

Earth Rotation Variations: Insights into Geophysical Processes

J O Dickey (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91 109; tel.: 818-354-3235; E-Mail: JOD@LOGOS.JPL.NASA.GOV) “

The study of the Earth's rotation encompasses the complex nature of orientation changes, the excitation of these changes and their geophysical implications in a broad variety of areas, Earth system studies have embarked on a new era with the advent of highly accurate space geodetic techniques and the increasing availability of complementary geophysical data sets. Techniques utilized include laser ranging to the Moon and artificial satellites (LLR and SLR), very long baseline interferometry (VLBI) and the newly developing GPS technology. The measurements reveal minute but complicated changes of up to several parts in 10^8 in the speed of the Earth's rotation, corresponding to several milliseconds in the length of the day (LOD). Intercomparisons indicate that Earth rotation is now routinely determined at the -1 cm level for both UT1 and polar motion with higher accuracy being achieved in some cases.

Highly accurate observations of Earth rotation provide a unique and truly global measure of natural and man-made changes in the atmosphere, oceans, and interior of the Earth, Earth rotation, when studied in combination with other parameters such as global integrated atmospheric angular momentum (AAM) and the Southern Oscillation Index, allows new and unique insights into geophysical processes. From intercomparisons of AAM and LOD, we find that Earth rotation variations over time scales of a few years to days are excited by atmospheric effects, with a dominant seasonal cycle and significant variability on the intraseasonal (40 to 50 day) time scale. Subdaily variations are largely due to ocean tidal effects. Variations on interannual time scales have been related to the El Niño/Southern Oscillation phenomenon. Torques between the core and mantle are the most probable cause for the longer-scale “decade” fluctuations in the LOD. Trends found on even longer time scales (the “secular” changes) are due to tidal dissipation torques, which produce a steady increase in the LOD at a rate estimated from ancient eclipse records to lie between 1 and 2 milliseconds per century. Contributions to LOD changes on the same secular time scale are also produced by internal sources, such as changes in the moment of inertia of the solid Earth resulting from the melting of ice after the last glacial maximum. Current activities will be reviewed; anticipated advances and prospects for the future will be highlighted,

1. 1994 AGU Fall Meeting
2. 001310361 (AGU)
- 3a. J. O. Dickey
MS 238-332
JPL/Caltech
4800 Oak Grove Drive
Pasadena, CA 91109
- 3b. 818-354-3235 (Office)
- 3c. 818-393-6890 (FAX)
4. Union
- 5a. U 9 Session in honor of
R. Hide
- 5b. 1239 Rotational Variations
1294 Instruments and
Techniques
1299 General or
miscellaneous
6. Oral
7. invited Review Paper
8. Charge \$50 to Master Card
5286-3056-8324-4492,
expires 9/96
9. Invited (by R. Hide &
J. Dickey)
10. None
11. No