Responses to Reviewer Comments for Manuscript EGUSPHERE-2023-2604

Responses to Anonymous Referee #2

Addressed Comments for Publication to

The Cryosphere

by

Ange Haddjeri,

Matthieu Baron,

Matthieu Lafaysse,

Louis Le Toumelin,

César Deschamps-Berger,

Vincent Vionnet,

Simon Gascoin,

Matthieu Vernay,

and Marie Dumont

Dear Masashi Niwano,

Please find enclosed the detailed responses to Anonymous Referee #2 for the manuscript entitled 'Analysing the sensitivity of a blowing snow model (SnowPappus) to precipitation forcing, blowing snow, and spatial resolution' with manuscript number EGUSPHERE-2023-2604. We would like to thank you and both reviewers for the valuable comments that helped improving the quality of our manuscript.

Sincerely,

Ange Haddjeri,
Matthieu Baron,
Matthieu Lafaysse,
Louis Le Toumelin,
César Deschamps-Berger,
Vincent Vionnet,
Simon Gascoin,
Matthieu Vernay,
and Marie Dumont

Note: To enhance the legibility of this response letter, all the editor's and reviewers' comments are typeset in boxes. Rephrased or added sentences are typeset in color. The respective parts in the manuscript are highlighted to indicate changes.

Authors' Response to Reviewer 2

General Comments.

The authors have taken into account my comments and made substantial changes. I believe this results in a much improved manuscript that more clearly quantifies the improvement offered by the SnowPappus model. I recommend to publish if the authors address the corrections listed below.

I list 'Technical corrections' which must be addressed before publication followed by 'Minor comments for consideration'.

Response:

Thank you for the positive assessment of our manuscript changes and your previous recommendation for publication. We appreciate your time and valuable feedback.

We carefully considered the Technical corrections and Minor comments you have outlined. We have followed all your Technical corrections and addressed your minor comments.

Authors' Response to technical comments

Comment 1

Section 3.4 P31 L539 "(more points at high and low snow heights)" this isn't true. It is more disperse, yes, meaning a greater variance, less consistent/reliable.

Response: Thank you for the comment.

We agree with this remark, we removed this part of the sentence for better clarity and changed the text accordingly.

> For each simulation, we see more dispersed scatter plots for simulations with snow transport (greater variance).

Comment 2

Section 4.1 P35 L570 "Looking at the Pléiades bias values in Fig.6 and Fig. 8 (a) and (d), blowing snow reduces the absolute mean bias value of snow height in all simulations." No it doesn't. Fig 6a both SAFRAN simulations, 6d both SAFRANs and ANTILOPE, 8a ANTILOPE, 8d ANTILOPE. Perhaps you have jus misphrased it because the bias do all lower in values, but a more negative bias is not a reduced absolute mean bias. Clarify what you mean.

Response: Thank you for the comment.

We've changed the sentence to make it clearer to understand.

> Looking at the Pléiades bias values in Fig. 6 and Fig. 8 (a) and (d), blowing snow lowers in value the mean bias of all simulations with snow transport compared to simulations without snow transport.

Comment 3

L432 grammar "…and every the elevation bands."

Response: Thank you for the comment.

We agree with this remark and changed the sentence for better understanding.

> Continuing the analysis, the observed median SMOD shows an earlier melt at all elevation for the 2018-2019 season.

Comment 4

Inconsistent use of words and numerals to represent numbers, e.g. P42 L790: "4 different dates over 3 different snow seasons. Eight different snow simulations.."

Response: Thank you for the comment.

We agree with this remark and changed the text accordingly.

> The Pléiades comparisons were conducted in two different areas, on four different dates and during three different snow seasons.

Authors' Response to minor comments

Comment 1

Section 3.1.4 p 17 L411-414 – don't understand what you are trying to say here, worth making clearer.

Response: Thank you for the comment.

We agree with this remark and improve the sentence to make the paragraph clearer.

> In Fig. 6, 8, the difference in the different scores between a simulation with and without snow transport is smaller for simulations computed at a 30 m resolution, compared to the 250 m computed simulations (orange dashed and continuous lines are less distant or equivalent to the green dashed and continuous lines).

Comment 2

Figure 14 and tables 3 and 4:

- Not keen on the way you've presented this, you could have one legend for all 16 subplots and fit the correlation values on the graphs.
- Figure 14 doesn't really support that SnowPappus is improving the simulated snow height. As you say in L 545, correlation decreases. Would be more supportive if you did these for your Z>2700m.
- Table 3 and 4. Why not one overall summary statistic? This more clearly separates the impact SnowPappus from the preciptation forcing, assuming your choice of precipitation forcings is representative.

Response: Thank you for the comment.

- We agree with this comment, we changed the Figure 14 legend so it appears once and added Pearson correlation values in each plot.
- We agree with this comment. Therefore, we have modified Fig. 14 and Fig. 15 to better support our result and clearly show that SnowPappus improves the simulated snow height

distribution for both pixels with elevation > 2700m and pixels >0.

Firstly, fig. 14 was added to the manuscript at the request of both reviewers in the previous review round. The aim was to show the degree of agreement between observations and simulations directly from the dataset. From this graph and Tables 3 and 4, we can see that the correlation slightly deteriorates with the addition of transport (looking at all heights). However, as shown in Tables 3 and 4, by restricting the points to transport zones to elevations >2700m, the correlation values are better in the snow transport simulations, but much lower. Given the low correlation values and the following analysis, we felt that there was no great added value in showing a restricted part of the dataset in the scatter plots. However, you can find the scatter plots you requested for points with elevations > 2700m in Fig. 1 below.

