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Lake St. Clair-Thames River Water Quality and Harmful Algal Bloom Assessment

PRELIMINARY FINDINGS

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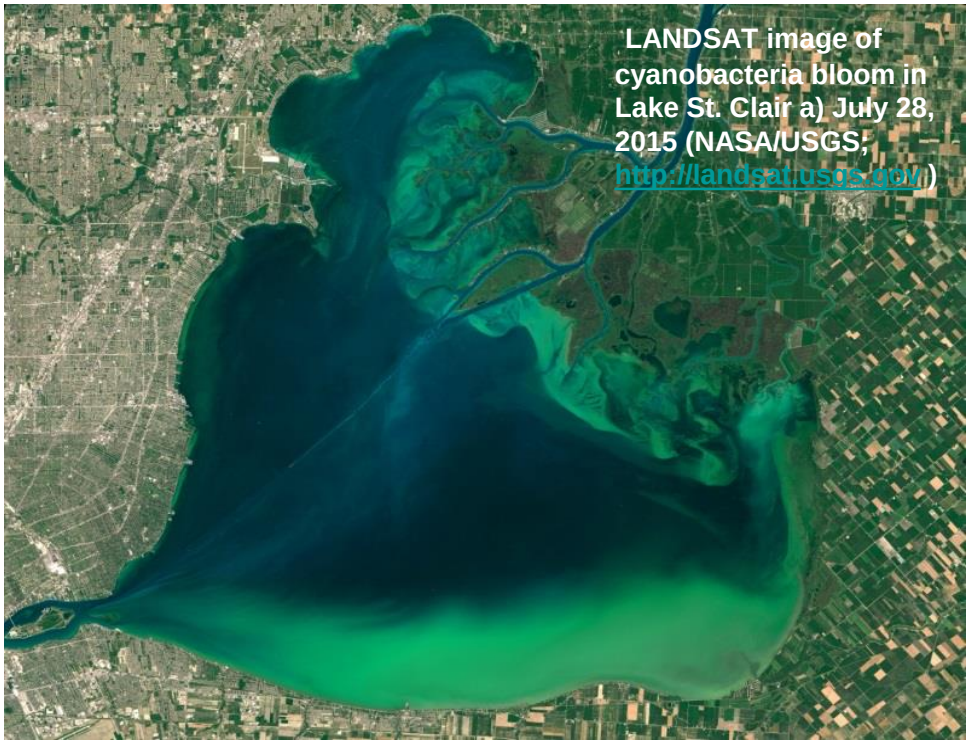
Lake St. Clair-Thames River



- Lake St. Clair is a shallow mesotrophic lake (≤ 6 m)
- Recent satellite imagery of Lake St. Clair indicate potential wide-spread cyanobacterial blooms
- Thames River is the largest Canadian tributary along Lake St. Clair and is identified as a priority tributary under Annex 4 – Nutrients of the GLWQA
- Identified a need to understand water quality conditions in Lake St. Clair and linkage between discharges from the Thames River to lake conditions

Objectives

1. Assess the range of water quality conditions in Lake St. Clair nearshore with emphasis on the Thames River area

2. Assess the extent, occurrence, magnitude and frequency of potential HABs in Lake St. Clair

3. Assessment of the drivers and causal linkages underlying water quality patterns and cyanobacterial blooms in Lake St. Clair

4. Quantify the role of Thames River discharges on water quality conditions of Lake St. Clair and relative contributions of nutrients and materials to Detroit River and Lake Erie

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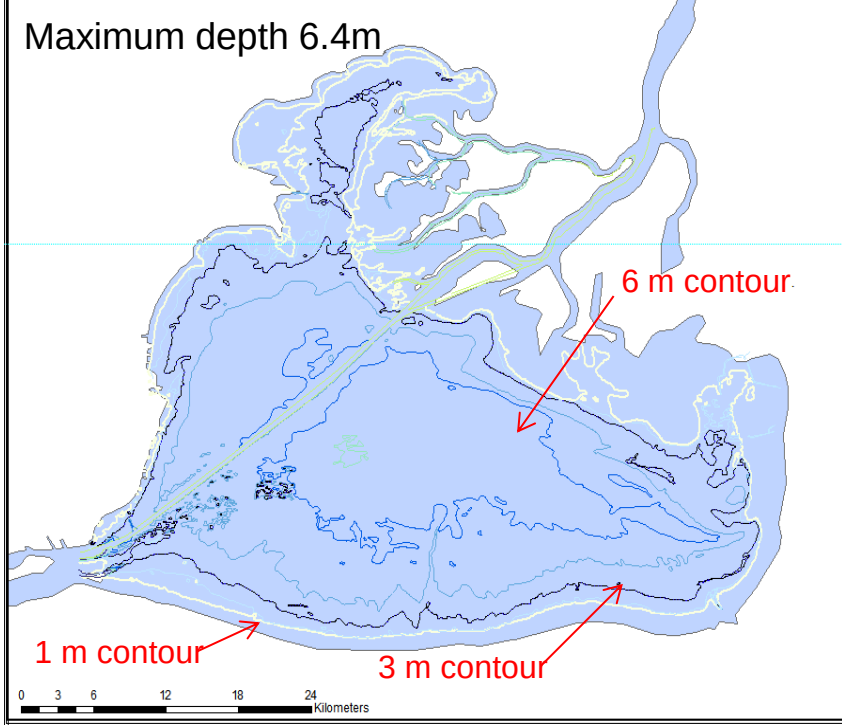
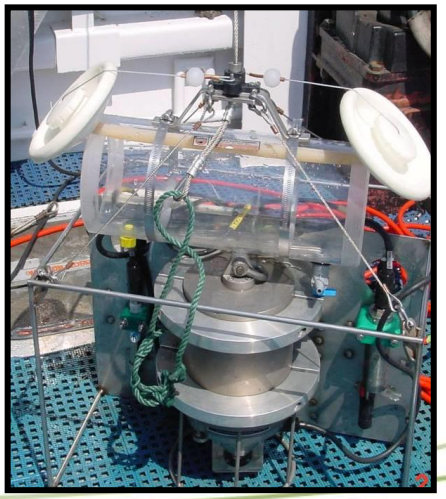
Survey Design



To capture the key limnological features, multiple sampling platforms were used concurrently to track water quality conditions:

- **Spatially**: from Chenal Ecarte to Detroit River, Thames River mouth to Chatham
- **Temporally**: real-time sensors deployed across Lake St. Clair and the mouth of the Thames River to capture water quality trends over the ice-free season
- **Across habitat types**: sampling across Lake St. Clair at tributary, inshore (1 – 3 m) and nearshore (3 – 6 m) locations
- **Using predictive tools**: 3D hydrodynamic model to inform survey design and future modelling of Lake St. Clair system



