



PCIC UPDATE NOVEMBER 2014

EVALUATING A HYDROLOGIC MODEL'S ABILITY TO SIMULATE STREAMFLOW INDICATORS

Simulated hydrologic streamflow indicators are often used to understand the effects of human-induced changes, such as land-use change, and climate change. Given that the ability of hydrologic models to replicate the different components of streamflow is affected by uncertainties, PCIC initiated a study to evaluate the ability of the Variable Infiltration Capacity (VIC) hydrologic model to simulate variations in a wide range of ecologically relevant streamflow indicators. The evaluation was undertaken for two headwater sub-basins in the Fraser River (Salmon and Willow), using the VIC model. One simulation used the VIC model driven by observations and eight simulations used statistically downscaled global climate model output.

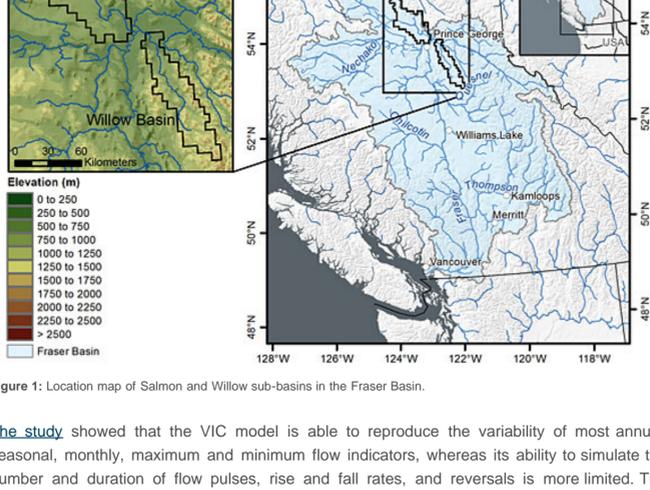
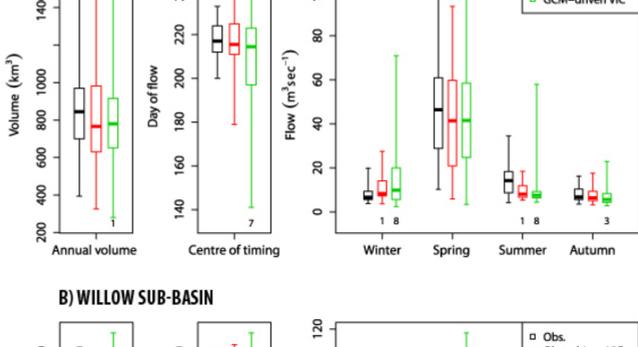


Figure 1: Location map of Salmon and Willow sub-basins in the Fraser Basin.

The study showed that the VIC model is able to reproduce the variability of most annual, seasonal, monthly, maximum and minimum flow indicators, whereas its ability to simulate the number and duration of flow pulses, rise and fall rates, and reversals is more limited. The comparisons of the distributions of the observed-climate driven and GCM-driven VIC streamflow indicators (Figure 2) indicate that, when driven with observations, the VIC model shows good skill in replicating annual flow volumes and the date at which half that amount has been produced. Spring and autumn flows are also well simulated, but simulated winter flows are larger than observed, and summer flows are smaller. The GCM-driven results showed larger discrepancies, with statistically significant differences from observations for some of the seasonal and annual flow volumes. In summary, the ability of the hydrologic model to simulate a given streamflow indicator needs to be carefully examined before using it to assess future hydrologic changes. For further details, readers are referred to our article, [Shrestha et al. \(2014\)](#). The second phase of the study is currently underway, which considers the model's ability to simulate hydrologic responses to the Pacific Decadal Oscillation (PDO) and El Niño–Southern Oscillation (ENSO) climate states.

