Since the ionosphere impacts communication and navigation applications relying on radio signal transmission, accurate monitoring and forecasting of the ionosphere is of great importance. For this purpose, physics based modelling of the coupled thermosphere – ionosphere (TI) system is rather important, because good forecast of ionospheric variability especially during storms need to consider the various physical driving processes in the thermosphere and ionosphere.

One of the state of the art numerical models is the Coupled Thermosphere Ionosphere Plasmasphere electrodynamics (CTIPe) model. Recent developments improved the capabilities of reproducing Ti conditions during storms. These capabilities will be demonstrated based on comparison of CTIPe results during the St. Patrick’s Day storm on 17 March 2015 with ground and space based observations. We use SWARM measurements, ionosondes and GNSS based TEC estimations.

CTIPe is a global non linear physics based model that solves the equations of momentum, energy and composition for neutral and ionized atmosphere. It uses as inputs: ACE measurements, TIROS/NOAA auroral precipitation, solar UV, EUV, electric field [Weimer, 2005] model and the WAM for the lower atmosphere.

Maps of ionosphere’s Total Electron Content (TEC) in near real time derived from GNSS measurements, are a powerful tool for detecting ionospheric storms and monitoring their behavior. TEC can be calculated integrating the electron density N_e along a ray path Δs, and measured in TEC units (1 TECU = 10^{16} e^-/m^2).

CTIPe will serve as a background model for a new assimilation scheme named Thermosphere Ionosphere Data Assimilation (TIDA). This new scheme is based on an Ensemble Kalman Filter approach as required by the strongly forced nature of the modeled system. The first step has been done assimilating neutral mass density from SWARM.

CTIPe can reproduce the ionospheric disturbances produced by the 2015 St. Patrick day geomagnetic storm as well as its thermospheric drivers.

TEC derived from GNSS shows very good agreement with the model. However foF2 critical frequency and maximum hI layer from ionosonde data show latitudinal dependency with the CTIPe model results.

Next step in the study of Ti dynamics during storm conditions will be done using a new assimilation scheme TIDA based on and Ensemble Kalman Filter.

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Conclusion:

- CTIPe can reproduce the ionospheric disturbances produced by the 2015 St. Patrick day geomagnetic storm as well as its thermospheric drivers.
- Neutral mass density derived from SWARM satellite in comparison with CTIPe results indicates that the thermospheric storm conditions are correctly characterized by the CTIPe model.
- TEC derived from GNSS shows very good agreement with the model. However foF2 critical frequency and maximum hI layer from ionosonde data show latitudinal dependency with the CTIPe model results.
- Next step in the study of Ti dynamics during storm conditions will be done using a new assimilation scheme TIDA based on and Ensemble Kalman Filter.