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# Statistical Interpretation of the Thermospheric Density Responding to Geomagnetic Disturbances

Variations in thermospheric density play an essential role in satellite operations, particularly during geomagnetic disturbances, where fluctuations in atmospheric drag impact orbital stability. A significant incident on February 4, 2022, saw SpaceX lose 38 Starlink satellites due to unanticipated atmospheric drag following a geomagnetic storm. This study aims to identify high- risk periods in thermospheric density using observational data from ESA's Swarm Satellite C. By integrating key geomagnetic indices such as Kp, AE, and SYM-H, this research studies the geomagnetic activity with thermospheric density variations to assess space weather disturbances. The study uses statistical analysis to develop a predictive framework for identifying potentially hazardous periods, ensuring future satellite missions are better equipped to prevent similar risks. Data visualisation techniques, including plotted density fluctuations, provide deeper insights into the relationship between geomagnetic activity and atmospheric variability. The findings contribute to a broader understanding of thermospheric dynamics and their implications for satellite operations, mission planning, and the long-term sustainability of space activities.

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