Nunavut Research Institute

License Holder Reporting requirements

For research undertaken in the 2024 calendar year (commencing January 01, 2024 and ending December 31, 2024)

Project Title:

SuperDARN Radar Sites

Project Leader(s): Full name, affiliation, and contact information (address, phone number, email) of each project leader (principle investigator and co-PIs)

Kathryn McWilliams
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University of Saskatchewan
116 Science Place
Saskatoon, SK
S7N 5E2 Canada

Project Team: Full name, affiliation, and address (name of city/community and province/territory/state) of each member of the project team

T. Kolkman, R. Rohel, D. Galeschuk, S. Marei, M. Alarcon
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Abstract: A concise summary of what was done, found, and concluded to date, and how the results/information will be used. This summary must be translated into the appropriate dialect of Inuktut. Suggested length: 250-300 words. ***This section will be published in the NRI's annual compendium of licensed research**

The SuperDARN Canada research group from the University of Saskatchewan operate radars near Clyde River and Rankin Inlet. These radars are part of a worldwide network of radars that monitor "space weather," which is important in the appearance and liveliness of the Northern Lights. Space weather also affects satellite navigation and communication, passengers and crews on polar flights, power grids, pipelines, astronauts on the space station, and other technologies Canadians rely on. Leveraging the 2023 upgrades to our computing infrastructure—which included a new network setup, enhanced computer systems, and the integration of Starlink internet connections—our engineers now have the capability to customize radar scans for more complex operations. This enables us to collaborate with both ground-based and satellite instruments while remotely managing radar sites. These upgrades significantly improved radar performance in 2024, boosting uptime to 97.4% at Clyde River and maintaining a steady 96.3% at Rankin Inlet. In parallel with these technical advancements, our team at SuperDARN Canada published two articles in Radio Science in 2023 and 2024: Borealis: An Advanced Digital Hardware and Software Design for SuperDARN Radar Systems and Application of Wide-Beam Transmission for Advanced Operations of SuperDARN Borealis Radars in Monostatic and Multistatic Modes.
There have been no significant changes to the project, and the SuperDARN radars will continue to operate in 2025. The funding period is six years–from 2023 to 2029, and the funding supports all five radars we operate. The radars are supported by the Canada Foundation for Innovation, the Canadian Space Agency and Innovation Saskatchewan. Data and information about the project can be found on our website: https://superdarn.ca.

Note: Please see the translated document on a separate sheet.

Key messages: Concise, plain language summary of key take-away messages of work to date, findings and conclusions. Preferably 3-5 points, in bullet form.

Objectives: Project objectives, preferably in bullet form.

* The purpose of the SuperDARN is to study plasma in the near-Earth space system, its interaction with the Earth's atmosphere and geospace environment, its effects on the terrestrial "hard" infrastructure (e.g. communications, energy, transportation, etc.), and it's role in the Sun-Earth system.
* SuperDARN convection/voltage maps are essential for studies of the impact of space weather at Earth. Space weather researchers rely on SuperDARN data for putting their localized observations in context.

Annual activities: A description of activities and methods carried out during the current reporting period. This section should answer the questions: What? Where? When? Who? How? Include dates team members conducted research at remote field sites or collected data (including interviews) in communities; append a map with locations and/or coordinates of remote field sites, if applicable.

At the Clyde River radar site, custodian Mike Jaypoody conducted essential maintenance on June 27, 2024. He installed a new battery for the backup power system and restarted the storage system, which had previously shut down due to overheating in April. Despite these efforts, the system overheated again and shut down on June 28. Mike also replaced malfunctioning equipment that had caused frequent system restarts and changed a damaged network cable. On July 29, 2024, Mike returned to address further issues. He observed that the radar shack was excessively warm and installed a new fan to improve temperature control. Additionally, he restarted the storage system, replaced a faulty drive, and powered up a computer that had shut down after a power outage. These steps were aimed at stabilizing the site and mitigating persistent overheating issues.
At the Rankin Inlet radar site, custodian Todd McKay visited on July 4, 2024, to switch the system from heating to cooling. He installed a new fan, connected it to the same circuit as the air conditioning unit, and moved the storage system to a cooler shelf after it had overheated. During an exterior inspection, he identified broken wires and guy lines that needed replacement. Todd returned on July 26, 2024, to complete the wiring for the air conditioning unit and fan. On August 8, 2024, he revisited the site to correct a connection error that had caused the radar shack to become excessively hot, resulting in another storage system shutdown. Todd restarted the system and fixed the fan connection.
SuperDARN Canada staff typically visit radar sites every two years, with the last visit occurring in 2023. The next planned site visit and maintenance for Rankin Inlet and Clyde River, is scheduled for July or August 2025. During this visit, SuperDARN staff will conduct an inspection and carry out any necessary repairs and system upgrades to ensure the ongoing reliability of the radars.

