



2021 Virtual Symposium

April 20, 22, 27 & 29, 2021



2021 Conference Planning Committee

PGO gratefully acknowledges the work of the Conference Planning Committee in organizing this symposium.

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- Kristin Hanson
- Robert Hearst
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- Imran Khan
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- Kristina Small
- Andrea Waldie
- Craig Waldie
- James Whyte
- Tony Andrews
- Marilen Miguel

2021 VIRTUAL SYMPOSIUM

Panel Session D

Innovation in Geoscience: Implications of Emerging Technologies and Their Applications

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Panel Session D Co-Chairs



Mark Priddle, P.Ge.



Tony Andrews, PhD

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Presentation 1

The Bissett Creek Graphite Deposit and its Role in the Green Economy



Gregory Bowes

Chief Executive Officer
Northern Graphite

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Graphite's Role in the Green Economy and the Bissett Creek Deposit

Gregory Bowes

April 28, 2021



What is graphite?

- One of only two natural, pure forms of carbon (diamonds)
- “Two-dimensional” flake material
- Non-toxic, not a carcinogen
- Not burned as fuel, not a source of CO²
- Quality/prices vary with flake size and purity
 - +150/+100/+80/+50/+32 mesh sizes
 - “powder, sand, pepper to parsley” in size
- Corrosion and heat resistant
- Excellent conductor of heat and electricity
- Light weight reinforcement material, natural, dry lubricant
- Synthetic graphite is made from petroleum coke
 - composite materials incl. golf clubs, tennis racquets, hockey sticks
 - electrodes for steel industry



XL/XXL flake

What is Natural Graphite Used For?

40 per cent of demand is refractories

- Essentially fire bricks that line blast furnaces
- Light weight reinforcement making up 10-25% of the bricks
- Does not melt or corrode
- Thermally conductive additive
- Mainly in steel industry, also cement and glass manufacturing
- Bricks must be replaced periodically
- Consumable in the steel making process, not an alloy



What is Natural Graphite Used For?

35 per cent of demand is multiple smaller markets

- Pencils
- Brake & clutch parts
- Thermal management in electronics
- Conductive additive in regular batteries
- Gaskets
- Lubricants
- Fire retardants
- Carbon brushes in electric motors
- Insulation products
- Drilling Fluids



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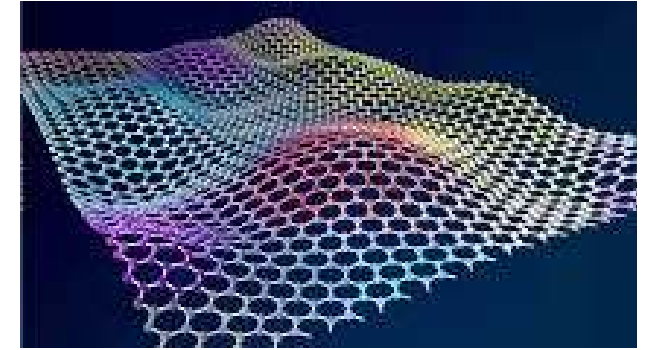
Green Energy Applications

25 per cent of demand is mainly lithium ion batteries

- Anode material in a lithium ion battery (and the largest single component)
- Fuel cells
- Vanadium redox flow batteries
- Light weight composite materials (graphene)



What is Graphene?



- A one atom thick sheet of carbon atoms arranged in a hexagonal pattern
- 200 x stronger than steel, 100 x more conductive than copper, flexible, transparent
- A graphite flake is hundreds of thousands of graphene layers
- De-lamination of graphite is one production method
- Mainly results in 2-10 layer “near” graphene or “nano” graphite
- Can be added to composite materials to make them stronger, lighter and thermally or electrically conductive
- More fuel efficient vehicles, longer lasting tires, lighter wind turbines, more efficient solar panels etc. etc. etc.

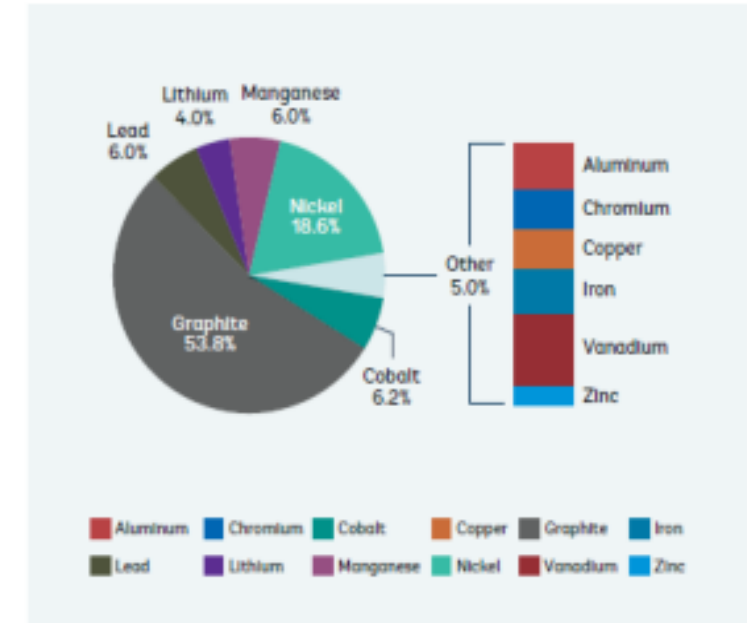
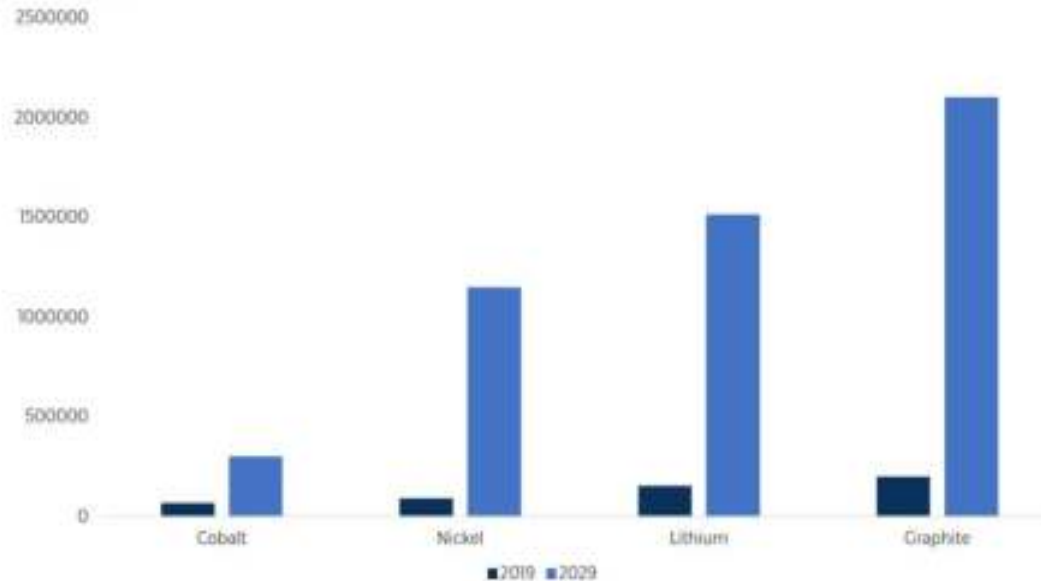
The China Factor



- World flake graphite production is approximately 850,000tpa
- China produces and consumes 70 to 80%
- China produces almost ALL battery anode material
- China has large resources but is forecasting a large supply deficit in 2025 due to EV growth
- Graphite production must more than double to meet the sales forecasts of the automobile manufacturers
- The west needs its own sources of supply
- US and EU have both declared graphite a supply critical mineral

Graphite Demand Growth

Battery raw material demand will grow between 5x and 13x to feed the megafactories



Share of Mineral Demand from Energy Storage
(source:IEA)

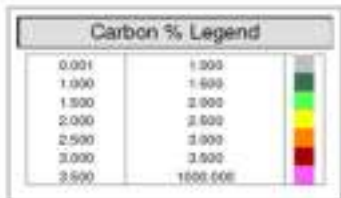
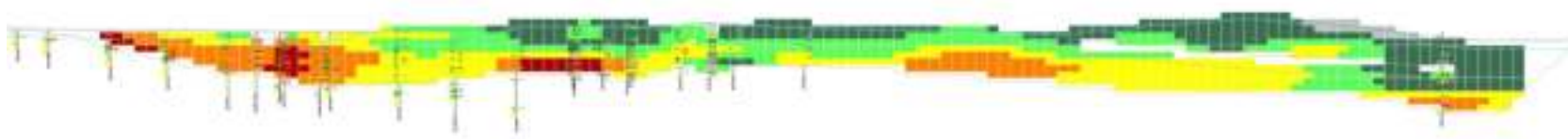
Bissett Creek Project

- 15km from Trans-Canada highway
- Close to labor, supplies, infrastructure, natural gas supply
- Direct trucking to US markets, five hours from port of Montreal
- Highest percentage of “large flake” in the world
- FS completed for 25,000tpy, 80-100,000tpy capability
- Major mining permit received
- No local/First Nation opposition



Simple Mining and Metallurgy

- Open pit mining, low waste/ore ratio
- Simple flotation flowsheet
- Natural gas power generation
- Co generation plant to dry concentrates
- 97% of tailings non acid generating
- Life cycle/carbon footprint analysis underway



Northern Graphite Summary

- Battery/EV graphite demand growing rapidly, new mines will be needed
- Market needs an alternative to Chinese supply
- Market needs more XL/XXL flake production
- Only North American mine closing
- Most competing projects in Africa
- Highest percentage of XL/XXL flake
- Reasonable capital cost
- Feasibility Study completed, construction ready



But graphite prices are still low!

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Permitting Status

(for a “benign” project with no local or FN opposition)

- Mine Closure Plan approved in 2013
- Amendment required due to throughput increase
- After seven years of effort and millions spent no other permits have been received
- Class EA, PTTW, LRIA, ESA all outstanding
- The biggest problem is not the regulations
- Government agencies refuse to make decisions, take responsibility for anything or act in a timely fashion
- Ontario is an expensive/difficult place to do business
- Our mines are at a competitive disadvantage and value added processing will take place elsewhere

Thank you

Presentation 2

Getting the Most
Out of Your Data
and Efforts:
Application of
Machine Learning
to Geoscience



Rebecca Montsion

PhD Candidate at Laurentian University's Mineral Exploration Research Center (MERC) and the University of Western Australia's Center for Exploration Targeting (CET)

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Getting the most out of your data and efforts

Application of machine learning to geoscience

Rebecca Montsion*, Stéphane Perrouty, Mark Lindsay
rebecca.montsion@gmail.com

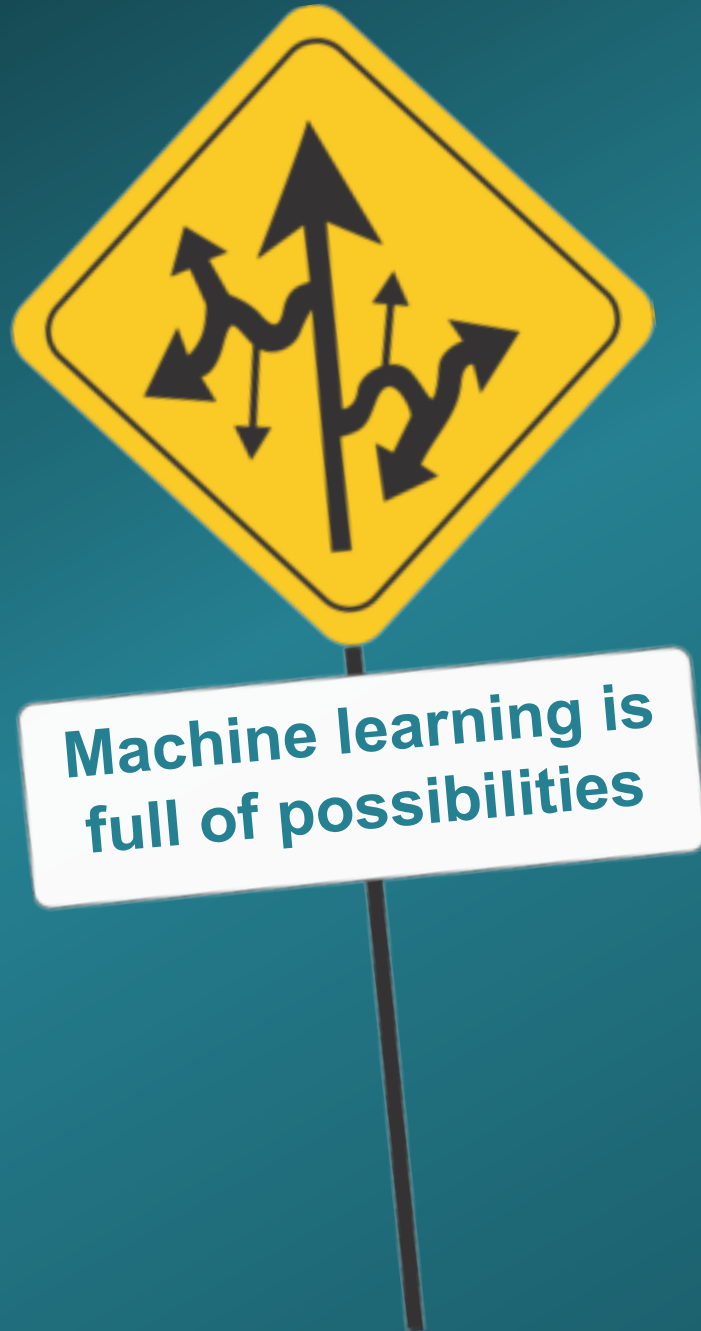
Two camps

Unsupervised

Exploratory process to understand the **statistical structure** of data (**no prior assumptions**)

Supervised

To make **predictions/ classification** given **prior knowledge** (labeled training set)



SOME applications with machine learning

Very brief descriptions of techniques and case studies to highlight critical elements of machine learning

Classification

Unsupervised

Group points given a set of parameters (exploratory)

E.g., Clustering (k-means, fuzzy c-means, agglomerative, etc.)

Parameters: 4 clusters

Variables: X, Y, orientation, colour



Supervised

Based on prior knowledge about what defines a 'class'

E.g., Random Forest, Neural Networks

Parameters: 4 clusters

Variables: X, Y, orientation, colour

Orogenic Au

Classification ex 1

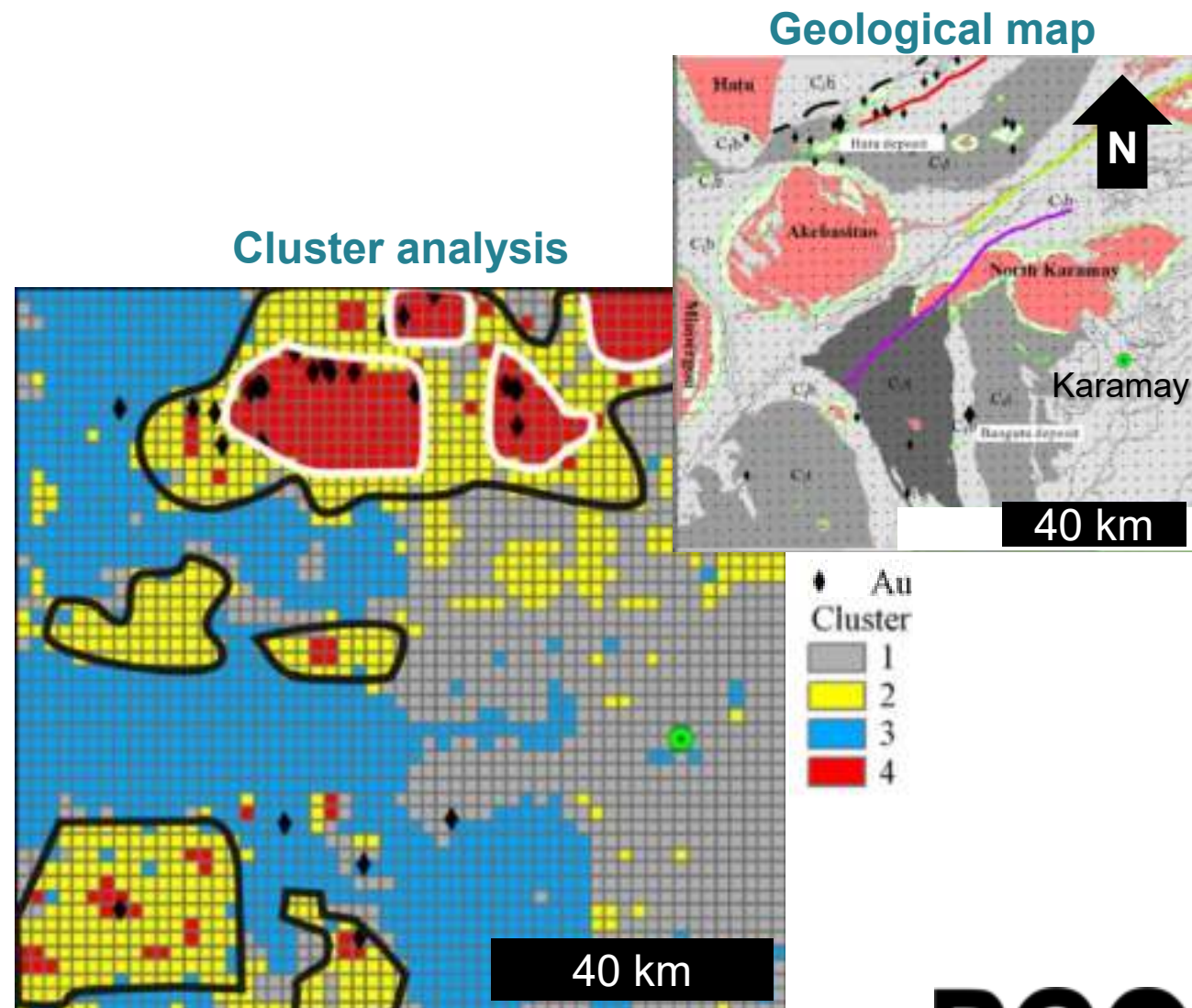
Aim

- Data-driven method to narrow search space

Inputs

- Whole rock geochemistry with ~1 x 1 km sampling grid (N = 1444)
- Interpolated element grids

Carefully select hyper-parameters
(e.g., transformation technique & clustering algorithm)



Orogenic Au

Classification ex 1

No transformation (NT)

Poor comparison between abundant and trace elements

Z-score transformation (ZST)

Preserves shape of distribution; Does not deal with 'closure'

