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Climatological perspectives of the ionospheric irregularities formation at low latitudes as probed by GNSS

Luca Spogli (1,2), Vincenzo Romano (1,2), Claudio Cesaroni (1), Giorgiana De Franceschi (1), and Ingrid Hunstad (1)

(1) Istituto Nazionale di Geofisica e Vulcanologia, Rome, Italy , (2) SpacEarth Technology, Rome, Italy

The presence of Equatorial Plasma Bubbles (EPB) is the principal responsible for the ionospheric scintillation on GNSS signals in the low and equatorial latitudes ionosphere. Being their formation the consequence of the regular behavior of the electrodynamics of the equatorial ionosphere-thermosphere system, patterns of scintillation occurrence have a clear dependence on local time and season under quiet geomagnetic conditions.
When solar energetic events hit the Earth, mass/energy input from the solar wind into the ionosphere through the magnetosphere significantly affects the low-latitude electrodynamics. In the specific, the equatorial zonal electric field undergoes significant modifications mainly due to two notable effects: the prompt penetration of electric field (PPEF) and the Disturbance Dynamo Electric Field (DDEF). From the irregularity formation point of view, the joint effect of the two phenomena may lead to an intensified or weakened ExB uplift of the F-layer in the local post-sunset hours and the consequent enhancement or suppression of the EPB formations.
Currently, a complete picture of the possible ionospheric scenarios in terms of EPB variations and morphology following geoeffective solar events is still missing, due also to the largely varying nature of the Space Weather events on the terrestrial ionosphere. By consequence, the modeling of ionospheric effects on GNSS in the low latitude ionosphere is still challenging and mitigation on GNSS-reliant services in the region is still an open issue.
Climatological approaches, like the Ground Based Scintillation Climatology technique, allows studying and characterizing the recurrent features of the ionospheric irregularities dynamics and temporal evolution on long data series, eventually highlighting correspondences with scintillation occurrence and the dependence on helio-geophysical parameters.
This work aims at presenting the recent and main results of climatological studies of the low-latitude scintillation on GNSS, speculating on the role of the geospace forcing in the found patterns of scintillation occurrence.