

An update from Dr. Stephen Déry, Project Leader

The summer of 2021 is certainly one we will not soon forget given the exceptional weather we experienced across northern BC. The record-breaking heat wave in late June and early July 2021 provided the perfect conditions for the outbreak of major wildfires across the province. Tragically, this led to devastation in Lytton after a wildfire swept through the community on June 30th, 2021 leading to two confirmed fatalities. Wildfires also erupted across the Nechako Watershed including the massive Cutoff Creek wildfire that has burned uncontrollably across 31,602 hectares of forests as of September 7th, 2021. This prolonged heat spell also made its marks on regional water temperatures, which spiked in response to the early summer heat dome.

In this newsletter, Rajtantra Lihare and Jingwen Wu put into a historical perspective the 2021 summer heat wave and its impacts on river water temperatures in the Nechako Watershed. They explore trends in both air and water temperatures thereby providing some important information on the regional climate's current trajectory. Apart from this, this IRC newsletter issue focuses on the Tahtsa Ranges Atmospheric River Experiment (TRARE) field campaign. TRARE is a field campaign dedicated to the study of the atmospheric phenomenon commonly referred to as the "Pineapple Express" storm along the west coast of North America. In September and October this year, a crew of UNBC graduate students and researchers along with support from colleagues at the Université du Québec à Montréal (UQAM) will be based at Huckleberry Mine and at the Nadina Lake Lodge to take detailed observations of storms impacting the upper Nechako Watershed. Kelly Hurley, the project manager for TRARE, provides an overview of the field campaign and the state-of-the-art equipment being deployed to monitor the storms. As well, Jeremy Morris and Derek Gilbert provide a summary of this past summer's field activities in the Nechako Watershed in preparation for the TRARE field campaign.

We are excited to welcome one new member to the NSERC/Rio Tinto IRC team this month. Anna Kaveney joins the team as a Research Skills Trainee who will participate in the data collection effort for the TRARE field campaign. As well, Derek Gilbert will continue his position as a Research Skills Trainee this autumn in support of TRARE while Spencer Woyke will pursue an internship this fall as part of his undergraduate program in environmental science at UNBC. We also wish to congratulate both Jeremy Morris and Joseph Gothreau for successfully defending their Master's theses in mid-August! Jeremy will continue to work as the Northern Hydrometeorology Group's research manager and outreach coordinator this fall and early winter and will be fully engaged in the TRARE field campaign as well. Meanwhile, Joseph has contributed to the development of the Nechako webportal through his Master's research, a platform that will likely be used to share data and findings from the IRC program of research.

Our communication efforts continued over the summer with several public presentations. On July 6th, Jeremy Morris presented an overview of the IRC program of research and the water temperature monitoring network in the Stuart River Basin to the Binche Whut'en First Nation Chief and Council. Stephen also presented an update on the NSERC/Rio Tinto IRC in climate change and water security to the Nechako First Nations on August 24th. UNBC also issued a media release on the TRARE field campaign on September 3rd, leading to regional media coverage on TRARE. Details on our recent outreach efforts are also included in this newsletter.

The IRC team wishes everyone a fantastic fall season and looks forward to continued interactions with the residents and stakeholders of the Nechako Watershed during the TRARE field campaign and beyond!

Stephen Déry

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Special points of interest

- Summer heat in the Nechako
- Epic field photos!
- Newcomers to B.C.
- Weather Balloons!
- State of the art equipment



The NHG mascot, Angel, overseeing our two new research assistants, Derek & Spencer, on their first station visit. Ness Lake Weather Station, May 7, 2021

Research Manager Update

Jeremy Morris

We've had a wild summer here at the NHG. The field team has completed roughly 50 site visits over 30 days of field work across the Cariboo Mountains and Nechako watershed. Huge thanks to Derek, Spencer and Kelly for all the hard work this year, and congratulations to them for developing the field and technical skills required for this research in such a short timeframe. During this busy season, we spent two full weeks in the western end of the Nechako reservoir in preparation for the TRARE field campaign. During these two weeks, we deployed a new weather station at the Nadina River Spawning Channel, moved the Mt. Sweeney station to a new location at ~1400 m elevation, and deployed several rain gauges around the Rhine and Whiting creek watersheds.