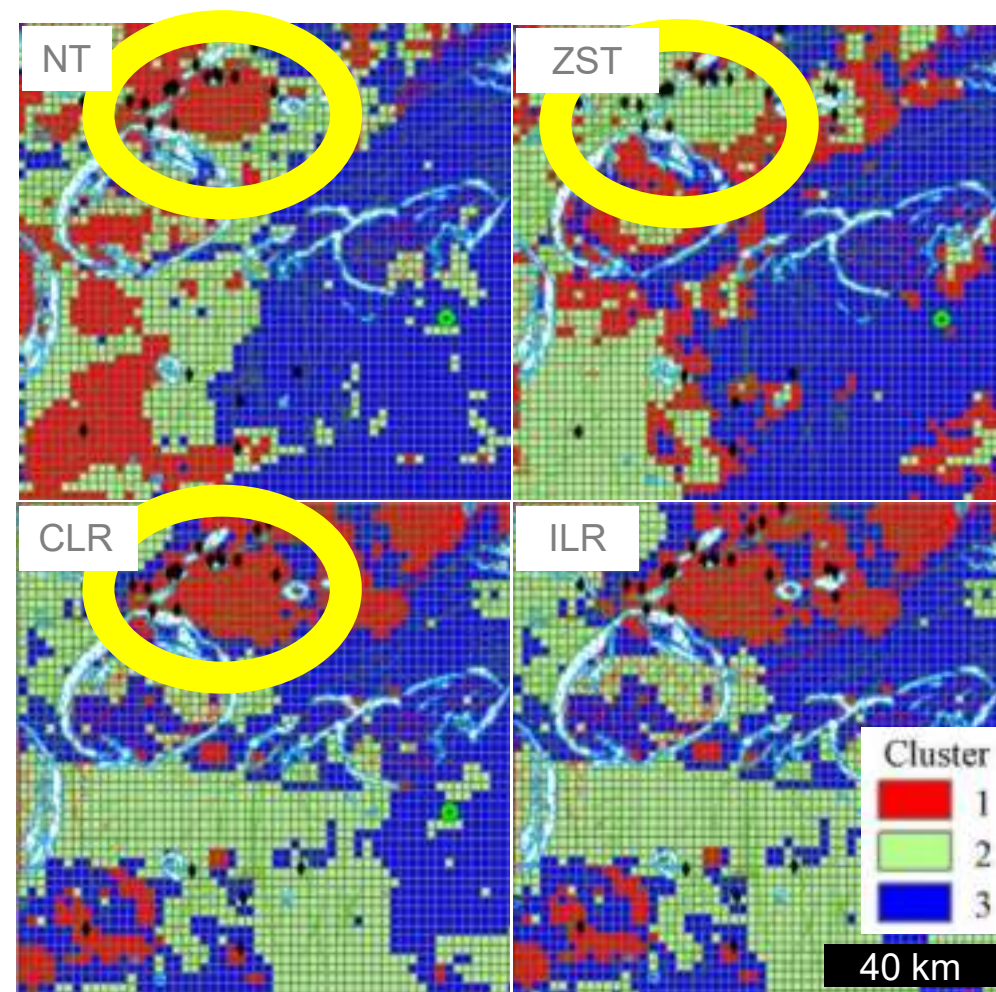
Center Log-ratio Transform (CLR)

'Opens' constant sum; Normal/Gaussian distribution; Some 'spurious correlations'

Isometric Log-Ratio (ILR)

Same as CLR but rotated/reflected to retain only real data correlations

Carefully select hyper-parameters
(e.g., transformation technique & clustering algorithm)



♦ Au deposits

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Classification

Unsupervised

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E.g., Clustering (k-means, fuzzy c-means, agglomerative, etc.)

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Supervised

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E.g., Random Forest, Neural Networks

Parameters: 4 clusters

Variables: X, Y, orientation, colour

Be smart about labels
(e.g., What do they mean? How well do they match your data? Scale/Resolution?)

Mineral mapping drill core

Classification ex 2

Aim

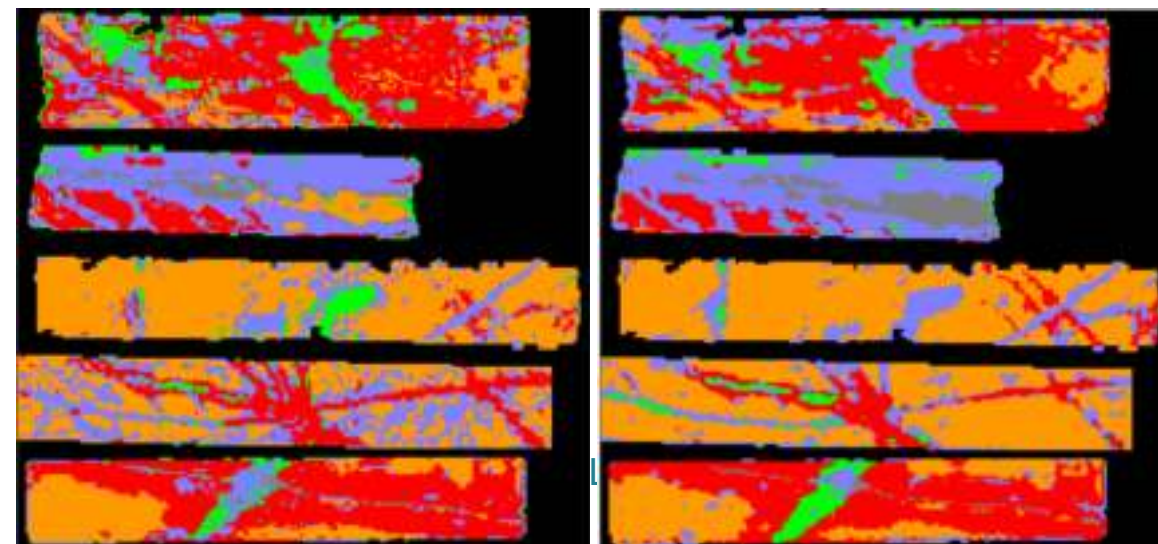
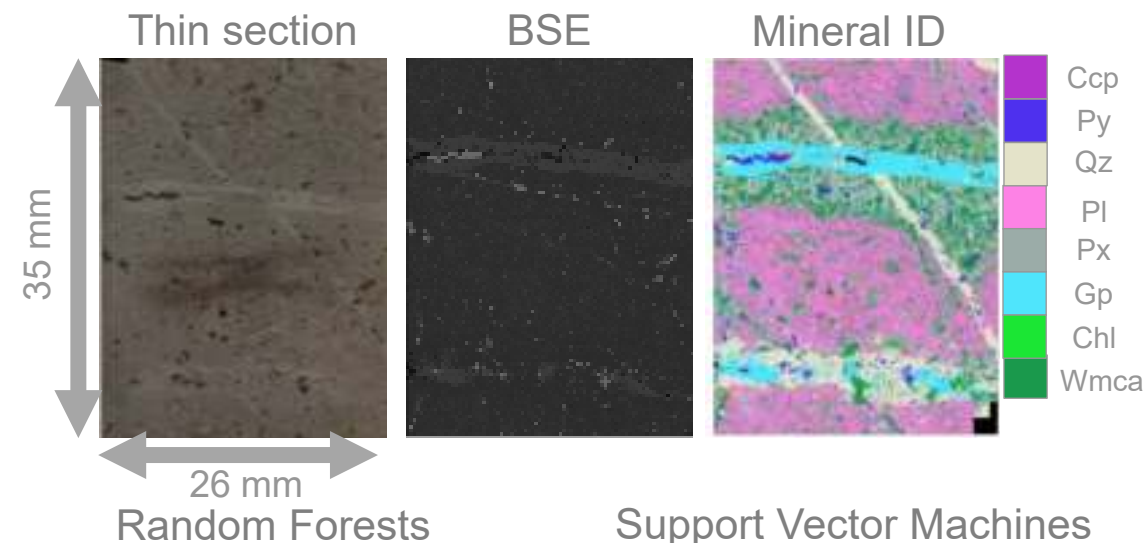
- Reduce subjectivity in core logging

Inputs

- SEM Backscattered Electron (BSE) of thin section
- Hyperspectral scan of core

Methods

- Define 'labels' using SEM liberation analysis
- Clustering: Random Forest & Support Vector Machines

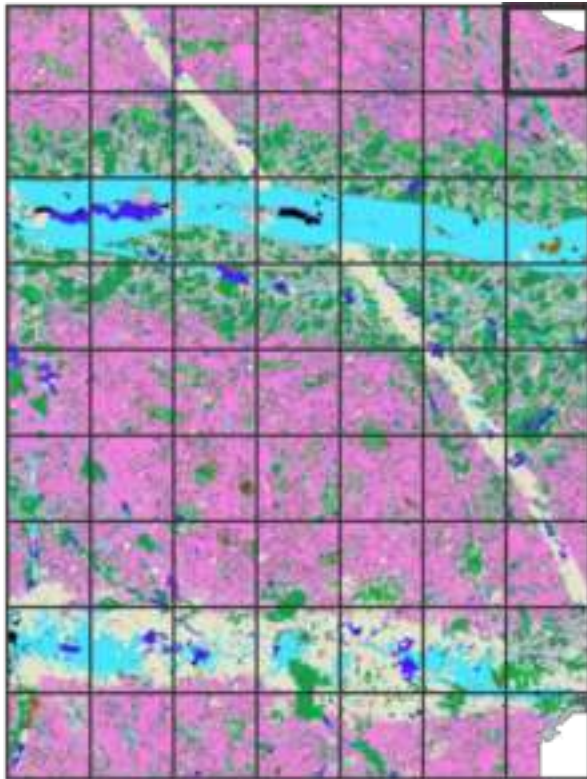


Be smart about labels
(e.g., What do they mean? How well do they match your data? Scale/Resolution?)

Mineral mapping drill core

Classification ex 2

1) Re-grid Mineral ID to HS resolution

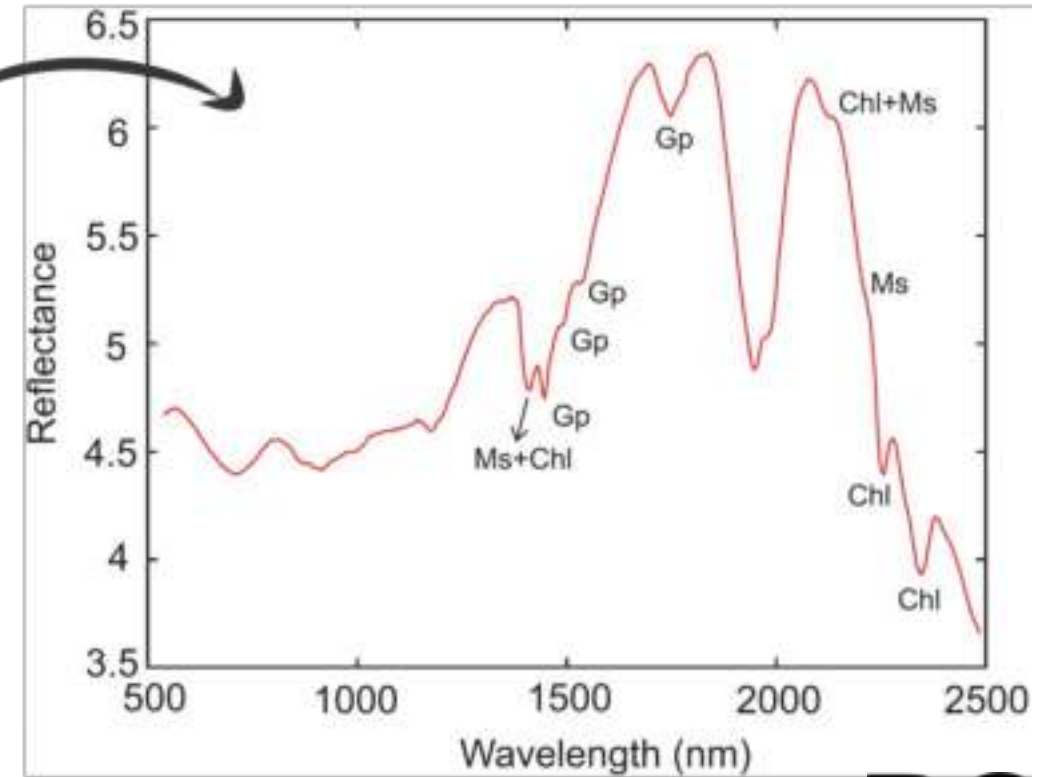


2) For each cell, find the 'dominant' mineral



3) Assign class

4) Record spectral curve for class



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Prediction

Supervised

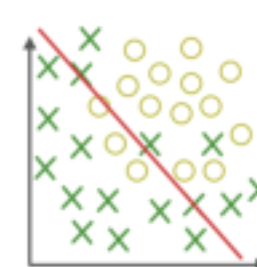
Based on prior knowledge,
fill in the blank/extrapolate

E.g., Regression, Support Vector
Machines, Random Forest, Neural
Networks

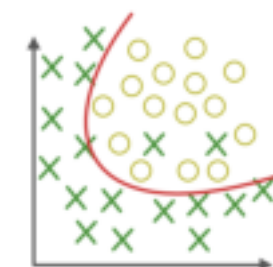
Prediction

Support Vector Machines (SVM)

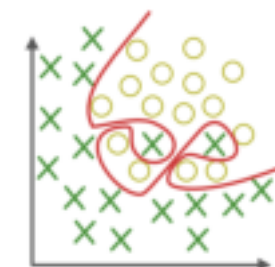
1. Find the edge of training set classes
2. Draw a threshold/boundary
3. Plot all the other data
4. Classify accordingly



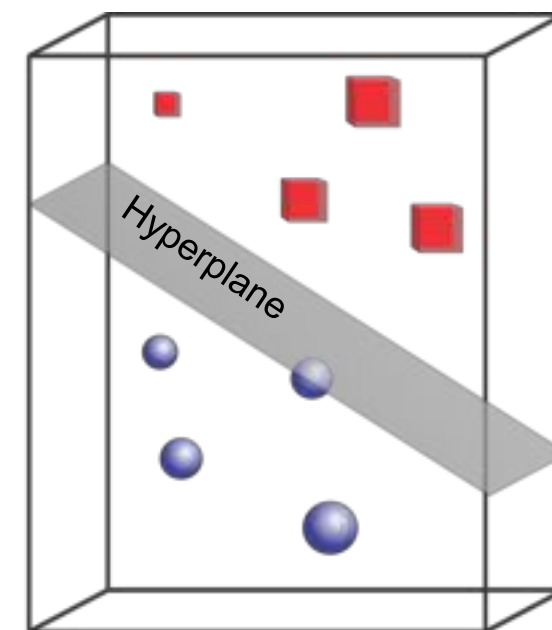
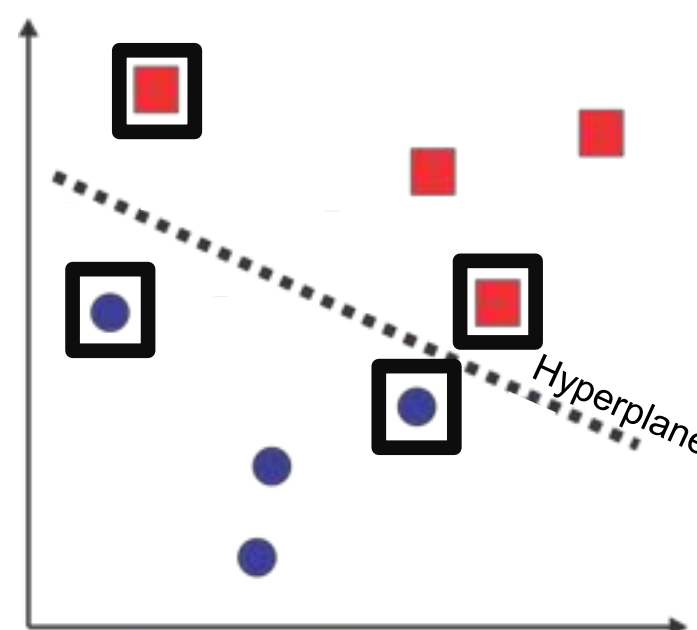
Under fit



Balanced fit



Over fit



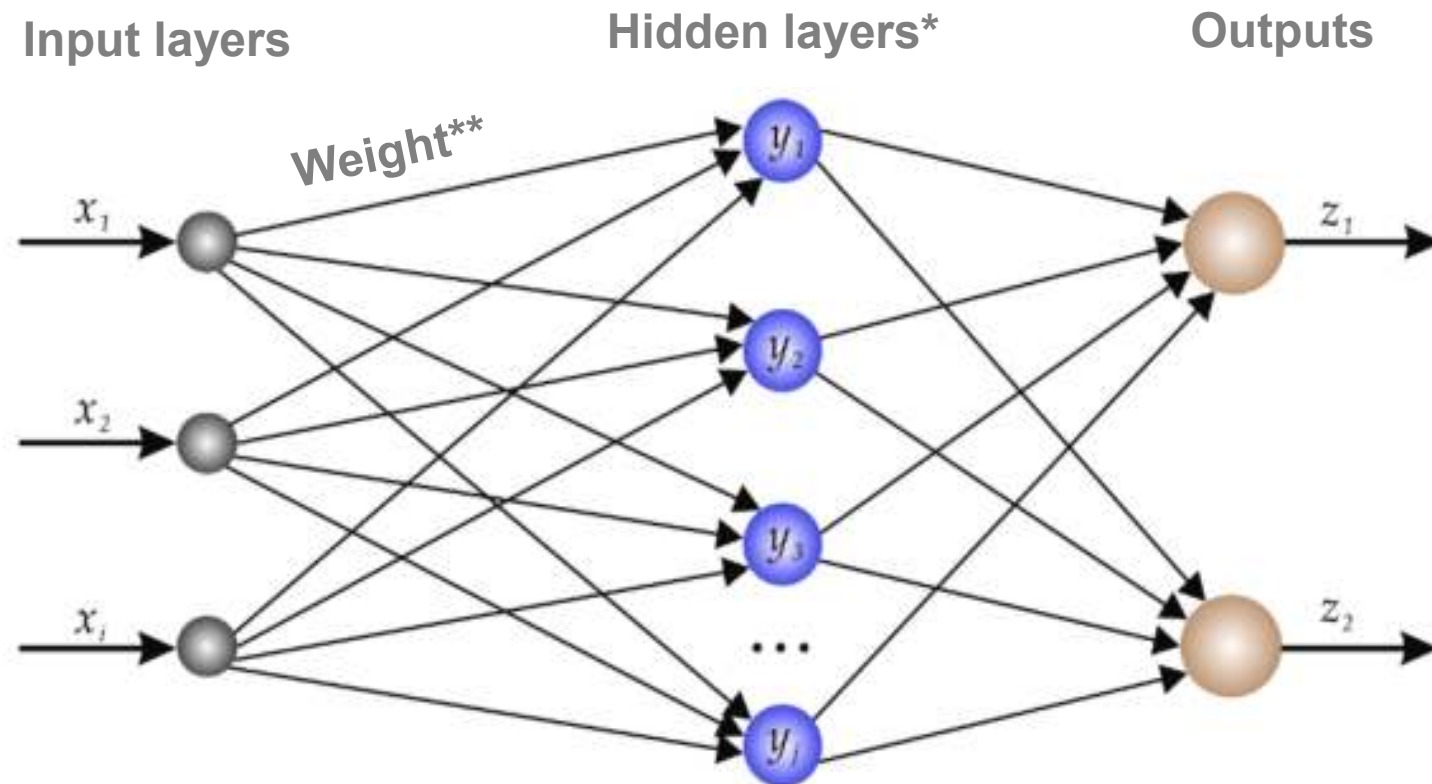
	Class	1	2
Training set			
Data			

Difficult to interpret
****Spatially aware****

Prediction

Neural Networks (NN)

