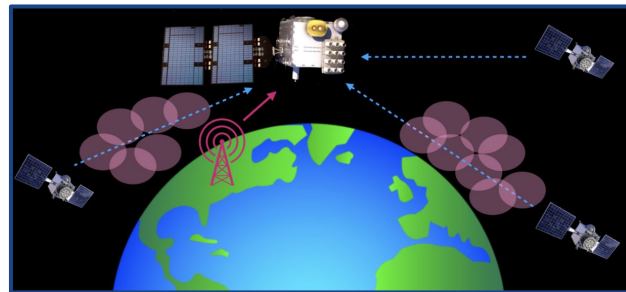


Radio Frequency Interference (RFI) Detection from Radio Occultation Measurements

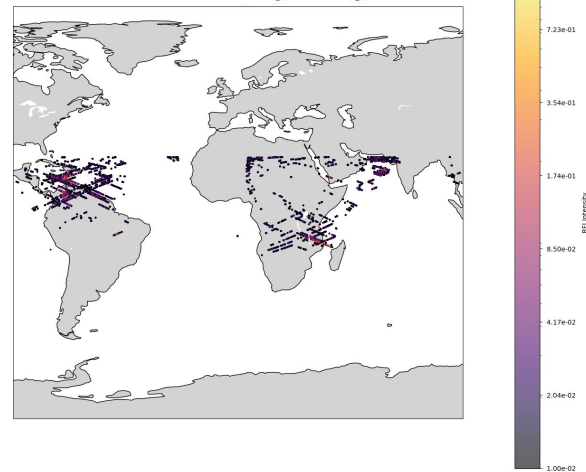
By James Hawkins (University of Maryland, College Park)
Mentors: Dr. Bin Zhang, Dr. Xi Shao, Dr. Changyong Cao

- The COSMIC-2 Mission monitors the atmosphere for ionospheric disturbances.
- Radio Frequency Interference impacts the detection of disturbances/scintillation.
- We want to isolate RFI from scintillation.
- Focused on the algorithm developed by Roberts et al. (2022) from NASA JPL.
- Compared algorithm results to the RFI metric of the COSMIC Data Analysis and Archive Center (CDAAC).



[RFI diagram from Roberts et al.](#)

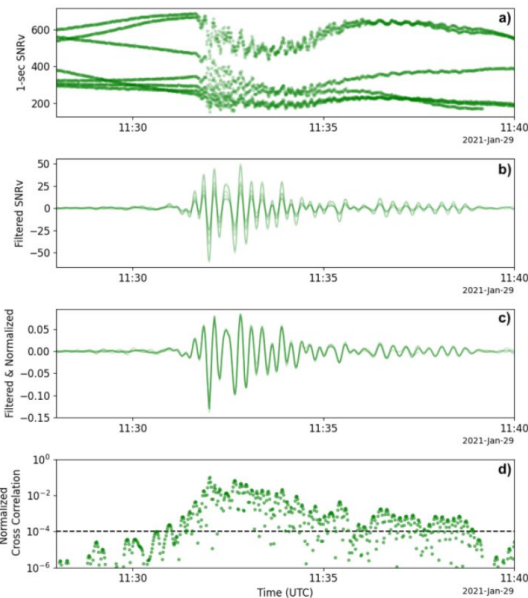
RFI Locations and Intensity on day 3 of 2026



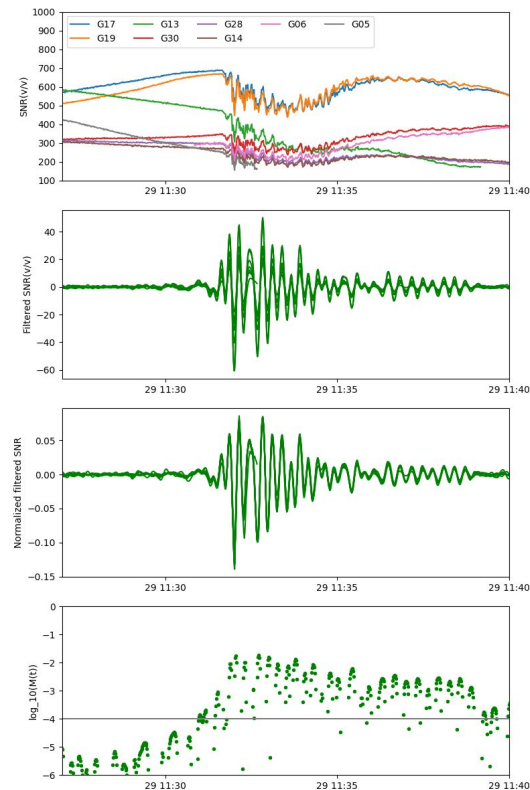
JPL Algorithm

- Calculates RFI by cross-correlation among signal-to-noise ratio (SNR) time series of different GNSS signals. Steps:
- 1) Run each SNR track through a Butterworth Bandpass Filter
- 2) Normalize each SNR track.
- 3) Define time window length (15 minutes).
- 4) Calculate RFI for each time index with sliding window and the formula.

