Project Title: Statistical Model to Predict the Compressibility of Florida’s Soils
(BDV24 TWO 977-24)

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Work Tasks

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- **Tasks**
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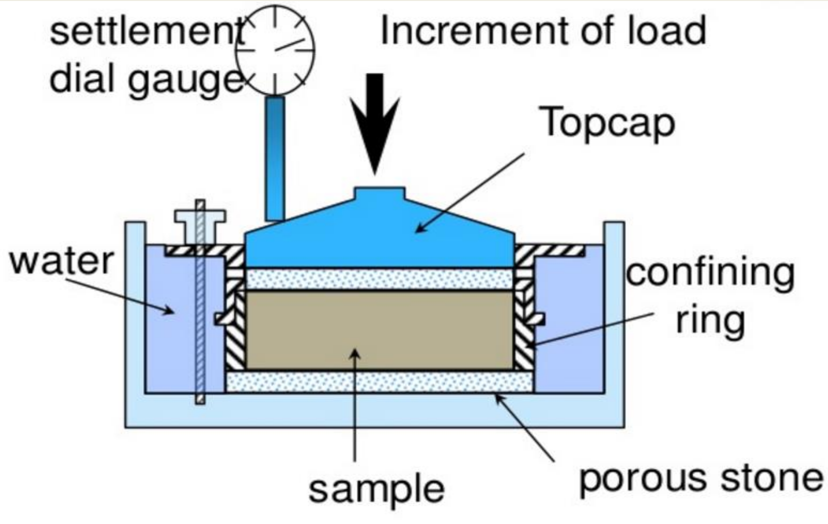
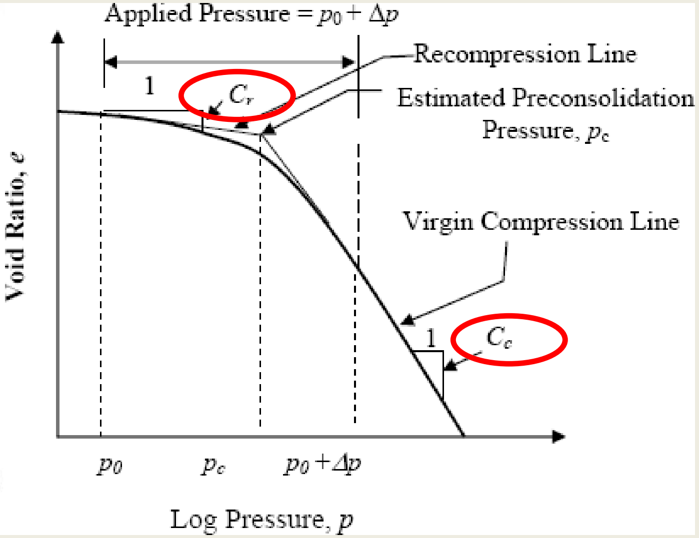
Project Objectives

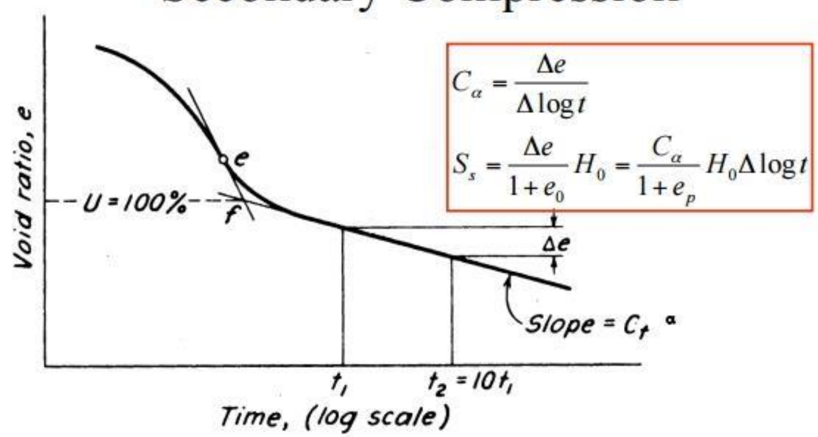
- To identify statistically significant affecting variables on Cc and Cr and to evaluate their correlations
- To identify the most accurate model of soil compressibility (from statistical perspective) for Florida’s soils.
- To develop the best performing statistical models to predict Cc, Cr, Cv, and Ca for Florida’s soils
  - State-of-the-art statistical techniques will be used
  - Models will be developed for specific soil types

Background





Secondary Compression



$$C_\alpha = \frac{\Delta e}{\Delta \log t}$$

$$S_s = \frac{\Delta e}{1+e_0} H_0 = \frac{C_\alpha}{1+e_p} H_0 \Delta \log t$$

- Deformation of soil under constant load
- No excess pore pressure
- Affects properties of the clay
- Secondary compression index = C_α

$$c_v = \frac{T H^2_{D_{50}}}{t}$$

where:

T = a dimensionless time factor: for method 12.3.1 use 50 % consolidation with T $= T_{50} = 0.197$, for method 12.3.2 use 90 % consolidation with $T = T_{90} = 0.848$,

t = time corresponding to the particular degree of consolidation, s or min; for method 12.3.1 use $t = t_{50}$, for method 12.3.2 use $t = t_{90}$, and

$H_{D_{50}}$ = length of the drainage path at 50 % consolidation,

Cv = coefficient of consolidation

C_α = secondary compression index

Background (cont.)

Problem Statement:

- Consolidation testing for the Cc, Cr, and Cv (coefficient of consolidation) is time-consuming and labor-intensive. Those indexes are difficult to quantify and have large uncertainty.
- Two ways to determine Cc, Cr, and Cv: (1) direct measurement via lab test and (2) correlation to other soil data determined from lab tests.
- Many previous studies on prediction models of soil compressibility such as Cc, Cr, and Cv. However, those models may not be accurate enough for Florida’s soil conditions because the models are constructed based on local soils and most models are based on a simple linear regression model.

Task 1: Identify the existing Cc, Cr, and Cv models

- Literature review to identify the existing correlations of soil compressibility.

- Informal survey to Districts and consultants

Existing prediction models

Ind. Variable	Dep. Variable	Equation	Reference	Notes
Cc	w	$C_c = 0.01w - 0.05$	Azzouz (1976)	All soils
		$C_c = 0.01w$	Koppula (1981)	Clays
		$C_c = 0.01w - 0.075$	Herrero (1983)	Clays
		$C_c = 0.013w - 0.115$	Park, Lee (2011)	Clays
		$C_c = 0.0075w$	Miyakawa (1960)	Peat
		$C_c = 0.011w$	Cook (1956)	Peat
	e	$C_c = 0.54e - 0.19$	Nishida (1956)	Clays
		$C_c = 0.43e - 0.11$	Cozzolino (1961)	Clays
		$C_c = 0.75e - 0.38$	Sowers (1970)	Clays
		$C_c = 0.49e - 0.11$	Park, Lee (2011)	Clays
		$C_c = 0.4(e-0.25)$	Azzouz (1976)	All soils
		$C_c = 0.15e + 0.01077$	Bowles (1989)	Clays
		$C_c = 0.287e - 0.015$	Ahadiyan (2008)	Clays
		$C_c = 0.6e$	Sowers (1970)	Peat
		$C_c = 0.3(e-0.27)$	Hough (1957)	Clays
	LL	$C_c = 0.006(LL-9)$	Azzouz (1976)	Clays
		$C_c = (LL-13)/109$	Mayne (1980)	Clays
		$C_c = 0.009(LL-10)$	Terzaghi, Peck (1967)	Clays

		$C_c = 0.014LL-0.168$	Park, Lee (2011)	Clays
		$C_c = 0.0046(LL-9)$	Bowles (1989)	Clays
		$C_c = 0.011(LL-16)$	McClelland (1967)	Clays
	w, LL	$C_c = 0.009w + 0.005LL$	Koppula (1981)	Clays
		$C_c = 0.009w + 0.002LL - 0.01$	Azzouz (1976)	Clays
	e, w	$C_c = 0.4(e + 0.001w - 0.25)$	Azzouz (1976)	All soils
	e, LL	$C_c = -0.156 + 0.411e - 0.00058LL$	Al-Khafaji, Andersland (1992)	Clays
		$C_c = -0.023 + 0.271e + 0.001LL$	Ahadiyan (2008)	Clays
	e, w, LL	$C_c = 0.37(e + 0.003LL +).0004w - 0.34)$	Azzouz (1976)	Clays
		$C_c = -0.404 + 0.341e + 0.006w + 0.004LL$	Yoon, Kim (2008)	Clays
	w, LL, e, γ_{dry}	$C_c = 0.1597(w^{-0.0187})(1 + e)^{1.592}(LL^{-0.0638})(\gamma_{dry}{}^{-0.8276})$	Ozer (2008)	Clays
		$C_c = 0.151 + 0.001225w + 0.193e - 0.000258LL - 0.0699\gamma_{dry}$	Ozer (2008)	Clays
Cr	e	$C_r = 0.156e + 0.0107$	Elnaggar, Krizek (1971)	Clays
		$C_r = 0.208e + 0.0083$	Peck, Reed (1954)	Clays
		$C_r = 0.14(e+0.007)$	Azzouz (1976)	All soils
	w	$C_r = 0.003(w + 7)$	Azzouz (1976)	All soils
	LL	$C_r = 0.002(LL + 9)$	Azzouz (1976)	All soils
	e, w	$C_r = 0.142(e - 0.009w + 0.006)$	Azzouz (1976)	All soils
	w, LL	$C_r = 0.003w + 0.0006LL + 0.004$	Azzouz (1976)	All soils
	e, LL	$C_r = 0.126(e + 0.003LL-0.06)$	Azzouz (1976)	All soils
	e, w, LL	$C_r = 0.135(e + 0.1LL-0.002w - 0.06)$	Azzouz (1976)	All soils

Existing prediction models (cont.)

Cv	LL	$C_v = 116.45LL^{-2.8784}$	US Navy (1971)	Clays
		$C_v = 4258LL^{-1.75}$ (m^2/s)	Asma et al. (2011)	Clays
	ACT, LI, PI	$C_v = [9.09\times10^{-7}(1.192+ACT^{-1})^{6.993}(4.135LI+1)^{4.29}]/[PI(2.04LI+1.192+ACT^{-1})^{7.993}]$ (m^2/s)	Carrier (1985)	Clays
	e_{LL}, σ_v	$C_v = [1+ e_{LL}\ (1.23-0.276\log\sigma_v)]/\ e_{LL} \times[1/\sigma_v^{0.353}]\times10^{-3}$ (cm^2/s)	Raju et al. (1995)	Clays
	SI=LL-SL	$C_v = 3/[100(SI)^{3.54}]$ (m^2/s)	Sridharan, Nagaraj (2004)	Clays
	PI	$C_v = 7.7525PI^{-3.1021}$ (cm^2/s)	Solanki (2011)	Clays
Cα	PI	$C_\alpha = 0.00168 + 0.00033PI$	Nakase et al. (1988)	
	w	$C_\alpha = 0.0001w$	NAVFAC (1982)	
		$C_\alpha = 0.00018w$	Simons, Menzies (1999)	
	Cc	$C_\alpha = 0.032C_c$	Mesri and Godlewski (1977)	$0.025 < C_a < 0.1$
		$C_\alpha = 0.06$ to $0.07C_c$	Mesri (1986)	Peats and organic soil
		$C_\alpha = 0.015$ to $0.03C_c$	Mesri et al. (1990)	Sandy clays
	Cc, LL, PL, w	$C_\alpha = 0.001C_c\cdot LL\cdot PL^{-1.571}\cdot w$	Anagnostopoulos, Grammatikopoulos (2011)	Silts/Clay