1. Input several layers (e.g., grids of data)
2. Apply a range of weights to each neuron
3. Combine weighted inputs with 'math'



* >2 hidden layers = 'deep learning'

** Weights can be imposed by someone or auto-selected

Easily interpreted
****Not spatially aware****

Prediction

Random Forests (RF)

Phase 1 – Building trees

1. Randomly subsample points from training set (bagging)
2. Randomly select a subset of input layers
3. For each layer (node):
 - a. *Compute a threshold*
 - b. *Classify based on threshold*



Cu-rich skarns

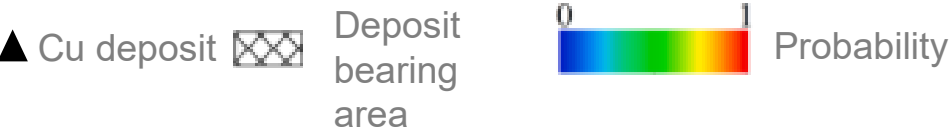
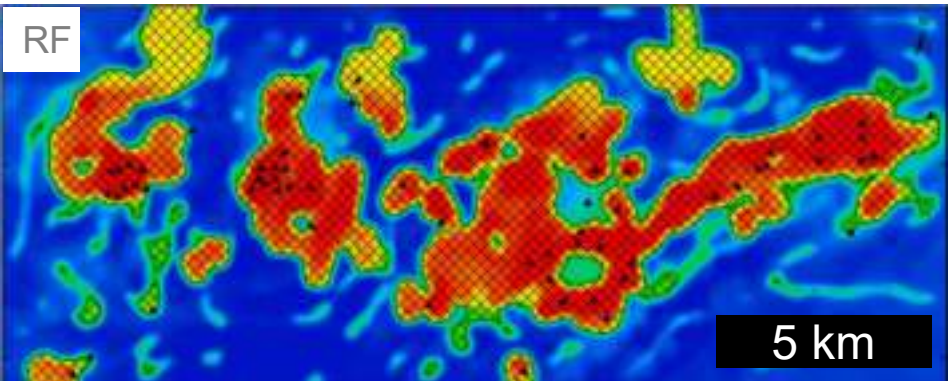
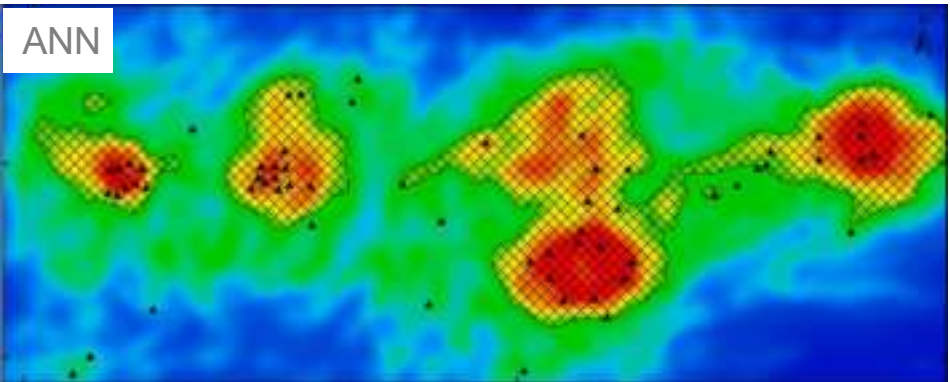
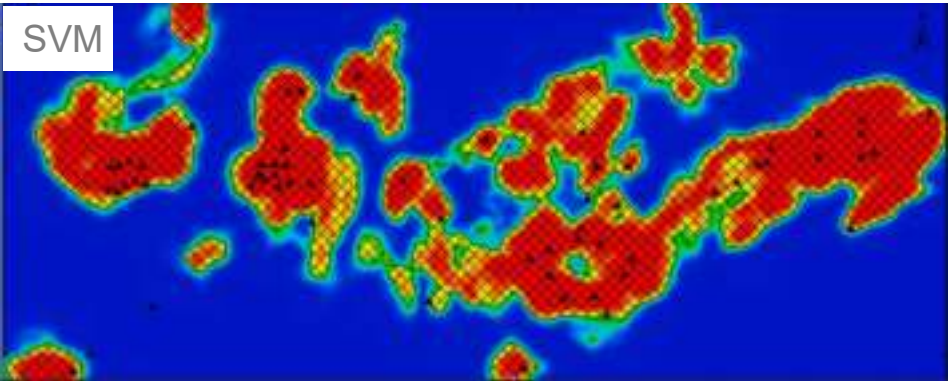
Prediction example

Aim

- Data-driven method to narrow search space
- Quantitative datasets/results for enhanced interrogation

Methods

- 12 layers representing relevant features in mineral system
- Prediction of Cu
 - *Support Vector Machines (SVM)*
 - *Artificial Neural Network (ANN)*
 - *Random Forests (RF)*



Cu-rich skarns

Prediction example

Picking training sets

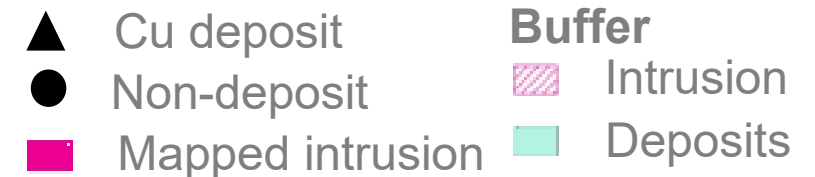
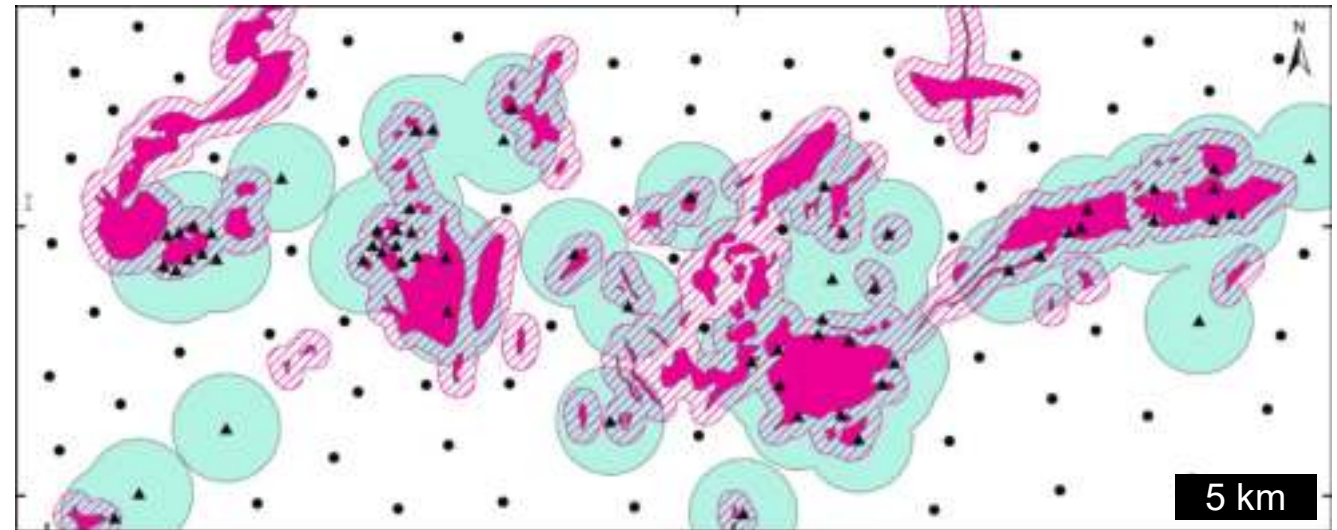
Positive:

- 63 Known deposits

Negative:

- 63 Random locations
 - $\geq 1\,838\text{ m}$ from known deposits
 - $\geq 500\text{ m}$ from prospective lithologies

Be smart about training
(e.g., Balanced? Representative?
Biased?)



Barriers to success

Data availability

- Source (e.g., geochemical, geophysical)
- Type (e.g., discrete/point, continuous/gradient)
- Sample distribution (e.g., dense, clustered, sparse)

Preconceptions

- Data selected
- Data processing/Feature engineering
- Training sets

Test for success

- Limited by small number of 'positive' training points



Cautions

1. Know what **question** you want to ask
2. Know what your **data** can actually tell you
3. Be mindful of **biases** throughout your workflow
4. Strategically select appropriate **hyperparameters**

E.g., transformations, interpolation techniques, modeling algorithm





Machine learning is
full of possibilities

Thank you

rebecca.montsion@gmail.com

Orogenic Au

Classification ex 1

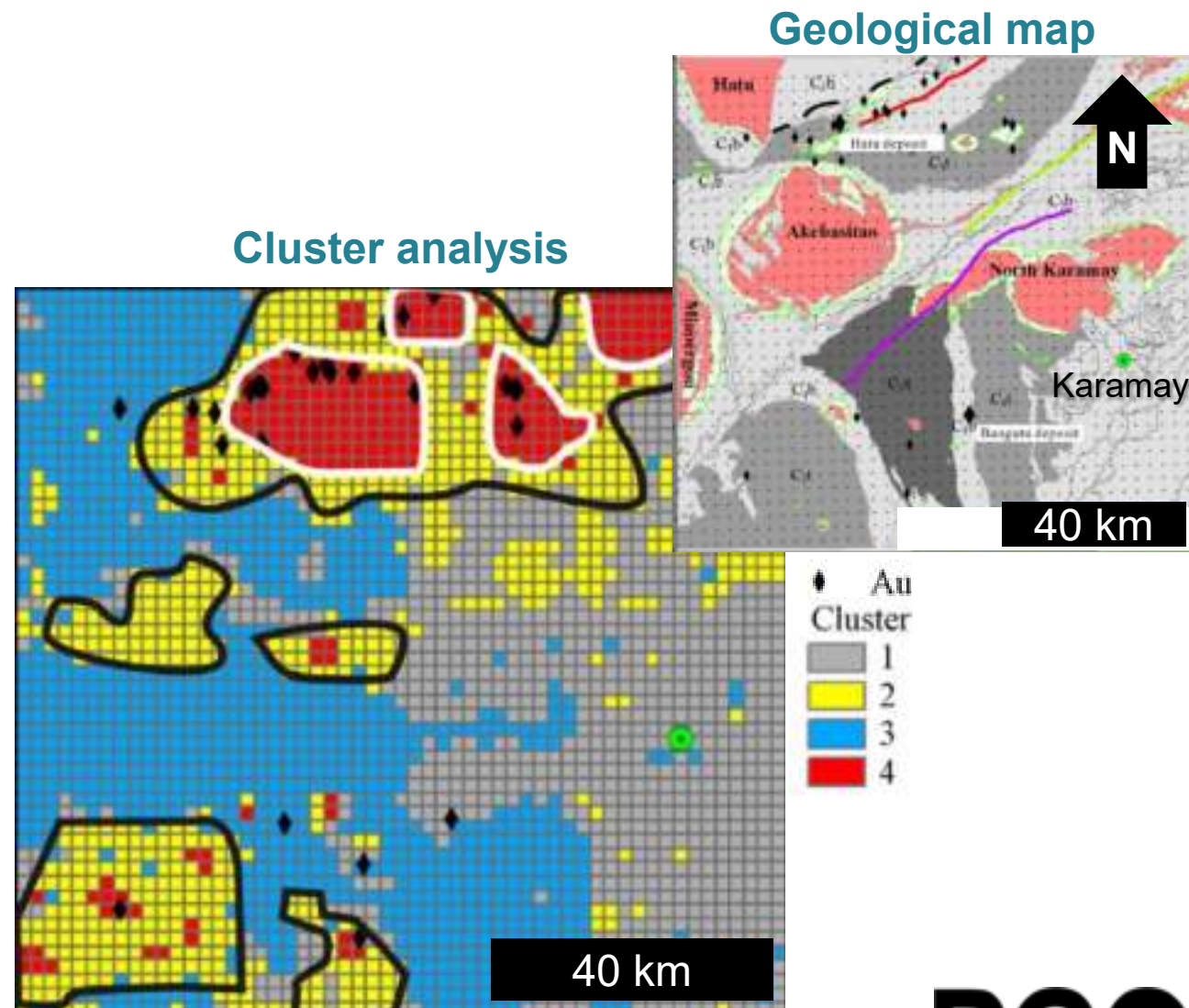
Methods

- Element associations (R-type clustering)
- Clusters of similar samples (Q-type)
 - *U-Mo-Au- Sb-B-Hg-W-As-Ag*

Conclusions

- R-type sensitive to transformation type
- Q-type is best with Center/Isometric Log-Ratio Transform using k-means or fuzzy c-means

Carefully select hyper-parameters
(e.g., transformation technique & clustering algorithm)



Mineral mapping drill core

Classification ex 2

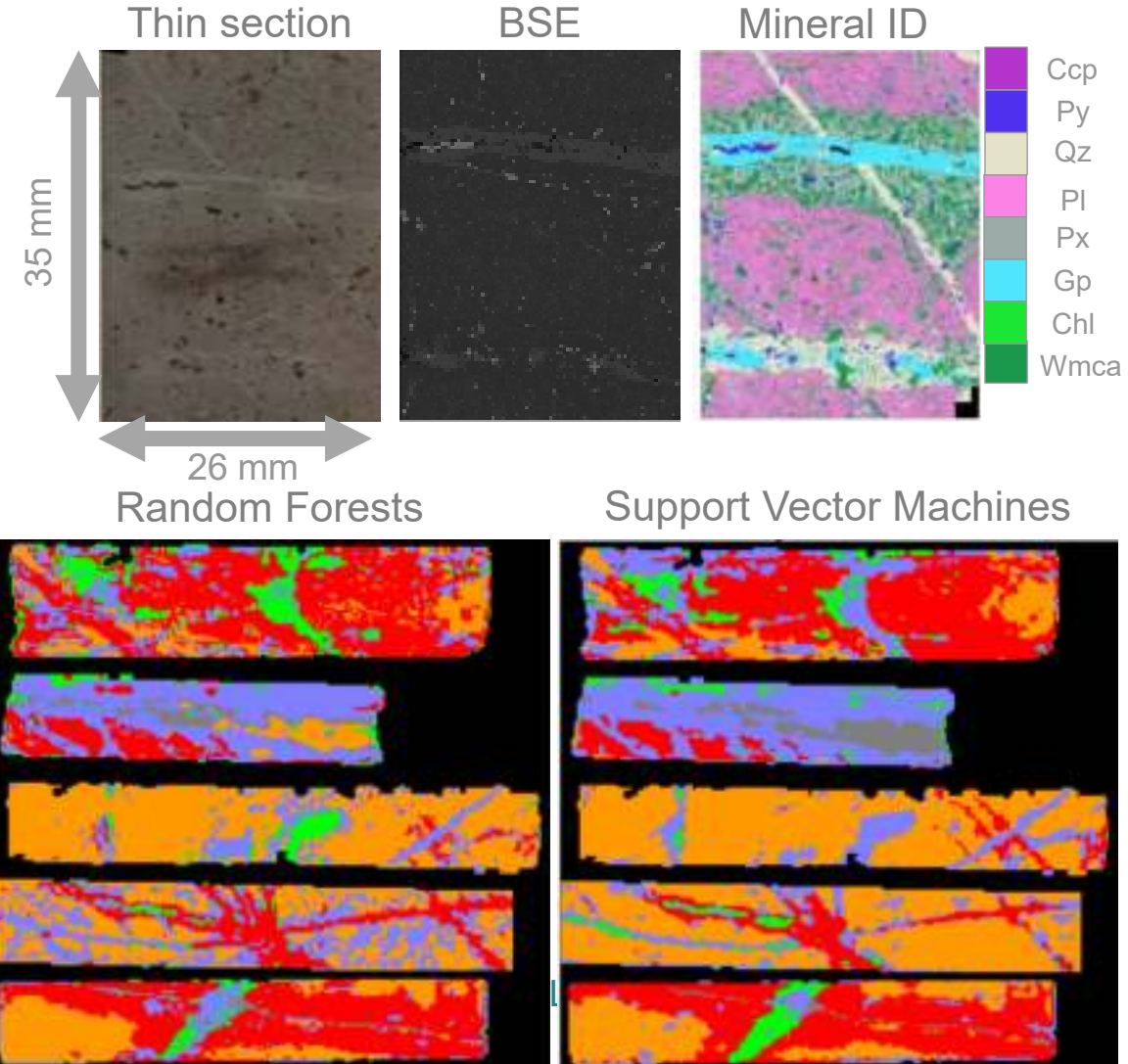
Be smart about labels
(e.g., What do they mean? How well do they match your data? Scale/Resolution?)

Methods

- Define 'labels' using SEM liberation analysis
- Random Forests: An ensemble of decision trees combined to vote on 'most likely'
- Support Vector Machines: Finds the edges of classes and sets a midpoint field boundary

Conclusions

- Fusing methods (SEM and HS) makes core logging more robust

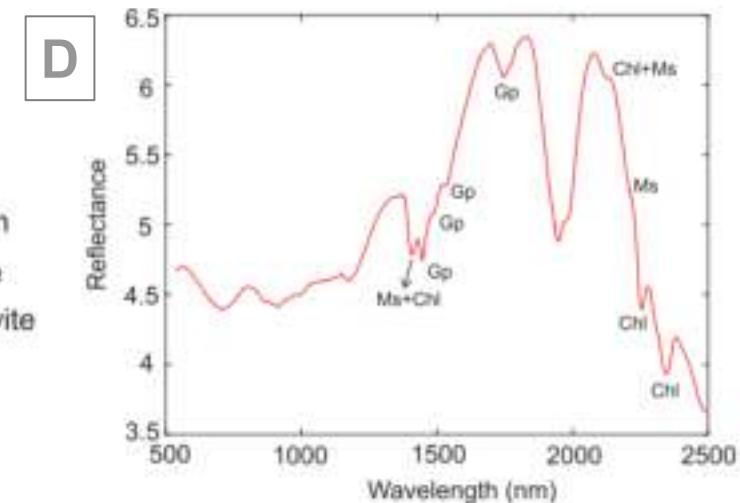
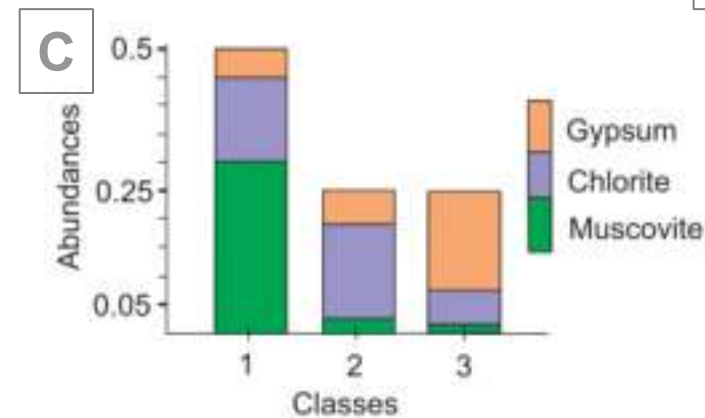
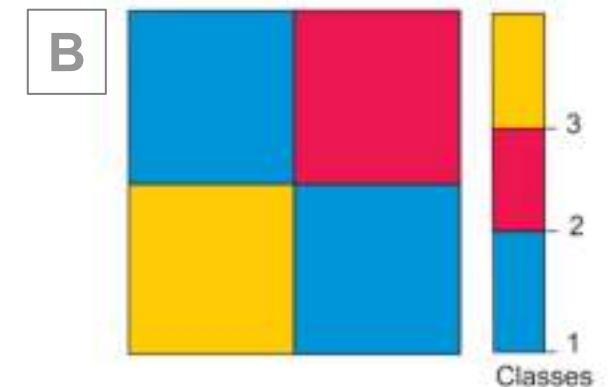
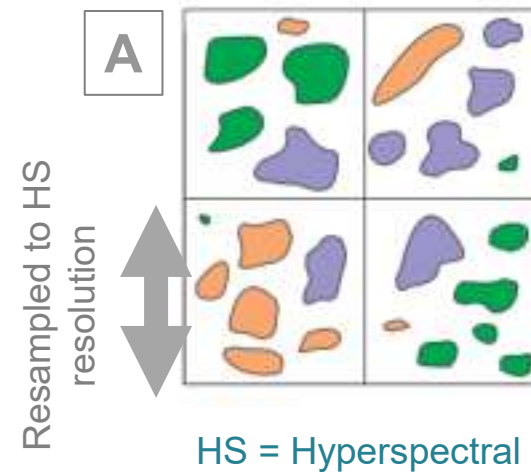


Mineral mapping drill core

Classification ex 2

‘Soft labelling’

1. New grid based on HS resolution (A)
2. Determine dominant mineral (A)
3. Assign ‘class’ (B)
4. Degree of membership (C)
5. Record type-curves for each class (D)



Be smart about labels
(e.g., What do they mean? How well do they match your data? Scale/Resolution?)

