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Comment on hess-2022-136

Anonymous Referee #1

Referee comment on "Precipitation biases and snow physics limitations drive the uncertainties in macroscale modeled snow water equivalent" by Eunsang Cho et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2022-136-RC1>, 2022

Title: Precipitation Biases and Snow Physics Limitations Drive the Uncertainties in Macroscale Modeled Snow Water Equivalent
Author(s): Eunsang Cho et al.
MS No.: hess-2022-136
MS type: Research article

General comments:

The manuscript by Eundang Cho and others is well organized and clearly presented. The research fits well into the larger picture of mountain snow research and highlights the need for improving LSM estimates of SWE. The authors imply a focus on precipitation/snowfall accumulation is an important first step. Without proper precipitation accumulations, the model is unable to properly evolve the snowpack. It is important to identify the issues with LSM SWE estimates and this manuscript does just that. It does not rank the LSM outputs, but rather uses them to provide strong conclusions about the next steps in improving the models.

The authors provide a lengthy discussion that addresses the main shortcomings of the models and observations used in their research. This provides good context to how their work fits into the larger picture of snow research and I found the discussion to be just as important as the rest of the paper.

I am happy to have reviewed this paper and know of the conclusions. The paper receives excellent marks in terms of the HESS review criteria of scientific significance, scientific quality, and presentation quality. Thus, I recommend this paper be accepted to HESS. I have given a few minor suggestions below that may contribute to the improvement of the manuscript:

- 1) When discussing the potential of using wet-bulb temperature as a rain/snow

partitioning method, the inclusion of Sims and Liu, 2015 (https://journals.ametsoc.org/view/journals/hydr/16/4/jhm-d-14-0211_1.xml) would be beneficial to the reader. This partitioning method is used for satellite remote sensing of precipitation.

2) A few minor corrections:

Line 74: Rephrase "Furthermore, most of the prior studies used a single or multiple LSMs with a single meteorological forcing and/or simulated/reanalysis SWE with relatively coarse spatial resolutions (e.g., 12.5 km to 50 km), which impedes the quantification of the contributions by producing additional uncertainties." ---> "Furthermore, most of the prior studies used a single or multiple LSMs with one meteorological forcing and either simulated or reanalysis SWE with relatively coarse spatial resolutions...."

Line 163: Simplify "The data matrix was pre-processed: the values in each column were normalized with the following two steps: 1) the mean of each column is zero, and 2) each column was standardized to the unit norm as the variables have different units." ---> "Data in the matrix was pre-processed such that the mean and standard deviation of each variable is zero and one, respectively."

Line 199: Change "... fractioning method partitions partial precipitation..." ---> "... fractioning method partitions precipitation..."