Identification of travelling ionospheric disturbances with HF and GNSS experiments

Travelling Ionospheric Disturbances (TIDs) are the ionospheric manifestation of atmospheric gravity waves (AGW) in the neutral atmosphere. TIDs constitute an important Space Weather effect in the upper atmosphere driven by the near-Earth space dynamics and by lower atmosphere phenomena. Independent of their source, TIDs can impose significant disturbances in the electron density, and Doppler frequency shifts on High Frequency (HF) signals, affecting all technologies using predictable ionospheric characteristics. Recently it is clearly demonstrated that TIDs can have multiple effects in the operation of aerospatial and ground-based infrastructures and especially in the European Geostationary Navigation Overlay Service (EGNOS) and Network Real-Time Kinematic (N-RTK) services, in HF communications, in radio reconnaissance operations and in Very High Frequency – Ultra High Frequency (VHF – UHF) radiowave propagation. The newly funded EC Horizon 2020 Project TechTIDE has the objective to design and test new viable TID impact mitigation strategies for the technologies affected. For this purpose, it is primarily required to develop a system able to calculate in real-time the main TID characteristics (velocity, amplitude, propagation direction) and to realistically specify background ionospheric conditions. The talk reviews on several methodologies for the identification and tracking of TIDs and reports on results obtained from HF experiments and from GNSS TEC analysis techniques. The analysis focuses primarily on periods of enhanced auroral activity and on perturbations in the amplitude of the electron density and on the specification of the TID propagation direction. It is expected however to constitute the framework of additional validation studies that are under implementation for the needs of the TechTIDE EC H2020 project, which will cover TID activity periods of both auroral and lower atmosphere triggering sources.