MODELING THE COUPLED THERMOSPHERE-IONOSPHERE SYSTEM RESPONSE TO EXTERNAL FORCING

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For the purpose of understanding the response of the coupled thermosphere-ionosphere (T-I) system to magnetic activity, first-principles models of the T-I system, such as Coupled Thermosphere Ionosphere Plasmasphere electrodynamics (CTIPe) model, have been continuously improved and have undergone extensive validation against various types of observations. Recent comparison demonstrates that the CTIPe model can reasonably capture the neutral density variations for both the quiet and magnetically disturbed conditions obtained from the CHAMP observations. The study indicates that the energy budget in the T-I system described in the model is consistent with uncertainties in empirical or physics-based estimates, although quantification of the precise external forcing from the solar and geomagnetic sources still remains one of the major challenges towards accurate prediction and short-term forecast of neutral density, for satellite drag and other space weather applications. An effort has also been underway to coupling the magnetosphere and T-I models towards an improved understanding of the electrodynamic and mass coupling processes between the magnetosphere and T-I system. Modeling the response of the global ionospheric electric field to magnetic activity is one such example. The storm time electric fields can be reproduced in reasonable agreement with observations, by including into the models, the externally applied potentials by the prompt penetration process as well as the internally generated electric potentials by the disturbance dynamo process. The approach of self-consistent coupling allows study of the feedback of the T-I system to the magnetosphere, such as represented by the fly wheel effect. With an anticipation of more sophisticated measurements of the electromagnetic pointing vector from the upcoming SWARM mission, together with the ionospheric electric and magnetic fields, we will attempt to suggest some ideas how the mission could help the future modeling effort to address some outstanding issues such as the energy flow from the magnetosphere to T-I system and the response of the dynamics and energetics in the T-I system.

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