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Comment on acp-2022-604

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Community comment on "Meteorological export and deposition fluxes of black carbon on glaciers of the central Chilean Andes" by Rémy Lapere et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-604-CC1, 2022

Comments

The article: "Meteorological export and deposition fluxes of Black Carbon on glaciers of the central Chilean Andes" analyzes the BC transport and deposition on glaciers of central Andes during a summer and a winter month. The study addresses important aspects related to the BC transport to the Andes cryosphere, increasing our knowledge on this topic, which has vital implications for water management and availability over the study region. I think the manuscript can be accepted for publication if the authors first address some major and minor comments, which are described below.

Major comments

- I see no reason to include figures as a separate Appendix. I suggest changing the figures in the Appendix to the main text to prevent going back and forward between figures in the main text and those in the Appendix, which slightly worsens the reading fluency.

- L85: This paragraph creates a bit of confusion for me when reading the text. This paragraph seems to justify the use of Zhang et al. (2001) dry deposition scheme in this study based on results obtained by Beegum et al. (2020) in the Arabian Peninsula comparing Zhang et al. (2001) and Wesely et al. (1989) schemes. I think this does not justify Zhang et al.'s choice unless you discuss how the Arabian Peninsula is similar to the Andes. On the other hand, section 4 mentions that "Beegum et al. (2020) showed that the performance of both deposition schemes depends on the season and location considered. Thus, it does not matter which dry deposition scheme is used, if there is not a wide data coverage to assess the model, which is the case. Please, modify the paragraph in L85 to avoid this contradiction. Maybe remove the reference to Beegum et al. (2020) in that paragraph and just mention that a discussion of the choice of the dry deposition scheme will be described in Section 4.

- L260: Authors mention that synoptic-scale circulations in central Chile are driven by the position of the SPH and the passage of migratory "mid-level" anticyclones. However, synoptic-scale circulations are also affected every year by the passage of cold fronts (mainly between May and September) and cut-off lows to a lesser extent. In particular, the passage of cold fronts in fall and winter bring northwest/west winds to the region that

may affect the average circulation shown in Fig. 5b. That, together with the usual seasonal variation of the SPH circulation, may result in less intense southwesterly winds in winter. I suggest the authors include this discussion in this part of the text.

- Figures 6 and 7 show mean conditions for circulations. I think the authors should complement those results by analyzing how circulations behave during January and July 2015 to add support to these results. For instance, if authors choose a group of glaciers in the Mapocho basin and another group of glaciers in the Maipo basins with large deposition fluxes, would they be associated with a larger percent of wind directions indicative of synoptic-scale + upward mountain-valley circulations in January and a larger percent of wind directions indicative of down-valley circulations in July in agreement with what the average circulations show?

- Section 4: Authors may discuss in that section that although the RCP8.5 is the hypothetically most extreme scenario in the use of fossil fuel, the RCP2.6 scenario maybe will be a more likely scenario by the end of the century, and results from RCP2.6 may receive more attention than those from the RCP8.5 scenario.

- A winter and a summer month of 2015 was used in the study to better understand BC transport and deposition over central Andes. However, the year 2015 is an El Niño year, which involves large-scale perturbed circulations that may have affected the region much differently during that year. Authors should discuss this in the text.

To show that the results obtained this year are not very different from those obtained in the 2011-2021 period, the authors present the time evolution of PM2.5 concentrations and wind speed at PQH station in downtown Santiago. However, using only one Santiago station in this comparison might not be representative of what authors have shown in the Results section, particularly for winter months since the total BC deposition attributable to Santiago emissions accounts for less than 20% of the total BC deposition. I think that authors should show an overall comparison using all the PM2.5 concentration and wind speed data available in the region (30-37ºS) to better show that conditions in 2015 are not very different from the other years. At least they should present this comparison for observations from other towns/cities in the region. There are several SINCA stations in the OHiggins, El Maule, and Bio Bio regions. Authors could compare mean PM2.5 and wind speed distributions at other sites for January and July between 2015 and the other years or compare how anomalous the regional wind speed and PM2.5 concentrations were compared to the other years of the 2011-2021 period. I leave it out to the authors to choose the best way to show this.

