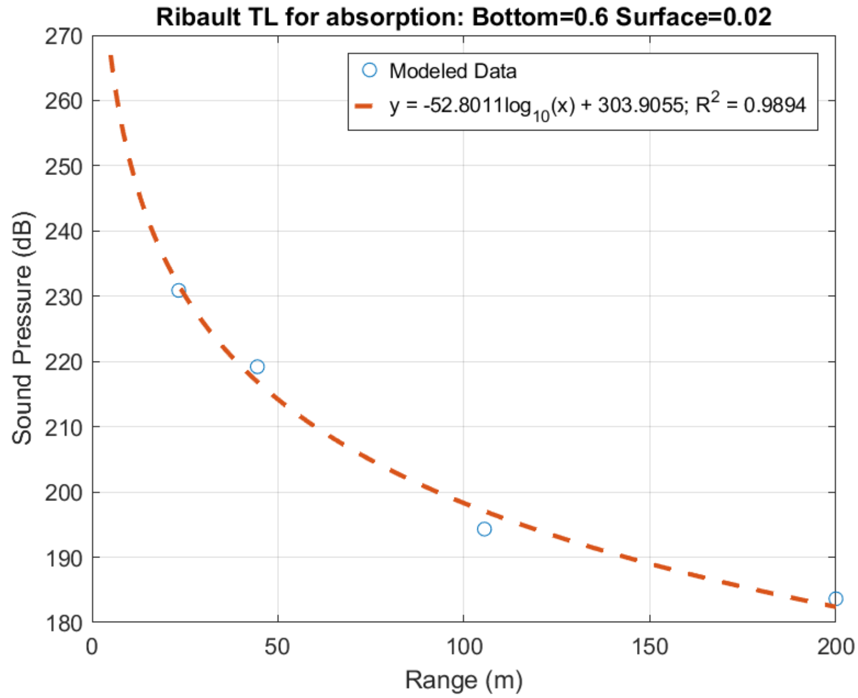


Figure H-77. Ribault TL curve for 0.6 Bottom-0.02 Surface Absorption

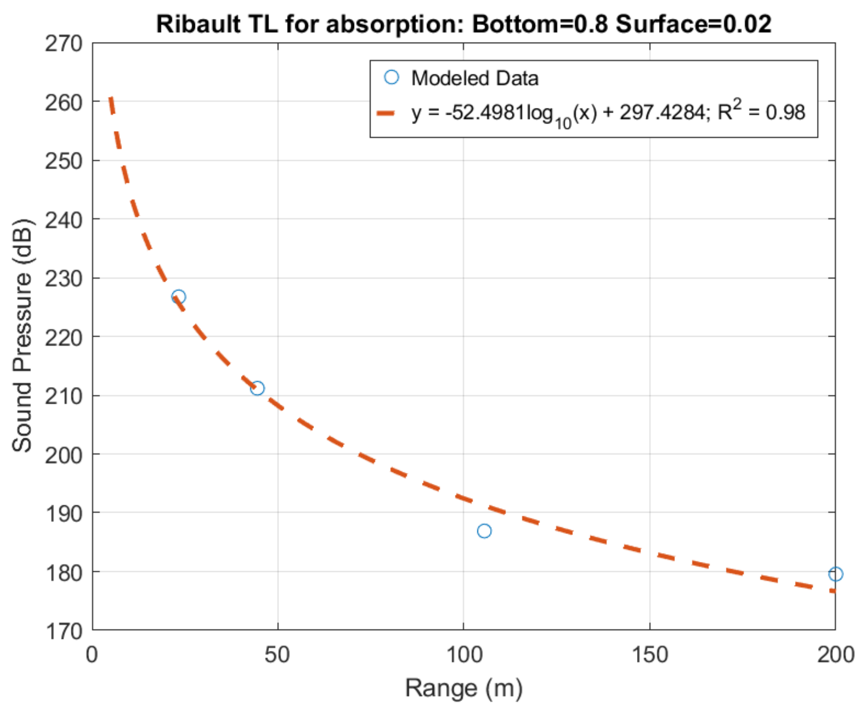


Figure H-78. Ribault TL curve for 0.8 Bottom-0.02 Surface Absorption

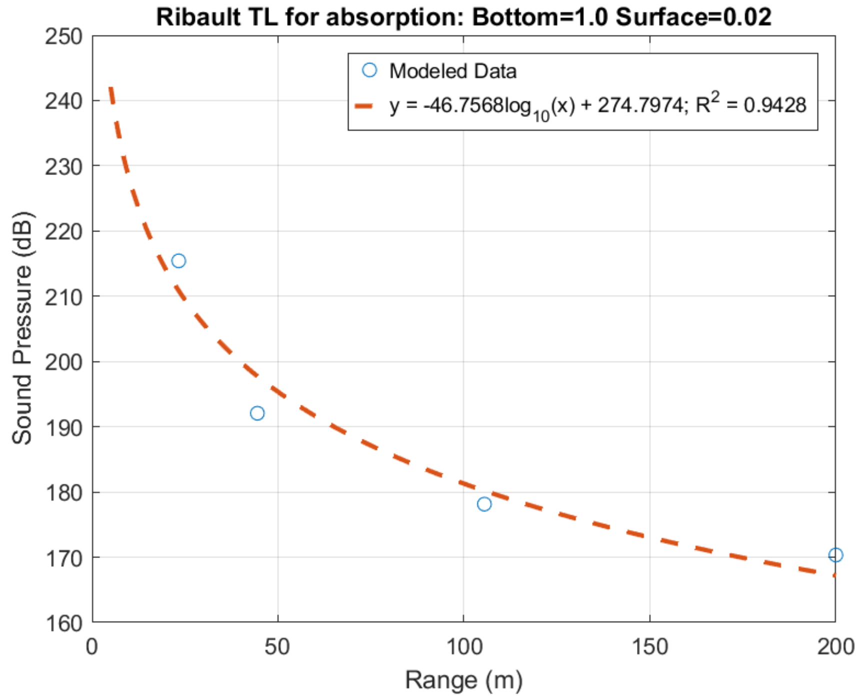


Figure H-79. Ribault TL curve for 1.0 Bottom-0.02 Surface Absorption

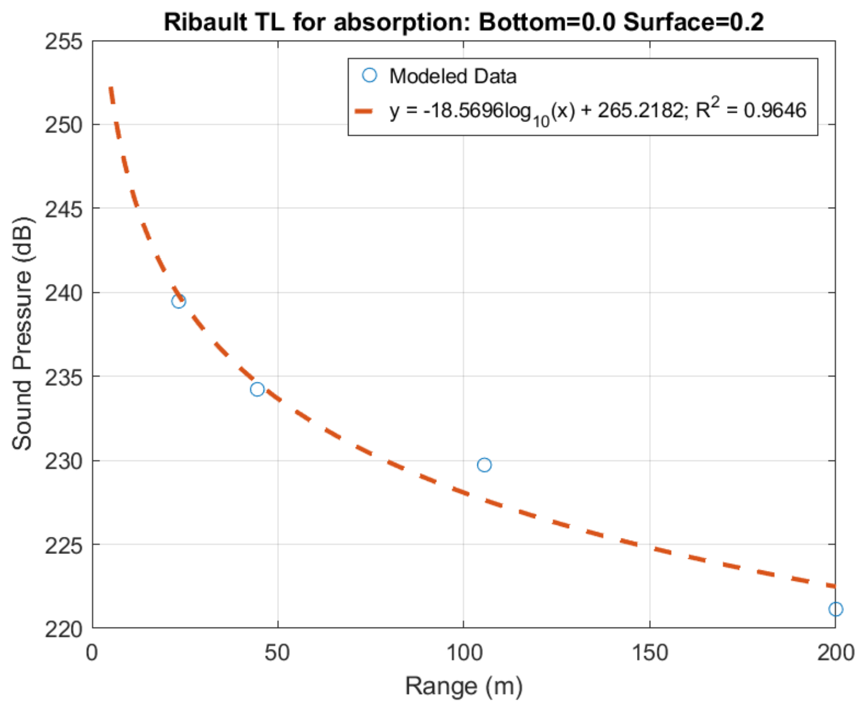


Figure H-80. Ribault TL curve for 0.0 Bottom-0.2 Surface Absorption

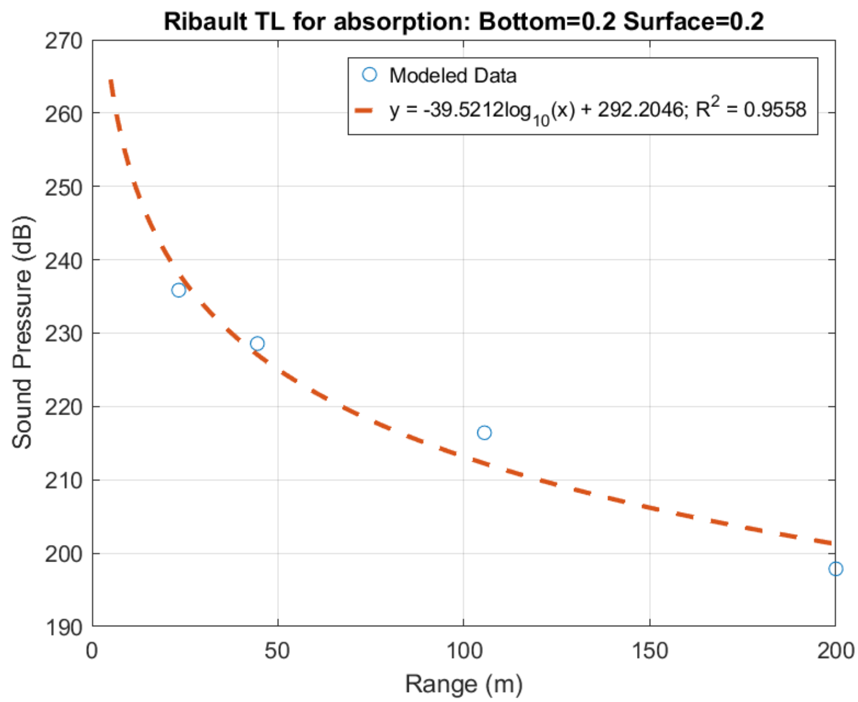


Figure H-81. Ribault TL curve for 0.2 Bottom-0.2 Surface Absorption

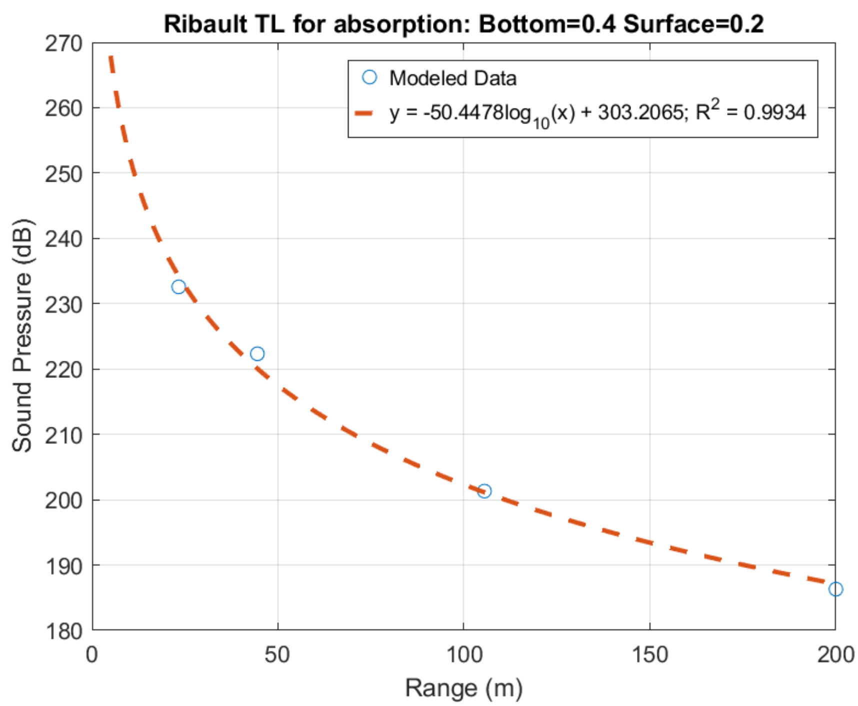


Figure H-82. Ribault TL curve for 0.4 Bottom-0.2 Surface Absorption

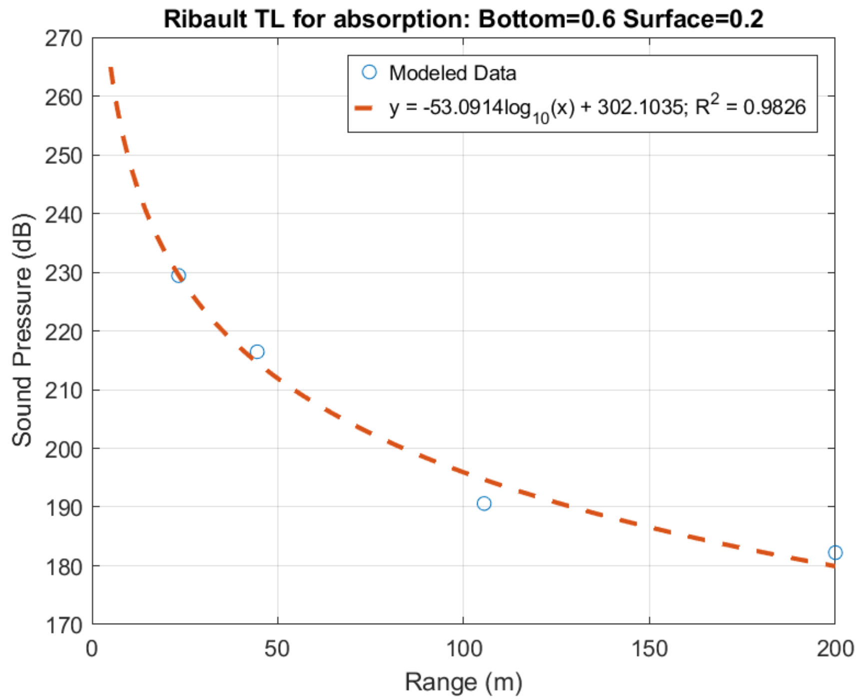


Figure H-83. Ribault TL curve for 0.6 Bottom-0.2 Surface Absorption

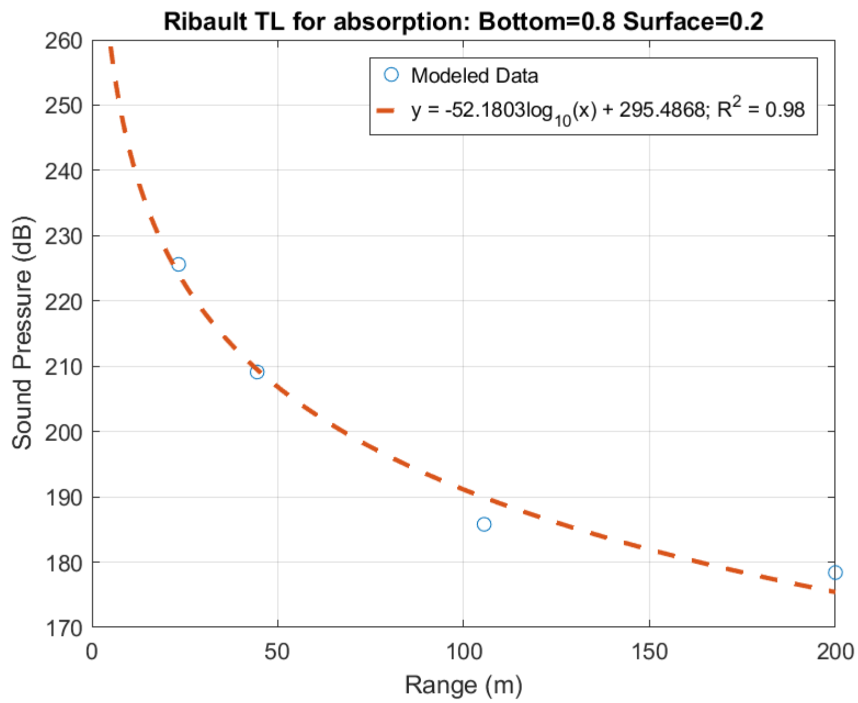


Figure H-84. Ribault TL curve for 0.8 Bottom-0.2 Surface Absorption

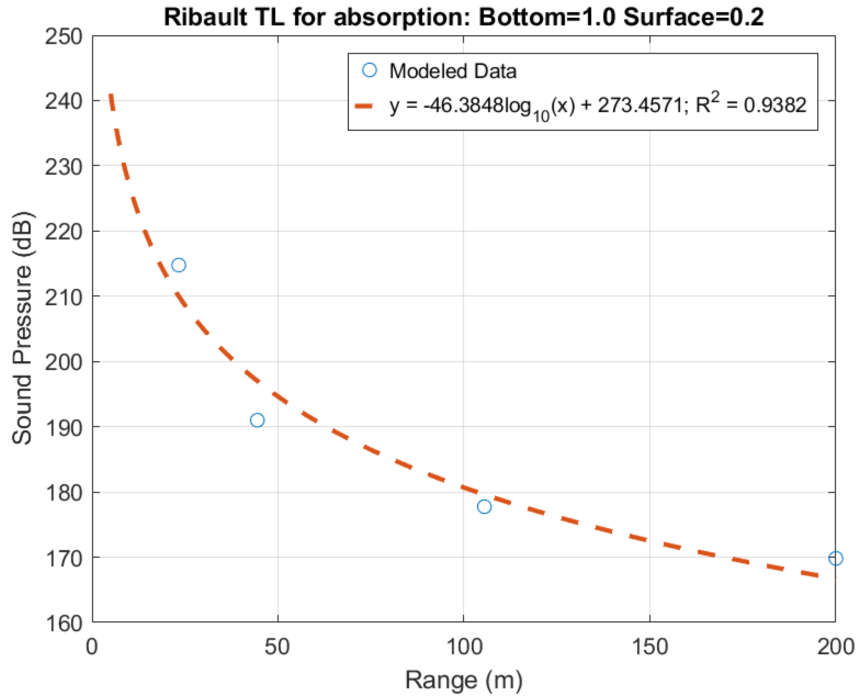


Figure H-85. Ribault TL curve for 1.0 Bottom-0.2 Surface Absorption

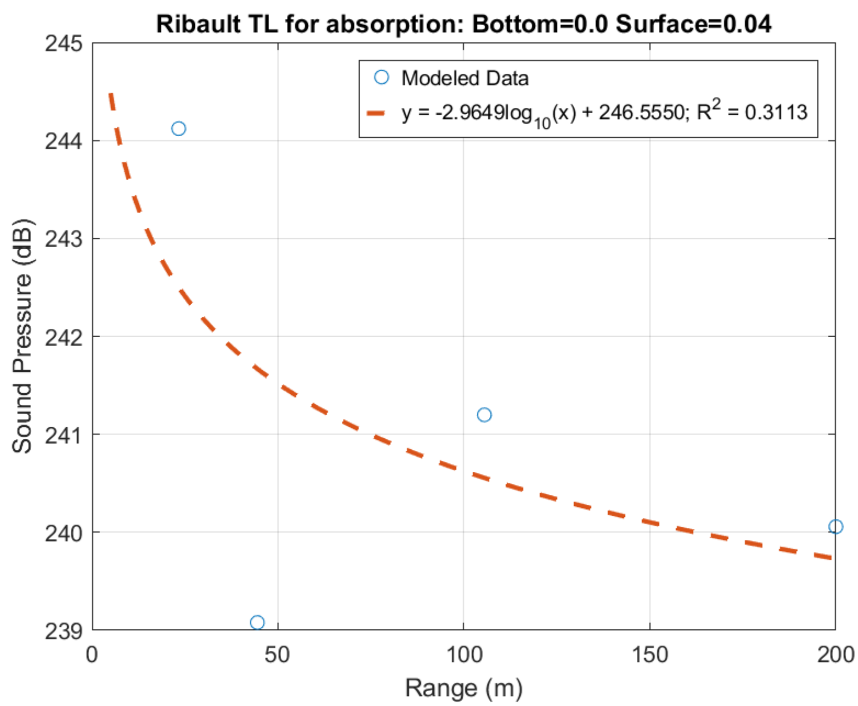


Figure H-86. Ribault TL curve for 0.0 Bottom-0.04 Surface Absorption

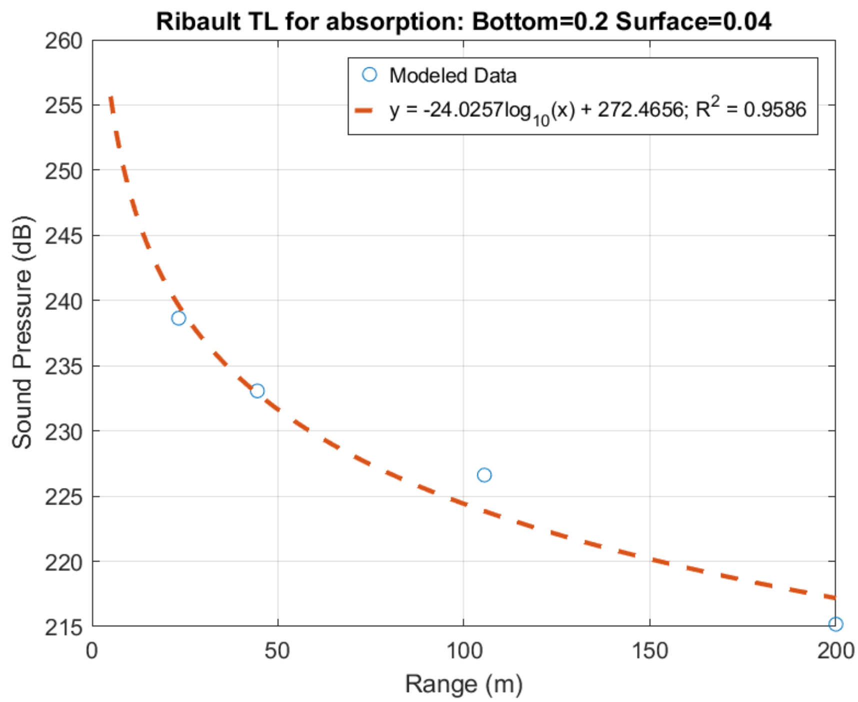


