

Spatial-temporal response of space debris distribution to geomagnetic fluctuations

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Growing population of space debris due to increasing payload launches and explosions/collisions of orbiting space objects is a big concern for sustainable future space exploration. In the context of space weather science, space debris issues have been regarded as a part of space environmental mitigation/remediation studies.

In this study, we introduce a different viewpoint into this background. We utilize archived orbital data of thousands of space debris in the thermospheric altitude region as multiple in-situ sensors that respond to atmospheric density fluctuation induced by Joule heating in the ionosphere.

As initial study, we analyze correlations between geomagnetic indices data and time deviations of space debris orbit data to evaluate spatial-temporal response of the space debris distribution to geomagnetic storms. The initial result suggests that 1) there is high correlation between Kp-index and the 1st-order time deviation of orbit mean motion (dn/dt) at a certain time delay from Kp to dn/dt , and 2) trends of the time delay mapped into orbital elements space have characteristic patterns that may supply evidences to mechanisms of the thermosphere-ionosphere system.