$$M(t) = \frac{1}{N} \sum_{(i,j)}^N \sum_{\tau=0}^T \frac{S\tilde{N}R_{V,i}(t)}{SNR_{V,i}(t)} \frac{S\tilde{N}R_{V,j}(t - \tau)}{SNR_{V,j}(t - \tau)}$$

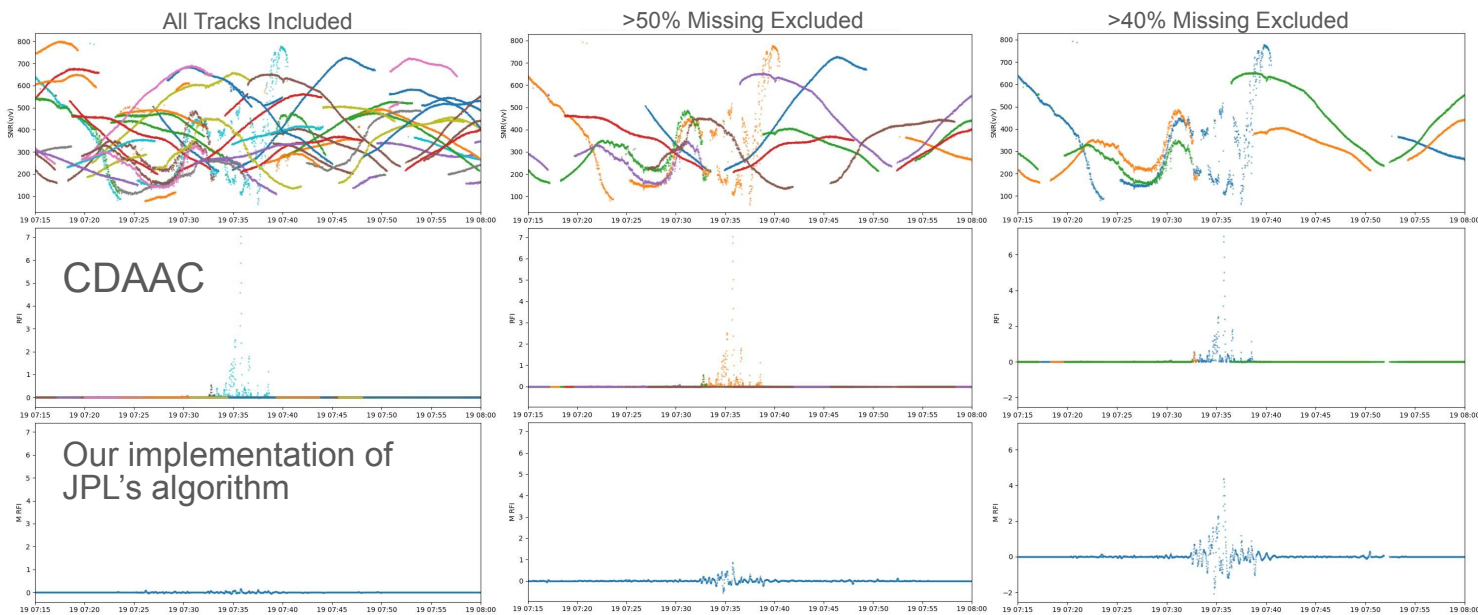


Original Paper



Our Implementation

Analysis & Conclusions



- Assumes all tracks are complete, which is far from reality.
- JPL's original solution is to replace NaN values with zero (problematic).
- Tried excluding tracks based on ratio of missing samples to nonmissing samples.
- Found the calculations to be highly variable depending on what tracks are included.
- To make this algorithm generally applicable in real applications, should be revised to account for missing values/gaps.
- Requires further work to align with CDAAC's existing RFI metric.

Reference

T. M. Roberts, T. K. Meehan, J. Y. Tien and L. E. Young, "Detection and Localization of Terrestrial L-Band RFI With GNSS Receivers," in IEEE Transactions on Geoscience and Remote Sensing, vol. 60, pp. 1-11, 2022, Art no. 5801311, doi: 10.1109/TGRS.2021.3109524.