Figure H-87. Ribault TL curve for 0.2 Bottom-0.04 Surface Absorption

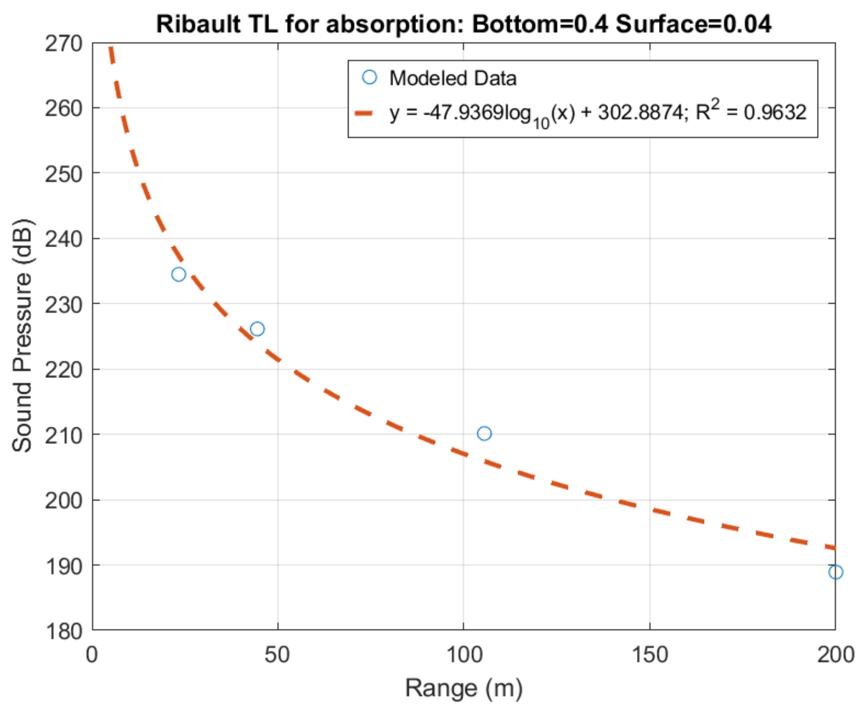


Figure H-88. Ribault TL curve for 0.4 Bottom-0.04 Surface Absorption

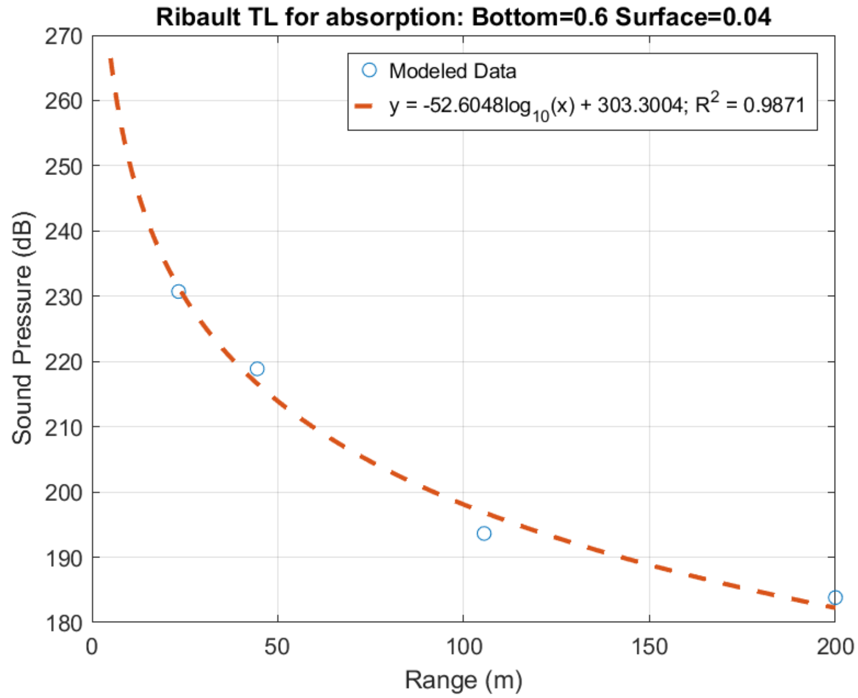


Figure H-89. Ribault TL curve for 0.6 Bottom-0.04 Surface Absorption

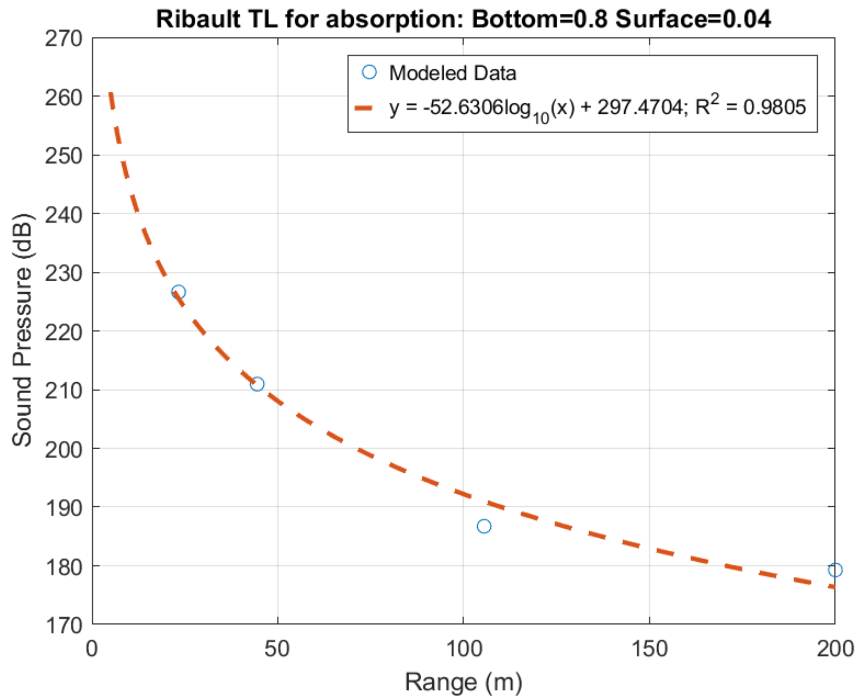


Figure H-90. Ribault TL curve for 0.8 Bottom-0.04 Surface Absorption

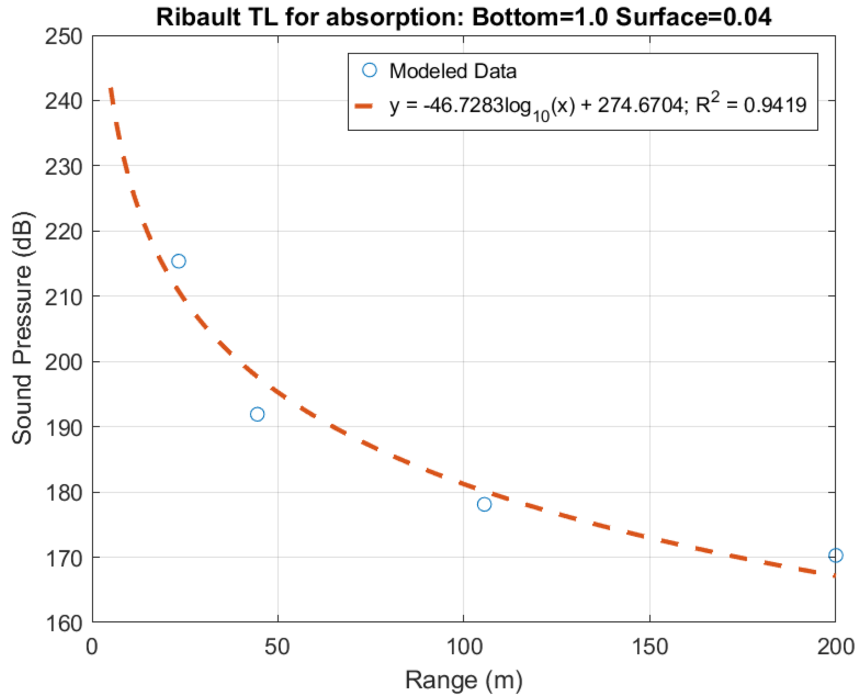


Figure H-91. Ribault TL curve for 1.0 Bottom-0.04 Surface Absorption

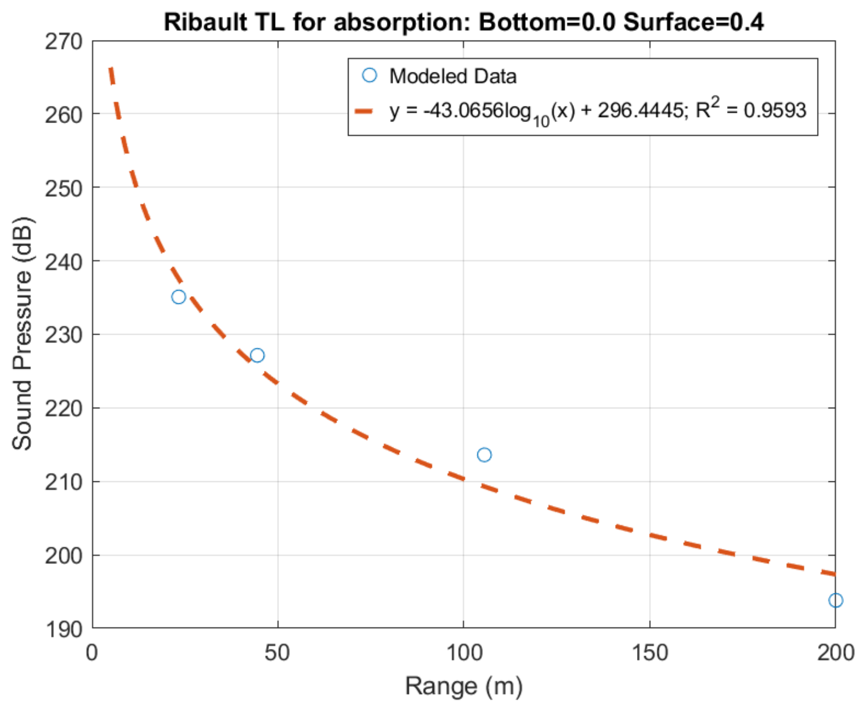


Figure H-92. Ribault TL curve for 0.0 Bottom-0.4 Surface Absorption

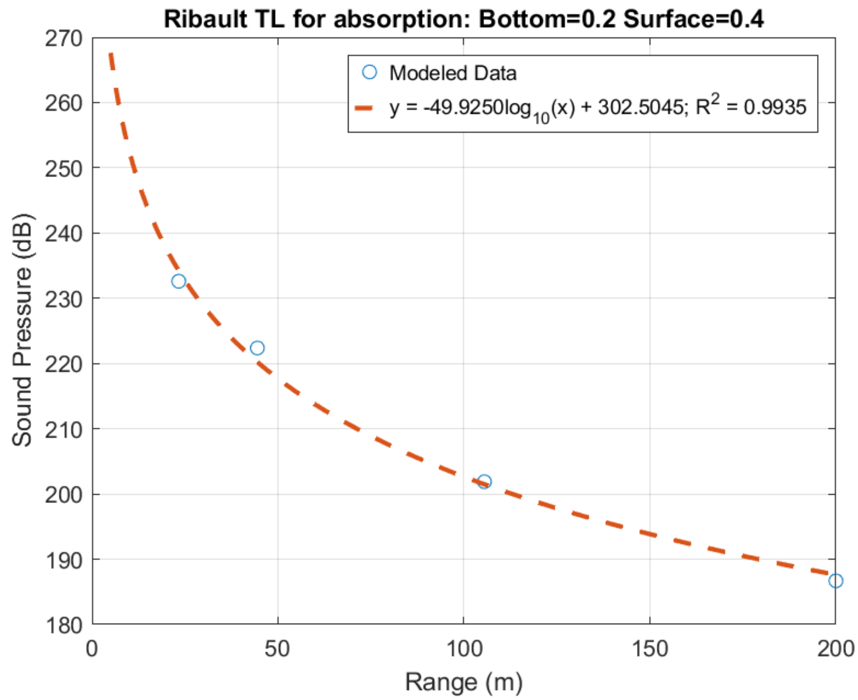


Figure H-93. Ribault TL curve for 0.2 Bottom-0.4 Surface Absorption

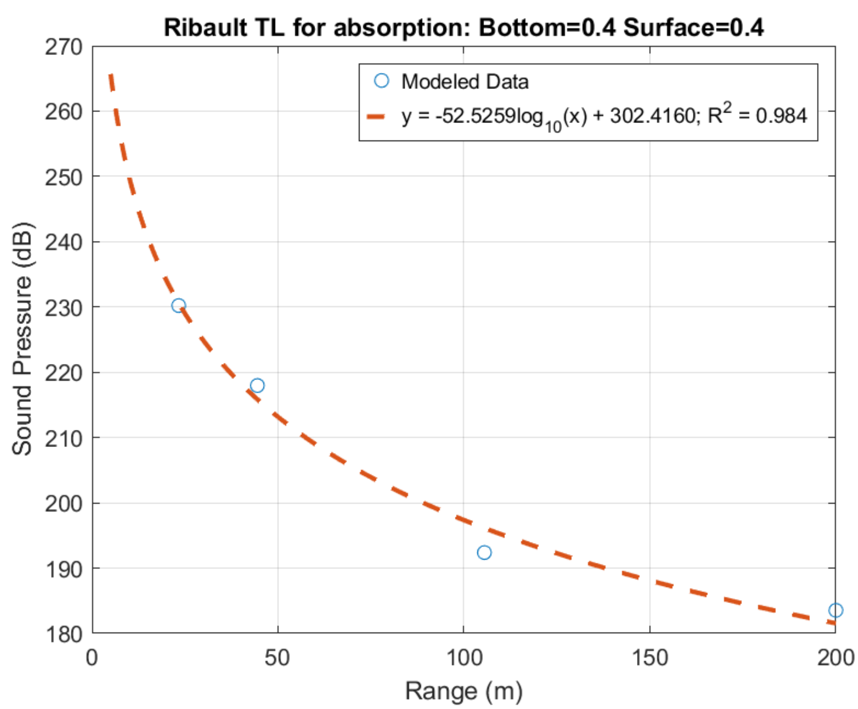


Figure H-94. Ribault TL curve for 0.4 Bottom-0.4 Surface Absorption

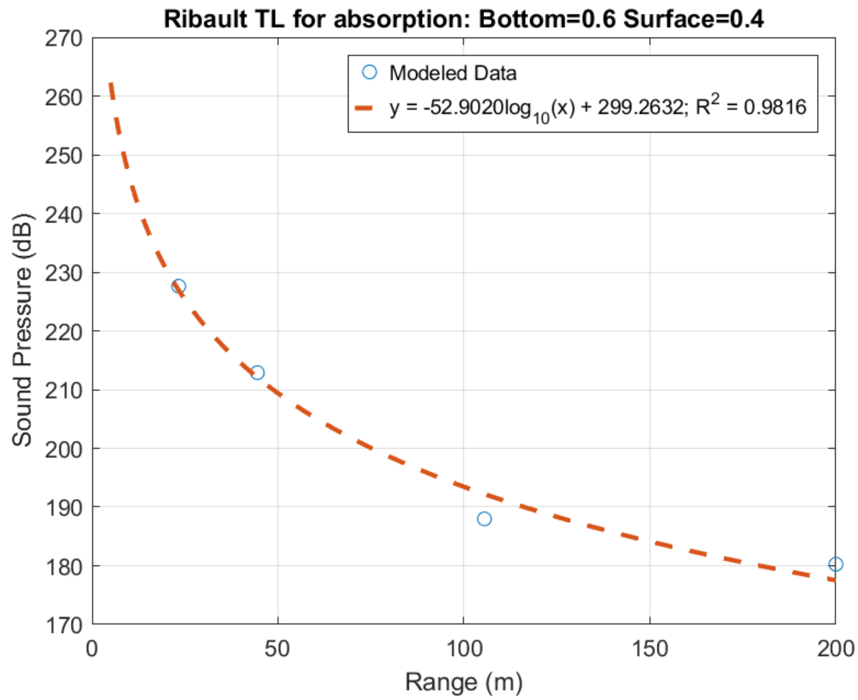


Figure H-95. Ribault TL curve for 0.6 Bottom-0.4 Surface Absorption

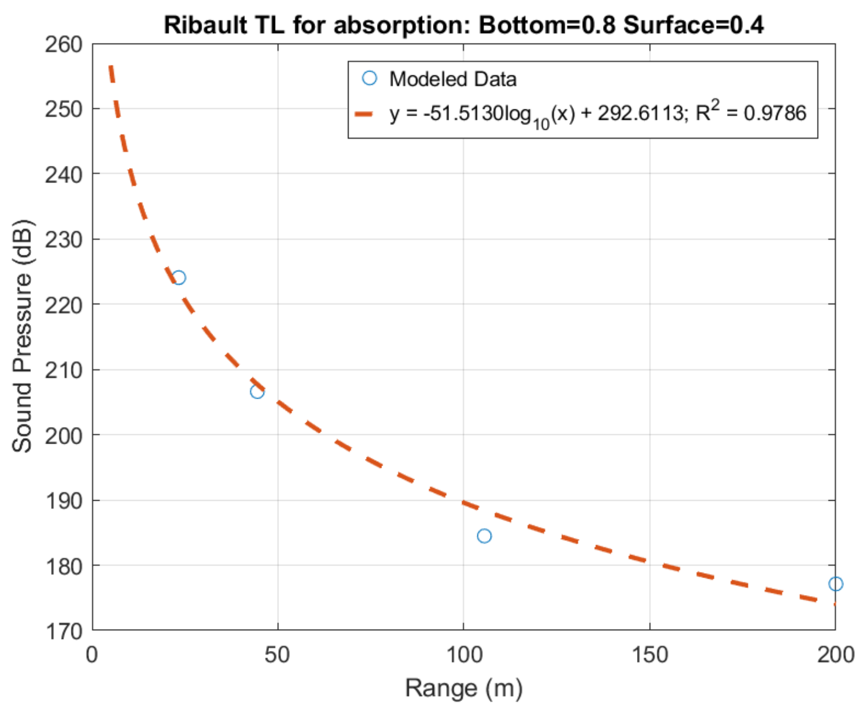


Figure H-96. Ribault TL curve for 0.8 Bottom-0.4 Surface Absorption

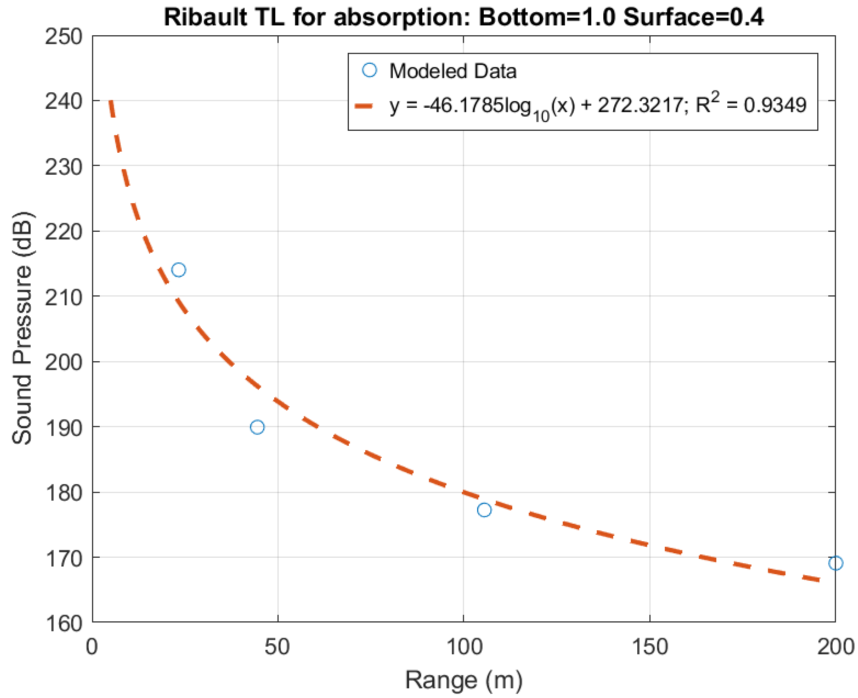


Figure H-97. Ribault TL curve for 1.0 Bottom-0.4 Surface Absorption