Cu-rich skarns

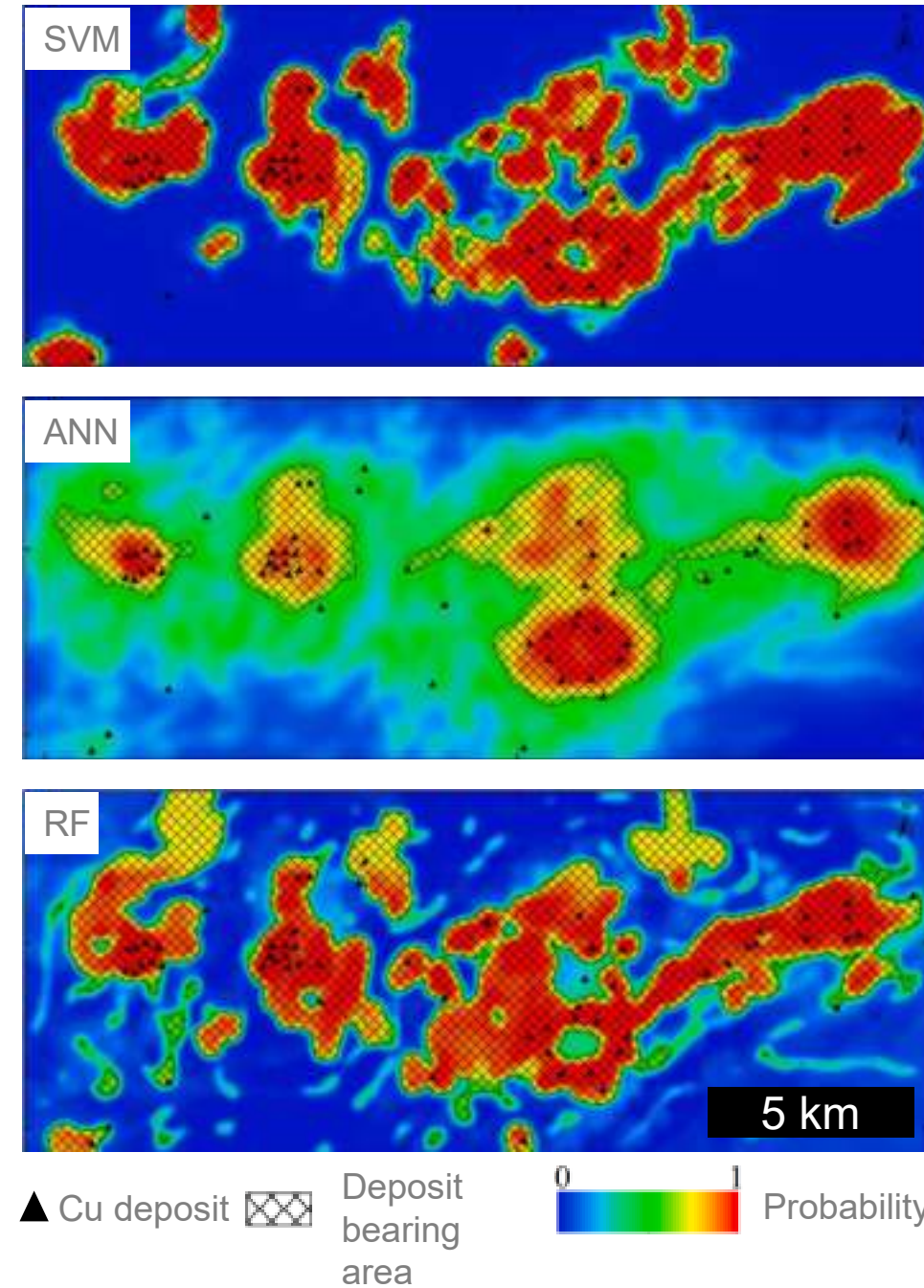
Prediction example

Methods

- Identify relevant aspects of mineral system
- Generate 12 representative layers
- Train layers with known mineralization and 'random' non-deposit sites
- Prediction of Cu
 - *Support Vector Machines (SVM)*
 - *Artificial Neural Network (ANN)*
 - *Random Forests (RF)*

Conclusions

- RF most stable against variation in parameters and most accurate predictions



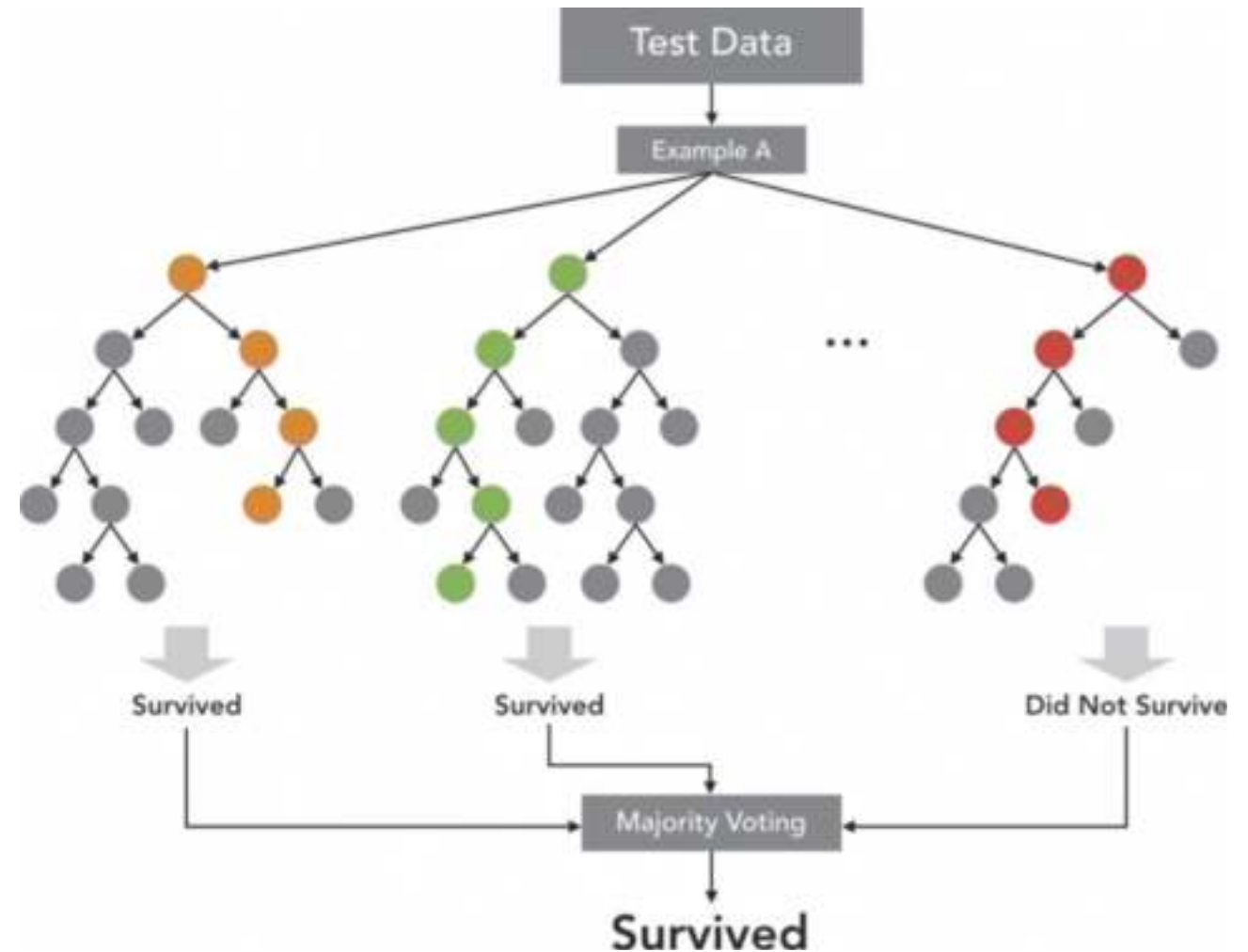
Easily interpreted
****Not spatially aware****

Prediction

Random Forests (RF)

Phase 2 – Prediction

1. Feed in subsets of all data
2. Run it through the trees
3. Majority voting



Presentation 3

Water Management and Big Data – Are We There Yet?



Steve Holysh

Senior Hydrogeologist
Co-Program Manager, Oak Ridges
Moraine Groundwater Program

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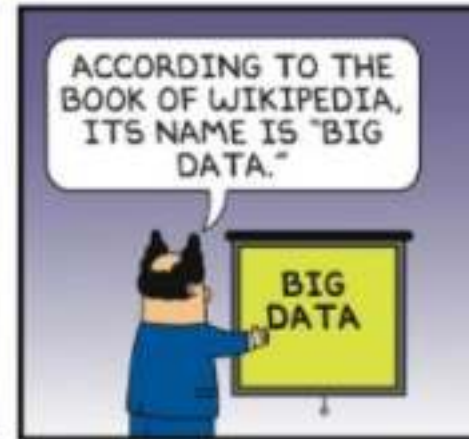
Water Management and Big Data – Are we there yet?

Steve Holysh, P.Geo

April 29, 2021

DILBERT

BY SCOTT ADAMS



Big Data and Water - Basics

1. *Storage System; Handling Process; Analysis Mechanism*
2. *Five Vs*
 - Volume – generally >1 terabyte
 - Velocity – generated at a high rate
 - Variety – structured + unstructured (video/social media, etc.)
 - Veracity – inaccuracy and uncertainty
 - Value – must contain new knowledge or improve efficiency
3. *Focus on data quality rather than quantity (clean, calibrate, validate sensors)*
4. *Measure only what is useful*
5. *Think dynamics – not steady state*
6. *Recognize different time scales*
7. *Consider how to handle outliers and extraordinary events*

Big Data and Water - Examples

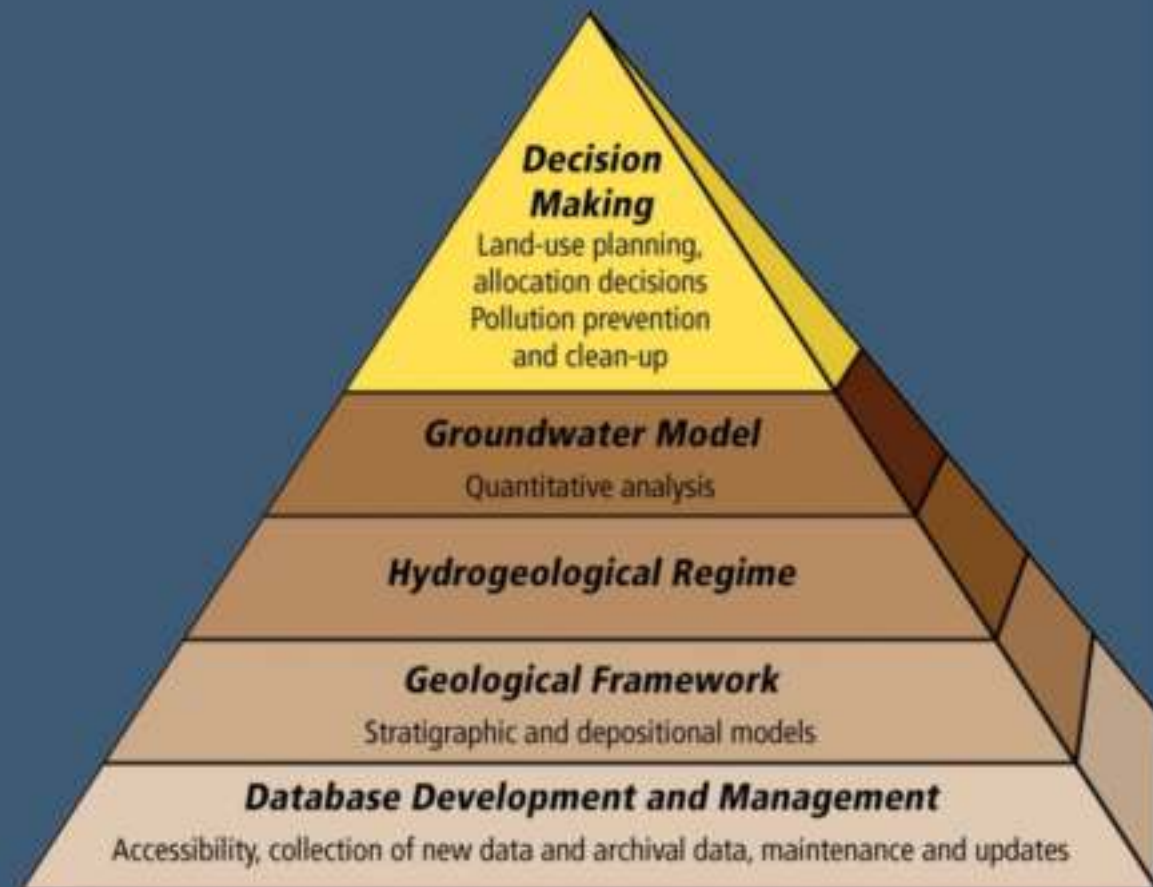
1. Water and wastewater distribution systems – flow/pressure sensors in pipes looking for leaks/anomalous water use
2. Sensors to automate irrigation systems
 1. *Climate (temp, radiation, wind speed, humidity,)*
 2. *Crop (height, leaf area index, density)*
 3. *Soil (moisture, infiltration)*
3. Global/Regional Climate Models
4. Sensors track river/estuarine system water quality
5. Ontario – 2014-15 – initiation of integrated environmental monitoring of Grand River Watershed - SOWC/Grand River/IBM/UofWaterloo)

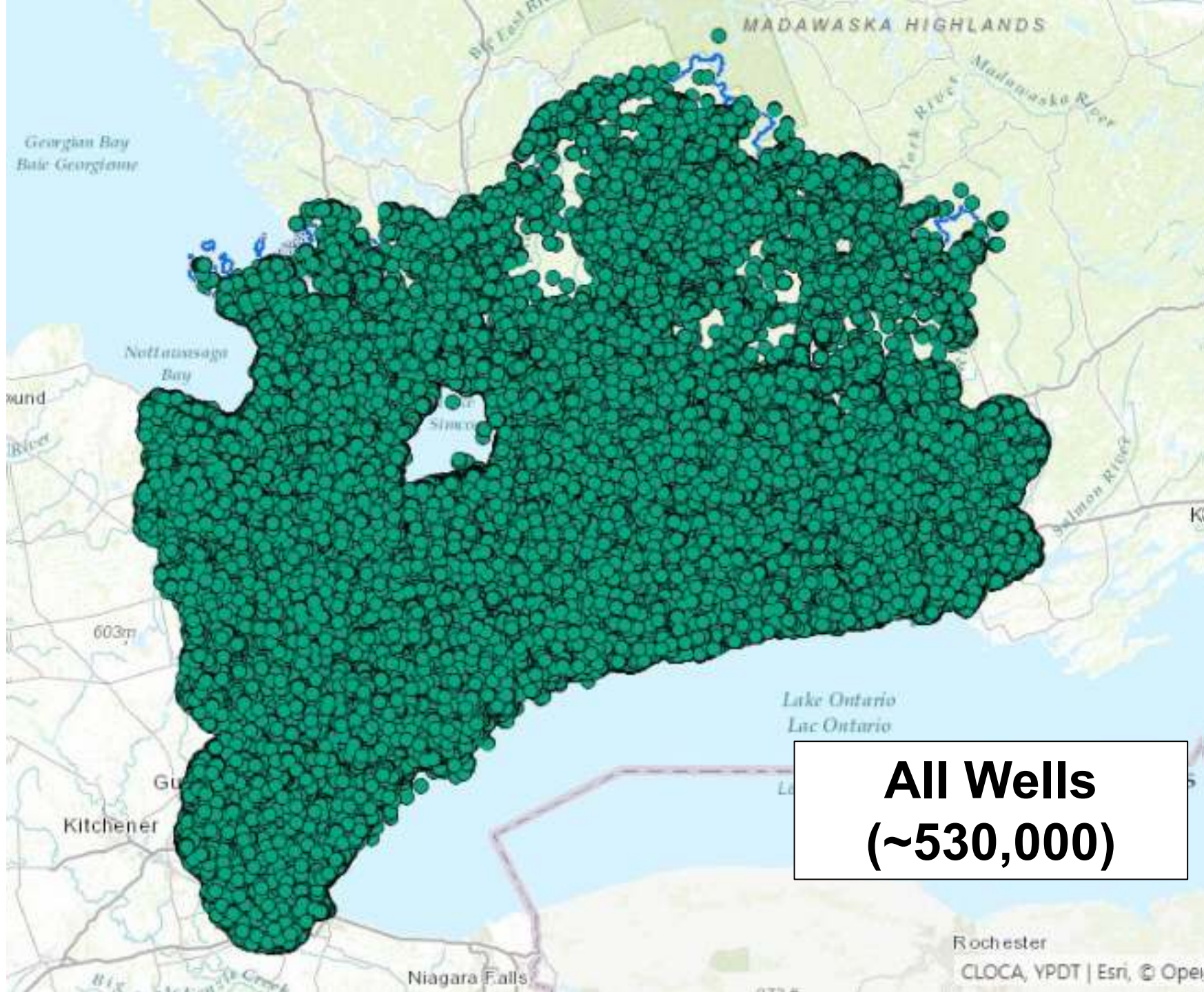
At every level of government in Ontario there are many different departments, ministries and agencies all collecting water-related data –

