Role of the terrestrial bow shock on magnetic clouds' structure: 1. CLUSTER observations downstream of the bow shock

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Abstract

< !–[if gte mso 9]> Normal 0 21 false false false FR X-NONE X-NONE < ![endif]–> < !–[if gte mso 9]> < ![endif]–> < !–[if gte mso 10]> /* Style Definitions */ table.MsoNormalTable {mso-style-name:"Tableau Normal"; mso-tstyle-rowband-size:0; mso-tstyle-colband-size:0; mso-style-noshow:yes; mso-style-priority:99; mso-style-qformat:yes; mso-style-parent:""; mso-padding-alt:0cm 5.4pt 0cm 5.4pt; mso-para-margin:0cm; mso-para-margin-bottom:.0001pt; mso-pagination:widow-orphan; font-size:11.0pt; font-family:"Calibri","sans-serif"; mso-ascii-font-family:Calibri; mso-ascii-theme-font:minor-latin; mso-fareast-font-family:"Times New Roman"; mso-fareast-theme-font:minor-fareast; mso-hansi-font-family:Calibri; mso-hansi-theme-font:minor-latin;} < ![endif]–> Magnetic clouds are known as very geoeffective structures, in the sense that they can be at the origin of large magnetic storms in the Earth's environment, as measured by the Dst index. An important parameter considered in the geoeffectiveness studies is the North-South component of the Interplanetary Magnetic Field (IMF). But the correlation between geoeffectiveness and IMF is not straightforward and statistical studies revealed a much more complex situation. Indeed, before reaching the magnetosphere, the magnetic clouds encounter first the bow shock which decreases the solar wind velocity down to sub-sonic and sub-Alvénic values, modifies the magnetic field structure, and finally changes the conditions of the interaction with the magnetosphere. These modifications can be observed by the CLUSTER satellites along orbits that go out of the magnetosphere and cross the region downstream of the bow shock. We show cases where the magnetic field structure of the magnetic clouds is maintained. But we also observed cases where it is strongly modified, with large rotations of the magnetic field. We interpret these modifications as a function of the magnetic field direction relative to the local normal, leading to different shock conditions: quasi-parallel, quasi-perpendicular, ... The consequences are that the interaction of these magnetic clouds with the magnetosphere and thus their geoeffectiveness differ from what could be assumed from their initial configuration in the solar wind. This effect stresses the need of modeling to predict accurate interaction conditions with the magnetosphere.

Keywords: magnetic clouds, magnetosheath, CLUSTER observations

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