

THE GEOID12A README FILE

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You have downloaded these files from the National Geodetic Survey (NGS) web site.

INTG.EXE (PC) or The geoid interpolation program
INTG (Solaris) (source code is available)

Ensure that you have downloaded these programs from this page as these are the most recent versions that will definitely read the GEOID12A and USGG2012 models.
Previous versions of INTG and XNTG may not.

Grid Name longitude)	Model	Region Covered (latitude & both East/West
g2012au0.bin	GEOID12A	entire grid for CONUS (24-58N, 230-300E/130-60W)
g2012au1.bin	GEOID12A	grid #1 for CONUS (40-58N, 230-249E/130-111W)
g2012au2.bin	GEOID12A	grid #2 for CONUS (40-58N, 247-266E/113-94W)
g2012au3.bin	GEOID12A	grid #3 for CONUS (40-58N, 264-283E/96-77W)
g2012au4.bin	GEOID12A	grid #4 for CONUS (40-58N, 281-300E/79-60W)
g2012au5.bin	GEOID12A	grid #5 for CONUS (24-42N, 230-249E/130-111W)
g2012au6.bin	GEOID12A	grid #6 for CONUS (24-42N, 247-266E/113-94W)
g2012au7.bin	GEOID12A	grid #7 for CONUS (24-42N, 264-283E/96-77W)
g2012au8.bin	GEOID12A	grid #8 for CONUS (24-42N, 281-300E/79-60W)
g2012aa0.bin 126W)	GEOID12A	entire grid for Alaska (60-72N, 172-204E/188-
g2012aa1.bin	GEOID12A	grid #1 for Alaska (60-72N, 172-204E/188-156W)
g2012aa2.bin	GEOID12A	grid #2 for Alaska (60-72N, 202-234E/158-126W)
g2012aa3.bin	GEOID12A	grid #3 for Alaska (49-61N, 172-204E/188-156W)
g2012aa4.bin	GEOID12A	grid #4 for Alaska (49-61N, 202-234E/158-126W)
g2012ah0.bin 154W)	GEOID12A	entire grid for Hawaii (18-24N, 199-206E/161-
g2012ag0.bin 214W)	GEOID12A	entire grid for Guam/CNMI (11-18N, 143-146E/217-

g2012ap0.bin GEOID12A entire grid for Puerto Rico and U.S. Virgin Islands (13-21N, 291-296E/69-64W)

g2012as0.bin GEOID12A entire grid for American Samoa (17-11S, 186-192E/174-168W)

To Install:

- 1) Make a subdirectory on your hard disk.
- 2) Copy the various geoid files into that subdirectory. You need not put the geoid files in the same directory as the INTG and XNTG programs though you will need to then specify the path. If you have also received USGG2012 or any other model files, you may safely place them in the same directory as GEOID12, if you like.

To Execute

(PC or Sun) Type INTG, and follow the prompts in a Command Prompt shell in Windows or a Unix terminal to ensure that it doesn't close immediately after completion to permit examination of the output statistics.

To Terminate

You can stop the program at any time using <Control> C.

File Structure

The files (ASCII and binary) all follow the same structure of a one line header followed by the data in row-major format. The one line header contains 4 double (real*8) words followed by three long (int*4) words. These parameters define the geographic extent of the area:

SLAT: Southernmost North latitude in whole degrees.
 Use a minus sign (-) to indicate South latitudes.
WLON: Westernmost East longitude in whole degrees.
DLAT: Distance interval in latitude in whole degrees
 (point spacing in E-W direction)
DLON: Distance interval in longitude in whole degrees
 (point spacing in N-S direction)
NLAT: Number of rows
 (starts with SLAT and moves northward DLAT to next row)
NLON: Number of columns
 (starts with WLON and moves eastward DLON to next column)
IKIND: Always equal to one (indicates data are real*4 and endian condition)

After this one line header, the data follow. The first row represents the southernmost row of data with the first data point being in the SW corner. The row is NLON values wide spaced at DLAT intervals, and then increments to the next row which is DLAT to the north.

This continues until the last row where the last value represents the northeast corner.

The easternmost longitude is = WLON + (NLON - 1) * DLON, while the northernmost latitude is = SLAT + (NLAT - 1) * DLAT.

Check The Byte Counts of all Downloaded Files

Before beginning, it will be useful to ensure that all files you have received are the correct size. (Download problems are

often manifested by incorrect byte counts in the files). Check with the list below to make sure your files match these numbers exactly. These values are good for the PC and Sun versions of the data.

PC or Sun Data:

g2012au0.bin	34,297,008 bytes
g2012au*.bin	4,933,728 bytes
g2012aa0.bin	20,554,848 bytes
g2012aa*.bin	5,540,208 bytes
g2012ah0.bin	607,968 bytes
g2012ag0.bin	304,848 bytes
g2012ap0.bin	434,688 bytes
g2012as0.bin	521,328 bytes

ASCII Data (uncompressed):

g2012au0.asc	86,816,078 bytes
g2012au*.asc	12,488,895 bytes
g2012aa0.asc	52,030,658 bytes
g2012aa*.asc	14,024,273 bytes
g2012ah0.asc	1,539,045 bytes
g2012ag0.asc	771,795 bytes
g2012ap0.asc	1,100,430 bytes
g2012as0.asc	1,319,918 bytes

C Program Source Code:

INTG_V317.ZIP	106,269 bytes
XNTG_V12.ZIP	28,914 bytes

PC executables:

INTG.EXE	122,331 bytes
XNTG.EXE	127,414 bytes

Sun executables:

INTG	186,500 bytes
XNTG	95,212 bytes

How Program INTG Works

The various geoid height grids are stored in the ".bin" files. Program INTG will prompt you for the name of the directory where you have chosen to store the .bin files, as well as prompting you for which geoid model you wish to use. You can operate with as few as one .bin file, or the entire geoid model data set. If a master file is given (e.g., g2012au0.bin for CONUS), then this will be preferentially used over the individual subgrids. When the program interpolates a given point, it checks an internal list of .bin boundaries, and uses the earliest list entry whose boundaries contain the best data scheme to interpolate that point. The order in which the .bin file names appear on the opening screen indicates the order in which the .bin files are searched. This applies especially to where the CONUS and Alaska grids overlap.

