

# Nechako Research NEWSLETTER

March 2026 | Volume 8 | Issue 1



## RIO TINTO RESEARCH CHAIRS

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# Territorial Acknowledgement

Working on traditional First Nations territories in a scientific context is a humbling and deeply appreciated privilege. The opportunity to work hand-in-hand with Indigenous communities is a gift for which we are sincerely grateful. This collaboration not only enriches scientific understanding but also fosters mutual respect and cultural exchange. We are grateful for the trust and partnership extended to us, and we strive to approach this work with the utmost gratitude and responsibility. We acknowledge that our work takes place within the unceded traditional lands of 15 First Nations:

- Binche Whut'en
- Lheidli T'enneh
- Nee-Tahi-Buhn Indian Band
- Stelat'en
- Ts'il Kaz Koh (Burns Lake) Band
- Cheslatta Carrier Nation
- Nadleh-Whut'en
- Saik'uz
- Takla Lake
- Wet'suwet'en First Nation
- Lake Babine Nation
- Nak'azdli Whut'en
- Skin Tyee Band
- Tl'azt'en
- Yekooche First Nation



Netja koh (Nechako River) at Cottonwood Island Nature Park in Prince George

The Nechako River is referred to as Netja koh, meaning 'Big River' in the traditional language of the Dakelh Nations.

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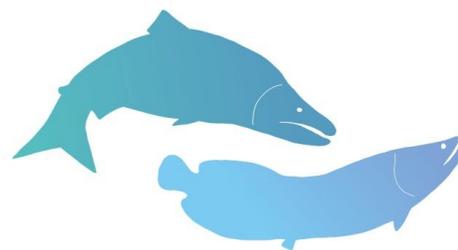
## **Outreach—Presentations, Publications, Media**

Summary of NHG and FFEL outreach this quarter.

# FFEL Team

Dr. Eduardo Martins is the Rio Tinto Research Chair in Climate Change and Freshwater Fish Ecology.

Rio Tinto Research Chair team members from the Freshwater Fish Ecology Lab.



**Freshwater Fish Ecology  
Laboratory** | UNBC



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# FFEL Updates

As summers across northern British Columbia continue to become warmer and more variable, understanding how fish respond to warming water temperature has become an increasingly important part of our research program in the Nechako River watershed. Cold-water fishes, such as rainbow trout and mountain whitefish encountered in many of the watershed's rivers, depend on relatively cool summer temperatures to survive and grow. During heatwaves, these species often rely on small pockets of colder water (groundwater-fed areas, tributary junctions, or deeper sections of rivers and nearby lakes) to escape potentially lethal temperatures.



**Eduardo Martins**  
Project Leader

In this issue of the newsletter, we highlight a new study that will help us better understand how fish respond to warming waters. MSc student Kirsten Mathison and PhD candidate Lucas Moura will begin a series of experiments this summer to determine how fish from the Stellako River respond to thermal stress and how effectively the use of cooler habitats may help them recover. Their work will focus on juvenile rainbow trout and mountain whitefish, two species that are common in the river and play important roles in the local aquatic ecosystem and the broader Nechako River watershed.

Heatwaves can sometimes lead to sudden high mortality events in the wild, but these events are very difficult to observe and quantify directly in freshwater environments. This leaves us without a critical piece of information needed to determine the impacts of extreme heat events on the mortality and abundance of populations. A key goal of this new research is to develop models that will enable us to quantify temperature-related mortality in nature. To address this challenge, Kirsten and Lucas will use established thermal tolerance experimental protocols that allow researchers to measure how fish respond to increasing temperatures, but with experimental designs that will allow us to use the data to develop predictive models of mortality in nature.

Furthermore, Kirsten and Lucas will also use the findings of these experiments to investigate how cooler patches of water (thermal refuges) might help fish recover from thermal stress. Rivers such as the Stellako contain many small areas of colder water that can act as thermal refuges during hot periods. By studying how fish respond when they encounter these cooler conditions, the team hopes to better understand how important these habitats may be for survival during heatwaves.



Rainbow trout, Stellako River



Mountain whitefish, Stellako River

We recognize that experiments exposing fish to stressful temperatures may be unsettling for some readers. As researchers who care deeply about the fish we study, we respect and share these concerns and take them very seriously. For this reason, the protocols are designed to minimize harm during capture, handling, holding, and trials, following strict animal care protocols in accordance with guidelines set out by the Canadian Council of Animal Care and approved by the UNBC Animal Care and Use Committee. Fish are exposed to thermal stress for a relatively short period of time, typically 25-45 minutes once temperature reaches a stressful threshold, as opposed to another available method that exposes fish to stressful high temperatures for days to weeks. They are monitored continuously throughout the trials and the experiments stop as soon as the fish can no longer maintain normal swimming behaviour (loses equilibrium). Individuals are then immediately placed in cool water to fully recover (determined by assessing standard fish reflex and welfare indicators [e.g., ability to burst swim when grabbed by the tail, re-orient themselves after being turned upside down, regular gill cover movements]) before being returned to their capture location in the river.

While these procedures involve short periods of stress to the study fish, they allow us to obtain knowledge that would otherwise be impossible to quantify in the field. This knowledge will help us develop models that predict how heatwaves may affect fish populations and guide conservation and management actions in the Nechako River watershed. Ultimately, the goal of this work is to better understand how fish cope with warming waters so that we can help ensure that species like rainbow trout and mountain whitefish continue to thrive in the Stellako and other rivers of the Nechako River watershed for generations to come.



Rainbow trout, mountain whitefish, and sockeye salmon in the Stellako River during August 2025.

# Tracking fish responses to heat in the Stellako River

To mitigate the effects of warming, fish often rely on movement between habitats with varying temperatures to regulate their body temperature (i.e., behavioural thermoregulation). This movement allows them to avoid temperature extremes and remain near temperatures conducive to survival. When water temperatures become too warm during heatwaves, freshwater fish seek refuge in cooler zones within rivers, such as cold tributaries or deeper lake regions. If unable to do so, these organisms can experience mass mortality, which is difficult to quantify precisely in the field.

This summer, our team will explore the impacts of temperature on freshwater fish mortality, focusing on juvenile rainbow trout (*Oncorhynchus mykiss*) and mountain whitefish (*Prosopium williamsoni*) in the Stellako River. We will assess thermal tolerance using Critical Thermal Maximum (CTMax) trials. CTMax trials are used to determine a fish's thermal tolerance by gradually increasing the temperature at a constant rate until the fish loses equilibrium or is no longer able to swim normally. Loss of equilibrium is a non-lethal end point that represents likely death in nature, as the fish would be unable to escape predators or other environmental hazards. After reaching this end point, fish can recover in cool water before being returned to their capture location. All procedures follow strict animal care guidelines to minimize stress and handling time.

