

Response to Reviewer 3

General comment:

This manuscript presents wind, snow depth, and air temperature measurements from four automatic weather stations and measurements of blowing snow transport in a high elevation site in the Col du Lac Blanc, France. This is a useful dataset contribution, providing a valuable set of observations, which can be very useful for high resolution snow transport modelling in cold regions. The manuscript is well-written and could be improved by cutting details about modelling and empirical method and reorganizing the text. I recommend publication in Earth System Science Data as a regular article in the data section after a moderate revision. Below are some specific comments and suggestions for improving this manuscript:

We thank Reviewer 3 for his insightful comments. We answered below to all his points. His comments are in normal font while our answers appear in blue. Changes made to the original version of the paper appear in blue italic.

1. The manuscript is too long. I would recommend authors to focus more on the data and less on modelling and empirical estimation of snow transport.

There are differences of points of view between the reviewers about this question (see for example the first comment of reviewer 1: “I encourage to include a new section explaining and describing Blowing snow data and the methods used (this is, change section 2.3 to section 3), since this probably is the most novel part of the paper.”). During the review process, we chose to follow Reviewer 1’s advice and clearly described the blowing snow data since they are innovative. No numerical modelling is presented in this paper. As explained in the text, we simply applied regression on the SPC-S7 data to provide a consistent dataset throughout wintertime and to avoid the limitations associated with the changing height of the SPC-S7 sensors above the snow surface. The empirical database has clear limitations that are discussed in the text but we believe it provides valuable information to evaluate reanalysis or output of regional climate models.

2. From the text it is not clear how data gaps were filled and quality controlled?

No gap filling was performed during the process of quality control. Measurements identified as erroneous were simply removed from the dataset and replaced by nan values in the csv files. Sentences describing the quality control for each variable were added in the revised version of the manuscript:

- Wind: *“The temporal consistency of the wind speed data from the different AWS was controlled. Wind data (speed and direction) were removed from the datasets during periods of icing of the sensors identified with a visual inspection of webcam images for the period 2004-2016 and in the reports from the operators visiting CLB on weekly basis and thanks to a comparison between heated and non-heated anemometers data.” L139 in the revised version of paper.*
- Temperature: *“Times series of air temperature were visually inspected and outliers removed from the final dataset, in particular when suspicious heating of the temperature sensors was identified during springtime periods with low wind and high solar radiation.” L147*
- Snow depth: *“Time series of snow depth measurements were visually inspected and outliers removed from the dataset, most often occurring during snowfall.” L155 in the revised version of paper.*
- Blowing snow fluxes: *The size distribution of blowing snow particles at a given height is represented by a gamma density function (Nishimura and Nemoto, 2005). That’s why the size distribution recorded by SPC-7 is used to assess the temporal consistency of the blowing snow fluxes. Moreover calibration is performed prior to use at the beginning of winter season. L249 in the revised version of paper.*

3. So many acronyms were used in the abstract and text that makes it difficult to follow the content. It is suggested to avoid unnecessary references (e.g., one in the abstract) and acronyms e.g., OZCAR, SAFRAN, CLIMate, OSUG, CNRS, ETNA, IRSTEA or Irstea (line 61), ARPEGE (166).

The reference to Gaillardet et al. (2018) has been removed from the abstract. The acronym SAFRAN has been also removed from the abstract and its meaning is explained at the beginning of Sect. 2.2.4. CRYOBSCLIM, OSUG, OZCAR have been removed from the abstract.

Finally, we've tried to do our best concerning acronyms (ARPEGE was removed for example) but we can not ignore institutes or organizations which finance our salaries (CNRS, ETNA, IRSTEA – affiliation), support our research (OZCAR) or host the data (OSUG) even if they are not internationally recognized.

4. The main concern is that comparison of the two snow transport (frequency and mass) products, estimated by an empirical method and measured by Snow Particle Counter (SPC), is not one to one and I could not obtain the same conclusions that the authors have provided at the end of the section 2.3.3.

