Geophysical Research Abstracts
Vol. 14, EGU2012-447, 2012
EGU General Assembly 2012

Does High-Speed Plasma Sheet Flux Transport Contribute to Inner Magnetosphere Dipolarisation? : A Multi Year, Multi-Mission, Multi-Spacecraft, Multi-Instrument Statistical Study

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Advancement in solar-terrestrial science is more easily achieved through the use of multi-point and multi-mission measurement over single spacecraft methods. Multi-spacecraft observations can be used to address long standing questions regarding the connection between separated regions of the Earth's magnetosphere as well as help define observed phenomena with more clarity. One such long standing question relates to the relationship between widespread dipolarisation of the inner magnetosphere and the observable phenomenon of earthward fast flows in the tail plasma sheet (often termed "bursty bulk flows", or BBFs). The former is associated with the substorm expansion phase and the latter can be associated with reconnection at the near-Earth neutral line (NENL).

We used all four Cluster spacecraft, in a multi-spacecraft configuration, to detect fast flows in the magnetotail plasma sheet region. The flows were measured using a multi-instrument approach, implementing ExB drift velocity data where 3D electric field data could be reliably reconstructed from the available 2D measurements, and particle instrument data at other times. Inter-calibration was performed using statistical methods. In addition to the Cluster fast flow detections, we used both Double Star spacecraft, when available, to detect reconfiguration of the magnetic field earthwards of the position of Cluster in the plasma sheet. Moreover, we made use of the Frey & Mende (2006) substorm onset list, compiled from data collected by the IMAGE mission, to relate observations of the tail to substorm phase. These multi-mission data were gathered from the 'tail season' intervals of 2004 & 2005. This multi-year period was chosen as they were the times when the conjunctions between Cluster & Double Star were favourable in the tail and the IMAGE mission was actively observing substorm onset signatures in Earth's auroral regions.

We discuss our methods and report on progress.