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From the Haicheng EQ lesson to a Multi-parametric t-DASH System for seismic prone area monitoring: the example of TIR observations from space.

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Abstract

The prediction of the February 4, 1975, Haicheng, Liaoning Province, China, Ms7.3 earthquake remains the first (and only) successful prediction of a major earthquake, which actually permitted the mitigation of its potentially disastrous consequences. Together with the interdisciplinary collaboration among scientists, the active involvement of citizen observers, and the close attention of the local authorities, this remains the first case in which a multi-parametric approach to short-term earthquake forecasting was put in place.

After several decades of collecting ground and satellite-based observations, the implementation of a multiparametric system, offering decision makers a similarly effective time-dependent Assessment of Seismic Hazards (t-DASH), is still waiting to be achieved.

Until now, long-term analyses of single parameter variations, with a complete assessment of its actual predictive capabilities (e.g. in terms of false positive rates in the absence of seismic activity), have been performed in just a few cases.

This is a mandatory step before a parameter can be usefully employed in a multi-parametric t-DASH system.

In this paper, as an example, spatial-temporal anomalies of the Earth's Emitted Radiation in the Thermal InfraRed (EER-TIR) generated by the application of the RST approach (Robust Satellite Techniques) to long-term satellite time-series are evaluated, as a candidate parameter to be included in a multi-parametric t-DASH system, considering our present capabilities:

- to identify (isolating them from all the other possible sources) those anomalies (in the spatial/temporal domain) possibly associated with the occurrence of major earthquakes

- to qualify such a candidate parameter in terms of: a) temporal alert window; b) spatial (depending on the expected earthquake magnitude) window; c) actual predictive capability (or associated forecast probability); for different seismic zones (Greece, Italy, Japan, Turkey, etc.) around the world.

A similar preliminary qualification process is expected to be applied to all the other candidate parameters to be usefully included in whatever regional multi-parametric t-DASH systems.

It will be demonstrated that - even starting from single parameters with low predictive capability (e.g high false positive rate) and quite high alerted space-time volumes - a multi-parametric t-DASH approach can easily achieve short-term forecasting capabilities well above those offered by any other traditional method, significantly reducing the alerted space-time volumes compared to those, often too large, associated with each single parameter.