ENHANCING THE INTEGRITY OF THE NATIONAL GEODETIC DATA BASES IN EGYPT

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Objectives

2. H from OSU91A global geoid model
2. Accuracy = 1.5 m
- Performance of recent global geopotential models
- Analysis of local geoid models
- Develop a new precise geoid

Recent GPS net along Nile + New Geoid
more reliable H of national GPS reference framework in Egypt

Performance of Global Spherical Harmonic Geopotential Models over Egypt

\[ \Delta N \text{ Over check points:} \]

<table>
<thead>
<tr>
<th></th>
<th>OSU91A</th>
<th>EGM96</th>
<th>PGM2000</th>
<th>UCPH2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min</td>
<td>-1.63</td>
<td>0.11</td>
<td>0.15</td>
<td>-3.95</td>
</tr>
<tr>
<td>Max</td>
<td>1.97</td>
<td>1.89</td>
<td>1.92</td>
<td>3.94</td>
</tr>
<tr>
<td>Mean</td>
<td>-1.63</td>
<td>-0.43</td>
<td>-0.47</td>
<td>1.59</td>
</tr>
<tr>
<td>RMS</td>
<td>1.86</td>
<td>0.78</td>
<td>0.80</td>
<td>2.19</td>
</tr>
</tbody>
</table>

- EGM96 is the "best" global model
- All models do not precisely represent the gravitational field over Egypt

Recent national geoid models in Egypt

Grav. Geoid \rightarrow GPS/Levelling \rightarrow Comb. Geoid
- Saad and Dawod 2002:
  - Check: -0.39 to 0.34
  - mean: -0.10, RMS: 0.48
- Abdel-Motael 2002:
  - a single GPS point
  - Data distribution
- Hassouna 2003:
  - Check: -0.39 to 0.33
  - mean: 0.07, RMS: 0.27
- Data distribution

Geodetic Data Bases in Egypt

- High Accuracy Reference Network (HARN)
  - 1995: 30 stations, 200 km apart
  - precision 1:10,000,000
- National Agricultural Cadastral Network (NACN)
  - 112 stations, 50 km apart
  - precision 1:1,000,000
Available Data

1. Hydrographic Survey of Nile
2. Reach 4: 408 km
3. GPS control Networks: Int. Spec. 1st order net
   1 ppm accuracy
   168 GPS
   130 h/H
4. Tie to HARN+NACN
   20 stations
   Mean distance 5.7 km
5. Nile 2004 Geoid

Processing

- Nile 2004+SRI2002 -> more reliable geoid
- Kriging interpolation:
  \[ \Delta N_{i,j} = N_j - N_i \]
  \[ \Delta h_{i,j} = h_j - h_i \]
  \[ H_i = h_i - N_i \] and \[ H_j = h_j - N_j \]
  \[ \Delta H_{i,j} = \Delta h_{i,j} - \Delta N_{i,j} \]
- \[ H_{\text{NACN}} = H_{\text{GPS}} + \Delta H \]
- Least-squares adjustment

Results

- \( H \) for 15 NACN points
- Over 5 check points:
  \[ \Delta H \text{ from 0.06 m to 0.42 m} \]
  Average 0.18 m (0.80 EGM96)
  1 cm/km level of relative precision
- Economic benefits

Conclusions

- \( H \) of national GPS nets from OSU91A
- Global geoid models:
  OSU91A, EGM96, PGM2000A & UCPH2002
  Precision: 0.80 ~ 2.19 m
  EGM96 is still the “best” global geoid model
- Integrate 2 geoid models for Nile Valley
  A geoid with \( \approx 5 \) cm accuracy
- Estimated \( H \) for NACN points: 0.18 m accuracy
- National GPS data bases: \( \phi, \lambda, h, H \)

Recommendations

- Apply developed geoid in surveys of water resources management
- Apply same strategy for other NACN & HARN nets
- Unify efforts towards national geodetic database
- Local data in new global geoid models