

Coronal Mass Ejections as Key Players in Sun-Earth Connection

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The Sun largely controls the heliosphere - the Sun-Earth system in particular - via the mass and electromagnetic emissions that are highly variable. Of the mass emissions, coronal mass ejections (CMEs) have been recognized as the primary source of violent disturbances affecting the Sun-Earth system. Although such a preeminent role played by CMEs has been recognized in the early 1990s, it is the Solar and Heliospheric Observatory (SOHO) mission that fully demonstrated the importance of CMEs. The fortunate availability of interplanetary observatories such as Wind and the Advanced Composition Explorer (ACE) helped track the mass ejections with their coiled magnetic field lines from the Sun all the way to Earth. The Geostationary Operational Environmental Satellites (GOES) and the ground-based magnetometers recorded, respectively the devastation caused by the CMEs in the form of solar energetic particles they accelerate and the geomagnetic storms they cause upon Earth arrival. Both these CME-related phenomena have far-reaching consequences from the magnetosphere to the neutral atmosphere. This Lecture will summarize some of the recent results on CMEs and their interplanetary consequences as revealed by the SOHO data and by the recent Solar Terrestrial Relations Observatory (STEREO) data. In particular, it will describe special populations such as halo CMEs, shock-driving CMEs (which accelerate energetic particles and produce type II radio bursts), and CMEs resulting in interplanetary magnetic clouds that produce the maximum impact on the space environment of Earth.

Keywords: coronal mass ejections; flares; shocks; solar energetic particles; type II radio bursts; interplanetary flux ropes; geomagnetic storms.