Survey Result

Soil Compress. Model	Dependent variable	Equation	Reference	Notes	Number of responses
Cc	w	$C_c = 0.01w - 0.05$	Azzouz (1976)	All soils	1
		$C_c = 0.0054(2.6w - 35)$	Nishida (1956)	Clays	1
		$C_c = 0.01w$	Koppula (1981)	Clays	2
		$C_c = 0.01w - 0.075$	Herrero (1983)	Clays	
		$C_c = 0.013w - 0.115$	Park and Lee (2011)	Clays	
		$C_c = 0.0075w$	Miyakawa (1960)	Peat	1
		$C_c = 0.011w$	Cook (1956)	Peat	2
		$C_c = 0.0102(w - 9.15)$	Hough (1957)	Clays	1
		$C_c = 0.0074w - 0.007$	Kalantary et al. (2012)	Clays	
	e	$C_c = 0.54e - 0.19$	Nishida (1956)	Clays	1
		$C_c = 0.5217(e - 0.2)$	Nishida (1956)	Clays	1
		$C_c = 0.43e - 0.11$	Cozzolino (1961)	Clays	
		$C_c = 0.75e - 0.38$	Sowers (1970)	Clays	
		$C_c = 0.49e - 0.11$	Park, Lee (2011)	Clays	
		$C_c = 0.4(e-0.25)$	Azzouz (1976)	All soils	1
		$C_c = 0.15e + 0.01077$	Bowles (1989)	Clays	2
		$C_c = 0.287e - 0.015$	Ahadiyan (2008)	Clays	
		$C_c = 0.6e$	Sowers (1970)	Peat	1
		$C_c = 0.3(e-0.27)$ Rendon-Herrero (1980)	Hough (1957)??	Clays	1
		$C_c = 0.4049(e-0.3216)$	Hough (1957)	Clays	1
		$C_c = 0.3608e - 0.0713$	Kalantary et al. (2012)	Clays	
	LL	$C_c = 0.006(LL-9)$	Azzouz (1976)	Clays	2
		$C_c = (LL-13)/109$	Mayne (1980)	Clays	1
		$C_c = 0.009(LL-10)$	Terzaghi and Peck (1967)	Clays	10
		$C_c = 0.014LL-0.168$	Park and Lee (2011)	Clays	1
		$C_c = 0.0046(LL-9)$	Bowles (1989)	Clays	2
		$C_c = 0.011(LL-16)$	McClelland (1967)	Clays	
	w, LL	$C_c = 0.009w + 0.005LL$	Koppula (1981)	Clays	4
		$C_c = 0.009w + 0.002LL - 0.01$	Azzouz (1976)	Clays	2
	e, w	$C_c = 0.4(e + 0.001w - 0.25)$	Azzouz (1976)	All soils	1
	e, LL	$C_c = -0.156 + 0.411e - 0.00058LL$	Al-Khafaji, Andersland (1992)	Clays	1
		$C_c = -0.023 + 0.271e + 0.001LL$	Ahadiyan (2008)	Clays	
	e, w, LL	$C_c = 0.37(e + 0.003LL +).0004w - 0.34)$	Azzouz (1976)	Clays	1
		$C_c = -0.404 + 0.341e + 0.006w + 0.004LL$	Yoon and Kim (2008)	Clays	
	w, LL, e, γ_{dry}	$C_c = 0.1597(w^{-0.0187})(1 + e)^{1.592}(LL^{-0.0638})(\gamma_{dry}^{-0.8276})$	Ozer (2008)	Clays	
		$C_c = 0.151 + 0.001225w + 0.193e - 0.000258LL - 0.0699\gamma_{dry}$	Ozer (2008)	Clays	
	Gs, PI	$C_c = 0.5Gs*[PI(\%)]/100$	Wroth and Wood (1978)	Clays	1

Top Correlation:

Terzaghi and Peck (1967)

$$C_c = 0.009(LL - 10)$$

Survey Result

- Total 10 responses

Cr	e	C_r = 0.156e + 0.0107	Elnaggar and Krizek (1971)	Clays	
		C_r = 0.208e + 0.0083	Peck and Reed (1954)	Clays	2
		C_r = 0.14(e+0.007)	Azzouz (1976)	All soils	1
	w	C_r = 0.003(w + 7)	Azzouz (1976)	All soils	2
		C_r = w/1000	Cheney and Chassie (1993)	All soils	2
	LL	C_r = 0.002(LL + 9)	Azzouz (1976)	All soils	1
	e, w	C_r = 0.142(e – 0.009w + 0.006)	Azzouz (1976)	All soils	1
	w, LL	C_r = 0.003w + 0.0006LL + 0.004	Azzouz (1976)	All soils	3
	e, LL	C_r = 0.126(e + 0.003LL-0.06)	Azzouz (1976)	All soils	1
	e, w, LL	C_r = 0.135(e + 0.1LL-0.002w – 0.06)	Azzouz (1976)	All soils	1
	Cc	C_r = (0.05 to 0.2)* C_c			1
	PI	C_r = PI/370	Kulhawy and Mayne (1990)	Clays	1

Top Correlation:
Azzouz et al. (1976)

$$C_r = 0.003w + 0.0006LL + 0.004$$

Survey Result

- Total 10 responses

Cv	**LL**	$C_v = 116.45LL^{-2.8784}$	US Navy (1971)	Clays	2
		$C_v = 4258LL^{-1.75}$ (m^2/s)	Asma et al. (2011)	Clays	1
	ACT, LI, PI	$C_v = [9.09\times10^{-7}(1.192+ACT^{-1})^{6.993}(4.135LI+1)^{4.29}]/[PI(2.04LI+1.192+ACT^{-1})^{7.993}]$ (m^2/s)	Carrier (1985)	Clays	1
	e_{LL}, σ_v	$C_v = [1+ e_{LL} (1.23-0.276\log\sigma_v)]/ e_{LL} \times[1/\sigma_v^{0.353}]\times10^{-3}$ (cm^2/s)	Raju et al. (1995)	Clays	
	SI=LL-SL	$C_v = 3/[100(SI)^{3.54}]$ (m^2/s)	Sridharan, Nagaraj (2004)	Clays	
	PI	$C_v = 7.7525PI^{-3.1021}$ (cm^2/s)	Solanki (2011)	Clays	
Cα	PI	$C_\alpha = 0.00168 + 0.00033PI$	Nakase et al. (1988)		2
	w	$C_\alpha = 0.0001w$	NAVFAC (1982)		3
		$C_\alpha = 0.00018w$	Simons, Menzies (1999)		
	Cc	$C_\alpha = 0.032C_c$	Mesri and Godlewski (1977)	$0.025 < C_a < 0.1$	
		$C_\alpha = 0.06$ to $0.07C_c$	Mesri (1986)	Peats and organic soil	3
		$C_\alpha = 0.015$ to $0.03C_c$	Mesri et al. (1990)	Sandy clays	1
		$C_\alpha = (0.03$ to $0.09)*C_c$			1
	Cc, LL, PL, w	$C_\alpha = 0.001C_c\cdot LL\cdot PL^{-1.571}\cdot w$	Anagnostopoulos, Grammatikopoulos (2011)	Silts/Clay	

Top Correlations:

US Navy (1971)

$$C_v = 116.45 * LL^{-2.8784}$$

NAVFAC (1982)

$$C_a = 0.0001w$$

Task 2: Compare the accuracy with existing models

- Compare the accuracy of the prediction models identified in Task 1.
  - With respect to root mean square error (RMSE) and R2
- Identify good performing models for Florida's soils
  - Database for Florida's soils (644 data set; 551 used)

Consolidation parameter	Equation	Reference	Notes	R^2	RMSE
Cc	$C_c = 0.01w - 0.05$	Azzouz (1976)	All soils	0.7448	0.8359
	$C_c = 0.01w$	Koppula (1981)	Clays	0.5202	0.4191
	$C_c = 0.01w - 0.075$	Herrero (1983)	Clays	0.5189	0.4336
	$C_c = 0.013w-0.115$	Park, Lee (2011)	Clays	0.6729	0.3953
	$C_c = 0.0075w$	Miyakawa (1960)	Peat	0.5784	1.5194
	$C_c = 0.011w$	Cook (1956)	Peat	0.6611	1.9601
	$C_c = 0.54e - 0.19$	Nishida (1956)	Clays	0.7236	0.3945
	$C_c = 0.43e - 0.11$	Cozzolino (1961)	Clays	0.6120	0.4046
	$C_c = 0.75e - 0.38$	Sowers (1970)	Clays	0.7362	0.5552
	$C_c = 0.49e - 0.11$	Park, Lee (2011)	Clays	0.6847	0.3924
	$C_c = 0.4(e - 0.25)$	Azzouz (1976)	All soils	0.5676	0.7501
	$C_c = 0.15e + 0.01077$	Bowles (1989)	Clays	0.3157	0.7536
	$C_c = 0.287e - 0.015$	Ahadiyan (2008)	Clays	0.3847	0.7692
	$C_c = 0.6e$	Sowers (1970)	Peat	0.6715	1.7876
	$C_c = 0.3(e-0.27)$	Hough (1957)	Clays	0.4081	0.5425
	$C_c = 0.006(LL - 9)$	Azzouz (1976)	Clays	0.2857	0.6213
	$C_c = (LL-13)/109$	Mayne (1980)	Clays	0.4323	0.5638
	$C_c = 0.009(LL -10)$	Terzaghi, Peck (1967)	Clays	0.4236	0.5641
	$C_c = 0.014LL - 0.168$	Park, Lee (2011)	Clays	0.5569	0.7921
	$C_c = 0.0046(LL-9)$	Bowles (1989)	Clays	0.2780	0.6989
	$C_c = 0.011(LL-16)$	McClelland (1967)	Clays	0.5094	0.5991
	$C_c = 0.009w + 0.005LL$	Koppula (1981)	Clays	0.5701	0.5518
	$C_c = 0.009w + 0.002LL - 0.01$	Azzouz (1976)	Clays	0.5866	0.4875
	$C_c = 0.4(e + 0.001w - 0.25)$	Azzouz (1976)	All soils	0.7057	0.7414
	$C_c = -0.156 + 0.411e - 0.00058LL$	Al-Khafaji, Andersland (1992)	Clays	0.5276	0.3881
	$C_c = -0.023 + 0.271e + 0.001LL$	Ahadiyan (2008)	Clays	0.3400	0.4597
	$C_c = 0.37(e + 0.003LL +).0004w - 0.34)$	Azzouz (1976)	Clays	0.5014	0.3888
	$C_c = -0.404 + 0.341e + 0.006w + 0.004LL$	Yoon, Kim (2006)	Clays	0.6805	0.4991
	$C_c = 0.1597(w^{-0.0187})(1 + e)^{1.592}(LL^{-0.0638})(\gamma_{dry}^{-0.8276})$	Ozer (2008)	Clays	0.6824	0.5886
	$C_c = 0.151 + 0.001225w + 0.193e - 0.000258LL - 0.0699\gamma_{dry}$	Ozer (2008)	Clays	0.3006	0.5204

Cr	$C_r = 0.156e + 0.0107$	Elnaggar, Krizek (1971)	Clays	0.5330	0.2536
	$C_r = 0.208e + 0.0083$	Peck, Reed (1954)	Clays	0.5419	0.3643
	$C_r = 0.14(e+0.007)$	Azzouz (1976)	All soils	0.6016	0.3369
	$C_r = 0.003(w + 7)$	Azzouz (1976)	All soils	0.5780	0.4415
	$C_r = 0.002(LL + 9)$	Azzouz (1976)	All soils	0.5485	0.1682
	$C_r = 0.142(e – 0.009w + 0.006)$	Azzouz (1976)	All soils	0.6089	0.1802
	$C_r = 0.003w + 0.0006LL + 0.004$	Azzouz (1976)	All soils	0.5674	0.2344
	$C_r = 0.126(e + 0.003LL-0.06)$	Azzouz (1976)	All soils	0.5808	0.2109
	$C_r = 0.135(e + 0.1LL-0.002w – 0.06)$	Azzouz (1976)	All soils	0.5548	0.3131

