

SEISMIC AND TSUNAMI EARLY WARNING IN ICELAND

**Einar Kjartansson, Kristín S. Vogfjörð, Sigurlaug Hjaltadóttir,
Hjörleifur Sveinbjörnsson, Gunnar B. Gudmundsson, Sigthróður Ármannsdóttir,
Halldór Geirsson, Matthew J. Roberts, and Bergthóra S. Þorbjarnadóttir**

Icelandic Meteorological Office, Reykjavík

Abstract

Tools for real-time analysis have been implemented at seismic stations in the SIL system in Iceland, as a part of the Icelandic Meteorological Office participation in the SAFER and TRANSFER projects. These tools include processes to support alert maps and Shake Maps, first steps towards fast magnitude determination based on dominant frequency, and the development of procedures to map faults in near real-time.

Data for alert maps and Shake Maps is obtained using a real-time process that monitors both ground velocity and acceleration in 4 separate frequency bands at each station: 4-50 Hz, 1-10 Hz, 0.25-2.5 Hz and 0.05-0.5 Hz. A reference level is maintained for horizontal and vertical components in each frequency band, such that it is exceeded a few times per hour. When signals exceed this level by more than 50%, a report is sent to the processing centre. When 5 or more stations send reports within a time interval of 20 seconds, alert maps are generated. The alert maps show observed values for each station, including peak ground velocity and arrival times for peaks in ground motion and first break

An attempt is also made to solve for the location of the event. The location solution is based on the assumption that time when the vertical component first exceeds the reference level by a certain amount indicate the arrival of the P wave from an earthquake.

All possible combinations of 3 stations are used to compute potential solutions; the location that yields the lowest sum of absolute residuals is then found. Once the location has been determined, conventional magnitude can be calculated, using recently refined magnitude-distance relations for Icelandic earthquakes. When a good fit is obtained

for at least 5 stations, for both arrival times and amplitudes, and the magnitude indicated is greater than 2.0, a Shake Map is generated and placed online automatically. The Shake Maps are usually ready within 3 minutes of the earthquake. The maps can be accessed at <http://hraun.vedur.is/ja/alert>. This real-time analysis has been implemented on 56 stations in the SIL system. These tools have yielded accurate magnitude estimations for nearly all earthquakes that have been felt in the past 12 months. In order to get more accurate Shake Maps, data on near-surface seismic properties have been collected, and used to estimate the effect of site on seismic shaking. In addition to the parameters used for Shake Maps, estimates of dominant period for first 4 seconds after trigger on the vertical are computed, in real time. These may be used to estimate magnitude, before location has been determined as in the ElarmS methodology. In order to obtain more reliable results for earthquakes offshore North Iceland, data are obtained in near real-time through ORFEUS from station on Jan Mayen and Greenland. This data will be integrated into the near- real-time processing of data from the SIL stations. Mapping of faults in near real-time is performed by using double-difference relocation of automatically located micro-earthquakes, relative to a library of events already located with high precision. Thus, taking advantage of the tens of thousands of earthquakes in South Iceland that have been relatively located. Automation of the relocation process is under development. When completed, the process will enable near real-time delineation of activated faults by the distribution of micro-earthquakes.