Abstract. 1-hour resolution Earth Rotation Parameters (ERP) from VLBI and GNSS observations during the CONT08 period are compared with atmospheric angular momentum (AAM) functions derived from hourly 4DVar data of the European Centre for Medium-Range Weather Forecasts (ECMWF). These comparisons, carried out in the frequency domain, highlight the discrepancies between atmospheric excitation and the observations at daily and sub-daily periods.

Time Series

VLBI and GPS – Hourly ERP for the time span of CONT08 (12.8.-26.8.2008) were estimated by Dan MacMillan (NVI/Goddard Space Flight Center) and Peter Steigenberger (Technical University Munich) using Calc/Solve and the Bernese Software.

Figure 1. Amplitude spectrum of polar motion at diurnal and semi-diurnal periods, calculated from GPS (black) and VLBI data (grey).

Figure 2. Amplitude spectrum of LOD at diurnal and semi-diurnal periods, calculated from GPS (black) and VLBI data (grey).

The main part of variations in Earth rotation at high frequencies is due to ocean tides and can be removed by applying the IERS model (Eanes). The resulting residual VLBI and GPS estimates reveal large discrepancies, especially in the equatorial component. (See amplitude spectra in Figure 1 and 2, smoothed a priori values were subtracted.)

AAM – The 4DVar (Four-dimensional Variational Assimilation) Analysis provides hourly meteorological data in order to evaluate short-period atmospheric excitation during CONT08. Initialized at 9 and 21 UT, every 12 hours a 4DVar Analysis assimilates the most recent observations to update an atmospheric forecast model in an integration (Figure 3).

Figure 3. Illustration of the 4DVar principle: Updating a forecast model by including observations.

The AAM functions, calculated as integrals over surface pressure (matter term, Non-LB) and pressure increments (motion term), contain jumps at 9 and 21 UT which have to be removed in order to properly evaluate amplitude spectra of atmospheric excitation. A specific way of concatenation is applied, that distributes the offsets at 9 and 21 UT over the adjacent 12 hour arcs and uses polynomials to adjust the resulting function.

Atmospheric Excitation

Comparison of the axial AAM function and LOD is straightforward. For the equatorial component the transfer function of Brzezinski et al. (2002) is applied. The mean amplitudes taken from the resulting spectra are summarized in Table 1.

Table 1. Atmospheric excitation: maximum mean amplitudes of polar motion [µas] and LOD [µs] at diurnal and semi-diurnal frequencies, calculated from hourly AAM functions.

<table>
<thead>
<tr>
<th>Component</th>
<th>Period</th>
<th>Amplitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polar motion</td>
<td>24 h</td>
<td>2.9</td>
</tr>
<tr>
<td></td>
<td>12 h</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>-12 h</td>
<td>1.3</td>
</tr>
<tr>
<td>LOD</td>
<td>24 h</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td>12 h</td>
<td>1.3</td>
</tr>
</tbody>
</table>

Figure 4. Amplitude spectrum of χ3 and real part of spectrum as sum of matter term and motion term.

Conclusions

- VLBI and GPS yield different estimates of high frequency polar motion during CONT08.
- The atmosphere explains only a small fraction of diurnal and sub-diurnal variability in ERP.
- Additionally, 4DVar-based AAM functions lead to much smaller values of atmospheric excitation than usually estimated with 6-hourly data, e.g. Brzezinski et al. (2002). In particular, it can be observed that the amplitudes of matter and motion terms are likely to cancel each other at daily and sub-daily periods (Figure 4).

References.
