



Acquisition of reference events to improve earthquake locations and to test 3-D Earth models

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A project to improve the accuracy of earthquake locations in many regions and eventually worldwide has been organized under an IASPEI Working Group on Reference Events. The immediate goal of the Working Group is to develop a set of earthquakes or other seismic sources for which hypocenter information (origin time, depth, latitude, longitude) is accurately known, and whose seismic signals are large enough to be detected at distances out to 1000 km and perhaps teleseismically. We are calling such earthquakes (or other seismic sources) "reference events". Our larger goal is to enable the seismological community to do a better job of locating earthquakes. By building up a large enough set of reference events, we anticipate that empirical information on travel times as a function of distance, phase, and azimuth (and eventually as a function of depth) can be obtained for individual stations detecting the events. From stations calibrated in this way, we anticipate that it will be possible to improve the accuracy of earthquake locations over broad regions for which reference events are available. Moreover, the data derived from these reference events can be used to test 3-D Earth models such as the proposed European Reference Model. Reference events can be found in a number of different ways. We use the notation GT_n for an event whose epicenter is confidently known to within *n* kilometers. In part this recognizes that depth is often more difficult to estimate, although it can be traded off with the origin time. When we are being careful in our designation of an event as, say GT₅, we mean that this uncertainty describes an area of $\pi * 5 * 5 = 78.5$ sq. km, which has a 95% chance of including the actual hypocenter. A number of successful ways in which reference events have been identified, as well as the types of data and information that we seek to acquire, will be discussed. Because there may not be general agreement on what evidence is needed to attain, say, GT₅ or GT₂ or better quality, we anticipate

the need to evaluate contributed GT events, at least in the early process of building up this archive. Possibly, once a number of different guidelines are agreed upon, it will be enough simply to certify that one or another set of guidelines has been followed — or, to demonstrate that other evidence has been used. We anticipate that during an initial period of about two years, we shall be able to build a significant dataset of reference events using previous lists of such events that have been developed as a result of research projects already accomplished. At the same time, and continuing for a longer period, we shall want to build sets of reference events that fill in gaps in our knowledge.