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The Nechako IRC Newsletter

An update from Dr. Stephen Déry, Project Leader

Seasons Greetings!

Snow arrived early in parts of the Nechako Watershed this fall and has led to wintry landscapes since then. Indeed, an active weather pattern this fall marked by several "Pineapple Express" storms led to a wet and snowy autumn in the region. Winter recreation sports such as snowshoeing, skiing and snowmobiling got to an early start, and the seasonal snowpack continues to accumulate, particularly in the higher elevations of the Coast Mountains. The seasonal snowpack remains the primary source of water replenishment into the Nechako Reservoir and River, and tracking its amount allows Rio Tinto's hydrologists a source of predictability in how much water replenishment will occur during spring snowmelt.

In this edition of the Nechako IRC newsletter, we welcome a new member to the team, Kelly Hurley, who is leading preparations for a field campaign that will study Pineapple Express storms (aka Atmospheric Rivers) in the fall 2021 in the upper Nechako Watershed. You will also find an introduction to Pineapple Express storms and a description of the Tahtsa Ranges Atmospheric River Experiment (TRARE) planned for fall 2021 to track these storms and their impacts on the upper Nechako Watershed. An update on recent field activities including water temperature logger deployment in the Stellako and Endako Rivers and weather station commissioning at Eutsuk River are also provided. The newsletter also includes a description of the flows in the Nechako River in fall 2020 relative to historical data. You will also find the usual updates from the IRC support team.

As the year comes to a close, the IRC team at UNBC wishes one and all very Happy (and safe!) Holidays! It has been a challenging year for all but we embark on a New Year in anticipation of new adventures and discoveries as we continue exploring the complex Nechako Watershed!

Stephen

Northern Hydrometeorology Group (NHG), UNBC

Inside this issue

Special points of interest

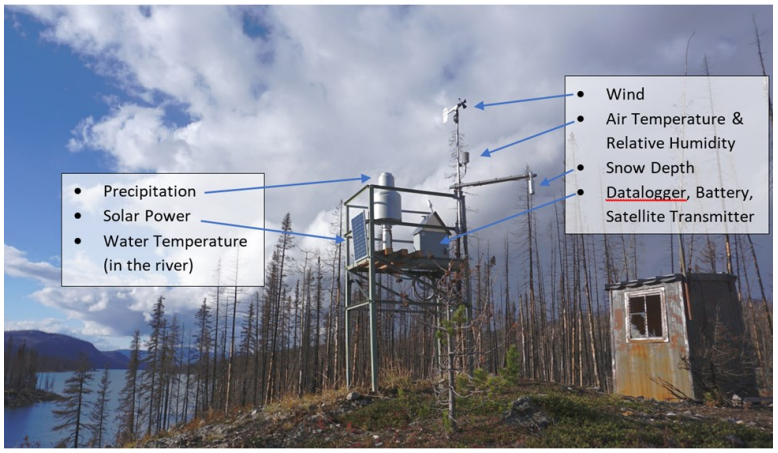
- The IRC team met with the Rio Tinto hydrological modeling team on November 17th
- Jeremy Morris along with IRC team members visited the Mt. Sweeney weather station on December 3rd.
- There was a Science Advisory Board meeting on December 8th.
- The IRC project was featured in a 'This is UNBC 'article.

Nechako River near Miworth

Research Manager update

Jeremy Morris

I'm extremely proud to say that the NHG team has deployed all planned Nechako sensor installations through a challenging year. With the support of the Stellat'en First Nation, the final stream temperature probes were installed in the Stellako and Endako rivers. These deployments were led by Masters student Adam Macdonald (supported voluntarily by former technician Danny!) who has seamlessly taken up command of the water temperature dataset for his research. Additionally, in partnership with Rio Tinto, a comprehensive weather station was deployed at Eutsuk Narrows in North Tweedsmuir Provincial Park. The site was originally a river flow monitoring station developed by the Water Survey of Canada, and subsequently operated by Rio Tinto prior to being decommissioned in the last decade. On October 21st , myself along with a consultant from Avison Management Ltd flew to site from Skins Spillway to install new equipment on the remnant scaffolding from previous operation. The new station includes water temperature probes, a Pluvio2 all-weather precipitation gauge to collect year round precipitation data, and an iridium satellite modem for hourly access to data for Rio Tinto's reservoir management planning. As part of the collaboration, NHG included several standard meteorological sensors including an RM Young wind sensor, HMP temperature and relative humidity sensor, and an SR50 snow depth sensor.



