Earthquake Location in Austria: Accuracy, Reliability and Improvements for hypocenters after 2000

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Earthquake location at the Seismological Service of Austria (ZAMG) routinely includes a 1D-velocity model (IASP91) and waveform data from the national seismic network (OE). Data from permanent networks of the neighboring countries as well as temporary networks deployed in Austria are also available for analysis. The national seismic network of Austria consists of 19 broad-band stations (isolated places) and 20 strong-motion stations (populated areas). The actual network geometry is unevenly distributed and therefore the accuracy of earthquake locations (especially the focal depth) can vary considerably along Austria. High-precision epicenter locations can be obtained for certain areas in Austria from seismic data of temporary networks such as AlpArray, TU-SeisNet or SwathD. However, for seismic hazard assessment the use of long-term earthquake records with precise hypocenter locations is essential to resolve active tectonic processes and to parametrize active faults.

Reliability network locations are found and are accurate to within 5 km with a 95% confidence level when the GT5 criterion is met. We relocated more than 1200 GT5 events using the probabilistic earthquake location method NonLinLoc combined with a 3D-velocity model to account for the complex structure of the Eastern Alps (MOHO, sedimentary basins). To document our relocations we investigated the differences in depth, latitude and longitude between routine ZAMG locations and the probabilistic earthquake location combined with the 3D-model. Focal depths were also compared to depths derived from macroseismic evaluations.

Absolute location uncertainty was assessed by locating single events from several quarries in Tyrol, South Tyrol, Lower Austria, and Burgenland. For relative location uncertainty events from two recent earthquake series near Fulpmes (Tyrol) and Alland (Lower Austria) were evaluated. We investigated the routine ZAMG location procedure and that of the probabilistic earthquake location combined with either the 3D-model and or the 1D-model.

The new 3D-locations fulfilling the GT5 criteria will be used to delimitate the trend of active faults, to delimitate areas of similar focal depths and to assign representative depths to active faults.

Preliminary data show that for poorly constrained locations (not fulfilling GT5 criteria) the performance of the probabilistic earthquake location with the 3D-model is comparable and sometimes slightly worse than the routine ZAMG location. For well constrained locations (fulfilling GT5 criteria) the probabilistic earthquake location with the 3D-model yields more precise and reliable hypocenter locations. The 3D-locations are slightly shallower as before and are better in agreement with depths derived from macroseismic evaluations.