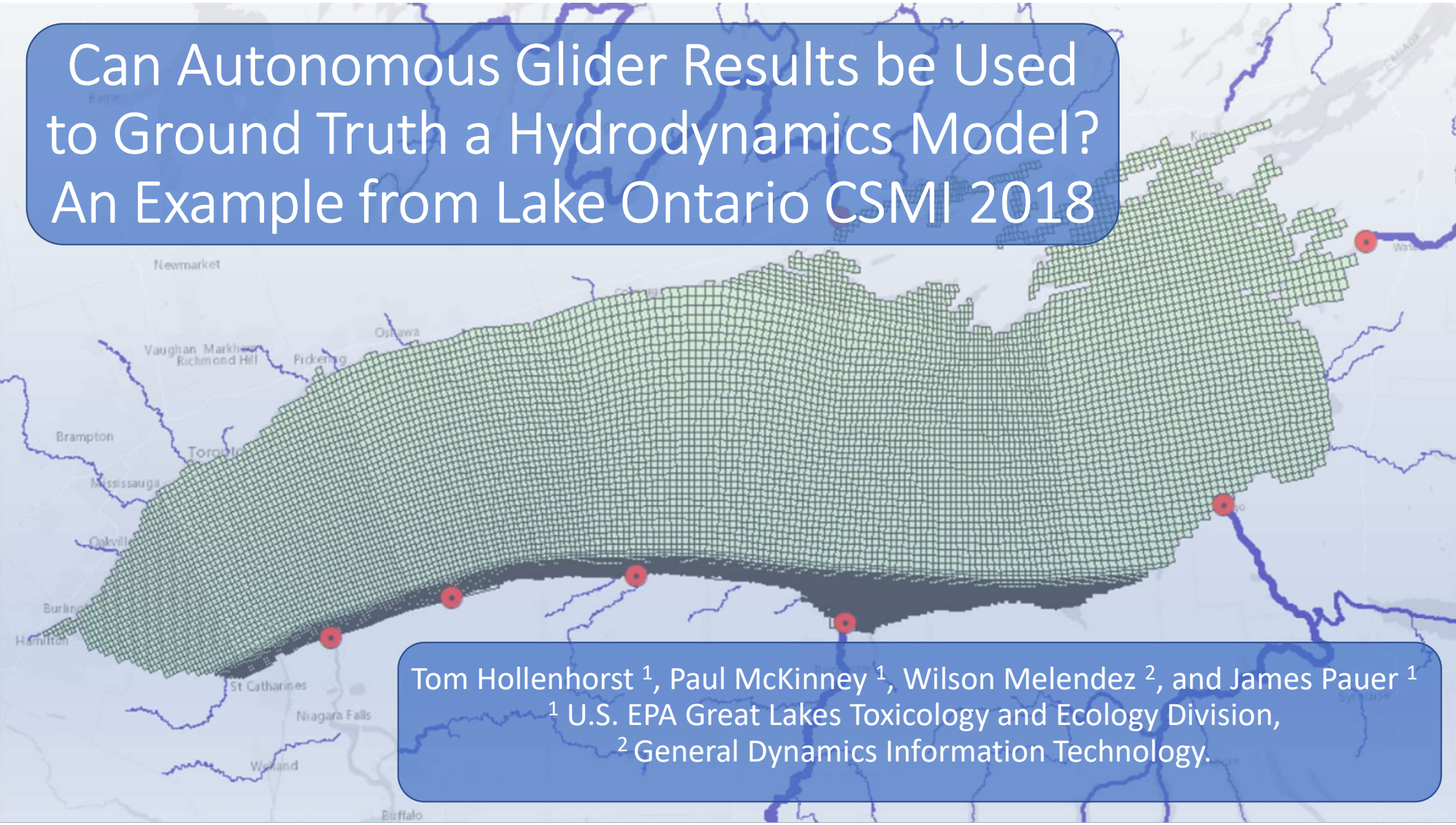
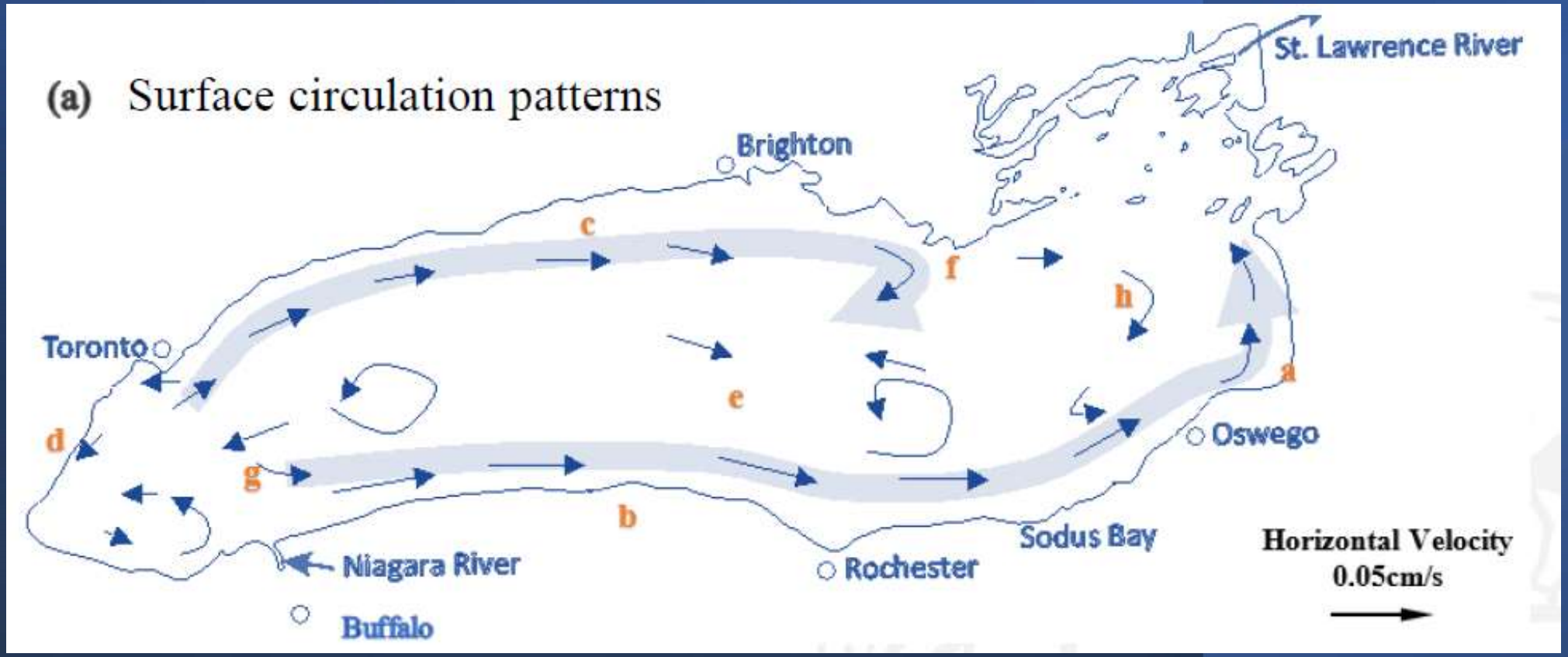
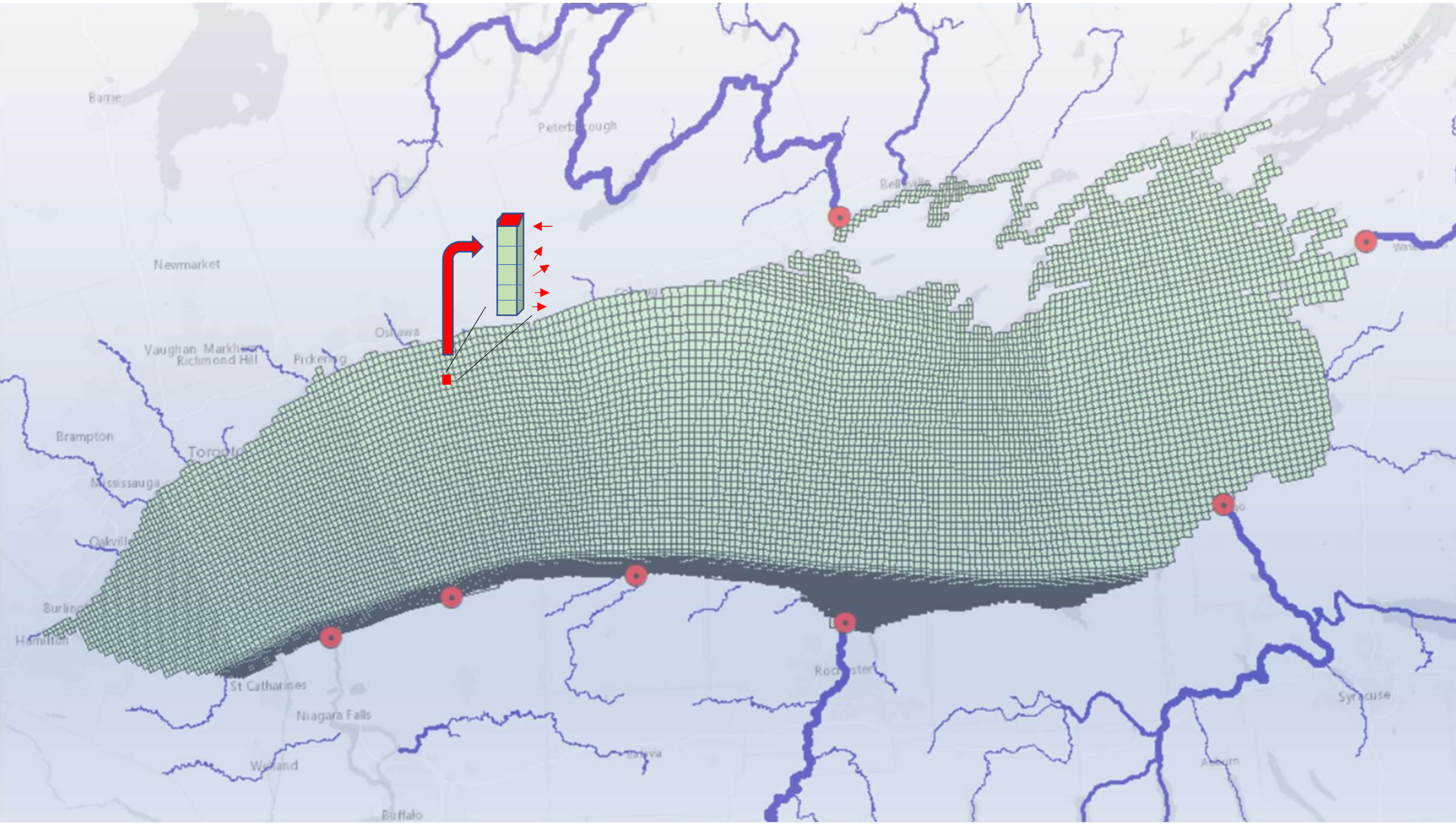
