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Impact of the Earth bow shock crossing on magnetic clouds structure

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In the solar wind, magnetic clouds (MC) display a well-defined magnetic structure. When they reach the vicinity of the Earth, their structure is modified by their interaction with the Earth environment. In this study, we focus on the bow shock crossing of MCs, and more specifically on how it alters their magnetic structure. We compare observations from the Cluster spacecraft in the magnetosheath to ACE magnetic field measurements in the solar wind, in order to highlight the differences before and after the bow shock crossing. We find that the magnetic field amplitude is higher inside the magnetosheath, as expected from the compression behind the shock, but that the magnetic field direction can exhibit different features. It can be similar to the solar wind magnetic field direction, display a phase shift or the smooth rotation can even disappear in the magnetosheath. The correlation between the variation of the magnetic field direction from the solar wind to the magnetosheath and the shock obliquity angle is investigated. Finally, a simple 3D MHD model is developed to describe the interaction of a MC with the bow shock and calculate the magnetic field amplitude and direction inside the magnetosheath. We show several outputs of the model, corresponding to different orientations of the MC axis. We compare these modeled cases to observations. In some cases, the results show that the trends are in qualitative agreement, and other cases are further discussed.