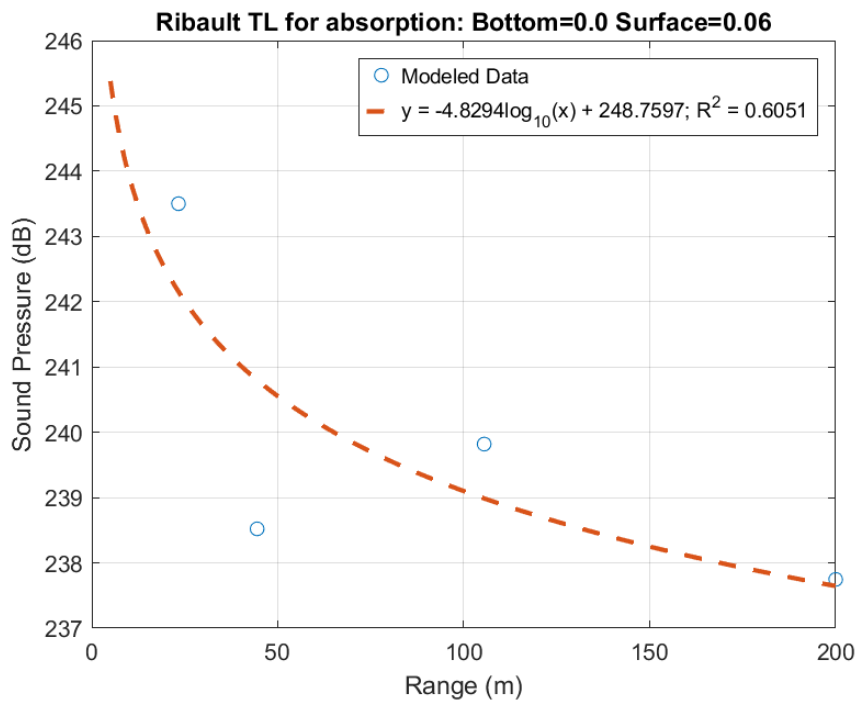


Figure H-98. Ribault TL curve for 0.0 Bottom-0.06 Surface Absorption

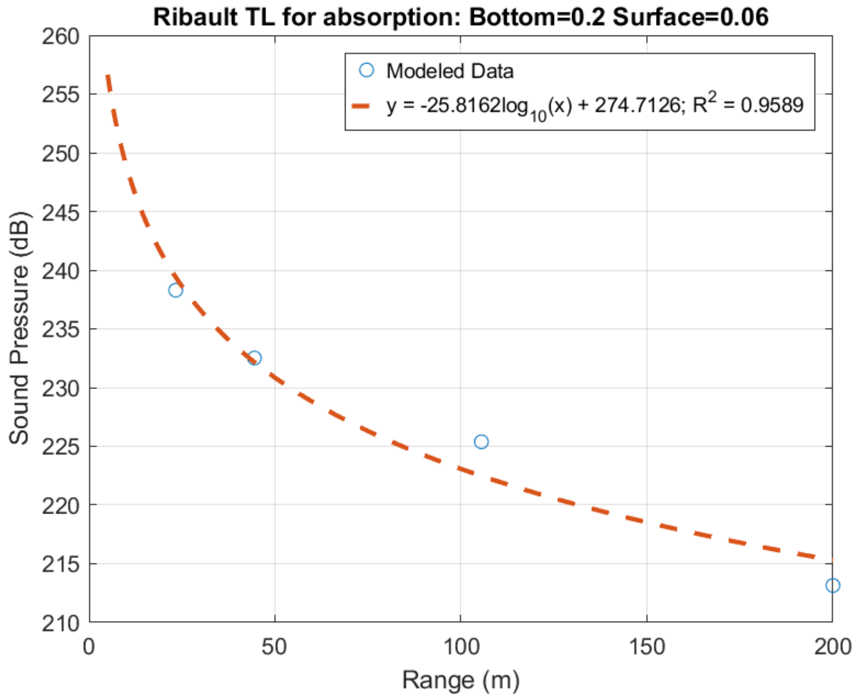


Figure H-99. Ribault TL curve for 0.2 Bottom-0.06 Surface Absorption

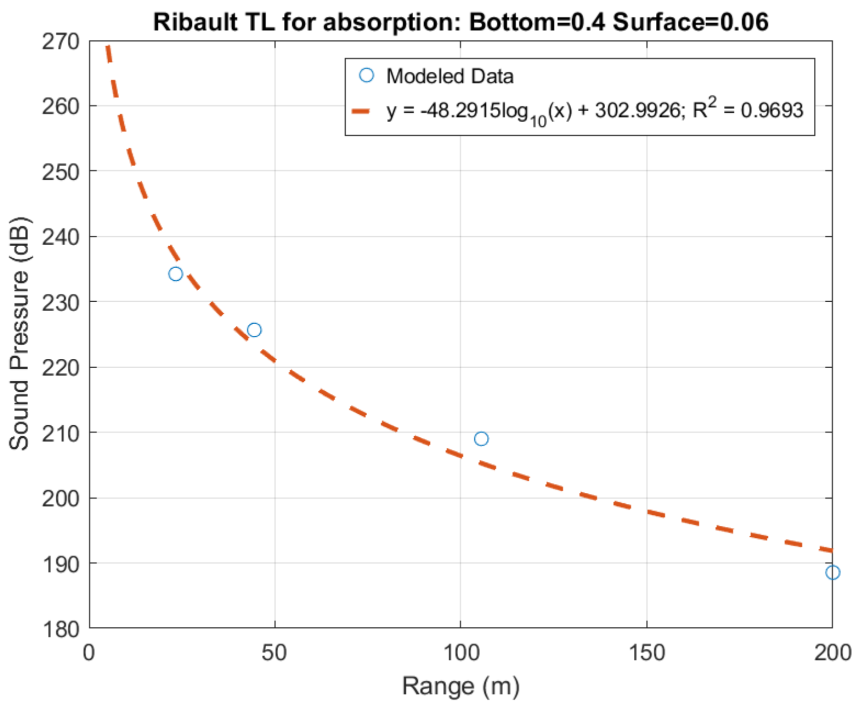


Figure H-100. Ribault TL curve for 0.4 Bottom-0.06 Surface Absorption

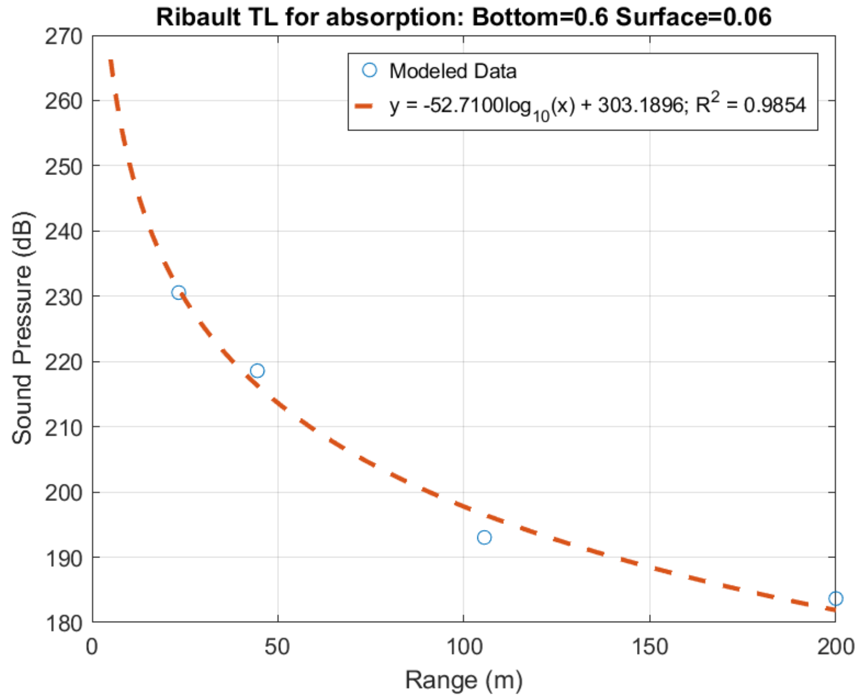


Figure H-101. Ribault TL curve for 0.6 Bottom-0.06 Surface Absorption

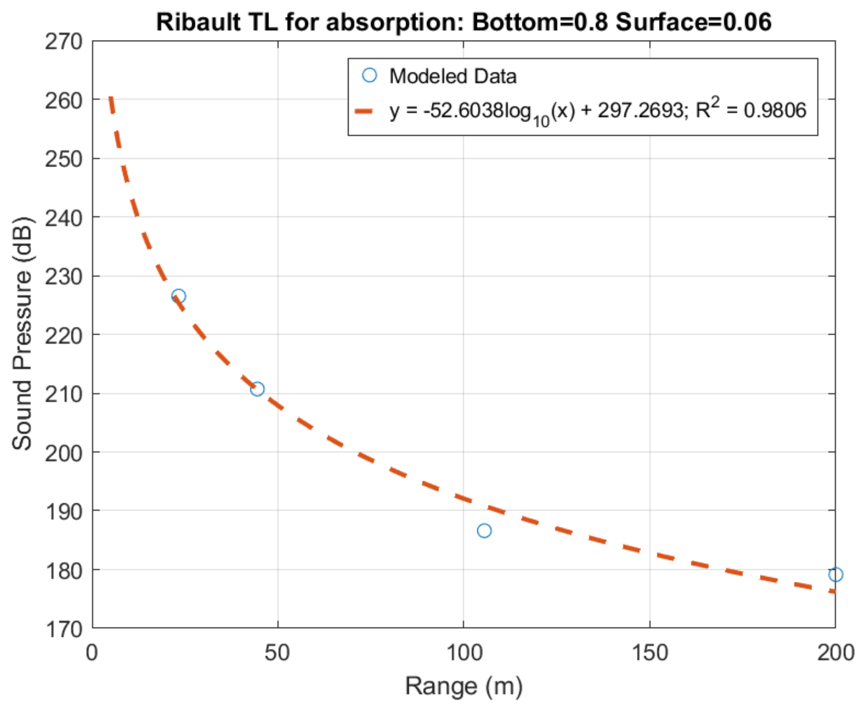


Figure H-102. Ribault TL curve for 0.8 Bottom-0.06 Surface Absorption

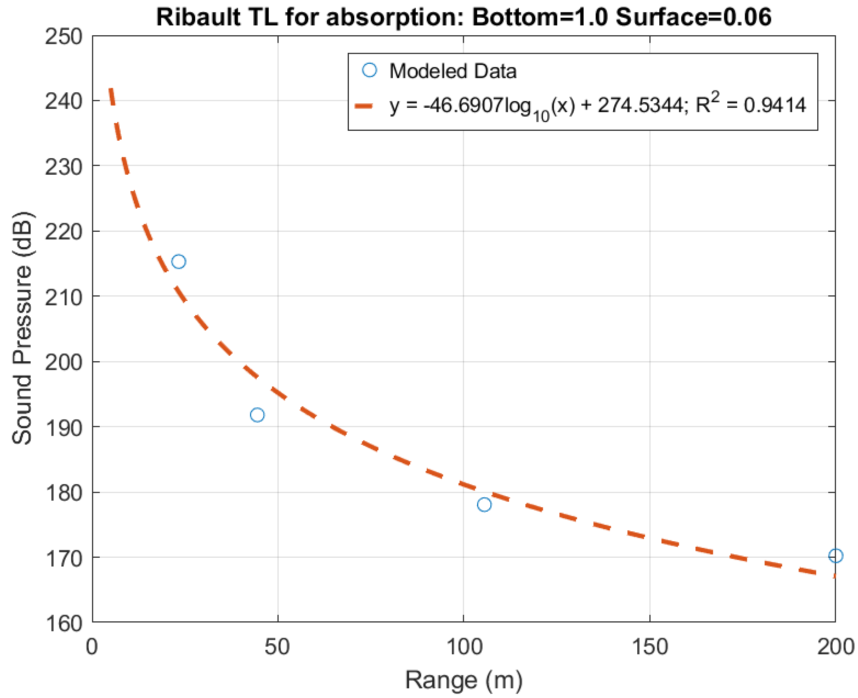


Figure H-103. Ribault TL curve for 1.0 Bottom-0.06 Surface Absorption

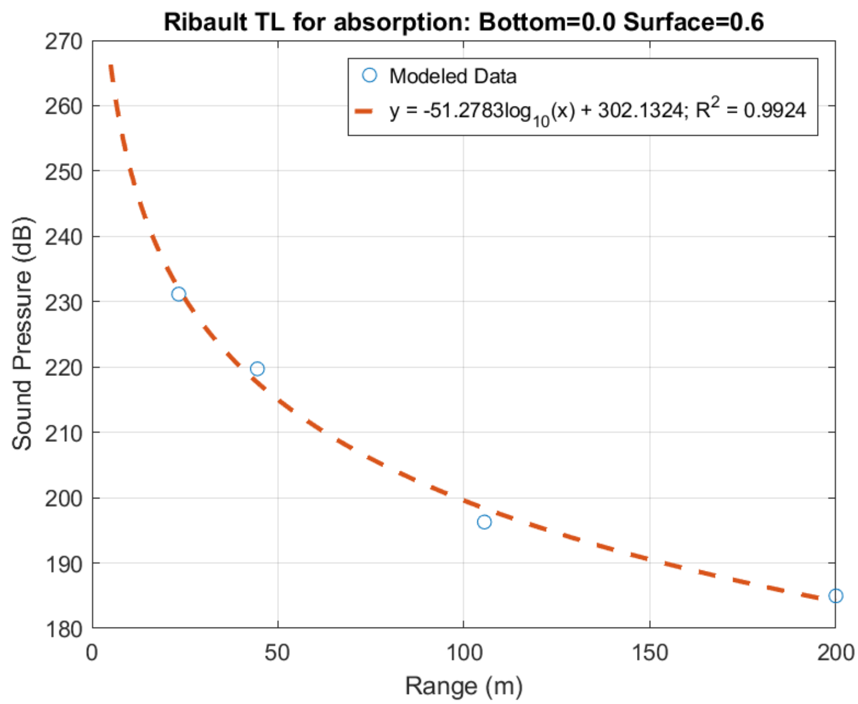


Figure H-104. Ribault TL curve for 0.0 Bottom-0.6 Surface Absorption

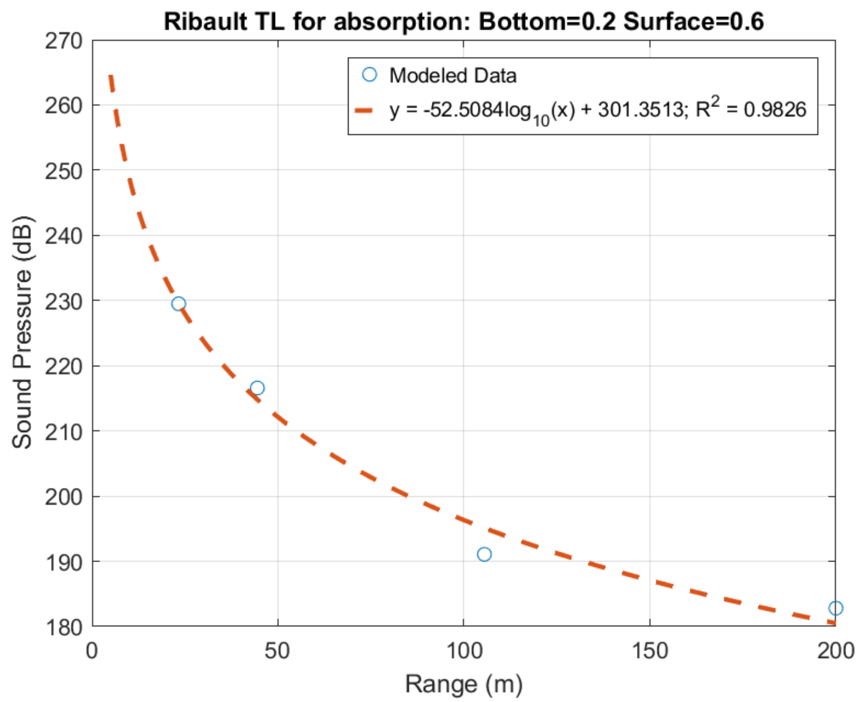


Figure H-105. Ribault TL curve for 0.2 Bottom-0.6 Surface Absorption

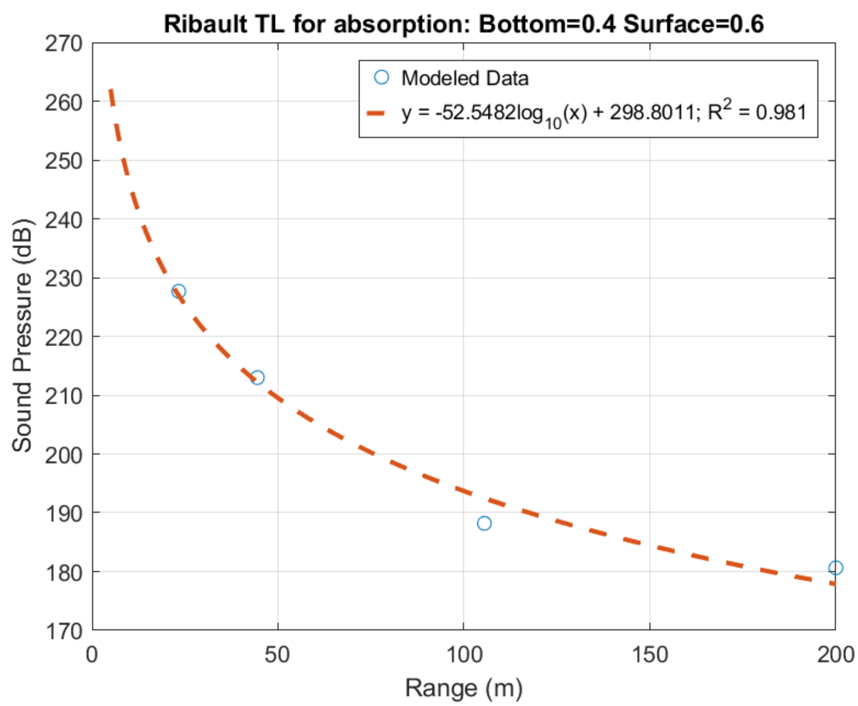


Figure H-106. Ribault TL curve for 0.4 Bottom-0.6 Surface Absorption

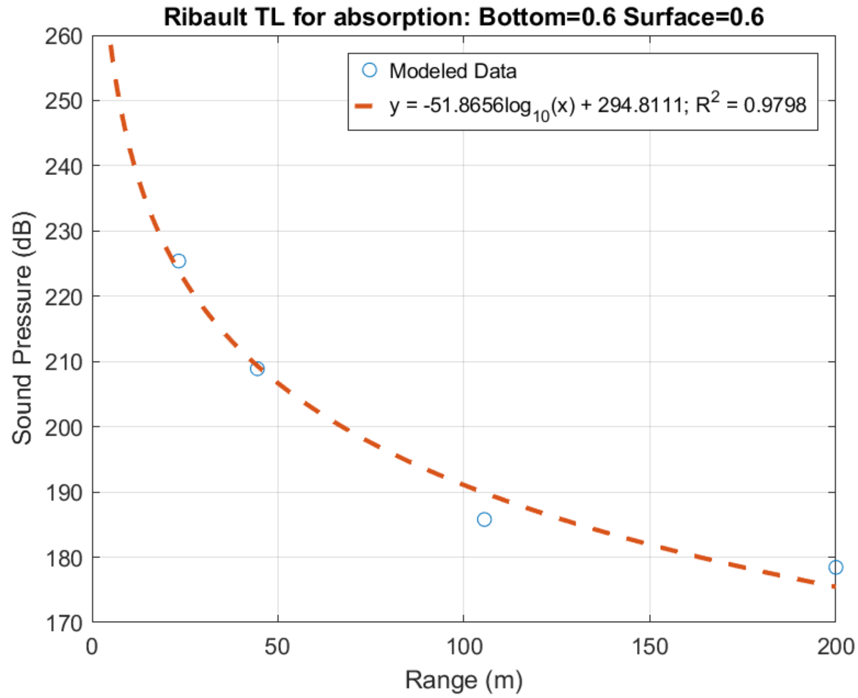


Figure H-107. Ribault TL curve for 0.6 Bottom-0.6 Surface Absorption

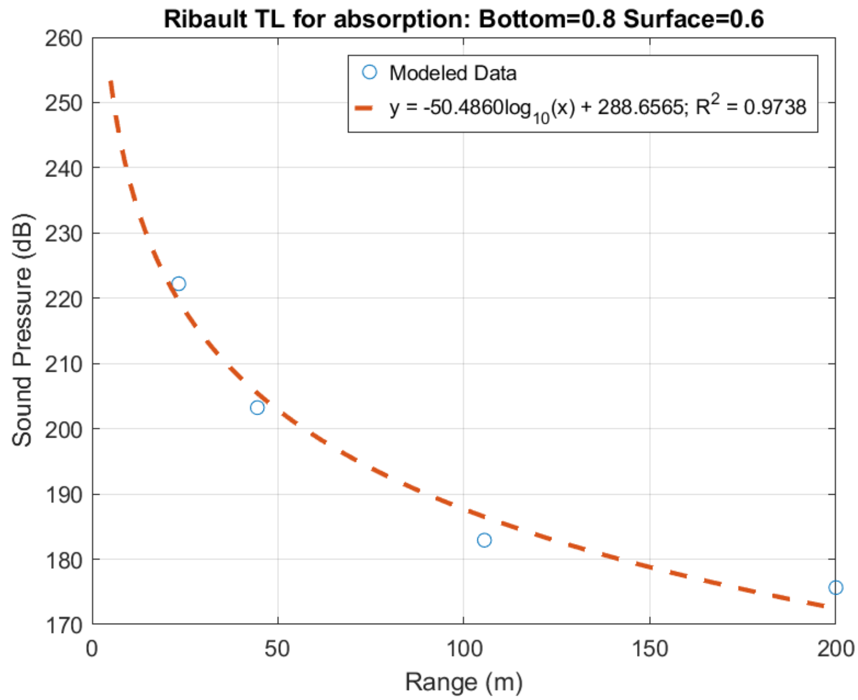


