A04-O10

CME FRONT AND SEVERE SPACE WEATHER

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What determines the severity of space weather, and whether it can be predicted are not yet known. We present results obtained from the analysis of coronal mass ejections (CME), solar energetic particle (SEP) events, interplanetary magnetic field (IMF), CME-magnetosphere coupling and geomagnetic storms associated with the major space weather events since 1998 by combining data from the ACE and GOES satellites with geomagnetic parameters, and the Carrington event of 1859, the Quebec event of 1989, and an event in 1958. The results seem to indicate that (1) it is the impulsive energy mainly due to the impulsive velocity and orientation of IMF Bz at the leading edge of the CMEs (or CME front) that determine the severity of space weather. (2) CMEs having high impulsive velocity (sudden non-fluctuating increase by over 275 km s^{-1} over the background) caused severe space weather (SvSW) in the heliosphere (failure of the SWI mode of SWEPAM in ACE) probably by suddenly accelerating the high energy particles in the SEPs ahead directly or through the shocks. (3) The impact of such CMEs which also show the IMF Bz southward from the leading edge caused SvSW at the Earth including extreme geomagnetic storms of mean Dst MP < -250 nT during main phases; and the known electric power outages happened during some of these SvSW events. (4) The higher the impulsive velocity, the more severe the space weather, like faster weather fronts and tsunami fronts causing more severe damage through impulsive action. (5) The CMEs having IMF Bz northward at the leading edge do not seem to cause SvSW on Earth though, later when the IMF Bz turns southward, they can lead to super geomagnetic storms of intensity (DstMin) less than even -400 nT.