Using Aerogravity to Produce a Refined Vertical Datum

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XXV FIG Congress
16-21 June 2014
Kuala Lumpur, Malaysia
Session TS01A, Paper 7303

Power Spectrum plot of gravity field (blue line). Most power is at longest wavelengths (λ) at left on the lowest degree harmonics, where satellite (light blue bar) data dominate. Surface data (brown bar) contain the shortest to the right. Aerogravity (green bar) overlaps both parts of spectrum (red boxes).
GRAV-D Aerogravity (07 June 2014)
Gravity for the Redefinition of the American Vertical Datum

Map Key - Airborne Gravity Data
Green: Available data and metadata
Blue: Data being processed
Orange: Data collection underway
White: Planned for data collection

http://www.ngs.noaa.gov/GRAV-D/data_products.shtml

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GRAV-D Aerogravity Collection

• Aircraft: rotating between King Air, Pilatus, P-3
• Equipment: GPS, IMU, & gravity meters
• Data sampling: 1 Hz
• Nominal Flight elevation: 6.1 km (20 kft)
• Nominal air speed: 407 kmh (220 knots)
• Track spacing: 10 km track (50 km crossovers)
• Typical block: 400 x 500 km (41 profiles)
• Nominal spectral band: 20-400 km
EN06 – Collected over Maine

EN06 Aerogravity (Beta vers.) Biases by Profile w.r.t. EGM2008

Profiles for 3 regions (no bias)

- Each profile is essentially independent
- Spatially correlated systematic features between profiles
- Likely error sources are in surface gravity:
  - Near shore (altimetry)
  - Onshore follows topo
  - Back bay areas
Airborne vs. Surface Gravity

- Cleaning of gravity data
- Second transition band
- Remove biases w.r.t aerogravity (normalize)
- Makes surface data consistent with aerogravity
- Preserves short wavelength in surface
Mean = 0.0 cm STDEV = 0.5 cm MIN = -42.8 cm MAX = 34.6 cm

<table>
<thead>
<tr>
<th>unit</th>
<th>Cmm_T (Ref)</th>
<th>Cmm_Z00 (Ref+Airborn)</th>
<th>Ref+Airborn+Surface (Ref)</th>
<th>#points</th>
</tr>
</thead>
<tbody>
<tr>
<td>cm</td>
<td>std</td>
<td>std</td>
<td>std</td>
<td>#points</td>
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<tr>
<td>Gulf Coast</td>
<td>9.93</td>
<td>9.26</td>
<td>9.23(240)</td>
<td>482</td>
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<td>PRVI</td>
<td>11.70</td>
<td>10.37</td>
<td>10.49(240) 10.25(480)</td>
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<tr>
<td>Great Lakes</td>
<td>10.72</td>
<td>10.68</td>
<td>10.56(240) 10.56(480)</td>
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<tr>
<td>North East</td>
<td>3.81</td>
<td>2.99</td>
<td>3.30(240) 3.19(360) 3.04(480) 2.97(600)</td>
<td>168 (Altimetry problem ?)</td>
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<tr>
<td>GSVS11</td>
<td>1.86</td>
<td>1.08</td>
<td>1.37(240) 1.07(480)</td>
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<tr>
<td>CA11 (45N,36N,234W,241W)</td>
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<td>11.27</td>
<td>11.21(240) 11.21(480)</td>
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<tr>
<td>Lake Michigan (47N,40N,270W,278W)</td>
<td>7.55</td>
<td>7.48</td>
<td>7.44(240)</td>
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</tr>
</tbody>
</table>
Outlook

• 30 June 2014 Beta release of xGEOID14A/B
• Look for links on the NGS Main or GEOID pages
• Incorporates aerogravity from 20 regions
• First experimental model using aerogravity
• Annual releases to follow (roughly same time)
• Data cleaning: 2,000,000 surface gravity in 1400 different surveys
• Eventual usage as vertical datum in 2022

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• Relevant NGS webpages:
  – Geoid Page: http://www.ngs.noaa.gov/GEOID/
  – GRAV-D: http://www.ngs.noaa.gov/GRAV-D/
Great Lakes through Northeast U.S.

Puerto Rico & USVI