Response to Reviewer 1 Comments: *Blowing snow detection from ground-based ceilometers: application to East Antarctica*

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For clarifying our answers to the referees' comments, the following scheme is used: comments of the referees are denoted in **bold**, our answers are denoted in black and quotes from the revised text are in *italic*. Please note that reference to figures in the answer refer to the original manuscript, or to the improved figure displayed in the Response document. Figures referenced in the italic text are relative to the new manuscript.

General comments: The paper is generally well written, although a more rigorous attention is required in some parts when describing and discussing the blowing snow processes. The results are interesting and original and can be of great potential but a substantial revision is needed before the paper becomes acceptable for publication. More specifically, I have some reservations on the profile classification procedure in its current form. The distinction between precipitation and mixed blowing snow – precipitation events (Fig. 5) is not convincing. Information is lacking on how precipitation data are used to identify the occurrence of precipitation, as well as on the availability of data over the measurement period at PE. The (monthly and annual) frequency of occurrence is not studied at PE despite 7 years of measurements. Other potentially valuable information may be produced such as the inter-annual variability in blowing snow frequency (at both locations) or the relative proportion of mixed and pure blowing snow events (at least at PE). If you can use your profile classification to discriminate between blowing snow and mixed blowing snow events at Neumayer, this would be also of great interest. More generally, some parts need clarification and/or rearrangement, and the switching between different notions or locations make the manuscript sometimes difficult to read. Section 4.2 is not very useful. The conclusion, as well as the abstract, could contain more of the main (potential) results (annual and monthly frequencies, inter-annual variability, relative proportions of mixed blowing snow events, mean blowing snow layer heights). Indicate also in the abstract the respective locations (Neumayer/PE) and the time period to which your results correspond to. I

recommend that all co-authors carry out thorough reading of the paper before resubmission.

Thank you for your thorough and advised comments. First of all, the methodology has been revised and the profiles classification is now used to detect the presence of clouds and/or precipitations from the ceilometer attenuated backscatter signal shape only. This enables to conduct the analysis of dry blowing snow versus blowing snow mixed with snowfall at both stations. Additionally, cases where blowing snow is mixed with heavy snowfall are also identified and occur 67 % of the cases at Neumayer III and 43 % of the cases at PE station, while 25 - 27 % of the events take place under cloudy or precipitating events. Cloudless blowing snow is rare (8%) at Neumayer III station, and reaches 30 % at PE. Figure 5 has also been adapted by choosing more adequate examples. Concerning the results and the detailed comments, please find individual answers below. Regarding the availability of the data, a graph is added to the Supplements (Fig. S2). Frequencies at PE are also present in the Supplements (Fig. S1). However, since only one year of full measurements is available, the Antarctic winter cannot be studied. For instance, the high frequency in July 2015 and lower frequencies for the May, June, and August months are not robust enough. Regarding the inter-annual blowing snow frequency, it is not displayed in the Annual cycle at PE, but is present in Fig. 7 in the original manuscript as the error bar and is in the range of $\pm 5\%$. Section 4.2 has been removed. Abstract and conclusion contain now more of the main results.

1 Question 1: P2, L1-4: Despite the abundant literature on that topic, I recommend not to use wind speed ranges as a criterion to distinguish between drifting and blowing snow. As it is mentioned in the paper, the occurrence of drifting and blowing snow is strongly related to surface snow properties, which make the characterization of wind speed thresholds relative to the local climate conditions. For instance, low wind speeds can initiate erosion where loose snow is frequently brought by snowfall, while high wind speeds are needed to erode consolidated snow. The actual turbulent quantity involved in aerodynamic entrainment of surface snow particles is the friction velocity. Erosion starts when the actual friction velocity (depending on atmospheric flow conditions and surface aerodynamic properties) exceeds a threshold friction velocity (related to surface physical snow properties: density, cohesion, grain size, etc.). In the context of this paper, using a more general classification by mentioning just the height at which windborne snow is observed is a more convenient way to describe the drifting (< 2m) and blowing snow (> 2m) processes. Besides, it is not correct to discriminate between suspension and blowing snow. Suspension is a transport mode and refers to diffusion of snow particles in the atmosphere picked up at the top of the saltation layer by turbulent eddies. For a given erosion event, the maximum elevation reached by suspended particles in define the height of the blowing sow layer, which is thus not necessarily confined to a few meters above the surface. Saltation is the other main transport mode, and describes ballistic trajectories and periodic rebounds of particles at the surface. Drifting and blowing snow thus must be seen as differently balanced situations between these two transport modes: drifting snow more generally refers to a situation where saltation is the dominant transport mode, while blowing snow stands for the opposite

The paragraph in the paper has been changed accordingly, not referring to wind speeds thresholds, and with a more refined reference to saltation and suspension modes in blowing and drifting snow.

Snow particles can be dislodged from the snow surface, picked up by the wind and lifted from the ground into the near-surface atmospheric layer. This phenomenon occurs approximatively on 70% of the Antarctic continent during winter (Palm et al., 2011). Generally, drifting snow events are shallower than blowing snow events. Drifting snow typically stays below 2 m *height whereas blowing snow can reach heights of several hundreds of meters. The transport involves a mix of suspension and saltation transport modes (Leonard et al., 2011), with a dominance of saltating particles (Bagnold, 1974) in the case of drifting snow, and suspended particles in blowing snow layers (Mellor, 1965).*

2 Question 2: P2, L10: Similarly, the threshold speed of 11 m s-1 given by Kodama et al. (1985) is relative to the measurement period and location in Adelie Land and should not be presented as a general threshold above which the influence of snowdrift sublimation on SMB become significant.

The threshold wind speed has been removed.

However, blowing snow is crucial for the regional SMB (Lenaerts and van den Broeke, 2012; Déry and Yau, 2002; Gallée et al. , 2001; Groot Zwaaftink et al., 2013) through the displacement and relocation of the snow particles (Déry and Tremblay, 2004). In addition, sublimation contributes substantially to SMB (Takahashi et al., 1992; Thiery et al., 2012; Dai and Huang, 2014; Kodama et al., 1985). This process can even be more effective to remove mass than surface sublimation (van den Broeke et al., 2004).

3 Question 3: P2, L11: This is not always the case. Change for "can be more effective".

The text has been adapted accordingly.

See question 2 above.

4 Question 4: P2, L17: "Affecting [. . .] the surface energy balance", not "affect [. . .] on surface . . .".

The text has been adapted accordingly.

Blowing snow also plays a role in determining snow surface characteristics (Déry and Yau, 2002), affecting the surface energy balance (Lesins et al., 2009; Mahesh et al., 2003; Yamanouchi and Kawaguchi, 1985).

5 Question 5: P2, L34: You should refer to Trouvilliez et al. (2014), who also report drifting snow statistics in East Antarctica from ground-based measurements with Flow-Capt instruments, instead of Trouvilliez et al. (2015) who present an evaluation of the Flow-Capt in the French Alps. The paper of Barral et al. has been published in 2014.

The references have been changed accordingly

A number of measurement campaigns have been organized in various regions of the AIS, using different types of devices: nets, mechanical traps and rocket traps, photoelectric and single-beam photoelectric sensors. Various studies have also worked with Flow-Capts or piezoelectric devices (Leonard et al., 2011; Amory et al., 2015; Trouvilliez et. al., 2014; Barral et al., 2014).

