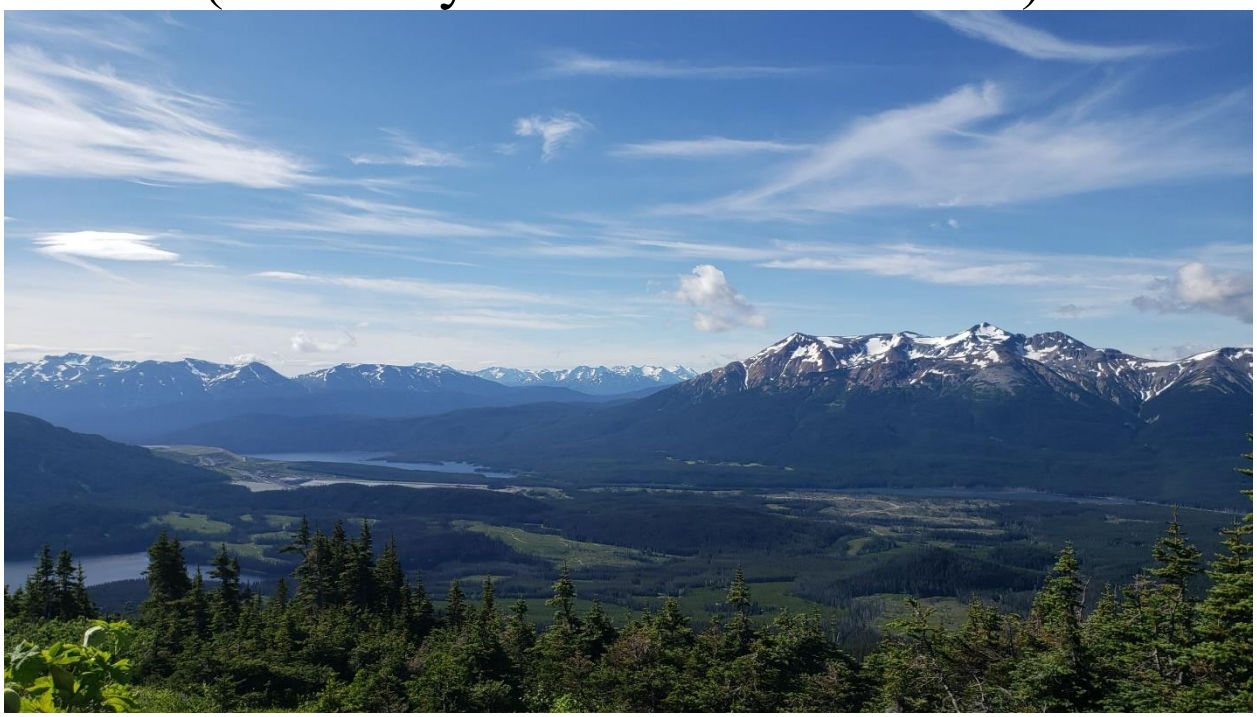
# Rio Tinto Research Chair (RTRC) in Climate Change and Water Security

## Annual Report – Year 1

(1 January – 31 December 2025)



Prepared by Dr. Stephen Déry

# 2025 RTRC Annual Report

## Preamble

December 31st, 2025 marks the completion of the first year of the Rio Tinto Research Chair (RTRC) in climate change and water security at UNBC. The 5-year program of research started on January 1st, 2025 with the overarching objective to better understand and quantify the roles of climate change and hydrometeorological extremes on the long-term water security of the Nechako Watershed. Among other research topics, we are: 1) elucidating the role of extreme events such as droughts and atmospheric rivers on the water budget of the Nechako Watershed, 2) exploring the microclimates and climate change in the Vanderhoof agricultural belt, and 3) investigating water temperature variability and predictability across the Nechako Watershed. This annual report provides an update on personnel recruitment and training, program and data management, our field activities and research, communication strategy and community engagement, and the budget.

