



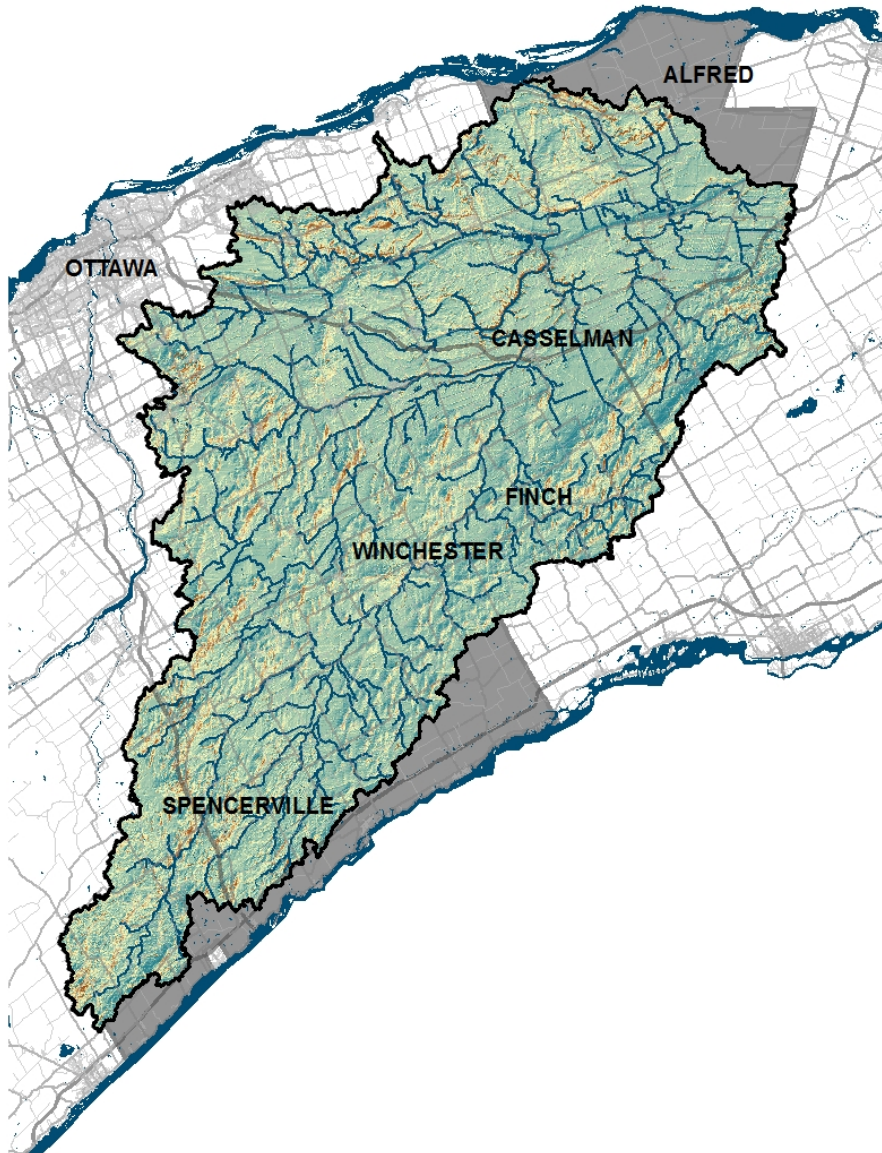
SOUTH NATION
CONSERVATION
DE LA NATION SUD

Enhancing Flood and Drought Forecasting Tools in the South Nation Watershed September 20th, 2018





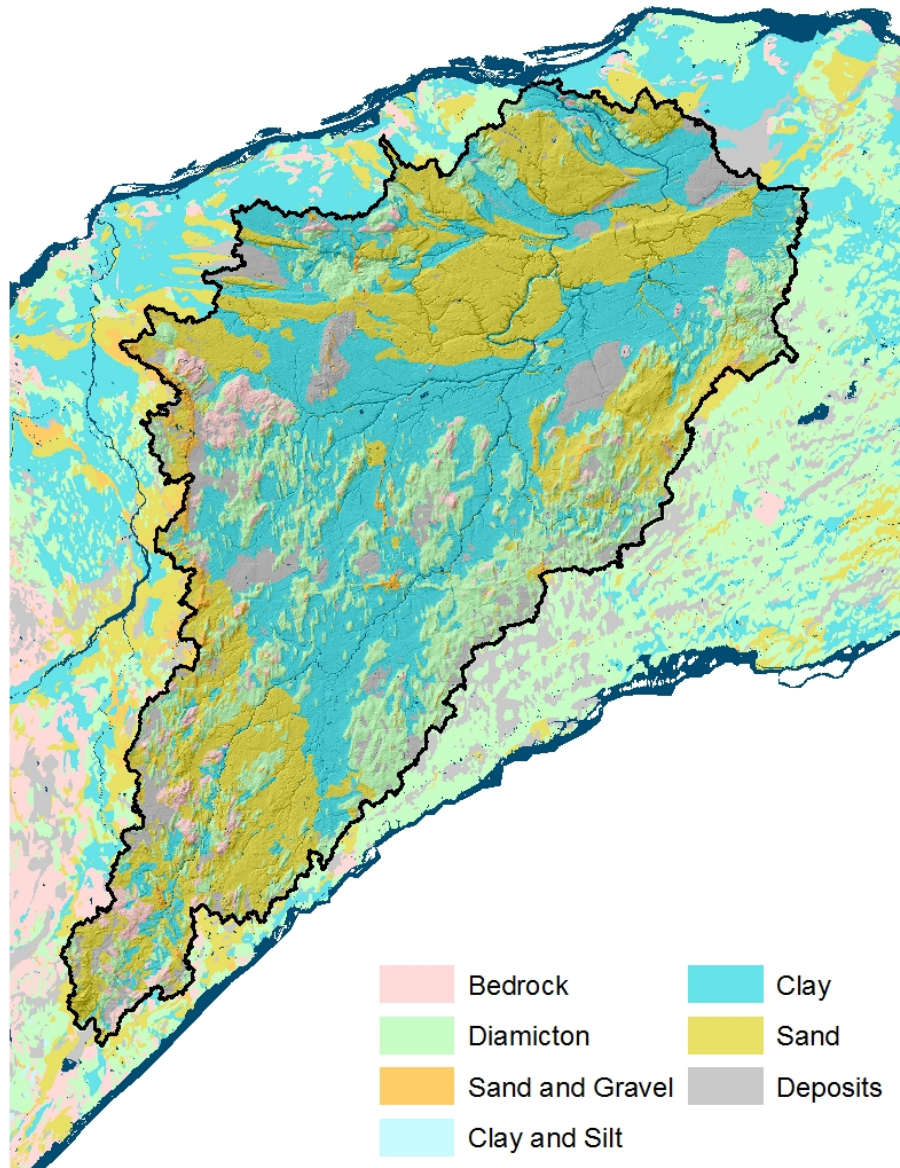
SNC Jurisdiction



- 4,384 km² jurisdiction
- 16 municipalities
- Population: ~200,000



South Nation River Watershed



- 3,900 km²
- 175 km main channel
- 85 m drop
- 250 km tributaries

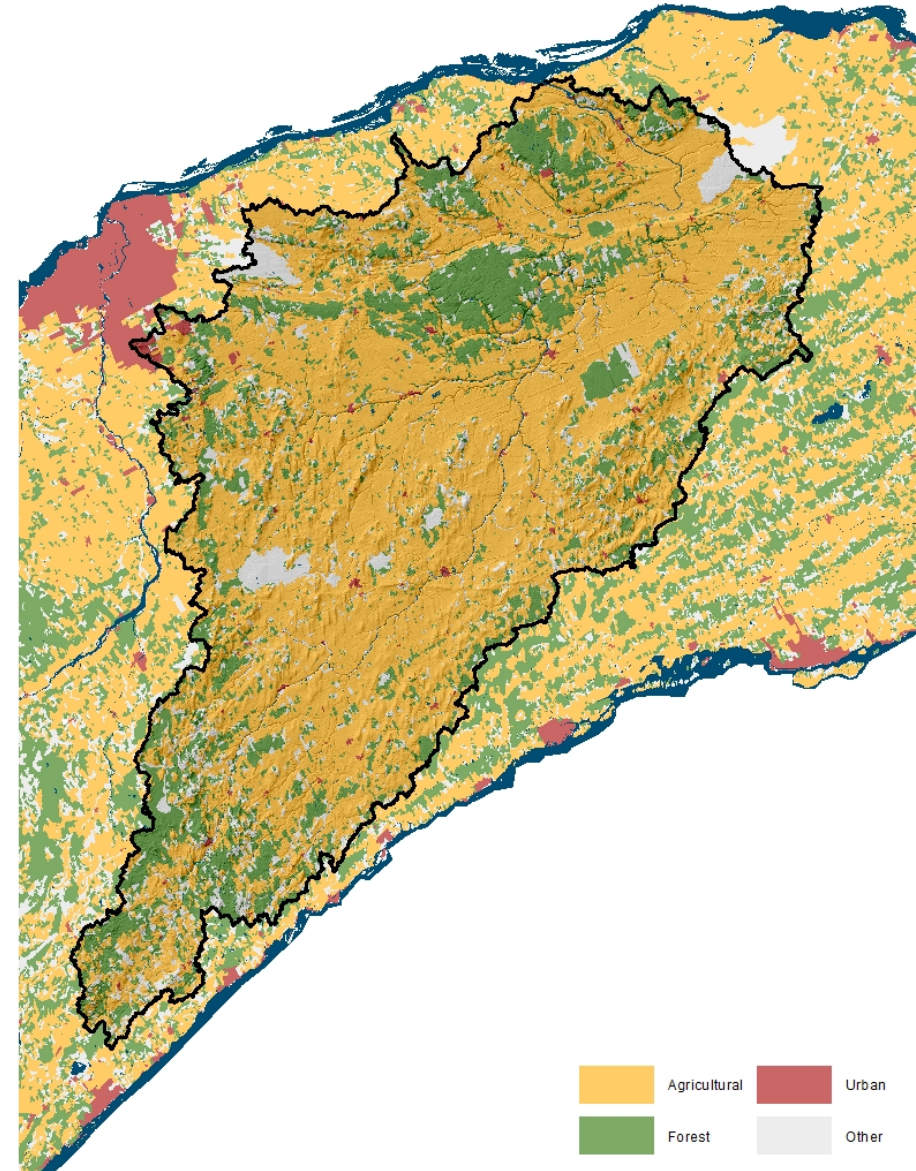


Efforts to Control: Flood and Drought





Flood and Drought: Still a Problem...



