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On the relationship between interplanetary coronal mass ejections and magnetic clouds

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The relationship of magnetic clouds (MCs) to interplanetary coronal mass ejections (ICMEs) is still an open issue in space research. The view that all ICMEs would originate as magnetic flux ropes has received increasing attention, although near the orbit of the Earth only about one-third of ICMEs show clear MC signatures and often the MC occupies only a portion of the ICME. We have performed a systematic comparison of the cases where ICME and MC signatures coincided and where ICME signatures extended significantly beyond the MC boundaries. We found clear differences in the ICME properties (eg., speed, magnetic field magnitude), in the ambient solar wind structure, and in the solar cycle dependence for these two event types. We show that the MC and the regions of ICME-related plasma in front and behind the MC have all distinct characteristics enforcing the conception that they have intrinsically different origin or evolve differently. Erosion of magnetic flux in front of the ICME may also reconfigure the initial three-part CME seen in white-light images to a more complex ICME, but the geometrical effect (i.e. the encounter through the CME leg and/or far from the flux rope center) has little contribution to the observed mismathch in the MC and ICME boundary times. We will also discuss ramifications to CME and space weather research.