Topic: Empirical modelling and prediction of auroral absorption during interplanetary coronal mass ejection (ICME) events.

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Abstract

Energetic particle precipitation with (>keV) energetic electrons from closed field lines and (>MeV) protons from the solar wind are responsible for enhanced high frequency radiowave absorption in the high latitude ionosphere. Measuring the propagation of radio waves through the ionosphere has been utilised for investigating particle precipitation into the upper atmosphere. Although various methods and models previously proposed for auroral and polar cap absorptions have significantly contributed to our knowledge, there are progressive efforts to improve these models as a result of improved understanding of already made assumptions, development of more efficient equipment and availability of real-time data. Mostly, statistical models have been utilised in the prediction of radio absorption. These statistical models have mostly utilised data over every time sector. However, particle precipitation during periods of specific solar events such as events of interplanetary coronal mass ejections (ICMEs) is known to be of stronger than during solar quiet and moderate periods. This study combined data from ground-based imaging riometer during (1996-2009) and ICME details from the Richardson and Cane catalogue (www.srl.catech.ACE/SRC/DATA/level3/icmetablw2.htm) for the same period to model radio absorption during periods of interplanetary coronal mass ejections. The modelled results have been compared with the imaging riometer for ionospheric studies (IRIS). The key observation shows that absorption associated with ICMEs exhibits different character depending on ICME start times. ICMEs were categorised into day time events (solar zenith of riometer station $\chi \leq 80^0$) and as night time events ($\chi \geq 100^0$). Differing absorption signatures were observed for day and night ICME events. Utilising a single geophysical parameter as the coupling coefficient for ICME absorption did not yield the desired outcome, for improved performance, pressure related terms were combined with IMF terms. This work ranked various solar wind parameters to obtain the best coupling parameter for day and night time absorption. The result indicates that, day time ICME model is based on solar wind dynamic pressure and the product of the flow speed (V) and the z-component of the IMF (Bz) (i.e.VBz) , while night time ICME model is based on Bz and the product of number density (n) and the cube of the flow speed (V^3) (i.e.nV^3). Comparison of ICME induced absorption with absorption induced by solar flares, illustrates that ICME induced absorption is seen to have longer duration (~ of hours) and stronger magnitude than those associated with solar flares (~ of minutes).