Evolution of the applications of the Earth rotation time

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Abstract

Our talk reviews the evolution of the applications of the Earth rotation Time. In the 1930's the discovery of its instability shacked its status as Universal Time (UT), i.e. the world's standard clock. Until the 1970's, the Earth rotation time variations were more perceived as time defects to be eliminated in the realization of the UT, basis of any civil time, than an Earth Rotation Parameter like the pole coordinates, which had been monitored by an international service since 1899. Finally, it was renamed UT1 and was substituted in 1972 with the more stable Coordinated Universal Time (UTC), an atomic time, nevertheless kept synchronized with UT1 to within 0.9 s through the insertion of leap second since 1972. The radio-dissemination of UTC enabled the practice of star navigation at long distance to within 450 m, an error consistent with the optical observations. In 1988 with the demise of the Bureau International de l'Heure, the official determination of UT1 was entrusted to the International Earth Rotation Service created in 1987, and UT1 was incorporated into the Earth Orientation Parameters, that made possible to determine the rotation transformation between celestial and Earth-fixed space coordinate systems with an accuracy of 0.5 mas. The advent of Global Navigation Space Systems (GNSS) in the 1990's have changed the game: they require now an error of 10 micro-secondes on UT1 or a few millimeter on the Earth surface, so that the UTC approximation of UT1 to within 0.9 s is not useful, even when incorporating supplementary correction UT1-UTC to within 0.1 s (disseminated through IERS Bulletin D). So, the pertinent quantity in GNSS is UT1, while UTC is only used for dating and the leap second system appears obsolete. In this respect, UT1 is monitored daily by VLBI. Since the 1970's, UT1 irregularity has thwarted all prognoses, and its variations ranging from a few hours to some decades became an invaluable source of information on the Earth properties and the global processes that affect it, namely tides and geophysical fluid transports.

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