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High Resolution Earth Rotation Parameters Determined During the CONT02 Campaign

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Abstract

For the two weeks of the CONT02 campaign in October 2002 the Earth rotation parameters, ERP (xpol, ypol, UT1-UTC) were determined with a resolution of one hour by VLBI and also by GPS. Analyses of these two very precise polar motion series reveal oscillations with periods of 8h, 6h and 4h-5h. Rapid oscillations of polar motion with periods of 8h and 5h-6h had already been found in the two-hourly polar motion series determined by GPS (CODE) in the period 1997.5 through 2001.0 but in that time it was unclear whether these phenomena are real or connected with the observational technique, e.g. with effects of the satellite orbits.

The detection of the 8h, 6h and 4h-5h oscillations in polar motion independently determined by two accurate space geodetic techniques is a first evidence for a real sub-semidiurnal variation of the ERP. On the other hand the oscillations might still be an artifact stemming from similar methods of data sampling or from un-recovered diurnal drifts in the time series. Oscillations with periods of 8h, 6h, 4h-5h were also detected in the time series of UT1-UTC determined by GPS and VLBI.

1. Analyses

Rapid oscillations of polar motion and UT1-UTC with subdaily periods had been detected by GPS and VLBI in former investigations (Kolaczek et al., 2000; Schmitz-Hübsch and Schuh, 2003; Weber et al., 2002) (Fig.1). The oscillation with a period of 8 hours was also detected in the series of Atmospheric Excitation Functions (Chi1, Chi2) which were available with a resolution of 3 hours (Weber et al., 2002, Fig.1).

In that time the analyzed series were not simultaneous and it was not possible to find the origin of the oscillation and to decide whether the oscillation of 8 hours comes from the GPS technique (e.g. caused by the orbit computation) or is a real oscillation of polar motion.

The CONT02 campaign observed in October 2002 by the IVS delivered dense simultaneous series of Earth rotation parameters determined by VLBI with a resolution of one hour. The GPS results were taken from the CODE Analysis Center. Spectra of polar motion and UT1-UTC computed by the Fourier Transform Band Pass Filter (Kosek, 1995) clearly show similarities. In the results of both techniques, oscillations with periods of 8h, 6h, 4h-5h are detected besides the well-known semi-diurnal oscillations (Fig.2). However, there is a discrepancy at the 8 hours oscillation which shows up as prograde wave in the VLBI spectrum of polar motion but retrograde in GPS (see Figs.2a, 5). Computed time variable spectra (FTBPF) of polar motion show some time variations of amplitudes of these rapid oscillations (Figs.3, 5). Amplitudes of these oscillations are usually higher in the case of the VLBI data while variability of amplitudes is larger in the case of the GPS data (Figs.3, 5). The amplitude of the retrograde part of the 12h oscillation in the

