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Early aftershocks statistics: first results of prospective test of alarm-based model (EAST)

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It was shown recently that the c-value systematically changes across different faulting styles and thus may reflect the state of stress. Hypothesizing that smaller c-values indicate places more vulnerable to moderate and large earthquakes, we suggested a simple alarm-based forecasting model, called EAST, submitted for the test in CSEP in California (3-month, $M \geq 4$ class); the official test was started on July 1, 2009. We replaced the c-value by more robust parameter, the geometric average of the aftershock elapsed times (the ea-value). We normalize the ea-value calculated for last 5 years by the value calculated for preceding 25 years. When and where the normalized ea-value exceeds a given threshold, an “alarm” is issued: an earthquake is expected to occur within the next 3 months. Retrospective tests of the model show good and stable results (even better for targets $M \geq 5$). During the first 6 months of the prospective test 22 target earthquakes took place in the testing area. 14 of them (more than 60%) were forecasted with the alarm threshold resulting in only 1% of space-time occupied by alarms (5% if space is normalized by past earthquake frequencies). This highly encouraging result was obtained mostly due to successful forecast of the sequence of 11 earthquakes near Lone Pine in 1-9 October 2009. However, if we disregard aftershocks as targets, then 4 out of 9 main shocks occurred in alarms with normalized ea-value threshold resulting in 2.5% of normalized space-time occupied by alarms, the result is also impossible to get by chance at a significance level 1%. To expand the evaluation of the EAST model relative to larger number of forecast models, we have developed its frequency-based version. We estimate the expected frequency of earthquakes using joint retrospective statistics of targets and the ea-value.