Influence of snow and meteorological conditions on snow-avalanche deposit volumes and consequences for road-network vulnerability

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Abstract

Snow avalanches are a major component of the mountain cryosphere that frequently create a menace for the road network. Deposit characteristics determine the extent of damage and disruption to communication networks, but the factors controlling snow-deposit volumes remain largely unknown. This study investigates the influence of meteorological and snowpack conditions on snow-avalanche deposits and road-network vulnerability based on 1986 deposit volumes from 182 paths located in two regions of the French Alps between 2003 and 2017: Guil and Haute-Maurienne valleys. During the period, 195 avalanches impacted the road network in these areas, leading to major disruptions. In Haute-Maurienne, correlations between deposit volumes and meteorological and snowpack conditions are high in winter. However, the relationships differ with path elevation and orientation. Results do not show any significant relationship between volumes and meteorological or snowpack conditions for the spring season. Focusing on deposits that disturbed the road network, winter and spring reveal a distinct influence of meteorological and snow variables compared to the overall data set, with snowfall intensity as the predominant control variable of deposit volumes leading to road cuts. When the same analysis is conducted by considering Guil valley separately or by aggregating Haute-Maurienne with Guil valley area data, results do not show any significant relationship, highlighting the specific regional nature of relations between deposit volumes and meteorological and snowpack conditions.

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\[
X^t_\omega = \omega^t_{HM} X^t_{HM} + \omega_{GV} X^t_{GV}
\]

with
\[
\begin{align*}
\omega^t_{HM} &= \frac{N^t_{HM}}{N^t_{HM} + N^t_{GV}} \\
\omega^t_{GV} &= \frac{N^t_{GV}}{N^t_{HM} + N^t_{GV}} = 1 - \omega^t_{HM}
\end{align*}
\]
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Table 1.docx available at https://authorea.com/users/513723/articles/589795-influence-of-snow-and-meteorological-conditions-on-snow-avalanche-deposit-volumes-and-consequences-for-road-network-vulnerability

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