

## Effect of Forbush Decrease on Global Electric Circuit

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During Forbush decreases (FDs), the fluxes of high-energy galactic cosmic rays (GCRs) are suppressed. As a consequence, the ionization profile of the atmosphere is affected and the global electric circuit (GEC) system is perturbed. Recently, using cosmic ray measurements from the Alpha Magnetic Spectrometer (AMS-02) onboard the International Space Station rather than traditional ground level neutron monitor data to classify FDs, Tacza et al. (2024) have shown that the potential gradients (PGs) in ground-based measurements taken in fair weather conditions only show noticeable increases during large FDs, but not in smaller FDs. Continuing this work, in Li et al. (2025) we further examine why large FDs are PG-effective but smaller FDs are not. For the events examined in Tacza et al. (2024), we compute the subsolar standoff distance  $R_0$  during FDs using both an empirical formula and a magnetohydrodynamic (MHD) simulation. We find that PG-effective and PG-ineffective FDs naturally fall into two populations based on the subsolar standoff distance and the GCR flux amplitude decrease  $A$  as measured from the AMS-02. We also find the MHD turbulence level, as measured by the root mean square of  $\delta B$ , correlates with  $R_0$ . We extend the analysis to include all FDs as reported in Wang et al. (2023), separating into Coronal Mass Ejection (CME) associated and Corotating Interaction Region (CIR) associated two subclasses, and find this two population remain conspicuous. Based on our findings, we propose a new classification scheme of FDs.

### References:

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- [3] Wang, S., Bindi, V., Consolandi, C., Corti, C., Light, C., Nikonov, N., & Kuhlman, A. (2023). *The Astrophysical Journal*, 950 (1), 23.

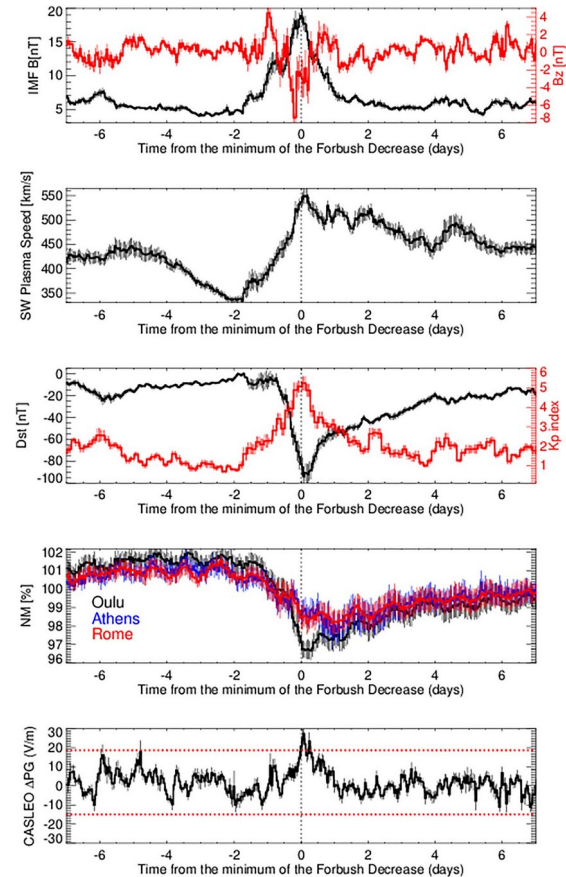


Figure 1: SEA of various solar wind parameters and the Dst/Kp indices for large FD events. From top to bottom these panels are: the temporal variation of the interplanetary magnetic field (IMF), the z-component magnetic field (Bz), the solar wind plasma speed, the Dst and Kp indices, the neutron monitor data, and the CASLEO PG data. From Tacza et al. (2024).