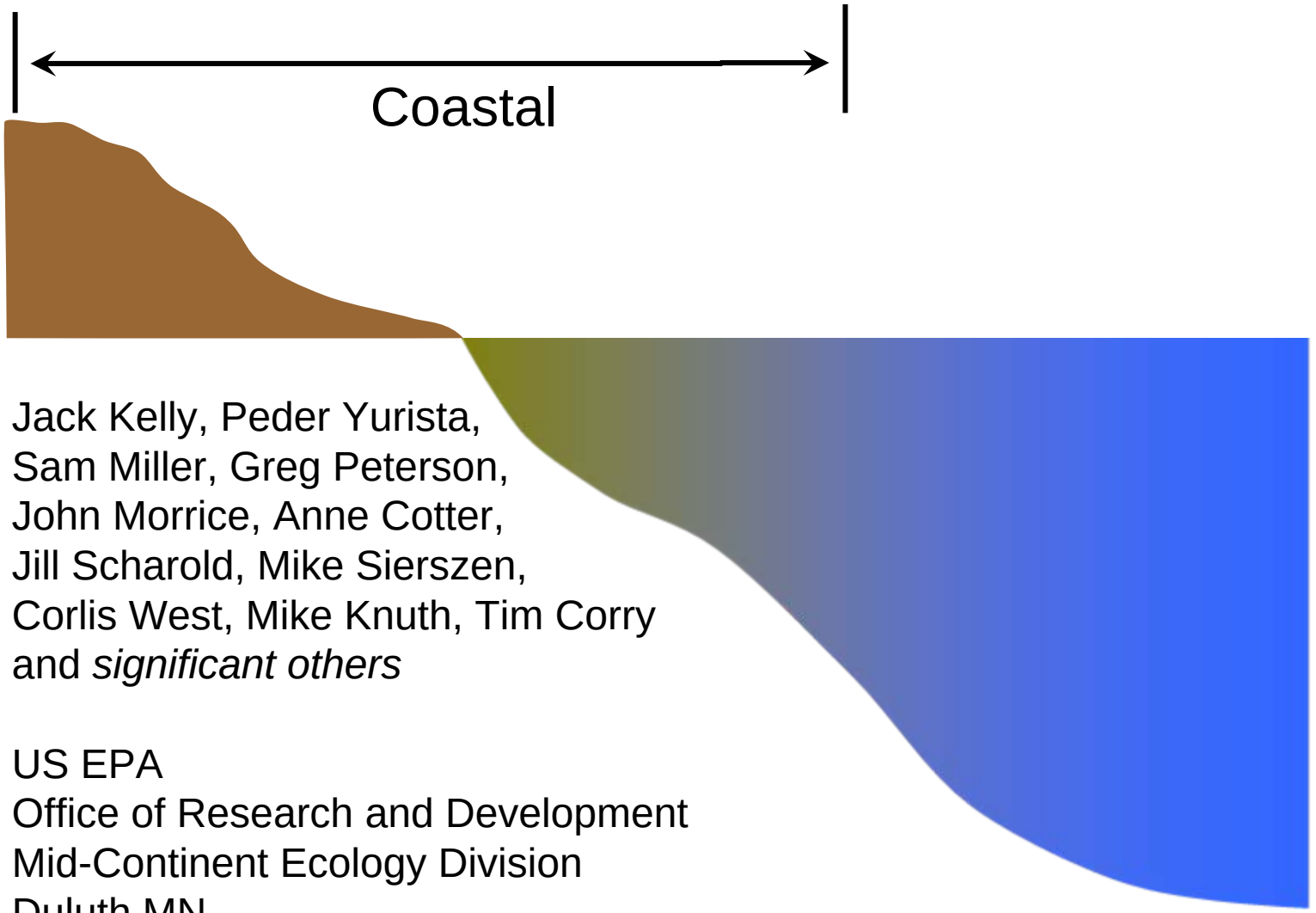
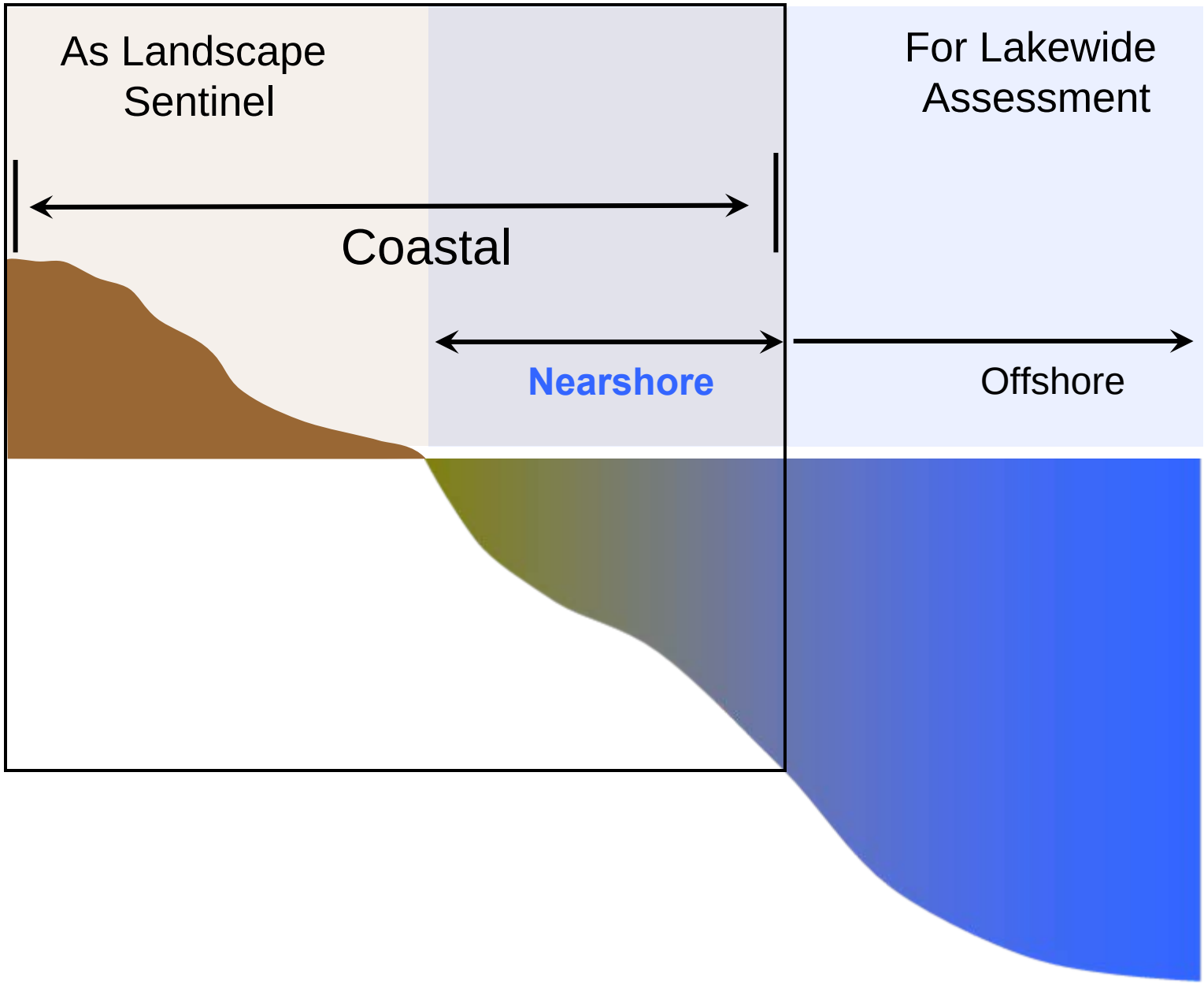
Finding Signals of Landscape in Coastal Ecosystems

