

# **The Effect of Including S Arrival Times in Global Seismic Location at the International Seismological Centre**

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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. This method is inadequate 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. S phases now represent 20% of the arrival times reported to ISC, and the increasing availability of digital stations with advanced signal processing has improved the accuracy of their reporting. In this paper we use both P and S arrival times to relocate earthquakes reported by ISC during the last three months of 1997. 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 71% to 83%. We also generally reduce the formal uncertainty of the source location. The use of S arrival times makes the inversion more robust and reduces mislocation due to wrong picking of P arrival times. At certain distances pP is more energetic than P and can be wrongly identified as P. 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.