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Seismic localization and dynamical characterization of snow avalanches and slush flows of Mt. Fuji, Japan

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Snow avalanches and slush flows are often released at the stratovolcano of Mt. Fuji, which is the highest mountain of Japan (3776 m a.s.l.). These flows represent a major natural hazard as they may attain run-out distances up to 4 km, destroy parts of the forest, and sometimes damage infrastructure. We detected large dimension flows released in the winter seasons of 2014, 2016 and 2018 using the local seismic network installed to monitor the volcanic activity of Mt. Fuji. The maximum detection distance of the seismic network is approximately 15 km for the largest avalanche size class 4–5 (Canadian avalanche classification). Using data from several seismic sensors, we applied the automated approach of amplitude source location (ASL) based on the decay of the seismic amplitudes with distance to localize and track the avalanche flow paths. We also conducted numerical simulations with Titan2D to reconstruct the avalanche trajectories and thus to assess the precision of the seismic tracking as a function of time, showing mean location errors ranging between 85 and 271 m. The average front speeds estimated from the seismic tracking, which ranged from 27 to 51 m s^{-1}, are consistent with the numerically predicted speeds. In addition, we correlated the source amplitudes and the estimated seismic energies with the approximate run-out distances of the avalanches deduced from the ASL method. The obtained scaling relationships can be useful to empirically classify the flow size. An important task in the near future will be to develop highly effective methods for automatically detecting and tracking avalanche events in the seismic data in near-real time. One approach for the automatization of avalanche detection is the discrimination of seismic sources in the continuous recordings by applying machine learning classification methods. We expect that the precision of the flow tracking could be improved through adaptive weighting of the signals from different stations according to the source–receiver distances and angles.