ANALYSIS OF SUB DIURNAL EOP VARIATION

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ABSTRACT. The paper presents a study of the high frequency variations in the LOD and Polar motion series derived from the GPS observations. The initial time series have a 2 hour resolution and cover the time span from 1995 till 1998. Prior to spectral analysis the diurnal and semi-diurnal tidal effects have been eliminated from the data. The time variability of spectral lines at frequencies 3,4,5 cycle per day were thoroughly investigated by wavelet analysis. The wavelets clearly revealed that all the specific changes in the time dependent spectra coincide with the borders of the different segments of which the full time series under consideration had been constructed. It is concluded that the above mentioned oscillations are hardly connected with the Earth rotation and are most likely generated by processing of the GPS observation.

1. INTRODUCTION

A lot of geodesical and geophysical information may be derived from variations of the sub-diurnal Earth orientation parameters. In this connection the VLBI and GPS observations are of great importance. In the frames of Gipson and Eanes models the variations of Polar motion and length of day are comprised of several dozens of tidal terms. However, one may expect that other signals may be found in the range of periods from one hour up to several days.

Guided by this idea we made an analysis of a unique ERP data derived from GPS observations by the Center for Orbit Determination (CODE) [1]. These data form a continuous uninterrupted series of the LOD and of the Polar motion lasting 3.12 years (JD 49719-50859) with a time resolution as much as 2 hours. The first study of this data was presented by Rothacer and Beutler [1]. In particular, they reported the existence of non-tidal signals at the frequencies 3,4,5 cpd and posed the problem of their further study. The main goal of this paper is to clarify the nature of these harmonics.

2. METHODS OF ANALYSIS

We studied the post-fit residuals which were obtained after subtraction of all known harmonic components from initial data. They were: a) the tidal effects in the frame of Gipson model for LOD and Polar motion, b) the Chandler and annual components (for Polar motion only). The parameters of the Chandler and annual wobbles were derived from the data published by IERS for 1988- 2000.

The spectral properties of the residuals were studied by Fourier transform and by wavelet

transform with Morlet analyzing function [2].[3],[4].

3. RESULTS

First of all, we notice that the strong peaks near the frequencies $\nu = 1, 2$ cpd are still seen in the power spectra though the tidal effects in diurnal and semi-diurnal bands have been eliminated. Probably, such behavior may be explained by inconsistancy of Gipson model with GPS observations since this model was derived from VLBI data.

Now we are in position to describe the main item of our study, i.e. the frequency band from 2.5 till 5.5 cpd. Fourier spectra for series under consideration show three peaks at frequencies $\nu = 3; 4; 5$ cpd. It is clear, that these oscillations are beyond the Gipson model, and this is all what can be extracted from Fourier power spectra. To get more information we applied the wavelet technique [4] to the time series of LOD and x-, y- coordinates of Polar motion. Figure 1 exibit the wavelet spectrum of LOD (wavelet spectra of Polar motion series are analogous). The plot shows that the spectral lines at frequencies 3,4,5 cpd change their intensities with time. The crucial fact is that the wavelet spectrum for the first 636 days significantly differ from the spectrum from 637-th till 1140-th day. Actually, in the first part one can see the harmonic components at all mentioned frequencies (1-5 cpd), whereas the second part contains the harmonics at frequencies 1,2 cpd only (with noise at other frequencies). To our mind, the reason of this drastic change is connected with the changing of the orbit determination model for GPS satellites after 636-th day of observation [1].

Thus, we come to our main conclusion: since the time-dependent spectra reveal the date when at least two heterogeneous segments have been glued together, is naturally to suppose that the harmonics at frequencies 3,4,5 cpd are generated by processing of GPS observation, not by Earth rotation.

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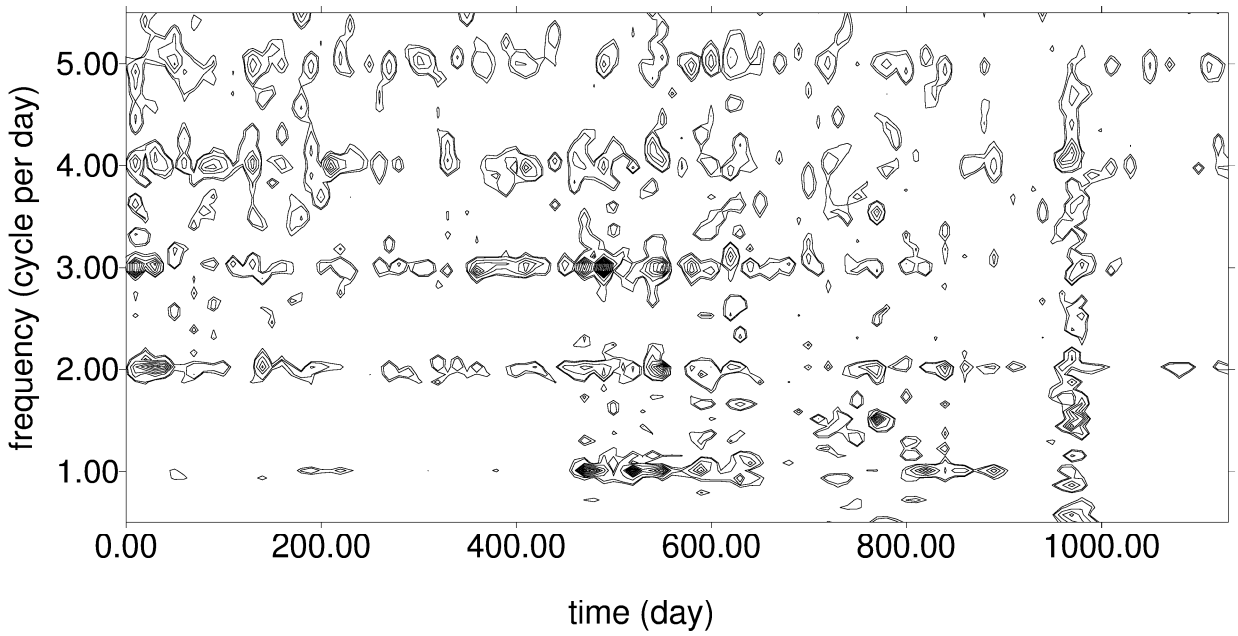

Figure 1: Wavelet spectrum of LOD series.

3. REFERENCES

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