



Toward uncertainties in gravimetrically derived excitation mechanisms of Earth rotation: A case study of degree-1 Stokes coefficients and C20

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Earth rotation variations are caused by redistribution and motion of masses within the Earth system. Since 2002, the satellite mission GRACE (Gravity Recovery And Climate Experiment) observes gravity field variations of the Earth which are caused by mass displacements within the Earth system. Therefore, time variable GRACE gravity field models can be used to determine mass-related excitation mechanisms of Earth rotation. By applying suitable filter techniques and masks not only the integral mass effect on Earth rotation but also the mass effects of the oceans, continental hydrosphere and cryosphere can be studied. These gravimetrically derived excitations suffer from uncertainties due to (1) the destriping and filtering of the GRACE data, (2) the separation of the individual contributions (leakage effect), (3) the reduction of glacial isostatic adjustment and (4) an appropriate replacement of the Stokes coefficients C10, C11, S11 and C20. The latter aspect shall be investigated in this study.

Due to the fact that the GRACE data processing is performed in the Earth's center-of-mass (CM) frame the degree-1 Stokes coefficients are zero by definition. But due to the fact that processes at the Earth's surface and interior are referred to a coordinate system attached to the Earth's crust which moves relative to the CM this effect has to be taken into account within the determination of mass variations. This movement is described by the so called geocenter motion – the position of the CM wrt. the center-of-figure (CF) – or by the degree-1 Stokes coefficients, respectively. In this study SLR (Satellite Laser Ranging) solutions for geocenter motion and solutions for the degree-1 Stokes coefficients derived from GRACE and ocean models or from GPS, GRACE and ocean bottom pressure from a model are investigated with focus on gravimetrically derived excitation mechanisms of Earth rotation.

The Stokes coefficient C20 obtained by GRACE still suffers from ocean tide model errors. We use three SLR solutions for C20 and one solution for C20 based on a combination of GRACE data and geophysical models to replace the C20 coefficient in the GRACE time variable gravity field models. In this way we study the impact of C20 on gravimetrically derived oceanic, hydrological and cryospheric excitation mechanisms of Earth rotation.