

Interactive comment on “Layer disturbances and the radio-echo free zone in ice sheets” by R. Drews et al.

K. Matsuoka (Referee)

matsuoka@ess.washington.edu

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Drews et al. discussed possible causes of the absence of significant radar reflections from ice at depths greater than ~ 2100 m ($> 89\%$ of the local ice thickness) at EPICA DML ice core site. 60-nsec and 600-nsec radar data were used to present that radar system performance is adequate to look deep radar layers. Line-scanner and DEP data from the ice core are discussed in the context of layer undulations and weaken contrasts in the DEP conductivity/permittivity related to the layering and diffusion.

I think that this paper shows new insights about EFZ and worth to be published in the Cryosphere. However, there are several major issues that should be addressed:

1) Definition of the EFZ can be presented more clearly in Introduction. It is usual in

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inland Antarctic ice sheet that radar returned power drops to the noise floor well above the bed. Recent papers (Fujita et al., 1999; Matsuoka et al., 2003 and 2004) identified EFZ only if returned power abruptly decreases to the noise floor so that the echoes are disappeared not because of the attenuation of the overburden ice but because of the properties of the deep ice. The second paragraph in the Introduction discuss these issues. I think that it is much clearer if it is presented in this order: 1) general description of the radar data (lack of layering at great depths), 2) possible causes of such absence, 3) define EFZ. It is also important to clarify the definition of EFZ is inherently radar-performance dependent.

2) DEP data are discussed in the text but not shown in this paper. I recommend to include the DEP profiles in Figure 2 (show line scanner images and DEP data next to each other) so that the arguments in the text are warranted.

3) 60-nsec data were used to show that 600-nsec radar has adequate penetration performance (p.313, lines 1-4). 600-nsec data have 10 dB larger system gain than 60-nsec data (if others are kept equal). More clarifications are necessary for the 15-dB correction at the system side (line 21, p.312). 600-nsec data show that the bed echo is ~6 dB above the noise floor. If the 60-nsec noise floor is at the same level, the bed cannot be detected (6 dB s/n ratio is too small to compensate 15 dB smaller gain). Why is the bed visible in Fig. 3b? I like the idea to use both 600-nsec and 60-nsec data for this discussion, but more quantitative arguments must be made. Equations may be helpful.

4) Discussion about isotherm ice (lines 10-15, p.313) is unclear. Layers can be absent if path-integrated attenuation within the overburden ice compensates radar system gain, which can be happen even if the temperature varies smoothly. What's background physics of this idea?

5) Discussion at lines 7-27 in page 314 is weak and brings no solid conclusions. Following this discussion, the authors conclude that roughness is the main reason for the

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loss of internal layering. However, in my opinion, this conclusion is too specific to be supported by the discussion above. Smaller reflectivity can be caused by tilted layers (even if these layers are smooth) too. And, it is inherently impossible to discuss detail characteristics of the layers in the scale of Fresnel Zone (tens of meters) using the ice core (~ 10 cm).

6) Please revise Section 4 to show observational results first, solid interpretations next, and finally speculations. The first sentence in this section is not well supported by the results. In the result section, the authors showed that visible layers are distorted in areas where EFZ were identified from radargrams (comparison of 60 and 600 nsecs). However, no discussion is made originally in this paper about stronger shear, changing rheology etc; they are more or less consequential interpretation/speculation from the solid results. Such weaker conclusions should be mentioned after solid results are presented.

Some editorial issues

Line 19 page 309 : Existing hypotheses are not clearly presented. In earlier parts, refer previous work like "xx hypothesized" so that existing hypotheses can be referred clearly. Also, relevant conclusions are necessary: "hypothesis x is rejected/supported".

Line 8 page 314: "first Fresnel zones' -> "first SEVERAL fresnel zones"

Line 17, page 315: EFZ depths are radar-system dependent. The statement about paleocliamte interpretations of the ice-core data are too strong (if a radar with poor performance is used, paleocliamte proxies for younger ages would be doubted?).

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