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Characteristics of higher order ionospheric effects on GNSS observations: Monitoring using IGS network

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The ionospheric refractive index equation along the GNSS ray path includes second and third order terms. These as well as geometric and slant Total Electron Content (TEC) difference ray bending effects are usually referred to as higher order ionospheric effects. Unlike first order effects, these can not be eliminated using a linear combination of dual frequency observations. Higher order effects (mainly second order term) can reach several centimeters especially at low elevation angle observations and during ionospheric storm conditions [1, 2]. It has been shown that higher order ionospheric effects can affect high precision positioning applications, especially satellite orbit and clock estimation from global GNSS network data [1, 3].

Since Natural Resources Canada, an IGS Ionospheric Analysis Center [4], resumed its submissions of global TEC maps to IGS data centers, second and third order ionospheric effects are regularly estimated at ionospheric pierce points observed by more than 350 globally distributed GNSS stations. In this presentation, a statistical analysis is carried out to examine the characteristics of the second and third order ionospheric estimates over time and location during the current solar cycle. The impact of uncertainties of slant TEC and geomagnetic reference field, the two main parameters used in second order ionospheric computations, is also analyzed. This can help define accuracy criteria for higher order ionospheric computation parameters for applications such as satellite orbit and clock estimation using global GNSS networks.

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