Dear Editor Dr Melody Sandells and Reviewers,

Thank you very much for taking the time to review our manuscript once again and for providing valuable feedback. We really appreciate your efforts which have much improved the manuscript. In response to your comments, we provide clarification and description of revisions below. We have included a revised version (Revision-2) and a tracked changes version (TRACKED-2) for your consideration. Line numbers refer to the PDF document 'TRACKED-2_Brett-et-al_Satellite-altimetry-detection-of-ice-shelf-influenced-fast-ice'.

Thank you very much for reviewing our manuscript.

Best wishes,

Gemma Brett (on behalf of all co-authors).

Editor Comment:

Thank you for addressing the comments of the reviewers and making substantial changes, particularly to the discussion section of the paper. I would hope that these changes meet most of the reviewers' expectations. There are still a few issues that need further attention. Please make the following changes to progress the paper:

Two of the reviewers requested greater clarity of the novel aspects of this study. Although the response to the reviewers indicated that the method is not new the application is (which is absolutely fine), this conflicts with the statement on line 464 that 'The method to identify the best-matching freeboard interface for individual CS2 tracks (sect. 3.1).' is novel and on line 282 'We applied a novel technique to select the best-matching freeboard interface for each track'. It is essential to be clear on how this study differs from Price et al. (2019). Section 3.1 contains the equations already presented in Price et al. (2019) but even if this study uses the method of Price et al. (2019) the level of detail on the best-matching freeboard method either in this paper or Price et al. (2019) is insufficient to allow this study to be repeatable (e.g. what constitutes a 'match' / what cost function was used to find the 'penetration depth')? If development from Price et al. (2019) is to use equations 1 and 2 first, then resort to equation 3, this is not particularly new as equation 3 is the same as equation 1 if Pd=0 or equation 2 if Pd=Ts. As a minimum the equations must be included, but it would be far better to provide the code to complete the analysis (as per Data Policy for The Cryosphere) with the publication. In addition, I would avoid the terminology 'penetration depth' as this is not a measure of 1/e reduction in electromagnetic radiation.

Author Response:

We thank the editor and the reviewers for this comment. Our apologies, we agree that the principle of the method is much the same as that applied in Price et al., 2019. We have thus removed all statements that this method is novel and have also changed 'penetration depth' to 'penetration factor'.

Price et al., 2019 explored the range of ice thicknesses obtained from CS2 freeboard when using different snow products and hydrostatic equations. They then assessed ice thicknesses obtained from CS2 freeboard using interpolated in situ measured snow depth and a range of penetration factors (refer to their Figure 6). They compared the mean interpolated in situ measured Mass Equivalent Thickness (MET) (i.e., what CryoSat-2 measures) with the mean CS2 ice thicknesses obtained from a range of penetration factors. They found the closest agreement of mean CS2 ice thickness and in situ measured MET when the penetration factor was 0.07 m (shown in their Figure 6). Those mean values were calculated over a defined fast ice area where the in situ measurements were made.

In this study, we compared the profiles of calculated CS2 ice thickness and drill hole measured Mass Equivalent Thickness along each individual track. To select the best matching freeboard interface and corresponding hydrostatic equation, we assessed 1) the along-track profiles of interpolated in situ MET with the CS2 ice thicknesses visually (this was evident if the best interface was sea ice or snow freeboard), 2) linear regression analyses if there was a gradient in thicknesses, or 3) by comparing mean values along-track according to Price et al., 2019. We tried to identify the optimum freeboard interface using the in situ and CryoSat-2 information, as opposed to assuming some arbitrary or constant freeboard interface which would have simplified the analyses but also weakened the results. The main result (shown in Figures 5 and 6) is that the CryoSat-2 ice freeboard and ice thickness in the centre of McMurdo Sound increased towards the ice shelf with increasing in situ measured ice shelf-influenced fast ice and SPL. In the east, the gradients were flat because the influence of supercooled ISW is less pronounced and CryoSat-2 detected this. The snow distribution was also advantageous as we could be assured that the higher CS2 freeboard and increasing trends in the centre were not due to the snow cover which was generally thin and loosely packed (Line 452-453; and 463-469). We have better clarified this in the text on Line 287-294, referred to Price et al., 2019 (Line 218 and 294) and discussed potential limitations on Line 444-447

Editor Comment:
More information on the data used under Data Availability is welcomed, but please refer to the specific DOI for the in situ data and cite them (please see https://www.the-cryosphere.net/policies/data_policy.html) to give appropriate credit to the groups who collected these data.

Author Response:
Our apologies, the specific DOIs for the individual 2011, 2013 and 2017 in situ datasets were not available at the DOI provided in Haas et al., 2020. This data submission has been complicated by the datasets being collected under different projects, funding, principal investigators and field teams and being supplement to multiple publications since 2009. As a co-author on that publication, I have taken over managing this data submission on behalf of all co-authors and can assure you that the DOIS for all data will be available soon.

The 2018 dataset has been submitted and is under review in Pangaea. We are still waiting for a temporary DOI and have been informed by the Pangaea editorial team that it could take several months for the data to be reviewed and the DOI to be fully minted.

Editor Comment:
Please revisit the colour scheme for Figure 5. Fig 5b and 5c have a similar colour bar but opposite in direction, which is confusing. Please use divergent colour schemes (Fig 5a is good)

rather than rainbow schemes, which are hard to interpret for those who are colour-blind. I recommend checking all images with an online colour-blindness checker.

Author Response:

Thank you for this comment. We have taken this into consideration and changed the colour schemes of Figures 1 and 5b and 5c to divergent colour schemes.