Geophysical Research Abstracts
Vol. 20, EGU2018-6816, 2018
EGU General Assembly 2018

Infrasound array analysis of debris-flows: an application to Illgraben, Switzerland.

Emanuele Marchetti (1), Fabian Walter (2), and Maurizio Ripepe (1)

(1) University of Firenze, Department of Earth Sciences, Firenze, Italy (emanuele.marchetti@unifi.it), (2) Laboratory of Hydraulics, Hydrology and Glaciology (VAW), ETH, Zurich, Switzerland (walter@vaw.baug.ethz.ch)

Debris flows are mobilized water/sediment mixtures in steep mountain torrents with volumes commonly exceeding thousands of m3. Whereas debris flows constitute a severe natural hazard for downstream communities, they move at moderate velocities (typically < 10 m/s) so that early warning is in principle possible if the flows are detected early upon formation. Several monitoring and detection systems (e.g., seismic, radar, infrasound) have been tested and applied, but the pronounced mountain topography and difficult terrain access complicates instrument installation and commonly limits detection efficiency.

As moving sediments perturb the atmosphere near the Earth's surface, infrasound waves (low frequency sound) are generated during debris flow events. Although infrasound radiation from debris flow has been documented, high background noise levels and emergent debris flow signals have complicated its operational use.

Here we apply infrasound array analysis to monitor, automatically detect and locate debris flows. We analyze debris-flow activity at Illgraben, one of the most debris-flow-prone torrents in Switzerland. The infrasound antenna was located at low altitude behind a mountain ridge around 1 km north of the torrent catchment. We recorded 3 debris flows at Illgraben in May and June 2017, with volumes up to 200.000 m3 and front discharge up to 550 m3/s. Infrasound signals show a spindle shaped envelope with duration spanning from 15 to 45 minutes and peak amplitude of <0.5 Pa.

We process our infrasound array data with multichannel correlation, which increases the signal-to-noise ratio and identifies signal back-azimuth and apparent velocity. Comparison with seismic records and in-torrent detections shows that besides the actual flows, the infrasound antenna detects precursory and post-event activity in the upper torrent catchment. For the largest event, clear infrasound from the catchment is recorded up to 15 minutes before the flow is detected at the first check damn. Moreover, the 3 flows radiate infrasound with consistent wave parameters among each other, thus suggesting the potential for a robust remote debris flow monitoring and early warning system.