



## **Remote detection of artificially triggered avalanches below a fixed avalanche control installation**

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Avalanche control by explosives is widely used as a temporary preventive measure to reduce avalanche hazard. The goal is to artificially trigger smaller less destructive avalanches, by detonating charges either above or on the snow surface. Hand charges are most often used, whereby the explosives are deployed by manually hand tossing or lowering onto the snow slope. Given the inherent dangers and limitations of this type of avalanche control, fixed avalanche control installations are increasingly used. These consist of strategically placed remote controlled installations that generate an explosion above the snow pack in an avalanche starting zone. While fixed installations can be used at any time and minimize the risk to avalanche control personnel, visual confirmation is still required to verify if an avalanche released. In order to remotely detect artificially triggered avalanches, we therefore developed a low-cost seismic monitoring system. We deployed the monitoring system in a ski area above the town of Davos, in the eastern Swiss Alps, below a Gazex installation, a remote controlled installation that generates an air blast by detonating a fuel-air explosive above the snow pack. The monitoring system consists of three vertical component geophones inserted in the ground at approximately 14, 27 and 46 meters from the Gazex installation. Our results show that, despite the relatively low precision of the monitoring equipment, both the detonation and the resulting avalanches can clearly be identified in the seismic data. Specifically, detonations are characterized by short, high amplitude broadband signals, while avalanches generate much longer, low frequency signals. Furthermore, information on the size of the artificially triggered avalanches is also obtained as it directly relates to the duration of the generated seismic signal. The overall goal is to assess the effectiveness of the fixed avalanche control installation with regards to yield (i.e. number of avalanches triggered per explosion) and avalanche size.