6 Question 6: P5, L7 to P6, L2: These sentences belong to the methodology and should be moved in section 3.2

These sentences have been moved to section 3.2

Section 2.2

The Vaisala CL-31 ceilometer (firmware 1.72) was installed on the roof of the station in December 2009 and is operational at present. It emits laser pulses at a central wavelength of 910 ± *10* nm *at 298* K. *The measurement resolution is set to 10* m *and the reporting interval on 15* s. *Several outages of the energy provision system limit the data mainly to Antarctic summer season (December to March is best represented). Only one year of continuous measurements was achieved (2015). The Metek vertically-profiling precipitation radar, set up since 2010, enables to retrieve snowfall rates, using the return from the vertically profiling Doppler radar operating at a frequency of 24* GHz. *The raw Doppler spectra is post-processed following Maahn and Kollias (2012), to calculate radar reflectivity profiles which are then linked to snowfall rates using the newly developed Ze-Sr relation for PE by Souverijns et al. (2017) and has a sensitivity up to -14 and -8 dBz (Souverijns et al., 2017). A full description of micro-rain radars can be found in Klugmann et al. (1996) and the radar set up at Princess Elisabeth is described in Gorodetskaya et al. (2015).*

Section 3.2

The information retrieved from the Micro Rain Radar (hourly precipitation rates) is collocated to ceilometer blowing snow detection, to determine the time (in hours) since the last precipitation event.

7 Question 7: P6, L3: How do you use this information in the study?

The cloud base temperature is used as an atmospheric variable. In the case of blowing snow, the measured cloud temperature is actually the blowing snow layer temperature. It was used in the cluster analysis, and in the PCA. However, it was not a determining variable. This information is left out in the new version of the paper.

8 Question 8: P7, L19: Distinguishing visually between pure blowing snow and mixed blowing snow-precipitation events seems far too subjective to me, even if “the blowing snow layer is not too dense”.

Yes, the visual detection of pure blowing snow versus mixed events is subjective. This method is applied by the visual observer at Neumayer station, following the procedure described by Gert König-Langlo (personal communication, 2016). This further reinforces our position of not treating the visual observations as "ground truth".

9 Question 9: P8, L31: the first “of” has to be removed. Change “layer. E.g.” for “layer, e.g.”

The text has been changed accordingly

Studies investigating the boundary-layer properties based on ceilometer attenuated backscatter make use of both properties of the signal (shape and intensity), to evaluate the presence and extent of a particular layer, e.g. in order to determine the height of the mixing layer (Wiegner et al., 2014).

10 Question 10: P10, L5 and onwards: It is likely that I don’t understand correctly the detection principle, but in its current form I have some reservations about your classification procedure, especially about the distinction between precipitation with and without blowing snow, and the omission of strong precipitation associated with heavy blowing snow. I tried to list them below. It is difficult to relate the profile features described in the text using heights and bin numbers to the plotted profiles in Fig. 5. You could, for instance, clearly indicate the discontinuity between the 4th and 5th bins, and specify to which bin the lowermost backscatter intensity value reported on the graph correspond to. This would facilitate the understanding of the description of the detection algorithm.

- **The increase in the backscatter signal between the first and the second bins in the mixed blowing snow profile in Fig. 5 is of very small intensity compare to the one characterizing pure blowing snow. Except for this aspect, this profile seems very similar to the pure precipitation profile. Moreover, I suppose that a mixed profile should include both the signature of precipitation and blowing snow (strong signal close to the surface). Are you sure that this absence of the blowing snow signature does not simply imply that there is no blowing snow?**
- **L14: “between 40 and 50 m”: give the corresponding bin numbers.**
- **L17: I don’t understand why during strong precipitation associated with storms, the precipitation intensity might cover the blowing snow signal close to the ground. I’m wondering even further if the opposite would be true. The strong backscatter signal close to the surface in the typical blowing snow profile illustrates the influence of high particle density layers. This would be particularly amplified when abundant snowfalls provide a large supply of fresh snow that can be easily eroded by strong winds. By discarding these cases, you might omit an important part of the mixed blowing snow events, which can further affect all your statistics. This could be a major issue since you say latter in the paper that most of the blowing snow events occur simultaneously with precipitation. If the situation with strong precipitation and blowing snow is a clear limitation of your approach, you have to quantify it, especially since the occurrence of overcast conditions is also a limitation to satellite retrieval. You should give the relative proportion of each profile category (blowing snow, precipitation + blowing snow, precipitation, clear sky and omissions).**

Figure 5 (Fig.6 in the new manuscript, Fig. 1 below) has been adapted to show both bin number and height (m agl). The discontinuity is clearly indicated in grey.

- Figure 5 is indeed not clear: it was based on only one day (24.04.2016) during which blowing snow was accompanied by clouds/precipitation at the end of the blowing snow event, hence, the lower intensities and the resemblance to the pure precipitation profile. Another day was therefore selected for the new version of the manuscript (10.02.2014), to illustrate the pure precipitation and the mixed event. In this new figure (Fig.1 below, Fig.6 in the new manuscript), the intensity of the profile in the lowermost bins is clearly indicative of blowing snow (red line), and the increase around the 15th bin indicates the presence of clouds/precipitations (arrow). In the case of precipitation/cloud without blowing snow, this low-level decrease is absent, and the increase around the 17th bin reflects the presence of a cloud/precipitation.

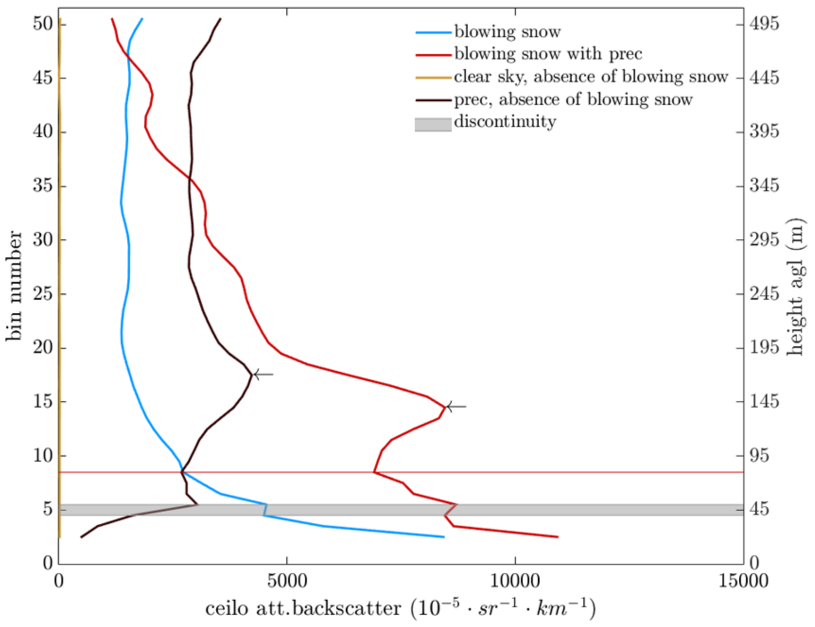

Figure 1. Different types of profiles relevant for blowing snow measured by the ceilometer at PE station: blue line - typical blowing snow signal with no precipitation nor clouds (24-04-2016); red line - blowing snow overlaid by precipitation (10-02-2016); black line - precipitation with no blowing snow (10-02-2014); yellow line - near-zero signal for clear sky conditions (24-04-2016). The height above ground is indicated on the right axis and the corresponding bin number on the left axis. All profiles exclude the lowermost bin, and start at the second bin (15 m agl.). The grey lines represent the discontinuity between bins 4 and 5 (35-45 m). The arrows indicate the presence of precipitation.

- The bin numbers have been added in Fig. 5 and in the text (see Fig.1 below, Fig.6 in the new manuscript).
- Given the specific conditions during heavy precipitation events, we treat these events differently in the improved manuscript. We know that most of the time, blowing snow happens together with storms and intense precipitation (the snowflakes rebound on the ground and are displaced by strong winds). Hence, in some cases the signal intensity is not decreasing with height, and the profile criterion could not be met. Therefore, we decided to create a new category "heavy mixed events" for the situation in which the signal in the second bin exceeds 1000 $\cdot 10^{-5} \cdot \mathrm{km}^{-1} \cdot \mathrm{sr}^{-1}$ (threshold adapted from (Gorodetskaya et al., 2015)). Of those heavy mixed events, 45 % do not show an increase of the signal in the overlying bins at Neumayer III station, and would have therefore been discarded by the algorithm.

