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EARTH ROTATION OBSERVATIONS AND THEIR GEOPHYSICAL IMPLICATIONS

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During the last 25 years and more particularly since 1989, the measurements of the Earth rotation fluctuations were dramatically improved. Till 1970, the classical astronomical methods were the only ones allowing to measure the three Earth rotation parameters with a precision of the order of 0″01. Fundamental stars catalogues provided the external reference.

In the beginning of the seventies new external references appeared such as the orbital plane of the Moon or of artificial satellites and the position of quasars; all became the usual reference systems.

Starting in 1972 space geodesy, based on the observations of Transit satellites, contributed to the Polar Motion with a higher weight than the astronomical methods; the interest of the last ones decreased rapidly with the Laser ranging to the satellite Lageos or the Moon and mainly by the deployment of world network based on the Very Long Base Interferometry (VLBI).

In 1988, the new techniques conducted the scientific community to set up the International Earth Rotation Service (IERS) which replaced the Bureau International de l'Heure (BIH) and the International Latitude Service (ILS); this new Internation Service turned in operation in January 1989. Since that time VLBI, Laser ranging to the Moon and to Lageos provided the observations which reach now a precision of the order of 0″0001. More recently a new world network based on the Global Positioning System (GPS), has been deployed; close to 200 stations, distributed all over the world, are contributing to the measurements of the three Earth rotation parameters. The network is managed by the International Geodynamics Service (IGS); it contributes to IERS since 1993. The precision of absolute positioning with GPS reflects its capabilities for the measurement of Earth rotation parameters; it is at the level of few centimeters while in differential positioning, the precision is of the order of 10^{-9} in horizontal displacements and 1 centimeter in altitude over distances of 1000 km.

Beside the classical correction of atmospheric refraction such a precision, obtained both by GPS and VLBI, calls for new inputs to remove errors introduced in the observations themselves. It conducts to take into account external perturbations induced by abnormal ionospheric conditions while geodetic marks, located on the ground, are to be corrected for oceanic and solid tides, atmospheric loading.

Moreover the quality of the observations let appear deficiencies in the astronomical nutations models which in turn require a better understanding of the Earth interior.

We shall end this presentation by reviewing some of those effects that were investigated at the Royal Observatory of Belgium:

- ionospheric disturbances,
- displacement of geodetic marks generated by the atmospheric loading,
- duality between Earth interior and nutations models.