Effects of different Substructures of Coronal Mass Ejections (CMEs) on the geomagnetic field

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Abstract: A Coronal Mass Ejection (CME) is a massive burst of plasma ejected from the solar corona. CMEs are often associated with various substructures such as interplanetary (IP) shocks, sheath regions, and magnetic clouds (MCs). Occasionally, CMEs also feature Directional Discontinuities (DDs) in the magnetic field. Each of these substructures influences Earth's magnetosphere in distinct ways. The impact of these substructures on the geomagnetic field can be observed through changes in the geomagnetic field. Sudden Commencements (SCs) in the geomagnetic field are typically linked to IP shocks. The strength and geometry of these shocks are crucial in determining their effects on the geomagnetic field. The front boundary of a magnetic cloud (MC) is marked by a sudden drop in solar wind density (solar wind dynamic pressure), which can lead to the extremely large decrease in the geomagnetic field, especially at the equator. Additionally, DDs associated with solar wind density enhancements can result in asymmetric geomagnetic disturbances at low latitudes over short periods. This colloquium will explore the effects of the IP shock, the front boundary of the MC, and DDs on the geomagnetic field.