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Assessing the impact of climate change on the flow regime of the Rhone river basin using a distributed hydrological model: first results

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Glacierized catchments are absolutely among the most vulnerable environments to climate changes. So, due to their high climate sensitivity and low human impact, glacier river basin have been proposed as significant indicators for the first alarming signals from hydrological responses to climate change. For this reason, it is really important to model the role of the glaciers in the hydrological balance in order to quantify the contribution of melt water, that, as known, in Alpine catchments is a significant source of supply for the rivers that originate there. Furthermore, it is significant to assess the impact of climate change on glaciers retreat in order to face the management of water resources under new runoff characteristics of glacierized river basin.

In this study a new module was implemented into the distributed hydrological model FEST-EWB (Flash–flood Event–based Spatially–distributed rainfall–runoff Transformation based on Energy and Water Balance) in order to simulate glacier dynamics at a basin scale and the evaluation of changes in the hydrological regime subjected to a future climate scenario. The study site is the Rhone basin, in Switzerland, which is covered for about the 13% by glaciers.

The developed glacier model, based on degree day approach for melting and on simple models of mass accumulation, is sufficiently simple to be used both for climate change analysis, which require only temperature and precipitation data as input, and for reducing calculation time. The model has been calibrated knowing the percentage reduction of glaciers volume from 1999 to 2008.

Calibration and validation of the snow dynamic model have been carried out comparing the trend of the percentage of the simulated snow cover on the basin with those observed by satellite.

Finally, the introduction as model input of temperature and precipitation data from 2009 to 2050 coming from the REMO Regional Climate Model and concerning the A1B IPCC scenario, allowed to assessing changes in the hydrological regime of the river basin, which appears qualitatively to be drastically altered by 2050. However, the coarse spatial resolution of input data, squares 25 km, is a great limit for the quantitative interpretation of results.