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Spatial extent of Permafrost in the Southern Alps: Modeling from spring water temperature sources and topoclimatic factors.

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In the actual global warming context, permafrost warming and thaw has been reported in many mountainous regions. Hence, permafrost environmental responses to warmer temperatures such as modified hydrology, slope instability or changing ecosystems have also been observed. Therefore, distribution models on wide areas (e.g. watershed and regional scale) are needed, particularly in highly populated areas where permafrost represents a hydrological support and where its thaws could enhance natural hazards.
Most of the existing permafrost distribution models are valid for specific areas as they are built on local permafrost evidences and topoclimatic conditions. Because of spatial heterogeneity of topoclimatic factors (induced by steep relief in mountain areas), applying local models to wider areas can lead to inappropriate permafrost spatial extent in the model. Thus, to represent permafrost distribution on such areas, a wide quantity of topoclimatic conditions is needed.
We present a permafrost distribution model based on a combination of permafrost evidences and statistical analysis. The empirical data was obtained using spring water temperature collection method (50 points collected during summer 2007 and 2009 in Clarée and Ubaye valleys, both located in the southern French Alps). Topographic variables (altitude, slope, curvature) and climatic variables (latitude, longitude and incoming solar radiation) are used as predictor variables and derived from a 25 m DEM (Digital Elevation Model) (BdAlti-IGN) in a GIS (Geographical Information System).
Three statistical models were developed, one for the Clarée valley, one for the Ubaye valley and one for the Southern Alps. For the first two models, linear regressions were used to model the lower limit of permafrost occurrence based on spring water temperature measurements. For the third model, a logistic regression model was used and based on presence/absence of permafrost occurrence from the former models. Permafrost extent is thus represented at different scales by interpolation with the help of a GIS.