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Satellite-Based Studies of Ionospheric Dynamics and Space Weather

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Space weather, taken here to mean the effects of the geospace environment on humans and technological systems, encompasses many different phenomena originating throughout near-Earth space. This talk will address the space-weather significance of the ionosphere, especially pertaining to navigation and communication systems. Receivers are sensitive to the integrated effects of the ionosphere along the propagation path, making it difficult to relate specific irregularities measured in situ to signal fluctuations on the ground for example. This is especially true since most satellites orbit well above the F region peak, and therefore above the bulk of the ionospheric plasma. Nevertheless it is clear that radio scintillations observed on the ground correlate well with density fluctuations measured in the topside ionosphere in the range 400-800 km. Furthermore, receivers on satellites, including Swarm orbiting between 400-510 km, regularly detect strong scintillation and loss of lock, demonstrating that even the rarefied topside ionosphere is dense and structured enough to affect space weather. This talk will review recent satellite-based studies of ionospheric irregularities and their space-weather consequences, along with a summary of outstanding challenges in identifying the physical mechanisms responsible for space weather phenomena.