

## **Cluster and ground-based observations of the magnetosheath-cusp region during geomagnetic storms**

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The effects on the magnetosheath and cusp regions (down to the ionosphere) of the strong solar winds that passed through the Earth during the early main phases of the geomagnetic storms on 24 and 29 October 2003 are presented using data from ACE, Geotail, Cluster (CIS, FGM, STAFF and EWS) and ground-based instruments (EISCAT radars and Tromso magnetometer chain). During the early main phase of the moderate storm on 24 October, a strong solar wind (speed about 600 km/s, density up to 75 cm<sup>-3</sup>, temperature up to 0.5 MK and dynamic pressure about 10 nPa) reached ACE at 14:47:15 UT, and IMF Bz turned strongly northward slightly afterwards. About 38 min later when the solar wind reached magnetopause, the Cluster spacecrafts, which were entering the southern magnetospheric cusp from the magnetosheath, started detecting sudden increases in ion densities (over 400 times in H<sup>+</sup>, He<sup>++</sup> and hot ions) and ion temperatures (over 10 times), with strong southward turning of the ion velocity (-300 km/s) for about 2.5 hours (15:25-18:02 UT) until the spacecrafts exited the cusp. These observations indicate direct magnetosheath-cusp population by the strong solar wind. The EISCAT VHF radar (field of view about 74N) and magnetometer chain detected large and sudden changes in the ionosphere during this event. A similar event happened during the early main phase of a severe geomagnetic storm on 29 October when an abnormally strong solar wind (speed exceeding 1500 km/s, density and pressure not available) arrived ACE at 05:58:28 UT and IMF Bz fluctuated around zero. The events at Cluster started about 13.5 min later when the wind reached the magnetopause and the spacecrafts were entering the cusp from the magnetosheath.

**Keywords:** Cusp, Magnetosheath, solar wind, geomagnetic storms, Cluster, ground-based instruments.