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Investigating the Role of Geomagnetic Activity in Loss of Navigational Capability in the Swarm Satellite Mission

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The Swarm satellite mission, launched by the European Space Agency in 2013, investigates Earth's ionosphere using advanced onboard instruments, including GPS receivers capable of tracking signals from up to eight satellites simultaneously. Loss of navigational capability, defined as periods when fewer than four GPS satellites are tracked, poses significant challenges for precise positioning and mission operations.

Before 2020, the frequency of these events was relatively low, with fewer than 200 occurrences for Swarm A and C, and fewer than 100 for Swarm B. After 2020, the number of events increased dramatically, exceeding 1,400 for Swarm A and C, and 400 for Swarm B. While geomagnetic activity directly affects high-latitude regions, less than 10% of these events occur in the high-latitude ionosphere, suggesting indirect influences of magnetic storms on other latitudes through associated phenomena.

This study investigates the correlation between geomagnetic activity and loss of navigational capability, exploring whether geomagnetic indices and magnetic storms act as precursors or are unrelated to these events. The findings will provide insights into the interplay between space weather and satellite-based navigation, contributing to improved operational resilience in future satellite missions.