Second review of: Comparison of measurements from different radio-echo sounding systems and synchronization with the ice core at Dome C, Antarctica

Anna Winter et al. 2016, The Cryosphere.

Reviewer: Tom Jordan, University of Bristol, 14th October 2016.

Summary

The revised manuscript is much improved, and I now recommend publication to The Cryosphere subject to minor revisions. Below I provide a response to the specific/major comments which I previously raised, along with some additional minor comments.

Response to previous specific/major comments

1. *We broadened our introduction and conclusions by including further glaciological applications*

I am pleased that the authors have taken the opportunity to broaden the impact of their study by mentioning other relevant information that can be derived from IRHs. The scientific gains that can be made from data combination are also now clearly described, which is helpful for motivating the rest of the study. The authors have also provided a better explanation regarding what distinguishes their study from Cavitte et al. 2016.

The conclusions are clear that IRH-derived data combination that is dependent upon reflection amplitudes (e.g. attenuation/temperature) requires further investigation, which nicely motivates further studies. I think it may be useful, however, to add a sentence or two about the consequences of the study for data-combination regarding IRH-derived information about ice dynamics.

2. *We extended our introduction, discussion and conclusions by the frequency dependence of conductivity and conductivity caused reflection amplitudes*

In my first set of reviewer comments I mentioned that frequency dependence could be impactful for the study in two different respects: (i) with respect to frequency dependent attenuation/frequency dependent reflection coefficients (i.e. related to intrinsic dielectric properties), (ii) with respect to thin-film interference effects (i.e. related to the optical thickness of the layers in the simulation, and the frequency dependent resonances which occur).

Whilst I think the authors have dealt excellently with point (i) in the revised manuscript, I still think that point (ii) could have be investigated using the simulation framework available (if only drawing a comparison between the relative reflection amplitudes of the synthetic traces for different frequencies, with all other parameters being kept the same). However, given that the authors now give a good discussion why reflection amplitudes both complex to investigate, and are a key issue to address in future data combination work, I think it is ok to leave this out of the final manuscript. As a compromise, it would be helpful to add to the bottom of page 15 (6.2.1) that frequency dependent thin film interference effects could also impact upon reflection amplitudes, and may complicate data combination yet further.

3. *We made substantial changes to the method sections to clarify why we use the methods and to describe our approach more precisely*

The methods (Section 2) is much improved and symbols are now properly defined. The limitations of using the EM simulation method for comparing burst/pulse systems (which the simulation method

best approximates) with the chirped systems is now made clear. The referencing and description of equations/symbols is also greatly improved. Section 2.3 (Assessing the permittivity of ice) has also been substantially revised and the authors have been much clearer about the purpose of sub-investigation.

Minor comments/typographical errors

Abstract, L10: Then we → We then

P5, L2: proceeding→ procedure

P5, L7,L14: It may be more useful to provide more recent references for the Courant criterion and Hilbert magnitude transformation. I appreciate to some of the readership these may be common knowledge, but a recent textbook reference could be useful for those wishing to replicate the simulation.

P6, L16: in→ at a

P5, L2: Missing prime on epsilon_ice?

P8, L10: Missing full stop.

P9, L24: I think it should be noted that the peaks in the grad(sigma) plot, represent the greatest discontinuities in the dielectric properties, and hence are associated with the reflection peaks.

P14, L7. Delete `do'

P16, L5. Reword sentence beginning with `Over'

Figures/Tables

Table 1: `Modeled' needs to be realigned

Figure 4: time in micron → time in microseconds (micron has dimensions of length). It may also be helpful to note that the intersection point is ~1 km south of the core in the caption.