Landuse:

- 65% agriculture
- Forest cover 28%, decreased ~6% in the last 10 years
- 5% mixed urban
- 2% other
- 1,300 municipal drains
- Virtually all agricultural fields are tile drained



Impacts to Agriculture

CBCnews | Ottawa

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Canada Ottawa

Ottawa area hay farmers could lose crop due to record rainfalls

'It's been from one extreme to the other,' farmer says

CBC News Posted: Jul 14, 2017 6:35 AM ET | Last Updated: Jul 14, 2017 6:40 AM ET

Severe drought affecting South Dundas farmers

P. Blancher - Leader staff
MORRISBURG - A few showers over the weekend has not helped the drought farmers in South Dundas are dealing with this year. "No one can remember this, where it starts dry and stays dry."

"It's a crop insurance claim year," stated Schneckenburger. "Corn is already below the threshold for crop insurance. If we had had rain two weeks ago, it would have been a different story." The high heat has not been

"They continue to grow but they are suffering. We won't have a record crop but it will be okay." Farmers with a diversified growing plan won't be at a complete loss.

Morrisburg Leader, August 17, 2016

'CUT WATER USE BY 20%'

By ANGELA BROWN
News Staff

North Glengarry residents are being asked to reduce water use by 20 per cent since much of Eastern Ontario continues to be in a "Level 2" drought.

the South Nation agency. "They are both telling us the same thing. It's very dry out there," said Mr. Gagnon. The CAO added Mill Pond water levels are adequate because the RRCA manages the dams to ensure the township has enough water in Mill Pond, the town

Glengarry News, August 17, 2016



Concerns: Flood and Drought



- 15+ years partnership with Agriculture and Agri-Food Canada
- Enhance Flood and Drought Forecasting Tools in the South Nation Watershed

Christian Lafleche with his controlled tile drain structure, St. Albert, ON.



Enhanced Forecasting Project

Project Phase 1:

- Enhance the monitoring network
- Develop a real-time forecasting model
- Conceptual online portal

Partners:





Monitoring Network



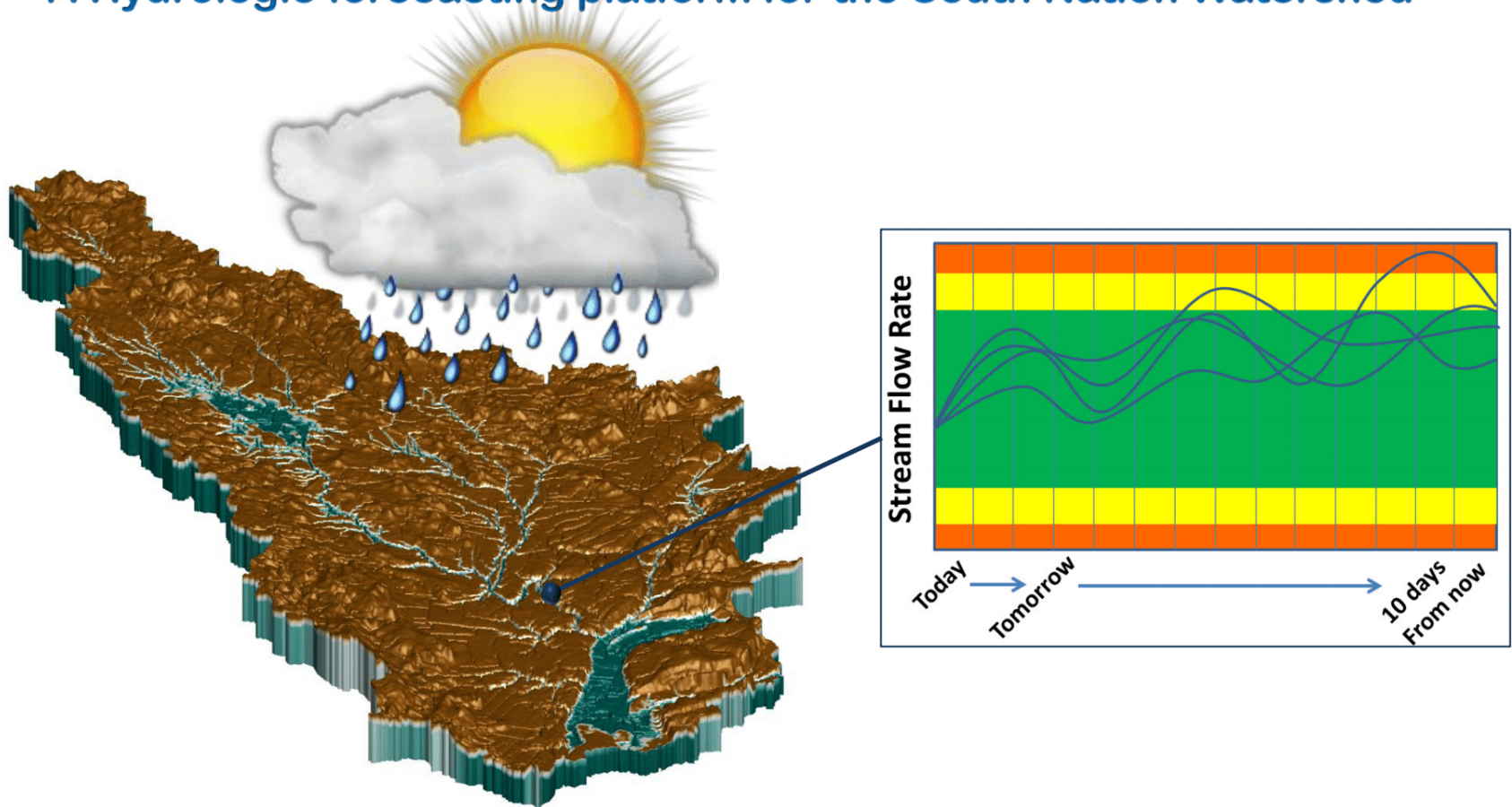
Installation of new real-time monitoring equipment, Winchester site

- 10 existing real-time stream flow gauges
- 8 upgraded monitoring stations to real-time
 - Temperature
 - Rain and snow equivalent
 - Groundwater levels
 - Soil moisture
- All data compiled in centralized system - WISKI



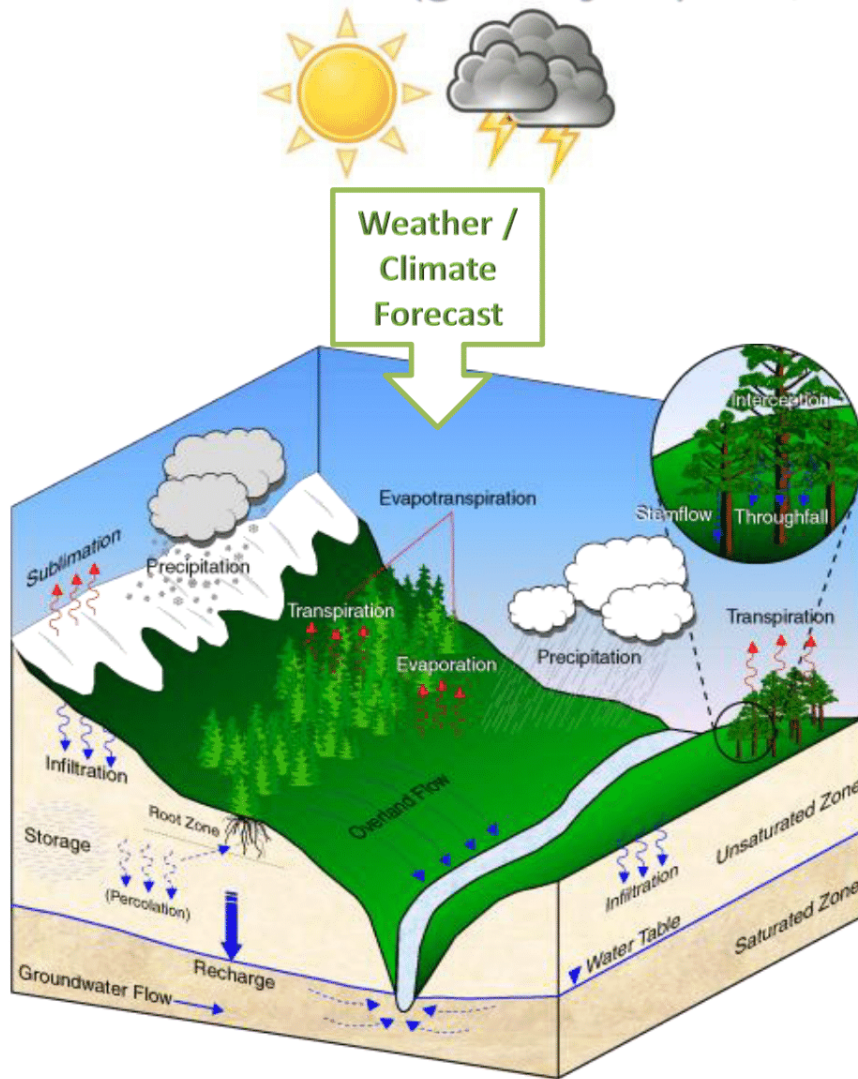
Real-time tools to assess effects of adverse weather on agricultural and rural infrastructure:

