

Reanalysis of JMA initial phase mechanism solution to extract inter-plate earthquakes

*ryota nakamaru¹, Ryoya Ikuta²

1. Department of Earth and Environmental Sciences, Graduate School of Environmental Studies, Nagoya University, 2. Department of Science, Shizuoka University

In this study, we developed a method to reanalyze the initial phase mechanism solution provided by JMA to extract inter-plate earthquakes which are not listed in the catalogue.

Although the earthquake mechanism determination based on the initial P wave polarity has an advantage against CMT solution in applicability to both smaller and old earthquakes which do not have enough waveform information, the solutions have large uncertainty affected by biased station distribution and seismic velocity structure. The JMA initial phase mechanism catalogue is listing only earthquakes whose mechanisms are well solved. Especially, inter-plate earthquakes seem to be often ignored.

We researched the initial phase mechanisms for the known 70 inter-plate earthquakes larger than M6 occurring on the surface of the subducted Pacific plate beneath eastern Japan in this 20 years. Among them, only 23 earthquakes are listed in the JMA catalogue and 16 of them are classified as thrust faulting. First, we resolved the mechanism of all these earthquakes using the same method with JMA.

Among the 70 earthquakes, 28 are classified into inter-plate earthquakes by the initial phase mechanism. The other 42 earthquakes are not correctly classified. Since the given depth of these earthquakes differ from the depth of plate interface, we moved them onto the plate interface.

We researched the not-correctly-classified solutions to find that the assumed incident angles of the P waves near nodal plane of the thrust faulting need to be decreased to fit to the thrust faulting with the observed push-pull distribution. Therefore, we tested several correction patterns of the incident angle revising the seismic velocity profile based on the original JMA2001 velocity. When the push-pull distribution of the stations on the focal sphere with the revised incident angles fits to the CMT solutions, the correction pattern is regarded as the best one.

As a result, when assuming the layer to become a corrected structure in which the higher velocity increases within of seismic wave over 45km beneath from the depth of hypocenter depth, I could get the initial phase mechanism solutions well matched CMT solutions well. In this case, the solutions classified into as inter-plate earthquakes increased from 28 to 44 and not of in total 70 earthquakes (an example is shown in the Figure) classified into inter-plate earthquakes was 26.

Among the rest 26 solutions which show other mechanism than inter-plate solution, 23 seem not to be solved as inter-plate earthquake. It is may be difficult in principle to correct these solution to be inter-plate earthquake improvement 23 of 26 solutions of not classified into inter-plate earthquakes for with this method using only initial P wave.

Figure

Initial phase mechanism of the Ibaraki earthquake (M7.0, May 8, 2008). (a) Polarity distribution with the

incident angle based on JMA2001. (b) Polarity with the corrected incident angle. The solution score improved from 91% in (a) to 97% in (b). (c) Polarity distribution on map.

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