Climate Change Effects on Agricultural Nutrient Transport in a Southern Ontario Sand Plain System

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What are we doing?

1. Quantifying nitrate transport originating from fertilizers
2. Linking extreme storm events to variations in concentration
3. Connecting nitrate transport to a water flow model
4. Projecting the influence of future climates
5. Proposing environmentally and economically sustainable best management practices

Where are we working?

Lower Whitemans Creek flows west to east through the town of Burford, Ontario and surrounding agricultural land. Nutrients, such as nitrogen, from farms producing corn, soy, and winter wheat overlaying an overburden sandy aquifer easily infiltrate. The creek receives water through groundwater discharge and surface runoff.

What was done before?

1. Conceptual water balance study of the Lower Whitemans Creek subcatchment[1]
   - Quantifies water use, recharge, and related conflicts
   - Describes hydrogeological structures in the sub-catchment and information related to groundwater recharge and discharge
2. SWAT-MODFLOW Model[2]
   - Informed by soil types, land usage, topography, and geology
   - Elucidates the water availability and quality under climate change and land-use change scenarios

Why bother?

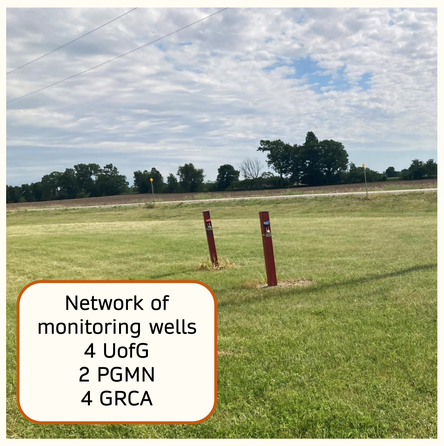
The long history of agriculture is a testament to value and appreciation for nature, attention and respect for the weather, and relentless ingenuity.

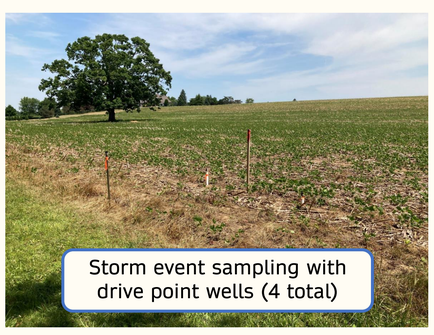
Agriculture depends on knowing what to expect in the short- and long-term ⇨ We know that there are patterns that can hint to the future

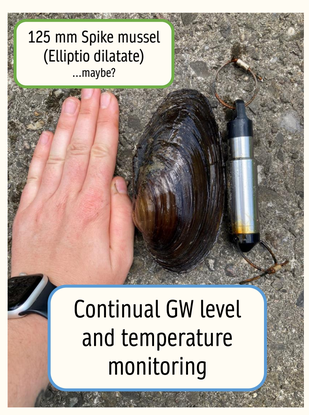
Fertilizer nutrient loss negatively impacts economics and ecology ⇨ We can measure the weather, water quantity, and water quality

Climate is changing and it is affecting our understanding of "business as usual" ⇨ We have the computing power to make predictions in the face of complex change