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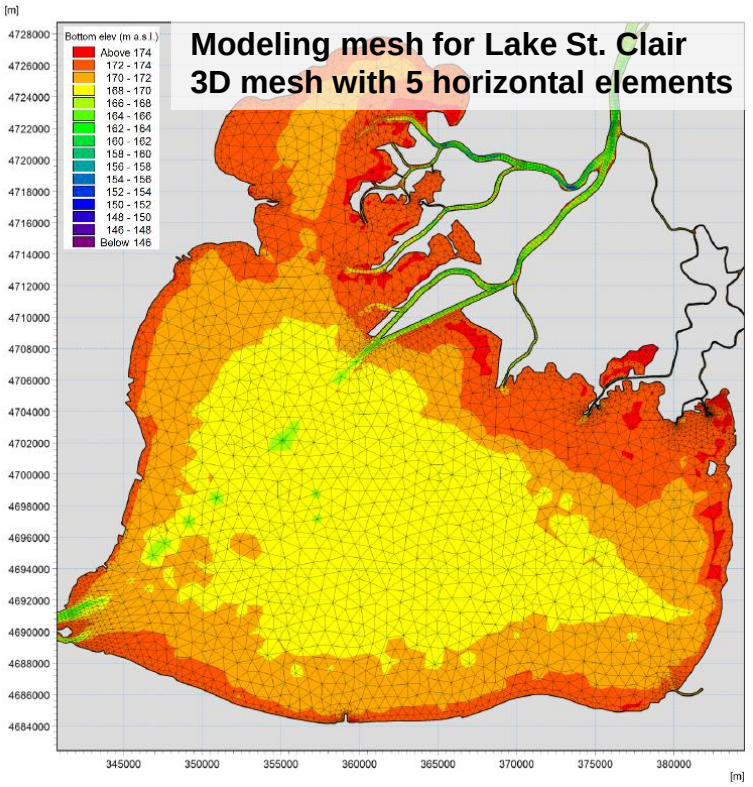
Hydrodynamic Modeling – Great Lakes

Key objectives are to assess:

- the impact of key tributaries to Lake St. Clair (discharge, movement and mixing)
- the hydrodynamic characteristics of Lake St. Clair
- the transport of nutrients and material from Lake St. Clair to Detroit River and Lake Erie

Inform development survey design and provide framework for subsequent model applications



- Tributaries: Thames River, Sydenham River, Belle River, Ruscom River
- Modeling of L St. Clair is part of larger Great Lakes modeling initiative

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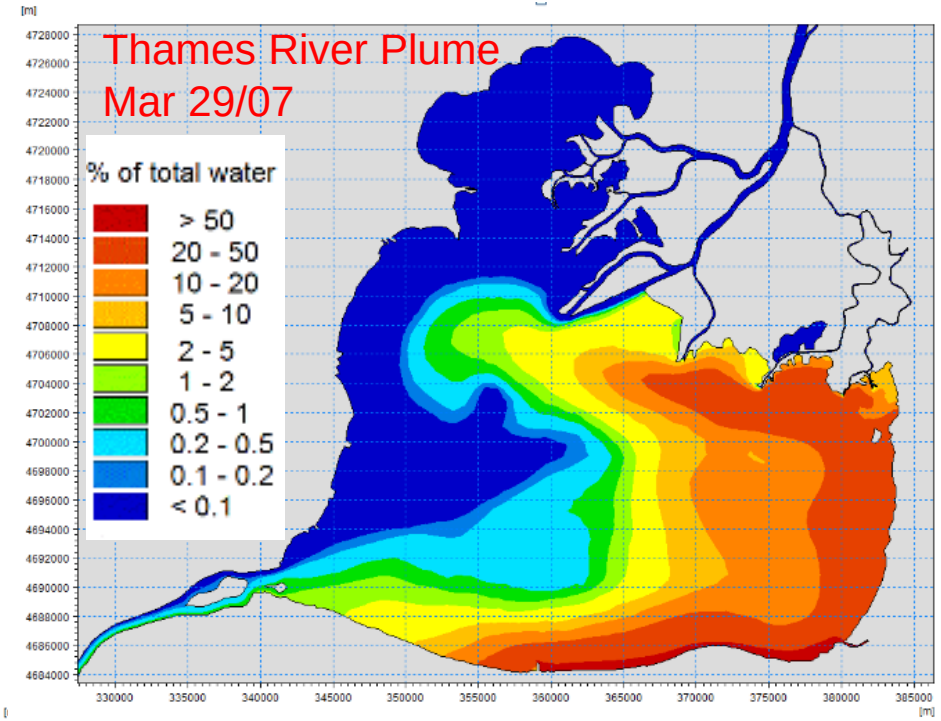
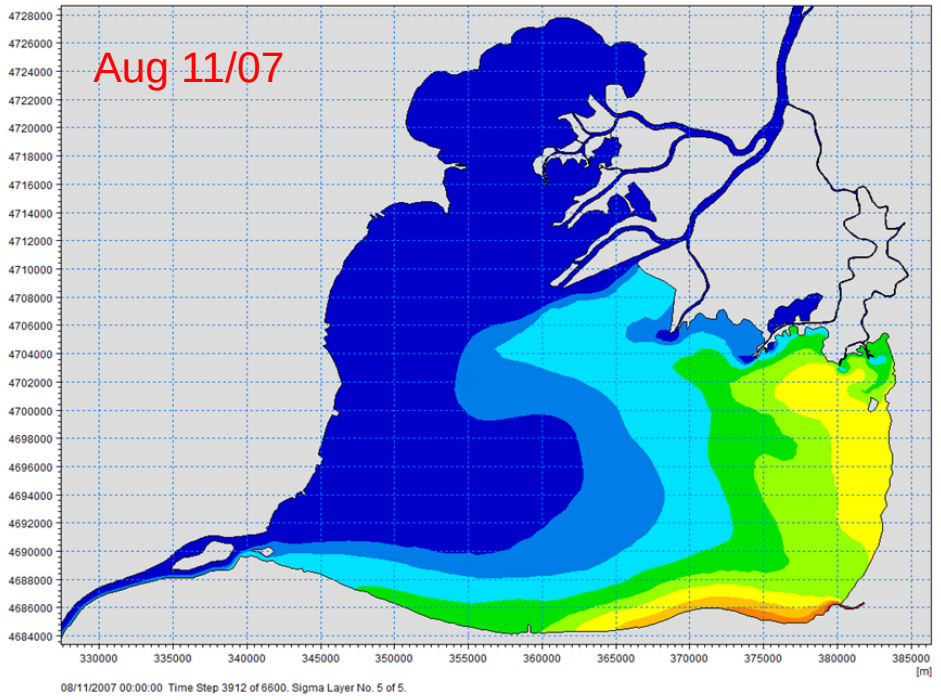
Modeling

