DEVELOPMENT HISTORY AND FUTURE POTENTIAL OF THE SIL SYSTEM

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Abstract

The European Council recommended in 1979 a concentrated effort on earthquake risk mitigation and earthquake prediction in five test areas in Europe. One of the suggested areas was the South Iceland Lowland (SIL). In the early eighties, Ragnar Stefánsson initiated discussions among Nordic seismologists regarding Nordic cooperation towards earthquake prediction in the form of a joint research project between the Nordic countries using the SIL test area. In April 1986, a three-day workshop was organized in Oslo where some specifications and the first draft of the network design was done (The Blue Book). In 1987, funds were made available to the project from the Nordic Minister Council, the Icelandic Government and the research councils of the Nordic countries and 1989, 20 years ago, the first SIL station was installed and two years later, the whole network of 8 stations was in operation in a fully automatic manner. Since then, the number of stations has increased to 55 and the number of earthquakes recorded and analysed are more than 300,000.

The request stated in the Blue Book was a design of a real-time seismological network with extremely high sensitivity that would record all seismic events down to magnitude zero within the network. The technical requirements were high dynamic range (> 130dB), high sampling frequency (>=100 s/s) and high timing accuracy (< 1 ms) with reasonable low investment and operational cost. This was not an easy task with the technology (digitizers, computers and data communication) available at that time.

In 1988 Sigurður Th. Rögnvaldsson started his PhD studies in Uppsala and most of his research was related to the seismological methods used in the SIL system which were to a large extent based on earlier work by Ragnar Slunga. The success of the SIL system is to large extent thanks to the work of Sigurður and the scientific descriptions of the methods are mainly found in his PhD theses and other scientific papers he has published. The unique features of the SIL system are the high detectability, ability to handle large amount of earthquakes in real-time, the automatic estimations of fault plane solutions using the spectral amplitude and first motion direction for all earthquakes and the relative location methods allowing for mapping of active sub-surface faults. Many of the innovative methods implemented in the SIL system in its early development stage were first recognized ten to fifteen years later by the international seismological community but are now to a larger extent also implemented in other seismological networks in the world. The SIL system technology is used in the Swedish National Seismic Network which consists of more than 60 stations.

Although the SIL system is performing very well at the present, there is a large potential for further development. The technical development during the last twenty years allows for further development of methods for extracting geophysical information from the crust (through small earthquakes) in real time. Some of these methods can make use of the new achievement in communication technology, which allows for real-time streams of time-stamped digital data from almost anywhere using cellular phones. Another, not less important technical achievement is the improvement of the computer capacity available. This opens for more massive analysis of data streams in real time and thus opens for the automatic event detection and location to perform better. Use of correlation techniques of the continuous data stream and continuous spatial mapping are two examples of methods that can implemented thanks to the technical developments.

This will decrease the amount of labour needed for the routine interactive analysis but increase the quality of the overall analysis. The seismologists can focus more on the geophysics reflected by the seismic activity in real time.