As the first year of the RTRC in climate change and water security overlapped the final six months of the NSERC / Rio Tinto Industrial Research Chair (IRC) in climate change and water security in January to June 2025, some progress for both are reported in this annual report. Please consult the final annual report (July 2024-June 2025) for the NSERC / Rio Tinto for additional details on that program of research's outcomes and accomplishments. As well, there is some overlap in this report with the research, HQP training, communication and outreach activities of the Rio Tinto Research Chair in climate change and freshwater fish ecology led by Dr. Eduardo Martins that also began on 1 January 2025. The report also refers to the Northern Hydrometeorology Group (NHG) led by Dr. Déry and UNBC's Integrated Watershed Research Group (IWRG), of which Dr. Déry is a member.

## Personnel and Training

During the first year of activity, a number of highly-qualified personnel (HQP) were retained or recruited to support the RTRC program of research. In a supporting role, Erica Lee (as of 2 December 2024), co-supervised with Dr. Eduardo Martins, acted as the research manager (RM) for the two Rio Tinto Research Chairs at UNBC. A new Data Manager, Maziyar Dowlatabadibazaz was recruited on 2 September 2025 to lead our team's data management efforts. Dylan Broeke also continued to support the team as a Research Skills Development Trainee and as field crew leader.

Training of graduate and undergraduate students are central to the objectives of the RTRC. Three undergraduate students from UNBC, Kainen Parmar, Lynn Poeppelmann and Maria Tavares, were recruited as field assistants to support our spring/summer 2025 field activities. Maria Tavares also supported data management activities on a part-time basis during the winter 2025 semester. The trio of undergraduate students were responsible for conducting field work across the Nechako Watershed including site visits for data collection.

Two graduate students were also recruited under the RTRC umbrella. As of September 2025, an

MSc student, Kainen Parmar, leads a project on the microclimates and climate change in the Vanderhoof agricultural belt. Meanwhile, Nisarga Sharma also began an MSc program in September 2025 by investigating atmospheric rivers affecting the Nechako Watershed. In addition, two post-doctoral fellows (PDFs) worked for the IRC program of research over the past year. Dr. Mostafa Khorsandi worked on station-based modelling of water temperature using the Air2Stream model. Another PDF, Dr. Tamar Richards-Thomas, continued exploring three atmospheric rivers that impacted the upper Nechako Watershed during the TRARE field campaign in autumn 2021. A new Research Associate, Dr. Mehdi Bateni, joined the team in December 2025 to initiate a project on droughts in the Nechako Watershed. Furthermore, a Research Skills Development Trainee, Devin Wittig, was recruited in September 2025 to explore the role of landfalling atmospheric rivers on water temperatures in the upper Nechako Watershed.

As part of our commitment to education and training, we implemented a comprehensive training program for returning staff members. This involved a two-week training program covering the following topics: history of the Nechako River Basin and its local and regional significance, administration and communication practices, field safety, site and equipment management, and data management practices. The training also included several day trips focused on building a weather station, coding in the field, data collection, collecting robust field notes, and GPS training.

Research Management

The Science Advisory Board (SAB) was formed in late 2025 to oversee the progress of the RTRC program of research and will have its first meeting in early January 2026. The SAB comprises seven members: Mr. Mark Barnes (UNBC), Mrs. Vanessa Foord (BC Ministry of Forests), Mrs. Penína Sara-Lynn Harding (UNBC), Mr. Andy Lecuyer (Rio Tinto), Mr. Brian Toth (Carrier Sekani Tribal Council), Mr. Chelton van Geloven (Lheidli T'enneh First Nation), and Dr. Francis Zwiers (Scientist Emeritus, Pacific Climate Impacts Consortium). The SAB for the NSERC / Rio Tinto Industrial Research Chair (IRC) in climate change and water security, along with the Director of the UNBC Office of Research and Innovation, Mr. Mark Barnes, met on 23 June 2025 to evaluate progress with the IRC and RTRC programs of research through an online/hybrid presentation by Dr. Déry and the research chair teams.

Research Themes and Progress

The overarching objective motivating this program of research is: *To better understand and quantify the roles of climate change and hydrometeorological extremes on the long-term water security of the Nechako Watershed*. To address this broad objective, three main themes are explored: 1) hydrometeorological extremes including droughts and atmospheric rivers, 2) microclimates and climate change in the Vanderhoof agricultural belt, and 3) variability and predictability of water temperatures. Research on these themes span from the headwaters of the Nechako Watershed to the Nechako River's confluence with the Fraser River in Prince George. The following paragraphs provide updates on each of these three themes with the focus on plans

over the next four years given many of these projects are just being initiated.