Minor comments

- L70: The WRF model is not only developed by the National Center for Atmospheric Research (NCAR), it has been developed by different institutions. Based on information from its webpage: "it is a collaborative partnership of the National Center for Atmospheric Research (NCAR), the National Oceanic and Atmospheric Administration (represented by the National Centers for Environmental Prediction (NCEP) and the Earth System Research Laboratory), the U.S. Air Force, the Naval Research Laboratory, the University of Oklahoma, and the Federal Aviation Administration (FAA).

- L70: Please describe how the authors did not take into account wildfire events. Did they use a database of wildfires to remove those dates from the analysis?

- Please expand a bit more on the discussion of simulation in the text. The authors mention to the reader to look for details in Lapere et al. (2021)a, but still, I think a bit

more information about simulations should be provided in this manuscript. For instance, what WRF model version was used in this study, and whether there is a reason supporting the use of this configuration of parameterizations for this region. In addition, include Table A1 in section 2.1.

- Why did the authors prefer to put Fig. A1 in Appendix A, instead of putting it within the text as Fig. 2? I would suggest including it as Fig. 2 in the text since the text can be read more fluidly. Please see the major comments above.

- L170: I found the following sentence confusing: "In these absolute totals, the contribution of Santiago emissions is dominant in summertime with 50% of the BC particles deposited coming from the capital city, while it accounts for only 15% in wintertime at the scale of central Chile (pink pie

charts in Figure 1)." Since I agree that contributions from other parts of central Chile are dominant in wintertime compared to that from Santiago for the whole of central Chile (85% vs 15%), the contribution in summertime is 50% each. Thus, I suggest changing the word "dominant" to "larger".

- L210: In the direct vicinity of the capital city (between 33◦ S and 34◦ S), the contribution ranges from 50% to 100%, with a northward gradient in summertime.

- Please also include the labels Mapocho and Maipo in Figs. 3b-d

- In the description of Figure 4, I suggest avoiding saying that the gray line is a summertime corrected profile. That would imply to me that the summertime profile is not accurate or it is biased and it needs to be corrected by the gray profile, which is not the case. If I understood well, you are only theoretically analyzing how the summertime deposition profile change (together with its implication) if using winter instead of summertime emissions. In addition, I would also suggest changing the legend in Fig. 4a from "January 2015 – emissions corrected" to "January 2015 – wintertime emissions".

- L260: The summertime synoptic wind direction is thus consistent with the orientation of the Mapocho and Olivares canyons (Fig. A1 (or Fig. 2 following the above suggestion)) …

- L270: Otherwise, the large deposition rates obtained in the chemistry-transport simulations along the Maipo river canyon (Fig. 3a), which has an NW-SE orientation perpendicular to the synoptic wind direction, would not be observed in this month if only the synoptic scale played a role.

- L280: Above the mixing layer, a smooth transition towards stronger northerly/northwesterly winds of 6 to 8 m s−1 is observed.

L290: Figures 6b and c show the average daily cycle of wind speed (colormap) and direction (arrows) profile in Santiago, averaged over DJF and JJA, respectively.

- L315: The description of the atmospheric weather station data used in this study should be included in the Data and Methodology section. Another reason to move the figures in the Appendix to the main text. I also suggest including the information of the stations used in the study as a Table in that section with the location (lat,lon) of each station and the period of data availability.

- Fig. 6a: Please detail the latitude and longitude of the Era5 grid-point used to create the plot.

- L285: Change sentence to: "Figure 6b and c show the average daily cycle of wind speed

(colormap) and direction (arrows) profile in Santiago, averaged over DJF and JJA, respectively.

- Fig. 6 caption: Please spell PQH.

- L360: Similarly, no trend is observed in wind direction for that scenario in summertime (Figure 8c).

- Figure 8 caption: … (c) same as (a) but for wind direction **in January**.

- L380: Change infra-yearly by intra-yearly

- L400: I suggest something like: " … showing that the DJF and JJA distributions of PM2.5 concentration and wind speed in Santiago cannot be distinguished from those in January and July, respectively."

Please also note the supplement to this comment:
https://acp.copernicus.org/preprints/acp-2022-604/acp-2022-604-CC1-supplement.pdf