Response to RC2:

Note that we quote the reviewer's comments and suggestions in red.

Major comments:

Writing style
The manuscript would benefit from (and strongly needs) a thorough tightening up of the writing style of the whole manuscript, including but not limited to:
● Use a clear structure with separated sections for the data and the methodology. At present, the input data and input products are presented "here and there" within the method section.

We will try to make a clearer separation between data and methodology. Having to separate sections "Data" and "Methods", however, does not seem very useful to us, as mentioning all data *before* explaining the method is much information that cannot be used yet, and mentioning the data *after* the describing the method would be too late. We rather suggest a table listing the input data and auxiliary data at the end of section 2

● Avoid repetitions. Several repetitions occur and sometimes a simple re-ordering of the sentences would make the reading flow better
● Make sure that information given across the manuscript is in synergy with itself. For instance, it is very unclear whether the new product covers 2013-2019, 2013-2020, or 2013-present.
● Make use of general spell checking.

We will try to straighten the text, eliminate inconsistencies like the one mentioned, and, of course, apply a spell checker again.

The presentation of this work should be clearly separated from possible improvements or potential future works. Future works or possible upgrades should rather be listed and discussed in a discussion section or the Conclusion.

We think that mentioning some possible improvements/potential future works in the course of the paper is unavoidable: For example. when discussing the wrong multiyear ice in the Ross Sea, we of course mention possible ways to mitigate that (L311 ff.). However, we agree that it makes sense to list all possible improvements and future work in one place towards the end. We will either do that at the end of the discussion or in the final summary/outlook chapter.

Algorithm presentation vs presentation of long-term time series
The manuscript seems to have two main goals. On the one hand, it presents a methodology for mapping the Antarctic sea ice type from remote sensing data. And on the other hand, it presents, for the first time, a longer time series of Antarctic sea ice types. Both these topics are very relevant, however, at the present stage, the manuscript covers these in an inadequate manner.
In order to be a manuscript presenting a new method, the methodology is only superficially described. Below are some specific points to be considered:

We did not want to repeat the description of the ECICE algorithm and the two correction schemes here, as they are described in the respective publications, but we will try to follow the suggestions below.

● I suggest naming the full algorithm which is implemented at the University of Bremen. When reading the manuscript, it is unclear if "the new method" is ECICE, modified ECICE, or ECICE + post-processing. Examples of this:

(The reference is already at the end of that sentence.)
Thank you for pointing this out. We agree that we must make the naming more consistent throughout
the manuscript and will do that.

This information is saved along with the resultss of ECICE. We will insert a brief discussion of that.

We consider including a flow diagram of the methodology but are unsure about the degree of detail
needed here. The ECICE algorithm is described in detail in the cited publications (Shokr et al., 2008 ;
Shokr and Agnew, 2013) and we do not want to repeat too much of that here.

We combine all AMSR swaths of one day and then interpolate to the grid using a distance-weighted
near-neighbor approach (the one from Generic Mapping Tools with four sectors). The ASCAT swath
data are converted to common incidence angle of 40° and then interpolated to the grid. We will either
add these details in this section or put this into a small section in the appendix.

We made sure the used FYI areas are so far away from the start-of-the-season MYI that the latter
cannot have drifted there. If we assume 15 km of maximum daily drift (rough estimate from 1 year of
OSISAF drift data), this would mean, e.g. 1500 km in June. We will add such an estimate to the
description.

In general, under permanent melting conditions, the radiometric/backscattering properties of sea ice
change considerably and differences between the ice type diminish or even vanish. Therefore using

ECICE in summer does not yield reasonable ice types. We apologise for not having stated this important fact and will add a similar explanation to section 2.1 on ECICE.

● The final output is "corrected MYI" (L193), however the "uncorrected FYI, MYI, and YI" are also provided.
○ It is not clear if the uncorrected fields are "pure ECICE" outcome?

Yes, the uncorrected fields are the "pure ECICE" outcome. We will add this were we mention the preliminary ice types (L194, "without applying and correction")

○ uncorrected MYI (or Ex-MYI) is never presented, and maybe they should be shown?

We have actually already considered that and decided against it as ExMYI should first be investigated in more detail. Please note that other ice concentration algorithms that produce MYI do not apply corrections to account for anomalies in the locations of the MYI. The correction scheme used in ECICE can be used in any algorithm.