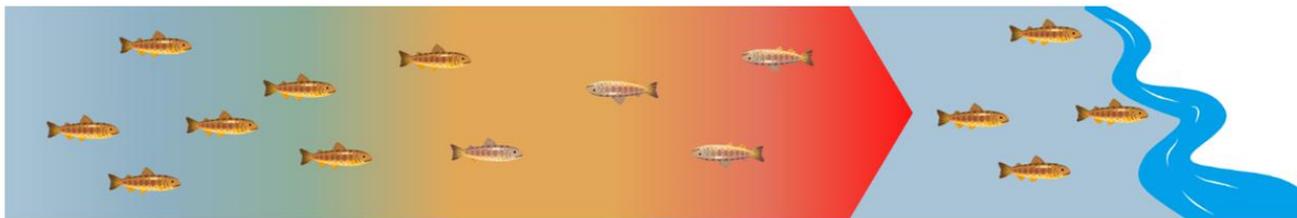


**Kirsten Mathison**  
M.Sc. Student



**Lucas Moura**  
Ph.D. Candidate

## Critical Thermal Maximum (CTMax) Trials

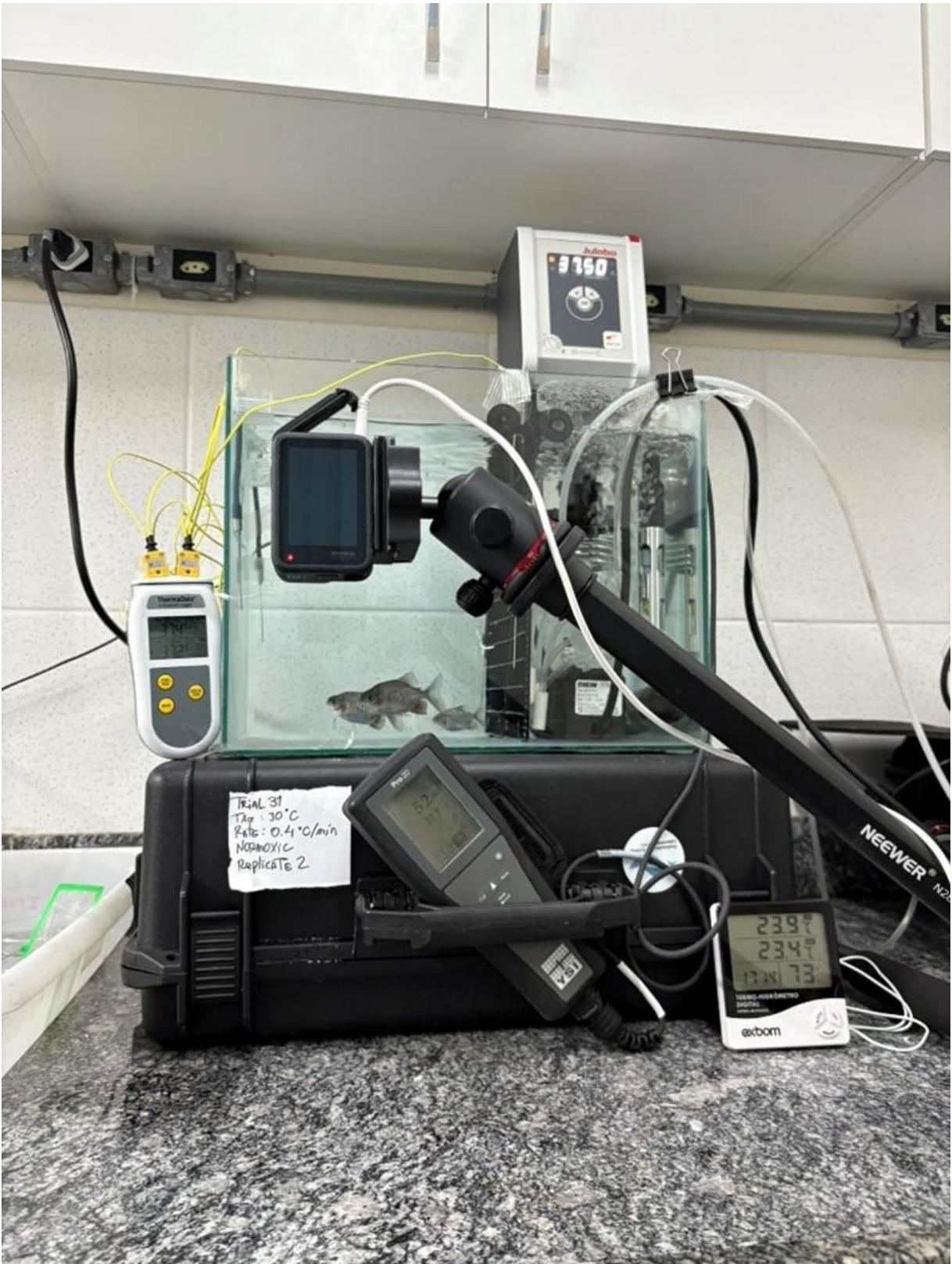


Gradually increase temperature in tank

Record temperature when fish lose equilibrium

Fish can recover in cool water before returning to river

**Figure 1:** Schematic representation of a standard CTmax trial used to assess upper thermal tolerance in fish.



**Figure 2:** Experimental setup for thermal tolerance trials, with a controlled temperature system and loggers to record experimental parameters and fish behaviour. This will be used with juvenile fish sampled from the Stellako River to perform CTmax assessments.

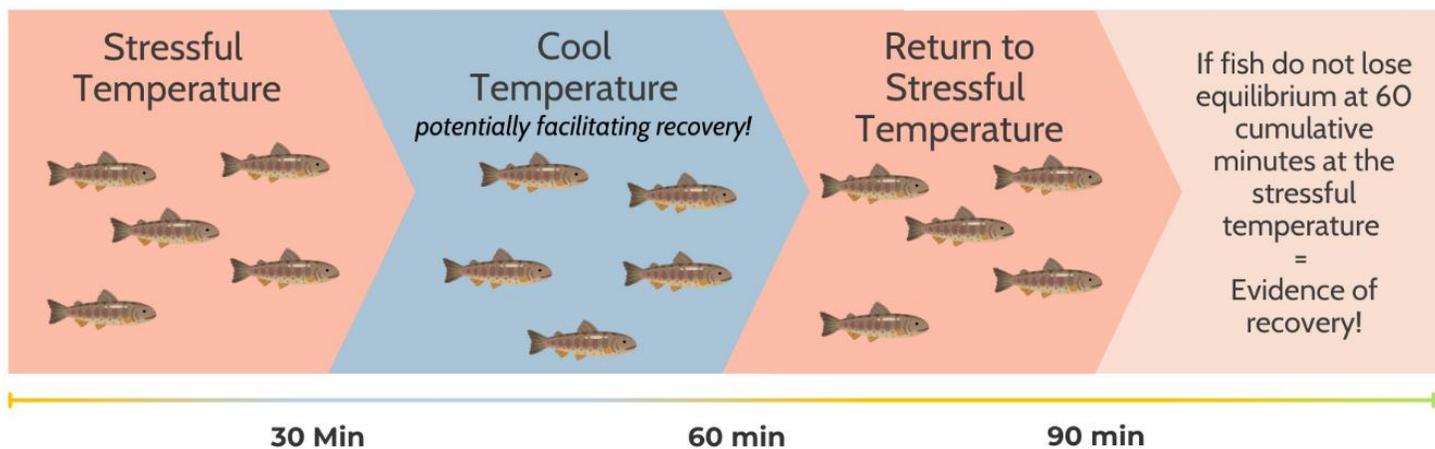
While CTmax estimates are valuable for comparing the vulnerability of species and populations to warming, they do not, on their own, predict temperature-related mortality in natural settings or the degree to which thermal refuges can improve survival. To address this gap, our research will use CTmax data to build a more ecologically relevant framework called thermal tolerance landscapes. These integrative models combine temperature intensity and duration to better predict when and where heat stress becomes lethal.

This experimental approach will allow us to more realistically estimate how fish may respond to different thermal conditions. In particular, our research will focus on the potential impacts of extreme heat events, such as heatwaves, and a second experiment will explore the recovery potential of colder patches of water, commonly referred to as thermal refuges.

The data from the CTMax trials will inform thermal recovery experiments. Using the same experimental system, fish will first be exposed to a stressful temperature predicted to cause loss of equilibrium after one hour. After 30 minutes of exposure, the fish will be moved to a tank with cooler water, simulating a thermal refuge for 30 minutes before the temperature is increased once again to the initial stressful temperature. If the refuge period promotes recovery, we expect the fish to withstand more than 30 additional minutes of exposure to the stressful temperature.

## Recovery Trials

Estimate from the CTMax trials the temperature that will cause loss of equilibrium after 60 minutes of exposure



**Figure 3:** Schematic overview of the thermal recovery trial design, depicting exposure to a stressful temperature, transfer to a cooler refuge, and subsequent re-exposure to the initial stressor to evaluate recovery capacity.

