Constraints on Earth's core processes by space gravimetry

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Space gravimetric missions such as GRACE and GRACE Follow-On have been measuring the temporal mass variations within the Earth since 2002. GRACE products have been widely used to study continental water mass redistributions bringing additional constraints to hydrological models. GRACE solutions have also enabled to study internal mass redistributions before, during and after large earthquakes, putting some new constraints on the seismic cycle. In the deeper Earth's interior, the core also possesses a broad range of dynamical mechanisms involving mass variations. We compute the gravity perturbations expected for several core processes using the gravito-elastic equations governing the Earth's response to any internal forcing. We focus on the interannual signals generated by the dynamic pressure changes at the Core Mantle Boundary (CMB) associated with core flows reconstructed from geomagnetic observations, the reorientation of the inner core controlled by gravitational coupling with the Earth's mantle and time-varying topography changes at the CMB associated with dissolution and crystallization processes for instance. We then confront the predicted signatures with the current uncertainties linked to the GRACE data. New constraints on these core processes are finally obtained from space gravimetry. Some of the current limitations in the search for Earth's core signatures in space gravity records could be lifted with the future space gravimetric missions.