

Spire POD/Neutral Density Assessment

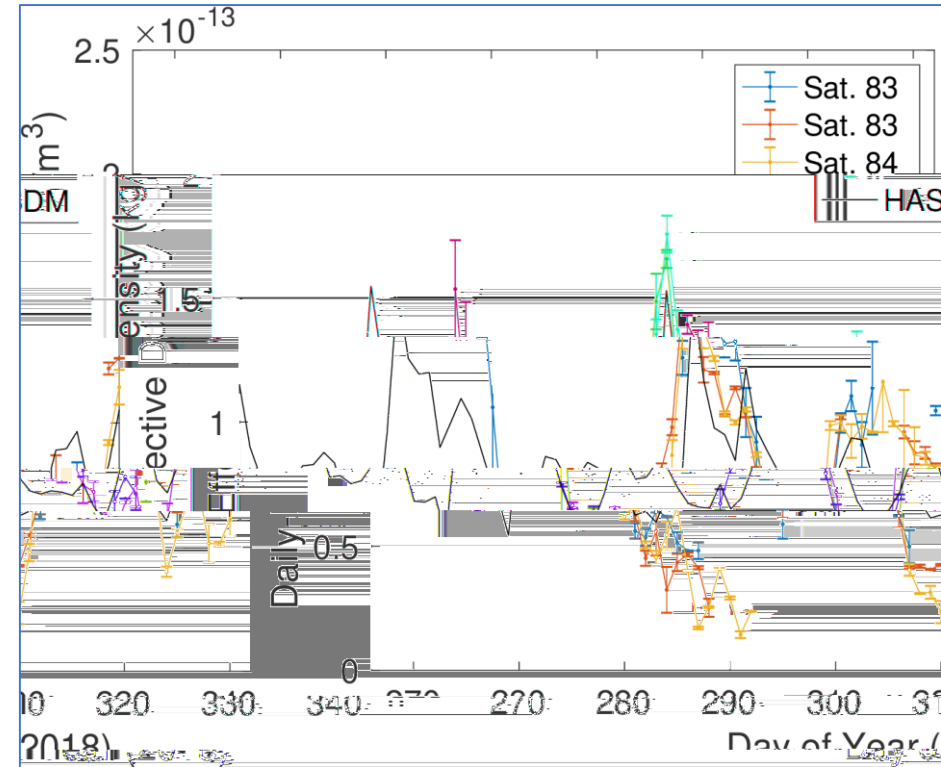
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Purpose: Advance our national capabilities to nowcast and forecast the state of the upper atmosphere, thereby improving our ability to track, identify, catalog, and protect space assets

Study Objective: Assess the suitability of Spire's currently existing data products for specifying the in situ upper-atmospheric mass density on a daily cadence

Imagery: Spire Precise Orbital Determination (POD) measurements, Spire near-continuous attitude quaternions, Spire satellite descope CAD models

Findings: The analysis shows that the day-to-day variability of the thermosphere can be readily extracted from existing Spire CubeSat data products, although validation with other data sources is problematic due to the lack of reliable sources during the assessment period. While the technique struggled with lower duty cycles early in the assessment period, the atmospheric drag signal is clearly present in the POD data thereafter, as evidenced by the consistency of inferred densities between the 3 satellites in essentially the same orbit and the comparison with the operational HASDM model. However, the timescales of interest in the upper atmosphere are on the order of 1 hour to several days. Therefore, it will be important in the future to extract upper atmospheric densities on a sub-daily cadence. This should be possible with improved POD orbit fits of the GNSS observables.



The daily-effective density retrieved from the satellite POD for three different satellites as compared to the USAF HASDM model.