This project will contribute to emerging research in thermal ecology by providing more accurate and ecologically relevant predictions of the impacts of thermal stress and capacity for recovery. This will improve our ability to predict how fish in the Stellako River, and more broadly in the Nechako Watershed, will respond to extreme heat events exacerbated by climate change. Developing more accurate thresholds for thermal stress can inform future management decisions and inform effective and targeted conservation actions.



# NHG Team



**Stephen Déry**

Project Leader

Dr. Stephen Déry is the Rio Tinto Research Chair in Climate Change and Water Security.



Rio Tinto Research Chair team members from the Northern Hydrometeorology Group.



**Kainen Parmar**

M.Sc. Student



**Nisarga Sharma**

M.Sc. Student



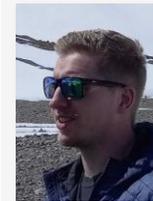
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**Devin Wittig**

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**Mehdi Bateni**

Research Associate



**Duane Noel**

Visiting Intern  
Ph.D. Candidate at Concordia  
University

# NHG Updates



**Stephen Déry**  
Project Leader

Happy Spring Equinox!

As winter winds down, we look forward to the transition to the spring season and longer, warmer days across the Nechako Watershed. The winter of 2025/2026 marked yet another cool season with unusual temperature and precipitation patterns. While December 2025 was near normal for both air temperature and precipitation accumulation, the weather in Prince George then embarked on a 3-week stretch of above average temperatures in late January and early to mid-February 2026. Indeed, starting on January 28th to February 14th, 2026, maximum daily air temperatures at the Prince George Airport rose above the freezing point. This led to extended periods of rainfall, rapid melt of the snowpack accumulated in December and, in some locations, very icy roads. Temperatures remained cold enough in mountainous areas such that the snowpack levels are near or above normal in parts of the Nechako Watershed. A succession of landfalling atmospheric rivers brought copious amounts of snowfall in the upper Nechako Watershed this winter, bringing much needed drought relief to that system. Current long-term forecasts issued by Environment and Climate Change Canada anticipate continued above average air temperatures this spring in the Nechako Watershed along with near normal precipitation. Hopefully this will alleviate the long-term drought that afflicted the region since the summer of 2022 and suppress wildfire activity during the upcoming summer.

With the arrival of 2026, we embarked on the second year of the Rio Tinto Research Chair (RTRC) in climate change and water security with a full complement of graduate students and researchers. As you will read in this issue, we continue addressing key topics of interest to many stakeholders across the Nechako Watershed including extreme events, microclimates in the Vanderhoof Agricultural Belt as well as changing streamflows and water temperatures. In this issue of the RTRC newsletter, MSc student Kainen Parmar describes his project exploring the microclimates and climate change in the Vanderhoof Agricultural Belt (VAB). Local observations note significant spatial variability in meteorological conditions across the VAB that leads to well-defined microclimates that Kainen will quantify through his MSc project. Recent MSc graduate Justin Kokoszka also describes a reconstruction of the naturalized streamflows for the mainstem Nechako River. This is a critical step in disentangling the effects of climate and water management on the historical flows of the Nechako River since the development of hydropower and water management infrastructure in the upper Nechako Watershed in the early 1950s.



Confluence of the Nechako and Fraser Rivers

Another topic of much interest being addressed through the RTRC in climate change and water security is the atmospheric river phenomenon. Several members of the Northern Hydrometeorology Group (NHG) including MSc student Nisarga Sharma are investigating the role of atmospheric rivers on British Columbia's climate, hydrology and natural hazards. Specifically, Nisarga is exploring the different types or "flavors" of atmospheric rivers that influence the Nechako Watershed and their associated hazards including strong winds, heavy precipitation and floods. Over the past two months, the NHG also hosted Duane Noel, a PhD candidate at Concordia University in Montreal, as an intern to identify and characterize landfalling atmospheric rivers influencing the Pacific Coast of western Canada since 2021. It has been a tremendous pleasure to host Duane over the duration of his internship and we wish him well as he pursues his doctorate degree at Concordia University. From the knowledge and skills gained during his internship at UNBC, Duane will be able to explore the role of atmospheric rivers on floods in northeastern North America.

Aside from hosting Duane Noel as an intern in January and February 2026, there has been no change to the composition of the RTRC in climate change and water security team. However, we are pleased to have several team members have their positions extended for another year in support of our program of research. This includes Research Manager Erica Lee (co-supervised with Dr. Eduardo Martins), Field Crew Manager Dylan Broeke, and Research Skills Development Trainee Justin Kokoszka. As well, the field crew for the summer 2026 field season has been recruited. Returning to the field crew this summer are Maria Tavares and Kainen Parmar, and joining the team this year is new MSc student Serenity Poirier.

With my ongoing sabbatical, I have been able to dedicate considerable time to writing papers and funding applications. Over the past few months, we were able to secure additional funding from Eco Canada to support Data Manager Maziyar Dowlatabadibazaz who continues working on our group's data management efforts. As well, UNBC's Integrated Watershed Research Group (IWRG) successfully applied to the Nechako Environmental Enhancement Fund (NEEF) to undertake a fourth phase of integrated watershed research in the Nechako Watershed. This fourth phase of research will start on May 1st, 2026 and will focus on the "dry" Nechako Canyon where the IWRG will collect some baseline data prior to the wetting of the Canyon once the Ne Too hydropower project and cold water release facility are constructed at Kenney Dam. Led by new MSc student Serenity Poirier, our team will undertake a project on mapping incoming solar radiation (or "radiation loading") in the Nechako Canyon. Several other funding applications are also in preparation as we seek additional funding to expand our research in the Nechako Watershed.



Cottonwood Island Nature Park, Prince George

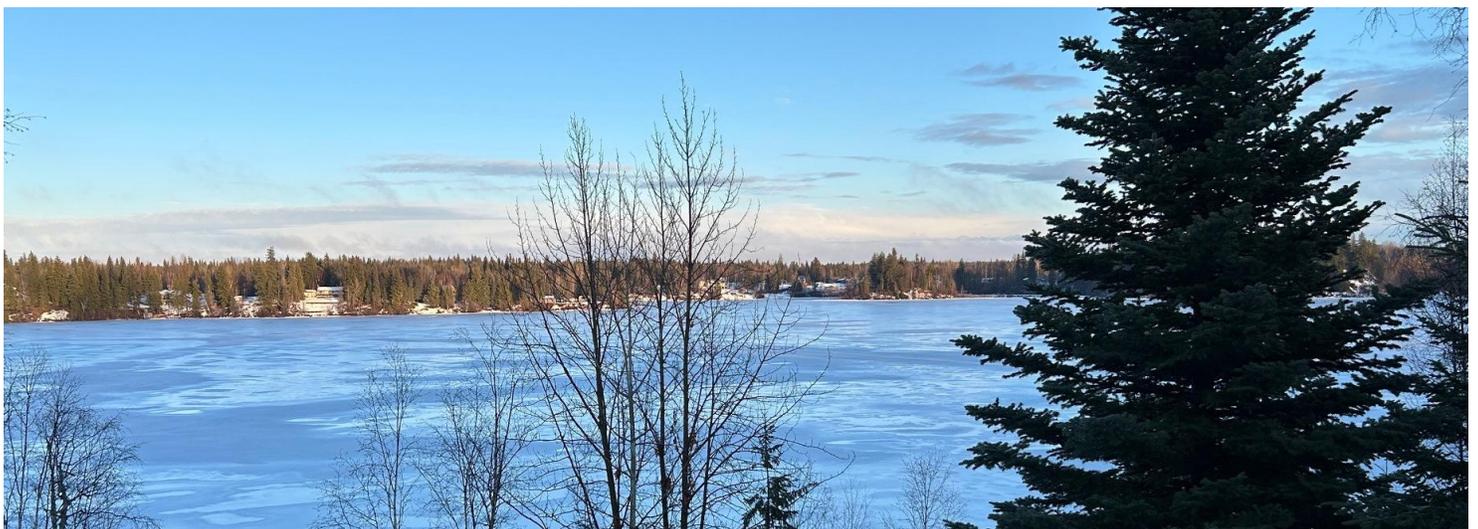
The RTRC in climate change and water security team continued its active participation in multiple groups and outreach activities in early 2026. This included a presentation by Kainen Parmar, Dylan Broeke and I at the annual general meeting (AGM) of the Nulki-Tachick Lakes Stewardship Society (NTLSS) on 31 January 2026. I am pleased to report that I have been elected as a Director for the NTLSS and look forward to being further engaged in the Society over the next few years. I also continue being involved in multiple groups such as the Nechako Watershed Roundtable's Large Lakes Monitoring Group, its Climate Change Adaptation and Resilience Group, and the Nechako Producers Group. In early 2026, I also conducted several interviews with local and national media including CKPG News, Global TV and Canada's National Observer. Please consult the list of outreach activities at the end of the newsletter for further details.

