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Mechanism of Ionospheric Day-to-day Variation Studied with an Atmosphere-Ionosphere Coupled Model

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Other than regular variations due to solar activity cycle and season, and perturbations during magnetic storms, ionosphere also behaves irregularly on the day-to-day basis. Day-to-day variation of ionospheric electron density is known to become a primary error factor for satellite positioning system. Occurrence of equatorial plasma bubble, which causes scintillation and sometimes lock-off of satellite-ground radio propagation, also varies on day-to-day. In this way, study of ionospheric day-to-day variations and their prediction are one of the most important targets for space weather research. In addition, recent observations and numerical simulations have revealed relation between the day-to-day variations of upper atmosphere and lower meteorological phenomena, which has now become one of the frontier researches for the upper atmospheric physics.

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). The model can reproduce day-to-day variations of upper atmosphere, including equatorial ionospheric anomaly. In this paper, we discuss the mechanisms of the ionospheric day-to-day variations. We also compare our results with other ionospheric simulation (SAMI2), and with ionospheric observations to discuss the limitation of present model and direction of future improvement.

Keywords: ionosphere, thermosphere, lower atmosphere, atmosphere-ionosphere coupling, simulation, space weather