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Extreme value statistics of snowfall in the Swiss Alpine region

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The mountain snowcover is an important source of water but also leads to natural hazards such as avalanches and floods. We use data collected during winters 1999/00 to 2007/08 by 239 automatic and manual measurement stations in Switzerland to highlight spatial characteristics of extreme snowfall. With the help of extreme value theory based on a "peaks over threshold" approach and a Poisson point process representation, we analyse spatial patterns and correlation characteristics. Our analyses show that a significant number of stations do not follow the Gumbel distribution. In particular, low altitude stations in the Swiss Plateau are heavy-tailed because of rare extraordinary snowfall events. Spatial characteristics of extreme snowfall are compared to those of the mean snowfall. Altitudinal dependence and spatial distribution of mean and extreme snowfall are similar. Both mean and extreme snowfall show an increase of magnitude between 400 and 2200 m a.s.l. and a constant or slightly decreasing magnitude at higher altitudes. Below 1200 m a.s.l., the increase with altitude is stronger because of the rain - snow transition. Another finding is that the spatial correlation pattern of extreme snowfall is similar to that of mean snowfall, both of which are determined by the main climatological regions of Switzerland.