A Hydrologic forecasting platform for the South Nation Watershed



Physically-based Integrated Hydrologic Model

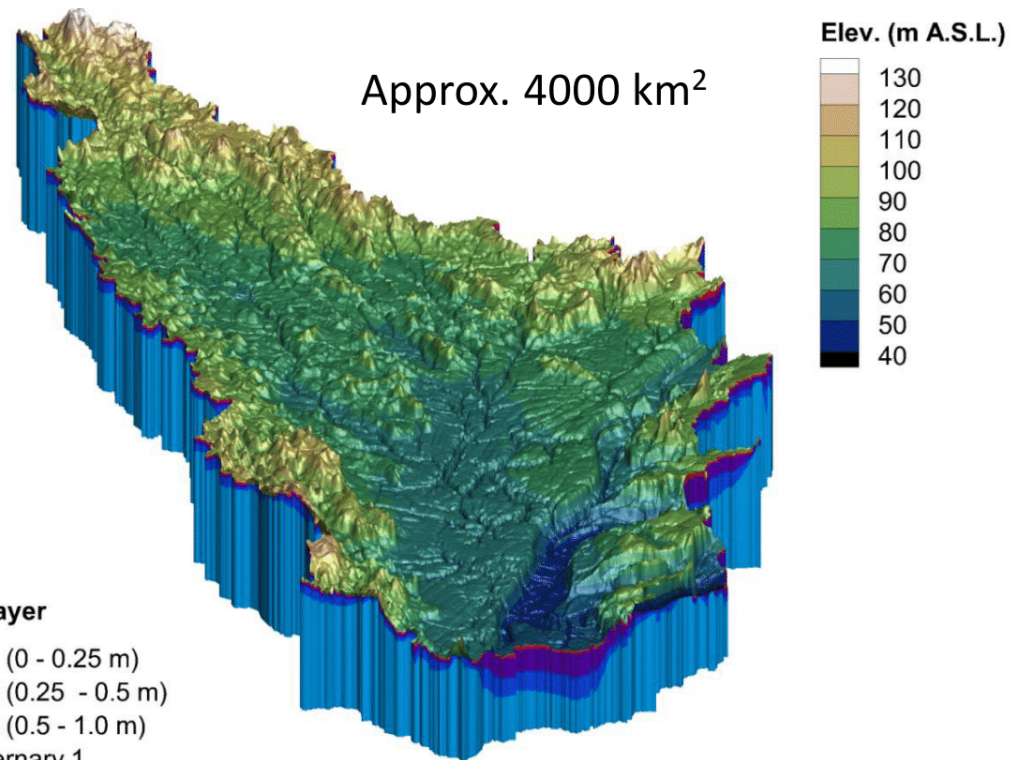
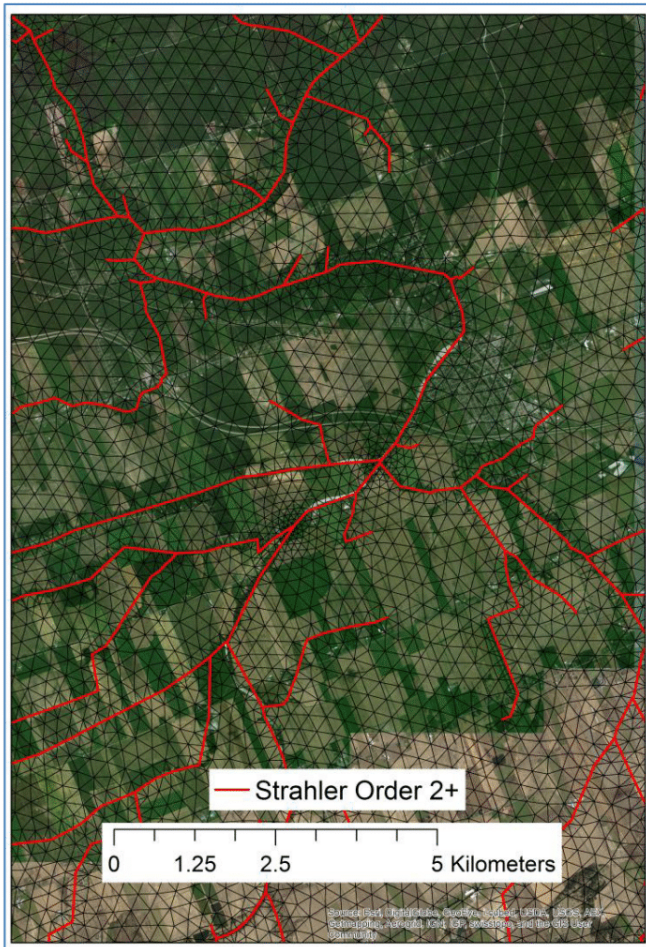
(globally implicit, fully-coupled, ...)



HGS *Simulation*™

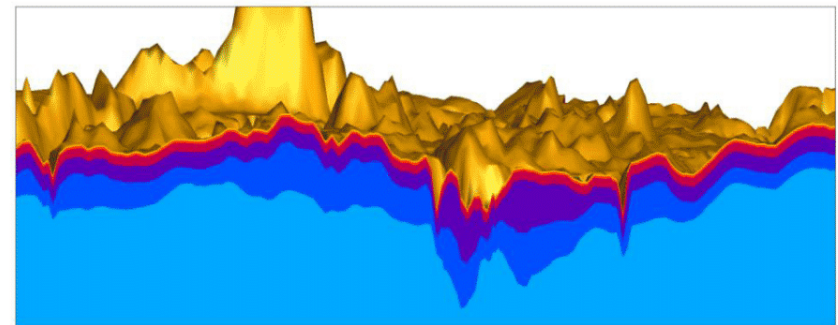
- Simulation of the entire terrestrial water cycle in 3D
- Emphasis on physics, PDE-based
- Utilize state of the art HPC, parallel computing, cloud computing
- Fast, robust numerical methods
- Adaptive time stepping, sub-timing
- Flexible meshing, unstructured grids
- Flexible to reduce process complexity, dimensionality
- Can include solute/heat transport
- Density-dependent flow (brines)

The South Nation Watershed 3D HGS Model



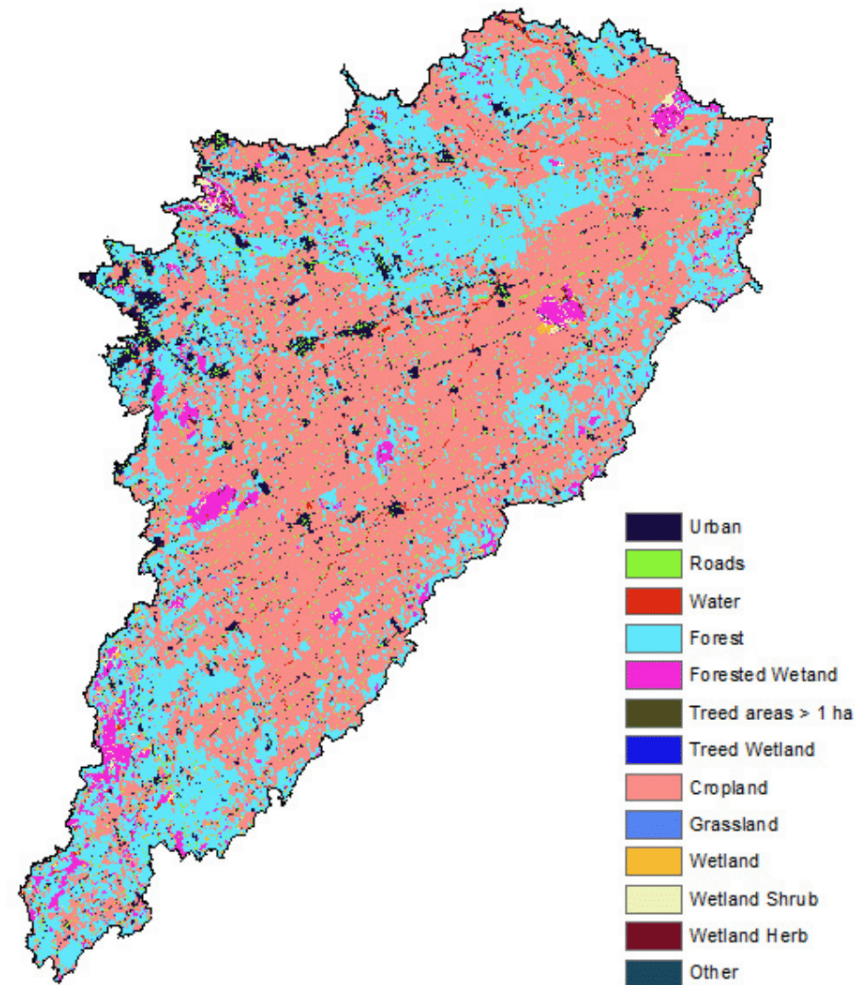
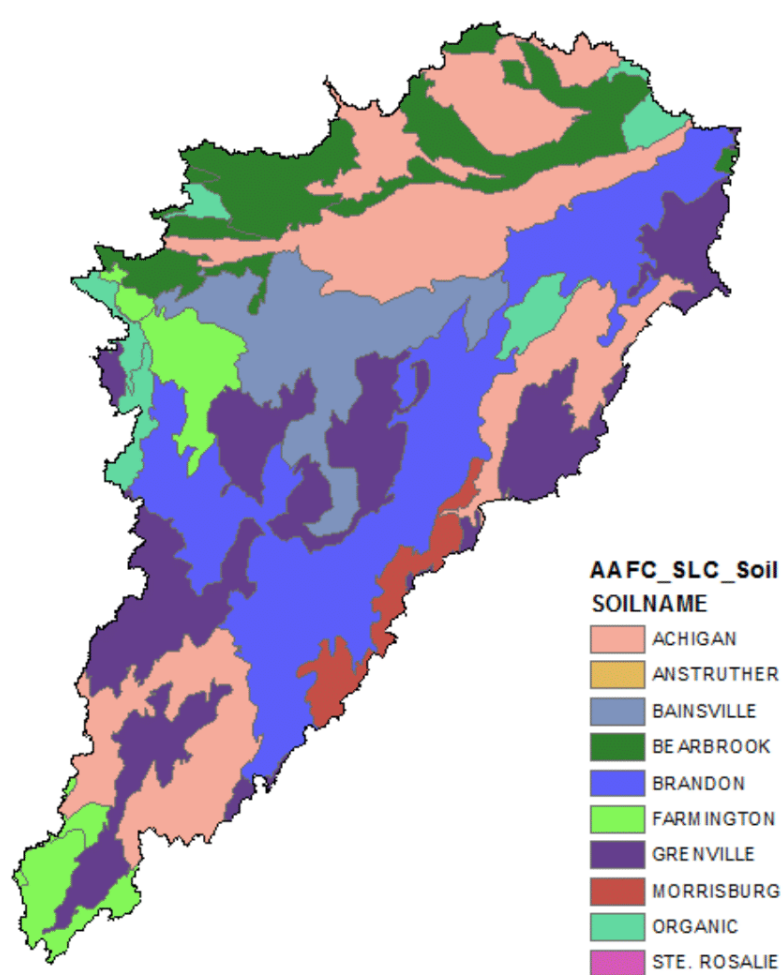
Subsurface Layer

