PACIFIC CLIMATE IMPACTS CONSORTIUM

PCIC UPDATE February 2024

PROJECT AND RESEARCH UPDATES

New PCIC Director Featured in UVic News

A recent UVic News article reports on PCIC's new Director, Dr. Xuebin Zhang. PCIC is pleased to welcome Dr. Zhang, who joined as our new Director on October 1st. The article describes Dr. Zhang's previous roles as a Research Scientist with Environment and Climate Change Canada for 25 years and as a collaborator with PCIC researchers for more than ten years. It also covers some of Dr. Zhang's accolades as a Fellow of the Royal Society of Canada and his position as a leading expert in the detection and attribution of climate change and climate extremes. In addition, the article provides a brief overview of PCIC and Dr. Zhang's view of how PCIC will evolve under his leadership.

- Read the UVic News article.

City of Vancouver Climate Report Released

PCIC is pleased to announce the release of a summary report on future climate projections for the City of Vancouver. *Climate Projections for the City of Vancouver: Highlights Report* covers projected changes to a suite of climatic indicators over the remainder of the century, derived from the latest set of Coupled Model Intercomparison Project (CMIP6) global climate model (GCM) simulations that were run for a range of emissions scenarios. Some possible impacts of the simulated changes in the 13 indicators considered are also explored. In brief, the projections paint a picture of a city with warmer temperatures during all seasons, with hotter (Figure 1), drier summers, longer heatwaves, more precipitation in the fall, winter and spring, and a smaller fraction of precipitation falling as snow.

