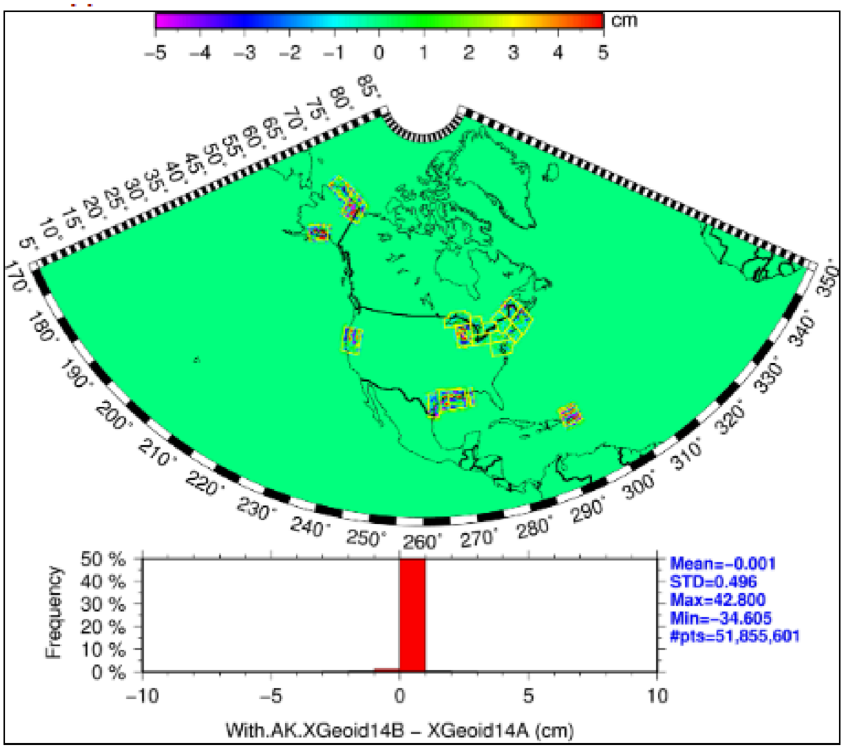
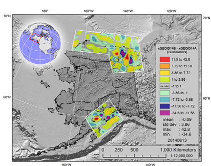
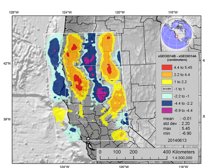
xGEOID14 Supplemental Information



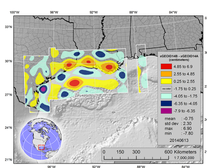
Map 1 - Master grid



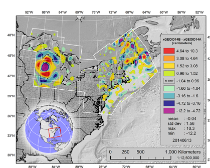
Map 2 - Alaska



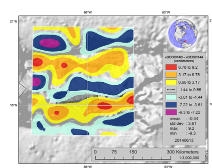
Map 3 - CA/OR



Map 4 - Gulf



Map 5 - North East



Map 6 - PRVI

Overview

The xGEOID14A and xGEOID14B models represent a first effort a producing geoid height models that span all of Alaska, Hawaii, the CONterminious United States (CONUS), and Puerto Rico and the USVI (PRVI). Being developed from a single model means that derived heights will reference the same datum across all four regions. The image shown on the main page shows xGEOID14B and demonstrates this span. Map 1 above shows the difference between xGEOID14A and xGEOID14B with the boxes showing the specific regions where aerogravity was included. The differences between the models is focused in these regions.

To compare with GEOID12A and USGG2012, the larger single model was parsed into the same size regions. This makes determination of geoid heights easier and more consistent. The five other thumbnail images on this page highlight the differences between xGEOID14B and xGEOID14A. Aerogravity for CONUS, Alaska, and PRVI were available to make xGEOID14B and is highlighted by boxes in those grids. These boxes correspond to the locations of the **GRAV-D Data Products webpage** that contained data suitable for inclusion in this model as of March 31, 2014. Hence, not all the green boxes shown on the GRAV-D Data Products Page will be reflected in this model. Those will remain for inclusion next year. Aerogravity is essentially limited to the boxes though adjacent regions are impacted. For areas well away from the aerogravity, little difference is seen between the two experimental geoid models.