Now that the TRARE project has commenced, we have been working flat out for the last three weeks. We arrived at Huckleberry Mine on September 8th where we proceeded to deploy a wide array of weather instrumentation. We additionally visited all nearby existing sensors in the area in preparation for our observations of fall storms. With all the field data collection ongoing now, we have created a solid data management system for the duration of the campaign here. We are glad to state that as of last week our preparations paid off! As readers are likely aware, a storm hammered the BC coast over September 20-21 delivering 50 mm of rainfall to the TRARE research area over a 24 hour period. NHG members worked in shifts to maintain manual storm observations over the duration of the event and to ensure continued sensor operation. Our team additionally launched two weather balloons to collect vertical profiles of temperature and humidity in the atmosphere during the storm. The first success of many!

As for me, I have finished my Masters research at UNBC and my time at the institution is in its twilight. I will remain in my role into winter to help train the next Research Manager before I transition to a new job as Water Resource Scientist at EDI in Prince George. That said, I hope to continue my collaboration with the NHG, and with the various partners across the Nechako basin to keep developing our knowledge of our regions' hydrology!



2021 NHG field crew atop Mt. Sweeney with their backs to Tahtsa Reach and the Whitesail Range.

Climate change increases water temperatures in the Nechako Watershed

Jingwen Wu & Rajtantra Lilhare

According to NOAA's 2020 Annual Climate Report the combined land and ocean temperature has increased at an average rate of 0.08 °C per decade since 1880; Canada is no exception, its average (mean) annual temperature increased by 1.7 °C from 1948 to 2016, about double the global rate. Most notably this year, sixty historic air temperature records were smashed across B.C. on June 29th, and with a highest air temperature of 49.6 °C at Lytton, B.C. With air temperatures increasing, water temperatures follow suit, which can affect aquatic species and habitats. Therefore, it is important to see how water temperatures are changing with warming air temperatures across the Nechako watershed.

We analyzed the summer air temperature data (from June to August) at four Environment and Climate Change Canada weather stations (i.e., Vanderhoof, Ootsa Lake / Skins Lake Spillway, Fort St. James, and Burns Lake) across the Nechako Watershed for 1991–2021. These data clearly show a significant increasing trend in summer air temperature at all weather stations across Nechako Watershed (Figure 1). Moreover, the summer air temperatures reached their highest level in the year 2021 at most weather stations. We also analyzed the summer water temperature data at Finmoore between July 10th to August 20th for 1987–2017. This clearly shows an increasing trend in the summer water temperature, at a rate of 0.03 °C per year (Figure 2). The scatter plot shows the relationship between the summer air temperature and water temperature across the Nechako Watershed (Figure 3). It shows that, for all weather stations, a positive correlation ($r^2 > 0.61$) between the summer air temperature and water temperature across Nechako Watershed. In other words, increases in air temperatures explain more than 60% of the water temperature increase for the Nechako River at Finmoore. Our analyses show that the increasing summer air temperatures play an important role in changing water temperatures; with global temperatures warming unceasingly as projected by the Intergovernmental Panel on Climate Change (IPCC), water temperature are likely to continue rising.

Summer air temperature comparison across the Nechako River basin (June to August)

