



Attempt to Determine Hypocenters of the Earthquakes Occurred in Pre-modern Japan

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In this study, we are constructing a database useful for understanding long-term seismic activity in Japan by investigating and analyzing high-quality historical diaries that include descriptions of the intensity of earthquakes and the resulting damage. We are also trying to determine the hypocenter of the described earthquakes in this historical database by comparing historical earthquakes to modern earthquakes of which hypocenters are analyzed for observed seismic intensity maps.

In evaluating future earthquake occurrence risk in the Japanese archipelago, where earthquakes occur frequently, it is very important to understand long-term seismic activity. The historical diaries are essential to understanding daily seismic activity including small- and medium-scale earthquakes in the pre-modern era, which is hundreds of years before the development of modern earthquake observation instruments.

The daily earthquake information between A.D. 1853 and 1856 were surveyed at 28 sites that are distributed widely in Japan and about 2,800 felt earthquake descriptions were registered in the historical database. The number of survey sites was 13 in our previous study (Nishiyama et al., 2018, EGU) and it was more than doubled to understand the whole image of seismic intensity distribution and to increase the number of events that can be covered by the historical database. To test the capability of earthquake detection through the present distribution of the survey sites, we used a modern earthquake record database provided by Japan Meteorological Agency (JMA). In the JMA database, we first found the nearby observation points of the 28 survey sites of the historical database. Then, we counted the number of earthquakes that have the seismic intensity of one and above at any of the 28 points. As a results, 5,847 (9.5%) events could be detected from the whole 61,352 events of the JMA database during A.D. 2000-2016. For only 2016, 273 (4.1%) events out of 6,712 events could be detected.

To understand the seismic activity from the limited number of the survey sites of the historical database, we are trying to determine the hypocenter of the earthquake events recorded in the database. To do this, there is a challenge to determine the hypocenter only from the seismic intensity, as there is no seismic wave record. To check the possibility of this approach, we compared the events in 2016 to the events in 2000-2015 using the JMA database. For every one of the 273 events detected by the 28 observation points in 2016, we estimated the hypocenter of each event by finding the event that has the most similar earthquake intensity distribution in 2000-2015 and referring the hypocenter of the found similar event. As a result, 141 (51.6%) events showed less than 100-km difference between the locations of estimated and true epicenters. For the estimated magnitude, the average error was 19.1% and the standard deviation of the error was 16.1%. After refining the methodology, we will estimate the hypocenters of historical events.