Subseasonal GNSS Positioning Errors

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GPS positioning errors over seasonal and longer time scales have been well studied for more than 15 years. It is known that coordinate errors are spatially and temporally correlated, and that their background spectra closely follow a flicker noise process, with some white noise at the highest frequencies. Overlaying this are strong annual and semi-annual variations that cannot be explained by any single phenomenon. Crustal displacements due to pressure loading variations from the atmosphere, ocean, and continental water account for only about half of the non-linear vertical motions (2.4 mm global median annual amplitude). Much smaller portions of the horizontal variations (10 to 20%) are caused by surface loads if the models are reliable.

Next most prominent are harmonics of the GPS draconitic year, with periods of (351.4/N) d for N up to at least 6. These features are pervasive in nearly all products of the International GNSS Service (IGS). One explanation is that demonstrated errors in the IERS model for subdaily EOP tidal variations (near 12/24 hr periods) are absorbed into the resonant GPS orbits, resulting mainly in draconitic and fortnightly alias signatures for standard 24 hr product sampling.

With the change in IGS station coordinates from weekly to daily resolution on 19 Aug 2012, it is now possible to study subseasonal performance. Most Analysis Centers (ACs) show fortnightly signals but the resolution is not yet sufficient to distinguish direct from aliased subdaily tidal sources, though the latter are expected. Most ACs that include GLONASS data also have signals at ~8 d periods, the ground repeat period for GLONASS orbits. Two ACs possess unique short-period features.