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Debris flow and climate relations in the North French Alps region

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Debris flow is a dominant mass movement process in mountain areas all over the world and is a significant natural hazard. Among factors resulting in a DF triggering, meteorological conditions are considered to be the most relevant. As it is known that debris flows are often triggered by strong storm events, a change in the global climate in the future could have an impact on the magnitude and /or frequency of these processes. Consequently, a better knowledge of the relationship between debris flow and climate is a fundamental issue.
In the French Alps, very few studies have been conducted at a large spatial scale. Most studies were composed of technical reports that focused on a special catchment area that revealed risks of debris flow. The main goal of our study is to document the relationships between current climate and debris flow activity in the North French Alps region, based on a large historical data of debris flow events over the last nearly 40 years.
Descriptors of each debris flow in the region event include localization for each debris flow catchment area and date of the event. A database with nearly 300 debris flow events collected from different sources by Restauration des Terrains de Montagne (RTM) service. This service is responsible for registration all kind of natural hazards and was initiated in the 1900s by French foresters and covers the entire French Alps.
As debris flow survey methods have changed significantly over the years, our analysis was conducted only over a 38-year period (1970-2008). But even this period couldn't be considered as homogeneous as in the middle of 1980ies survey methods were significantly improved.
To reduce the problem of missing events we filter the annual debris flow counts at the catchment scale by confronting them to confidence intervals derived from running means of various length. When the observation is too low, it is considered as a missing value. Best results are obtained with a 20-year running mean filter, which corresponds to the underlying assumption that, for each local series, data collection has been consistent during at least 20 years.
To extract a regional meteorological signal a Principal Component Analysis were than computed for meteorological parameters (such as mean monthly temperature and precipitation) from four weather stations at different locations and elevations.
After all a correlation test was fitted between the main principal components of meteorological parameters and debris flow event number. Results revealed that the most successful meteorological predictors corresponding to debris flow triggering are minimal monthly temperature and the number of rainy days between May and September.