

## ***Interactive comment on “Observation of the process of snow accumulation on the Antarctic Plateau by time lapse laserscanning” by Ghislain Picard et al.***

### **Anonymous Referee #1**

Received and published: 29 January 2019

The authors show a very interesting laser scanner dataset capturing the patchy accumulation of snow at Dome C. The analysis and discussion correctly highlight the issues this accumulation pattern may create for interpretation of presumed horizontal stratigraphy. The paper is of high quality and merits publication after a few issues are fixed. 1. Is the major accumulation event real or did the scanner tower tip. Convince your reader/reviewer of your conclusion. 2. Errors of the scanner precision under real world applications and errors added by interpolation process are underrepresented in the analysis and not used as benchmarks in deciding when erosion or accumulation is detected. They could be used to argue for statistical certainty of erosion or accumulation. 3. Some more thought should be given to the role of repeated redistribution

in homogenization of the snowpack. The authors present the patchy accumulation as if it assures signals from short lived events (e.g. eruption ash) will be absent from many locations. It is also true that the redistribution vertically mixes short lived events, however, and may after many redistributions, place evidence of them at most locations.

Minor corrections follow: Page 2 Line 3 – “model’s skills” check – did you mean model skill? models’ skill Line 5 – condensation is transition to liquid from vapor. Deposition is phase transition to solid from vapor. Deposition is likely what is meant. Line 7 – maybe clarify here that sublimation of blowing snow possible too, not just “from the surface”? Line 14 – ... scale of interest get(s)... Line 16-18 – It is not clear whether erosion or deposition is the predominant cause of roughness, or which increases the roughness more. Over time, the authors note that the roughness remains nearly constant. Perhaps remove the statement that erosion is “generally increasing the roughness”

Page 3 Line 7 The approach was quite successful (in reproducing) the... Line 15 delete space before ? Line 29 consider clarifying ... “in high (natural) light illumination” Line 32 “... enabling operations (at temperatures as low as -80C)...”

Page 4 Line 9-11 The criterial of 6 cm here, combined with an interpolation to 2 and 3 cm grids, respectively could be generating a considerable amount of ‘made up’ data. Can you defend this better for your reader? How many points did not have an actual observation within 1 or 1.5cm radius (the interpolated point spacing)? What is the total number of points before and after interpolation, particularly in low density areas of the survey?

Page 5 line 20-30 It is unclear in this discussion if the threshold for positive change is also applied to negative change. The discussion also does not incorporate any handling of instrument surface position detection error, which sounded above like it was around 1cm. It would seem that the threshold for change must be at least the instrument error, and that this should be applied for both accumulation and erosion. It is not reasonably possible to ‘see’ either erosion or deposition of less than the instrument

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error.

Page 6. Line 3-5 “ Due to the absence of reliable methods... ERA-I is one of the most reliable sources of information” What? There’s no meaningful observations and therefore a model is reliable? This is pretty suspect logic. The winds don’t even agree that well, in magnitude, and they are considerably easier to model than precip. Please revise this statement.

Page 6 line 20 (ac)cumulated Line 25 Condensation→ deposition Line 31 artefacts → artifacts Line 31 – please clarify what the contribution of instrument error, artifacts, and blowing snow returns is in this.

Page 7 Line 1 What role did the instrumentation presence play in increasing roughness?

Line 17 Shouldn’t hiatus be anytime there not positive accumulation – erosion shouldn’t actually be required to have a “hiatus”

Page 7 Line 26-27 This is too strong a conclusion based on this non-statistically significant, somewhat vague agreement. Change to ...”that despite the small extent of the RLS scanned area, the distribution of net annual accumulation (may be) representative of a wide(r) area.”

Page 8 line 6 mathematical(ly)

Page 9 line 10 does not exists → (exist) Please confront: To what degree does the snow mix? If it should mix over some time period, perhaps accumulation is still somewhat by a continuous layer, rather than a “patchy” pattern. The layers just don’t have the vertical resolution expected.

Page 9 line 22 – While this may be true for the ideal case, the reviewer does not believe that the scanner achieves a practical precision of 0.5 cm in surface positioning of real snow surfaces, particularly considering the interpolation involved in producing the gridded product.

Page 9 line 30 – Given the errors calling the 73 cm number “total deposition” is not a good terminology. It isn’t really known what the total deposition is. Can you come up with a descriptor that doesn’t misrepresent?

Line 32 rising→raising

Line 33 preventing description of the precise. . .

Line 33 delete “certainly” and replace with “likely” unless you have concrete evidence showing the scanner window was covered with snow.

Page 10 line 1 – speculative. Perhaps you can look up the wind speed and at least ensure it was well above the saltation threshold.

Page 10 line 2 rising → raising (Please get a native speaker to read. Not that this is poor quality writing, but there are a number of issues like this I’ve stopped correcting. There are also many unusual phrasings that are not exactly wrong, but hard to read).

Page 10 line 3-4 is this a dune or a drift caused by the laser station?

Figure 6. Sure looks like the tower tilted. What makes you sure it didn’t? Is there independent confirmation of a large snow event?

Page 10 Line 12-15. Reviewer disagrees that this age of final deposition discontinuity necessarily results in large differences in snow chemistry. Some more thought should be given to the role of repeated redistribution in homogenization of the snowpack.

Page 13 Line 1-5 This sintering “increases over time at a rate increasing with temperature” – this doesn’t seem to make sense, and it is not clear that sintering is faster (or more importantly creates more durable bonds more quickly) at higher temperatures. In contrast snow tends to sinter quite well under cold conditions with wind. The remaining two sentences after this are so speculative as to add little to the discussion.

Page 13 (4mm is the maximum of snow over the three year period in ERA-I). – Sure but that is irrelevant if you saw a much bigger accumulation in your data. ERA-I is just

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a model.

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Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2019-4>, 2019.

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