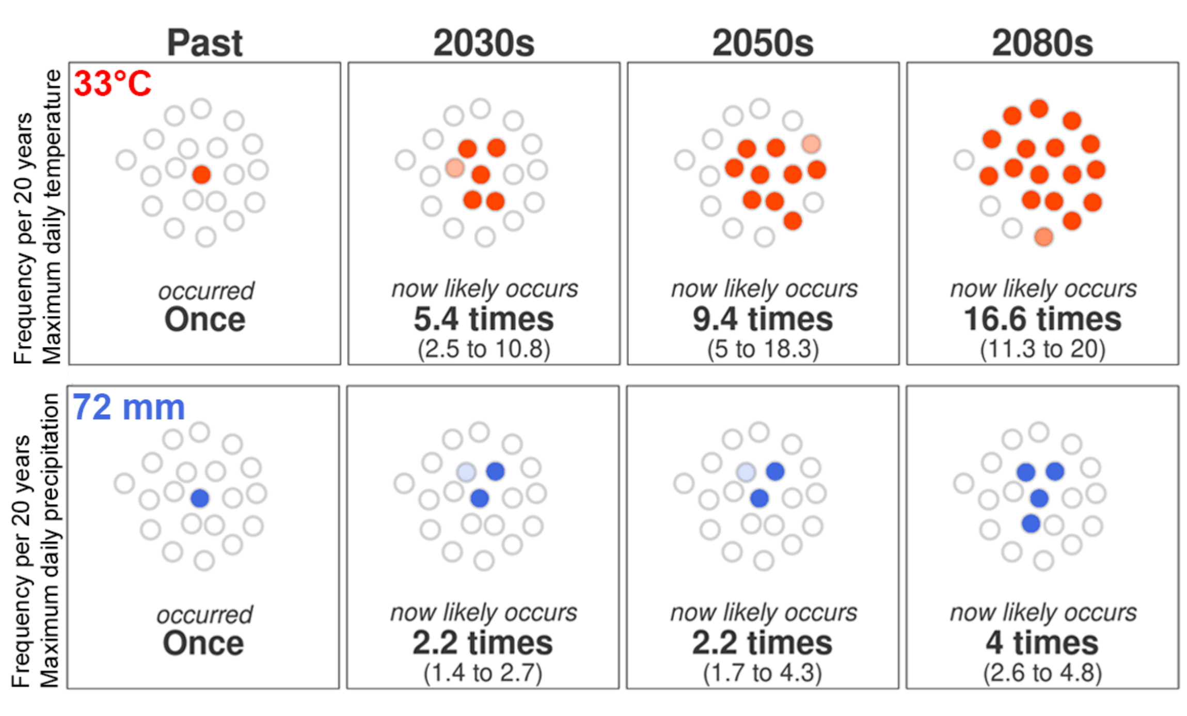

Figure 1: The upper panels show the frequency of a 1-in-20 year daily maximum temperature event in the past (1981-2010), estimated to be a day with a high temperature of 33°C, and the projected frequency of years with summer days at least as hot in the three future periods. The lower panels show the frequency of a 1-in-20 year annual maximum daily rainfall event in the past, estimated to be a 72 mm event, and the projected frequency of years with wettest days of that level or higher in the three future periods. All projections were made based on emissions that follow the Shared Socioeconomic Pathway 5-8.5. Figure design is taken from similar infographics in the IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., et al. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 3-32, doi:10.1017/9781009157896.001.

Leading up to the report, PCIC applied statistical downscaling techniques to output from an ensemble of nine GCMs participating in CMIP6 to produce very high resolution temperature and precipitation scenarios for the Vancouver area. Specifically, PCIC's team transformed the GCM data, with a horizontal scale of 100-280 kilometres, into a product of 800-metre resolution, using observation-based reference data at the higher resolution. From these fine-scale data, our team derived information more tailored to specific applications, such as the fraction of precipitation that falls as snow and the number and intensity of multi-day heatwaves. These were derived separately for GCMs running under low, medium and high emissions scenarios, respectively. The results were summarized in maps and tables, and results from the high emissions scenario were the focus of the report, which also contains a brief discussion of their context and implications.

Amongst other impacts, warming temperatures in the region have implications for existing and future building energy needs and design. For example, heating degree days (used to estimate energy needs for heating) are projected to decrease by about a third by the end of the century while cooling degree days (used to estimate energy needs for cooling) are projected to increase by a factor of eight. The report notes that the occasional outflow of cold, polar air means that sub-zero cold snaps will still occur into the future, and that buildings must therefore remain capable of dealing with sub-zero temperatures. This implies that buildings will need to be retrofitted or redesigned to meet this large projected increase in cooling demand, while remaining resilient to the colder-than-normal temperatures that will occasionally occur due to year-to-year climate variability.

The pervasive warming that is projected also comes with changes to the hydrological cycle. Summer rainfall is projected to decrease by around 16% by the 2080s (compared to 1990s values), with dry spells projected to increase in length by about the same relative amount (but with a large model range) for the 2080s. Combined with hotter summer temperatures, this elevates the risk of droughts. At the same time, total annual precipitation is projected to increase overall, with higher rainfall amounts in the cooler seasons but substantially less snow in winter. The largest rainfall increases occur in the fall (around 20% by end of century), while annual snowfall will decrease by an estimated 60% by the 2050s.

In addition, the projected warming will affect the frequency and intensity of extreme temperature and precipitation events. Under a high-emissions scenario, days with temperatures over 33°C, which occurred only once every 20 years on average in the past (defined as the 1981-2010 period), are projected to occur much more often in future decades: nearly every other year by the 2050s and almost every year by the end of the century (Figure 1). Less respite will be offered by summer evenings, as the number of warm nights with temperatures above 16°C are projected to increase from around 7 per year in the past to almost 60 per year in the 2050s and to around 90 per year by the 2080s. Substantial increases in extreme cool season rainfall are also projected. An example of this is that a 1-in-20 year single day rainfall of 72 mm, typical of the past, is projected to occur roughly once every 10 years by the 2050s and once every 5 years by the 2080s (Figure 1). These expected changes to seasonal and single-storm precipitation amounts indicate that designers of urban drainage systems will need to plan for higher rainfall runoff amounts.

- Read the report .

