TORQUE BALANCE EVOLUTION WITHIN THE CORE OVER THE LAST 150 YEARS

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Time evolution of the torque balance on the core fluid annuli coaxial with the Earth's rotation axis is investigated. Based on the time-varying part of a core surface flow model (1840.0-1990.0) inferred from the GUFM1 geomagnetic model, we compute time variations of three torques on the annuli: inertial torque, electromagnetic core-mantle torque (CMB-EM torque) and electromagnetic torque on the lateral surface of the annuli (internal-EM torque). For the computation of the CMB-EM torque, we assume a conductive layer at the bottom of the mantle, with a conductance of 10^8 S. For the computation of the internal-EM torque, we assume several profiles of magnetic flux through the lateral surfaces of the annuli. The magnitude of the computed internal-EM torques reaches that of inertial or CMB-EM torques, if the average field through the annuli lateral surface is as large as 10^5 nT. Fluctuations of the computed internal-EM torques have timescales no shorter than decades and are not consistent with those of the inertial torques with timescales of several years. We also estimate the magnetic flux profile by imposing a temporally continuous equilibrium of the three torques in the time domain. It is revealed that the decadal components of the inertial and CMB-EM torques may be correlated to the EM-internal torque at the mid-latitudes. However, the inertial-EM torque still does not fit the short-timescale fluctuations of the inertial torque.

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