Ideas and plans for ISWAT clusters focused on ionosphere variability and impact on communications and navigation

The ionospheric variability is the result of major processes that occur within the coupled atmosphere-ionosphere-magnetosphere system.

Short-wavelength solar radiation, magnetospheric energetic particles, and magnetospheric convection are the key drivers that trigger enhancement of the ionospheric conductance at high latitudes and modify the electrical currents that flow between the ionosphere and magnetosphere. These injections of energy drive a global thermospheric circulation, exciting a spectrum of waves that redistribute energy both locally and globally. Planetary waves, tides, and gravity waves from the lower atmosphere propagate upwards, deposit momentum into the mean circulation, and generate electric fields via the dynamo mechanism in the lower ionosphere. Neutral winds and electric fields from these combined sources redistribute plasma over local, regional, and global scales and sometimes create conditions for instability and production of smaller-scale structures in neutral and plasma components of the system.

The resulting large scale ionospheric effects, travelling ionospheric disturbances, scintillations and bubbles constitute a threat for operational systems using predictable ionospheric characteristics, such as GNSS, SBAS, HF communications, geolocation systems and for scientific observations such as the radio astronomy. Because of the strong local time and latitudinal character of the perturbations, the development of a global monitoring and prediction system for all scales of ionospheric disturbances is extremely challenging.

This requires, at first, continuous improvements in the models' prediction capability to match users' requirements. Another major challenge is the users' awareness. This must be primarily addressed through the setup of a Research-to-Operations (R2O) validation framework which is the main mission of the CCMC at NASA and it is also attempted in the framework of the ESA SSA SWE programme for the European assets. Another important activity, which is implemented for the needs of the EC H2020 TechTIDE project, is the specification of the impacts with one-to-one correspondence between the type of ionospheric phenomena and the imposed perturbations in each affected system. This is attempted through the establishment of an open dialogue with the users that can lead to a database of effects, and through joint actions between scientists and users for the developments of mitigation technologies.

The talk reviews ongoing efforts worldwide and provide recommendations for teaming and collaboration activities.