NRC·CNRC

ARCTIC PROGRAM NEWS

Increasing the quality of life for Northerners through research

MARCH 2021

PROJECT UPDATES

WHAT'S NEXT?

The National Research Council of Canada's (NRC) Arctic program, with partners from government, Indigenous and northern communities, industry and academia, seeks to address opportunities and challenges through four main research streams: northern transportation; marine safety; resource development; and community infrastructure. The aim of the program is to support sustainable and low-impact development of the North, while also increasing the quality of life for Northerners. Read through this year's snapshots to learn about our progress and accomplishments in these four research streams.

MESSAGE FROM THE PROGRAM LEAD

ANNE BARKER

It is hard to believe that eight years have passed since the launch of the NRC's program-based model for conducting research. Launched in the first wave of programs, the NRC Arctic program was underway in 2013, with its official kick-off in August 2014. Throughout that time, the NRC and its partners have performed research and development that has led to best practices, scientific innovation and technological improvements, adopted and deployed by governments, industry and communities.

While this version of the research program is winding down as planned, it doesn't mean that the NRC's Arctic research is slowing down! Read on for an update of 2020's research (yes, it carried on despite the pandemic), including field research on northern housing in Cambridge Bay, Nunavut, research to assess the impact of Vessels of Opportunity on exposure time in the event of a northern maritime emergency and safe shipping tools for operational use. While 2020 has presented challenges in leading a research program, the ability of research teams and partners to adapt to a new reality and find new ways to execute their plans has been amazing to see.

If you're interested in being a part of the NRC's Arctic research, please get in touch to learn how we can partner on impactful research projects or help identify solutions for your R&D needs. If you'd like more information on our past research efforts, visit the NRC's publication archive (**NPARC**) for research papers on these and other related topics.

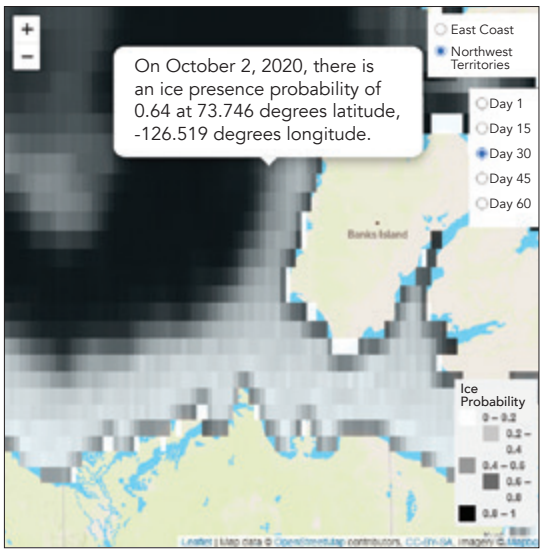
Finally, I would like to extend my sincere thanks to all of our partners throughout the program's life-cycle. It has been truly amazing to get to know and work with you. My experience of leading this program has led to a new outlook on the role of research in the Arctic and Canada's north, and how it can be successfully executed through thoughtful collaboration. The NRC's staff has been the determining factor in making this research impactful. Without their interest, initiative, effort, and enthusiasm, the successes of the program would not have been possible. Thank you everyone.

