Earth Surf. Dynam. Discuss.,
https://doi.org/10.5194/esurf-2019-45-AC1, 2019

Interactive comment on "Comment on: Dynamics of the Askja caldera July 2014 landslide, Iceland, from seismic signal analysis: precursor, motion and aftermath" *by* Tómas Jóhannesson et al.

Tómas Jóhannesson et al.

tj@vedur.is

Received and published: 4 October 2019

We thank the reviewer (Tim Greenfield) for his comments. We will rephrase the second paragraph that he found difficult to read to make it more easily understandable.

Regarding our second criticism mentioned by the reviewer, that the maximum average velocity at the shoreline calculated by Schöpa et al. (2018) (7±0.7 m/s) is almost an order of magnitude smaller than suggested by the modelling of Gylfadóttir et al. (2017) (31 m/s), we note in our comment that this low magnitude of the velocity is also physically unreasonable in the middle of the path of a rockslide released from an elevation of hundreds of meters. This discrepancy needs to be discussed in a paper suggesting

such remarkably low velocity, of course because a much higher velocity at the shoreline had been obtained by tsunami modelling and published by Gylfadóttir et al. (2017), but perhaps more importantly because it is unreasonable from a physical standpoint for a rockslide that will propagate 2100 m farther into the lake and deposit half of its volume beyond this point. It is true that Schöpa et al. discuss the discrepancy between the velocity obtained from their analysis and the frontal velocity when the rockslide enters the lake estimated Gylfadóttir et al. They suggest three possible explanations for this, "(i) the limited applicability of a constant mass assumption in the waveform inversion, (ii) the fact that the inversion gives the velocity of the total landslide mass, whereas the tsunami modelling is calculating the velocity of the front of the slide, and (iii) uncertainties in the volume of the material sliding into the lake used for the modelling." These explanations may all matter but do not properly reflect the possibility that there is something fundamentally or seriously wrong with the analysis that causes this discrepancy. In this context, the uncertainty of the velocity of ±0.7 m/s presented by Schöpa et al. seems remarkable.

The reviewer notes that the seismic analysis of Schöpa leads to a maximum velocity of ca. 18 m/s somewhat higher up the slope before the slide approaches the shoreline, which is on the correct order of magnitude compared with the velocity estimate of 31 m/s by Gylfadóttir et al. (2017). We will in our revision clarify that both velocity estimates discussed in our comment apply to the point where rockslide enters the lake. We also note that the rockslide may be expected to have been retarded somewhat at the shoreline from the maximum velocity farther up the path because it has propagated ∼600 meters over relatively flat terrain from the location where it reached its highest velocity before it comes to the shoreline. Therefore, the velocity estimate of 31 m/s at the shoreline by Gylfadóttir et al. corresponds to considerably higher velocity higher up in the path when the analysis of Schöpa indicates that the velocity is at maximum ca. 18 m/s. The maximum velocity of ca. 18 m/s, that may be inferred from Fig. 5b in Schöpa et al., corresponds to the foot of the slope before the rockslide enters the run-out zone and where there presumably has been comparatively little retardation of the rockslide mass. The kinetic energy corresponding to this velocity is ∼160 J/kg. For comparison, the average potential energy released in the descent of the rockslide mass down ca. 250 m vertically may be estimated on the order of 2500 J/kg. A velocity of ca. 18 m/s at the foot of the slope, therefore, implies that more than 90% of the original potential energy of the rockslide is already dissipated by friction when the rockslide enters the run-out zone and has 2700 m farther to go into the run-out zone and the lake. Of course the center of mass of the moving material does not propagate this far into the lake. It nevertheless seems dynamically implausible that the rockslide propagates at ca. 18 m/s at the foot of the slope after falling down 250 m, as well as propagating at ca. 7 m/s at the shoreline with 2100 m farther to go. We further note that both 7 m/s (in the middle or above the middle of the run-out zone) and 18 m/s (maximum velocity at the start of the run-out zone) are quite low velocities for large rockslides with volumes of tens of millions of m^3, see e.g. inferred velocities of several large langslides qouted by Evans et al. (2006).

Evans, S. G., Scarascia Mugnozza, G., Strom, A. L., Hermanns, R. L., Ischuk, A., and Vinnichenko, S.: Landslides from massive rock slope failure and associated phenomena. In: Evans, S. G., Scarascia Mugnozza, G., Strom, A. L., and Hermanns, R. L. (eds.), Landslides from Massive Rock Slope Failure. NATO Science series IV. Earth and Environmental Sciences, 49, Springer, 2006.

Interactive comment on Earth Surf. Dynam. Discuss., https://doi.org/10.5194/esurf-2019-45, 2019.