Application of geostationary GNSS signals for studying TEC variability in equatorial ionosphere on different time scales.

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In this talk we address some possibilities for ionospheric disturbances studies based on new GNSS systems, with special emphasis on equatorial region. Here, COMPASS/BeiDou (BDS) has a lot of potential due to geostationary satellites included in its constellation. Those satellites have the advantage of almost static ionospheric pierce points (IPP), which can be exploited to perform continuous TEC monitoring along a fixed satellite-receiver line of sight at arbitrarily large time scales. Moreover, recent studies have shown that TEC estimates using BDS-GEO satellites have the highest signal-to-noise ratio among currently available geostationary systems.

We present examples of applying geostationary TEC data based on BDS-GEO signals for studying equatorial ionosphere variations at broad range of temporal scales. Namely using IGS/MGEX receivers in low and mid latitudes of European-African longitude sector we show coherent response of geostationary TEC to the sequence of X-class Solar flares on September 6, 2017. We also consider longer time scales and present geostationary TEC variations for latitude - distributed receivers in Asia-Oceania sector during the positive ionospheric storm caused by the G3 geomagnetic storm of May 28–29, 2017, as well as during minor and final major SSW events of February-March 2016.

We also suggest and discuss capabilities of geostationary ROTI index for characterizing equatorial ionosphere disturbances. The main advantage of proposed GEO ROTI index when compared to standard GNSS ROTI is its constant geolocation and possibility to obtain continuous dataseries with single satellite. It also leads to the fact that GEO ROTI only accounts for temporal ionospheric variability, while conventional GNSS ROTI is impacted by both temporal and spatial ionospheric variability and the contribution of the latter is highly dependent on the relative motion of IPPs and ionospheric disturbances. Consequentially, geostationary indices avoid another major problem of GNSS-based ionospheric disturbance indices, i.e. spatial variability along the arc and influence of low-elevation data. Comparison of suggested GEO ROTI with conventional GNSS ROTI for African and Asia-Oceania equatorial regions is provided highlighting mentioned above features. Our results also indicate that GEO ROTI is capable to successfully represent the typical features of diurnal and seasonal variations as well as storm-induced ionospheric disturbances in studied regions.

We also discuss capabilities of BDS-GEO signals for TIDs interferometry (detection of direction and propagation velocity) in equatorial region. With static IPPs BDS-GEO provides a significant advantage in estimating real propagation velocities instead of virtual ones in case of GPS/GLONASS. We present preliminary results on medium to large scale TIDs detection in equatorial Asia-Oceania longitude sector.

In general our results show large potential of BDS-GEO for continuous monitoring of ionospheric disturbances of various scales in the near equatorial region taking into account increasing number of dedicated receivers.