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UNIVERSITY OF  
NORTHERN BRITISH COLUMBIA

# **NSERC/Rio Tinto Industrial Research Chair on Climate Change and Water Security**

## **Annual Report – Year 3**

(1 July 2021 – 30 June 2022)



Prepared by Dr. Stephen Déry

## 2021-2022 IRC Annual Report

### Preamble

June 30<sup>th</sup>, 2022 marks the completion of the third year of the Natural Sciences and Engineering Research Council of Canada (NSERC)/Rio Tinto Industrial Research Chair (IRC) in Climate Change and Water Security at UNBC. The 5-year program of research started on July 1<sup>st</sup>, 2019 with the objective to better understand and quantify the roles of climate variability, climate change, and water management on the long term water security of the Nechako Watershed. Among other research topics, we are elucidating some of the complex interactions between climate change and human interventions on flow volumes and water temperatures in the Nechako River using a combination of in situ observations and computer modelling. This annual report provides a progress update on personnel recruitment and training, program management, our field activities and research, communication strategy and community engagement, and the budget.

### Personnel and Training

During the third year of activity, a number of highly-qualified personnel (HQP) were retained or recruited to support the IRC program of research. In supporting roles, Jeremy Morris (until 28 February 2022) and Kelly Hurley (as of 1 March 2022) acted as the research managers (RMs) and outreach coordinators (OCs) while Justin Kokoszka remained the data manager (DM). In May 2022, Abhishek Arora was recruited for the summer on a part-time basis as Data Administrator in support of our data management efforts.

Training of graduate and undergraduate students is central to the objectives of the IRC. An undergraduate student from UNBC, Spencer Woyke, and a recent graduate from UBCO, Derek Gilbert, were recruited as field assistants to support our spring/summer 2021 field activities while a research skills trainee recruited in fall 2020, Kelly Hurley, led the planning, preparations, and execution of the fall 2021 TRARE field campaign. Anna Kaveney was recruited in September 2021 as another research skills trainee to participate in the TRARE field campaign and to assist with data quality assessment and control. In the spring of 2021, two new undergraduate students, Jade Reynolds and Meghan Hunter-Gauthier, were recruited as field and research assistants. Their positions started in early May 2022 and will run until the end of August 2022. They are responsible for conducting field work across the Nechako Watershed including site visits for data collection. In late May 2022, another research skills trainee, Gracie Wilson, joined the IRC team to conduct water temperature data quality assessment, control and analysis.

Two graduate students have been recruited so far under the IRC umbrella. As of May 2020, a MSc student, Justin Kokoszka, leads a project on the naturalization of flows in the Nechako River using a water balance approach. Meanwhile, Bruno Sobral began in 2020 his PhD program investigating atmospheric rivers affecting the Nechako Watershed. Two post-doctoral fellows (PDFs) continued working for the IRC program of research over the past year. Dr. Rajtantra Lilhare (as of 1 May 2022 on a part-time position) leads the historical hydrological modelling efforts while Dr. Jingwen

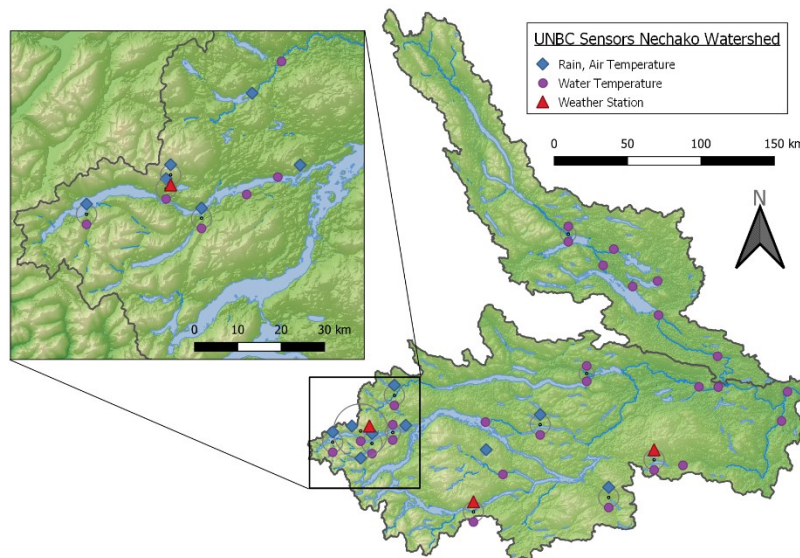
Wu works on hydrological modelling in the context of future climate projections. Recruitment of graduate students will continue this summer to ensure all IRC projects are completed in two years.