Both research groups of the RTRC in climate change and water security led by myself and the RTRC in freshwater fish ecology led by Dr. Eduardo Martins met with our Science Advisory Board (SAB) on January 16th for a full progress update. We are most grateful to our seven SAB members for their willingness to support our teams in this way. We therefore thank Mark Barnes (Interim Associate Vice-President, Strategy and Outreach, UNBC), Vanessa Foord (BC Ministry of Forests), Penina Sara-Lynn Harding (Interim Associate Vice-President, Indigenous, UNBC), Andy Lecuyer (Rio Tinto), Brian Toth (Carrier Sekani Tribal Council), Chelton van Geloven (Lheidli T'enneh First Nation), and Dr. Francis Zwiers (Pacific Climate Impacts Consortium/University of Victoria) for their most helpful feedback and guidance on our research, field activities and outreach associated with our programs of research.

With the arrival of spring, our focus will shift from planning and preparation for another field season to execution of field activities. We anticipate field activities to ramp up in early to mid-May as we return to visit our 35 water temperature monitoring sites, eight weather stations and several tipping bucket rain gauges deployed in the Nechako Watershed. We therefore look forward to engaging with many of you during our site visits this spring and summer.

Enjoy the spring season and Happy Equinox!

Stephen Déry



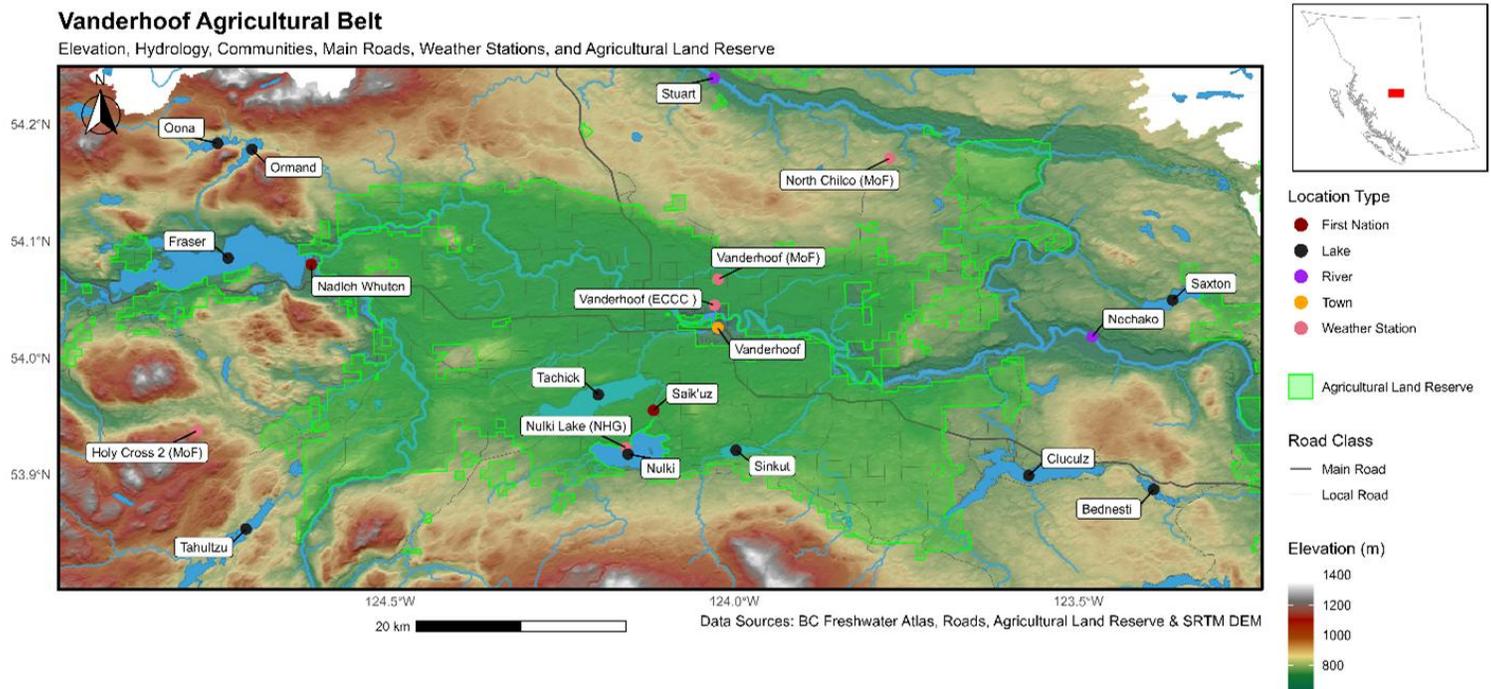
Ness Lake

# Spatiotemporal analysis of microclimates in the Vanderhoof Agricultural Belt



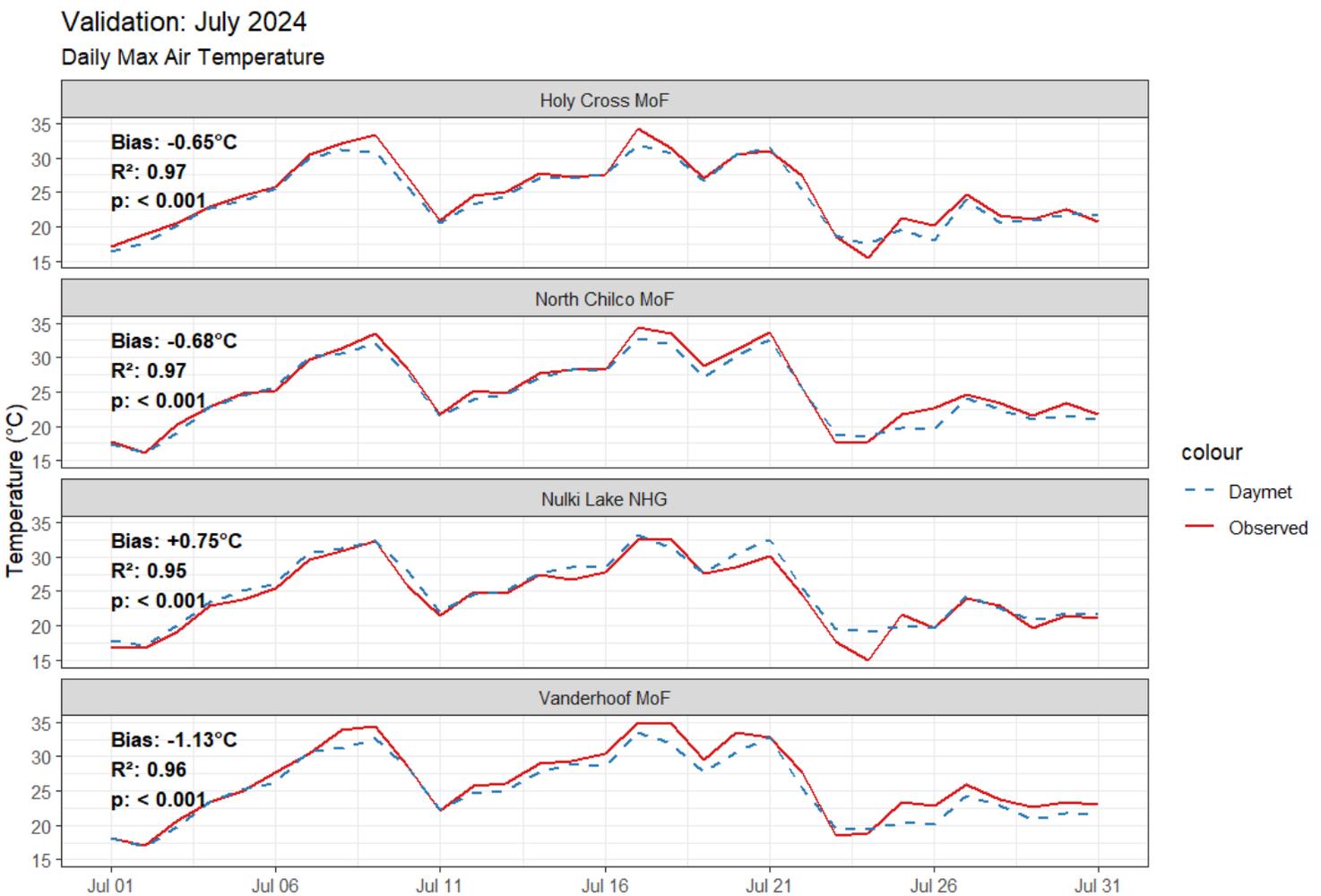
**Kainen Parmar**  
M.Sc. Student

My research in the Natural Resources and Environmental Studies Graduate Program at UNBC focuses on the spatiotemporal analysis of microclimates within the Vanderhoof Agricultural Belt (VAB), BC. My project aims to characterize how local climate variables such as air temperature, precipitation, and snow water equivalent (SWE), have changed from the 1980s to 2025. My goal is to integrate Daymet, a gridded climate estimate dataset (1 km spatial resolution, daily record) with remote sensing data (Landsat imagery) validated against local weather stations to characterize climate variability and change within the VAB. Figure 4 displays the VAB study area which includes a large portion of the British Columbia Agricultural Land Reserve cover, major waterbodies favored by the community, and established weather stations. My work is supervised by Dr. Stephen Déry and committee members Dr. Diogo Spinola and Dr. Peter Jackson and is supported by the Rio Tinto / UNBC Research Partnership. The research is actively being informed through outreach and meetings with local environmentalists and agricultural producers to ensure the project remains relevant to local agriculture.



**Figure 4.** Vanderhoof Agricultural belt study area boundary with the Agricultural Land Reserve (ALR), major lakes, rivers, roads, weather stations and communities marked.

