Geophysical Research Abstracts
Vol. 18, EGU2016-8927, 2016
EGU General Assembly 2016

The 2014 Lake Askja rockslide tsunami – optimization of landslide parameters comparing numerical simulations with observed run-up

Sigríður Sif Gylfadóttir (1), Jihwan Kim (2), Jón Kristinn Helgason (1), Sveinn Brynjólfsson (1), Ármann Höskuldsson (3), Tómas Jóhannesson (1), Carl Bonnevie Harbitz (2), and Finn Løvholt (2)

(1) Icelandic Meteorological Office, Reykjavik, Iceland (siggasif@vedur.is), (2) Norwegian Geotechnical Institute, Oslo, Norway, (3) Institute of Earth Sciences, University of Iceland, Reykjavik, Iceland

The Askja central volcano is located in the Northern Volcanic Zone of Iceland. Within the main caldera an inner caldera was formed in an eruption in 1875 and over the next 40 years it gradually subsided and filled up with water, forming Lake Askja. A large rockslide was released from the Southeast margin of the inner caldera into Lake Askja on 21 July 2014. The release zone was located from 150 m to 350 m above the water level and measured 800 m across. The volume of the rockslide is estimated to have been 15–30 million m^3, of which 10.5 million m^3 was deposited in the lake, raising the water level by almost a meter. The rockslide caused a large tsunami that traveled across the lake, and inundated the shores around the entire lake after 1–2 minutes. The vertical run-up varied typically between 10–40 m, but in some locations close to the impact area it ranged up to 70 m. Lake Askja is a popular destination visited by tens of thousands of tourists every year but as luck would have it, the event occurred near midnight when no one was in the area.

Field surveys conducted in the months following the event resulted in an extensive dataset. The dataset contains e.g. maximum inundation, high-resolution digital elevation model of the entire inner caldera, as well as a high resolution bathymetry of the lake displaying the landslide deposits. Using these data, a numerical model of the Lake Askja landslide and tsunami was developed using GeoClaw, a software package for numerical analysis of geophysical flow problems. Both the shallow water version and an extension of GeoClaw that includes dispersion, was employed to simulate the wave generation, propagation, and run-up due to the rockslide plunging into the lake. The rockslide was modeled as a block that was allowed to stretch during run-out after entering the lake. An optimization approach was adopted to constrain the landslide parameters through inverse modeling by comparing the calculated inundation with the observed run-up. By taking the minimum mean squared error between simulations and observations, a set of best-fit landslide parameters (friction parameters, initial speed and block size) were determined. While we were able to obtain a close fit with observations using the dispersive model, it proved impossible to constrain the landslide parameters to fit the data using a shallow water model. As a consequence, we conclude that in the present case, dispersive effects were crucial in obtaining the correct inundation pattern, and that a shallow water model produced large artificial offsets.