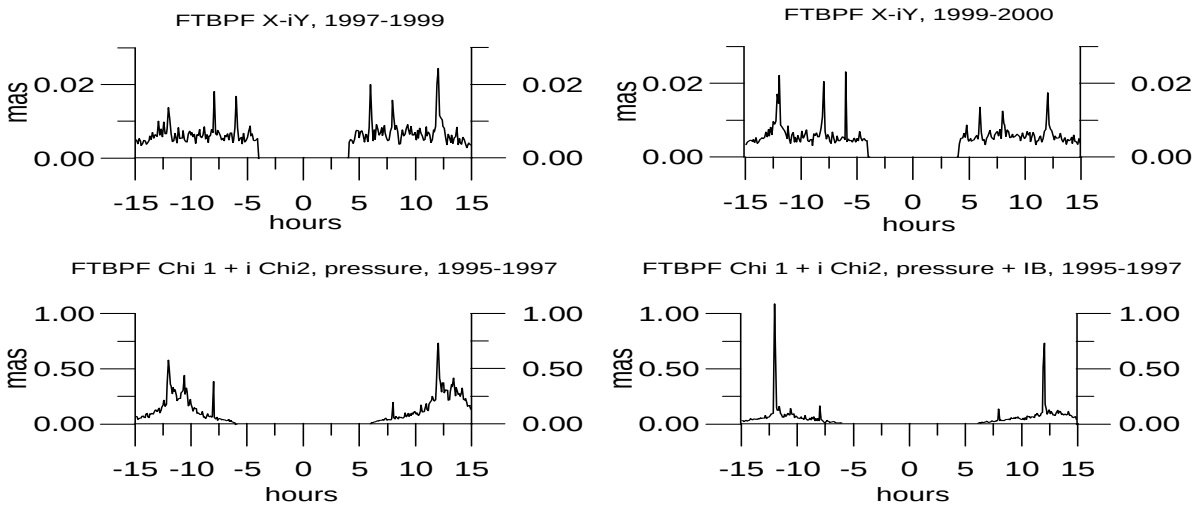

Figure 1. FTBPF spectra of short period oscillations of GPS (CODE) polar motion and atmospheric excitation functions computed with parameter $\lambda = 0.007$ [3].

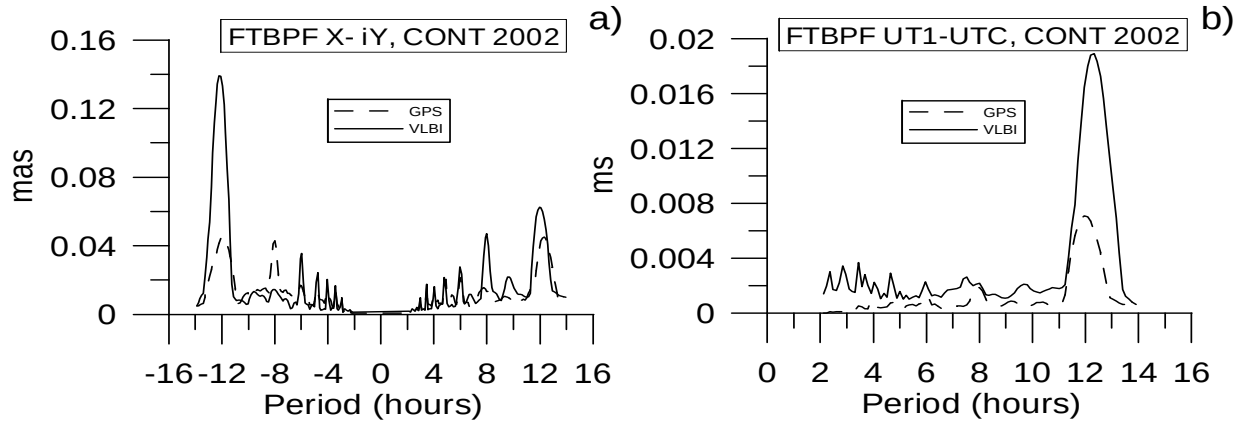

Figure 2. FTBPF spectra of short period oscillations of GPS and VLBI polar motion and UT1-UTC, respectively computed with parameter $\lambda = 0.006$.

VLBI data is two times higher than in the case of the GPS data (Figs.2a,3). The detection of rapid oscillations with periods of 8h, 6h, 4h-5h by two different techniques suggests that these are real oscillations of polar motion. Their origins need further studies.

Analyses of UT1-UTC data determined during the CONT02 campaign by VLBI and GPS detected besides the strong 12 hours oscillation additional short period variations (Figs.2b, 4, 6). Again, there are time variations of the amplitudes, especially in the case of the GPS data.