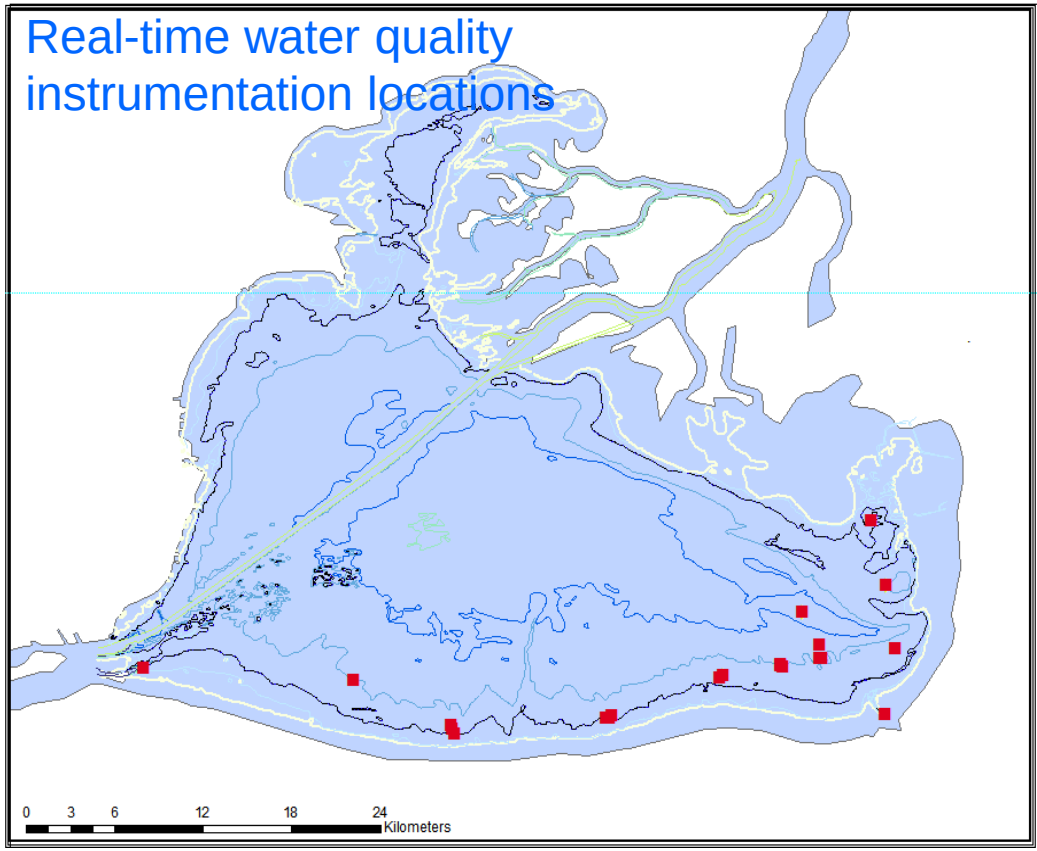
- Delineated dynamic distribution of water from each source
- Nearshore conditions can change rapidly on daily time-scales
- Rapid displacement of water; Thames R plume is highly dynamic
- Expected seasonal differences
- Currents are spatially differentiated
  - 10 cm/s nearshore
  - Upwards of 50 cm/s inshore
  - ~ 75 cm/s at Thames River mouth and head of Detroit River





Temporal Patterns: Real-time Water Quality Sensors

- Water quality data logged continuously throughout the ice-free season (May – Nov) in 10 to 30 min increments
- 12 general monitoring areas including the Thames River mouth
- Parameters: current velocity and direction, turbidity, chlorophyll a, temperature, conductivity and photosynthetically active radiation (PAR)



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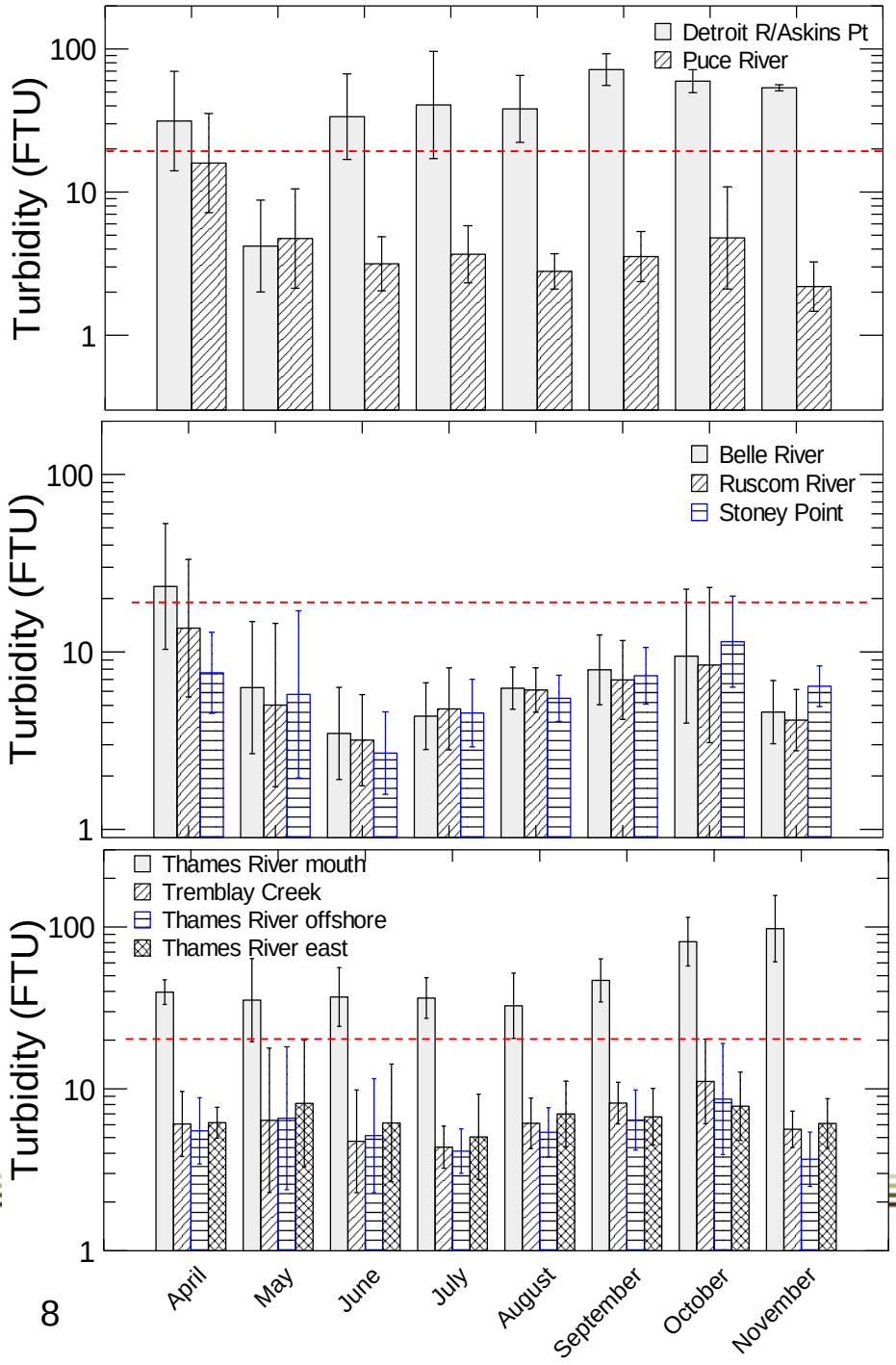