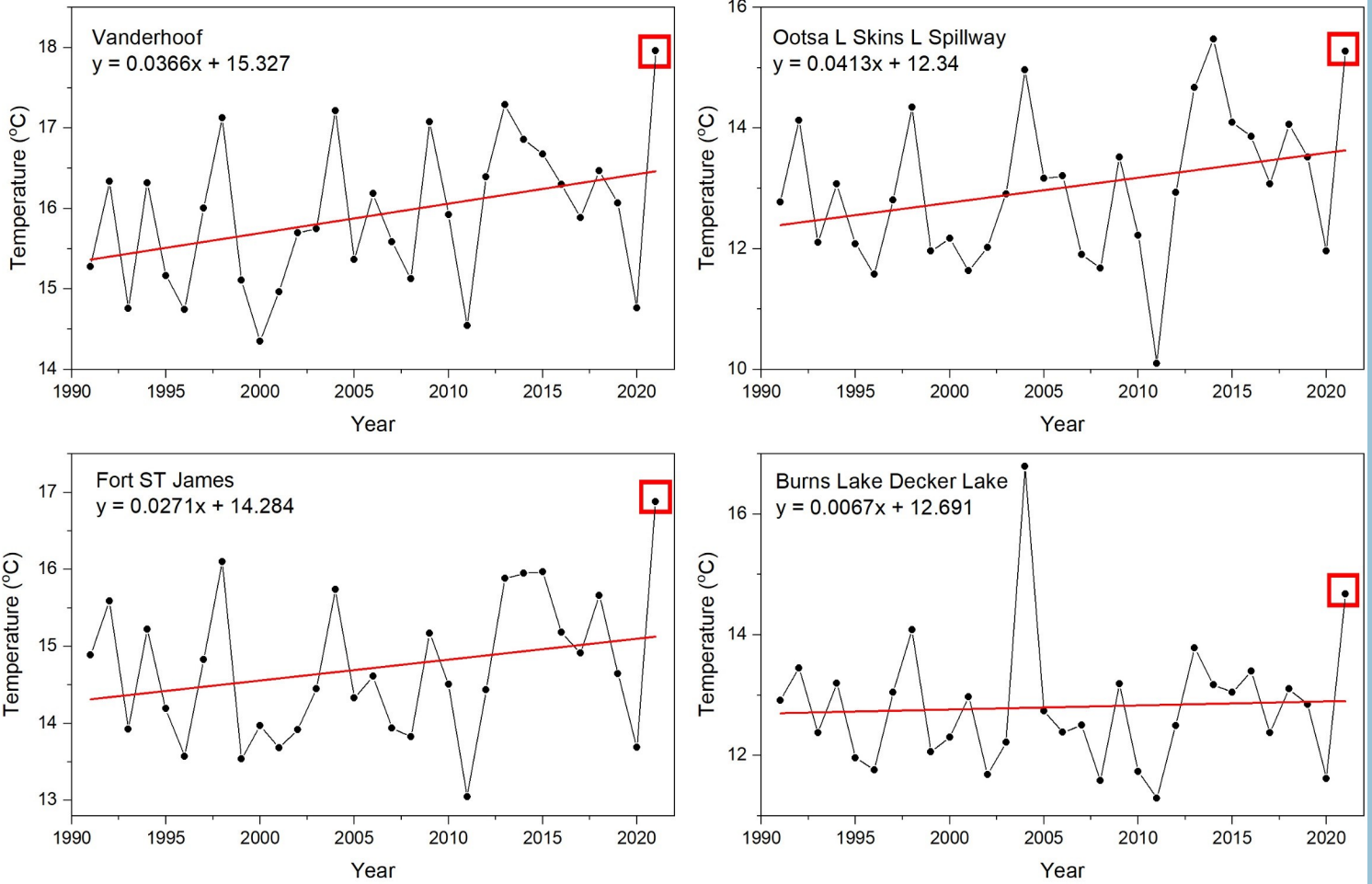


Figure 1: Average summer (June, July, and August) air temperature across the Nechako watershed from 1991-2021.

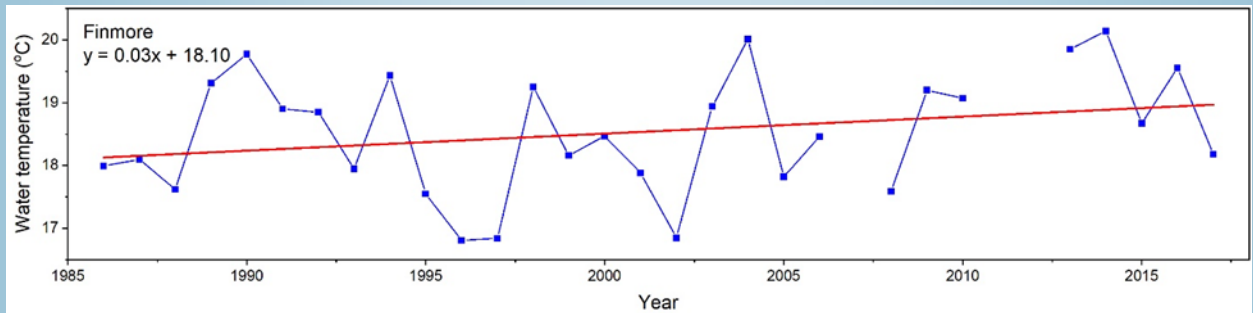


Figure 2: Average summer (July 10th to August 20th) water temperature at Finmore from 1981-2017.

