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Hydro-meteorological monitoring of a mountain catchment, the example of the Vorz (Belledonne, France)

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The 22th August 2005, an important flash flood happened on the Vorz torrent (Belledonne Moutain, Alps region, France). The village of Saint-Agnès downstream this torrent was hit leading to 7 millions Euros of damages. Civil authorities launched then a research program to evaluate the expected changes of the frequency of such events considering climatic changes. Such upslope mountainous catchments are often the main source of drinkable water resources for these high-elevated villages (for example the Saint-Agnès village uses the water of the Freydanne glacier embedded within the Vorz catchment). Then, this project aims also to consider the entire hydrological cycle and not only hazardous events. This research program includes obviously modelling work packages. But relevant modelling cannot be reached without minimal amount of data, which are always very difficult to obtain in mountainous regions. This particular issue is addressed in this communication.

Many sources and different kinds of data are needed to feed and corroborate hydrological and snow melting simulations models. However, the principal problem in mountain area is the energy consuming, the collecting and the saving of data. The second problem is the important spatial variability of the meteorological parameters and their sampling in extremes conditions. Finally, it is wished that the sensor network remains as much money-saving as possible. Within the Vorz catchment, meteorological forcing variables (temperatures, rainfall and snow stock) are measured as well as the hydrological closing budget with one discharge station at its outlet. All the sensors were spreaded within the catchment at various elevations ranging from 900 to 2500meters. The flow is estimated using an original sensor based on a continuous video monitoring of the torrent. The river height and the surface velocities are then automatically estimated every 5 minutes. Supplementary information regarding the topography of the cross section allow then a reasonably accurate discharge measurement with a captor that remains sheltered from the hazardous floods, as it is not immersed in the torrent.

50 temperature sensors were installed within the catchment: 22 installed 2-3 meter above the soil surface and 16 installed 5cm under the soil surface. Rainfalls are sampled using three rain gauges for liquid rainfall and three cumulative snow gauges (at 1250, 1950 and 2200 meters). Solar radiation is also sampled. The last important variable that is measured is the snow cover on the catchment. Generally this snow cover is present between November and June in the top of the catchment. The snow cover is calculated using terrestrial pictures taken by two cameras able to shot up to six pictures per day (from 8.00am to 8.00pm). It is then possible to build the snow cover cartography of the catchment at 1 meter spatial resolution in the sampling zone and to accurately observe the spatial distribution of the snow during the melting period.

Instrumentation in mountain area is a very difficult task with many sources of uncertainties and technicals challenges. The strategy that will be discussed in this presentation wish to multiply the number of measure points at "low" costs. The dense network of different types of measures is expected to compensate the uncertainty in the rainfall measurements within mountainous regions.