

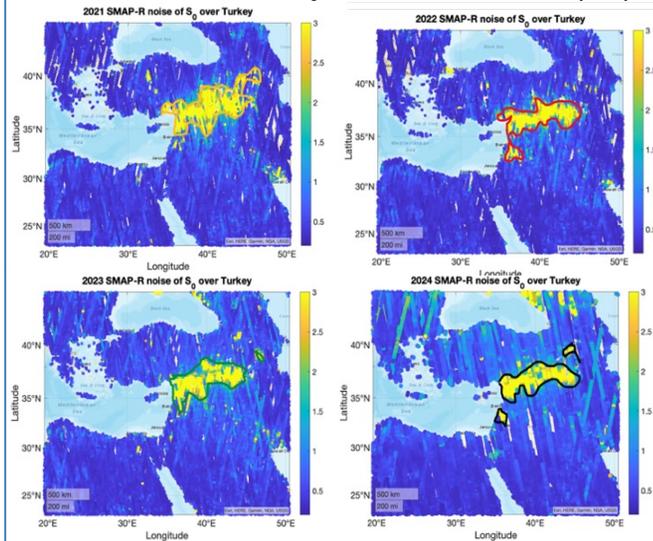


A Decade of L2c GNSS Signal Disruptions in SMAP-R Full-Polarimetric Observations

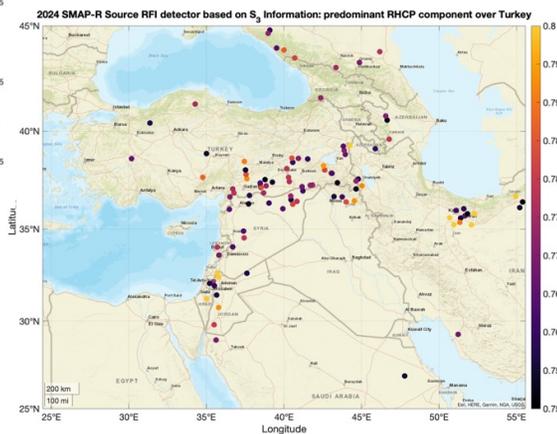


Problem: RFI increasingly corrupts GNSS-R measurements, especially in conflict zones, degrading SNR and polarimetric observables and compromising geophysical retrievals. Using SMAP-R's unique decade-long, global, full-polarimetric L2C record, we detect and characterize these disruptions and develop a robust Stokes-based RFI flagging approach for current and future GNSS-R missions.

Mapping of the RFI based on noise levels for total intensity measurement (S_0)



2024 SMAP-R source RFI detection based on the polarimetric measurement (S_3)



Finding: SMAP-R shows a sharp post-2020 rise in RFI, with growing clusters over the Ukraine-Russia region, the Türkiye-Syria (image) border, and Burma. Noise floors rise to sixfold, collapsing SNR, and Stokes S_2/S_3 distortions reveal depolarization and RHCP jamming. Reflectivity appears stable but masks contamination seen in polarimetry. A Stokes-based S_1/S_3 flag removes corrupted data while preserving useful observations.

Impact: Full-polarimetric GNSS-R is essential for detecting and filtering RFI, preserving data integrity. A practical S_1/S_3 RFI flag supports missions like HydroGNSS and enables cleaner long-term retrievals. SMAP-R's RFI maps provide geopolitical insight and its polarimetric framework guides future GNSS-R mission design and mitigation strategies.