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The Cryosphere Discussions

Interactive comment on "Snow Ensemble Uncertainty Project (SEUP): Quantification of snow water equivalent uncertainty across North America via ensemble land surface modeling" *by* Rhae Sung Kim et al.

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Kim et al. quantify uncertainty in estimates of snow storage by a set of operational models and forcing datasets. This is a topic of considerable interest, given the importance of snow storage for water resources and the difficulty of estimating it by remote sensing. The paper is interesting and generally well written; my comments focus on clarifying the methodology.

119

Why was the three-layer snow scheme in JULES, described by Best et al. (2011) and operational at the Met Office, not used?

122

"not tuned in this study to assess current configurations" is ambiguous. I assume that "to assess current configurations, parameters were not tuned" is what is intended.

130

State the original spatial and temporal resolutions of the forcing datasets.

132

Doesn't SRTM extend only to 60N? How is the downscaling achieved up to 71.875N?

134

How are relative humidity, wind and longwave radiation downscaled? I don't think that this is described in Cosgrove et al. (2003).

137

It is worth noting that Kumar et al. (2013) concluded that topographic adjustments to radiation should be included in models with resolutions finer than 16 km, but the adjustments are likely to be small at 5 km resolution.

154

Should this be "If the observation is more than 10% higher than the highest ensemble member, then the rank is set to 13"?

161

Conventionally, an integral would not have the "X=" in its limits. "P0 represents the observations occurrence" is not clear – it is a step function at the observed value.

184

To be clear, CMC includes an estimate of SWE, but only snow depth observations are used in the CMC analysis.

222

Give some context for what can be regarded as a “low” value of CRPS.

243

Some information should be given (earlier, or refer to S1) on how rain/snow partitioning schemes differ between the LSMs. Three of the four are identical.

284

Raleigh et al. (2016) and Guenther et al. (2019) added uncertainty to single forcing datasets, rather than using multiple forcing datasets as here.

381

Is SWS averaged over the entire time period meaningful for comparing different snow classes, when it conflates the amount and duration of snow cover? How about looking at average annual maximum SWS?

456 For “c urrent operational capabilities”, note that several countries now have operational limited area numerical weather prediction models with spatial resolutions on the order of 1 km.

Figure 2 caption

Average CRPS.

Move the information “13 is more snow than all ensembles and 0 is less snow than all ensembles” from the figure to the caption

Figure 6

Does “without outliers” mean that outliers are omitted from the diagram (in which case,

how is an outlier defined?) or that the ends of the whiskers are the SWE range?

There is room to put the LSM and forcing dataset labels on the figure axis, removing the need for the reader to relate the figure legend to the boxes and removing the need for colour.

If I understand correctly, five statistics (minimum, 25th percentile, median, 75th percentile and maximum mean annual average of SWE) have been calculated from just three data points for each LSM (mean annual average SWE for three different forcing datasets). Why not just show the points?

Figures 1, 3, 4 and 11

Rainbow colour scales are widely deprecated.

If latitudes and longitudes are not going to be marked, remove the redundant grid lines.

For the figures that use a divergent colour scale centred on white, the coastline would be a nice addition.

Figures 7, 9 and 10

All of the colours in these figures are redundant.

Minor corrections:

49

“National Academies”

203

“the influence of vegetation on SWE uncertainty”

255

Remove redundant words: “ranges from December-April in the lower latitudes to May-June in the high latitudes”

278

“across the forcing datasets when driving a common LSM”

260

SW spread is Fig 4b.

323

“between February and March”

324

“JULES simulates permanent snow”

341

“a somewhat similar ensemble mean approach to SEUP”

348

Similar, not identical.

407

“non-forested regions have larger spatial variability”

417

“Since runoff (R), in particular, is significantly influenced by snow evolution”

480

“critical to developing”

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