Ranking Cc model

Consolidation parameter	Equation	Reference	Notes	RMSE	Rank
Cc	$C_c = -0.156 + 0.411e - 0.00058LL$	Al-Khafaji, Andersland (1992)	Clays	0.3881	1
	$C_c = 0.37(e + 0.003LL +).0004w - 0.34)$	Azzouz (1976)	Clays	0.3888	2
	$C_c = 0.49e - 0.11$	Park, Lee (2011)	Clays	0.3924	3
	$C_c = 0.54e - 0.19$	Nishida (1956)	Clays	0.3945	4
	$C_c = 0.013w-0.115$	Park, Lee (2011)	Clays	0.3953	5
	$C_c = 0.43e - 0.11$	Cozzolino (1961)	Clays	0.4046	6
	$C_c = 0.01w$	Koppula (1981)	Clays	0.4191	7
	$C_c = 0.01w - 0.075$	Herrero (1983)	Clays	0.4336	8
	$C_c = -0.023 + 0.271e + 0.001LL$	Ahadiyan (2008)	Clays	0.4597	9
	$C_c = 0.009w + 0.002LL - 0.01$	Azzouz (1976)	Clays	0.4875	10
	$C_c = -0.404 + 0.341e + 0.006w + 0.004LL$	Yoon, Kim (2006)	Clays	0.4991	11
	$C_c = 0.151 + 0.001225w + 0.193e - 0.000258LL - 0.0699\gamma_{dry}$	Ozer (2008)	Clays	0.5204	12
	$C_c = 0.3(e-0.27)$	Hough (1957)	Clays	0.5425	13
	$C_c = 0.009w + 0.005LL$	Koppula (1981)	Clays	0.5518	14
	$C_c = 0.75e - 0.38$	Sowers (1970)	Clays	0.5552	15
	$C_c = (LL-13)/109$	Mayne (1980)	Clays	0.5638	16
	$C_c = 0.009(LL -10)$	Terzaghi, Peck (1967)	Clays	0.5641	17
	$C_c = 0.1597(w^{-0.0187})(1 + e)^{1.592}(LL^{-0.0638})(\gamma_{dry}^{-0.8276})$	Ozer (2008)	Clays	0.5886	18
	$C_c = 0.011(LL-16)$	McClelland (1967)	Clays	0.5991	19
	$C_c = 0.006(LL - 9)$	Azzouz (1976)	Clays	0.6213	20
	$C_c = 0.0046(LL-9)$	Bowles (1989)	Clays	0.6989	21
	$C_c = 0.4(e + 0.001w - 0.25)$	Azzouz (1976)	All soils	0.7414	22
	$C_c = 0.4(e - 0.25)$	Azzouz (1976)	All soils	0.7501	23
	$C_c = 0.15e + 0.01077$	Bowles (1989)	Clays	0.7536	24
	$C_c = 0.287e - 0.015$	Ahadiyan (2008)	Clays	0.7692	25
	$C_c = 0.014LL - 0.168$	Park, Lee (2011)	Clays	0.7921	26
	$C_c = 0.01w - 0.05$	Azzouz (1976)	All soils	0.8359	27
	$C_c = 0.0075w$	Miyakawa (1960)	Peat	1.5194	28
	$C_c = 0.6e$	Sowers (1970)	Peat	1.7876	29
	$C_c = 0.011w$	Cook (1956)	Peat	1.9601	30

Ranking
Cr model

Cr	$C_r = 0.002(LL + 9)$	Azzouz (1976)	All soils	0.1682	1
	$C_r = 0.142(e - 0.009w + 0.006)$	Azzouz (1976)	All soils	0.1802	2
	$C_r = 0.126(e + 0.003LL - 0.06)$	Azzouz (1976)	All soils	0.2109	3
	$C_r = 0.003w + 0.0006LL + 0.004$	Azzouz (1976)	All soils	0.2344	4
	$C_r = 0.156e + 0.0107$	Elnaggar, Krizek (1971)	Clays	0.2536	5
	$C_r = 0.135(e + 0.1LL - 0.002w - 0.06)$	Azzouz (1976)	All soils	0.3131	6
	$C_r = 0.14(e+0.007)$	Azzouz (1976)	All soils	0.3369	7
	$C_r = 0.208e + 0.0083$	Peck, Reed (1954)	Clays	0.3643	8
	$C_r = 0.003(w + 7)$	Azzouz (1976)	All soils	0.4415	9

Ranking
Cv model

Consolidation parameter	Equation	Reference	Soil type	RMSE	Rank
Cv	$C_v = 4258LL^{-1.75}$ (m^2/s)	Asma et al. (2011)	Clays	0.8193	1
	$C_v = 116.45LL^{-2.8784}$	US Navy (1971)	Clays	0.8373	2
	$C_v = [1+ e_{LL} (1.23-0.276\log\sigma_v)]/ e_{LL} \times[1/\sigma_v^{0.353}]\times10^{-3}$ (cm^2/s)	Raju et al. (1995)	Clays	0.8497	3
	$C_v = [9.09\times10^{-7}(1.192+ACT^{-1})^{6.993}(4.135LI+1)^{4.29}] /[PI(2.04LI+1.192+ACT^{-1})^{7.993}]$ (m^2/s)	Carrier (1985)	Clays	0.8604	4
	$C_v = 7.7525PI^{-3.1021}$ (cm^2/s)	Solanki (2011)	Clays	0.8677	5
	$C_v = 3/[100(SI)^{3.54}]$ (m^2/s)	Sridharan, Nagaraj (2004)	Clays	n/a	n/a

Ranking
Ca model

Consolidation parameter	Equation	Reference	Soil type	RMSE	Rank
Cα	$C_\alpha = 0.0001w$	NAVFAC (1982)	All soils	0.0049	1
	$C_\alpha = 0.00018w$	Simons, Menzies (1999)	All soils	0.0101	2
	$C_\alpha = 0.00168 + 0.00033PI$	Nakase et al. (1988)	All soils	0.0245	3

Task 3: Collect data and create comprehensive Florida's geotechnical database

- Data collection has included:
  - Soil type and classification
  - Natural moisture
  - Dry and Wet density
  - Fines (passing No. 200)
  - Initial void ratio
  - Specific gravity
  - Atterberg limits (liquid limit (LL), Plasticity index (PI))
  - Organic content
  - Automatic hammer SPT N value
  - Effective overburden pressure
  - Soil compressibility index (Cc, Cr, Cv, Ca)

Data Collection

Soil type		# of Data points	
		Cc	Cr
Fine grained	clays	396	380
	silts	31	21
Organic soils		124	89
Coarse grained		93	93
Total		644	583

Stress Level	Stress Range (psf)	# of Data points	
		Cv	Ca
Low	< 2000	150	38
Intermediate	$2000 \le \sigma \le 4000$	147	38
High	> 4000	143	37
Total		440	113

Example data set of Cc and Cr

Project	County	Soil Type	USCS	Natural Moisture (%)	g_{dry} (pcf)	g_{wet} (pcf)	Gs	Fines (-200) (%)	Liquid Limit (LL)	Plasticity Index (PI)	Organic Content (%)	Void Ratio (e_o)	σ'_o (ksf)	Cc	Cr
SR 223 over CR 100A and CSX RR	Bradford	Fine Grained	CH	82	50.3	91.6	2.64	98	133	99		2.28	2.28	1.05	0.24
SW 42nd St. Flyover	Marion	Fine Grained	CH	55	67.0	103.9	2.66	95	157	118		1.48	3.08	0.35	0.10
SR 10 at Little Pottsburg Creek	Duval	Organic Peat	PT	414	12.7	65.4	2.19	1			87	9.76	1.85	6.41	0.63

⋮

Example data set of Cv and Ca

Soil Type	(USCS)	σ'_o (ksf)	g_{dry} (pcf)	g_{wet} (pcf)	Natural Moisture (%)	Fines (-200) (%)	Liquid Limit (LL)	Plasticity Index (PI)	Initial Void Ratio (e)	Specific Gravity	Cv	Ca	Stress Range
Fine Grained	CH	1.12	71.6	104.6	46.1	58	61	44	1.35	2.7	0.01	0.009	High
Fine Grained	CH	1.12	71.6	104.6	46.1	58	61	44	1.35	2.7	0.05	0.003	Intermediate
Fine Grained	CH	1.49	52.8	95.3	80.4	88	108	75	2.24	2.74	0.11	0.001	Low
Organic Peat	PT	0.09	11.3	62.8	456	59	-	-	8.08	1.64	0.07	0.024	Intermediate
Organic Peat	PT	0.15	5.4	55.8	934	94	-	-	12.68	1.18	0.0001	0.015	Low

⋮

Task 4: Evaluate the correlations of key affecting parameters and soil compressibility

- Evaluate the impact of variables on the soil compressibility (Cc, Cr, Cv, and Ca).
- Specific index parameters can have dominant influence in compressibility of specific soil types.
  - Cc and Cr → CH, CL, silt, and organic soil
  - Cv and Ca → clay and organic soil under three stress level (Low, Intermediate, High)
    - Low stress level: 500-1000 psf
    - Intermediate stress level: 2000 - 3000 psf
    - High stress level: 5000 – 6000 psf

*Coefficient of Determination (R^2) and Root Mean Square Error (RMSE) values were calculated to quantify the performance level of the key index parameters and appear on the Excel file.

Top 3 Index Parameters – **Cc** for **high plasticity clays**

Type	***Var1***	***Var2***	***Pearson's Correlation Coefficient***	***R-Squared***	***RMSE***
Clays – (CH)	Cc	Effective Overburden Pressure (ksf)	-0.021	0.000	0.716
	Cc	Wet Density (pcf)	-0.702	0.494	0.510
	Cc	Dry Density (pcf)	-0.789	0.622	0.441
	Cc	Natural Moisture (%)	0.815	0.664	0.415
	Cc	Automatic Hammer Blow Count	-0.336	0.113	0.675
	Cc	Fines (-200) (%)	-0.116	0.013	0.712
	Cc	Liquid Limit (LL)	0.460	0.212	0.636
	Cc	Plasticity Index (PI)	0.361	0.130	0.668
	Cc	Initial Void Ratio (e)	0.829	0.687	0.401
	Cc	Specific Gravity	-0.047	0.002	0.716

Top 3 Index Parameters – **Cr** for **high plasticity clays**

Type	***Var1***	***Var2***	***Pearson's Correlation Coefficient***	***R-Squared***	***RMSE***
Clays – (CH)	Cr	Effective Overburden Pressure (ksf)	-0.079	0.006	0.089
	Cr	Wet Density (pcf)	-0.423	0.179	0.081
	Cr	Dry Density (pcf)	-0.467	0.218	0.079
	Cr	Natural Moisture (%)	0.454	0.206	0.079
	Cr	Automatic Hammer Blow Count	-0.167	0.028	0.088
	Cr	Fines (-200) (%)	-0.131	0.017	0.088
	Cr	Liquid Limit (LL)	0.439	0.193	0.080
	Cr	Plasticity Index (PI)	0.255	0.065	0.086
	Cr	Initial Void Ratio (e)	0.436	0.190	0.080
	Cr	Specific Gravity	-0.099	0.010	0.088