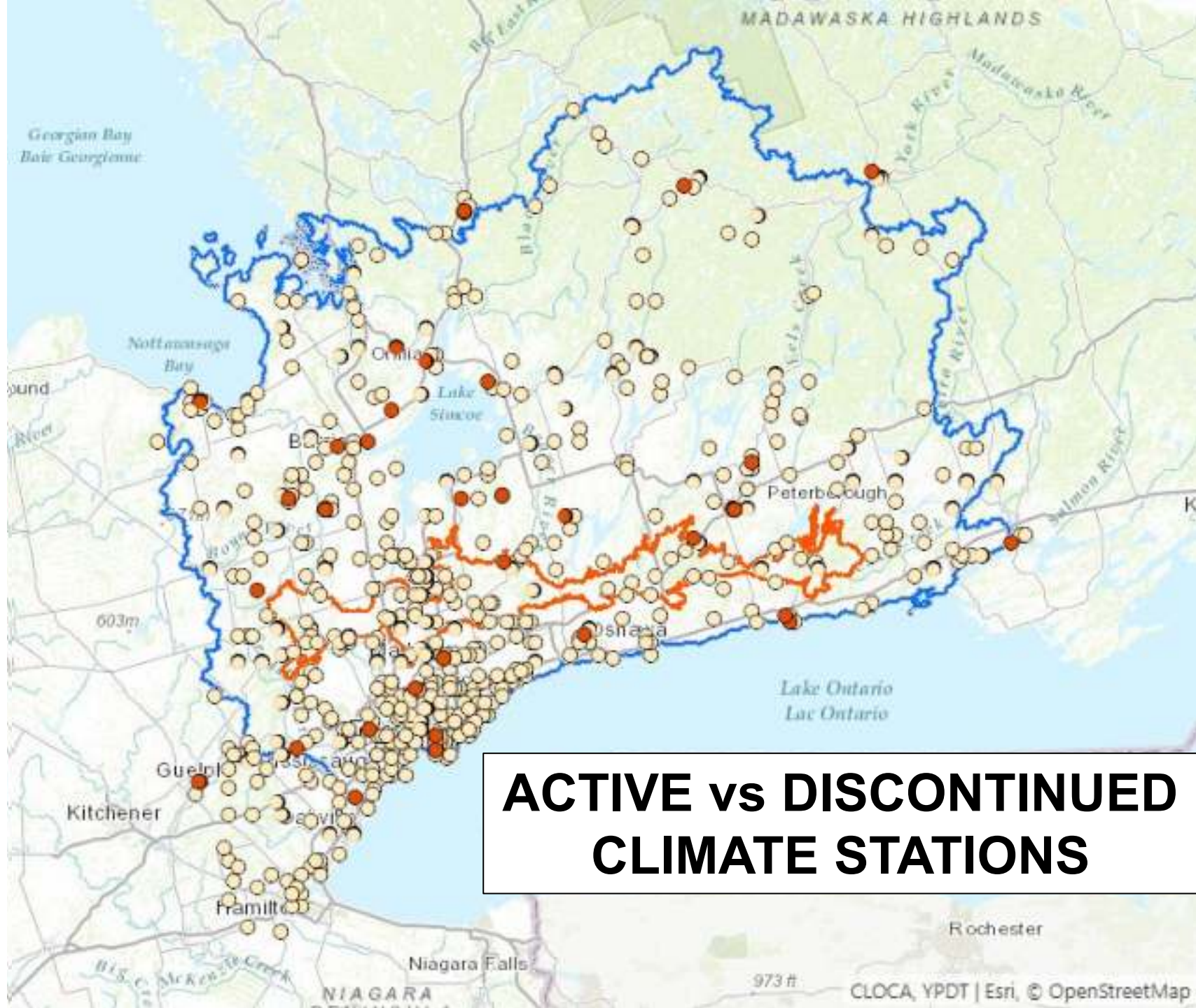
- often in the same aquifers/water bodies, and
- often without knowing what others are collecting.

Commonly, these data are stored on individual computers and files, and then used only once to inform the decisions for which they were collected.

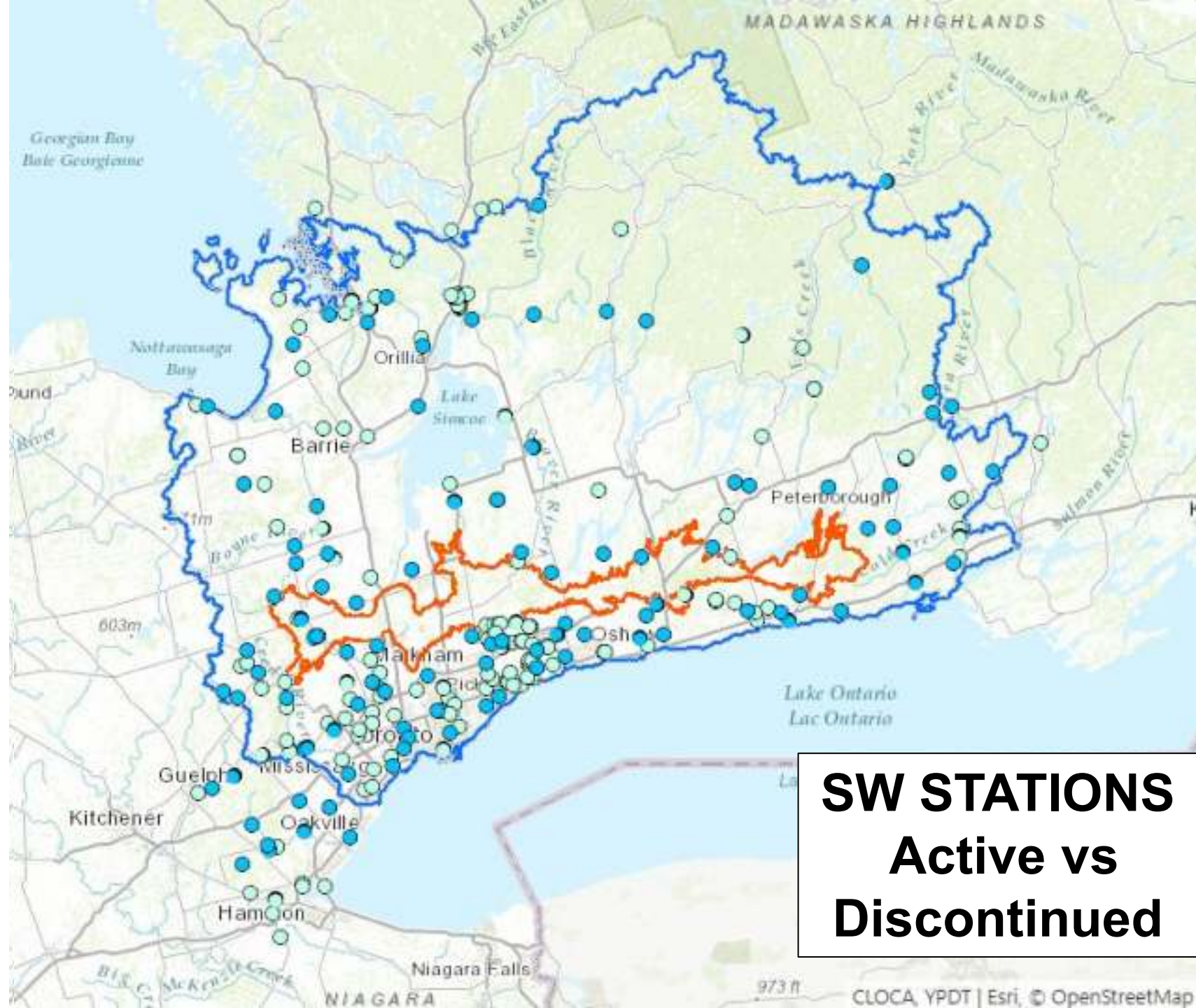
These data become lost and therefore unusable as input to longer term decision making.







ACTIVE vs DISCONTINUED CLIMATE STATIONS



SW STATIONS
Active vs
Discontinued

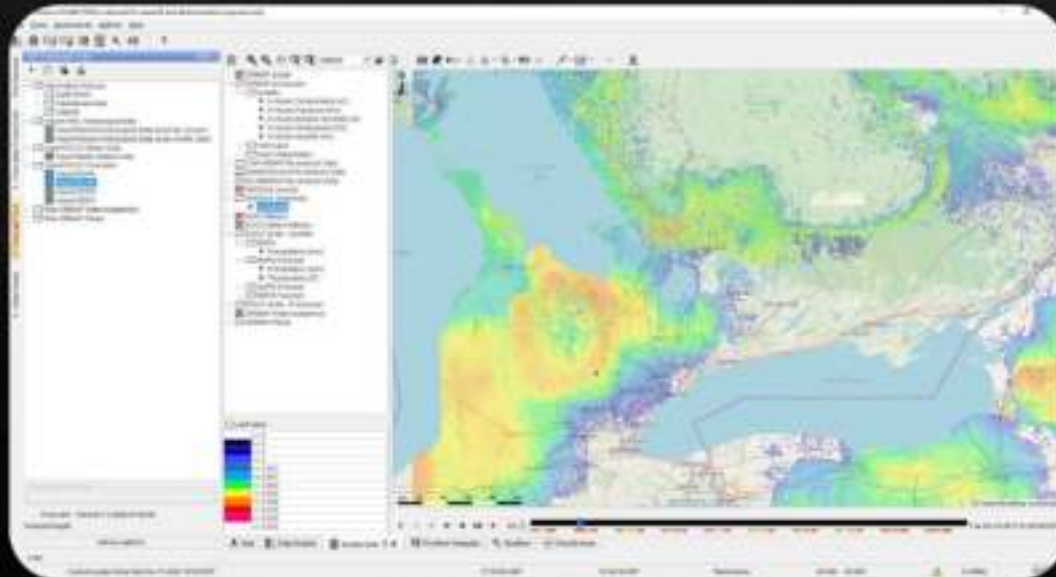
Main ORMGP Data Holdings

- Wells/BHs – 532,324 wells (1,491 Monitoring Wells)
 - *120.3 million water levels*
 - *644,000 water quality parameter analyses*
 - *1.2 million pumping records*
 - *1.94 million geological layers*
- Climate – 820 Stations
 - *28.6 million temporal records (mostly Temp and Precip)*
- Stream – 16,078 Stations
 - *1.61 million flow measurements*
- ~12,000 Consultant/Gov't Reports
- Numerical Models ~ 1 Terrabyte

Point Data vs Grid Data

Grid

- Many points in space
- Field
- Distributed
- 2D
- Timeseries
- Multiple metrics



Non-scalar (Gridded) Data Sources

- ◆ CaPA-RDPA: precipitation, 10km resolution, 6-hourly, since 2002
- ◆ CaPA-HRDPA: precipitation, 2.5km resolution, 6-hourly, since 2016
- ◆ SNODAS: SWE, snowmelt, 30m resolution, daily, since 2010
- ◆ Earth2Observe global re-analysis data 2005-2015 (Precipitation, temperature, PET)
- ◆ Forecast products: GDPS, GEPS, RDPS, REPS, etc...
- ◆ Models: Inputs and outputs



Delft-FEWS

Key ORMGP Data Tenets

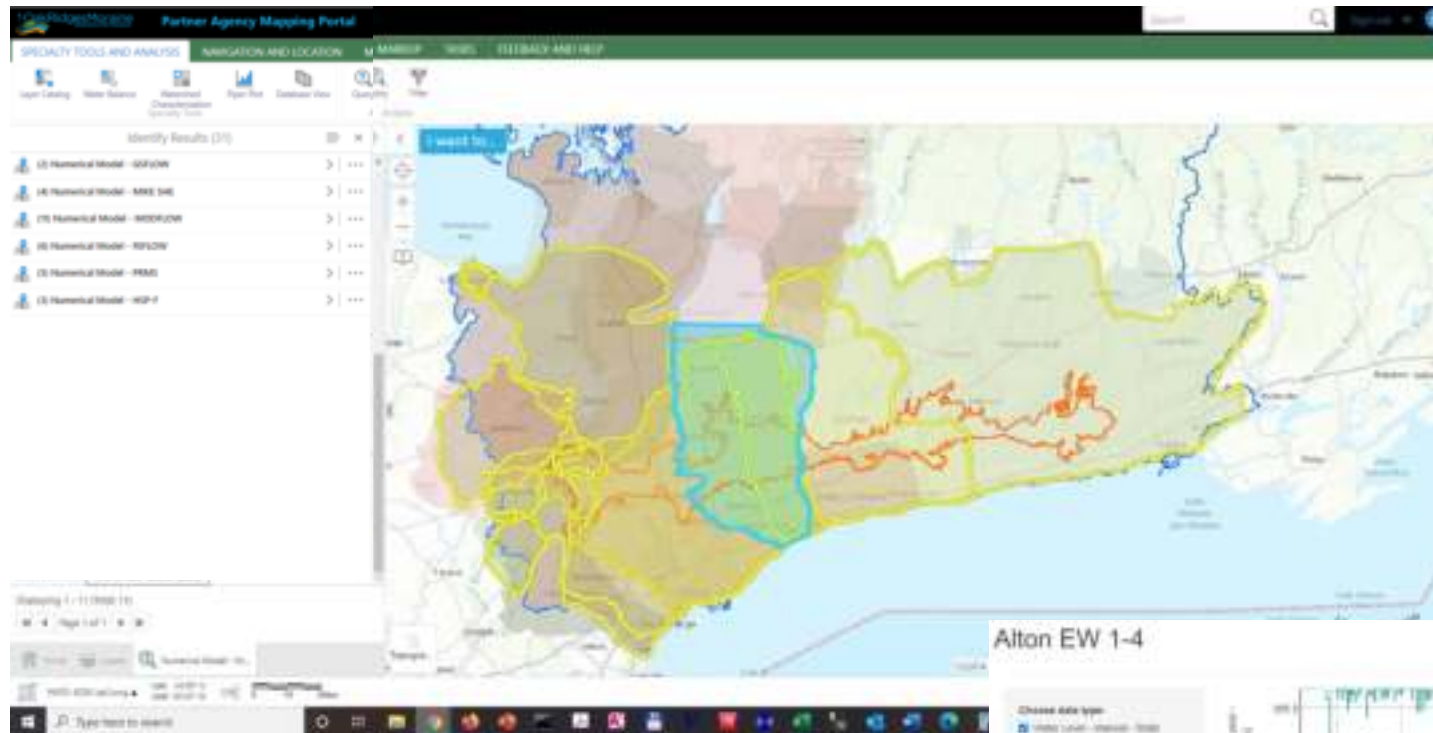
- 'Opportunistic' data acquisition
- Importance of numerical modelling
- Treat data with respect – hydrogeological data (water and geology) should not only be used once
- Data at site scale can be used regionally and regional data can be applied at site scale
- Access to raw data insufficient – use the data!



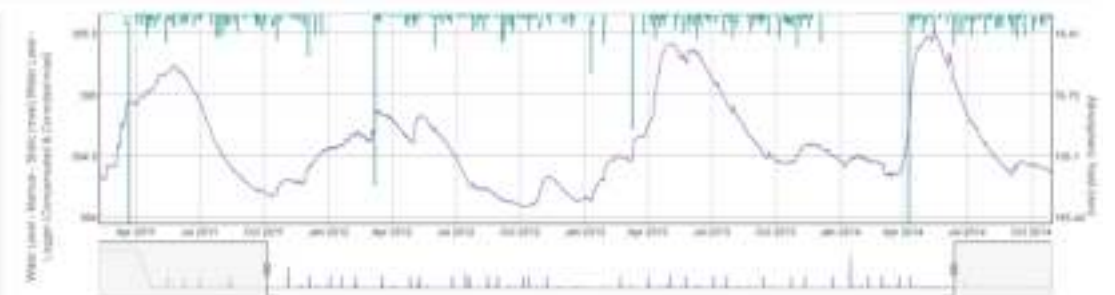
‘Opportunistic’ Data Acquisition

The screenshot displays the 'OakRidgesMoraine Partner Agency Mapping Portal'. The interface includes a top navigation bar with a search function and a 'Sign out' button. Below this is a green header with tabs for 'SPECIALTY TOOLS AND ANALYSIS', 'NAVIGATION AND LOCATION', 'MARKUP', 'TASKS', and 'FEEDBACK AND HELP'. A toolbar contains icons for 'Layer Catalog', 'Water Balance', 'Watershed Characterization', 'Rapid Plot', 'Database View', 'Query', and 'Filter'. The main map area shows a geographical region with a dense cluster of brown square markers. A sidebar on the left, titled 'Layers', lists various data layers with checkboxes, including 'Boundary', 'Assessment Parcel', 'Lots and Concessions', 'Documents', and 'Documents by Scale'. A pop-up window titled 'I want to...' is open, showing details for document 'T053', including a study bibliography and links to 'Open Report Folder' and 'View Additional Details'. A black arrow points from the map area to a document thumbnail on the right side of the interface. The bottom of the screen shows a status bar with coordinates (WVD 4326 Lat/Long, Lat: 45.20° N, Lon: 75.51° W) and a scale bar (0 to 40km).