To conclude, a new method for precipitation/cloud detection based on the ceilometer profile only has been developed (see Fig.2): the algorithm searches upwards of the 7th bin (maximum limit for the profile criterion of the BSD algorithm) for a second increase in signal that is (1) above 100 $\cdot 10^{-5} \cdot \mathrm{km}^{-1} \cdot \mathrm{sr}^{-1}$, which is the threshold for clouds detection (Van Tricht et al. (2014)), and (2) thicker than 9 bins (85m) (Van Tricht et al., 2014). This enables to detect overcast conditions, in the

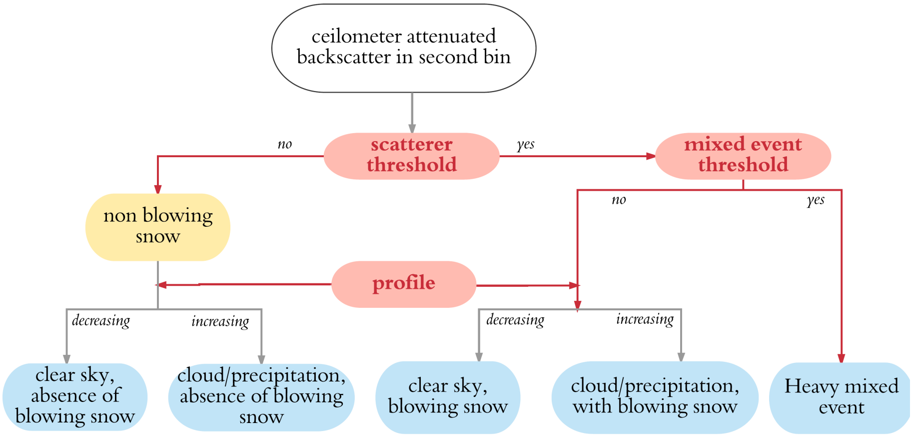

Figure 2. Chart of the method used to detect blowing snow from the attenuated backscatter signal of the ceilometer.

presence of blowing snow or not.

Regarding the intense mixed events, once the backscatter in the second range bin exceeds the blowing snow threshold, the algorithm evaluates if the threshold for intense mixed events is reached (above $1000 \cdot 10^{-5} \cdot \mathrm{km}^{-1} \cdot \mathrm{sr}^{-1}$, adapted from Gorodetskaya et al. (2015)). If it is the case, blowing snow is assumed present and the profile is not investigated.

The algorithm therefore investigates the shape of the profile in order to detect blowing snow. A condition is set, that a blowing snow profile implies that the mean of the overlying bins 3 to 7 (25 to 65 m*) must be lower than the signal in the second range bin (15* m*). In this way, the discontinuity, as described in section 3.1. (visible in Figures 1 and 5 between 35 and 45 m in the original manuscript, Fig.1 and 6 in the new manuscript), is not affecting our retrievals. In order to detect blowing snow occurring during clouds or precipitation, the profile shape is analyzed to identify a second increases in the signal intensity above the 7th bin (65 m height). A clear differentiation between clouds or precipitation cannot be made on the basis of the ceilometer alone, but the presence of clouds and/or precipitation can be identified. This analysis is carried out for both blowing snow and non blowing snow measurements. [...]*

Inherent to this profile-based method, the detection of blowing snow during precipitating events is limited to cases when the blowing snow signal is preserved close to the ground. In case of precipitation associated with storms, there is always blowing snow due to the high wind displacing the snow, and no distinction between precipitation and blowing snow is possible, as the ceilometer signal is entirely attenuated near the surface (Gorodetskaya et al., 2015), it is not possible to get signal in the overlying bins, and the profile of the backscatter intensity might not decrease upwards. Such intense precipitating events mixed with snowfall are identified as having a second bin signal higher than 1000 $\cdot 10^{-5} \cdot \mathrm{km}^{-1} \cdot \mathrm{sr}^{-1}$ *(threshold adapted from Gorodetskaya et al. (2015)). In those cases, the events are classified as a heavy mixed blowing snow event, and the profile analysis is eluded by the algorithm.*

11 Question 11: P11, Section 4.1: There is a temporal discordance between visual observations (performed 6 times a day) and ceilometer measurements (hourly means). Have you re-sampled the ceilometer dataset to match the frequency of visual observations, or do you compare the ceilometer hourly output corresponding to the time at which the visual observations were performed? Are the visual observations continuous over the measurement period (2010-2015)?

We have re-sampled ceilometer to hourly output, and selected the re-sampled data corresponding to the time at which visual observations are carried (1) if there are more than 140 measurements (35 mins) with a NaN value, the measurements within the hour are discarded. Else, if there is more than 20 mins of blowing snow detections, blowing snow is assumed for that measured hour (only to get rid of really short lived events). Then, we compare this with the visual observation.
Yes, the visual observation are continuous over the measurement period, but omit observations at 03 and 06:00 UTC.

In order to investigate the type of blowing snow detected by the BSD algorithm, we compare it to visual observations at Neumayer, carried out routinely at 09-12-15-18-21 and 24:00. All ceilometer measurements are considered over one hour, corresponding to the time at which visual observations are carried out. We identify a blowing snow event when blowing snow is present in at least 80 profiles (20 mins). The WMO visual observations are categorized in six classes of blowing and/or drifting snow events, ranging in intensity and whether there is precipitation or not (Table S3 in Supplements).

and section 2.3

The measurements are carried out daily every 3 hours but visual observations are omitted at 03 and 06:00 UTC.

12 Question 12: P12, Figure 6: Indicate N for each category.

The figure has been removed from the new version of the manuscript. Table 1 below (Table 3 in the new manuscript) lists the number of detections (N) for each category. The total number of event for each category is also displayed in the wind rose figures (Figs 3 and 4 below, Figs. 9 and 10 in the new manuscript).

13 Question 13: P12, L16: Don't you think you could use the profile classification developed at PE (in terms of vertical variation in backscatter intensity) to discriminate the occurrence of precipitation at Neumayer?

We have conducted this analysis (see Question 10), and similar trends as observed at PE station regarding blowing snow associated with precipitating events and synoptic disturbances.

Further, we investigate the specific meteorological conditions (near-surface temperature inversion, relative humidity, surface temperature, wind speed and direction, in- and outgoing longwave fluxes, and the time since the last precipitation event)

Table 1. Detection numbers and scores of the different categories of observations. The first 4 columns give N BS$_{both}$- stands for blowing snow detected by both the algorithm and the visual observations, N BS$_{none}$ - when both methods agree that there is no blowing snow, N BS$_{ceilo}$ and N BS$_{vis}$ - represent detections by the algorithm and the observer only, respectively (the corresponding percentages are presented in table S4, in the supplement). The four last columns give the scores. B stands for blowing and D for drifting snow. The total number of measurements is 10584.

	N BS$_{both}$	N BS$_{none}$	N BS$_{ceilo}$	N BS$_{vis}$	accuracy	sensitivity	specificity	TSS
B and D snow, with or without prec	2404	5170	972	2308	0.70	0.51	0.84	0.35
B and D snow, without prec	992	6578	2373	897	0.70	0.52	0.73	0.26
heavy B snow, without prec	378	7406	2998	72	0.72	0.84	0.71	0.55
all B snow, without prec	822	6993	2554	485	0.72	0.63	0.73	0.36
all B snow, with or without prec	1856	6665	1520	813	0.78	0.69	0.81	0.51
heavy blowing snow, with or without prec	1114	7249	2262	229	0.77	0.83	0.76	0.59

during blowing snow events.

