Re-evaluation of GPS and GLONASS satellite antenna phase center offsets

Methodology

Daily estimates of the GPS and GLONASS satellite antenna PCO-Ds were obtained from 8 series of IGS AC repro2+operational SINEX files. Those were unconstrained and inverted applying NNV=INT=INS constraints w.r.t. the preliminary IGS14 (augmented with annual and semi-annual station motions) solution. Figure 4 shows, as an example, the time series of daily PCO estimates for GPS satellite SVN47.

A linear regression was then performed for each of the PCO time series, where points with normalized residuals > 3 were iteratively removed. Thus, the figure (elevation of the Sun above the orbital plane) and eclipse-related signals present in the X- and Y-PCO time series could be partially cut. Mean increments to the iGPS.atx values were finally computed for each satellite and AC by weighted averaging of the cleared time series (Figure 5).

Additionally, we computed AC-specific weighted mean trends from the 2-PCO time series of all satellites. In Table 1, these are compared with weighted mean trends obtained using the IGb08 reference frame instead of IGS14. The mean trends indicate how the intrinsic GNSS scale rate (governed by the assumed stability of the satellite (Z-PCOs) agrees with the corresponding reference frame scale rate.

**Table 1**: Weighted mean trends [mm/yr] of the 2-PCO time series obtained for each satellite using either the IGS14 or the IGb08 reference frame.

<table>
<thead>
<tr>
<th>Satellite</th>
<th>IGS14</th>
<th>IGb08</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-PCO</td>
<td>4.0 ± 1.5</td>
<td>4.2 ± 1.6</td>
</tr>
<tr>
<td>Y-PCO</td>
<td>5.8 ± 2.0</td>
<td>5.6 ± 2.1</td>
</tr>
<tr>
<td>Z-PCO</td>
<td>4.2 ± 1.5</td>
<td>4.3 ± 1.6</td>
</tr>
</tbody>
</table>

**Summary**

- The X- and Y-PCO time series are contaminated by large B- and eclipse-related signals, making it complicated to obtain reliable mean values. The mean X- and Y-PCO increments shown in Figure 5 are generally small (few cm), except for a few GNSS antennas.
- Should X- and Y-PCO values be updated in iGPS.atx?
- The X- and Y-PCO time series need to be updated by about 5 to 10 cm so that IGS products are consistent with the ITRF2014/IGS14 scale.
- The weighted mean trends of the Z-PCO time series (see Table 1) are significantly smaller when using IGb08 instead of IGS14.
- The "intrinsic GNSS scale rate" given by the assumed stability of the satellite antenna Z-PCOs is therefore close to the ITRF2008 scale rate.
- The trends in the satellite antenna Z-PCO time series derived using IGb08 will therefore have to be taken into account in order to keep the final iGPS.atx values to a common epoch.

References:

Preparations for the IGS realization of ITRF2014
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