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Forecasting Moderate Seismicity by Using the Moment Ratio Method

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Abstract. Recently, we introduced a new alarm-based forecasting model for earthquakes, called moment ratio (MR) model. In this model, the ratio of the mean inter-event time over the variance is used as a precursory alarm function to forecast future earthquakes in a given region. In a former study, this model was successfully tested in forecasting large earthquakes with magnitude M >= 7, occurred in Japan. As a first step towards testing the applicability of our model in forecasting earthquakes in moderate seismicity areas as Northern Algeria, the MR model is tested on target earthquakes with magnitude M >= 5. For this purpose, a composite catalog covering all Japan within the period 679-2011 is used. This catalog was compiled using the Japan Meteorological Agency (JMA) catalog for the period 1923-2011 and the Utsu historical seismicity records for the period 679-1922. Time periods used in training and testing are selected by taking into account the completeness of the magnitude. Molchan error diagrams are used to evaluate the forecasting performance of the MR method in a series of retrospective tests applied at short, intermediate and long-term. Then, MR forecasting maps are obtained based on minimizing miss and alarm rates. The limitations of the MR model are discussed focusing on cases of poor catalog data with epicenter location errors. The applicability of the Collaboratory for the Study of Earthquake Predictability CSEP prospective tests to the MR method is discussed by tuning different free parameters of the model. Results show that the minimal inter-event time sample size used to calculate the moment ratio together with the size of inter-event time sampling area shape the study region, and play important role in the calibration of our model to CSEP 'rules of game'. Finally, we discuss the impact of the MR forecasts on seismic hazard assessment in a given region.

Keywords: Earthquake forecasting, Inter-event times, Alarm function, Molchan diagram