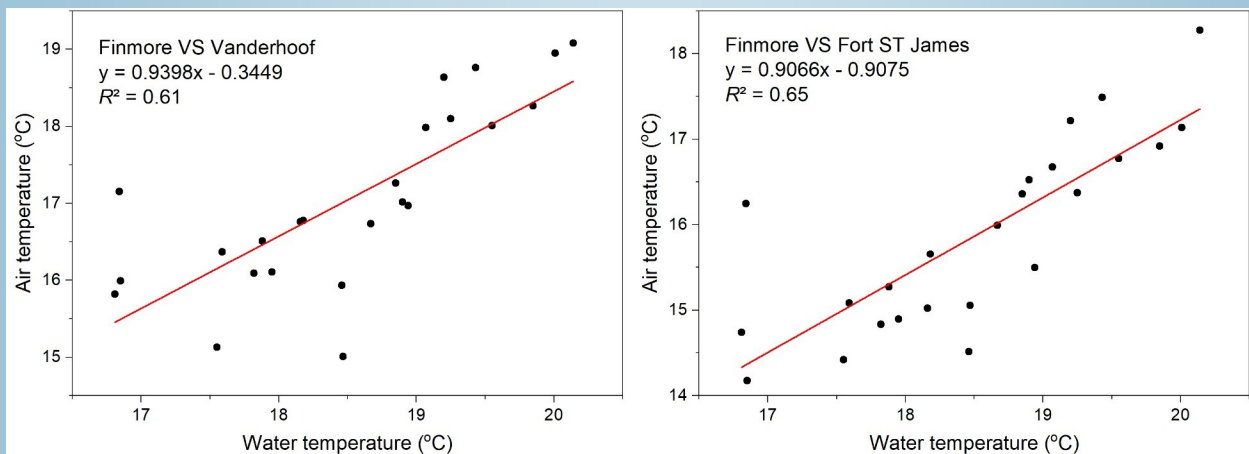


Figure 3: Scatter plot between average summer water temperature (between 10th July to 20th August) and average summer air temperature (between June to August) across the Nechako watershed from 1987-2017.

TRARE Project Overview

Kelly Hurley, Project Manager

Hello from the field! I am writing to you from the Huckleberry Mine, our TRARE headquarters, as I look out onto a mossy bluff, scattered with pine and alder trees. The beauty of the Tahtsa mountain ranges is undeniable, but we have nevertheless remained productive, despite the stunning views that incessantly compete for our attention.

In the first six days of TRARE, we have deployed four tripods at the Huckleberry Mine, which all house various instruments, from rain gauges, to temperature probes, to micro rain radars (MRR), to laser disdrometers. We have also installed one MRR and one laser disdrometer each at the Skins lake spillway and the Kemano Powerhouse. Visits have been made to the weather station and six rain gauges that lie at varying elevations along the slopes of Mount Sweeney. Finally, Jeremy has taught us how to use the Flowtracker 1, an instrument that will be used to measure discharge in Whiting Creek and Rhine Creek. Today, we will launch our first weather balloon at 00:00 UTC (17:00 PDT) to train participants on weather balloon launches, and to compare our data to the weather balloon data that are concurrently gathered by Environment and Climate Change Canada (ECCC) in Prince George.



Images: (Top) Huckleberry Mine storm monitoring equipment. (Bottom, left to right) Pond Hotplate Weather Sensor, Metek Micro-Rain Radar, OTT Parsivel Laser Disdrometer, Weather station with wind speed, net radiation, air temperature and relative humidity.



TRARE Project Overview

Kelly Hurley, Project Manager

Our productive first week can be partially attributed to the participation and expertise of our three colleagues from the Université du Québec à Montréal (UQAM), Dr. Julie Thériault, Emile Cardinal, and Hadleigh Thompson. Emile and Hadleigh work for Julie, who is the co-investigator of TRARE, and whom has lent us a significant portion of the instruments we are deploying for this field campaign. We are incredibly grateful for the support of our UQAM colleagues; TRARE would not be possible without them. Thank you Julie, Emile and Hadleigh!



Images: Hadleigh (left) and Emile (right) after deploying the MRR Pro and the Parsivel 1 laser disdrometer in Kemano, BC. Photo by Andy Lecuyer.

One of the corner stones of the TRARE field campaign is to record our visual observations of atmospheric river (AR) storms. However, there are no ARs forecasted for the next 7 days. Although this can be frustrating, this will allow us to practice our observation skills - such as identifying cloud types- on the non-AR rain events that will occur this week. Additionally, the lack of ARs will allow us time to get fully settled into our makeshift “office” at the Huckleberry Mine and solidify one of the most crucial (although often overlooked) aspects of our campaign – data management. As the next few weeks roll by, we will be collecting data from over 25 instruments, so keeping track of these data is of paramount importance. We look forward to sharing our data and preliminary findings with you in our next newsletter!