Top 3 Index Parameters – **Cc** for **organic soils**

Type	***Var1***	***Var2***	***Pearson's Correlation Coefficient***	***R-Squared***	***RMSE***
Organic	Cc	Effective Overburden Pressure (ksf)	-0.261	0.068	2.116
	Cc	Wet Density (pcf)	-0.374	0.140	2.033
	Cc	Dry Density (pcf)	-0.602	0.363	1.750
	Cc	Natural Moisture (%)	0.706	0.499	1.552
	Cc	Automatic Hammer Blow Count	-0.162	0.026	2.163
	Cc	Fines (-200) (%)	-0.187	0.035	2.154
	Cc	Organic Content (%)	0.436	0.190	1.973
	Cc	Initial Void Ratio (e)	0.716	0.513	1.530
	Cc	Specific Gravity	-0.197	0.039	2.149

Top 3 Index Parameters – **Cr** for **organic soils**

Type	*Var1*	*Var2*	*Pearson's Correlation Coefficient*	*R-Squared*	*RMSE*
Organic	Cr	Effective Overburden Pressure (ksf)	-0.222	0.049	0.297
	Cr	Wet Density (pcf)	-0.273	0.074	0.293
	Cr	Dry Density (pcf)	-0.467	0.218	0.269
	Cr	Natural Moisture (%)	0.541	0.293	0.256
	Cr	Automatic Hammer Blow Count	-0.182	0.033	0.300
	Cr	Fines (-200) (%)	-0.181	0.033	0.300
	Cr	Organic Content (%)	0.255	0.065	0.295
	Cr	Initial Void Ratio (e)	0.823	0.677	0.173
	Cr	Specific Gravity	-0.007	0.000	0.305

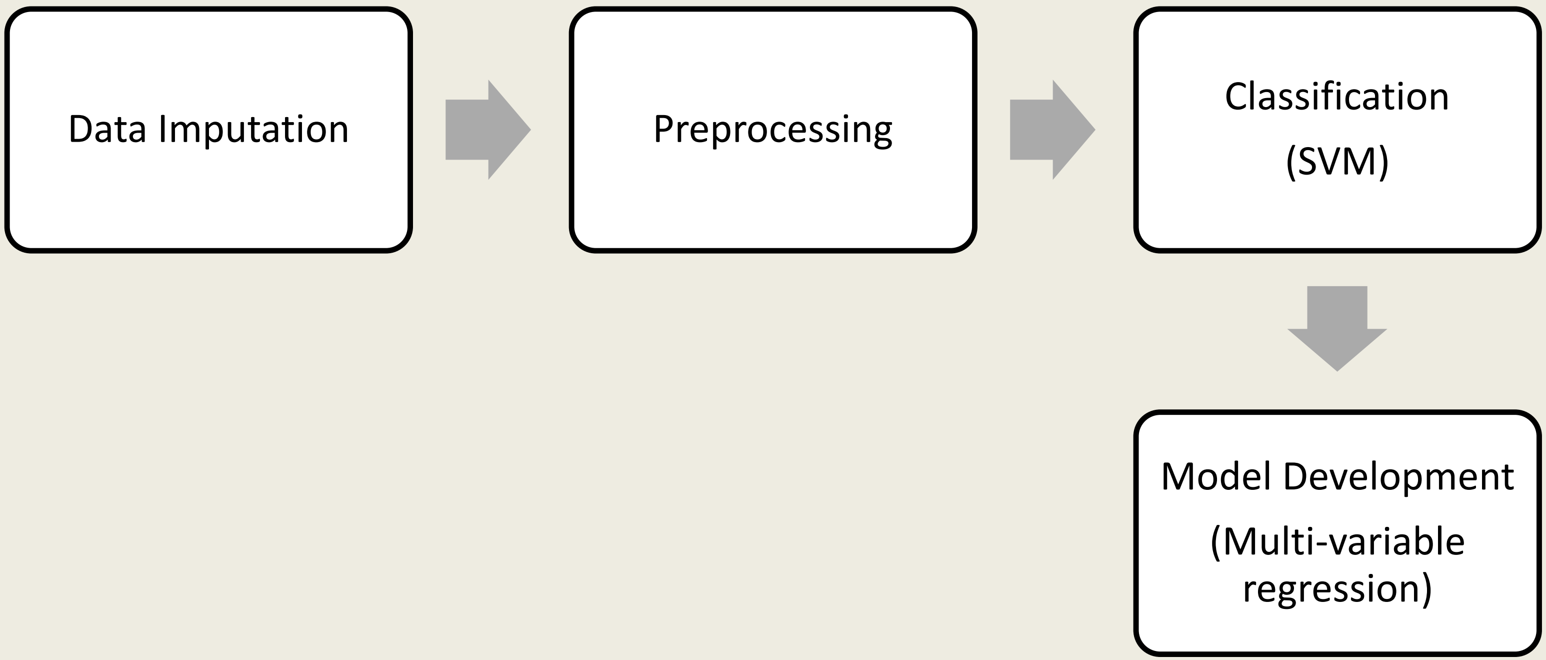
Final selection of the variables

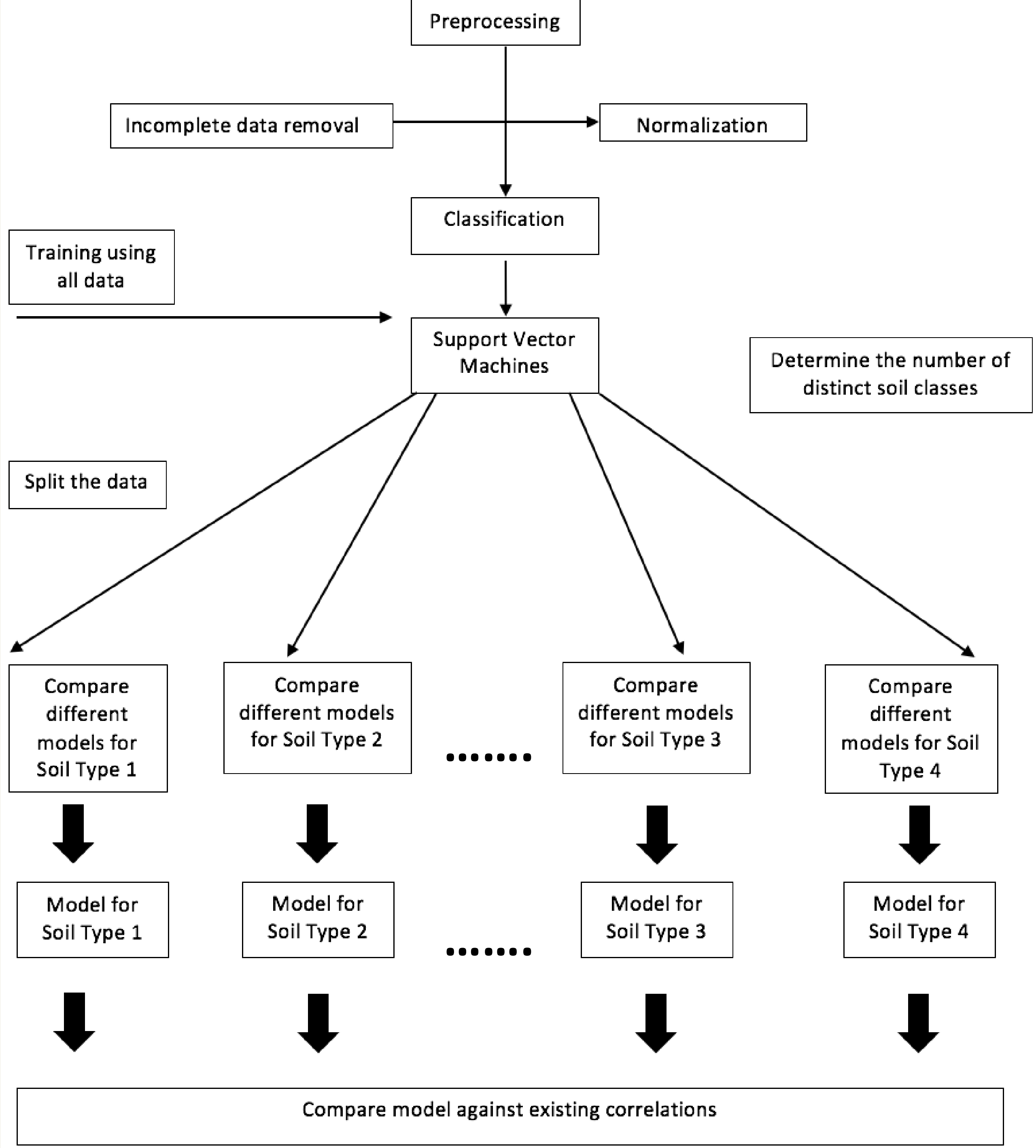
- Final variables included in the model development
  - moisture content (w)
  - automatic hammer SPT blow count (N)
  - overburden stress (σ)
  - fines content (-200)
  - liquid limit (LL)
  - Percent organic content (OC %)
  - plasticity index (PI)
  - specific gravity (Gs)

The final selection includes only "initial" measurement data not from consolidation testing and/or double-correlation.

Task 5: Develop a methodology to construct the statistical Cc, Cr, Cv, and Ca models

Procedure of data analysis

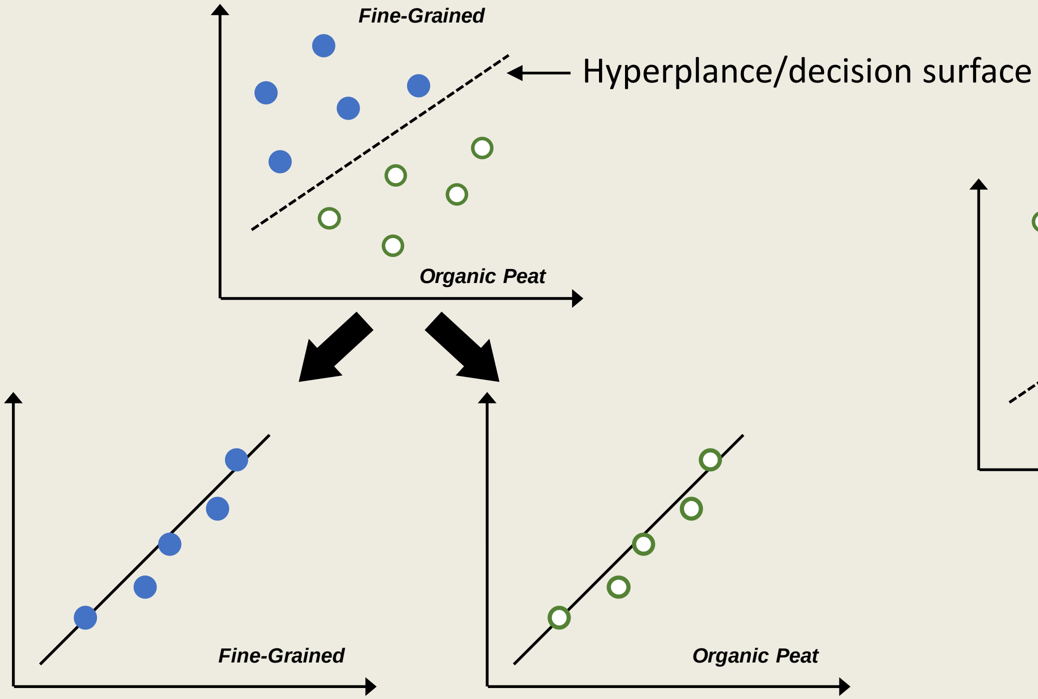


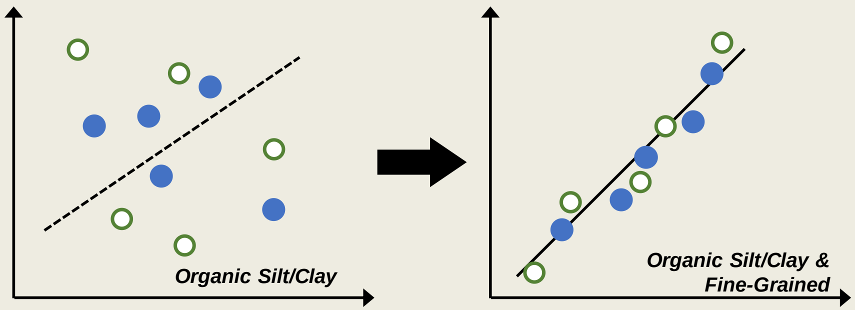


<u>Note:</u>

- 6 assumed soil class (CH, CL, MH, OH, OL, Pt)
- Automatic classification is SVM