To ensure the accuracy of the gridded climate models, I will validate them against ground observations from a number of local weather stations. This will include the Northern Hydrometeorology Group’s (NHG) field station at Nulki Lake, a number of Ministry of Forests (MoF) stations, and the Environment and Climate Change Canada’s (ECCC) Vanderhoof and Fraser Lake stations, now both decommissioned. Figure 5 displays preliminary validation results for July 2024 where we see a statistically significant correlation between the Daymet estimates for daily maximum air temperature estimates and the weather station observations. My research will help provide a detailed characterization of the meteorological changes that have occurred within the VAB over the past 45 years, helping to inform future agricultural planning and land use management locally. The research will also provide insight into the viability of the Daymet climate product for other research projects in the region.



**Figure 5.** Validation of Daymet maximum daily air temperature validated against the NHG’s Nulki Lake, and Ministry of Forest’s Holy Cross, Vanderhoof, and North Chilco weather stations during July 2024.

# Hydrological alteration in the Nechako River Basin: Quantifying the individual roles of climate and flow regulation on streamflow

I am excited to share that I have officially completed my Master of Science in Natural Resources and Environmental Studies and successfully defended my thesis. After being immersed in the data of the Nechako River Basin (NRB), I have summarized the key findings of my research here.

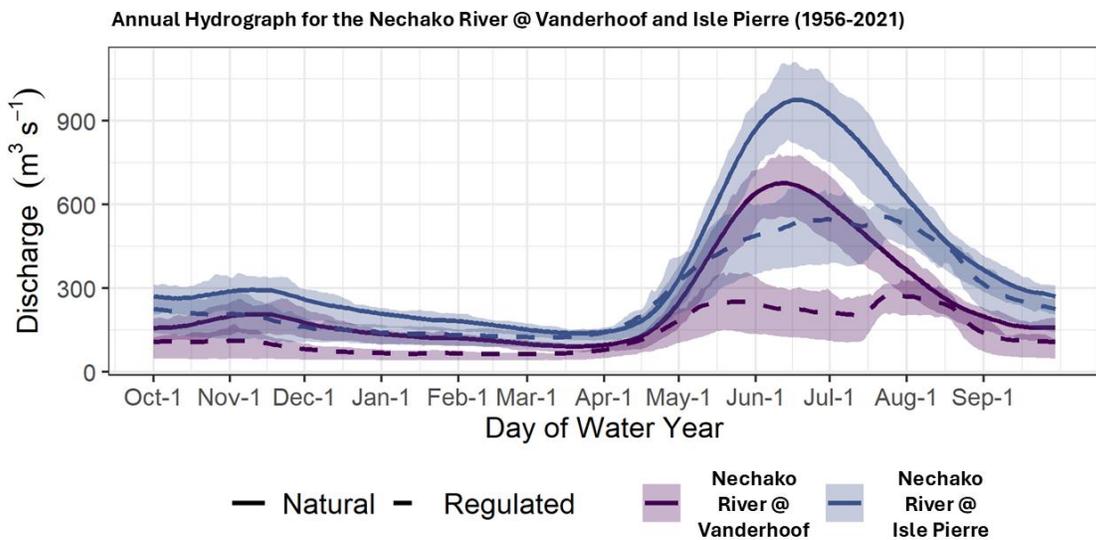
## Motivation and Approach

The Nechako River Basin (NRB) is a vital tributary to the Fraser River, providing critical habitat for Pacific salmon and the endangered Nechako white sturgeon.

For over 70 years, this system has been shaped by two key drivers of change: Kenney Dam and flow regulation, which diverts a significant portion of water for power generation, and a changing climate that has seen regional temperatures rise by over 2°C since 1950. Because the Nechako River has been regulated since 1952, there is no "natural" river to observe. This study used daily reservoir inflows and a simplified routing model to reconstruct a naturalized daily streamflow record from 1956 to 2021. By comparing this natural flow regime scenario against the actual "observed" flows, I was able to isolate the influence of climate from that of flow regulation for the Nechako River at Vanderhoof and Isle Pierre (Figure 6).



**Justin Kokoszka**  
Research Skills  
Development Trainee,  
Recent M.Sc. Graduate



**Figure 6.** This hydrograph shows the "naturalized" flow (solid lines) representing what the river would look like under natural conditions without flow regulation, compared to the "observed" flow (dashed lines) which shows the actual regulated flow for the Nechako at Vanderhoof (purple) and Isle Pierre (blue). The shaded bands represent the average 10<sup>th</sup>-90<sup>th</sup> percentile range of daily flows between 1956 and 2021.

## Measuring Hydrological Alteration

To measure alteration, I utilized 32 Indicators of Hydrological Alteration (IHA's), ecologically relevant metrics that describe the magnitude, timing, duration, frequency, and rate of change of a river's flow regime. To make the data accessible, I focused on 12 IHA's, determined by Principal Component Analysis. All 12 monthly metrics were retained for a total of 22 primary indicators. Using the Range of Variability Approach (RVA), I first quantified the degree of alteration resulting from flow regulation. This method quantifies the degree of hydrological alteration, showing how often the regulated river stayed within its "natural" boundaries.

