

Investigating Ionospheric F-Layer Irregularities through Multi-Source data

The rapid growth of space-based applications and the space industry requires closer examination of ionospheric irregularities that affect radio signal propagation used for satellite telecommunications and navigation. This research will focus on large-to-small scale plasma irregularities occurring in the ionospheric F-layer. This PhD research aims to study the occurrence climatology, physical origins, and variability of these irregularities by integrating multiple observational techniques, including ground-based GNSS stations, GNSS radio occultation, ionosonde measurements, and geomagnetic data from space missions such as Swarm.

A central objective is to characterize their driving mechanisms, both internal (e.g., atmospheric dynamics) and external by solar activity. The research will also examine coupling processes between different atmospheric layers in order to characterize how the different drivers lead to variations in the electron density. The potential of Artificial Intelligence techniques for automated detection and classification of different irregularity types will also be explored.

By combining and comparing diverse datasets and methodologies, this work seeks to advance the understanding of ionospheric irregularities, their drivers, and their implications for the performance and reliability of satellite-based communication systems.

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