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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Application of machine learning techniques for regional bias correction of SWE estimates in Ontario, Canada" *by* Fraser King et al.

Anonymous Referee #1

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General comments

This study quantifies bias between SNOWDAS assimilation dataset and in situ SWE observations in Ontario region (Canada) and compares efficiency of three different bias correction methods in terms of improvement of SWE prediction and estimated snowmelt volumes. The results indicate that there is a bias between SNODAS and in situ SWE, particularly in the period 2011-2013 and that the machine learning technique (random forest) approach outperforms simple mean subtraction and linear regression bias correction methods.

Overall, the manuscript is clearly written and has a good structure. The topic is relevant

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Discussion paper

and within the scope of the journal. I would like to make only a few general comments:

1) The results indicate that there is a clear difference in SNOWDAS agreement (against in situ SWE) in the period 2011-2013 and 2014-onwards. It will be interesting to see/understand why? Is it the change in assimilation frequency, sources used in assimilation, their accuracy? I think such understanding can then support the selection of approach used for bias correction. It has some implications also for the design of this study. If there is a step change in SNOWDAS, then it is not surprising that simple mean subtraction method is not working well for the entire period. It will be interesting to see why does the random forest outperform the other methods in such case and what factors are controlling its efficiency? (Is it because using year of observation?) Will it be not more fair in this case to compare the methods in two separate periods?

2) I think that the referencing (used in the Introduction and Discussion) can be improved. There are some relevant papers which are not addressed: e.g. Zahmatkesh et al. (2019) evaluating bias correction of SNODAS in Canadian basins or some studies cited in Lv et al. (2019) focusing on the accuracy assessment of SNODAS. Please consider to formulate how does this study compare to these studies (in Intro and Discussion sections).

3) I have to say that the part related to evaluation of the impacts of different bias corrected SWE estimates on snowmelt is not clear to me. Using monthly estimates without accounting for evapotranspiration and other processes is somewhat less robust. Comparison of observed daily discharge with daily simulations driven by a hydrologic model will be more representative example.

4) How to account for scale gap between SNODAS and in situ observations?

Specific comments

Fig.1b. What do the lines represent? Mean over 383 stations?

Fig.2,3,4,5. Please explain the meaning of abbreviations MBS, SLR, etc. in figure

caption.

References:

Zahra Zahmatkesh, Dominique Tapsoba, James Leach & Paulin Coulibaly (2019) Evaluation and bias correction of SNODAS snow water equivalent (SWE) for streamflow simulation in eastern Canadian basins, Hydrological Sciences Journal, 64:13, 1541-1555, DOI: 10.1080/02626667.2019.1660780

Zhibang Lv John W. Pomeroy Xing Fang (2019) Evaluation of SNODAS Snow Water Equivalent in Western Canada and Assimilation Into a Cold Region Hydrological Model, WRR, https://doi.org/10.1029/2019WR025333

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