PCIC's Evolution Over the Past 15 Years: A Retrospective by Rachel Goldsworthy

In a retrospective published in Times Higher Education, Rachel Goldsworthy looks over PCIC's growth in the 15 years of Dr. Francis Zwiers's tenure as PCIC's director, a period of extensive growth in the services and data provided by PCIC. The article discusses PCIC's role as a regional climate service provider and one of Canada's leading sources of climate information at the regional scales useful for planning and adaptation. It also talks about the importance of the longstanding partnerships that enable much of PCIC's research and data offerings. The article closes by talking about PCIC's role as place for early stage scientists to conduct cutting edge research with established scientists and grow their careers.

- Read the article on UVic's site or in our Corporate Report (starting on Page 2).

Supporting Risk Assessments in BC

PCIC is pleased to be partnering with the British Columbia (BC) Ministry of Emergency Management and Climate Readiness to support the integration of climate science information into disaster risk management and climate adaptation policies in the province. PCIC is one of four groups that are receiving financial support to aid the Province in reducing the impacts of climate-related disasters on people by ensuring critical disaster risk information is available to support community resilience, planning and decision-making. The other groups being supported are the Social Planning and Resource Council of BC, the University of British Columbia's Disaster Resilience Research Network, and our sister organisation, the Pacific Institute for Climate Solutions.

PCIC's research staff are active participants in the international research efforts to understand how and why change is occurring in the extreme weather and climate events that cause disasters in our province. We look forward to leveraging the expertise of our scientific team to provide support and guidance on integrating current climate science research into risk assessments in our province.

- Read the press release on this from the BC Ministry of Emergency Management and Climate Readiness.

STAFF PROFILE: MARKUS SCHNORBUS

PCIC's Hydrologic Impacts (HI) Theme studies the implications of climate change on hydrologic systems in BC and this issue's staff profile is on its long-time Lead, Markus Schnorbus. Markus is responsible for planning and managing PCIC's effort to quantify the effects of climate change on hydrological processes throughout the PCIC domain. This work involves continual development and deployment of state-of-the-science modelling tools, the generation of hydrologic projections to keep pace with the latest climate projections, and analysis and interpretation of model outputs in response to stakeholder-driven questions and issues. It also includes the delivery of data, information and tools to facilitate adaptation and risk reduction in support of water resources planning and management activities.

Markus began his academic journey in mechanical engineering at the Royal Military College of Canada, but after almost a decade in the Canadian Armed Forces, elected on a different path, choosing to pursue forest hydrology at the University of British Columbia. He then went on to become a Hydrologic Modelling Scientist and Forecaster with the BC Ministry of Environment's River Forecast Centre, where he analyzed observed climate and hydrometric data and applied hydrologic models for flood, drought, and seasonal streamflow forecasting. Markus decided to join PCIC when given an opportunity to collaborate on a project investigating the hydrologic impacts of the Mountain Pine Beetle infestation in British Columbia.

Reflecting on his work as a theme lead, Markus says that "one of the most interesting, and challenging, aspects of this position is the requirement to support the constantly evolving needs of stakeholders with a broad range of requirements." These requirements include modelling to support reliable future hydro-power production, the need for updated engineering design and design standards, sustainable fisheries management, risk management and public safety. He continues, "addressing these needs requires modelling potential impacts across the entire hydrologic cycle and exploring and understanding changes in, for example, the availability of streamflow across a range of temporal scales, changes in the magnitude and frequency of extreme hydrologic events (e.g. flood and droughts), changes in snow and glacier cover, and changes to water temperatures. —And all of this must be conducted over a large, hydro-climatically complex domain."

One of HI's main projects, that is supported by BC Hydro, is the transition of hydrologic modelling from the venerable VIC-GL model to the more flexible and modern Raven Hydrologic Modeling Framework. Markus explains, "the adoption of Raven will shorten the model development – deployment - projections cycle and allow us to focus more time and effort on data delivery, analysis, and interpretation." While the long-term objective is to roll-out Raven over the entire PCIC domain (BC and Yukon), initial deployment will focus on producing hydrologic projections for several small coastal basins with BC Hydro operations. Another project currently underway is the generation and delivery of streamflow and thermal projections at very high spatial resolution over a spatial domain that includes all BC drainage areas flowing into the Pacific Ocean. Speaking on this, Markus says, "this region covers that vast majority of salmon conservation units along Canada's west coast and the data and information from this project will support salmon vulnerability assessments and allow fisheries managers to develop appropriate strategies to sustainably manage salmon populations."