Images: A photo of Anna (left) and Emile (right) working in our makeshift TRARE office that we made out of a spare bedroom in the Huckleberry Mine staff bunkhouse.

TRARE Preparations and Atmospheric Rivers

Bruno Sobral

As Fall 2021 begins, so does the next big project of the NHG, the Tahtsa Ranges Atmospheric River Experiment (TRARE). While part of the team is on standby in the leeward side of the Tahtsa Ranges foothills waiting for the passage of storms for observation and collection of climatological data, another part remains in the NHG headquarters at UNBC providing daily updated forecasts via the internet. The forecasts are an important part of TRARE to ensure that the field crews know in advance what to expect for that day in regards to atmospheric rivers (AR) and other storms over the western Nechako region. Climatological data such as temperature, probability and type of precipitation, AR occurrence and intensity, wind speed and direction, wildfire locations and UV index are sent on to the field team, allowing the group to better plan and perform their daily field activities while keeping safe from potential hydrometeorological hazards. Different sources of climate data are used and combined with satellite images for a visual confirmation of the formation, approximation, intensity and landfall location of AR storms through the field campaign.

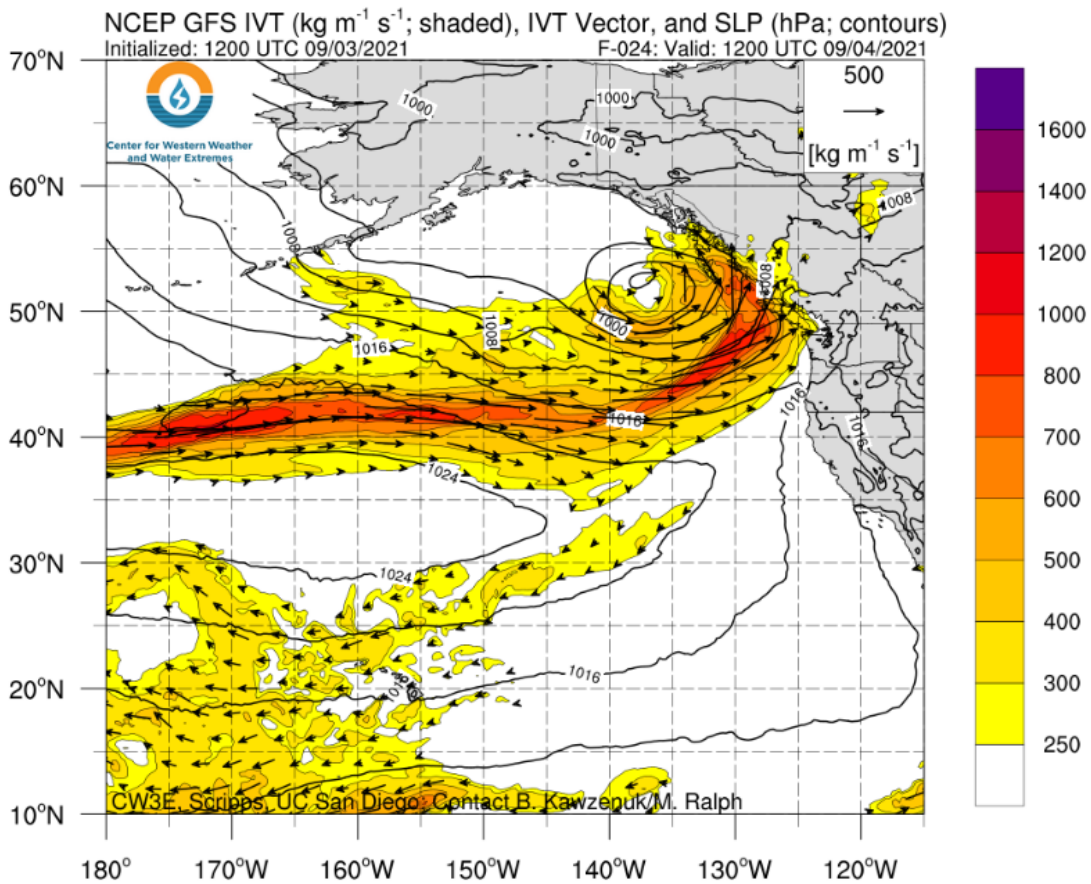


Figure: Formation of atmospheric river in early September 2021

During TRARE the NHG has the privilege of the experience and support of members of the Cheslatta Carrier Nation, who have kindly volunteered to take daily measurements of rainfall levels at manual gauges. The collected information will then be sent to the NHG headquarters for record and comparison with automated gauges distributed over the Nechako. The data collected by the Cheslatta will allow the group to better understand the dynamics of ARs in regions where gauges are not available and ensure that the field equipment is properly calibrated in regions already equipped with rain gauges. We are looking forward to improve our knowledge on ARs during the next month while we also work closer with the Cheslatta Carrier Nation to achieve better results in our field campaign.

Nechako Field Work Update

Derek Gilbert, Research Skills Trainee

