Characteristics of the foreshocks and aftershocks activity inferred from the JMA seismic catalog improved by automatic processing

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In research of seismic activity, it is important to lower a completeness magnitude (Mc) of the G-R law. If we have a sufficient number of earthquakes, we can evaluate seismic activity with high spatiotemporal resolution, such as ETAS analysis, detection of background seismicity rate change, and stress state estimation by b value analysis. Also, a catalog including smaller earthquakes is useful to understand characteristics of foreshocks activity which is generally low seismicity. After April 2016, the JMA unified seismic catalog was improved by a new automatic processing system (Tamaribuchi et al., 2016, in Japanese), which led to the almost twice identifications of earthquakes compared with the conventional catalog. In the 2016 Kumamoto Earthquake, however, all of detected earthquakes could not be cataloged in real time due to a delay of visual inspection for the numerous aftershocks. Therefore, we created a catalog data merged a JMA unified seismic catalog and an automatic processed catalog. In this research, we extracted features of foreshocks and aftershocks activities inferred from this merged catalog. Many clustering methods have been proposed for analysis of big data. We therefore used the Nearest-Neighbor Distance method, which is an objective and systematic clustering method proposed by Zaliapin and Ben-Zion (2013, JGR), and used the efficient program devised by Kasahara (2016). In this method, it is possible to cluster seismic activity objectively and automatically by defining "distance between hypocenters" using epicentral distance, time difference, and magnitude. We confirmed that the histogram of the NND distance is bimodal, and that the seismic activity can be automatically clustered with the same NND threshold value of the conventional research. Therefore, we could categorized events into the foreshocks, mainshocks and aftershocks from these clusters, and analyzed statistics such as b value. In particular, we calculated the b value for 5 clusters with more than 50 foreshocks. The b value of the foreshocks is significantly lower than that of the aftershocks in 2 cases, the 2016 Kumamoto Earthquake and the activity in central Tottori prefecture in October. This low b value may correspond to the increased local stress before the mainshock. On the other hand, it was also found that there are many clusters in which the b value of the foreshocks and aftershocks were almost the same. In the future, we expect that the features of the foreshock and aftershock activities will become clearer with this improved catalog obtained by automatic processing.

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