Observations of traveling ionospheric disturbances associated with geomagnetic storms.

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Abstract

Traveling ionospheric disturbances (TIDs) are the ionospheric manifestation of gravity waves propagating in the neutral atmosphere. These disturbances are one of the most common ionospheric phenomena that contribute to the perturbations in ionospheric measurements such as total electron content (TEC) and frequency measurements among others. Different mechanisms are responsible for observed TIDs such as solar eclipses, solar terminator and geomagnetic storms. TIDs are classified into two main classes, namely medium scale and large scale TIDs, based on their characteristics such as period, velocity, source and spatial distribution. For instance, medium scale TIDs (MSTIDs) have periods of less than an hour and are thought to originate from a large number of sources such as seismic events and shears in the jet streams. Meanwhile, large scale TIDs (LSTIDs) have periods of over an hour and their main source are geomagnetic disturbances. Large scale TIDs normally originate at high latitude regions but during intense geomagnetic storms can propagate to mid-latitudes, low latitudes and even into the opposite hemisphere.

Although TIDs have been observed for many years and many of their characteristics have been discovered most of the studies have been conducted in the Northern Hemisphere regions largely due to data limitation in the Southern Hemisphere regions. Therefore TID observations over the Southern Hemisphere will provide additional and complementary information on the characteristics of the structures. For this goal, ionospheric features of traveling ionospheric disturbances over mid-latitude regions in the Southern Hemisphere have been observed using at least three ionosondes in South Africa during and after several geomagnetic storms in 2005, 2006, 2010 and 2011. The three ionosondes are used in order to obtain direction of propagation of the TID; as large scale TIDs have been observed to show time delays at different stations. The ionosonde observations from the 2011 geomagnetic storms are further compared to HF Doppler Radar measurements. Temporal and spatial information relating to the size, period, and velocity of the TID structures will be presented.

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