Importance of Numerical Models

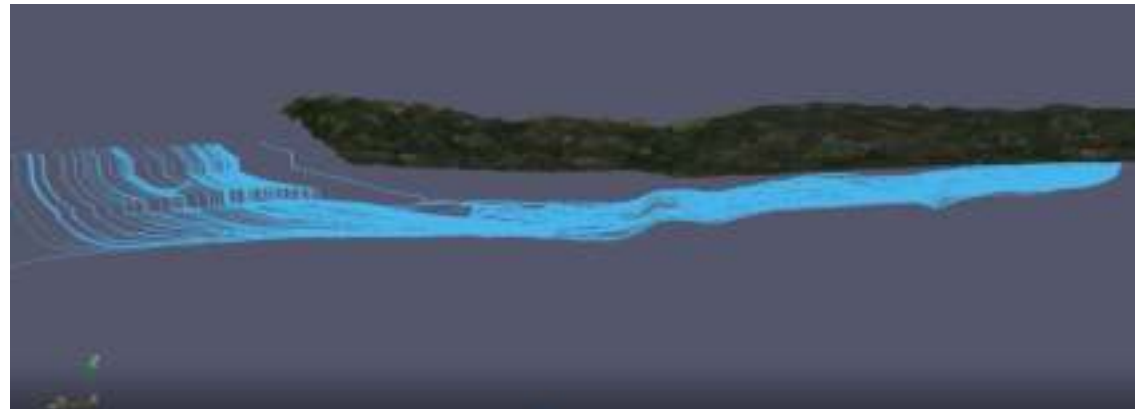


Alton EW 1-4



Importance of Numerical Models

- Hydrogeologists – Fully integrate water cycle data
 - *Climate Science – starting to recognize role of GW in atmospheric process (shallower WT – higher ET)*
 - *Hydrologists – frequently have treated groundwater system as ‘black box’*
 - *Hydrogeologists – in trying to fully understand flow system dynamics – forced to incorporate: 1) water inputs (precip/ET, runoff, recharge); 2) flow through subsurface; 3) discharge to streams*
- Data QA/QC tools



Respect for Data

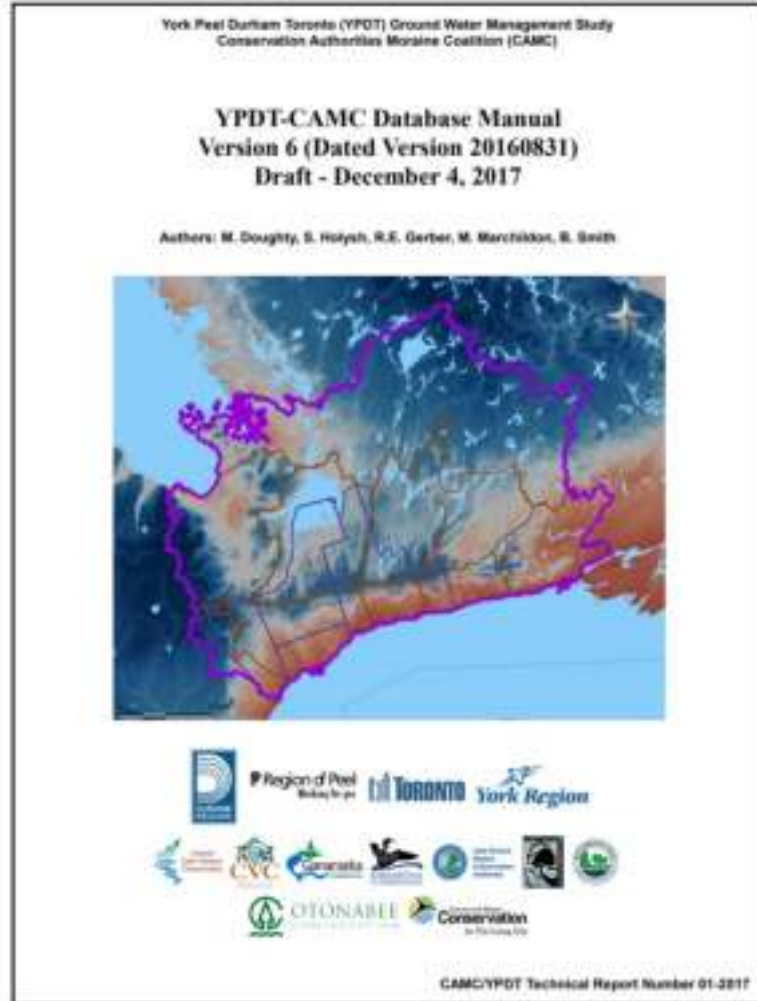


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References

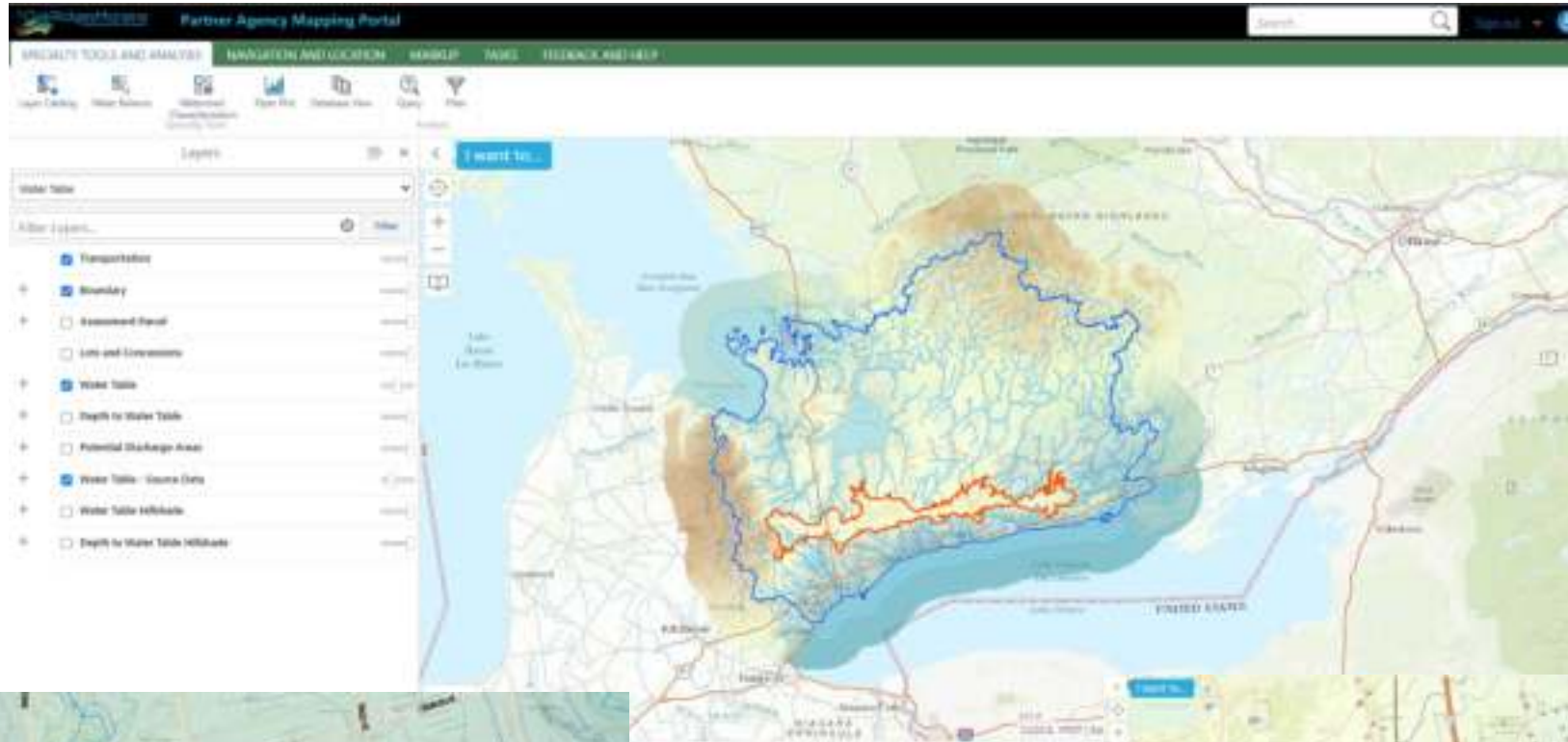
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Big Data = Big Database Manual (542 Pages)

Regional vs Site Scale Data



Make Use of the Data



ORMGP - GW INFRASTRUCTURE

(Millions \$)

- Program Cost (2001 – 2020) \$ 14.0
- BHs/Wells (550K/1.3 million m) \$ 162.5
 - Assume \$40/ft drilling)
- Water Quality (116K samples) \$ 32.6
 - Assume \$280/sample)
- Monitoring WLs (>100 million) \$ 18.1
 - Assume quarterly 1-day site visits for every 15 monitoring wells
- Documents/Reports (~12K) \$ 595.3
 - Assume \$50,000/Report
- Numerical Models (~70 Models) \$ 24.0

EST. ORMGP INFRASTRUCTURE VALUE \$833 MILLION

Big Data and Water

Closing Thoughts

- Emphasis on 'real time' data and on 'real time' decision making
 - Time scale of land use change/policy making is not necessarily 'real time'
 - Need time to 'see' subtle changes in environment that might lead to societal land use changes
 - Expectations - don't want to sacrifice monitoring if no "real time" decisions come forth
- Think about users and decisions to be made – ORMGP generally focuses on scale of land use change (site to watershed) – data/interpretations/tools/analysis focused at this scale
- 'Open Data' movement – good initiative
- Data ownership still 'muddies the waters' – NFT's?

Key Take Aways

- “Well-maintained data appreciate in value like a vintage car.”
- “As our models increase in sophistication we should be investing in more comprehensive monitoring to shed light on how well the models reflect reality.”
- “Each and every hydrologist needs to imagine what their information needs might be in 20 years time, and from that perspective consider what monitoring decisions need to be made today in order to supply those information needs.”

Completing the loop: from data to decisions and back to data

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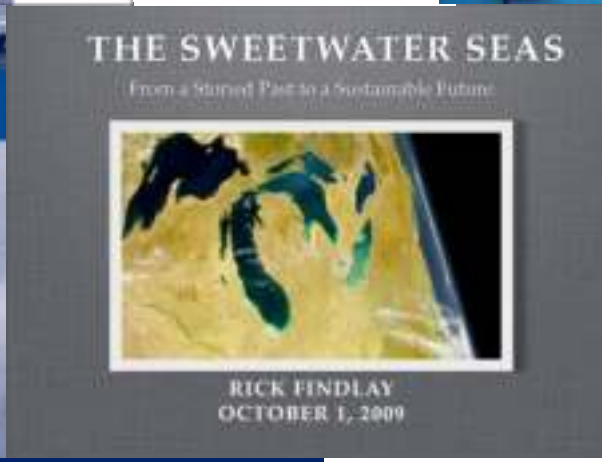
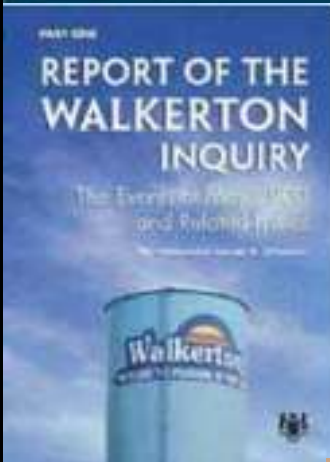
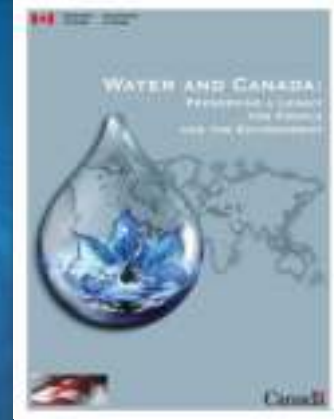
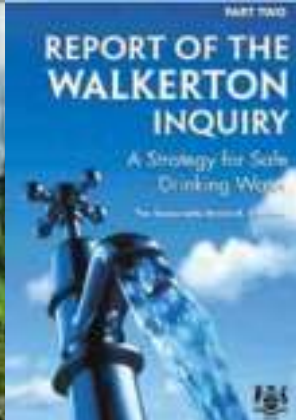
The role of science in decision-making has been compared to the role of meat in a hamburger. By itself, it is meaty, but when contained by the bun of policy it becomes more palatable. Extending this metaphor, data can be thought of as the cost that is processed into meat by the scientific process. However, the topic of where the meat comes from rarely comes up in public conversation.

Unfortunately, there is a ‘tragedy of the commons’ occurring—everyone wants a piece of the cost but no one wants to feed it. Furthermore, no one wants to buy a bull that will allow the cow to reproduce. The cow is languishing for the very reason that grain given to the cow is at the expense of the starving graduate students needed to produce prodigious volumes of output. In the meantime, information husbandry is left in the hands of bureaucrats who are accountable only for their ability to balance a budget and who are not held accountable for the legacy they leave.

There is increasing demand for quick answers to complex questions. This appetite for ‘fast food’ has resulted in resources being diverted from information husbandry to computer modelling (Hartensink et al., 2001). Scientists have to resort to data scavenging—obtaining whatever ‘road-kill’ they can find to grind up into meat to serve policy objectives.

Contemporary environmental science is calorie-rich but low in essential nutrients. When more money is invested in science it results in a ‘super-size’ model that has extra bulk provided by modelling, but with little added nutritional value. This is because the scientific community is focused on their contemporary needs—to fund graduate students and to publish papers, forgetting the ethics of their profession, which would have them leave a rich legacy upon which their prestige can build their careers. We are consuming the information legacies of previous generations, but leaving the soil barren for future generations.

Well-maintained data appreciate in value like a vintage car. In contrast, model output is like an ice cream cone on a hot summer day. It is intended for immediate consumption with no residual value. Many modellers view the world through the lens of their model algorithms, and sometimes this view of reality is as if seen through a kaleidoscope. In





water
saga



A Story of Water management in Ontario
1954 - 1968

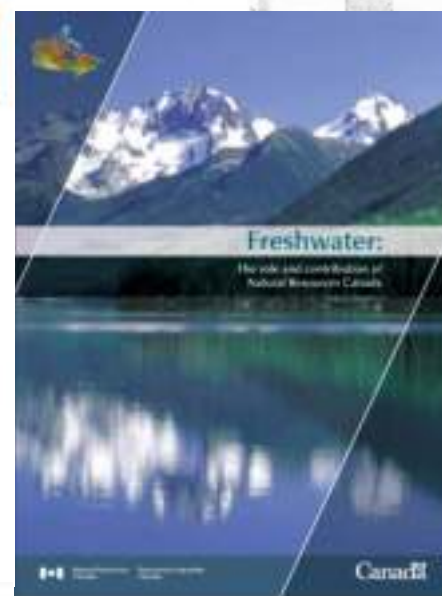
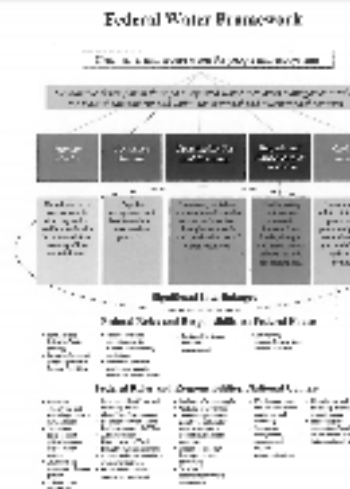
On the Table: Water, Energy and North American Integration

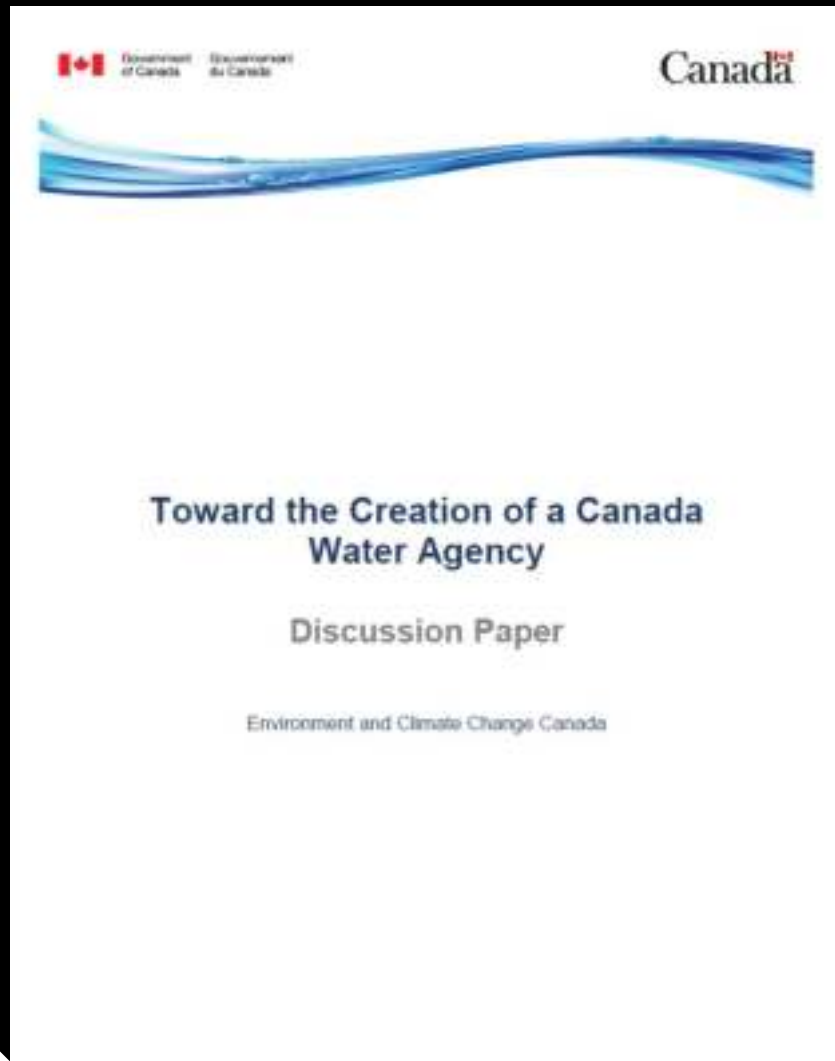
September 4, 2007

Embargoed until 8:00 am Sept. 10, 2007

Andrew Nikiforuk

The program in water issues





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Canada Water Agency

- Goal - “work together with the provinces, territories, Indigenous communities, local authorities, scientists, and others to find the best ways to keep our water safe, clean and well-managed.”



DataStream

Lake Winnipeg
Mackenzie
Atlantic

DataStream is a powerful online platform for sharing information about freshwater health.

[Visit Mackenzie DataStream](#)

[Visit Atlantic DataStream](#)

[Visit Lake Winnipeg DataStream](#)



Great Lakes DataStream - coming fall 2021

Great Lakes DataStream will be released in fall 2021, covering the Great Lakes and St. Lawrence region.

Through spring and summer 2021 a DataStream is being piloted by data groups within their state or jurisdiction to assess regional data.



U.S. Initiatives



INTERNET OF WATER: SHARING AND INTEGRATING WATER DATA FOR SUSTAINABILITY

A REPORT FROM THE ASPEN INSTITUTE
DIALOGUE SERIES ON WATER DATA



Water Quality Portal Contributing Organizations

[WQMP Home](#) [Download Data](#) [How to use the WQMP](#) [National Results Coverage](#) [About the WQMP](#)

ARS

The Agricultural Research Service (ARS) is the U.S. Department of Agriculture's chief in-house scientific research agency. Our job is finding solutions to agricultural problems that affect Americans every day, from food to fiber. ARS conducts research to develop and transfer solutions to agricultural problems of high national priority and provide information access and dissemination to, among other topics, enhance the natural resource base and the environment.

EPA

The Environmental Protection Agency (EPA) gathers and distributes water quality monitoring data collected by states, tribes, watershed groups, other federal agencies, volunteer groups, and universities through the Water Quality Exchange Framework in the STORET Warehouse.

USGS

The United States Geological Survey (USGS) investigates the occurrence, quantity, quality, distribution, and movement of surface waters and ground waters and disseminates the data to the public, state, and local governments, public and private utilities, and other federal agencies involved with managing our water resources.

Contact Us



Welcome to Colorado's Decision Support System!

In order to reduce the impact of 2019-18 (2019-18), the Department of Natural Resources (DNR) is doing its best through every step in the process. As of April 1, 2019, all of DNR's employees will work from home and its main office buildings will be closed to the public. However, the DNR will continue to provide services through phone or email to serve the people of Colorado. Please stay informed and flexible during this unprecedented time, and please stay safe with respect to COVID-19. (2019-18) (2019-18) (2019-18)

(Last Update - Please note that all links in (2019-18) (2019-18) have been updated. Please make sure to update your bookmarks. December 2019)



AB 1755: Open and Transparent Water Data Platform for California

What is the Open and Transparent Data Act?

