PACIFIC CLIMATE IMPACTS CONSORTIUM

PCIC UPDATE JUNE 2018

PROJECT AND RESEARCH UPDATES

New on the Data Portal from the Hydrologic Impacts Theme: Gridded Meteorological Datasets

The PCIC Data Portal continues to expand its offerings with three new Daily Gridded Meteorological Datasets. These datasets span a development period that goes back for about a decade. The earliest is the PCIC meteorology for BC (PBCmet) dataset. It was developed by PCIC scientists in 2007. It covers British Columbia and northern parts of Washington, Idaho and Montana, for the period of 1950-2004, at a resolution of 1/16°, or about 6 kilometres, depending on latitude. This dataset was made from a mix of station networks and developed taking into account the topography of the region. It also includes wind speed based on reanalysis data.

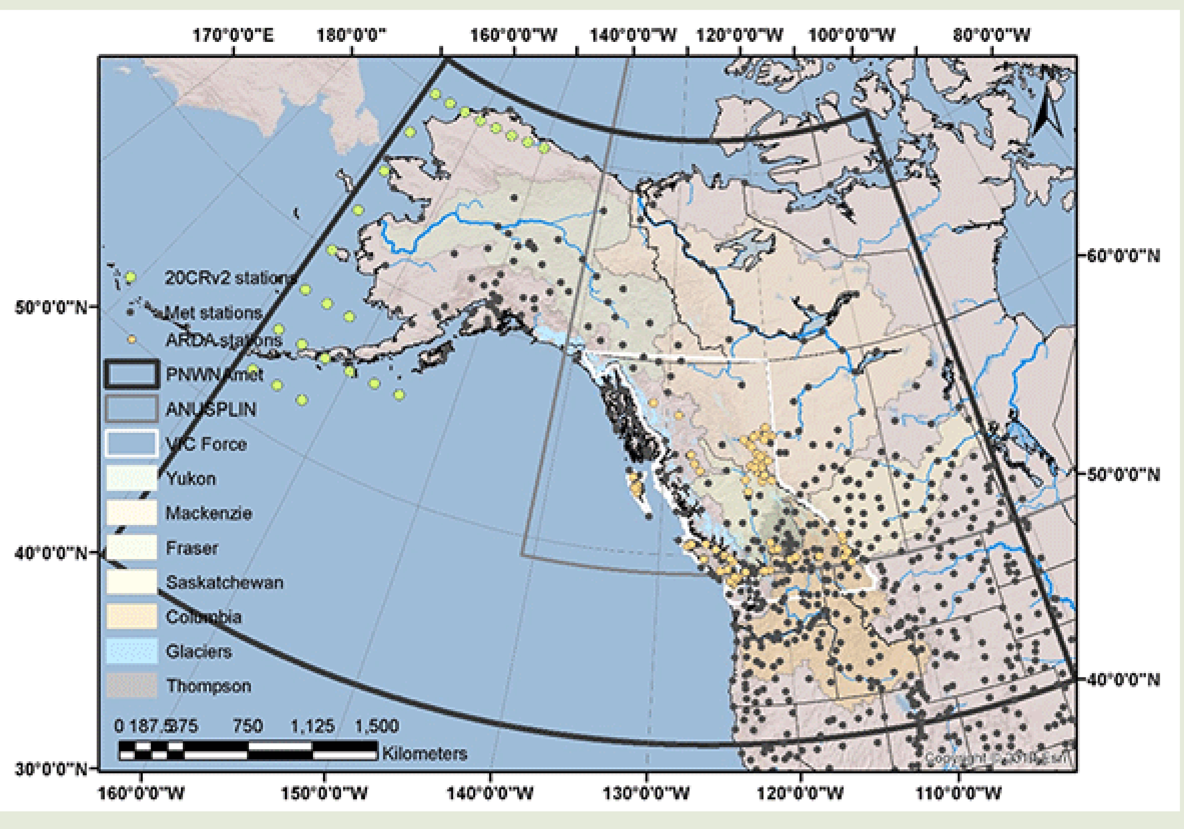

Figure 1: This figure shows the domain of the new PNWNAmet dataset (land contained within the thick black line) along with the locations of the meteorological stations (grey dots) and reanalysis data (green dots) used to construct it. Also shown are meteorological stations (orange dots) used to evaluate PNWNAmet, and the domains of two earlier datasets (grey and white outlines, as indicated above).

