Exploration on the Impact of Solar Variabilities on TID Occurrence Characteristics using Ionospheric Tilt Measurements (ExSoTIDs)

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Traveling ionospheric disturbances (TIDs) are wave-like perturbations in plasma density that can be broadly classified into two categories: 1) Large-Scale TIDs (LSTIDs) and 2) Medium-Scale TIDs (MSTIDs). LSTIDs are frequently observed during disturbed geomagnetic conditions, while MSTIDs arise from various sources, including severe tropospheric convection, jet streams, earthquakes, tsunamis, E-F region coupling, and geomagnetic disturbances. This variety of sources makes forecasting MSTIDs a complex task. Additionally, the occurrence and propagation characteristics of MSTIDs vary depending on the time of day, location, season, and levels of solar activity. However, the relationship between solar activity and MSTIDs in the European sector has not been thoroughly explored.

MSTIDs can lead to significant ionospheric plasma density gradients, which are particularly important for High Frequency (HF) geolocation applications. In these applications, angles of arrival (AoAs) are utilized to determine target positions, making it crucial to understand the presence of these gradients for accurate target localization. To develop a more effective forecasting model, it is essential to quantify the characteristics of MSTIDs. Simultaneous multi-instrument observations, spanning from the troposphere to the ionosphere, will greatly aid in this effort. Recent studies have shown that measuring ionospheric tilt using the DSP-4 ionosonde is an effective method for investigating TIDs. Consequently, this presentation aims to details the impact of solar variability on the occurrence and propagation characteristics of TIDs through ionospheric tilt measurements and model simulations.