

Assessment of Historical Seismological Records at Kyoto University and Steps Towards Digitization

京都大学地震計記録のアセスメントとデジタル化への指針作り

This project was funded for the long-term visit of Prof. Miaki Ishii of Harvard University to come to Kyoto University, DPRI. The main purpose of the visit was to conduct a survey of the archive of historical seismograms at DPRI's Abuyama Observatory and evaluate the potential for digitization of these valuable data. Because of the health situation due to the Corona virus, Prof. Ishii was not able to come to Kyoto for the long-term research visit.

Objectives

The purpose of this project was to assess the condition and inventory of the analogue seismogram collection at Kyoto University. This is part of a larger global effort to preserve valuable information from old earthquakes that is beginning to deteriorate on paper records. At Harvard University, Prof. Ishii and colleagues have been working for 10 years to scan and digitize the collection of about 12,000 seismograms that date back to the 1930's. The availability of digitized seismograms from large historical events around the world will allow modern analyses to investigate the earthquakes and other time-dependent subsurface events. The knowledge of old earthquakes has obvious importance for evaluating the current seismic hazards in Japan and other regions of the world.

Also, digitization of historical seismograms has been used by Prof. Ishii to interest Japanese high school students in seismology. Prof. Ishii contributes to these efforts with annual visits to Japan.

Abuyama Earthquake Data

The archive of old seismograms at Kyoto University's Abuyama Observatory has much valuable data. Records from before the mid-1960's are particularly important because after that time the World-wide Standard Seismograph Network (WWSSN) operated by the US Geological Survey, has provided relatively good global coverage. For example, there are recordings from a three-component Wiechert seismometer from the 1930's to the 1980's. Also records from the low-gain Sassa seismograph starting in the 1930's provide valuable data for larger earthquakes in Japan. Fig. 1 shows an example of a digitized record from a 1931 Tohoku earthquake as recorded on the Sassa seismograph.

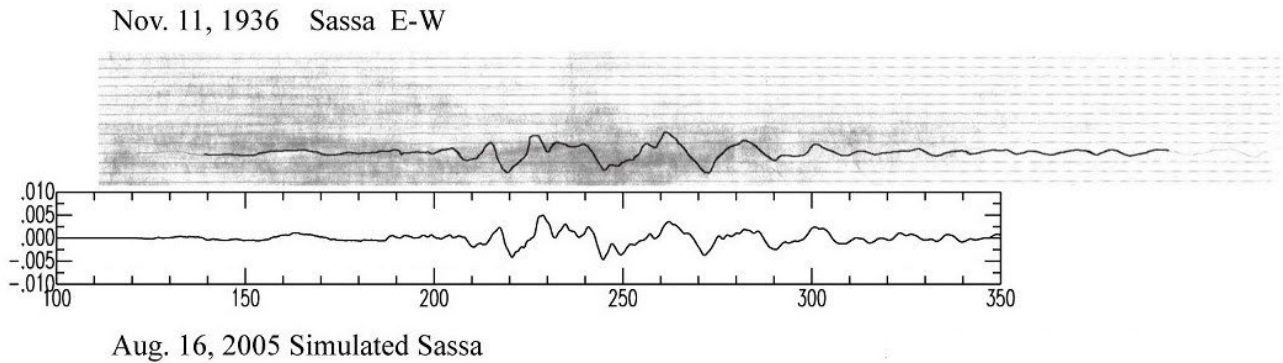


Fig. 1. The upper trace shows the digitized data from the Nov. 11, 1936 Tohoku earthquake (Ms7.2). Bottom trace is a modern record from an earthquake near the same location on Aug. 16, 2005 (Mw7.2), as recorded on a broadband instrument and converted to the instrument response of the Sassa seismograph. Note the striking similarity between the recordings, which indicates that the two earthquakes had similar depths and similar focal mechanisms.

Digitization Software

The DigitSeis software which digitizes scanned seismograms was modified to be compatible with the Kyoto collection. We chose a few key events to digitize to test the scanning and digitization process. For example, the digitized data from the Harvard archive of the 1944 Bolu-Gerede, Turkey earthquake (Ms7.2) is shown below in Fig. 2. Also for comparison of the quality of the recordings, the recordings of the US nuclear test on xx as recorded in the US and Japan were investigated.

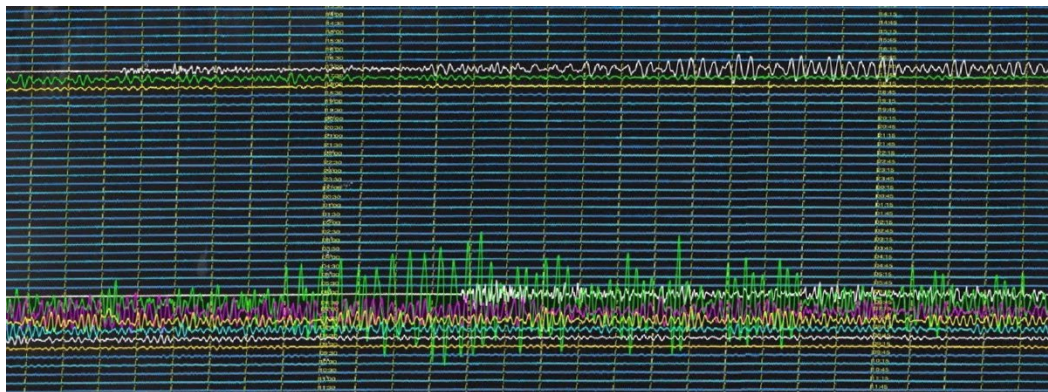


Fig. 2. Example of DigitSeis software showing the 1944 Bolu-Gerede, Turkey earthquake as recorded at Harvard University. The clear largest amplitude waves are surface waves that can be seen in the bottom traces. The surface waves can be used for determination of focal mechanism and an estimate of the fault size. The initial P wave (light green color for about 2 minutes) is also clearly seen can contribute to source information about the earthquake. The vertical columns of time marks show one minute spacings.

Outreach project for high school students

Prof. Ishii has an ongoing project to visit Japanese high schools and interest the students in seismology by digitizing historical seismograms (地震計記録のデジタル化プロジェクト). During 2018-2019 in this project involved about 300 students from 16 high schools in Kansai and other

regions of Japan. Students participated in helping to digitize old earthquake records.
<http://seismology.harvard.edu/research/DigitSeisJapan/index.html>

The majority of the unused travel funds was used to purchase Windows computers for this high school outreach effort. The project has been in need of new computers to enable the students to analyze the historical earthquake data.