The amplitude of the 12h oscillation of UT1-UTC is much stronger in the case of the VLBI data

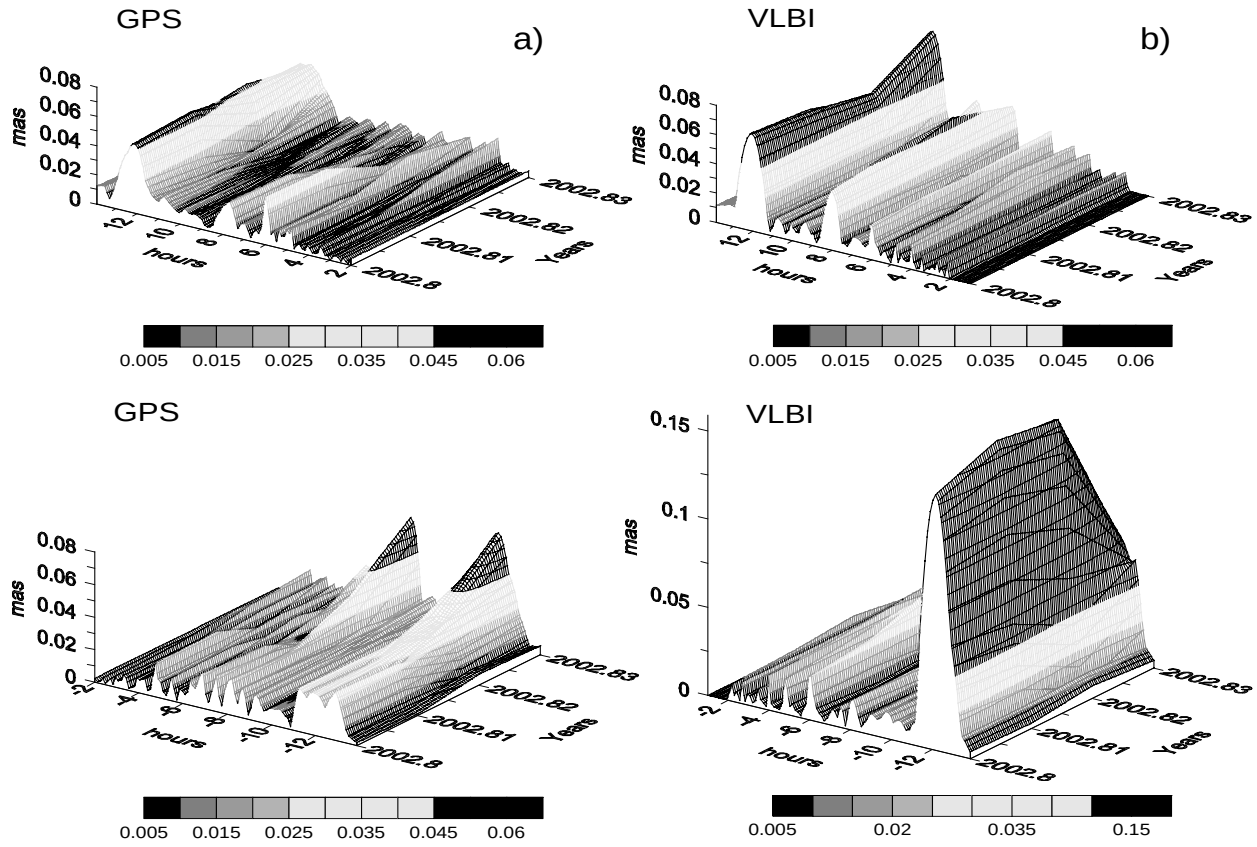

Figure 3. FTBPF spectra of short period oscillations (periods < 13 hours) of polar motion determined by GPS and VLBI respectively, computed with parameter $\lambda = 0.006$.

