Statistical analysis of magnetic cloud erosion by magnetic reconnection

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Abstract

Magnetic clouds (MCs), described as large-scale toroidal magnetic structures, interact with the surrounding interplanetary medium during propagation. It has been suggested in particular that magnetic reconnection may peel off their outer magnetic structure. Recently, Ruffenach et al. (2012) confirmed the occurrence of MC erosion thanks to a multi-spacecraft study combining a set of key signatures expected from this process. The aim of the present study is to extend previous works on the topic to all MCs of solar cycle 23 in order to quantify this phenomenon. This statistical analysis, primarily carried out with WIND and complemented with recent STEREO data, focuses on three signatures. First, based on careful determination of the MCs main axes, we estimate the amount of magnetic flux eroded for each event by analysing the azimuthal flux imbalance during the spacecraft sampling of the flux rope. We also search for magnetic reconnection signatures at the front boundary of the MCs. Finally, we investigate the characteristics of suprathermal electrons in the back region of the MCs. Those electrons are considered to signal potential large-scale topological changes expected from the erosion process.

Keywords: ICME, Magnetic Cloud, Magnetic Reconnection

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