- | | |
|---|-----------------------|
| 1 | Soil 1 (0 - 0.25 m) |
| 2 | Soil 2 (0.25 - 0.5 m) |
| 3 | Soil 3 (0.5 - 1.0 m) |
| 4 | Quaternary 1 |
| 5 | Quaternary 2 |
| 6 | Quaternary 3 |
| 7 | Bedrock |



- Currently 90,000 nodes per layer
- 375 m max spacing
- 125 m spacing along streams

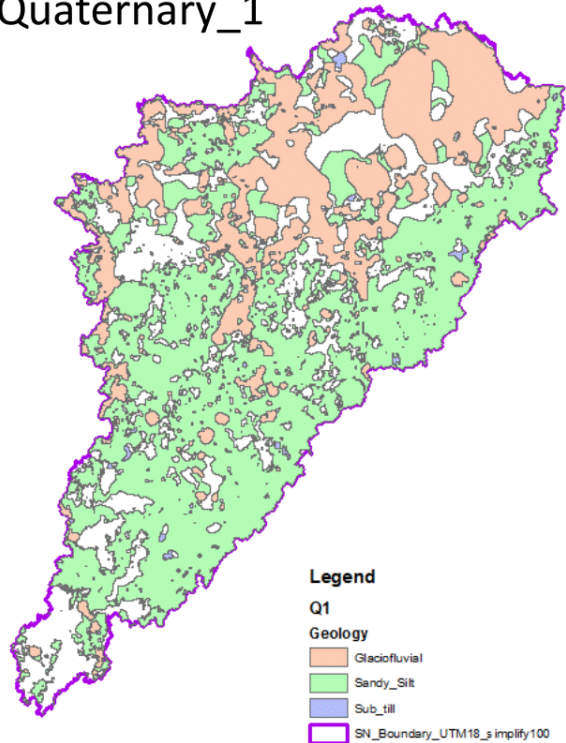
Soil and Landcover Resolution



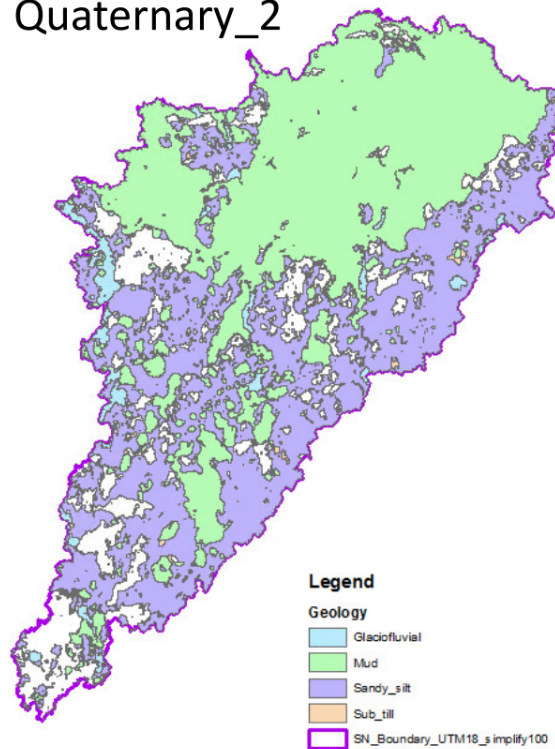
AAFC 2010 30 m Land Use

Quaternary Material Distribution

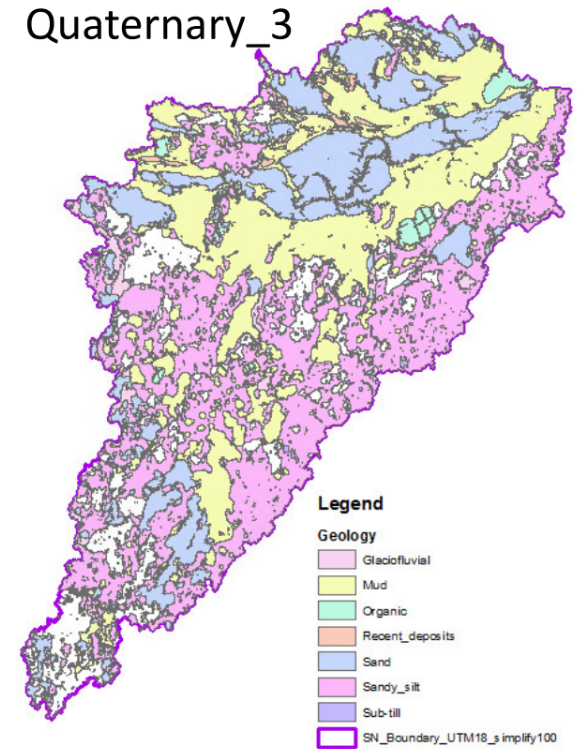
Quaternary_1



Quaternary_2



Quaternary_3

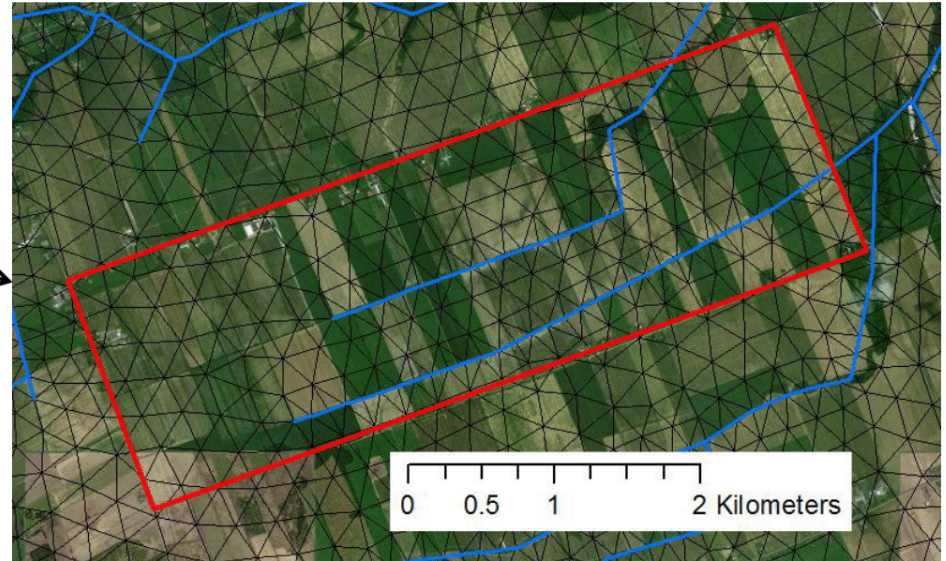
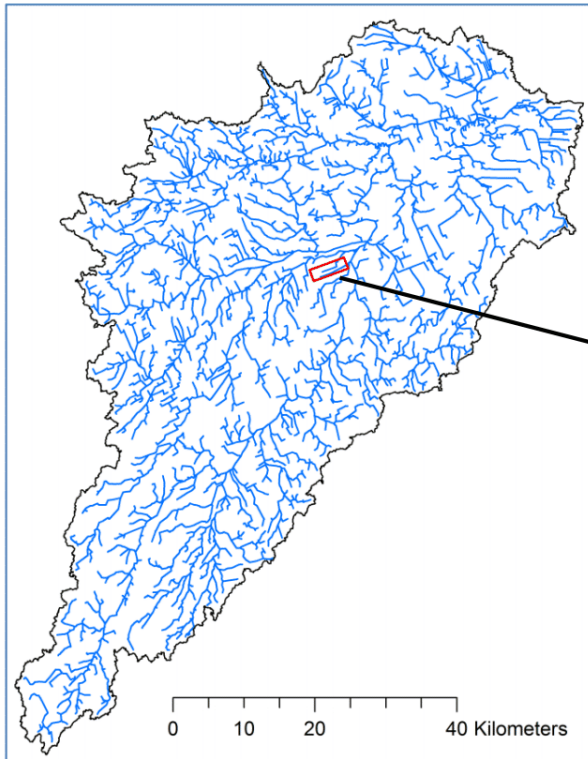


Derived from: Logan, C., Cummings, D.I., Pullan, S., Pugin, A., Russell, H.A.J. and Sharpe, D.R.
2009: Hydrostratigraphic model of the South Nation watershed region, south-eastern Ontario; Geological Survey of Canada, Open File 6206.