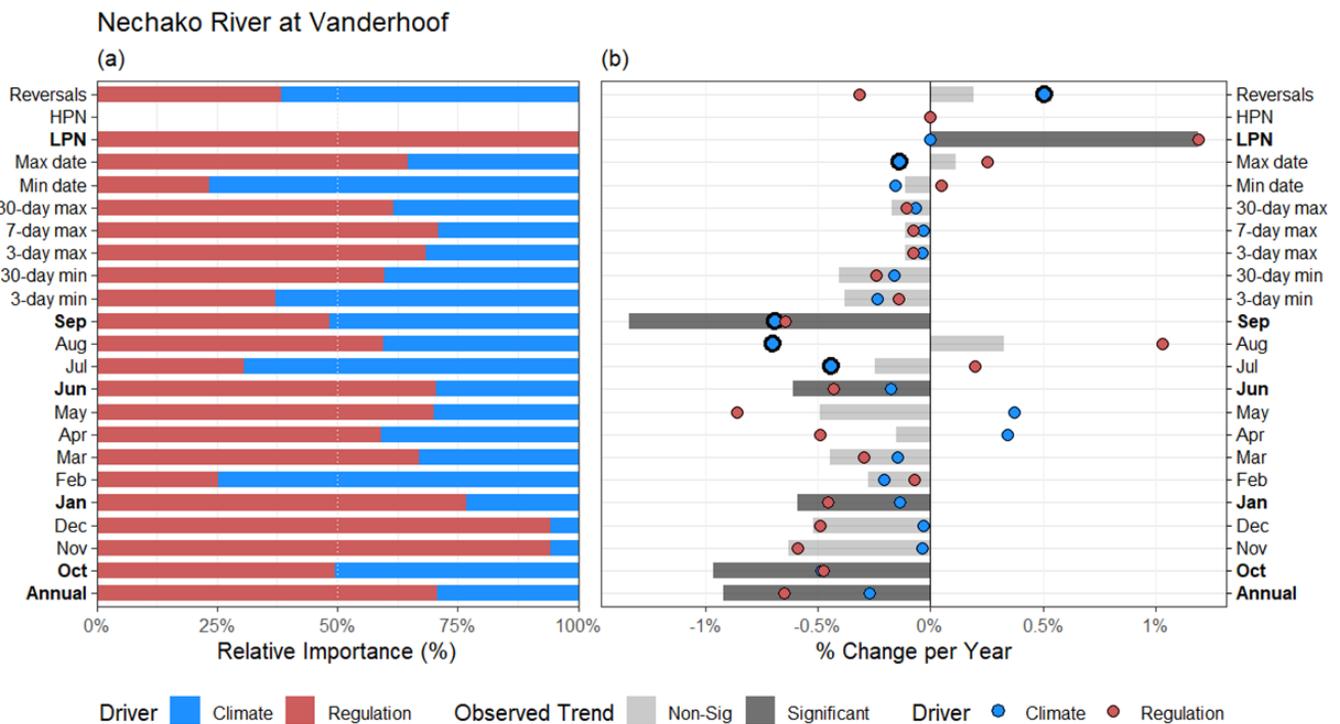
The results revealed that the Nechako River at Vanderhoof was 'highly altered' (71%) while downstream Isle Pierre was 'moderately altered' (53%). These alterations were primarily driven by a reduction in overall flow magnitudes including high-flow events that naturally flush the river system. The river is now dominated by low-flow conditions which persist for much of the year, resulting in a 'flattened hydrograph' (see Figure 6).

## Separating Climate from Flow Regulation

I used a simple subtraction framework to quantify how each driver influenced long-term streamflow. Firstly, I used Mann-Kendall test and Sen's Slope estimator to identify statistically significant trends under both natural and regulated conditions. Since the natural flow record is driven by climate, any significant trends were assumed to be climate driven. In the observed flow record, trends were assumed to be driven by both climate and flow regulation. By subtracting the climate trend from the observed trend, I was able to "cancel out" the influence of climate to quantify the trend driven by flow regulation.

## Trends and Drivers: The Role of Climate and Flow Regulation

Here I summarize results obtained for the Nechako River at Vanderhoof. There was a clear "drying" signal driven by climate, particularly in late summer and autumn. However, because of the release of water during mid-June to mid-August (Summer Temperature Management Program; STMP), these natural climate trends are often hidden or "masked" in the observed flow record, suggesting a tug-of-war between the two drivers (Figure 7b). The results also show flow regulation as primary driver of long-term changes across five of the six statistically significant trends (observed record). Both climate and flow regulation contributed to a long-term decline in September median flows, with climate contributing slightly more.



**Figure 7.** This figure displays a) the relative importance of climate and flow regulation to their absolute total magnitudes for each primary hydrological indicator, and b) the combined (observed flow record) and individual (climate-driven and regulation-driven) trend magnitudes for each primary hydrological indicator. The y-axis includes metrics for magnitude (annual and monthly flows), timing of annual extremes (Min date and Max date), duration of extreme flows (3-day min/max, 7-day max, 30-day min/max), and number of low pulses (LPN), number of high pulses (HPN), and number of reversals. The grey bars show trends from the observed flow record, while the blue and red dots illustrate the individual trends of climate and regulation. Dark grey bars and bolded outlines show statistically significant trends (p-value < 0.05).

## Implications and Research Limitations

The Nechako River's natural flow regime has been fundamentally moved outside of the range that local ecosystems and species, like the Nechako white sturgeon, evolved to thrive in. While the STMP effectively maintains the river's natural late-summer flow state, the "flattened" hydrograph suggests the river lacks the natural pulses required to maintain healthy fish habitats. The trending increase in low-flow days, trending decline in natural summer flows, combined with warmer air temperatures also signals a thermal risk to migrating salmon into the future.

While this study provides a vital natural flow baseline, it primarily focuses on flow magnitude and timing over long-term periods. Future research should integrate land-cover changes over different time periods, such as the impacts of wildfires and forestry, which also affect how water moves through the landscape. The baseline itself could be improved with the use of hydrological models, which can account for physical processes that are missed in the routing model, such as icing conditions and ice jams. These models also can run future projections under different climate scenarios, a feature that is lacking when using the data-driven flow routing approach. Nonetheless, this research serves as a starting point for "environmental flow" targets aimed at management strategies that aim to mimic natural river patterns to support both the environment and the communities that rely on the Nechako River.

## Concluding Remarks

This journey has been a long and rewarding one. I would like to express gratitude to my supervisor, my committee, and the community in Northern BC for their support throughout this project. It is my hope that this data contributes to a more sustainable and resilient future for the Nechako River Basin. Thank you for following along with this research!



Nechako River

# Atmospheric rivers in British Columbia: Types, impacts, and why they matter



**Nisarga Sharma**  
M.Sc. Student

## **The Invisible Giant Above Us**

Imagine the Amazon River but suspended a few kilometers above your head in the sky, that's an Atmospheric River (AR). It is essentially a river in the sky made up of massive amounts of moisture traveling in the atmosphere with the help of low-level jet streams or winds often stretching thousands of kilometers in length and a few hundred kilometers wide. These ARs transport abundant moisture, occasionally making landfall along the BC coast where they encounter terrain and release precipitation in the form of rain or snow. Depending on the amount of precipitation and the duration of the landfall an AR makes over a watershed, we can qualify an AR to be very beneficial or very hazardous. Beneficial in the sense that the precipitation helps to replenish freshwater resources and recharge soil moisture; however, the AR can also be detrimental if it causes heavy precipitation in a short period leading to flash floods and landslides. So, we can say these invisible giants above us can be both good and bad for us. Hence, it is highly important to understand them effectively and have early predictions about them so we can be well prepared.

