We would like to thank the reviewer for their comments on our paper. Please find our answers below:

Reviewer #1:

This paper looks at potential future shifts in climate and streamflow for four river catchments in southern Ontario. The CRCM5-LE RCP 8.5 scenario projections of air temperature and precipitation were used as input in the Precipitation Runoff Modelling System (PRMS) to determine future streamflows. One conclusion of the work is the increase in winter streamflows in the future, particularly in the months of January and February. I find this very speculative because the bias between the observed and simulated flows for the historical period is greatest for these months. The bias is not adequately addressed in the paper and the uncertainties contributing to this bias are not adequately discussed. Hence, I recommend major revisions be carried out before the paper is considered for publication.

Please find below our answer to address the bias.

Major comments include:

Page 1, Line 27: "glaciated or nival catchments" – why even mention this since southern Ontario is a region that has neither glaciated not nival areas?

"Glaciated and nival catchment" will be replaced by ''snow-dominated region'' in the new version of the manuscript. Snow is a very important component of the hydrology in southern Ontario and we found it important to mention that similar shifts in streamflow were observed in other snow-dominated catchments around the world.

Page 3, Line 20: You use the reference Marstrom et al. But I believe, PRMS was first developed by George Leavesley from USGS in the 1980s – shouldn't he be credited for the model development as well?

The reference Leavesley et al., (1983) will be added to the manuscript.

Page 5, Line 16: Please expound on the difference between observational and controlled streamflow.

Observational streamflow is the streamflow measured at each watershed outlet and controlled streamflow is the streamflow simulated by PRMS using observed temperature and precipitation. These details will be added to the manuscript.

Page 5, Line 16: Please explain the meaning of "controlled stream flow" and why CanGRD is used specifically to simulate it.

Controlled streamflow is the streamflow simulated by PRMS using observed temperature and precipitation. We called it control to not confuse it with the streamflow simulated using biased corrected CRCM5-LE temperature and precipitation (HIST). It also needs to be distinguished from the streamflow measured at the outlet (OBS). The expression "controlled streamflow" will be removed to avoid confusion and details about OBS and CTL will be added.

CanGRD meteorological dataset was used in a previous study focusing in southern Ontario (Wazneh et al., 2017). This dataset is often referred to as NRCANmet in number of other studies and is the most commonly used gridded climate dataset in Canada (Werner et al., 2019). The dataset was produced using station-based observations from Environment Canada and Natural Resources Canada and the gridding was accomplished using the Australian National University Spline (ANUSPLIN) with latitude, longitude and elevation as predictors (Hutchinson et al., 2009). To avoid confusion with a monthly product created by Environment Canada called CanGRD, the dataset will be renamed NRCANmet in the entire manuscript.

Page 5, Line 18: More discussion is required on the performance of the simulations of the historical period.

Page 5, Line 18: A comparison is required between historical and observed results to provide some confidence in the simulations.

Page 5, Lines 15 to 24: More discussion is required on model and data uncertainties, perhaps not here but elsewhere. Perhaps the bias correction is ok, but there may be some major issues with the hydrological model?

Figure 3: As stated above, the bias in flows for January and February are too large to be glanced over quickly and requires more attention in the paper, especially since you are making substantial conclusions from these periods with largest bias. Due to this major weakness in the paper, the rest of the paper loses credibility and the subsequent discussion seems moot.

A paragraph discussing the historical discrepancy between OBS, CTL and HIST was included in the discussion of the submitted manuscript (Section 4.1). The streamflow from CTL is clearly overestimated by PRMS in Big Creek and Thames River as compared to OBS but the annual cycle was well reproduced by PRMS. PRMS have been previously used for these watersheds and snow processes in Big Creek watershed were well simulated (Champagne et al., 2019). Overestimation of streamflow may be from the ANNUSPLIN method that overestimates precipitation in this region (Newlands et al., 2011). Despite the biases from ANNUSPLIN, NRCANmet is the most widely used gridded dataset in Canada (Werner et al., 2019) and can be used with confidence. Further discussion on overestimation from ANNUSPLIN will be added to the manuscript. The authors are also aware that the results are from a single model chain and it will be relevant in the future to use other models. We will therefore mention this concern in the conclusion of the manuscript: ‘’Despite a large number of regional climate simulations used here to drive a hydrological model, the 50 member ensemble used here represents internal variability derived from a single model chain (CanESM2, CRCM5 and PRMS). As a result, this ensemble does not consider other important sources of uncertainty from emission scenario and model structure’’.

Some editorial comments are:

Page 1, Line 28: period at end of sentence is missing

Page 2, Line 12: “conditions”, not “condition”

Page 2, Line15: should read: . . . the GCMs’

Page 2, Line 22: closed bracket missing after Leduc et al., 2019)

Page 2, Line 27: should read: Seiller and Anctil (2014)

Page 2, Line 28: should read: Erler at al. (2018)

Page 3, Line 8: should read: . . . Brantford along (on?) the Grand River and London along (on?) the Thames River . . .

Page 3, Line 22: “The latter”, not “These latest” - the former phrase refers to a position in sequence, the latter to a point in time.

Page 4, Line 25: reference should read: Ines and Hansen (2006)

Page 5, Line 11: reference should read: Deser et al (2014)

Page 5, Line 22: The simulated range . . . is “wide”, not “high”? I’m referring to the second occurrence of “high” in that line.

These errors will be corrected

I’ll stop here. There are too many errors and I’ll leave it to the editor to pick those up.

The grammar and typographic errors will be corrected in the entire manuscript

Comments to figures: The color shading in the legend of Figure 3 is not consistent with the shading of the graphs. Also the color shading is not consistent with the legend shading in Figure 4. The graphs are very busy and hard to interpret, especially with the inconsistent shadings between graphs and legends. This needs to be fixed.

The shade colors in the legend will be modified to correspond to colors from the graphs. To make the graph less busy we will remove the horizon 2080s which were not included in the analyses (Figure R1). Figures 4 and 5 will be similarly modified.

References:

Champagne, O., Arain, M. A. and Coulibaly, P.: Atmospheric circulation amplifies shift of winter streamflow in Southern Ontario, Journal of Hydrology, 124051, doi:10.1016/j.jhydrol.2019.124051, 2019.

Leavesley, G. H., Lichty, R. W., Troutman, B. M. and Saindon, L. G.: Precipitation-runoff modeling system; user’s manual., 1983.

Newlands, N. K., Davidson, A., Howard, A. and Hill, H.: Validation and inter-comparison of three methodologies for interpolating daily precipitation and temperature across Canada, Environmetrics, 22(2), 205–223, doi:10.1002/env.1044, 2011.

Werner, A. T., Schnorbus, M. A., Shrestha, R. R., Cannon, A. J., Zwiers, F. W., Dayon, G. and Anslow, F.: A long-term, temporally consistent, gridded daily meteorological dataset for northwestern North America, Scientific Data, 6(1), doi:10.1038/sdata.2018.299, 2019.