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Evaluation of annual, global seismicity forecasts, including ensemble models

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In 2009, the Collaboratory for the Study of the Earthquake Predictability (CSEP) initiated a prototype global earthquake forecast experiment. Three models participated in this experiment for 2009, 2010 and 2011—each model forecast the number of earthquakes above magnitude 6 in 1x1 degree cells that span the globe. Here we use likelihood-based metrics to evaluate the consistency of the forecasts with the observed seismicity. We compare model performance with statistical tests and a new method based on the peer-to-peer gambling score. The results of the comparisons are used to build ensemble models that are a weighted combination of the individual models. Notably, in these experiments the ensemble model always performs significantly better than the single best-performing model. Our results indicate the following: i) time-varying forecasts, if not updated after each major shock, may not provide significant advantages with respect to time-invariant models in 1-year forecast experiments; ii) the spatial distribution seems to be the most important feature to characterize the different forecasting performances of the models; iii) the interpretation of consistency tests may be misleading because some good models may be rejected while trivial models may pass consistency tests; iv) a proper ensemble modeling seems to be a valuable procedure to get the best performing model for practical purposes.