

## ***Interactive comment on “Canadian Snow and Sea Ice: Trends (1981–2015) and Projections (2020–2050)” by Lawrence Mudryk et al.***

**Lawrence Mudryk et al.**

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Received and published: 15 January 2018

### **Specific comments**

**1) Several of the figures were provided at rather low resolution, for example Figure 6. Please provide high-resolution figures in the end.**

Yes, these will be provided.

**2) Line 35: If possible, you might consider providing the information about CAN-SISE in the acknowledgments rather than in the introduction; it is not of scientific interest perse.**

Moved

C1

**3) Line 42: A more relevant reference for CMIP6 is Eyring et al., GMD 2016: <https://www.geosci-model-dev.net/9/1937/2016/>**

Reference changed.

**4) Line 79: “future projections”: climate projections are always for the future, I think. “climate projections” might be better**

Agreed (→ line 87).

**5) Line 159: “Laliberte” -> “Laliberté”**

Changed.

**6) Line 187: “This difference may stem from...”: It should be possible to evaluate how much of the discrepancy is due to not using the NOAA record. This might be an interesting information.**

The plot attached illustrates both points during the spring (AMJ): 1) Arctic snow cover trends over Eurasia are stronger in both data sets than over North America; 2) the trend over the NH as a whole and over the NH Arctic region is about 50% stronger in the NOAA dataset than the multiple-source dataset used in our analysis. Both of these issues are discussed in detail in the Mudryk et al 2017 citation listed on line 209.

Caption: AMJ SCF trends in multi-source dataset (left) and NOAA dataset for 1981-2015 period. Pairs of numbers on the far right indicate the average trend over the entire NH (black), NH Arctic (blue) and Canada (red) for the multisource dataset (top) and the NOAA dataset (bottom).

**7) Line 205: “The reduced warming and cooling over northwestern Canada...” This sentence is a bit cryptic. Can you be a bit more explicit, e.g. explain what the Mudryk et al 2014 paper says?**

We have added text at lines 224-229.

C2

**8) Line 211-217: It is unclear to me why subtracting a mean value should change the correlation – which means that I certainly haven't understood your explanation of centered and uncentered spatial correlations. Please consider giving some more detail on the method. What does an uncentered correlation mean physically?**

The Pearson's correlation coefficient that is typically calculated \*is\* a centered correlation (the mean field value is subtracted before the fields are multiplied). For an uncentered correlation, the mean value is not removed. This metric measures the average behavior of the fields (whether they are both positive on average, both negative on average, of opposite sign on average, or unrelated on average). Because spatial patterns of SIC and SCF trends may fluctuate in response to multiple drivers other than TAS, the uncentered correlation provides confirmation that overall, both fields are decreasing in response to increasing surface temperature (as expected), however, there may be differences resulting from other drivers.

**9) Line 224: "...ice (...) is more difficult to melt than snow..." OK, one understands this of course, but the formulation sounds a bit strange.**

Wording clarified on line 245.

**10) Line 239 "the summer is ice season": delete "is"**

Thanks.

**11) Line 281: Relative impact of natural variability, scenario uncertainty and model uncertainty: Can you quantify this a bit better in this particular context?**

We have changed the citation to Hawkins and Sutton, 2009 and 2011 which allows us to cite their estimates of the fraction of uncertainty due to forcing scenario at a lead time appropriate for mid-century projections (lines 310-313).

**12) Line 287: Typo ("reigon")**

C3

I couldn't find this typo. Perhaps it got changed at some point.

**13) Line 302: OK, but SCF should also depend on precipitation rate, and probably more so than SIC does.**

As part of the response to reviewer 1, we have included additional analysis on snowfall trends (new Figure 5) and new text at lines: 252-263.

**14) Line 324: Missing full stop at the end of the sentence. This result (that a large portion of the inter-model spread is associated with internal variability) is striking and might be emphasized/elaborated on a bit more.**

We have added an additional reference at line 356.

**15) Line 356: Full description in Laliberté et al., 2016: OK but can you give a very short description of the method here?**

Included (lines 394-399).

**16) Line 361: "...will be sea ice free in September." Add, for clarity, "by 2050"; please indicate whether this concerns decadal averages, 30-year averages, extreme years,....**

Added "by 2050". The additional description should address the latter portion of the comment.

**17) Line 388: "precipitation availability": sounds strange to me. Precipitation either occurs or not, it is not "available" for somebody to buy it.**

This was a typo. We have rephrased the sentence (line 430).

Please also note the supplement to this comment:

<https://www.the-cryosphere-discuss.net/tc-2017-198/tc-2017-198-AC2-supplement.pdf>

C4

C5

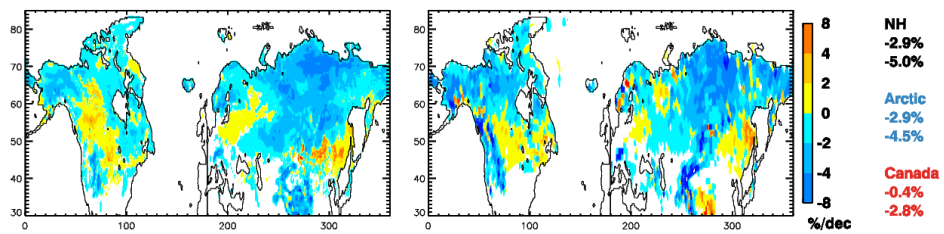


Fig. 1. AMJ SCF trends

C6