

The UNBC IRC Research on Climate Change and Water Security Program begins!

An update from Dr. Stephen Déry, Project Leader

I am delighted to announce that we have initiated the Natural Sciences and Engineering Research Council of Canada (NSERC) Rio Tinto Senior Industrial Research Chair (IRC) on Climate Change and Water Security research focusing on the rapidly changing Nechako Watershed. The long-term goal of the NSERC/Rio Tinto Senior IRC in Climate Change and Water Security is to better monitor and assess recent changes in weather and precipitation patterns affecting the Nechako Watershed, and to establish their impacts on changing seasonal snowpack evolution and on the vast network of streams and rivers of the Nechako Watershed.

Our first field season: pilot temperature sampling

To assist with future water temperature modelling efforts, we began a pilot project designed to test automatic water temperature data loggers in the Nechako Watershed. This season we deployed 8 self-logging HOBO water temperature loggers (Figures 1a,b,c) at various sites in the Nechako watershed (Figure 2) to capture spatio-temporal patterns in water temperatures and assist with future Air2Stream modelling efforts.



An NHG weather station, this one at Tatuk Lake in the upper Chilako River Watershed

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Special points of interest

- Our pilot project on sampling water temperature started in the summer of 2019 and continued until November 2019
- A selected number of data loggers have been left deployed to test over-winter 'survival'
- Results for our pilot project are very encouraging

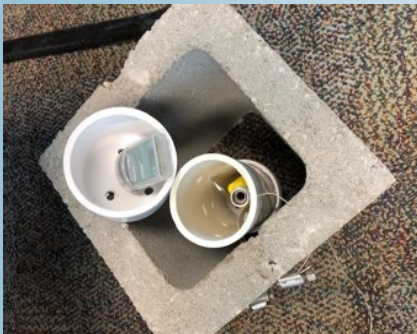


Figure 1 a. HOBO logger housed in PVC pipe and attached to a small cinder block



Figure 1 b. HOBO logger on its way to start recording data.

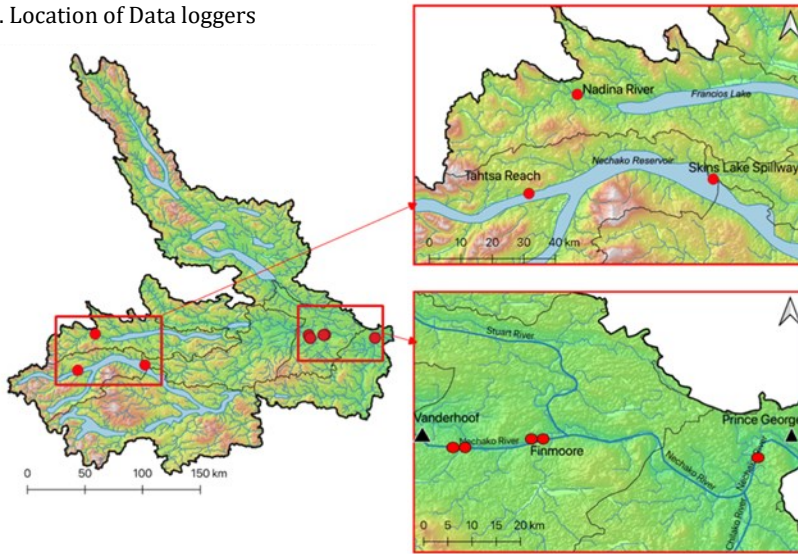


Figure 1 c. HOBO logger fully deployed

Our initial work:

To test our sampling methods, we deployed water data loggers throughout the Nechako Watershed (Figure 2).

Figure 2. Location of Data loggers



Nechako main stem (5)
Upstream* & downstream of the Sinkut River
Upstream* & downstream of Clucluz Creek.
Miworth, near Prince George.

These loggers were deployed on June 26th.
Data were retrieved on dates prior to and
after the initiation of the Summer
Temperature Management Program (STMP).

