DIAGNOSIS OF MAGNETOTAIL DRIVERS FOR IONOSPHERIC ELECTRODYNAMICS USING NETWORKS OF GROUND-BASED MAGNETOMETERS

IAN MANN1, I. Jonathan Rae1, K. Murphy1, D.K. Milling1, C.T Russell2, V. Angelopoulos2

1. Dept. of Physics, University of Alberta, Edmonton, AB T6G 2G7, Canada
2. Institute of Geophysics and Planetary Physics, University of California at Los Angeles, Los Angeles, CA 90024-1567, United States

One of the most important problems in solar-terrestrial physics concerns understanding the response of the ionosphere to a variety of physical drivers from the magnetotail. In particular, determining the ionospheric response to magnetotail disturbances such as current disruptions and Earthward-directed bursty bulk flows is key to understanding the causal sequence of events during substorms. We present a series of case studies using data from combined networks of magnetometers in the Canadian sector, including those from CARISMA (www.carisma.ca) and the THEMIS ground-based observatory (GBO) network and supporting arrays, to examine the current response in the ionosphere to substorm expansion phase onset. These analyses highlight the importance of extensive magnetometer coverage in order to correctly identify and characterise the initiation and temporal dynamics of substorm-time ionospheric electrodynamics and current systems. We present details of a magnetic disturbance diagnostic which may distinguish between tail drivers. We suggest that the structure of the resulting current systems may enable these processes to be distinguished using a new set of local magnetometer derived disturbance indices. We suggest forms for these new ionospheric disturbance indices, as an extension to the traditional AE, AL and AU indices. We show how these diagnostics can provide important input into substorm studies, especially in partnership with in-situ measurements from the THEMIS probes, and contribute towards resolving the causal sequence of energy release in the substorm cycle. Finally, we reiterate the importance of understanding the limitations of the inferences made from the standard AE indices, and how they may be used (or misused) in the course of substorm diagnosis.

substorms, magnetometers, solar-terrestrial physics

Ian Mann, Dept. of Physics, University of Alberta, Edmonton, AB T6G 2G7, Canada. tel: +1 780-492-6882, fax: +1 780-492-0714, e-mail: imann@phys.ualberta.ca