Response to Review Comments

Arctic sea ice cover data from spaceborne SAR by deep learning

Report #1

I would like to thank the authors for preparing the revision and addressing all of my concerns. This version of the paper is significantly improved. I do not notice any more major issues with this version. The only recommendations I have are about the presentation.

Thanks for the suggestions from the reviewer. The figures are updated and long sentences are modified for a better presentation. The changes to address the comments are discussed below and are highlighted in blue in the revised manuscript.

Comments 1: There are a few figures, whose fonts are too small to read, such as Figures 7, 9, and 11. Maybe the fonts can be increased for better readability.

Response 1:
The fronts have been increased for figures 6, 7, 9, 11, 15, 16, 17, and 18. Please refer to the revised manuscript.

Comments 2: Some of the sentences are long and hard to parse. And some sentences seem to become run-on sentences and comma splices. E.g. this sentence around line 320, "This image was acquired at the northeast of Severnaya Zemlya, presenting large areas of both open water and floating sea ice, as shown in Figure 10 (a), the RGB false-color composite image." There are a few similar sentences. I recommend checking all long sentences and break them into smaller ones if possible.

Response 2:
We have carefully read through the entire manuscript and made the necessary changes for the long sentences. For the mentioned sentence, it has been divided into two shorter ones as follows: *"This image was acquired at the northeast of Severnaya Zemlya, presenting large areas of both open water and floating sea ice. Figure 10 (a) shows the RGB false-color composite image."*

Comments 3: Indenting the new paragraphs can improve readability.

Response 3:
The original format of the paragraphs was based on the template provided by ESSD. According to this advice, we use indentations for the first line of each paragraph in the revised manuscript.

Report #2

Authors addressed my comments well. I am ok to recommend the paper for publication after minor comments/suggestions been addressed.

Thanks for the comments and suggestions from the reviewer. The changes that we have made to address the comments are discussed below and are highlighted in blue in the revised manuscript.

Comments 1: in sections 2.2 and 2.3, you talked about pixel by pixel comparison between S1 and AMSR2, S1 and IMS, I wondering if you can really match them pixel by pixel (no overlapping)? If yes, how you did that to make them real match..,

Response 1:
The pixel-level match refers to the pixels of lower resolution data. The comparisons are further explained in sections 4.2 and 4.3.

For comparison between S1-derived results and AMSR2:
"The S1-derived sea ice cover data (with a spatial resolution of 400 m) were converted into sea ice concentration on a regular grid of 6.25 km (the same as the spatial resolution of the AMSR2 data), with the center of each grid corresponding to each pixel of AMSR2. Then, the sea ice concentration data were matched with the AMSR2 data on a pixel-by-pixel basis."

For comparison between S1-derived resutls and IMS:
"The 400 m pixel size of the S1-derived sea ice cover data is comparable to that of the IMS data on a grid size of 1 km. We directly compared the IMS data and S1-derived results by matching the nearest pixels of the two data."

Comments 2: for figure 4, a,b, there are dark areas, what they are? For c/d, is the lower right corner sea ice or water?

Response 2:
For figure 4 (a) and (b), the upper dark areas are land covered by the black land mask; while the dark areas at the lower right corner are open water with low radar backscatter intensity. For figure 4 (c) and (d), the lower right areas are sea ice. To clarify these two points, figure 4 has been updated with more labels.

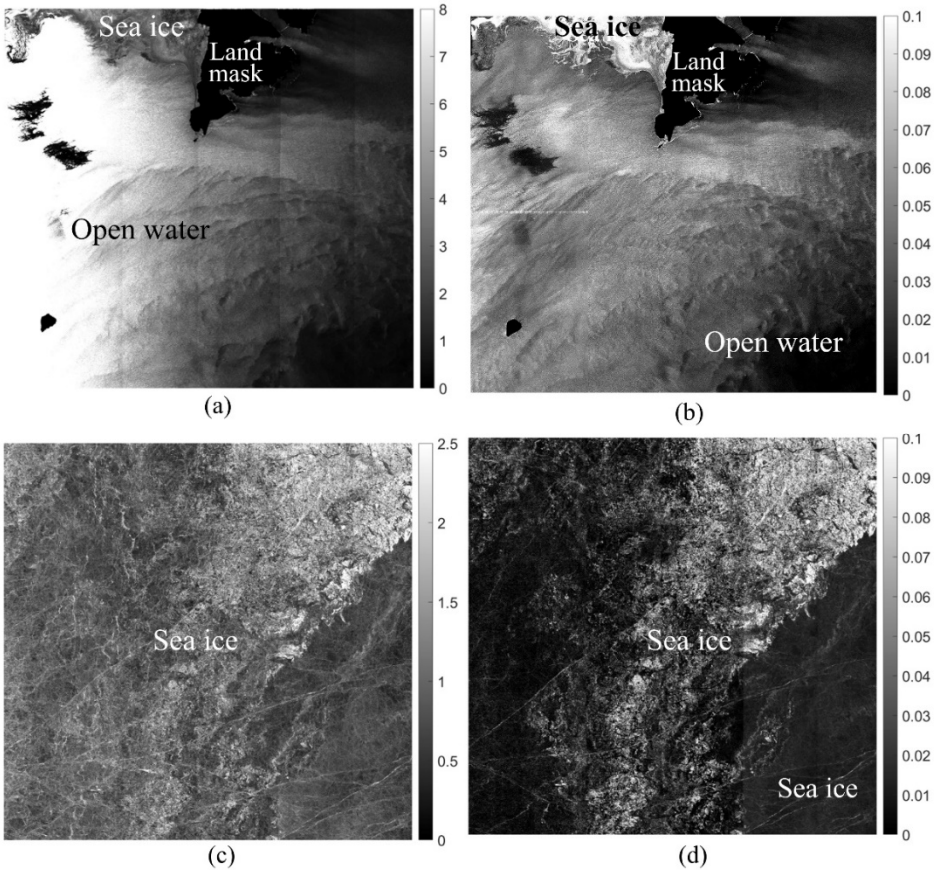

Figure 1. Examples of S1 EW images presenting the challenges in sea ice segmentation. (a) HH-polarized and (b) HV-polarized S1 EW images of a windy sea surface. (c) HH-polarized and (d) HV-polarized S1 EW images of a smooth thin ice surface. (Image ID: (a) and (b) S1A_EW_GRDM_1SDH_20190130T060740_20190130T060840_025703_02DB20_85BC; (c and (d) S1B_EW_GRDM_1SDH_20190115T194015_20190115T194115_014509_01B066_11F1)

