

Estimation of the frequency-magnitude Gutenberg-Richter b-value without level of completeness

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One of the weakest points of the classic Aki-Utsu b-value estimator is its heavy dependence on the level of magnitude completeness m_c . At the same time, the assessment of m_c is in itself not a trivial task. New estimators for frequency-magnitude Gutenberg-Richter b-value that are not dependent on the level of completeness m_c are proposed in the place of the Aki (1965) maximum likelihood and Utsu (1965) moment estimators. The Monte-Carlo simulations show that the newly derived estimators are especially effective when the apparent, incomplete frequency-magnitude distribution is gradually curved and has only one maximum i.e. according to classification by Mignan (2012) belongs to distributions of category IV. The most striking feature of the newly derived moment estimator is its simplicity as it can be expressed by the first three sample central magnitude moments: the mean, standard deviation and skewness. The simulations also show that the proposed maximum likelihood estimator of the b-value is considerably less accurate than its moment counterpart. In the case where the applied sample of earthquake magnitudes is complete, the equations describing the newly derived the moment and the maximum likelihood b-value estimators take the form of the classic Aki (1965) and Utsu (1965) b-value solutions. Since the newly proposed b-value estimators also incorporate weak seismic events, they can be used in for more reliable earthquake hazard, forecasting and prediction assessments.

Keywords: level of completeness, Aki-Utsu b-value estimators

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