Nechako tributaries and reservoir (3)
Nadina River
Tatsha Lake, Nechako Reservoir*
Immediately downstream of Skins Lake
spillway*

* These loggers have been left in their
respective locations for the duration of the
winter and data will be retrieved after break up.

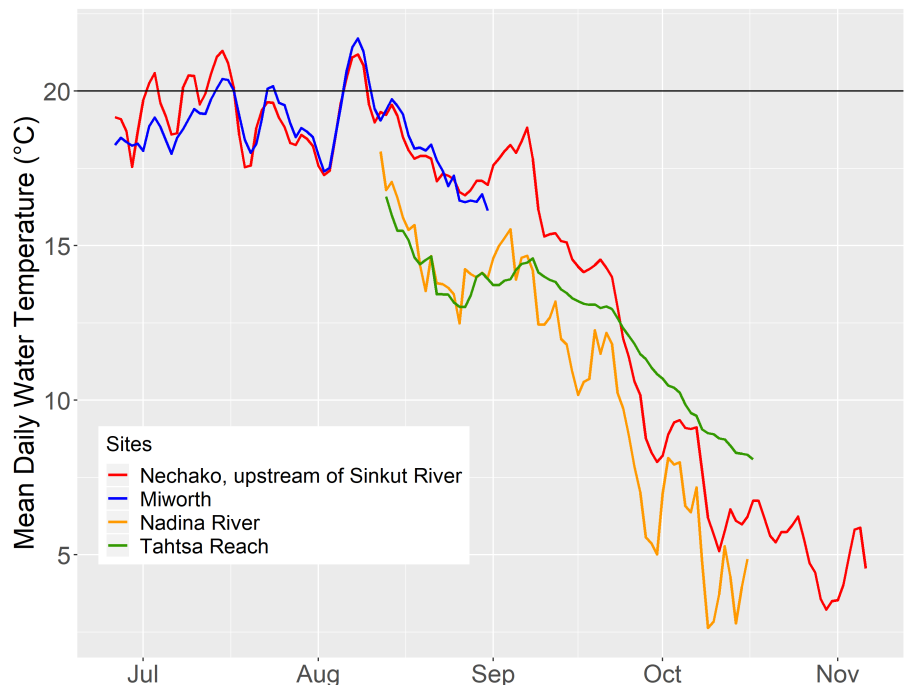
Preliminary Results

After our first field season on the project we have some preliminary results from the water temperature loggers.

Of the eight loggers, Figure 3 shows the results of four contrasting sites. The temperature loggers on the main stem of the Nechako upstream of the Sinkut River and Miworth recorded the highest mean daily temperatures of the sites. The warmer temperatures were as expected as water absorbs heat from the sun over time as it flows downstream. Throughout the peak summer months Nechako upstream of the Sinkut and Miworth recorded mean daily water temperatures exceeding 20°C for 14 and 11 days, respectively. The 20°C threshold is significant as salmon become particularly vulnerable to heat related stresses, such as reduced oxygen in the water, which can prove fatal.

Further up the watershed in the reservoir at Tahtsa Reach, the temperature pattern is much smoother than the other sites. The water temperature is regulated by the large body of water reducing day-to-day fluctuations. The Nadina River is the only site to date that we have monitored with a flow that is unaffected due to the influence of the Kenney Dam. We can see it has the highest variation in temperature from one day to the next. Our next field season will involve adding data loggers to sites along the Stuart River to increase our data set of unregulated streamflow to better allow for comparisons between regulated and unregulated sites.

Figure 3. Mean daily water temperature by site in the Nechako Watershed



The IRC Team

Research Lead

Dr. Stephen Déry is professor in the Environmental Science and Engineering undergraduate program and the Natural Resources and Environmental Studies graduate program at the University of Northern British Columbia (UNBC), Prince George, BC. Stephen leads the Northern Hydrometeorology Group (NHG) and is a member of UNBC's Integrated Watershed Research Group. As of 1 July 2019, Dr. Déry holds the NSERC/Rio Tinto Senior Industrial Research Chair in Climate Change and Water Security with a 5-year program of research focused on the Nechako Watershed. His background is in atmospheric science and he has degrees from York University (BSc and MSc) and McGill University (PhD). Dr. Déry completed post-doctoral positions at the Lamont-Doherty Earth Observatory of Columbia University, New York and held a Visiting Research Scientist position at Princeton University in New Jersey. He investigates the consequences of climate change and water management on the water cycle of northern and alpine regions. A major aspect of this research is to better monitor, understand and project the water balance and streamflow trends in major watersheds such as the Nechako based on observational data and numerical simulations.



