Review for hess-2021-562

Anonymous Referee #1

Referee comment on "A comparison of hydrological models with different level of complexity in Alpine regions in the context of climate change" by Francesca Carletti et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-562-RC1, 2022

I enjoyed reading the manuscript on snow model comparison and climate change impact assessment in different catchments.

I have several major concerns:

1)Spatial resolution of 500m seems course for this region. Why didn't authors select a higher resolution to run their models?

2)Both hydrologic models are semi-distributed models even though one is grid based. In such complex topography a fully distributed hydrologic model (even based on energy balance) with multi parameter regionalization approach would be more suitable than those two semi distributed models. mHM is one these models with day degree method. However, it is open source model in which other complex formulations could be introduced in its Fortran code.

3)The authors preferred RMSE, NSE and KGE metrics. However, in a satellite based remote sensing study, the readers would expect spatial pattern evaluation metrics for evaluating spatial snow cover output of the models.

The authors should include one of these well established metrics e.g. FSS, EOF, Kappa or SPAEF.

Specific comments:

-P16L5-10: Calibrated values of many parameters were taken from other studies. Why? Computer source limitation? Apparently this is not an issue as P15L7 indicates that 10k model runs were performed.

-Why MC method was used for calibration? and not CMAES, DDS or SCE requiring less model runs. Please justify.

-Little details were given about model calibration. Instead of taking calibrated values from the literature it would be more robust to apply spatial sensitivity analysis first to select most important parameters affecting snow processes (see doi:10.5194/hess-19-1887-2015)

Then a rigorous calibration with a global search algorithm (listed above) should be applied with appropriate objective functions (spatial error metrics) focusing on spatial distribution of snow.

Currently the methods section is not well organized. A separate section should solely focus on calibration details in addition to statistical scores (3.2)