Figure H-108. Ribault TL curve for 0.8 Bottom-0.6 Surface Absorption

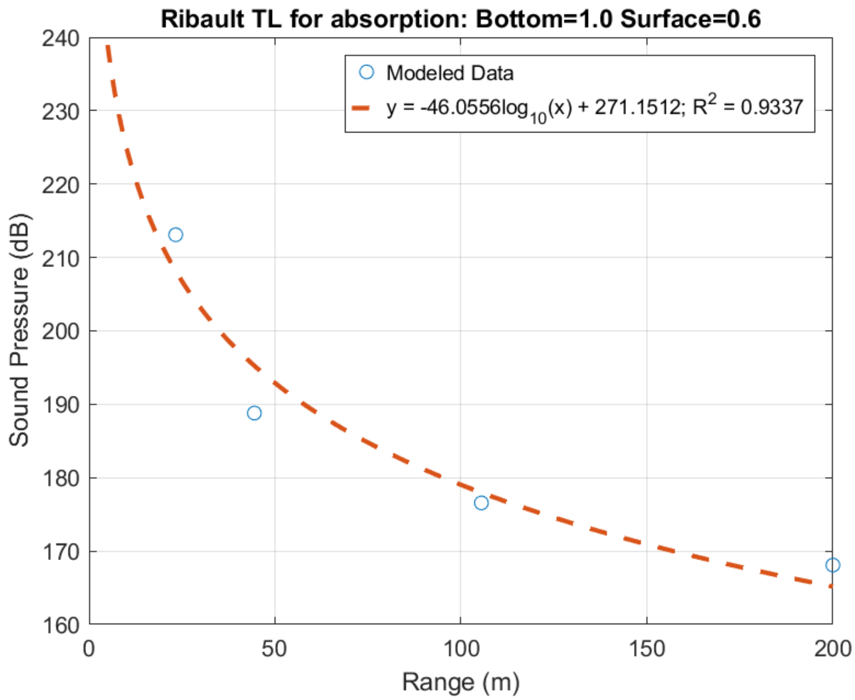


Figure H-109. Ribault TL curve for 1.0 Bottom-0.6 Surface Absorption

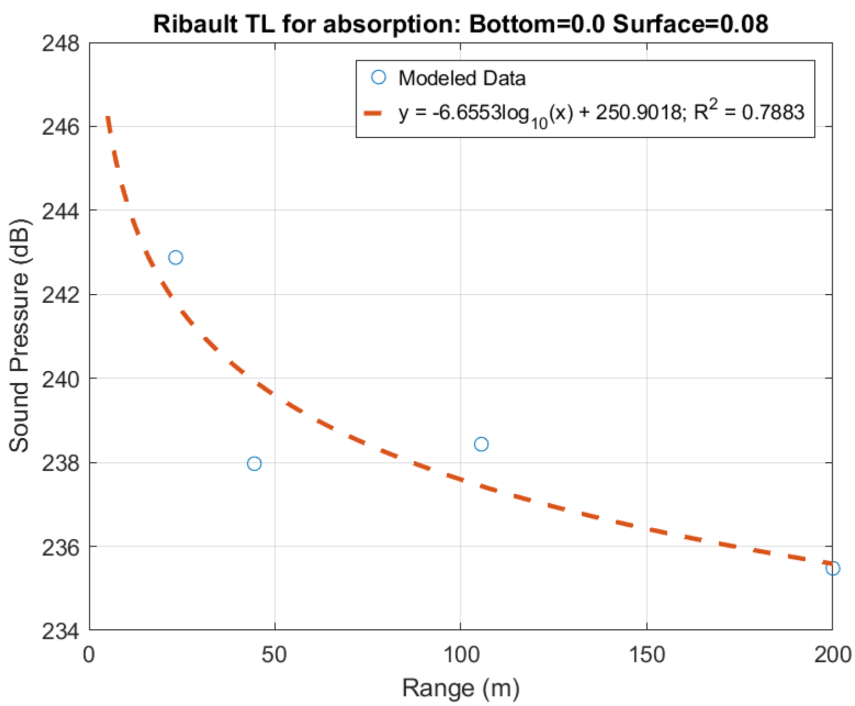


Figure H-110. Ribault TL curve for 0.0 Bottom-0.08 Surface Absorption

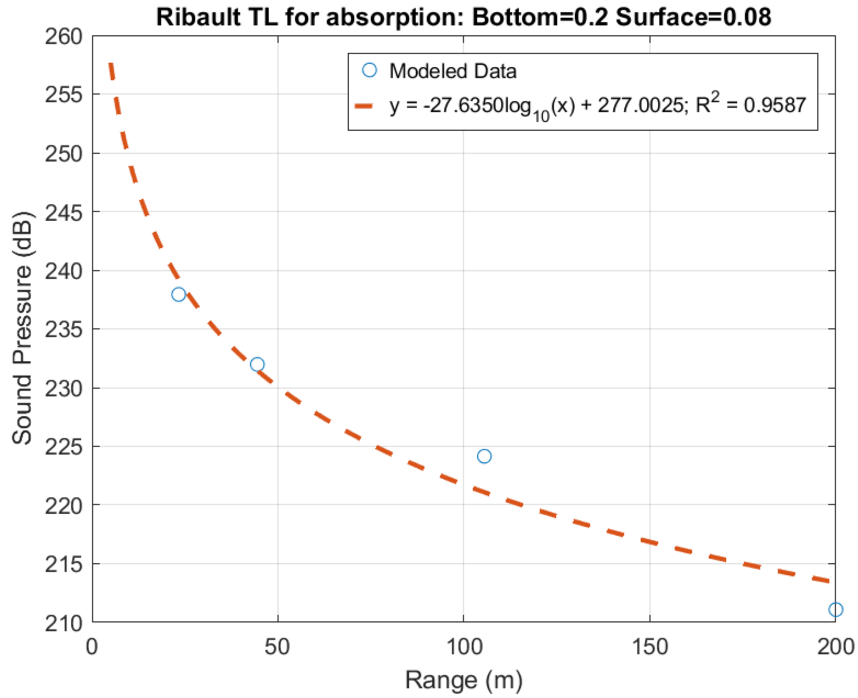


Figure H-111. Ribault TL curve for 0.2 Bottom-0.08 Surface Absorption

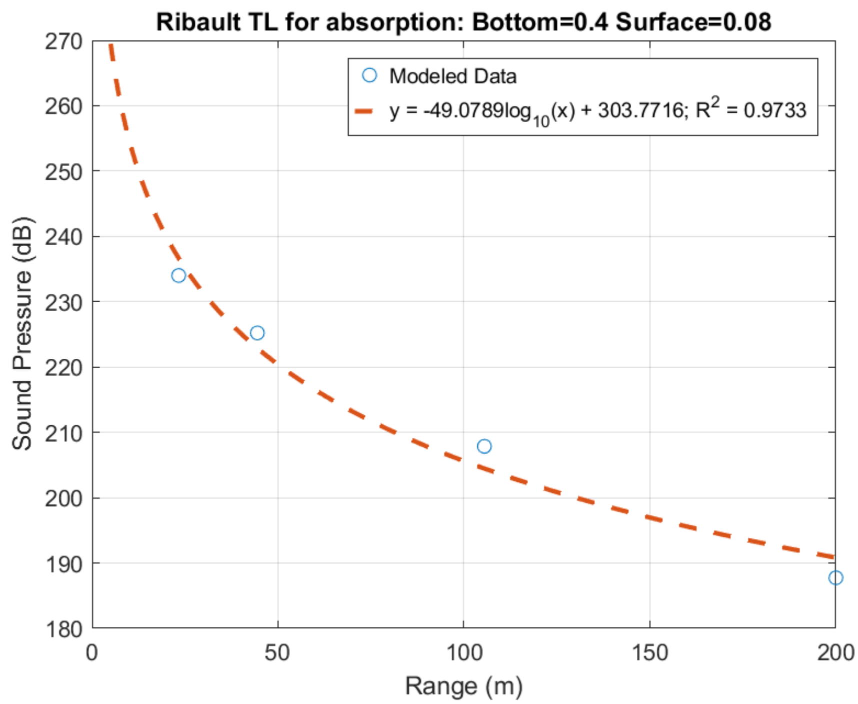


Figure H-112. Ribault TL curve for 0.4 Bottom-0.08 Surface Absorption

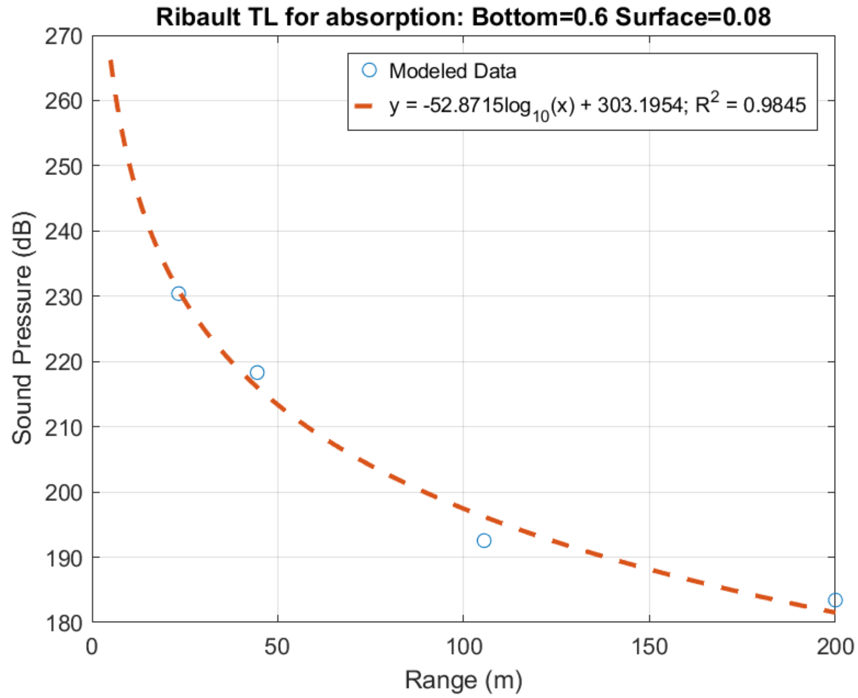


Figure H-113. Ribault TL curve for 0.4 Bottom-0.08 Surface Absorption

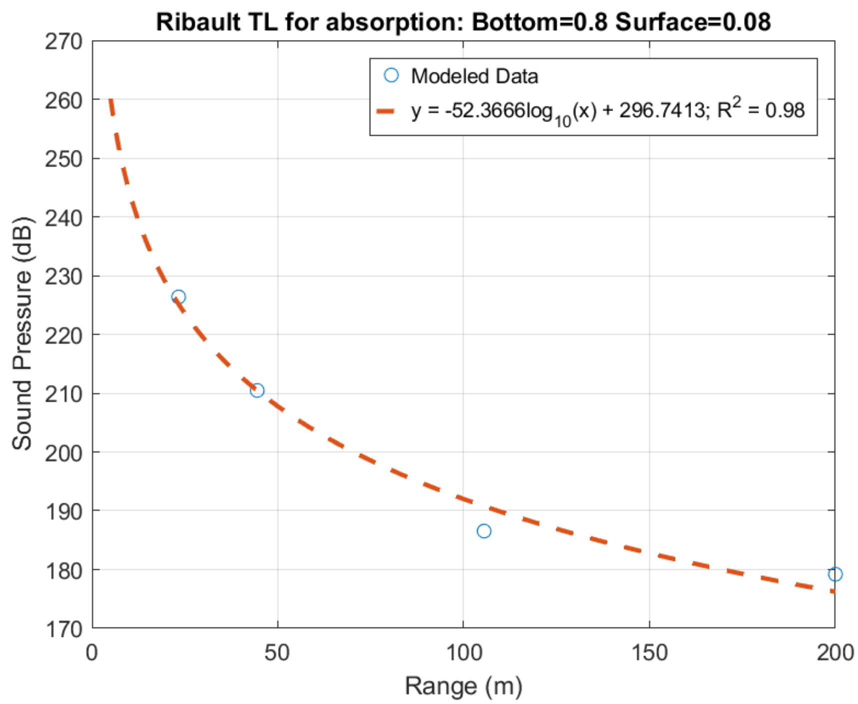


Figure H-114. Ribault TL curve for 0.8 Bottom-0.08 Surface Absorption

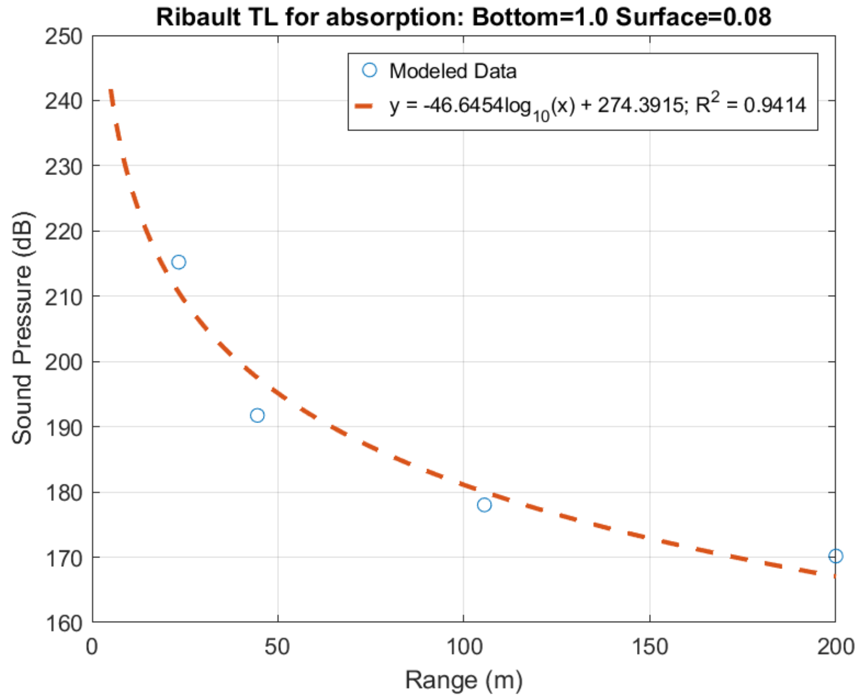


Figure H-115. Ribault TL curve for 1.0 Bottom-0.08 Surface Absorption

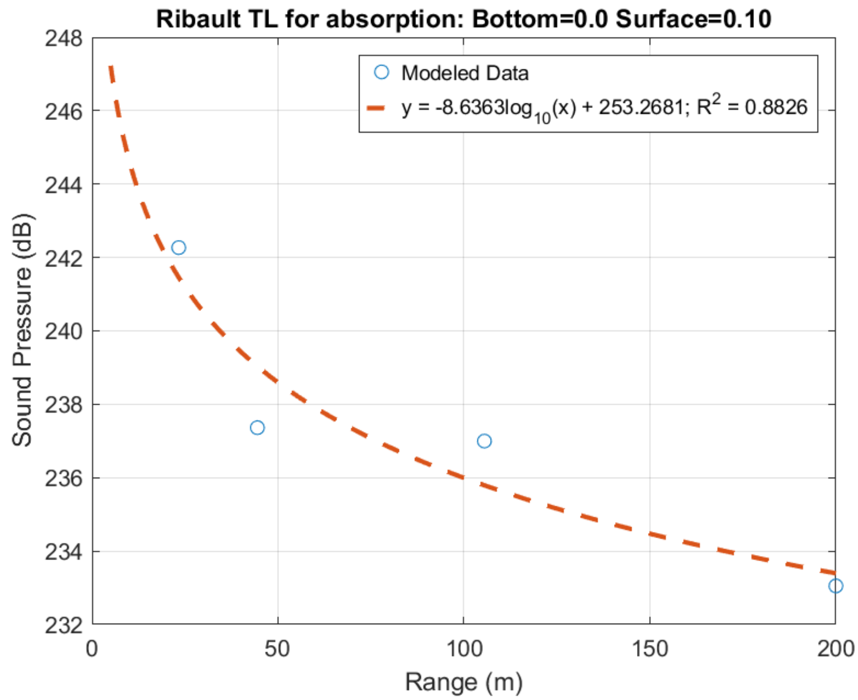


Figure H-116. Ribault TL curve for 0.0 Bottom-0.10 Surface Absorption

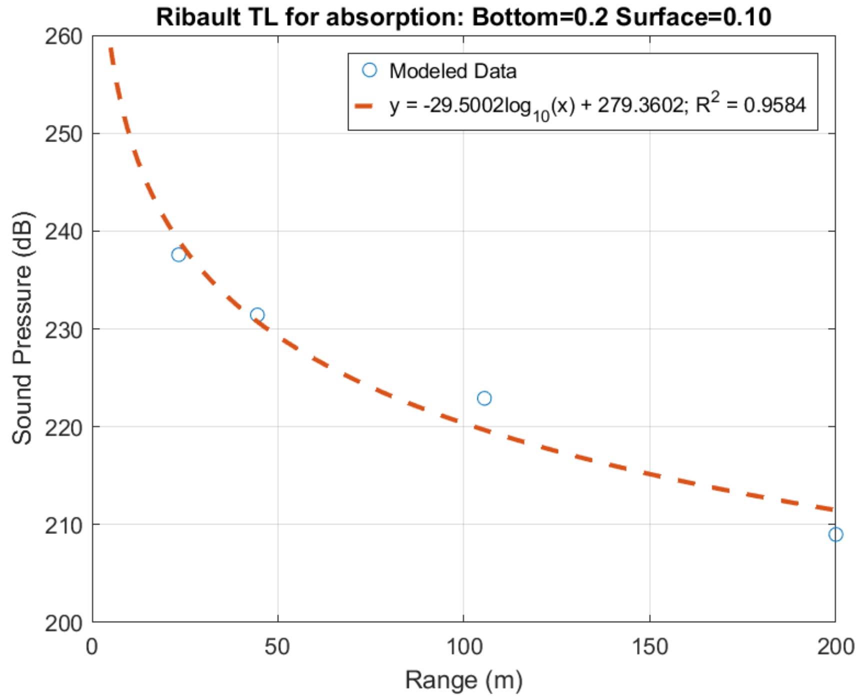


Figure H-117. Ribault TL curve for 0.2 Bottom-0.10 Surface Absorption

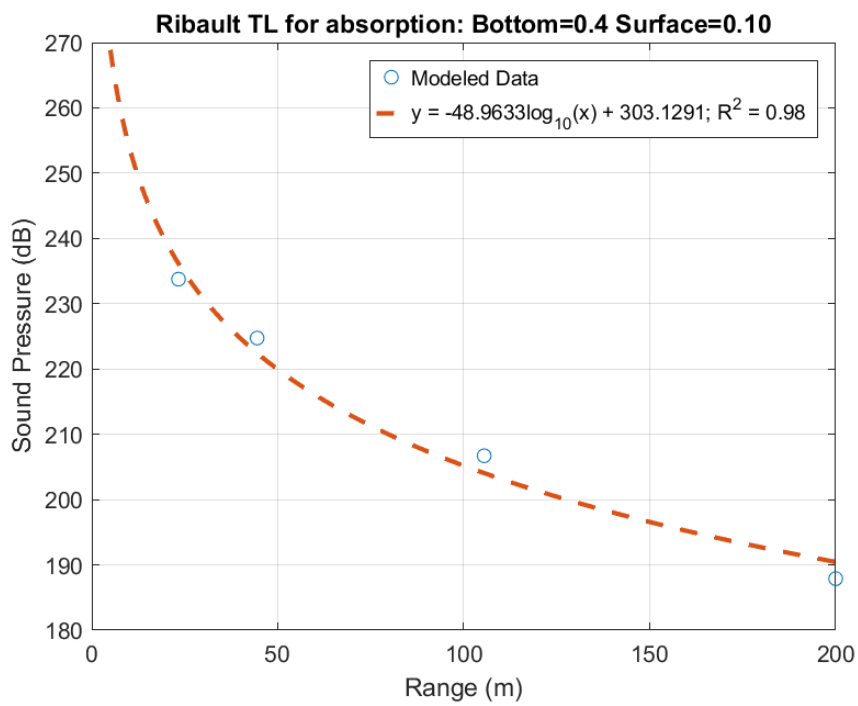


Figure H-118. Ribault TL curve for 0.4 Bottom-0.10 Surface Absorption