The revised version of the paper includes a new section only dedicated to blowing snow data (Section 3). In particular, the sub-section describing the comparison between the 2 sources of blowing data (empirical database of blowing snow events and SPC measurements) has been fully rewritten to provide a more accurate analysis of the results presented in Table 3. It is written as follows:

“The estimation of blowing snow occurrence determined with the SPC-S7 reported on Table 2 differs from the results obtained with the empirical database (Fig. 3). To gain more understanding on these differences, we determined the quantity of snow transported between 0.2 and 1.2 m per linear meter during the periods identified as blowing snow periods in the empirical database and we compared this value with the total quantity of snow transported between 0.2 and 1.2 m per linear meter derived with the SPC-S7 for the same winter season. The result is expressed as a percentage in Table 3. It shows that the empirical database of blowing snow occurrence detects 55 % of the total transported snow mass measured by the SPC-S7. This results from the non-detection of blowing snow events of low to moderate intensity with the empirical method as discussed in Vionnet et al. (2013). This method only reports the main blowing snow events. This mainly results from assumptions made in the method: the minimal event duration is set to 4 hours and only period with wind speed greater than 6 m s^{-1} are included during snowfall. Therefore, the estimation of blowing snow occurrence with the empirical method (12.0 % of the time for the period 2010-2016; Table3) constitutes a lower bound for the estimation of blowing snow occurrence at CLB. SPC-S7 provides estimations ranging between 23 and 50 % of the time, depending on the threshold value used when filtering the SPC-S7 data as discussed in the previous section.

The empirical database of blowing snow events and the SPC-S7 data are two sources of information on blowing snow occurrence and intensity at CLB. We recommend the use of SPC-S7 data for the study of blowing snow processes and the evaluation of models at fine temporal scales whereas the empirical database of blowing snow events can be used to evaluate reanalysis or output of regional climate models on a longer term. Compare to the SPC-S7 data, the empirical database covers a longer time period (11 additional years: 2000-2010). It also provides continuous hourly estimations of blowing snow occurrence whereas about 25 % of the SPC-S7 data can be considered as invalid or missing over the period 2010-2016 (Fig. 4).” (L 316) in the revised version of paper.

Editorial comments:

Abstract-Line 20: Remove "data" after "Observations". Correction included

Abstract: What does "SAFRAN" stand for? What is a local meteorological reanalysis?

SAFRAN stands for Systeme d'Analyse Fournissant des Renseignements Atmospheriques a la Neige ; Analysis System Providing Atmospheric Information to Snow. We removed the acronym SAFRAN from the abstract and add the meaning of the acronym in Section 2.2.4.

We initially used the term « local » since SAFRAN outputs are only available in the French mountains but we agree that this term is not appropriate without a proper explanation. For this reason, we removed it from the abstract.

Replace "altitude" with "elevation" in the manuscript. "Elevation" represents the position of the sites and stations better than "altitude".

We replaced "altitude" by "elevation" in the revised version of paper. In particular, we changed the title of the paper.

Line 54: Which "last seasons"? Provide more details.

We replaced "over the last 6 seasons" by "from winter 2010-2011 to 2015-2016".

Line 65: replace "strong" with "large". [Correction included](#)

Figure 1: define all the subplots in the figure caption. Only subplot c is defined in the current caption. Add geographic names on subplot a.

The new caption of Figure 1 defines all the subplots and includes modifications based on comments made by Reviewer 1 and 2. It is written as follows:

"Figure 1: Location of the Col du Lac Blanc experimental site seen at different scales: (a) general location in France, (b) location within the Grandes Rousses mountain range, (c) details of the study area showing the location of the four AWS surrounding the site and described in Table 1. The blue dashed area on map (c) shows the approximate area covered by the picture in Fig. 2. Contour lines spacing is 100 m for the major lines and 25 m for the minor lines in map b and 50 m and 10 m in map (c)."

I recommend Table 1 to be merged to Table 2

Table 1 is now merged with Table 2

Line 133-134: The "...from AWS Muzelle and Col are available from winter 2002-2003 and 2010-2011..." is not consistent with Table 2. Check this. Even it is recommended that you remove this as it is already repeated in Table 2.

We thank Reviewer 3 for pointing out this inconsistency. Temperature and snow depth data are available at AWS Muzelle since December 2004 whereas wind data are available since December 2002. We decided to keep the sentence in the manuscript since we believe it is important to explicitly mention in the text that the data from the different stations do not fully cover the period 2000-2016.

Section 2.2.1 Wind speed and direction: I would avoid using indices or names for the sensors (e.g., lines 138, 141, 147, 157) in the text and mention them only in Table 2.

Name of the sensors are now mentioned only in Table 1.

Line 168: replace "get" with "obtain". [Correction included](#)