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Glacio-hydrological modelling on few alpine catchments: from recent past simulation to scenarios of future evolution.

Matthieu Le Lay, Joël Gailhard, Garavaglia Federico, and Agnes Brenot
EDF-DTG, Grenoble, France (matthieu.le-lay@edf.fr)

On many alpine catchments, understanding the effect of glacier recession on streamflow response is crucial for modelling past hydrology and for predicting water resources in the next decades. This study aims to evaluate a glacio-hydrological model on both observed streamflow and glacier mass balance, on two partially glacierized catchments: the Upper Rhone in Switzerland (Rhone at Porte de Scex, 5237 km^2) and the Arve in France (Arve at Arthaz, 1650 km^2). In glacier hydrology, first challenge is the water balance closure, given that total annual runoff is affected by glacier mass balance. An empirical method derived from the Budyko approach is used to estimate a realistic rainfall input, consistent with an interannual glacier melt proxy. We then evaluate the performance of the MORDOR-SD semi-distributed hydrological model (Garavaglia et al. 2017) to simulate river discharges, snow cover and glacier mass balance on long-term periods. Within this conceptual model, glacier melt is modelled by a classical temperature-index method and glacier area may be considered constant or variable. Model calibration and evaluation are performed on the two catchments of interest, considering not only runoff simulation, but also snow and glacier simulations. On evaluation periods, we show a very strong agreement between model and observations. The model simulates daily, seasonal and annual streamflows very consistently. In the same, time snow cover dynamic and proxy mass balance (Aletsch and Argentiere glaciers) are precisely reproduced over several decades. Pluvial, nival and glacier contributions to the hydrological response are well identified. In the last part of this study, we model future streamflow response for these catchments, considering several CMIP5 climate projections and contrasted glacier evolution scenarios.