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Interactive comment on "Satellite ice extent, sea surface temperature, and atmospheric methane trends in the Barents and Kara seas" *by* Ira Leifer et al.

Anonymous Referee #1

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Review of "Review of Leifer et al: Methane trends in the Barents and Kara Seas"

The submitted paper presents new observations of methane from the Barents and Kara Seas, and also other Arctic areas. Large anomalies are documented in some areas, and these new observations appear fine, and probably deserves to be published.

In addition to the methane data the paper also aims at documenting changes in the sea ice cover, and draw conclusions about changes in ocean currents based on SST data. This effort is not well focused, and there are a number of fundamental problems listed below.

So I am sorry to say that I cannot recommend publication of this paper in any form

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close to this submitted version. My advise is to extract only the Methane data, present and discuss that, but stop there.

Perhaps the most fundamental problem is already clear in the first 4 words in the abstract: "Long-term (2003-2015) . . . ". Available observations for the Barents Sea go back at least 100 years, and the Kola section data is available through the PINRO institute, also cited in the paper (Page 17, line 574).

There are large oscillations in this very coupled air-ice-ocean system, om many time-scales, up to at least 50-60 years. Stating that 13 years of data is "long-term" in such a system reveals a fundamental lack of physical understanding, and also neglects the most basic findings in this area. Some essential papers are cited in this regard, but still the short time-series made available "suggests" a number of things to the authors.

There are also fundamental data missing for drawing the conclusions; one cannot deduce changes in ocean currents without observations of flow, or vertical structure of salt and temperature. Likewise - when concluding on changes in sea ice cover and SST, data on heat fluxes to that atmosphere is fundamental, and not included here.

Other Major Issues:

Length: The Results starts on page 12. There is a very long attempt at summarizing different aspects, but not a good one. There is also 4 pages of “Methods” with text that should have been in the introduction (Section 2.3 Settings). So overall this is just summarizing other peoples work, and it is also not a good summary. At least here “Long term” is used in the correct way (Page 10, line 350), stating 1905 onwards.

Figures. The figures are of a poor quality. Legends are too small (Fig. 7 – for example), There are a number of errors – the worst probably that the East Greenland Current flows northwards! In Fig. 4 a). Figure captions are not clear, and some Figures are missing (Fig. 3 c) stated in Figure 6 caption. Trends – as used in Figure 9 caption does not show trends, but a time series.

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The Language is poor – see examples below.

Some citations are used wrongly.

There is an overall lack of physical understanding – or perhaps just sloppy language. One Example from Page 4, line 131: “Sea ice significantly reduces surface albedo in the Arctic summer”. Sea ice INCREASES surface albedo. Along the same lines the Barents Sea has lost sea ice during winter mostly, and is certainly not the place that has the largest summer ice loss. Sea ice data is available back to 1850 (Walsh et a. 2017), and the southern Barents Sea has also been ice free during all that time.

The contribution from the atmosphere is totally ignored – but is of vital importance (Lee et al. 2017)

The conclusions drawn are not supported by the data made available.

A few of the (too many) Minor Issues:

Figure 1: Use Polar Stereographic Map. The Arctic is the focus here.

Figure 2: Legend states Jul, caption states Januay.

Figure 3: Red diamonds shows what kind of averages?

Figure 4: What is the citation for the currents? Northwards EGC!

Figure 5: PINRU in Caption. The 5 a) Map should be similar to the other maps.

Figure 6: Missing Fig. 3 c). Are the A areas the same as the numbers in Fig. 4?

Figure 7: Too small caption.

Figure 8: Legend in wrong figures. A - areas are what?

Figure 9: Trends are not single points. No trends on figure.

Line 78: The largest is loss in the WINTER – not SUMMER. (Onarheim et al 2018).

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Line 134 – 135: Summer or Winter? A warm annual-mean surface is mostly driven by increased AW inflow, preventing sea ice formation (Årthun et al 2013).

Line 143: winter mixed layer extends to bottom? Citation needed!

Line 435: The Barents Sea is included in the Arctic Ocean.

Line 439 – 446: Lacking fundamental physics. Ice advection and surface fluxes are not even mentioned.

Line 483 – 484: . . . "likely arises from variations in the strength and location of the MC". You have shown no data to support this statement. It is just a wild guess.

Line 489 – 490: There is no importance AW heat visible in Fig. 9.

Line 515 – 516: What about solar forcing – which you state is important in the Barents Sea. Here it would probably be the major contributor – not mentioned at all.

Line 536: No data on vertical mixed water.

Line 539 – 541: There is a fundamental lack of physics discussing atmospheric forcing. This is probably the major cause of the ice loss here (Lee et al, 2017).

Line 550 – 554: Just speculations – without surface flux estimates.

Line 574: No vertical data is shown, plenty is available.

Line 614 – 622: Alos wind forcing is not included, analyzed or discussed properly.

Line 682: Sloppy language: "Stronger currents could relate to larger oceanographic trends." What trends?

Line 686: Sloppy language: "currents are pushing the marginal ice zone."

Line 731: The southern Barents Sea has been ice free since 1850 (Walsh, et al 2017).

Line 751: Percey Current weaking? No – you show an SST cooling.

Line 757: “Clearly shifting?” - No – you do not shown any atmospheric fluxes.

Line 772: No methane discussion in Onarheim and Årthun (2017).

Line 779: . . . part of an apriori what?

Line 790 and 796: Again mistaking as increased SST signal with a strengthening current without further evidence.

A few suggested papers too read:

Lee at al (2017) Revisiting the cause of the 1989-2009 Arctic Surface Warming. GRL. 44.

Årthun et al (2013) Quantifying the Influence of Atlantic Heat on Barents Sea Ice Variability and Retreat J Clim., 25, doi:10.1175/JCLI-D-11-00466.1, 2012

Onarheim et al (2018) Seasonal and regional manifestation of Arctic sea ice loss, J. Clim. 31, doi:10.1175/JCLI-D-17- 0427.1

Walsh et al. (2017) A database for depicting Arctic sea ice variations back to 1850. Geogr. Rev., 107, 89–107, https://doi.org/10.1111/j.1931-0846.2016.12195.x.

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