The 2022 Starlink Geomagnetic Storms: Global Thermospheric Response to a High-Latitude Ionospheric Driver

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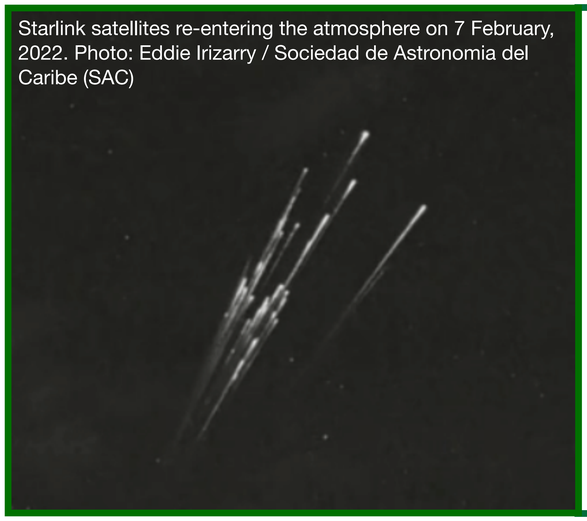
Space Weather

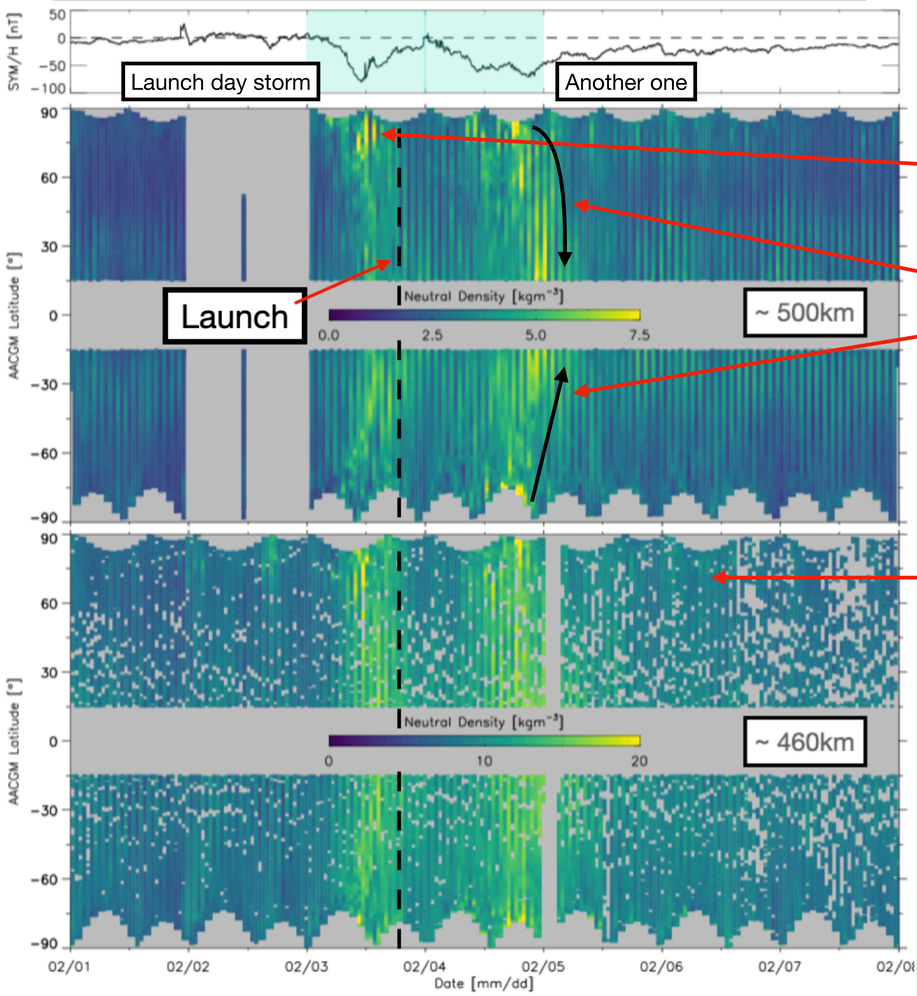


Starlink satellites re-entering the atmosphere on 7 February, 2022. Photo: Eddie Irizarry / Sociedad de Astronomia del Caribe (SAC)

A Catastrophic Failure

- In February 2022, 38 out of 49 Starlink satellites were lost due to the occurrence of two **geomagnetic storms**.
- Each storm significantly perturbed the **global thermospheric density**, causing drag on the spacecraft.
- We examine the high-latitude Magnetosphere-Ionpshere-Thermosphere dynamics during these storms.

