The Cryosphere

Discussions

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Interactive comment on "Quantification of the radiative impact of light-absorbing particles during two contrasted snow seasons at Col du Lautaret (2058 m a.s.l., French Alps)" *by* François Tuzet et al.
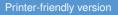
Anonymous Referee #1

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Summary comment:

This was a worthwhile project which deserves publication, but I found the paper difficult to read.

Major comments:

(1) Figure 4 compares two established methods for measuring black carbon. It shows, for example, that when rBC=5 ng/g, EC can be anywhere from 4 to 75 ng/g. This is disturbing and demands explanation. The very low rBC values from the SP2 make

me skeptical. The authors cite Wendl et al 2014 (on page 8 line 11). However, the Wendl paper discusses the effect of using different nebulizers, so I'm not sure which one was used here. More detail should be given about how the measurements were done, including the expected sampling efficiency of the SP2 set-up.

(2) In places the discussion of a figure disagrees with what the figure actually shows. For example, page 1 line 20 says "LAP concentration and SSA are correctly reproduced". But Figure 5 shows disagreements commonly a factor of 10 for LAP, and a factor of 2 for SSA.

Page 15 line 22-23, describing Figure 5a, says "temporal variations of near-surface AEC are correctly reproduced. But Figure 5a for 2018 shows poor agreement: e.g. for 2018-03 the red line is at ~3 ng/g, but the black crosses (autosolex) show two clusters of values, one an order-of-magnitude higher at ~50 ng/g, and one an order-of-magnitude lower at ~0.5 ng/g.

Page 15 line 22 gives the correlation r2=0.78. Was this correlation done linearly or logarithmically? If it was done linearly, the apparently good correlation will be the result of many points near zero (i.e. 10-9 not distinguished from 10-8) and a few points at the high end (10-6).

In the discussion of Figure 5b, page 15 line 29 says "there is no significant bias between Crocus SSA and the measurements". This figure should be redrawn, plotting SSA on a log scale instead of linear. In the middle of March 2017, the difference is barely distinguishable, but with magnification I can see that the black crosses average ~5.3 m2/kg and the red line ~3.3 m2/kg, indicating a factor-of-1.6 disagreement (and corresponding to effective radii re of 600 and 1000 microns respectively). The same problem would result from changing the vertical axis to be linear in re, because that would shrink the high-SSA region. But there is no reason to prefer either SSA or re as the choice for showing area-to-mass ratio, so to be fair the axis should be in logSSA (or logre); both choices then give the same intervals.

Page 16 line 12 states "the highest AECs estimated from Autosolexs are within the simulated concentrations by our ensemble". I assume AEC means LAP concentration? If so than the statement is not true. If I am reading Figure 5a correctly, the highest AECs from Autosolex (black crosses) are above the red shading, e.g. 2017-03, 2018-03, 2018-04.

Minor comments:

p 7 line 11. "350 to 1050 nm" What is done to account for the rest of the solar spectrum, 300-350 and 1050-2800 nm?

p 11 Eq.3. Instead of requiring the reader to consult Dumont 2017 (which in turn requires going back to Libois 2013 and Picaro 2016), it would help the reader if the authors would describe this equation briefly. For example, why the factor 32/3? And I think B has not been defined.

p 11 line 20. The definitions have been reversed. The density should be rho-ice, not n-ice.

p 12 Eq.4. It would be helpful to describe the psi-function. For example, approximately how much dust would be needed to have the albedo-lowering effect of 1 ng/g BC? Dang et al (JGR 2015) estimated a factor of $\sim$200 for Saharan dust.

p13 Eq.7. The numerator looks wrong. I think it should instead be E(indirect)-E(pristine).

p 14 line 2. Change "2c" to "2b".

p 15 line 1. Change "50 g-1" to "50 ng g-1".

p 15 line 26. "The dispersion . . . is quite low regarding the median value". I don't understand this phrase; perhaps "regarding" is the wrong word.

p 16 line 17. How can snow cover lower the amount of incoming radiation?

p 25 line 32. This paper has now been published in JGR, so the citation can be updated.

Figures 2a and 3c (showing snow depth, with gaps), disagree with Figure 5c (which has no gaps). 2a and 3c will be easier to read if the gaps are filled in.

Figure 2a has two kinds of vertical blue dashed lines. What is the distinction between the bold lines and the faint lines?

Figure 2 caption line 1. Reverse (b) and (c). Wind speed is (b).

Figure 3 caption line 3. "grey diamonds". I don't see any grey diamonds.

Figure 4. Give units for both horizontal and vertical axes.

Figure 5. Do the ticks on the horizontal axis mean the beginning of the month or the middle of the month?

Figure 5 caption line 1. Change "(b)" to "(a)". Change "(c)" to "(b)".

Figure 5 caption is confusing. Line 1 says "measured and simulated near-surface LAP". But no measurements of LAP are actually plotted here. What is plotted are not measured LAP, but rather LAP inferred from albedo.

Figure 6. The horizontal grid lines for the right-hand plots (2018) differ from those in the left-hand plots (2017), indicating a different scale. But the vertical axis has a scale only on the left-hand plot. Add vertical-axis labels to the 2018 plots.

Figure 8 caption last line refers to "brown shading" for the major dust deposition event. I do not see the brown shading.