A) SALMON SUB-BASIN



B) WILLOW SUB-BASIN

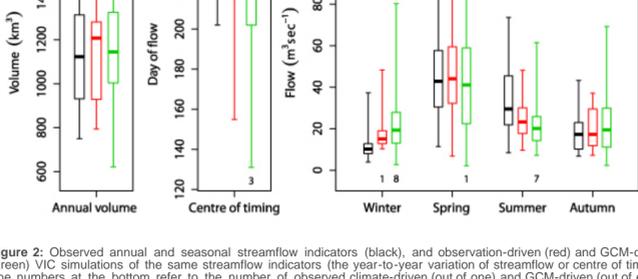


Figure 2: Observed annual and seasonal streamflow indicators (black), and observation-driven (red) and GCM-driven (green) VIC simulations of the same streamflow indicators (the year-to-year variation of streamflow or centre of timing). The numbers at the bottom refer to the number of observed climate-driven (out of one) and GCM-driven (out of eight) results with statistically significant differences from observations. All runs are for the climate of the 20th Century, with the Salmon sub-basin being simulated over 1971–2000 and the Willow sub-basin being simulated over 1976–2000. Box plots illustrate the median and inter-quartile range, and whiskers represent the upper and lower limits. The numbers at the bottom refer to the number of observed climate-driven (out of one) and GCM-driven (out of eight) results with statistically significant differences from observations.

PCIC EXPANDS OUR DATA PORTAL WITH STATION HYDROLOGIC MODEL OUTPUT

Since the launch of PCIC's Data Portal in 2012 with the BC Station Data Page, PCIC has been working to make more data available to scientists, planners and consultants interested in the climate of the BC-Yukon Region. To this end, PCIC is pleased to announce the release of the newest portal page: [Station Hydrologic Model Output](#) which joins PCIC's other portal pages: [BC Station Data](#), [High Resolution PRISM Climatology](#), [Statistically-Downscaled Climate Scenarios](#) and [VIC Hydrologic Model Output](#). The [Station Hydrologic Model Output](#) portal page provides modelled streamflow data for over 120 sites located in four basins in British Columbia. These projections were made at PCIC with the Variable Infiltration Capacity hydrologic model, using statistically-downscaled output from global climate models that were run using three different future emissions scenarios. Projections are available as daily time series from 1950 until 2098. PCIC gratefully acknowledges the BC Government and BC Hydro for funding that made this project possible.

Visit the new [Station Hydrologic Model Output Data Portal Page](#).

CLIMATE INSIGHTS 101 COMPLETED

Figure 3: Example of the Climate Insights 101 interface and content.

The Pacific Institute for Climate Solutions, working with PCIC scientists, has completed the development of the three Climate Insights 101 courses. These courses, comprised of three-to-four sets of lessons apiece, concentrate on three areas: climate science basics, BC impacts and adaptation, and mitigation. Climate Insights 101 provides a comprehensive introduction to the foundations of climate science, climate projections and impacts, as well as adaptation opportunities and the tools and initiatives available for mitigation.

Begin exploring [Climate Insights 101](#).

NOVEMBER WORKSHOP: QUANTIFYING FUTURE WATER AVAILABILITY IN A CHANGING CLIMATE

On November 18th, the Canadian Water Resources Association's BC Branch held a workshop in Vancouver at which PCIC scientists contributed by discussing their hydrologic projections for four watersheds in BC: the Fraser, Peace, Campbell and Columbia. The researchers explained their methodology, shared their results, and detailed some of the uncertainties and limitations of their projections. PCIC's projections, which include gridded surface runoff, baseflow, evaporation, snow water equivalent, and soil moisture for an area of 430 km² at a resolution of approximately 30 km², are now available online via PCIC's [Data Portal](#), through an intuitive point-and-click interface. PCIC scientists also discussed the use of this Data Portal Page, [Station Hydrologic Model Output](#).

IPCC AR5 SYNTHESIS REPORT RELEASED

On Sunday, November 2nd, the IPCC released the Synthesis Report that brings together the findings of the three working groups contributing to the Fifth Assessment Report (AR5). This Synthesis Report covers a large number of topics, from observations to economic assessments, at a high level and repeats with greater certainty findings that have figured prominently in earlier IPCC assessment reports.

See our [News section](#) for more information or read the [Synthesis Report](#) on the [IPCC's website](#).