Temporal Patterns: Real-time Turbidity

- Episodic turbidity peaks indicative of tributary plume waters
- Conditions highly variable in the Thames River area and Detroit River
- Moderate to high turbidity across all sites
  - Turbidity typically < 10 NTU at nearshore sites

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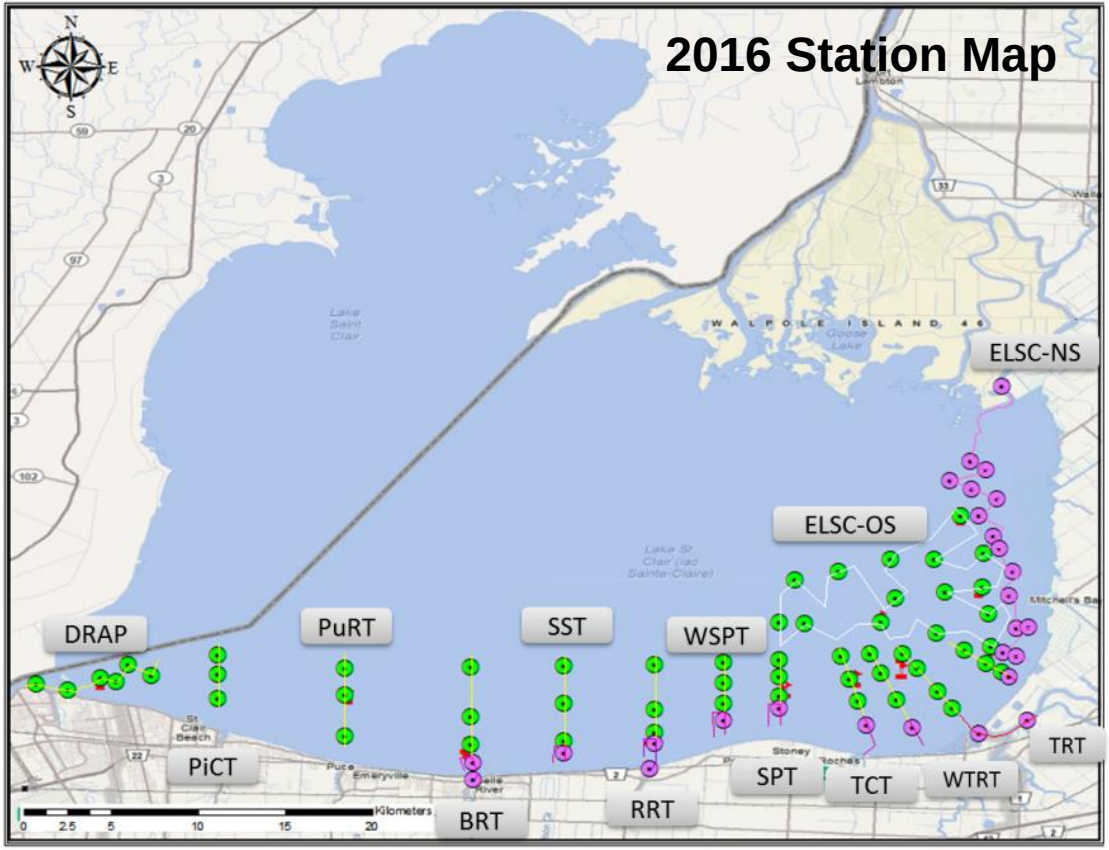
Water Quality Surveillance

- Three sampling categories stratified by depth and water type:
  - Inshore 1 – 3m depths and tributary sites (small vessel)
  - Nearshore sites > 3 m depths (Guardian)
- ~ 96 stations sampled across Lake St. Clair and Thames River
- 2016 sampling events: June (inshore only), August and October



Parameters: total & dissolved phosphorus, soluble reactive phosphorus , chlorophyll, conductivity, chloride, phycocyanin, suspended solids, dissolved organic carbon, sulphate, bacteriodes, nitrogen and secchi

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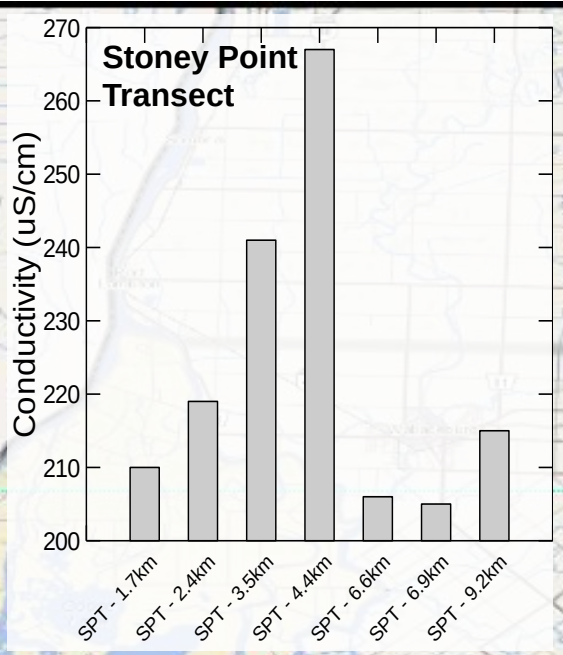
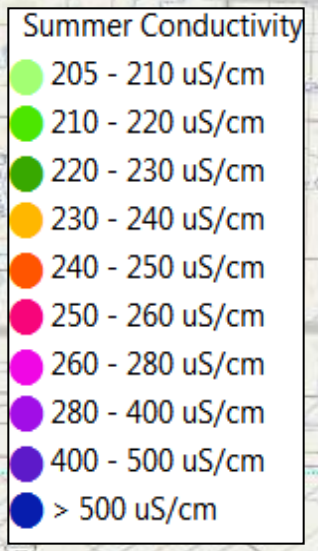
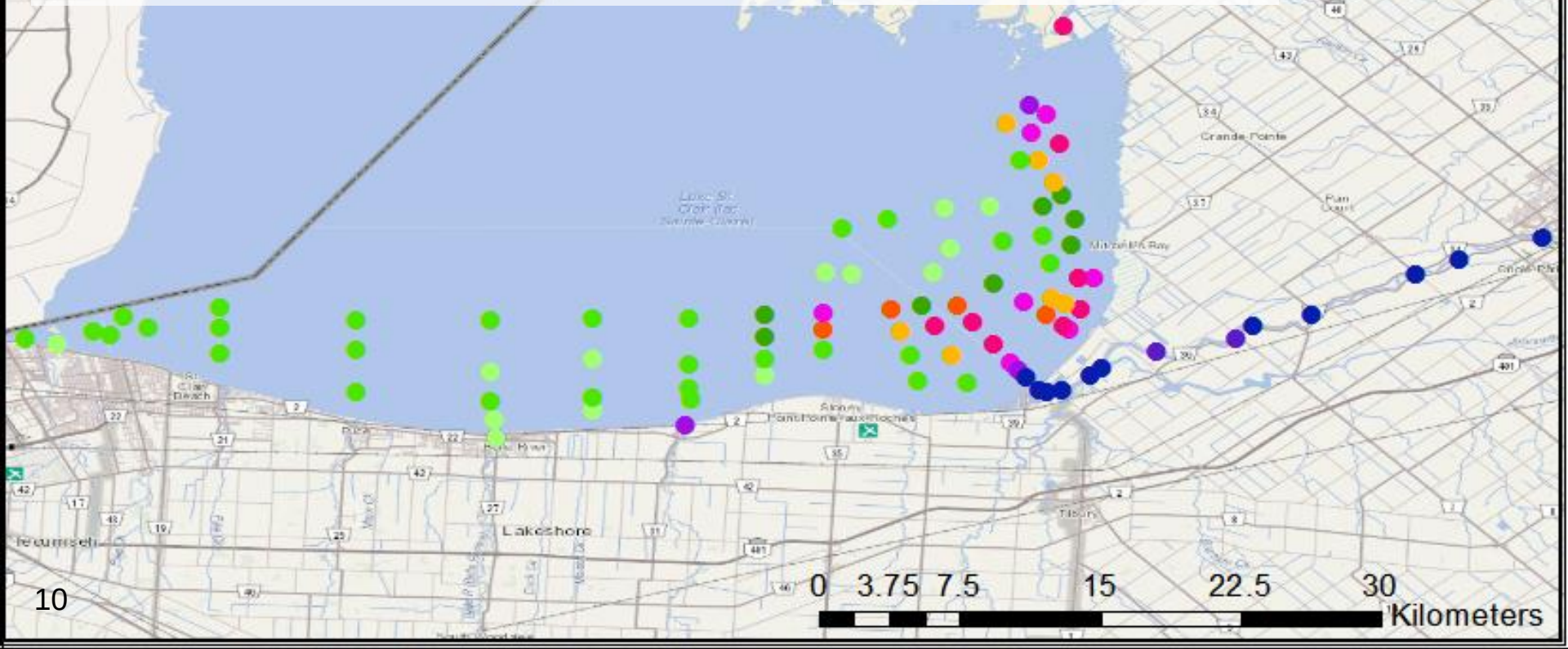
Conductivity

