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Impact of higher-order ionosphere terms on GPS-derived global network solutions

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During the years of routine GPS processing since the official start of the IGS in 1994, the models applied in the data analysis as well as the processing strategies have considerably improved. In order to obtain homogeneous and consistent time series of global geodetic parameters free of processing changes, the Technical Universities of Dresden and Munich decided to perform a reprocessing of a global GPS network over the last ten years in a joint effort.

Such a reprocessing provides also the opportunity of considering new standards as well as applying advanced modeling techniques. The relevance of such a reprocessing effort becomes more and more evident in view of the fact that modeling appears to be one of the limiting factors for a further improvement of high-quality and accurate GPS-based results. This consideration also includes the treatment of ionospheric corrections.

Dual-frequency observables allow the elimination of the 1st-order ionospheric term. Although higher-order ionospheric terms may cause range biases of several centimeters (Kedar et al, 2003), taking into account such effects is not a common strategy yet. In view of the size of these terms, the 2nd and 3rd-order ionospheric corrections were implemented in our reprocessing strategy. Preliminary results allow a first assessment of the benefits to be expected from this approach.

This presentation will point out the significant impact of an expanded ionosphere delay modeling using 2nd and 3rd-order ionospheric terms. The already known latitude-dependent southward shift of globally distributed stations will be discussed together

with questions arising for a refined reference frame realization. Furthermore, the daily variations of the total electron content cause changes in other estimated parameters, in particular on sub-daily time scales. Moreover, long-period variations in the intensity of the Sun's radiation affect the magnitude of the resulting parameter changes.

Reference: Kedar S., Hajj G.A., Wilson B.D., Heflin M.B. (2003): The effect of the second order GPS ionospheric correction on receiver positions. Geophys. Res. L., 30, 1829, doi:10.1029/2003GL017639