Extent, duration and timing of the sea ice cover in Hornsund, Svalbard in 2014-2023

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General comments

In this paper sea ice coverage in Hornsund fjord, Svalbard is investigated. Sea ice coverage was estimated by classifying Sentinel-1 SAR imagery to binary open water – sea ice maps at 50 m resolution. SAR imagery classification includes image segmentation following a previous study by Johansson et al. (2020) (i.e., not developed in this study) and manual classification of image segments to open water and sea ice. The temporal coverage of S-1 SAR imagery was nine ice seasons from 2014/15 to 2022/23. Validation of the open water – sea ice map was conducted by manually tracing fast ice edge in 20 Sentinel-2 images, and good co-incidence of S-1 vs. S-2 fast ice edge was found. Error sources for the classification, e.g. thin and wet sea ice mixed with open water, were also discussed. Supporting data include in-situ air and sea water temperature from the Polish Polar Station (PPS).

The maps were used for statistical analyses of spatial and temporal patterns in the sea ice coverage in the entire Hornsund fjord and its main basin and three major bays; including interannual variability and annual onset and end of drift and fast ice. For example, a large inter-annual variability in the sea ice coverage was observed, and at the nine-season scale there was no gradual trend of decreasing sea ice coverage.

The S-1 sea ice maps were also combined with maps from Muckenhuber et al. (2016) resulting sea ice coverage maps for 24 seasons; from 1999/00 to 2022/23. Seasons with low and high sea ice coverage were identified, again with no coverage trend was present, but there is an overlap of higher air temperatures and lower sea ice coverage, and lower air temperatures and higher sea ice coverage.

As the authors say this paper increases the understanding of the sea ice extent, duration and timing in a High Arctic fjord environment, and facilitate between-site comparison on changing sea ice conditions in Svalbard.

In general, the study set up with data acquisitions and data processing is well presented and conducted, and results which are based on large amount data are nicely presented and discussed. Conclusions of the study are well based on the statistical analyses and observations in the dataset. The paper is also very well written. I did not find any major shortcomings in the paper, and below are only few specific comments.

Specific comments

l. 26: “Sea ice plays a key role for the climate by controlling heat, moisture, gas and light transfer between the ocean and the atmosphere. It impacts wildlife and human activities in high latitudes (Maier and Stroeve, 2008).”

l. 50: “Passive microwave-derived sea ice products have the longest temporal record but lack the high spatial resolution offered by synthetic aperture radar (SAR) imagery (Wang et al., 2016).”

These are not the original references here, and references can be removed.

l. 45: Reference Overeem et al. 2011 is missing from the reference list.

Figures 1, 2, 4, 5 and 6 should have larger size, now difficult to see details.

l. 477: “The binary ice/open water maps can be further used to improve nearshore wind wave transformation modelling and risk assessment for the coastal zone.”

This usage of the maps should be also described in Introduction Section.

You could show an example of original, segmented and classified SAR images. Preferably together with a Sentinel-2 image.