Long-term RST analysis of anomalous TIR sequences in relation with earthquakes occurred in Turkey in the period 2004–2015

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Real-time integration of multi-parametric observations is expected to accelerate the process toward improved, and operationally more effective, systems for time-Dependent Assessment of Seismic Hazard (t-DASH) and earthquake short term (from days to weeks) forecast. However a very preliminary step in this direction is the identification of those parameters (chemical, physical, biological, etc.) whose anomalous variations can be, to some extent, associated to the complex process of preparation of major earthquakes. In this paper one of these parameter (the Earth's emitted radiation in the Thermal Infra-Red spectral region) is considered for its possible correlation with M$\geq$4 earthquakes occurred in Turkey in between 2004 and 2015. The RST (Robust Satellite Technique) data analysis approach and RETIRA (Robust Estimator of TIR Anomalies) index were used to preliminarily define, and then to identify, Significant Sequences of TIR Anomalies (SSTAs) in 12 years (1 April 2004- 31 October 2015) of daily TIR images acquired by the Spinning Enhanced Visible and Infrared Imager (SEVIRI) on board the Meteosat Second Generation (MSG) satellite. Taking into account physical models proposed for justifying the existence of a correlation among TIR anomalies and earthquakes occurrence, specific validation rules (in line with the ones used by the Collaboratory for the Study of Earthquake Predictability - CSEP - Project) have been defined to drive a retrospective correlation analysis process. The analysis shows that more than 67% of all identified SSTAs occur in the pre-fixed space-time window around the occurrence time and location of earthquakes (M$\geq$4), with a false positive rate smaller than 33%. Moreover, to better qualify the possible contribution of the use of SSTAs in the framework of a multiparametric system for a t-DASH, a Molchan error diagram analysis was applied in order to verify the actual SSTAs added value in comparison with a random alarm function. Notwithstanding the huge amount of missed events due to frequent space/time data gaps produced by the presence of clouds over the scene the achieved results, and particularly the low rate of false positives registered on a so long testing period, seems sufficient (at least) to qualify TIR anomalies (identified by RST approach and RETIRA index) among the parameters to be considered in the framework of a multi-parametric approach to time-Dependent Assessment of Seismic Hazard (t-DASH).