## **Not All Storms Are the Same**

All of the atmospheric rivers coming in and making landfall are not the same, they differ from each other in terms of moisture content and the speed of the wind carrying it. To categorize any storm or event as an AR, we calculate a quantity called Integrated Water Vapor Transport (IVT). IVT is a metric that combines the total amount of water vapor in the air column with the wind speed to inform us how much moisture is being transported and how fast. Essentially, it is a combination of wind and moisture together, the higher the value, the more intense the AR is.

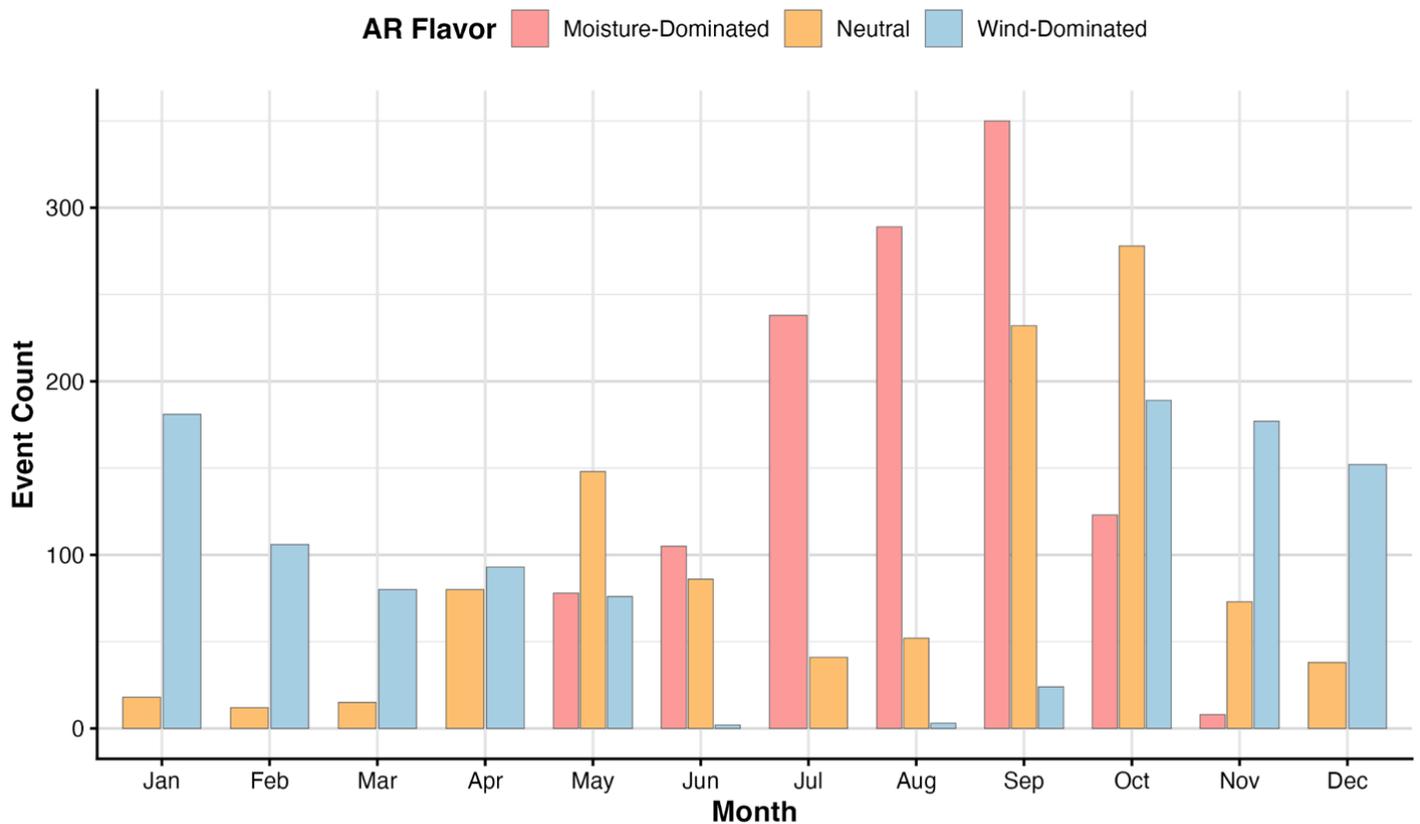
However, the value of IVT can be skewed due to a large contribution from just one component, which might make it difficult for us to know the true nature of an AR if we only depend on the IVT value. Hence, a new classification called "flavors" of ARs is introduced. This classifies the AR into three different flavors namely: Wet, Windy, and Neutral. An AR with a higher moisture component relative to wind is called a Wet AR, while those with a higher wind component are called Windy ARs. A balance of these two components gives us a Neutral AR.

## **Why Are We Studying the Flavors?**

The main reason to study ARs by classifying them into flavors is largely due to the fact that each flavor has a different and distinct impact or response during landfall. Different flavors behave differently. For instance, the Wet AR, having more moisture content, causes higher precipitation. In contrast, the Windy AR might make landfall further inland, penetrating deeper into the province due to the higher wind component driving it over the mountains. Since the watershed response from these different flavors is largely different, we must study the ARs by categorizing and classifying them.

# Seasonality of Atmospheric River (AR) Flavors

Monthly distribution of AR flavor occurrences in British Columbia



**Figure 8.** Seasonality of Atmospheric River (AR) Flavors in British Columbia (1948-2018)

In Figure 8 above, we can see the distinct separation of flavors across seasons, showing clear peaks where certain types are more dominant. Hence, since specific flavors are more frequent in specific months, understanding them helps us to predict the unique impacts expected for that time of year in a better way.

## Project Goals and Future Application

Most past work and research have been done regarding the intensity and frequency of ARs. My graduate studies will focus more towards understanding the properties and science behind these ARs by classifying them and then looking at the watershed responses due to these different flavors. This gives us a better understanding of recent trends and changes, specifically what is more dominant and what we should be focused and careful about. The study area will cover the whole of British Columbia, later specializing and focusing on the Nechako Watershed region for conclusive and definitive answers.

My project will also involve conducting application-oriented work after understanding these AR types and their individual impacts. I will be developing a machine learning model that aims to reduce and minimize the bias, and errors present in the current forecast models, like the Global Forecast System (GFS), by considering local factors, parameters, and the complex topography of BC. I plan to develop a model to make the forecast more precise with reduced latency. This will ultimately be very useful for improving flood warning systems, helping dam operators manage reservoirs safely, and mitigating the risks to public infrastructure.

# An aspiring hydrologist's new journey in Prince George, BC, learning about the impacts of atmospheric rivers on floods



**Duane Noel**  
Visiting Intern,  
Ph.D. Candidate  
(Concordia University)

The winter season in Canada represents a time for introspection. As a graduate student from Concordia University in Montreal, Quebec, studying how floods are generated in eastern Canada, Canadian winters serves as a great opportunity to shelter away from the cold, make progress in my research and plan for future conferences. Throughout my academic career, my training in water resource management primarily focused on floods in eastern Canada. I spent several years studying the main contributing factors to flooding (i.e. snowmelt, ice jams and heavy rainfall), however, I lacked training in western Canadian hydrology. River floods in western Canada are affected by different conditions compared to eastern Canada. As a young hydrologist, understanding the differences between western and eastern Canadian hydrology is vital for developing flood mitigation strategies that are applicable to the entire country.

In eastern Canada, the discussion of atmospheric rivers (also known as “rivers in the sky”) is less commonly reported in the news, as compared to western Canada. Given the importance of atmospheric rivers’ contribution to the water budget in arid watersheds, and their ability to carry large amounts of water vapour across long distances, which can lead to heavy rainfall and unprecedented flash floods, understanding how atmospheric rivers are formed and their impact on floods is vital for flood risk management. Without this fundamental understanding of atmospheric rivers and other hydrological processes that occur more frequently in western and northern Canada, my studies as a young hydrologist will be incomplete.