The next dataset is the NRCANmet observational dataset, developed by Natural Resources Canada (NRCan) over the 2011-2013 period. It was made using the Australian National University Spline method (ANUSPLIN) from quality-controlled, unadjusted station precipitation and temperature data. It is available at a spatial resolution of 1/12°, or about ~10 km depending on latitude, and covers all of Canada for the period of 1950-2012.

The newest of these datasets is the PCIC NorthWest North America meteorological dataset (PNWNAmet), developed by PCIC researchers over 2017 to meet the need for meteorological data to drive an updated version of the Variable Infiltration Capacity hydrologic model with glaciers (VIC-GL). This dataset includes all of northwestern North America, a region stretching from Northern California to the Arctic and from the west coast to partway through Manitoba. It covers the 1945-2012 period, at a resolution of 1/16°, or about six kilometres, depending on latitude. It uses daily precipitation, and minimum and maximum temperature station records from three observational datasets and supplements this with reanalysis data for the north and west coasts of Alaska. The gridded data was created using a thin-plate spline method, and was tested against an independent observational dataset, against which it performs well, especially in the timing of periods in which precipitation and minimum temperature are increasing or decreasing.

All three Gridded Meteorological Datasets can be accessed here: http://pacificclimate.org/data/daily-gridded-meteorological-datasets.

Updated Guidance for the Engineering Community

Canada's changing climate will affect the nation's buildings and public infrastructure. The National Research Council of Canada (NRC) is supporting PCIC in a collaboration with Environment and Climate Change Canada (ECCC) that will contribute to the development of updated guidance to the engineering community for infrastructure design that takes recent climate observations and projected climate change into account. The NRC is the federal agency that supports the development of the National Building Code of Canada and is a lead contributor to the Canadian Highway Bridge Code (CSA S6). PCIC is very pleased to be able to collaborate with both the NRC and ECCC on this important project.

Climate Data for the Northwest Territories and Yukon

To increase overall understanding of the climate of western Canada and aid in planning, PCIC has been participating in efforts to make weather and climate data more available in this region. To this end, PCIC has recently entered into an agreement with the Government of the Northwest Territories to characterize observational data for use in climate mapping there and in Yukon. This work will involve the formation of a database for weather data, a data portal to deliver it, reporting on PRISM climatology interpolation methods suitable for the territory, and an assessment of spatial and temporal data availability for climate mapping. This work opens up the potential for a longer-term relationship with northern territories for delivering climate services using tools and methods that PCIC has developed.

Agricultural Data Network Analysis

Those working in agriculture require tools and resources that present the best characterization of weather and climate in their region. This enables planning and adaptation to seasonal weather conditions and long-term climate change as they evolve. PCIC has been working with the BC Agricultural Climate Adaptation Research Network (ACARN) and the BC Ministry of Agriculture to help determine if farmers' needs for weather data are being met. The ongoing analysis documents what weather variables are being collected, where they are being collected and what the gaps in those measurements are. Additionally, PCIC analyzed the Provincial Climate dataset archive of temperature and precipitation data on a seasonal and monthly basis to determine how widely spaced weather stations may be while still permitting representative climate and monthly weather analysis. Results show that BC's complex topography demands increased observation sites in some regions for monthly analysis and that the need for daily and sub-daily observations are probably not being met in many regions. Overall, the need for precipitation observations outweighs the need for temperature. For variables other than temperature and precipitation, the observational network is likely inadequate for many agricultural activities.

Renewed Climate Related Monitoring Program Agreement

Since 2010, the province of British Columbia has been engaged in a nationally unique effort to collaboratively share weather data and information about best practices, streamline the operation of weather station networks and form a historical archive of records for the province. These activities form the Climate Related Monitoring Program, whose participants are several BC ministries that collect weather data, BC Hydro, Rio Tinto, Metro Vancouver, the Capital Regional District and PCIC. PCIC's role in this agreement is to aggregate, apply quality control measures to and supply this data though PCIC's Data Portal. Earlier this year, the agreement was renewed which continues these activities and introduced observational networks from the newest partners, Metro Vancouver and the Capital Regional District. This renewed agreement will help make the collection and sharing of data more comprehensive and enable a better overall understanding of weather and climate in the province.

Regional Assessment for Northeastern BC

Planners who are considering how climate change may affect their regions require information tailored to their locations and the needs of their stakeholders. PCIC is working in partnership with the Fraser Basin Council over the next two years to develop a regional assessment for Northeastern British Columbia. The assessment will initially be used to inform community planning in six Northeastern BC communities and is to be expanded at a later date. This work is funded by municipal partners, the Federation of Canadian Municipalities, and the BC Ministries of Municipal Affairs and Housing and Environment and Climate Change Strategy.