Results and Achievements: Findings and results to date of the above activities, highlighting any key research achievements (see guide below for formatting tips regarding tables and figures).

Challenges/Obstacles: In this section, please comment on any challenges/obstacles (if any) that you experienced during this project year. If there were any actions to mitigate or resolve these challenges, please list them here. Were any concerns raised regarding the conduct of research team members or the impacts of the project?

Expected Project Completion Date: Provide month and year of expected completion date of the project.

Project is expected to continue but funding cycle ends March 2029

Project website (if applicable): If your project has a presence on the internet, including a website and/or social media page, please provide the link and/or account handle.

superdarn.ca

Citations: Please append a complete reference list if citations are used anywhere in the document.

POLICY RELEVANCE

Does this research support policy development or decision-making in Nunavut? If yes, please describe.

RESEARCH OUTCOMES: BENEFITS

Community engagement: Briefly list and describe any community consultation, engagement, collaboration and outreach activities that you have undertaken for the project; describe the role(s) that community members and/or specific organizations have played in research co-design and activities.

Youth engagement: Briefly list and describe any outreach, school or classroom activities that you have undertaken for the project; describe the role(s) that youth have played in your research activities.

Training and Employment:

How many Nunavummiut received training from team members? Please describe training and/or compensation provided.

How many team members received training from Nunavummiut? Please describe training received and/or what knowledge sharing and/or skills exchange took place.

How many Nunavummiut received employment? Please describe employment type and length, role(s) and responsibilities, and compensation provided.

How many Nunavummiut received honoraria as research participants? Please describe method of participation (interview, observation, sample, survey, etc.), including compensation provided.

Please explain how the project directly benefited Nunavut organizations and/or businesses (e.g., through contract services, local purchases, equipment donations, etc.)

Local communities and services are typically involved in our project. Mike Jaypoody (Clyde River) and Todd McKay (Rankin Inlet) are hired to provide us with field technical support for our remote operations, including site maintenance and electronic and antenna system issues. Local involvement also extends to internet services provided by Qiniq in Nunavut and Qulliq Energy Corporation. Lease rates for the land where the radar is located are paid to the Municipalities of Rankin Inlet and Clyde River.

OPTIONAL: Nunavut Team Members, hires, and/or trainees (excluding research participants e.g., interviewees)

The NRI is creating an inventory of Nunavummiut who are skilled and/or interested in research. The information provided below will not be shared publicly but will support long-term capacity sharing by connecting local and visiting researchers with research talent in each community.

Name	Expertise/skills	Training/interest areas	Contact Info	Community

Academic Mobility

If you are affiliated with an academic institution, please answer the following question: For which Level of Project(s) will the data be used? (Check all that may apply)

- ☑ Research
- ☑ Post-Doctoral Research
- ☑ PhD Thesis
- ☑ Masters (Major Research Paper)
- ☑ Masters (Thesis)
- ☑ Graduate Course Project
- ☑ Staff/Administration Research
- ☑ Undergraduate Honours Thesis

Other ☐ Space weather monitoring, government, camera operators, amateur radio operators, hobbyists

BUDGET

Please complete the table below to detail your projected and actual research expenditures during the reporting period.

Category	Planned/Approved Expenditure	Actual Expenditure
Travel and Accommodation		
Equipment, Materials and Supplies		
Salaries/Wages for Nunavut residents		
Salaries/Wages for non-Nunavut resident researchers		
Professional Fees and services in Nunavut		
Professional Fees and Services outside of Nunavut		
TOTAL EXPENDITURES		

List the total $ amount of funding from each funding source for your full research program, including in-kind support

RESEARCH OUTPUTS / REPORTING TOOLS

What research outputs were generated? Please list below and append copies of each. Specify which outputs (if any) may be made public on the NRI research licensing database.