Eutsuk Narrows weather station, October 21, 2020

With these final deployments complete, I shift into a new phase of the research manager position, supporting further field research and maintaining this network over the next field seasons. All that said, I am looking forward to the break from field work to get a bit more time for my Masters research in Chun T'Oh Whudujut Park. Best wishes to all as we approach what will surely be an abnormal holiday season, stay safe and enjoy the snow!

An introduction to atmospheric rivers

Kelly Hurley and Bruno Sobral

Atmospheric Rivers (ARs) are known to transport abundant amounts of water vapour through narrow-shaped, low altitude corridors, moving from the tropics or sub-tropics to mid-latitude regions. They are also known as "Pineapple Express" storms due to the moisture that builds up in the tropical Pacific region-near the Hawaiian Islands and that can reach North America, causing a copious amount of precipitation and snowfall. The regional winds and temperature patterns where ARs make landfall will influence the intensity and duration of AR events. In BC, ARs occur mainly in September-October and are impacted by the Coast Mountains. When air masses encounter the steep mountain slopes, the air is forced upwards and triggers rainfall in higher altitudes west of the mountain range (Figure 1). Moving inland to the east and towards the Interior Plateau of British Columbia, there is a well-marked rain shadow effect that influences precipitation distribution over complex hydrological systems, such as the Nechako watershed. Recent studies by the NHG of UNBC reveal that an average of 35 ARs make landfall annually in British Columbia and Southeastern Alaska, where the Nechako is located, and account for about 30% of regional streamflow. These findings also forecast higher annual frequency in the occurrence of these storms over the region.

While ARs are important drivers of moisture flux to the west coast of North America, increasing water availability for many activities, they can also favour the occurrence of hydro-meteorological disasters such as floods and landslides. These storms, along with their subsequent risks, impact Rio Tinto's operations in the Nechako Reservoir. During times of water surplus, Rio Tinto has the delicate task of mitigating flood

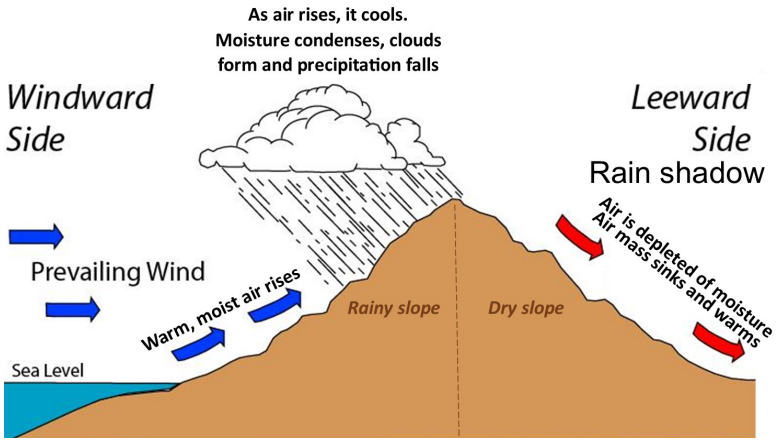


Figure 1. The rain shadow effect (Orographic uplift). Creative commons, artist: Meg Stewart, remixed by Kelly Hurley

events and prioritizing the safety of the public. Due to the significant hydrological impacts of ARs, it is important to better understand how they impact the Nechako and nearby watersheds.

Scheduled for autumn 2021, the Tahtsa Ranges Atmospheric Rivers Experiment (TRARE), with the support of Rio Tinto and NSERC, will record and monitor these singular precipitation events as well as the rain shadow effect created by the Coast Mountains. TRARE will answer questions such as: *How much precipitation falls? Will it fall as snow or rain? How does the amount and type of precipitation vary at different elevations? How does the amount and type of precipitation vary as the storm moves inland from the coast? How will this precipitation impact water level in nearby rivers, lakes and reservoirs?*

During the TRARE field campaign, the IRC team will expand its weather station network around the Nechako watershed. New precipitation measurement equipment will be stationed at sites that vary in their distance inland from the coast (longitude) as well as at varying elevations so that we can compare precipitation amount and type across spatial scales. By analyzing the data that we collect during TRARE, we can begin to paint a picture of the type, amount and spatial distribution of the precipitation brought on by ARs in the Nechako. This will allow us to understand how weather and climate change may influence the Nechako's hydrology, which, in turn, impacts humans and local ecosystems through floods, landslides and hydropower generation.

