

Interactive comment on “Blowing Snow Sublimation and Transport over Antarctica from 11 Years of CALIPSO Observations” by Stephen P. Palm et al.

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Palm et al. use CALIPSO observations and simple parameterizations to estimate Antarctic ice sheet blowing snow sublimation and transport for the period 2005-2017. This is an interesting, innovative, and timely contribution to the (necessarily) growing body of literature on the impact of blowing snow on ice sheet SMB, contains the methods and results to sufficiently support the conclusions, and is relatively well written (although that needs to be improved in some places). I support publication in TC after one major issue is considered, and thorough rewriting is performed in a revised version.

Major issue

C1

I have strong reservations with regard to the use of simplified, steady-state parameterizations and meteorological forcing, which put a strong constraint on the resulting blowing snow sublimation. The authors use MERRA-2 temperature and RH data to derive sublimation rates, but these MERRA-2 data are (a) not at all evaluated over Antarctica, and – more importantly – (b) since MERRA-2 does not simulate blowing snow, do not imply the atmospheric effects of the well-documented self-limiting behavior of blowing snow sublimation, in which sublimation will lead to latent heat release to the atmosphere at the top of the blowing snow layer, in turn cooling and moistening the atmosphere and limiting subsequent sublimation. This effect is expected to have a first-order negative effect on the sublimation (while retaining the blowing snow layer transport active, so this is not observable from space), and should – in some way or another – be included in this approach. I realize that the authors do not (and do not want to) utilize a model that includes this behavior, nor include blowing snow processes in MERRA-2. One option is to perform multiple sensitivity tests with gradually higher RH_{ice} values and lower temperatures, based on and in combination with a MERRA-2 near-surface climate evaluation at select stations over Antarctica.

These sensitivity tests should be combined with varying other important parameters to determine sensitivity. For instance, why did the authors choose a fall velocity of 0.1 m/s? I would strongly suggest to expand the Section 4 and include a detailed description of the sensitivity tests.

Minor issues

The writing should be improved in places and caution is warranted to very clearly describe the process the authors are referring to. Also, some parts are clearly too speculative and should be revised (see below).

L13: near-surface

L15: define surface mass balance

C2

L17 and beyond: clearly mention the time period considered in this study

L23: blowing snow sublimation!

L29: 2006-2015

L94: it would be helpful to mention all sublimation rates (also those from earlier literature) in the same units to facilitate comparison. Which time period are these from?

L108: 20,000 km – reference needed

L152: 1064/532 – include units

L189: (Walden et al., 2003)

L233: How to go from blowing snow mixing ratio to extinction? What are the units of this extinction, and why does they relate as $\alpha(z) = 3/2 q_b(z)/r(z)$?

L240 and around: The use of MERRA-2 needs to be described here. How are T and RH incorporated here? How is temporal and vertical interpolation dealt with?

L241: Equations are not numbered

L321: It would be very helpful to plot the CloudSAT precipitation numbers and plot the ratio sublimation/precipitation to guide this discussion.

L339: 419 Gt/yr – this is a different number than mentioned anywhere else.

L344-348: This is extremely speculative and contains the wrong translation from Gt/yr to mm sea level rise (~ 360 Gt = 1 mm SLE). Most of the sublimation is probably recycled on the ice sheet, and of course Antarctic SMB is positive and dominated by precipitation. Please remove.

L349-355: is the trend significant? Probably not, with significant inter-annual variability and only 10 years in the time series. If it is not significant, please remove. If it is significant, it would be useful to relate this to MERRA-2 T and RH averages.

C3

L357: clarify if you consider the grounded or total (include ice shelves) ice sheet.

L371: size of Texas – quantify.

Table I: Is the average from 2006-2015 (the full years)? Clarify.

Figures 9 and 10 can be removed or moved to supplements. They do not contain any results that are necessary to be shown in a separate (main) figure.

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C4