A review of The Cryosphere manuscript tc-2021-121 by Fraser et al.

This is a well-written and important manuscript that represents an in-depth baseline analysis of variability and change in circum-Antarctic fast-ice distribution. The analysis is based on interpreting a new 18-year (2000 – 2018) high-resolution fast ice extent time series generated from MODIS imagery that was released in 2020. It proposes eight new regions for the purpose of identifying trends in fast ice extent anomalies and fast ice persistence, as well as characterising the distribution of fast ice in relation to bathymetry. It also exploits a new technique to model the seasonal cycle of fast ice and sea ice extent that was presented in a manuscript by Handcock in Raphael in 2020.

I have only a few major comments / suggestions to make, followed by a number of minor comments and suggestions.

Major suggestions / comments (line numbers given where appropriate).

Line 75: The authors state that the new fast ice regions were grouped manually because an automated selection using a decorrelation length scale minimum-based approach (Raphael and Hobbs, 2014) did not work, and present their partitioning technique in Appendix B. However, sufficient details to determine how the partioning was done are not provided, other than stating that an investigation of the fast ice anomaly cross-correlation matrix as a function of longitude was undertaken. Can the authors provide more details on how this partioning was done, particularly as they are introducing a "fundamental new region definition". Can they also comment on the implications of using a non-conservative region definition (e.g. does not include all of the Antarctic coastline / ice shelf edges) as opposed to the Zwalley et al. (1983) oceanic sectors?

Lines 100–104: Can the authors provide a more indepth description of the technique they used to model the seasonal cycle of sea ice and fast ice. The Handcock and Raphael (2020) paper presents three techniques for modelling annual sea ice extent cycles that are time variant (amplitude only, phase only and amplitude + phase). These models were also only applied to daily sea ice extents, not 15-day interval fast ice extents, although it was noted in the Handcock and Raphael manuscript that this technique could readily be applied to other datasets.

Minor suggestions / comments (line numbers given where appropriate).

Lines 22 and 23: The first sentence of this paragraph is not a complete sentence, I suggest rewording by combining it with the next sentence.

Line 50: There is a missing "a" before "suitable underlying dataset".

Lines 76 and 77: "Raphael and Hobbs" is repeated.

Line 80: “the” is repeated.

Line 116: replace “approx” with “approximate”.

Line 120: Be consistent with use of hyphenation with “mid” and “late”.

Line 123: I do not understand what is meant by “(as a percentage of average residence time)”. How is average residence time defined? If percentages are relative to an average time, why do they never exceed 100 %? This definition differs to the description in the Fig. 2 caption – the caption definition makes sense to me.

Line 143: Capitalise “coast”.

Lines 160 + 161 (Comment only): Another area that experienced a large change from multi-year fast ice to seasonal fast ice in the period is the southern reaches of McMurdo Sound. This was due to the presence of large tabular icebergs (B-16 and C-16) (Brunt et al., 2006). I suspect the trend does not appear as stong here as in other regions due to the relative timing of the iceberg affected fast ice cover (2001 - 2011) with reference to the length of the data set (2000 - 2018).

Line 173: Replace reference to Fig. S3 with Fig. C1.

Line 176: Suggest moving “only” to before “useful”.

Line 180: Replace “total sea ice extent” with “total fast ice extent”.

Line 183: Remove duplicate “Fraser et al.”.

Line 185: Replace Fig. 5b with Fig. 5c.

Line 186: Replace Fig. 5d with Fig. 5e.

Line 193: Replace “that” with “than”.

Line 199: replace “than the that of sea ice” with “than that of sea ice”

Line 208: Replace “overall sea ice” with “the overall sea ice maximum”.

Lines 223 and 226: Replace ref to Fig. S3 with Fig. C1.

Line 231: Replace Massom (2003); Massom et al. (2009) with (Massom, 2003; Massom et al., 2009)

Line 293: Suggest insert a comma after “however”.

Lines 296 + 297: move (0.67 ± 0.55 %/y) to before “sectors”.

Line 321: What do the authors mean by “... was re-run using only pre-calving post-calving fast ice anomaly data.”? I assume from the following sentences that the regional selection algorithm was run twice, once with pre-calving conditions, and a second time with post-calving conditions,

but this needs clarification.

Data availability. The authors need to add a description of how the sea ice concentration from the National Oceanic and Atmospheric Administration/National Snow and Ice Data Center Climate Data Record of Passive Microwave Sea Ice Concentration, Version 3 can be obtained, as well as a citation to Meier, W. N., F. Fetterer, M. Savoie, S. Mallory, R. Duerr, and J. Stroeve. 2017. NOAA/NSIDC Climate Data Record of Passive Microwave Sea Ice Concentration, Version 3. [Indicate subset used]. Boulder, Colorado USA. NSIDC: National Snow and Ice Data Center. doi: https://doi.org/10.7265/N59P2ZTG. [Date Accessed]. as described in the dataset's condition of use, reference: https://nsidc.org/data/G02202/versions/3.

Line 399: I could not find the Kooyman and Burns 1999 manuscript and Kooyman does not appear to list this publication on his website. I did find some other references to a 2009 publication in American Zoologist, so was left wondering if American Zoology should be American Zoologist?

Figure 1: I suggest the authors use the same y-axis label for sub-figure a and b. I find it confusing comparing the green line in sub-figure a with the green line in sub-figure b due to the different temporal scales between the two sub-figures, but I appreciate that too much detail might be lost if the width of sub-figure b was reduced.

Figure 2: "coast" in "Marie Byrd Land coast" needs to be capitalised. Missing 180° label.

Figure 5: Caption indicates that p-value of the trend is indicated in the title of each sub-plot, but I could not find this information in the sub-plot titles. To me the need for stating p-values in sub-titles is negated by the last sentence in the caption.

Figure A1: The trendline for the Indian Ocean sector is not easily distinguishable from the zero line. I suggest the authors consider using a colour other than black to represent the Indian Ocean anomalies and trend.

Figure B1: The vertical red and blue lines and blue boxes are somewhat difficult to view against the cross-correlation colour scale. I suggest either using thicker lines or choosing colours that do not fall within / near the cross-correlation colour scale. Acronyms for newly defined regions should be spelled out in the figure caption. I find it a bit confusing that the spatial scales on the two axes of a spatial cross-correlation plot are different, and that the coastline on the y-axis is facing the opposite direction relative to the plot than the coastline shown on the x-axis. It would also be useful to distinguish between land and ice shelves in the provided coastal outlines.