Current and Historical Streamflows: Nechako River

Justin Kokoszka and Rajtantra Lilhare

As part of a new series, the NHG will explore both current and historical streamflow for the Nechako River at Vanderhoof on a seasonal basis. For our first contribution, we looked at the 40-year average (1980-2019) of daily and monthly flows and compared those against current data for 2020 at Vanderhoof and other locations including the Nautley River and Skins Lake Spillway (Figures 1 and 2). Our analyses focus on streamflow for the fall season (September 1st to November 12th), but also includes annual streamflow from January 1st to November 12th. Our past analyses show that the summer of 2020 was particularly wet in the lower Nechako system at Prince George and Vanderhoof, but less so in the upper watershed near the Skins Lake Spillway. Certainly, these conditions have impacted 2020 summer and fall streamflow within the Nechako River.

This year's warm spring led to earlier snowmelt that generated higher than average streamflows for both the late spring and early summer months (April to June). Summer precipitation was above average in 2020 and resulted in higher than average peak flows during summer months, mainly in August (Figure 1). Historical averages for the Nautley River provide context for the unregulated portion of the Nechako River upstream of Vanderhoof. So far, the Nechako River at Vanderhoof shows a 13.3% increase

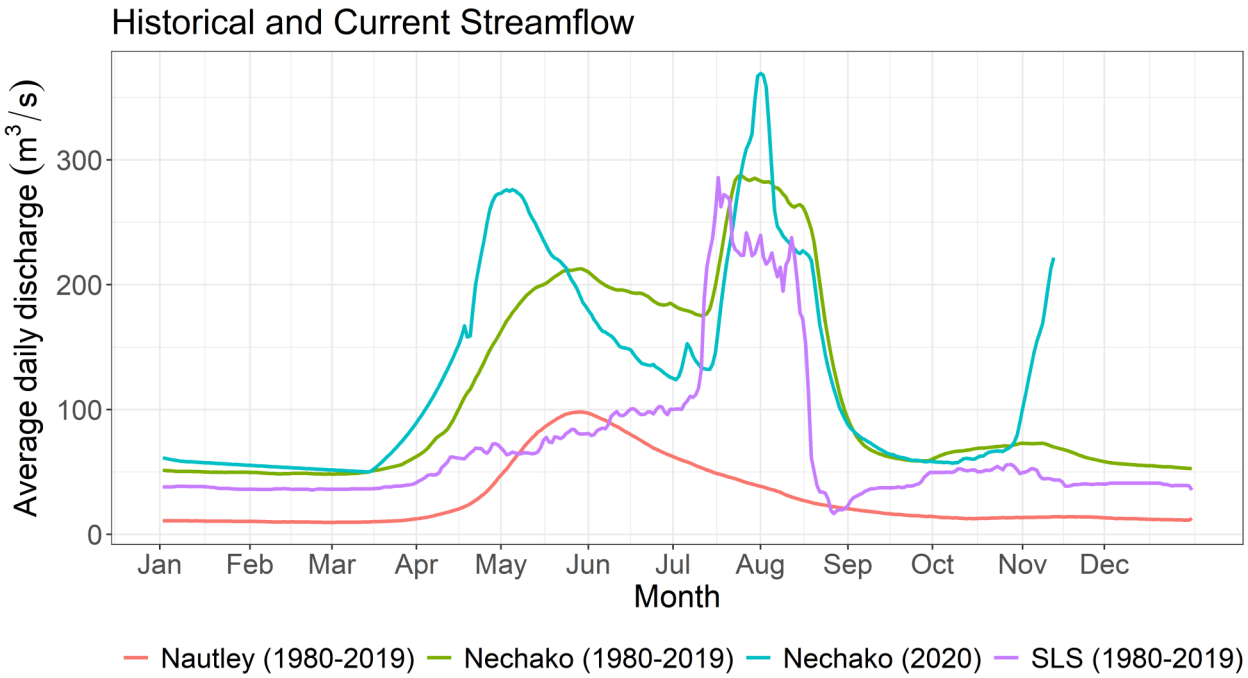
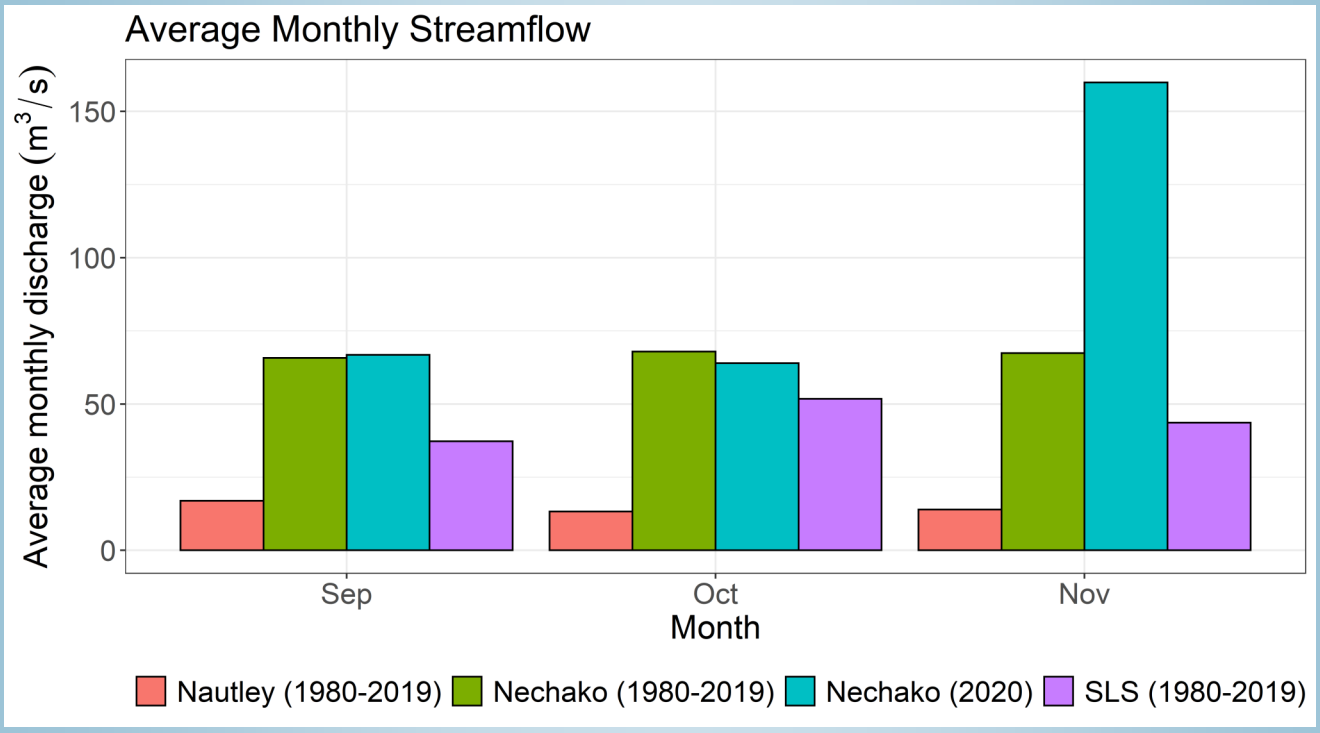


