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Preliminary Analysis of IGS Reprocessed Orbit and Polar Motion Estimates

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The Analysis Centers (ACs) of the International GNSS Service (IGS) are reanalyzing the history of global network GPS data collected since 1994 in a consistent way using the latest models and methodology. This is the first reprocessing by the IGS, but it is expected to be repeated in the future as further analysis and reference frame changes occur. All eight final-product ACs are participating, together with three other related groups.

First partial results consisting of IGS combined weekly SINEX TRF and EOP combinations have been submitted to the IERS for ITRF2008. A snapshot of the available AC weekly SINEX files was used covering the reprocessed years 2000 through 2007 plus the IGS regular operational solutions for 2008 (from week 1460 onward). Meanwhile, the full reprocessing campaign will continue to completion by about the end of 2009 and will cover the period 1994 to present with long-term consistent, combined SINEX, orbit, and clock products.

We have examined the reprocessed AC orbit and polar motion (PM) estimates from the 1024 days (or 1025 for differences) of results till the end of 2007. These parameters are linked since PM is sensed in the GPS modeling as a global diurnal sinusoidal motion of the terrestrial frame relative to the satellite frame. Any similar type errors in the orbital frame can bias the PM and PM rate estimates.

For the orbits, each daily AC satellite ephemeris for each pair of consecutive days has been fit to the extended CODE orbit model, extrapolated to the mid-point epoch between the days, and the geocentric satellite position differences computed to give time series of orbit repeatabilities. Occasional data gaps have been filled by linear interpolation, FFT power spectra computed, and the spectra stacked over the full GPS constellation and lightly smoothed. Our analysis reveals considerable diversity among AC orbits. Several show broad semi-annual (probably related mostly to eclipsing) and fortnightly spectral peaks, as well as even harmonics of the GPS draconitic year (1.040 cpy) with varying amplitudes. High-frequency white noise floors can be detected in most AC orbit spectra, with an average sigma of 14 mm and larger.

AC PM spectra mostly follow a power law with slope -4 for periods shorter than about 20 d, as expected, except in the few cases when ACs have applied tight day-to-day continuity constraints. Indications of high-frequency white noise are seen in some AC series. Day-boundary discontinuities computed using the AC PM rate estimates can provide a sensitive probe of the quality of the AC modeling, especially for the satellite orbit dynamics. Like the orbit discontinuities, we find the PM discontinuities vary greatly among the ACs. But most spectra of the PM discontinuities show peaks at the annual (broad) and the O1 tidal alias period of 14.19 d (narrow), in addition to odd (rather than even) harmonics of 1.040 cpy. Previously both even and odd harmonics of 1.040 cpy have been found in the spectra of station position time series.