



## The use of GNSS signals for Space Weather monitoring and prediction

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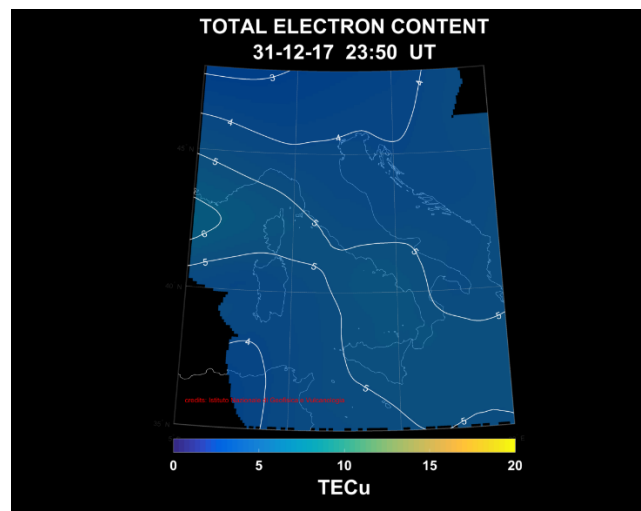
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When passing through the ionosphere, the L-band signals transmitted from the GNSS (Global Navigation Satellite Systems) constellations are delayed because of the presence of free electrons. Additionally, when they encounter regions of inhomogeneous distribution of the plasma (ionospheric irregularities), they can be also refracted and reflected. At ground, it results into fluctuations on the amplitude and on the phase of the received signals, known as scintillations.

The Istituto Nazionale di Geofisica e Vulcanologia (INGV) is responsible for the systematic upper atmosphere monitoring in Italy, polar regions, and in other sites at low and mid-latitudes. Observations are performed by means of permanent ionospheric and scintillation observatories. INGV monitors the ionospheric scintillations and the Total Electron Content by specific GNSS (GPS, GLONASS, Galileo) receivers located in Svalbard Islands (Arctic), in Antarctica, in Argentina, in Brazil and in the Mediterranean area. Such large amount of Space Weather – related data are managed and made available by means of dedicated ICT infrastructures, accessible to the scientific and user community through the web.

The data are used to learn more about the upper atmosphere physics and to develop space weather tools capable to nowcast and forecast the ionospheric disturbances that jeopardize the GNSS-band based operations. Being the ionosphere the major natural contributor to the positioning errors and as the high demand of positioning accuracy for a variety of different applications, the understanding of the physical mechanisms causing the degradation is becoming more and more necessary.

Thanks to the collection of data spanning two solar cycles and to the scientific and technological skills matured in the last 15 years, the INGV researchers are successfully contributing to the assessment of a scintillation climatology, to the detection of significant ionospheric weather events and to the development of scintillations and TEC nowcasting and forecasting tools.



**Figure 1.** Ionospheric Total Electron Content (TEC) map derived from INGV RING (Rete Integrata Nazionale GPS) data