Geophysical Research Abstracts
Vol. 21, EGU2019-16983, 2019
EGU General Assembly 2019

Coupled modelling of the atmosphere/ionosphere system with the whole atmosphere model EAGLE

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With a rising knowledge about atmospheric sciences related to progress, both, in measurements and models, it became clear that interrelation between the upper (>80 km) and the lower (<80 km) atmospheric layers is important and needs to be addressed explicitly. We present a step in this direction with a focus on the ionosphere by showing the results from the new Entire Atmosphere Global Model (EAGLE) that combines Chemistry-Climate model (CCM) HAMMONIA and Global Self-Consistent Model of the Thermosphere, Ionosphere and Protonosphere (GSM TIP). The model allows calculating the atmospheric state from the ground to 15 radii of the Earth including ionosphere and plasmasphere interactively simulating the main physical, radiative, chemical, and dynamical processes in the lower, middle and upper atmosphere. The model treats thermodynamic interaction of charged and neutral components of photochemical ionospheric processes and excitation of the dynamo-electric field under the influence of the tidal winds. It also includes production of nitric oxides from energetic electron precipitation in the thermosphere, and can realistically describe the electric field distribution and other parameters of the ionosphere close to the geomagnetic equator. The vertical model domain starts from the ground, which allows studying the lower atmosphere influence on the thermosphere/ionosphere system. In this study, we discuss the development of EAGLE, its performance under different conditions, and its ability to represent reaction of the upper atmosphere to different atmospheric phenomena like sudden stratospheric warmings and solar proton events.

This investigation was performed with the financial support of the Russian Science Foundation grant №17-17-01060.