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Development of Japan's magnetosphere-ionosphere-atmosphere coupled model

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The solar-terrestrial system consists of the solar atmosphere, the interplanetary space, the earth's magnetosphere, the ionosphere, and the neutral atmosphere. Those regions have different physical characteristics and phenomena with different temporal and spatial scales. 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. Even within each region, there are strong interactions between physical processes with different temporal and spatial scales. Furthermore, the geospace environment significantly varies as electromagnetic energy and particles from the sun vary. In order to quantitatively understand the solar-terrestrial environment, it is necessary to model the sun-earth system by including fundamental processes self-consistently. Although many kinds of global numerical models of the geospace have been constructed and used to study geospace disturbances, most of them focus on the effects of the solar origin. However, recent observations have indicated that atmospheric waves generated in the lower atmosphere significantly influence the upper atmosphere, the ionosphere, and possibly the magnetosphere of the earth. In order to quantitatively study the effects of the magnetosphere and the lower atmosphere on the ionosphere, we have developed an ionosphere-atmosphere coupled model, which includes the whole atmosphere and ionospheric dynamo processes. It is planned that the model is coupled with a magnetosphere model developed by Tanaka and co-workers, which eventually leads to an integrated simulation model of the solar-terrestrial system. We will report the status and future plan of our magnetosphere-ionosphere-atmosphere coupled model.

Keywords: ionosphere, atmosphere, coupling, model, simulation, solar-terrestrial system