Supporting team members

Jeremy Morris is the current part-time Research Manager in the IRC program of research and a Master of Science student in the Natural Resources and Environmental Studies program at UNBC. Jeremy holds a Bachelor of Science in Earth Sciences and his current research examines inundation patterns within a wetland complex in Ancient Forest/Chun T'Oh Whudujut Provincial Park. His role in the IRC program will entail managing the field research, including overseeing instrumentation deployments, database management, and training new team members.



Ivy Evergreen Strother recently finished her BSc in Biology with Honours at UNBC. She is the newest addition to the NHG group and will be working as a field and lab research assistant over the winter. Her research as an undergraduate student primarily focused on plants and lichens in Northern BC. She is looking forward to expanding her climate and hydrology knowledge while learning technical skills.



Rajtantra Lilhare is a Ph.D. candidate and researcher at UNBC. He completed his master's degree (2011-2013) in Remote Sensing and GIS from the Indian Institute of Remote Sensing, Indian Space Research Organization, Dehradun, India, and received his bachelor's degree (2007-2011) in Agricultural Engineering from Jawaharlal Nehru Agriculture University, Jabalpur, India. He

Selecting sampling sites:



Location of logger at Tatsha Reach, note the Coast Mountains in the background

Because we wanted to get a sense of the geographical variability of the Nechako River system, selection of sampling sites for our pilot season took us to some pretty remote and stunningly beautiful places in the Nechako Watershed. We visited the shores of Tatsha Reach on the Nechako Reservoir, the Nadina River, near the extinct volcano Mt Nadina, the Nechako River near Vanderhoof, and immediately downstream of the Skins Lake Spillway.

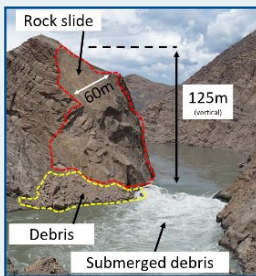


Jeremy Morris seen here pondering how to anchor the data logger downstream of the Skins Lake Spillway knowing that flows next spring will be 10 times what they were on the day of installation.

IRC team continued.....

Added reasons for IRC water temperature work

Our preliminary work on water temperature is gaining prominence as climate change is working in concert with a range of factors that are resulting in what is referred to as cumulative effects. The most recent factor of concern was the rock slide near Big Bar on the Fraser River.



*Big Bar rock slide.
Photo Province of BC*

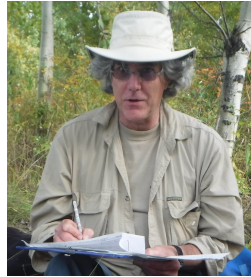
The slide has effected all of the spring and summer runs of Chinook, Coho and sockeye such that understanding potential further impacts of thermal stress due to increasing water temperatures will be of paramount importance.



*Sockeye salmon spawning on the
Stellako River, October 2018*

During the 2019 season the Province requested Rio Tinto to suspend the Summer Temperature Management Program as fisheries agencies indicated that the reduction of flows as a result of the suspension would assist the migration of salmon past the Big Bar Landslide.

worked as a Senior Research Fellow (2014-2015) at the Indian Institute of Technology, Gandhinagar, and Kharagpur, India. Rajtantra started his Ph.D. in 2015 at UNBC and is involved with the BaySys project (in close collaboration with the University of Manitoba and Manitoba Hydro). In the IRC program, he will be modelling the historical and future hydrology of the Nechako River Basin using an updated version of the Variable Infiltration Capacity model that includes a glacier dynamics module (VIC-GL). Rajtantra's research interests involve studying hydrology, hydrological modelling, climate change, and remote sensing and GIS application in water resources.