Have peer-reviewed manuscripts been published as a result of your project? If Yes,

complete the following table:

Full citation	Publicly accessible/ free to access (Y/N)	Link (if available) and DOI (if available)
R. A. Rohel, P. Ponomarenko, K. A. McWilliams, Application of Wide-Beam Transmission for Advanced Operations of SuperD	Y	https://doi.org/10.1029/2023RS007900
McWilliams, K. A., Detwiller, M., Kotyk, K., Krieger, K., Rohel, R., Billett, D. D., et al. (2023). Borealis: An advanced digital hard	Y	https://doi.org/10.1029/2022RS007591

If No, do you intend to submit a manuscript (or manuscripts) for peer reviewed publication?

Were non-peer reviewed materials produced to either communicate or synthesize results to the public? Examples of these materials include (but are not limited to): websites, reports, brochures, podcasts, webinars, presentations, non-peer reviewed publications, etc.

If Yes, complete the following table:

Title	Description of Materials	Link (if available)	DOI (if available)

Did your project develop a communications plan? Please describe communications/reporting tools used, and list the target audience for each and/or who requested which.

SuperDARN Canada maintains a robust online presence through our website, https://superdarn.ca/. This platform offers a wealth of resources, including publications, a forum, surveys, real-time data displays, a mailing list, and our contact email and information. Since our radars operate autonomously and remotely (based at the University of Saskatchewan in Saskatoon), we encourage interaction with all interested parties through our online resources.

How were Nunavummiut credited and/or acknowledged in all project outputs, such as co-authorship, participant biographies, article acknowledgements, etc.

DATA AND INTELLECTUAL PROPERTY

Did you enter into a research agreement, data-sharing agreement and/or intellectual property rights agreement with a community and/or designated Inuit organization (DIO)? If yes, please explain.

Do intellectual property rights apply to your research? If yes, please explain.

Who owns the data? Has the raw data been shared with the appropriate community and/or DIO? If yes, how? How is data security and storage handled by community-based co-owners?

Where is the data stored and will the data be destroyed within a set timeframe?

The data we store does not contain personal information, so confidentiality is not a concern for this project.

In terms of our data storage policy, we have planned for creating a reliable data product with an eye to long term data preservation. We keep the original data (Level 0) at the research site for more than two years. Every one to two years, during a site visit, we copy this data onto external hard drives and bring it back to the University of Saskatchewan in Saskatoon for safekeeping. We store it on special network drives and also rotate it between different hard drives.

The processed data we share with others (Level 1) is also backed up at the research site for more than two years. We transfer this data to the University within approximately 24 hours for distribution to the international SuperDARN partners. The data is transferred to and stored by the Federated Research Data Repository (FRDR) for long term storage. We also keep a backup copy of Level 1 data on campus.

Is the data trackable and/or available in a public data repository? If yes, please provide the appropriate information and/or link to ensure the findability and accessibility of the data.

Please append a copy of your data management plan.

CLIMATE CHANGE

Is your research about climate change (causes, impacts, mitigation, adaptation, etc.)? If yes, explain.

PHOTOGRAPHS

If possible, please provide high-resolution photos of licensed research activities that NRI may use in communication materials, organizational reporting, and other promotional purposes. The photographer and all recognizable people in each photo must sign the attached Photo and Video Release form. Please also complete the table below for each photo provided and submit to NRI along with all required NRI photo release forms. The photographer/owner will be credited in all uses of the photograph(s).

File Name	Location	Description	Subjects	Photographer/Owner	Date

Would you like your project to be considered for a research profile and promotion by the NRI? Yes

FORMATTING TIPS

Main text:
Please supply report in a standard manuscript format (**Microsoft Word format is required**).

Tables:
Any number of tables can appear in one file (as long as they are clearly marked). Tables prepared using simple table formats as provided in word processing programs such as WordPerfect are preferred. Each table should be numbered according to its appearance in the text (e.g., Table 1, Table 2) and each should have a brief descriptive heading.

Figures:
Each figure or graphic element should be submitted as a separate file. Black & white and colour graphics are both acceptable. We can accommodate most standard graphic file formats, however, please indicate in which format the graphic was prepared.

References:
Please use the APA or MLA Citation Style while referencing throughout the report.

Size:
The size of the electronic document must not exceed 4MB (if larger than 4MB, please send attachments separately and number the emails).