○ Could you include a comment whether MYIcorrected+FYI+YI or MYI+FYI+YI add opp to 100%? And if not, please comment on this as well.

The uncorrected ice type concentrations add up to the total ice concentration (which can be between 0% and 100%, of course), When correcting MYI, the amount added or subtracted is not subtracted or added from FYI or YI as we cannot say to which of the latter two it "belongs". Hence, MYIcorrected+FYI+YI cannot add up to the total ice concentration. We will add this explanation to the text.

● It is not clear if a threshold is used for the ice edge? Or are all surfaces with >0% ice concentration classified?

We do not use any threshold, but directly retrieve the concentration of the three ice types everywhere. In areas of open water (100%), all ice types have 0% of course. We consider mentioning this in an appropriate place.

● Several places it is announced that this computation can be extended to present time. What will the latency be for such a retrieval?

We have since implemented daily retrieval. The ECICE output is in near real time, within 1 day of receiving AMSR2 and ASCAT data. The latency of the corrected MYI is 16 days. We will mention this important information at an appropriate place.

In order to be a manuscript presentating a longer time series, it is surprising to see that there is a complete lack of presenting or showing any long-term (seasonal, interannual, regional) behaviour or variability. Only a few hand-picked days are shown and the year 2018 MYI total area time series. Since this is the first time a longer time-series of ice type is presented for the Antarctic, then it would be appropriate to show a full record plot and potentially discuss any trends and variabilities, (or missing trends).

We will add a section showing complete (2013-2021) time series and discuss them.

Several places it is mentioned the possibility of a record covering the period 2002 to present. However, the present record covers the period 2013-2019. Can you make this more clear - what defines the period you present and why is this period selected? And hereafter (best fitted in a discussion or conclusion section) mention possibilities for extending the time series and what this would require and what is the timeline for implementing this.

We will state this more clearly: The period starts with the availability of AMSR2 data, in principle in July 2012. As the drift correction scheme needs to starts at the beginning of the cold season, we start to retrieve in 2013. The end of the period is now 2021 – we will change the text accordingly.

Other comments

The use of "top right" etc. seems common practice in many publications, but we will consider the sub-figure approach.

We will modify the figure along the suggestions given.

Yes, e.g. the distribution of MYI in GR17,37V, the red curve in the lower left plot, shows to almost distinct peaks. This might point at to subtypes. However, in order to retrieve one more ice type (by splitting "MYI" into two subtypes), ECICE would also need one more input channels as the number of input channels must be equal or larger than the number of retrieved surface types. We are not sure if is makes sense to add this discussion into the manuscript, though.

We will do that (overview map or text).

Usually there is just one caption under a figure. We will consider readability and try to improve on that.

We consider combining the figures, but are not sure if this makes them better to read. The meaning of the grey areas will be defined in the caption, of course.

As mentioned in the caption, this is the full MYI area, taking the MYI ice concentration of each pixel (0% to 100%) into account. So this is *not* the extent, which is commonly defined as the sum of the full area of all pixels with an ice concentration above 15%.

Will be fixed.

Yes, we add reference to the WMO Sea Ice Nomenclature when we first introduce the ice types.

We will add the remark that almost all Antarctic sea ice will drift out into lower latitudes and meld within two years.

L38-39: "Antarctic sea ice has strong region-dependent ..." This sentence stands a bit alone.
Could you say a few more words on this?

As this statement is not really relevant here, we rather delete it.

L43: Move "in the Antarctic" to the beginning: "Sea ice cover in the Antarctic..."

Yes.

L51: repeats that MYI typically is in Weddell Sea (L31)

Yes, but we see no problem in repeating this statement here as we here discuss the importance of the Weddell Sea in particular.

L62: "Total and partial sea ice concentration ..." when first time reading this, it was not clear
that "partial sea ice concentration" was referring to the ice types. I suggest re-wording this
whole paragraph.

We well reword this: "The concentration of total sea ice and of the sea ice types"

L72: "Ye et al., 2019" is not accepted for publication. Can you find another reference?

A revision of the cited study is in progress, for the time being, there is only the discussion paper.

L74: replace "regularly" with "operationally"

Yes

L77: "brief account of ECICE and its adaption to Antarctic ..." Would it be more correct with
"brief account of ECICE, implemented correction schemes, and the adaption to Antarctic ..."

Yes, of course – we will correct this.

