FUZZY MODELING OF THE SNOWPACK EVOLUTION

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ABSTRACT: The assessment of snow conditions and transformations is an important task; it is included in the more general field of environmental monitoring in mountainous regions where it plays a central role in both preventing emergencies and guiding sustainable development.

This task can be performed by research and operational models, which consider, among numerous parameters, the temperature gradient and equi-temperature metamorphism as the driving forces to describe the snow crystal changes.

Since changes in the metamorphic status of snow can be predicted by the temperature environment, we made snow-pits to determine the snow and ground temperature and the snow crystal form in different experimental sites in the Italian Alps, where also automatic measurements were performed. Then, we inserted rules based on temperature gradient in an inference engine fed by input values of snow temperature considering both automatic and non-automatic measurements.

The temperature gradient rules have been "fuzzified" to mitigate their main fault, i.e. the crisp thresholds which could drive to completely different results also if input values are similar. In our approach the thresholds are no more crisp values but soft values; also the output values of rule application are Fuzzy. The rules are used to predict the evolution of snow in terms of degrees of possibility that certain types of granules are present/absent in either the whole snowpack or in its individual layers. The aim is to create a prompt methodology to locate alarming situations that deserve increased observations and a deeper analysis by more complex models.

We describe the experiences we have performed and critically presents the results of comparing predicted values and observed samples. We also discuss and identify further developments and perspectives of the approach.

KEYWORDS: snow metamorphism, fuzzy sets, temperature environment, soft thresholds.

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