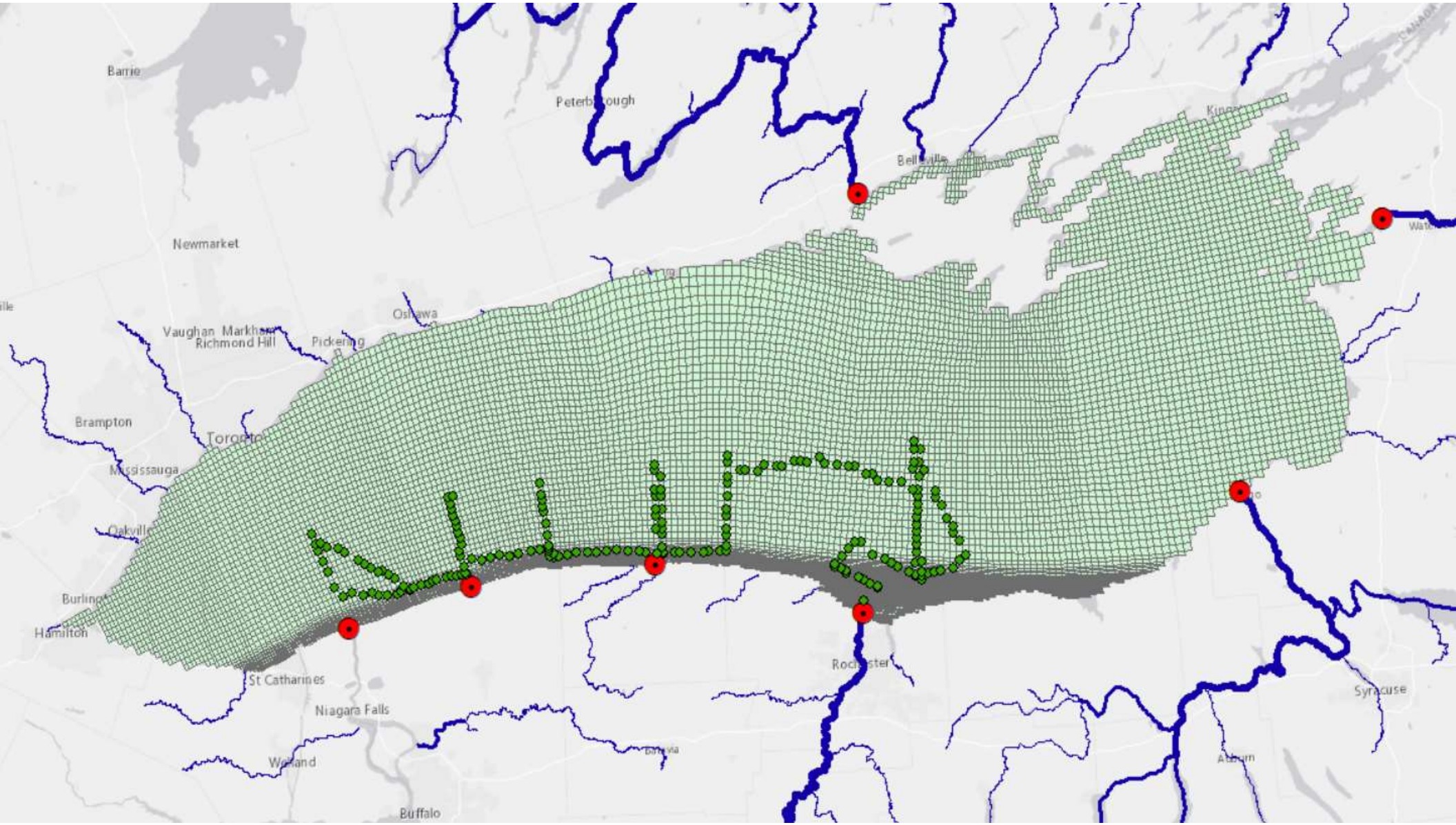
Can Autonomous Glider Results be Used to Ground Truth a Hydrodynamics Model? An Example from Lake Ontario CSMI 2018



