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

Anonymous Referee #3

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General Comments. The paper examines the ability of CryoSAT 2 to detect the existence of a sub-ice platelet layer found under McMurdo Sound fast ice and previously determined to result from the upwelling of supercooled Ice Shelf Water. The study provided good comparisons with the freeboard rise from satellite altimetry with a detailed ground truth campaign conducted over four years of measured sea ice freeboard, snow depth, sea ice thickness and sub-ice platelet layer thickness distributions. Proof of the utility of satellite altimetry to effectively determine the distribution of these sub-ice platelet layers even in a selected region like McMurdo Sound is worthy of publication given that the lack of ground truth in other sea ice studies is a continuous impediment to progress in maximizing the potential of satellite remote sensing to effective monitoring of sea ice processes from space. There are some needed revisions to fully realize

the paper's potential.

Specific Comments. Proof of the utility of satellite altimetry to determine the distribution of these sub-ice platelet layers will provide an effective means of monitoring them from space and help in monitoring the interannual variability of the flux of Ice Shelf Water from underneath the Ross and McMurdo Ice Shelves in future. That said, there are some difficulties in the presentation of the results. For example, in Figure 5, the use of the same color bars for quite different scales, CS2 freeboard in 5a (up to 0.6m), CS2 ice thickness in 5b (up to 5.8m) and drill hole MET in fig 5c (up to 3.5m) is difficult to interpret correctly. (note also in Technical Comments about the need for intermediate values). In the abstract the sentence "We demonstrate the capability of CryoSat-2 to detect higher Ice Shelf Water influenced fast ice freeboard in McMurdo Sound and the wider application of this method as a potential tool to identify regions of ice shelf-influenced fast ice elsewhere on the Antarctic coastline." Is a reach too far, given the unique condition of McMurdo with its generally very thin snow cover which may not be generally found in other coastal regions. There is also no attempt in the paper itself to apply the technique to other regions. Suggest limiting the statement to only: "We demonstrate the capability of CryoSat-2 to detect higher Ice Shelf Water influenced fast ice freeboard in McMurdo Sound." In the discussion of the paper, the concepts can be best given as to applicability to other regions, with sufficient caveats given as to the role of thicker snow than found in McMurdo Sound for example, and how this may affect the interpretations elsewhere.

Technical Comments. Abstract: "We attribute this overestimate in satellite altimeter obtained ice thickness to the additional buoyant forcing of the sub-ice platelet layer. " Comment: Need to know if the measurement of the sub-ice platelet layer distribution verified this. Line 124: What were the equivalent freeboard rises in cm to the 12% and 19% freeboard increases at those locations? Were there also thickness measurements of the SPL at that time? Line 139 (Grammar error)."Refer to Brett et al. (2020) for a detailed description of the thickness distributions of ice shelf-influenced fast ice, the

SPL and snow in McMurdo Sound in November of 2011, 2013 and 2017." Change to: Brett et al. (2020) provide a detailed description of the thickness distributions of ice shelf-influenced fast ice, the SPL and snow in McMurdo Sound in November of 2011, 2013 and 2017.

Line 140 Change to: Here we summarize those descriptions to show general patterns and also include the fast ice conditions in 2018. Line 146 give a value for more substantial deposition of snow Figure 1. Give some intermediate SPL values on the color bar rather than just the High and Low. Might also include a few (4 or 5) of these as identified contour lines on the map plot. In the caption point out that the red square on the inset map is the area (McMurdo Sound) shown on the MODIS image to the right. Figure 5 need intermediate values on the color bar (Freeboard, C2-2 Ice thickness, Drill Hole MET) and address concerns about the same color bars but different scales for a, b and c. Line 490 Appendix A Seems hard to read, Line 530 This indicates that the geoid is de-trended for twice (?? Don't understand this sentence)

Lines 516-532 (Appendix A). I find this discussion rather confusing, perhaps hampered by my own limited knowledge of Geodesy. For example, the sentence (Line 507) "The open ocean surface with MSS and ocean/tidal corrections removed was consistent from 2011 to 2017." Is this both MSS and ocean/tidal corrections removed (Item 4) or Is it Item 3, MSS applied and ocean /tidal corrections removed? I infer that the authors' find the best practice for surface elevation is Item 6. in their first list but this is difficult to suss out from their discussion. Suggest a Table listing the various options and some index of performance e.g. Good, Fair , Poor along with better referencing of the number of the option in the accompanying text would help to clarify.

Line 542 "The in situ data included in this study will not be available at the time of publication but it is intended that it will be deposited in a data repository." However from the Journal Data Policy:"Copernicus Publications requests depositing data that correspond to journal articles in reliable (public) data repositories, assigning digital object identifiers, and properly citing data sets as individual contributions. . ... Authors are re-

quired to provide a statement on how their underlying research data can be accessed. This must be placed as the section "Data availability" at the end of the manuscript." Reviewer Comment: Further revisions should include the citation to Data Availability required by this journal. A substantive further review may require the reviewers' and editor to examine the data used in the paper before final approval and the paper cannot be examined by others without the ability to further examine the data and conduct their own analyses.

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