

## All world statistical validation of the Lithosphere-Atmosphere-Ionosphere coupling by 3.5 years of Swarm satellite electromagnetic pre-earthquake anomalies

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SAFE ("Swarm for Earthquake study") project (funded by ESA in the framework of "STSE Swarm+Innovation") deals with the integrated analysis of more physical parameters whose abnormal variations have been found to be possibly associated with impending earthquakes. These observations are mainly: electromagnetic variations; total electron content and the electron density in the ionosphere, measured both from Swarm satellites and ground-based observatories. We show here the results of a systematic analysis of around 3.5 years of magnetic and electron density satellite anomalies in the whole space-time interval of interest, avoiding high magnetic latitudes (1 Jan 2014-31 Aug. 2017, lgeomagnetic latitudel $\leq$ 50 degrees) which are correlated with earthquakes by means of a superimposed epoch approach. Both analyses show that the anomaly concentrations are superior with respect to random anomaly distributions by more than 3 times the standard deviation, confirming a lithosphere-atmosphere-ionosphere coupling in the preparation phase of earthquakes.