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Estimation of meteorological parameters in the French Alps at different spatial scales and applications to mountainous risk management.

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The Centre d'Etudes de la Neige (CEN, CNRM/Météo-France) uses a full chain of numerical models for the study of meteorology and snow in mountainous areas. This chain of models produces an hourly estimation of weather conditions, snow characteristics and snow cover stability, including effects of slope, elevation and aspects, at the massif scale (about 500 km2). These results are used for real time operational applications but also for research studies. For instance, past climate in the Alps has been studied using a relationship between past meteorological parameters at the massif scale and the NAO index.

In the framework of a study which aims to improve the spatial estimation of the avalanche risk (EU « IRASMOS» project (Integral Risk Management of Extremely Rapid Mass Movements)), research has been undertaken to determine meteorological parameters at local scale. Dynamic numerical downscaling operators were developed. They simulate the 3D airflow dynamic and the associated thermodynamical processes using the fine scale geographical information of a DTM and a simple cloud physics parametrization. The downscaling operators are driven by data from a meteorological analysis system (SAFRAN) run at the massif-scale. They provide hourly values of precipitation, temperature, humidity and cloudiness on an horizontal kilometer grid and different levels of pressure. Preliminary results on some massifs of the French Alps

show that the downscaling operators prove promising to provide detailed estimate of meteorological parameters in mountainous terrain involving orographic generation of precipitation. A test study to validate the magnitude and the distribution of precipitation is currently performed at several alpine sites.

The fine-scale meteorological information will be used, in the second step of this study, to feed a spatially distributed snow model (CROCUS) and an expert system for avalanche risk forecasting (MEPRA). However, further applications may concern other fine scale impact studies, such as the study of climate change effects on water cycle and glacier evolution in mountainous areas.