1 - Days surrounding launch



Both GRACE-FO and Swarm-C accelerometers see **global scale density perturbations**

Higher densities are seen at **high latitudes**

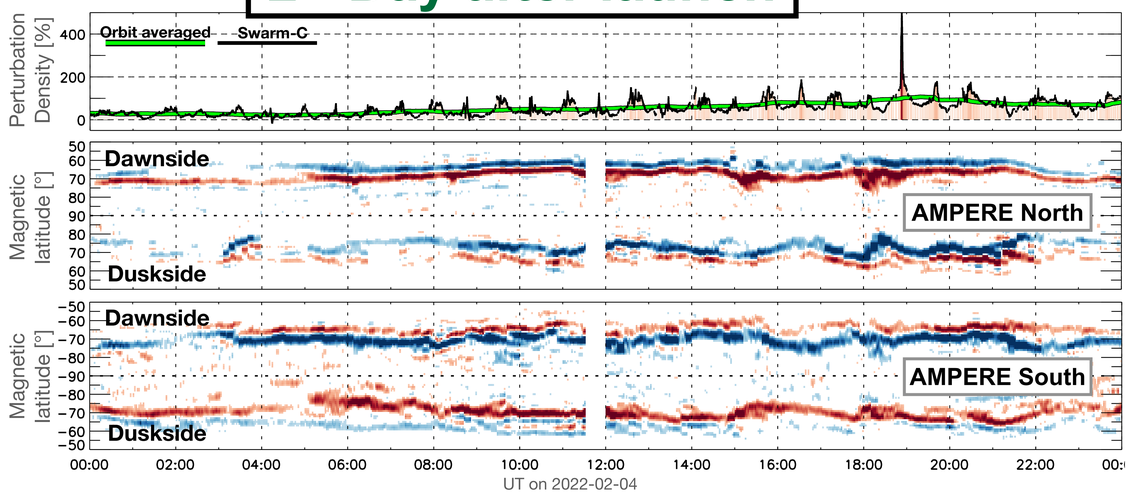
Propagation to lower latitudes via **gravity waves** can be seen

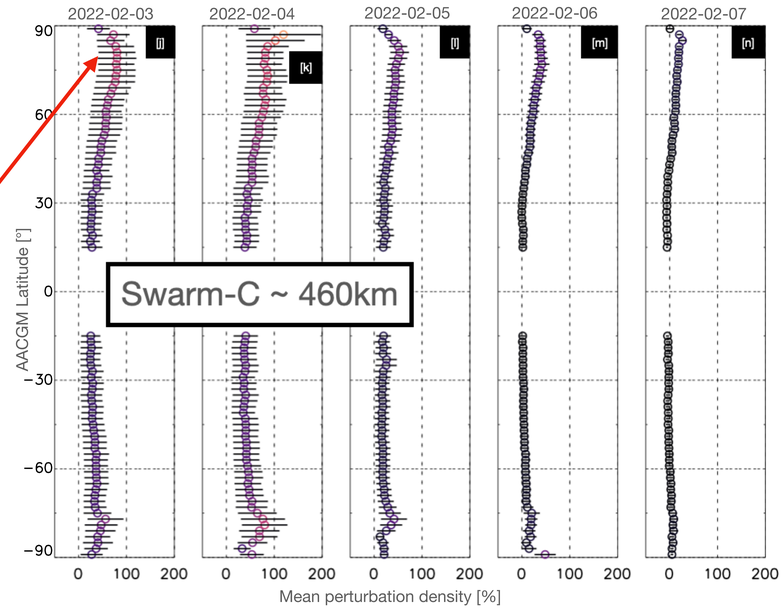
Hemispheric asymmetry

Conditions remain enhanced for **several days** after the second storm

Perturbations consistent with altitude

2 - Day after launch





In the days after the storms, thermospheric densities **remained high at high latitudes**

Immediately following the second storm, the **global thermosphere was relaxing to pre-storm densities**

No geomagnetic forcing, but **perturbed conditions remained**

3 - After the storm: still not safe?