Review of https://doi.org/10.5194/egusphere-2025-3944: 'Basal Unit Radar Characteristics at the Southern Flank of Dome A, East Antarctica', by Yan et al.

This article describes the englacial basal units classified from the analysis of scattering in radar images. The authors discuss two types of units, depending on how sharp or gradual is the scattering variation, and relate the transition spatial transition between units to changes in englacial temperature and bed geomorphology. From my point of view, the main contributions of the article are the methods for limiting the upper layer of the basal unit, and for classifying the basal content with the two discussed types.

The structure of the paper facilitates the reading. In particular, the introduction nicely explains what the reader will find in the article. The images are very well chosen and meaningful, with scientific colour maps for universal interpretation. The references I checked support the article. The data are in public repositories and are open, except maybe one data set, maybe currently under embargo.

Below I include my comments and suggested additions and minor corrections. My main comments are related to how reflections are classified between specular or scattering, to the interpretation of the two discussed types of basal unit types, and to the presence of sidelobes in the SAR images. Please do not hesitate to disagree with any of my comments.

Main comments

1. The document is very well written, and very interesting to read. I personally found the reading very fluent. However, the next times I read the document, I found it more difficult to follow in detail. These are my reasons:
    a. the names of the two reflection types ('specular', and 'scattering') and the 'incoherent' scattering. The term 'scattering' I think is quite general, and it could also include 'specular' scattering. For example, you also use the incoherent scattering to show the presence of the basal unit. I would change the term 'scattering' as a reflection type. In line 140-141 you explain the nature of the scattering of this type, as 'volume scatterer distributing the energy over a broad range of angles', and in line 160 with 'mode diffuse'. I think these two explanations are very clear to the reader, so maybe the new name could be obtained from there.
    b. there are terms like 'true scattering energy' (line 154) and 'coherent scattering', that could be defined. For example, in the article I interpret that there is coherent scattering when the layers can be traced in the image, although I don't fully agree.
    c. I was confused between the two types of basal unit content (type I and type II), and the two reflection types (specular and scattering). In my first reading, I thought they were the same, but later I realised that they were not. Maybe this could be made explicit in the text.
2. The introduction section 1.2 is great. In particular, the five mechanisms explaining why the basal unit can be more obscured, strongly catch the attention of the readers. However, only mechanisms 2) and 4) are included in the conclusions later in the article; for example the fabric is later mentioned only in line 155, and debris in section 4). I would mention which of these mechanisms are going to be discussed, and why some seem not that important (or at least this is my interpretation from the article). My main concern is that if mechanism 5) is not discussed, and 1) and 3) not seem important, maybe the attribution of basal units to englacial temperature and geomorphology could be not valid. For example, from my experience the polarization used (co-

polar or cross-polar) affects the aspect of the basal unit: in cross-polar we can reach deeper, and better trace the basal-unit layers than with the co-polar.

3. The SAR images in Fig. 3 have sidelobes, or ghosts from the surface. They are not very clear in Fig. 3, but in Fig. 4a they affect the power ratios in travel times beyond 35 us, at horizontal distances ~100 km, ~250 km, and ~450 km. I wonder if Fig. 4b would be different without these sidelobes or ghosts. I mention this as a main comment because these two images are very important in the article, and I recognise that improving the SAR image in Fig. 3b could be challenging. If it can't be corrected, I would explain this for the reader to be aware.

Minor comments

- Line 47: with 'disrupted to ice flow', do you mean the base unit to be stagnant or faster?
- Line 68: does 'folding below range resolution' mean that the folding would be resolved in the image and then appear as incoherent?
- Figure 1 and Figure 3: I guess they are images with same polarization in transmission and reception, but I would mention it. In Fig. 1 there is a clear obscure banding within 100 km and 225 km; if it means a different ice fabric, maybe it could be commented for Fig. 3.
- Figure 2: I would increase the font size of the 200 m intervals.
- Line 119: the mapping is done manually or by the software package?
- Line 123: instead of 'same englacial reflection' I would write 'same layer'.
- Lines 120 and 130: I would check the references 'Yan et al….', because they might correspond to data sets, and referring to the 'Fig.3' and 'Fig 2-c' of those references could be not correct. From lines 425 to 430, the references 2022b and 2025a are in the same paragraph.
- Figure 3: very nice images, with the dash lines very helpful.
- Figure 4: I would include the same dash lines are in Fig.3 b.
- Line 143-147: to determine if there is a reflection in the output window, I guess there is a threshold in the amplitude levels. From my experience, I find this is not as trivial as it might seem, so it would be great to know your interpretation.
- Line 163: (this might be a very personal interpretation, so please ignore if you don't agree) because of the sharp transition in type I, maybe is better to remove in line 160 the word 'more' next to diffuse? 'more' might mean a transition compared to the upper layers.
- Line 190-192: I would mark in Fig. 3b and Fig. 4 the location at where the incoherently scattering disappears, and where the 'scattering diminishes' and 'vanishes at the bottom', because I'm not able to locate these descriptions in the images.
- Line 204-205: I'm confused with the expressions 'lowering the depth' and 'raising the … depth'. The 'lowering' means deeper or shallower? I would remove the word 'attenuation', because the critical depth does not depend only on the attenuation, but on the amplitude.
- Line 217: with 'give rise to incoherent scattering', do you mean 'the erasing of the heterogeneities'? It might be interpreted as 'heterogeneities that rise incoherent scattering'.
- Line 227: I would add that 'radar data alone' cannot confirm the origin of the scattering reflectors, to reinforce what you say in lines 223-225.
- Section 5: the last paragraph is excellent, suggesting exploitation of legacy data and new models considering the radar data.
- Figure 7: it is very illustrative! I would just add the noise at each panel. My doubt is always whether these differences in perpendicular tracks are due to noise or to clutter.
- Data availability: for the data in Open Polar Radar, if possible, I would give a specific link to the data set. The Delay-Doppler analysis result is not currently open; is it under embargo?
- References: if there are references with only data sets, I think the term [data set] should be included.