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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Examining controls on peak annual streamflow and floods in the Fraser River Basin of British Columbia" *by* Charles L. Curry and Francis W. Zwiers

S. Dery (Referee)

sdery@unbc.ca

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Summary: This is a very interesting effort highly suitable for publication in Hydrology and Earth System Sciences. The paper is very well-written and figures are generally clear and entirely appropriate to illustrate key points. Perhaps one weakness is that the structure of the paper is confusing, with a mixture of methods, results and discussion within the Results section. This report provides guidance that the authors should consider in revising their manuscript.

General Comments:

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1) The structure of the manuscript requires some reorganization, as methodological information is at times provided in the Results section. All aspects of the methods should be provided in Section 2, which should improve the legibility of the paper. Similarly, the Discussion is rather brief and needs to be enhanced to better describe the implications of the results and potential applicability to other snow-dominated watersheds worldwide.

2) Apart from manual snow surveys (usually conducted on a bi-weekly basis), the British Columbia (BC) River Forecast Centre operates an extensive network of snow pillow stations that provide daily snow depth, snow water equivalent (SWE) and meteorological data in real-time. Why not incorporate the data from the snow pillow network within and near the study area (FRB) to improve the potential predictability of annual peak flows in the Fraser River? The snow pillow data are an integral part of operational flood forecasting in BC and so incorporating those data in the statistical models would inform provincial hydrologists on the importance of those snow data in predicting annual peak flows (APFs) in the Fraser River.

3) Why are some of the larger subbasins of the FRB not included in the present study? The Nechako, Blackwater (West Road) and Chilcotin Rivers all form important tributaries to the Fraser River with generally complete observational records from the early 1950s onward (early 1970s for the Chilcotin River) and could provide further regional insights on the contributions of these systems to the APFs observed on the Fraser River at Hope.

4) Overall, which subbasins contribute most to the observed APFs on the Fraser River at Hope and what are the lag times between their high flows and those downstream? Presumably information on upstream flows alone can provide a measure of predictability on the potential high flows for the Fraser River at Hope. . .

Specific Comments:

1) P. 2, lines 3-14: The introduction could highlight the ecological importance of the

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Fraser River, namely its globally-significant salmon populations who migrate twice through the river to/from the Pacific Ocean during their lifetimes.

2) P. 2, line 10: The abbreviation for British Columbia was defined on line 3, so use it henceforth. A similar issue arises with other abbreviations that are not necessarily used after being defined.

3) P. 2, lines 19-20: Why provide here the details of the Water Survey of Canada hydrometric gauge on the Fraser River at Hope, BC? This detailed information can be provided in the Data and Methods section.

4) P. 3, lines 16-18: Note that Déry et al. (2012) explored trends in the variability of flows at 139 sites across the FRB while Hernández-Henríquez et al. (2017) assess trends in flows for 136 sites for rivers draining BC's Coast and Insular Mountains. While there is some overlap between the two datasets used in these efforts, they remain two independent studies with different goals, study areas and streamflow datasets.

5) P. 4, line 23: Rather than 'private communication', this should likely be 'personal communication'.

6) P. 5, line 4 and elsewhere: Date formats may need to be changed depending on the journal's preference, i.e. perhaps '5 June'.

7) P. 5, line 6 and elsewhere: Use superscripts for all units, i.e. 'm3 s-1'.

8) P. 6, line 3: Here again abbreviations for the FRB and BC could be used.

9) P. 6, line 18: Add the year of this publication.

10) P. 6, lines 22 and 23: Spell out "WNA" and "PRISM".

11) P. 7, line 3: How many elevation bands are used in the VIC simulations?

12) P. 7, lines 19-24: Moore and McKendry (1996) and Hsieh and Tang (2001) both provide relevant information on the impacts of large-scale teleconnections on BC's

snowpacks and should therefore be included as important references here. Whitfield et al. (2010) also provide a comprehensive overview of the impacts of the Pacific Decadal Oscillation on the hydroclimate of western Canada.

13) P. 7, line 31: Fix comma before “see”.

14) P. 8, line 28: Why are trends inferred from linear regressions and not the Mann-Kendall test instead?

15) P. 9, line 9: Why focus only on 1 April SWE when many sites across the FRB experience their peak annual accumulations near 1 May (e.g., Déry et al., 2014)?

16) P. 11, line 22: Should this be “latter half”?

17) P. 12, lines 28-30: What are the units for the variables in Equations (1) and (2)?

18) P. 15, line 23: The ‘p-value’ is missing here.

19) P. 17, line 7: Here again units are missing for the variables in the multivariate regression (Equation (3)).

20) P. 21, line 13: Delete ‘in order’.

21) P. 22, line 5: Same comment.

22) P. 22, line 30: Please provide the full range of pages for this reference.

23) P. 23, line 29: Add the article number for this reference.

24) P. 24, line 2: Add the full range of pages for this reference.

25) P. 24, line 19: Add the volume and correct page range for this reference.

26) P. 25, line 18: Add the article number for this reference.

27) P. 27, line 20: Update this reference if this paper has now been published in the regular section of HESS.

28) P. 28, Table 1: Why are the Upper Fraser, Quesnel, Thompson and Chilko Rivers selected as subbasins for this study? Why does the period of record end in 2013 for three of these rivers?

29) P. 36, Figure 5(a): Are the discrepancies between observed and VIC-simulated flows for the APFs due to the lack of a representation of the interbasin diversion of flows from the Nechako Reservoir and River towards the Kemano River?

References:

Déry, S. J., Hernández-Henríquez, M. A., Owens, P. N., Parkes, M. W., and Petticrew, E. L.: A century of hydrological variability and trends in the Fraser River Basin, Env. Res. Lett., 7, 024019, 2012.

Déry, S. J., Knudsvig, H. K., Hernández-Henríquez, M. A. and Coxson, D. S.: Net snowpack accumulation and ablation characteristics in the Inland Temperate Rainforest of the Upper Fraser Basin, Canada, Hydrology, 1, 1-19, 2014.

Hernández-Henríquez, M. A., Sharma, A. R., and Déry, S. J., 2017: Variability and trends in runoff in the rivers of British Columbia's Coast and Insular Mountains, Hydrol. Proc., 31(18), 3269-3282.

Hsieh, W. W. and Tang, B.: Interannual variability of accumulated snow in the Columbia basin, British Columbia, Water Resour. Res., 37, 1753-1759, 2001.

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Whitfield, P. H., Moore, R. D., Fleming, S. W., and Zawadzski, A.: Pacific Decadal Oscillation and the hydroclimatology of western Canada – Review and Prospects, Can. Water Resour. J., 35, 1-27, 2010.

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