

Dear Reviewer,

We would like to express our sincere gratitude to you for dedicating your time and effort to provide valuable comments. In this document, we have addressed your comments point by point. Your original comments are presented in *blue italic*, while our responses are in regular black text.

Based on a comprehensive consideration of the comments from the three reviewers, we have made the following major revisions to the manuscript:

1. Significantly condensed the introduction and conclusion;
2. Appropriately adjusted the structure of the manuscript to highlight the theme;
3. Added discussions on the impact of blowing snow on wind speed;
4. Corrected the drawing errors of the blowing snow cross-sections and unified the drawing style for blowing snow.

Major comments:

This paper presents a high-resolution numerical simulation of a severe blowing-snow event near Zhongshan Station, East Antarctica, using the CRYOWRF coupled atmosphere–snow model. The study aims to investigate the interactions between katabatic winds, cyclonic forcing, and snow transport processes, and compares model results with ground-based and satellite observations. The manuscript addresses an important topic for Antarctic meteorology and surface mass balance studies, and it uses a promising modelling framework. Several of the reported results, especially those concerning the sensitivity of local meteorological processes to the activation of the blowing snow module, are potentially very valuable. However, the manuscript in its current form does not yet realize this potential.

Substantial work is required to (i) redefine and clarify the study objectives, (ii) streamline the presentation, and (iii) strengthen the scientific argumentation connecting the experiments to the broader knowledge gaps outlined in the introduction. The paper is overly long and sometimes loses focus through extensive, loosely connected descriptive passages. The introduction in particular reads as a dense compilation of facts, often lacking clear logical transitions or explicit linkage to the scientific questions addressed later. Many sentences remain vague or imprecise, weakening the overall clarity. A major review of redundant material would significantly improve readability. Despite these issues, the dataset and modelling framework are of clear scientific interest, and I would be pleased to read a revised version once these structural and conceptual improvements are made.

Re: We would like to express our sincere gratitude for your highly constructive comments on this paper. In response to your feedback, we have optimized the overall structure of the paper and strengthened the research focus. Specifically, we have made substantial revisions to the introduction, refined the conclusions, deleted non-essential figures in the main text, and adjusted the structure to highlight the core theme of blowing snow. Through these revisions, we aim to enhance the focus and readability of the paper. Thank you again for your valuable insights.

Specific comments:

1. *L43–44: “Most direct compared to what?” The meaning of direct is unclear here. Please reformulate precisely. L45: “The main way for the redistribution of surface snow”: it is indeed the main way, because it is also the only one. Please rephrase or qualify. L45–46: “Adjustment of surface mass balance”: the term adjustment seems meaningless in this context.*

Re: We have revised the above two sentences to: “Blowing snow is a very common phenomenon in Antarctica, which has a major impact on mass balance primarily through redistribution of snow and enhanced sublimation”. Additionally, the use of “only way” may lead to ambiguity, as the redistribution of surface snow should also include surface melt and runoff, precipitation (accumulation), and ice dynamics (glacier flow and calving). Thanks for your suggestion.

2. *L47: Sentence too generic and vague, please remove.*

Re: Done. Thanks.

3. *L58: “strong wind duration, etc.”: “etc.” should be deleted; the phrase as written is nonsensical.*

Re: This sentence has been removed in the revised version of the introduction. Thanks.

4. *L59–61: Missing reference.*

Re: This sentence has been adjusted in the revised version of the introduction, and the relevant references have been listed. Thanks.

5. *L67: Define the acronym WRF at first use and remove “etc.”*

Re: Done. Thanks.

6. *L66–70: Add an appropriate reference.*

Re: Sorry, due to the excessive length of the original sentence, it might have led to the misunderstanding that no literature was cited. The original text has been condensed, with the cited literature being “Vignon et al., 2020”.

7. *L104: “snow quality”: define this expression or link it to a measurable physical property related to snow erodibility (e.g., snow cohesion).*

Re: Done. The Sentence has been modified as: “Additionally, the physical properties (such as dendricity, density, sphericity, and particle sizes) of the snowpack surface layer undergo dynamic changes due to wind erosion and compaction, which in turn affects the accurate assessment of blowing snow flux (Lehning et al., 2000; Gallée et al., 2001; Clifton et al., 2006)”. Thanks.

8. *L105–109; L112–114: Add supporting references.*

Re: Done. The previous version was overly verbose, with one piece of work content split into two sentences, which made the citation appear missing, but it has now been revised. Thanks.

9. *Introductory structure: The introduction lists results and ideas densely, often without clear connection. It would benefit from restructuring with one explicit objective per section and by adjusting the level of detail to match the research question. Many ideas appear at once, making the text hard to follow.*

Re: Thank you very much for your suggestion. We have made substantial revisions to the introduction to enhance its logical flow. Additionally, as the framework of the main text has also been adjusted, the introduction has been logically aligned with this revised main text structure. Thank you again.

10. *Referencing: References should appear immediately with the first sentence that cites their results.*

Re: Done. Thanks

11. *L127: “surface mass balance budgets”: redundant. Choose either balance or budget and use it consistently throughout the paper.*

Re: Done. Thanks

12. *L128–129: Too vague. Specify which aspects remain uncertain and what knowledge gaps are being targeted. The discussion should also include previous modelling work on blowing snow to contextualize the study (e.g., Lenaerts and van den Broeke 2012; Gerber et al. 2023; Amory et al. 2021) and highlight the complementarity of the present approach.*

Re: Done. Given the substantial revisions made to the introduction section of the manuscript, we have incorporated the references provided by you in the following positions to support the introduction. (1) Both Amory et al. (2021) and Lenaerts and van den Broeke (2012) noted that regional climate models may have uncertainties in simulations under rugged terrain, and we have used this as a basis for introducing the high-resolution non-hydrostatic CRYOWRF model adopted in this study, which can be found in Introduction. (2) The evaluation by Amory et al. (2021) also pointed out that blowing snow assessments are usually focused near the surface. This is relevant to our finding that blowing snow can be transported over long distances in this case study, so we have added relevant descriptions in the discussion section, located in Discussion. (3) Gerber et al. (2023) evaluated the accuracy of CRYOWRF and noted that there are uncertainties in the saltation parameterization scheme. We have included in Discussion.

13. L130–133: *The phrase “inaccurately characterizing” is ambiguous: by whom or by what? Albedo and thermal conductivity are physical properties, not processes. Clarify the logical link between these properties and the blowing-snow process introduced earlier. L133–139: Only a small fraction of CMIP6 ESMs implement multi-layer snow schemes; please nuance and rephrase accordingly.*

Re: Given that the relevance of this part of the introduction to the current study is not particularly strong, we have removed the relevant statements and citations. Thanks.