Statistical analysis for the identification of ionospheric perturbations in Total Electron Content (TEC) possibly related to earthquake occurrence

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In association with the complex process of preparation of earthquakes have been proposed, in the last few decades several parameters (chemical, physical, biological, etc.). Especially the variability of space parameters has been linked, since long time, to the occurrence of strong and imminent earthquakes. This variability could be optimally captured by the detection of anomalous Ionospheric-Total Electron Content (TEC) variations.

Analyze historical data related to the preparatory phase of past strong earthquakes can be useful to understand the physical processes involved and to develop a future short-term warning system.

In this work, TEC measurements recorded by the GPS satellite constellation have been statistically analysed in order to discriminate anomalous signals from normal fluctuations of the signal itself.

To this aim, we studied the behavior of the TEC parameter, proceeding to the construction of a multi-year dataset of observations (>10 years) in Mediterranean seismically active areas, both in presence and in absence, of strong seismic events (M≥4).

The achieved results are discussed and compared with the results obtained through an independent RST (Robust Satellite Techniques; Tramutoli, 1998; 2005; 2007) analyses carried out on the Earth's Thermal Infrared Radiation (TIR) parameter. The general change detection approach RST has been used, since 2001, to discern anomalies in Earth's thermal emission measured by satellite possibly associated to seismic activity, from standard oscillations of the signal related to other causes (e.g. meteorological), independent on the earthquake occurrence.

The comparison of the results obtained using the two parameters (TEC and TIR) is made in order to evaluate how the joint use of the parameters themselves, in the framework of a multi-parametric approach, can improve the present capability of detection of these perturbations.

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