Automatic classification





<u>Separable dataset:</u>
Example of regression model development for two distinct classifications of data

<u>Inseparable dataset:</u>
Recommending that datasets of organic/silt/clay and fine-grained soils will need to be grouped together

Task 6: Develop the soil compressibility prediction models for specific soil types

- With the framework developed in Task 5, the models to be developed include:
  - C_c model
  - C_r model
  - C_v model
  - C_α model
- Soil types to be considered:
  - C_c and C_r models:
    - CH, CL, MH, OH, OL, Pt
  - C_v and C_a models:
    - Clay, Organic, Peat
  - Full vs. Reduced models
    - Reduced model => minimize the number of variables without sacrificing the model accuracy

Cc Models

Equation	Notes	Input variables	R^2	R^2_{adj}	RMSE
C_c = - 1.4045 + 0.0155 * w + 0.0005 * LL + 0.398 * Gs - 0.00003 * [(w - 68.837) * (LL -105.48)] - 0.00002 * [(w - 68.837) * (w - 68.837)]	CH	w, LL, Gs	0.731	0.726	0.375
Reduced C_c -> Same as C_c	CH	w, LL, Gs			
C_c = - 1.6912 + 0.0118 * w + 0.5919 * Gs	CL	w, Gs	0.525	0.495	0.174
Reduced C_c -> Same as C_c	CL	w, Gs			
C_C = - 8.4424 + 0.0077 * w + 0.0085 * Fines (-200) + 0.0143 * PI + 2.7149 * Gs + 0.0828 * [(w - 89.8) * (Gs – 2.664)]	MH	w, Fines, PI, Gs	0.984	0.975	0.075
Reduced C_C = - 9.2573 + 0.0087 * w + 0.009 * PI + 3.337 * Gs + 0.1095 * [(w - 89.8) * (Gs – 2.6635)]	MH	w, PI, Gs	0.935	0.906	0.145
C_C = -0.4799 + 0.076 * σ_o'(ksf) + 0.0098 * w + 0.0046 * PI + 0.0005 * [(σ_o'(ksf) – 1.445) * (w – 123.02)] + 0.0036 * [(σ_o'(ksf) – 1.445) * (PI – 81.879)]	OH	σo', PI, w	0.793	0.779	0.439
Reduced C_C -> Same as C_c	OH	σo', PI, w			
C_C = 0.8164 + 0.0096 * w - 0.0145 * Fines (-200)	OL	w, Fines	0.488	0.428	0.564
Reduced C_C -> Same as C_C	OL	w, Fines			
Cc = - 10.7737 + 0.0078 * w + 0.0772 * OC + 2.8672 * Gs + 0.0074 * [(w – 481.673) * (Gs - 1.5677)] - 0.2644 * [(OC – 83.0208) * (Gs - 1.5677)] + 0.0075 * [$(OC – 83.0208)^2$]	Pt	w, OC, Gs	0.795	0.765	1.284
Reduced C_c -> Same as C_c	Pt	w, OC, Gs			

Cr Models

Equation	Notes	Input variables	R^2	R^2_{adj}	RMSE
C_r = - 0.0057 - 0.00069 * σo' (ksf) + 0.0012 * w + 0.0015 * N + 0.00007 * LL - 0.0196 * LI - 0.0014 * [(σo'(ksf) -1.986) * (w - 68.175)] + 0.0009 * [(σo'(ksf) -1.986) * (LL - 105.323)] + 0.0603 * [(σo'(ksf) -1.986) * (LI – 0.520)] + 0.00008 * [(w - 68.175) * (N - 5.473)] + 0.000009 * [(w - 68.175) * (LL - 105.323)] + 0.0005 * [(w - 68.175) * (LI – 0.520)]	CH	σo', w, N, LL, LI	0.608	0.590	0.069
Reduced C_r = - 0.0136 - 0.0023 * σo'(ksf) + 0.0014 * w + 0.0001 * LL - 0.0004 * [(σo'(ksf) -1.986) * (w - 68.175)] + 0.0002 * [(σo'(ksf) -1.986) * (LL- 105.323)] + 0.000007 * [(w - 68.175) * (LL- 105.323)]]	CH	σo', w, LL	0.527	0.516	0.076
C_r = - 0.05 + 0.0021 * w + 0.0018 * N	CL	w, N	0.312	0.269	0.047
Reduced C_r -> Same as C_r	CL	w, N			
C_r = - 3.5505 + 0.0014 * w - 0.009 * N + 0.0006 * PI + 1.324 * Gs - 0.00002 * [(w – 100.99) * (PI – 48.0397)] + 0.0254 * [(w – 100.99) * (Gs – 2.656)]	MH	w, N, PI, Gs,	1.000	0.999	0.002
Reduced C_r = -3.0434 + 0.0014 * w -0.0063 * N + 1.1368 * Gs + 0.0244 * [(w – 100.99) * (Gs – 2.656)]	MH	w, N, Gs	0.940	0.892	0.022
C_r = -0.1101 + 0.0485 * σo'(ksf) + 0.0019 * w - 0.0042 * N - 0.0000002 * LL - 0.0022 * OC + 0.0004 * PI + 0.0051 * [(σo'(ksf) - 1.4864) * (OC-21.652)] - 0.0008 * [(N - 3.05) * (OC -21.6517)] -0.00003 * [(LL - 150.138) * (OC - 21.6517)]	OH	σo', w, N, LL, OC, PI	0.742	0.703	0.077
Reduced C_r = - 0.0667 + 0.0326 * σo'(ksf) + 0.002 * w - 0.0036 * OC + 0.0029 * [(σo'(ksf) – 1.4864) * (OC – 21.6517)]	OH	σo', w, OC	0.565	0.538	0.096
Cr = 0.8808 + 0.0346 * σo'(ksf) + 0.0002 * w + 0.0048 * OC – 0.048 * PI + 0.0121 * [(σo'(ksf) - 1.015) * (PI - 20.2964)] - 0.0069 * [(OC – 17.8) * (PI - 20.2964)] - 0.0188 * [(σo'(ksf) - 1.015) * (σo'(ksf) - 1.015)] + 0.0006 * $[(OC – 17.8)^2]$	OL	σo', w, OC, PI	1.000	0.998	0.002
Reduced Cr = 2.3651 + 0.0039 * σo'(ksf) + 0.011 * OC – 0.1212 * PI + 0.0586 * [(σo'(ksf) - 1.015) * (PI – 20.2964)] - 0.0167 * [(OC – 17.8) * (PI – 20.2964)] - 0.0263 * [(σo'(ksf) - 1.015) * (σo'(ksf) - 1.015)] + 0.0009 * $[(OC – 17.8)^2]$	OL	σo', OC, PI	0.991	0.961	0.008
Cr = - 0.5938 + 0.0009 * w + 0.3356 * Gs + 0.5344 * $[(Gs - 1.4373)^2]$ + 0.0017 * [(w - 472.835) * (Gs - 1.4373)]	PT	w, Gs	0.768	0.739	0.182
Reduced C_r -> Same as C_r	PT	W, Gs			

Cv Models

Equation	Notes	Input variables	R^2	R^2_{adj}	RMSE
C_v = - 3.3179 + 0.121 * σo'(ksf) + 0.0023 * w – 0.0283 * N - 0.0099 * Fines – 0.8108 * Gs – 0.00003 * Stress Level - 0.0592 * [(σo'(ksf) - 1.5932) * (N – 4.5071)] + 0.0024 * [(w - 57.1574) * (N – 5.5071)] - 0.0074 * [(N – 4.5071)) * (Fines(-200) – 82.1046)] + 0.151 * [(σo'(ksf) - 1.5932) * (σo'(ksf) - 1.5932)] + 0.0000000009 * [(Stress Level – 4909.97 * (Stress Level - 4909.97)]	Clay	σo', w, N, Fines, Gs, Stress level	0.226	0.215	0.914
Reduced C_v = 0.788 + 0.1213 * σo'(ksf) – 0.02 * N - 0.0058 * Fines(-200) – 0.0718 * [(σo'(ksf) - 1.5932) * (N – 4.5071)] - 0.0043 * [(N – 4.5071)) * (Fines(-200) – 82.1046)] + 0.1231 * [(σo'(ksf) - 1.5932)^2]	Clay	σ_o', N, Fines	0.146	0.139	0.957
C_v = 1.1395 – 0.0022 * w + 0.0556 * N + 0.0018 * PI + 0.00001 * Stress Level – 0.4432 * Gs	Organic	w, N, PI	0.090	0.047	0.333
Reduced C_v = 1.1959 – 0.0625 * N + 0.002 * PI + 0.000009 * Stress Level	Organic	N, PI, Stress level	0.068	0.042	0.334
C_v = 11.7596 + 0.0815 * N - 0.0762 * Fines(-200) + 0.0317 * OC - 3.1765 * Gs - 0.0002 * Stress Level - 0.0024 * [(Fines(-200) - 56.9176) * (OC – 59.522)] - 0.1156 * [(OC - 59.522) * (Gs – 1.9426)] - 0.00001 * [(OC - 59.522) * (Stress Level – 2391.88)] - 0.0005 * [(Gs - 1.9426) * (Stress Level – 2391.88)] - 0.4487 * [(N - 2.1618)^2] – 0.0004 * [(Fines (-200) - 56.9176)^2]	Peat	N, Fines, OC, Gs, Stress level,	0.522	0.491	1.519
Reduced C_v = 7.7106 + 0.0644 * N - 0.0647 * Fines (-200) + 0.0415 * OC - 2.014 * Gs - 0.0019 * [(Fines (-200) - 56.9176) * (OC – 59.522)] – 0.1051 * [(OC - 59.522) * (Gs – 1.9426)] - 0.3782 * [(N - 2.1618)^2] - 0.0005 * [(Fines(-200) - 56.9176)^2]	Peat	N, Fines, OC, Gs	0.433	0.407	1.640

