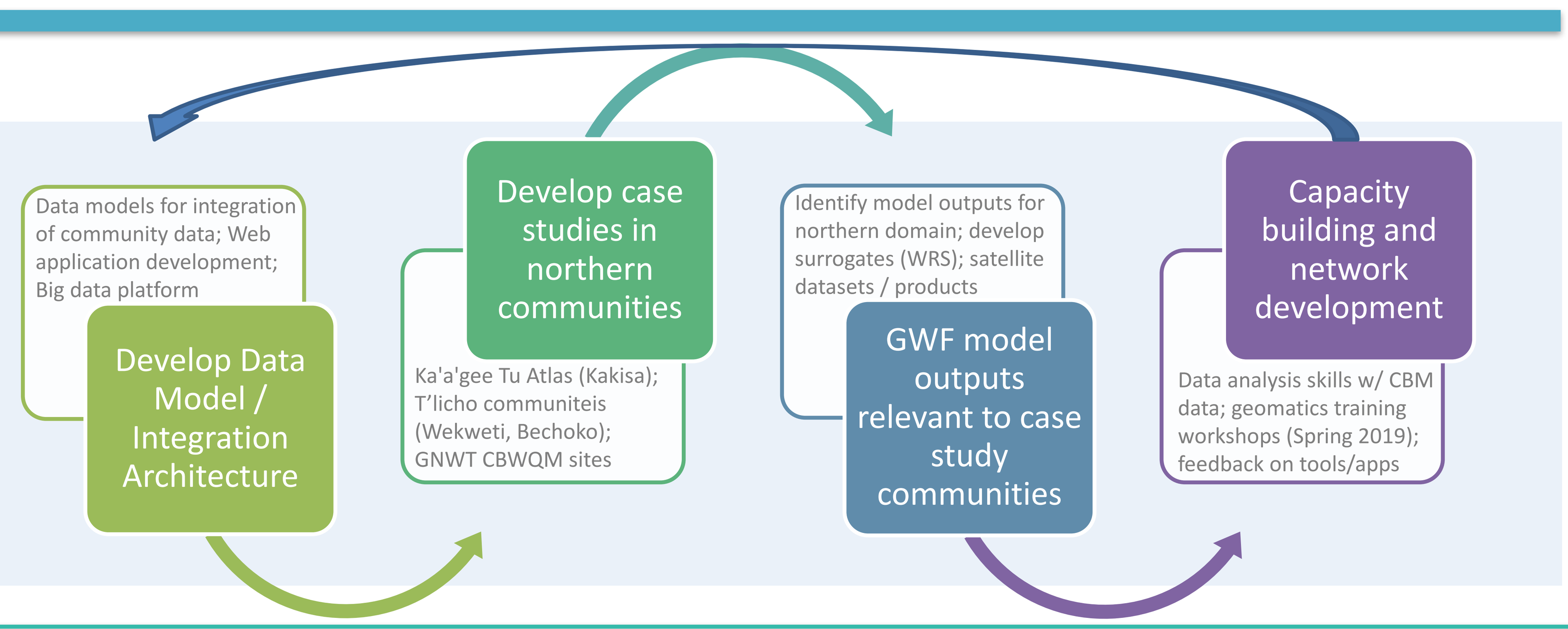
Global Water Citizenship (GWC)

Integrating Networked Citizens, Scientists, and Local Decision Makers

Colin Robertson (Laurier); Rob Feick (Waterloo); Steven Roberts (Laurier); Michael English (Laurier)

Introduction

There is widespread agreement on the need to engage citizens in environmental monitoring especially in regions of rapid climate change. While there has been a rapid increase in citizen science and community-based monitoring approaches, too frequently these programs occur in isolation from more traditional scientific research and monitoring. There is a need to develop new tools, frameworks, and approaches for integrating community-based and citizen approaches with science data, models, and knowledge.



Objectives

1. **Inventory existing networks**
   Build a national inventory of citizen science projects for water resources

2. **Make citizen data more useful**
   Develop new tools to reduce barriers to use of citizen science data

3. **Make science data more meaningful**
   Develop approaches to maximize use of GWF information products by vulnerable communities and citizens.

4. **Create new opportunities for participation**
   Expand participation and improve knowledge of documenting environmental change in Canada's cold regions

Methodology

Currently, several inter-related studies and activities are being pursued in order to achieve the project objectives:

1. Evaluating new data models for science-community data fusion (obj.3)

Leads: Steven Roberts, Colin Robertson
HQP: Chiranjib Chauhurdi (Post-doc); Ben Bonduruk (MSc
Summary:
Discrete global grid systems offer many potential advantages for storing, accessing, and analyzing digital spatial data – including directly handling spatial uncertainty. We are evaluating different tools for spatial data representation and storage that facilitate integration. The Open Geographic Consortium (OGC) Standard for Discrete Global Grid Systems was used to evaluate two existing implementations of DGGS. Preliminary findings indicate reviewed packages (H3 and OpenEAGGR) do not meet OGC specifications.

