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In this study, to obtain optimal estimates of the earthquake hazard in North China based on the modern earthquake catalogue, we used two variable kernel function estimation methods and two spatial tessellation methods to calculate the total and background seismic spatial occurrence rates for the study area.

The first problem of this study is to derive the best estimate of the long-term earthquake risk in North China. To address the first problem, we use the kernel function estimation methods of Stock and Smith (2002) and Zhuang et al. (2002), the Bayesian Delaunay-Tessellation Smoothing Method used by Ogata (ODTB) (2003, 2004), and ICVT to estimate the total earthquake hazard for North China. The results were compared and analyzed through the cross-validation method, to ensure accurate reflection of the seismic activity in North China. The sophisticated ODTB method is more stable than the others, but is relatively expensive, in terms of computation demands, while Zhuang et al.’s kernel estimate and the new ICVT method are able to provide reasonable estimates and easier to implement.

For the second problem, of b-value, we use Ogata’s method (2004, 2015) based on free nodes, to calculate the *b*-value spatial distribution. We expect that the obtained results of the spatial distribution of seismic risk and *b*-value provide a reference for the evaluation and prediction of large earthquakes and stress distribution in the study area.

For the third problem, we use two methods to estimate background seismic rates, and compare the results. The first method uses the result of the background seismic event probability, calculated by the epidemic-type aftershock sequence (ETAS) model (Zhuang et al., 2002; Zhuang, 2011), to simulate the background seismic risk distribution. The second method is to calculate the spatial distribution of earthquake hazard by using the HIST-ETAS model (Ogata, 2004).

Using comparative analyses and simulation experiments, we show that all of methods give similar spatial patterns of seismic occurrences.

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