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[*Abstract*]

## Space weather and satellite anomalies

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**Abstract:** Space weather phenomena, driven by solar activity and its interaction with Earth's magnetosphere, pose significant risks to satellite operations across various orbital regimes. This paper provides a comprehensive overview of the primary space weather factors—including solar flares, coronal mass ejections, high-speed solar wind streams, solar proton events, cosmic rays, and radiation belts—and their mechanisms of impact on spacecraft. We examine the orbit-dependent nature of these anomalies, highlighting the distinct vulnerabilities of low-Earth orbit (LEO), medium-Earth orbit (MEO), and geostationary orbit (GEO) satellites. Statistical analyses reveal clear dependencies on local time, geomagnetic activity, and solar cycle phase, with anomaly rates often peaking during the rising and declining phases of solar cycles. The paper also discusses mitigation strategies, including design hardening, operational responses, and advanced forecasting techniques, emphasizing the need for probabilistic, environment-aware risk management to enhance satellite resilience in an increasingly space-dependent world.

**Keywords:** space weather phenomena, impact on spacecraft, orbital dependence