- Distinctive water mass characteristics
- Inshore sites: high turbidity/suspended solids, low water clarity and higher conductivity and chloride levels
- Nearshore sites: low turbidity/suspended solids, high water clarity and low chloride levels and conductivity

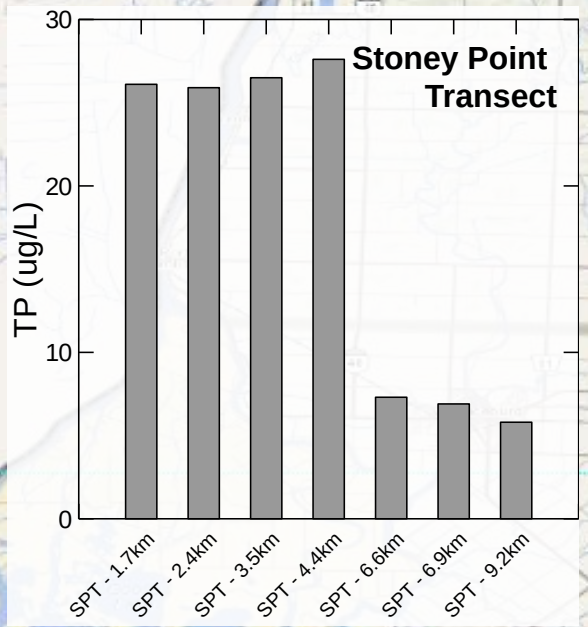


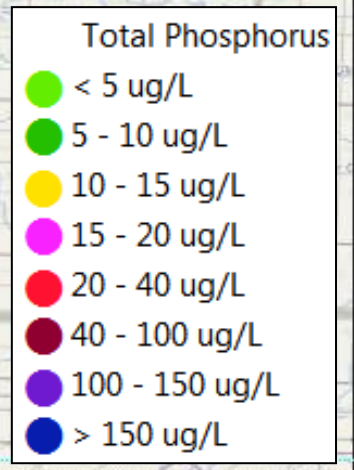




Nutrients

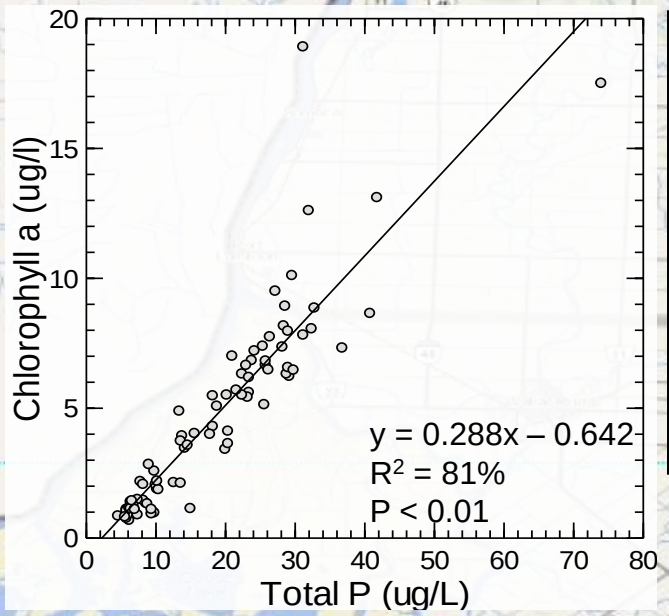
- Nutrient-enriched, turbid waters with higher conductivity and chloride are indicative of tributary plume water
- Low-nutrient, clear water with low chloride and conductivity indicative of lake water
- High variability across sites and surveys

