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Using MODIS snow cover data to detect the best model hypotheses for snow-dominated watershed

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Many hydropower reservoirs like those of EDF (Electricité de France) in mountain areas are mainly filled with the melting of the snowpack in the spring. Good estimate of snow accumulation and ablation over the watersheds is thus critical for water resources management. Historically, the forecasts of the spring runoff for a watershed was carried out using regression models linking local measures on this watershed (rainfall totals and snow sampling) to spring runoff. Hydrological modelling has today replaced this approach by proposing estimates of the water equivalent of snowpack and the corresponding snowy area. The aim of the study is to compare these estimations with MODIS remote sensing data.

The MODIS remote sensing data, covering now a period of 10 years, are first locally evaluated by comparison with daily ground observations gathered from the EDF snow gauges network. A network of about 36 Cosmic-Ray Snow Sensors in the french mountainous regions. The Cosmic-Ray Snow Sensor provides a real-time measurement of the snow water equivalent by measuring the absorption of the cosmic-ray by the snowpack. The comparison between MODIS snow cover data and snow water equivalent observations is performed for each pixel centred on snow gauge. Different types of performance criteria were adopted based on contingency tables. A good agreement between the ground observations and MODIS data comes out. The main problem is the mask generated by clouds on these optical data, in particular on mountainous areas. A simple method for building snowy area chronicle of the watershed has been developed to use a maximum of observed days.

Based on the Drac watershed at the Sautet dam, MODIS snow cover data are then compared with hydrological modelling. Two hydrological models are considered, both based on temperature index approach to model snowmelt : The MORDOR model (Garçon, 1996) and The MORDOR SNE model (Paquet, 2004). They differ according to their spatial snow representation. The MORDOR model uses a global simulation approach and provides a percentage of snow cover area. The MORDOR SNE uses a semi-distributed approach where snow accumulation and snow ablation are computed per elevations bands (here 10 elevation bands). The study points out the limits of the global approach in hydrological modelling. The semi-distributed approach has a more realistic snow representation, and is more appropriate for remote sensing data assimilation, in order to constrain the parameters of the hydrological model. The main advantage of using a semi-distributed model is its ability to account for the orographic increase in precipitation, allowing thus a better representation of snowpack with elevation.

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Paquet, E. (2004). Evolution du modèle hydrologique MORDOR: modélisation du stock nival à différentes altitudes. La Houille Blanche, , 75-82.