

The Cryosphere Discuss., referee comment RC2
<https://doi.org/10.5194/tc-2021-285-RC2>, 2022
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Comment on tc-2021-285

Anonymous Referee #2

Referee comment on "Snow cover prediction in the Italian central Apennines using weather forecast and land surface numerical models" by Edoardo Raparelli et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2021-285-RC2>, 2022

In "Snow cover prediction in the Italian Central Apennines using weather forecast and snowpack numerical models" the authors present an application of the Noah LSM and Alpine3D snowmodels forced with WRF 3km data. Overall this manuscript is well written and generally clear. Figures are mostly clear and I enjoyed the contextualization of the climate during the study period.

My main concern is that at the 3km lateral spatial resolution, we know a point-scale model is not representative of the sub-grid dynamics across such a large area -- blowing snow, canopy interactions, avalanching, sublimation on exposed ridges, variable compaction rates, surface exchange, etc. The authors note this but I'd like to see more attention drawn to it as a (major in my opinion) limitation. Indeed I would like to see more discussion on this scale mismatch between the vertical resolution -- O(mm) and O(cm) scales with SNOWPACK -- and the lateral O(km) scales. Reposed, is the computational effort of running Alpine3D warranted over a simpler snow model but at a finer spatial resolution? What are the process representations in SNOWPACK that have the largest impact on the simulations versus Noah? As there seems to be no treatment for sub-grid fractional snow cover, it isn't clear to me how the vegetation interactions are considered in this context. Lastly, I'd like to see a bit more detail regarding how wind downscaling was done as it wasn't completely clear -- is it straight out of WRF using the 3km topography? This is a large source of uncertainty with respect to surface exchanges.

In general I'm left a bit uncertain what the novel take away of this manuscript is. The application domain is certainly unique but I'm left feeling that there is a missing discussion on the "why" of comparing these two models. Specifically, how the process representation in these models and the uncertainty in parameter estimation leads to "better" or "worse" process representation. Figure 15 suggests some very fundamental differences outside of the snow microstructure scheme resulting in such large SWE differences. I'm missing a deep understanding as to what is causing this.

I would suggest moderate revisions to contextualize the 'why' better.

Specific comments:

Abstract:

Can be tightened up with the results more succinctly summarized

L8 "online" -> Is this a two-way coupling?

L 9 "LSM" remove.

L 9 "Alpine3D"

As I understand it Alpine3D is essentially met downscaling/interp + blowing snow + distributed SNOWPACK. I think this should clearly stated as to what the underlying snowmodel is as that is most relevant to this study.

L23 "at moderate spatial resolution (3 km)"

Be explicit that the snowmodel was run at this resolution.

L31 snowpacl -> spelling

L35 precipitations -> No s

L55 Suggest you include Vionnet, 2021 (<https://doi.org/10.5194/tc-15-743-2021>)

L100 "Classified as Cfs"

Please remind the read what Cfs stands for.

L103 "thermal excursion"

is not clear to me in this context. word choice or can you clarify?

L111 "being the yearly maxima mainly localized in the western slope"

This is not clear

L114 "it is worth to mention"

-> It is worth mentioning

although this is a bit colloquial. I suggest you change.

L117 "the same"
The same as what?

L118 "on annual basis"
On /an/ annual basis

L135 "the second decade"
Decade? Do you mean "the second half"?

L137 "small cold"
Small, cold

L 137 "impulse"
Uncertain of meaning in this context. Word choice?

L137 leaded

L140 "determined"
Caused?

L 142 "impulse"
Uncertain of meaning in this context. Word choice?

L152 automatic weather stations and use previously defined AWS only

L154 "The measured variables"
List units and how frequently they were visited please

L190 "for WRF,"
remove comma

L190 "it resulted the best"
Resulted in

L199 "is run from 1 December 2018"
Why not the commonly used October 1? Can the authors confirm there were no missed snowfall events? How does this impact soil temperature?

L220 "After a sensitivity test (not shown here)"
What forcing variables/parameters were tested? How was this done?

L221 "as well as the selection of the "Zwart" and "Lehning new""
Please describe what these are including the associated references. How do these compare to what was selected in Noah?

L224 "of the simulation results"
Of what, specifically?

L417 "lower part"
Lower elevation?

Figures:
All timeseries figures need a starting $x=0$ tick and in general all would benefit from more x -axis ticks