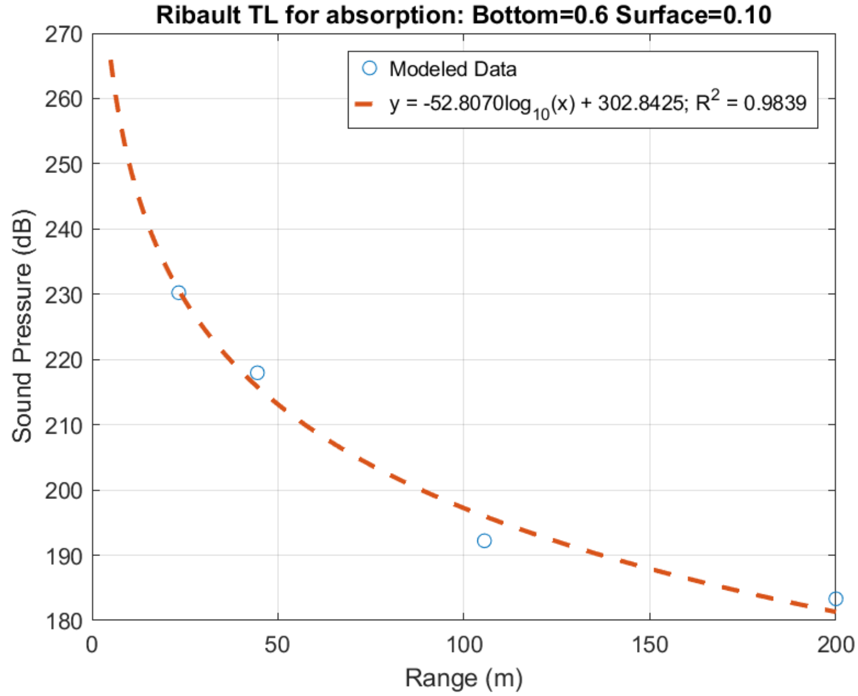


Figure H-119. Ribault TL curve for 0.6 Bottom-0.10 Surface Absorption

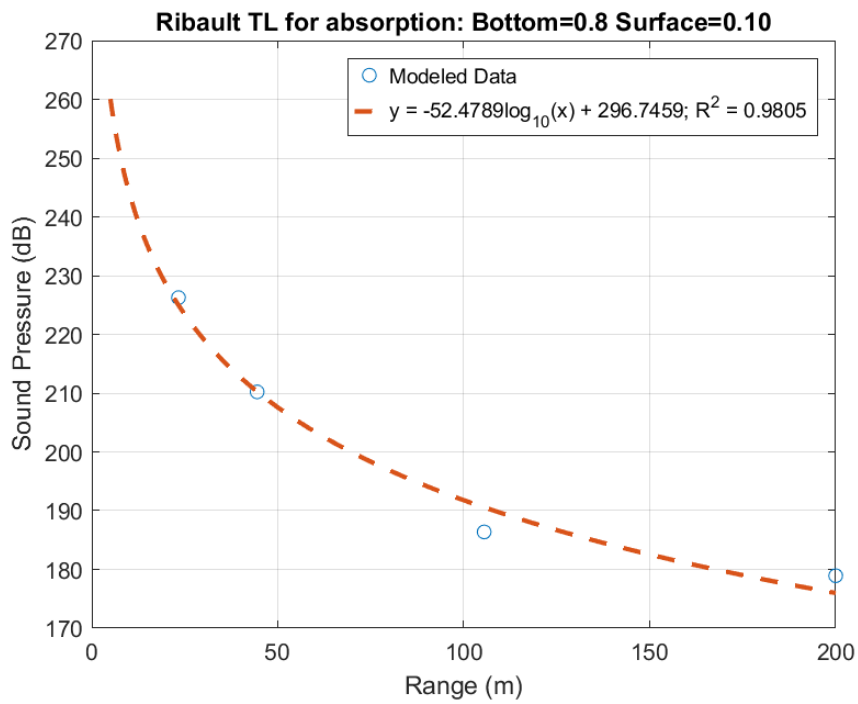


Figure H-120. Ribault TL curve for 0.8 Bottom-0.10 Surface Absorption

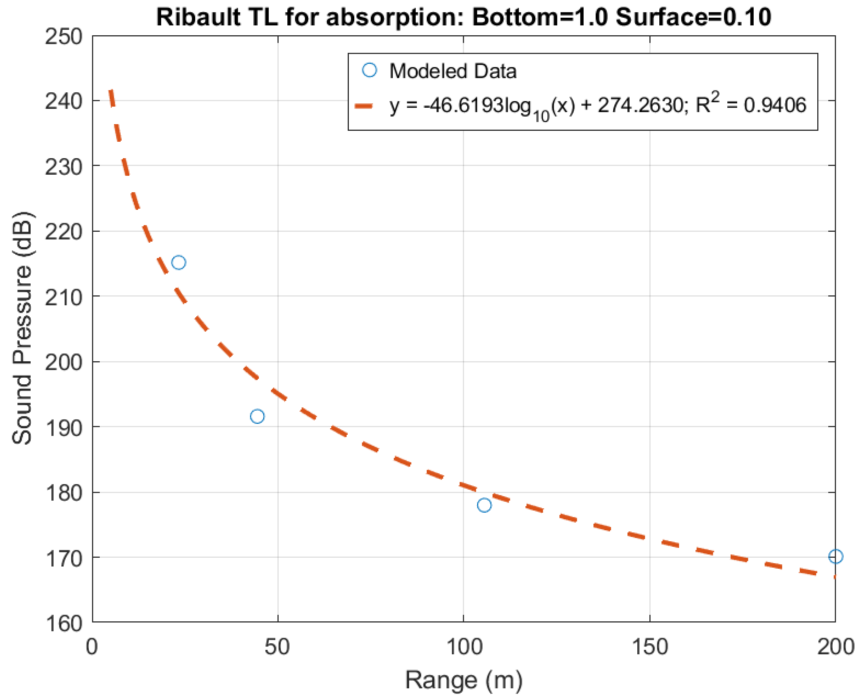


Figure H-121. Ribault TL curve for 1.0 Bottom-0.10 Surface Absorption

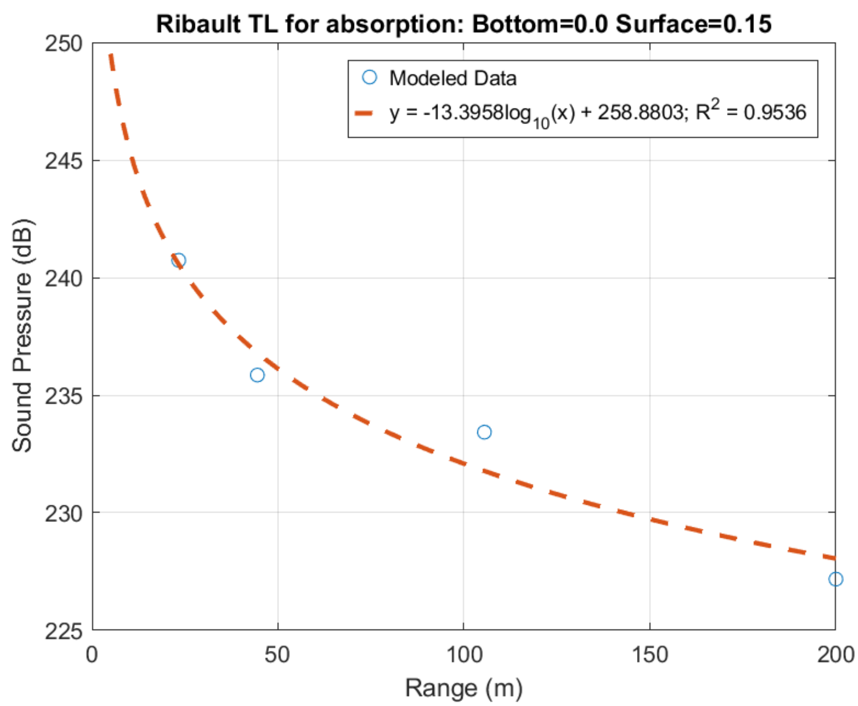


Figure H-122. Ribault TL curve for 0.0 Bottom-0.15 Surface Absorption

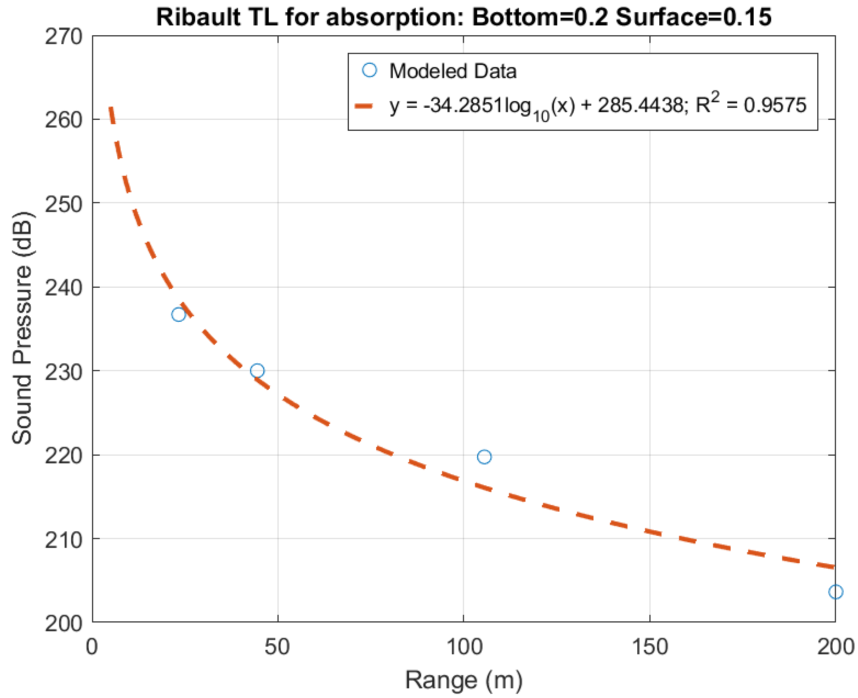


Figure H-123. Ribault TL curve for 0.2 Bottom-0.15 Surface Absorption

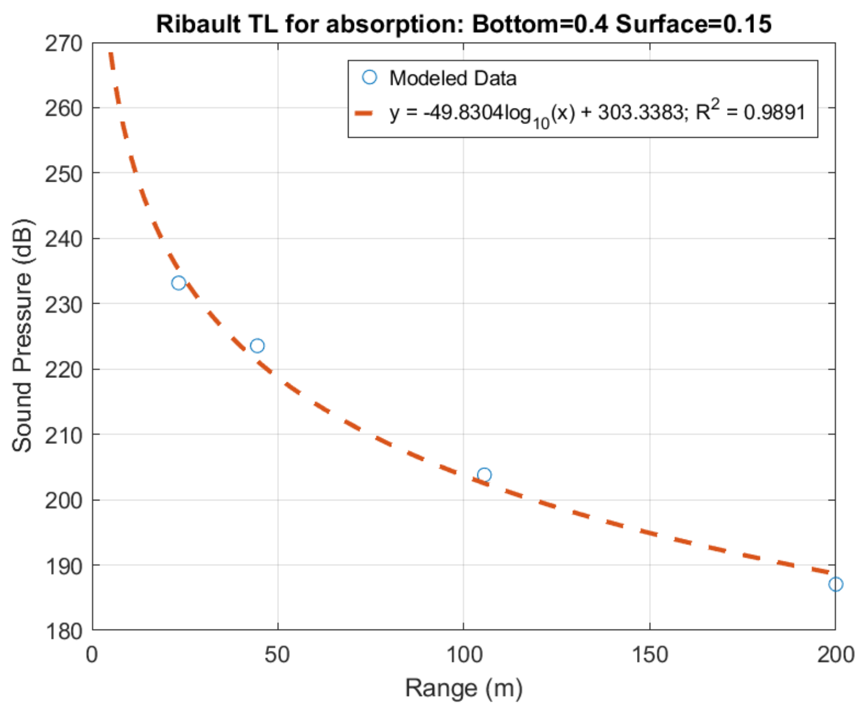


Figure H-124. Ribault TL curve for 0.4 Bottom-0.15 Surface Absorption

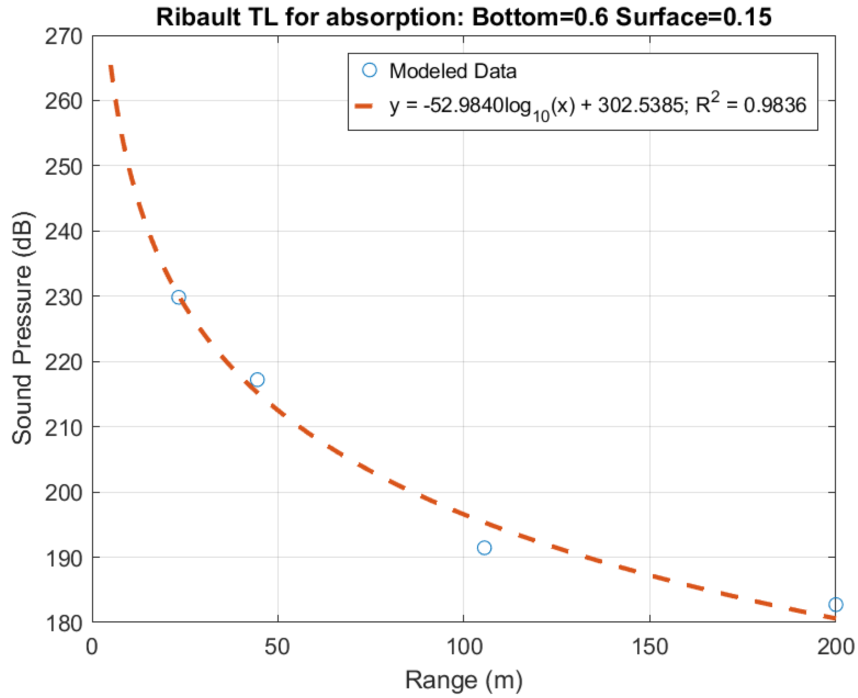


Figure H-125. Ribault TL curve for 0.6 Bottom-0.15 Surface Absorption

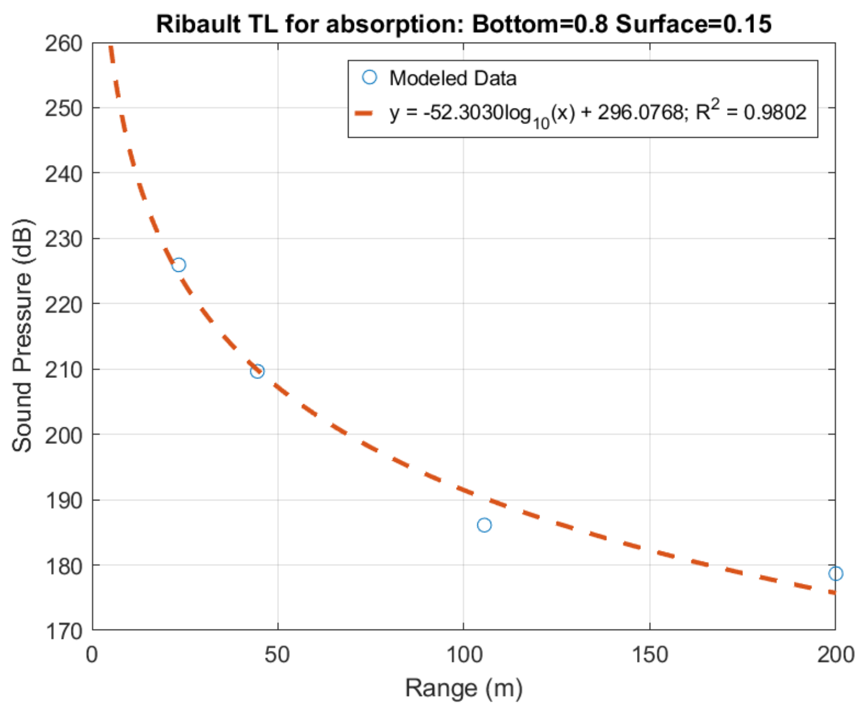


Figure H-126. Ribault TL curve for 0.8 Bottom-0.15 Surface Absorption

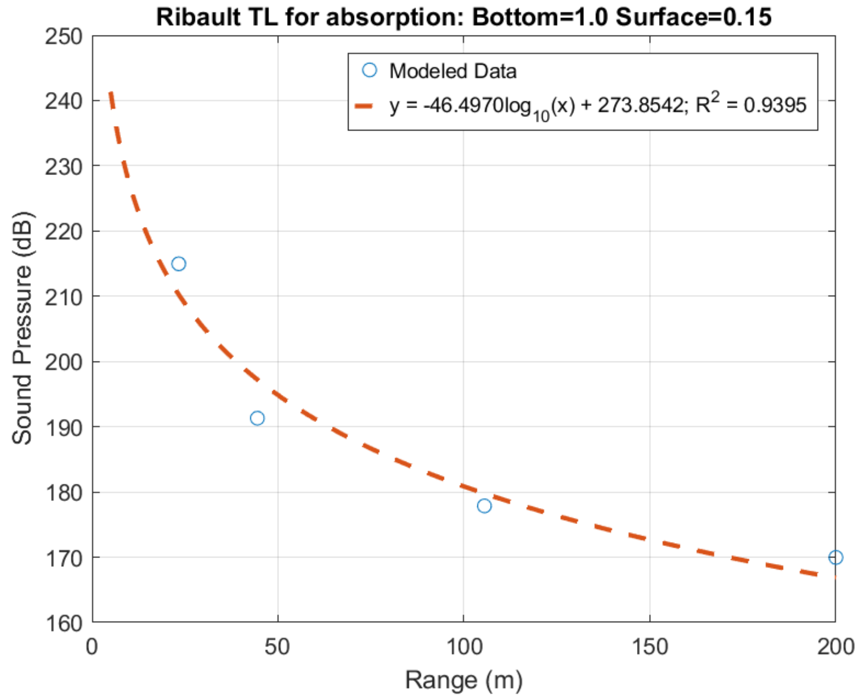
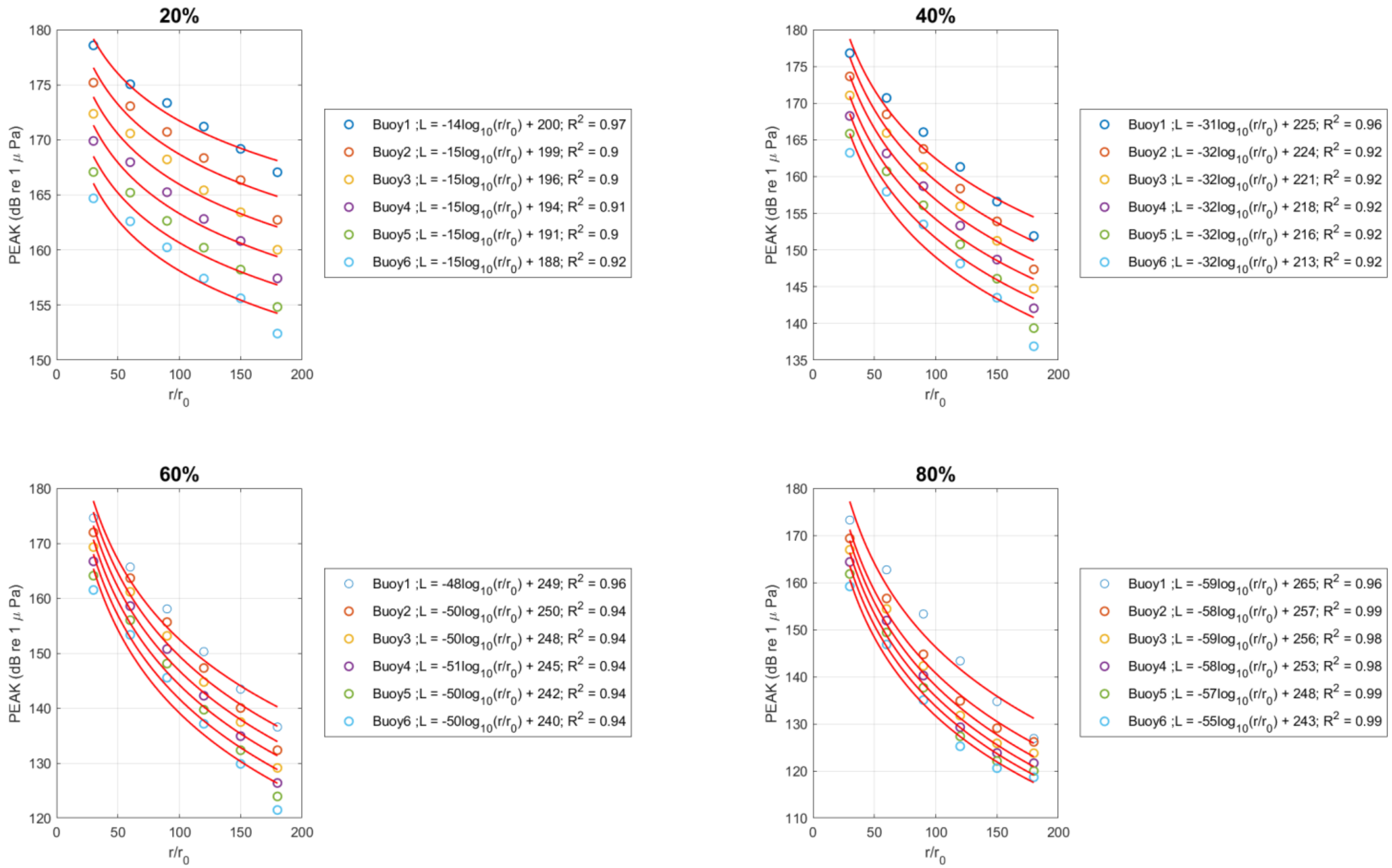
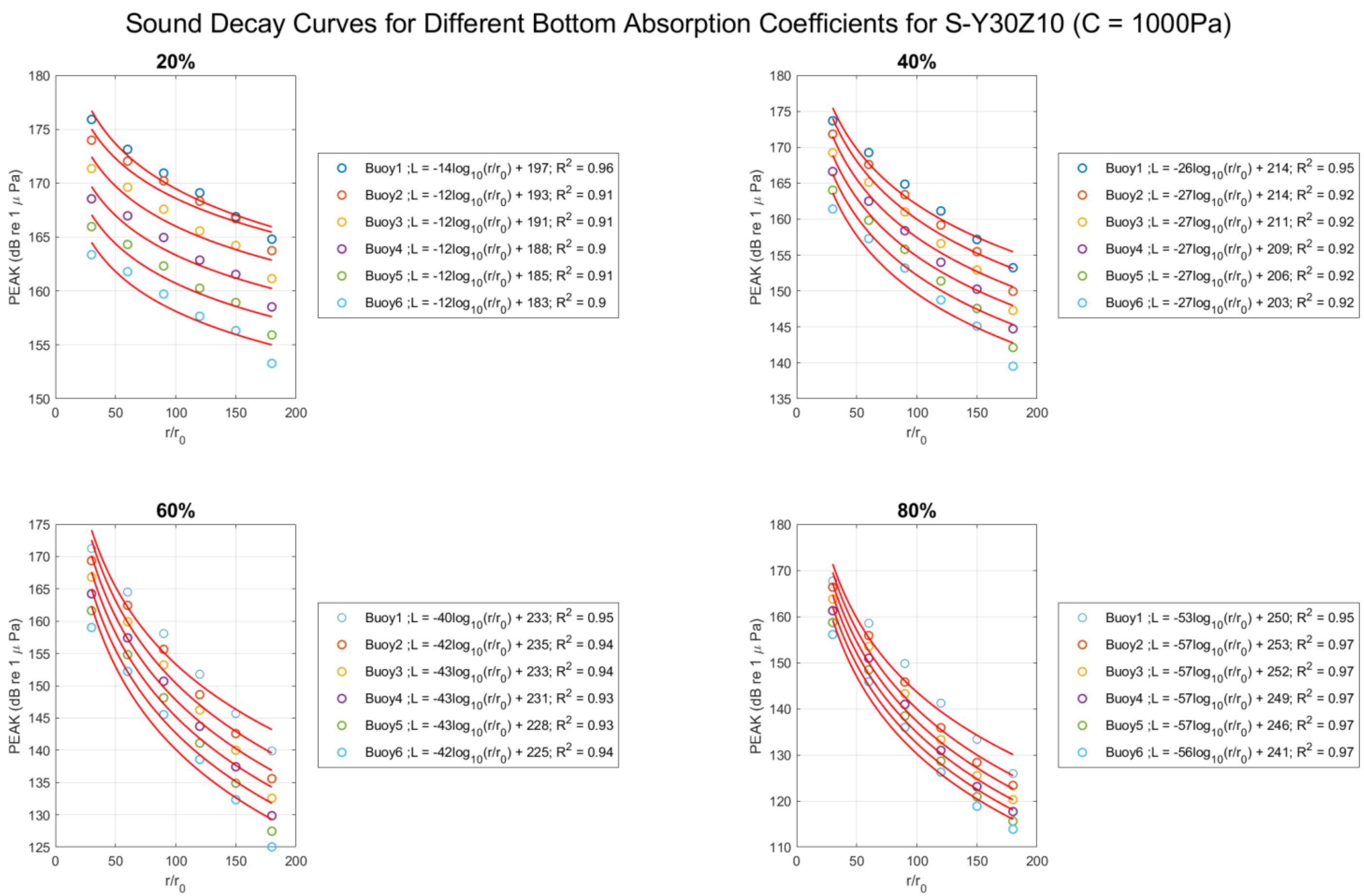


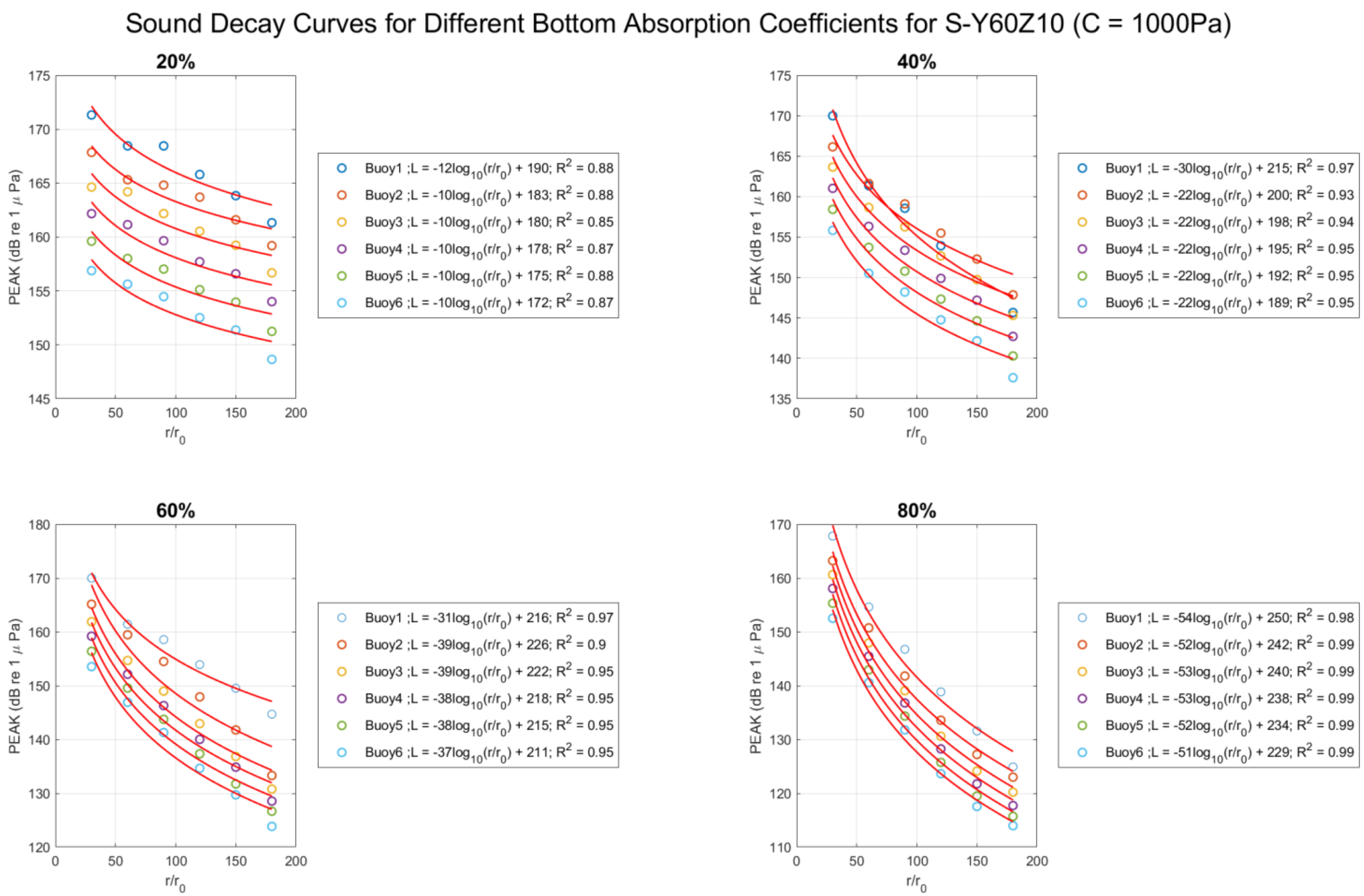
Figure H-127. Ribault TL curve for 1.0 Bottom-0.15 Surface Absorption