Tom Hollenhorst [1], Paul McKinney [1], Wilson Melendez [2], and James Pauer [1]
[1] U.S. EPA Great Lakes Toxicology and Ecology Division,
[2] General Dynamics Information Technology.

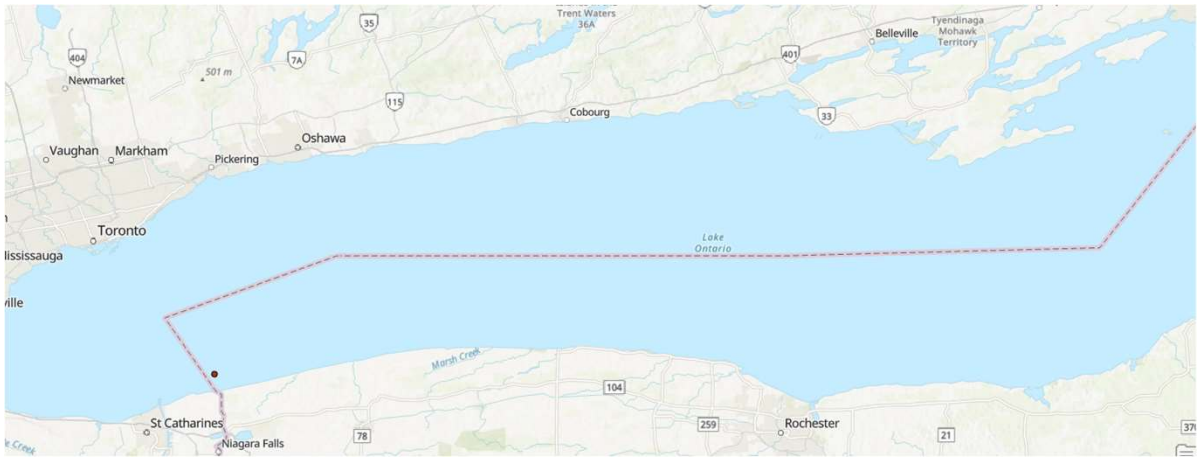

(a) Surface circulation patterns
St. Lawrence River
Brighton
Toronto
Oswego
Niagara River
Buffalo
Rochester
Sodus Bay
a
b
c
d
e
f
g
h
Horizontal Velocity
0.05cm/s


Barrie
Peterborough
Newmarket
Vaughan
Markham
Richmond Hill
Pickering
Oshawa
Brampton
Toronto
Mississauga
Oakville
Burlington
Hamilton
St Catharines
Niagara Falls
Welland
Buffalo
Rochester
Syracuse

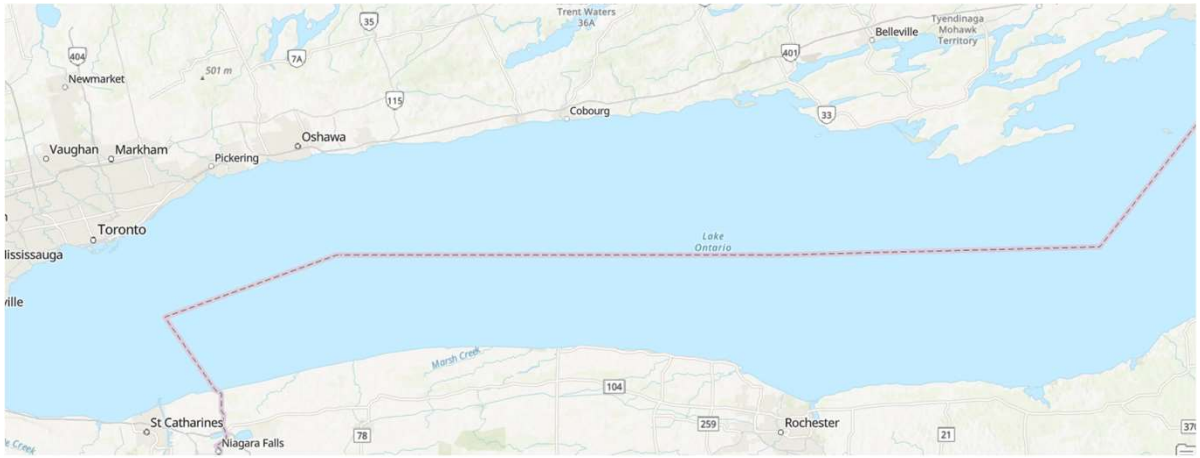

Barrie
Newmarket
Vaughan
Markham
Richmond Hill
Pickering
Oshawa
Brampton
Toronto
Mississauga
Oakville
Burlington
Hamilton
St Catharines
Niagara Falls
Welland
Buffalo
Peterborough
Belleville
Rochester
Syracuse
Auburn

Meet Nokomis

an autonomous underwater vehicle (AUV), that propels itself by changing its buoyancy and "gliding" forward as it sinks downward or floats upward in the water



May 23- June 12, 2018



July 27 –Aug 14, 2018

- A three-dimensional EFDC hydrodynamic model was developed for Lake Ontario
- The model was developed using the open-source Environmental Fluid Dynamics Code (EFDC).
- EFDC widely used open-source solver for hydrodynamic modeling in rivers, lakes, and estuaries.

