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Hydrology and Earth System Sciences Discussions

Interactive comment on "Uncertainty in the impacts of projected climate change on the hydrology of a subarctic environment: Liard River Basin" *by* R. Thorne

Anonymous Referee #2

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Review comments on the manuscript:

Uncertainty in the impacts of projected climate change on the hydrology of a subarctic environment: Liard River Basin

By R. Thorne

The manuscript presents a study of the impacts of different climate models on the hydrological cycle of a subarctic catchment. The author uses seven GCM scenarios and forces a semi-distributed model with the GCM outputs. The hydrological model has been calibrated against discharge data and the designated parameters are used

for the scenario simulations. The author finds that river discharge will be impacted by atmospheric warming greater than the global average. However, the subarctic nival regime will be preserved in the future. The uncertainty of simulated discharge ranges from a 15% increase to 3% decrease in annual runoff. The analysis of GCM forced hydrological modelling uncertainty is not new and the manuscript presents no scientific innovation. Looking only into changes/uncertainty in discharge is not state of the art any more and deeper assessments of the impacts of GCM uncertainty on further variables of the hydrological cycle should be studied. The manuscript, as it is now, is a nice case study but not a scientific contribution which adds knowledge to the field of hydrological modelling and climate change impact assessments.

Major comments:

1. The introduction is too general and does not give a good overview of the state of the art. The uncertainty which is emphasized in the title of the manuscript is not only caused by the GCM outputs but also by the hydrological model and its parameters. Internal inconsistencies of the hydrological model are significant sources of errors, which need to be addressed in the introduction. 2. Some more details on the catchment characteristics would be interesting, e.g. which are the main aquifer systems where the water is stored; average precipitation amounts (snow and rain), etc. 3. The hydrological model needs to be described in more details. Which melt model is used? How is evapotranspiration calculated? How is the gridded climate data used as input to the semi-distributed model? 4. Calibration of hydrological models against discharge data is a standard approach. However, especially in melt water dominated environments this could lead to significant internal inconstancies which can have a great impact on the scenario simulations. The uncertainty of the hydrological model needs to be analysed, especially if absolute values (in % p. 3142, lines 25, 26) are given. This could be done by means of Monte-Carlo simulations (e.g. Konz and Seibert, 2010 (JoH)). 5. Why was only one gauging station used to calibrate the model? According to Burn et al. (2004, Hydrological Sciences Journal) there are 12 stations available in the basin. 6.

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It seems that the model has only been calibrated without validation in an independent time period. 7. Figure 2 does not add additional information. 8. The author discusses the different sources of errors in the data and methods chapter (pp. 3133 lines 12ff) but does not consider that in the uncertainty analysis. 9. The discussion of the uncertainties in projected changes in air temperature and precipitation are to long and should be shortened. I suggest showing the spatial variability of the different GCM outputs as one map which shows, on a pixel basis, the standard deviations of the GCMs produced air temperature fields and precipitation fields. The same could be done for 6a. 10. In chapter 6.1 the spatial variability of all components of the hydrological cycle should be discussed rather than only looking into discharge. What about changes in storages of water? 11. Table 1 gives no uncertainty caused by discharge simulations of this hydrological model this is important and needs to be added. 12. It would be interesting to compare the uncertainty induced by the GCM outputs with the uncertainty caused by the hydrological model parameters. This could be shown in Figure 7. 13. pp. 3143, lines 6ff: This is textbook knowledge. I am wondering what can be learned from this study compared to the main other case studies on CC impact assessments already published in literature.

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