Theme 1: Hydrometeorological extremes including droughts and atmospheric rivers

Over the past few years, extreme hydrometeorological events have had devastating impacts on the lands, waters, wildlife and residents of the Nechako Watershed. For instance, the 2021 heat dome led to record-breaking air and water temperatures while the 2022-2024 drought resulted in massive wildfires, poor air quality, low water levels and high water temperatures with deleterious consequences to the forestry, agriculture, mining and tourism industries, among others. Thus, one goal for Theme 1 is an investigation of the 2022-2025 drought across the Nechako Watershed and placing this event into a historical context and assessing potential future drought occurrences. This first requires characterizing the environmental conditions, at various spatial and temporal scales, that led to the persistent drought conditions during 2022-2025. Work is now being initiated to explore sea-surface temperature (SST) and large-scale atmospheric teleconnection patterns during the drought to detect any influences of El Niño Southern Oscillation (ENSO), Pacific Decadal Oscillation (PDO), and the Pacific North American (PNA) pattern on storm track activity and precipitation distribution. Meteorological drought will then be quantified through precipitation deficits across the Nechako Watershed with impacts to snowpacks, soil moisture, lakes, reservoirs and rivers. Hydrological drought characterization will consist of assessing anomalies in water levels in lakes and reservoirs and discharge in rivers and creeks relative to long-term means. Dr. Mehdi Bateni has been recruited to lead this project, an effort that began on 1 December 2025. The first month of activity consisted of a literature review and data acquisition with analyses to begin in early 2026.

The other phenomenon of interest in Theme 1 is the atmospheric river. This project focuses on the distribution of precipitation associated with atmospheric rivers, both spatially and temporally, across the Nechako Watershed. Following up on the work of Dr. Tamar Richards-Thomas, efforts are being made to describe the impacts of the different "flavours" of atmospheric rivers, namely the "wet", "windy" and "wet-windy" types of atmospheric rivers. Their impacts are likely different across the Nechako Watershed. "Wet" atmospheric rivers contain abundant moisture but are associated with weaker winds and hence less transport across the Coast Mountains and reduced orographic enhancement of precipitation. Conversely, "windy" atmospheric rivers promote further inland transport of atmospheric moisture thereby impacting a larger portion of the Nechako Watershed. This project is also in its initial phase and is led by MSc student Nisarga Sharma. Mr. Sharma began his graduate program at UNBC in September 2025 with coursework being the focus of the fall semester.

Theme 2: Microclimates and climate change in the Vanderhoof agricultural belt

The Vanderhoof agricultural belt (VAB) forms one of the most productive agricultural areas in the province of British Columbia (BC). Despite its importance to provincial food security, details on its microclimates in the context of a rapidly changing climate remain poorly quantified and understood. Local knowledge suggests there is marked variability in meteorological conditions across the VAB with air temperature, precipitation and wind patterns showing steep gradients across the region. This project is therefore exploring the spatio-temporal variability of the VAB's

microclimates using both in-situ data and high-resolution reanalyses such as the 1-km Daymet. Relationships between the region's microclimates and landcover type (e.g., open water, forests), topography (e.g., elevation, slope) and land uses will be explored. Trends in climatic variables from the 1980s to present will be investigated to assess potential relationships with land use changes and landcover disturbances. MSc student Kainen Parmar, who began his graduate program in September 2025, leads this project. Preliminary analyses conducted by Kainen show that the Daymet product compares favourably with in-situ observations of air temperature for the Nulki Lake weather station during 2024-2025. Ongoing work is assessing the accuracy of Daymet for a suite of meteorological variables to ensure its reliability for microclimate and climate change analysis.

