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An innovative sensor to cartography the Snow covering using simple terrestrial photography

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Using photography in natural environment seems to be an efficient method to measure large type of environmental variables. Currently, progress in numerical cameras resolution allows using terrestrial pictures in many situations. This communication focus on one important forcing variables of the water cycle in mountainous region: the snow cover.
Usual method of snow cover measurement such as remote sensing or aerial photography cannot quantify accurately the snow covering on a small mountainous catchment at hydrological models spatial and temporal resolution. Consequently, we decided to develop a specific monitoring system based on terrestrial photography analysis to calculate the snow cover with a resolution of several hours (5 or 7 pictures per day). Thus, a lot of data on snow covering are acquired at a minimal costs.

The first part of the communication will present the techniques and methods used to calculate the snow cover from a simple picture. First, we must realize a back-map of the photography (2D) into a topographical model (3D – real world). To make this 2D to 3D conversion, the camera referential needs to be relocated in the catchment referential by geometrical transformations. This operation is automatically realized by automatic recognition of geo referenced ground points (particular DTM points) within the camera pictures and resolution of a matrix system. When successfully solved, every picture pixel can then be dropped on the DTM taking into account classical problems such as hidden faces.
The second part of the job is to perform the snow detection in the picture automatically. Indeed, we must treat 5 or 7 pictures for each day and each camera and this work can't be made manually. The recurrent problem is the luminosity variation and cloud cover of the catchment. It is often very difficult to distinguish between white clouds and snow within the picture by automatic algorithm. Difficulties also arise when shading effects fade colours of the compressed pictures. An original automatic auto-calibrating algorithm leading to robust snow identification was then developed and will be discussed.

Finally, at the end of this operation, we obtain automatically, for each picture the snow cover map associate and we obtains a lot of information on the localization and quantity of snow using a simple picture. All this information can be used to understand and model the snow evolution during a season and then to constraint a snow stock model that will be developed in the future. Indeed, we have a good coverage of the catchment with our two cameras and it is possible to detect the preferential areas of accumulation and melting of the snow. Statistics on the distribution of the snow cover according to the elevation, the exposure and some many factors will be present.

This type of sensor seems well adapted to mountains areas and extremes conditions because of the low energy consumer, the autonomy and the number of measures realized. The multiplicity of picture and the number of snow cover measures allows forcing the hydrological model, which is coupled with a snow modelling of the catchment. Moreover, this sensor is particularly economic compare to use of traditional remote sensing.