The Cryosphere Discuss.,
https://doi.org/10.5194/tc-2019-4-RC2, 2019

The Cryosphere Discussions

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 #2

Received and published: 29 March 2019

The manuscript "Observation of the process of snow accumulation on the Antarctic Plateau by time lapse laserscanning" by Picard et al. describes a very interesting, unique data set of daily repeated laser scans from the surface elevation at Dome C, Antarctica. Their is a lot of original, interesting analysis presented, which basically shows how complicated the assessment of the Antarctic mass balance is. The authors find that the accumulation is typically very patchy, multiple erosion/deposition cycles seem present before mass is finally "consolidated" into the snowpack. The snow surface shows high variability in terms of age of the snow. The manuscript is well written, and suited for The Cryosphere. There are a few issues that the authors should resolve before publication.

1) Treatment of "noise" is inconsistent, in any case in its explanation:

- p4,l6-7: I think it should be discussed how this accuracy changed due to the increase in installation height. I'm not convinced that the result from the 2016 study can just be applied here for period 2 as well.

- p4,l12-14: ".... must be kept in mind for the analysis." This remark is not followed up in the rest of the manuscript. How exactly is it taken into account in the analysis?

- p8,l18: Note that p4, l6 mentions a vertical accuracy of < 1cm, and here it is suddenly claimed that it is 0.25 cm? Where does this number comes from?

- If the accuracy is 0.25 cm, I'm not convinced that the class 0 - 0.5 cm and -0.5 to 0 cm in Fig. 5 has any significant meaning. Similar to the volume calculation in p9,l30, the 0 cmˆ3 threshold seems to ignore any potential accuracy issues.

- An important point for me is that the reader should be given some sense of how the choice of thresholds influence the provided statistics. For example, the statistic in p.10,l14: "About 55% of the surface is younger than 100 days" How would this statistic change if a threshold of 0.25 cm would be chosen, instead of 1 cm (p5,l25). It's important that those kind of statistics are accompanied by some kind of error estimate. Maybe repeat the analysis with a threshold of 0.5 and 1.5, and express the range in brackes after each statistic.

- Apparently, surface sublimation is not detectable? Maybe this could be briefly discussed by the authors?

2) It has not been discussed how the tilt angle is accounted for:

- p7,l2-6: I'm not convinced that it makes sense to analyze the raw standard deviation. Has there been any correction for the installation angle? Here, and throughout the rest of the manuscript, I think it would be much better to subtract the overall slope first, before analyzing the standard deviation. It could well be that the slope is due to a tilt angle, rather than some large scale feature.

- p14,L22: "standard deviation of up to 8 cm" is a misleading statement, as there is a background slope. Again, I would suggest analyzing the data after removing the slope, as a tilt in the mast with the laser scanner can produce a bias in standard deviation. For example, the increase in standard deviation from 4 cm in the beginning of the observation period to 8 cm towards the end could as well be explained by tilting of the mast with the laser scanner.

Other remarks:

p9,l1-2: Please explain why these dates were chosen.

p6,l1: As far as I know the literature, ERA-I is known to underestimate the SMB in the interior of Antarctica, see for example the Wang et al. 2016 paper. The authors even conclude that this is the case (p12,l20-22). So even though the overall SMB of Antarctica is correct, including high SMB coastal areas, we can expect ERA-I to underestimate the SMB at Dome C. That's a crucial point of information here, and deserves some discussion at this point.

p6,l15 and p8,l30: It should be better substantiated that this is not a measurement error. It's a very strange event. p8,l30: is ERA-I giving any strange weather patterns during this period? It's not only the accumulation that is strange, also the strong decrease in surface elevation afterwards, first steep decrease, then flattening out towards the end of the installation period 1, is something very out of the ordinary given the data presented for period 2a and 2b. Could the authors report in more detail what happened here, when looking at the individual scans?

Minor comments:

p3,l25: specify typical "unfavourable" conditions.

p3,l32: What are "reduced motors"?

p6,l20: The Petit, 1982 reference is a little bit out of place here, given that ERA-I is much more recent. How does the Petit, 1982 reference relates to ERA-I?

p12,l4: "patches on their way windward" I don't understand, should not be written that the patches migrate downwind?

p15,l10: superfluous "

Fig. 1: Please provide a detailed photo of the lasermeter. It's impossible to see now in the figure.

Fig. 2: Please provide a legend. The colours seem to slightly change between Period 1, 2a and 2b. Is this on purpose? If so, please, explain in the figure caption.

Fig. 6: Isn't the color bar legend "Daily accumulation" mistaken? It rather is the total accumulation over the 14 day period, I assume.

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