G. EARTH ORIENTATION PARAMETERS

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Since the beginning of regular space geodetic measurements of EOP marked by the beginning of the MERIT short campaign in 1980, SLR has routinely provided polar motion and length of day (or high frequency UT1) solutions to the IERS. In the following decade SLR and VLBI (with contributions to UT1 from LLR) became the only techniques used by the IERS in providing the international standard series of EOP. As the decade of the 1990s began the development of GPS as a tool for studying EOP variation accelerated and by the time of the GIG campaign in 1991 the technique produced polar motion results competitive with SLR and VLBI. See Eubanks [1993] for an excellent review of the scientific importance of monitoring EOP variations as well as a description of each of the techniques discussed here. At the current time, GPS regularly produces daily polar motion solutions with 0.4 mas accuracy, equivalent to that of the routine 1-day VLBI experiments and SLR solutions using 3 days of Lageos-1 data (IERS Bulletin B, March 1994). These high quality GPS solutions should continue indefinitely under the auspices of the International GPS Service (IGS). The rapid progress of the GPS technique forces a review of any resource allocations for VLBI and SLR measurements of EOP.

The VLBI EOP results are unique because of the technique's inherent ability to access the Celestial Reference Frame (CRF), realized by the positions of distant quasars, with respect to the Terrestrial Reference Frame (TRF) defined by the positions of the radio telescopes. This allows VLBI to determine all of the parameters describing the orientation of the CRF and TRF, namely precession, nutation, polar motion and universal time (UT1). Conversely, the satellite based techniques (GPS and SLR) can access the CRF only to the accuracy of the dynamical models that predict the satellite's motion in the CRF. Errors in the dynamical models for GPS satellites and for Lageos prevent getting meaningful estimates of precession and nutation and degrade the long term stability of the UT1 estimates. The model's ability to predict the motion of the longitude of the ascending node of the satellite's orbit determines how rapidly the UT1 product will degrade. For Lageos-1 SLR the error in UT1 grows at an RMS rate of 0.02 millisecond per day. The error growth in GPS UT1 results is not clear at the present time, but is thought to be more rapid than that of Lageos-1 due to the much larger errors in the models of the non-gravitational accelerations on the GPS spacecraft.

As long as regular VLBI observations are continued with experiments scheduled every few days, and especially if the short duration daily IRIS intensive series is continued, then adequate resolution of high frequency UT1 variations (few day periods) can be maintained. If, on the other hand, VLBI is cut back to a weekly or longer rhythm then either GPS or SLR must fill in the missing high frequency measurements. If the GPS derived UT1 product's drift is larger than that of Lageos-1 SLR then Lageos-1 SLR must be maintained to retain adequate UT1 accuracy at all frequencies. The drift rate quoted above for SLR is from the single satellite results from Lageos-1. Switching to a dual satellite SLR EOP analysis using Lageos-1 and Lageos-2 will reduce the UT1 drift rate somewhat. If a Lageos-3 target in supplementary orbit to either Lageos-1 or Lageos-2 is added the SLR UT1 drift rate will be reduced substantially.

A relatively recent thrust of research in EOP analysis is toward determining the high frequency fluctuations in the EOP and in the geocenter caused by diurnal and semidiurnal tides. The SLR, VLBI and GPS techniques are all sensitive to these small, but significant fluctuations. The results obtained to date are being compared between techniques and to predictions from existing tidal models [Lichten et al., 1992, Sovers et al., 1993, Herring and Dong 1994, Watkins and Eanes 1994]. Currently, the space geodesy results agree better with each other than they do to the tide models indicating that the observations can provide useful constraints that can be used to test for improvements in the tide models.

In summary, if regular daily IRIS intensive observations continue, then the combination of VLBI and GPS will be adequate to provide EOP with sufficient accuracy for all uses. If VLBI cutbacks eliminate the daily measurements then Lageos SLR may be required to adequately interpolate UT1 between weekly VLBI sessions. All three techniques should be continued for a few more years in order to provide independent measurements of rapid changes in EOP including diurnal and semi-diurnal tidal fluctuations.

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