New EPN multi-year solution expressed in IGS14

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With contributions of
C. Bruyninx, T. Liwosz, A. Kenyeres, A. Araskiewicz
# EPN combined daily SINEXs: Status

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
<th>Type</th>
<th>Antenna Calibration</th>
<th>Offsets</th>
</tr>
</thead>
<tbody>
<tr>
<td>0834 – 1</td>
<td>1772 – 6</td>
<td>EPN-Repro2</td>
<td>epn_08.atx (igs08.atx)</td>
<td>Applied</td>
</tr>
<tr>
<td>1996/001</td>
<td>2013/362</td>
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<tr>
<td>1996-01-01</td>
<td>2013-12-28</td>
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<tr>
<td>1773 – 0</td>
<td>1933 – 6</td>
<td>ROUTINE</td>
<td>epn_08.atx (igs08.atx)</td>
<td>Applied</td>
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<tr>
<td>2013/363</td>
<td>2017/028</td>
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<tr>
<td>2013-12-29</td>
<td>2017-01-29</td>
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<td>1934 – 0</td>
<td>1940 – 6</td>
<td>ROUTINE</td>
<td>epn_14.atx (igs14.atx)</td>
<td>-</td>
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<td>2017/028</td>
<td>2017/077</td>
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<td>2017-01-29</td>
<td>2017-03-18</td>
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</tbody>
</table>

Switch from **epn_08.atx** to **epn_14.atx**
**New EPN solution: new features**

<table>
<thead>
<tr>
<th></th>
<th>C1934</th>
<th>New</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference frame</td>
<td>IGb08</td>
<td>IGS14</td>
</tr>
<tr>
<td>Input SINEXs</td>
<td>weekly</td>
<td>daily</td>
</tr>
<tr>
<td>Reference frame epoch</td>
<td>2005.0</td>
<td>2010.0</td>
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<tr>
<td>Earthquake modelling for ITRF stations</td>
<td>Several linear trends</td>
<td>Post-seismic deformation modelled for ANKR00TUR, BUCU00ROU, ISTA00TUR, REYK00ISL, TUBI00TUR</td>
</tr>
<tr>
<td>Annual and semi-annual estimated</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Discontinuity list</td>
<td>C1934</td>
<td>Update</td>
</tr>
<tr>
<td>Software</td>
<td>CATREF</td>
<td>CATREF</td>
</tr>
<tr>
<td>Align to IGxxx with</td>
<td>translation, rotation, scale</td>
<td>translation, rotation, scale</td>
</tr>
</tbody>
</table>

**C1934 Update**

**New Reference frame**

**Input SINEXs**

**Reference frame epoch**

**Earthquake modelling for ITRF stations**

**Annual and semi-annual estimated**

**Discontinuity list**

**Software**

**Align to IGxxx with**

**Translation, rotation, scale**
New combined multi-year solution
EPN Network

- 373 EPN Stations in the combined solution

- 139 ITRF2014 Stations with period of observation, completeness of the time series... comparable to EPN
- 24 stations not comparable

- IGS14 Stations in the EPN (60 stations)
Post seismic deformation modelled

Annual and semi-annual estimated
Weighted RMS: comparison wrt C1934
Comparison with IGS14 and C1934 solutions
New EPN vs IGS14 velocity differences

North

East

Up
New EPN vs IGS14

Reference stations
velocity differences
New EPN vs IGS14 position differences at epoch 2010.0

North

East

Up
New EPN vs IGS14
Reference stations
position differences
at epoch 2010.0

North
East
Up
New EPN vs C1934 velocity differences

> 2 years of observations
no velocity discontinuity
New EPN vs C1934 position differences at epoch 2010.0

Not with the same antenna calibration!! Differences can partly be explained by the positions offsets epn08.atx/epn14.atx + soln not harmonised raw comparison

> 2 years of observations no velocity discontinuity
Impact of the switch from `epn_08.atx` to `epn_14.atx`
Impact of the switch from epn_08.atx to epn_14.atx at day 029/2017

293 stations were observing in January 2017

Switch can have different effects on the 293 stations:

- the antenna model has not changed => No impact (202 stations)
- the antenna model has changed
  - we have a value for the position offset:
    - estimated by the IGS for the station/antenna (30 stations)
    - modelled with the IGS latitude dependent model (52 stations)
  - we don’t have any value to model the discontinuity (9 stations)
Impact of the switch from epn_08.atx to epn_14.atx at day 029/2017

293 stations were observing in January 2017

- 202 stations with no impact
- 73 stations corrected by model
- 18 stations discontinuity introduced

<table>
<thead>
<tr>
<th>Category</th>
<th>Soln introduced</th>
<th>Corrected by Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>IGS value</td>
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<td>27</td>
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<tr>
<td>IGS Latitude Model</td>
<td>9</td>
<td>43</td>
</tr>
<tr>
<td>Unknown</td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>
Position change at epn_08.atx to epn_14.atx switch

- IGS value applied
- Lat. Mod. applied
- Unknown no model applied
Impact of the switch from EPN-repro2 to Routine
Impact of the switch from EPN-repro2 to Routine

- 257 stations were observing before and after 29-12-2013
- Different level of noise before and after the switch for some of the stations
- A jump clearly affects some stations
  - Introducing a discontinuity is not always the best option
  - 39 stations with a discontinuity introduced
- Small offsets but unfortunately cannot be neglected
- Reference stations with discontinuity (BUCU00ROU, GLSV00UKR, KIRU00SWE, MAR600SWE, NYA100NOR, POTS00DEU, RABT00MAR)
Observed position changes at EPN-repro2 ⇒ Routine switch
Position and Velocity Discontinuities
Position and Velocity discontinuities

- List revised
  - Former list, IGS14, IGS and ITRF2014 (for good stations) list used
  - quality checks have been used, de-trended time series with jumps have been checked, test with and without have been done  (especially in case of disagreement)
  - 9 IGS14 stations with a different discontinuity  (to be discussed with IGS)

- Several clear velocity changes are observed:
  - 20 stations – 9 are IGS14 (6 same, 3 different)  (to be discussed with IGS)
  - Check and validate (tectonic, collocated/twin stations)

- Stations with non linear behaviour: to be investigated
Velocity Fields
EPN velocity field wrt Eurasian plate fixed

> 3 years of observations

2 mm/yr
EPN velocity field wrt Eurasian plate fixed

> 3 years of observations

ZOOM
Conclusions

• Agreement of the new EPN solution with IGS14 is really good.

• Ice melting in Greenland entails changes in the vertical motion and make the Greenland stations weaker for reference frame definition

• Post seismic deformation modelling improved a lot the stations where it has been applied ANKR00TUR, BUCU00ROU, ISTA00TUR, REYK00ISL, TUBI00TUR

• Annual and semi-annual estimations allows to improve the residual position time series and help a lot in the discontinuity detection

• Velocity changes: bad period with velocity changes or non linear behaviour are observed for some stations: more investigation in the future

• Current solution (after minor revision) have been accepted by the governing board and will be release within ~ 2 months after implementation at epncb web site
Thank you

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