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Interactive comment on "Satellite altimetry detection of ice shelf-influenced fast ice" *by* Gemma M. Brett et al.

Anonymous Referee #2

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Fast ice is an important component of the Antarctic climate system, especially for a better understanding of processes between ice shelf and ocean. It is therefore out of question that there is a great interest in the community to obtain better estimates of the thickness of the solid ice over the whole area and thus to be able to conduct further calculations of sea ice volume in the next step. However, the manuscript still shows fundamental weaknesses at this stage, so that it needs to be extensively revised before the work can be published.

That is why I only mention here general remarks, which should be implemented first, before in a next iteration more detailed points can be raised.

General Comments:

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Discussion paper

1. I see a major mismatch between the title, the objectives and the actual content of the manuscript. What is basically done in the manuscript is to compare measured on-site freeboard values related to fast-ice and platelet ice thickness with satellite retrieved freeboard values. However, this does not reflect the actual influence of ISW on the fast ice, as ISW is not necessarily the same as platelet ice.

2. Therefore, a fundamental revision of clearly stated objectives is required, which are then also addressed accordingly in the manuscript.

3. All applied methods in the manuscript are very poorly presented, so that it is not always 100% clear what was really done in detail. Therefore, in order to be able to judge the exact quality and reliability of the analyses presented, they must be made clearer. Furthermore, there is no clear distinction between the work/analyses presented here and what was done in previous work.

4. The snow cover on Antarctic sea ice is known to play a crucial role in both remote sensing and the buoyancy principle of sea ice. Even though the time series shown here seems to have a negligible snow thickness, this cannot be neglected in such a study. Instead, much more attention must be paid to potential difficulties caused by superimposed ice, snow ice or severe snow metamorphism.

5. Moreover, this very thin layer of snow raises serious doubts as to the extent to which such a study can be used beyond the study area shown here. Indeed, a stronger positive freeboard of fast ice areas is not only due to the buoyant platelet layer. Instead, studies, e.g. in Atka Bay (Arndt et al., 2020), have shown that it is not the platelet ice that is the decisive component for the freeboard of the fast ice, but the snow cover. I therefore strongly recommend to do similar sensitivity studies for this region - and also to use data from previous years to emphasize that in McMurdo Sound there is always this low snow load. Even if this is the case, the conclusions must still be strongly weakened, because a strong positive freeboard can have different reasons - which cannot be quantified with CryoSat alone.

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6. Referring to the previous point, the work shown here would greatly benefit from putting the measured snow, fast ice and platelet ice thicknesses into a more global context with measurements from other regions or other points in time in the same region. Otherwise, the results found here are unfortunately not very reliable and raise great doubts that they can be applied on a larger scale.

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