Contents lists available at ScienceDirect

Journal of Great Lakes Research

journal homepage: www.elsevier.com/locate/jglr

Mass balance analysis and calculation of wind effects on heat fluxes and water temperature in a large lake

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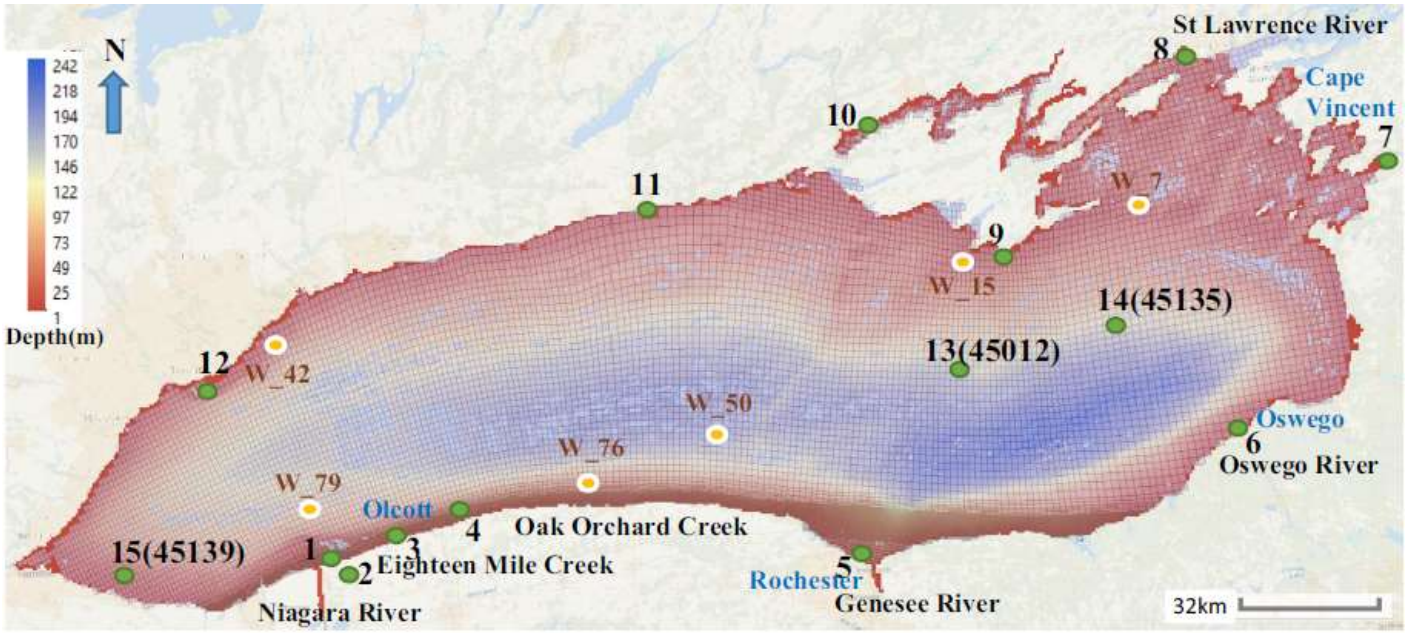
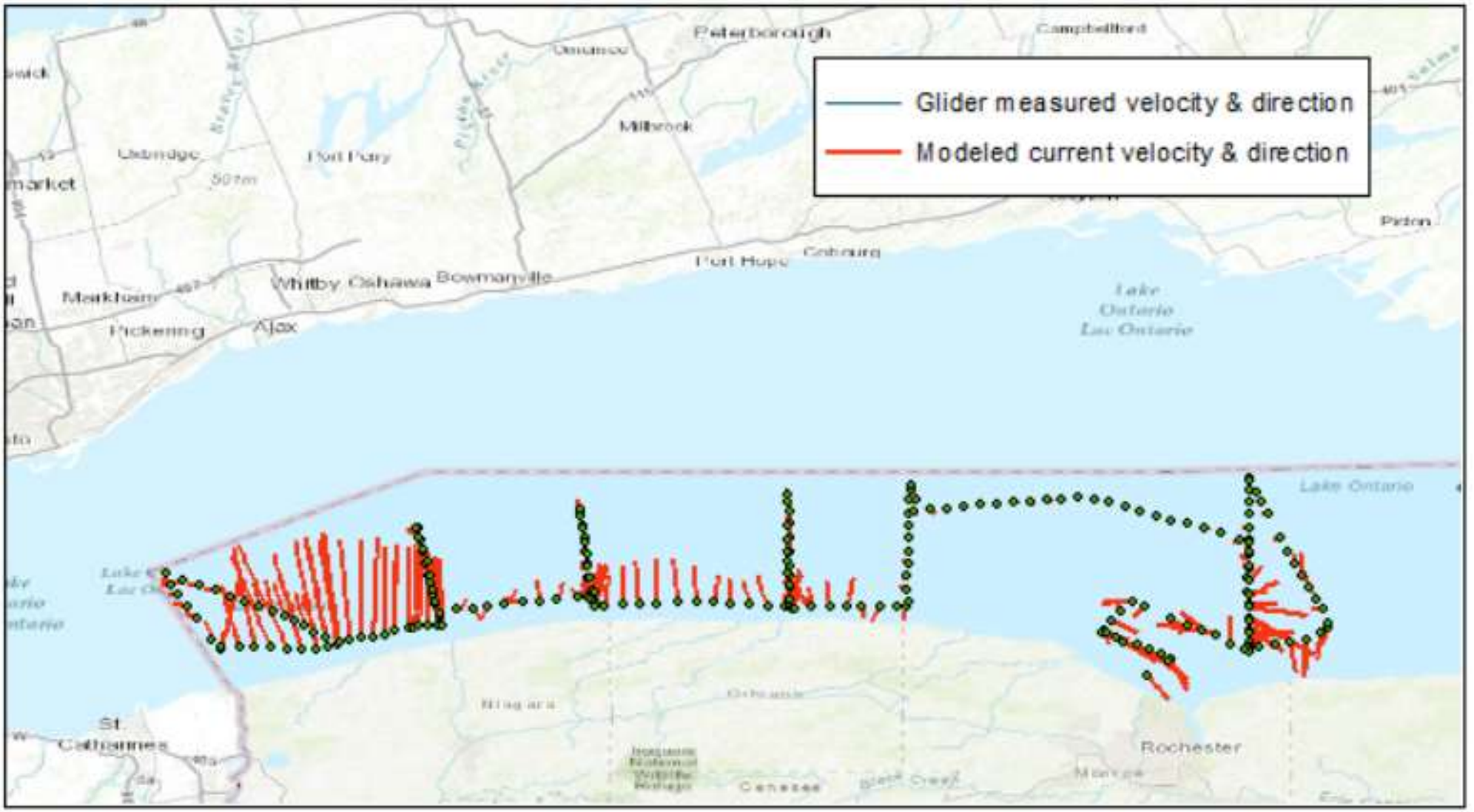
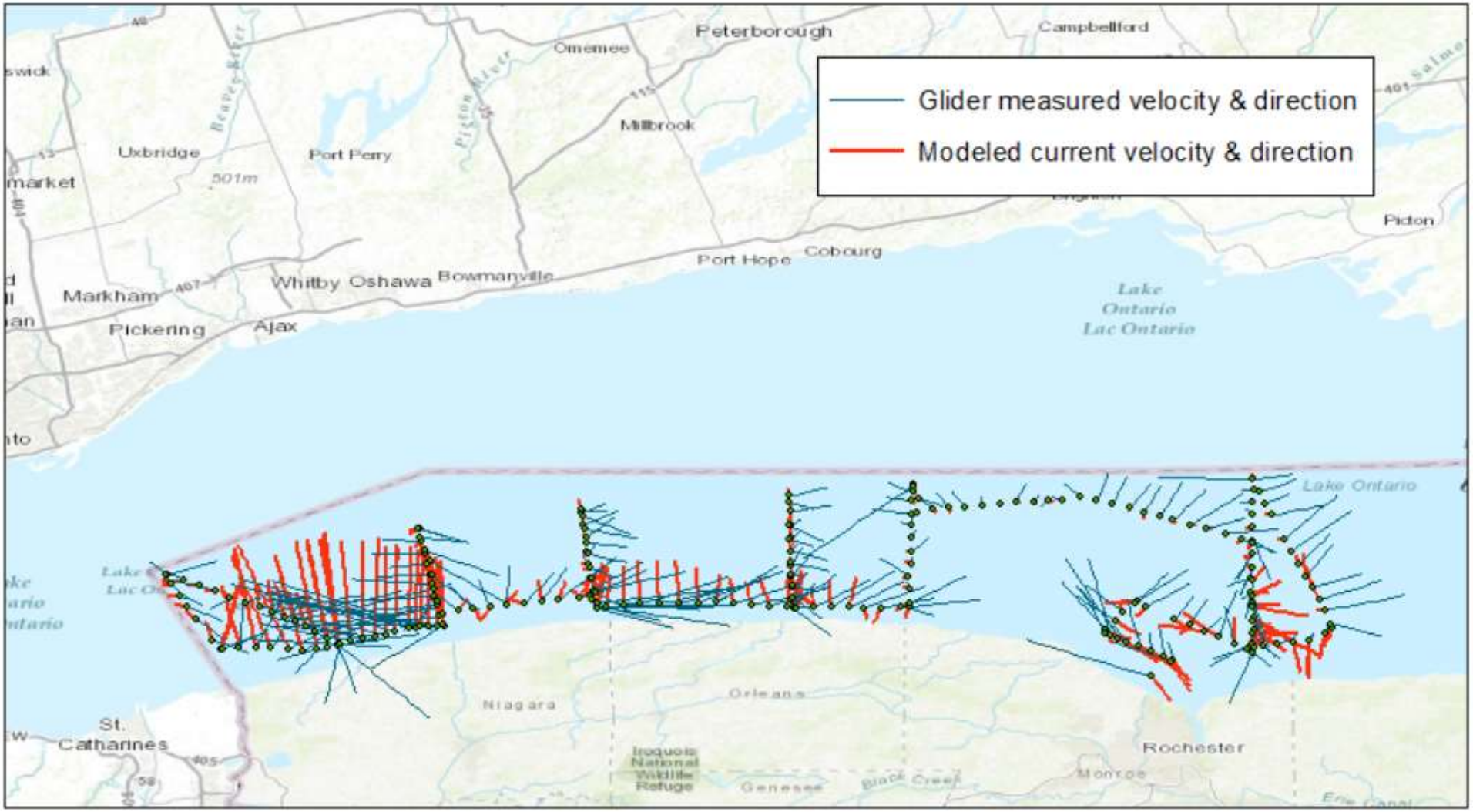
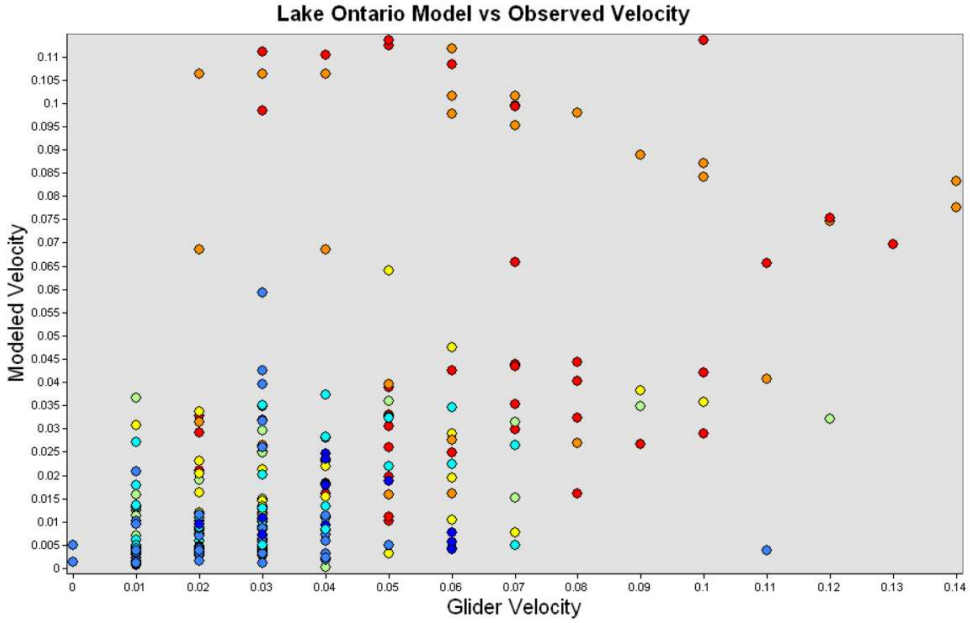