Theme 3: Variability and predictability of water temperatures

During 2025, we maintained and expanded a network of 33 water temperature loggers across the Nechako Watershed first initiated through the NSERC / Rio Tinto IRC (Figure 1). Enhanced and sustained monitoring of water temperatures across the Nechako Watershed is central to Theme 3 as these data will be used by an MSc student (to be recruited in 2026) who will explore their spatio-temporal variability. Specifically, analyses will be conducted to assess mean annual and monthly water temperatures, extreme conditions, and exceedances above critical values such as 20°C. This will include a review of the Summer Temperature Management Project (STMP) that mandates Rio Tinto to release additional water at the Skins Lake Spillway when water temperatures on the main stem Nechako River near Finmoore approach 20°C between 20 July and 20 August each year. Furthermore, efforts will be dedicated to better understand the response of freshwater to extreme hydrometeorological events such as the 2021 heat dome, the 2022-2025 persistent drought and to landfalling atmospheric rivers in the upper Nechako Watershed. To that end, Research Skills Development Trainee Devin Wittig is exploring water temperature responses to landfalling atmospheric rivers in the upper Nechako Watershed during the autumns of 2024 and 2025.

Site visits for maintenance of the water temperature monitoring network was kindly 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 are also deployed. Nak'azdli Whut'en provided staff support when accessing streams near Fort St. James. Finally, staff members from Stellat'en First Nation joined some of the field visits at the Endako, Nithi and Stellako rivers and Ormond Creek.

In the latter stages of the RTRC program of research, the water temperature data will be used in a water temperature forecasting model for the Cheslatta and Nechako Rivers along with their primary tributaries. This forecasting system will involve the application of the Air2Stream water

temperature model driven by forecasts of air temperature and river discharge. Another option may be the application of Artificial Intelligence (AI) techniques to optimize water temperature forecasts in the Nechako Watershed.