### Research Management

The Science Advisory Board (SAB) formed in late 2019 oversees the progress of the IRC program of research and met on two occasions during the reporting period. The SAB comprises five members: Mr. Andy Lecuyer (Rio Tinto), Dr. Ellen Petticrew (UNBC), Mr. James Rakochy (Cheslatta Carrier Nation), Mr. Chelton van Geloven (BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD)), and Dr. Francis Zwiers (Pacific Climate Impacts Consortium). The SAB along with the UNBC Director of Research, Mr. Mark Barnes, met on 2 December 2021 and on 14 June 2022 to hear and evaluate progress thus far with the IRC program of research through online presentations by Dr. Déry and the IRC team. The SAB will continue meeting with the Chairholder and his personnel twice annually to ensure the IRC objectives are met, to provide feedback, and to assess progress. The SAB reports to the UNBC Interim Vice-President of Research and Innovation, Dr. Kathy Lewis.

### Field Activities

During our third year of activity and despite ongoing challenges with COVID-19, we maintained a network of 25 water temperature loggers, nine tipping bucket rain gauges (although two were damaged), and two complete meteorological stations across the entire Nechako Watershed (Figure 1). Improved monitoring of water temperatures and hydrometeorological conditions across the Nechako Watershed is central to Theme 1 of the IRC program of research. Not only are these data providing high-resolution information on the spatio-temporal variations in water temperatures and rainfall in the Nechako Watershed but are also assisting with modelling efforts (Themes 2 and 3).



**Figure 1:** Map of water temperature logger, tipping bucket rain gauge and meteorological station sites.

Servicing of the water temperature loggers, tipping bucket rain gauges and meteorological stations was once again generously supported by several First Nations and by Rio Tinto. Cheslatta Carrier Nation provided boat access to reach sites in the upper Nechako Watershed including streams flowing into Tahtsa Lake and to the south shore of the Nechako Reservoir. Tl'azt'en First Nation also provided boat support and staff time to reach Kazchek Creek and the Middle River where water temperature probes were also deployed. Nak'azdli Whut'en provided staff support when accessing streams near Fort St. James.

Aside from the usual site visits, the Tahtsa Ranges Atmospheric River Experiment (TRARE) was held in September and October 2021. This highly successful field campaign assembled 11 UNBC and UQAM researchers in the upper Nechako Watershed to collect high-resolution hydrometeorological data during atmospheric rivers and other storms. The primary base of activities was Huckleberry Mine near Tahtsa Narrows, with other sites at Mt. Sweeney, Nadina Lake, Skins Lake Spillway, Kemano and Terrace. State-of-the-art equipment deployed during TRARE included four laser disdrometers and four micro rain radars, a hot plate to measure precipitation, an array of tipping bucket rain gauges, and water level loggers. Weather balloons were launched prior to and during storms to collect detailed atmospheric conditions up to the stratosphere. A total of 11 storms were sampled during TRARE and 75 GB of high-quality data were collected. Rio Tinto provided generous support through helicopter flight time for deployment of the meteorological equipment at Kemano and facilitated a similar installation on their property at the Skins Lake Spillway. Two volunteers from the Cheslatta Carrier Nation provide additional rainfall measurement on their territory thereby filling another gap in our monitoring network in the vast Nechako Watershed.

### Communication Strategy

We maintain a comprehensive communication strategy to ensure information on the IRC program of research is disseminated widely and in a timely fashion. This includes a [new website](#), presence on social media (e.g. Twitter, ResearchGate and Rio Tinto's Facebook page), and a Slack workspace to facilitate interactions between the IRC team members. Dr. Déry is also profiled on [NSERC's online Chairholder database](#). Three media releases issued by UNBC (3 September 2021, 29 November 2021 and 22 February 2022) reporting on IRC-related activities including the TRARE field campaign plus a funding announcement led to several articles in the regional press and online media. The IRC team prepares a quarterly newsletter posted on the IRC website and emailed to our extensive distribution list to disseminate further information on the IRC to the general public. Dr. Déry was interviewed ~30 times over the past year by various media outlets including on his perspectives of the mid-November atmospheric river-related floods in southwestern BC. Furthermore, a distinct effort was made over the past year to develop short videos focusing on the TRARE field campaign following three days of filming by the UNBC Communications Office in the upper Nechako (an example video produced during TRARE is available here: <https://www.youtube.com/watch?v=Pq6zda71Zp0>).

