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Infrasound and seismic array analysis of snow avalanches: results from the 2015-2017 experiment in Dischma valley above Davos, Switzerland

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While flowing downhill a snow avalanche radiates seismic and infrasonic waves being coupled both with the ground and the atmosphere. Infrasound waves are mostly generated by the powder cloud of the avalanche, while seismic waves are mostly generated by the dense flowing snow mass on the ground, resulting in different energy partitioning between seismic and infrasound for different kinds of avalanches. This results into a general uncertainty on the efficiency of seismic and infrasound monitoring, in terms of the size and source-to-receiver distance of detectable events. Nevertheless, both seismic and infrasound have been used as monitoring systems for the remote detection of snow avalanches, being the reliable detection of snow avalanches of crucial importance to better understand triggering mechanisms, identify possible precursors, or improve avalanche forecasting.

We present infrasonic and seismic array data collected during the winters of 2015- 2016 and 2016-2017 in the Dischma valley above Davos, Switzerland, where a five element infrasound array and a 7 element seismic array had been deployed at short distance from each other and with several avalanche paths nearby. Avalanche observation in the area is performed through automatic cameras providing additional information on the location, type (dry or wet), size and occurrence time of the avalanches released.

The use of arrays instead of single sensors allows increasing the signal-to-noise ratio and identifying events in terms of back-azimuth and apparent velocity of the wave-field, thus providing indication on the source position of the recorded signal. For selected snow avalanches captured with automatic cameras, we therefore perform seismic and infrasound array processing to constrain the avalanche path and dynamics and investigate the partitioning of seismic and infrasound energy for the different portions of the avalanche path.

Moreover we compare results of seismic and infrasound array processing for the whole 2015-2016 winter season in order to investigate the ability of the two monitoring systems to identify and characterize snow avalanches and the benefit of the combined seismo-acoustic analysis.