Figure 1: Annual hydrograph showing average daily streamflow between 1980 and 2019 for Skins Lake Spillway (SLS), Nautley River (Nautley), and Nechako River at Vanderhoof (Nechako). Current average daily flows (2020) are shown for the Nechako River at Vanderhoof between 1st January to 12th November. Note the increase in streamflow from mid-July to mid-August which corresponds to the Summer Temperature Management Program, and hence additional water release from the Skins Lake Spillway to keep water temperatures below 20 °C at Finmoore

in annual flow (January 1st to November 12th) compared to the historical average (1980-2019; January 1st to December 31st). September streamflow was 1.5% greater than the historical average, meanwhile streamflow in October was 5.8% less than the historical average (Table 1). A significant increase in streamflow occurred in November (up to November 12th) with about 137% more streamflow compared to the historical average (Figure 2). The increase in November streamflow is due to the above normal release of water at the Skins Lake Spillway for ice jam management (See https://nechako.riotintoflowfacts.com/#reservoir).

In 2020, high spring and summer flows in the Nechako River at Vanderhoof have been a result of an earlier snowmelt and a cooler and wetter summer in the northern BC, respectively. We do not see any significant above or below average streamflow conditions for the early fall months (September and October) in 2020. Does that mean this pattern will continue in near future? Our previous analyses show that Nechako may experience drier summer and wetter winter seasons in future. This may result in more frequent earlier snowmelts in spring and thus higher than average streamflows in the spring and summer. Stay tuned as we investigate



streamflow for the Nechako River at Vanderhoof for future seasons!

