



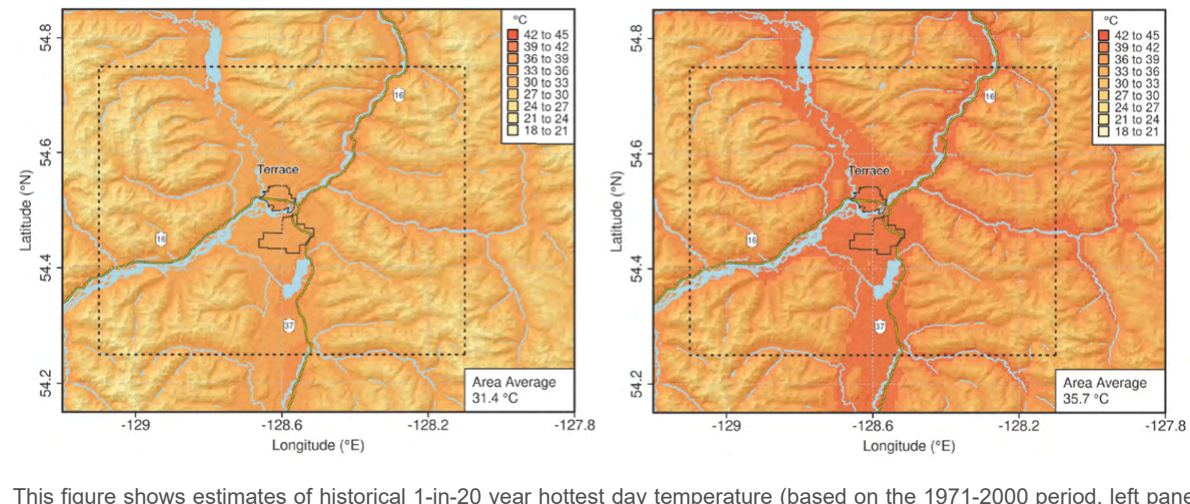
## PCIC UPDATE

June 2023

### PROJECT AND RESEARCH UPDATES

#### Climate Projections for the City of Terrace Released

PCIC has partnered with the City of Terrace to provide climate information and interpretation to support adaptation planning and this has resulted in a report that has just been released. The *Climate Projections for the City of Terrace* report, prepared by PCIC and Pinna Sustainability, provides projections and impacts analysis that serve as the first phase in the development of a Climate Adaptation Plan.



This figure shows estimates of historical 1-in-20 year hottest day temperature (based on the 1971-2000 period, left panel) and corresponding values projected for the mid 21st century (2041-2070, right panel) under a high emissions scenario (Representative Concentration Pathway 8.5). Temperatures are as indicated in the legend. The dark outlines near the map centre show the Terrace city limits, while the dashed grey lines encompass the surrounding area that also formed part of PCIC's analysis.

As with many other places in BC, Terrace has faced several extreme weather events over the past few years, including the heat dome in summer of 2021, which brought temperatures over 30°C, and an extreme cold spell that was followed by an extreme rainfall event that winter, which temporarily overwhelmed the sanitary sewer system. Terrace commissioned the report, for which PCIC provided downscaling, analysis and data interpretation, to inform planning that aims to make the city more climate resilient. The report covers standard climate variables, such as temperature and precipitation, as well as the Climdex indices developed by the Expert Team on Climate Change Detection and Indices, statistics that describe aspects of temperature and precipitation extremes. The overall picture provided by climate change projections for Terrace is one of warming across all seasons, with fewer days that have freezing temperatures, more extreme hot days during summer (see Figure) and an extended growing season. The climate projections also suggest that the region will see an increase in precipitation during all seasons except summer and a decrease in the amount of precipitation falling as snow.

- [Read the report](#)

#### A Mystery Gremlin Resolved!

PCIC's computational support team recently finished some detective work that would make Sherlock Holmes proud, running a series of increasingly complex experiments, and hunting through the connections between software and hardware, to identify and remove a mystery gremlin that was sporadically causing PCIC's Plan2Adapt tool and Climate Explorer to fail to load for some users.

To understand what happened, a little background about how these tools function is required. PCIC tools are rich in features and rely on multiple software packages and hardware components running together. A tool like the PCIC Climate Explorer is, in a sense, not one thing, but a dozen collaborating components, with multiple instances of each piece of the software architecture that comprises it running at any given time. Bringing together multiple pieces of software allows PCIC to leverage the best, most up-to-date tools available for the features we offer. Having multiple instances of each piece of software running at any given time allows for resiliency and for upgrades to be done without any downtime for our users. However, it was in the complexity of the interactions between these parts that the error arose.

The first time the errors were observed was in the fall, shortly after PCIC migrated a set of data from a single physical database to a cluster of upgraded database servers. A very small subset of users reported that Plan2Adapt and the Climate Explorer would sporadically fail to load, and under circumstances that were difficult to reproduce. PCIC's computational support group found an error in their log files indicating that the user had been disconnected from the database. Determining the cause of this error was far from trivial given the complexity and dynamic nature of the path that connects users' web browsers to PCIC's database, with multiple levels of security along the way. It was in this dynamic, ever changing set of connections that our team needed to search for the bug. In addition, the issue was happening sporadically, seemingly at random, in systems that were otherwise functioning well, adding to its perplexing nature.