California's Open and Transparent Data Act (AB 1755) requires state agencies to make their data more accessible and transparent to the public. The act is designed to increase transparency and accountability in government operations and to provide the public with access to government data.

Government agencies are required to make their data more accessible and transparent to the public. The act is designed to increase transparency and accountability in government operations and to provide the public with access to government data.

Recent Events

Contact Us

For more information, please contact the California Open and Transparent Data Act Task Force.

Resources

California Open and Transparent Data Act Task Force

California Open and Transparent Data Act Task Force

California Open and Transparent Data Act Task Force





Thank you

Presentation 4

Teaching,
Learning and
Research with
Electronic
Circuits:
Measurement and
Monitoring of
Environmental
Phenomena



Nicholas Kinar

Centre for Hydrology of University
of Saskatchewan
Global Institute for Water Security

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Teaching, Learning and Research with Electronic Circuits: Measurement and Monitoring of Environmental Phenomena

Dr. Nicholas J. Kinar

29 April 2021



*In Saskatoon, Saskatchewan, we acknowledge we are on Treaty 6 Territory and the Homeland of the Métis.
We pay our respect to the First Nations and Métis ancestors of this place and reaffirm our relationship with one another.*

Who Am I?



Hydrology Paper of the Day
@KinarNicholas



I design, build and test novel electronic circuits that can be used to quantify environmental phenomena and provide data inputs for models used for prediction and forecasting.

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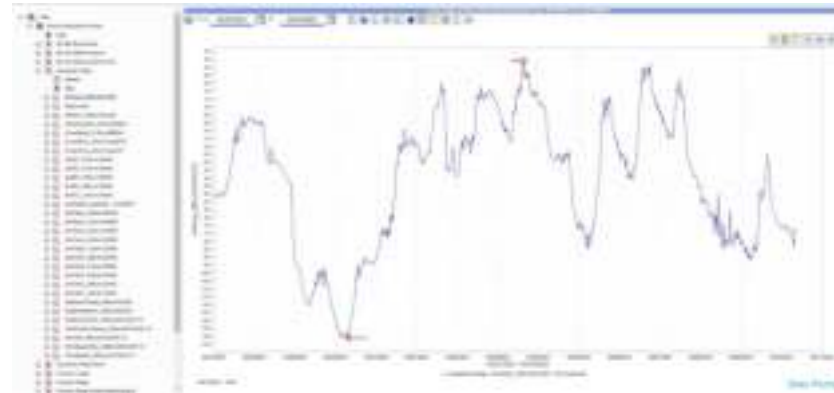
Environmental Measurement Systems

2010-present

1960s-1980s



1990s-2010



Kinar, N. J. and Pomeroy, J. W.: Environmental Electronic Sensing Systems, in: Geography, Oxford University Press Bibliographies, *in typesetting*, 2021

Kinar, N. J. and Pomeroy, J. W.: Measurement of Terrestrial Snow, in: Geography, Oxford University Press Bibliographies, <https://doi.org/10.1093/obo/9780199874002-0225>, 2021

Kinar, N. J. and Pomeroy, J. W.: Measurement of the Physical Properties of the Snowpack, 53, 481–544, <https://doi.org/10.1002/2015RG000481>, 2015.

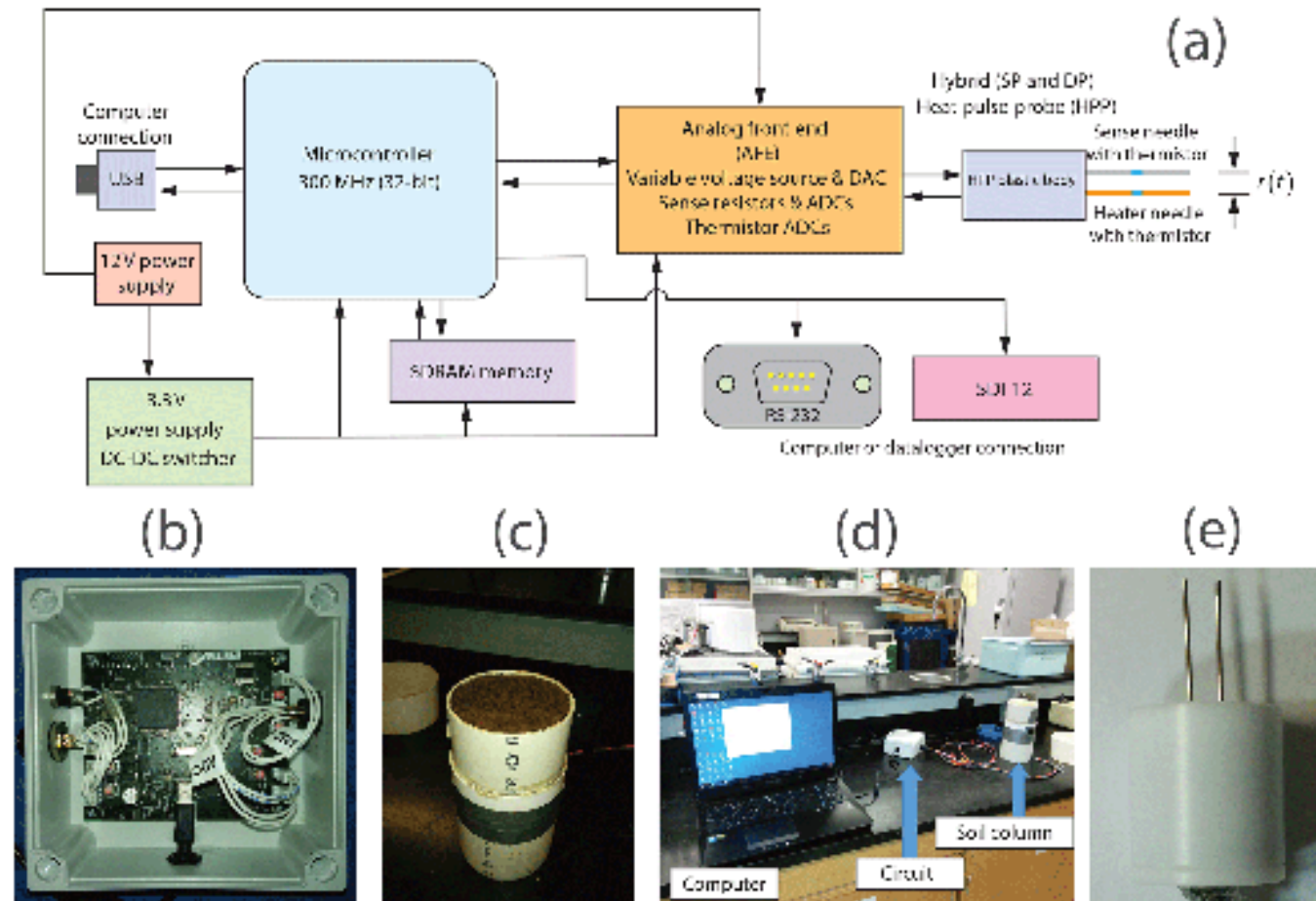
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Electronic Circuits and Systems



Chione (System for Acoustic Sensing of Snow)

Kinar, N. J. and Pomeroy, J. W.: SAS2: the system for acoustic sensing of snow, *Hydrol. Process.*, 29, 4032–4050, <https://doi.org/10.1002/hyp.10535>, 2015.



Self-Calibrating Heat Pulse Probe (SCHEPP)

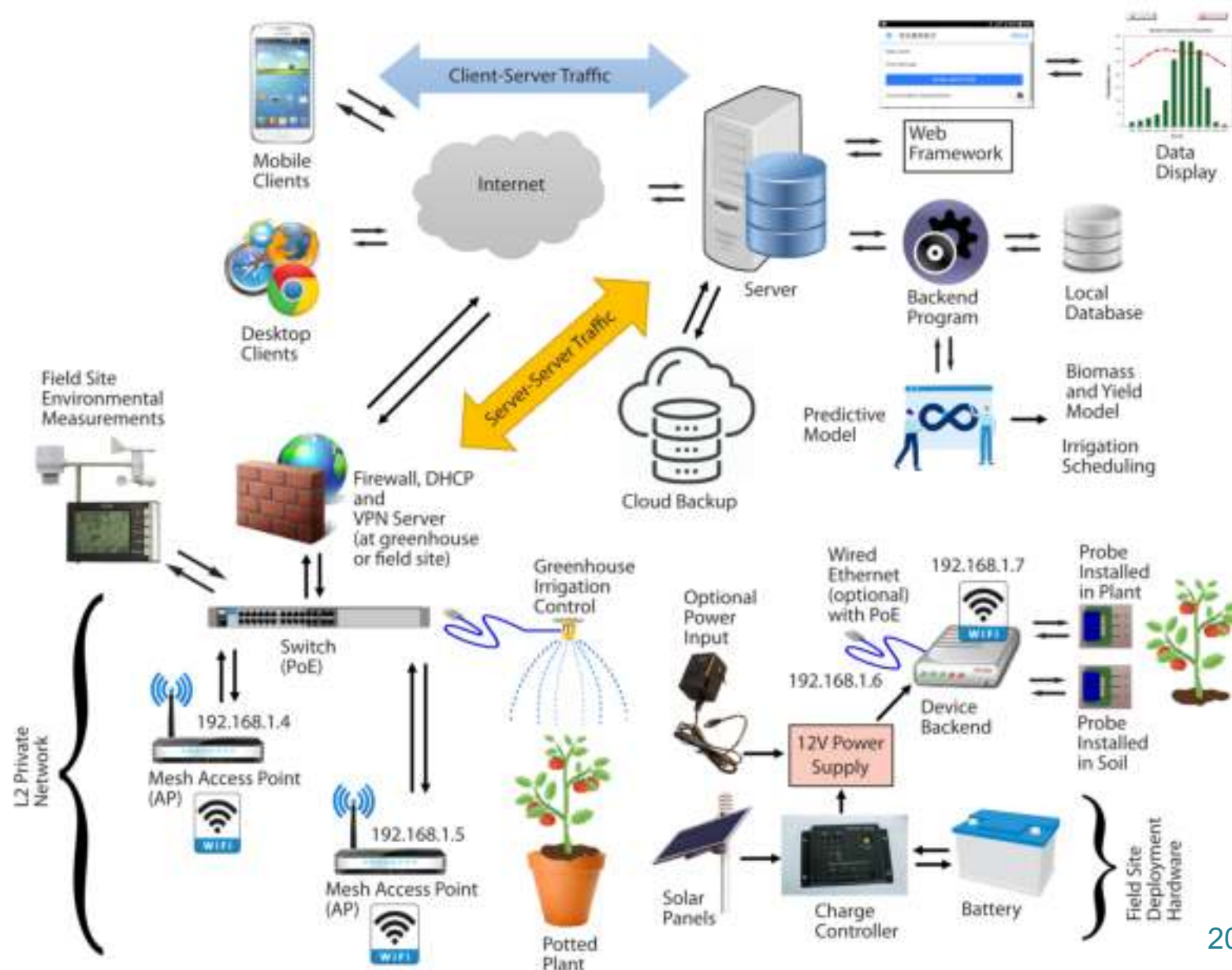
Kinar, N. J., Pomeroy, J. W., and Si, B.: Signal processing for in situ detection of effective heat pulse probe spacing radius as the basis of a self-calibrating heat pulse probe, 9, 293–315, <https://doi.org/10.5194/gi-9-293-2020>, 2020.

Internet-of-Things (IoT)



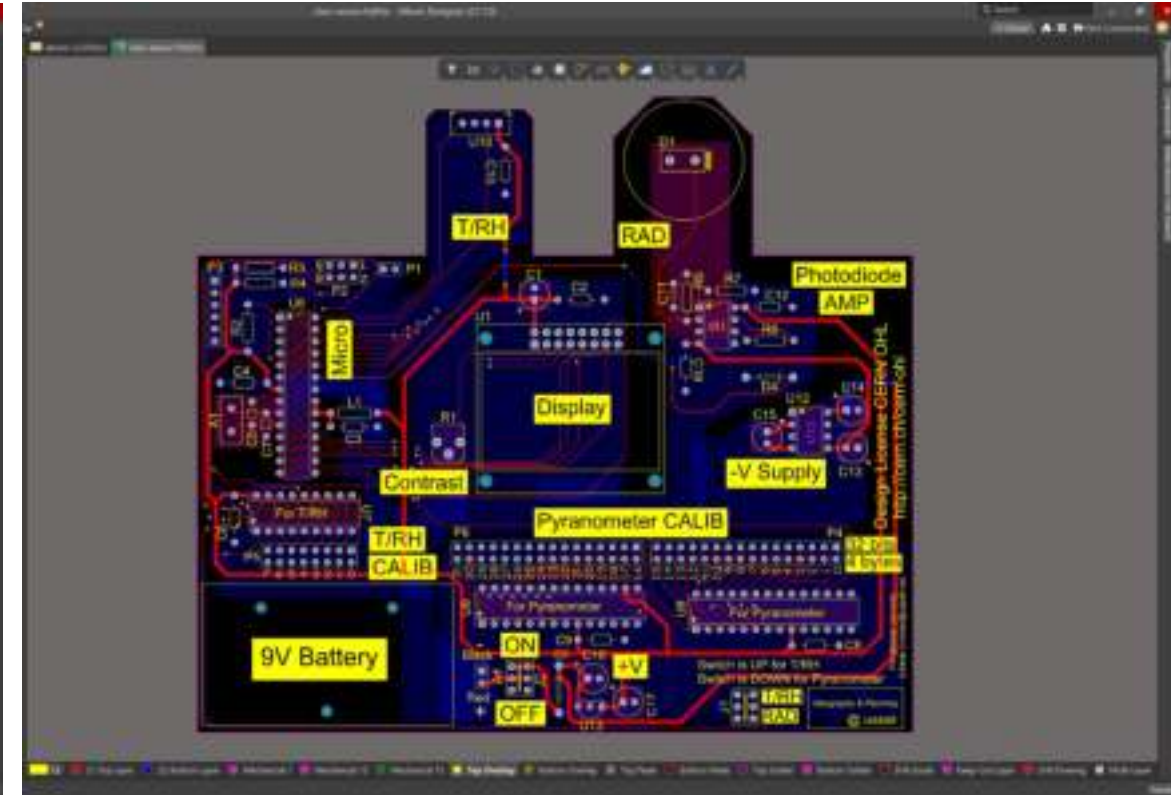
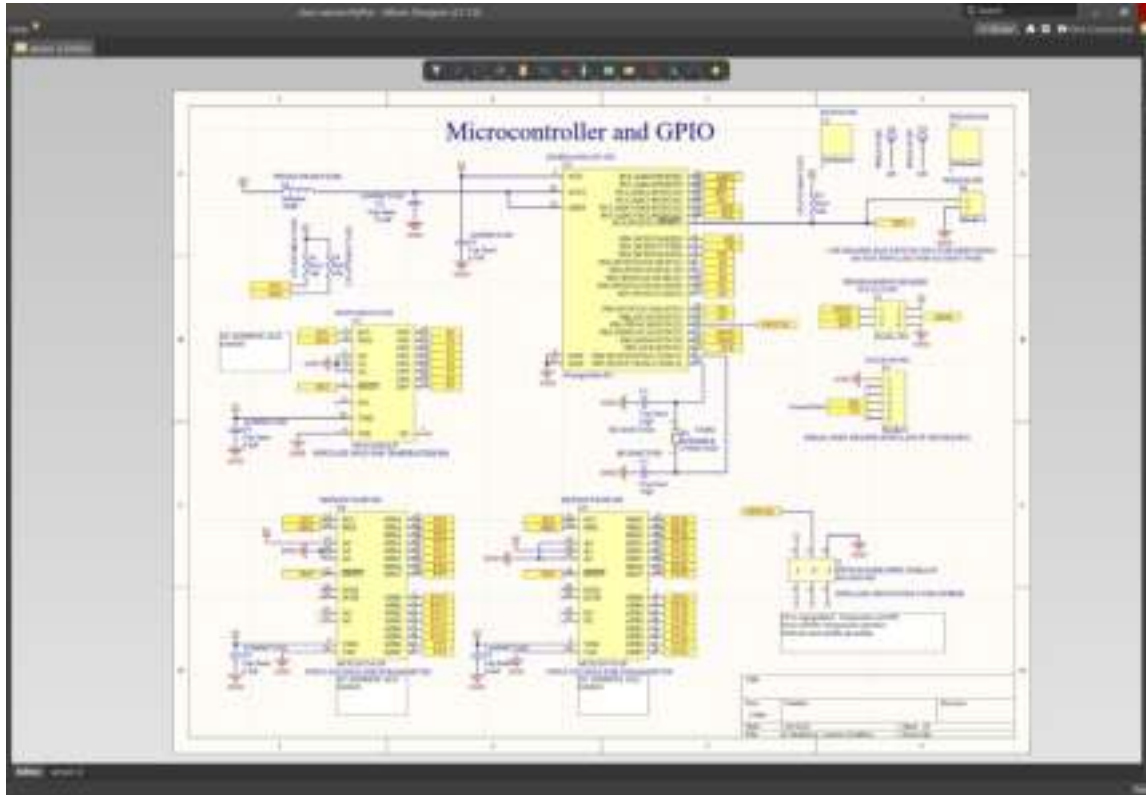
<https://www.go-fair.org>

- **Findable** for humans and computers
- **Accessible** metadata and data products
- **Interoperable** – can be utilized with software and other datasets
- **Reusable** – data is clearly described and useful for other studies



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Circuit Boards and Open Source Hardware



