**Re-review to Tulaczyk and Foley, August 2020**

The paper is improved from the last submission. In particular, the new table summarizing subglacial conductivities and reflection values is a welcome addition, and I think it will be widely referred to in the field. There are, however, some specific points that are underdeveloped, some of which were not addressed from my previous review. Ultimately, I think the paper has provoked some worthwhile debate, so I hope the comments are viewed as being constructive with the aim of further improving the paper.

**Specific points**

**(1) A clearer presentation of how conductivity impacts on decibel reflectivity values is required.** In delineation of basal water/radiometric analysis, the field generally uses the decibel form of the radar power equation and radar reflection coefficient, [R]_dB=20*log10|r|. Table 1 would therefore be greatly improved if dB columns (or dB values in brackets) were added in. The dB reflectivity values should then be discussed in the context of the radar power equation and related uncertainties (attenuation loss, rough-surface scattering etc) when performing radiometric analysis, as I suggested previously.

A point which highlights why this is essential, is the statement in L332 `*This means that high conductivity subglacial materials can appear significantly brighter than subglacial lakes filled with fresh meltwater'* as this is not true in the dB scale (due to dB reflectivity values being `compressed' for bright reflectors). For example, from Table 1, dB reflection values at 10 MHz are: Clay(10 MHz) =20*log10(0.878) = -1.1 dB and Water(10 MHZ) =20*log10(0.724) =-2.8 dB. This < 2 dB difference would not be measurable/significant given other uncertainties in the radar power equation, especially since lakes are likely to be a more specular reflector than clay (therefore off-setting the brightness difference). In my view: *`This means that high conductivity subglacial materials can be of comparable brightness to subglacial lakes filled with fresh meltwater'* is more accurate given inherent uncertainties in radiometric analysis. This still a very useful result and conceivably has lead to a false-positive identification of subglacial lakes and electrically deep water (for me, this is the most important take-home message from the paper)

On a related note, I think Fig. 1D also had the [R]_dB values removed from the previous submission, so it would be helpful to add these back in.

**(2) The establishment of high/low loss limits (via psi) should be made specific to the subglacial materials in Table 1.** The value of the control parameter, psi, is critical to the analysis in the paper. I therefore think that extra columns for psi(10 MHz) and psi(100 MHz) are needed so that the reader can connect the loss-regime of these materials to the general theory in Fig. 1B. I appreciate this is done in part in the text, but this could be much clearer.

1It also makes sense to point out that psi is equivalent to loss tangent, and also occurs as a control parameter in the permittivity form of the equations in Peters et al. 2005. There are circumstances in radar analysis when the loss tangent is used to discriminate/classify geologic materials (e.g. when assessing losses in a material of unknown permittivity, as often is the case in planetary radar), so makes sense to include these psi values in the look-up table for this reason too.

**(3) The `typical frequency range' in radioglaciolology (1-100 MHz) is an underestimate.** Both in the abstract and throughout the article the authors assert that typical frequency range is 1-100 MHz in radioglaciology with 100 MHz representing a `typical high end'. However - this is simply not the case for airborne systems. For example, the radar system summary table in Winter et al. 2017 lists 4 of the 5 radar systems as being above 100 MHz, with 150 MHz being the most common center frequency.

To address this, I recommend adding a new paragraph in the introduction reviewing the frequency of different radar systems used in radioglaciology, making a clearer distinction between ground-based and airborne systems and their relevant frequency ranges (60-200 MHz being typical for airborne systems). Better distinguishing between these radar-system groups would be helpful for the general discussion, as airborne systems need higher conductivity materials to be relevant to the results in this study (in part, it justifies, why Oswald 2008 and other airborne studies have focused on permittivity).

Note: I appreciate that 100 MHz is still preferable to use in the plots due to use of 1 and 10 MHz.

Winter, A., Steinhage, D., Arnold, E. J., Blankenship, D. D., Cavitte, M. G. P., Corr, H. F. J., Paden, J. D., Urbini, S., Young, D. A., and Eisen, O.: Comparison of measurements from different radio-echo sounding systems and synchronization with the ice core at Dome C, Antarctica, The Cryosphere, 11, 653–668, https://doi.org/10.5194/tc-11-653-2017, 2017.

**(4) Justification for the `wavenumber version' of Fresnel equation**

L53. ` *We believe that the use of complex variables in past studies may have been a barrier to more widespread consideration of the impact of electrical conductivity on radar reflectivity in radioglaciology.*' To me, this line of reasoning does not make sense as a justification for the Stratton/wavenumber formalism. The E-field reflectivity equations used in the paper still contain a complex variable, eq. 7b. It is just that a complex wavenumber is used rather than the complex permittivity (arguably the square-root in the permittivity-form is annoying though!)

In my view the advantages of the Stratton/wavenumber form are:

a. The wavenumber form enables a cleaner evaluation of the high-conductivity limit for the reflection coefficient, eq. (12). This is algebraically messier to obtain if you start with the permittivity form with the square-root present.
b. The conductivity is arguably less `submerged' in the wavenumber form (due to being part of the loss tangent in the permittivity form).

**(5) Title**

I still think it is desirable to add a reference to glaciers – e.g. `T*he role of electrical conductivity in radar wave reflection from glacier beds'.* The current title could apply to analysis of any EM media and the new contribution is the application to glacier beds. Also, within glaciology the title could also apply to satellite radar, which is a very different frequency band.