PROJECT UPDATES

NORTHERN TRANSPORTATION

Improving Arctic shipping resiliency with CASRAS

The Canadian Arctic Shipping Risk Assessment System (CASRAS) is a map-based software tool for viewing and analyzing Arctic data — with a focus on ice — relevant to shipping operations. Initially developed in 2016 through internal funding from the NRC's Arctic program, Transport Canada selected CASRAS as a project to be funded under the National Trade Corridors Fund (NTCF) in 2019. The aim of this five-year project is to provide tools to northern partners to improve marine trade corridor efficiency, reliability and safety in the western Arctic. The CASRAS software will be delivered to the Government of Northwest Territories (NT) in early 2021, along with training and testing, so that mariners (including those doing community resupply) will be able to use the system in the upcoming Arctic summer shipping season. The Government of NT, along with other partners at Transport Canada and the Canadian Coast Guard, will provide feedback and data to improve the system. Also recently added to the list of CASRAS users are Defence Research and Development Canada (DRDC) of the Department of National Defence, and partners at Transport Canada's Marine Safety and Security. The Canadian Coast Guard has been using CASRAS since 2018 to aid in the assessment of ice-related risks and to view other data sets, such as community port information and marine protected areas across the Canadian north. This software allows its users to analyze an ice chart, and toggle between views of ice thickness or stage of development, as well as the Arctic Ice Regime Shipping System (AIRSS)'s Ice Numeral or Polaris Risk Index for a given vessel. The stand-alone system minimizes the effects of limited internet access in the North. Internet

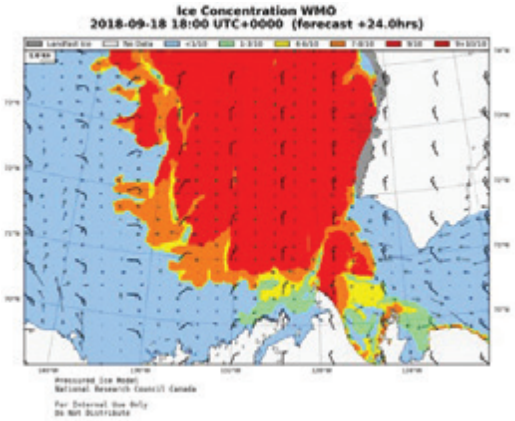


Sea ice forecasting using deep learning proof of concept output, implemented in the Western Arctic domain

connectivity is only needed to download the latest ice chart; archived data sets are stored on a hard drive for easy access and can be updated when in port.

The latest developments for the CASRAS software include new capabilities for viewing ice forecasts. The NRC's Ocean, Coastal and River Engineering Research Centre's ice dynamics forecasting system is being used to generate two-day, high-resolution ice forecasts that are being integrated into CASRAS. This will allow users to view the predicted ice thickness, concentration and pressure along a planned route. Later this year, the Ocean, Coastal and River Engineering Research Centre will begin integrating its longer range (up to 90 day) ice forecasts. These seasonal forecasts allow for risk assessment to include the effects of climate trends on ice formation. As part of the NTCF project, the Ocean, Coastal and River Engineering Research Centre will also improve its mariner knowledge data set, capturing and sharing "grey data" from experienced mariners that might otherwise be lost. In collaboration with Transport Canada, the places of refuge (places where vessels could shelter when in need of assistance) data set in CASRAS will also be enhanced, leading to a minimization of the probability and severity of adverse consequences in Arctic waters. CASRAS empowers users to assess shipping risks in the Arctic and other cold regions, thereby enhancing the safety and efficiency of marine activities and logistics.

Learn more: **nrc.canada.ca/en/research-development/products-services/technical-advisory-services/canadian-arctic-shipping-risk-assessment-system-casras**



High-resolution maps for the ice concentration forecast.

RESOURCE DEVELOPMENT

Advancing the Iceberg Drift Model with international community partners

Icebergs pose a serious threat to navigation and offshore installations over many areas of Canadian waters, and with climatic changes, the risk could increase since there may be more icebergs travelling south through Arctic waters. Once they are located, an accurate method of forecasting drift paths of the icebergs is essential for safe shipping and offshore drilling operations. As mentioned in our **2018 newsletter**, the Iceberg Drift Model is shared with international agencies that issue iceberg forecasts: Canada (the Canadian Ice Service), the United States (the International Ice Patrol, the US National Ice Centre and the US Naval Research Laboratory), Norway (the Norwegian Meteorological Institute), Denmark (the Danish Meteorological Institute) and Argentina (Sistema de Información Glaciológica). This international community aims to coordinate efforts to use and improve the Iceberg Drift Model to support safe navigation and offshore operations in all waters where icebergs are a concern. The NRC is leading an initiative to modernize the Iceberg Drift Model. The modernized system can forecast iceberg trajectories using a traditional physics-based approach and a new artificial intelligence-based module that is under development. With the collaboration of the University of Ottawa and Carleton University, the updated system supports a variety of weather hindcast and forecast products and will provide a validation procedure standardizing system assessment across the international partners.