THE PACIFIC CLIMATE SEMINAR SERIES

Over the fall, PCIC hosted three talks as part of our Pacific Climate Seminar Series. The first of these was delivered by Dr. Neil C. Swart, a climate scientist specializing in earth system modelling at the Canadian Centre for Climate Modelling and Analysis, where he coordinates the team that builds the Canadian Earth System Model (CanESM). Dr. Swart delivered his talk, *Towards Canadian Focused Projections using the CCCma Integrated Climate Modelling System*, on September 27th. This was followed by a talk delivered by Dr. John R.J. Thompson, Assistant Professor at the University of British Columbia (Okanagan campus) whose areas of expertise are nonparametric and applied statistics and machine learning. Dr. Thompson spoke on, *Clustering for Climate Science Insights*, on November 22nd. The closing talk for the fall semester was delivered on December 4th, by Dr. Erich Fischer, senior scientist at ETH Zürich and a lead author of the IPCC's Sixth Assessment Report, whose areas of expertise include climate and weather extremes, and detection and attribution. He spoke on, *Record-shattering extremes - Challenges and opportunities for attribution and event storylines*. These talks were recorded and are available via the links below.

The first talk in our spring session will be given by Dr. Kate Moran, President and CEO of Ocean Networks Canada, on February 28th. This will be followed by a talk on March 27th by Dr. Andreas Prein, Project Scientist III at the National Center for Atmospheric Research. These talks will be held at 3:00 p.m., Pacific Time online via Zoom Meetings and further details for both will be announced soon. Please check our website for updates.

- Access Dr. Swart's talk.
- Access Dr. Thompson's talk.
- Access Dr. Fischer's talk.

PCIC STAFF NEWS

The autumn and winter seasons have been a time of considerable change at PCIC, as can be seen from the articles in this newsletter. As we shared above and announced in the September PCIC Update, we welcomed Dr. Xuebin Zhang as our new Director and at the same time are grateful to continue having the experience and expertise of Dr. Francis Zwiers at our organisation, as he transitions to PCIC Scientist Emeritus.

In addition to these leadership changes, PCIC is pleased to welcome Kristyn Lang and Izzy Farmer to our Regional Climate Impacts Theme, Narges Sayah to the Hydrologic Impacts Theme and John Sampson to our Computational Support Group. Kristyn is PCIC's new Climate Impacts Analyst and Knowledge Translator, a position in which she focuses on obtaining and analyzing downscaled climate projections for climate risk assessment and assisting stakeholders in understanding climate data and its implications. As the Content Development and User Engagement Coordinator at PCIC, Izzy works to develop practical information on the physical impacts of climate change for climate service users. Narges is a Data Analyst (Co-Op) who is examining the impacts of future climate change on low streamflow indicators. John Sampson is a Programmer/Analyst who is helping to develop PCIC's online tools and data portals.

The fall PCIC also bid farewell to long-time Research Associate Dr. Mohamed Ali Ben Alaya and User Engagement and Training Specialist Kari Tyler. Ben Alaya's work at PCIC included research contributions to a variety of PCIC's user-commissioned projects and to the Global Water Futures research program, for which he focused on the estimation of rare precipitation extremes to inform engineering design. Kari's work centered on applying principles of adult learning to the use of climate science, and meeting with the community of PCIC's users and regional stakeholders to build on PCIC's strong relationship with them, to better understand and meet their evolving learning needs. We wish Ben Alaya and Kari the best in their future endeavours, and look forward to continued collaboration with Ben Alaya on the study of extreme precipitation.

PUBLICATIONS

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Zwiers, F.W. and **X. Zhang**, 2023: Translating science into actionable policy information – a perspective on the IPCC process. Chapter 1 in *Applied Data Science: Data Translators Across the Disciplines*, Woolford, D., D. Kotsopoulo and B. Samuels, eds., Springer Interdisciplinary Applied Sciences, doi:10.1007/978-3-031-29937-7.

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