Geophysical Research Abstracts
Vol. 19, EGU2017-1258, 2017
EGU General Assembly 2017

Variability in Terrestrial Water Storage and its effect on polar motion

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Explaining the hydrological part of observed polar motion excitation has been a major challenge over a dozen years. The terrestrial water storage (TWS) excitation of polar motion - hydrological angular momentum (HAM), has been investigated widely using global hydrological models mainly at seasonal timescales. Unfortunately, the results from the models do not fully explain the role of hydrological signal in polar motion excitation. The determination of TWS from the Earth's gravity field observations represents an indirect approach for estimating land hydrology. Throughout the past decade, the Gravity Recovery and Climate Experiment (GRACE) has given an unprecedented view on global variations in Terrestrial Water Storage.

Our investigations are focused on the influence of Terrestrial Water Storage (TWS) variations obtained from Gravity Recovery and Climate Experiment (GRACE) mission on polar motion excitation functions at decadal and inter-annual timescales. The global and regional trend, seasonal cycle as well as some extremes in TWS variations are considered here.

Here TWS are obtained from the monthly mass grids land GRACE Tellus data: GRACE CSR RL05, GRACE GFZ RL05 and GRACE JPL RL05. As a comparative dataset, we also use TWS estimates determined from the World Climate Research Programme's Coupled Model Intercomparison Project Phase 5 (CMIP5). GRACE data and state-of-the-art CMIP5 climate models allow us to show the variability of hydrological part of polar motion under climate changes.

Our studies include two steps: first, the determination and comparisons of regional patterns of TWS obtained from GRACE data and climate models, and second, comparison of the regional and global hydrological excitation functions of polar motion with a hydrological signal in the geodetic excitation functions of polar motion.