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Global testing of earthquake prediction algorithms

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Two decades ago in the article entitled “Whatever happened to earthquake prediction” Christopher H. Scholz has written his famous: “Predicting earthquakes is as easy as one-two-three.” Regretfully, none of the proposed earthquake precursory signals evaluated by the International Association for Seismology and Physics of the Earth’s Interior showed sufficient evidence to be claimed a reliable precursor at that time, and, as of today, none of the gridded rate-based forecast models passed the rigid testing by Collaboratory for the Study of Earthquake Predictability (CSEP). Making prediction claims is easy but these will remain not reliable without quantitative confirmation in an extended rigorous testing of the method predictions against real observations. The convincing statistics of testing an earthquake prediction algorithm cannot be achieved without a few hypotheses on stochastic properties such as regularity and/or ergodicity of seismic activity in geophysical environment under study and real-time experiment lasting long enough to reject a possibility of random coincidental occurrence of alarms and target events. For decades we apply the Error Diagram and Seismic Roulette null-hypothesis as the most adequate tools for evaluation of the performance of any systematic earthquake prediction claims versus random guessing that accounts for the empirical spatial distribution of target earthquakes. The methodology is illustrated by application to the global experimental real-time testing of the two methods:
(i) the M8 algorithm intermediate-term predictions of the great earthquakes in 1992-present and
(ii) the OLR (i.e. outgoing long-wavelength radiation) hot-spot alarms of the strong earthquakes in 2013.

The M8 algorithm has predicted time and location of 15 out of 23 target magnitude M8.0+ earthquakes in less than 30% of Seismic Roulette sectors which accounts for the level of statistical significance less than 0.05%, characterizing very high confidence of above 99.95%. The OLR hot-spot alarms in 2013 have predicted 20 out of 113 magnitude M6.0+ earthquakes in about a quarter of Seismic Roulette sectors which is less than expected from random guessing. Naturally, these summary results and other in detail information obtained in course of the real-time testing provide a realistic estimate of confidence and related recommendations on the level of seismic hazard and risks in case of the algorithms’ alerts.