

Interactive comment on “The role of electrical conductivity in radarwave reflection” by Slawek M. Tulaczyk and Neil T. Foley

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The handling editor, Dr. Nanna Karlsson, informed us that at this stage she does not need a line-by-line response to reviewers' comments because we had a back-and-forth discussion with them. The editor did, however, request that we outline the actions intended to incorporate the reviewers' suggestions in the revised version of this manuscript. We do so in the text provided below.

We have analyzed the helpful feedback provided by the two reviewers and propose the following major changes to the revised manuscript to improve it in a way consistent with reviewers' suggestions. Besides these major changes we will also make any minor improvements suggested by the reviewers (e.g., fixing typos, etc.)

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Discussion paper



(1) After considering the possibility of re-formatting our manuscript into the format of a TCD brief communication, we think that this format is too restrictive to allow us to improve the manuscript based on the feedback from the reviewers. Only up to 20 references are allowed by this format, and we already have more than 20 references cited in our manuscript. Besides, responding to reviewers' feedback will require additional references, not fewer references (see below). This manuscript will be most useful to the community if it is published as a regular paper, not a brief communication. Reviewer 2 commended the readability of our manuscript, so we would rather not cut its length drastically. Reviewer 1 also appears to have ultimately agreed that an extended version will be more useful than a brief communication. This manuscript needs to be readable because it deals with issues that are relatively abstract and mathematical. Moreover, we have to have sufficient space to make a compelling case that the conventional thinking about the meaning of bed reflectivity is too narrow. However, we will combine some of our figures into a single figure with multiple panels, to save space.

(2) We believe that the best way to address several reviewers' comments, is to include in the revised version of this manuscript a table of resistivity/conductivity values for glacial materials (glacial sediments, basal ice, etc.) This table will be an updated version of Table 1 published by Christianson et al. (2016). Their values for electrical conductivity / resistivity of glacial materials were largely based on Looyenga's dielectric mixing model (Looyenga, 1965). However, we will use values either observed in laboratory experiments (e.g., Arcone et al., 2008; Josh and Clennell, 2015) or in the field (e.g., Foley et al., 2015; Mikucki et al., 2015; Jorgensen et al., 2012; Steuer et al., 2009). This table will communicate to the radioglaciology community observationally constrained ranges of electrical conductivity for glacial materials. These ranges will be considerably broader than those used in prior similar compilations (e.g., Table 1 in Christianson et al., 2016). This table will support our contention that radioglaciological interpretations of subglacial materials need to consider the impact of electrical resistivity of such materials on the radar reflection from ice beds. We propose to include this new table in section 3 (Low-loss assumption and its limitation). We will modify the text

of this section to discuss this new table.

(3) In response to reviewers' concerns that our manuscript is not relevant or needed, we want to give more pertinent examples from recent radioglaciological studies. These examples will review how the published studies would have benefited from considering the possibility that the electrical conductivity of subglacial materials influences the strength of the bed reflection coefficient. In particular, both of the examples we used for this purpose in our Discussion section, come from one specific part of Antarctica. In the revised version of the manuscript, we will draw on recent work in Greenland (e.g., Chu et al., 2018; Jordan et al., 2017, 2018; Oswald and Gogineni, 2008; Oswald et al., 2018). We will expressly point out how the conclusions of these papers may have changed if the authors would consider the impact of electrical conductivity on bed reflectivity. We will work integrating our observations into a table, or a figure, that will provide a more concise and more graphically compelling summary of this part of our manuscript. These revisions will significantly modify the Discussion section of the manuscript.

(4) Finally, we believe that the revised manuscript will benefit from expanding the Discussion section to include a paragraph explaining that consideration of electrical conductivity in interpretations of the bed reflection coefficient will be constructive. For instance, this approach will help map subglacial geology and may enable the determination of the salinity of subglacial lakes and oceans on icy planetary bodies. The latter is now only mentioned in passing in the conclusions, but it should be discussed more fully in the revised version.

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