Lessons from ITRF2008 and future considerations

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Lessons from ITRF2008

• Technical Considerations:
  – Impact and usage of local ties in ITRF combination
  – ITRF2008 accuracy

• Structural Considerations
  – Schedule to be agreed upon and respected for next ITRF solution
  – ITRF PC role
Consistency btw local ties and space geodesy estimates

• GPS is linking SLR, VLBI & DORIS because
  – VLBI-SLR alone: 8 co-locations only
  – VLBI or SLR-DORIS alone: 10 co-locations only

• Tie discrepancies < 6 mm for:
  – 47% GPS-VLBI
  – 43% GPS-SLR
  – 34% GPS-DORIS

• Tie discrepancies > 10 mm for:
  – 30% GPS-VLBI
  – 30% GPS-SLR
  – 54% GPS-DORIS
Scale and weighting of local ties

<table>
<thead>
<tr>
<th>Case</th>
<th>SLR</th>
<th>DORIS</th>
<th>GPS</th>
<th>VF</th>
<th>Tie handling</th>
</tr>
</thead>
<tbody>
<tr>
<td>ITRF2008</td>
<td>-1.05</td>
<td>0.18</td>
<td>0.67</td>
<td>0.90</td>
<td>All tie SINEX files, weighted</td>
</tr>
<tr>
<td></td>
<td>±0.13</td>
<td>±0.20</td>
<td>±0.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ITRF2008 without EOPs</td>
<td>-1.11</td>
<td>0.04</td>
<td>0.41</td>
<td>1.66</td>
<td>All tie vectors, weighted</td>
</tr>
<tr>
<td></td>
<td>±0.26</td>
<td>±0.31</td>
<td>±0.19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case-1</td>
<td>-1.20</td>
<td>-0.31</td>
<td>0.49</td>
<td>4.00</td>
<td>Selection of local ties, σ = 1 mm</td>
</tr>
<tr>
<td></td>
<td>±0.16</td>
<td>±0.34</td>
<td>±0.14</td>
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<td></td>
</tr>
<tr>
<td>Case-2</td>
<td>-1.02</td>
<td>-0.30</td>
<td>0.52</td>
<td>31.70</td>
<td>Selection of local ties, σ = 0.1 mm</td>
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<tr>
<td></td>
<td>±0.31</td>
<td>±0.84</td>
<td>±0.31</td>
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<tr>
<td>Case-3</td>
<td>0.0²</td>
<td>0.48</td>
<td>1.28</td>
<td>4.28</td>
<td>Same as Case-1</td>
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<tr>
<td></td>
<td>±0.32</td>
<td>±0.08</td>
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</tbody>
</table>

¹ Variance Factor
² parameter eliminated from the normal equation; assumed to be equal to VLBI scale

Scales with respect to VLBI (ppb) at 2005.0
Accuracy of ITRF2008 Origin

• Defined by SLR only

• Agreement with ITRF2005
  – 4.7 mm in Z-translation at epoch 2005
  – 0.3 mm/yr drift in X-translation

• ==> “Accuracy”: 1 cm over the time-span of SLR observations
Accuracy of ITRF2008 Scale

- Defined by the average of VLBI and SLR
- Difference btw the two technique solutions:
  - 1.05 ppb at epoch 2005.0
  - 0.049 ppb/yr

- ==> “Accuracy”: 1.2 ppb (8 mm) over the common time-span of VLBI and SLR observations
Uncertainties of the Transfer of SLR origin and SLR&VLBI mean scale to GPS frame

<table>
<thead>
<tr>
<th>Ties used</th>
<th>TX mm</th>
<th>TY mm</th>
<th>TZ mm</th>
<th>Scale mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ties – SG Discrepancies</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 6 mm</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>1.4</td>
</tr>
<tr>
<td>Ties – SG Discrepancies</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 10 mm</td>
<td>1.4</td>
<td>1.1</td>
<td>1.2</td>
<td>1.2</td>
</tr>
<tr>
<td>All – SNX ITRF2008</td>
<td>0.6</td>
<td>0.5</td>
<td>0.6</td>
<td>0.6</td>
</tr>
</tbody>
</table>
Conclusion of Technical Considerations

• Local ties:
  – All available ties should be used with proper weighting
  – The more ties used the more precise is the estimation

• Accuracy of ITRF2008 origin&scale: ~ 1 cm
  – Origin: ~ 1 cm
  – Scale: 1.2 ppb

• Technique-specific systematic errors
  – GPS uncalibrated radome
  – VLBI antenna gravitational deformations
  – SLR range/timing biases
  – DORIS beacon reference point behavior?
Structural Considerations (1/2)

• Avoid repeating the ITRF2005 and ITRF2008 dilemma:
  – Harmful for IERS and the Technique Services
  – Users are confused and get less confident on IERS/ITRF

• Given the estimated ITRF2008 accuracy (~1 cm):
  – difference between IGN and DGFI solutions is less than 1 cm
  – despite DGFI unrealistic assumptions
Structural Consideration (2/2)

- IERS should take its responsibility and decide according to the agreed structure:
  - IERS has a mission of providing unique set of reference products
  - Reasonable and agreed schedule should be observed and respected for next ITRF solutions
  - Avoid soliciting the technique services to decide instead of IERS
  - Enforce the ITRF PC role ==> will improve the IERS image
  - ITRF PC solution is the official IERS standard solution, unless DGFI (or other groups) demonstrate something superior, but this did not happen for two times in the past
  - Encourage DGFI (& other groups) to do combinations
  - ITRFyy should reflect an IERS label and be unique
    ==> request that DGFI names its TRF solutions differently, e.g. DGFI2008 or something similar