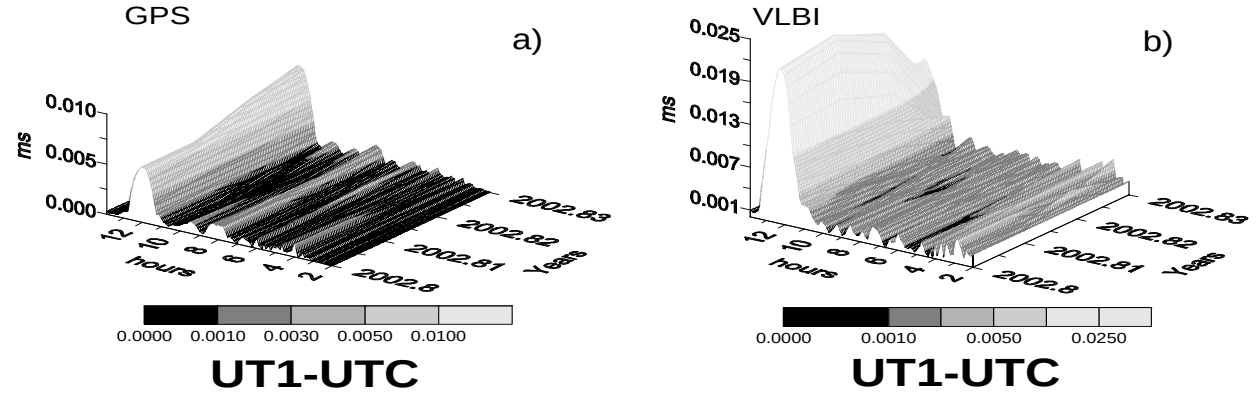

Figure 4. FTBPF time variable spectra of short period oscillations (periods < 13 hours) of UT1-UTC determined by GPS and VLBI respectively, computed with parameter $\lambda = 0.006$.