Dr. Déry delivered several presentations over the past year to a range of stakeholders in the

Nechako Watershed and beyond. This included two presentations to the Main Table of Rio Tinto's Water Engagement Initiative (24 November 2021 and 25 May 2022). As well, Dr. Déry presented aspects of the IRC program of research including the TRARE field campaign to the BC Hydro Board of Directors on 24 February 2022. He also delivered two online public presentations on the topic of atmospheric rivers including findings from the TRARE field campaign to the Prince George Exploration Place's Adult Speakers Series on 25 April 2022 and to the Real Estate Foundation of BC and BC Northern Real Estate Board on 8 June 2022.

As results are now emerging from the IRC program of research, conference presentations and peer-reviewed publications are in development. The following provides a list of recently submitted papers and others in preparation in addition to conference presentations from the past year.

#### Journal Articles:

Gilbert, D. E., Morris, J. E., Kaveney, A. R., Déry, S. J., 2022: Sub-hourly water temperature data collected across the Nechako Watershed, 2019-2021, submitted to *Data in Brief*.

Hurley, K. M., Morris, J. E., Cardinal, É., Gilbert, D. E., Kaveney, A. R., Sobral, B., Thompson, H. D., Thériault, J. M., and Déry, S. J., 2022: Hydrometeorological data collected during the Tahtsa Ranges Atmospheric River Experiment (TRARE), to be submitted to *Earth System Science Data*.

Morris, J. E., Hernández-Henríquez, M. A., and Déry, S. J., 2022: Recent updates to the Cariboo Alpine Mesonet network and database, 2017-2021, submitted to *Earth System Science Data*.

#### Conference Presentations:

Hurley, K. M.: The Tahtsa Ranges Atmospheric River Experiment (TRARE), UNBC Research Week, 4 March 2022.

Hurley, K. M., Morris, J. E., Cardinal, É., Gilbert, D. E., Kaveney, A. R., Sobral, B., Thompson, H. D., Thériault, J. M., and Déry, S. J.: The Tahtsa Ranges Atmospheric River Experiment (TRARE), Joint CMOS/CGU/ESC congress, 1 June 2022.

Lilhare, R. and Déry, S. J.: Impacts of climate change and anthropogenic activities on the hydrology of the Nechako River Basin, UNBC Research Week, 28 February 2022.

Lilhare, R. and Déry, S. J.: Impacts of climate change and anthropogenic activities on the hydrology of the Nechako River Basin, Joint CMOS/CGU/ESC congress, 1 June 2022.

Wu, J. and Déry, S. J.: Preliminary analysis of future climate changes in Nechako River Basin, BC. UNBC Research Week, 2 March 2022.



## Community Engagement

The success of the IRC relies on a broad communication strategy and community engagement. To that end, efforts are routinely made to communicate with First Nations as to where field work and other research is being undertaken as part of the IRC. Over the past year, we maintained our engagement with four First Nations: Cheslatta Carrier Nation, Stelat'en, Nak'azdli Whut'en, and Tl'azt'en First Nations. This has been of particular importance due to concerns expressed by some First Nations relating to outside activities in traditional territories during the COVID-19 pandemic. Dr. Déry also provided the Nechako First Nations a summary of recent research in the Nechako Watershed on 24 August 2021 while Jeremy Morris presented an overview of our water temperature monitoring efforts to the Binche Whut'en First Nation Council on 6 July 2021. Finally, in summer 2021, a youth intern, Konnor McIntosh, of the Lheidli T'enneh First Nation, was involved in field work at the Ancient Forest and equipment testing on the UNBC campus.