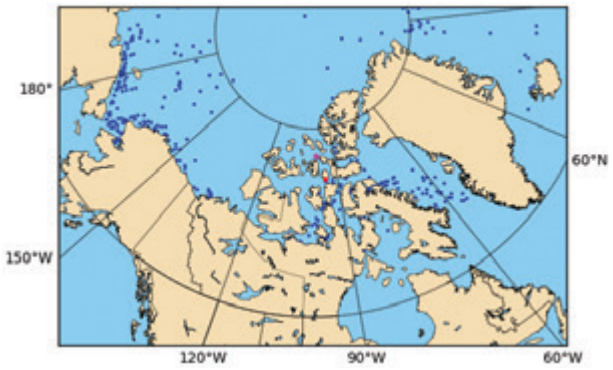
In addition, NRC researchers continue compiling and updating three long-standing and high-quality databases: iceberg sightings, iceberg management and iceberg shape. These databases are available to the public. Please contact us if you would like access or if you have data that you would like to contribute to those databases. We are always on the search for new datasets!

Learn more: **nrc.canada.ca/en/research-development/research-collaboration/programs/project-refining-iceberg-drift-model**

MARINE SAFETY TECHNOLOGIES

Incorporating vessels of opportunity into exposure time estimates

With increasing marine traffic in Polar regions due to diminishing sea ice, the chance of an accident rises. A marine accident survivor in Polar regions would find themselves in some of the most isolated areas on the planet, and could possibly be waiting days for rescue to arrive. The International Maritime Organization's (IMO) International Code for Ships Operating in Polar Waters (Polar Code) stipulates that "the expected time of rescue in cold regions should not be less than five days," but previous NRC research has suggested that the time could be much longer than that (Kennedy et al., 2013). To help other Polar nations estimate how long a person may be waiting for rescue in Polar Regions, the NRC worked with Transport Canada (TC) to develop a methodology for calculating these times (Piercey et al., 2019). This methodology was submitted to IMO's seventh meeting of the sub-committee on Ship Systems and Equipment (SSE), where it received positive feedback along with suggestions that vessels of opportunity may affect the estimated exposure time in some situations by providing assistance before search and rescue assets arrive and thus, reducing the overall rescue time. Vessels of opportunity are vessels that happen to be in a region where an incident has occurred. They could be any type of vessel, from a small fishing boat to an icebreaker.



Example plot of presence of vessels of opportunity in Arctic waters, August 2020.

In partnership with TC, the NRC incorporated the effect that vessels of opportunity may have on exposure time into the corresponding methodology. This work was a collaborative effort with input from many different stakeholders including the Canadian Coast Guard, the US Coast Guard, Norwegian Maritime Authority, Norwegian Coastal Authority, Maritime New Zealand, and private organizations who all provided valuable feedback to allow for refinement of the calculations. This updated methodology will be submitted to IMO for the next SSE meeting to solicit feedback from the other members. The NRC will continue to work with TC, IMO members, and other stakeholders to further develop the exposure time methodology to ensure that it is a helpful tool to support safety planning and preparation for Polar region voyages.

