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Combined coupling torques for the electromagnetic and topographic core-mantle coupling and their influence on Earth's rotation

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For the computation of the electromagnetic (EM) coupling torque, we have to calculate the poloidal and toroidal geomagnetic field at the core-mantle boundary (CMB). For this purpose, we apply the non-harmonic downward continuation *(Ballani et al., 2002; GJI 149)* to the poloidal geomagnetic field. A requirement for the determination of the toroidal geomagnetic field at the CMB is the fluid-flow inversion *(Wardinski, 2005; GFZ STR 05/07)* for core surface velocity. Based on this time-dependent fluid-flow velocities, the topographic (TOP) coupling torque is determined consistently. Moreover, the combined coupling torque provides us the possibility to deduce equivalent excitation functions for the comparison with other contributions to the Earth's orientation parameters (EOPs) on the decadal time scale.

The uncertainties in the input parameter, like the stratification of the electrical conductivity in the mantle or the topography of the CMB, require to produce a set of numerical results based on different input parameters. We consider four different conductivity and four different CMB-topography representations. A comparison of these results yields detailed insights to the relation between input parameters and the variability of the resulting torques.

The individual contribution of EM and TOP torques to the different components of the combined coupling torque shows the necessity for its determination. Since all three components of the combined coupling torque have the same order of magnitude as the observation-based mechanical torques, it is now reasonable to compute so-called equivalent excitation functions. Moreover, we discuss these results on the background of a comparison of with EOPs, which are reduced by atmospheric and oceanic angular momentum functions.