

Improved Locations for Moderately Large Earthquakes Using Regional S and PKP

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The ISC Bulletin contains the largest collection of different phases associated with seismic events all over the world. Currently only P arrival times at a distance up to 105 degrees are used for computing ISC hypocentres. Arrivals other than P serve only to indicate a gross mislocation.

A relevant question is whether ISC should follow the example of other international agencies like pIDC and change its location policy to include phases other than P. The most benefit would appear to come from the use of S and PKP arrival times. Used in addition to P, local S arrivals would assist in constraining the origin time, and thereby improve determination of other parameters. Use of PKP arrivals near the caustic is likely to help in the trade-off between origin time and depth as well as improving station azimuthal coverage. Taken together these measures will generally contribute towards optimising location using the same Jeffreys-Bullen travel times.

Another implication of such a policy change would be the possibility of reducing the number of events in the ISC Bulletin with no ISC epicentre. During 1996-1997 the global ISC threshold for completeness is known to be between Mb 4.0 and 5.0. Yet about 10% of events with Mb between 4.0 and 4.5 have no ISC hypocentral estimate. Such events are usually found in the Kermadecs, Tonga, Samoa, Fiji, Vanuatu, Afghanistan etc, where the local network is either non-existent or placed unfavourably and the azimuthal coverage of P arrivals alone is usually too poor to give a reliable location.

We relocated all events with PKP reports available from the ISC Bulletin for the period of one year. The most benefit have appeared to come from the use of S-arrivals at close distances and PKP-arrivals at distances close to the caustic. The essential improvement in location was achieved for the events below magnitude 4.5 Mb. The results of relocation did not show any bias in shift of main hypocentre parameters. On average the uncertainty of earthquake location have generally improved, whilst the standard deviation of travel time residuals have slightly risen. We have presented an example, where the event previously known to be deep was found to be shallow as a result of relocation. The other example illustrates cases where low azimuthal coverage of reporting stations could be tolerated as a result of using arrivals other than P.