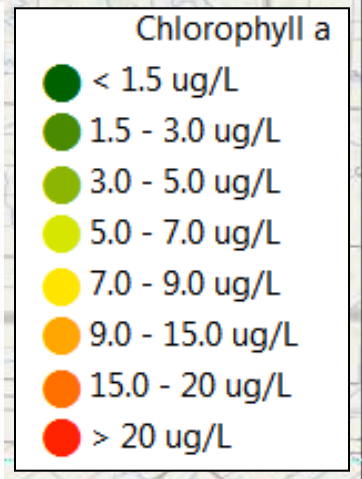




Chlorophyll *a*

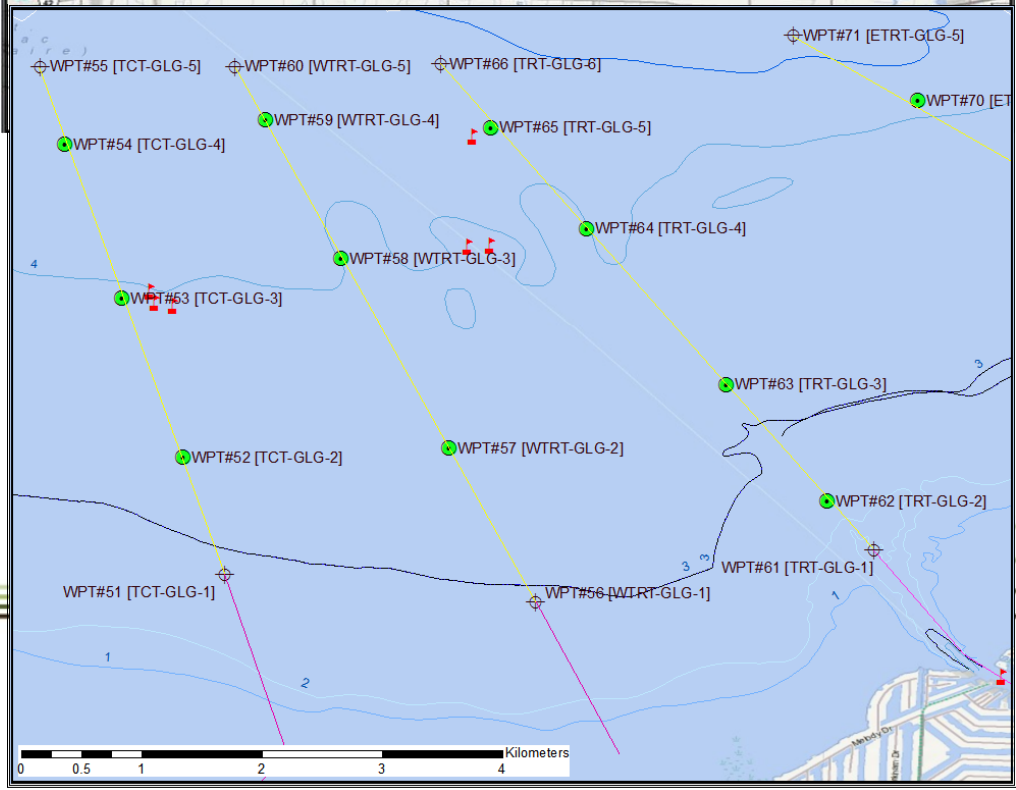
- High chlorophyll *a* levels inshore and in tributaries
- Moderate chlorophyll *a* levels offshore and near Detroit River
- Ongoing analyses on 2016 dataset





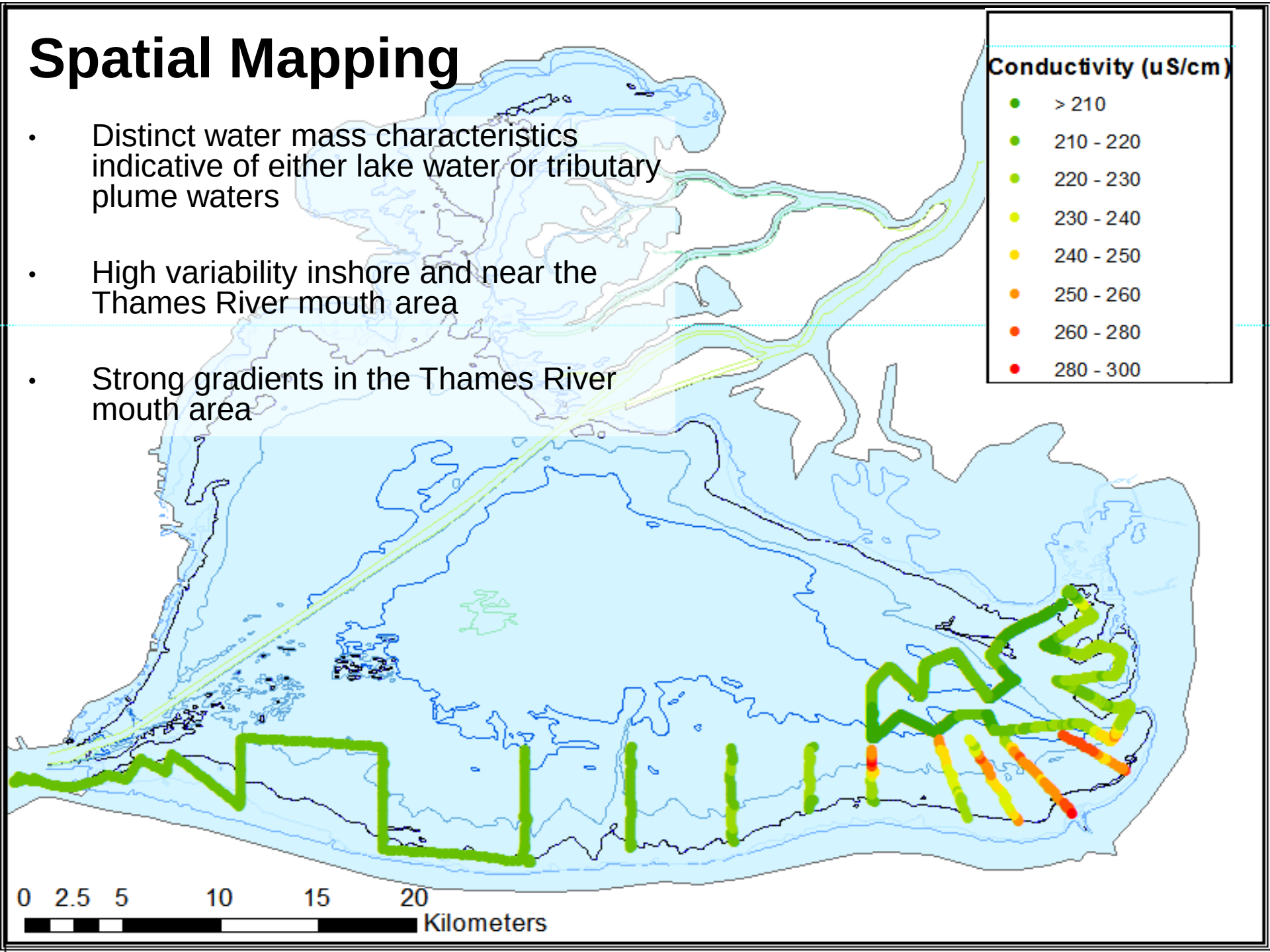
Spatial Mapping

- In situ mapping of water quality conditions concurrently with water quality sampling
- 12 mapping lines (~ 8 km) and three tracks (~35 km)
- Mapping area from 1 to 6 m depth
- Surface mapping (1 – 1.5m) and vertical profiles
- Real-time sensors: temperature, conductivity, chlorophyll a, phycocyanin and turbidity and fluorescence, dissolved oxygen



