Response to review #3
Snow model comparison to simulate snow depth evolution and sublimation at point scale in the semi-arid Andes of Chile

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August 11, 2021

Dear editor,

First, we would like to thank the editor for his careful third evaluation of our work and the detailed suggestions and comments. Below we adress our detailed responses to all the comments.

As for the first rounds of reviews, in this response-to-review document we clarified and addressed each of the editor's suggestions and comments. Therefore we have copied the comments in blue boxes and have addressed them one by one. In the response we use italic fonts to quote text from the revised manuscript. Additional to the revised manuscript, we have uploaded a supplementary version of the manuscript with highlighted track changes that indicate where the manuscript has changed (red=removed; blue=added).

Yours sincerely, Annelies Voordendag & co-authors

Response to the Editor B. Noel

> Dear Annelies Voordendag and co-authors,
> Thank you for submitting your revised manuscript to TC. The authors provided convincing answers to reviewer #3. The manuscript could still benefit from a few clarifications, and the editor recommends publication in TC after applying/considering the minor comments/suggestions below. Note that the line numbering is based on the "tracked changes" version of the revised manuscript.
> The editor will re-assess the revised manuscript before acceptance in TC. Best wishes,
> Brice Noël

The authors thank the editor for his new careful reading and his feedback. As requested, in this revised version of the manuscript, along with accounting for the suggestions, we briefly present the main findings and limitations of the studies performed by (Gascoin et al., 2013) and (Réveillet et al., 2020) in the introduction. We also clarified the meaning of P_{cor}.

Editor's minor comments

> 1. The editor agrees with reviewer #3 that the authors should briefly present the main findings of (1) Gascoin et al. (2013) and (2) Réveillet et al. (2020) in the introduction. These two studies present (1) a process that is not accounted for in this study (i.e. snow drift) and (2) another estimate of the relative contribution of melt/sublimation to total ablation in the area.

More details about these studies have been added in the reviewed version, following your comment. You can now read:

In previous studies, Gascoin et al. (2013) assessed the effect of wind transport on snow cover in the semi-arid Andes using numerical simulations with SnowModel (Liston and Elder, 2006), and highlighted the significant importance of blowing snow sublimation. They also evidenced the difficulty of the model to capture the small-scale snow depth spatial variability, partly related to the lack of reliable input data such as precipitation. Réveillet et al. (2020) indicated that ablation is dominated by sublimation in the semi-arid Andes and that the sublimation ratio increases with elevation. They also quantified a similar proportion of sublimation ratio for two years with contrasting climatic

conditions (i.e. dry versus wet), but pointed out the significant uncertainties related to the forcing. The study performed by Mengual Henríquez (2017) assessed the snow types in different Chilean regions with SNOWPACK (Bartelt and Lehning, 2002; Lehning et al., 2002a,b) and mainly found that SNOWPACK is a powerful snow model, but an improvement of the forcing data is needed to improve simulations.

> 2. In L189-192: The authors should clarify that the precipitation correction of "Pcor" used in "optimal" simulations is based on Wolff et al. (2015).

The text now reads:
Due to complexities with the assimilated precipitation data and the need for SWE as validation data, the precipitation data set (P_{cor}) that is used in the further study is based on a wind correction by Wolff et al. (2015) (See Sect. 4.1).

> 3. For clarity, the authors should verify that "P" is used for observed (uncorrected) precipitation and "Pcor" for the optimal (corrected) precipitation data used in the sensitivity experiments (including both parameterization and perturbed forcing). For instance, "P data" in L210 and "P" in L217 should better be replaced by "Pcor". In addition, the authors could add "(P)" after "Precipitation forcing" in L89.

The proposed adjustments have been made, along with adding P_{cor} in the caption of Table 3.

> 4. The authors should clearly mention in the caption of all Figures showing SWE that the black solid (dotted) line represents measurements from potassium (thallium).

We have done this for Figures 3, 4, 5, S2.1 and S3.1.

Editor's specific comments

> L101: For clarity, the authors could replace "accuracy" by "uncertainty".

Done.

> L177: This sentence remains unclear. Do the authors mean "This cumulative SWE approach does not account for snow drift deposition, which inclusion would have resulted in ... "?

The text now reads:
The positive SWE changes beyond precipitation events are not accounted for, as they might originate from deposition caused by snow drift and its inclusion would have resulted in an overestimation in this data set.

> Figure 2 caption: "air temperature (TA)".

Done.

> Figure 3 caption: "The solid (dotted) line in c-d) indicates more (less) reliable SWE measurement from potassium (thallium) rays ...". See also minor comment #4.

Done. The caption now reads: *a-b) SD, c-d) SWE and e-f) the cumulative assimilated precipitation for the simulations with SNOWPACK (a,c,e) and SnowModel (b,d,f) and observations (black). The different input variables are given in the legenda. The solid (dotted) line in c-d) indicates the more (less) reliable SWE measurement from potassium (thallium) rays (See Sect. 2.3) and the dotted line in e-f) is P_{cor}. The models have assimilated the observed precipitation (black) to the output (red/blue) given in e-f). Only one red and one blue line is shown for SNOWPACK as the other eight simulations crashed. The simulations for $z_0 = 1\,mm$ are found in Sect. S2.*

> Figures 4-5 caption: See previous comment and minor comment #4.

Done.

> Figure S2.1 caption: "red line is visible in e-f).": "the dotted line in c-d) ...".

The caption now reads:

a-b) SD, c-d) SWE and e-f) the cumulative assimilated precipitation for SNOWPACK (a,c,e) and SnowModel (b,d,f) and observations (black). The different forcing parameters are given in the legenda. The simulations with SNOWPACK for every different input set were done with five different fresh snow density parameters and the simulations with SnowModel for every input set were done with six combinations out of three fresh snow density and two albedo parameterizations. PSWE is equal for z_0 is 1 mm and 1 cm and thus only the red line is visible in e-f). The solid (dotted) line in c-d) indicates the more (less) reliable SWE measurement from potassium (thallium) rays.

Figure S3 caption: "precipitation from SWE (PSWE) ..."

We have added precipitation constructed from SWE:

Observed cumulative precipitation, precipitation corrected from SWE (PSWE) and precipitation corrections (MacDonald and Pomeroy, 2007; Smith, 2007; Wolff et al., 2015). The two SWE observations with potassium (K) and thallium (Tl) gamma rays are also given.

Editor's suggestions

L65: "Despite these previous studies," instead of "Nevertheless,".

Done.

L99: The editor suggests: "but differences of up to ... between potassium and thallium gamma ray measurements at 300 ...".

Done.

L150: For consistency with L157, replace "calibrated" by "set up".

Done.

L159: "observed surface albedo when there is no snow cover.".

Done.

L163: Replace "first snow" by "fresh snow".

Done.

L168: "Therefore, to correct the precipitation used as input for the models, ..."

Done.

L190: Add "in Fig. 3" after "precipitation data sets are shown".

Done.

L224-225: "and the difference between the ... cover approximately 200 mm w.e. (Sect 4.1)."

Done.

L250: "align".

Done.

L262: "in Fig. 4e-f), as it is ...".

Done.

L264: "decrease are observed ... which is likely due to snow erosion that is not considered ...".

Done.

> L288: "fresh snow density parameterization".

Done.

> L320: "shows a similar".

Done.

> L339: The editor suggests "Impacts" instead of "Consequences".

Done.

> L347: "strongly".

Done.

> L419: The editor suggests "evaluated" instead of "verified".

Done.

References

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