



Prospective Evaluation of the Global Earthquake Activity Rate Model (GEAR1) Earthquake Forecast: Preliminary Results

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The Global Earthquake Activity Rate Model (GEAR1) is a hybrid seismicity model, constructed from a loglinear combination of smoothed seismicity from the Global Centroid Moment Tensor (CMT) earthquake catalog and geodetic strain rates (Global Strain Rate Map, version 2.1). For the 2005-2012 retrospective evaluation period, GEAR1 outperformed both parent strain rate and smoothed seismicity forecasts. Since 1. October 2015, GEAR1 has been prospectively evaluated by the Collaboratory for the Study of Earthquake Predictability (CSEP) testing center. Here, we present initial one-year test results of the GEAR1, GSRM and GSRM2.1, as well as localized evaluation of GEAR1 performance. The models were evaluated on the consistency in number (N-test), spatial (S-test) and magnitude (M-test) distribution of forecasted and observed earthquakes, as well as overall data consistency (CL-, L-tests). Performance at target earthquake locations was compared between models using the classical paired T-test and its non-parametric equivalent, the W-test, to determine if one model could be rejected in favor of another at the 0.05 significance level.

For the evaluation period from 1. October 2015 to 1. October 2016, the GEAR1, GSRM and GSRM2.1 forecasts pass all CSEP likelihood tests. Comparative test results show statistically significant improvement of GEAR1 performance over both strain rate-based forecasts, both of which can be rejected in favor of GEAR1. Using point process residual analysis, we investigate the spatial distribution of differences in GEAR1, GSRM and GSRM2 model performance, to identify regions where the GEAR1 model should be adjusted, that could not be inferred from CSEP test results. Furthermore, we investigate whether the optimal combination of smoothed seismicity and strain rates remains stable over space and time.