In order to pin down the error, PCIC's computational support group began running experiments in which they developed a script that "replayed" all of the user requests that had been made in the past, essentially trying to recreate the timing of the events, to see if the error would happen again and whether it could be provoked by requests that were coming in too fast. However, no errors showed up. PCIC's team then started to recreate the overall circumstances under which the errors occurred, trying a test application on a cluster of databases for an hour, then a test application on three database clusters for an hour, and finally setting two test applications bombarding three of the live production database clusters making requests for 16 hours. Yet still, after all of this, the error had yet to reappear.

Finally, PCIC's team set test applications of the entire production system to run over two 16-hour-long experiments—and then the errors appeared. The computational support group then went into database logs and analytics and spotted an issue: the application server that generates content on the web page was holding onto stale database connections. The connections had long timed out, yet the application server and database server thought that they were still connected, and the proxy server behind UVic's firewall, which is situated between the application and database servers, told both sides that there was no record of the connections, and so the connections failed. PCIC's computer scientists then tested to see if this was in fact the issue causing the problem that users were seeing. Further tests confirmed that this was the gremlin causing the problem. With gremlin identified, PCIC's team worked to fix it, changing the application server so that it proactively checks to see whether it needs to renew its connection with the database service. Finally, after tracking clues and running multiple experiments on increasingly complicated systems, the error had been caught and resolved. This gives a sense of how PCIC's teams work behind the scenes to improve and maintain reliable tools for our users.

#### Talks and Training Session

The spring semester came to a close with three talks. The last speaker for the Pacific Climate Seminar Series was Nic Annau from the Climate Research Division of Environment and Climate Change Canada, who delivered his talk, *Algorithmic Hallucinations of Near Surface Winds: Statistical Downscaling with Generative AI*, on May 24<sup>th</sup>. This was followed on May 29<sup>th</sup> by a talk that was jointly sponsored by the Pacific Institute for Climate Solutions, the Uvic Research and Innovation, Environment and Climate Change Canada and PCIC. Dr. Myles Allen, Professor of Geosystem Science at the University of Oxford and Director of the Oxford Net Zero initiative, spoke on, *Geological Net Zero: How we will stop fossil fuels from causing global warming*. Finally, PCIC, the Canadian Centre for Climate Services and Engineers and Geoscientists BC partnered to deliver a training session on PCIC's newest web-based tool the Design Value Explorer on June 8<sup>th</sup>. The talk, titled, *Introducing the Design Value Explorer – Integrating Future Climate Data into the Built Environment*, was jointly delivered by Stacey O'Sullivan from PCIC, Dr. Rob Lepage, PhD., P. Eng. from the Canadian Centre for Climate Services and Harshan Radhakrishnan, P. Eng., from Engineers and Geoscientists British Columbia.

- [Watch Nic Annau's talk.](#)
- [Watch Dr. Allen's talk.](#)
- [Watch the DVE training session.](#)

### STAFF PROFILE: TOM KUNKEL

Tom Kunkel works with PCIC's Computational Support Group as the Linux specialist and systems administrator. His background is diverse, spanning continents and industries, from Banking in Germany, to Oil & Gas in the Middle East, to Forestry in BC's Central Interior. And now to supporting climate research at PCIC. Tom is picking up from a distinguished line of predecessor system administrators, continuing the tradition of balancing best-of-breed information technology (IT) technologies and practices against the specific needs and realities of research and academic institutions. He is adding to these initiatives by building resilience, adding concurrent maintenance, and migrating legacy solutions.

Tom's role is varied, ranging from designing and implementing hardware solutions, through managing multiple layers of security and firewalls, to assisting colleagues with their IT issues. Speaking of this, Tom says, "at PCIC, there is no such thing as a 'typical day.'" He elaborates, "some can be quiet and work on projects can take place. Other days are filled with dealing with interesting requests and puzzling out solutions to new problems." PCIC's technology stack leverages a wide variety of leading-edge and open-source technologies. When this is combined with the rapidly changing nature of IT and the needs of the research community, it requires nimble and proactive support, which Tom provides.

### PCIC STAFF NEWS

This spring, PCIC said a fond farewell to Dr. Travis Tai. Dr. Tai joined PCIC in September 2020 to work on salmon population risk assessments as part of the BC Salmon Restoration and Innovation Fund. PCIC is grateful for Dr. Tai's work that centered on developing a climate change risk assessment framework for salmon species across BC and we wish him the best in his future endeavours. PCIC is also pleased to welcome Ameneh Mollasharif as a Data Analyst (Co-op). Ameneh's work at PCIC will be focused on deriving streamflow and water temperature hazard exposure indicators from hydrologic simulations and conducting analyses to help PCIC researchers better understand the impacts of future climate change on the habitat of salmon in BC's rivers.

### PUBLICATIONS

Lao, I.R., A. Feinberg, and N. Borduas-Dedekind, 2023: [Regional Sources and Sinks of Atmospheric Particulate Selenium in the United States Based on Seasonality Profiles](#). *Environmental Science and Technology*, **57**, 19, 7401–7409, doi:10.1021/acs.est.2c08243.

Souaissi, Z, T.B. Ouarda, A. St-Hilaire and D. Ouali, 2023: [Regional frequency analysis of souai temperature at ungauged sites using non-linear regional correlation analysis and generalized additive models](#). *Environmental Modelling & Software*, **163**, 105682, doi:10.1016/j.envsoft.2023.105682.

Sun, Q. F.W. Zwiers, X. Zhang and Y. Tan, 2023: [The effect of greenhouse gas induced warming on the impact of El Niño and La Niña events on precipitation extremes](#). *Journal of Climate*, Early Online Access, doi:10.1175/JCLI-D-22-0713.1.

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