Evaluating the performance of operational infrasound avalanche detection systems

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In recent years, algorithms for the automatic detection of avalanches in continuous infrasound data have greatly improved. Indeed, by using array processing techniques, it is possible to locate signal sources, greatly facilitating the discrimination of signals generated by avalanches from other infasonic sources. This has led to the development of an operational infrasound avalanche detection system, known as IDA (infrasound detection of avalanches). To evaluate the detection performance of these systems, we therefore conducted a thorough survey of avalanche activity at three different sites throughout the Swiss Alps during two entire winter seasons. Avalanches were recorded by using a network of automatic cameras and detailed field observations by local observers. These observations were then compared to automatically detected events by the IDA systems to evaluate the detection performance in terms of distance to the array, avalanche size and type (dry or wet). Results show that the overall probability of detection (POD) increases with avalanche size and decreases with distance. While large avalanches (on the order of 100 x 1000m) within a distance of 3 to 4 km were typically well detected (POD>90%), independent of the type, the detection rates for wet snow avalanches decreased more rapidly with size than for dry snow avalanches. Since most automatic detections were during periods of poor visibility, evaluating the false alarm rate was not straightforward. Nevertheless, conservative estimates suggest values around 20% and highlight the influence of topographic barriers. Overall, our results show that in the absence of major topographic barriers infrasound avalanche detection systems are well suited to reliably monitor larger avalanches up to a distance of about 4 kilometers.