EGU2015-2492 - IDS Combined Solution improvements between ITRF2008 and ITRF2013

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• What has changed between ITRF2008 and ITRF2014?

• Performances of IDS contribution to ITRF2014 compared to IDS contribution to ITRF2008.
  – DORIS Network.
  – Origin and Scale.
  – Stations position residuals.
  – EOPs.

• First results of the IDS 09 (ITRF2014) cumulative solution.

• IDS News
What has changed between ITRF2008 and ITRF2014?

• **In terms of Data**

  ITRF2014 = ITRF2008 + new missions
  (Jason-2, Cryosat-2, HY-2A*, Saral*)
  + Jason-1 (SAA corrected data)
    between TOPEX and Jason-2 only
  + SPOT5 SAA corrected data from 2006

• **In terms of Time Span**

  1993.0-2008.0 \(\Rightarrow\) 1993.0–2014.67 (due to data latency and to respect IERS submission deadline Feb 27th)

• **In terms of Forces and Models**

  ITRF2014
  ✓ Includes Time variable Gravity field.
  ✓ Accounts for beacon frequency offsets (changes wrt nominal frequency).
  ✓ Integrates phase center antennae corrections (PCV: Alcatel/Starec).
6 ACs from 6 different institutions with 5 different software packages

1 AC less compared to ITRF2008

<table>
<thead>
<tr>
<th>AC</th>
<th>Software</th>
<th>Series number</th>
<th>Solution Type</th>
<th>Phase laws</th>
<th>Time Span</th>
<th>Nb of SINEXs</th>
<th>EOPs</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESA</td>
<td>NAPEOS</td>
<td>10</td>
<td>NEQ</td>
<td>Yes</td>
<td>1993.0-2014.45</td>
<td>1103 (1082)*</td>
<td>Motion+rate+LOD</td>
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<tr>
<td>GOP</td>
<td>BERNESSE</td>
<td>43/45</td>
<td>COV</td>
<td>Yes</td>
<td>1993.0-2014.67</td>
<td>1125 (1119)*</td>
<td>Motion+rate</td>
</tr>
<tr>
<td>GSC</td>
<td>GEODYN</td>
<td>26</td>
<td>NEQ</td>
<td>Yes</td>
<td>1993.0-2014.67</td>
<td>1131 (1116)*</td>
<td>Motion</td>
</tr>
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<td>IGN</td>
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<td>15</td>
<td>COV</td>
<td>Yes</td>
<td>1993.0-2014.67</td>
<td>1131 (1127)*</td>
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<tr>
<td>INA</td>
<td>GIPSY-OASIS II</td>
<td>08</td>
<td>COV</td>
<td>No</td>
<td>1993.0-2014.67</td>
<td>1130 (1123)*</td>
<td>Motion+rate+LODR+UT</td>
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<tr>
<td>GRG</td>
<td>GINS-DYNAMO</td>
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<td>COV</td>
<td>Yes</td>
<td>1993.0-2014.67</td>
<td>1128 (1118)*</td>
<td>Motion</td>
</tr>
<tr>
<td>IDS</td>
<td>CATREF</td>
<td>09</td>
<td>COV</td>
<td></td>
<td>1993.0-2014.67</td>
<td>1130</td>
<td>Motion</td>
</tr>
</tbody>
</table>

Does not contribute to the combined scale

(*** *) *= number of weeks included in the IDS combined solution
DORIS ITRF2014 Network

156 stations over 71 sites (38 in northern hemisphere).

5 new sites (★) wrt ITRF2008: Betio, Cold-Bay, Grasse, Rikitea and Socorro.
Results are improved when more satellites available and with new DGXX receivers.

- Origin: Improvements of Tx, Ty and Tz after 2002 (lower STDs, less annual signal).

- IDS 09 Scale:
  - Shows an offset wrt IDS 03’ due to beacons PCVs.
  - Has no more scale discontinuity in 2002 thanks to beacon frequency offset estimations.
  - Presents an increase of around 10mm mid 2012 and is more stable before.
• Similar scales behavior from GOP, GSC and INA single-satellite solutions.
• Cryosat-2 and Jason-2 present a scale increase mid 2012.
  ➔ Scale increase of the multi-satellites solution grg40.
• Origin of Cryosat-2 and Jason-2 scale
  ✓ Does not seem to be the consequence of any network changes.
  ✓ Part of the increase depends on the origin of the CoM-CoP vector.
  ✓ Is not yet explained but is still under investigations.
- Substantial degradation from 1993 to mid-2002.
  - Mainly in the East direction.
  - Smaller differences if IDS 09 network is set to IDS 03 mean diff. decreases from 4 to 1.7 mm).

- Slightly better performances since mid 2002 thanks to beacon frequency offset estimations.
- North direction gives best performances.

- Results improved when more satellites are available and with new DGXX receivers.
  - Below 10 mm after including Jason-1 (late 2004).
  - Around 7-8 mm since late 2011 (HY-2A adding).
IDS 09 – IDS 03

- Substantial degradation from 1993 to mid-2002 on X pole mainly (2 ACs less compared to ITRF2008).
- X-pole differences present draconitic periods of 118 days (TOPEX, Jason-1/2).
- Results are improved when more satellites are available.

<table>
<thead>
<tr>
<th>Period of time</th>
<th>Std $\Delta X$ [mas]</th>
<th>Std $\Delta Y$ [mas]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996.00-2002.00</td>
<td>0.68</td>
<td>0.63</td>
</tr>
<tr>
<td>2002.50-2008.50</td>
<td>0.31</td>
<td>0.29</td>
</tr>
<tr>
<td>2008.67-2014.67</td>
<td>0.24</td>
<td>0.23</td>
</tr>
</tbody>
</table>
From 1130 IDS 09 weekly SINEX files over time span 1993.0 – 2014.67
Makes use of 96 DORIS-DORIS tie vectors and 132 velocity constraints.
IDS 09 (resp. IDS 03) counts 63 (resp. 53) position discontinuities
✓ 34 (resp. 14) with seismic origin.
✓ 11 (resp. 07) with beacon change origin.
✓ 18 (resp. 32) with unknown origin.
Summary of IDS contribution to ITRF2014

• For DORIS
  – 6 Analysis Centers.
  – Up to 12 DORIS missions.

• Results improved
  • With beacon frequency variations included: removes sporadic jumps in the station height for some stations as well as scale jump early 2002.
  • With time variable gravity field: reduces periodic signal on translations.
  • With Jason-1 SAA corrected data.
  • With new DGXX satellites.
  • 3D positioning is at 7-8 mm from 2010 onward.
• New DORIS missions (2015)
  – Jason-3 (July).
  – Sentinel-3A (October).

• IDS beacon network
  – Deployment of new generation of antennae where phase center location is controlled to +/- 1 mm.

• IDS main studies
  – New missions data (format and contents) ⇒ use of DORIS RINEX data.
  – Scale increase mid 2012.
  – SPOT5 scale pattern.

• Next IDS Analysis Working Group
  – Toulouse, May 28-29th.
  – Washington (October, TBC).

• DORIS Special Issue in Advances in Space Research (submission deadline: May 31st, 2015).