Reconstruction of Magnetic Clouds from In-Situ Spacecraft Measurements and Intercomparison with Their Solar Sources

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Abstract

Coronal Mass Ejections (CMEs) are explosive events that originate, propagate away from the Sun, and carry along solar material with embedded solar magnetic field. Some are accompanied by prominence eruptions. The entire process can be observed by multiple instrumentations on-board several on-going spacecraft missions. The interplanetary counterparts of CMEs (ICMEs) are often detected in-situ by spacecraft ACE and Wind, which provide both magnetic field and plasma measurements sampled along the spacecraft path across the ICME structure. All these remote-sensing and in-situ measurements make it possible to perform the intercomparison between the (I)CMEs and their source regions at the Sun. In particular, a subset of ICMEs, so-called Magnetic Clouds (MCs) can be characterized by magnetic flux-rope structures. We will apply the Grad-Shafranov reconstruction technique to examine the configuration of MCs and to derive relevant physical quantities, such as magnetic flux content, the field-line twist, and relative magnetic helicity. We will select recent events during the rising phase of enhanced solar activity, and utilize additional observations from the most recent spacecraft missions, such as the STEREO and SDO spacecraft. Both observational analyses of solar source region characteristics including flaring and dimming, and the corresponding MC structures will be presented. We will perform both statistical and detailed case studies to examine the properties of different events with and without associated prominence eruptions. We will try to discern the role of prominence in the formation of flux ropes and its relations to MC properties derived from in-situ measurements.

Keywords: Magnetic Clouds, Magnetic Flux Rope, CME, ICME, In Situ Measurements, Prominence

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