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# Effects of snow cover properties and path topography on front velocities measured by GEODAR radar

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One main challenge in snow avalanche dynamics is to understand the complicated nature of the front dynamics of both cold (dry-dense, powder) and warm (moist, wet) avalanches under changing snow and topographic conditions. Even more complex, by entraining warmer snow at lower altitude, transitional avalanches are able to change the frontal dynamics from cold to warm along the path making the prediction of frontal velocity a challenging task.

In order to gain an understanding on avalanche front dynamics, we analyze the front velocities of numerous avalanches measured with the GEODAR radar system installed at the Swiss Vallée de la Sionne full-scale test site. With a spatial resolution of 1 m down slope and a frame rate of 50 Hz, this radar enables the tracking of features at the avalanche front over time, thus allowing a precise definition of the front dynamics. Information on the snow cover is obtained from numerical simulation performed with the model SNOWPACK. Geo-referenced avalanche pictures together with lateral steered GEODAR reflections yield the location and path topography.

We compare the front velocities of transitional avalanches with snow cover data and topography along the avalanche path. We show under which conditions changes from cold to warm flow may occur. This analysis is of fundamental importance to understand the effect of snow cover properties on the avalanches dynamics, but also to avoid erroneous interpretations in case the frontal dynamic data are used to calibrate models.