The Cryosphere Discuss.,
https://doi.org/10.5194/tc-2020-268-RC1, 2020

The Cryosphere Discussions
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Interactive comment on "Airborne mapping of the sub-ice platelet layer under fast ice in McMurdo Sound, Antarctica" *by* Christian Haas et al.

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Received and published: 25 October 2020

This paper describes a novel yet simple approach to derive the presence, thickness, and spatial distribution of the sub-ice platelet layer (SIPL) under McMurdo Sound consolidated sea ice through forward modeling of airborne electromagnetic induction (inphase and quadrature component) survey data regressed with drill-hole measurements. The underlying premise of the approach is based on the well-documented (since the 1960's) approach of electromagnetic induction (EM) sounding measurements of ice thickness to ice and sea water conductivity under half-space considerations. However, the presence of a platelet layer under consolidated sea ice challenges the simple two-layer (near non-conductive sea ice over highly conductive sea water) model considerations. This new model is based upon an apparent SIPL thickness

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derived from a much more robust forward model application of a Hankel transform of sea ice EM reflection coefficients, electrical conductivity, magnetic permeability, and layer thickness, as well as survey/instrument geometry such as coil spacing, instrument height, and operating frequency. Model derived apparent thickness of the SIPL is then calibrated against drillhole-derived thickness, yielding a scaling factor to derive true thickness. The scaling factor appears to be somewhat variable depending on intra-annual ice conditions driving variability in assumptions of bulk conductivity of the SIPL ice crystal-sea water mixture.

General Comments: This referee's opinion of the author's approach, mathematical model, results, and presentation is quite positive. Having some practical knowledge myself in EM sounding of ice thickness, with awareness of the latest research in this geophysical endeavor, I rate the originality of the approach as excellent. The manuscript, likewise, is very readable and clear in its development of the premises of the model and the application toward this very important development in mapping the presence, thickness, and physical properties of the SIPL. The methods are rigorous but straightforward and understandable, meeting the needs of both researchers and laymen interested in the topic. This manuscript gets my full endorsement for publication in TC with only some minor revision as described below in my specific comments.

Specific Comments: In section 2.1.2 (line 167), the authors state that the conductivity of the consolidated ice in this layered model is set at 0 ms/m (infinite resistivity). Such a conductivity would assume that all entrained brine has been drained from the sea ice and I'm wondering if such an assumption is valid. Even with very cold first year ice, I would assume that some brine pockets remain albeit not necessarily connected in a significantly porous permeable network. Could the author's comment on this and if you considered a non-zero conductivity in your model (say at $<$ 50 ms/m bulk ice conductivity)? In section 2.1.3, the author's present a mathematical model based on a continuous integration (Hankel transform). Is there a discrete version of this transform, and if so how was it computationally implemented? I'm not looking for an elaborate

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explanation, but just a short description of what the discrete transform looks like and if it was solved/applied in Matlab or some other software package. This would be useful for other researchers in applying the method. Perhaps an addenda describing the computational approach in more detail. Saves us from having to reinvent the wheel so to speak. In section 3.3, paragraph 2, the authors describe only the cementation factor in the application of Archie's Law. There are 2 other factors or coefficients relevant to Archie's Law ( )for brine saturated porous media, the tortuosity factor (a) and the saturation exponent (n). Could the author's address this and if such coefficients/exponents have been formulated for ice media? Both numbers I suspect would be relevant in an ice matrix.

Technical comments: In section 2.1 (line 108-9), the sentence beginning "The surveys covered . . ." could be rephrased as it reads a bit awkward. In line 117, is "levelness" best word choice? In that same line, could the author's elaborate briefly on "occasional noise" and what it entails? In section 2.1.3 (line 254) do you mean to say "derived apparent conductivities" or "derived apparent thicknesses"? This possible typo is repeated in line 271, "from the apparent (conductivity) of the Q measurement". Please check as I think you meant to say "thickness" in both cases. In section 2.2 (line 316), "we assume of typical" is strange wording. Maybe drop the "of".

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