

Traveling ionospheric disturbances using GPS network

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In the earth's ionosphere, disturbances of electron density distribution with a horizontal scale of more than 1000 km occurs. This phenomenon is called Large-scale ionospheric disturbance (LSTID). The cause of disturbances is considered the acoustic gravity wave generated by Joule heating in the region of auroral electrojet or Lorentz force and so on [Hines (1960)]. Although observations of LSTIDs have been carried out by radar and GPS, the generation mechanism and propagation process from auroral region to mid latitude are not understood in detail.

To understand the generation mechanism of LSTIDs, we used map of total electron content obtained by the GPS Earth Observation Network (GEONET), and analyzed 21 events of LSTIDs propagating over Japan from 10 August 2003 to 30 November 2003.

We estimate horizontal propagation velocity and direction of the 17 events out of 21. During magnetic storms, average propagation velocity of LSTIDs is 633 m/s. In quiet geomagnetic conditions, it is 492 m/s. Average velocity of all the events is 600 m/s. 1 event propagate toward the equator. Also we estimate period of the 20 events out of 21. Average of them is 73 minutes. We examined Dst index and AE index to investigate geomagnetic activity at the time of observed LSTIDs existed. As a result, 15 LSTIDs occurred during magnetic storms, and it is confirmed that LSTIDs are mainly generated under disturbed geomagnetic condition. We estimate generation regions of LSTIDs by using start time of AE index fluctuation, propagation velocity and direction. The estimated generation regions are concentrated in polar region. This result suggests that the strong auroral electrojet generates LSTIDs.

Reference

Hines, C. O.,(1960),Internal atmospheric gravity waves at ionospheric heights, Can. J.Phys.Lett.,38,1441-1481.