

# ***Interactive comment on “Predicting natural streamflows in regulated snowmelt-driven watersheds using regionalization methods” by D. Kim and J. Kaluarachchi***

**J. Seibert (Editor)**

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Received and published: 10 October 2013

This is an interesting manuscript on regionalization in snow dominated catchments based on flow duration curves. The two reviewers provide valuable comments and suggestion. Based on their assessment and my own reading moderate to major revisions are required before publication.

A major limitation is the lumped representation of snow in the Tank model (p9446), as mentioned by reviewer #1. The on/off step transition from full catchment snow coverage to no snow at all is unrealistic and, I would argue, also unnecessary; using

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elevation zones can allow for a more gradual transition without requiring additional parameters and is common use in conceptual models. The catchments used in this study have partly huge elevation differences (Sevier River more than 2000 m !), which makes the assumption of ONE SWE time series very unrealistic. We (Uhlenbrook et al., 1999) and others have clearly demonstrated that ignoring elevation/vegetation zones for snow will lead to significantly poorer model performances. Please consider to use the Tank model with different elevation zones.

Parameter calibration, objective function, (p9445, Eq 11): Is this Eq correct? Shouldn't there be an exponent 2 or an 'abs'. As it reads now the errors might cancel out. Please also specify how low flow and high flow seasons were defined. Please also comment on the performance of the MATLAB optimization. In my own experience, such optimization tools can have problems with poorly defined optimization problems as catchment models usually are. Can you comment on this and the issue of parameter uncertainty in general. Would it be useful to use several 'best/calibrated' parameter sets instead of one?

Please comment also on observational uncertainties in the data being used here (as nicely discussed by McMillan et al., 2010) these can be significant). Would an approach similar to Westerberg et al. (2011) be suitable to consider uncertainties in the FDCs?

The model efficiency is used for evaluation of the SWE simulations. Is this really the best possible objective function? SWE has a much higher temporal correlation than Q, for which the model efficiency is usually used. Does the efficiency for SWE really ensure that the important characteristics of the SWE time series are evaluated?

As listed by the reviewers there is some need for clarifications and improvement of the figures. At several places the reader has to guess what exactly has been done. Please make sure that such guessing can be avoided.

The manuscript would benefit from improving the English.

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McMillan, H., Freer, J., Pappenberger, F., Krueger, T. and Clark, M. (2010), Impacts of uncertain river flow data on rainfall-runoff model calibration and discharge predictions. *Hydrol. Process.*, 24: 1270–1284. doi: 10.1002/hyp.7587

Uhlenbrook, S., Seibert, J., Leibundgut, Ch. and Rodhe, A., 1999, Prediction uncertainty of conceptual rainfall-runoff models caused by problems to identify model parameters and structure, *Hydrological Sciences - Journal des Sciences Hydrologiques* 44(5): 779-798.

Westerberg, I. K., Guerrero, J.-L., Younger, P. M., Beven, K. J., Seibert, J., Halldin, S., Freer, J. E., and Xu, C.-Y., 2011. Calibration of hydrological models using flow-duration curves, *Hydrol. Earth Syst. Sci.*, 15, 2205-2227, doi:10.5194/hess-15-2205-2011

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Interactive comment on *Hydrol. Earth Syst. Sci. Discuss.*, 10, 9435, 2013.

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10, C5524–C5526, 2013

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