Improving medium-term earthquake forecasts by compensating the EEPAS model for the time-lag

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The “Every Earthquake a Precursor According to Scale” (EEPAS) model treats every earthquake as a precursor of larger earthquakes to follow it in the medium term. Each earthquake contributes a transient increment to the expected rate of earthquake occurrence in its vicinity, based on empirical predictive scaling relations associated with the precursory scale increase phenomenon. Incomplete information on precursory earthquakes causes the EEPAS model to under-predict the expected number of earthquakes when forecasting across a time-lag. We modify EEPAS to compensate for the time-lag when calculating future forecasts. Given a set of model parameters, the completeness of precursory information can be expressed as a function of the target earthquake magnitude and the time-lag. The EEPAS model has a time-varying component and a background component. We consider two end-members for compensating the model for incompleteness: one entirely in the background component, and the other entirely in the time-varying component. We estimate an optimal mixture of these two end-members for time-lags out to 12 years using several different versions of the EEPAS model and subsets of the New Zealand earthquake catalogue to which EEPAS was previously fitted. Performance is checked on an independent test period. The optimal compensated model having increasingly high information gains over the original EEPAS model with increasing time-lags. Using catalogue data complete to 2018, the compensated models forecast increased annual probabilities of earthquake occurrence above magnitude thresholds from 6.0 to 8.0 in central New Zealand in the period 2019-2030 relative to the preceding period 2008-2018.

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