For all three categories of blowing snow events, the 2m *wind direction shows a preferential easterly/north-easterly orientation at both Neumayer and PE, while the absence of blowing snow is characterized by a wider spectrum of wind directions (Figs.3 and 4 below, Figs. 9 and 10 in the new manuscript). Positive anomalies in wind speed and RH occur during blowing snow events. Cyclonic events are a common feature at Neumayer (König-Langlo and Loose, 2007), bringing easterly winds during which most of the drifting and blowing snow occur. Also at PE, most of the blowing snow events (N = 1643, 92 %) are associated with the warm synopic and transitional regimes, when moist air is brought from the ocean, that precipitate inland (Gorodetskaya et al., 2013). Thiery et al. (2012) also showed that at PE drifting snow sublimation occurs mostly during transitional regimes. These regimes occur 41-48 % of the time (Gorodetskaya et al., 2013, 2014). Very few blowing snow events occur in cloudless cold conditions (cold katabatic regime), when the northerly winds blows from the interior towards the coast (N = 139; 8%).*

Intense mixed events (Fig.1 above, Fig. 6 in the new manuscript) occur together with north-easterly strong winds : 87°to N, 10 $\mathrm{m \cdot s^{-1}}$ *at PE and 65°to N, 13* $\mathrm{m \cdot s^{-1}}$ *at Neumayer III , warmer surface temperatures and higher relative humidity. These are the signature of storms associated with synoptic events, during which the turbulent mixing reduces the vertical temperature gradient (Gorodetskaya et al., 2013). The majority (60 %) of the blowing snow events occur during storms or overcast conditions (with cloud and/or precipitation). These mixed events have generally a short time lag since the last precipitation event and reach high atmospheric levels. Dry blowing snow has a mean wind direction of 120°to N at PE and 77°at Neumayer III, lower wind speeds (6-7*$\mathrm{m \cdot s^{-1}}$*) and a greater temperature inversion. The mean time lag since the last precipitation event at PE (23 hours) indicates that these events most likely occur after a storm, and that cloudless blowing snow (8 %) is mostly associated to katabatic winds.*

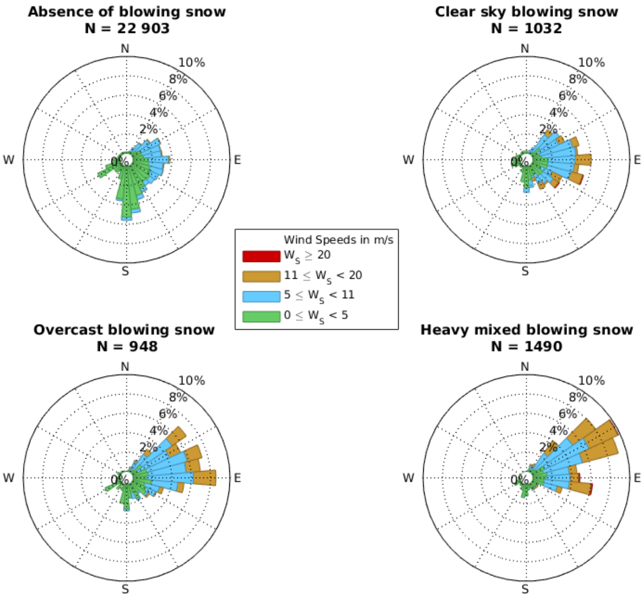

Figure 3. Wind rose at PE station, N = number of events

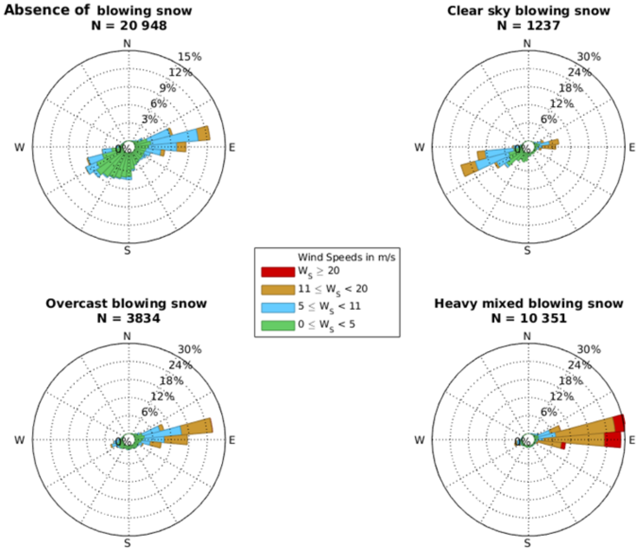

Figure 4. Wind rose at Neumayer station, N = number of events

14 Question 14 : P12, L19: An “r” is missing in the penultimate word.

The "r" has been added.

15 Question 15: P13, Fig. 7: How can you explain the apparently systematic discordance between visual observations and the detection algorithm in January?

Indeed, January fall completely outside the variability of the other months in the visual observations. We suspect that there is some issue with these data in January, as no visual observations are reported in January 2011, 2013, and only a few are available during January 2014 and 2015. Other months, such as February 2011-2013 and 2015, as well as November and December 2014 and 2015 have also a restricted number of visual reports. We suspect that the observers might have been away on the field or not available for reporting during those periods. However, the ceilometer was operating continuously during these months. In addition, by sub-sampling the ceilometer blowing snow detections to the corresponding visual observation hours, the frequencies retrieved are biased (if a storm occurred between midnight and 09:00 UTC, it is not reported, and therefore excluded from the frequencies calculation). The frequency distribution presented here (Fig.5 below, Fig. 7 in the new manuscript) is therefore calculated on ceilometer measurements only, which are continuous over time, and are not compared to visual observations. The total frequency is of 36 %, and the reason this frequency is higher than in the previous manuscript, is that we now include heavy mixed events.

16 Question 16 : P13, L7: Please indicate over which period of time the frequency is computed

The period (2011-2015) was indicated. The sentence has been adapted to make it clearer.

The frequency is calculated here by reporting the sum of all hours during which blowing snow occurs (n = 2 714 164) over the total number of observation hours (n= 9 742 717). Blowing snow at Neumayer III occurs on average 28% of the time for the 2011-2015 period, as detected by the BSD algorithm. [...] The overall blowing snow frequency is computed at PE for the 2010-2017 period. However, the limited availability of Antarctic winter data (due to power failures at the station) might lead to an underestimation of the blowing snow frequency. Total blowing snow frequency reaches 13 % at PE station, which is lower than at Neumayer [...]