Towards the end of the summer field season, the NHG became busy with preparations for the TRARE field campaign and finishing up maintenance and data collection from remaining sites that had not yet been visited over the summer.

The TRARE preparations involved the testing of new equipment, including a new weather station and other pieces of equipment to ensure equipment would not malfunction during the extent of the field campaign. Several pieces of equipment from both McGill and UQAM were checked for defects from their long shipping journey and to ensure all parts were in fact present. A week was spent in the Upper Nechako installing the new weather station and more tipping buckets for TRARE, as well as data collection and maintenance of existing tipping bucket and water temperature sites on the Southside of Tahtsa Lake by boat access (Figure 1). Many gauges and tipping buckets unfortunately experienced the forces of wildlife on the Southside but were replaced where possible (Figure 2&3).



Figure 1: Cheslatta Carrier Nation Boat



Figure 2: Kasalka/Blue Creek Tipping Bucket



Figure 3: Laventie Creek Tipping Bucket

The remaining time was allotted to completing data collection from water temperature sites in the Endako, Stelako, and Cheslatta Lake. The summer field season was wrapped up successfully, having collected data from most of our sites that were accessible. The preparation for TRARE was very busy, however the field campaign has kicked off to a very promising start, already having observed one atmospheric river, which many more forecasted to reach our study sites.

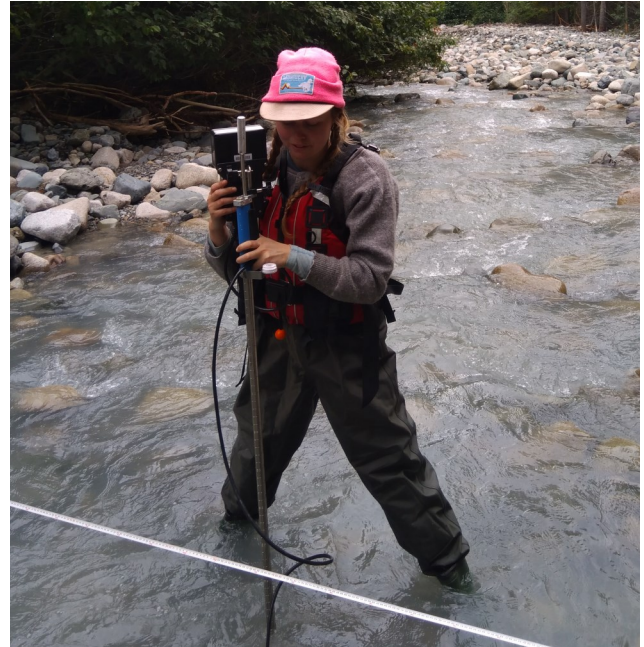
New TRARE Team Members

Anna Kaveney Research Skills Trainee UNBC

Anna is excited to join the NHG as a Research Skills Trainee. She graduated from the University of British Columbia in 2020 with a B.Sc in Global Resource Systems, specializing in hydrology, geomorphology and climate science. Anna has previously worked as a research assistant on various hydrology, glaciology and human geography projects. She is looking forwards to learning more about atmospheric science and being out in the field.



Image: Anna Kaveney (left, UNBC Research Skills Trainee) and Émile Cardinal (right, UQAM Masters Student) in front of the Huckleberry Mine TRARE weather station.



Images: Stream velocity measurements, by Anna Kaveney in Rhine Creek (top) and Emile Cardinal in Whiting Creek (bottom).

