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Predetermination of snow avalanches release depths using a Spatial Extreme statistical approach.

Johan Gaume, Nicolas Eckert, Guillaume Chambon, and Mohamed Naaim
CEMAGREF, Unité ETNA, St Martin d'Heres, France (johan.gaume@cemagref.fr)

Numerical models of snow avalanches propagation have acquired a central role among decision tools for avalanche protection engineering. Nevertheless, the systematic implementation of these models still faces a number of difficulties including the precise evaluation of the avalanche release depths. In our work, the predetermination of snow depths in any potential release zone is achieved by spatial interpolation of the precipitation data acquired in the existing measurement stations. We use the daily data of 40 meteorological sites in the French Alps from 1966 to 2004 and we consider annual maxima of precipitation over 24h. These sites are generally located away and at lower altitudes from the release zones, so we need to take into account orographic gradient effects. We take advantage of a recent mathematical formalism which has been proposed to characterize the spatial dependence of extremes. Within this framework, we use the R SpatialExtremes Package to analyse our datasets. Using simple models of spatial evolution of the GEV parameters, we are able to establish precipitation maps for different return periods. The results show that for a given return period, the snow depths are more important in the eastern regions (Mont Blanc, Tarentaise, Maurienne, Queyras) with a SW-NE increasing preferred direction. Highest means are located NW, whereas for the variance, maxima are located in the SE (which corresponds to the Mediterranean influence that tends to bring more variability). Finally, we show that the spatial correlation of extreme values of the precipitations depends on the orientation of the Alps. The maximum correlation length is 30km along the main axis of the alpine range, while it is 20km along the perpendicular axis.