17 Question 17: P13, Second paragraph: this paragraph is hard to follow and needs rearrangement:

- **L9-11: You switch between annual and monthly time scales, and frequency and blowing snow rates. Move the sentence in which you describe the calculation of the frequencies at the beginning of the paragraph. Indicate the time period over which König-Langlo and Goose (2007) computed their frequencies. Remove “blowing snow**

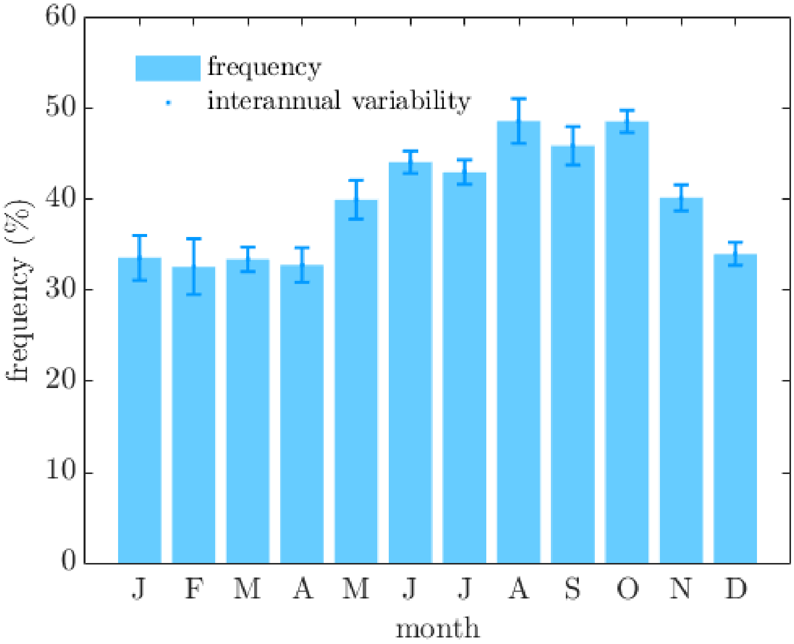

Figure 5. Yearly cycle of blowing snow at Neumayer III station (2011-2015). The error bars represent the interannual variations.

rates" and stay focus on frequencies to compare apples and apples. Indicate also the measurement period for the frequency computed at PE (and for this you also need to discuss the representativeness of the winter data due to power supply issues).

- the frequencies paragraph has been changed accordingly.
- **L13: See also Trouvilliez et al. (2014) and Amory et al. (2017) for similar statistics from ground-based measurements.**
- the references have been added and the text was modified.
- **L14: "Reasonable" is not rigorous. Please replace.**
- 'reasonable' has been rephrased
- **L16: In the previous sentence you give the frequency for two locations (Neumayer: 28% and PE: 9%): which one do you compare with Palm's results? "Coherent" and "analogous" give no quantitative information, and are somewhat confusing when used together. Give directly the values from Palm et al. (2011) (and indicate the measurement period) and, then, discuss the particular geographical settings of PE to explain the contrast in wind speed and, ultimately, in blowing snow frequencies, with the other results/locations mentioned in the text. If the**

frequencies compare reasonably well with satellite measurements, does this mean that the hindering effect of clouds is not so influent? Again this appears contradictory with the apparently frequent occurrence of precipitation and overcast conditions during blowing snow events.

- The map present in (Palm et al., 2011) gives a range rather than a precise number. In the case of PE station, for instance, blowing snow frequency is 0-10 % while the BSD algorithm reaches 13 % of blowing snow (not 9 % since we include the heavy blowing snow events, the frequency increased). In this case, the BSD frequency is higher than the detection rate by the satellite method. This can be related to the number of blowing snow events occurring together with clouds/precipitation, missed by the satellite, and to the different spatial and temporal dimensions of the different methods. In addition, the geographical settings of PE station are discussed.

The frequency is calculated here by reporting the sum of all hours during which blowing snow occurs at Neumayer based on the BSD algorithm over the total number of observation hours. Blowing snow at Neumayer III occurs on average 36% of the time for the 2011-2015 period. This is consistent with König-Langlo and Loose (2007), who report 20 % of drifting and 40 % drifting and blowing snow for the 1981 - 2006 period. However, there is an inter-annual variability that reaches ± 5 % , also observed by Lenaerts et al. (2010). The pattern visible in Fig.5 above (Fig. 7 in the new manuscript) is common for blowing snow over Antarctica: a seasonal cycle peaking during the Antarctic winter (March - November) and displaying lower values for the rest of the year (Mahesh et al., 2003; Lenaerts et al., 2010; Scarchili et al., 2010; Palm et al., 2011; Amory et al., 2017). The overall blowing snow frequency is computed at PE for the 2010-2017 period and reaches 13%. This lower blowing snow frequency at PE can be explained by the location of the station: the station is shielded from the katabatic winds by the Utsteinen mountain range, making it a quieter zone between the flows diverged to the sides of the station (Parish and Bromwich, 2007), while Neumayer III station is located on the ice shelf and experiences higher wind speeds [...] and is more exposed to storms. In addition, the limited availability of Antarctic winter data (due to power failures at the station) leads to an underestimation of the blowing snow frequency as mostly extended summer period was used, and only one winter is taken into account.

The frequencies measured by the BSD algorithm are larger than those retrieved by satellite method: Palm et al. (2011) gives a range of 0-10 % blowing snow for both locations. This can be related to the number of blowing snow events occurring together with clouds/precipitation, missed by the satellite, and to the different spatial and temporal dimensions of the different methods. Of all blowing snow detected events, 67 % is mixed with intense events at Neumayer III, and 43 % at PE station. Cloudless blowing snow is very rare at Neumayer III station (8 % of the events), while it reaches 30 % at PE station.

18 Question 18: P14, Fig. 8 (legend): Non blowing snow (not “no”)

The figure is not displayed in the new version of the manuscript.

19 Question 19: P14, section 4.2: This section could have been more organized. You alternate between katabatic and synoptic conditions, blowing snow and non-blowing snow conditions, PE and Neumayer, and results and theory. Some sentences are ambiguous, others contain syntax errors, irrelevant or incomplete information, and some conclusions seem a bit early. I think you could remove this section entirely without disturbing your global analysis. Moreover, this would avoid redundant information with section 4.3, in which you actually refer to the work of Gorodetskaya et al. (2013) to define the two meteorological regimes. Find more detailed comments below:

This section has been removed, only parts are kept in section 4.3. Separate answers are given for the remarks still present in the new version of the paper:

- **L5: "Fig. 8 and 10": an "s" is lacking**
- L5 : The figures are not displayed anymore
- **L5-7: You only use a wind direction criterion to distinguish katabatic from synoptic conditions. What about a combined influence of katabatic and synoptic conditions? Is the deflection due to the Coriolis force also an influent factor accounting for the easterly component of the surface flow?**
- L 5-7: There are three regimes: warm synoptic, cold katabatic, and transitional, when the situation evolves from synoptic to katabatic or the other way around as was defined by Gorodetskaya et al. (2013). While the wind direction was the dominant parameter in the PCA analysis, the parameters used to distinguish between these regimes are the wind direction, together with the temperature inversion and cloudiness, as well as the wind speed and relative humidity. Regarding the deflation to the East, ongoing analysis (Souverijns et al, in prep) showed that among the low pressure systems that are circling eastward around Antarctica over the Southern Ocean - mostly those centered to the north and to the northwest from PE determine the synoptic conditions at the PE station. As winds turn clockwise around the cyclone, air from oceanic areas is drawn towards the station. These oceanic air masses have the potential to take up a lot of moisture, and precipitate at the coastal areas of Dronning Maud Land, as winds are forced to rise against the Antarctic plateau. In those cases, winds at PE originate from the north east (when the cyclone is located to the northwest) or from the more inland areas at the east (when the low pressure system is located north of the station).
- **L8-10: This sentence is ambiguous. Please rephrase.**
- This sentence has been removed.
- **L11-13: Harsh construction. The colon (":") is misused. "wind speeds are high enough to be able to. . .and saltation" is clumsy: I guess "wind speeds are high enough to initiate snowdrift" is analogous but more concise.**
- The sentence has been rephrased accordingly.
- **L12: The increase in RH is (partly) caused by blowing snow, not a cause of, so it doesn't "privilege" blowing snow.**

- The sentence has been removed.

- **L13-15: Mentioning the self-limiting process of blowing snow sublimation and the increase in roughness due to windborne snow particles is not relevant since i) they are not a result here and ii) they don't explain any described feature.**

- The sentence has been removed.

- **L15-16: This sentence needs rephrasing: "The increase in RH is both a result [. . .] and sublimation (not "due to") of precipitating and blowing snow particles."**

- The sentence has been removed.

