



Estimated evolution of the speed of powder, wet and transitional avalanches between two distant locations in VDSL experimental site extracted from the analysis of seismic signals.

Emma Suriñach (1) and Elsa Leticia Flores-Márquez (2)

(1) RISKNAT- ALLAUS Group, Institut Geomodels. Departament de Dinàmica de la Terra i l'Oceà, Secció de Geodinàmica i Geofísica, Facultat de Ciències de la Terra, Universitat de Barcelona, C/Martí i Franquès s/n., 08028 Barcelona, Spain (emma.surinach@ub.edu), (2) Instituto de Geofísica, UNAM, Circuito Instituto S/N, Coyoacán, 04510 CDMX, México (leticia@igeofisica.unam.mx)

Seismic signals generated by snow avalanches of different size and type (powder, transitional and wet) descending along the same path at the Vallée de la Sion (VdLS, Valais, Switzerland) experimental site (SFL, Davos) recorded at two different locations distant 690 m helped us to estimate the evolution of the avalanches speed along the path. We use the Hough Transform to obtain the numerical characteristics of the shape of the spectrograms of the total seismograms (3 components). Spectrograms are a 3D representation (amplitude, frequency, time) that indicates the evolution over time of the frequency content of the signals. Taking into account that the frequency content in the spectrograms increases over time due to the attenuation of seismic waves (anelastic/ intrinsic attenuation and geometrical spreading), the velocity of an avalanche can be estimated from the exponential form $F(t) = B \cdot \exp(A \cdot t)$ observed in the spectrograms. The values of parameters A and B obtained for the three different types of avalanches in the two locations are included in different ranges that generate different curves.

For the highest location, the curves collapse (are grouped) according to the type of avalanche. The values obtained indicate that powder avalanches are faster than transitional avalanches and these are faster than wet ones.

The curves for the lowest location have a more homogeneous behavior regardless of the type of avalanche. However, the peculiarities of each type persist, although powder and transitional avalanches collapse mostly than wet avalanches.

In the lowest location the curves are more lying down. This behavior indicates a decrease in speed from the highest to the lowest location. The avalanche speed values at the highest location are in the range of [83-123] m/s for powder avalanches, [43-65] m/s for transitional avalanches and [26-39] m/s for wet avalanches. These avalanche speed values are in accordance with the speed values obtained directly from experimental field measurements. However, for the location at 690 m downhill, the speeds are lower and are in the range of [33-49] m/s for powder avalanches, from [28-41] m/s for transitional avalanches and [16-24] m/s for wet avalanches.

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