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Reducing filter effects in GRACE-derived polar motion excitations

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Polar motion is caused by mass redistribution and motion within the Earth system. The GRACE satellite mission observed variations of the Earth's gravity field which are caused by mass redistribution. Therefore GRACE time variable gravity field models are a valuable source to estimate individual geophysical mass-related excitations of polar motion. Since GRACE observations contain erroneous meridional stripes, filtering is essential in order to retrieve meaningful information about mass redistribution within the Earth system. However filtering reduces not only the noise but also smooths the signal and induces leakage of neighboring subsystems into each other.

We present a novel approach to reduce these filter effects in GRACE-derived equivalent water heights and polar motion excitation functions which is based on once and twice filtered gravity field solutions. The advantages of this method are that it is independent from geophysical model information, works on global grid point scale and can therefore be used for mass variation estimations of several subsystems of the Earth (e.g. continental hydrosphere, oceans, Antarctica and Greenland). In order to validate this new method, we perform a closed-loop simulation based on a realistic orbit scenario and error assumptions for instruments and background models, apply it to real GRACE data (GFZ RL06) and show comparisons with ocean model results from ECCO and MPIOM.