Height Modernization in the U.S.: Implementing a Vertical Datum Referenced to a Gravimetric Geoid Model

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National Geodetic Survey Mission

- Define, maintain, provide access to National Spatial Reference System (NSRS)
- Essentially the same Mission for over 200 years
- Historically datum definition includes realization of the datum, i.e. the passive control used to access it
- Historically maintaining the datum has meant re-establishing marks when they were destroyed
National Geodetic Survey Mission

• Today NGS provides access through geodetic control: passive (survey disks) and active (CORS)
• Other federal mapping agencies use the NSRS for cadastral, topographic, floodplain, and other mapping applications – NGS does not do the mapping
• NGS incorporates geodetic data from outside NGS into the NSRS
  – from other federal agencies
  – from the surveying community at large

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National Geodetic Survey Mission

• What’s changed? [horizontal]
  – Defined through active control – CORS
  – Maintained by computing and modeling velocities
• What’s the same? [vertical]
  – Many users still access NSRS with passive control
  – Leveling still provides the most accurate heights – GNSS alone can’t do the job
• What does this mean?
  – Dwindling resources make it difficult for NGS to maintain NSRS, particularly the vertical
NGS’ Height Modernization Program

- User driven – Congressional support
- Goal: Improve access to vertical control
- Method: Refine geoid height model to fit NAVD 88 so GNSS could be used

Program Focus
- Infrastructure: GPS on bench marks
- Guidelines, models, tools: specifications for GNSS surveys, geoid and velocity models
- Education, capacity building

Problems with this Approach

- Dependence on passive control
  - Susceptible to movement, destruction
  - Requires major resources to maintain
- Error apparent in network
  - Inherent error at continental scale
  - Using GNSS to survey larger areas reveals distortions not apparent before
  - Expectations are greater – desire is for fast and accurate heights using GNSS
NGS Ten-year Plan and Height Modernization

• Science
  – Redefining the datums
  – Improving the geoid model
  – GRAV-D: Gravity for the Redefinition of the American Vertical Datum

• Program
  – Transition
  – Implementation

Height Modernization Strategic Plan

• Improve access to NAVD 88 today
  – Identify areas of immediate critical need
  – Build infrastructure that will help access today, **and** support access in the future

• Prepare for transition to new vertical datum
  – Models, tools, guidelines, specifications
  – Education, outreach, capacity building
Goal 1: NGS Understands User Capability to Get 2 cm Heights

- NAVD 88 today
  - Review data holdings: density of CORS, passive control, ties to tide gages, gravity data
  - Consider conditions: topography, dynamic processes, population, tree cover and extreme weather
  - Evaluate guidelines, models, tools
- Gravimetric geoid-based datum tomorrow
  - Define infrastructure needed to achieve 2 cm heights reference to new datum
  - Identify guidelines, models, tools that will need to be updated

Goal 2: Strategically Address Gaps
Goal 3: Maintain Access to Vertical Datum

- NAVD 88 today
  - Recommend actions to address gaps/weaknesses in infrastructure – surveys, pilot projects, velocity models
  - Special attention to dynamic regions
  - Modify delivery of control: modify accuracies or expire outdated control
  - Support local communities’ capacity to validate/maintain vertical control: guidelines, tools
- Gravimetric geoid-based datum tomorrow
  - Actions done today will support transition to new datum
Goal 4: Education, Capacity Building

- Publications: technical journals, web site
- Training: workshops, webinars, conferences
- Capacity building: hands-on surveying and processing workshops
- Opportunities for collaboration: pilot and research survey projects

- Research grants: to test and develop guidelines, models, and tools
- Outreach: traditional and non-traditional user community

Height Modernization will succeed if:

- NGS works with user community, federal and local agencies, universities
- Activities are multi-faceted, e.g. surveys
  - . . . address gaps
  - . . . test guidelines
  - . . . provide opportunities to maintain core capabilities in NGS
    and train user community
- Activities are prioritized
  - Areas of critical need
  - Support access to NAVD 88 now plus transition to new datum
Questions

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