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Sensitivity study on the avalanche hazard estimation by numerical methods during the "winter 99" events in France in the framework of the EU-FP6 IRASMOS project.

Y. Durand and IRASMOS-GAME/CNRM-CEN

Centre d'Etudes de la Neige (GAME/CNRS - CNRM/Météo-France), 1441, rue de la Piscine

38406 St Martin d'Hères Cedex, France. (yves.Durand@meteo.fr)

In order to complete and illustrate the recommendations of the IRASMOS project (Chamonix workshop) concerning the possibilities and the existing gaps in avalanche hazard estimation at local scale, the "Centre d'Etudes de la Neige" (CEN) of Meteo-France has performed a study based on the dramatically events of February 1999 in the Chamonix valley where a lot of returned information is now available. This work aims at two main points. The first one concerns the present possibilities for predicting one or two days in advance a valuable estimation of avalanche hazard suitable by local forecasters and local decision makers in order to help them in matter of defense, closure or evacuation which is an important issue of the IRASMOS project. It is so an illustration of the possibilities of the present knowledge and available tools so as of their current gaps as pointed out by the previous Chamonix IRASMOS workshop. The second point of this work is a sensibility analysis, always concerning avalanche hazard, on the influence of critical snow and weather parameters. The here used scenarii concern the part of the buried weak layers, the precipitation amounts and some indication on the snowdrift phenomena.

These studies are based on the use of the "Safran/Crocus/Mepra" (SCM) chain where snow is simulated by the "Crocus" numerical model. The meteorological conditions have been provided by the "Safran" model and the stability diagnostics are based

on the “Mepra” model outputs and specific indexes which have been developed for this study. Additional information on the snowdrift impact has been provided by the “Sytron1” model integrated in the SCM chain.

Based on the forecasted results we can only say that in the framework of the used modelling and the limitations of the used indices, a very high instability was predicted a little in advance without more information on its possible extreme magnitude nor its precise location inside the massif. Our major conclusion is that the main cause of the observed avalanche events is the different events of fresh snow accumulation. At mid and high elevations, the weak layers where the fractures occurred were located inside buried layers of fresh fallen snow. The importance of the amount of accumulated fresh snow is shown by a specific experiment which exhibits less instability with half reduced precipitations. The impact of the deeply buried faceted crystals is low but perhaps a bit more important at lower elevation or in some drifted areas, which we have not investigated yet.

The present work illustrates well the interest of numerical tools in the estimation and the forecasting of avalanche hazard some hours in advance but without a precise localization of the possible avalanche triggering. The modeled results can be thus of great importance for local users but cannot be used alone. This automatically provided information has thus to be merged with numerous local observations, a precise climatology of the past events, an accurate zoning and mapping and the skill and the experience of the local actor. This kind of study can also be applied in a different format to other risks linked strongly and at short term to the meteorological conditions as, for example, debris flows. The “Safran” analysis is thus able to initialise different surface modelling and it is presently applied to hydrological risks in France.