All CMEs Originating Near the Disk Center of the Sun Do Not Arrive at Earth: Why?

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Coronal Mass Ejections (CMEs) originating from close to the disk center of the Sun are expected to arrive at Earth and cause space weather effects. However, not all such CMEs arrive at Earth (Gopalswamy et al. 2012, JGR 117, A08106). In this paper, we consider all wide CMEs (width 60 degrees) in the period 2009 October to 2012 July. During this period, STEREO A/B spacecraft had side views of these CMEs at angles from +/- 60 to +/- 120 degrees, so the CME kinematics can be measured accurately. The solar sources of the CMEs had Central Meridian Distance 30 degrees. We tracked 232 such CMEs using SOHO and STEREO coronagraph data to see whether or not they impacted Earth. We also used in situ data from SOHO/Wind/ACE to check Earth arrival. We found that 1) 34% (79/232) of CMEs faded out before reaching Earth, 2) 29% (67/232) of CMEs arrived at Earth, 3) 25% (57/232) were captured by following faster CMEs, and 4) 13% (29/232) of CMEs left the ecliptic plane. The Earth-arriving CMEs (603 km/s) were faster (in the COR1 to COR2 FOV) than the fading-out CMEs (307 km/s). The Earth-arriving CMEs show a wider range (64-2046 km/s) speeds than the fading out events (98-790 km/s). Among the Earth-arriving CMEs, 45% (30/67) had magnetic cloud signatures based on ACE data. ICME ejecta and complex signatures were found in 37% (25/67) and 9% (6/67), respectively. Six Earth-arriving CMEs did not show any in situ signature. We also investigated the geoeffectiveness of the Earth-arriving CMEs and found that only 3% (2/67) and 27% (18/67) had Dst index -100 nT and -50 nT, respectively.

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