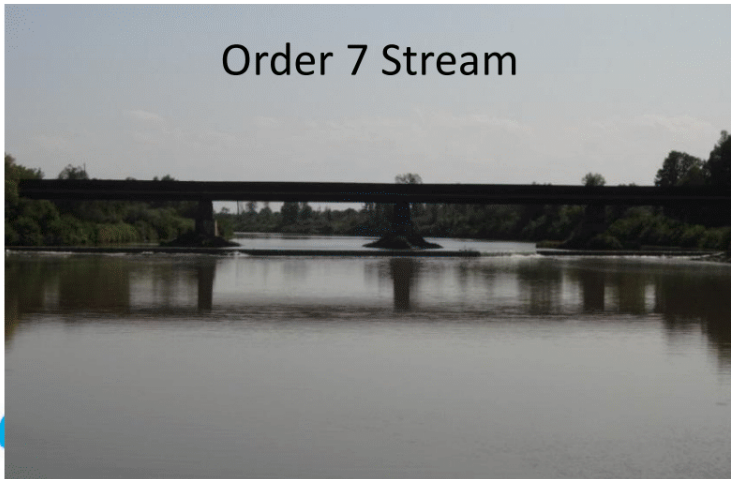
Stream Network Representation



2735 km of surface water features (Strahler 2+)



Order 7 Stream



Order 2 Stream





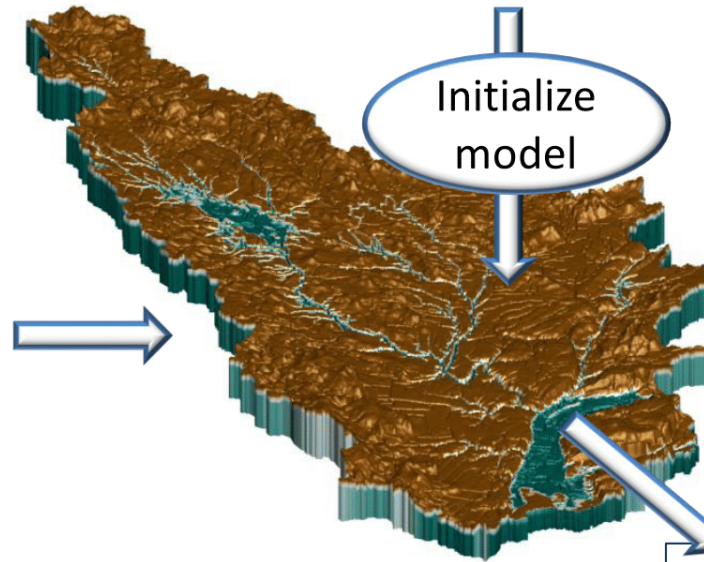
Conceptual Overview of Methodology



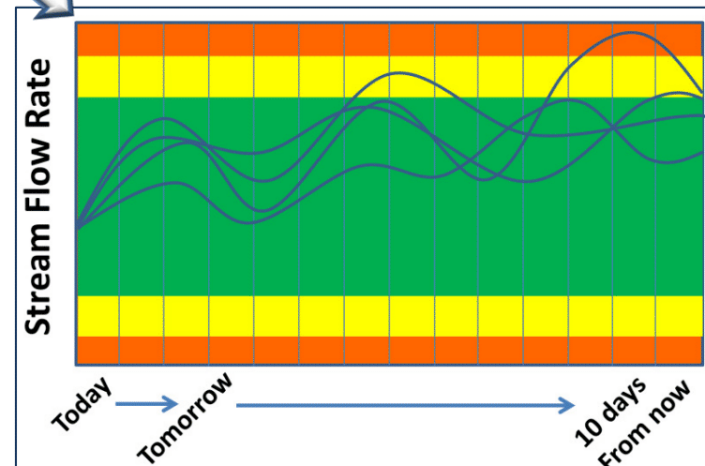
Weather Forecast
(2 week)

