Multi-Year RST-Based Analysis of TIR Anomalies: Advances with a Focus on the 2019 Californian Ridgecrest Sequence (M7.1)

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Abstract

For over 25 years, Robust Satellite Techniques (RST) have been employed in the analysis of long-term satellite Thermal InfraRed (TIR) radiance data to detect anomalies—both spatial and temporal—that may be linked to the occurrence of significant earthquakes.
The findings obtained by analyzing multi-year (over a decade) time series of TIR satellite imagery across various continents and seismic settings indicate that more than 67% of the recognized space-time-persistent anomalies fall within a predefined window around the time and location of earthquakes with magnitude ≥4. The observed false positive rate remains below 33%.
Additionally, Molchan error diagram assessments support a statistically significant correlation, clearly distinguishing the results from random occurrence.
Following the most extensive evaluations conducted across regions such as Greece, Italy, Turkey, and Japan, this work presents a critical discussion of initial results obtained over California, with a specific focus on the 2019 Ridgecrest sequence (M7.1), through the application of RST methodologies to long-term GOES radiance data.
Furthermore, the analyses, based on the application of the RETIRA index (Robust Estimator of TIR Anomalies), will also be critically examined in relation to the RETIRSA technique (Robust Estimator of TIR Slope Anomalies), which may offer an additional contribution to locally filter out the effects of transient warming events, typically linked to meteorological fronts.