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The use of Full Earth Rotation Vector Derived from Ring Laser Data

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Current active ring laser technology demonstrates the capability to measure variations of the rotation of the Earth. The large ring laser gyroscope "G" at the Geodetic Observatory Wettzell, Germany, shows a stability which allows the measurement of the wobble of the Earth axis. Earth rotation currently is determined routinely in the framework of the International Earth Rotation and Reference Systems Service (IERS) using space geodetic techniques such as Global Navigation Satellite Systems (GNSS), Satellite Laser Ranging (SLR), and Very Long Baseline Interferometry (VLBI). These techniques measure the rotation of the Earth kinematically by determining the motion of ground stations with respect to space objects, i.e. based on a technique also called "stellar compass". Ring laser gyroscopes on the other hand measure Earth rotation locally based on the observation of inertial accelerations, i.e. based on a technique also called "inertial compass". The fundamentally different measurement principles complement each other. It is, e.g., well known that forced polar motion, the so called Oppolzer terms, are not observable by space geodetic techniques due to strong correlation with the motion of the Earth axis in space. For the same reason the determination of subdaily Earth rotation parameters with space geodetic techniques is prone to strong systematic errors while exact knowledge of such terms is relevant, e.g., to determine high quality orbits of GNSS satellites. This presentation shall highlight the potential of the ring laser technology as additional sensor for monitoring Earth rotation, in particular with the upcoming capability to measure the full Earth rotation vector.