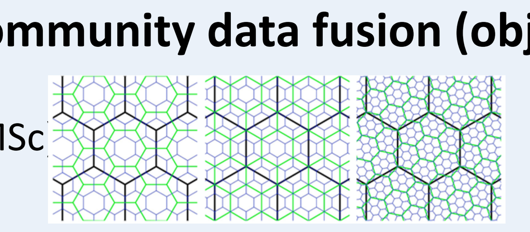


Figure 1.1 Examples of different aperture settings for hexagon-based DGGS: aperture 3 (left), 4 (middle), and 7 (right)

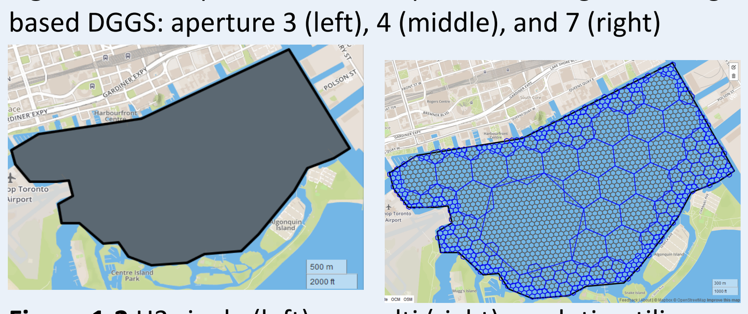


Figure 1.2 H3 single (left) vs. multi (right) resolution tiling with H3 package

2. Water quality monitoring decision support tool development (obj. 2)

Leads: Colin Robertson
HQP: Annie Gray (Undergrad honours student);
Summary:
Literature reviews and outcomes from many citizen science projects indicate one of the biggest barriers to use of data is concerns about data quality. We are using a case study of the water quality monitoring network the Mackenzie Valley DataStream to develop a new tool for analysis of water quality monitoring data. A web-based data analysis tool has been created and will soon be evaluated by identified stakeholders across Canada. Results from evaluation will inform redesign and roll out.

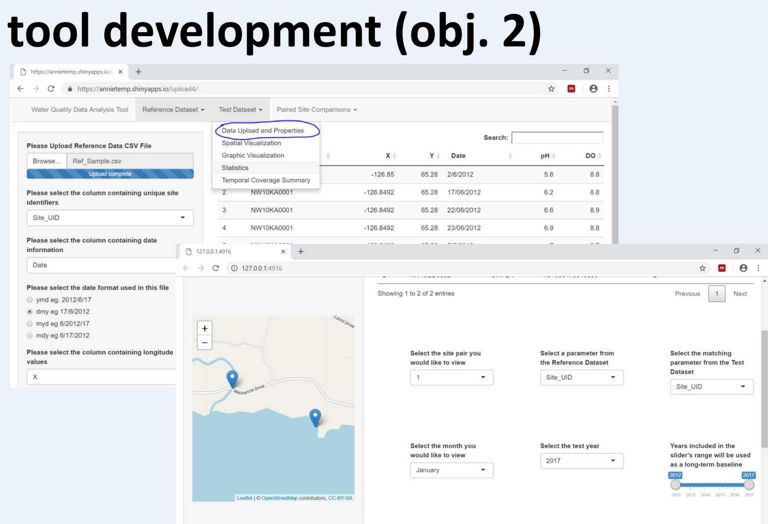


Figure 2.1 Sample screenshots from web-based data quality tool currently in development

3. Integrating knowledge on precipitation extremes in northern Canada (obj. 2)

Leads: Colin Robertson
HQP: Chiranjib Chaudhuri (Post-doc);
Summary:
This study focused on the analysis of extreme precipitation over the Arctic regions of Canada using a novel spatial pooling method to spatially decorrelate ANU Spline gridded precipitation dataset for 1950-2010 and computed unbiased trends over these regions. The trend pattern suggests increasing frequency and variability of extreme precipitation over the Southern Arctic region. Our analysis emphasizes the need for robust trend estimation methods in the arctic regions where data uncertainty is very high due to low station density. Standard trend analysis of the gridded observation data may lead to false positive trends.

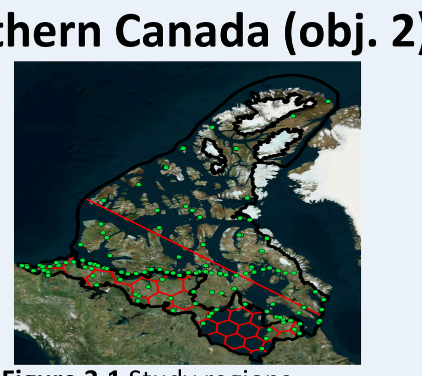


Figure 3.1 Study regions

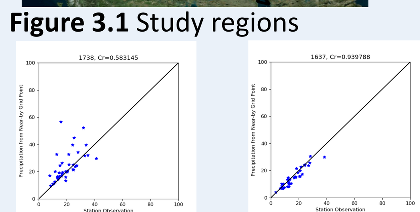


Figure 3.2 Station vs. gridded in northern (left) and southern arctic (right)

4. Ka'a'gee Tu Atlas Redevelopment (obj. 3 and 4)

Leads: Colin Robertson, Rob Feick, Andrew Spring (NWF Project)
HQP: Misha Kuzma (Co-op student); Neomi Jayaratne (NWF MA student)
Summary:
The Ka'a'gee Tu First Nation in the Dehcho region of NWT has been engaged in a community-based monitoring project over the last few years. An existing prototype has gained significant feedback and interest from community members to document changes on the land. We are partnering with NWF researchers to redevelop this atlas; adding features requested through community consultation.

