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Future challenges for water management and related hydrological modelling in the Swiss Alps

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In recent years, the water management in the Alps has to deal with apparently more frequent extreme events and extreme hydrological years. Considering that this area has already experienced a warming of between 1˚C and 2˚C compared to the period 1960 – 1990, the question inevitably arises whether these events are a result of climate change and how the hydrological regime will evolve in the near future.

The quantification of potential climate change impacts on the water management in the Alps is urgent: High mountainous water resource systems are particularly sensitive to a potential modification of the prevalent climate. And climate change will also affect the water demand side, in the Swiss Alps namely the water need for hydropower production but also for irrigation, for drinking water or for snow production. Another important aspect has to be taken into account: In the Swiss Alps, major long-term economic investments for flood protection are planned and the water use concessions for most Swiss hydropower plants are to be renewed soon for the next 80 years. In this context, the need for reliable climate change impact predictions is constantly growing.

We have studied potential climate change impacts on the hydrological regime of eleven high mountainous basins in the Swiss Alps. The aim of this study was to quantify the modification of the hydropower offer in the near future and to compare the results to the evolution of the energy demand in Switzerland (estimated by the Swiss Federal Office for Energy). Based on the obtained results, we discuss the impacts on major water management questions - namely hydropower production but also flood protection and minimum low flow. The results of the study also point out the main problems that arise in climate change impact prediction on water management in the

Alps: From a hydrological point of the view, one of the most difficult aspects was the prediction of the future water balance, especially future evapotranspiration rates. From the socio-economic point of view, the study highlights the need for further developments in the area of prediction uncertainty quantification but also the difficulty to integrate hydrological results directly into water management studies.