

The Solar Origins of Severe Space Weather

Nat Gopalswamy

Solar cycle 23 witnessed an unprecedented array of space- and ground-based instruments observing the violent eruptions from the Sun that had huge impact on the heliosphere. Coronal mass ejections (CMEs) contribute to space weather by producing geomagnetic storms and accelerating energetic particles, the two aspects that concern the space weather community. This paper discusses the kinematic and solar-source properties of these CMEs and how they vary with the solar activity cycle with particular emphasis on the following issues. Intense geomagnetic storms are caused by the out-of-the-ecliptic component of the magnetic field in CMEs and/or their sheath. Geoeffective CMEs originate close to the disk center of the Sun. Geoeffective CMEs are more energetic (average speed ~ 1000 km/s, mostly halo CMEs or partial halo CMEs). CMEs producing solar energetic particles are the fastest (average speed ~ 1600 km/s) of all CME populations and have very high halo CME fraction. The source location requirement is different for Geoeffective and SEP-producing CMEs because of the different paths taken by CME plasma and energetic particles.