SUMMARIES OF PCIC MEETING SERIES RELEASED

Over the past year, PCIC has held three meetings between the scientists working on its three research themes and the users of the services and products developed by each of these themes. These meetings served as a two-way exchanges between users researchers that provided all involved an opportunity to take stock of the research and results to-date, provide feedback and discuss the road map for the theme's near future, helping PCIC to focus theme activities on the dissemination of information and the provision of data that is relevant to stakeholder's needs and objectives. The highlights of these discussions have now been released as workshop summaries, available from our Publications Library.

For more information, read the [Climate Analysis and Monitoring Meeting Summary](#), the [Regional Climate Impacts Meeting Summary](#) and the [Hydrologic Impacts Meeting Summary](#).

NEWSWORTHY SCIENCE

PCIC has released a new science brief that covers a recent article in the journal *Nature Climate Change* by Meehl and colleagues. Their work examines output from the models participating in the fifth phase of the Coupled Model Intercomparison Project (CMIP5) to see if any simulations replicated the warming "hiatus" of the past 15 years and if so, if these simulations show changes in the Pacific Ocean that are consistent with current research regarding the temperature hiatus, and whether the hiatus could have been predicted. They find that model simulations that had a negative phase of the Interdecadal Pacific Oscillation (IPO) also simulate hiatus conditions. They conclude that the hiatus could have been predicted with CMIP5 models initialized only with data that was available prior to the hiatus.

[Read this Science Brief.](#)

RECENT PAPERS AUTHORED BY PCIC STAFF

Cannon, A.J., in press. [Selecting GCM scenarios that span the range of changes in a multimodel ensemble: application to CMIP5 climate extremes indices](#). *Journal of Climate*, doi:10.1175/JCLI-D-14-00636.1.

Christidis, N., P.A. Stott and F.W. Zwiers, 2014: [Fast-track attribution assessments based on pre-computed estimates of changes in the odds of warm extremes](#). *Climate Dynamics*, doi:10.1007/s00382-014-2408-x

Kumar, S., P. Dirmeyer, D. Lawrence, T. DelSole, E. L. Altshuler, B. A. Cash, M. J. Fennessy, Z. Guo, J. L. Kinter III and D. M. Strauts, accepted. [Effects of Realistic Land Surface Initializations on Sub-seasonal to Seasonal Soil Moisture and Temperature predictability in North America and in Changing Climate simulated by CCSM4](#). *Journal of Geophysical Research Atmospheres*, doi:10.1002/2014JD022110.

Schnorbus, M.A. and A.J. Cannon, in press. [Statistical emulation of streamflow projections from a distributed hydrological model: application to CMIP3 and CMIP5 climate projections for British Columbia, Canada](#). *Water Resources Research*, doi:10.1002/2014WR015279.

Shrestha, R.R., D.L. Peters and M.A. Schnorbus, 2014: [Evaluating the ability of a hydrologic model to replicate hydro-ecologically relevant indicators](#). *Hydrological Processes*, 28, 14, 4294–4310, doi:10.1002/hyp.9997.

Sillmann, J., M.G. Donat, J.C. Fyfe and F.W. Zwiers, 2014: [Observed and simulated temperature extremes during the recent warming hiatus](#). *Environmental Research Letters*, 9, 064023, doi:10.1088/1748-9326/9/6/064023.

Stott, P.A., G.C. Hegerl, S.C. Herring, M.P. Hoerling, T.C. Peterson, X. Zhang and F.W. Zwiers, 2014: [Introduction to explaining extreme events of 2013 from a climate perspective. In Explaining Extremes of 2013 from a Climate Perspective](#), Herring, S.C., M.P. Hoerling, T.C. Peterson, and P.A. Stott, Eds., *Bulletin of the American Meteorological Society*, 95, 9 S1–S96.

Sun, Y., X. Zhang, F.W. Zwiers, L. Song, H. Wan, t. Hu, H. Yin and G. Ren, 2014: [Rapid increase in the risk of extreme summer heat in Eastern China](#). *Nature Climate Change*, Advance Online Publication, doi:10.1038/nclimate2410.

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