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Editorial: Advances in mesosphere and thermosphere dynamics

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Editorial on the Research Topic
Advances in mesosphere and thermosphere dynamics

The mesosphere-thermosphere is a coupled system that is affected by both lower atmospheric and magnetospheric forcings. Various atmospheric waves in the troposphere can reach this region in the course of propagation that control and modify the ambient dynamics. Large-scale middle atmospheric disturbances, such as sudden stratospheric warming, have a mighty impact on the overlying mesosphere-thermosphere system through dynamical coupling. The geomagnetic disturbances driven by strong solar activities can significantly impact the precipitation of energetic charge particles in the ionosphere, causing heating and associated alterations in the circulation pattern therein. Owing to the complexities of physical processes and lack of investigation, various observed features are not completely understood and require extensive multi-platform and multi-instrument observations as well as modeling studies. A clear understanding of this coupled region is essential to delineate a broader perspective of the Sun–Earth interactions.

Atmospheric waves excited in the lower atmosphere cause significant changes in the dynamics of the middle and upper atmosphere by transporting and depositing energy therein. Gravity waves act as a seeding agent to cause ionospheric irregularities, such as equatorial spread F, plasma bubbles, and various kinds of plasma instabilities in the ionosphere. Due to breaking of these waves in the mesosphere, secondary wave generation take place which propagate upward and impact the ionospheric electrodynamics. Tides are important agents that cause ionospheric E-region dynamo and determine the preferential wind direction. Planetary waves are responsible for global-scale disturbances that affect the mesospheric thermal structure and ionospheric processes. Small-, medium-, and large-scale traveling ionospheric disturbances (TID) are complex outcomes of waves and instabilities. In addition to the lower atmospheric forcings, geomagnetic storms due to solar active conditions can affect the magnetosphere-ionosphere system, notably through energetic charge particle precipitation. The present Research Topic focuses on the neutral and electrodynamical mesosphere-thermosphere processes. It invited original articles utilizing ground and space-based observations and model/simulation studies.

The present Research Topic includes five articles related to atmospheric discharge, ionospheric electrodynamics, and mesosphere and lower thermosphere (MLT) dynamics.

The study by Abdelaal et al. presents experimental results on the electromagnetic signatures of atmospheric discharges, including the breakdown and interactions of charged dust particles. It provides insights into distinctive electromagnetic processes in connection with atmospheric discharge. Santos et al. investigated the climatology of the impact of solar tides on the ionospheric F2 parameters during solar minimum over American sectors. They report latitudinal and seasonal variability of the ionospheric parameters. Features of annual and semiannual oscillation in the ionosphere were found. Sathishkumar et al. investigated the impact of the sudden stratospheric warming on the low latitude MLT dynamics in terms of gravity waves, planetary waves, and wave-mean flow interactions coupled with the Coriolis force. Zhang et al. present their results on the double peak sub-auroral ion drift (DSAID) carried out with a statistical approach. They report that the DSAID could be associated with double peak as well as single peak ion upflow.

The guest editors are thankful to all authors for submitting their valuable work to this Research Topic. Thanks are due to the reviewers for their valuable time and effort in reviewing the manuscripts. We sincerely hope that the present Research Topic has illuminated the complex mesosphere and thermosphere processes to improve our current understanding of this Research Topic.

Author contributions

AG: writing–original draft, writing–review and editing. SS: writing–review and editing. IP: writing–review and editing.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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