On the precursory information in ULF seismo-electromagnetic phenomena

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Previous statistical studies showed that there were correlations between seismo-electromagnetic phenomena and sizeable earthquakes in Japan. In this study, utilizing Molchan's error diagram, we evaluate whether these phenomena contain precursory information and discuss how they can be used in short-term forecasting of large earthquake events. In practice, for given series of precursory signals and related earthquake events, each prediction strategy is characterized by the leading time of alarms, the length of alarm window, the alarm radius (area) and magnitude. The leading time is the time length between a detected anomaly and its following alarm, and the alarm window is the duration that an alarm lasts. The alarm radius and magnitude are maximum predictable distance and minimum predictable magnitude of earthquake events, respectively. We introduce the modified probability gain (PG') and the probability difference (D') to quantify the forecasting performance and to explore the optimal prediction parameters for a given electromagnetic observation. The above methodology is firstly applied to ULF magnetic data registered at the KAK station in Japan. The results show that the earthquake predictions based on electromagnetic anomalies are significantly better than random guesses, indicating the data contain potential useful precursory information. Meanwhile, we reveal the optimal prediction parameters. The methodology proposed in this study could be also applied to other pre-earthquake phenomena to find out whether there is precursory information, and explore the optimal alarm parameters in practical short-term forecast.

References:

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