ionospheric day-to-day and longitudinal variations studied with an atmosphere-ionosphere coupled model

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Recent observations and numerical simulations have revealed that energy inputs from the lower atmosphere and the magnetosphere cause spatial and temporal variations of the upper atmosphere. During geomagnetically disturbed periods, the observed behaviors of ionospheric storms differ event by event, which potentially suggests complex effects of storm drivers, such as disturbed thermospheric circulation and composition, disturbed global ionospheric current system, and penetration of magnetospheric convection electric field, sometimes operating simultaneously and interacting mutually. Even during the quiet periods, large variability of equatorial ionospheric anomaly is observed, probably associated with atmospheric waves in the thermosphere and their dynamo process. Recent studies have also suggested that the longitudinal variation of equatorial ionization anomaly is affected by atmospheric waves excited in the troposphere and propagating upward.

In order to investigate the regional coupling processes and the interaction between the neutral and ionized atmospheres, we are developing an atmosphere-ionosphere coupled model, by coupling together several independent models (a whole atmospheric GCM, an ionospheric model, and an electrodynamics model). We are also introducing an IGRF-based coordinate system in order to get more accurate solution of electric potential distribution.

In this paper, we present several results of the first version of coupled model, including day-to-day and longitudinal variations of equatorial ionospheric anomaly, and discuss their relation to the atmospheric waves excited in the lower atmosphere. We also introduce future direction of the atmosphere-ionosphere coupled model.