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Are seismic hazard assessment errors and earthquake surprises unavoidable?

Vladimir Kossobokov (1,2)

(1) Institute of Earthquake Prediction Theory & Mathematical Geophysics, RAS, Moscow, Russian Federation (volodya@mitp.ru), (2) Institut de Physique du Globe de Paris, Paris, France (volodya@ipgp.fr)

Why earthquake occurrences bring us so many surprises? The answer seems evident if we review the relationships that are commonly used to assess seismic hazard. The time-span of physically reliable Seismic History is yet a small portion of a rupture recurrence cycle at an earthquake-prone site, which makes premature any kind of reliable probabilistic statements about narrowly localized seismic hazard. Moreover, seismic evidences accumulated to-date demonstrate clearly that most of the empirical relations commonly accepted in the early history of instrumental seismology can be proved erroneous when testing statistical significance is applied. Seismic events, including mega-earthquakes, cluster displaying behaviors that are far from independent or periodic. Their distribution in space is possibly fractal, definitely, far from uniform even in a single segment of a fault zone. Such a situation contradicts generally accepted assumptions used for analytically tractable or computer simulations and complicates design of reliable methodologies for realistic earthquake hazard assessment, as well as search and definition of precursory behaviors to be used for forecast/prediction purposes. As a result, the conclusions drawn from such simulations and analyses can MISLEAD TO SCIENTIFICALLY GROUNDLESS APPLICATION, which is unwise and extremely dangerous in assessing expected societal risks and losses.

For example, a systematic comparison of the GSHAP peak ground acceleration estimates with those related to actual strong earthquakes, unfortunately, discloses gross inadequacy of this “probabilistic” product, which appears UNACCEPTABLE FOR ANY KIND OF RESPONSIBLE SEISMIC RISK EVALUATION AND KNOWLEDGEABLE DISASTER PREVENTION. The self-evident shortcomings and failures of GSHAP appeals to all earthquake scientists and engineers for an urgent revision of the global seismic hazard maps from the first principles including background methodologies involved, such that there becomes: (a) a demonstrated and sufficient justification of hazard assessment protocols; (b) a more complete learning of the actual range of earthquake hazards to local communities and populations, and (c) a more ethically responsible control over how seismic hazard and seismic risk is implemented to protect public safety. It follows that the international project GEM is on the wrong track, if it continues to base seismic risk estimates on the standard method to assess seismic hazard.

The situation is not hopeless and could be improved dramatically due to available geological, geomorphologic, seismic, and tectonic evidences and data combined with deterministic pattern recognition methodologies, specifically, when intending to PREDICT PREDICTABLE, but not the exact size, site, date, and probability of a target event. Understanding the complexity of non-linear dynamics of hierarchically organized systems of blocks-and-faults has led already to methodologies of neo-deterministic seismic hazard analysis and intermediate-term middle- to narrow-range earthquake prediction algorithms tested in real-time applications over the last decades. It proves that Contemporary Science can do a better job in disclosing Natural Hazards, assessing Risks, and delivering such info in advance extreme catastrophes, which are LOW PROBABILITY EVENTS THAT HAPPEN WITH CERTAINTY. Geoscientists must initiate shifting the minds of community from pessimistic disbelieve to optimistic challenging issues of neo-deterministic Hazard Predictability.