

Significance of Improved Hypocentres for a Globally Distributed Set of Earthquakes

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Many seismological agencies are considering new algorithms and travel time models to compute more accurate hypocentres and uncertainties. It is preferable to evaluate alternative hypocentres by comparison with reference locations for very well located events. But reference locations remain sparse in some regions, so a supplementary approach to evaluation is useful.

One approach is to compare differences between predicted and observed arrival times for alternative hypocentres, but difficulties arise in evaluating statistical significance since these residuals are likely to include outliers. Outliers are accommodated within location algorithms using robust statistics, but these statistics may have properties that prevent them from showing improvement even if it occurs.

I show that there are robust statistics that will show improvement if the fit to arrival times is genuinely better. The population distribution of robust statistics is often unknown, but I show that non-parametric tests of these statistics can nevertheless demonstrate the significance of improvement. For a globally distributed set more than 3000 events I show that ak135 travel times improve the fit to arrival times compared with Jeffreys-Bullen and that a tomographic model of Karason and van der Hilst provides further improvement. For geographic subsets of only hundreds of events, however, only the total improvement from Jeffreys-Bullen to the tomographic model is statistically significant.