

Interactive comment on “Recent trends and variability in river discharge across northern Canada” by S. J. Déry et al.

Anonymous Referee #1

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This manuscript, based on the lead author's previous work and experience, re-evaluates river discharge trends across northern Canada. It examines long-term (50 yrs) and large-scale changes/variability in discharge for 42 rivers draining northern Canada. The research question of this paper is important, i.e. whether or not river discharge in northern Canada has a continued decrease in the twenty-first century as first reported by Déry and Wood (2005). This work also discusses the effects of flow regulation and climate variability over the large regions. The data, methods, and results of this analysis are useful for cold region hydrology/climate and arctic research.

This paper is clearly written and easy to follow and read. I have some comments and suggestions below and would recommend a minor revision to further improve the quality of this manuscript.

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Dam effect and regulation: Flow regulation by dams and reservoirs exist in most of the large northern basins in Canada. Many studies clearly show that dam regulation significantly affects the timing and magnitude of discharge at season to annual time scales. This paper separated basins with and without dams and compared their flow changes and variations. To better understand dam effects in this analysis, it is necessary to collect and present the dam info for each basin. I would suggest providing dam info in Table 1, including number of dams in the basins and total capacity of all reservoirs relative to the basin mean flow. This will be a useful measure to reflect the degree of regulation for a specific watershed. With this info for all the regulated basins, it is then possible and useful to integrate it into the regional scale and discussion of the flow CV and change.

This paper discussed the regional flow regimes without the use of any hydrographs. The authors do have the daily and monthly flow records for each basin. It is very useful to show the mean hydrograph for the regions in discussion. With the hydrographs, monthly flow data will be used and presented to show the seasonality of flow and also the difference of mean flows between the regulated and unregulated basins. I would also suggest, for the regulated basins, to work out and compare the mean flows for the pre- and post-dam periods, so as to demonstrate the magnitude of dam effects on flow conditions.

Citation of papers: Rivers are very different from one to the other. Many good papers have been published in the last 10 years on northern river hydrology; some of them are extremely useful for this work over northern Canada. The authors should read and cite more papers (a short list below), particularly those on basin-scale analyses of hydrological regimes and changes induced by climate variation and human impacts.

Woo, M.K., Thorne, R., 2003: Streamflow in the Mackenzie Basin, Canada. *Arctic* 56, 328-340.

Peters, D.L., Prowse, T.D., 2001: Regulation effects on the lower Peace River, Canada.

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Hydrol. Process. 15, 3181e3194.

Yang, D., X. Shi, P. Marsh, 2014: Variability and extreme of Mackenzie River daily discharge during, 1973-2011, Quaternary International, doi/10.1016 /j.quaint.2014.09.023

Wang S. J. Huang, D. Yang, G. Pavlic, and J. Li, 2014: An assessment of long-term water budget closures for large drainage basins in Canada, Hydrological Processes, DOI: 10.1002/hyp.10343.

Conclusion: The paper states. . .” Of note is the augmented variability in both regulated and unregulated rivers during the most recent decade of study (2004-2013), which may be climate-driven. It is clear from many other studies that the regulated basins are not reliable to reflect climate change impact to basin hydrology change. The argument in this paper about climate-driven similar changes in flow variation in regulated and unregulated basins might be true; however, the fact remains that with the strong dam regulation, it is difficult or impossible to detect climate signal over a basin. Thus, it is always better to rely on flow data and info from the unregulated rivers.

Finally, at the end of the Conclusion Section, the paper states “Use of a hydrological model forced by output from global climate models under various scenarios also allows projections of future discharge across northern Canada. This work is currently being undertaken by the authors with the Arctic-HYPE hydrological model (Andersson et al., 2015) for the Hudson and James Bay drainage basin.” This work is interesting, but it is unclear if the ongoing modeling work has considered human activities, particularly dams in the basins.

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