Barry Booth, R.P. Bio, is the current part-time outreach coordinator in the IRC program of research and has a B.Sc in Zoology and a MSc in Forestry Wildlife Management, both from UBC. Barry is also the part-time research manager with the Integrated Watershed Research Group at UNBC. Barry has extensive experience in research, community engagement, stewardship and resource management in BC. He will be assisting the IRC team by providing assistance with reporting findings of the team's research back to the community.

Recent and upcoming events

- The official launch of the NSERC/Rio Tinto IRC was held on the UNBC campus in Prince George on Monday November 4th. For more information on the launch of the IRC program of research, please consult the [media release](#) issued jointly by UNBC and Rio Tinto.
- A science advisory board (SAB) has been formed to oversee progress for the IRC program of research. The SAB members include Dr. Ellen Petticrew (UNBC), Dr. Francis Zwiers (Pacific Climate Impacts Consortium, University of Victoria), Mr. James Rakochy (Cheslatta Carrier Nation), Mr. Chelton van Geloven (BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development) and Mr. Justus Benckhuysen (Rio Tinto) who will report back to Dr. Geoff Payne, the UNBC Vice-President Research and Graduate Programs.
- Additional meteorological equipment is being purchased for future deployment in the Nechako Watershed to fill gaps in the current observational network. In 2020, we plan to deploy a complete weather station at Mt. Sweeney, to the north of Tahtsa Lake, and an array of 10 precipitation gauges from the Coast Mountains into the Interior Plateau. This will allow us to monitor so-called "Pineapple Express" storms that periodically bring copious amounts of precipitation to the Tahtsa Ranges.
- In January 2020 we will also begin applying a hydrological model to simulate the past hydrology of the Nechako Watershed to infer the impacts of climate change, landscape disturbances (such as wildfires) and flow regulation on the hydrology of the Nechako River. These simulations will span from 1945 (prior to regulation of

Future site of new Mt Sweeney
Weather Station

Our new weather station on Mt
Sweeney will be situated in close
proximity to an existing Telus
Repeater station atop Mt Sweeney at
1700m elevation.



Recent and upcoming events continued

the Nechako River) to near present and will provide information on changing snowpacks and streamflow at a daily time scale across the watershed.

- We intend to conduct several outreach events starting in January 2020 to initiate discussions about our research plan with stakeholders across the Nechako Watershed. Please consult our website for details on these upcoming events.

Related research findings:

We published a report this year that quantifies climate change impacts on river water temperatures across the Fraser River Basin (FRB) in British Columbia using the Air2Stream model. We investigated the impact of both air temperature and streamflow changes on river water temperatures from 1950 to 2015 across 17 river sites in the FRB. Our modelling results show the FRB's summer water temperatures rose by nearly 1.0°C during 1950–2015 and such increases in water temperature have doubled the number of days exceeding a critical salmonid temperature of 20°C for some sites. The number of days exceeding 20°C is highest across the Stuart River when compared to all other sites. Furthermore, the simulations reveal that the overall water temperature increases in the Nechako River are mainly due to climate change rather than regulation. The major conclusion to this study is the salmon returning to spawn in the Fraser River and tributaries such as Nechako are facing continued and increasing physical challenges due to increases in river water temperature. You can find the full report below.

Islam, S., Hay, R. W., Déry S. J., Booth, B. P. 2019. Modelling the impacts of climate change on riverine thermal regimes in western Canada's largest Pacific watershed, *Scientific Reports*. <https://www.nature.com/articles/s41598-019-47804-2#MOESM1>

Acknowledgements:

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The IRC team at UNBC would like
to wish everyone a Happy Holiday!

UNBC IRC Research Program

3333 University Way
Prince George, BC
V2N 4Z9

Phone: 250-960-5193
E-mail: irc@unbc.ca
Website: <http://web.unbc.ca/~sdery/irc.htm>

Seasons Greetings from the IRC team!