Estimated Current
Watershed Condition

Initialize
model



Simulated Conditions
Over Next 2 weeks





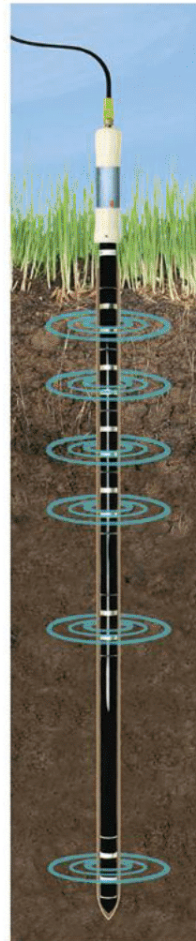
Observation Data Collection - Sensors

Stream Flow Rates

Groundwater
Levels



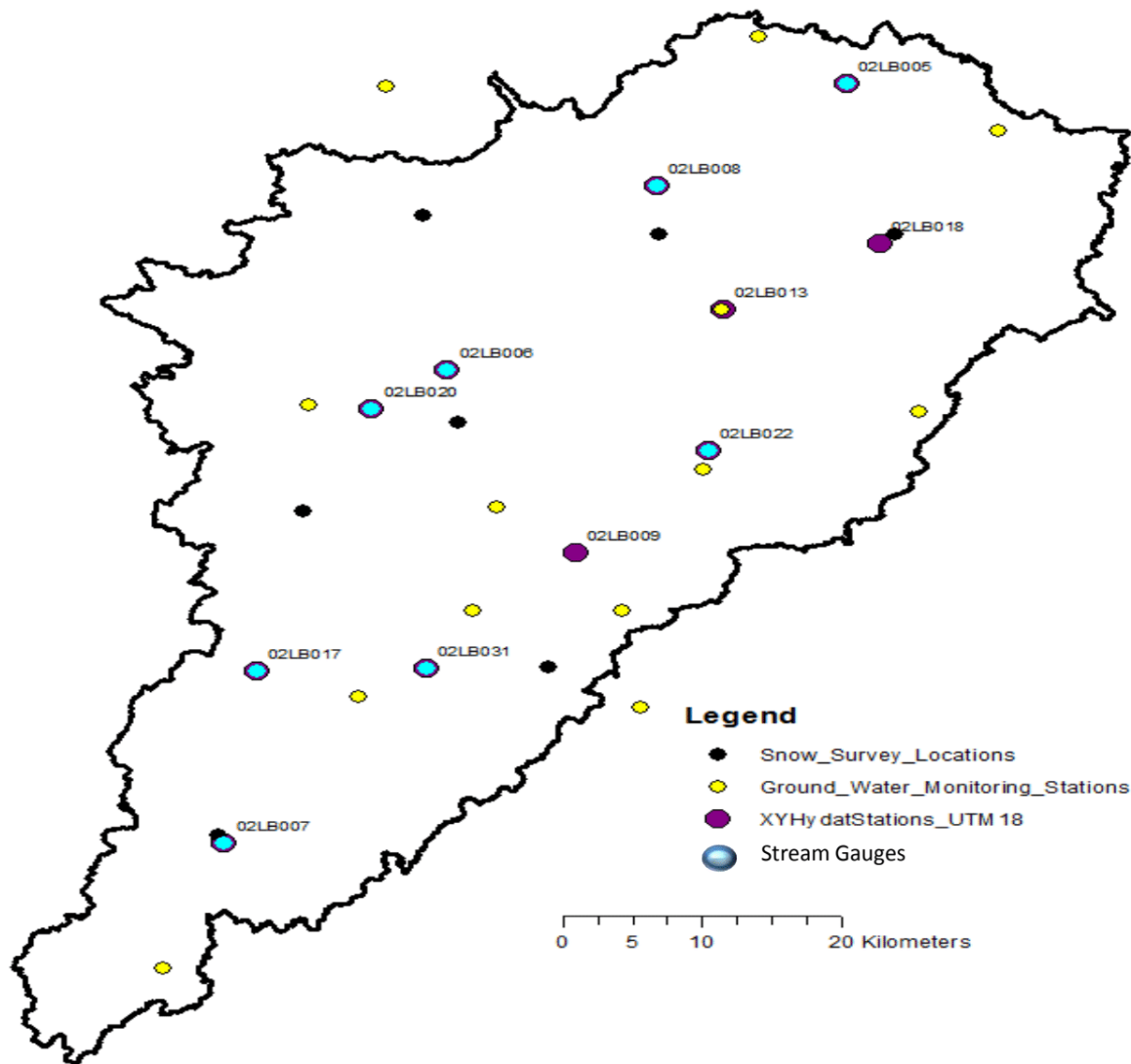
Soil
Moisture



Snow Depth



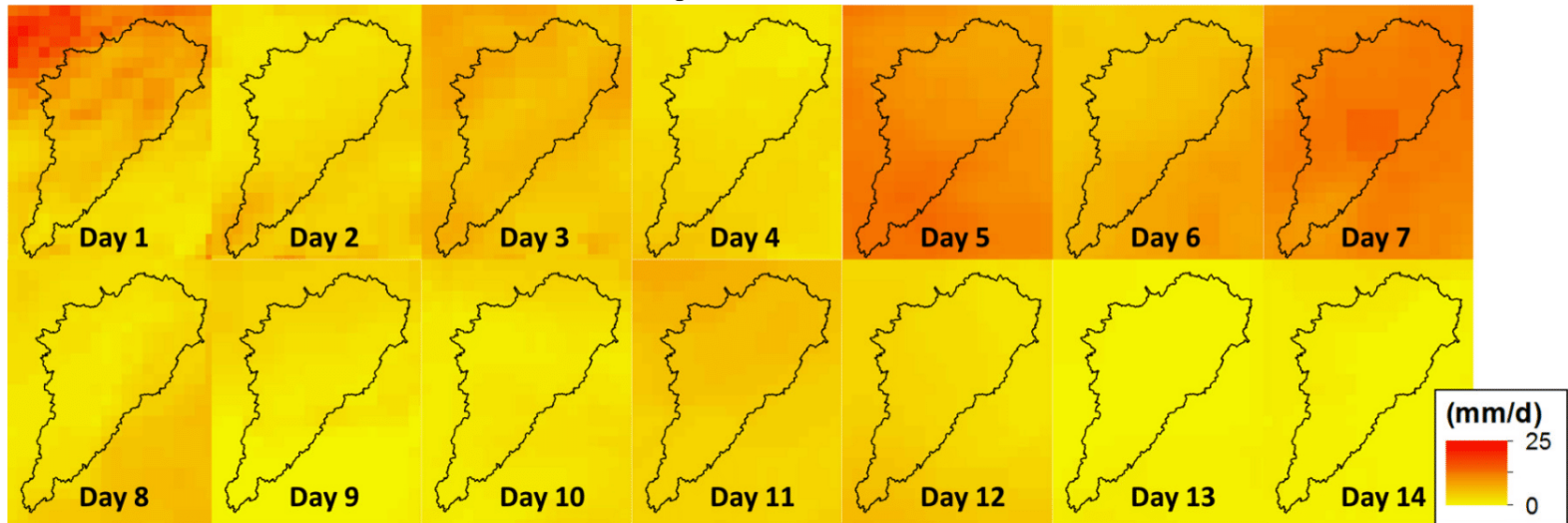
Wireless Instrumentation



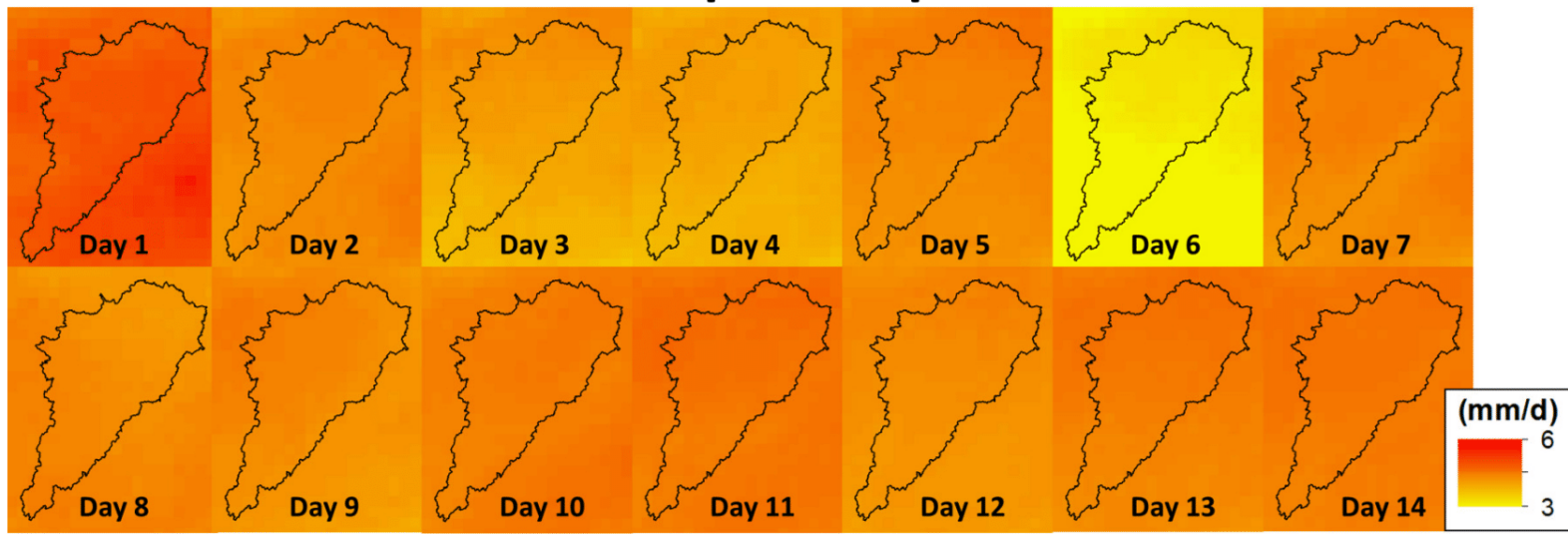
Ensemble of Gridded Weather Forecast Input: The Weather Company (IBM), Environment Canada



