An interhemispheric survey of travelling ionospheric disturbances and their relationship to geomagnetic activity

Introduction

Travelling ionospheric disturbances (TIDs) are transient perturbations in ionospheric electron density, caused by processes such as atmospheric gravity waves, that focus and defocus SuperDARN signals producing a characteristic pattern of ground backscattered power (Samson et al., 1989, 1990).

Early studies concluded that likely sources of these disturbances correspond to ionospheric current surges (Brunt et al., 1994) in the dayside auroral zone (Huang et al., 1998a).

Subsequent studies have indicated that they can result from transient, or oscillatory perturbations in the IMF implying a direct link with solar wind driving (Huang et al., 1998b; Sofko and Huang, 2000).

If TIDs are associated with a purely magnetospheric driver then one would expect similar signatures of the IMF implying a direct link with solar wind driving (Huang et al., 1998b; Sofko and Huang, 2000).

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We focus on data from the Falkland Islands Radar (FIR), which has observed a large variety of TID signatures since its deployment in February 2010, and compare this to data from Wallops, Blackstone to the geomagnetic AE and Dst indices.

Monthly, half-monthly, and seasonal variations were available for WAL after 11 Oct 2010, when we have used BKS.

It is clear that ground scatter coverage is a major factor in whether or not conjugate TID observations are made. For example, during otherwise similar intervals, sometimes the range at which the 1 hop ground backscatter is observed changes, and at times the TIDs are apparent in both the 1 and 2 hop ground backscatter.

During this more recent interval, changes in the TID characteristics appear to precede the storm main phase, but do occur after a modest increase in Dst. A second change in TID characteristics then occurs after the main phase onset. Changes also occur in the ri-H, that are significantly different to their S-H counterparts.

Summary

This plot shows the observation statistics of TIDs in the FIR and WAL observations. No data were available for WAL after 11 Oct 2010, when we have used BKS.

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A number of avenues of further study are open to us to better understand these observations. Data from additional radars can be inspected, for example, to extend the database both in time and in space.

It is also important to perform additional analysis on the TID observations, to determine characteristics such as frequency, wavelength and phase speed, which will enable a more comprehensive categorisation and quantitative analysis.

It might also be advantageous to conduct a targeted campaign, to limit the effects of variables such as season and operating frequency.