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Residuals of GRACE gravimetric excitation function of polar motion over ocean

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Motion of the Earth's pole may be excited by variability in the mass distribution in the geophysical fluids, which can be captured by changes in the gravity field from observations by the Gravity Recovery and Climate Experiment (GRACE) satellite system.

Because the polar motion excitation functions are themselves equivalent to the C21 and S21 harmonics of mass, a direct way of detecting polar motion from mass is simply to use these harmonics from the expansion of the GRACE gravimetric solution, which are monthly solutions. Here the mass changes can be thought of as concentrated in a very thin layer of fluid at the Earth's surface, whose thickness changes. An alternative method of estimation of the excitation functions for polar motion, is to take the expanded gravity fields from the GRACE solution and integrate these whole grids of water thickness.

Thus we compare the gravimetric polar motion excitation functions computed by two methods: either from the GSM – GRACE coefficients or from the GRACE-water thickness fields. Attention is focused on the contribution of mass variability over ocean area, remaining after removing an ocean model, to polar motion excitation Gravimetric excitations of polar motion are compared with residual-hydrological part of geodetic polar motion excitation computed by removing observed or modelled atmospheric and oceanic signals from the geodetic data.

The prominent signals are still situated over the ocean areas even after removing atmospheric and oceanic models from the GRACE fields. These signals likely reflects a deficiency of the ocean model used during the processing. The differences between the gravimetric excitation functions obtained from the GRACE data, from different centers are the smallest when land areas only are taking into account in the computations. The signals from the residual oceans are the main source of the differences between the two solutions based on processing in the GRACE analysis centers. Removing the residual ocean signals from the gravimetric excitation improves its correlation with the hydrological signals in the observed geodetic excitation.