Toward an empirical model of the CME-storm relationship

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Solar and Space Weather group in KASI has been examining the physcial characteristics of geoeffective CMEs in order to develop an empirical model of the CME-storm relationship. First, we have presented the probablities of CME geoeffectiveness depending its solar surface location, speed, and earthward direction using front-side SOHO/LASCO halo CMEs from 1997 to 2003. Second, we have examined the relationship between several CME physical parameters (e.g., earthward direction, density, mass) and its associated geomagnetic storm for very fast halo CMEs. In particular, we suggest a new direction parameter that is directly observable from coronagraph observations. Third, we have examined the relationship between the field orientation in a CME source region and a geomagnetic storm using a coronal flux rope model as well as its dependence on ICME classification (magnetic cloud or ejecta). Major results are as follows. (1) The most probably areas whose geoeffectiveness fraction is larger than the mean probability (0.4), are $0 < L < 30$ deg for slower speed CMEs (< 800km/s), and $-30 < L < 60$ deg for faster CMEs (> 800 km/s). (2) The CME direction and its column density have much better correlations with the Dst index than other parameters for very fast halo CMEs. (3) The relationship between the field orientation and the geomagnetic storm for magnetic cloud is much better than that for ejecta, implying that the field orientation of the magnetic clouds are well conserved through the heliosphere. (4) The CME earthward direction seems to be a key parameter to select geoeffective CMEs, especially for fast halo CMEs. Finally, we discuss several issues to be solved for setting up an empirical model of the CME-storm relationship.