- **P15, L1: "Those also have an impact on the radiative budget": This is elusive. Illustrate and discussed further or remove.**

- The sentence has been removed.

- **P15, L2: Turbulent mixing generally occurs during strong winds, whatever their origin (synoptic or katabatic). How do you distinguish between synoptic and katabatic conditions?**

- PE station is shielded by the Utsteinen mountain range, therefore katabatic winds have the lowest wind speeds (see Fig.3 above and Fig. 10 in the new manuscript), compared to synoptic or transitional regimes.

- **P15, L4: "These variables": You mean "trends" (?)**

- Yes, the sentence has been adapted accordingly

The near surface atmosphere changes, associated with blowing snow events, are investigated for both stations, and detailed means and standard deviation are displayed in Table S6 and S7, in supplements. We investigate how blowing snow hourly means relate to weather regimes, derived from the hierarchical cluster analysis applied in Gorodetskaya et al. (2013), which defines the weather regimes at PE station: "cold katabatic", "warm synoptic", and "transitional synoptic". The cold katabatic regime is characterized by slower wind speeds and lower humidity, reduced incoming long wave radiation, a slight surface pressure increase, and a substantial temperature inversion. Warm synoptic conditions involve higher wind speeds and specific humidity, strongly positive anomalies of incoming long wave radiation. The surface pressure is slightly lower, and the temperature inversion is strongly reduced than during average conditions. Finally, average wind speeds, humidity and incoming long wave radiation, as well as slightly lower surface pressure are observed during the transitional regime, when the situation evolves from synoptic to katabatic or the other way around (Gorodetskaya et al., 2013). Further, we investigate the specific meteorological conditions (near-surface temperature inversion, relative humidity, surface temperature, wind speed and direction, in- and outgoing longwave fluxes, and the time since the last precipitation event) during blowing snow events.

For all three categories of blowing snow events, the 2m *wind direction shows a preferential easterly/north-easterly orientation* *at both Neumayer and PE, while non-blowing snow takes place under a wider spectrum of wind directions (Figs. 9 and 10). Positive anomalies in wind speed and RH occur during blowing snow events. Cyclonic events are a common feature at Neumayer (König-Langlo and Loose, 2007), bringing easterly winds during which most of the drifting and blowing snow occur. Also at PE, most of the blowing snow events (N = 1643, 92 %) are associated with the warm synopic and transitional regimes, when moist air is brought from the ocean, that precipitate inland (Gorodetskaya et al., 2013). These regimes occur 41-48 % of the time (Gorodetskaya et al., 2013, 2014). Very few blowing snow events occur in cloudless cold conditions (cold katabatic regime), when the northerly winds blows from the interior towards the coast (N = 139; 8%).*

Intense mixed events (see Fig.5) occur together with north-easterly strong winds : 87°to N, 10 $\mathrm{m \cdot s^{-1}}$ *at PE and 65°to N, 13* $\mathrm{m \cdot s^{-1}}$ *at Neumayer III , warmer surface temperatures and higher relative humidity. These are the signature of storms associated with synoptic events, during which the turbulent mixing reduces the vertical temperature gradient (Gorodetskaya et al., 2013). The majority (60 %) of the blowing snow events occur during storms or overcast conditions (with cloud and/or precipitation). These mixed events have generally a short time lag since the last precipitation event and reach high atmospheric levels. Dry blowing snow has a mean wind direction of 120°to N at PE and 77°at Neumayer III, lower wind speeds (6-7*$\mathrm{m \cdot s^{-1}}$*) and a greater temperature inversion at. The mean time lag since the last precipitation event at PE (23 hours) indicates that these events most likely occur after a storm, and that cloudless blowing snow (8 %) is mostly associated to katabatic winds.*

20 Question 20: P16, Fig. 10 (caption): Indicate the relative proportion of each category.

The proportions have been added to the Figs. 3 and 4 above (Figs.9 and 10 in the new manuscript).

21 Question 21: P16, L4: “as”, not “although”.

The sentence has been corrected

a great part of the events during the synoptic regime would be missed, as they represent more than half of the events observed at PE

22 Question 22: P16, L13: Remove “anymore”.

The sentence has been corrected

This is, however, not so obvious if we normalize the distribution of blowing snow events taking into account the total number of measurements within each time lag after precipitation.

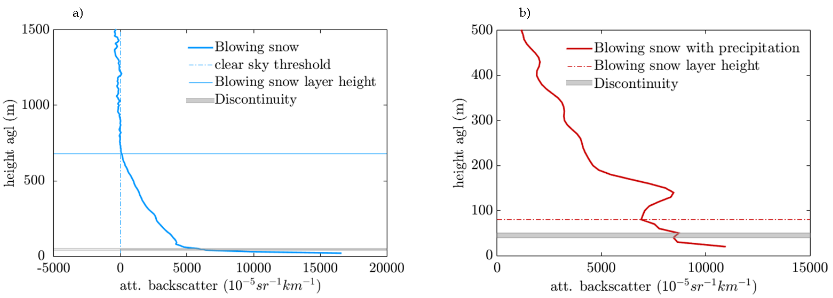

Figure 6. Determination of the height of the layer by the BSD algorithm. (a) in case of a cloud free blowing snow profile, the height of the layer is attained when the backscatter intensity reaches the clear sky threshold. (b) in case of precipitation, the height of the blowing snow layer is reached when the intensity of the backscatter signal re-increases.

23 Question 23: P17, section 4.3.2: It is not clear how the depth of the blowing snow layer is determined.

The explanation fo the blowing snow depth determination lies in P11, L2-7, a reference to this section as been added. In addition, illustrations are added in the Supplements (Fig.6 above, Fig. S3 in supplements)

The height of the blowing snow layer (algorithm explained in section 3.2.) varies according to different parameters: wind speed, and the size and density of the snow particles.

and section 3.2.

In addition to the detection of blowing snow, the BSD algorithm quantifies the height of the layer (see Fig. S3, supplements) This is done as follows; if the profile decreases steadily (indication of absence of precipitation), the range gate at which the intensity of β_{att} drops under the clear sky threshold value is the top of the layer. Anything above this height is considered clear sky. If there is precipitation or a cloud during the blowing snow event, the shape of the backscatter profile does not decrease monotonously, but shows an increase in higher levels. In that case, the range gate at which the profile increases again is the top of the blowing snow layer, and the base of the cloud and/or precipitation.

24 Question 24: P18, Fig. 11 (ordinate axis): Indicate the units.

The figure on page 18 is Figure 13, the figure label has been changed accordingly.

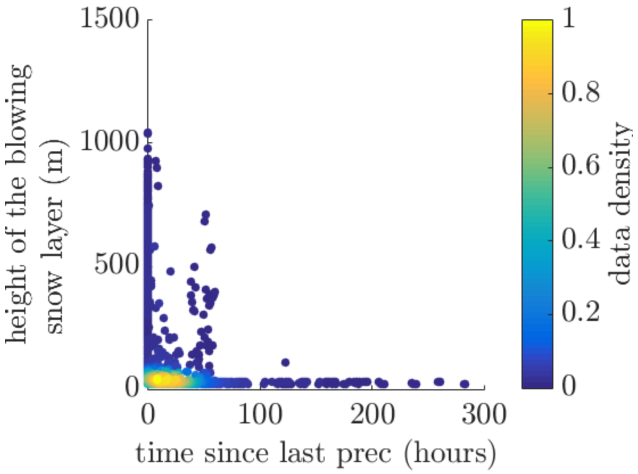

Figure 7. Scatter plot of the time since last precipitation event versus height of the blowing snow layer. Each point represents a blowing snow event. The colorbar represent the data density (number of observations divided by the entire sample size).

