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Emerging Topics in Ionospheric Space Weather

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The combination of the thermosphere-ionosphere is now widely recognized as a deeply coupled piece of the Sun-Earth system as it plays a critical role in moderating energy flow from the solar wind into the Earth's atmosphere. In simple terms, thermospheric densities and winds set the stage against which ionospheric conductance is built, thus providing a controlling stake in the location and strength of the ionospheric "resistive load" on the magnetosphere-ionosphere-thermosphere (M-I-T) coupled circuit. In the context of space weather, or the impact of these physical processes on human technological systems, the M-I-T relationship must be re-evaluated to illuminate its role in signal scintillation, ground magnetic disturbances, and more. As our understanding of the magnetosphere-ionosphere-thermosphere system grows, new ways in which the ionosphere-thermosphere moderates space weather effects are identified.

This talk discusses emerging topics in ionospheric space weather. This includes the ionosphere's role in producing localized (~200km) spikes in the surface geoelectric field. The thermospheric contribution to localized spikes will also be explored, including the contribution of the neutral dynamo. It remains unknown how these effects compare to other sources of small-scale magnetic disturbances, such as solar wind turbulence or the effect of structures in ground conductivity. The growing topic of interhemispheric asymmetries and their relevance to space weather effects will also be discussed. Straight-forward asymmetries driven by seasonal and diurnal variations affect which latitudes and regions are most vulnerable to a solar storm; asymmetries driven by east-west interplanetary magnetic fields, asymmetric interhemispheric plasma and neutral conditions, and other sources further complicate our ability to understand and predict space weather. Finally, these topics will be placed in global context to see how they affect the global state of the M-I-T system. Examples will be illustrated with observations and first-principles-based modeling results.