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Climatology of low latitude F-region irregularities using GPS radio occultation data

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Since the presence of electrons in the upper atmosphere affects radio waves, GNSS signals which operate at radio frequencies result in weak signal strength at reception. Such affected signals can be associated with the Signal-to-Noise (SNR) to study disturbances which are caused by irregularities in the Earth's ionosphere.

For this study we use data obtained by the GPS radio occultation method, a satellite-satellite remote sensing technique. The general idea of this method is to track the GPS radio signal, as it passes through the Earth's atmosphere crossing Earth's limb. This weather independent method provides global coverage, high accuracy and a high vertical resolution. Due to the refraction of the GPS electromagnetic waves induced by electron density gradients in ionospheric altitudes, the GPS signals contain information on current ionospheric conditions.

The study mainly focuses on providing a climatology of disturbances at low latitude region of the ionosphere taking into account the measurements obtained from FORMOSAT-3/COSMIC (2006-2013). We use GPS L1 profiles tracked in 1Hz mode which scans the Earth's atmosphere with an altitude resolution of 2km. Strong SNR fluctuations are referred to vertical changes in the electron density. The six FORMOSAT-3/COSMIC satellites provide in total about 2,000 radio occultation profiles per day on an average. About 5 millions of profiles were processed for this study, of which 0.16% contain strong disturbances in the ionospheric F-region. We observed that the F-region irregularity phenomenon occurs mainly at night time close to the Earth's magnetic equator during years with high solar activity. Distinctive seasonal variations can be seen from such investigations when analyzed for different years of data. This phenomenon is traditionally explained as a consequence of plasma instability.