From solar cycle 23 to solar cycle 24: Twelve years of ionospheric scintillations measurements at Ny-Ålesund (Svalbard Island).

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Extended Abstract

INGV is operating a network of GNSS (GPS, GLONASS, Galileo) receivers acquiring data at 50 Hz incorporating a firmware especially modified to provide several parameters useful to monitor the perturbations of the high latitudes upper atmosphere. In particular, the first GPS receiver was installed in 2003 at Ny-Ålesund (Svalbard Island, 78°55'N 11°55'E). The analysis exploits the scintillations parameters (S4 and $\sigma_\phi$) measured by INGV receiver, together with the calibrated TEC derived by applying the calibration technique described in [1] on data acquired from IGS stations almost co-located with the INGV one, to study the behaviour of the high latitudes ionosphere during the different phase of a solar cycle. With the aim to derive the long-term trend of the behaviour of the ionospheric irregularities driving L-band scintillation and to study, on different time scales, the external forcing effects on the ionosphere, the so-called Hilbert-Huang transform (HHT), is applied. HHT is an adaptive non-linear technique based on the Empirical Mode Decomposition (EMD) and on the Hilbert Spectral Analysis (HSA), capable to produce physically meaningful representations of data related to non-stationary processes as the fluctuations of the GNSS signals caused by small-scale ionospheric irregularities [2]. Differently from other spectral techniques, such as Fourier transform, HHT is able to provide both the amplitude and the frequency of each component as functions of time giving the opportunity to highlight transient phenomena such as the perturbations induced in the ionosphere by a geomagnetic storm.

In this paper, the application of an improved version of the EMD, the Ensemble Empirical Mode Decomposition (EEMD), on both TEC and scintillations long time series, is presented with the scope to infer the relationship between the physical processes ruling the morphology of the high latitudes ionosphere and the amplitude and phase scintillations on GNSS signals. The knowledge of such relationship is necessary in view of a long term forecasting of the disruptive effects of the ionosphere on the L-band signals affecting the applications based on GNSS such as precise positioning and navigation.

References


2. Piersanti, M., Cesaroni C., Spogli L., Alberti T., Does TEC react to a sudden impulse whole? The 2015 Saint Patrick’s day Storm event. Accepted for publication on Advances in Space Research. doi: 10.1016/j.asr.2017.01.021