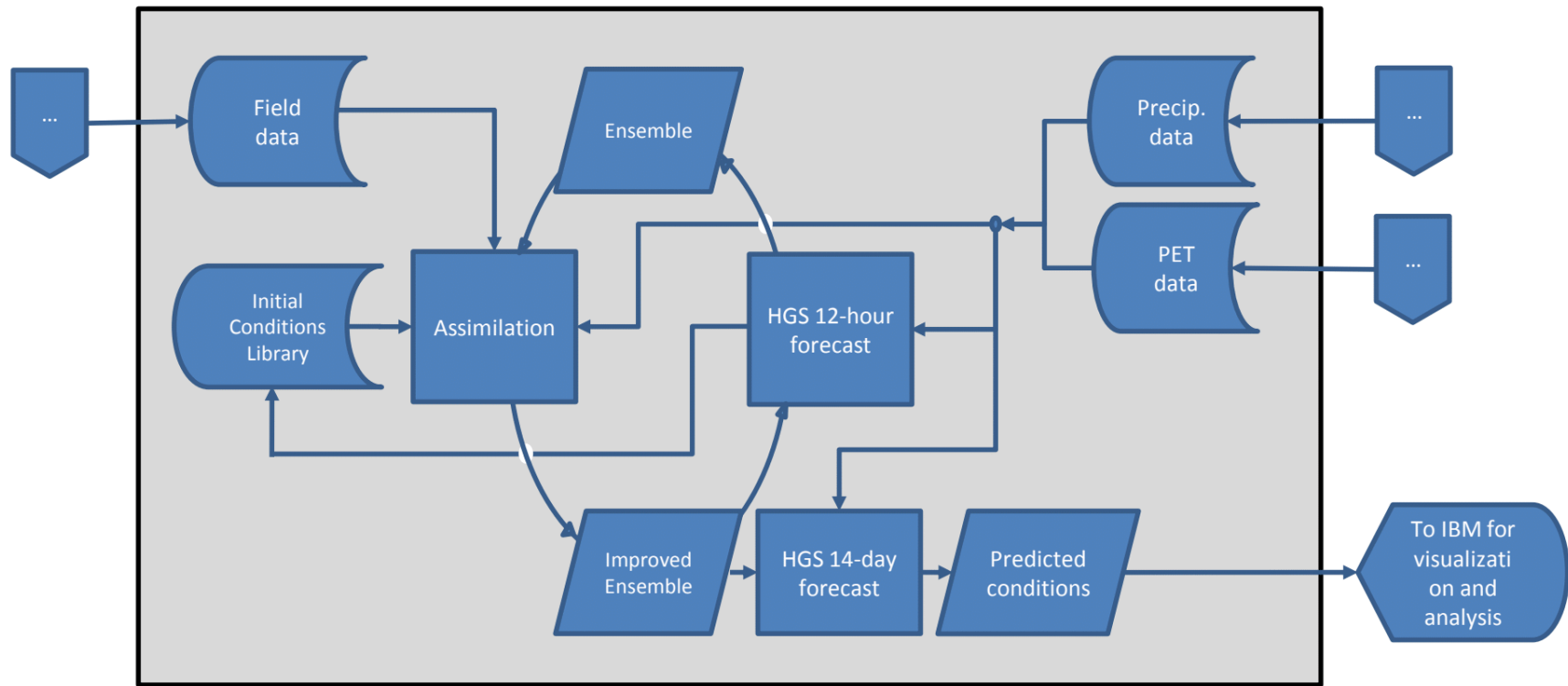
Precipitation



Potential Evapotranspiration



Hydrological Forecasting System



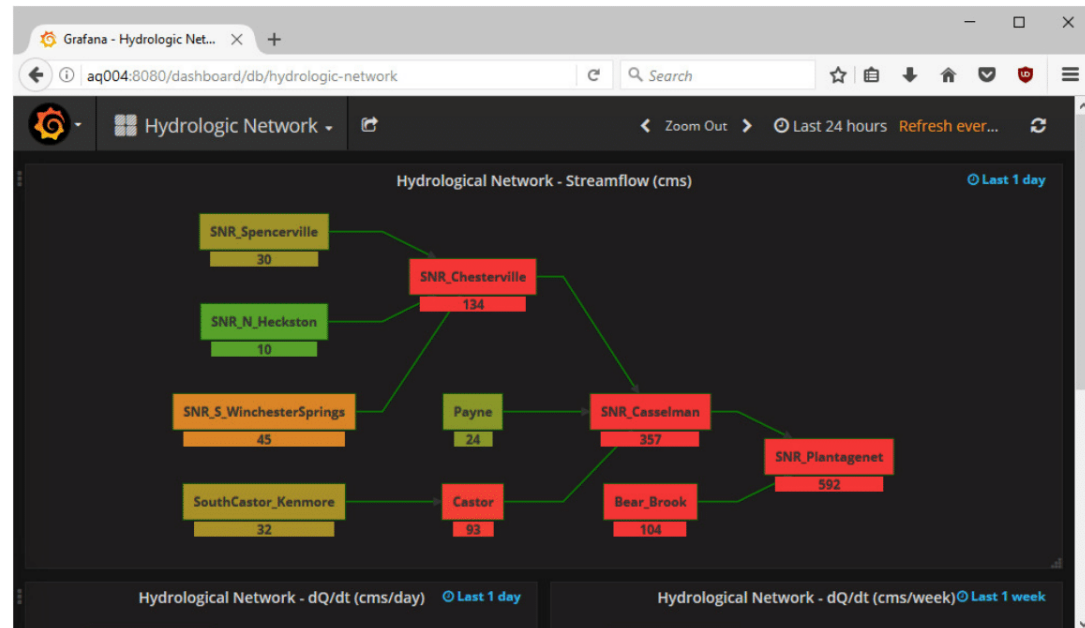
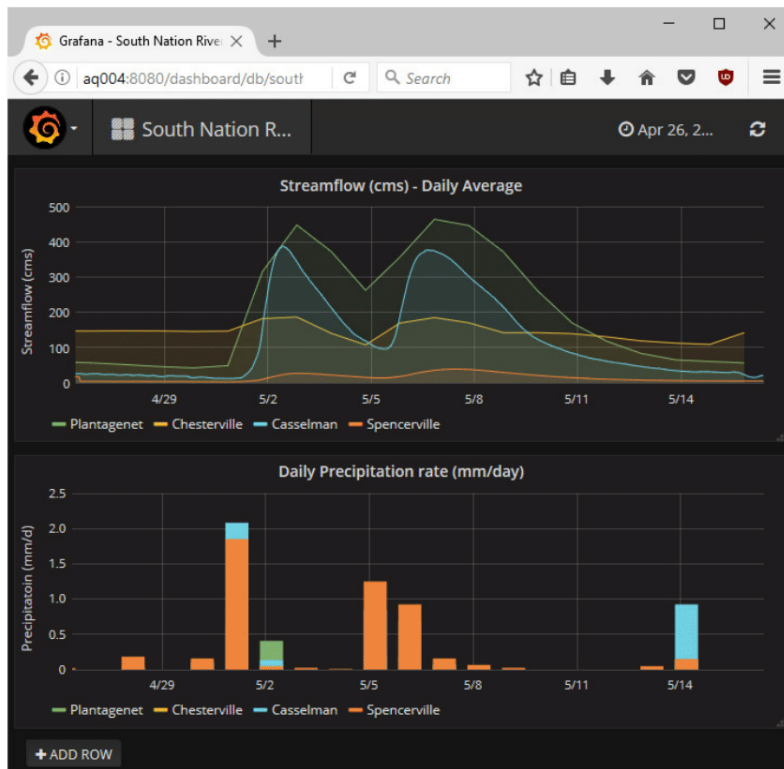
- Fully automated preprocessing, simulation, and postprocessing scripts on 12 & 24hr scheduler
- Internal dashboards in place to monitor system
- Scientific validation ongoing

Forecast Delivery

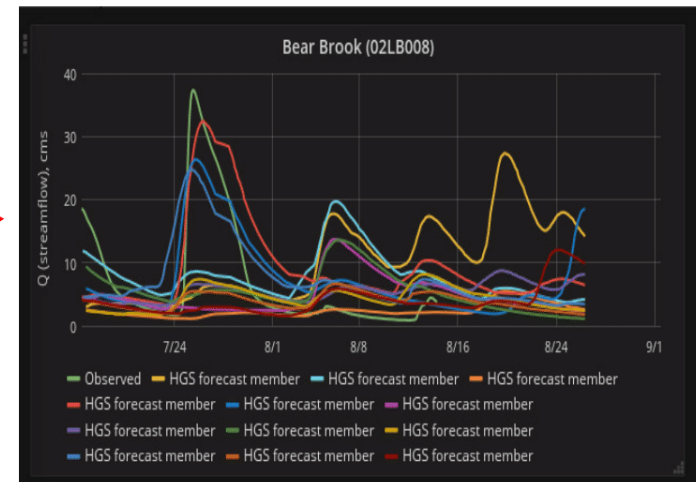
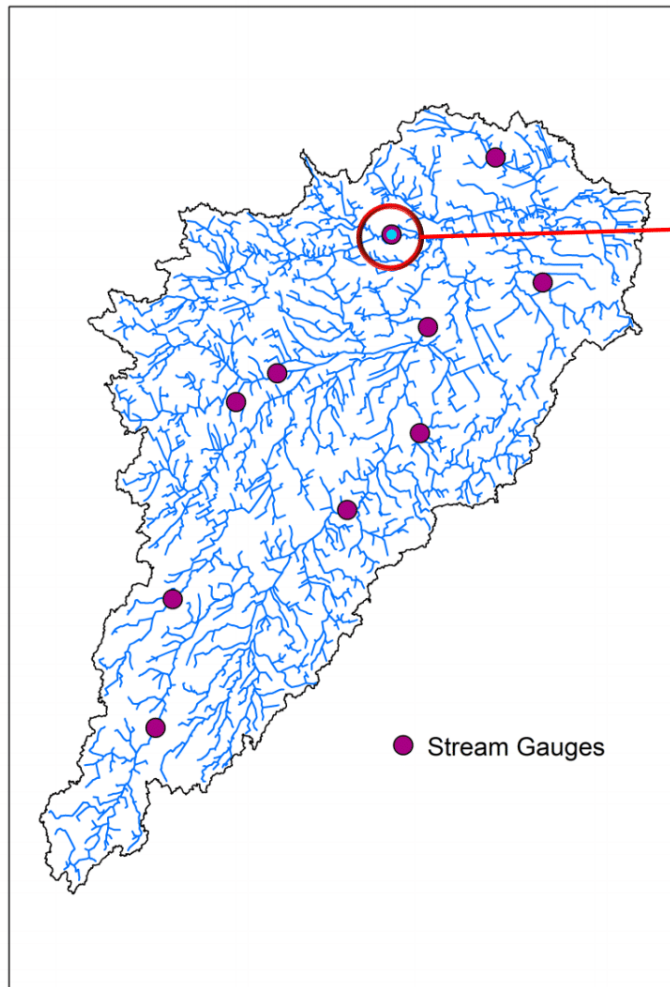
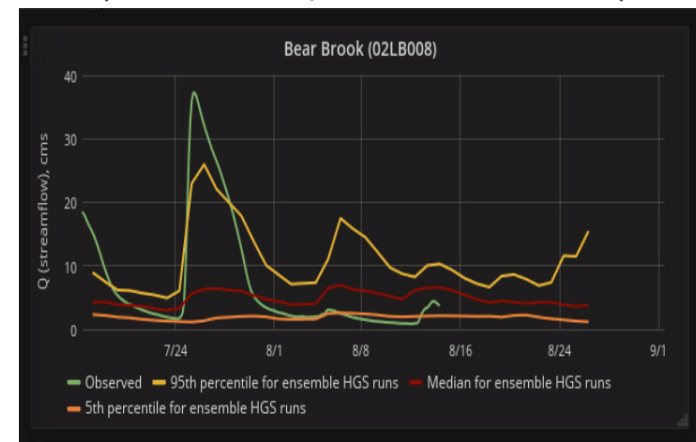
- 12 or 24 h release frequency
- Cloud-based
- User friendly visualization (IBM)

14 d forecast for:

- surface water flow
- soil moisture
- groundwater depth
- snow pack (winter)
- evapotranspiration (summer)
- hydrologic alarms



Ensemble of different models

Statistical presentation (median, 10th & 90th percentile)

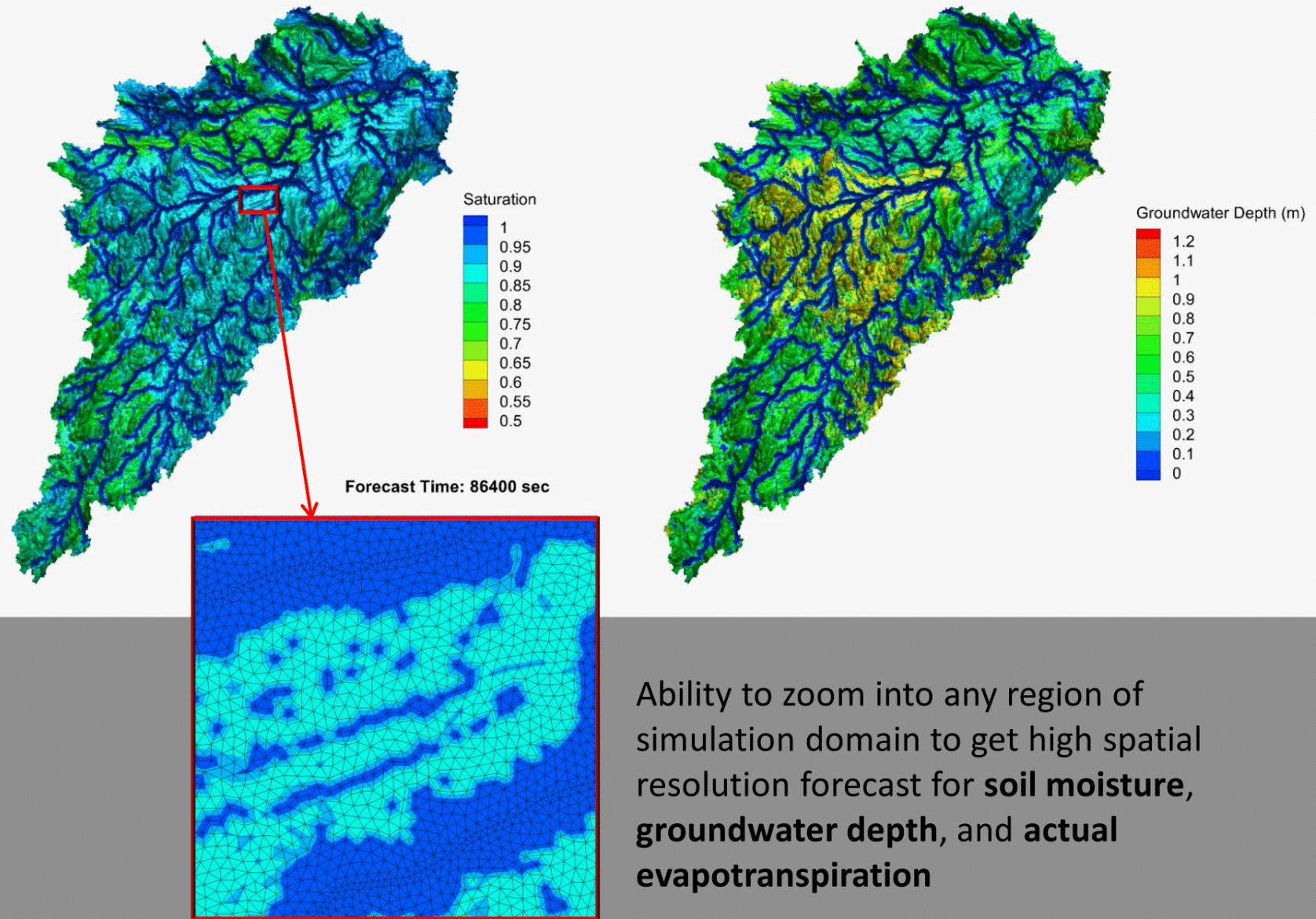
- Running multiple models with different forcing datasets provides an upper and lower bound on forecasted conditions.

