Geophysical Research Abstracts
Vol. 14, EGU2012-1388, 2012
EGU General Assembly 2012

The global impacts of foreshock phenomena on Earth's magnetosphere-ionosphere system

D. L. Turner (1), V. Angelopoulos (1), D. G. Sibeck (2), M. Hartinger (1), F. Plaschke (1), A. Kellerman (1,3), J. Weygand (1), R. Michell (1,4)

(1) Dept. of Earth and Space Sciences, Univ. of California, Los Angeles, United States (dturner@igpp.ucla.edu), (2) NASA Goddard Space Flight Center, Greenbelt, USA, (3) La Trobe University, Melbourne, Australia, (4) Southwest Research Institute, San Antonio, USA

Earth's ion foreshock is characterized by suprathermal ions backstreaming into the solar wind upstream of the bow shock. These ions interact with the incident solar wind plasma producing a variety of wave activity and other kinetic phenomena. Pressure variations resulting from transient foreshock events, such as foreshock cavities (FCs), hot flow anomalies (HFAs), and the recently discovered foreshock bubbles (FBs), can propagate through the magnetosheath and impact the magnetosphere. However, we don't yet have a good quantitative understanding of just how much these impacts drive global magnetospheric activity.

Here, we present new, multipoint observations from THEMIS, GOES, Cluster, and SuperDARN during the THEMIS dayside season (July – October) of 2008. We first show examples of several types of transient kinetic events observed in the foreshock, including FCs, HFAs, and FBs. We discuss the characteristics of each with a particular emphasis on the similarities and differences between HFAs and FBs. We stress the importance of multipoint observations when classifying these two phenomena, which appear very similar from single spacecraft observations but are truly very different in a global sense.

Next, using a fortuitous alignment of spacecraft and ground facilities on Bastille Day (14 July) 2008, we demonstrate the importance of transient foreshock phenomena for driving global magnetospheric activity. During this period of interest, THEMIS-B (TH-B) and TH-C are upstream of the bowshock and spend a considerable amount of time in the ion foreshock. TH-E and -D are near apogee along the dayside magnetopause, and they observe rapid magnetopause motion in response to HFAs and FBs observed upstream by TH-B and -C. GOES and Cluster spacecraft are used to examine the effects of these transient foreshock events on compressional and ULF wave activity, both of which reveal an increase in activity during active foreshock periods. The THEMIS ground magnetometer network, which was collocated in magnetic local time with the THEMIS constellation, observed the magnetic impulse events resulting from the enhanced current systems associated with the impacts from the transient foreshock events. These enhanced current systems are also apparent in, and consistent with, the Super-DARN radar data. This period clearly demonstrates how activity in both the magnetosphere and ionosphere can be directly driven by transient kinetic phenomena generated in Earth's foreshock region upstream of the bowshock.

Finally, we present preliminary statistics of numbers and types of events observed throughout the period. This demonstrates that the results from Bastille Day were not extremely unusual. In summary, we show here how large-scale transient events occur frequently (multiple times per day on active days) in the dayside foreshock, and they can have global impacts on Earth's magnetosphere, driving significant magnetopause motion and deformation, field-aligned and ionospheric currents, and compressional and ULF waves throughout the magnetosphere.