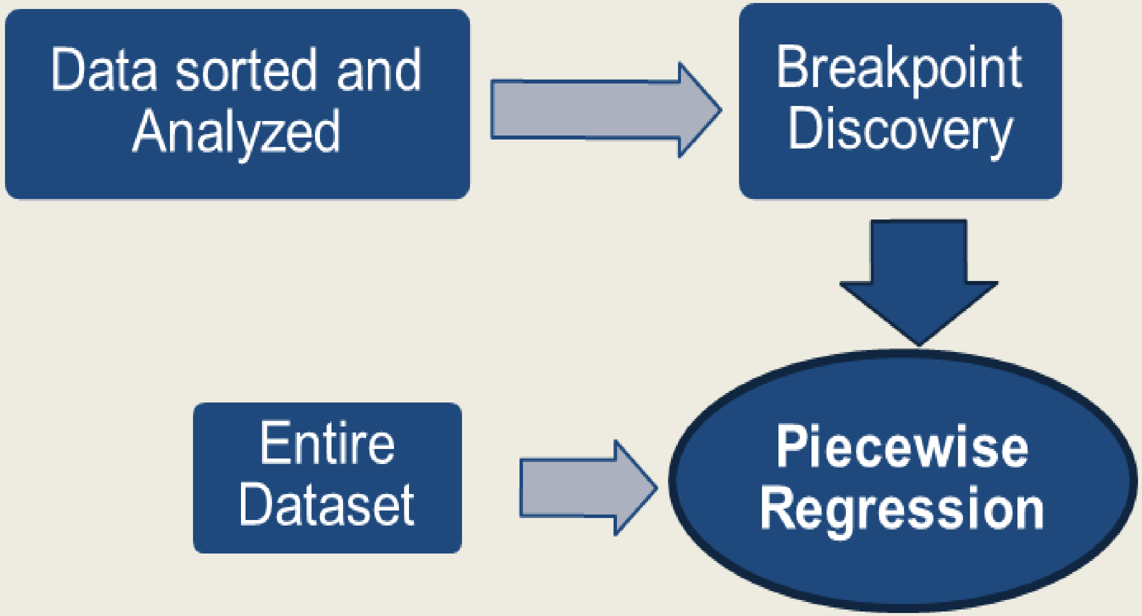
Ca Models

Equation	Notes	Input variables	R^2	R^2_{adj}	RMSE
C_α = - 0.0077 + 0.0001 * w + 0.000002 * PI + 0.0000006 * Stress Level - 0.000000009 * [(w - 60.3376) * (Stress Level - 10084.8)] + 0.000004 * [(PI - 70.5461)^2] - 0.000000000002 * [(Stress Level - 10084.8)^2]	Clay	w, PI, Stress level	0.545	0.525	0.007
Reduced C_α -> Same as C_α	Clay	w, PI, Stress level			
C_α = - 0.09 + 0.0001 * w + 0.0002 * Fines(-200) + 0.0001 * PI + 0.0185 * Gs + 0.000002 * Stress Level + 0.00000002 * [(w - 95.9455) * (Stress Level - 5674.24)] + 0.00000003 * [(Fines(-200) - 60.0606) * (Stress Level - 5674.24)] + 0.00000004 * [(PI - 92.4545) * (Stress Level - 5674.24)] + 0.000008 * [(Gs - 2.4) * (Stress Level - 5674.24)]	Organic	w, Fines, PI, Gs, Stress level	0.952	0.933	0.005
Reduced C_α = - 0.0436 + 0.0002 * PI + 0.0097 * Gs + 0.000001 * Stress Level + 0.00000006 * [(PI - 92.4545) * (Stress Level - 5674.24)] + 0.000004 * [(Gs - 2.4) * (Stress Level - 5674.24)]	Organic	PI, Gs, Stress level	0.840	0.810	0.008
C_α = - 0.0660 + 0.00005 * w + 0.0006 * OC + 0.000008 * Stress Level + 0.00000002 * [(w – 575.783) * (Stress Level – 2020.6)] + 0.0000004 * [(OC (%) – 64.933) * (Stress Level – 2020.6)]	Peat	w, OC, Stress level	0.778	0.732	0.009
Reduced C_α -> Same as C_α	Peat	w, OC, Stress level			

Delineation Analysis

<u>Purpose:</u>

A specific range of input variables may have a higher influence on the soil compressibility. Thus, the breakpoints of influential factors (e.g. LL, PI, OC) on Cc and Cr from the dataset were determined



Delineation Analysis Result

Cc model

***Cc Models** – See Table 4-4*		
Notes	***Breakpoint***	***R^2_{adj}***
Clays	LL < 85.6	0.482
Clays	LL > 85.6	0.427
Clays	PI < 33.3	0.155
Clays	PI > 33.3	0.386
Organic	OC < 66.9	0.794
Organic	OC > 66.9	0.763
Silts	LL < 69.8	0.855
Silts	LL > 69.8	0.689
Silts	PI - No Breakpoint was found	N/A

Cr model

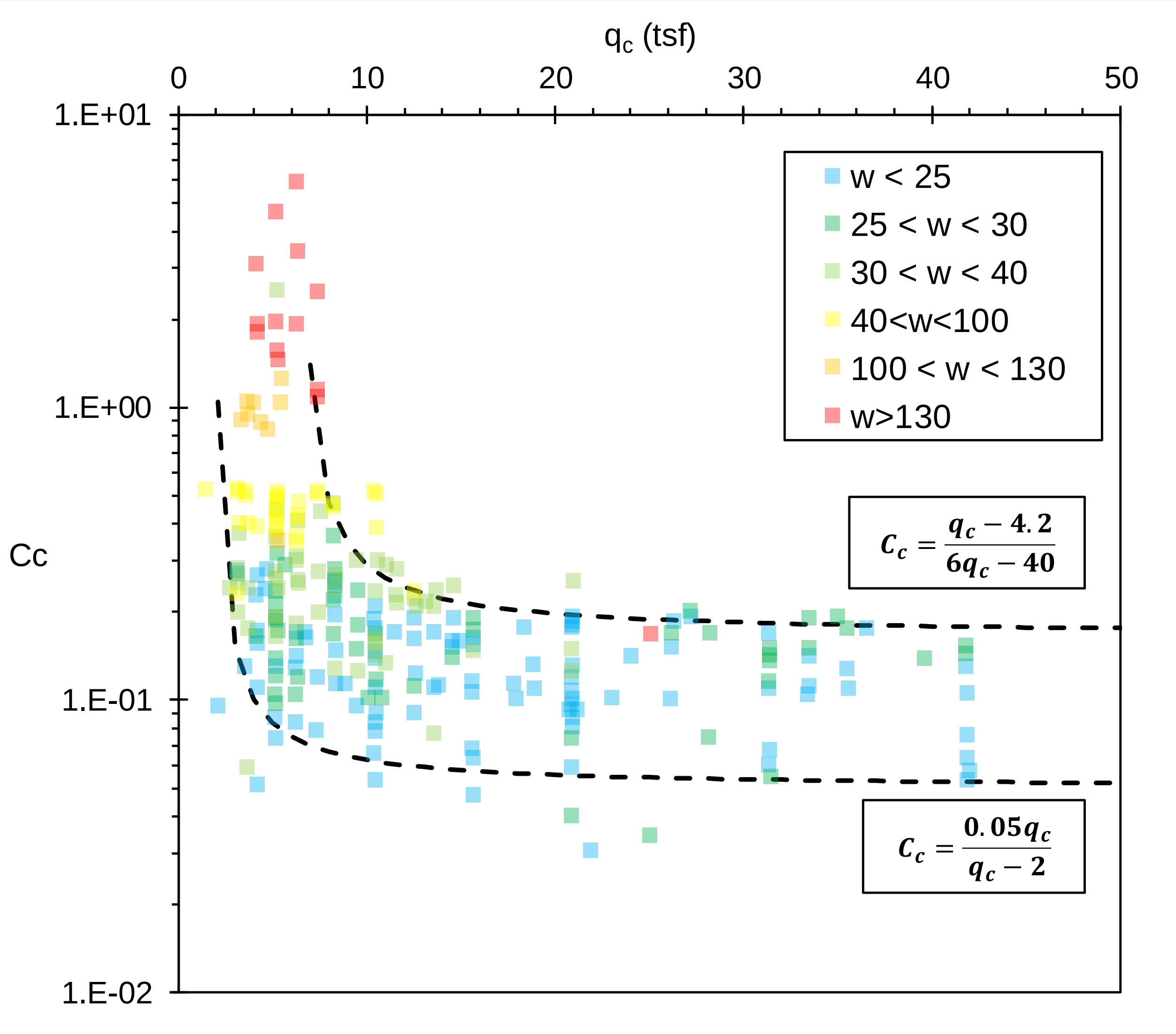
***Cr Models** – See Table 4-5*		
Notes	***Breakpoint***	***R^2_{adj}***
Clays	LL - No Breakpoint was found	N/A
Clays	PI < 70.4	0.129
Clays	PI > 70.4	0.236
Organic	OC < 74.6	0.632
Organic	OC > 74.6	0.840
Silts	LL < 92.9	0.619
Silts	LL > 92.9	0.625
Silts	PI < 48.0	0.558
Silts	PI > 48.0	0.665

Task 7: Investigate the relationship with CPT

- Investigate the relationship between CPT resistance outputs and the soil compressibility defining parameters
  - correlations of the compressibility (Cc and Cr) and CPT data (q_c, f_s) were checked
  - Literature review on any correlation between CPT q_c and soil compressibility (Sanglerat 1972)
  - Data collection throughout the state and additional CPT tests
- No available CPT data to correlate to Cv and Ca

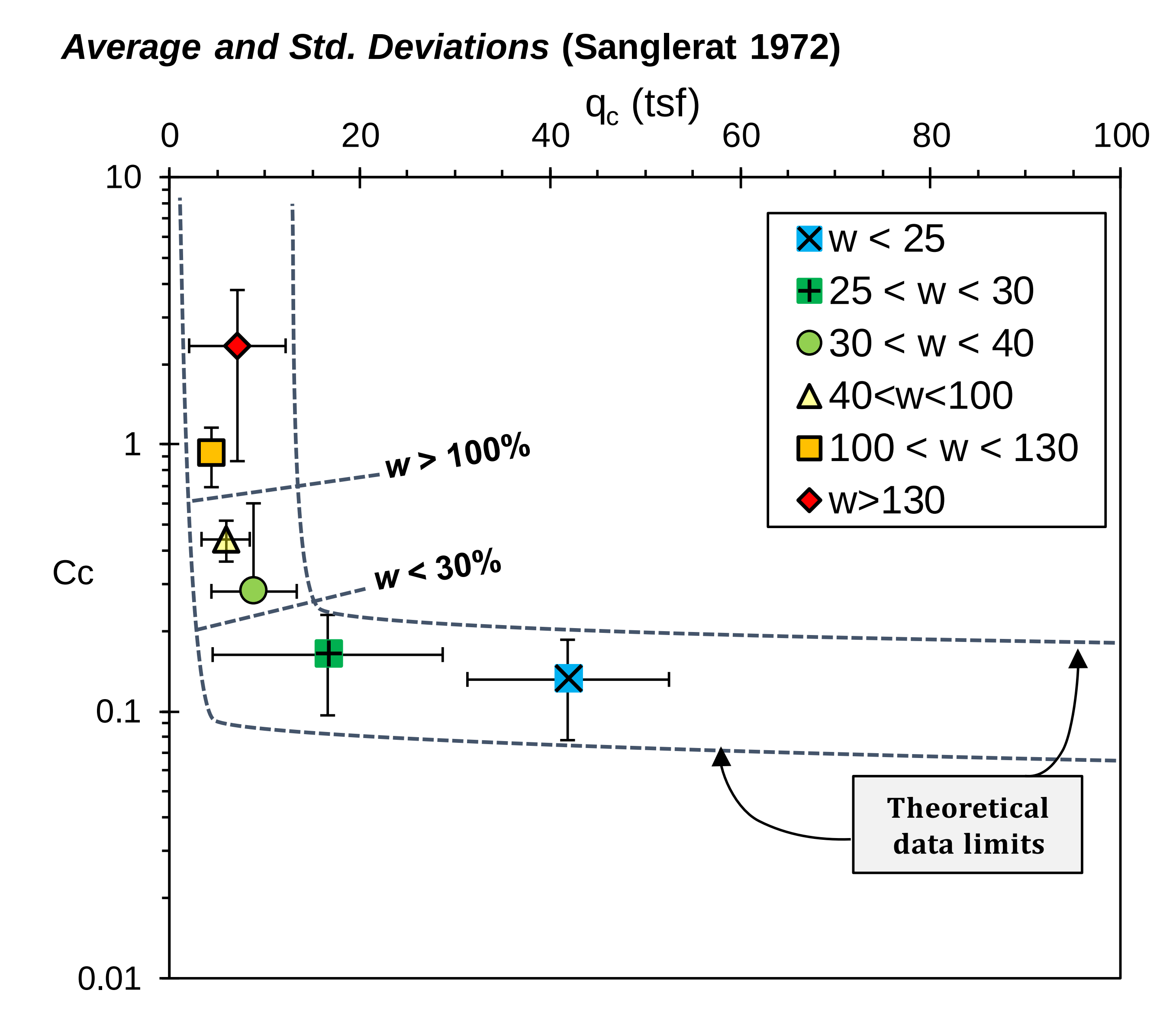
Sanglerat 1972

~600 samples CH/CL. shallow near Lyon, France.

