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Effects of a solar wind pressure pulse in the magnetosphere and in the ionosphere

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On 17 July 2005, an earthward bound north-south oriented magnetic cloud and its sheath were observed by the Advanced Composition Explorer (ACE), the Solar and Heliospheric Observatory (SoHO), and the Wind solar wind monitors. A steplike increase of the solar wind dynamic pressure was related to the leading edge of the sheath. A timing analysis between the three spacecraft revealed that this front was not aligned with GSE y axis, but tilted by an angle of about 55° towards the x axis. Hence, the first contact with the magnetosphere occured on the dawnside rather than at the subsolar point. Fortunately, Cluster, Double Star 1, and Geotail happened to be distributed close to the magnetopause in this region, which made it possible to closely monitor the motion of the magnetopause. When the pressure pulse impacted the magnetosphere, the magnetopause was perceived first to move inward and then immediatelly correct the overshoot by slightly expanding again such that it ended up between the Cluster constellation with Double Star 1 inside the magnetosphere and Geotail in the magnetosheath. In the ionosphere, the AE index showed a relatively weak enhancement with a peak of less than 200 nT. This enhancement lasted for about 10 minutes and coincided with the inward and subsequent outward motion of the magnetopause observed by the magnetospheric spacecraft. The ground-based International Monitor for Auroral Geomagnetic Effects (IMAGE) magnetometer network was also located on the dawn side during the arrival of the pressure pulse. The 1-D equivalent currents showed a peak of eastward current in the region covered by IMAGE, where the westward electrojet generally dominates at that time. After 10 minutes, the region of weakening eastward current was divided in two by the recovering westward electrojet. The 2-D equivalent currents further revealed that while the region of eastward current expanded from the east, the recovery of the westward electrojet began from the western edge of IMAGE field-of-view. We suggest that these observations could be interpreted as a temporary and local reversal of the direction of the plasma sheet convection due to the compression of the magnetosphere.