L78: remove "first"?
L78-79: since the entire record is never presented, I would suggest deleting the period.
Simply "In sec 3, the outcome of the Antarctic sea ice type concentration mapping is
compared with ..."

We rewrite the sentence as: "In Section 3, results of the Antarctic sea ice type concentration mapping are compared with results from..."

L91: Any reason why SSM/I can be included but not SSMIS (and other passive microwave
radiometers)? Why mention SSM/I if it is not included in the present method/production?

After 2002, the preferred satellite instruments to be used are AMSR-E and AMSR2 as they have higher resolution than SSM/I and SSMIS. SSM/I was mentioned as it can extend the record backwards before the AMSR-E era. SSMIS can, of course also be used, and actually it can close the gap between AMSR-E (until Oct 2011) and AMSR2 (from July 2012). We will mention this here.

L100: "Most methods" please include references.

We will include reference to the ice concentration algorithm comparison paper by Ivanova et al., (2014, doi:10.5194/tc-9-1797-2015), this saves specifying 10 extra references.

L132: "If MYI .. drops at any location during a warm spell ...". Are there not any restrictions
on this drop to occur in the vicinity of where the warm anomaly appears?

We actually meant "at any location affected by the warm spell" and will correct the text accordingly.

L140: "After that, MYI can only drift ..." What exactly do you mean by this? If you mean that
no more MYI will be created (per theoretical definition) after this point, then say this more
clearly. In the same sentence is used the word "melting" which is not a part of "drifting"...
Please re-phrase this sentence.

We will slightly reword the sentence: "After that, during the cold season, no new MYI can be generated. MYI can then only drift, and its concentration can only be changed by divergence, convergence, and melting."

We use a threshold of 20% MYI concentration to define the MYI boundary. We will insert this information in the manuscript

Yes, we use "sudden" in the standard, temporal, meaning, as the specification "(within one day)" suggests.

The values were empirically determined for the correction schemes in the Arctic and have been kept here. We will insert this information.

AMSR-E data will be used in the next step. However, using them has already been implemented.

Yes, it is, as the NSIDC grid in the context of sea ice type retrieval is described in more detail there.

Yes, the actual numbers will be inserted.

This is why we have put the full name and the link and reference into a footnote.

The MYI data are collected from the first months of the freezing season. We will add more details on that to the text.

When most of the presented work was done, ERA-5 was not available yet.

(NSIDC drift data have been used already for retrieval in the Arctic (see Ye at al., 2016b). At the time this study was started, the used OSISAF data seemed the best choice, but we are actiually considering switching).

Well, we once more reference Tables 2 and 3 (after referencing them in sections 2.2.1 and 2.2.2) and see no harm in that.

They were empirically chosen.

NIS of the Norwegian Met. Institute is at least one of the three partners of that project. As far as we know, NIS has contributed some regional ice charts (but not SoD?). -- We will leave out NMI/NIS

Thank you for pointing this out, concentration maps start in December 2014, but SoD maps only in May 2015. We will correct that.

We considered this information necessary because it makes some MYI (in the first half of the season, until end of June) appear in similar colours as FYI. We will check, however, this is is really needed here.

We have compared at least one SoD chart per month (there is one per week) for two entire seasons.We consider publishing these comparisons as supplementary data. We will elaborate on that.

As already mentioned above, we had decided against showing Ex-MYI as we have not investigated it thoroughly. We can only say that it is actually FYI or YI (but cannot tell which).We consider adding this information to the text.

Yes.

Yes, we will rephrase it to make it clearer.

In L315-316, we speak of a decline of MYI concentration, not an increase. We will consider adding a new figure here.

Yes. it should be "grid resolution".

We meant detailed and comprehensive ice type information (this OSISAF ice product has only FYI and MYI) that does not only rely on automatic satellite data processing. We will modify the text accordingly.

See L315-322 in the Discussion section: We retrieve much less MYI than the SoD charts which, however, seem a bit "unstable" or inconsistent. In the discussion, we give a possible physical explanation for an underestimation (L319-322). Here, in the summary, we will add a "probably" before "underestimated".

Thank you for this encouragement! We will remove these words, but add a "preliminary" earlier in this sentence.

L346-350: Give better and more correct references to upcoming satellites/sensors. And please add a comment on why 1.4 - 36.5 GHz is assumed to make scatterometer less important

We will revise these lines and add references, and mention a study that showed possible retrieval of ice types without scatterometer data.