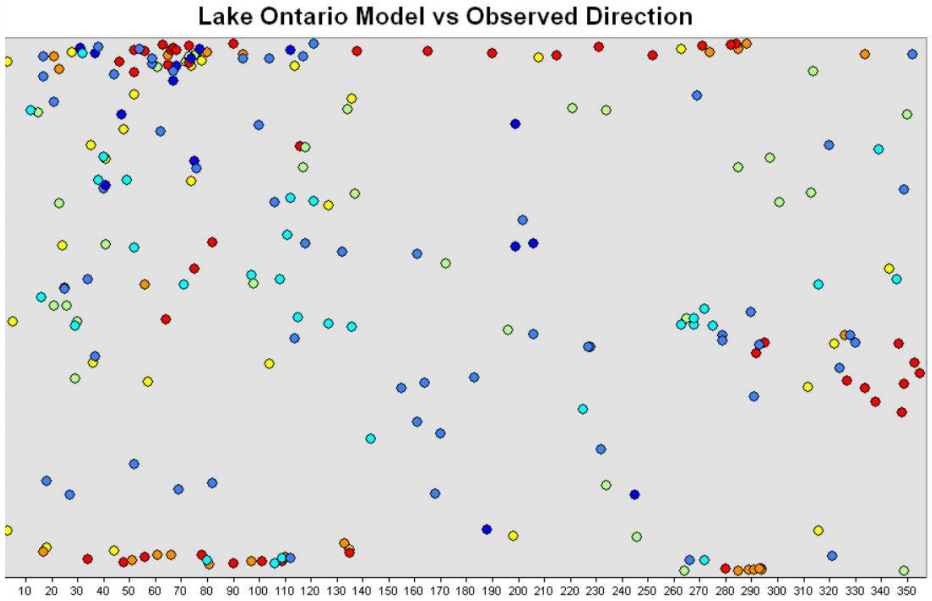


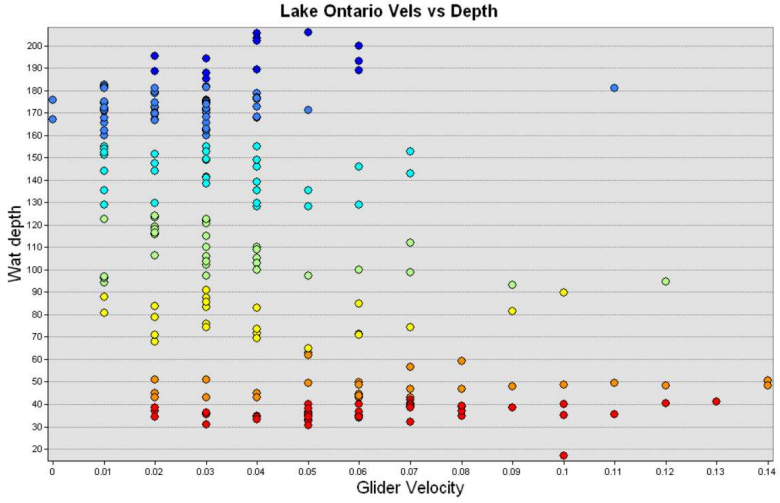
Modeled current velocity and direction expressed as lines

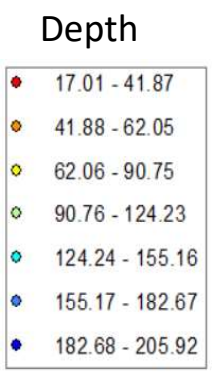


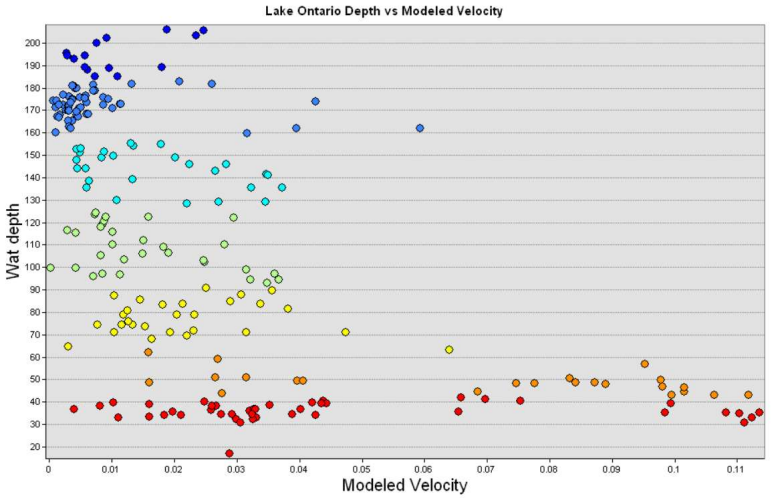
Glider measured and modeled current velocity and direction expressed as lines.


