Response to Review 1.

We thank J. Lenaerts for his review. Please find below our responses to the specific points raised.

P2760
title: I suggest to change the title, this is too specific and 'issues' is a vague term. What about 'Blowing snow in coastal Adélie Land and its impact on atmospheric moisture'?
abstract: this is characteristic for the remainder of the text. Try to structure the abstract, such that one sentence follows from the other. This version is extremely chaotic.

We agree to change the title, we liked the first part of your proposal but the last part (eg 'its impact on atmospheric moisture') seems to restrictive for us since it suggests that the study focuses on one impact whereas we discuss three impacts. Consequently we chose the following title :
Blowing snow in Adélie Land, coastal Antarctica : Three atmospheric moisture issues.
The abstract has been rewritten. We tried to explicitely describe the three impacts of blowing snow we worked on. We hoped it is less chaotic !

Three years of blowing snow observations and associated meteorology along a 7-m mast at site D17 in coastal Adélie Land are presented. The observations are used to address 3 atmospheric moisture issues related to the occurrence of blowing snow, a feature which largely affects many regions of Antarctica: 1) Blowing snow sublimation raises close to saturation the moisture content of the surface atmosphere, and atmospheric models and meteorological analyzes that do not carry blowing snow parameterizations are affected by a systematic dry bias; 2) While snowpack modeling with a parameterization of surface snow erosion by wind can reproduce the variability of snow accumulation and ablation, ignoring the high levels of atmospheric moisture content associated with blowing snow results in overestimating surface sublimation affecting the energy budget of the snowpack; 3) the well-known profile method to calculate turbulent moisture fluxes is not applicable when blowing snow occurs, because moisture gradients are weak due to blowing snow sublimation, and the impact of measurement uncertainties is strongly amplified in case of strong winds.

Comments relative to the structure :
"I think that the paper needs to be thoroughly
revised in terms of its structure. The text continuously jumps from one subject to the other, and from methods to results, which does not enhance its readability. "
P2768 L7: why not make a 'Results' section, with all current sections 3-5 as subsections?
Following your statement, the structure has been revised.
Several paragraphs have been revised and reordered in order to improve the readability and the clarity of the text. Moreover sections have been explicitely divided into subsections to help the reader not to be lost. For each section, introductory sentences have been added.
We decided not to write one big Method section and one big Results section. We tried that but the Method section was heavy and the final result was not satisfactory since results of section 3 helped to design the method for section 4, and results of both section 3 and 4 lead to the study discussed in section 5.
Finally, section 2) *Data and Method* becomes section 2) *Data and Model* and presents the tools we used for the all study : observationnal data, meteorological analysis data and the snow-pack model. Section 4 to 5 have their own method subsections.

L5-10: on L1 you mention a result of models, and here you write that models are needed. Restructure: first this, than the results.
Ok, you are right, it is better after reordering the ideas as you proposed.

L21-L22: this is important information, but at this point it is unclear how you will overcome this problem. This is described further in the text, which leaves this sentence a little lonely. I suggest combining both pieces of text.
The structure of the paragraph has been modified. We hope it is more convenient now.
P2766 L5-8: here you refer to the introduction and to section 3 at the same time, whereas you should focus on section 2, i.e. the methods. This is typical for many parts of the text.
The reviewer is right, using data presented in the paper to illustrate a point in the data and methods section is premature. Thus we removed the 2 sentences "As discussed … no exception".
P2769 L5-20: once more, this distracts the reader. These are not results, but a comparison of your results with existing literature.
These lines along with lines 7 to 27 on the precedent page have been rewritten and reordered to be less chaotic and to improve readability. These lines are now part of subsection *3.1 Relationship between atmospheric moisture and occurrence of blowing snow in the observations*
P2770 : L4-18: again, this is not a result. It would fit to the methods and/or the figure caption.
This part has been moved to the figure caption.
P2772 : this entire page can be deleted or moved to the methods (in short form) or appendix. This distracts the reader from the main story. P2773 until L14: same for this part
These details have been inserted into a new subsection : *4.1 Method : Model Adaptation for Antarctic snow and blowing snow parameterization* .
L25 – P2775 – P 2776 (L6): Model details should be moved to the methods.
The whole section 5 has been reordered and cutted into two subsections. Model details are inserted in subsection *5.1 Method*.

Other specific comments :

L3: East Antarctica
L10: define 'subsaturation'
L14: up to a point
L14: becomes an issue
L16: winds
-obsolete since we changed the abstract.

L22: what is 'frequent' and 'persistent'? specify
We used *frequent* to mean that katabatic events often occur and *persistent* to mean that these events last for a long time. We prefer keeping the two adjectives since we think that they emphasize two different features of Adélie Land katabatic winds.