We entertained a wide range of discussions with many individuals and organizations across the Nechako Watershed over the duration of the TRARE field campaign when our team was stationed at Huckleberry Mine and at Nadina Lake Lodge. This included conversations with Shane Flynn, general manager of Huckleberry Mine and staff at the mine for which a demonstration of a weather balloon launch was given. We also engaged routinely with Mitchell Harborne and staff members of the Fisheries and Oceans Canada's Nadina River Spawning Channel where a tipping bucket rain gauge and a full weather station were installed. As well, we interacted on a daily basis with Brad and Wendy Thompson at Nadina Lake Lodge during our stay there while undertaking TRARE field work. We also entertained discussions with Rio Tinto staff at the Skins Lake Spillway during bi-weekly visits for data downloads. We anticipate continued interactions with members of the community this summer as we return to our field sites for data collection and as we prepare for the deployment of the MECHE observatory at Huckleberry Mine.

Dr. Déry remains fully engaged in Rio Tinto's Water Engagement Initiative (WEI) and participates in monthly main table and bi-weekly technical working group meetings. He has also participated in periodic meetings related to climate change research in the Nechako Watershed in support of the WEI process. The annual reports and the IRC quarterly newsletters are distributed to the entire WEI mailing list. Additional information on the IRC is posted on Rio Tinto's [Get Involved website](#). Further, Dr. Déry and Jeremy Morris participated in the Nechako Watershed Roundtable's annual meeting on 17 November 2021. The 2020-2021 IRC annual report was also sent to the District of Vanderhoof Council for their information and review.

## Industrial Partner Engagement

Dr. Déry interacts on a regular basis with the industrial partner via email, phone, online and in person meetings. The principal contact person at Rio Tinto for research is Andy Lecuyer, while for outreach, interactions are facilitated by Lianne Olson (Advisor Communications/Communities) and Devrie Sanghera (Communities & Social Performance Advisor). Additional communication with Alec Mercier on the water management team proceeds on a periodic basis for the exchange

of data and metadata, information on Rio Tinto's operations and system in the Nechako Watershed, and to identify monitoring and information gaps in the basin. Dr. Déry, Kelly Hurley, Derek Gilbert and Spencer Woyke met in person Andy Lecuyer and staff at Ecofish in Terrace on 20 April 2022 to provide Rio Tinto an update on research progress with the IRC including on water temperatures.

Over the past year we maintained close collaboration with Scott Klassen of Avison Management Services for periodic site visits of UNBC meteorological equipment at Eutsuk Narrows and at Mt. Sweeney. Jenifer Bond at Triton and Alec Mercier also have provided access to water temperature data for several sites in the Nechako and Kemano Watersheds. Alec Mercier also provided up-to-date streamflow data at the Kemano Powerhouse and inflow data for the Nechako Reservoir that are being integrated into multiple IRC projects. Finally, Andy Lecuyer has provided continuous support by sharing his knowledge on Rio Tinto's operations across the Nechako Watershed.

### Budget

The IRC program of research is supported equally by NSERC and Rio Tinto with a total budget of \$1.5M over five years. Approximately half of this budget is allocated to support Dr. Déry's salary and benefits. With the release of these funds and to fulfil the requirements of NSERC's IRC program, UNBC hired in September 2020 a new tenure-track faculty member (Dr. Siraj ul Islam) to build institutional capacity in hydrometeorology. As of 10 June 2022, the remainder of the available funds for Year 3 was disbursed mainly for the support of HQP (81.7%) with other expenses related to field work including the TRARE field campaign, materials and supplies, computers, etc. (18.3%). As of 10 June 2021, we expended 96.3% of the overall allocated funds for Years 1 to 3 of the IRC. Any year-end surplus of funds will be transferred to Year 4 as we anticipate continued expenditures to support trainees, field work, travel and outreach activities.

While NSERC and Rio Tinto provide the bulk of the funding for the IRC program of research, extra support was provided through Project Learning Tree Canada (two successful applications totaling \$12K in 2021), and UNBC's General Research Fund (\$10K in 2021). An application to Global Water Futures has secured additional funding that is partly supporting Bruno Sobral's PhD project focusing on the terrestrial response to atmospheric rivers in the Nechako Watershed. A proposal for a \$194K equipment grant to the Canada Foundation for Innovation and the BC Knowledge Development Fund was successful. This will provide additional resources to monitor atmospheric rivers in the upper Nechako Watershed and to assess components of the water budget for Nechako headwater catchments. In the spring of 2021, we secured \$19.5K through to the Partnering Fund of the Real Estate Foundation of BC to purchase a complete meteorological station in Terrace, BC. The meteorological data collected in Terrace will benefit the IRC program of research by providing a counterpoint to observations collected further east in the upper Nechako Watershed.