Development of an operational prototype for the determination of the thermospheric density on the basis of a coupled thermosphere-ionosphere model

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Operational activities at GSSAC focus on the collision and the re-entry of objects such as Low-Earth-Orbiting (LEO) satellites and space debris. With respect to the determination and propagation of the trajectories of LEO objects, the thermospheric drag is the most important deceleration effect. Today, predictions of thermospheric drag are usually derived from thermospheric neutral densities which can be extracted from empirical models such as the Jacchia-Bowman model JB2008, the COSPAR International Reference Atmosphere model CIRA86 or the Drag Temperature Model DTM2013. These models are driven by globally defined space weather parameters such as the F10.7 (reflecting solar activity) and the Kp (reflecting magnetic activity) indices.

It is known that these empirical models provide rather different densities, in particular during stronger space weather events. For a better understanding and modelling of the thermospheric drag, an improved knowledge of the highly variable external driving parameters is required. It is our hypothesis that considering processes in the coupled thermosphere-ionosphere (TI) system, which describe the interaction of the neutral density of the thermosphere with the electron density of the ionosphere, will aid in improving density simulations.

The goal of our project is the representation of the thermospheric density as a function of the ionospheric electron density considering the TI processes. Recently, it was verified that solar events influence both satellite accelerometer measurements and measurements of the Total Electron Content (TEC) of the ionosphere. Consequently, we expect that both measurement types should be correlated with space weather events. Along this line, an empirical model of the thermospheric drag as a function of the electron density, including a prediction part for operational use, will be developed.

In this contribution we will present the main objectives, the project structure and some preliminary results of the project.