Coupled Magnetosphere-Ionosphere-Thermosphere (M-I-T) Dynamics at High-Latitudes and its Modelling with the UAM Model

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The upper atmosphere significantly depends on the highly variable solar wind conditions. Beside of the dynamic pressure of the supersonic solar wind past the magnetosphere, the strength and orientation of the interplanetary magnetic field (IMF) plays a particular important role. The IMF interactions with the magnetosphere via reconnection processes are the main driving forces for the global-scale magnetospheric convection and field-aligned current (FAC) system, which transmits the energy and momentum input of the solar wind to the high-latitude ionosphere-thermosphere. The dynamics of this coupled system has been modeled by use of the first-principle, time-dependent, and fully self-consistent numerical global Upper Atmosphere Model (UAM) for a series of intervals during different seasons and various solar wind and IMF conditions. In the present study, we use the recently developed high-resolution empirical FAC model MFACE, which is based on ten years of CHAMP observations and describes the FAC distribution in dependence of the IMF parameters.

To quantify the quality of the theoretical model prediction, we compared the simulation results with CHAMP satellite observations and with other empirical models as, e.g., the NRLMSISE-00 and HWM07 models. The results show a good agreement with satellite observations. Both the theoretical model and the empirical models reveal a similar statistical performance in terms of mean-square deviations, i.e., they describe the statistical average background level quite well. The theoretical model, however, reproduces furthermore some characteristics of meso-scale structures as, e.g., the vortices of neutral wind pattern of the upper atmosphere at high latitudes.

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