Fraser Valley Extremes

In order to assist with planning in the Fraser Valley, PCIC has partnered with the BC Blueberry Council and BC Agriculture and Food Climate Action Initiative. PCIC has produced indices of extremes for the region and aided in the interpretation of the results. These indices include the CLIMDEX climate extremes indices developed by the Expert Team on Climate Change Detection and Indices, and custom precipitation indices suitable for understanding agricultural drainage in the region. In addition, PCIC provided projections of how agricultural drainage indicators could change in the future. This work will be incorporated into the Fraser Valley Adaptation Strategies planning process.

New Projects

PCIC has recently signed the following agreements:

- BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development: *Climate change scenario modeling for Fraser River Watershed (Phase 2)*;
- FPInnovations: *Producing tables of projected climate change data and interpretation for a PIEVC assessment in Prince George*;
- Fraser Basin Council: *Northeast Climate Risk Network*;
- Vancouver Coastal Health: *Health and Climate Projections Report*.

STAFF PROFILE: STEPHEN SOBIE

Stephen Sobie is the Regional Climate Impacts Analyst at PCIC. The focus of his work is developing and implementing downscaling methods to produce locally relevant climate model simulations, and producing climate impacts assessments with a focus on regional groups and municipal governments. Stephen joined PCIC following his graduate studies at the UVic School of Earth and Ocean Sciences, where he used statistical downscaling to study future changes to extreme precipitation on Vancouver Island. "My work at PCIC greatly expands on that experience," Stephen says, "and includes developing ways for various user groups to use the information we produce."

Stephen mentions that one aspect of his work that he finds particularly interesting is "how the requirements of impacts assessments can drive the need for new approaches to using climate simulations." He continues, "Obtaining future projections of parameters that are meaningful for health or infrastructure assessments for example, can require new statistical or dynamical tools to obtain the necessary information." The methods that PCIC uses to link global climate model simulations to local conditions are also continually evolving. "Climate models themselves are being upgraded," Stephen explains, "with a new generation of models being used in the sixth phase of the Coupled Model Intercomparison Project (CMIP6), more computational resources are coming online both in house and at Compute Canada, and we are learning new ways of addressing current methods' limitations. This leads us to develop new methods to take advantage of the new tools and improve the projection data we provide."

Stephen is currently finishing the generation of high-resolution climate scenarios that combine PCIC's existing Canada-wide statistically downscaled climate scenarios with PCIC's PRISM observational dataset. This data will be used in various upcoming climate impacts assessments around the province.

PACIFIC CLIMATE SEMINAR SERIES

Figure 2: This figure shows Dr. Stephen J. Déry delivering his talk on June 27th.

The Pacific Climate Seminar Series, jointly hosted by PCIC and the Pacific Institute for Climate Solutions, continues into the summer, with the next two talks to be delivered by Dr. Jana Sillman, Research Director at the Center for International Climate Research–Oslo. These will be held on July 4th and August 28th. In the first of these, titled, *Understanding and modeling weather and climate extremes: Challenges and opportunities for science and society*, she will discuss the use of climate models and climate system knowledge to inform decision making. For more information, see the event's page. Details for the second talk will be announced shortly.

Earlier in the spring, climate scientist Dr. Jeremy Fyke delivered his talk, *Coupling Ice Sheets into Climate Models for Self Consistent Sea Level Projections: Progress and Challenges*, on March 28th. This was followed by three talks: *Reducing Climate Impacts in Industrial Buildings*, on April 25th by Stephanie Wall, a structural engineer in training; *Infrastructure for a Low-carbon Planet*, on May 15th, delivered by Dr. Christopher Kennedy, professor and chair of the UVic Department of Civil Engineering and *Disentangling the Impacts of Climate Change and Human Interventions on the Hydrology of Key Canadian Watersheds*, on June 27th by Dr. Stephen J. Déry, professor in the Environmental Science and Engineering undergraduate program and the Natural Resources and Environmental Studies graduate program at UNBC.

Details for Dr. Fyke's talk can be found here.

More information on Stephanie Wall's talk can be found here.

Details for Dr. Kennedy's talk can be found here.

More information on Dr. Déry's talk can be found here.

