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Using the field-aligned current model (MFACE) to model the M-I-T dynamics with the UAM model

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The upper atmosphere significantly depends on the highly variable solar wind conditions, in particular on changes of the strength and orientation of the Interplanetary Magnetic Field (IMF). The distribution of magnetospheric Field Aligned Currents (FAC) is the most important external driver for the complex system of the Earth's environment, in particular the high-latitude ionosphere and thermosphere. The FAC distribution is closely related to the magnetospheric electric field distribution, which maps into the ionosphere. The ion drag together with energy deposition via Joule heating and particle precipitations drive the neutral upper atmosphere variations. All of those processes are parts of the Magnetosphere – Ionosphere – Thermosphere (MIT) dynamic system.
The aim of this study is to test the recently developed empirical model of the Field-Aligned Currents MFACE. For this purpose the current distributions calculated with MFACE model were used as input of the time-dependent, fully self-consistent global Upper Atmosphere Model (UAM) for different seasons and various solar wind and IMF conditions.
To quantify the quality of the theoretical model prediction the simulation results were compared with satellite observations and other models. The direct comparison with the CHAMP accelerometer measurements was done for the thermospheric wind data and the neutral mass density. A statistical analysis was performed for differences between the UAM, NRLMSISE-00, HWM07 models and the CHAMP data.
The theoretical model shows a similar behavior as the empirical models. The new configuration of the UAM model reproduces realistic parameters and the M-I-T dynamics of the upper atmosphere for the Northern and Southern Hemispheres during stable IMF orientation as well as during dynamic situations. This variant of the UAM can be therefore used for space weather predictions.