Earthquake Monitoring in Tokachi-oki Using the Temporal Variation of b-value

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The relationship between the frequency-magnitude distribution (FMD) is described by the Gutenberg-Richter (GR) law, *log10NM=a-bM*. A coefficient b measures difference in the relative proportion of small and large earthquakes. And it was reported in many studies that b-value decreases prior to great earthquakes. It’s essential to decide the Magnitude of Completeness (Mc), above which earthquakes are recorded completely so that the FMD will follow the GR law. The detectability variates in time, so we investigate the temporal variation of Mc and choose the biggest one to represent Mc for the whole analyzed period. To investigate temporal variation of Mc, we divided earthquakes into windows chronologically and applied the bootstrap method to randomly resample a subset for each window, then we estimated Mc of subset using the MAXC (maximum curvature) technique. We also divided earthquakes in windows and applied maximum likelihood estimation to each window for calculation of b-value. We use Akaike Information Criterion (AIC) to compare each b-value to the b-value corresponding to the period of the normal seismicity. It shows significance of difference between 2 b-values if ΔAIC≧2. We applied bootstrap approach to resample for the period which has normal seismicity, and calculate b-values of subset as the reference b-values. We compute AIC between b-value and reference b-values and counted the number of ΔAIC≧2, and use the percentage (P) of ΔAIC≧2 to evaluate the significance level of variation in b-value. In stead of comparing the b-value with a single reference b-value, we can estimate the difference of b-values objectively in this process.

As an example, we investigated the daily variation of b-values and P in Tokachi-oki region Japan, over 1990-2014. It shows that P increases significantly 3 months prior to the 2003 Tokachi-oki earthquake (M8.0), which suggests the significance of decrease of b-value. This result is capable to show that the b-value has a potential capability of predicting an impending earthquake of M8 class. The details will be given in the presentation.

Keywords: b-value, AIC, Mc

