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The value of data availability versus model complexity to estimate snow, glacier and rain water in mountain streams

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The contribution of snow, glacier and rainwater to runoff in mountain streams is of major importance for water resources managers as climate change is expected to impact on all three sources (e.g. Huss, 2012). While glaciers are retreating worldwide, the snow cover during winter becomes shorter and precipitations events become more intense (e.g. Finger et al., 2012). Besides field investigation such as chemical fingerprints in water samples and artificial tracer experiments (e.g. Finger et al., 2013), the contribution of snow, glacier and rain can also be estimated with hydrological models, given that the modeling accounts adequately for snow-, glacier and rainwater runoff (Finger et al., 2011).
We present a multi-variable calibration technique to estimate runoff composition using the conceptual HBV-light model (Seibert and Vis, 2012). The model code was extended to allow calibration and validation of simulations against glacier mass balances and satellite derived snow cover area, in addition to the usual comparison against measured discharge. We tested the value of these additional data sets on three meso-scale catchments in Switzerland: i) Rhoneglacier (39km2; ∼50% glaciation), ii) Hinterrhein (53km2; ∼17% glaciation) and iii) Silvretta glacier (103km2; ∼8% glaciation). We also compared the results to a similar study performed with a physically based, fully distributed hydrological model (Finger et al., 2011). Preliminary results indicate that all three observational datasets are reproduced adequately by the model, allowing an accurate estimation of the runoff composition in the three mountain streams. However, the use of runoff alone to calibrate the model leads to unrealistic snow- and glacier melt, expressed by a low overall model performance. These results are in line with previous studies carried out with a more complex, physically based fully distributed hydrological model (Finger et al. 2011).
Based on these results we conclude that it is essential to use various observational datasets in order to constrain model parameters and compute realistic discharge estimations. Finally, we postulate based on the comparison of model performance of HBV-light and the physically based, fully distributed model that the availability and use of different datasets to calibrate hydrological models might be more important than model complexity in regard to realistic predictions of runoff composition.

REFERENCES:

Finger, D., A. Hugentobler, M. Huss, A. Voinesco, H.R. Wernli, D. Fischer, E. Weber, P-Y. Jeannin, M. Kauzlaric, A. Wirz, T. Vennemann, F. Hüsler, B. Schädler, and R. Weingartner (2013). Identification of glacial melt water runoff in a karstic environment and its implication for present and future water availability. Hydrol. Earth Syst. Sci. Discuss. 10, 1-45, doi: 10.5194/hessd-10-1-2013.

Finger, D., Heinrich, G., Gobiet, A., and Bauder, A.: Projections of future water resources and their uncertainty in a glacierized catchment in the Swiss Alps and the subsequent effects on hydropower production during the 21st century, Water Resources Research, 48, doi: 10.1029/2011wr010733, W02521, 2012.

Finger, D., Pellicciotti, F., Konz, M., Rimkus, S., and Burlando, P.: The value of glacier mass balance, satellite snow cover images, and hourly discharge for improving the performance of a physically based distributed hydrological model, Water Resources Research, 47, doi: W07519, 10.1029/2010wr009824, 2011.

Huss, M.: Present and future contribution of glacier storage change to runoff from macroscale drainage basins in Europe, Water Resources Research, 47, doi: W07511, 10.1029/2010wr010299, 2011.

Seibert, J., and Vis, M. J. P.: Teaching hydrological modeling with a user-friendly catchment-runoff-model software package, Hydrol. Earth Syst. Sci., 16, 3315-3325, doi: 10.5194/hess-16-3315-2012, 2012.