

## Comments from the Editor

The authors responded to reviewers adequately. However, this manuscript should be improved further to be accepted by the Cryosphere.

### **Major scientific issues**

1. The main conclusion of this paper is the presence of uninterrupted, spatially coherent layering, but the presented evidence is weak.

1.1 Present much longer radar data. Now the authors show only 160-m-long profile (Fig. 2) and argue that the layering is well preserved in all profiles (it is said “all profiles” and later “nearly all profiles” or such, please be consistent). Apparently, the presented evidence is inadequate to support the claim. It is hard to see whether the radar reflectors are really continuous or not in Figure 4. Figure 9 can be more meaningful if more extensive radar data are presented.

1.2 Revise Figure 2b using multiple color (not gray scale) so that the layering structure can be more clearly seen.

1.3 Explain why 100-MHz radar data show less uninterrupted layering than 200 MHz. In general, lower frequency (longer wavelength) radar show more continuous layering. Why does this frequency difference occur, and why can you argue uninterrupted layering despite of limited features imaged by 100 MHz radar? (or why do you trust 200 MHz data more than 100 MHz data)

1.4 Abundant presence of meltwater found in shallow cores (P10L7; by the way how shallow are they?) infers the presence of isolated scatterers (percolated waterbodies into the deeper ice) and possible disturbance of the ice stratigraphy. With this shallow core evidence and inadequate presentation of the radar data, I cannot immediately support author’s argument on the uninterrupted layering.

2. Ice thickness is estimated towards the western side of the NIF, where no radar data were collected (Fig. 7). However, ice thickness in that region is not at all data supported, and this affects the estimate of ice volume (Grid method). The authors discussed uncertainties in ice thickness, but such discussion can be valid within the area where data are present (central flat area). The sudden increase in the slope may be associated with the elevated bed near the boundary of the flat and steep areas (I.e. dam-up of the ice).

### **Major presentation/structure issues**

1. Stake height changes are presented in Figure 5 and constitutes a major part of discussion in Section 2.5. However, it is not mentioned at all in the methods and suddenly appear in the results section. Please mention stake methods (i.e. locations of the stake, measurement periods etc) and AWS in Section 2.1.

2. The surface topography is shown only in Figure 6 but the authors say “flat central basin” from the beginning of the paper. Please re-arrange the figures so that the satellite image and surface topography are presented in Figure 1 to give the full topographic framework. Both of them are not author’s original work so it can be presented as background knowledge.

### **Minor points**

1. "internal" and "englacial" are used in an inter-changeable manner. Please use either of them consistently throughout the manuscript.
2. P1L6: add depth ranges of major englacial reflectors associated with dust layers.
3. P1L13f: Cite Figure 1 at the beginning part of Introduction (e.g. P1L17). Also, rearrange the figure so that Figure 6b (GeoEye-1 satellite imagery of Kilimanjaro) is presented as part of Figure 1 (see the major structure point #2 above).
4. P2L8: change "bed conditions" to "bed topography". Conditions sound like that the authors are primarily interested in whether the glacier has the cold bed or wet bed.
5. P2L9: remove "total"
6. P3L9: add "vertical" in front of discontinuities
7. P4L8: Please clearly mention that there is no/insignificant firn here, because firn affects the radio-wave propagation speed.
8. P4L27: how much of firn was found in the core? The authors simply said "negligible" but is it possible to show an approximate fraction of firn and ice in the core?
9. P4L29: the authors interpreted the scattering near the surface exclusively caused by melt water. However, such scattering can occur with other causes, such as off-nadir crevasses or any structural features too (not in the plane of the radar profile).
10. P6L13: typo? "2011.46"? may be 2011.06??
11. P6L21-24: please revise. What do you mean by "all points"?
12. P7L2-3: cannot fully agree. Figure 1 shows patchy firn distributions (in the picture/image) and the vertical wall is in the blue ice area. The agreement at the wall does not validate the propagation speed and ice thickness measurement at the firn-covered area. Cross-over checks do not validate the propagation speed (as the same speed is used for both frequencies).
13. P8L22: revise to "with the presence of larger scattering near the surface" (it is not necessarily meltwater)
14. P8L26-28: The current flat surface does not imply the past flat surface (especially in this case where the ice is shrinking rapidly). Variable layer thickness can be caused by strain in the past. Also, ablation can happen from the surface or bottom but not inside of the ice body.
15. P8L29: please present the data. I cannot see any radar data supporting such localized layer convergence in the manuscript. Or do you refer gradual layer thickness change presented in Fig. 4?
16. Table 1: are samples for 200 MHz CMP measurements correct? Figure 3 looks like that there are more samples than 5.5 nsec/sample (= 100 nsec/18 samples). If it is not a typo and the sampling rate is so low, the data are not fully useful to determine the radio-wave propagation speed. Also, clarify "samples"; I understand that it is the number of samples within a time window (vertical range). Is it correct?
17. Table 3: does "relative depth" show the depth relative to the local ice thickness? Please clarify. And why are relative depths (in addition to the absolute depths) important for this context?
18. Figure 1: fill the area of tabular cliff with half-transparent color (or hatch). It is not easy to find out tabular cliff areas only using the outlines currently presented in this figure.
19. Figure 1: is it possible to add surface elevation contours to Figure 1? "the central flat area" is mentioned in Sections 1 and 2, but data supporting these sentences appear only in Figure 6. In general, the surface topography (and tabular cliffs) should be explained early in the manuscript, probably using a single paragraph in Section 1 (between "... Kilimanjaro's glaciers to climate

variability.” and “This especially ...:” (P2L10). Also, include the AWS location in Figure 1 (it is referred several times in the text but its location is not shown).

20. Figure 4: The two core sites NIF2 and NIF3 are shown at the end of the profile. Please include radar data beyond these points so that radar data in the both sides of the core sites are presented.
21. Fig. 5’s caption line 4: change “thick horizontal blue lines” to “thick horizontal blue markers”, “bars” or such (confusing with the blue curves in the lower panel).