

Interactive comment on “Multi-variable evaluation of hydrological model predictions for a headwater basin in the Canadian Rocky Mountains” by X. Fang et al.

Anonymous Referee #2

Received and published: 4 January 2013

This manuscript presents the Multi-variable evaluation of hydrological model (Cold Region Hydrological Model – CRHM) predictions for a headwater basin (Marmot Creek Research Basin) located in the Front Ranges of Canadian Rocky Mountains. The content of the manuscript is of weighted significance in hydrological modeling community as this paper discusses about the evaluation of the physically based hydrological model (CRHM) against field observations in simulating the hydrological processes of the proposed river basin. The authors claim that this modeling platform can be applicable for streamflow simulations of ungauged river basins (in the framework of Predictions in Ungauged Basins; PUB); but the results of this study show that the predictions are

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very poor in simulating streamflow although the authors insist that none of the model parameters are calibrated. I would like to emphasize that normally and in most cases, the physically based models do not need calibration since the hydrological processes are imitated following the physical rules. However, application and development of such physical models in Rocky Mountains is a difficult task.

This is a well written manuscript showing the evaluation of relatively well simulated soil moisture, snow water equivalent and poorly simulated ground water level and streamflow. As other variables (soil moisture, snow water equivalent) are relatively well simulated, it is necessary to deepen our understanding why the streamflow are poorly simulated. I strongly recommend the authors to re-analyze and investigate the poor simulation of streamflow and provide more insight about the causes and mechanism of such poor streamflow simulation. After addressing this issue, the manuscript shall be considered for publication in HESS.

Specific Comments/Suggestions

1. Page 12832, line 28, Please clarify “Upper clearing, Upper forest and level forest”
2. Please consider in shortening the chapter 3.2.6 Hillslope module parameters. Equations 1 to 4 can be represented in a single equation.
3. As the value for each parameter for different forest and sub-basins are almost same, I recommend to reorganize Table 2. For example, it can be written as soilrechmax 250 soilmoistmax 550 (425 at subalpine forest and 750 at confluence)
4. Please provide RMSD, NRMSD and MB for each snow season in Table 3.
5. Please revise figures 6 and 7 by showing line graph.
6. Why there is large discrepancy of SWE simulation in 2009/10 (Fig. 7 c,d,e) ? Please explain.
7. The observations for soil moisture are for 0-25 cm. At what depth, the soil moisture

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is modeled? Please relate clearly the modeled value to observations for analyzing the biases.

8. Please discuss a little about the future strategies for improving the groundwater simulation in CRHM in section 4.3.

9. Please consider not using qualitative words in streamflow simulation section – generally matched, quite comparable etc for poor simulation results.

10. Please provide yearly NSE, MB, RMSD in table 5.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 12825, 2012.