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Characteristics of Nighttime Medium-scale Traveling Ionospheric Disturbances: Longitudinal Comparison of their Seasonal and Local Time Variations

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This study presents a statistical analysis of the occurrence rate of midlatitude nighttime medium scale traveling ionospheric disturbances (MSTIDs) that were detected in Swarm plasma density measurements from 2014 to 2023. Monthly and local time variations of MSTID occurrence rates are compared in four longitude sectors: America, Africa, Asia, and Pacific. The spatial distribution showed a longitudinal variation as the MSTIDs were abundant in the Pacific region and scarce in the African sector. While the MSTIDs had occurrence peaks during both solstices, the winter solstice peak dominated in all longitude sectors, representing a seasonal asymmetry. The local time variation of the MSTIDs revealed they occur predominantly during the postmidnight hours in all longitude sectors. However, post-sunset MSTIDs observations were enhanced over the Asian and Pacific sectors during the solstices. The longitudinal variation in the occurrence of MSTIDs is probably linked to the E–F coupling as it matched that of the nighttime sporadic E variation obtained from ionosonde measurements. While the semiannual seasonal variation may be explained by interhemispheric E–F coupling, the winter dominance of MSTIDs matches that of gravity wave activity. This indicates that gravity waves probably play a major role in seeding the MSTIDs observed in this study. Theoretical assessments of the longitudinal variations of MSTID driving mechanisms are needed to better understand the seasonal asymmetry and how it is affected by solar activity.

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