NONTIDAL OCEANIC EXCITATION OF DIURNAL AND SEMIDIURNAL POLAR MOTION ESTIMATED FROM A BAROTROPIC OCEAN MODEL

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1. INTRODUCTION

The nontidal variability in the ocean is expected to have a significant influence on Earth rotation over a broad range of frequencies. We used a new 7.5-year time series of ocean angular momentum (OAM) with high temporal resolution (sampling interval 1 hour) calculated from a barotropic numerical model (Ponte and Ali, 2002), to study the influence of wind- and pressure-driven ocean signals on nutation and diurnal/semidiurnal polar motion. Here we will describe briefly the second part of the work, that is this concerning the oceanic contribution to high frequency polar motions; for details see (Brzeziński et al., 2004).

2. DATA ANALYSIS AND RESULTS

We process all terms of the OAM series by applying the procedure developed by Bizouard *et al.* (1998) and Petrov *et al.* (1998): 1) extract the components contributing to the three spectral bands of interest, prograde diurnal, retrograde and prograde semidiurnal, by performing the complex demodulation at frequencies +1, −2, +2 cycles per sidereal day (cpsd); 2) perform spectral analysis; 3) compute parameters of the harmonic model including all detected periodical constituents; 4) remove the model and consider separately the irregular remainder. The same procedure is applied to the 6-hourly atmospheric angular momentum (AAM) series (Salstein *et al.*, 1993) calculated from the NCEP-NCAR reanalysis fields (Kalnay *et al.*, 1996).

Prograde diurnal polar motion. The demodulated excitation series are shown in Fig. 1. The corresponding perturbation in polar motion $p = x_p - iy_p$ can be computed by multiplying the excitation $\chi = \chi_1 + i\chi_2$ first by the theoretical transfer coefficient -2.4×10^{-3}, then by the diurnal rotation factor $e^{i\,GST}$ (GST – Greenwich sidereal time) accounting for the demodulation. From Fig. 1, the motion terms of the AAM and OAM are of similar size but there is a large difference in phase. In case of the matter term, the AAM and AAMIB signals are quite similar while the OAM term has larger amplitude and is significantly delayed in phase. After removal of the model, the residual signal has a negligible influence on polar motion, at the level of 1 μas.

When considering the periodical components of excitation and adding various contributions (motion AAM+OAM plus matter AAMIB+OAM), the only significant contribution found is the S_1^+ harmonic with a period of +1 cycle per solar day. The dynamic model atmosphere-ocean yields a total amplitude in polar motion of 9 μas, which is slightly larger than the atmosphere alone (between 6 μas and 8 μas) and with phase delay of about 17°.

Semidiurnal polar motion. With the 6-hourly AAM estimates it is impossible to resolve the retrograde and prograde semidiurnal bands. The OAM series is sampled hourly but as the underlying barotropic model has been forced by the 6-hourly wind and pressure fields from

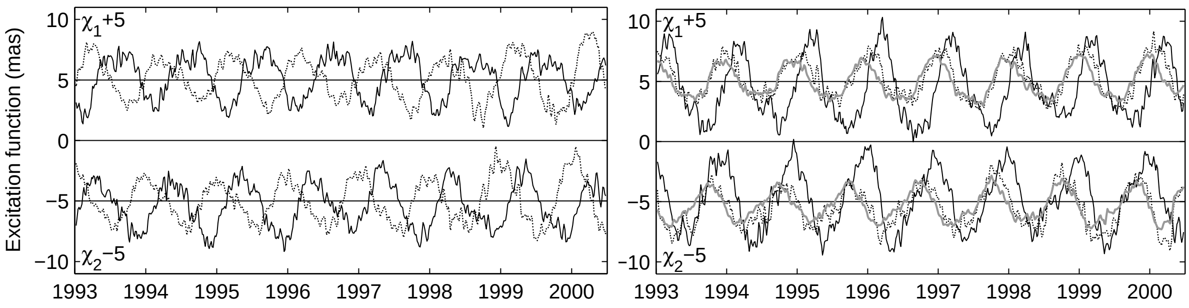

Figure 1: Effective angular momentum functions of the atmosphere (AAM - dotted line, AAMIB - solid gray line) and of the ocean (OAM - solid line), demodulated at frequency +1 cycle per sidereal day: motion terms (left) and matter terms (right). From (Brzeziński *et al.*, 2004).

the NCEP-NCAR reanalysis (Kalnay *et al.*, 1996), the reliability of the results concerning the semidiurnal excitation is low. Our analysis show that the only significant contribution to polar motion is from the S_2 constituent of the OAM, about 6 μas. Adding the influence estimated from the AAM can increase the amplitude up to 9 μas.

3. CONCLUSIONS

The estimated nontidal oceanic excitation of prograde diurnal polar is rather small – after accounting for the atmospheric excitation the peak-to-peak size is about 18 μas. But as the corresponding contribution from the S_1 ocean tide is about 7 times smaller, there is a good chance that future subdiurnal determinations of polar motion will verify our estimate. In case of the semidiurnal component the estimated nontidal contribution from the ocean is of similar size, but 1) its reliability is low due to the problem of data sampling, and 2) it will be difficult to separate this effect observationally from the much larger influence of the S_2 ocean tide.

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