25 Question 25: P18, L10: If your algorithm is applied "successfully", then you consider the visual observations as ground truth. Compare favorably with or something like that, would be more appropriate. Idem for "proved the applicability".

Indeed, this suggests that we consider visual observations as ground truth, which is not the case. The text has been changed accordingly.

The BSD algorithm developed for the Vaisala CL-31 ceilometer at PE was applied to the Vaisala CL-51 ceilometer at Neumayer III station. Comparing the BSD algorithm detections to visual observations at Neumayer showed a good agreement and the ability of the BSD algorithm to detect (heavy) blowing snow events, both under dry and precipitating conditions.

26 Question 26: P19, L15: Metamorphism does not impact the friction velocity, only the threshold friction velocity (see comment 1).

The sentence has been changed accordingly

These parameters change with metamorphism and impact the threshold friction velocity, and thus the and minimum wind speed required for particles uplift from the ground.

27 Question 27: P19, L17: Can you give more examples of such (many) studies?

Giovinetto et al. (1992), Déry and Yau (1999), Déry and Yau (2002), Yang et al. (2010) and Palm et al. (2011).

Here, we do not apply any wind speed threshold to the detection of blowing snow, whereas some modelling studies assume a drifting snow dependency on temperature and wind speed (Giovinetto et al., 1992; Déry and Yau, 1999, 2002; Yang et al., 2010). Palm et al. (2011) for instance, uses a minimum wind speed criterion to detect blowing snow from satellite backscatter, potentially leaving out some events.

28 Question 28: P19, L19: a "the" is redundant. The properties listed in brackets are not complementary information of "freshly fallen snow". Please rephrase.

The sentence has been adapted accordingly

We find that the presence of freshly fallen snow has a great impact on blowing snow occurrence and blowing snow layer height.

29 Question 29: P19, L29: Which role do you give to the turbulence during katabatic conditions in limiting the occurrence of blowing snow at PE?

The sentence was wrongly phrased. The 'limited ' was intended to be related to availability, but also to turbulence. During the katabatic regime, there is little turbulence at PE station, as the greater temperature inversion than for the synoptic regimes suggests. Less turbulence, therefore less particles lifted from the ground.

At PE, the explanation for the limited occurrence of blowing snow under katabatic conditions might lie in the fact that the station is shielded by the Sør Rondane mountains: wind speeds are lower and turbulence is reduced due to the very stable conditions that are frequently present (Gorodetskaya et al., 2013). In addition, the availability of fresh snow is limited as the time lag since the last precipitation event is greater, compared to synoptic conditions.

30 Question 30: P19, L29-31: Katabatic winds or conditions, not “katabatics”. Please clarify where and how the effect of katabatic winds on the occurrence of blowing snow has been overestimated? Do you actually mean that katabatic winds are not the main driven force behind blowing snow at PE, as usually considered? If so, you should limit this conclusion to the particular geographical settings of PE, which are likely non-representative of the general conditions in coastal East Antarctica.

Yes, The analysis of blowing snow occurrence at Princess Elisabeth station reveals that there are fewer blowing snow events during the cold katabatic regime : N = 152, 8%, than during the warm synoptic or transitional regimes. This is also illustrated in Fig.3 above: the wind roses show 1 to 2 % of blowing snow taking place during northerly winds. These special conditions at PE have been also described by Thiery et al. (2012) showing that most of the drifting snow sublimation occurs during transitional synoptic regime when the winds are strong due to the nearby cyclone, while air is undersaturated. Larger occurrences of katabatic winds are found in the absence of blowing snow. This indicates that blowing snow occurs predominantly under easterly and north easterly winds, and that the effect of katabatic winds are not the main driver for blowing snow occurrence at PE station. Regarding Neumayer III station, we find that blowing snow occurs mainly during synoptic disturbances, which is also stated by König-Langlo and Loose (2007): "blowing snow is limited to synoptic disturbances and advection from the east". Please note that we discuss significant blowing snow events (layers higher than 30 m height). Drifting snow might give different results, but is not investigated in this paper.

At PE, the explanation for the limited occurrence of blowing snow under katabatic conditions might lie in the fact that the station is shielded by the Sør Rondane mountains, but also due to the limited availability of fresh snow and the reduced turbulence during those events compared to synoptic conditions, maintaining particles aloft. This, together with the reduced number of blowing snow events occurring under katabatic winds (Fig. 10) might indicate that the effect of katabatic winds on blowing snow occurrence has been overestimated, and that synoptic events bringing fresh snow is a most possibly determining factor for blowing snow at Neumayer III and PE stations.

31 Question 31: P20, L7: Specify that this conclusion is only valid for PE.

The sentence has been adapted accordingly. However, this is also valid at Neumayer III station.

The presence of precipitation does not substantially limit the retrieval by the ceilometer. This is an improvement to satellite detection, limited to clear sky conditions and therefore missing a great part of the blowing snow as more than half of the blowing snow happens during a storm at PE and Neumayer III station.

32 Question 32: P20, L9: “mainly determines”.

the sentence has been changed accordingly

The availability of fresh snow mainly determines the onset of blowing snow, and the available fresh snow can be lifted to higher heights than during katabatic conditions whose effect is likely to have been overestimated for lifting snow from the surface.

33 Question 33: P20, L10-11: In which context this conclusion has been drawn?

The majority of the blowing snow events occur during transitional or warm regimes at both stations (around 92 %), and only a limited number of blowing snow events have been retrieved during katabatic conditions. In addition, 60 % of the blowing snow events happen together with precipitation, indicating synoptic or transitional events rather than katabatic conditions.

We further conclude that most of the blowing snow events happen during or shortly after precipitation, brought to the continent by the easterly winds associated to synoptic systems. The availability of fresh snow mainly determines the onset of blowing snow, and the available fresh snow can be lifted to higher heights than during katabatic conditions at PE and Neumayer stations. This highlights again the limitation of wind speed thresholds, when applied to blowing snow retrieval methods. The properties of the snow particles, as well as the availability of fresh snow need to be taken into account in order to accurately initiate blowing snow in models.

34 Question 34: P20, L12: “The availability”: you mean erodibility (availability of fresh snow is not a snow property)?

"Including" has been changed to "and".

This highlights again the limitation of wind speed thresholds, when applied to blowing snow retrieval methods. It also emphasizes the need to take into account the properties of the snow particles and the availability of fresh snow, in order to accurately initiate blowing snow in models.

35 Question 35: P20, L15: Use “evaluate” rather than “validate”.

the sentence has been changed accordingly

These can further be used to evaluate satellite retrieval and combined to produce blowing snow products over the ice sheets.

References

Amory, C., Gallée, H., Naaim-Bouvet, F., Favier, V., Vignon, E., Picard, G., Trouvilliez, A., Piard, L., Genthon, C., Bellot, H.: Seasonal Variations in Drag Coefficient over a Sastrugi-Covered Snowfield in Coastal East Antarctica, Boundary-Layer Meteorl., 164, 107–133, 2017.

Amory, C., Trouvilliez, A., Gallée, H., Favier, V., Naaim-Bouvet, F., Genthon, C., Agosta, C., Piard, L., and Bellot, H.: Comparison between observed and simulated eolian snow mass fluxes in Adélie Land, East Antarctica, The Cryosphere, 9, 1373–1383, 2015.

Bagnold, R. A.: The Physics of Blown Sand and Desert Dunes, Mathuen, London, 265 pp., 1954.

Barral, H., Genthon, C., Trouvilliez, A., Brun, C., Amory, C.: Blowing snow in coastal Adelie Land, Antarctica: three atmospheric-moisture issues, The Cryosphere, 8, 5, 1905–1919, 2014.

Dai, X., and Huang, N.: Numerical simulation of drifting snow sublimation in the saltation layer, Scientific Reports, 4 (6611), 1–5, doi: 10.1038, 2014.

