Comparison of DORIS site position and reference frame time series with other space techniques

B. Meisel, D. Angermann, H. Müller, V. Tesmer

Deutsches Geodätisches Forschungsinstitut (DGFI)
Marstallplatz 8, D-80539 München, Germany

email: meisel@dgfi.badw.de

International DORIS Service & DORIS Network Workshop, Biarritz, France, June 13, 2002
Motivation

• A highly accurate and consistent ITRF is of vital importance for geodetic, geodynamic and geophysical projects

• The accuracy achieved today is mainly limited by systematic errors of the individual space techniques (e.g. ITRF 2000 results)

• To detect the systematic errors it is necessary to compare the individual solutions, especially the time series of the parameters
Outline

- Analysis of DORIS, VLBI, SLR and GPS solutions (weekly/daily VLBI sessions)
- Helmert-transformation to ITRF 2000
- Time evolution of the reference frame (origin, scale)
- Investigation of site position time series at co-location sites
- Analysis with respect to non-linear effects, periodic signals, ...
## Data and solution characteristics

<table>
<thead>
<tr>
<th>Technique</th>
<th>Analysis Center</th>
<th>Software</th>
<th>Data Time Span</th>
<th>Number of Stations</th>
<th>Station Coordinates Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>DORIS</td>
<td>IGN/JPL</td>
<td>GIPSY / OASIS</td>
<td>1992.8-2002.0</td>
<td>82</td>
<td>all DORIS satellites weekly SINEX files</td>
</tr>
<tr>
<td>GPS</td>
<td>CODE</td>
<td>Bernese</td>
<td>1996.0-2002.2</td>
<td>171</td>
<td>weekly SINEX files</td>
</tr>
<tr>
<td>GPS</td>
<td>JPL</td>
<td>GIPSY</td>
<td>1996.0-2002.2</td>
<td>172</td>
<td>weekly SINEX files</td>
</tr>
<tr>
<td>GPS</td>
<td>SIO</td>
<td>GAMIT</td>
<td>1995.0-2002.2</td>
<td>147</td>
<td>weekly SINEX files</td>
</tr>
<tr>
<td>VLBI</td>
<td>DGFI</td>
<td>OCCAM</td>
<td>1984.0-2002.0</td>
<td>47</td>
<td>2227 session solutions</td>
</tr>
</tbody>
</table>
Station Networks used for Helmert-transformations

- 50 DORIS Stations
- 47 GPS Stations
- 20 SLR Stations
- 7 VLBI Stations (NEOS-A)
Power spectrum (FFT) - Translations

Tx

annual (amplitude: 0.6 cm)

Ty

annual (amplitude: 0.5 cm)

Tz

117.5 days (amplitude: 7.5 cm)

annual (amplitude: SIO 1.0 cm, JPL 1.9 cm, CODE 0.5 cm)

annual (amplitude: 0.45 cm)

frequency [1/days]

annual (amplitude: SIO 0.5 cm, JPL 0.8 cm, CODE 0.35 cm)

annual (amplitude: 0.3 cm)

annual (amplitude: 0.6 cm)

annual (amplitude: 0.3 cm)

annual (amplitude: 0.3 cm)

frequency [1/days]

annual (amplitude: 0.3 cm)
Yarragadee

Up [cm]

Power spectrum (FFT)

117.5 days
(amplitude: 2.1 cm)

annual
(amplitude: 0.5 cm)

DORIS (IGN)

GPS (SIO)

SLR (DGFI)
Arequipa (Peru)

North [cm]


- 40 - 30 - 20 - 10 0 10

DORIS (IGN)


- 60 - 40 - 20 0 10

GPS (SIO, JPL, CODE)

East [cm]


- 60 - 40 - 20 0 10

SLR (DGFi)


- 60 - 40 - 20 0 10

DGFi

Forschungsgruppe Satellitengeodäsie
Conclusion

- Recommended contribution of space-techniques for the datum definition of the ITRF
  - Origin: $x, y$ SLR (DORIS, GPS possible)
  - $z$ SLR
  - Scale: VLBI, SLR (GPS, DORIS possible)

- Realistic annual signal only in SLR translations (amplitudes: 3-4 mm)

- 120 days periodic signal in DORIS $z$-component (amplitudes: $\sim 7.5$ cm)

- Position time series reveal jumps (e.g. earthquakes) and periodic signals (e.g. annual, 120 days for DORIS)

- Further analysis of systematic differences between individual solutions is required (e.g. software, models, strategies)