PCIC STAFF NEWS

Dr. Jana Sillmann, Research Director of the Center for International Climate Research – Oslo (CICERO) is visiting PCIC for the summer to identify and establish links between PCIC and CICERO projects that would benefit from knowledge exchange and future collaboration. Such projects include those related to climate services, linkages between dynamical aspects and weather extremes, such as atmospheric rivers and precipitation extremes, as well as hydrological impact modeling.

PCIC extends its congratulations to former MSc student Yaqiong Wang and former PhD student Dr. Katherine Pingree-Shippee on their successful defenses. Dr. Pingree-Shippee defended her PhD thesis, *Seasonal Predictability of North American Coastal Extratropical Storm Activity during the Cold Months*, on April 27th. We wish Katie all the best in pursuing other ventures in Ottawa. Yaqiong Wang defended her MSc thesis, *Statistical Homogenization of Undocumented Monthly Temperature Data in British Columbia for Trend Analysis*, on April 26th. Yaqiong is now joining PCIC as a Research Associate, working with PCIC's Climate Analysis and Monitoring research theme.

Dr. Yanping He has also joined PCIC as a Research Associate with the Marine Environmental Observation Prediction and Response Network, where she is using her knowledge of dynamical and statistical modelling to develop statistical models for the study of surface winds and power outages for future trend estimation in coastal BC.

Dr. Megan Kirchmeier-Young is moving from PCIC to the Climate Research Division of Environment and Climate Change Canada. There she will be building on the post-doctoral research she conducted at PCIC examining climate extremes under the Canadian Sea Ice and Snow Evolution Network.

Dr. Mohamed Ali Ben Alaya has transitioned from his post-doctoral work at PCIC for the Canadian Network for Regional Climate and Weather Processes, to a Research Associate position under the Global Water Futures program, on a project that is examining climate-related precipitation extremes.

Nikola Rados has joined PCIC for the summer as an Assistant Programmer and Analyst. He is assisting the computational support group with the Climate Related Monitoring Program, by working on the computer code that handles the intake of data from weather stations and the code that handles errors in the database of observations.

PUBLICATIONS

PCIC Science Brief: Waves and Coastal Sea Levels and the Human Influence on Canadian Temperatures

PCIC's most recent Science Brief covers two recently published papers that examine the contribution that waves make to total water level rise and extremes on the coast, and the human influence on Canadian temperatures. Publishing in *Nature Climate Change*, Melet et al. (2018) find that the size of wave contributions varies regionally, but such contributions can strengthen, offset or, as is the case on locations on the west coast of North America, dominate sea level rise due to other causes. In their article in *Climate Dynamics*, Wan, Zhang and Zwiers (2018) find that about 1.0 °C of the 1.7 °C warming that Canada experienced over that period can be attributed to anthropogenic influences and about 0.8 °C of the 1.6 °C warming experienced by BC and Yukon. They also find that anthropogenic influences can be detected in changes to temperature extremes for Canada as a whole and at the regional level.

Read the latest Science Brief.

PEER-REVIEWED PUBLICATIONS

Ben Alaya, M.A., **F.W. Zwiers** and X. Zhang, 2018: Probable maximum precipitation: its estimation and uncertainty quantification using bivariate extreme value analysis. *Journal of Hydrometeorology*, doi: 10.1175/JHM-D-17-0110.1, accepted.

Curry, C.L. and **F.W. Zwiers**, 2018: Examining controls on peak annual streamflow and floods in the Fraser River Basin of British Columbia. *Hydrology and Earth System Sciences*, doi:10.5194/hess-2017-531, accepted.

Dayon G., J. Boé, É. Martin and J. Gailhard, 2018: Impacts of climate change on the hydrological cycle over France and associated uncertainties. *Comptes Rendus Geoscience*, **350**, 4, 41-153, doi:/10.1016/j.crte.2018.03.001.

Kharin, V.V., G.M. Flato, X. Zhang, N.P. Gillett, **F.W. Zwiers** and K. Anderson, 2018: Risks from climate extremes change differently from 1.5°C to 2.0°C depending on rarity. *Earth's Future*, **6**, doi: 10.1002/2018EF000813.

Zhang, X., G. Li, A. Cannon, **T. Murdock**, **S. Sobie**, **F.W. Zwiers**, K. Anderson and B. Qian, 2018: Indices of Canada's future climate for general and agricultural adaptation applications. *Climatic Change*, **148**, 1-2, 249-263, doi: 10.1007/s10584-018-2199-x.

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