Geophysical Research Abstracts
Vol. 18, EGU2016-6130, 2016
EGU General Assembly 2016

Magnetic clouds in the Earth's magnetosheath: a statistical study

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Magnetic clouds (MCs) are highly geoeffective solar wind transients. In the interplanetary space, they possess a well-defined magnetic structure, characterised by an enhanced and smoothly rotating magnetic field. We examine here whether their magnetic structure is modified when they encounter the outer regions of the geospace, namely the bow shock and the magnetosheath. Significant changes in the magnetic structure of MCs could in turn affect the level of geomagnetic activity they induce in the near-Earth's space. In this work, we study 82 MCs during which spacecraft observations are available simultaneously in the solar wind and in the magnetosheath. The observations inside the magnetosheath are related to the bow shock properties using a magnetosheath model (Turc et al., 2014, Ann. Geophys.). We find that the variation of an MC's magnetic field orientation from the solar wind to the magnetosheath is directly related to the encountered shock configuration. The angle between the magnetic field in the magnetosheath and that in the solar wind shows a very good correlation with the Θ_{Bn} angle (between the upstream magnetic field and the normal to the shock's surface) encountered at the bow shock's crossing. Because of its importance for the geoeffectivity, we examine how the magnetic field North-South (Bz) component is modified across the bow shock. In some cases, we find that Bz reverses in the magnetosheath. The conditions during which such reversals occur are investigated and their implications in terms of the MCs' geoeffectivity are discussed.