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Relationships between Earth Rotation and Gravity Field: Theoretical and practical point of view

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The masses distribution inside the Earth govern the Earth rotation rate (or equivalently, length of day), as well as the behaviour of the rotation axis in the Earth (polar motion), and in space (precession-nutation). This distribution of masses can be measured from space owing to artificial satellites, the orbitography of which provides the Earth gravity field determination. Then, the temporal variations of the Earth gravity field can be related to the variations of the Earth Orientation Parameters (EOP) (through the Inertia Tensor). Moreover, significant progresses were made in the last years in the framework of the fluid layers effects modelisation (atmosphere and oceans). And nowadays, the Earth orientation measurements in space, obtained with Very Long Baseline Interferometry (VLBI), have a precision better than the milliarcsecond level. In this paper, we present the work done during my PhD Thesis, which goal was to use the Earth gravity field measurements, as well as its variations, as a tool to complete the Earth orientation modelisation. A further purpose is a better understanding of the Earth global dynamics. In a first step, we present the theoretical links between the Earth Orientation Parameters and the temporal variations of the gravity field (see Lambeck 1980, or Gross 2000). Then, we use the temporal variations data of the geopotential degree 2 coefficients (from Lageos I and II satellites, or GRACE), in order to investigate their influence on the length of day, the polar motion, and the precession of the equator.