Tsunami waveform analysis of 1929 Grand banks landslide tsunami

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Large submarine landslides sometimes generated tsunamis causing the catastrophic disaster along the local coastal area. One of the most famous submarine landslide tsunamis is the 1929 Grand Banks tsunami generated off the east coast of Canada. On November 18th, 1929, the Grand Banks earthquake (Mw7.2) occurred, and tsunami struck the southern coast of Burin Peninsula in the east coast of Canada. Soon and some hours later of the earthquake, twelve intercontinental telegraph cables installed at the ocean bottom near the source area were cut one after another. This suggested that the cables were cut by submarine landslides. Previous seismological studies indicated that the earthquake was also generated by the single force, probably by the landslide. The tide gauge station in Halifax, Canada observed the tsunami waveform. In this paper, we try to model this tsunami waveform by the numerical simulation of both landslide and tsunami.

We assume that the landslides occurred at the continental slope which was located at the landward from the cut position and timing of telegraph cables by the submarine landslide. We also assume that those landslides occurred along the several submarine valleys in the continental slope. We calculate the submarine landslide tsunami with two-steps approach. The first step is mass movement calculation, and next step is tsunami calculation based on the result of first step. In the first step we used the Tsunami Squares method, which is not only a simple and effective method to calculate the time-dependent mass movement but also easy to introduce the effect of landslide propagation and start time difference of landslide for each point. In the next step, we calculate the tsunami propagation with finite different method. Time-dependent change of mass thickness in first step is treated as tsunami source.

The landslide mass distribution is estimated by comparing the computed and observed waveform at Halifax tide gauge. We put masses on three area based on the previous studies. In the figure, colors show the initial mass height distribution, brown line around the colors show the mass area, dots and number are the cable cut position and position name, points from 1 to 16 were cut immediately after the earthquake. For reproducing the first wave, masses in west and center area collapse all at once, and in east should collapse at 10 minutes after of west and center.

The waveform is shown in figure, black line is observed waveform and red is calculated one. The first wave is well recreated in sight of arrival time, amplitude and wavelength, but large negative pulse appears only in simulated waveform. We should improve our model by changing frictional parameters to reproduce the tsunami waveform at Halifax.

Keywords: landslide tsunami, 1929GrandBanks Earthquake