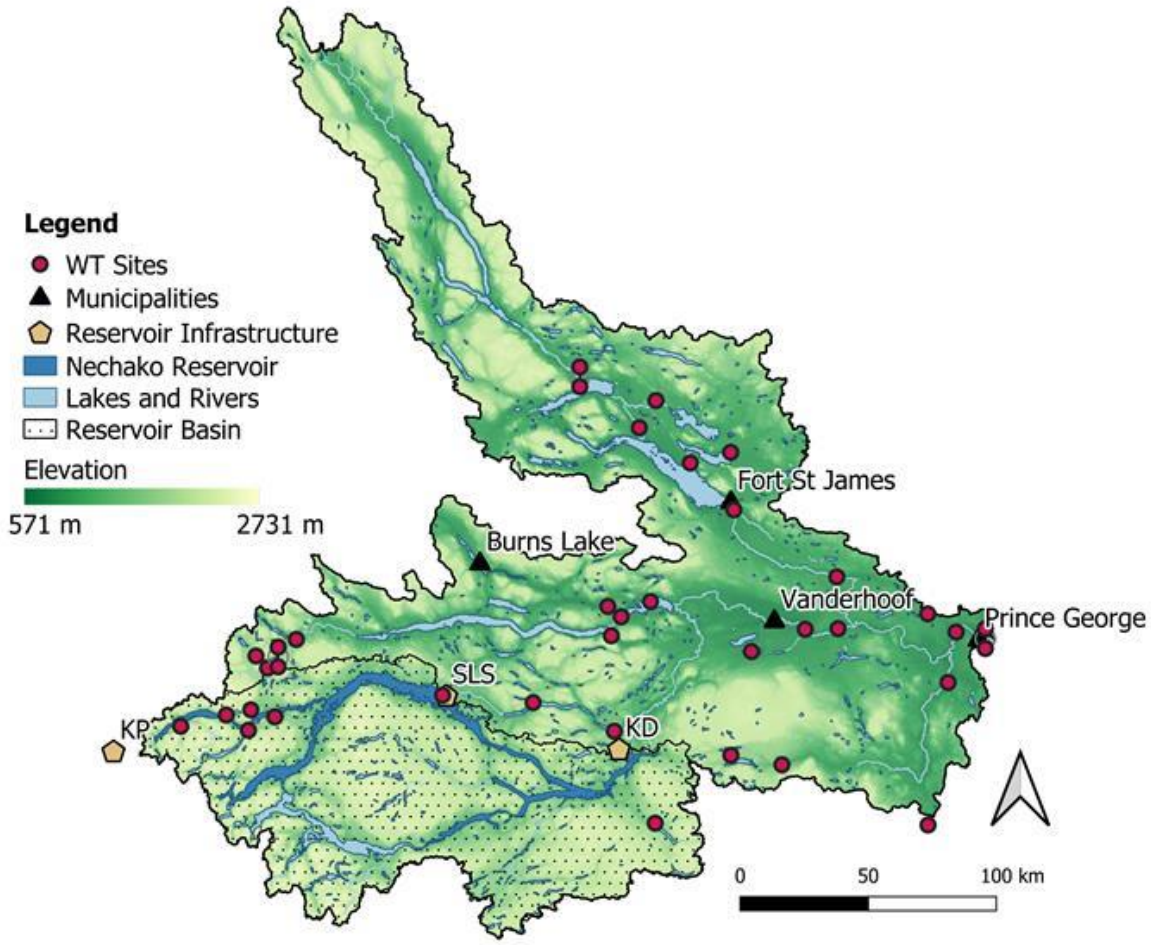



**Figure 1:** Map of active (as of 31 December 2025, red dots) water temperature logger sites across the Nechako Watershed (source: Justin Kokoszka).

Data Management

We continue efforts to organize our monitoring data into a centralized database, promoting data shareability, and enhancing data quality. This initiative, led by Data Manager Maziyar Dowlatabadibazaz, ensures easy access to information, facilitates collaborative research, enables efficient analysis, and ensures the longevity of data collected through the RTRC program of research. Additionally, the database includes a system to track and maintain equipment, ensuring accurate and reliable data collection.

Over the past year we have continued to fine-tune our field records collection software and field notes recording that include: site visit details, data downloads, equipment deployments/retrievals,

and annotated field photos. These records are stored in a central database for quick reference allowing access to field records, equipment details, in addition to raw data collected in the field. Additionally, we have developed an in-house quality assurance/quality control (QAQC) procedure to enhance our data quality and maintain consistency across all sites. In fall 2025, we completed the QAQC of our most recent water temperature records and developed a reporting procedure to generate data reports and fulfil specific data requests with ease. Fully updated and quality-controlled water temperature time series and associated metadata were then deposited at the NHG's new data visualization tool (https://nhgwatertemp.unbc.ca) created by Maziyar. In the coming months, we plan to extend our QAQC and data management strategy to our extensive meteorological database.

Communication Strategy

Over the past year we maintained a comprehensive communication strategy to ensure information on the RTRC program of research was disseminated widely and in a timely fashion. This included a dedicated website, presence on social media (e.g. ResearchGate and Rio Tinto's Facebook page), MS Teams and a Slack workspace to facilitate interactions between the RTRC team members. The RTRC team, led by Research Manager Erica Lee, prepared a quarterly newsletter posted on the RTRC website and emailed to our extensive distribution list (~120 individuals and organizations) to disseminate further information on the RTRC to the general public. Dr. Déry was interviewed a dozen times over the past year by various media outlets including on his perspectives of recent drought and low streamflow conditions in northern BC. This also included interviews following the official announcement of the new RTRC on 15 January 2025 at the Natural Resource Forum held in Prince George, BC. The announcement and official launch of the RTRC included a media release and a YouTube video highlighting key accomplishments from the IRC program of research.

Dr. Déry delivered several presentations over the past year to a wide range of stakeholders in the Nechako Watershed and beyond. For instance, he delivered a presentation on climate change in the Nechako Watershed at the spring technical meeting of the Nechako Watershed Roundtable (NWR) in Fort St. James on 2 June 2025. In May 2025, Dr. Déry provided an update on IRC and RTRC-related research to the True North 2025 Business Development Forum held in Prince George, BC. Dr. Déry also delivered presentations at the annual NWR meeting (14 October 2025), the 4 September 2025 quarterly NorthCAN meeting and the Water Engagement Initiative (WEI) meeting on 4 December 2025.

As results continue to emerge from the RTRC program of research, conference presentations and peer-reviewed publications will continue in the coming year. The following provides a list of a recently submitted paper for peer review and a conference presentation from the past year.

Recent Journal Articles

Sobral, B. S., Richards-Thomas, T. S., and Déry, S. J., 2026: Meteorological features and

hydrological impacts of three exceptional atmospheric rivers in British Columbia's Nechako River Basin, submitted to *Weather and Climate Extremes*.