APPENDIX I
SOUND DECAY CURVES FROM CFD HYPOTHETICAL MODEL

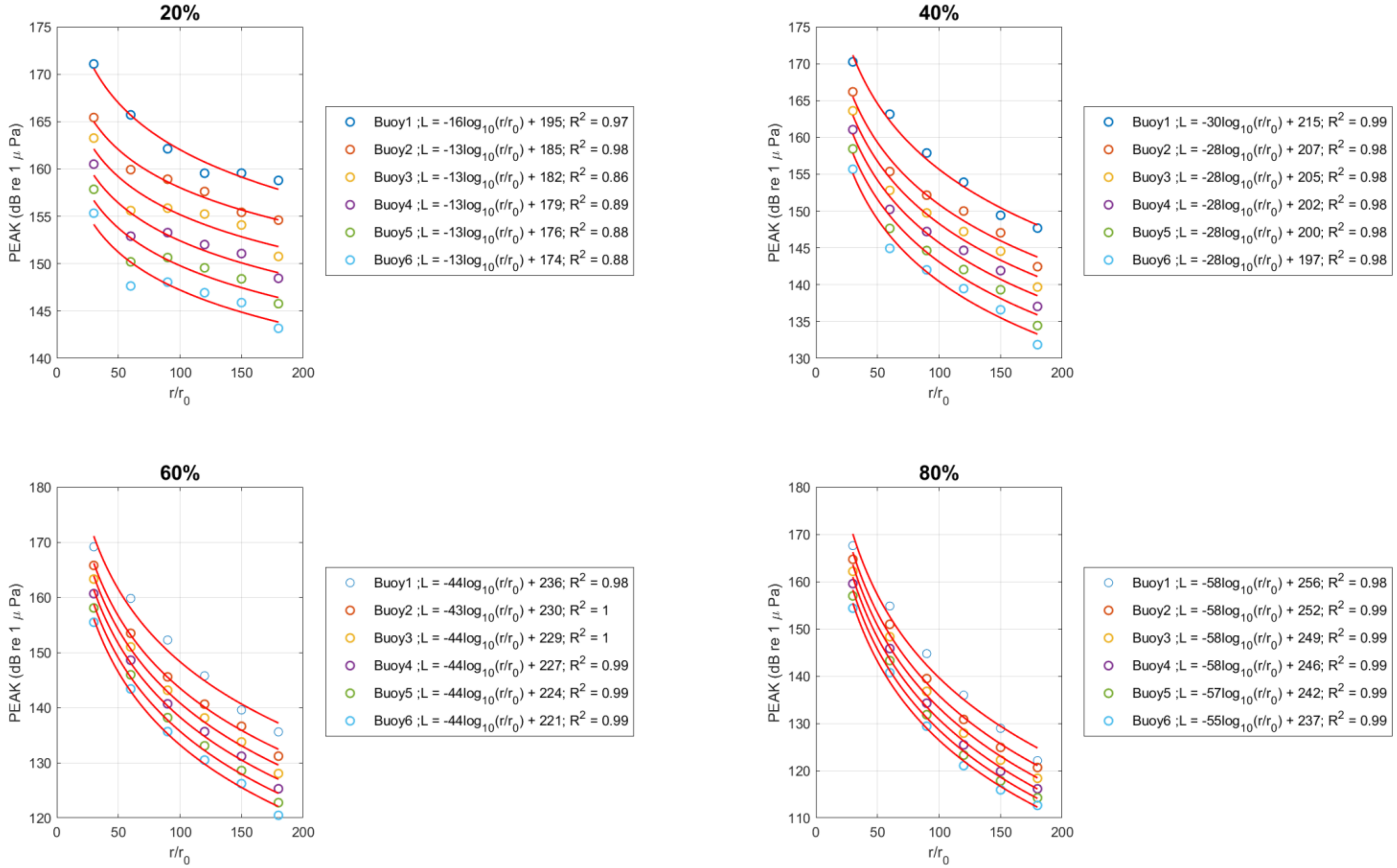
Sound Decay Curves for Different Bottom Absorption Coefficients for S-Y15Z10 (C = 1000Pa)



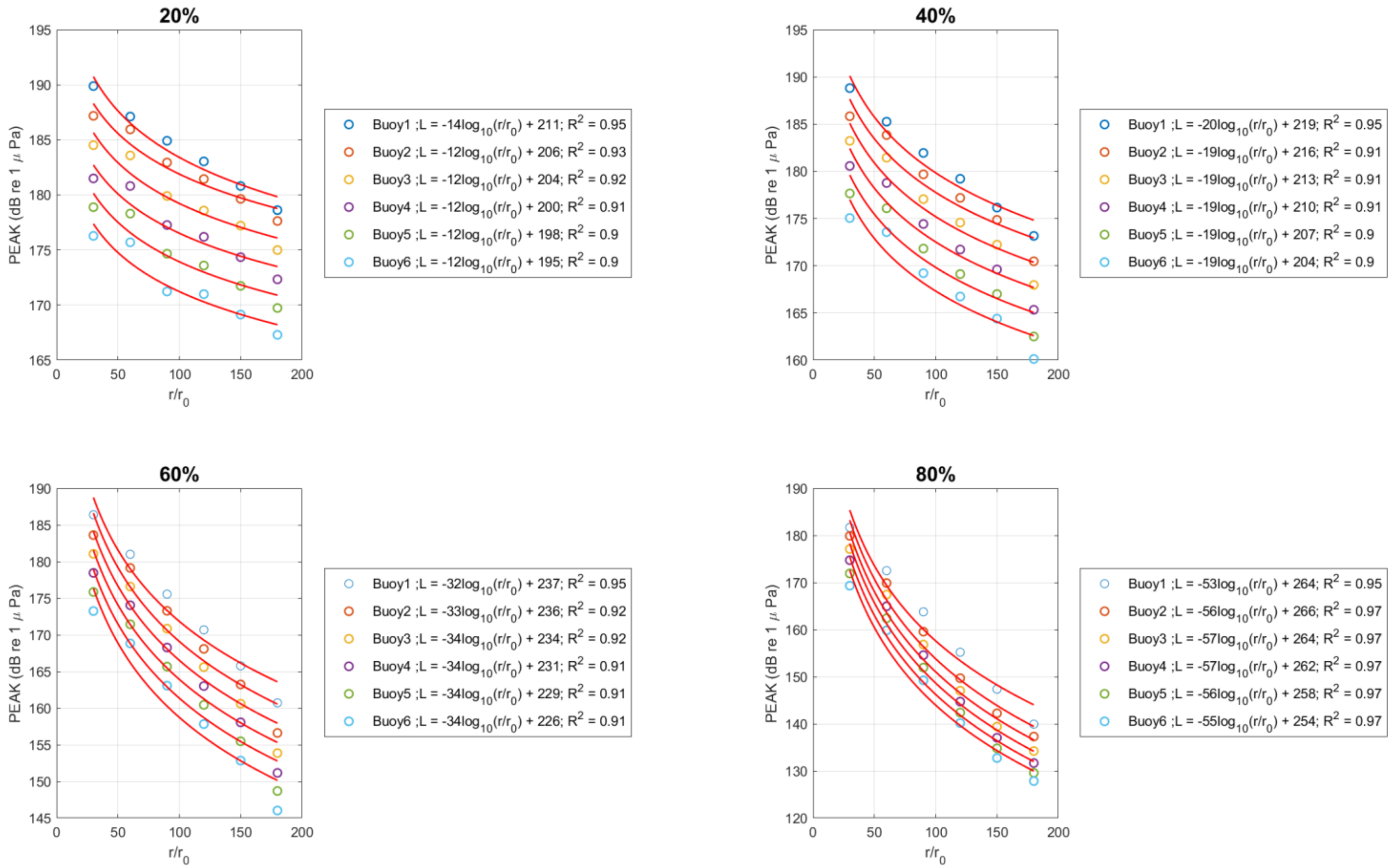

Sound Decay Curves for Different Bottom Absorption Coefficients for S-Y30Z10 (C = 1000Pa)
20%
40%
60%
80%
PEAK (dB re 1 μ Pa)
r/r0
Buoy1 ;L = -14log10(r/r0) + 197; R2 = 0.96
Buoy2 ;L = -12log10(r/r0) + 193; R2 = 0.91
Buoy3 ;L = -12log10(r/r0) + 191; R2 = 0.91
Buoy4 ;L = -12log10(r/r0) + 188; R2 = 0.9
Buoy5 ;L = -12log10(r/r0) + 185; R2 = 0.91
Buoy6 ;L = -12log10(r/r0) + 183; R2 = 0.9
Buoy1 ;L = -26log10(r/r0) + 214; R2 = 0.95
Buoy2 ;L = -27log10(r/r0) + 214; R2 = 0.92
Buoy3 ;L = -27log10(r/r0) + 211; R2 = 0.92
Buoy4 ;L = -27log10(r/r0) + 209; R2 = 0.92
Buoy5 ;L = -27log10(r/r0) + 206; R2 = 0.92
Buoy6 ;L = -27log10(r/r0) + 203; R2 = 0.92
Buoy1 ;L = -40log10(r/r0) + 233; R2 = 0.95
Buoy2 ;L = -42log10(r/r0) + 235; R2 = 0.94
Buoy3 ;L = -43log10(r/r0) + 233; R2 = 0.94
Buoy4 ;L = -43log10(r/r0) + 231; R2 = 0.93
Buoy5 ;L = -43log10(r/r0) + 228; R2 = 0.93
Buoy6 ;L = -42log10(r/r0) + 225; R2 = 0.94
Buoy1 ;L = -53log10(r/r0) + 250; R2 = 0.95
Buoy2 ;L = -57log10(r/r0) + 253; R2 = 0.97
Buoy3 ;L = -57log10(r/r0) + 252; R2 = 0.97
Buoy4 ;L = -57log10(r/r0) + 249; R2 = 0.97
Buoy5 ;L = -57log10(r/r0) + 246; R2 = 0.97
Buoy6 ;L = -56log10(r/r0) + 241; R2 = 0.97


Sound Decay Curves for Different Bottom Absorption Coefficients for S-Y60Z10 (C = 1000Pa)
20%
40%
60%
80%
PEAK (dB re 1 μ Pa)
r/r0
Buoy1 ;L = -12log10(r/r0) + 190; R2 = 0.88
Buoy2 ;L = -10log10(r/r0) + 183; R2 = 0.88
Buoy3 ;L = -10log10(r/r0) + 180; R2 = 0.85
Buoy4 ;L = -10log10(r/r0) + 178; R2 = 0.87
Buoy5 ;L = -10log10(r/r0) + 175; R2 = 0.88
Buoy6 ;L = -10log10(r/r0) + 172; R2 = 0.87
Buoy1 ;L = -30log10(r/r0) + 215; R2 = 0.97
Buoy2 ;L = -22log10(r/r0) + 200; R2 = 0.93
Buoy3 ;L = -22log10(r/r0) + 198; R2 = 0.94
Buoy4 ;L = -22log10(r/r0) + 195; R2 = 0.95
Buoy5 ;L = -22log10(r/r0) + 192; R2 = 0.95
Buoy6 ;L = -22log10(r/r0) + 189; R2 = 0.95
Buoy1 ;L = -31log10(r/r0) + 216; R2 = 0.97
Buoy2 ;L = -39log10(r/r0) + 226; R2 = 0.9
Buoy3 ;L = -39log10(r/r0) + 222; R2 = 0.95
Buoy4 ;L = -38log10(r/r0) + 218; R2 = 0.95
Buoy5 ;L = -38log10(r/r0) + 215; R2 = 0.95
Buoy6 ;L = -37log10(r/r0) + 211; R2 = 0.95
Buoy1 ;L = -54log10(r/r0) + 250; R2 = 0.98
Buoy2 ;L = -52log10(r/r0) + 242; R2 = 0.99
Buoy3 ;L = -53log10(r/r0) + 240; R2 = 0.99
Buoy4 ;L = -53log10(r/r0) + 238; R2 = 0.99
Buoy5 ;L = -52log10(r/r0) + 234; R2 = 0.99
Buoy6 ;L = -51log10(r/r0) + 229; R2 = 0.99

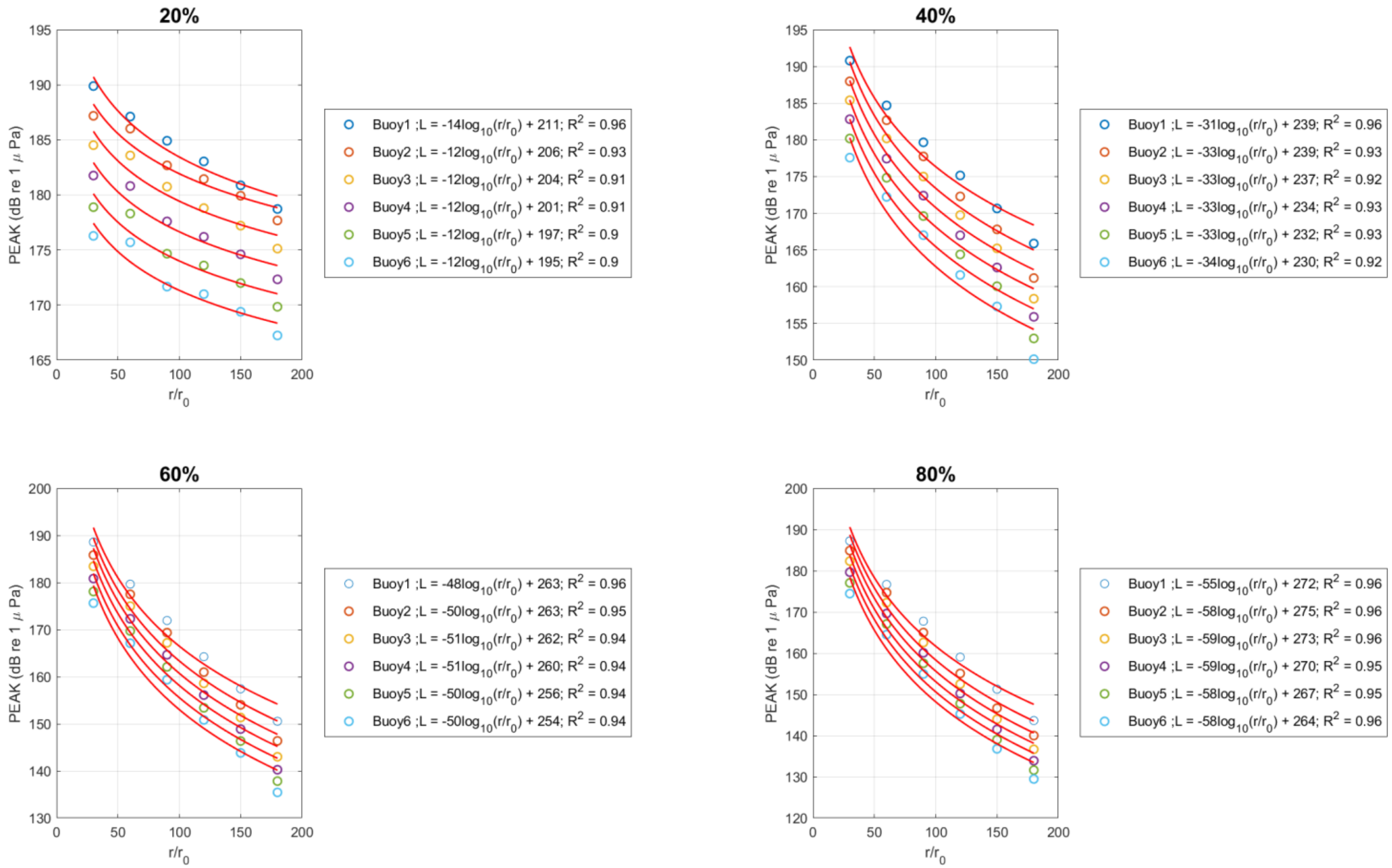
Sound Decay Curves for Different Bottom Absorption Coefficients for S-Y100Z10 (C = 1000Pa)

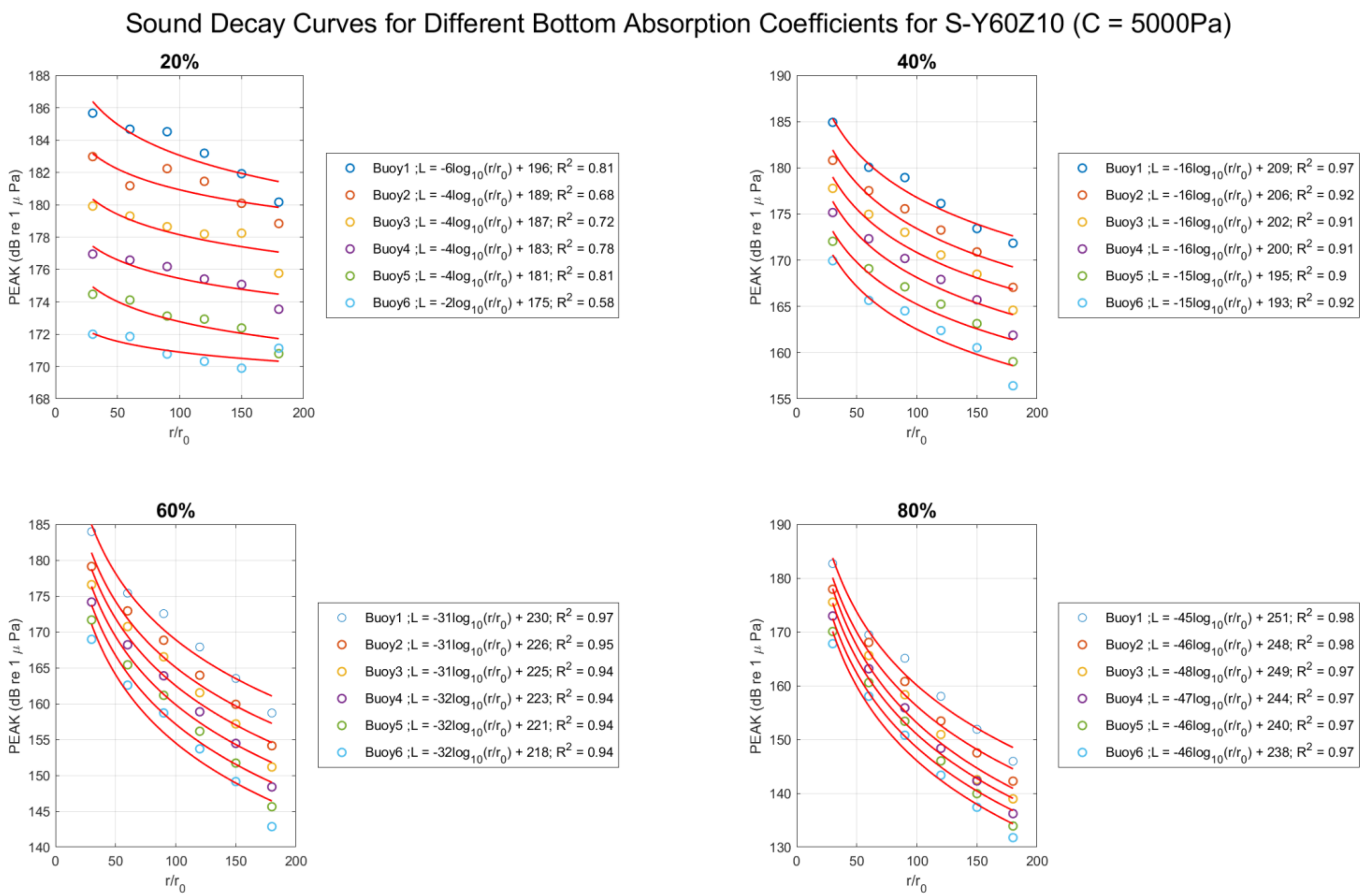


Sound Decay Curves for Different Bottom Absorption Coefficients for S-Y30Z10 (C = 5000Pa)

