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A Realistic Whole Atmosphere-Ionosphere Modeling and Collaboration with Observations

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There has been an increasing number of collaboration between modeling and observation for the study of upper atmospheric variability and its relation to the lower atmosphere. Observations are used as the forcing inputs to models as well as for their validation. Outputs from models can be useful for the interpretation of observed phenomena owing to their sufficient spatial and temporal coverage, especially for the analysis of phenomena whose effects extend beyond the several atmospheric layers. Recently, we have examined the effects of a prominent stratospheric sudden warming (SSW) in January 2009 on the upper atmospheric variability, by using a whole atmosphere-ionosphere coupled model called GAIA. The model used the meteorological reanalysis data as realistic lower atmospheric forcing, and we compared the model outputs with the satellite observations of upper atmosphere [Jin et al., 2012; Liu et al., 2012]. The comparison suggests that the model can reproduce the overall major features of the observed perturbed variations in the upper atmosphere during the SSW period, which ensures the usage of model output for the detail analysis of vertical coupling mechanism during the event.

In this study, we applied the same method for the inclusion of realistic lower atmospheric forcing and carried out a whole atmosphere-ionosphere simulation for longer period. We will show the relation of ionospheric variability to the climatological and irregular variations in the lower atmosphere including several SSW events. Initial results from data assimilation experiment will also be shown as an example of model-observation collaboration.

Keywords: ionosphere, thermosphere, atmospheric vertical coupling, simulation, data assimilation, space weather