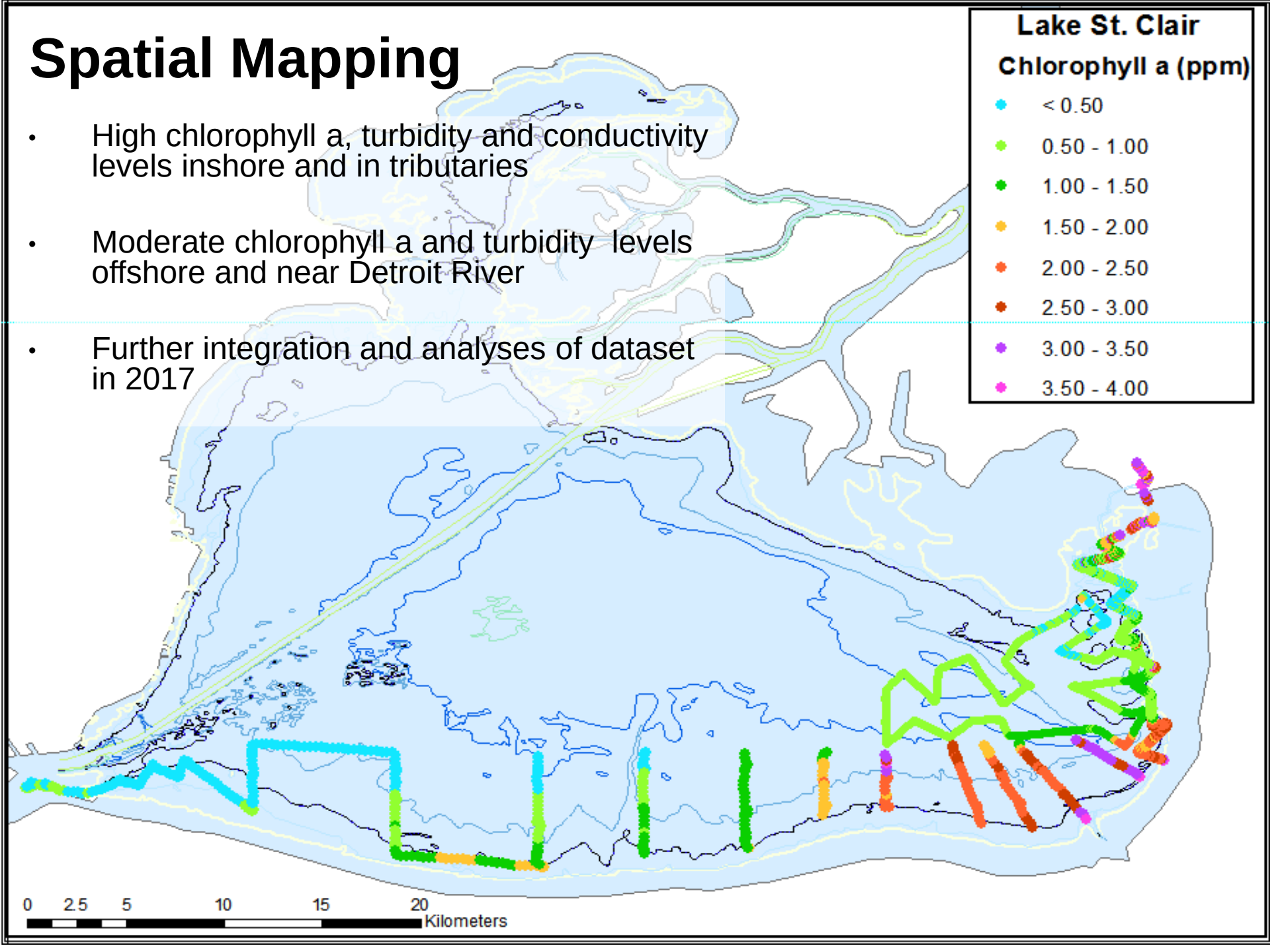
Spatial Mapping

- Distinct water mass characteristics indicative of either lake water or tributary plume waters
- High variability inshore and near the Thames River mouth area
- Strong gradients in the Thames River mouth area

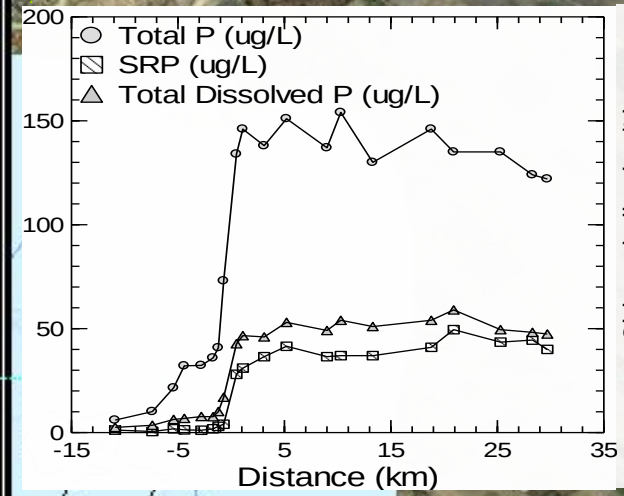


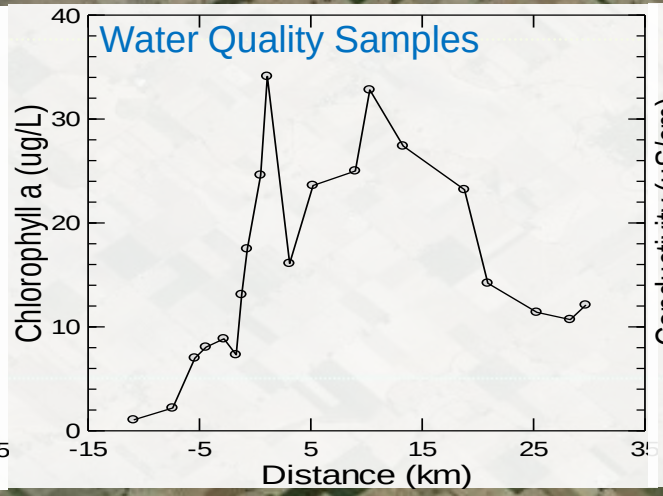
Spatial Mapping

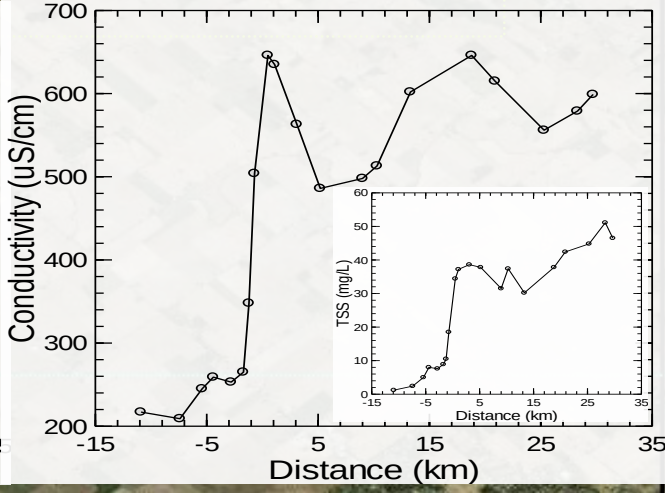
- High chlorophyll a, turbidity and conductivity levels inshore and in tributaries
- Moderate chlorophyll a and turbidity levels offshore and near Detroit River
- Further integration and analyses of dataset in 2017