Déry, S. J., and Tremblay, L. B.: Modeling the Effects of Wind Redistribution on the Snow Mass Budget of Polar Sea Ice, J. Phys. Oceanogr., 34, 258–271, 2004.

Déry, S. J., and Yau, M. K: A climatology of adverse winter-type weather events, J. Geophys. Res., 104, 16,657–16,672, 1999.

Déry, S. J., and Yau, M. K: Large-scale mass balance effects of blowing snow and surface sublimation, J. Geophys. Res, 107(D23), doi:10.1029/2001JD001251, 8-1 – 8-17, 2002.

Gallée, H., Guyomarc'h, G., and Brun, E.: Impact of snow drift on the Antarctic ice sheet surface mass balance : possible sensitivity to snow-surface properties, Boundary Layer Meteorol., 99, 1–19, 2001.

Giovinetto, M.B., Bromwich, D.H., and Wendler, D.: Atmospheric Net Transport of Water Vapor and Latent Heat Across 70°S, J. Geophys. Res., 97, 917–930, 1992.

Gorodetskaya, I. V., Tsukernik, M., Claes, K., Ralph, M. F., Neff, W. D., and van Lipzig, N. P. M.: The role of atmospheric rivers in anomalous snow accumulation in East Antarctica, Geophys. Res. Lett, 16, 6199-6206, 2014.

Gorodetskaya I. V., Kneifel, S., Maahn, S., Van Tricht, K., Thiery, W., Schween, J. H., Mangold, A., Crewell, S., and van Lipzig, N. P. M.: Cloud and precipitation properties from ground-based remote-sensing instruments in East Antarctica, The Cryosphere, 9, 286–304, 2015.

Gorodetskaya, I. V., van Lipzig, N. P. M., van den Broeke, M. R., Mangold, A., Boot, W., and Reijmer, C. H.: Meteorological regimes and accumulation patterns at Utsteinen, Dronning Maud Land, East Antarctica: Analysis of two contrasting years, J. Geophys. Res., 118, 4, 1700–1715, 2014.

Groot Zwaaftink, C. D., Cagnati, A., Crepaz, A., Fierz, C., Macelloni, G.,Valt, M., and Lehning, M.: Event-driven deposition of snow on the Antarctic Plateau: analyzing field measurements with SNOWPACK, The Cryosphere, 7(1), 333–347, 2013.

Klugmann, D., Heinsohn, K., Kirtzel, H.J.: A low cost 24 GHz FM-CW Doppler radar rain profiler, Contributions to Atm. Phys., 69, 247–253, 1996.

Kodama, Y., Wendler, G., and Gowink,J.: The effect of blowing snow on katabatic winds in Antarctica, Ann.Glaciol., 6, 59–62, 1985.

König-Langlo, G., and Loose, B.: The Meteorological Observatory at Neumayer Stations (GvN abd NM-II) Antarctica, Polarforschung, 76 (1-2), 25-38, 2007.

Lenaerts, J. T. M., and van den Broeke, M. R.: Modeling drifting snow in Antarctica with a regional climate model:2. Results, J. Geophys. Res., 117(D5), D05109, 2012.

Lenaerts, J. T. M., van den Broeke, M.R., Déry, S.J., König-Langlo, G., Ettema J., and Munneke, P.K.: Modelling snowdrift sublimation on an Antarctic ice shelf, The Cryosphere, 4, 179–190, 2010.

Leonard, K. C., Tremblay, L. B., Thom, J. E., and MacAyeal, D. R.: Drifting snow measurements near McMurdo station, Antarctica: A sensor comparison study, Cold Regions Science and Technology, 70, 71–80, 2011.

Lesins, G., Bourdages, L., Duk,T. J., Drummond, J. R., Eloranta, E. W., and Walden, V. P.: Large surface radiative forcing from topographic blowing snow residuals measured in the High Arctic at Eureka, Atm. Chem. Phys., 9(6), 1847–1862, 2009.

Maahn,M., and Kollias, P.: Improved Micro Rain Radar snow measurements using Doppler spectra post-processing, Atm. Meas. Tech., 5, 2661-2673, 2012.

Mahesh, A., Eager, R., Campbell,J. R., and Spirnhirne, J.D.: Observations of blowing snow at South Pole, Journal of Geophysical Research, 108 (D22), 4707, 2003.

Mellor, M.: Blowing Snow, Cold Regions Science and Engineering: Part II, section A3c., 78pp., 1965.

Palm, S. P., Yang, Y. Spirnhirne, J. D., and Marshak, A.: Satellite remote sensing of blowing snow properties over Antarctica, J. Geophys. Res., 116, D16123, 2011.

Parish, T. R. and Bromwich, D. H.:Reexamination of the Near-Surface Airflow over the Antarctic Continent and Implications on Atmospheric Circulations at High Southern Latitutdes, Mon. Wea. Rev., 135, 5, 961–1973, doi:10.1175/MWR3374.1, 2007.

Scarchili, C., Frezzotti, M., Grigioni, P., De Silvestri, L., Agnoletto, L., and Dolci, S.: Extraordinary blowing snow transport events in East Antarctica, Clim. Dyn., 34, 1195–1206, 2010.

Souverijns, N., Gossart, A., Lhermitte, S., Gorodetskaya, I.V., Kneifel, S., Maahn, M., Bilven, F.L., and van Lipzig, N.P.M.: Estimating radar reflectivity - snowfall rate relationships and their uncertainties over Antarctica by combining disdrometer and radar observations, Atmos. Res., accepted.

Takahashi, S., Endoh, T., Azuma,N., and Meshida, S.: Bare ice fields developed in the inland part of Antarctica, Proc. NIPR Symp. Polar Meteorol. Glaciol., 5, 128–139, 1992.

Thiery, W., Gorodetskaya, I.V., Bintanja,R., van Lipzig, N. M. P , van den Broeke, M.R., Reijmer, C. H., and Kuipers Munneke, P.: Surface and snowdrift sublimation at Princess Elisabeth station, East Antarctica, The Cryosphere, 6(4), 841–857, 2012.

Trouvilliez, A.,Naiim-Bouvet, F., Genthon, C., Piard, L., Favier, V., Bellot, H., Agosta, C., Palerme, C., Amory, C., and Gallée, H.: A novel experimental study of aeolian snow transport in Adelie Land (Antarctica), Cold Regions Science and Technology, 108, 125–138, 2014.

van den Broeke, M. R., Reijmer, C. H., and van de Wal, R. S. W.: A study of the surface mass balance in Dronning Maud Land, Antarctica, using automatic weather stations, J. Glaciol., 50 (171), 565–581, 2004.

Van Tricht, K., Gorodetskaya, I.V., Lhermitte, S., Turner, D.D., Schween, J.H., and van Lipzig,N.P.M.: An improved algorithm for polar clouds-base detection by ceilometer over the ice sheets, Atmos.Meas.Tech., 7, 1153–1167, 2014.

Wiegner, M., Madonna, F., Binietoglou, I., Forkel, R., Gasteiger, J., Geiß, A., Pappalard, G., Schäfer, K., and Thomas, W.: What is the benefit of ceilomteres for aerosol remote sensing? An answer from EARLINET, Atmos. Meas. Tech., 7, 1979–1997, 2014.

Yamanouchi, T., and Kawaguchi, S.: Effects of drifting snow on surface radiation budget in the katabatic wind zone, Antarctica, Ann. Glaciol., 6, 238–241, 1985.

Yang, J., Yau, M.K., Fang, X., and Pomeroy, J.W.: A triple-moment blowing snow-atmospheric model and its application in computing the seasonal wintertime snow mass budget, Hydrol. Earth Syst. Sci., 14, 1063–1079, 2010.