Secondly, in the following part of the manuscript we summarise the effect of snow transport on simulations mainly for areas >2700m using person correlation coefficients (Tables 3 and 4) and SPS values (Fig. 15). We agree that Fig. 14 looking at all elevation shows a reduction in correlations and is not very supportive of the model's effect on snow depth. To demonstrate more clearly the impact of SnowPappus at all elevations, we extended the analysis of Figure 15 to also show SPS values for the entire snow depth distribution (all elevations). The new version of Figure 15 now shows that the snow transport model improves the representation of the snow depth distribution for all observations for points with an elevation > 2700m, while not degrading the snow depth distribution, looking at the entire domain.

- In this manuscript, we show that spatial correlation plays an important role in the spatial variability of snow. We found it interesting to highlight this dependence on the source of precipitation in the tables. Figure 15 shows an overall summary statistic of all the precipitation sources.

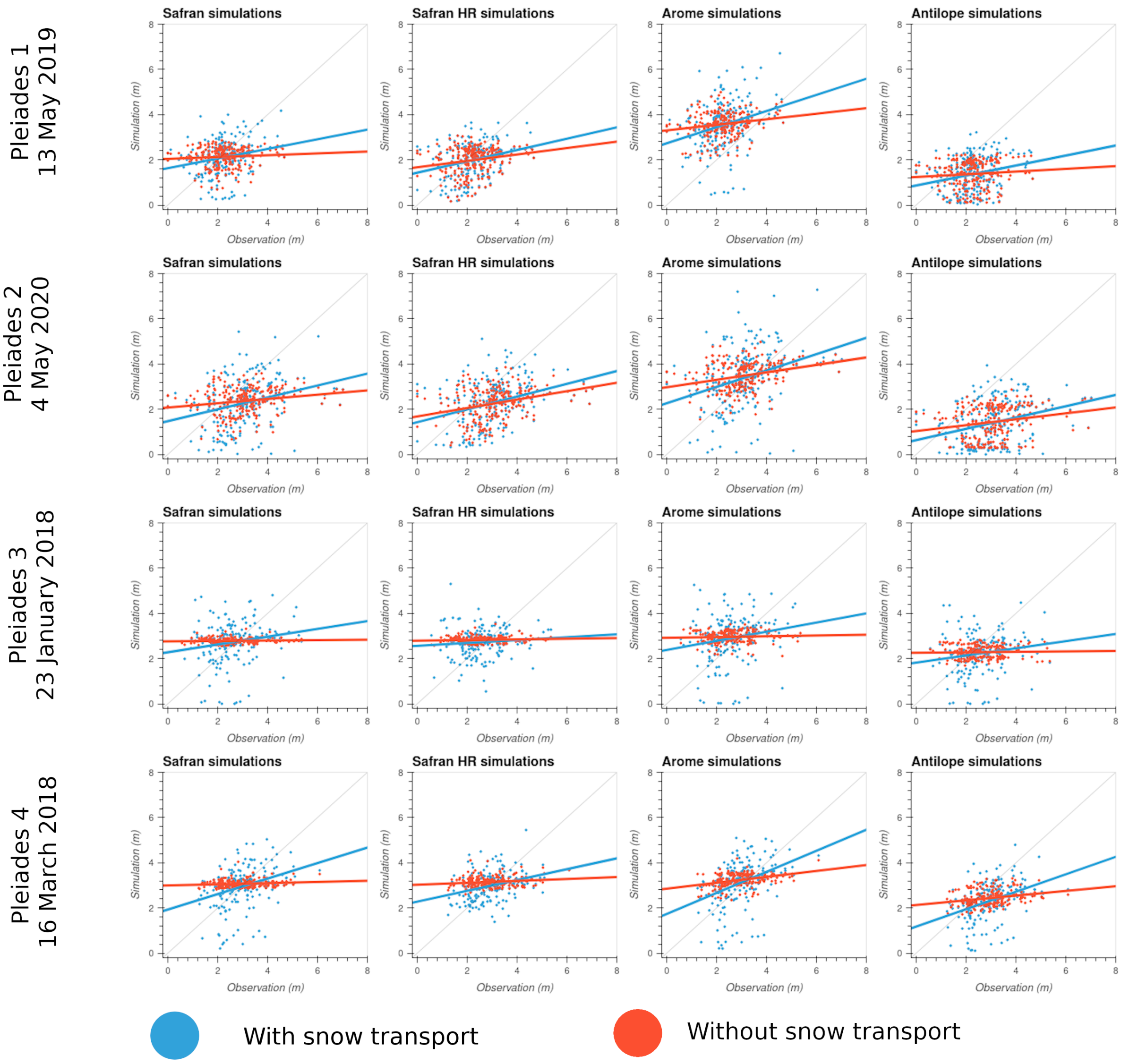

Figure 1: Observed vs simulated snow height scatter plots for the four different Pléiades observations (for elevation > 2700m) and the different precipitation forcings. For each precipitation forcing, the simulation with snow transport is in blue and without transport in red. Linear regression line synthesizes distribution changes when adding snow transport.