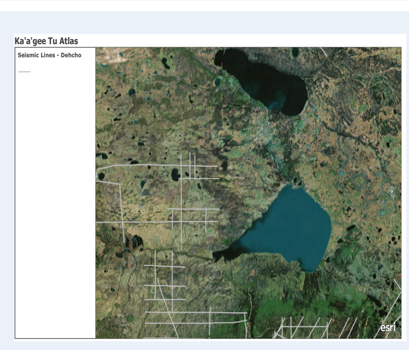


Figure 4.1 Preview of the Ka'a'gee Tu Atlas showing seismic lines.

5. Inventory for Community-Based Monitoring of Water in Canada (obj. 1)

Lead: Colin Robertson; Rob Feick
HQP: Annie Gray (summer Co-op student);
Summary:
We have collated a list of organizations and projects currently involved in some capacity with community-based monitoring of freshwater or water resources in Canada. Contact has been made with each organization and agreement to list on our inventory website. Data are organized into a PostgreSQL database and work is currently ongoing to develop a web application that will support the search, discovery, and addition of new projects and organizations.

How is GWC addressing GWF's three overarching goals?

1. Improved Disaster Warning

GWF aims to develop robust forecasting tools capable of warning stakeholders of impending floods, seasonal water flows, droughts and water quality. The GWC project is contributing to this in the following ways

- Developing technologies that will allow communities impacted by disasters to report the extent and severity of events when they occur. These inputs can then in turn be used to develop more accurate warnings
- Capacity building in GWC will enhance participation in community monitoring of local environments and in relation to industrial developments. Heightened awareness and capability to undertake monitoring and link local observations with regional and global models.

2. Predicting Water Futures

GWC aims to build new tools that allow communities and citizens to incorporate GWF science into daily decision-making. Currently we are using existing models (e.g., WRF) and datasets (e.g., globesnow) as proxies for GWF model output; however this will be expanded to operational GWF models as the project evolves. We will contribute to our ability to predict future water scenarios by:

- Providing technologies that link community observations with model outputs
- Provide an interface to models that support ad hoc end user queries about environmental change (e.g., "how unusual are river levels compared to historical data?")

3. Adapting and Managing Risk

In order to inspire action; knowledge of risks is required. Through our work on goals 1 and 2 we will be creating new tools that allow citizens to incorporate new GWF science into their decision-making. As part of citizen-scientist knowledge flows supported by GWC we will:

- Develop tools to georeference historical traditional knowledge of climatic change and adaptations

How is GWC addressing UN Sustainable Development Goals?

6 CLEAN WATER AND SANITATION

GOAL 6: Ensure access to water and sanitation for all

Target 6B of Goal 6B is to "Support and strengthen the participation of local communities in improving water and sanitation management". Our project directly contributes to this by enabling communities to share their own observations of water resources in their communities. By developing tools for stakeholders to examine data quality (Activity 2) and a community-monitoring altas (Activity 4), we will also facilitate researcher-to-community dissemination of cutting edge water science from the GWF Programme.

13 CLIMATE ACTION

GOAL 13: Take urgent action to combat climate change and its impacts

Building tools for community monitoring of environmental change directly engages people in understanding and developing adapatations to climate change impacts.

17 PARTNERSHIPS FOR THE GOALS

GOAL 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development

Citizen science and community-based monitoring builds relationships between citizens, scientists, and decision-makers. Through our survey of water quality monitoring analysis tools we are engaging a broad swath of civil society.

Next Steps

- Conduct capacity building with youth and professionals from Tlicho communities (May 2019). Focus on Geomatics skills for environmental monitoring.
- Finalize data modelling and big data platform development,
- Iterate development of Ka'a'gee Tu Atlas through the spring in coordination with NWF and community feedback. Seek new avenues to incorporate science data (e.g., permafrost probability) into the atlas. Develop app version.
- Expand data quality comparison tool; enabling the comparison of water quality monitoring parameters to baseline data from nearby stations; to wider array of cases where detecting change from baseline is the community information need.
- Develop stronger linkages with other GWF projects and their outputs

Contact and Additional Information

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Bondaruk, B., Roberts, S. A., Robertson, C. (2019). Discrete Global Grid Systems: Operational Capability of the Current State of the Art. Spatial Knowledge and Information Canada paper proceedings, 9. Feb 21-24 2019, Banff, AB.

Chaudhuri, C., Robertson, C. (2019). A novel method to analyze trends of extreme precipitation distribution- A case study over the Arctic regions of Canada. Spatial Knowledge and Information Canada paper proceedings, 9. Feb 21-24 2019, Banff, AB.