A Study of Medium-Scale Traveling Ionospheric Disturbances Observed with a GPS Network in Europe

YUICHI OTSUKA[1], KOUKI SUZUKI[1], KAZUO SHIOKAWA[1], TAKUYA TSUGAWA[2]

[1]*STEL, Nagoya University, Japan*
[2]*NICT, Japan*

Medium-Scale Traveling Ionospheric Disturbances (MSTIDs) were studied using the Total Electron Content (TEC) data taken from approximately 600 GPS receivers in Europe. To detect TEC perturbations caused by MSTIDs, we subtracted 1-hour running average from the TEC data taken from each satellite-receiver pair. The TEC perturbations were mapped on the ionospheric shell at the 300 km altitude with a pixel of 0.15^{o}x0.15^{o} in latitude and longitude. The TEC data within each pixel were averaged and then 5x5-pixels smoothing was performed to obtain two dimensional maps of the TEC perturbation. By analyzing the two-dimensional maps of TEC perturbations over Europe, we found that the observed MSTIDs can be categorized into two groups. One group is daytime MSTIDs, which frequently occur in winter. Since most of the daytime MSTIDs propagate southward, we speculate that the daytime MSTIDs could be caused by atmospheric gravity waves in the thermosphere. Second group is nighttime MSTIDs, which also frequently occur in winter. Nighttime MSTIDs propagate southwestward. This propagation direction is consistent with the idea that polarization electric fields could play an important role in generating nighttime MSTIDs. These results were compared with MSTIDs observed in Japan and South California with GPS-TEC maps. The propagation directions of the daytime and nighttime MSTIDs in Europe are consistent with those in Japan and Southern California. In the three regions, the daytime MSTIDs frequently occur in winter. On the other hand, occurrence rate of the nighttime MSTIDs is high in winter in Europe, whereas it is high in summer in Japan and South California. This result suggests that the nighttime MSTID occurrence rate has a longitudinal dependence.

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