Statistical analysis of Swarm satellite data for assessing the effectiveness of ionospheric precursors of earthquakes

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Analysing ionospheric electron density and magnetic field data from several years of the Swarm three-satellite mission we define a dataset of anomalies statistically. We then use a superposed epoch approach to study the possible relation with a corresponding dataset of earthquakes occurred in the same space-time domain. Two statistical quantities d and n are then established comparing the statistics of the real analyses with simulations to assess the effectiveness of the largest concentrations of anomalies as ionospheric precursors. In detail, d would show how much the real maximum concentration is above the expected typical maximum concentration of a random anomaly distribution; while n value measures how much the largest concentration deviates with respect a typical random deviation: the larger are the d and n values, the more the results of the analysis applied to real data deviate from randomness. The best cases for which the real analyses are well distinct from random simulations are selected when d≥1.5, because the anomaly density is equal to or larger than 50% of random distribution, and n≥4, because the probability to be random is equal to or less than 0.1%. This is the case of Y magnetic field component with a search in the Dobrovolsky area around each considered earthquake epicentre. The electron density is slightly less effective in the correlation with earthquakes, but still better than a homogeneous random distribution of anomalies.

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