ANALYSIS OF THE GEODETIC RESIDUALS AS DIFFERENCES BETWEEN GEODETIC AND SUM OF THE ATMOSPHERIC AND OCEANIC EXCITATION OF POLAR MOTION

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ABSTRACT. Up to now studies of geophysical excitation of polar motion containing AAM (Atmospheric Angular Momentum), OAM (Oceanic Angular Momentum) and HAM (Hydrological Angular Momentum) excitation functions of polar motion have not achieved the total agreement between geophysical and determined geodetic excitation (GAM, Geodetic Angular Momentum) functions of polar motion (Nastula and Kolaczek, 2005; Chen and Wilson, 2005; Brzezinski et al., 2009; Nastula et al., 2011, Gross et al., 2003).

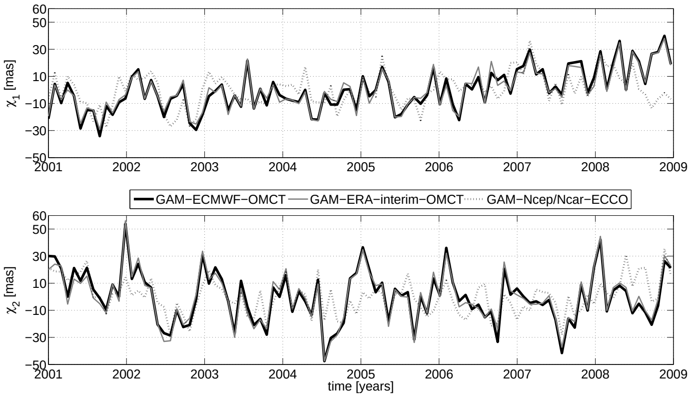

Figure 1: Geodetic residuals for the χ_1 and χ_2 components computed from different models of atmosphere and ocean.

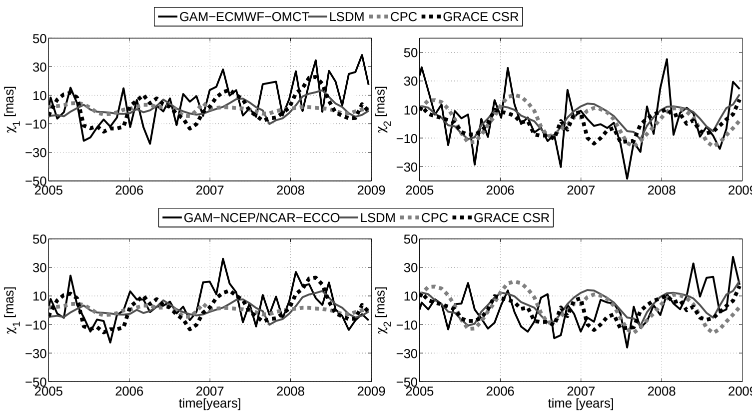

Figure 2: Comparison of geodetic residuals (GAM–ECMWF–OMCT and GAM–NCEP/NCAR–ECCO) in χ_1 and χ_2 components computed from different atmospheric and oceanic models with CPC, LSDM, GRACE CSR hydrological excitations.

Differences between geodetic excitation function of polar motion GAM and joint atmospheric plus oceanic excitation functions named geodetic residuals were computed for different models of AAM and OAM and were analyzed. The obtained geodetic residuals computed for different models of AAM and OAM are different from one model to the other. Standard deviations of the geodetic residuals considered have maxima of the order of over a dozen mas (Figure 1). In the case of geodetic residuals computed with the same OAM models, differences are of the order of several mas only (Figure 1). The results allow to conclude that errors of the OAM are larger than AAM errors.

In Figure 2 geodetic residuals computed for different models of AAM and OAM are compared with variations of different HAM input datasets. Correlation coefficients between the geodetic residuals and different hydrological models HAM are small — they are of the order of 0.1 for the χ_1 and 0.5 for the χ_2 components. It proves that the HAM excitation functions do not explain the considered geodetic residuals. In this situation the HAM excitation functions of polar motion are not able to improve the agreement between geodetic and geophysical excitation functions of polar motion. Other models of geophysical excitation functions have to be improved too.

In order to compare the compatibility between geophysical excitations and geodetic excitation of polar motion, prograde and retrograde components of annual complex polar motion excitation functions were computed for each atmospheric, oceanic and hydrological input dataset. Figure 3 shows that the HAM vectors draw the geophysical excitation closer to that of the GAM.

RESULTS

In these studies we choose the following geophysical models: AAM: ERA – Interim, ECMWF, NCEP/NCAR; OAM: ECCO, OMCT, HAM: LSDM, CPC and sattelite mission GRACE data from CSR (Thomas, 2002; Gross et al., 2003; Salstein et al., 1993).

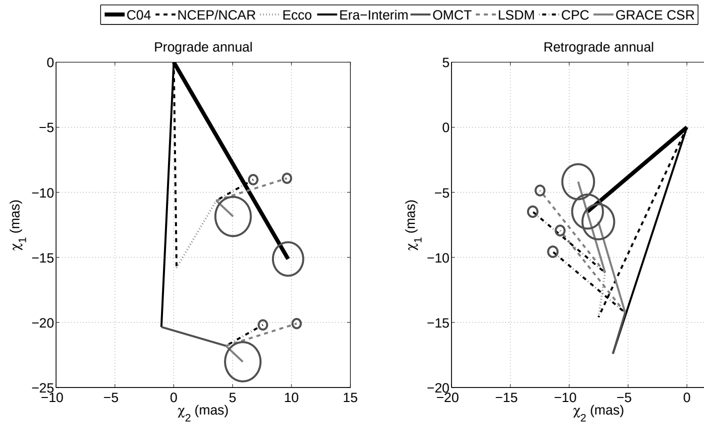

Figure 3: Phasor diagrams of the annual prograde and retrograde oscillation of the geodetic and geophysical excitation of polar motion (analysis done for the period 2001.0–2006.5).

Standard deviations of the considered geodetic residuals shown in Figure 1 have maxima of the order of over a dozen mas. These residuals are different when different OAM models are considered. In the case of geodetic residuals computed with the same OAM models, differences are of the order of several mas only (Figure 1).

To compare these geodetic residuals series with HAM data we choose two models of land hydrology and the HAM obtained from GRACE data (see Figure 2). In the case of the χ_2 component the geodetic residuals GAM-(Era-Interim + OMCT) are greater than the modeled HAM excitations. The geodetic residual GAM-(NCEP/NCAR+ECCO) are comparable with variations of the modeled HAM.

The determined phasor diagrams of geodetic and geophysical excitation functions show that adding successively atmospheric, oceanic and hydrological vectors, the final position becomes closest to the geodetic one but still not the same (Figure 3). Figure 3 shows that the HAM vectors draw the geophysical excitation function vector closer to that of the GAM vector.

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