

Improved Locations for Moderately Small Earthquakes Using Regional and Teleseismic S

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The main tasks of the International Seismological Centre are to re-determine earthquake locations making use of all available information, and to search for new earthquakes. At present ISC uses only P-wave arrival times to recompute earthquake locations. These data are insufficient when stations used are few in number or poorly distributed in azimuth, so the additional use of arrival times of secondary phases, such as S, is often needed to provide a satisfactory solution. Secondary phase times are likely to be available in many cases, since nearly 20% of arrival times reported to the ISC are identified as a teleseismic or regional S.

In this paper we use both P and S arrival times to relocate earthquakes from the ISC bulletin. We use the method of uniform reduction and the Jeffreys weighting function for P and S. The standard Jeffreys-Bullen travel times are used to calculate residuals. The additional use of S arrival times, permits epicentres to be determined for a number of earthquakes that could not be located using P arrival times only, and the proportion of events for which we can determine acceptable solutions rises from 70% to 85%. We also generally reduce the formal uncertainty of the source location. The combined use of P and S arrival times gives more control over the determination of origin time, and hence also of depth. For earthquakes of magnitude greater than 6, and with good coverage of station azimuth, the additional use of S arrival times does not significantly improve locations found by P arrivals only.

Since S phases are likely to have picking time errors larger than those of P, we carried out a test to assess the effect of such errors on source parameters. We perturbed P and S times with random numbers from normal distributions, with a standard deviation of 0.5s for P and 1.0s for S. For locations of stations that actually reported P and/or S phase times, we then re-determined source parameters using P alone and using P and S together. Comparing the results, we found that the use of S phases leads to more constrained solutions.