



The Height Modernization Program in the United States and the Future of the National Vertical Reference Frame

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Facing the Challenges - Building the Capacity

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Historical National Vertical Datums in the United States

- Orthometric heights
 - Up to National Geodetic Vertical Datum of 1929 (NGVD 29)
 - North American Vertical Datum of 1988 (NAVD 88)
 - Defined through leveling network
- Ellipsoid heights
 - North American Datum of 1983 (NAD 83)
- Geoid Heights
 - GRS80/NAD 83
 - Gravity
 - GPS on bench marks

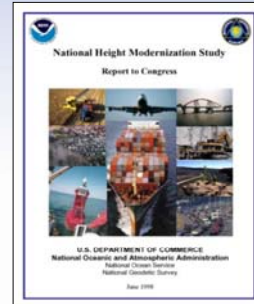


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NGS' Height Modernization Program

- Height Modernization Study – 1998
 - Cost benefits
 - Pilot projects
 - Guidelines
- Assistance to states through Federal Funding
- Refining geoid height model to fit NAVD 88
- Goal: Improve access to vertical control



Problems Maintaining this kind of Vertical Datum

- Dependence on passive control
- Dynamic nature of Earth's surface
- Inherent error propagated on a national scale in leveling measurements
- Expense of monitoring network – requires return to marks
- Maintaining multiple Datums – can't level between islands/territories and conterminous U.S.

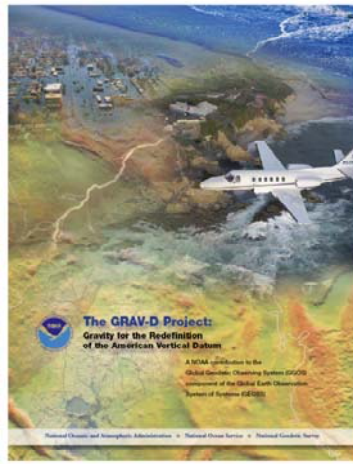
Fixing NAVD 88

- Short term fix: Height Modernization GNSS surveys
 - Requires accurate geoid model
 - Requires minimal NAVD 88 control to get the model
- Long term fix: Re-level NAVD 88
 - Cost estimate between \$200 million and \$2 billion
- Fixes don't address many issues with the datum
- Third option - Replace NAVD 88

When to Redefine a Datum

- When more observations/stations will improve the network accuracy/consistency
- When better field and adjustment procedures can improve results
- When deficiencies in the network make it distorted or inaccessible
- When better technology can give you more accurate data, or a better way to access datum

GRAV-D: Gravity for the Redefinition of the American Vertical Datum

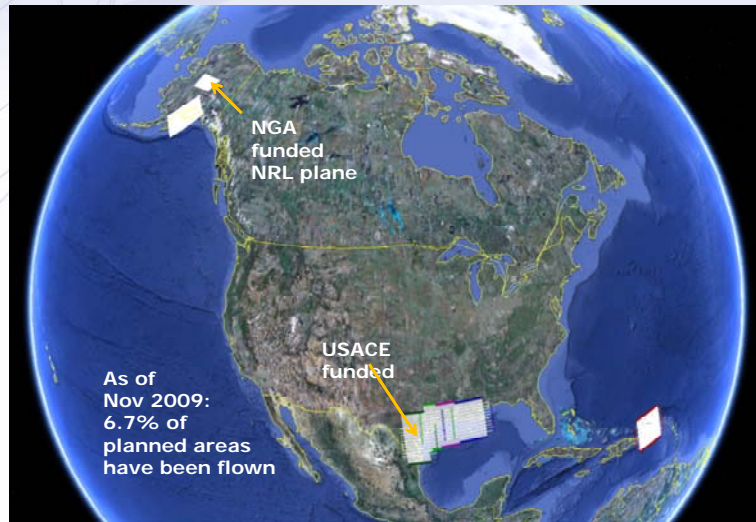


- Airborne Gravity Snapshot
- Absolute Gravity Tracking
- Re-define the Vertical Datum of the USA
- Target date 2018 per 10-year plan
- Target: 2 cm accuracy orthometric heights from GNSS and a geoid model

Maintaining a datum - monitoring gravity

- Space based gravity data
- Repeat absolute and relative gravity
- Static in short term
- Update in long term
- Metadata includes epoch, velocities

What is the status of GRAV-D?



Pros and Cons of the new Datum

- One consistent vertical datum spanning North America and US Territories
 - Canada – also moving to Geoid based Datum
 - Mexico, Central America, Caribbean – not planning on change yet but datum is available to them
- Datum is only accurate to 2 cm (4 cm network) at best at any given point (GNSS error + geoid error)
 - However, this is an improvement over NAVD 88 realization error
 - The datum could then be disseminated locally through very precise geodetic leveling

Height Modernization: Transitioning to a New Datum

- Improve access to NAVD 88 today
 - Identify areas of immediate critical need
 - Build infrastructure that will help access today, and transformation tomorrow
- Prepare for transition to new vertical datum tomorrow
 - Models, tools, guidelines, specifications
 - Education, outreach, capacity building

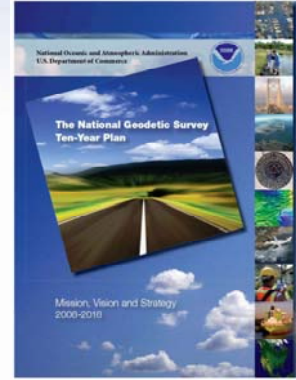
Achieving the mission through partnerships

- NGS maintains and monitors framework for defining Datums and accessing reference frame: Continuous GNSS stations (CORS) and gravity data
- Increasing reliance on partners, the user community, to maintain the passive control infrastructure to suit their needs
- NGS provides models, tools, guidelines, specifications, education
- NGS uses community-provided data to improve models

From NGS' 10-Year Plan

NGS Mission: "Modernize the Geopotential ("Vertical") Datum"

"The gravimetric geoid, long used as the foundation for hybrid geoid models, becomes *the most critical model produced by NGS.*"



Additional Information



The NGS 10 year plan (2008-2018)

<http://www.ngs.noaa.gov/INFO/NGS10yearplan.pdf>

The GRAV-D Project

<http://www.ngs.noaa.gov/GRAV-D>



Socio-Economic Benefits Study:
Scoping the Value of CORS and GRAV-D



Socio-Economic Benefits of CORS and GRAV-D

http://www.ngs.noaa.gov/PUBS_LIB/Socio-EconomicBenefitsofCORSandGRAV-D.pdf



Questions

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<http://www.ngs.noaa.gov/heightmod/EventsArchive.shtml>

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