COMPARISON OF REGIONAL HYDROLOGICAL EXCITATION OF POLAR MOTION DERIVED FROM HYDROLOGICAL MODELS AND THE GRACE GRAVITY FIELD DATA

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EXTENDED SUMMARY

1. ANALYSES AND RESULTS

Global geophysical excitation functions of polar motion do not explain fully the observed polar motion as determined by geodetic techniques. The impact of continental hydrologic signals, from land water, snow, and ice, on polar motion excitation HAM (Hydrological Angular Momentum), is still inadequately estimated and not known so well as atmospheric and oceanic ones. Recently the GRACE (Gravity Recovery and Climate Experiment) satellite mission monitoring Earth's time variable gravity field has allowed us to determine global mass term of the polar motion excitation functions, which inherently includes the atmospheric, oceanic and hydrological portions. We use these terms to make comparisons with the mass term of the geodetic and geophysical excitation functions of polar motion on seasonal scales. Global GRACE excitation function of polar motion and hydrological excitation function of polar motion have been determined and were studied earlier (Nastula et al., 2008, Chen & Wilson, 2008, Brzezinski et al., 2008).

For comparison of regional hydrological excitation of polar motion derived from hydrological models and the GRACE gravity field, data variances and residuals of these data from polar motion excitations were computed.

The following models of the HAM were considered in these studies: CPC–LDAS (Fan et al., 2003), LaD (Milly & Shamkin, 2002), GLDAS (Rodell et al., 2004). Regional and global gravimetric excitation functions over land were computed from the GRACE data based on equivalent water thickness, determined by D. P. Chambers from the RL04 solution of data processed at the GeoforschungsZentrum (GFZ), Jet Propulsion Laboratory (JPL), and Center for Space Research (CSR and available at `http://grace.jpl.nasa.gov`. The $1^o \times 1^o$ grids are an implementation of the destriping of Chambers (2006) who calibrated his results against sea surface height corrected for climatological steric expansion and contraction.

Variances of the data of regional GRACE gravimetric excitation functions of the solutions mentioned were computed over the globe with high spatial resolution, at $1^o \times 1^o$ (64800 sectors). These variances reach maxima of the order of 3×10^{-4} (mas/sector) over Southeast and South Asia, the Amazon Basin of South America, the Southeast United States and areas north of the Mediterranean Sea.

Residuals of the variances between the GFZ and CSR solutions show good agreement. Differences between other GRACE solutions are greater, however, and reach a value of the order of $1.5 - 2.0 \times 10^{-4}$ (mas/sector) in the regions of maximum variance.

Variances of the regional hydrological excitation functions computed from the LaD, CPC and GLDAS models reach maximum values of 3×10^{-4} (mas/sector). These occur in similar regions as in earlier studies; however, in regions of Southeast Europe and West Siberia only the LaD model has strong maxima.

Residuals of variances between regional hydrological excitation functions computed from the LAD and the CPC models reach maximum values of 2×10^{-4} (mas/sector)in some regions. Such values appear in the residuals of LaD and GRACE hydrological excitation functions in some regions, indicating that they are likely connected with the LaD model. Residual variations computed as differences between variances

of the regional hydrological excitation functions of the CPC model and GFZ solution of the GRACE - RL04 gravimetric variances are smaller than others.

2. CONCLUSIONS

Variances of regional excitation functions of polar motion computed from the GRACE gravity fields and from the hydrological models show similar geographic patterns, reaching maximum values in the regions Southeast and South Asia, the Amazon Basin of South America, the Southeast United States and areas north of the Mediterranean Sea.

Residuals of the variances between the GFZ and CSR indicate good agreement between these series. Differences between other solutions are greater. Comparison of residuals between the variances of regional excitation functions of polar motion from LaD and from GRACE with the residuals between the variances of regional excitation functions of polar motion from CPC and GRACE shows that the CPC has better agreement with the GRACE data.

The GRACE regional excitation functions of polar motion have larger magnitudes than the regional hydrological excitation functions.

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