The Cryosphere Discuss.,
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The Cryosphere Discussions

Interactive comment on "Brief Communication: Widespread potential for seawater infiltration on Antarctic ice shelves" *by* Sue Cook et al.

Anonymous Referee #2

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The manuscript uses firn densification modeling to assess where, in Antarctica, the permeable firn limit depth of Ice Shelves could lie below sea level (the so-called brine zone). The integrated possible brine zone area is estimated from 9% to 40% of the total area occupied by ice shelves in Antarctica. Ice Shelves with shear-margins have a buttressing effect slowing the flow of glaciers upstream. The disruption of ice shelves leads to faster delivery of grounded ice into the ocean, therefore increasing the rate of sea level rise. The possible lateral infiltration of sea water into permeable firn is a significant, so far under-considered, factor that could contribute to faster disruption of Ice Shelves.

The manuscript is an important contribution that should steer the research toward the brine infiltration mechanisms to constrain ice shelves stability. the manuscript is well

written and sound. I suggest publication in The Cryosphere after consideration of the following remarks.

Firn layer for brine residency

The authors study three firn layers where the brine could reside (750, 800, and 830 kg.mˆ{-3}). Considering these three firn layers is the largest source of uncertainty on the brine zone extent. To help qualitatively constrain this uncertainty, the authors should discuss where the brine is the most likely to reside. Using ice core observations, or radar-derived assessment for the brine depth found in the literature will help to feed such a discussion.

Brine extent controlled by snow accumulation variability

On the first paragraph p.5, the authors discuss the various processes that explain why the brine extent seems to overestimate the observed brine extents. The control of brine extent through snow accumulation is not clearly mentioned [Grima et al., 2019], while it does explain, at least, the western and eastern extension of the brine at SMIS. East of SMIS, downwrapping of internal layers has a significant role in controlling the brine extent. This setting will locally reduce the ice column over the brine layer, then reducing the horizontal pressure gradient to a point where it could eventually stop the brine propagation. On the West side, a negative surface mass balance is responsible for compact ice at the surface, limiting the brine extension.

Regional Model Limits

The SMIS brine described above is a good example showing how local singularities, that are not well accounted for by the continental data set used in the ms, might explained some mismatch between observed brine extent and the proposed brine zones. I suggest included such a remark in section 5.

Minor Comments

p.3-l.24-25. Please, cite the radio sounding papers providing brine layers extent at WIS

and MIS .

p.4-l.26. Could it also come from surface melting followed by downward migration?

Fig.2.a. The map contains more boxes (7) than actual sub-figures (4).

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