Lake Ontario Model vs Observed Velocity
Modeled Velocity
Glider Velocity


Lake Ontario Model vs Observed Direction

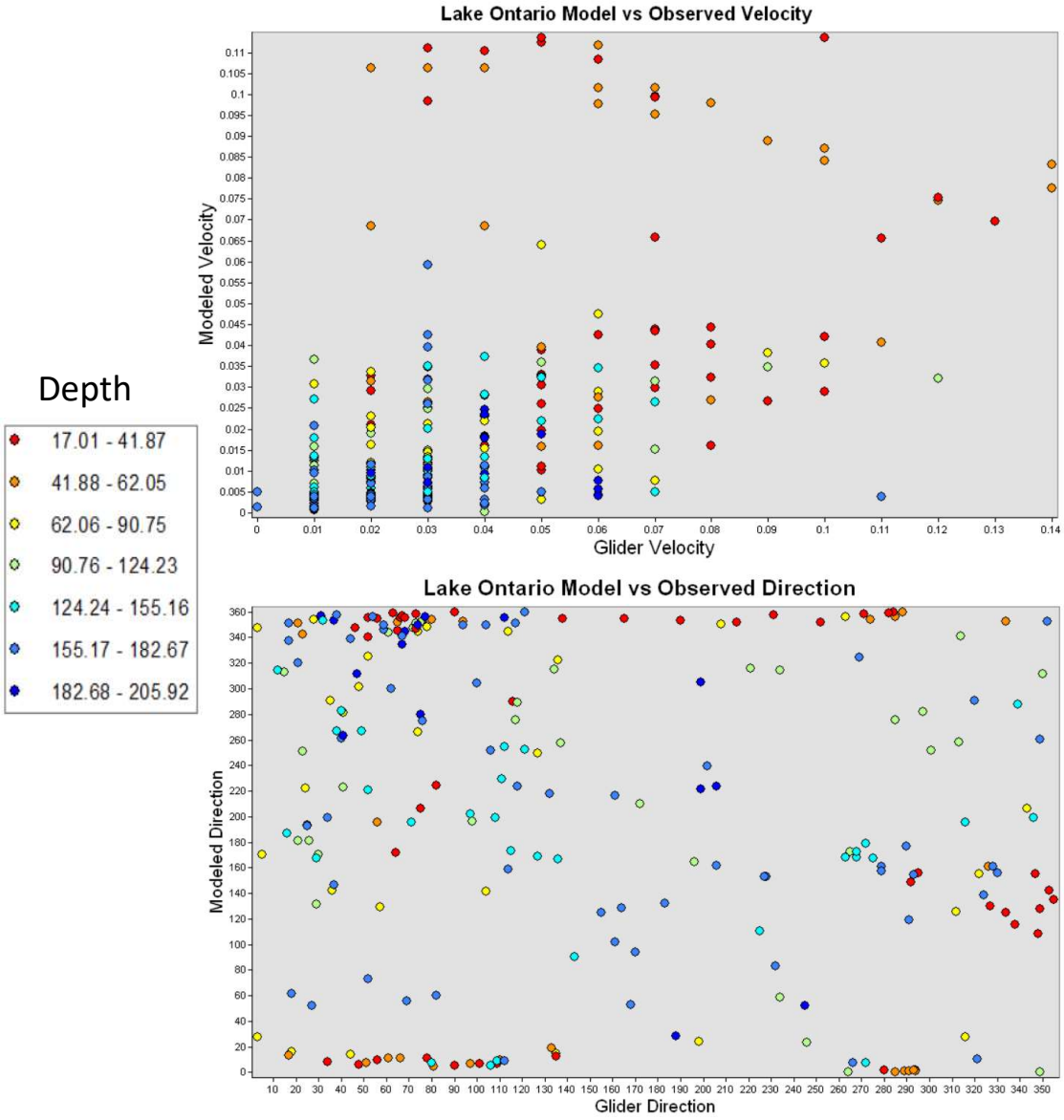

Lake Ontario Vels vs Depth
Wat depth
Glider Velocity


Depth
17.01 - 41.87
41.88 - 62.05
62.06 - 90.75
90.76 - 124.23
124.24 - 155.16
155.17 - 182.67
182.68 - 205.92


Lake Ontario Depth vs Modeled Velocity
Wat depth
Modeled Velocity

Glider versus Modeled Velocity and Direction

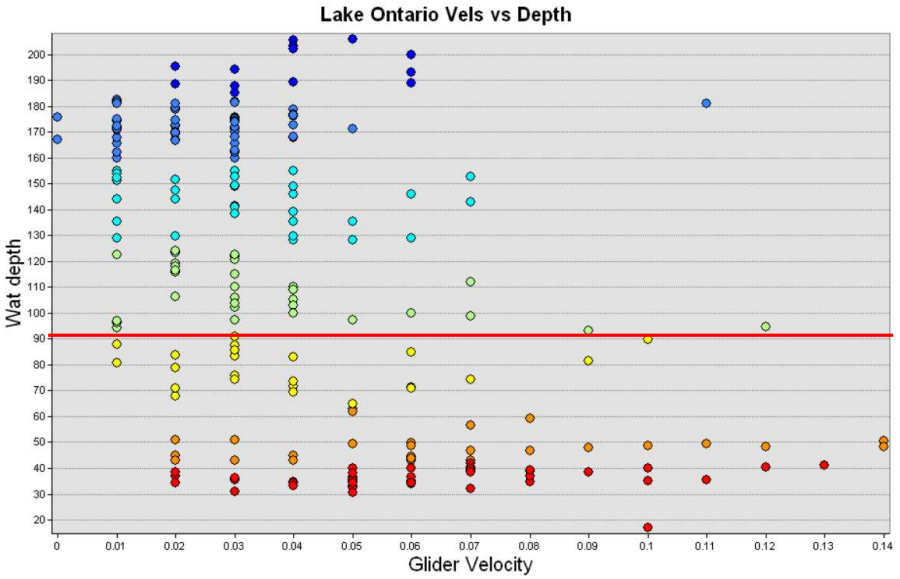
1. Inconclusive.. Why?
    1. Make sure that forcing's used for EFDC model were for 2018. Was it an average of more than one year?
    2. Would a sliding average show a better relationship (Average every 3 surfacing's, then try every 9, 15, etc.)
    3. Are there other averaged values we could compare? (e.g. seasonal, depth etc.)



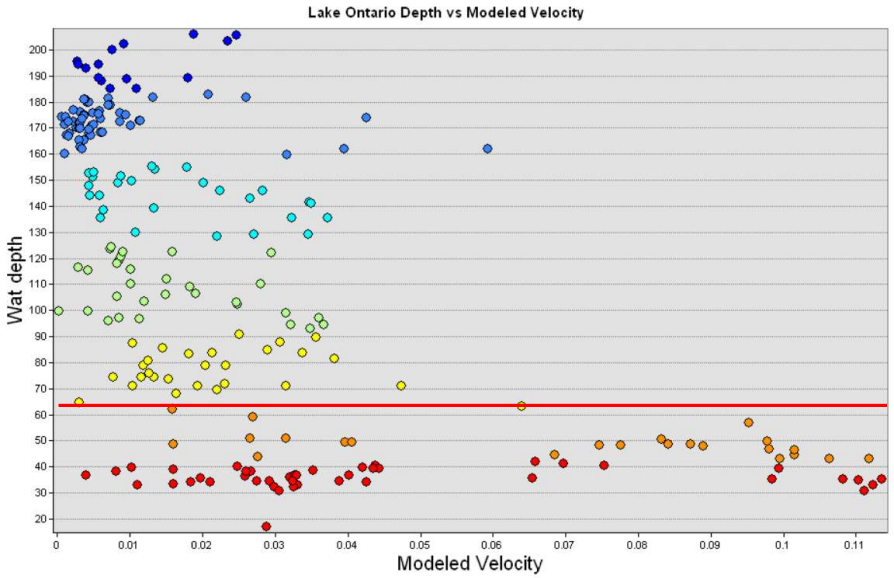
Depth versus Glider and Modeled Velocity

1. Depth versus Glider and Modeled Velocity (plot)
    1. Is there a shallow/fast VS deep/slow transition?
        1. How would it be detected?
        2. Is it driven by depth or distance from shore?
        3. Does stratification effect this, or is stratification affected by the shallow/fast transition
            1. Thermal Bar ??
               Seasonal effects??

