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The Cryosphere Discussions

Interactive comment on "Snow accumulation variability in Adelie Land (East Antarctica) derived from radar and firn core data. A 600 km transect from Dome C" *by* D. Verfaillie et al.

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Dear Reviewer,

Thanks for your comment on our paper and your suggestions, which we will take into account.

Please find below answers to your specific comments and questions:

1. We have now included some references in the introduction about previous work of long distance GPR traverses in East Antarctica, and explained the need for more GPR studies in EA.

2. The GPR system has been described in §2.1.

Justification for using 100MHz GPR: We had to use a Malå RTA antenna (Rough Terrain Antenna), because the use of common shielded sledge-like antennae would not have been possible along this transect due to the roughness of the terrain. There are a lot of sastruggi along the transect and, as the speed of the convoy is set at 18km/h, common shielded antennae would have been unstable. The highest possible resolution of RTA antennae is 100MHz, which is also a good compromise between the ideal resolution of reflecting horizons and the desired penetration depth in the snow (as we use horizons up to a depth of 70m).

3. We have changed our last two figures to compare accumulation to slope and elevation, and discussed it in the text.

4. The width of figures in this online version of our paper has been set by the typesetters of TC. Our original figures are larger, and I suppose they will be used to their full width in the final version of this paper. We have added a lower panel in figure 6 to zoom on the undulating part of the curve. Figure 2 has also been improved.

In the supplement:

- p. 2855: Title: Snow accumulation implicitly means “rates”, as it is usually measured in cm or mm/yr. We could possibly trade the word “variability” for “pattern” if this is more relevant. If we remove the “Dome C” notion, we have to specify that the study was made on the plateau, as Adelie Land is often referred to for studies conducted on the coast. The final title would be: “Snow accumulation patterns derived from radar and firn core data along a 600km transect in Adelie Land, East Antarctic plateau”.

- English usage errors have been corrected in the meantime by an English person

- p. 2856: We have added some details about the gradual accumulation increase towards the coast (from ∼3cm w.e. a-1 at Dome C to ∼17cm w.e. a-1 at the end of the transect). We already explain the main results in this paragraph, and consider that

giving more details about the results would not be advised in an abstract.

- p. 2857 : “Give 1 or 2 more examples using data from studies cited on next page”: We have now added one more example using data from Agosta et al., 2011.

- p. 2858 : TASTE-IDEA is a specific IPY project, thus not exactly the same as ITASE.

- p. 2859 : 2.1 Radar (first §) : We have recently added some information in this paragraph about the disadvantages of GPR (as suggested by the first reviewer). We think this paragraph is useful as a brief introduction and would like to keep it.

- p. 2859: “It is still unclear. . .”: This part has been changed to insert references of previous work on the origin of horizons in firn, and discussion about the above statement.

- p. 2861: Vertical resolution is usually evaluated between $\lambda/4$ and $\lambda/2$. In the firn, our wavelength is about 2m, so we took a resolution value in between 0,5m and 1m (0,75m).

- p. 2865 : Transformation of time into thickness given variable density :

1) A density fit is calculated at DC and D47 sites, where deep core measurements are available (see §2.4.1)

2) Wave speed vs depth is computed at DC and D47 on basis of fitted density. Then TWT vs depth (thickness) is calculated at DC and D47 on basis of wave speed, and a depth vs TWT fit at DC and D47 is obtained (see §2.4.2).

3) At each point along the transect, TWT is converted into depth by calculating the corresponding depth value at DC and at D47 and interpolating those two values as a function of the distance between those two sites.

- p. 2866: Amplification of structures with depth: We will read the literature and correct our statement accordingly.

- p. 2866: comparison with SMB climatologies: this has now been stated in the intro-

TCD
6, C1616–C1619, 2012

duction.

- p. 2883, fig. 3: the measurement interval is not the same for the five cores.

DC: this is a compilation of various datasets for DC core, with variable measurement interval

D47: the interval is also variable

F2 and F3: interval is 1m until a depth of 5m, then 50cm

F4: interval is 20cm

- p. 2884, fig. 4: There are indeed some clutter reflection problems, inherent to the GPR, due to reflections between the antennae, multiple reflections between antennae and the snow surface or the vehicle, and to punctual heterogeneities in the firn. These problems have been treated partially by filtering the signal. However, this clutter problem is visible all along the transect (and especially in the first meters of snow). We are convinced that what we see in Fig.4 around cores is really an expression of the surface and not a clutter problem, as this shift in the horizons appears around all of our cores (and only there), and the beginning and end of the shift appear at the points where the vehicle left the route and where it got back on the route.

- p. 2886, fig. 6: The ice speed along the transect ranges from about 1m/a at Dome C to 3-4m/a at the end of the transect. It is thus not large enough to affect the shape of the reflectors significantly. The fact that undulation crests are moving upwind is thus mainly due to interactions between katabatic wind and surface elevation or slope. A sentence has been added in §4.1 and in Fig.6 to explain this.

Interactive comment on The Cryosphere Discuss., 6, 2855, 2012.