

Topic: Plasma Neutral Gas Coupling

Project Title:

Investigation of Ion-neutral coupling processes in the equatorial F-region

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Project Information:

The influence of the lower thermosphere through the E-region dynamo on the equatorial ionosphere anomaly (EIA) has been widely studied; however the direct coupling between the neutral gas and ionized plasma in the equatorial F-region has not been well addressed. Recent observations of thermosphere mass density have revealed new features of the equatorial thermosphere anomaly (ETA) which have not been investigated. We propose to investigate ion-neutral coupling processes in the equatorial F region. This proposed work will use thermosphere observations from CHAMP and GRACE satellites, ionospheric datasets from CHAMP and COSMIC satellites and ground-based GPS observations. These observations of the ionosphere and thermosphere are used to investigate the variations of equatorial anomalies in both the ETA and EIA, and their interactions. The similarities and differences between the ETA and the EIA will be established under various geophysical conditions, providing important insight to the physical connections of this ion-neutral coupling problem. Observations will be combined with a state-of-the-art self-consistent coupled thermosphere-ionosphere general circulation model, NCAR-TIMEGCM to understand the fundamental physical and chemical ion-neutral processes in the equatorial F region. Specifically, we will address the following outstanding scientific questions: (1) What are the main mechanism(s) for the ETA formation, and why do the locations of the crests in the ETA and the EIA differ in latitude? (2) What are the causes of the differences in longitudinal variations between the ETA and the EIA? (3) How does geomagnetic activity modulate the coupling between the ETA and the EIA? (4) Why are the variations in the ETA dependent on solar activity, and how does solar activity modulate the coupling between the ETA and the EIA? The proposed work directly addresses the NASA LWS TR&T strategic goal focused science topic: Plasma-Neutral Gas Coupling. In addition, the simultaneous measurements of the equatorial anomalies in the thermosphere and ionosphere can provide a new way, in which the state-of-the-art NCAR-TIMEGCM can be tested, validated, and improved; a critical effort towards the LWS TR&T's goal of bringing closure between observations and models.

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