Glider



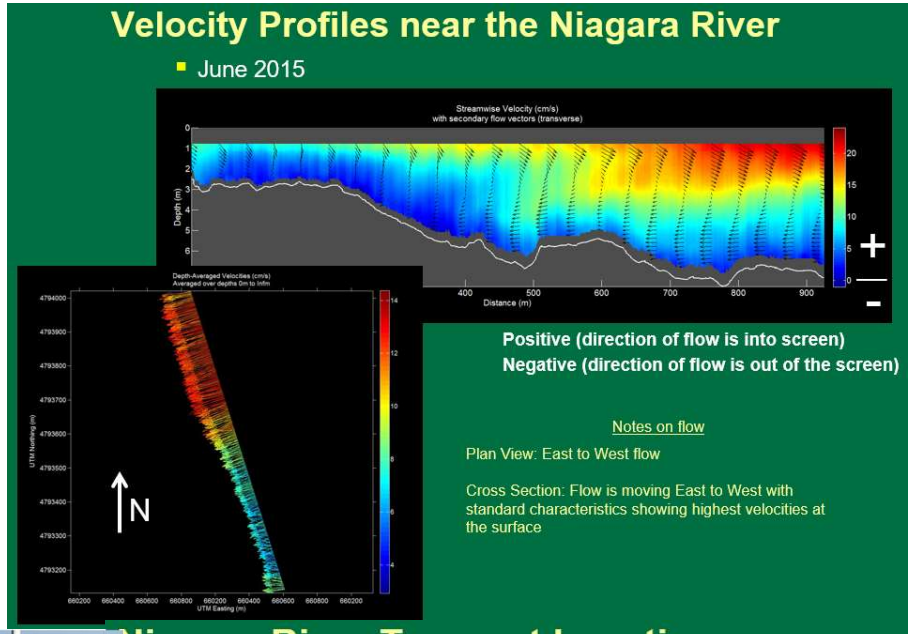
Model

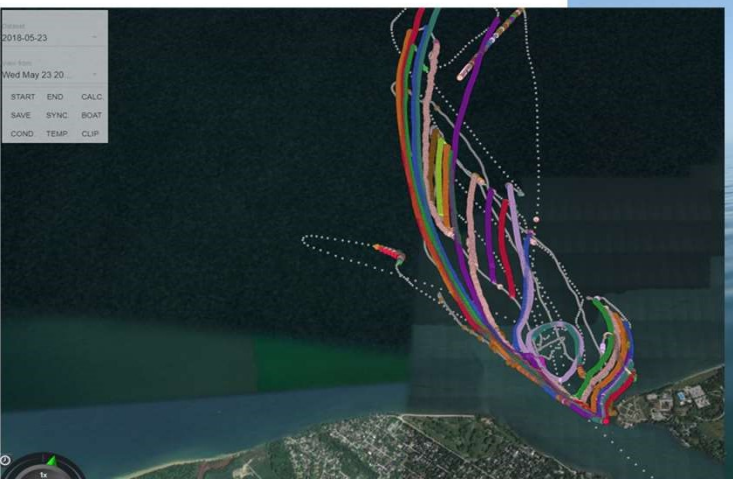


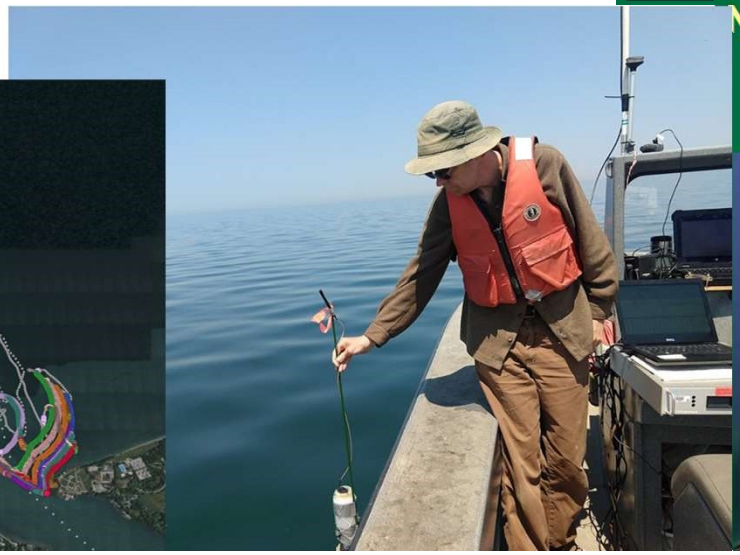
EFDC Grid is hi-res out
To about 60 meters…..

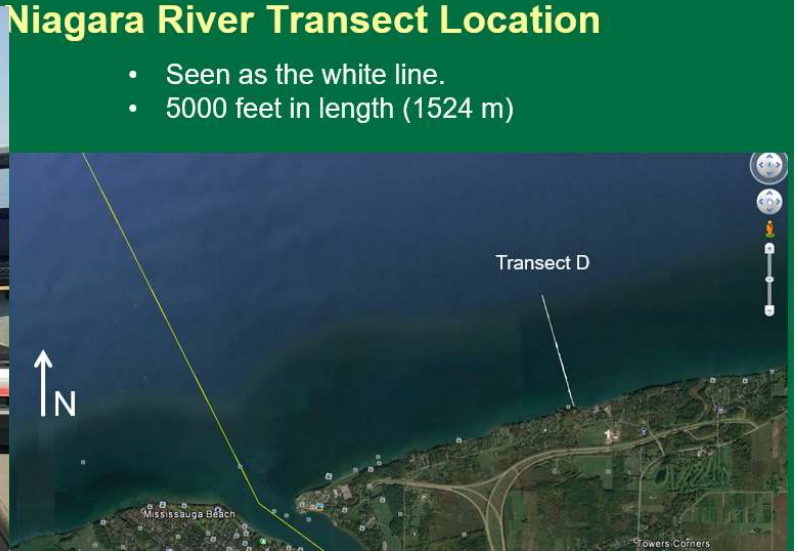
Conclusions

1. Next Steps
    1. Compare ADCP data from USGS
    2. Compare Drifter data from EPA GLTED









Thanks!