American Samoa, Guam, and the Commonwealth of the Northern Marian Islands (CNMI) lie well outside of the above region. Hence, no model has been yet developed for these regions. However, the same techniques can be applied to generate a geoid height model that would be consistent with these derived here.

Aerogravity

The aerogravity used to develop the xGEOID14B model provide overwhelming evidence of the significant systematic problems in the existing NGS terrestrial data. The fact that differences are evident indicates that the aerogravity is detecting a different gravity field than that of the surface gravity data used to develop the finer details of the geoid models. Most regions highlight some differences. Note however, that the majority of the Northeast CONUS shows only a few bumps of difference. This is because the surface and airborne gravity data largely agree though some differences exist.

The intent of the GRAV-D Project is that the aerogravity will be used to detect and mitigate these systematic differences so as to make surface gravity data consistent with the aerogravity at scales where the aerogravity are considered more accurate. This preserves the shortest wavelengths of the gravity from the surface data while fitting to the signal detected by the aerogravity.

This is necessary because a great deal of the metadata associated with the surface gravity data have been lost. This data was collected over a period of about 70 years with the bulk of it being over 50 years of age. These data could be used to produce a geoid model valid for 50-60 years ago but not today. Aerogravity can be used to account for the slow, systematic changes that have occurred over time as well as any blunders that may have occurred. For further details on how aerogravity are intended to perform this task, see the attached proceedings paper presented at the International Federation of Surveyors (FIG) Congress in June 2014 "**GRAV-D: Using Aerogravity to Produce a Refined Vertical Datum**".

Model Comparisons

For consistency, GEOID12A was converted from the NAD 83 (2011/PA11) reference frame into IGS08 - the same reference frame that USGG2012, xGEOID14A, and xGEOID14B are given in. Hence, if you compare the geoid heights from this model to those from the INTG software for GEOID12A, the geoid heights will be different. However, the orthometric heights will be the same since that height is given above the respective geopotential datum.

The input data is given as a comma-separated list with up to 20 entries possible. Input can be either NAD 83 (2011) for Alaska, CONUS, and PRVI or in NAD 83 (PA11) for Hawaii. Alternatively, input may be in IGS08. If coordinates are provided in NAD 83, they will be converted to IGS08 using the **Horizontal Time Dependent Positioning (HTDP) software**.

The output products will be provided in IGS08 - including the GEOID12A data. If an ellipsoid height was provided, then an orthometric height will be given for each geoid height model according to:

$$H = h - N$$

Where:

H = orthometric height above the respective datum
h = ellipsoid height in IGS08 (possibly after conversion from NAD 83
N = geoid height from the respective model

Note that geoid heights are ellipsoid heights that measure the distance to a datum surface from the ellipsoid reference surface in a specific reference frame (e.g., GRS-80 ellipsoid in IGS08) reference frame). GEOID12A refers to NAVD 88. USGG2012 refers to a geopotential surface that is expressed as 62,636,855.69 m2/s2. While both xGEOID14A and xGEOID14B refer to the geopotential surface of 62,636, 856.00 m2/s2.

Application

One possible application for this tool would be for a series of points along the same level line. Providing ellipsoid height inputs would result in different orthometric heights for each point based on the respective geopotential datums. By comparing between points on each datum, the height change can be examined. This would be useful in regions where height change over NAVD 88 might indicate a slope for a region known to be flat. In that case, examination of the height change based on xGEOID14B might be useful.

Another application would be examining the information on Tidal bench marks (TBM's). The geopotential surface for xGEOID14A/B was selected to be 62,636,856.00 m2/s2, because that was determined to be the mean geopotential value fitting through hundreds of tide gauges around the U.S. and Canada. So a comparison of the ellipsoidal height of local MSL should fit fairly closely to the geoid. However, significant local variations occur in MSL (e.g., the Gulf Stream) that may cause this not to fit unless this local ocean dynamic topography is also taken into account. However, along the Pacific Northwest Coast, orthometric heights derived using xGEOID14A/B should fit much more closely to local MSL that heights above NAVD 88.

The height differences between each successive point could be examined to determine which model best accounts for height changes along the line.

The model is limited to twenty (20) points primarily to keep it focused as a research tool for exploring the potential for a future vertical datum. Anyone interested in exploring the model more fully should contact the geoid team to make arrangements for a responsible transfer of the models.