

Interactive comment on “Spatial and temporal variability in summer snow pack in the Dronning Maud Land, Antarctica” by T. Vihma et al.

Anonymous Referee #1

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Review comments

Spatial and temporal variability in summer snow pack in the Dronning Maud Land, Antarctica T. Vihma, O.-P. Mattila , R. Pirazzini and M.M. Johansson

This paper describes a data set of snow pit observations obtained on Antarctica. The presented subject fits well in the general scope of the journal and the data set itself is new and interesting.

The authors describe a large data set of snow temperature and density observations on Antarctica. They present a detailed analysis of the observed temporal and spatial variability of their observations. My only main remark on this paper is that due to the

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large amount of observations described, the paper is not always easy to read. Most of my remarks are therefore intended to improve the readability of the paper, in addition to some questions for clarification.

General remarks

- The link between cloud cover and snow temperature is through the surface energy balance, and more specific through the radiation budget. You use cloud cover as an indication of the near surface radiative budget. Make that more clear especially in the first part of the manuscript.
- You refer to a weather station close to the Basen observations, but you do not present any observations of that station. Adding the observations can give more information about the radiation budget, mass balance and temperature at that site.
- Check when to use the word 'In' or 'On'.
- Make more clear when you refer to horizontal, vertical or temporal variability.
- Try not to use too long sentences.

Specific remarks

Title

I recommend a small change to the title: Spatial and temporal variability in the snow pack in Dronning Maud Land, Antarctica.

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Abstract

P1108

- The general goal of the research is missing from the abstract.

L2-5: reverse the sentence: ...showed that horizontal gradients...largest in the escarpment region, and the most homogeneous snow pack was found on the Riiser-Larsen Ice Shelf.

L6, L11, L12: On the scale.

L16: write out: 101 to 102.

Study area and its climate

P1112

L6-9: Split long sentence at 'This effect'

L19: Replace 'Based' by 'Basen'

Observations and methods

P1113

L18: Explain 'traverse', or remove remark, Suggestion: start by explaining in a few sentences the different years, then explain how the different observations are made during the different projects. Is the meaning of transect the same as traverse in this manuscript?

P1114

L2: Do you mean you determine the water mass and then use the known volume of

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the box to determine the density? Is it correct that in the Basen measurements the snow from the box was not measured but weighed directly?

L1-5: Have you tried to resample the snow fork observations to the same spatial resolution as the cylinder observations? How well do they match in that case?

L21: Add 'vertical' before 'profiles'.

L23: Replace 'to' by 'into' behind horizontally.

P1115

L8: Add 'vertical' before 'density profiles'.

L14: Were the horizontal profiles measured in 2006-2007 or 2007-2008 or both years?

L15: Were the cloud fraction observations done in both years?

L18-28: In the previous section you describe in detail at what depth etc you measured temperature and density. This information is completely missing in this paragraph.

P1116

L1: In the rest of the manuscript no data is used from this AWS, while the information might be of use for validation of the ECMWF output.

L4-12: Add information about the reliability of the ECMWF output. To my knowledge, ECMWF is not very reliable in precipitation over Antarctica.

Data analyses and results

Make subsections for the description of the temperature and density profiles in sections 4.1 and 4.2.

P1116

L17-22: It is not completely clear to me how the different standard deviations presented in e.g. figure 3 are calculated. Please rephrase this sentence, maybe split up in more sentences to explain the procedure in more detail.

L23: Remove 'Further'

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L23-25: I assume the classification is based on observed cloud fractions?

P1117

L2-3: Were there no observations carried out between 11 UTC and 18 UTC? Explain why it is interesting to make this distinction.

L5: Start new sentence and change sentence to 'In the summer of 2007-2008 no evening profiles were measured during cloudy days.'

L7-10: Very long sentence, please split in shorter sentences.

L7: I assume with small scale you mean spatial scale on order of m?

L12: Explain the exponential decrease with depth.

L13: Remove 'however'

L18: Split sentence at 'which demonstrates'.

L22: What were the average temperatures in the year/months preceding the observations? Do you have observations from AWS5 (air and/or snow temperature)?

L27-28: Replace 'that' by 'the' and add 'of 2007-2008' behind 'summer'.

P1118

L8: See remark about connection of clouds with snow temperature.

L8-21: How many days/observations are included in the clear and cloudy subset?

L8-21: Do you have any information about the actual diurnal cycle of the radiation components at the observation site from the AWS?

L24-28: Explain the difference.

P1119

L17-25: How reliable are the ECMWF analyses? Do you have mass balance observations available from the AWS?

P1120

L6-8: Is there any evidence of melting actually occurring? And how can melting result in lower densities?

L4-12: How many days/observations are included in the clear and cloudy subset?

L21: Replace 'in' by 'on' behind 'snow' and before 'escarpment 2'

P1121

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L27: Any information available about the snowfall event from local observations?

L29: Is there any evidence of melting actually occurring? And how can melting result in lower densities?

P1123

L21-25: Consider moving this paragraph to the discussion section.

Discussion

P1124

L3-8: Very long sentence, please split in shorter sentences.

L11-12: replace 102 by 100.

P1125, P1126

-Replace 10x by corresponding number in m or km.

P1126

L14: Replace 'Reijemer' by 'Reijmer'

P1127

L11: Replace 'that that' by 'that'

P1128

L16: See general comment about energy balance and clouds.

Conclusions

P1132

-Replace 10x by corresponding number in m or km.

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Tables

- Add table with the technical information about the density and temperature observations. Please add accuracy information on the 3 density observational methods. You can remove part of the information from the main text and refer to the table.
- Consider adding a table with all the measurement information, time, location, depth, number of observations etc. Especially when you present averages it could be useful to know how many observations are used in order to assess the reliability/significance of the results.

Figures

Figure 1.

Add small inset map of Antarctica to denote the general location of Dronning Maud Land. Mark AWS 5 in the map. Add the names of the 3 regions in figure 1b.

Check spaces between words in the caption. Remark that the numbering is based on mass balance stake numbers. Figure 2.

Add legend to the figure and remove legend information from caption. Suggestion: add lines denoting sample size of the snow cylinder observations.

Figure 3 and 5.

Remove title from panel a, add this information as a legend in the figure. Replace 'daily' by 'diurnal' in the legends of panels b and c. In the caption add the information that these profiles are for the Basen small spatial scale experiment.

Figure 7 and 8.

Dotted lines for escarpment 1 are not visible.

Figure 9.

The color scale includes higher and lower values than shown in the figure. Add information about latitude longitude location of the plotted area. Mention the origin of the

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data in the caption.

Figure 10.

The horizontal axis labels mention accumulation stake, replace with snow pit id. Add comment in caption that the figure illustrates the whole transect.

Figure 13.

Add legend to the figure and remove legend information from caption.

Interactive comment on The Cryosphere Discuss., 4, 1107, 2010.