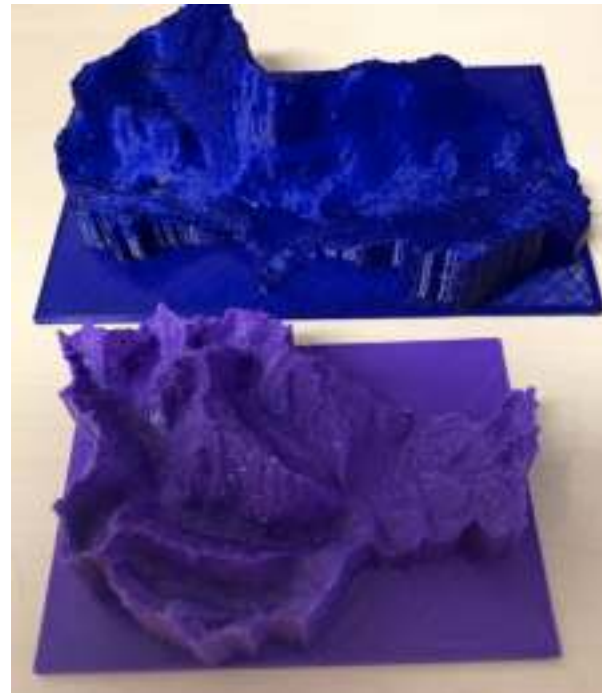
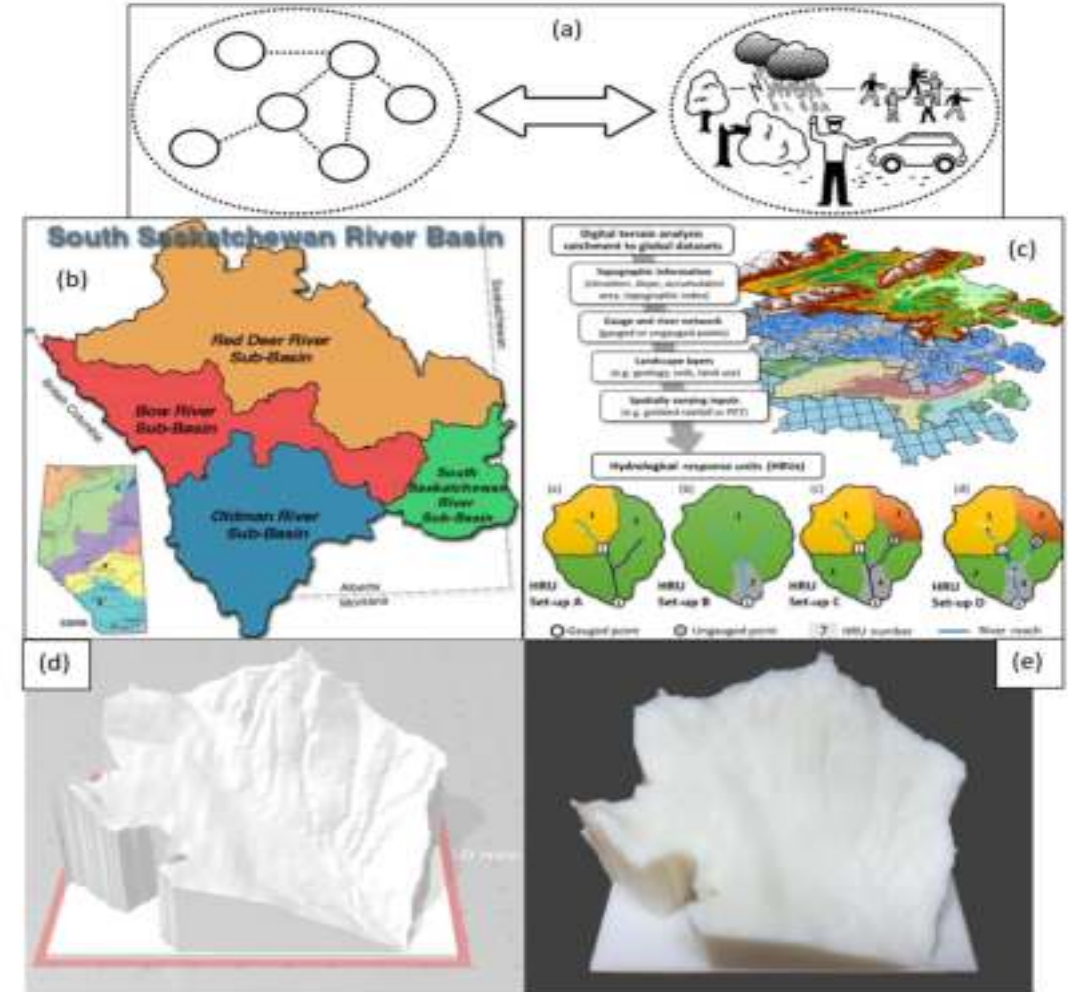
A schematic is similar to a map showing connectivity and a PCB has “layers” similar to a GIS!

CERN Open Hardware License (OHL)

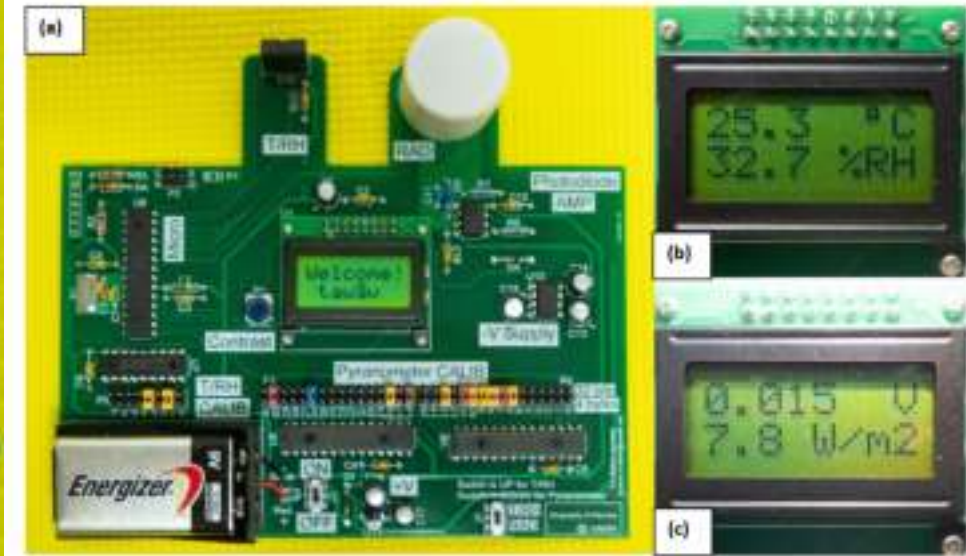
<https://ohwr.org/project/cernohl/wikis/home>

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3D Printing to Teach Hydrology



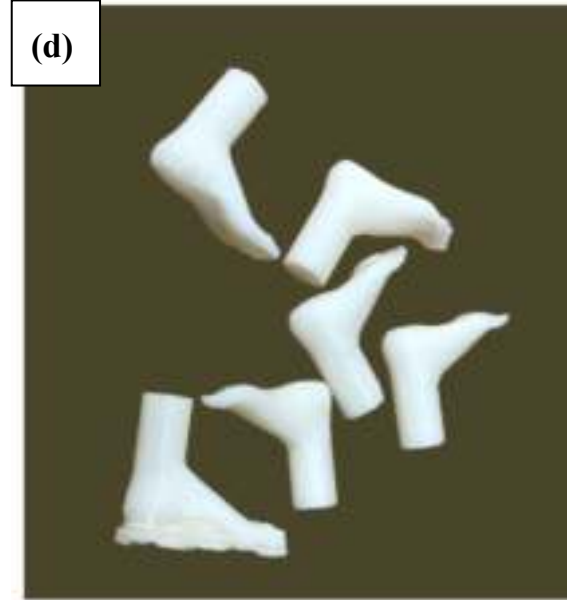
Electronic Circuits and Teaching Hydrology



Kinar, N. J.: Introducing Electronic Circuits and Hydrological Models to Postsecondary Physical Geography and Environmental Science Students: Systems Science, Circuit Theory, Construction and Calibration, Geoscience Communication. 2021

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Electronic Circuits and Teaching Hydrology



Kinar, N. J.: Introducing Electronic Circuits and Hydrological Models to Postsecondary Physical Geography and Environmental Science Students: Systems Science, Circuit Theory, Construction and Calibration, Geoscience Communication. 2021

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Teaching Microcontroller Programming



- Arduino open source platform programmed in C++
- Serves as a datalogger for environmental measurements



3D Printing and Water Quality Measurements



3D Model



Tank Testing

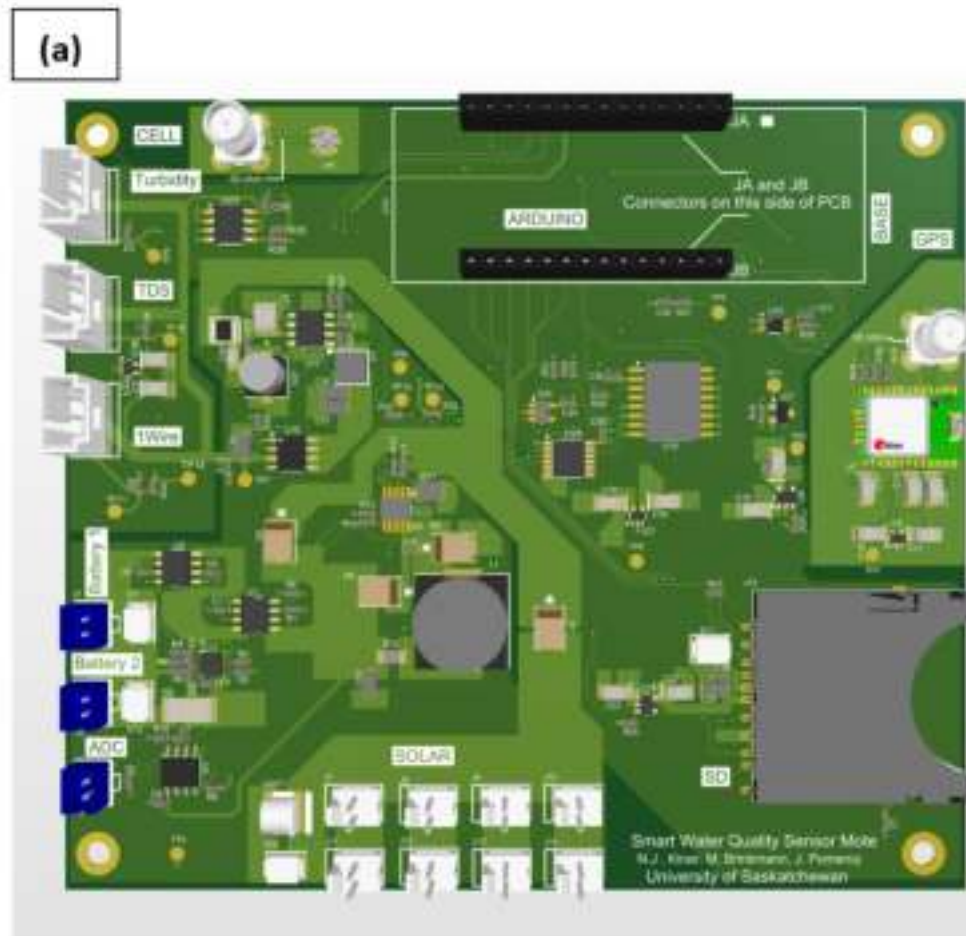


Does it Float?

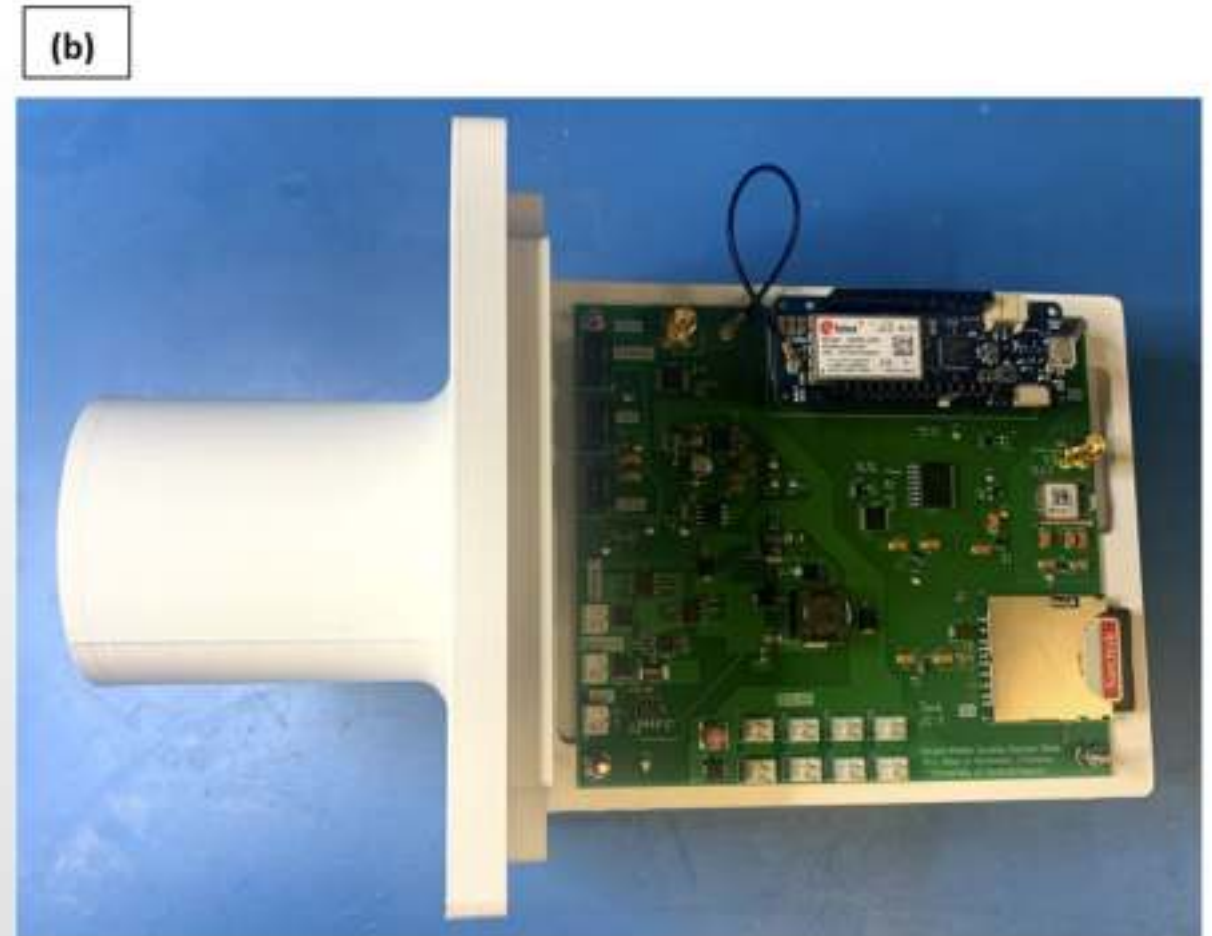
Kinar, N.J. and Brinkmann, M. Development of a Sensor and Measurement Platform for Water Quality Observations: Design, Sensor Integration, 3D Printing, and Open-Source Hardware. Environmental Monitoring and Assessment, *submitted*. 2021.

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3D Printing and Water Quality Measurements



3D Model



Actual Circuit Board

Kinar, N.J. and Brinkmann, M. Development of a Sensor and Measurement Platform for Water Quality Observations: Design, Sensor Integration, 3D Printing, and Open-Source Hardware. Environmental Monitoring and Assessment, *submitted*. 2021.

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3D Printing and Water Quality Measurements

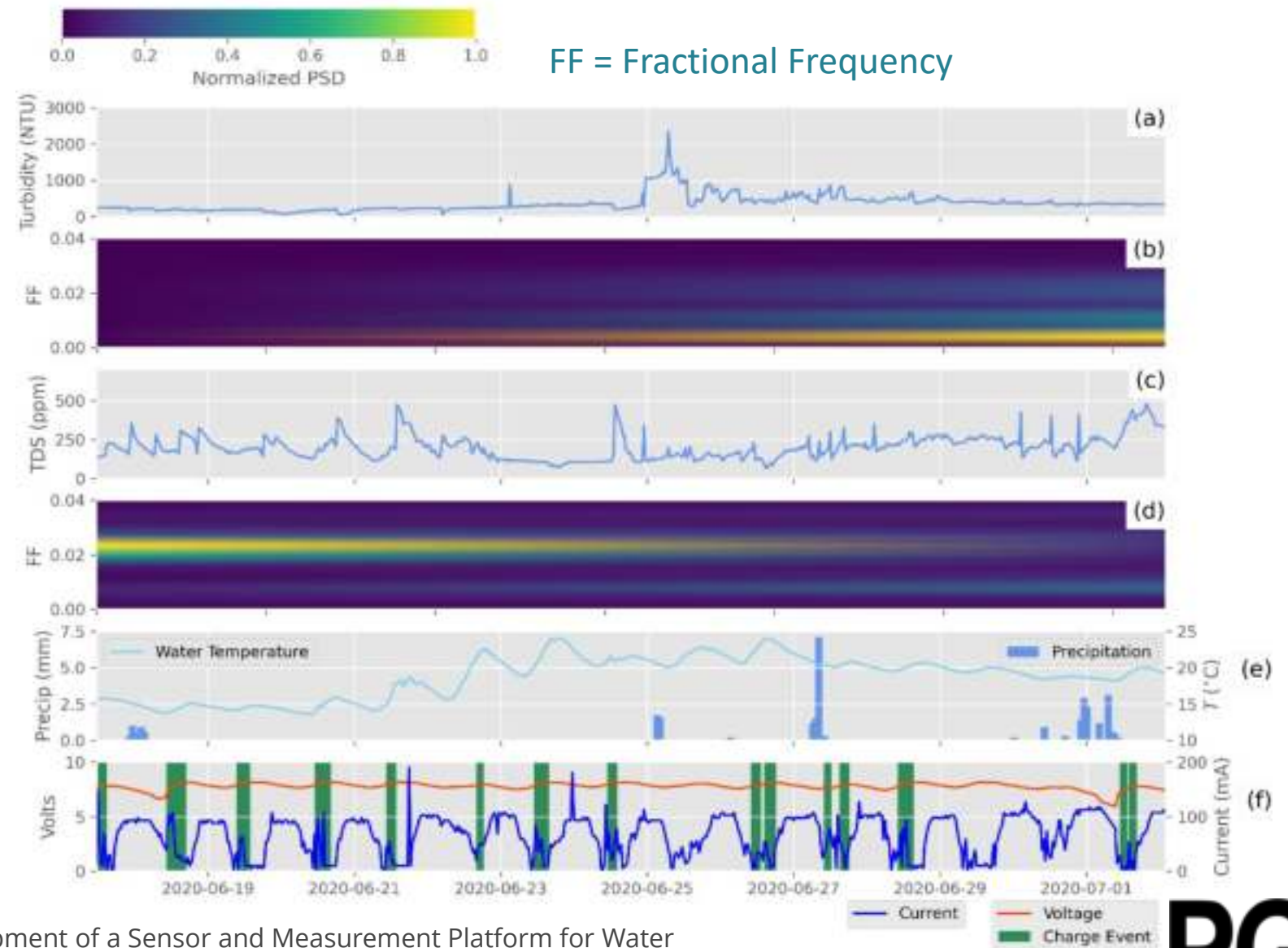


Aspen Ridge Forebay
City of Saskatoon

Preprint

<https://www.researchsquare.com/article/rs-449278/v1>

Kinar, N.J. and Brinkmann, M. Development of a Sensor and Measurement Platform for Water Quality Observations: Design, Sensor Integration, 3D Printing, and Open-Source Hardware. Environmental Monitoring and Assessment, *submitted*. 2021.



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Backyard / At Home Science – Everyone Can Participate



Thanks

- Dr. John Pomeroy, Director of Global Water Futures and Centre for Hydrology
- Coldwater Centre, Canmore, Alberta
- Dr. Markus Brinkmann, Toxicology Centre and Centre for Hydrology
- Global Institute for Water Security (GIWS)
- Smart Water Systems Lab (SWSL) and associates
- Judy Kinar for delicious Michigan-style pizza made in a special pan

Symposium contact information

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Disclaimer: The information, views and statements presented by speakers at PGO 2021 Virtual Symposium are solely those of the speakers and do not reflect the views of PGO nor do they represent explicit or implied endorsement by PGO.

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Thank you for joining us!

Visit www.pgo.ca for upcoming events.

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