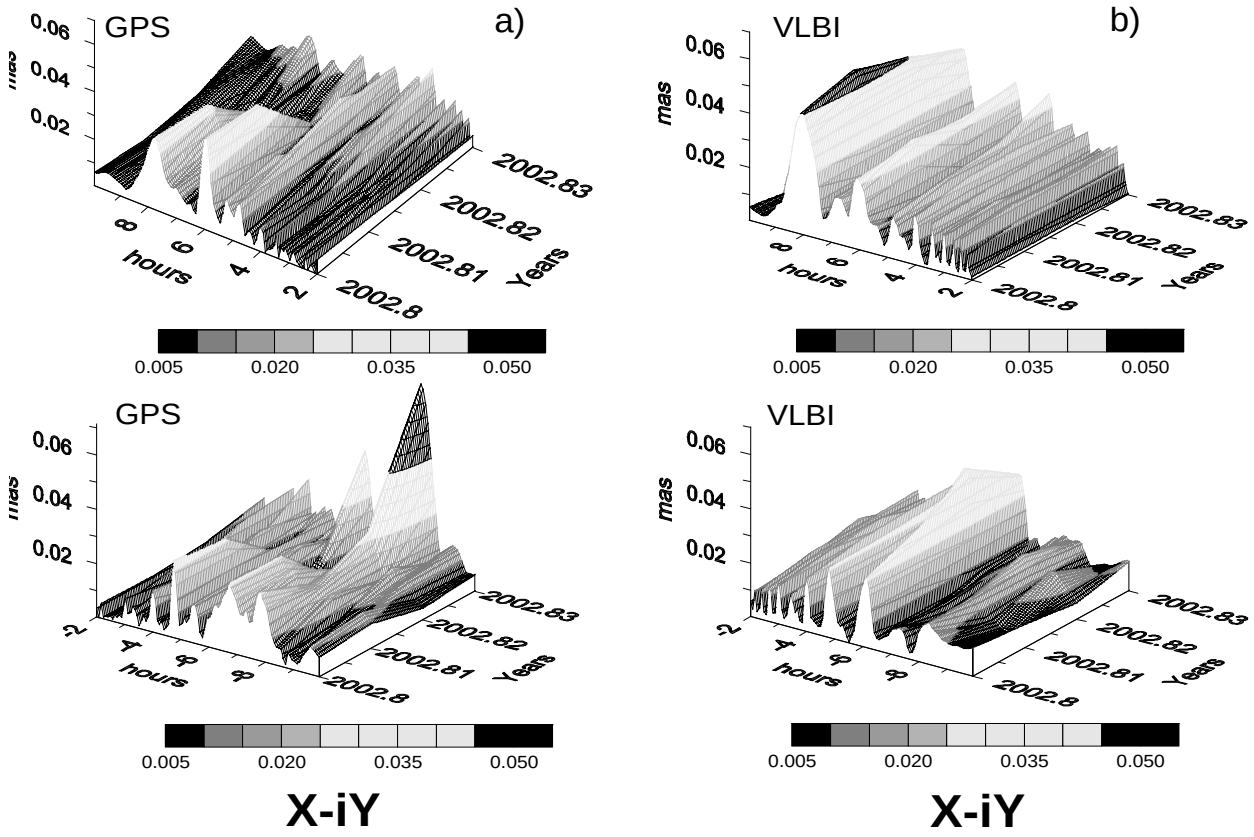

Figure 5. FTBPF time variable spectra of short period oscillations (periods < 10 hours) of polar motion determined by GPS and VLBI respectively, computed with parameter $\lambda = 0.01$, which gives higher time resolution of spectra than $\lambda = 0.006$.

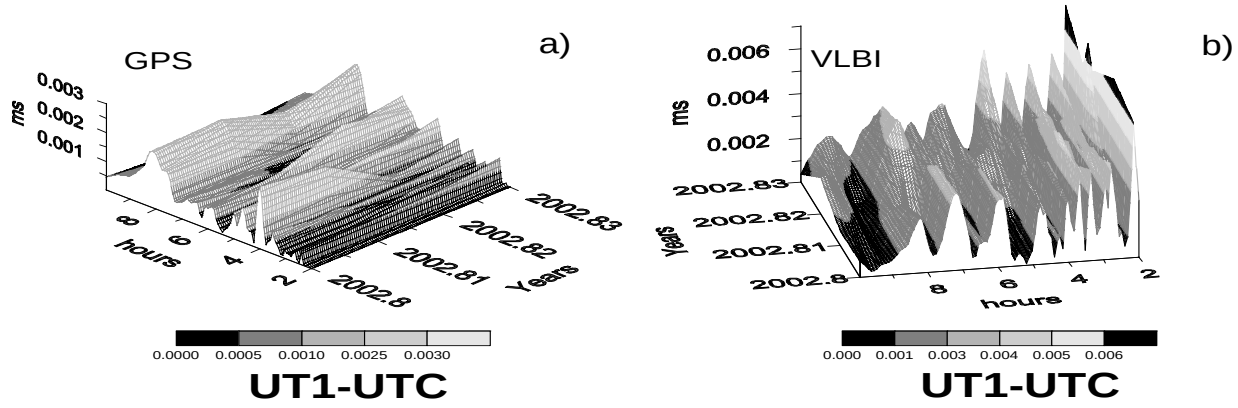

Figure 6. FTBPF time variable spectra of short period oscillations (periods < 10 hours) of UT1-UTC determined by GPS and VLBI respectively, computed with parameter $\lambda = 0.01$, which gives higher time resolution of spectra than $\lambda = 0.006$.

than of the GPS data. It is interesting that the VLBI results contain several strong oscillations in the spectral range between 2 and 4 hours (Fig.6).

2. Conclusions

Oscillations with periods of 8h, 6h, 4h-5h were detected by VLBI and GPS in polar motion and UT1-UTC, determined during the CONT02 campaign. It suggests that these oscillations can be real oscillations of Earth rotation parameters. Their origins need further studies.

There are temporal variations of the amplitudes of these rapid oscillations.

There is a discrepancy at the 8 hours oscillation of polar motion (prograde in VLBI and retrograde in GPS) that needs further investigations.

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