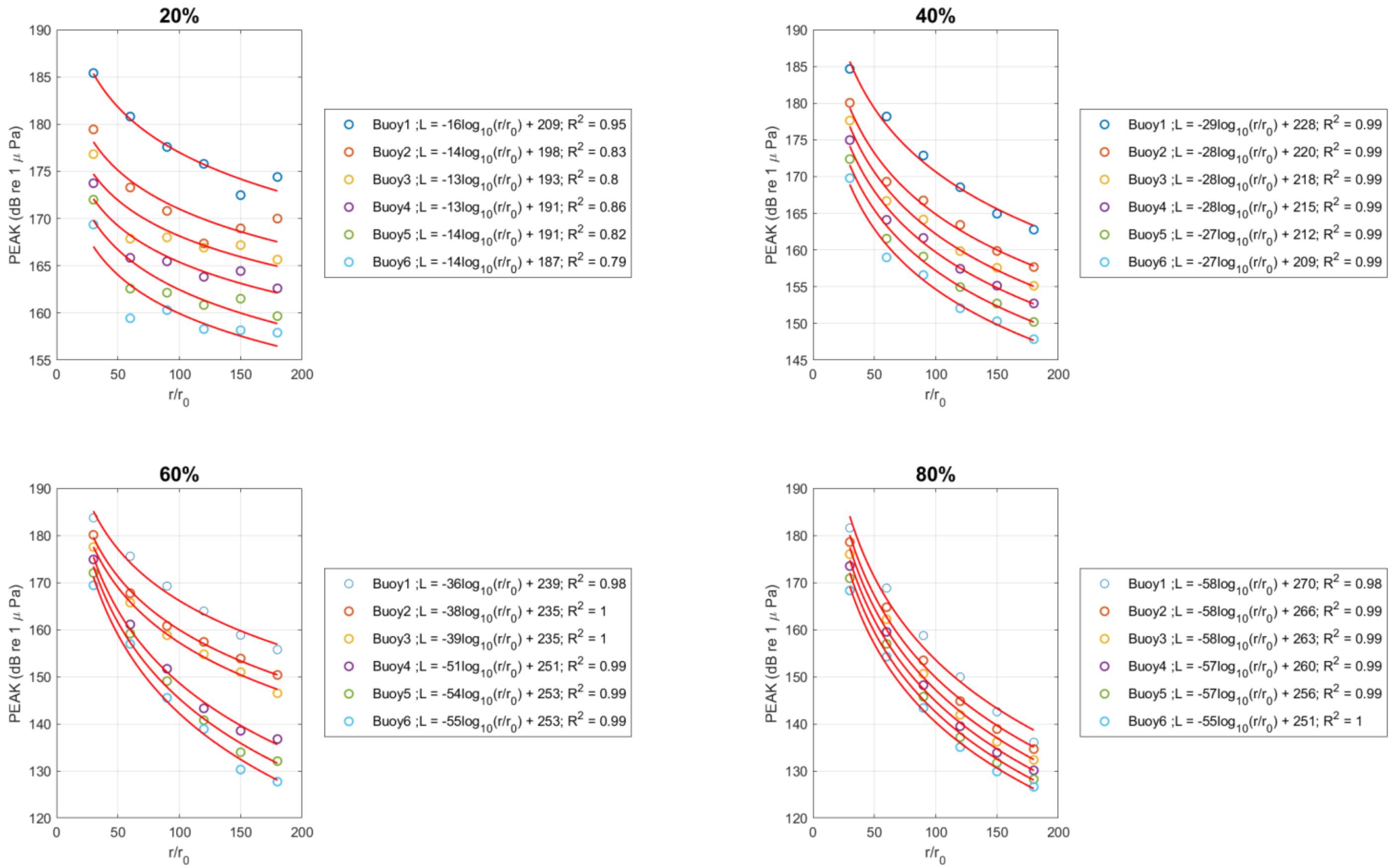


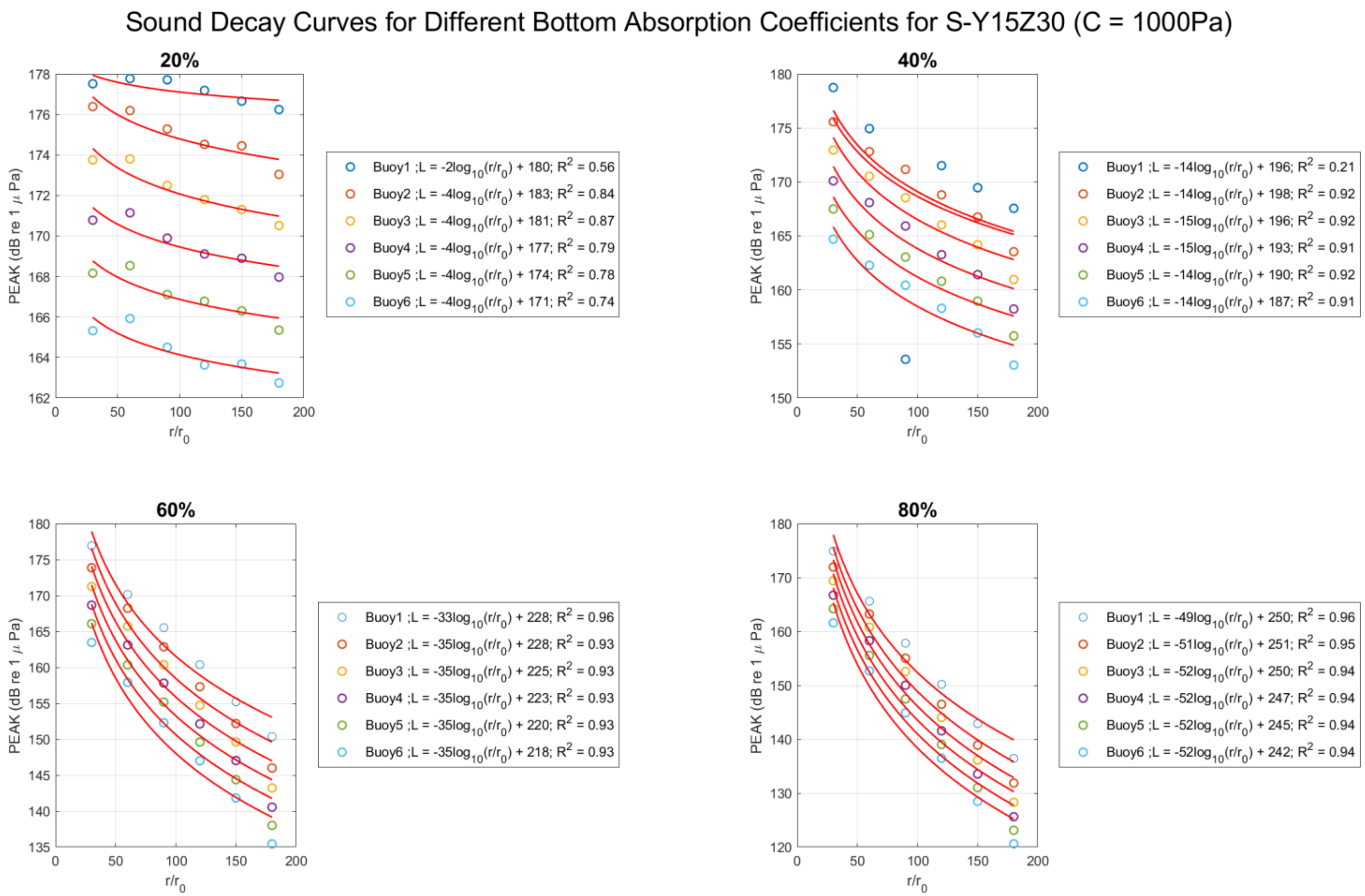
Sound Decay Curves for Different Bottom Absorption Coefficients for S-Y15Z10 (C = 5000Pa)




Sound Decay Curves for Different Bottom Absorption Coefficients for S-Y60Z10 (C = 5000Pa)
20%
Buoy1 ;$L = -6\log_{10}(r/r_0) + 196$; $R^2 = 0.81$
Buoy2 ;$L = -4\log_{10}(r/r_0) + 189$; $R^2 = 0.68$
Buoy3 ;$L = -4\log_{10}(r/r_0) + 187$; $R^2 = 0.72$
Buoy4 ;$L = -4\log_{10}(r/r_0) + 183$; $R^2 = 0.78$
Buoy5 ;$L = -4\log_{10}(r/r_0) + 181$; $R^2 = 0.81$
Buoy6 ;$L = -2\log_{10}(r/r_0) + 175$; $R^2 = 0.58$
40%
Buoy1 ;$L = -16\log_{10}(r/r_0) + 209$; $R^2 = 0.97$
Buoy2 ;$L = -16\log_{10}(r/r_0) + 206$; $R^2 = 0.92$
Buoy3 ;$L = -16\log_{10}(r/r_0) + 202$; $R^2 = 0.91$
Buoy4 ;$L = -16\log_{10}(r/r_0) + 200$; $R^2 = 0.91$
Buoy5 ;$L = -15\log_{10}(r/r_0) + 195$; $R^2 = 0.9$
Buoy6 ;$L = -15\log_{10}(r/r_0) + 193$; $R^2 = 0.92$
60%
Buoy1 ;$L = -31\log_{10}(r/r_0) + 230$; $R^2 = 0.97$
Buoy2 ;$L = -31\log_{10}(r/r_0) + 226$; $R^2 = 0.95$
Buoy3 ;$L = -31\log_{10}(r/r_0) + 225$; $R^2 = 0.94$
Buoy4 ;$L = -32\log_{10}(r/r_0) + 223$; $R^2 = 0.94$
Buoy5 ;$L = -32\log_{10}(r/r_0) + 221$; $R^2 = 0.94$
Buoy6 ;$L = -32\log_{10}(r/r_0) + 218$; $R^2 = 0.94$
80%
Buoy1 ;$L = -45\log_{10}(r/r_0) + 251$; $R^2 = 0.98$
Buoy2 ;$L = -46\log_{10}(r/r_0) + 248$; $R^2 = 0.98$
Buoy3 ;$L = -48\log_{10}(r/r_0) + 249$; $R^2 = 0.97$
Buoy4 ;$L = -47\log_{10}(r/r_0) + 244$; $R^2 = 0.97$
Buoy5 ;$L = -46\log_{10}(r/r_0) + 240$; $R^2 = 0.97$
Buoy6 ;$L = -46\log_{10}(r/r_0) + 238$; $R^2 = 0.97$
PEAK (dB re 1 μ Pa)
r/r_0

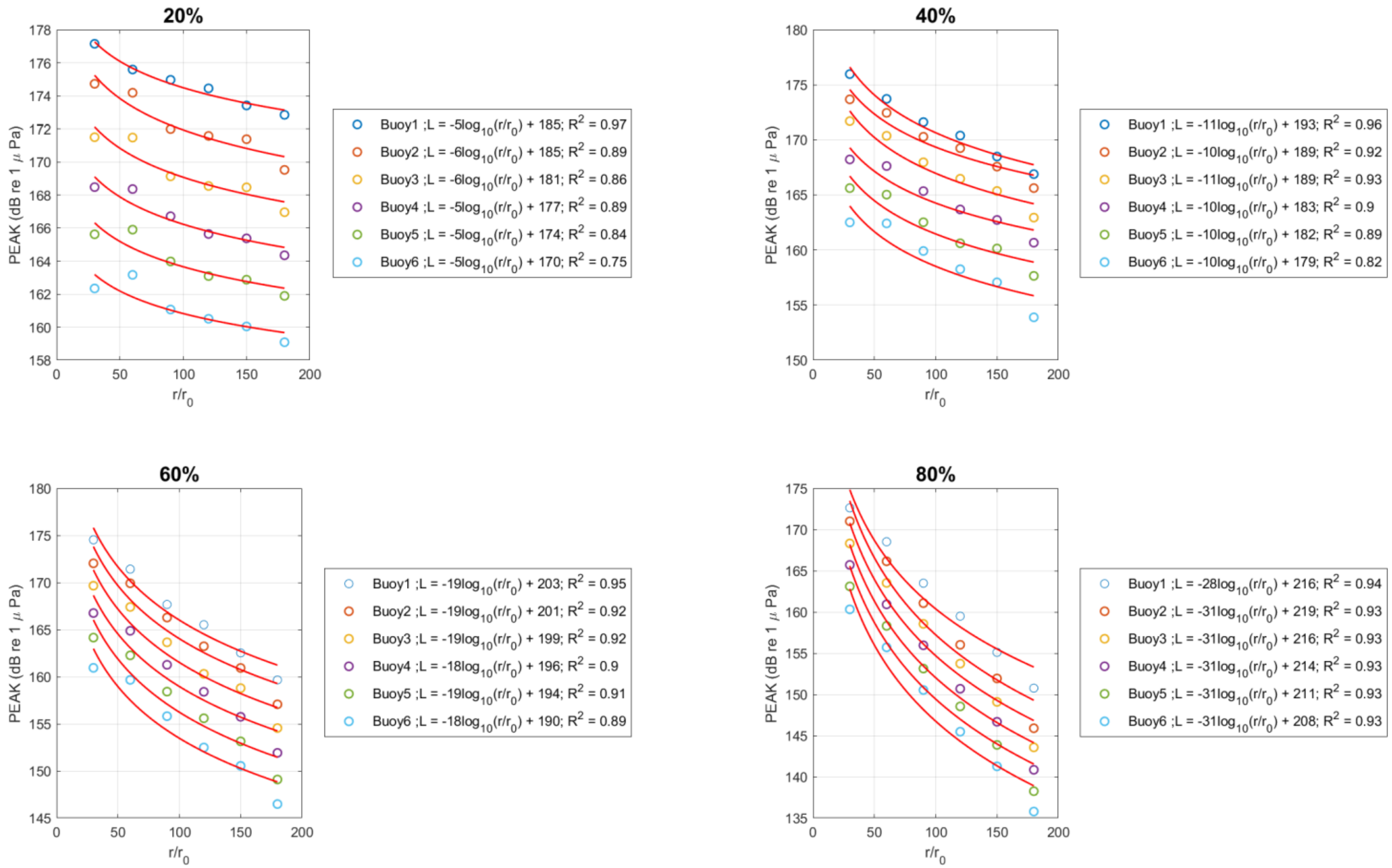
Sound Decay Curves for Different Bottom Absorption Coefficients for S-Y100Z10 (C = 5000Pa)



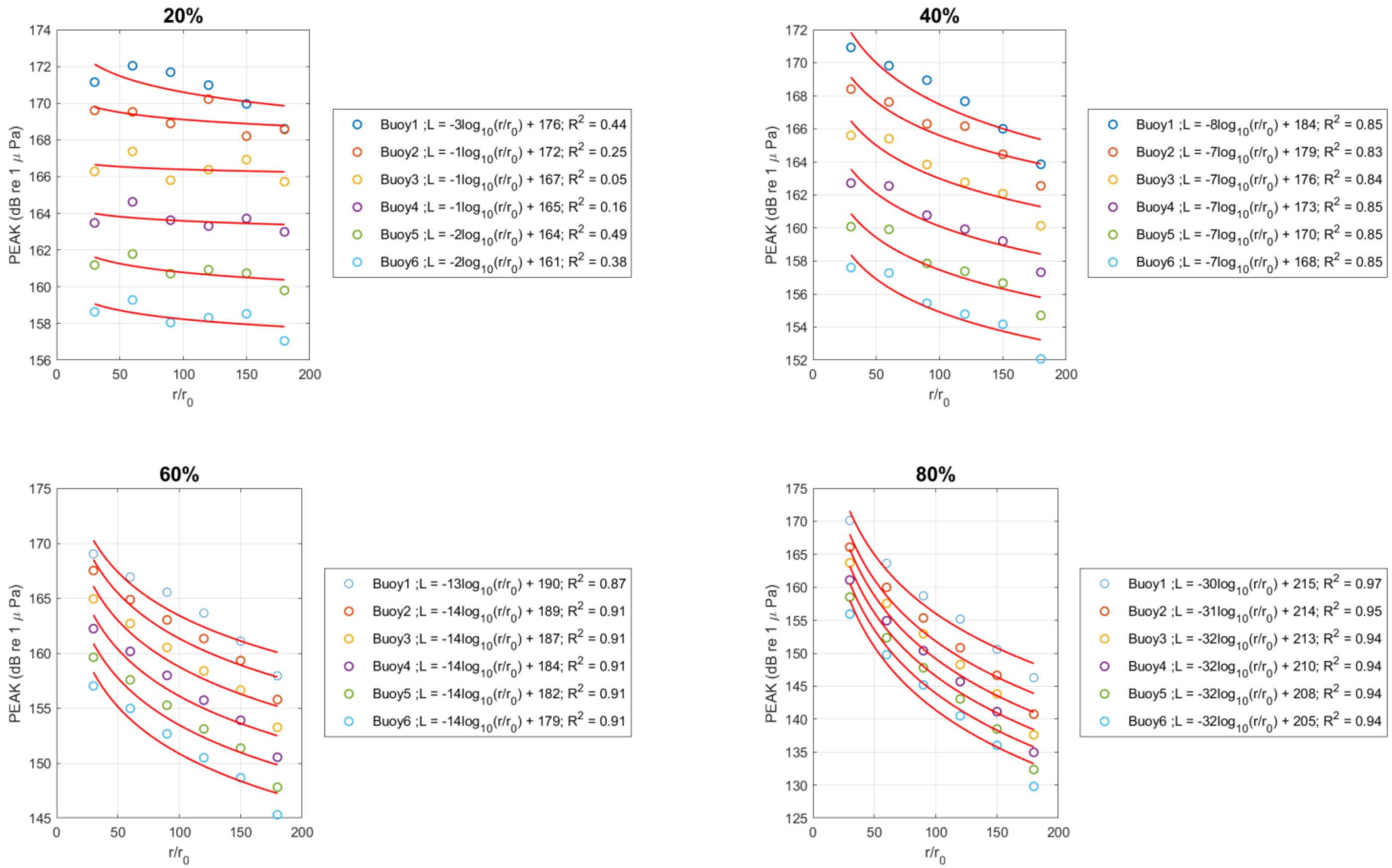


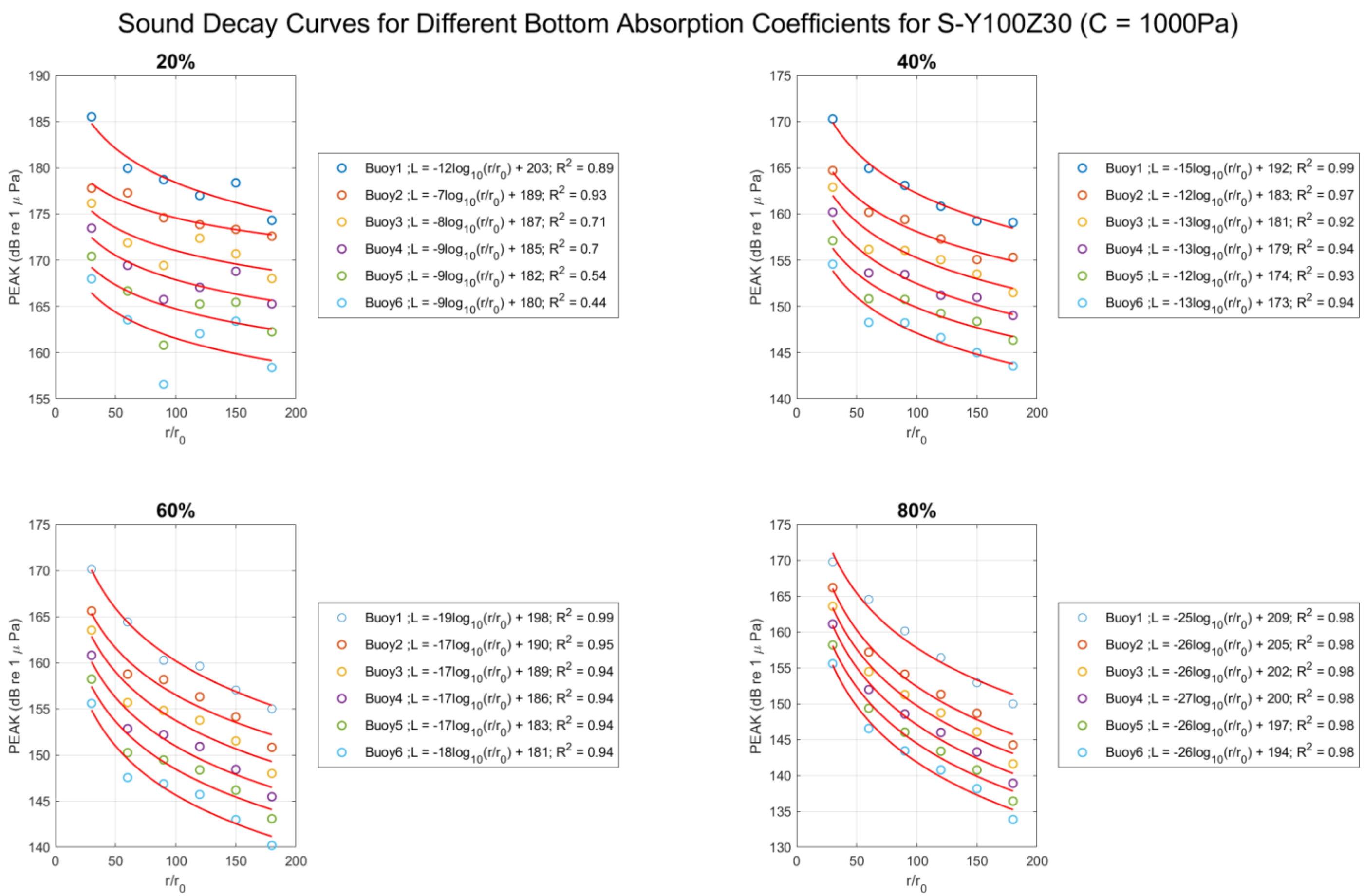
Sound Decay Curves for Different Bottom Absorption Coefficients for S-Y15Z30 (C = 1000Pa)
20%
Buoy1 ;L = -2log10(r/r0) + 180; R2 = 0.56
Buoy2 ;L = -4log10(r/r0) + 183; R2 = 0.84
Buoy3 ;L = -4log10(r/r0) + 181; R2 = 0.87
Buoy4 ;L = -4log10(r/r0) + 177; R2 = 0.79
Buoy5 ;L = -4log10(r/r0) + 174; R2 = 0.78
Buoy6 ;L = -4log10(r/r0) + 171; R2 = 0.74
40%
Buoy1 ;L = -14log10(r/r0) + 196; R2 = 0.21
Buoy2 ;L = -14log10(r/r0) + 198; R2 = 0.92
Buoy3 ;L = -15log10(r/r0) + 196; R2 = 0.92
Buoy4 ;L = -15log10(r/r0) + 193; R2 = 0.91
Buoy5 ;L = -14log10(r/r0) + 190; R2 = 0.92
Buoy6 ;L = -14log10(r/r0) + 187; R2 = 0.91
60%
Buoy1 ;L = -33log10(r/r0) + 228; R2 = 0.96
Buoy2 ;L = -35log10(r/r0) + 228; R2 = 0.93
Buoy3 ;L = -35log10(r/r0) + 225; R2 = 0.93
Buoy4 ;L = -35log10(r/r0) + 223; R2 = 0.93
Buoy5 ;L = -35log10(r/r0) + 220; R2 = 0.93
Buoy6 ;L = -35log10(r/r0) + 218; R2 = 0.93
80%
Buoy1 ;L = -49log10(r/r0) + 250; R2 = 0.96
Buoy2 ;L = -51log10(r/r0) + 251; R2 = 0.95
Buoy3 ;L = -52log10(r/r0) + 250; R2 = 0.94
Buoy4 ;L = -52log10(r/r0) + 247; R2 = 0.94
Buoy5 ;L = -52log10(r/r0) + 245; R2 = 0.94
Buoy6 ;L = -52log10(r/r0) + 242; R2 = 0.94
PEAK (dB re 1 μ Pa)
r/r0

