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Long lasting operational practice in forecasting earthquakes and related ground shaking

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Forecasting earthquakes and related ground shaking is not an easy task and it implies a careful application of statistics to data sets of limited size and different accuracy. Observations and physical models suggest that several processes in the Earth's lithosphere are predictable, but after substantial averaging and up to a limit. Accordingly, a success in forecasting earthquakes requires a holistic approach, where earthquake forecasting/prediction is posed as a successive, step-by-step, narrowing the magnitude range, territory, and time of expectation, all within the limits imposed by physics and data uncertainties.

As clearly stated by Kossobokov, Peresan and Panza (Seismological Research Letters, vol. 86, 287-290, 2015) any reliable anticipatory information about impending earthquakes can be (1) effective, (2) complementary to design and construction of seismo-resistant infrastructures, and (3) well appreciated by population as a timely precautious reminder and warning.

Seismic Hazard Assessment (SHA) as well as Operational Earthquake Forecasting (OEF) information must be reliable, tested, confirmed by evidence, and not necessarily probabilistic. It is indisputable that only by careful record of failures and successes one can eventually evaluate reliability and effectiveness of forecasting. Regretfully, the claims of a high potential and efficiency of a methodology are often based on a questionable application of statistics (e.g. nominal probability gain alone) and hardly suitable for communication to decision makers. The need to apply adequate tools for assessing SHA and OEF (e.g. the Error Diagram, introduced in early 1990ies, and the Seismic Roulette null-hypothesis) is evident. Moreover, such a testing must be done in advance claiming hazardous areas and/or times. The set of errors, i.e. the rates of failure and of the alerted space-time volume, compared to those obtained in the same number of random guess trials permits evaluating the forecasting method effectiveness and determining the optimal choice of the parameters defined by specified cost-benefit functions. The theoretical framework for the optimal choice of disaster preparedness measures undertaken in response to reliable forecast/prediction is available since the 1970ies.

Prudent cost-effective safety measures can be taken when prediction certainty is known, but not necessarily high. Obviously, the spectrum of doable low-key preparedness options increases in case of longer than short-term warnings. Therefore decision-makers are advised to use the full very broad spectrum of possible actions, following general strategy of response to predictions by escalation or de-escalation of safety measures, depending on expected losses and magnitude-space-time accuracy of reliable forecasting. Communicating earthquake hazard, particularly OEF information, and the related uncertainties must be done with a keen feeling of responsibility for the final outcome in warning people of looming disaster.