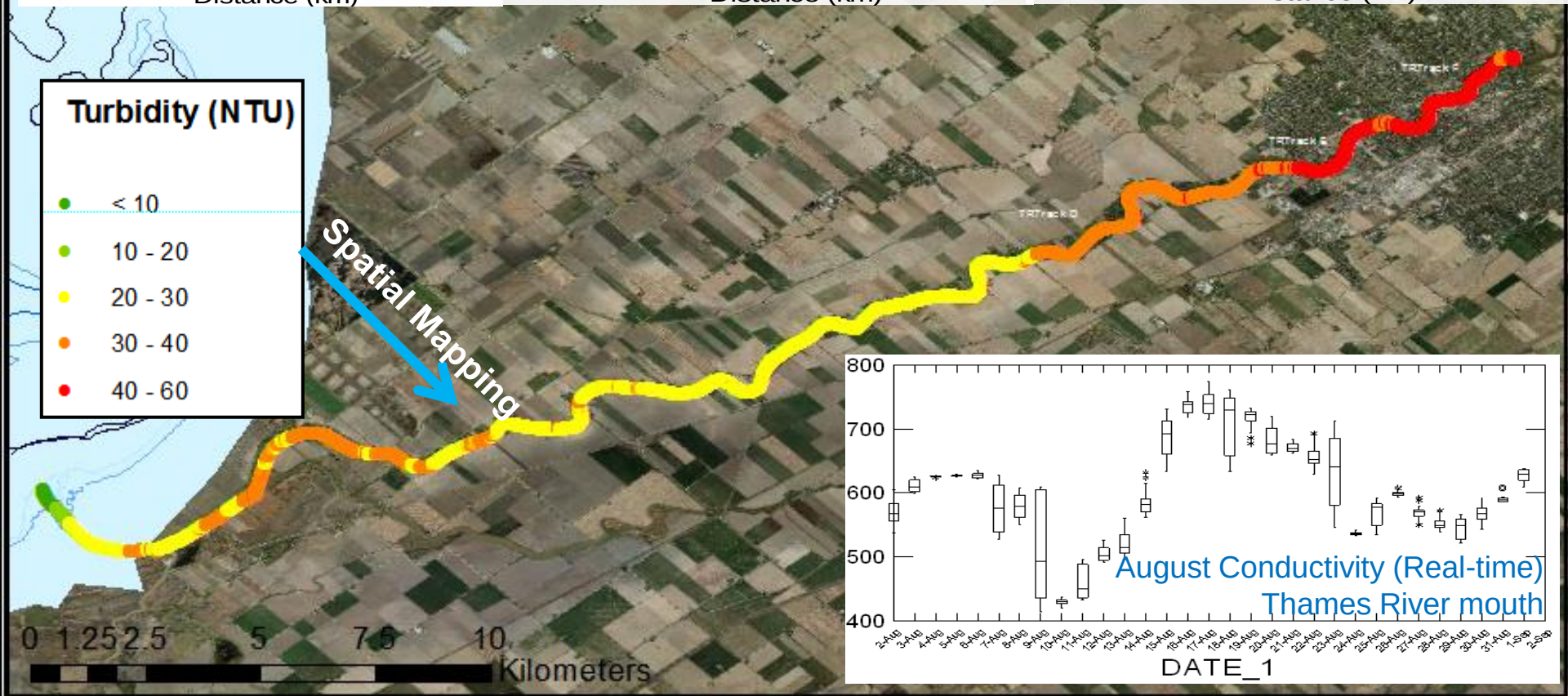


Synopsis: An integrated WQ approach

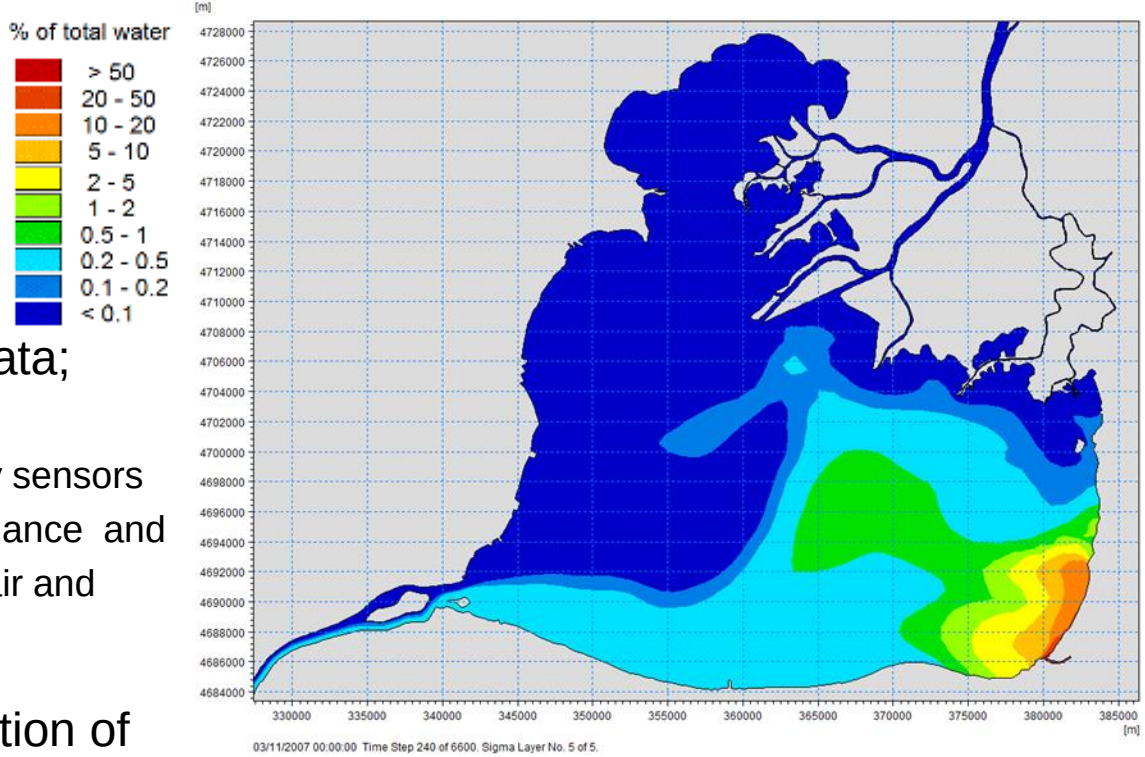








Summary



- Large suite of water quality data; multiple platforms
  - Real-time deployed water quality sensors
  - Field-based water quality surveillance and
  - Spatial mapping across L St. Clair and Thames River
- Ongoing analysis and integration of 2016 results
- 2017 field year in L St. Clair extending into upper Detroit River with increased sampling frequency to capture broader range of anticipated water quality conditions
- Opportunities for collaboration

Acknowledgements

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