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Hydrology and Earth System Sciences Discussions

Interactive comment on "Water balance estimation in high Alpine terrain by combining distributed modeling and a neural network approach (Berchtesgaden Alps, Germany)" *by* G. Kraller et al.

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The authors want to thank the referee for the comments which help to improve our manuscript. In the following we address the comments. Please note that reviewer's comments are bolded and our responses are in regular font format.

1. The geometry of ANN used in the manuscript is well described but there is no

specific comment why such geometry was used (what kind of tests have been performed and what results were obtained).

The referee is right, we did not explain why we decided to use an ANN as basis for hydrological model correction. What we know from recent studies in the area is that the water storage in the area and the underlying processes are very complex and it is not possible to physically describe those in detail. ANNs are nonlinear input-output models which are able to detect complex relationships where physically based methods are limited. In literature review we found, that feed forward back propagation networks are most commonly and successfully used in hydrology. Therefore we decided to fall back on that knowledge and chose this kind of geometry. We then tested 3 and 4 input nodes, chose the hidden nodes by an auto calibration routine and found that the tansig-function is the best in our case, because the ANN has to reproduce negative and positive values. We added information on model choice in the manuscript in chapter 4.

2. The origin of input parameters is not clear. In one place authors write that "Input variables" are distributed model outputs" and few lines below the inputs are described as exogenous. It is not clear if temperature and RH is distributed model output of input.

The origin of the input parameters is hydrological model outputs. We agree that this is not clearly described and revised the manuscript in chapter 4.1.

3. It is not described what the difference between network validation and testing is.

We agree with the referee, that we did not make clear enough what the difference between validation and testing is. We added additional information in chapter 4.

4. What represents the weights and biases presented in the table 5? Usually the training procedure is repeated several times with stochastic initial weights values to check if obtained results are consistent

Table 5 presents weights and bias of the ANN that revealed best performance in hydrological model correction (20-day time increment). As we derived the analytical solution of the ANN, the weights and biases of this now static network are now the values for the parameters to solve the ANN equation. We updated the manuscript in chapter 4.1.

Technical comments:
1. p.228: Number of datasets used for training/validation Step is inconsistent (56-11 = 67 not 65)

Based on the referees comments we completely revised ANN setups, we completely revised the codes and routines of the ANN and the influx to improve ANN results. We trained and tested ANNs with four Inputs for different time increments (5-day, 10-day, 15-day, 20-day, 25-day, and 30-day) and tested the effect of the correction on the hydrological model correction. The number of datasets used for training/validation changed and we revised the manuscript in chapter 4.1, 4.2. and 5

Thank you very much for your investment of time and effort.
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