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Short-term earthquake forecasting experiment before and during the L'Aquila seismic sequence of April 2009

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In this study, we compare the forecasting performance of several statistical models, which are used for describing the occurrence process of earthquakes, in forecasting the short-term earthquake probabilities during the occurrence of the L'Aquila earthquake sequence in central Italy, 2009. These models include the Proximity to Past Earthquake (PPE) model and two versions of the Epidemic Type Aftershock Sequence (ETAS) model. We used the information gains corresponding to the Poisson and binomial scores to evaluate the performance of these models. It is shown that both ETAS models work better than the PPE model. However, when comparing between the two types of the ETAS models, the one with the same fixed exponent coefficient ¥alpha=2.3 for both the productivity function and the scaling factor in the spatial response function (Model I), performs better in forecasting the active aftershock sequence, than the other model with different exponent coefficients (Model II) even though Model I is a subclass of Model II; Model II performs only better when a lower magnitude threshold of 2.0 and the binomial score are used. The reason is found to be: the catalog does has an event of similar magnitude as the L'aquila mainshock in the training period, and ¥alpha-value is under estimated and thus the forecasted seismicity is underestimated when the productivity function is extrapolated to high magnitudes. These results suggest that the training catalog used for estimating the model parameters should include earthquakes of similar magnitudes as the mainshock when forecasting seismicity in the duration of an aftershock sequences.

Keywords: earthquake forecast, probability forecast, ETAS model, information gain, 2009 L'aquila earthquake