November 2017 Flooding: Early Warning

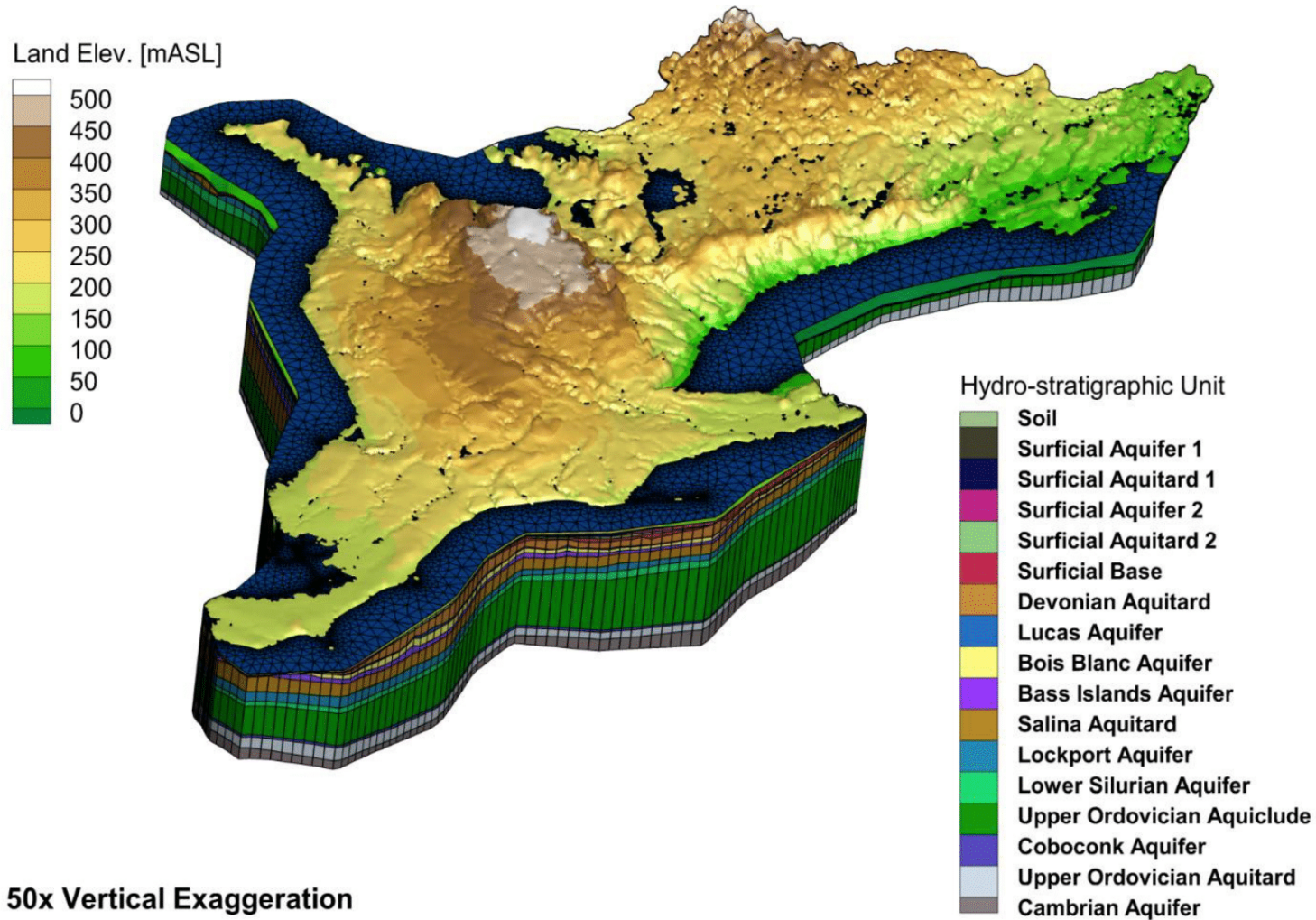


Soil Moisture and Groundwater Forecast

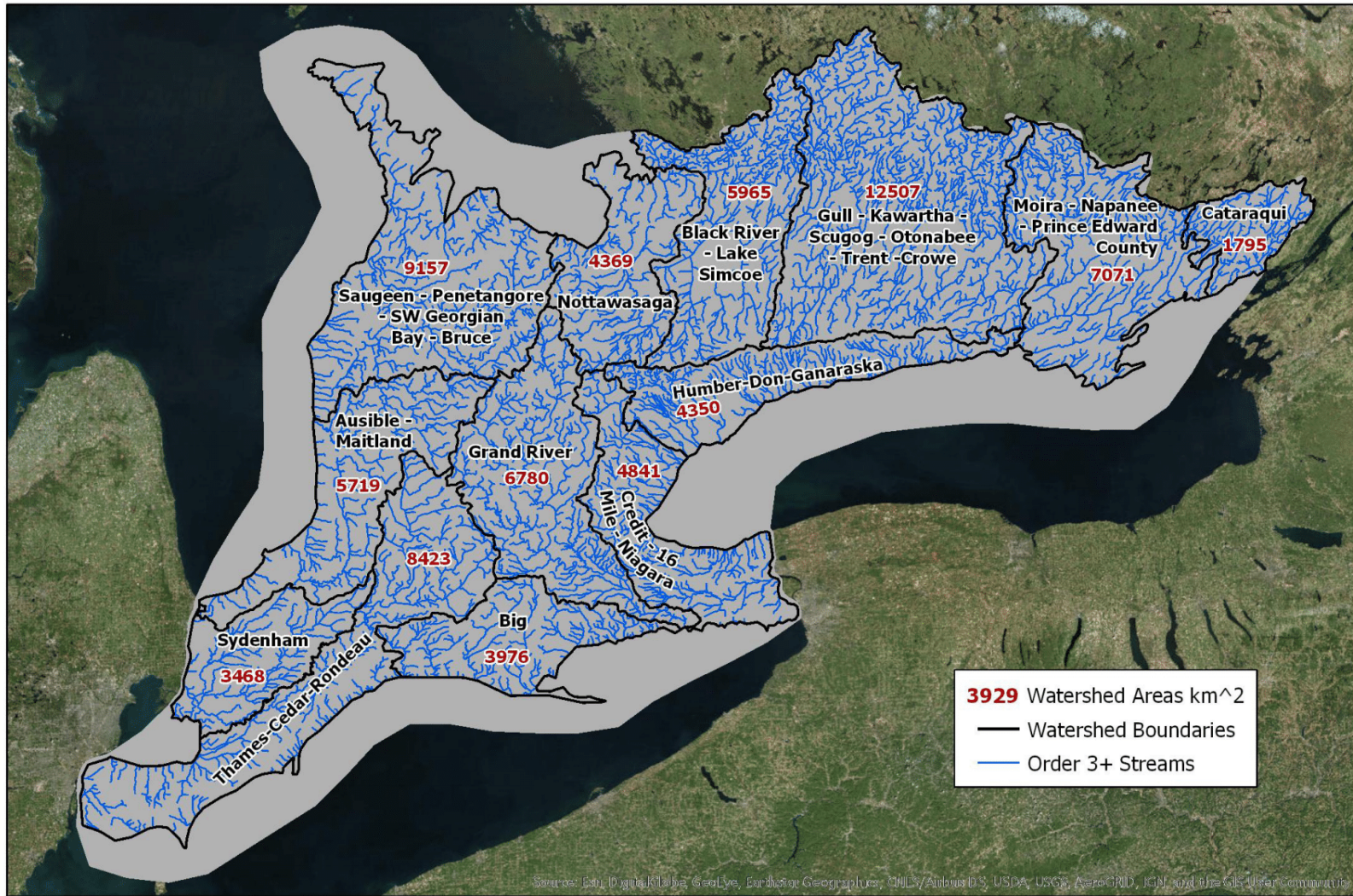
Spatially distributed model output



Expanding Coverage – Southern Ontario



Expanding Coverage – Southern Ontario





Thank You!

Questions?



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