When running program INTG.EXE (PC) or INTG (Sun), the latitude and longitude of each point must be input. The GEOID12A models are heights above the NAD 83 ellipsoid. While the latitudes and longitudes in the IGS08/GRS-80 and WGS84 systems are very close to those of the NAD 83 system (with only 1-2 meters of horizontal shift), NAD 83 (2011/PA11/MA11) coordinates should exclusively be used. If necessary, use HTDP (which is available in the NGS Tool Kit) to convert into the appropriate ellipsoidal datum (2011: for CONUS, AK, PR, VI; PA11 for HI and Am. Samoa;

and MA2011 for Guam and CNMI).

GEOID12A geoid heights will always reference NAD 83, not IGS08/GRS-80.
USGG2012 geoid heights will always reference IGS08/GRS-80, not NAD 83.

Do **NOT** use NAD 27 latitudes and longitudes. The horizontal shifts between NAD 83 and NAD 27 can exceed 100 meters, causing a noticeable difference in the interpolated geoid value. To convert from NAD 27 to NAD 83 latitudes and longitudes you may use program NADCON, available from the NGS Tool Kit.

Data Input

You can key data by hand, point by point, or you can create an input file using a text editor. Several file formats are provided, including the NGS "Blue Book" format. These formats are detailed in a "Help" menu option which appears if you specify that you wish to use an input file.

Data Output

Results may be collected into an output file. There is no default output file name. The format of the output file is linked to the format of the input file to maintain consistency. If, however, you input your data by keyboard, and ask for an output file, the format of that output file will be in the format known as "Free Format, Type 1".

The GEOID12A Model

The GEOID12A model is known as a hybrid geoid model, as it is modified from a gravimetric model to fit GPS ellipsoid heights on leveled bench marks. The GEOID12A model refers to a GRS-80 shaped ellipsoid, centered at the NAD83 origin. It supports direct conversion between NAD83 GPS ellipsoidal heights and NAVD88, GUV04, NMVD03, PRVD03, VIVD09, and ASVD03 orthometric heights. In Hawaii, note that there is no defined vertical datum. Hence, GEOID12A in Hawaii converts between NAD 83 (PA11) and the W0 surface used to define USGG2012 ($62,636,856.00 \text{ m}^2/\text{s}^2$).

When comparing the USGG2012 model with GPS ellipsoidal heights in the IGS08 reference frame and leveling in the NAVD 88 datum, one can discern a systematic offset at a 50 cm level and a national trend of about 1.2 m. It is likely that this offset is inherent in the definition of the NAVD 88, since this same trend is seen when comparing to global geoid height models. Since the errors are long-wavelength, they can be modeled locally as a plane; usually at a 1 to 2 part-per-million level (see GEOID12A Technical Details for further information on how GEOID12A was developed from the GPSBM2012 and OPUSDBBM12 Control Data).

Deriving Orthometric Heights From GPS

One key problem is deciding which orthometric height datum to use. NGVD 29 is not a sea-level datum, and the heights are not true Orthometric heights. The datum of NAVD 88 is selected to maintain reasonable conformance with existing height datums, and its Helmert heights are good approximations of true orthometric heights. And, while differential ellipsoidal heights obtained from GPS are precise, they are

often expressed in the NAD 83 datum, which is not exactly geocentric.

This leads to a warning:

Do not expect the difference of a GPS ellipsoidal height at a bench mark vertical datum height and the associated GEOID12A height to exactly match. The modeling process allowed for random errors that could approach 10 cm. However, one can combine the precision of differential carrier phase GPS with the precision of GEOID12A height differences, to approach that of leveling.

Include at least one existing bench mark in your GPS survey (preferably many bench marks). The difference between the published elevation(s) and the height obtained from differencing your adopted GPS ellipsoidal height and the GEOID12A model, could be considered a "local orthometric height datum correction". If you are surveying an extensive area (100+ km), and you occupy a lot of bench marks, then you might detect a trend in the corrections up to a one part-per-million level. This may be error in the GEOID12A model.

We do not currently consider geoid-corrected GPS orthometric heights as a substitute for geodetic leveling in meeting the Federal Geodetic Control Subcommittee (FGCS) standards for vertical control networks. Studies are underway, and many less stringent requirements can be satisfied by geoid modeling. Widespread success has been achieved with the preceding models.

The XNTG Utility Program

The XNTG program can perform various functions, none of which are required to use the INTG program. The functions of XNTG are the extraction of sub-grids from the provided geoid grids, the translation between ASCII and binary grids, and the reporting of basic statistics for geoid grids.

For More Information

For Products Available From the National Geodetic Survey:

Information Services Branch
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301-713-3242 fax: 301-713-4172

For Information on GEOID12A and Future Research:

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Visit our web site:

<http://www.ngs.noaa.gov/GEOID/GEOID12A>