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Earth Surface Dynamics Discussions

Interactive comment on "Automatic detection of avalanches using a combined array classification and localization" *by* Matthias Heck et al.

Anonymous Referee #2

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The paper by Heck et al. proposes a seismic methods to automatically determine the avalanche activity at a remote field site. Avalanches are automatically identified using a machine learning algorithm based on Hidden Markov Models (HMMs) applied to a little training dataset. The number of false detections was significantly reduced through two additional classification steps: (i) an additional HMM based classifier at a second array located 14km away to identify airplanes and earthquakes; (ii) the identification of the direction of the source. From the 117 initially detected events during a 4 month period were identified 90 false classifications based on these two additional steps. The obtained avalanche activity based on the remaining 27 avalanche events was in line with visual observations. The paper is well shaped and proposes a promising step forward in the field of seismic characterization of snow avalanches.

I'd like the author to better address the possible technical limitations of their methods, in particular the field deployment and the near-real-time application of the classification methods based on two stages. The HMM application to the seismic network object of the study is used to identify events and to filter possible false detection using a directional criterion. The authors already state that the computational time is reasonably short and almost near real-time whereas the localization would be very costly (three times real time). Maybe there is not a chance to perform a simplified, possibly faster directional classification based on few sensors and not on the whole seismic array. In addition, I expect that the network geometry has a strong impact on the success rate of this latter criterion, could you add some details on that? Then a second, distant seismic array is used to filter simultaneous signals produced by anthropic sources or earthquake. I have the impression that this second stage can be surely useful to recognize earthquakes but it probably needs a calibration for anthropic sources. In addition, technical limitations in such extreme environments like high Alpine areas (e.g., data transmission) can be a possible trivial but concrete limitation for a real time application.

The application of the proposed methodology on another dataset gathered on another test site would be of great interest for the reader. For instance, is it possible to run the methods the other way round, testing it on the other array currently used for the second classification step?

Visual observations are used as validation, could the authors add some information about that? Which are the observation sources? How is compiled the avalanche catalog? If available, an image of one reference event could be also useful to show the test site.

Figure 2, it would be useful to add a map with terrain information (slope, morphology, etc).

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