Earth Orientation Parameters – an Important Dataset for Science and Society

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Abstract

Earth Orientation is the difference of celestial and terrestrial orientations of geocentric reference systems. The corresponding set of parameters are the Earth Orientation Parameters (EOP). The EOP are offsets to the celestial pole coordinates computed with the conventional IAU2000A model: dX, dY, celestial pole offsets (CPO), the terrestrial pole coordinates x_p, y_p, and the phase offset between celestial and terrestrial intermediate origins on the CIP (celestial intermediate pole) equator: ERA (Earth Rotation Angle). Besides these five parameters, there are other parameters in use, such as length of day (LOD), most of which are time derivatives of the before mentioned five. The EOP are typically disseminated at integer midnight epochs with diurnal resolution. Interpolation at other daytimes can be done applying conventional models of sub-daily Earth rotation variation. Official datasets date back to the early 80ies, since the advent of the space geodetic techniques. Other EOP datasets involve optical astrometric observations and therefore start already in the 19th century.

The EOP have practical relevance for connecting the terrestrial and celestial reference frames. Doing so, they enable the data analysis of space geodetic techniques and allow for ground-based astronomy. They are applied for the attitude control of satellites and the planning and controlling of space missions and the associated orbits. The rotational speed of Earth also serves as a time scale called mean solar time (UT1~ERA), which is required to keep the civil time that is based on the atomic time compatible SI second attached to the local apparent position of Sun.

From the scientific point of view, the EOP contribute to the basic research of solid Earth. As drilling is not (yet) possible below about 20 km, the rotational motion of Earth provides valuable insides about its interior. Other rotational variations are due to angular momentum exchange between solid, liquid and gaseous envelopes of Earth. As the rotational state observed with ground-based space geodetic techniques displays the geometric situation for solid Earth only, comparisons with the centrifugal potential as a part of Earth time-variable gravity field can only be done, if the contributions due to the fluid envelopes are adequately modelled and subtracted. On the long-term, the speed of Earth rotation decreases due to tidal friction, which in turn leads to a growing lunar semi-major axis due to the exchange of angular momentum with the lunar orbit. Earth rotation is one of the oldest disciplines of astronomy. However, it is still a topic of modern scientific interest. Currently, the international community concentrates on the consistency of the EOP with the corresponding reference systems and on aspects of predictability of the dataset.

The presentation will cover general aspects of Earth rotation and a review of the current official EOP products. The main part will be a conceptual, qualitative and quantitative description of the parameters including their definition and observation by space geodetic techniques. Other sensors for Earth rotation determination are not mentioned. The focus of the presentation will be on the role of the EOP for geodesy.

Keywords: *Earth Orientation Parameters (EOP), Celestial Reference Frames and Systems, Terrestrial Reference Frames and Systems*