Conference Presentations

Khorsandi, M. and Déry, S. J. 2025: A novel method for frequency analysis of high water temperatures using temperature duration curves in a partially regulated watershed, 2025 joint congress of the Canadian Meteorological and Oceanographic Society and Canadian Geophysical Union, Saskatoon, Saskatchewan, 29 May 2025.

Community Engagement

The success of the RTRC 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 RTRC. Over the past year, we maintained our engagement with four First Nations: Cheslatta Carrier Nation, Stellat'en, Nak'azdli Whut'en, and Tl'azt'en First Nations. Most of the RTCC team travelled to Cheslatta Territory on 20 May 2025 to meet representatives from Cheslatta Carrier Nation. This included a presentation on the Nation's history and the geography their traditional territory covers. Furthermore, a renewed memorandum of understanding (MOU) was signed in 2025 between Dr. Déry and other UNBC faculty members with Stellat'en First Nation to ensure continued data sharing and appropriate, culturally-sensitive protocols are followed during field work on the Nation's traditional territory.

We continued to entertain a wide range of discussions with many individuals and organizations across the Nechako Watershed during field work across the upper Nechako Watershed. This included several site visits in 2025 at Huckleberry Mine for discussions with the mine's general manager, Mr. Marke Wong. We also connected with staff members of the Fisheries and Oceans Canada's Nadina River Spawning Channel where a new weather station is now installed.

Dr. Déry remained engaged in Rio Tinto's Water Engagement Initiative (WEI) and participated in main table and technical working group meetings over the past year. Further, Dr. Déry and Lucas Macedo Moura (IWRG Research Manager) participated in and presented at the Nechako Watershed Roundtable's (NWR's) spring technical meeting on 2-3 June 2025 in Fort St. James. Dr. Déry has also represented UNBC and the Integrated Watershed Research Group at monthly NWR Core Committee meetings starting in May 2024 to June 2025. Dr. Déry has also engaged in the UNBC-Nechako Valley Working Group by attending its bi-monthly meeting and participating and presenting at the annual general meeting of the Nulki-Tachick Lakes Stewardship Society.

Industrial Partner Engagement

Dr. Déry interacted on a regular basis with Rio Tinto, the industrial partner via email, phone, online and in person meetings. The principal contact person at Rio Tinto for research was Andy Lecuyer, while for outreach, interactions were facilitated by Lianne Olson (Senior Advisor, Community Social Performance) and Aman Parhar (Senior Adviser, Communities and Social Performance). 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.

Over the past year we maintained close collaboration with Scott Klassen of Avison Management Services for periodic site visits of UNBC meteorological equipment at Chedakuz Creek and at Eutsuk Narrows. Alec Mercier also continued to provide up-to-date streamflow and water temperature data at the Kemano Powerhouse, the Nechako Reservoir and other key sites that were integrated into multiple RTRC projects. Finally, Andy Lecuyer has provided continuous support by sharing his knowledge on Rio Tinto's operations across the Nechako Watershed.

Budget

The RTRC program of research supported by Rio Tinto has a total budget of $0.875M over five years with UNBC retaining one-quarter of this amount in overhead fees. Approximately 9% of the budget supports partially Dr. Déry's salary and benefits while another 8% provides course buyouts to reduce Dr. Déry's teaching load to one course per fall and winter semester. A total of 52% of the budget supports HQP including a co-supervised research manager, a field crew leader, graduate students and research staff. Other expenses accounting for 11.4% of the annual budget are related to field work, materials and supplies, communication and outreach. As of 31 December 2025, we expended 74.7% of the overall allocated funds for the RTRC program of research for Year 1. The remaining 25.3% in the budget for Year 1 are committed charges that will be processed during 2026.

While Rio Tinto provides the bulk of the funding for the RTCC program of research, extra support was secured through the Canada Water Agency (two successful applications in 2024/2025). Applications to the Nechako Environmental Enhancement Fund (NEEF), submitted by the IWRG in mid-December 2025, and to UNBC's Research Strategic Initiatives Grant may well provide additional resources in 2026.