Comments 3: figure 9, the last column, there is a gray/dark color type, beside the yellow and cyan, what is it? The same comment for the Figure 10 and figure 11;

Response 3:

The dark color in the RGB false-color composites and the gray color in the segmentation results both indicate the land mask. To clarify this point, the titles of figures 9, 10, 11, and 15 have been updated. Besides, the related description in section 3.2 has been revised as follows:

"The land area is masked as black in the images by the Global Self-consistent Hierarchical High-resolution Geography Database (GSHHG, https://www.ngdc.noaa.gov/mgg/shorelines/gshhs.html) with the full grid resolution of 1×1 arc-minute."

Comments 4: figure 12, I would suggest to use S1 concentration not the AMSR2 concentration, maybe including ASMR2 7-day average line for comparison, also the absolute difference, is S1-AMSR2, or AMSR2 – S1? Similar for the figure 14, SI concentration not IMS concentration, but adding its 7-day average….

Response 4:

According to this advice, the 7-day sea ice concentration/proportion based on S1-derived results has been added in figure 12 and figure 14. The daily plots of sea ice concentration/ proportion have been removed for better presentation. As for the absolute difference, S1-AMSR2, or AMSR2 – S1 makes no difference.

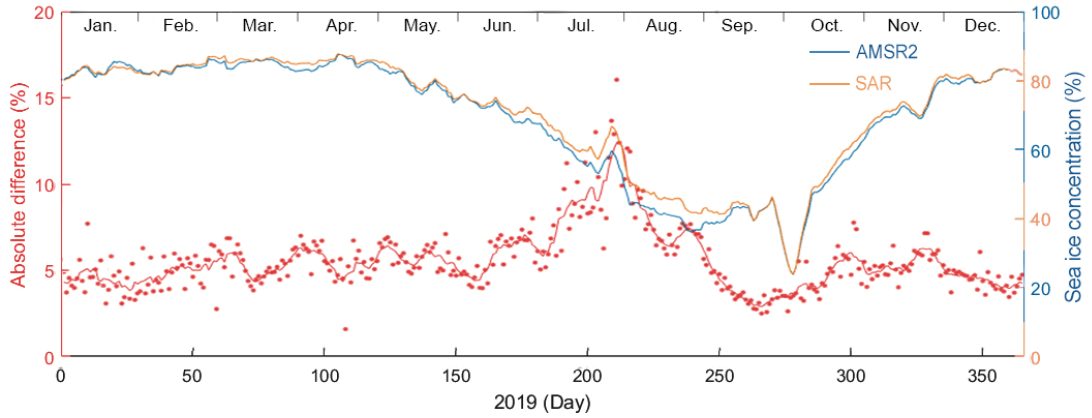

Figure 2. Comparison between the S1-derived Arctic sea ice concentration data and AMSR2 data for the whole year of 2019. The red dots reflect the absolute daily difference, and the red line is the 7-day average absolute difference. The blue line is the 7-day average sea ice concentrations in the S1-covered area calculated based on the AMSR2 data, and the orange line is the 7-day average sea ice concentration calculated based on S1-derived results.

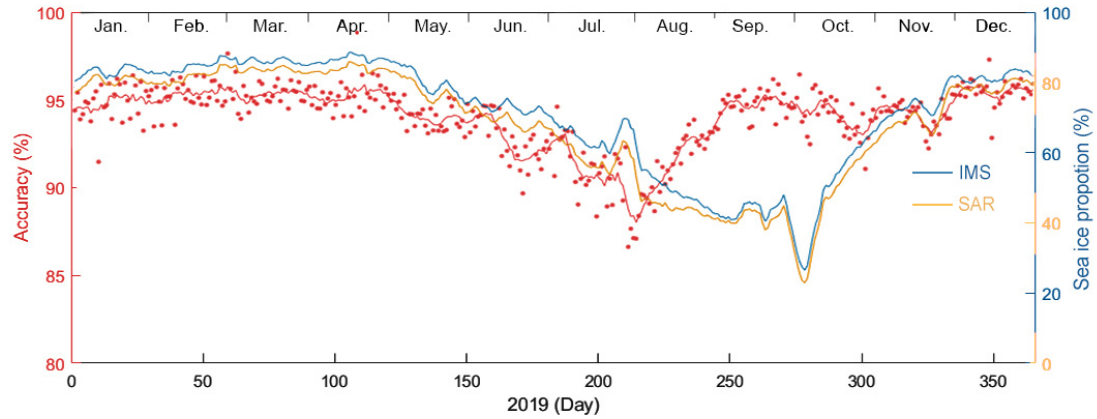

Figure 3. Comparison between the S1-derived Arctic sea ice cover product and the IMS data for the whole year of 2019. The red dots represent the daily average accuracy, and the red line is the 7-day average accuracy. The blue line is the 7-day average sea ice proportion in the S1-covered area calculated based on the AMSR2 data, and the orange line is the 7-day average sea ice proportion calculated based on S1-derived results.