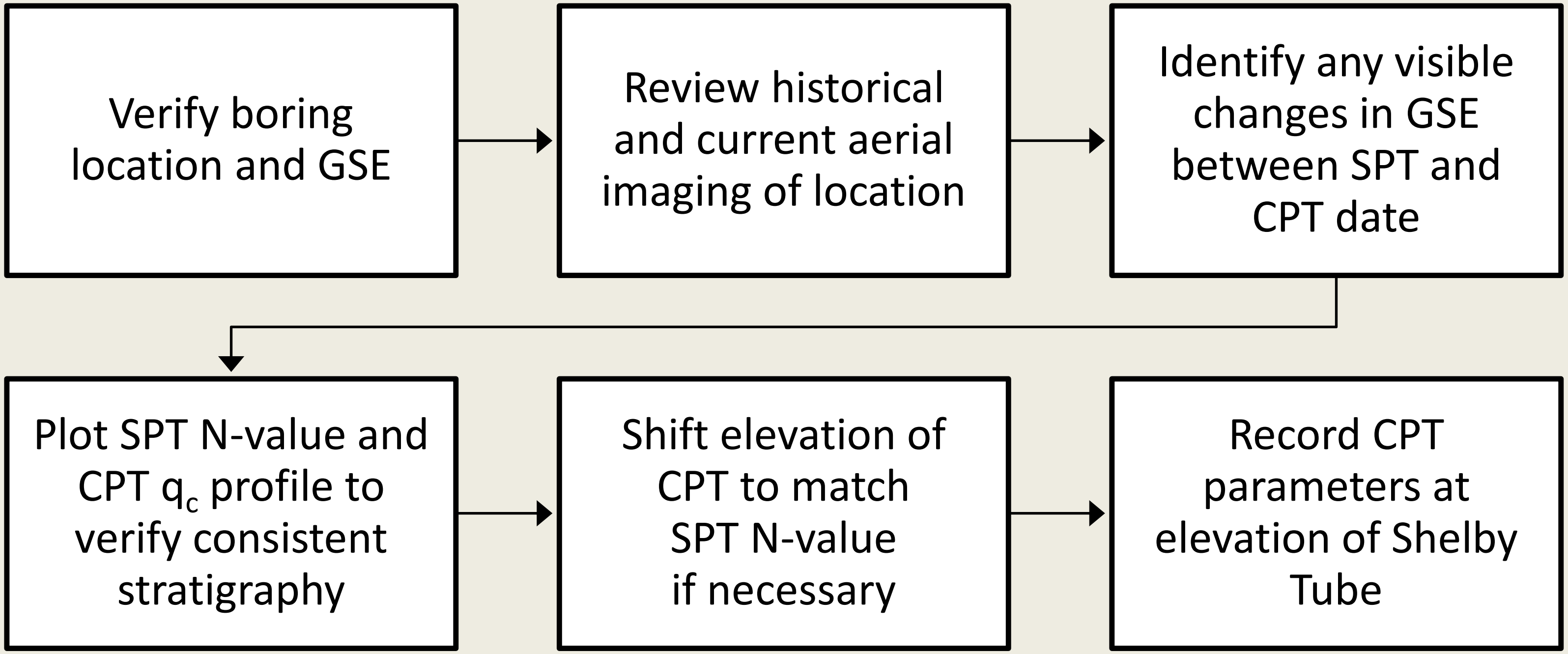


Sanglerat 1972

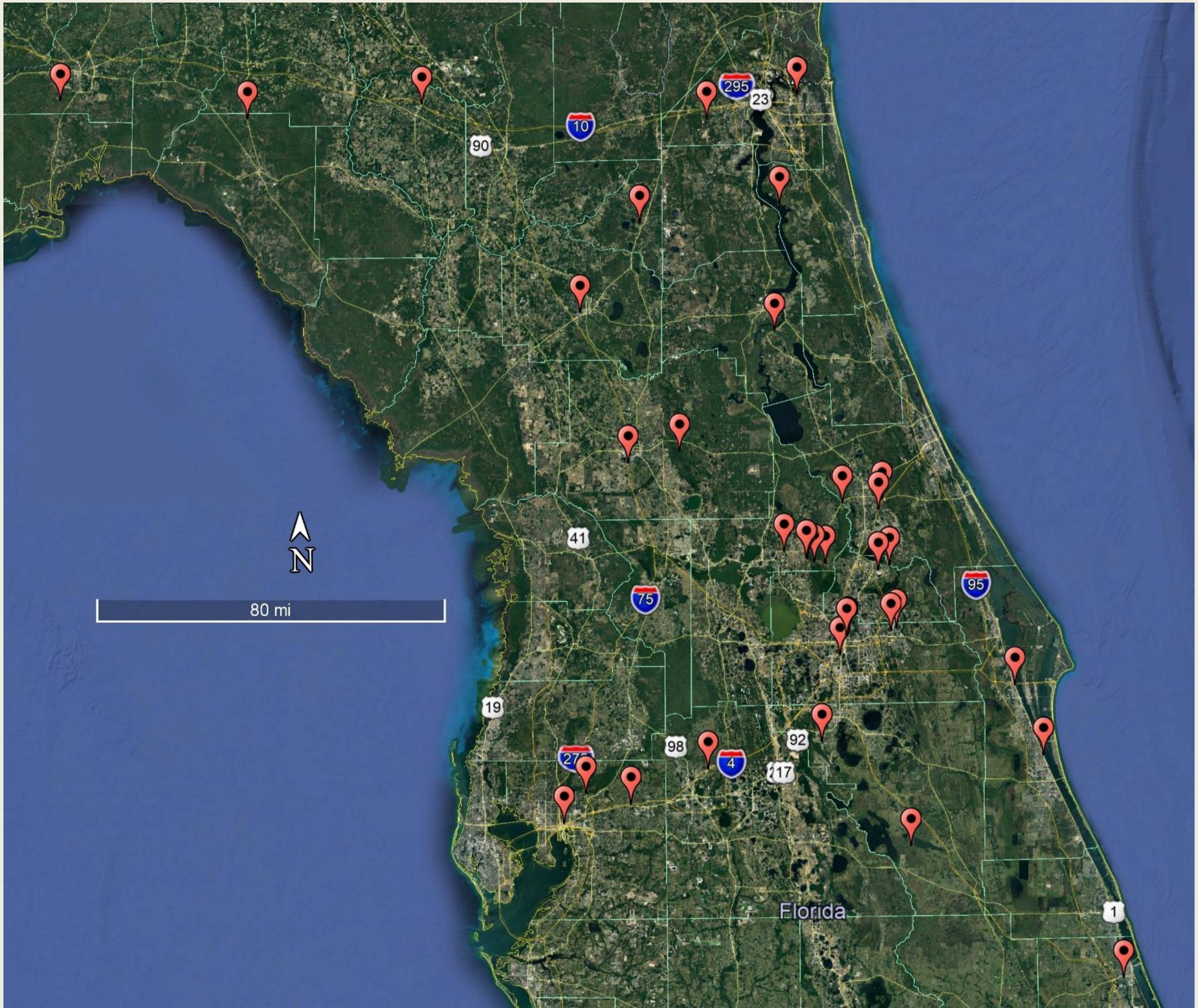
~600 samples CH/CL. shallow near Lyon, France.



