# Ground oscillations generated by the passage of Tsunamis : Observations and numerical simulations

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The broadband seismic stations near coastlines can record the passage of Tsunami. An example was shown during the 2017 large Greenland Landslide (Chao et al., SRL, 2018; Paris et al. Pageoph, 2019) for which Tsunami traveled along a fjord over 30 km and damaged severely a small coastal village (Nuugaatsiaq) after 10-15 minutes of the estimated origin time of landslide and tsunami generation. Due the lack of coastal measurement such tidal gauge, this seismic station (NUUG) is only the measurement available to characterize the Tsunami passage. The landslide radiated strong seismic waves, detected as an event of magnitude of about 4.8 event in GFZ catalog. We first obtained the source time function as a single force from the teleseismic inversion using five broardband stations available on Greenland. Two large pulses with a time lag of about 100 s was clearly distinguished in the solution. In parallel, the landslide into the sea and tsunami (generation and propagation) were simulated using a finite difference method (Kelfoun et al., JGR, 2010; Shi et al., Ocen Modell., 2012). The area is discretized with 100 m grid over 65 km x 45 km. The volume of landslide and the slope angles were estimated after the available InSAR data (Paris et al., 2019) and digital elevation data. We adapted the model parameters to be consistent with the guessed tsunami propagation (period and wave height). At last, we calculated the ground oscillations both from the single force at the origin of landslide and the spatio-tepmporal evolution of tsunami height. Both terms were added as forces on the ground surface in the framework of the elastodynamic equation using a finite difference method. The ground motions from the landslide attenuate quickly in space and time, while the ones accompanied by tsunami propagation attenuate gradually, namely peak ground velocity attenuates with 1/sqrt(r), where r is the distance from the origin. According to a synthetic case study, NUUG station (a few hundred meters from the coast) is sensible to the water level change within 2 km off the coast line. Our numerical test indicates that seismic station near the coast line can be used for monitoring the on-going tsunamis propagation.

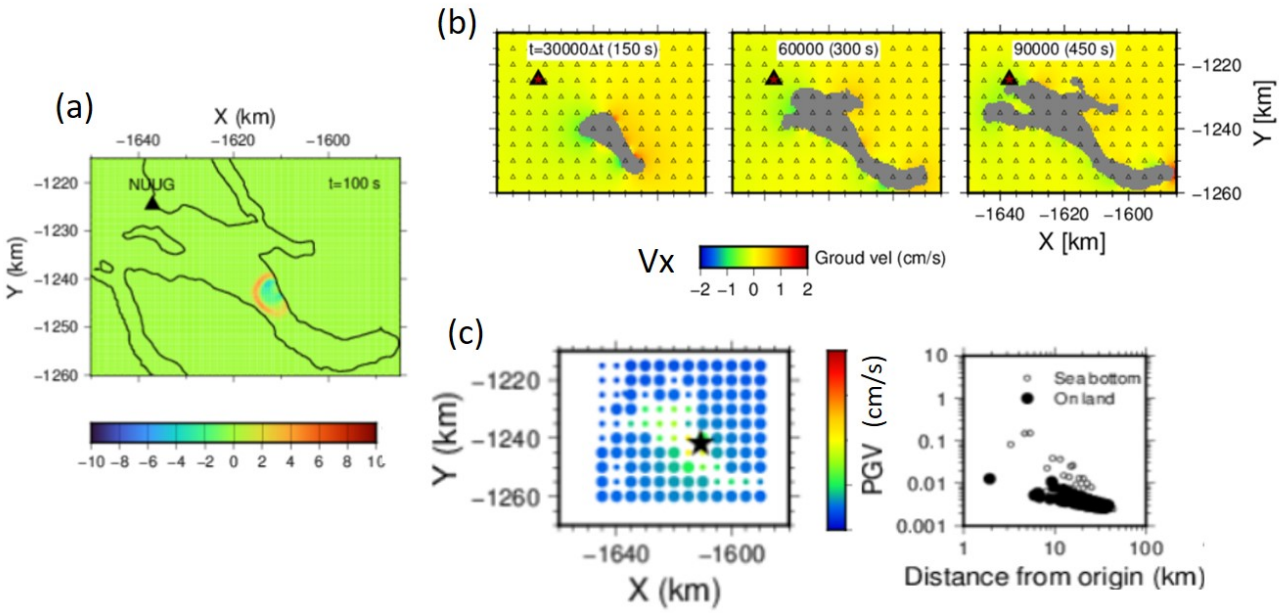


Figure: (a) A snapshot of landslide-tsunami simulation at time 100 s. NUUG station is about 30 km away from the origin of landslide and tsunami. (b) Snapshots of wave propagation on the ground surface (X component in velocity, without filter). A big triangle shows the position of NUUG, and smaller ones are the hypothetical receiver positions. The grey area indicates the implemented sources from Panel (a), showing the progress of tsunami propagation. (c) The peak ground velocity in space and in function of distance from the origin, for 2D horizontal component. The color scale and vertical axis of PGV are common. The star shows the position of tsunami generation, from which the distance is calculated. The solid big circles show the positions on land, while the others are at the sea bottom.