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Quantitative Earthquake Prediction

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The Earth is a hierarchy of volumes of different size. Driven by planetary convection these volumes are involved into joint and relative movement. The movement is controlled by a wide variety of processes on and around the fractal mesh of boundary zones, and does produce earthquakes. This hierarchy of movable volumes composes a large non-linear dynamical system. Prediction of such a system in a sense of extrapolation of trajectory into the future is futile. However, upon coarse-graining the integral empirical regularities emerge opening possibilities of prediction in a sense of the commonly accepted consensus definition worked out in 1976 by the US National Research Council.

Implications of the understanding hierarchical nature of lithosphere and its dynamics based on systematic monitoring and evidence of its unified space-energy similarity at different scales help avoiding basic errors in earthquake prediction claims. They suggest rules and recipes of adequate earthquake prediction classification, comparison and optimization. The approach has already led to the design of reproducible intermediate-term middle-range earthquake prediction technique. Its real-time testing aimed at prediction of the largest earthquakes worldwide has proved beyond any reasonable doubt the effectiveness of practical earthquake forecasting. In the first approximation, the accuracy is about 1-5 years and 5-10 times the anticipated source dimension. Further analysis allows reducing spatial uncertainty down to 1-3 source dimensions, although at a cost of additional failures-to-predict. Despite of limited accuracy a considerable damage could be prevented by timely knowledgeable use of the existing predictions and earthquake prediction strategies. (The talk is illustrated with the case-histories of the recent earthquakes, including the 26 December 2004 Asian Mega-earthquake.)