

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

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The current study analyses past and future snow and sea ice trends in Canada. For the past (1981-2015) the authors investigated snow trends from four different gridded data sets and sea ice trends from the CISD archive. For the future (2020-2050) they investigated the output of several dozens CMIP5 models. The results demonstrate clear changes for the past and the future despite some regional differences. Such analyses are important in a large northern region such as Canada because the corresponding changes in the surface energy budget may have a global impact. Moreover, such analyses are also an important basis to understand ecological and economical changes in such a sensitive region. The structure of the paper is clear, the text is concise and follows a obvious thread. The methods and results are nicely presented. Despite the

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many acronyms the study is relatively easy to read. One point I'm missing is the fact that the precipitation impact is totally neglected in the analysis of the past snow trend. Otherwise, I have only some minor comments, which are listed below:

L29: You use at least four different expressions for annual maximum SWE throughout the paper. I don't like peak pre-melt SWE, since melt can also happen before maximum SWE. I suggest using always the same expression.

L 38: I would like to see some references, which demonstrate “the critical importance of snow/sea ice to Canada's natural environment, ecosystems, and economy.”

L 99-104: Please write some sentences about the percentage of affected pixels and which regions are mainly impacted.

L 111-119: For consistency and understandability please introduce here somewhere the investigated sea ice variables, similarly as it has been done in the former chapter for snow.

L 116: As a non sea ice specialist, I would like to see short hint saying that sea ice concentration is a similar measure as snow cover fraction and is therefore also expressed in percentage.

L 136: Please provide some information about the spatial resolution of the used CMIP5 output.

L148-149: “. . .branch off from five different historical simulation. . . “ I don't understand this sentence, please elaborate.

L 159: The acronym “SIE” is not used anymore in the following text, so please delete.

L 179-180: What is the reason you define the seasons different from the usual meteorological definition? Maybe, add a corresponding sentence in the methods chapter.

L 205: “. . .region with positive SCF trends is slightly more extensive.” It would be helpful if you could at least write some sentences about the observed precipitation variability.

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L 275: “modal thickness”?

L 283-284: The multi-model projected mean changes in surface temperature are positive in all seasons, hence only reductions in ensemble mean SCF and SIC are evident in Figure 8.

L 310: “. . . balances projected increases in snowfall.” It’s the first and only time you write about projected increases in snowfall. Could you please elaborate.

L 311: “snow mass”, I guess you mean SWE, which would be a more familiar term and consistent with what you used already.

L 329: Is it not 1981-2015 for the present and 2020-2050 for the projection?

L 330: Why using a new variable Ts and not TAS?

L 349: . . .shows the observed record of annual sea ice extent. . .

L 377: MYI losses

L 413-418: This paragraph seems kind of odd at the first sight, because alpine snow has only been mentioned once at the beginning. Please link this important content to the corresponding analysis.

L 427: FYI as not been introduced so far.

L 445: (Laliberté et al, 2016) “Resolving the dates. . .has important implications for climates studies” Please elaborate.

L622: Not in press anymore. . .

L 664-665: Please elaborate more clearly what’s the difference between the region with single hatching and crossed hatching. The text in chapter 3.1 should also reflect these differences.

L 685: I suggest to put the 10^3 in the axis label for figure 6 a-d.

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L 705: Replace snow water mass with snow water equivalent.

L 711: Please explain “Tsd” and mention that Tth is -5°C , since the scale of the legend bar is not linear. Also elaborate what Tth actually controls, i.e. that the bluish colored regions are mainly controlled by precipitation.

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