Flow chart outlining the data analysis

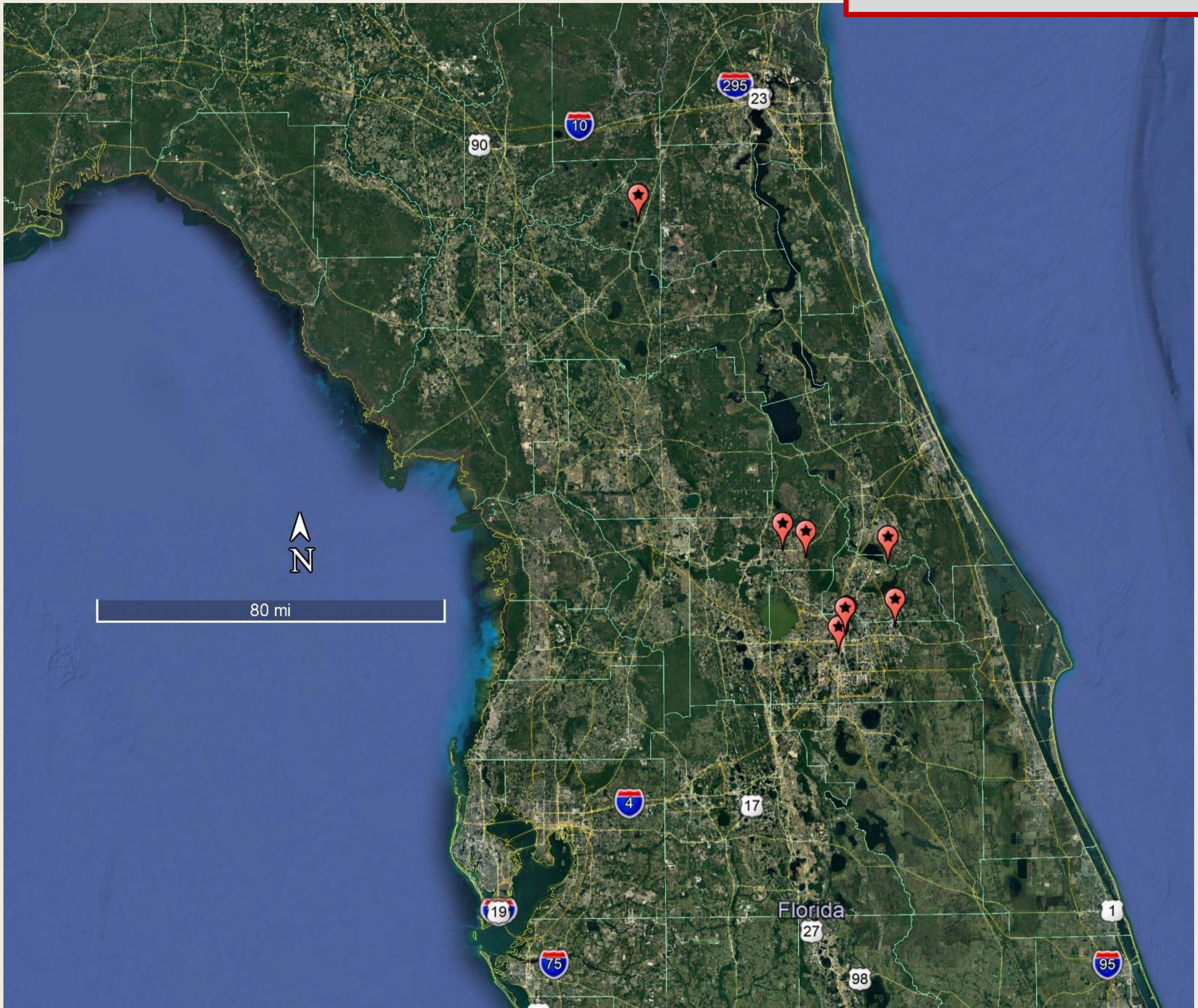


Potential locations

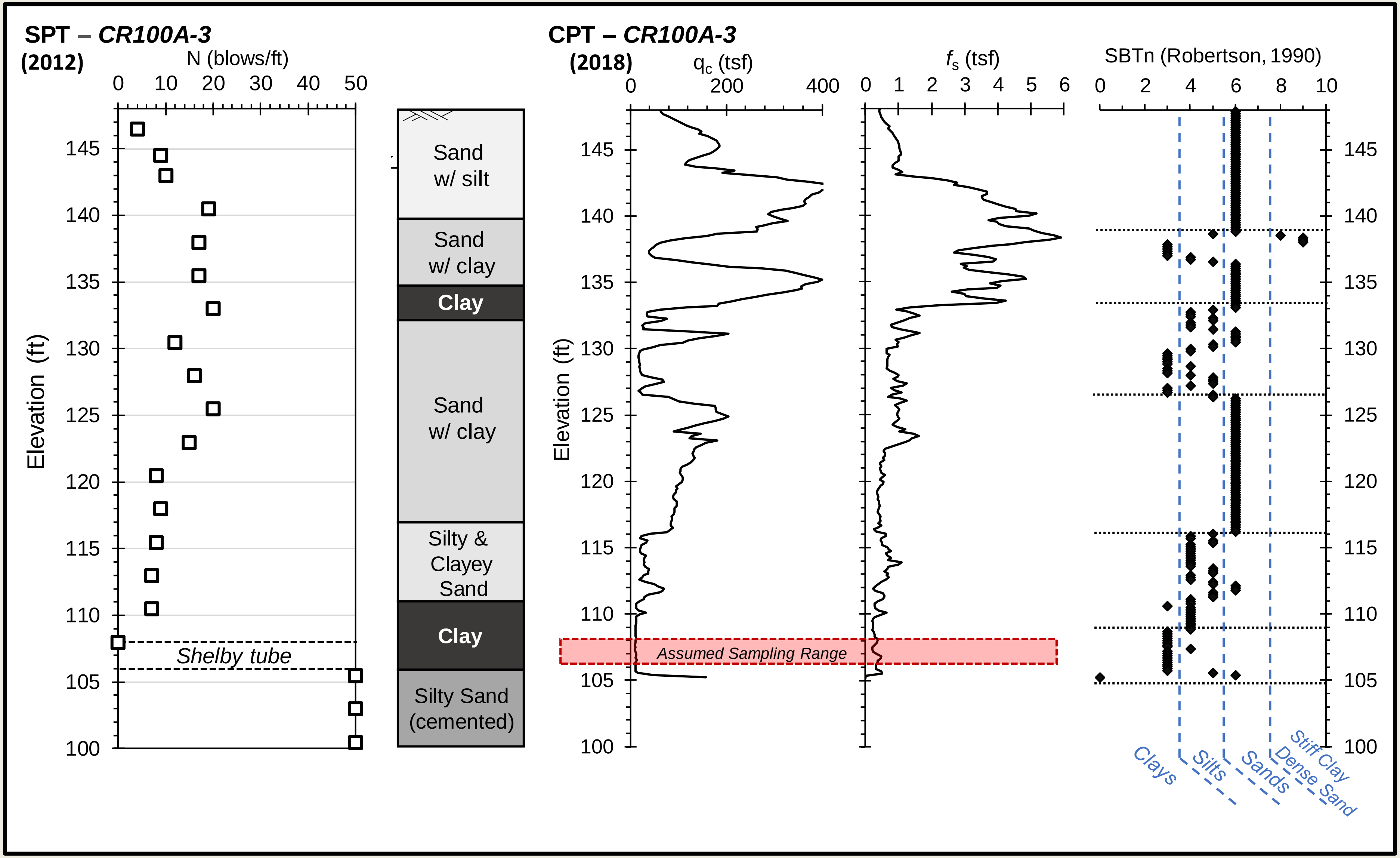


Feasible locations

8 total:
14 CPTs/Consols datasets



Data analysis



Summary of consolidation test data

Project I.D.	Sample Type (USCS)	Depth (ft)	-200 (%)	w (%)	LL (%)	PI (%)	s' (tsf)	Pc (tsf)	OCR	e_o	Cc	Cr
WPV_S1	CH	40 - 42	96	50	98	79	1.38	4.75	3.4	1.35	0.420	0.070
WPV_S2	SM	55 - 57	13	38	NP	NP	1.81	1.01	-	1.08	0.200	0.020
SR-100A	CH	30 - 32	99	68	117	96	0.96	6.10	6.4	2.52	0.940	0.130
i4 Ult_B204-2	CH	57 - 59	96	72	58	37	1.10	3.85	3.5	2.08	0.820	0.075
i4 Ult_B201-2	CH	40 - 42	97	67	89	61	1.01	3.45	3.4	1.84	1.000	0.138
i4 Ult B204-2	OH (44%)	30 - 32	96	123	61	22	0.96	3.63	3.8	2.17	1.390	0.060
SR415_TB6	CH	5.5	91	51	110	29	0.14	1.00	7.0	1.40	0.490	0.100
SR44_Dep1	MH	66	76	105	184	121	2.14	0.32	-	7.60	3.070	0.110
HospVill_2	CL	50.5	56	68	48	24	1.75	1.47	0.8	1.87	0.730	0.150
UCF_ST1	CL-ML	40 - 42	67	40	22	5	0.99	2.72	2.7	1.09	0.400	0.044
SR46_TB1	CH*	50 - 52	50	59	81	33	2.50	0.52	-	1.33	0.251	0.027
SR46_TB10	SC	42 - 45	48	58	64	34	2.35	0.25	-	1.16	0.144	0.033
SR46_TB12	CH	32 - 35	74	65	126	64	1.90	2.85	1.5	1.90	1.247	0.016
CR-100 A-3	CH	40 - 42	77	97	140	103	1.24	2.05	1.7	2.84	1.360	0.050

14 “reliable” data sets

(CPT - consolidation)

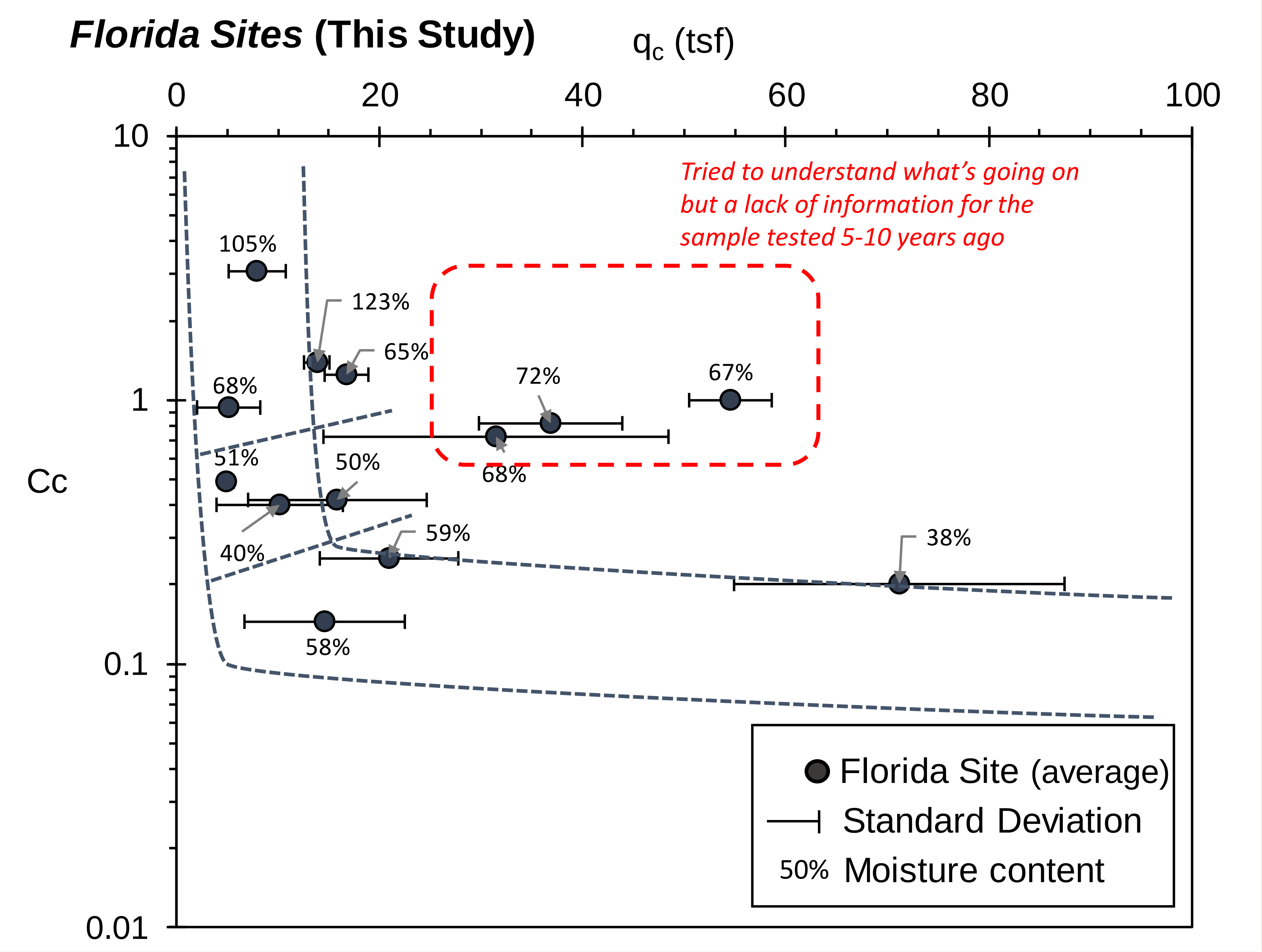
Summary of CPT data

Project I.D.	Data count	Tip Resistance, q_c (tsf)		Sleeve Friction, f_s (tsf)		Friction Ratio, R_f (%)	
		Avg.	Std. dev.	Avg.	Std. dev.	Avg.	Std. dev.
WPV_S1	6	15.84	8.81	1.07	0.20	7.04	1.53
WPV_S2	5	71.22	16.28	0.54	0.09	0.80	0.11
SR-100A	8	5.15	3.07	0.11	0.08	2.28	1.13
i4 Ult_B204-1	8	36.81	7.05	N/A	N/A	N/A	N/A
i4 Ult_B201-2	8	54.56	4.09	0.31	0.10	0.58	0.23
i4 Ult B204-2	7	13.86	1.26	0.28	0.03	2.00	0.11
SR415_TB6	12	4.87	0.72	0.30	0.05	6.18	0.51
SR44_Dep1	10	7.93	2.81	0.29	0.19	3.79	1.52
HospVill_2	6	31.48	16.95	0.43	0.14	1.48	0.29
UCF_ST1	6	10.15	6.26	0.16	0.08	1.69	0.14
SR46_TB1	14	20.91	6.82	0.61	0.06	2.99	0.95
SR46_TB10	13	14.60	7.94	0.49	0.24	3.11	0.43
SR46_TB12	15	16.77	2.12	0.34	0.09	1.81	0.32
CR-100 A-3	13	11.07	0.89	0.34	0.09	2.99	0.50

14 “reliable” data sets

(CPT - consolidation)

Compared to Sanglerat (1972)…



Conclusions

- Results from a state-wide survey to geotechnical practitioners shows that the existing correlations are used for preliminary design and estimating. However, the primary correlation used is one developed in 1967 and is not specific to Florida soils.

- The statistical models developed showed higher accuracy than the previous correlations. The authors believe the prediction accuracy is sufficient for a preliminary check.

- The general trend is that Cc decreases as CPT qc increases. Correlations from Cone Penetration Test outputs to consolidation parameters were inconclusive at the time of this study due to the limited data available

Recommendations

- Field validation of the model developed is necessary prior to the implementation.
- Use of high quality data to limit many variables
- CPTu and dissipation test data can provide “hydraulic” properties and could be used as input variables for the models and correlations

Acknowledgement

- Thanks the FDOT for the financial support
- Thanks to the Project Manager (David Horhota) and the Project Panel for their valuable comments and support
- Thanks to the CPT operation crew

Thank you!

Question?