

## ***Interactive comment on “Winter hydrometeorological extreme events modulated by large scale atmospheric circulation in southern Ontario” by Olivier Champagne et al.***

**Anonymous Referee #1**

Received and published: 7 November 2019

This manuscript presents an index to describe warm, heavy rain events during winter in southern Ontario. This index is then used to evaluate the occurrence of such events with different large scale circulation patterns and projections for the future. The paper presents a thorough analysis and I appreciate the detailed discussion included in Section 4. Some concerns are listed below.

My main concern is that the authors have not provided sufficient justification for the need to create a new index. The introduction focuses on rain on snow events, but this new index does not consider snow cover. This disconnect needs to be more fully explained. Why is the proposed index better than those used in previous literature?

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Considering this is a special issue on large ensembles, I think there should be more discussion about how this work is taking advantage of the large ensemble used here.

Specific comments:

Line 52: Is the “precipitation” here referring to rain or snow or both?

Line 84: Was only the future period bias corrected?

Line 87: Is precipitation frequency also modeled with a gamma distribution? This makes more sense for intensity.

Line 138-141: What effect would the trends within these two periods have?

Section2.4/Section 3.1: Were the top regimes determined separately for the model and reanalysis? If so, then I think the good agreement warrants more commentary. If not, can you describe more clearly how they are related?

Section 3.2: Is the modelled and bias-corrected data being compared against the dataset used for the bias correction target? If so, can you add a brief discussion on the implications?

Section 3.3: What does the model bias in the South regime mean for these projections? How robust are the streamflow projections when they do not account for changes in snowfall/snowpack or associated feedbacks?

Line 229: Do you mean the magnitude of the correlations here?

Line 237: Can you clarify what is meant by the combination of weather regimes? The value of using these combinations instead of just changes in individual regimes is not clear.

Figure 1: I found it very difficult to orient myself in this figure. It is hard to discern the coastlines of the Great Lakes from the contours in the large scale figure and the legend covers the land separating two lakes. It would be very helpful to label the lakes and

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key places here, especially since so much of the later discussion is very specific about local geography.

Figure 2: Why is the scale of the horizontal axis nonlinear? With the current spacing and connecting line, this time series is misleading.

Figures 4-7: The figure label (“simulations minus observations”) does not agree with the caption (“CanGRD minus CRCM5-LE”)

Figure 8: Are the ensemble values pooled or averaged?

Line 462: This paper should be cited as Jeong and Sushama

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Interactive comment on Earth Syst. Dynam. Discuss., <https://doi.org/10.5194/esd-2019-56>, 2019.

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