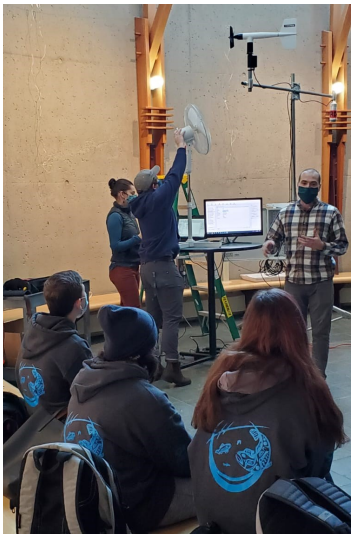
Figure 2: Monthly average streamflow between 1980 and 2019, for Skins Lake Spillway (SLS), Nautley River (Nautley), and Nechako River at Vanderhoof (Nechako). Current average monthly flows (2020) are shown for the Nechako River at Vanderhoof from 1st January to 12th November.

Time Period		Mean Streamflow m^3/s^{-1}	% Change
Annual	Historical	113.2	13.3
	Current	128.3	
September	Historical	65.8	1.5
	Current	66.8	
October	Historical	67.9	-5.8
	Current	64.0	
November	Historical	67.4	137.2
	Current	159.9	

Table 1: Average streamflow for the Nechako River at Vanderhoof. Historical streamflow (1980-2019) was averaged between January 1st January to December 31st. Current streamflow (2020) was averaged between January 1st to November 12th.

Otreach summary

Barry Booth, Outreach Coordinator



NVSS students at UNBC. Photo H. Hinz

The NHG team was busy summer and fall on the outreach front.

- Stephen gave a presentation to the Kitimat Public Advisory Committee in September to provide a progress update on the IRC
- On October 23rd, the NHG team met with a group of high school students from Vanderhoof who were on campus as part of an information exchange tour organized by the Koh-learning in our Watersheds Project. Here, the NHG team discussed the IRC research project and demonstrated how NHG weather stations function.
- We launched a new, IRC specific website this fall: http://web.unbc.ca/~sdery/irc/
- The team worked with UNBC Communications on a *'This is UNBC'* article that was released on December XX
- Stephen continues to be involved with the Rio Tinto Water Engagement Initiative (WEI) and WEI Technical Working Group;
- The IRC research team met with Rio Tinto staff on November 17th;
- We signed a memorandum of understanding with the Stellat'en First Nation and have developed strong working collaborations with the Cheslatta Carrier Nation , the Tl'azt'en Nation, and Nak'azdli Whut'en;
- The IRC is pleased to be mentioned as part of the research community at UNBC who was recognized as the university that saw the largest increase in research funding of any university in the undergraduate tier in the latest edition of Canada's Top 50 Research Universities.

Fall field report

Adam MacDonald

The last few months seemed to have blown by! Most of my time has been spent completing assignments and attending lectures so far. But I have had the opportunity to get away from my computer and head out to many of the water temperature logger sites in the past months. During these visits, the previous field assistant (Daniel Scurfield) was able to get me up to speed on how the water temperature data were collected and other necessary skills needed to manage the current network of loggers. Site visits included heading out to the lower Nechako area around Vanderhoof, sites spread around Stuart lake, additional sites located by Tatuk/Finger lake provincial park, and finally Daniel and I launched two new temperature loggers near Fraser Lake. Our two new loggers will be recording river temperatures on the Endako river near the community of Endako, and on the Stellako river, upriver from Fraser lake. Looking forward I am excited to finish up the current list of courses I am attending at UNBC and start devoting more of my time to analyzing the water temperature data already pouring in from around Nechako watershed.

Endako River

Kuzkwa River near Stuart Lake

New Team Members

We are pleased to add one new member to the IRC team

Kelly Hurley recently joined our team as a Research Skills Trainee. She will be planning the TRARE Field Campaign, which begins in fall 2021. She recently graduated from the University of British Columbia (UBC) with a Bachelor of Science in Global Resource Systems, specializing in physical geography, climate and cryospheric sciences. Kelly has previously worked in Dr. Michele Koppes' Climate & Cryosphere Lab at UBC, where she employed temperature-index models to estimate glacial contributions to streamflow in the Canadian Cordillera. She has enjoyed her previous fieldwork experiences in mountainous and remote areas, from the Ecuadorian Andes, to sub-arctic icefields in the Yukon. She is looking forward to learning more about atmospheric science and the different instrumentation used to measure climatic parameters.

Just another day at the NHG office!

A trip to Mt. Sweeney

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