EGU21-2565
https://doi.org/10.5194/egusphere-egu21-2565
EGU General Assembly 2021

Deciphering the seismic and normal-force fluctuation signatures of debris flows: an experimental assessment of the effects of flow composition and dynamics

Tjalling de Haas[1], Amanda Aaberg[1], Fabian Walter[2], and Zhen Zhang[2,3]
[1]Department of Physical Geography, Universiteit Utrecht, Utrecht, Netherlands (t.dehaas@uu.nl)
[2]Laboratory of Hydraulics, Hydrology and Glaciology (VAW), ETH Zürich, Zürich, Switzerland
[3]Institute of Mountain Hazards and Environment, Chinese Academy of Sciences, Chengdu, China

Debris flows are gravity-driven mass movements that are common natural hazards in mountain regions worldwide. Previous work has shown that measurements of ground vibrations are capable of detecting the timing, speed, and location of landslides and debris flows. A remaining question is whether or not additional flow properties, such as grain-size distribution, flow depth, and impact stress can be inferred reliably from seismic data. Here, we experimentally explore the relation of seismic vibrations and normal-force fluctuations with debris-flow composition and dynamics. We show that seismic vibrations and normal-force fluctuations induced by debris flows are strongly correlated, and that both are strongly affected by debris-flow composition. We find that the effects of the large-particle distribution on seismic vibrations and normal-force fluctuations are substantially more pronounced than the effects of water fraction, clay fraction, and flow volume, especially when normalized by flow depth. We further show that for flows with similar coarse-particle distributions seismic vibrations and normal-force fluctuations can be reasonably-well related to flow depth, even if total flow volume, water fraction, and the size distribution of fines varies. Our experimental results shed light on how changes in large-particle, clay, and water fractions affect the seismic and force-fluctuation signatures of debris flows, and provide important guidelines for their interpretation.