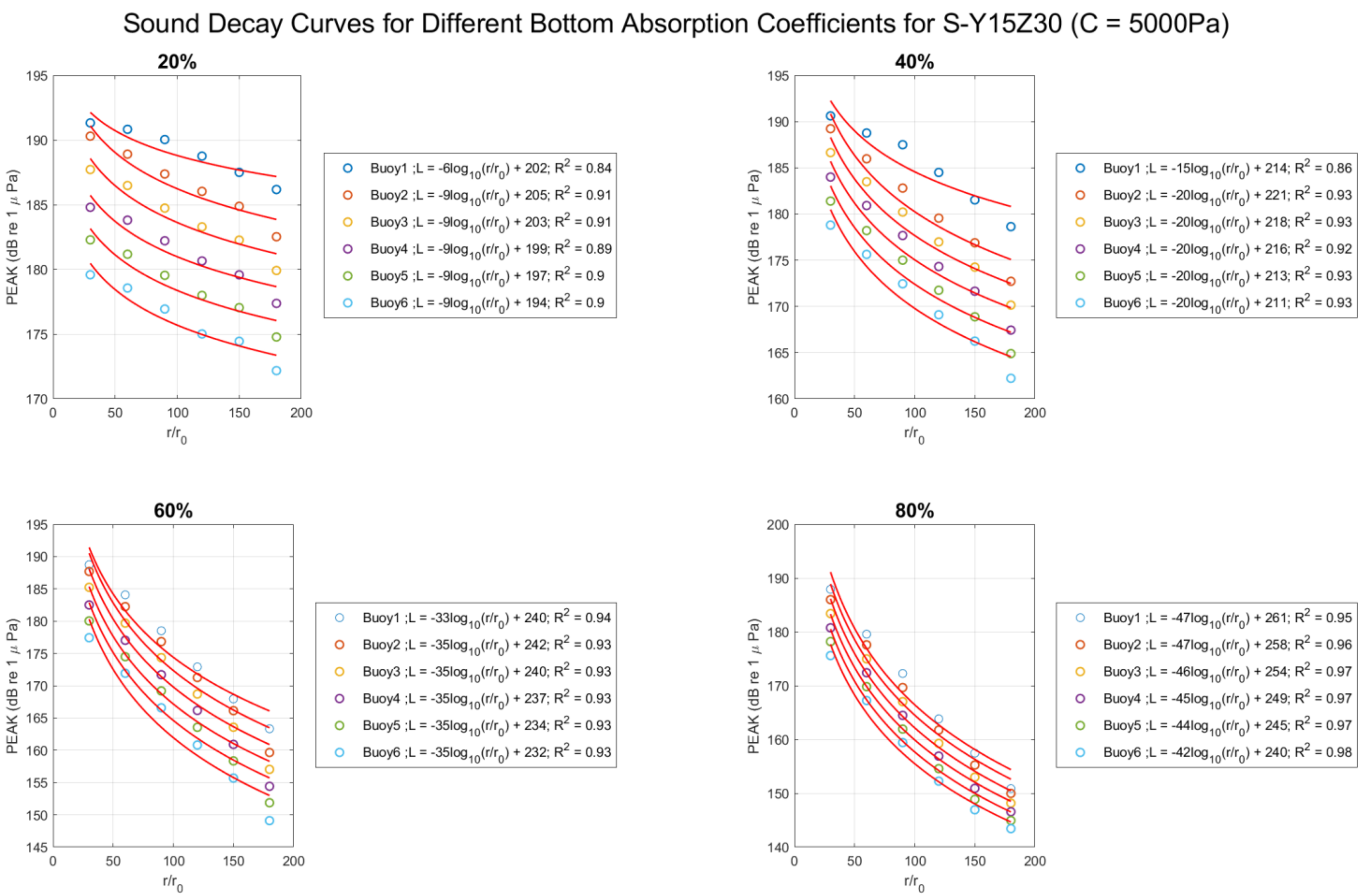
Sound Decay Curves for Different Bottom Absorption Coefficients for S-Y30Z30 (C = 1000Pa)



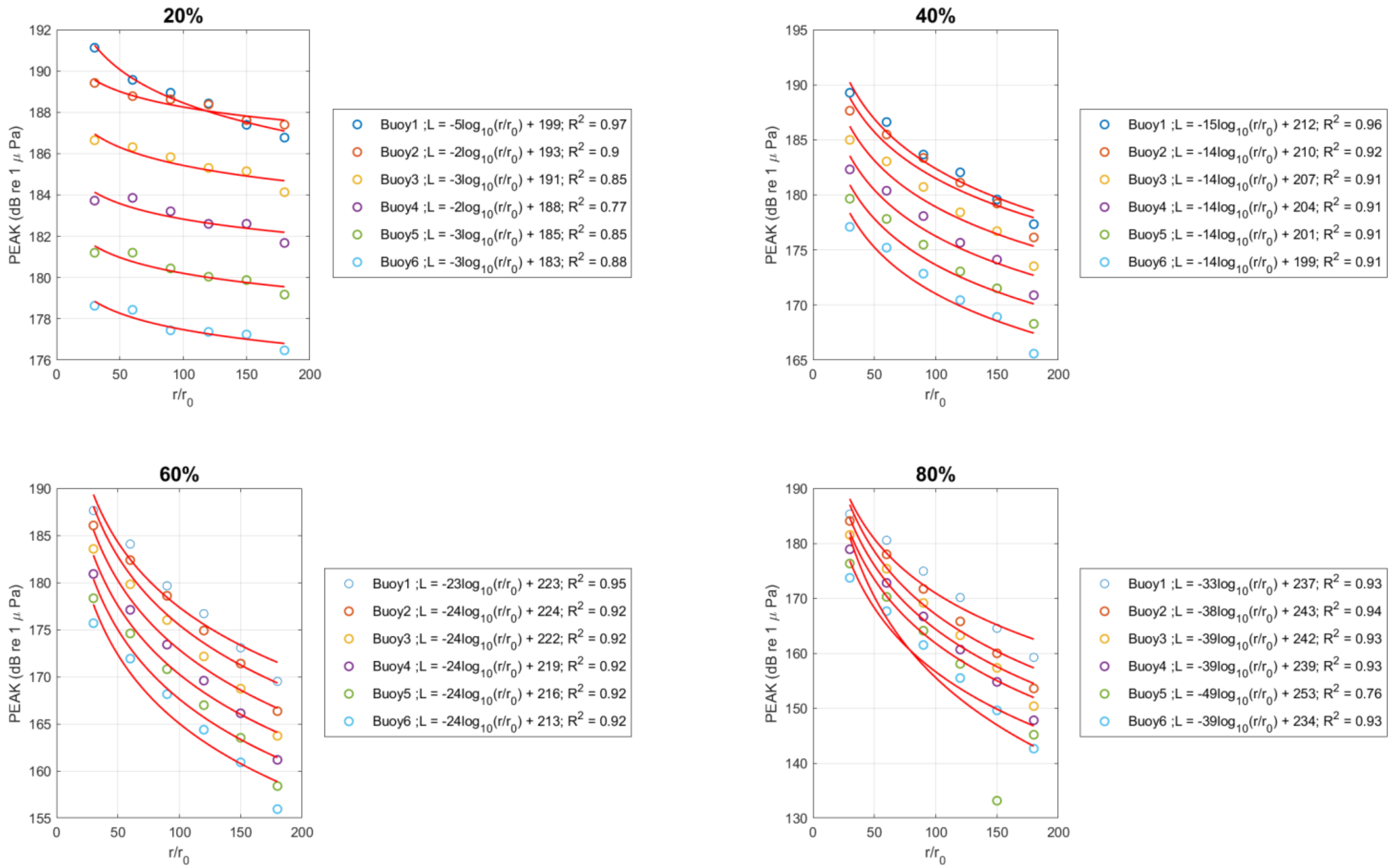
Sound Decay Curves for Different Bottom Absorption Coefficients for S-Y60Z30 (C = 1000Pa)

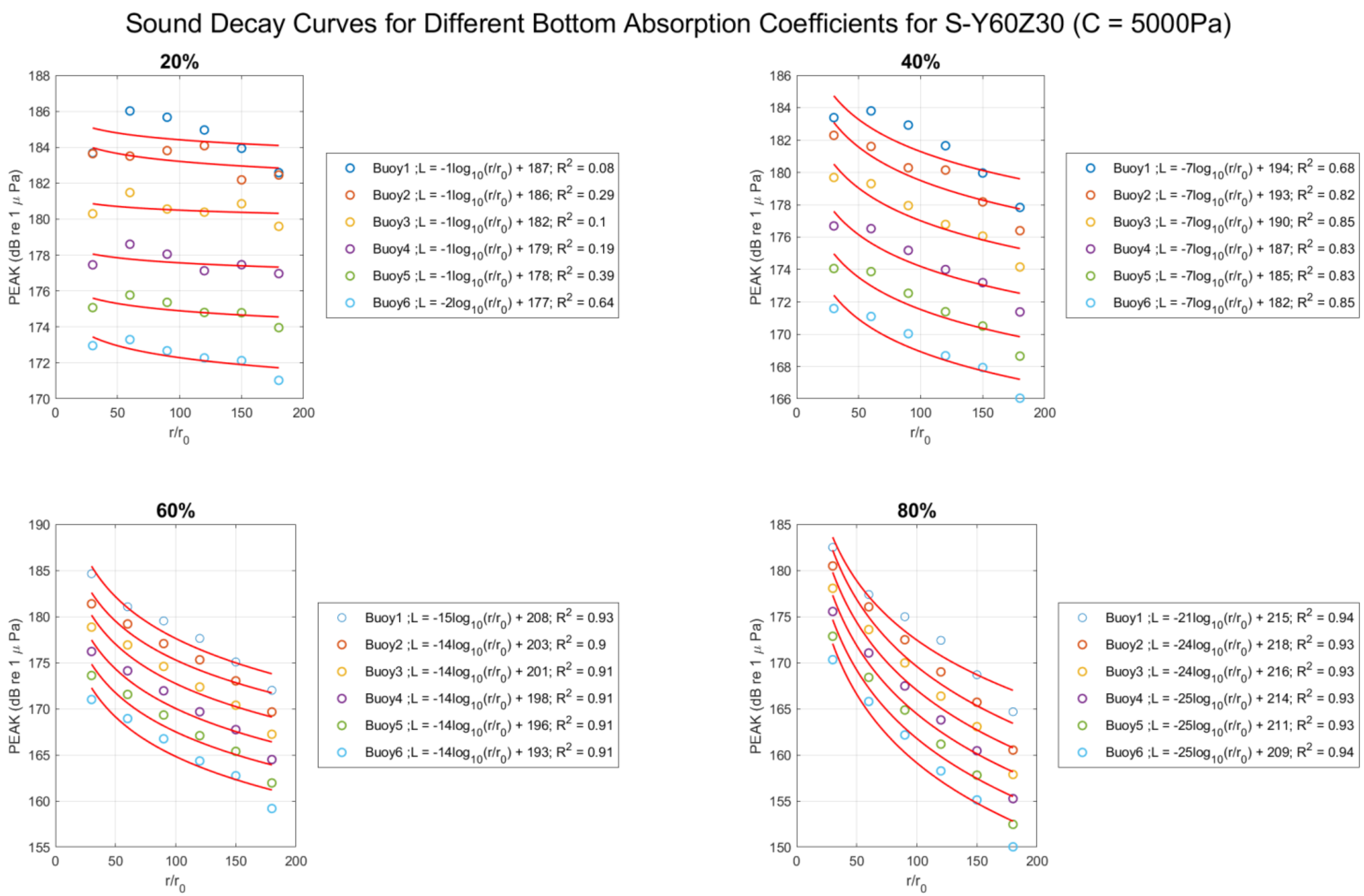



Sound Decay Curves for Different Bottom Absorption Coefficients for S-Y100Z30 (C = 1000Pa)
20%
40%
60%
80%
PEAK (dB re 1 μ Pa)
r/r0
Buoy1 ;L = -12log10(r/r0) + 203; R2 = 0.89
Buoy2 ;L = -7log10(r/r0) + 189; R2 = 0.93
Buoy3 ;L = -8log10(r/r0) + 187; R2 = 0.71
Buoy4 ;L = -9log10(r/r0) + 185; R2 = 0.7
Buoy5 ;L = -9log10(r/r0) + 182; R2 = 0.54
Buoy6 ;L = -9log10(r/r0) + 180; R2 = 0.44
Buoy1 ;L = -15log10(r/r0) + 192; R2 = 0.99
Buoy2 ;L = -12log10(r/r0) + 183; R2 = 0.97
Buoy3 ;L = -13log10(r/r0) + 181; R2 = 0.92
Buoy4 ;L = -13log10(r/r0) + 179; R2 = 0.94
Buoy5 ;L = -12log10(r/r0) + 174; R2 = 0.93
Buoy6 ;L = -13log10(r/r0) + 173; R2 = 0.94
Buoy1 ;L = -19log10(r/r0) + 198; R2 = 0.99
Buoy2 ;L = -17log10(r/r0) + 190; R2 = 0.95
Buoy3 ;L = -17log10(r/r0) + 189; R2 = 0.94
Buoy4 ;L = -17log10(r/r0) + 186; R2 = 0.94
Buoy5 ;L = -17log10(r/r0) + 183; R2 = 0.94
Buoy6 ;L = -18log10(r/r0) + 181; R2 = 0.94
Buoy1 ;L = -25log10(r/r0) + 209; R2 = 0.98
Buoy2 ;L = -26log10(r/r0) + 205; R2 = 0.98
Buoy3 ;L = -26log10(r/r0) + 202; R2 = 0.98
Buoy4 ;L = -27log10(r/r0) + 200; R2 = 0.98
Buoy5 ;L = -26log10(r/r0) + 197; R2 = 0.98
Buoy6 ;L = -26log10(r/r0) + 194; R2 = 0.98

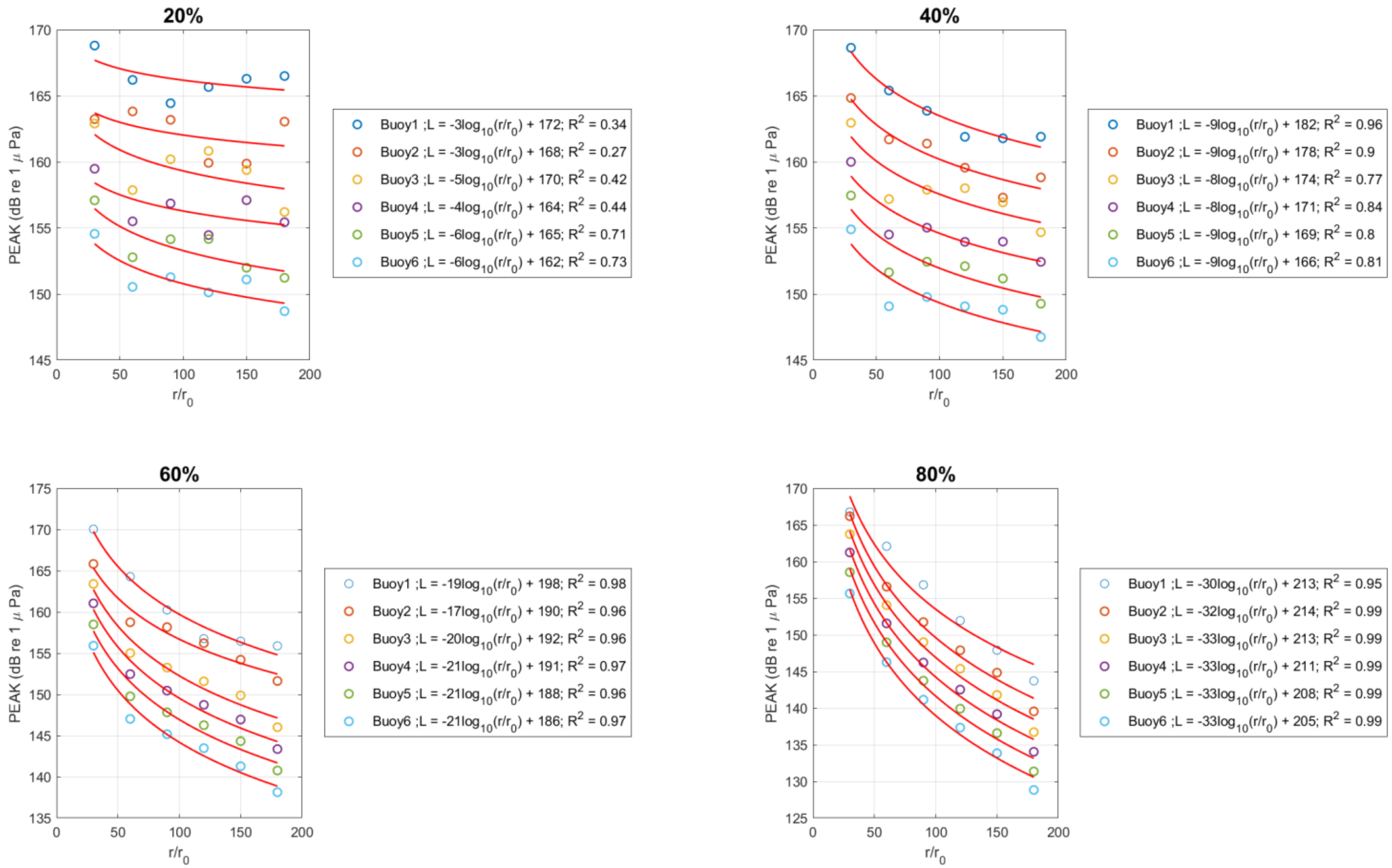

Sound Decay Curves for Different Bottom Absorption Coefficients for S-Y15Z30 (C = 5000Pa)
20%
40%
60%
80%
PEAK (dB re 1 μ Pa)
r/r0
Buoy1 ;L = -6log10(r/r0) + 202; R2 = 0.84
Buoy2 ;L = -9log10(r/r0) + 205; R2 = 0.91
Buoy3 ;L = -9log10(r/r0) + 203; R2 = 0.91
Buoy4 ;L = -9log10(r/r0) + 199; R2 = 0.89
Buoy5 ;L = -9log10(r/r0) + 197; R2 = 0.9
Buoy6 ;L = -9log10(r/r0) + 194; R2 = 0.9
Buoy1 ;L = -15log10(r/r0) + 214; R2 = 0.86
Buoy2 ;L = -20log10(r/r0) + 221; R2 = 0.93
Buoy3 ;L = -20log10(r/r0) + 218; R2 = 0.93
Buoy4 ;L = -20log10(r/r0) + 216; R2 = 0.92
Buoy5 ;L = -20log10(r/r0) + 213; R2 = 0.93
Buoy6 ;L = -20log10(r/r0) + 211; R2 = 0.93
Buoy1 ;L = -33log10(r/r0) + 240; R2 = 0.94
Buoy2 ;L = -35log10(r/r0) + 242; R2 = 0.93
Buoy3 ;L = -35log10(r/r0) + 240; R2 = 0.93
Buoy4 ;L = -35log10(r/r0) + 237; R2 = 0.93
Buoy5 ;L = -35log10(r/r0) + 234; R2 = 0.93
Buoy6 ;L = -35log10(r/r0) + 232; R2 = 0.93
Buoy1 ;L = -47log10(r/r0) + 261; R2 = 0.95
Buoy2 ;L = -47log10(r/r0) + 258; R2 = 0.96
Buoy3 ;L = -46log10(r/r0) + 254; R2 = 0.97
Buoy4 ;L = -45log10(r/r0) + 249; R2 = 0.97
Buoy5 ;L = -44log10(r/r0) + 245; R2 = 0.97
Buoy6 ;L = -42log10(r/r0) + 240; R2 = 0.98

Sound Decay Curves for Different Bottom Absorption Coefficients for S-Y30Z30 (C = 5000Pa)




Sound Decay Curves for Different Bottom Absorption Coefficients for S-Y60Z30 (C = 5000Pa)
20%
40%
60%
80%
PEAK (dB re 1 μ Pa)
r/r0
Buoy1 ;L = -1log10(r/r0) + 187; R2 = 0.08
Buoy2 ;L = -1log10(r/r0) + 186; R2 = 0.29
Buoy3 ;L = -1log10(r/r0) + 182; R2 = 0.1
Buoy4 ;L = -1log10(r/r0) + 179; R2 = 0.19
Buoy5 ;L = -1log10(r/r0) + 178; R2 = 0.39
Buoy6 ;L = -2log10(r/r0) + 177; R2 = 0.64
Buoy1 ;L = -7log10(r/r0) + 194; R2 = 0.68
Buoy2 ;L = -7log10(r/r0) + 193; R2 = 0.82
Buoy3 ;L = -7log10(r/r0) + 190; R2 = 0.85
Buoy4 ;L = -7log10(r/r0) + 187; R2 = 0.83
Buoy5 ;L = -7log10(r/r0) + 185; R2 = 0.83
Buoy6 ;L = -7log10(r/r0) + 182; R2 = 0.85
Buoy1 ;L = -15log10(r/r0) + 208; R2 = 0.93
Buoy2 ;L = -14log10(r/r0) + 203; R2 = 0.9
Buoy3 ;L = -14log10(r/r0) + 201; R2 = 0.91
Buoy4 ;L = -14log10(r/r0) + 198; R2 = 0.91
Buoy5 ;L = -14log10(r/r0) + 196; R2 = 0.91
Buoy6 ;L = -14log10(r/r0) + 193; R2 = 0.91
Buoy1 ;L = -21log10(r/r0) + 215; R2 = 0.94
Buoy2 ;L = -24log10(r/r0) + 218; R2 = 0.93
Buoy3 ;L = -24log10(r/r0) + 216; R2 = 0.93
Buoy4 ;L = -25log10(r/r0) + 214; R2 = 0.93
Buoy5 ;L = -25log10(r/r0) + 211; R2 = 0.93
Buoy6 ;L = -25log10(r/r0) + 209; R2 = 0.94

Sound Decay Curves for Different Bottom Absorption Coefficients for S-Y100Z30 (C = 5000Pa)



LIST OF REFERENCES

Ainslie, M. A., Dahl, P. E., de Jong, W. M., and Laws, R. M. "Practical Spreading Laws: The Snakes and Ladders of Underwater Acoustics." *Proc., 2nd International Conference and Exhibition on Underwater Acoustics*, 879-886.

Bagočius, D. (2015). "Piling underwater noise impact on migrating salmon fish during Lithuanian LNG terminal construction (Curonian Lagoon, Eastern Baltic Sea Coast)." *Marine Pollution Bulletin*, 92(1), 45-51.

Buehler, D., Oestman, R., Reyff, J., Pommerenck, K., and Mitchell, B. (2015). "Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish." California Department of Transportation, Sacramento, CA.

Castellanos, J. F. (2015). "Pile Driving Inspector's Qualification Course." Florida Department of Transportation Tallahassee, FL.

Cepowski, T. 2017. ndCurveMasater 6.0, www.ndcurvemaster.com.

Dahl, P. H. (2013). "Beam Forming of the Underwater Soudn Field from Impact Pile Driving." *Journal of Acoustic Society of America*, 134(EL1 (2013)).

Madsen, P. T., Johnson, M., Miller, P. J., Aguilar Soto, N., Lynch, J., and Tyack, P. (2006). "Quantitative measures of air-gun pulses recorded on sperm whales (Physeter macrocephalus) using acoustic tags during controlled exposure experiments." *J Acoust Soc Am*, 120(4), 2366-2379.

Popper, A. N., and Hawkins, A. D. (2019). "An overview of fish bioacoustics and the impacts of anthropogenic sounds on fishes." *Journal of Fish Biology*, 94(5), 692-713.

Reinhall, P. G., and Dahl, P. H. (2011). "An Investigation of Underwater Sound Propogation from Pile Driving." *WSDOT Research Report*, Washington State Department of Transportation, Office of Research and Library Services, Olympia, WA.

Reinhall, P. G., Dardis, T., and Dahl, P. H. (2015). "Underwater Noise Reduction of Marine Pile Driving using a Double Pile." Washington State Transportation Center, Seattle, WA.

Siemens. 2021. Simcenter STAR-CCM+, Version 2021.1, version 2021.1.