**Figure 9.** Duane Noel in-front of the I.K. Barber Enhanced Forestry (EFL) Building at the UNBC campus in Prince George, BC. The offices of the Northern Hydrometeorology Group are located inside the EFL building.

With this current gap in my knowledge, I was motivated to learn more about western Canadian hydrology and how large-scale meteorological processes can affect floods. This winter, I completed an internship with the Northern Hydrometeorology Group (NHG) at the University of Northern British Columbia (UNBC), in Prince George, British Columbia (BC) to undergo training in western and northern hydrometeorology. Under the supervision of Professor Stephen Déry, I spent seven weeks examining the climate context of the mid-November 2021, mid-October 2024 and mid-December 2025 floods in BC’s lower mainland. Previous studies have shown the impact of atmospheric rivers on the mid-November 2021 floods in BC’s Lower Mainland; however, few research have been conducted on comparing the climate conditions of the mid-November 2021 floods to more recent flood events in southwestern BC.

Prior to conducting my comparison analysis of antecedent flood conditions in southwestern BC, I participated in several training sessions hosted by current members of the NHG. First, I learned about the data extraction process used by members of the NHG to extract key metrics from the ERA5-Land reanalysis dataset such as total precipitation, snowmelt, snow water equivalent and surface runoff. These metrics are used to monitor antecedent climate conditions prior to a flood event. In addition, I learned how to use Python (a programming language) code to perform common tasks such as data cleaning, mathematical operations on matrices and creating graphs, all important tools needed for extracting and visualizing climate metrics from a large dataset. I also had the opportunity to meet Professor Tamar Richards-Thomas from the University of Regina, one of Professor Déry's colleagues, where I learned more about how hydrometeorologists detect atmospheric rivers. These training tutorials have been helpful for the analysis of the hydrometeorological variables I extracted from the ERA5-land dataset.

Furthermore, I learned about the NHG's work in the Nechako Watershed, one of the largest watersheds in BC. I learned how the Nechako River and the Fraser River meet at the confluence, located at Prince George. Additionally, I learned about the cultural, ecological and economic importance of the Nechako Watershed for the north-central BC region, and how the impacts of climate change led to more frequent wildfires and drought conditions in the region. Without proper management and monitoring of the water resources in the Nechako Watershed, Indigenous and other local communities' livelihoods remain at risk.

My research in BC's Lower Mainland has shown that atmospheric rivers played a role in the frequency of rain-on-snow events that led to higher streamflow in nearby rivers. I also found that the mid-November 2021's total precipitation and air temperature conditions were different to the mid-October 2024 conditions. Similar results were found for the comparison between the mid-October 2024 and the mid-December 2025 conditions. The mid-November 2021 and mid-December 2025 floods represented floods where rain-on-snow events led to excess surface runoff. In contrast, the mid-October 2024 flood represented a case where heavy rainfall caused excess surface runoff. Without consistent monitoring of the presence of atmospheric rivers and antecedent climate conditions, communities will remain susceptible to flooding.

To conclude, I would like to thank my host supervisor Professor Stephen Déry for the opportunity to complete this research internship in his lab. I gained valuable experience from his mentorship. The knowledge I gained completing this internship will be used in my own doctoral research on examining flood generating mechanisms in eastern Canadian rivers. This experience has enabled me to become more familiar with the different hydrometeorological processes that contribute to generating floods in western Canada. I would also like to thank the NSERC-CREATE and Quebec Mobility Bursary programs for the financial support to embark on this journey from Montreal to Prince George. Lastly, I would like to thank all the NHG members for their kindness and support. Each member has made my internship experience memorable. I look forward to hearing more about the advancement in research in the Nechako Watershed.



Nechako River



Fraser River

# Outreach

**Communicating our findings through various means continues to be a top priority!**

## Presentations

### Northern Hydrometeorology Group

- 2026/01/21 - Déry, S. J., Owens, P. N., Martins, E. G., and Parkes, M. W. (2026). Key accomplishments from the Integrated Watershed Research in the Nechako River Basin, Phase 3 Project. Meeting with the Board of Directors of the Nechako Environmental Enhancement Fund Society, Prince George, Canada
- 2026/01/31 - Parmar, K., Broeke, D. and Déry, S. J. (2026). Nulki Lake weather station project update. Annual General Meeting (AGM) of the Nulki-Tachick Lakes Stewardship Society, Vanderhoof, Canada

### Freshwater Fish Ecology Lab

- 01/22/2026 - Walters, C., Beaulieu, M., Bacon, B. A., Bondaroff, T., Czenohalan, A., and Johnson, J. BC Natural Resource Forum panel: Building Talent and Innovation for BC's Resource Future - Post Secondary Leadership in Action, Prince George, BC.
- 02/05/2026 - Walters, C., N. Gantner, N., Hagen, J., Spendlow, I., Pillipow, R., and Martins, E. G. Disentangling the contributions of density dependence and independence to population growth rates, BC Hydro Les Ecologistes Seminar Series.
- 02/16/2026 - Pugh, A., Walters, C., and Martins, E. G. Stellako Thermal Ecology Project Update. Nechako Nations Monthly Environmental Management Board Meeting.
- 02/27/2026. Pugh, A., Walters, C., and Martins, E. G. Stellako Thermal Ecology Project Update. Lhoosk'uz Dené Nation/Ulkatcho First Nation Advisory Group Meeting.

## Media Interactions

### Northern Hydrometeorology Group

- 2026/01/20 - Global surface air temperature forecasted by ECCO to reach 1.44 degrees Celsius in 2026, CKPG News, CKPG (Prince George, BC)
- 2026/01/26 - Atmospheric rivers in a changing climate, Global BC News, Global TV
- 2026/02/03 - Current mild and wet spell in Prince George, CKPG News, CKPG (Prince George, BC)
- 2026/02/10 - [New atmospheric river forecast technology could double British Columbians' flood warning time](#), Canada's National Observer
- 2026/02/17 - Current snowpack levels in the upper Fraser River Basin, CKPG News, CKPG (Prince George, BC)

### Freshwater Fish Ecology Lab

- 01/16/2026 - Prince George Citizen. [UNBC student bringing her perspectives to BC Natural Resources Forum](#)
- 01/16/2026 – University of Northern British Columbia. [Post-secondary leadership in action at the B.C. Natural Resources Forum](#)



**Check out our websites!**

<https://web.unbc.ca/~sdery/rtrc>

<https://www.ffishlab.ca/>

# Outreach

Communicating our findings through various means continues to be a top priority!

## Publications

- Walters, C. L., Gantner, N., Hagen, J., Spendlow, I., Pillipow, R., and Martins, E. G. 2026. "Disentangling the Contributions of Density Dependence and Independence to Population Growth Rates." *Ecological Applications* 36(2):e70199. <https://doi.org/10.1002/eap.70199>

## \*NEW\* Resources

- We are happy to announce that the NHG now has access to a Data Request web page, <https://nhgdatareq.unbc.ca/>. With this website, individuals around the world can simply request water, weather and all data that NHG collects, along with their respective reports. This removes previous friction points that were in place and organizes the data request process in a simple manner.

The screenshot shows a web form titled "Data Request Form" from the University of Northern British Columbia. The form is divided into four main sections:

- 1. Your Contact Information**: A text input field for "Your Email Address" with the placeholder "you@example.com".
- 2. Select Site**: A dropdown menu labeled "Choose a site:" with the placeholder "Select a site...".
- 3. Time Period**: A text input field for "Enter desired time period:" with the placeholder "e.g., January 1, 2023 to December 31, 2023".
- 4. Data Options**: A text input field for "Preferences (Interval, Format, Field Reports, etc.):" with the placeholder "Enter your preferences here...".

At the bottom of the form is a green "Submit Request" button. The footer of the page reads "© University of Northern British Columbia".



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