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A pattern-recognition approach to fully dynamic space-time earthquake forecasting

J B Rundle (1), JR Holliday (2), KF Tiampo (3), LE Knox (2), WJ Gaggioli (2)

(1) Department of Physics, University of California, Davis, CA, USA, (2) Xerasys, Inc., Davis, CA, USA, (3) Department of Earth Science, University of Western Ontario, ON, CAN (jbrundle@ucdavis.edu/ Fax +1 530-754-4885)

An approach used for commercial earthquake risk assessment is the forecast method developed by the Working Groups on California Earthquake Probabilities. The WG-CEP method, which is based on both data and expert opinion, is a set of conditional probabilities for major earthquakes occurring on the major surface faults at a few selected locations in the world over a specified time period, typically 30 years. However, it is known that major earthquakes alter the conditions for future earthquakes on time scales far shorter than 30 years, even on the time scales of minutes to hours. Therefore it should be expected that forecast probabilities should change rapidly in time. Moreover, the detailed geologic knowledge necessary to construct such fault-based models is often not available. In this lecture, I discuss a fully automated approach to short-term earthquake forecasting using the information available in online, global catalogs that are updated in real time. This approach, called *Relative Intensity – Pattern Informatics* (*RIPI*) has been developed, tested, verified, and validated over the past decade. The results of these studies have been extensively documented in journal publications. Using new ensemble classifier technology, together with signal detection theory, both of which grow out of modern pattern analysis methods, we are now finding that much tighter limits can be placed upon the space and time windows in which future major earthquakes will occur. Using these methods, probabilities for occurrence of major earthquakes having magnitudes $M > 6$ can be computed world-wide. Probabilities, together with estimates of standard deviations, can be computed for both short term forecasts (hours to days) and longer term forecasts (3 years and longer). Previously

published tests of our methods document an 80% - 90% hit (success) rate with a false alarm rate of 5%-6%. However, more accurate forecasts are now possible, along with new measures of forecast accuracy.