Emile Cardinal MSc. Student UQAM

Emile Cardinal is a MSc student from Université du Québec à Montréal (UQAM) that is participating in the TRARE campaign. Emile has a Bachelors of Science in Geographic Information Systems from Université de Sherbrooke. He has been studying atmospheric science for the last year and brings a wealth of knowledge to TRARE. When he is off the clock, Emile is an avid card player, piano player and hiker.

First Time in B.C.

Emile Cardinal, MSc Student UQAM

Before the beginning of September 2021, I've never been to the Western part of Canada. Many of my friends and family members have visited British Columbia and were so amazed by the geography and the beauty of the West Coast that they didn't want to come back to Montréal, Québec, where I'm from.

Things finally aligned for me heading to British Columbia, where my master's project in atmospheric science takes place. I was very excited going to the West and living a truly remote Canadian experience, but seeing this beauty with my own eyes (not pictures) was far beyond my expectations!

The Tahtsa Ranges Atmospheric River Experiment (TRARE) is a two-month long Earth science project that couples hydrology and weather observations data. Atmospheric rivers, also known as Pineapple Expresses, are corridors of very high moisture content and low level winds in warm sectors of mid-latitude extratropical cyclones, which make landfall along the West coast. The project aims to better understand how atmospheric river precipitation modifies the hydrological budget of the upper part of the Nechako River watershed, along the Coast Mountains.

In the second week of September, multiple data-collecting instruments were installed in the Huckleberry Mine, Nadina Lake, Kemano and Terrace areas of West-central British Columbia. For hydrology purposes, these include water level loggers along with stream temperature and flow sensors. For atmospheric purposes, these include rain gauges, vertically-pointing radars and disdrometers for measuring precipitation intensity, type and rate, as well as temperature sensors, plus an anemometer for measuring wind speed and direction. Setting up these instruments in the field is an incredible learning experience, not only from a scientific point of view, but also on how to behave with wildlife, nature safety, and, most importantly, bears!



Images: Scenery from Emile's helicopter journey from Terrace to Kemano to deploy equipment

The TRARE team is composed of experienced research assistants, research skills trainees, supervisors and graduate level students from two Canadian universities, namely the University of Northern British Columbia (UNBC) and Université du Québec à Montréal (UQAM), where I'm doing my master in atmospheric sciences. The TRARE project is closely related to my master's project, which is to analyze reasons behind locally extreme freezing precipitation events in the Terrace. This justifies my very privileged presence in the TRARE team, a unique experience!

Finally, I'll join the voice of my Québec fellows and I'll end with this final message, "I don't want to go back!"



Climate Station at Nadina Spawning Channel. Fingers crossed the grizzlies keep leaving it alone!



Mt Sweeney Climate station in its new permanent home in a meadow midway down the mountain.

Outreach Coordinator Update

Jeremy Morris, Outreach Coordinator

Public Presentations

- On August 24th, Stephen provided an overview and progress update on the IRC program of research to the Nechako First Nations.

Outreach

- On September 20th, the TRARE team at Huckleberry Mine demonstrated an atmospheric sounding balloon launch for several of the workers at the minesite.
- The TRARE team is committed to answering questions, and sharing preliminary results with locals in the research area, including at the minesite and at Nadina Lake Lodge.

Participation in Stakeholder Groups

- Stephen continues to participate in the monthly meetings on the Main Table of the Water Engagement Initiative
- Stephen continues to participate in the bi-weekly meetings of the Technical Working Group of the Water Engagement Initiative

Annual IRC Report

- The first draft of the 2020/2021 Annual Report for the IRC is now available on the IRC website. [Click here to view](#)

Interactions with Media

- 2021/09/27 The Tahtsa Ranges Atmospheric River Experiment, Les Années Lumière, [Radio-Canada](#)
- 2021/09/23 The Tahtsa Ranges Atmospheric River Experiment (TRARE), News Podcast, [CLICK News \(Smithers, BC\)](#)
- 2021/09/03— 2021/09/04 Tracking Pineapple Express storms during TRARE, CKPG News, CKPG (Prince George, BC)
- 2021/09/03 Field work will see UNBC researchers study storm impact on Nechako River Watershed, [Prince George Citizen](#)
- 2021/09/03 Getting aboard the Pineapple Express, [UNBC media release](#)

Acknowledgements

- Brad and Wendy Thompson at Nadina Lake Lodge
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- Ken Hanson at Skins Lake Spillway
- Shane Flynn and entire staff of Huckleberry Mines
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