***Interactive comment*** on "Using GRACE to derive corrections to precipitation data sets and improve modelled snow mass at high latitudes" by Emma L. Robinson and Douglas B. Clark

This study compared four commonly-used meteorological data sets with GRACE corrected precipitation over four basins at high latitudes and found that four commonly-used data sets generally underestimated the cold season precipitation. Undercatch correction was further employed to alleviate some of the underestimation of cold season precipitation. Driven by these original/corrected precipitation inputs, JULES land surface model was used over four high latitudes basins. Improvements on the simulation of seasonal maximum SWE and river discharge were found using the corrected precipitation data.

Finding ways to better define precipitation inputs is important for earth systems interpretation in terms of hydrological and biogeochemical cycles. This paper provides us with promising ways to improve the cold season precipitation data. However, such work is challengeable and full of uncertainties (e.g., uncertainties in other meteorology data, model physics…). I agree that authors propose to conduct systematic evaluation in combinations with other hydrological related products(e.g., GRACE TWS, SWE derived from remote sensing, river discharge…). While it will further result in multi-source of uncertainties. My concerns are thus as follows: i) is there a need to conduct the preliminary water balance check for assessing the various products; ii) if the model show consistent biases across several components, can we firmly conclude that data sets is of uncertainty? What is the role of model uncertainty? iii) what is the role of energy related regimes, especially in seasonally cold regions. As far as I know, thermal state can also largely affect the hydrologic variables(runoff, infiltration…).

The specific comments are as follows.

Abstract

Line 15: '… that that …' change into '… that …'
Line 17: '… much more modest improvements are found in modelled river discharge.' Here you emphasis the comparison in the model performance of maximum SWE and river discharge, why?

1 Introduction

Page 2, Line 1-Line 7: considering merging these two paragraphs?
Page2, Line 8: considering rephrase?
Page 2, Line 18: 'SWE (e.g. GlobSnow; Takala et al., 2011) but the need for an algorithm…'
    Add the comma between as 'SWE (e.g. GlobSnow; Takala et al., 2011), but the need for an algorithm…'
Page 2, Line 22-24: considering rephrase
Page 2, Line 27: what does 'the impact' mean?
Page 3, Line 2: 'that that' change into 'that'
Page 3, Line 24: 'of 45◦ N Yang et al. (2005)'
    add a comma as 'of 45◦ N, Yang et al. (2005)'
page 3, Line 26-28: considering rephrase
page 3, Line 30-31: considering rephrase
page 4, Line 10: delete 'Behrangi et al. (2017)' or put it at the end of sentence?

Page 4, Line 17: 'and that this leads to…' feel awkward.
Page 4, line 19-22: the result part should not be presented here
Page 8, Line 13: '1(c)' change into 'Fig. 1 (c)'
Page 9, Line 32- page 9, Line 1: is there a transition state between snowfall and rainfall, ie mixture of snow and rain? How to consider such state in a physical way?
Page 10, equation1:
$S_{b,i}$ is not shown in equation ($S_{i,b}$), is the unit necessary here?
Equation 2: what is the meaning of Ms?
Page 11, Equation 5: is the unit necessary here?
Page 13, Line 4-5: '…, and the SWE is less sharply peaked than the observations.' Why?
Page 13 ,Line 8-9: considering rephrase
Page 15, Line 7-8: better to add the corresponding figure here.
Page 15, Line 17: 'for for' change into 'for'
Page 17, Line 13-15: not clear, considering rephrase
Page 17, Line 28: how did you get such a conclusion? Please provide corresponding figure or reference.
Page 19, Line 1-2: do you have the simulations of interception loss?

Discussion: why did you only select the maximum of SWE as the model evaluation output? How about the starting date of snow accumulation?
What is the effect of the water storage before the accumulation of snow on the SWE simulations?

Figures:

Figure 1: add the x-axis title of fig. 1c.
Figure 2: add the x-axis title. Why did you define the cold season as 'october-february'? as I can see that from Figure 3, the maximum of SWE usually happens in March/April.
Figure 3: please add the x-axis title
Figure 6 & 7: add the x-axis title
Figure 8: x-axis title, unit seems to be truncated should be (mm $y^{-1}$), not (mm $v^{-1}$).
Supplement:
Figure S1 & S2 & S9: add the x-axis title
Figure S4: '(GLEAM…' the other bracket is missing?