Statistical study of medium-scale traveling ionospheric disturbances observed with GPS networks in Japan and Southern California

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Using GPS data obtained from GPS networks in Southern California and in Japan in 2002, we investigated total electron content (TEC) variations caused by Medium-Scale Traveling Ionospheric Disturbances (MSTIDs) to reveal statistical characteristics (occurrence rate, propagation direction, horizontal wavelength, horizontal phase velocity, and amplitude) of MSTIDs. Occurrence rate of MSTIDs has tree peaks in winter daytime, summer dusk, and summer nighttime. During daytime, most of MSTIDs propagate southeastward. Ions in the F region move by the neutral particles along the geomagnetic fields (B) at the same velocity as the neutral particles through neutral-ion collisions. Since the neutral particle oscillation parallel to B is larger for gravity waves propagating southward than for gravity waves propagating to other directions, southward-propagating MSTIDs could cause larger amplitude of TEC perturbations than MSTIDs propagating in other directions. This directivity in the response of the plasma density variations to the gravity waves could be responsible for the southward preference in propagation directions of daytime MSTIDs. During nighttime, most of MSTIDs have wavefronts elongated from northwest to southeast and propagate southwestward. This result is consistent with the previous observations of the nighttime MSTIDs using GPS networks and 630-nm all-sky airglow imagers. Electric currents in the F region could flow northeastward because neutral winds blow southeastward. In the condition that the northeastward electric currents and plasma density perturbations which has wavefronts elongated from northwest to southeast, northeastward (southwestward) polarization electric fields are generated to maintain divergence free of the electric currents. These polarization electric fields move the plasma upward (downward) to cause the plasma density perturbations. Therefore, polarization electric fields are expected to play an important role in generating the nighttime MSTIDs. The dusk MSTIDs have wavefronts which is almost parallel to the sunset terminator and propagate north-northwestward at velocity of 60-120 m/s. From these features, the dusk MSTIDs is expected to be caused by gravity waves originated from the sunset terminator.