Inferring gravitational changes from variations in the Earth's rotation

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Variations in the low-degree gravitational coefficients are caused by large-scale mass redistribution within and on the Earth. Studying the temporal evolution of these coefficients thus leads to a better understanding of the mass transports occurring in the Earth system. Different space-geodetic techniques, such as the GRACE satellite mission or satellite laser ranging (SLR) can be used to monitor variations in the low-degree coefficients. Changes in the degree-2 coefficients C_{20}, C_{21} and S_{21} can further be derived from Earth rotation data.

We give a brief overview of this latter technique, and explain how changes in the degree-2 gravitational coefficients can be inferred from measured Earth orientation parameters (EOP), provided that the effects of atmospheric winds and oceanic currents can be accurately modelled and removed from the observations. We further present some results from a recent study, where we use two different combinations of atmospheric and oceanic models to subtract the wind and ocean current contributions from the observations, and derive two different sets of degree-2 variations from Earth rotation data. We compare these coefficients to degree-2 estimates from GRACE and SLR at different time scales. We assess the general agreement between EOP-derived coefficients and the coefficients from satellite-based methods, as well as the relative performance of the two global geophysical fluids models we considered.