L25: give a reference
It is not clear what kind of reference the reviewer is requesting. If this is about blowing snow possibly originating from both snow fall and erosion of surface snow, this is a common fact and there is no outstanding reference for this. For instance, NOAA's national weather service glossary also states that "Blowing snow can be falling snow or snow that has already accumulated but is picked up and blown by strong wind. This same definition is also quoted by wikipedia. This does not seem to require a reference.

P2761
L1: models? Specify and quantify the impact
Ok. The following sentence has been added in order to quantify the impact.

The contribution of eroding and blowing snow to the surface mass balance (SMB) of Antarctica is estimated using models. The ranges varies from one model to another. Lenaerts et al 2012b computed that sublimation of blown particles removes almost 7% of the precipitation, considering the whole ice-sheet. Gallée et al, 2001 found about 30% along a 600 km transect in Wilkes Land.

L18: poor weather
We droped 'worst weather conditions' for 'harsh weather conditions'.

P2762
L4: through decreasing its buoyancy
We agree that mechanical energy for katabatic flow results from negative buoyancy. Decreasing buoyancy for something that is not buoyant (that is, rather, sinking) does not sound right. Rather, we replace “increasing its density” by “further decreasing its negative buoyancy”.
L5: the air is even more enhanced
Sentence replaced by :
The negative buoyancy of the air is further increased

L10: calculated
ok

L11: Wyoming? This needs a introductory sentence. Why look talk about Wyoming if your study is on Antarctica?

We decided to keep the reference on Schmidt's study in the Wyoming.
Indeed, we think it is important to note that the blowing snow issues are not restricted to Antarctica since they may have important implications in other regions. Historical studies as Schmidt, 1982 did not took place in Antarctica. Moreover, not so many studies of this kind (leading to an estimation from observatons of the rate of sublimation for airborne snow particles) have been published.

Further to your comment, the paragraph has been modified, introducing other studies from Antarctica and with an introductory sentence to justify our choice.

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Besides transporting solid water, the near-surface atmosphere transports more
water vapor than it would without blowing snow due to the sublimation of blown
snow particles. Some authors demonstrated through modelling studies that
snowdrift sublimation can exceed surface sublimation in coastal and windy
Antarctic areas \citep{Bintanja2001,Frezzoti2004}. In fact, the issue of blowing
snow is not limited to Antarctica, and historical studies  first took places in
mountainous regions. On the basis of direct in situ measurements,
\citet{Schmidt1982} calculated that sublimation amounts to 13.1\,\% of the
blowing snow transport rate in Southern Wyoming during blizzard events.
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Bintanja, R.: Snowdrift sublimation in a katabatic wind region of the Antarctic ice sheet, J. Appl. Meteorol., 40, 1952–1966, 2001.

Frezzotti, M., Pourchet, M., Flora, O., Gandolfi, S., Gay, M., Urbini, S., Vincent, C., Becagli, S., Gragnani, R., Proposito, M., Severi, M., Traversi, R., Udisti, R., and Fily, M.: New Estimations of Precipitation and Surface Sublimation in East Antarctica from Snow Accumulation Measurements, Clim. Dynam., 23, 803–813, 2004.

L16: this is partially compensated. . . How do you know? Quantify and/or give a reference.
Gosink, 1989 supports our statement :
“As the air and snow crystal mixture moves downslope, the ambient air temperature increases

owing to adiabatic compression. The adiabatic warming decreases the relative humidity, favoring the sublimation of snow crystals. ”

P2763
L3-4: this is too much detail, especially for an introduction
ok , this has been removed.

L18: seldom = rare
ok

L18: remarkable persistence of strong winds
Yes you are right, constancy should be reserved for direction.

L20: They proved to be
ok

P2764
L2: interrogated = sampled
L4: run = were set up
The sentence has been rewriten :
Data are sampled with a 10'' time step, the 30-min statistics are stored by a Campbell CR3000 data logger.

L19: access was possible
ok

P2766
L10: specify the resolution of both
Both resolutions have been specified.
(about 70 km for ERA-interim versus about 16\,km for operationnal analysis since 2010)

L13: than grid points located inland
ok

L24: this is unclear. First you discuss the importance of having high resolution, and it appears that you still use precipitation from ERA-Interim (which is probably the variablemost sensitive to resolution). Explain.
General remark: please give a reference when using ECMWF data.
Although there are common references for reanalyzes products, which are widely used for research purpose (e.g. Dee et al. For ERA-I), we do not know of an integrative reference for them. The fact is that we do not use the reanalyses, we use only operationnal analysis. The website has been added as footnote for want of reference.

Moreover, for better clarity, the paragraph has been slightly modified. We hope it is better now !

