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Travel-time source-specific station correction improves location accuracy

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Accurate earthquake locations are crucial for investigating seismogenic processes, as well as for applications like verifying compliance to the Comprehensive Test Ban Treaty (CTBT). Earthquake location accuracy is related to the degree of knowledge about the 3-D structure of seismic wave velocity in the Earth. It is well known that modeling errors of calculated travel times may have the effect of shifting the computed epicenters far from the real locations by a distance even larger than the size of the statistical error ellipses, regardless of the accuracy in picking seismic phase arrivals.
The consequences of large mislocations of seismic events in the context of the CTBT verification is particularly critical in order to trigger a possible On Site Inspection (OSI). In fact, the Treaty establishes that an OSI area cannot be larger than 1000 km2, and its larger linear dimension cannot be larger than 50 km. Moreover, depth accuracy is crucial for the application of the depth event screening criterion.
In the present study, we develop a method of source-specific travel times corrections based on a set of well located events recorded by dense national seismic networks in seismically active regions. The applications concern seismic sequences recorded in Japan, Iran and Italy.
We show that mislocations of the order of 10-20 km affecting the epicenters, as well as larger mislocations in hypocentral depths, calculated from a global seismic network and using the standard IASPEI91 travel times can be effectively removed by applying source-specific station corrections.