Long-Term Observation of Medium-Scale Traveling Ionospheric Disturbances Using GPS Receivers in Japan

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Medium-scale traveling ionospheric disturbance (MSTID) is a phenomenon of the plasma density perturbations in the F region. Using total electron content (TEC) data obtained from a GPS receiver network in Japan, two-dimensional structures of MSTIDs have been revealed in the maps of TEC perturbations obtained by subtracting 1-hour running average from the original TEC data for each satellite and receiver pair. We have found that characteristics of the MSTID in Japan are different between daytime and nighttime. The daytime MSTIDs frequently appear in winter, and most of them propagate southward or south-southeastward. These characteristics are consistent with an idea that the daytime MSTIDs are caused by atmospheric gravity waves. On the other hand, the nighttime MSTIDs frequently appear in summer, and most of them propagate southwestward. From these characteristics of the MSITDs, the nighttime MSTIDs are considered to be caused by the Perkins instability. In this study, we have analyzed the TEC data obtained from 1997 and 2017, and investigated MSTID activity, defined as dI/I, where dI is standard deviation of the TEC perturbations in an area within an area of 33.75°-37.80° N and 137.50° -141.55° E within an hour, and I is 1-hour averaged TEC. We have found that the MSITD activity during nighttime increases with decreasing solar activity. This feature is consistent with solar activity dependence of the growth rate of the Perkins instability. The MSTID activity during daytime also show anti-correlation with the solar activity although difference of the daytime MSTID activity between solar minimum and maximum is smaller than that of the nighttime MSTID activity. This result indicates that amplitude of neutral wind oscillation caused by gravity waves propagating from below into the thermosphere increases with decreasing solar activity because neutral density decreases with decreasing solar activity. In this presentation, we will investigate long-term variation of propagation velocity of MSTIDs as well as the MSTID activities to discuss mechanisms causing the MSTIDs.

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