Learn more: **nrc.canada.ca/en/research-development/research-collaboration/programs/project-analyzing-rescue-requirements-polar-code**

COMMUNITY INFRASTRUCTURE

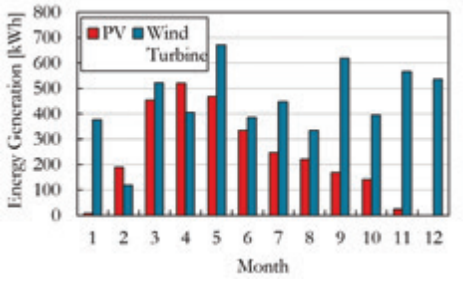
Arctic high performance buildings and renewables integration

Under the Arctic Program, the NRC's Construction Research Centre has provided expert advice and analysis on building design and wind and solar photovoltaic renewable energy systems. This was provided to support *illu inc.*, a builder based in Cambridge Bay, Nunavut, in constructing a multi-unit residential building that is designed to use 36 per cent less space heating energy compared to the code reference building. For a location with over two times the annual heating load of Ottawa, this is a substantial amount of energy savings. Modeling of a small wind turbine and solar photovoltaic array and its interactions with building loads enabled the building owner to assess the potential of incorporating these technologies in the high Arctic.

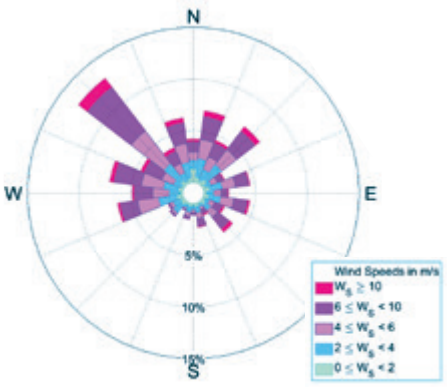
There are now several ongoing efforts by the NRC with northern collaborators for wind and solar pilot testing and load integration in the Arctic and exploration of electrification of heating for some applications in Nunavut. Pilot testing and continued research and development enables de-risking of these renewable energy technologies to increase market uptake. Although the challenges for operating and maintaining these systems is heightened in remote northern communities, a persistent effort towards technology advancement will lead to reduced fuel use and increased sustainability.

Photo top: Constructed building following placement of all modules on site in Cambridge Bay. Photo: Illu Inc.

Photo bottom: Pre-fabricated building modules arriving in Cambridge Bay on the sea lift barge. Photo: Illu Inc.



Monthly outputs for photovoltaic (PV) and wind turbine systems modeled in Cambridge Bay



Detailed multi-year wind analysis for Cambridge Bay, 2014-2018.

WHAT'S NEXT

So what's next for Arctic and Northern research at the NRC?

As part of the NRC's new suite of Collaborative Research Programs (**nrc.canada.ca/en/research-development/research-collaboration/programs/challenge-programs**), a new Challenge program, co-developed with input from northern residents, governments and industry, is set to launch in 2021. Stay tuned for this next wave of relevant, co-developed Arctic and Northern research that will continue bringing meaningful results to support multiple levels of Indigenous and government objectives and northern community priorities.

In the years to come, we expect to see outcomes from our current research projects, including:

- Implementation of regionally-appropriate technological solutions;
- Increased capacity in research and technology fields;
- Infrastructure that reflects Indigenous community needs;
- National and international standards, codes and guidance that reflect Canadian expertise and leadership;
- Reduced infrastructure incidents, damage and failure events; and
- Strategic decision-making by governments based upon sound research.

Looking even further ahead, we expect longer-term outcomes related to cost reductions (for procurements, construction, operations, maintenance, and training), climate resiliency (improved design life, and adaptation capacity) and community autonomy, ultimately leading to positive impacts for quality of life improvements for northern residents and economic diversification in the north.

At the NRC, our research centres offer specialized applied research services across many disciplines. The multi-disciplinary nature of the NRC links Arctic-based engineering activities to key sectors, including transportation, infrastructure, the environment, renewable energy and safety. Our engineers, scientists and technologists develop innovative tools and provide services that in turn support Canadian industry, regulators and stakeholders by reducing risk and improving the longevity and performance of Arctic infrastructure. Our unique expertise and comprehensive tools and facilities combined with customizable service options make us an ideal partner to support your vision.

If you would like further information or if you are interested in partnering on any of these projects, please contact us. We're excited to discuss your ideas and to help you solve your most challenging research problems.

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