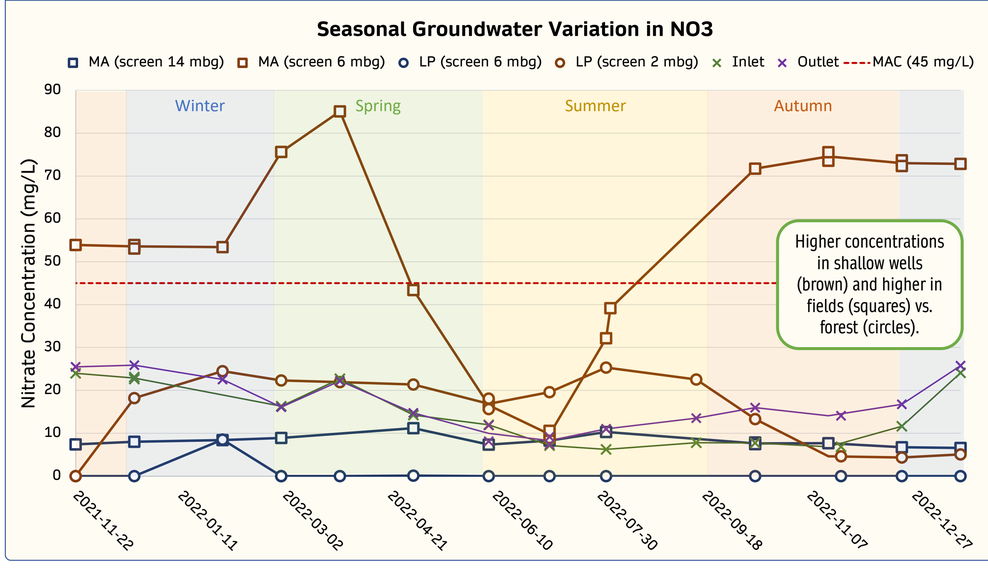
How are we going about it?

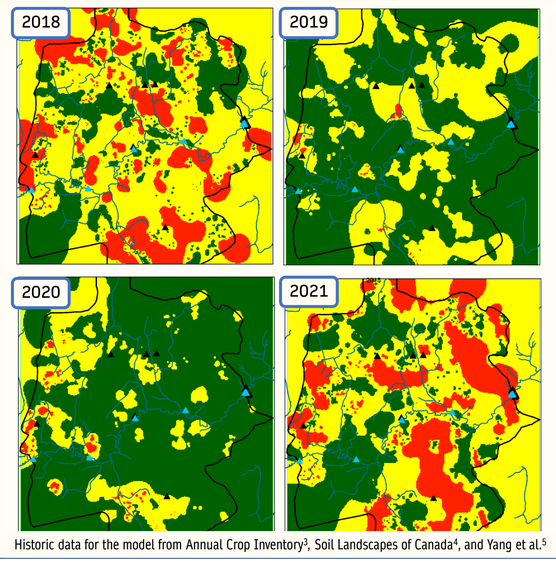




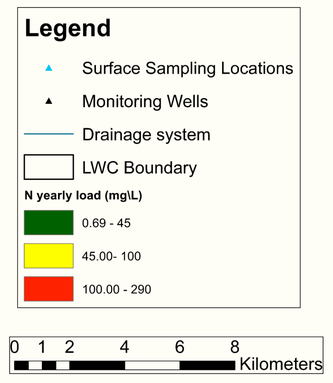


Some Preliminary Results





Historic data for the model from Annual Crop Inventory[3], Soil Landscapes of Canada[4], and Yang et al.[5]



Maps elaborated from outputs generated from the DNDC model for nitrogen leaching,

Next Steps

1. Conduct interviews with farmers in the study area.
2. Refine the data for the 3D model through varying methods to identify trends.
3. Update water budget and integrate nutrient transport into existing SWAT-MODFLOW model.

References:

1. R. M. Osman, "Water use conflict: a characterization and water quantity study in an agriculturally stressed subcatchment in Southwestern Ontario," Guelph, 2017.
2. M. Larocque, J. Levison, S. Gagné, and S. Saleem, "Groundwater use for agricultural production-current water budget and expected trends under climate change FINAL REPORT," 2019.
3. Annual Crop Inventory - https://open.canada.ca/data/en/dataset/ba2645d5-4458-414d-b196-6303ac06c1c9
4. Soil Landscapes of Canada - https://sis.agr.gc.ca/cansis/nsdb/slc/index.html
5. Yang, J. Y., et al. "Development of a Canadian Agricultural Nitrogen Budget (CANB v2. 0) model and the evaluation of various policy scenarios." Canadian Journal of Soil Science 87.Special Issue (2007): 153-165.

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Acknowledgements | Authors would like to thank Ryan Osman and Sylvain Gagne for the data from past studies.