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Development of a high-resolution whole atmosphere-ionosphere coupled model

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Geospace is a highly complex system, consisting of the solar wind, the magnetosphere, the ionosphere, and the neutral atmosphere. In particular, the magnetosphere, the ionosphere, and the neutral atmosphere are strongly coupled with each other, and interaction between the regions is nonlinear and extremely complicated. Furthermore, the upper atmospheric environment is significantly affected not only by electromagnetic energy and particles from the sun, but also by various kinds of atmospheric waves from the lower atmosphere. In order to quantitatively understand such a complicated system, it is necessary to model the entire region by including all fundamental processes self-consistently. A number of numerical models of geospace have been constructed and used to study space weather disturbances in many institutions in the world. We have developed an atmosphere-ionosphere coupled model, which includes the whole neutral atmosphere and the ionosphere. The model is called GAIA (Ground-to-topside model of Atmosphere and Ionosphere for Aeronomy). Using GAIA, some unsolved phenomena in the upper atmosphere have been reproduced and studied. The model will be a useful tool for space weather research and forecast. Based on GAIA, we are developing a more realistic atmosphere-ionosphere model with higher spatial resolution and more physical processes. We will report previous results obtained by GAIA, and a plan for the next-generation model.

Keywords: model, atmosphere, ionosphere, coupling, space weather, geospace