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The operational analyzes are shown here, rather than reanalyzes
→ The operational analyzes are used here, rather than reanalyzes

The ECMWF analyzes are used in Section \ref{p4_crocus}, as surface atmospheric
boundary conditions for a snow-pack model described in Section \ref{p22_ecmwf}.
While the observed temperature, moisture and wind could be (and are) used, the
snow-pack model also needs input of precipitation, radiation and cloudiness.
This is obtained from the meteorological analyzes. While cloudiness is really
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analyzed, precipitation and radiation are not. The 6- and 12-hour forecasts, produced by ECMWF with model initialization by the analyzes, are used instead.
→
The ECMWF analyzes are used in Section \ref{p4_crocus}, as surface atmospheric boundary conditions for a snow-pack model described in Section \ref{p22_ecmwf}. The snow-pack model needs input of near-surface temperature, moisture and wind but also precipitation, radiation and cloudiness. For the first group, observationnal data are used alternatively with meteorological analyzes. For the second group, (comprehensive observationnal data sets are not available) only meteorological analysis are used. It may be important to note that cloudiness is really analysed whereas precipitation and radiation are not, they are in fact forecast by the ECMWF model initialized by the analyzes.

L28: in various studies
ok

P2767
L2: a horizontally one-dimensional, vertically multi-layered physical model
ok
L3: calculates the surface snow height at hourly time steps
ok
L5: disposal = balance
ok

P2768
L13: values (below 30
ok
L14: values
ok
L24: remove 'or null'
ok
L26: homogeneous = constant
The sentence has been modified.
Moistening by the sublimation of the wind blown snow particles results in the vertical profile to be much more homogeneous.

P2769
L1-4: remove, unnecessary
The sentences have not been removed in order to respond to the comments of the second review.

P2770
L6: for two climate models
ok

L23: too dry
ok

L27: AMRC AWSs ? give a reference/link
A link to the official website has been added in footnote at the first occurrence of the acronym AMRC AWS.

P2771
L2: located on the Ross ice shelf
ok

L4: lost to the surface
'lost for the surface' has been changed to 'lost by the surface'.

L25: not difficult in a 10 year time series
To be more precise, the mean 2010 accumulation along the GLACIOCLIM-SAMBA stakes system was not only one of the highest but the highest on record.

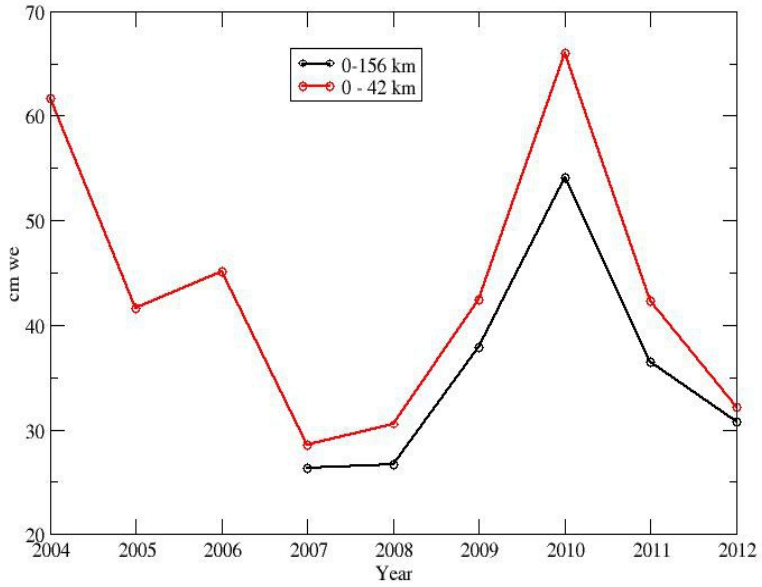

Illustration 1: Accumulation

Text 1: Accumulation along the GLACIOCLIM SAMBA stakes

P2774
L18: four simulations
ok
L20: I don't see a small impact. Sublimation changes with a factor of two!
The impact is small. We suppose the reviewer has compared the lines S2 with S1 or S4 in the table. The lines to be compared are S2 and S3. The assosciated fluxes are -11.1 W/m2 and -13.0W/m2. We support the impact is small. For a better clarity, we had the label of the lignes (S2 and S3) within brackets in the text.
L22: unexpectedly
ok

L25 – P2775 – P 2776 (L6): can be omitted entirely. The MO-theory is known and does not have to be explained.
We prefer keeping the details of the profile method. Indeed we think that the equations illustrate the text ; having the equations in mind helps to understand why uncertainties are enhanced in case of strong winds and weak gradients.

P2776
L18: FlowCapt threshold. . . can be moved to methods/figure caption
The sentence have been kept here in order to respond to the comments of the second review.

P2779

L10: I agree with this statement in terms of RH, but not in terms of temperature. I would advise to give the statistical significance of the linear trend, since I am quite sure it is not significant for temperature. In that case, I suggest removing it.
The reviewer is right, the linear trend is not of statistical significance. We removed it. The goal was not to exhibit a linear trend but to show the decrease. The figure has been arranged.

FIGURES
General comment: put the units of the displayed variable between brackets to enhance readability
ok

Figure 10: dispersion = variability
The word dispersion has been 'dropped' for 'spread'.