

Development of manual picking system of seismic wave correcting accurate automatic pickings

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1. Introduction

We have been developing P and S wave automatic arrival time picking system which is accurate compatible with manual picking. This system selects several candidates of arrival times and selects one among them by using many kinds of threshold parameters based on the knowledge of earthquake expert. As a result, it is able to pick 2-3 times of accurate arrival times and determines 2-3 times of hypocenters compared to the catalogue by Japan Meteorological Agency. However, in the case of automatic system, it is difficult to completely eliminate wrong readings. It is required to conduct manual checking for the detailed studies such as the seismic tomography or focal mechanisms using polarity data etc. In this study, we present on a manual picking system which makes picking by correcting automatic readings.

2. Adjustment of picking parameters of automatic system

The automatic processing system can read data with low S/N ratio though accuracy is low. However there are cases in some researches that it is better to read only accurate data. Therefore, firstly, we changed threshold levels defined in the software of automatic picking so that the accuracy or the number of pickings fits to the research purpose. We change the threshold levels so that the number of picking by the automatic system become nearly same with it by the manually picking.

3. Manual arrival time picking system

The present manual picking system reads triggered waveform data and conducts the automatic picking based on the threshold levels mentioned above. Next, it displays waveform data together with picked arrivals for about 10 stations simultaneously. The manual picking is made by searching for erroneous readings of automatic pickings and correcting them. It is possible to select one among waveforms of 1) Raw, 2) High-pass filter, 3) Filter by the AR model in the P wave correction and 1) Raw, 2) High-pass filter, 3) SH component, 4) P and S wave discrimination filter, 5) absolute value of horizontally component in the S wave correction. We added a function to display waveform data of only stations with large arrival time residuals. We also added various functions so that the mouse operation becomes minimum at times of changing time scale and shifting time axis, etc.

4. Results

There is a data set of arrival times picked manually by an experienced seismologist which are used for the training of how to make manual pickings. Using this data set, we changed parameters of the threshold level of automatic picking so that the number of pickings becomes nearly same between the automatic and manually picking. There are 19 events in the data set. The numbers of P and S wave arrival times are 1124 and 936, respectively and 806 polarity data. These values by the automatic were 1193, 1300, and 747, respectively. We compared the difference between P and S wave arrival times picked automatic and arrival times in the data set. We found that more than 90 % of P wave arrival time differences are within 0.025 second, and 90% of S waves within 0.05 sec. The number of polarity read by the two was 663, and 99% of readings are consistent. This result shows that required corrections of automatic pickings is limited to a small number. Because of the introduction of accurate automatic picking software in the manual picking, a veteran operator can conduct manual picking within about 5 minutes for an event having P and S wave arrivals from about 100 stations.

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Automatic picking compatible with manual picking