Evaluation of the method of eMAP based on the Poisson probability of seismic activity

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As means for visualization of seismic activity, the authors have applied the eMAP method to make clear and objective images, whereas Matsumura's method (Matsumura,2002) and ZMAP (Wiemer and Wyss, 1994) have been more often used to make such images. However, we have not characterized its features or differences from other methods. To clarify these, we compared the analyzed results from these methods based on the same epicenter data.

Survey was conducted in the crust of the Tokai region, which is considered to have a relatively high detection capability (Mc = 1.1), based on the unified catalog of the Japan Meteorological Agency. We made hypocenter data in which the value of M was changed in 11 steps from -0.5 to +0.5, and de-clustered them. Then we analyzed the data with the magnitude threshold of 1.6. The eMAP method evaluates the probability of the occurrence rate during the evaluation period from the Poisson distribution having an average of the occurrence rate during the reference period (P value). The target is a circular area centered on each epicenter. On the other hand, Matsumura's method evaluates the seismic activity based on the logarithmic ratio (L value) of the occurrence rates during the two periods, and ZMAP evaluates the seismic activity based on the relative difference divided by the standard deviation (Z value) of the occurrence rates during the two periods. The analysis is performed at all the grid points in the target region for both methods, but the former uses rectangular areas and the latter uses circular areas with variable radii keeping the number of events a constant.
According to the results of the analysis, in the latter two methods, L value and Z value showed almost linear relationship against M in the range where M changed. On the other hand, the eMAP result (P value) follows the cumulative probability curve of the Poisson distribution. It shows a positive correlation with the change in M, but it approaches 1 or 0 which means ‘saturation’ when the change in M exceeds 0.3. The above results suggest that the latter methods (C value and Z value) with high linearity is suitable for quantitatively analyzing the spatial distribution of seismic activity and that the eMAP method is suitable for detecting the region with high sensitivity where the seismic activity is remarkably quiet or active.

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