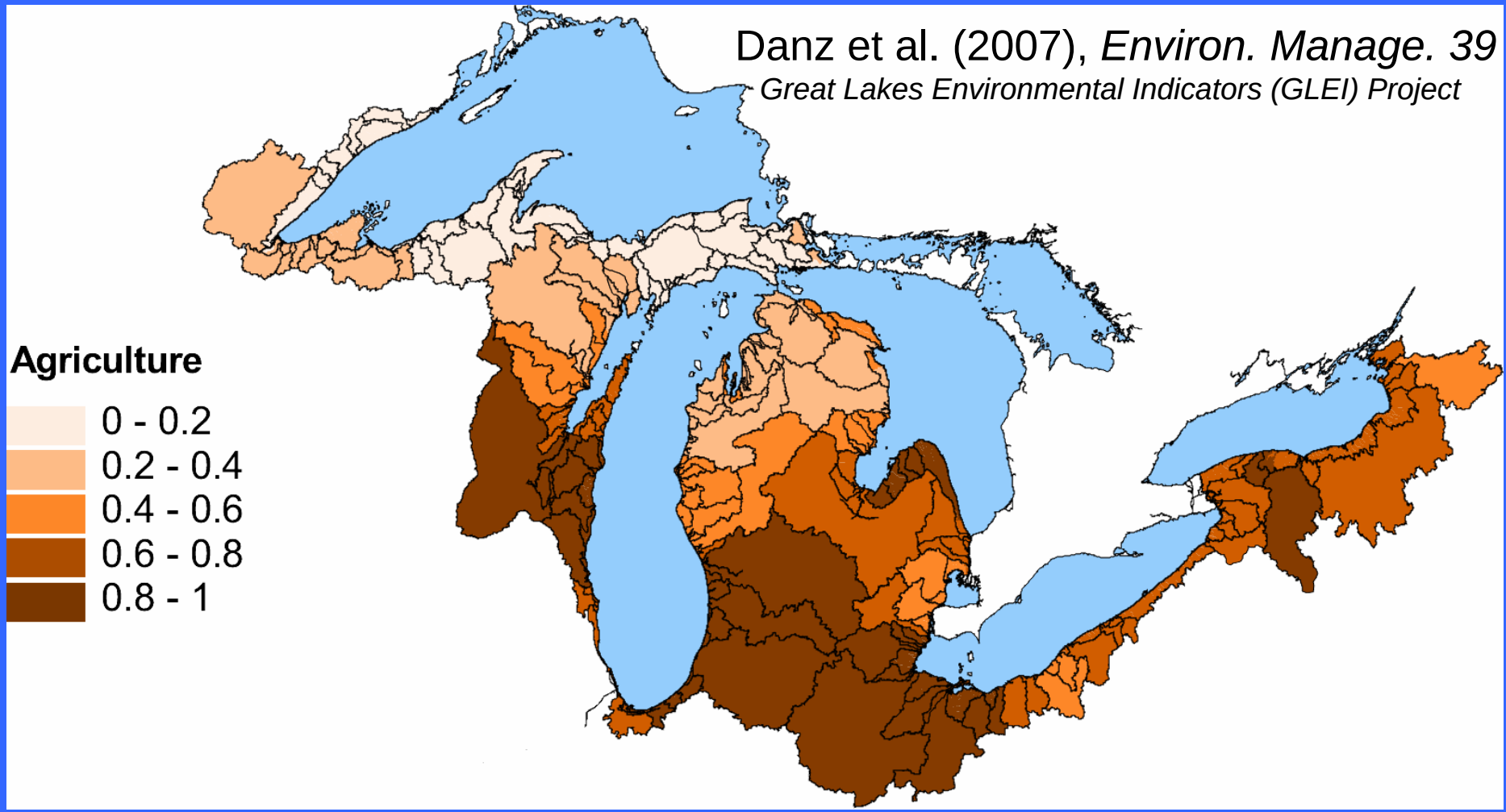


Jack Kelly, Peder Yurista,
Sam Miller, Greg Peterson,
John Morrice, Anne Cotter,
Jill Scharold, Mike Sierszen,
Corlis West, Mike Knuth, Tim Corry
and *significant others*

US EPA
Office of Research and Development
Mid-Continent Ecology Division
Duluth MN


As Landscape
Sentinel
For Lakewide
Assessment
Coastal
Nearshore
Offshore

Characterization of watersheds to establish landscape gradients

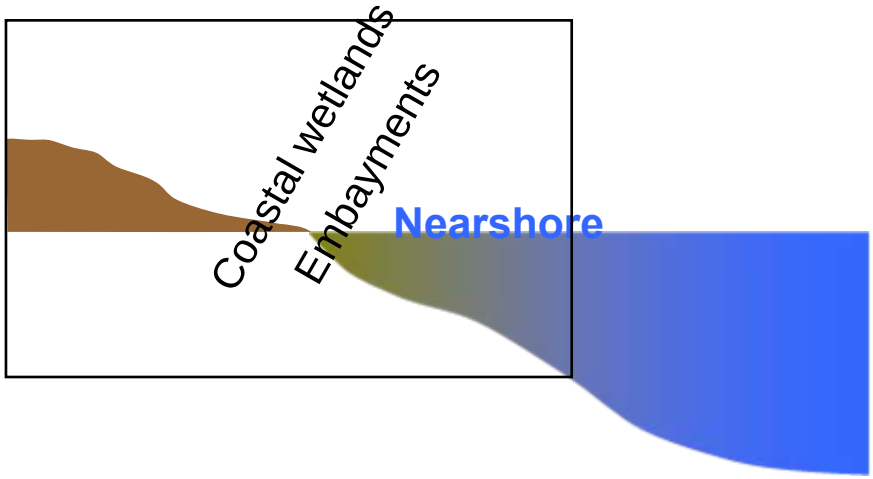


"Agriculture" metric (Ag-Chem Stressor) derived from 21 variables including fertilizer use, nutrient and cation loss, and soil erosion

Higher score indicates higher nutrient export potential

Through Studies Across Great Lakes Landscape Gradients …

…We can document a continuum in the “downstream expression” of landscape disturbance.



Water quality-borne landscape signals appear generally strongest in tributaries and coastal wetlands and become weaker moving into the lake.

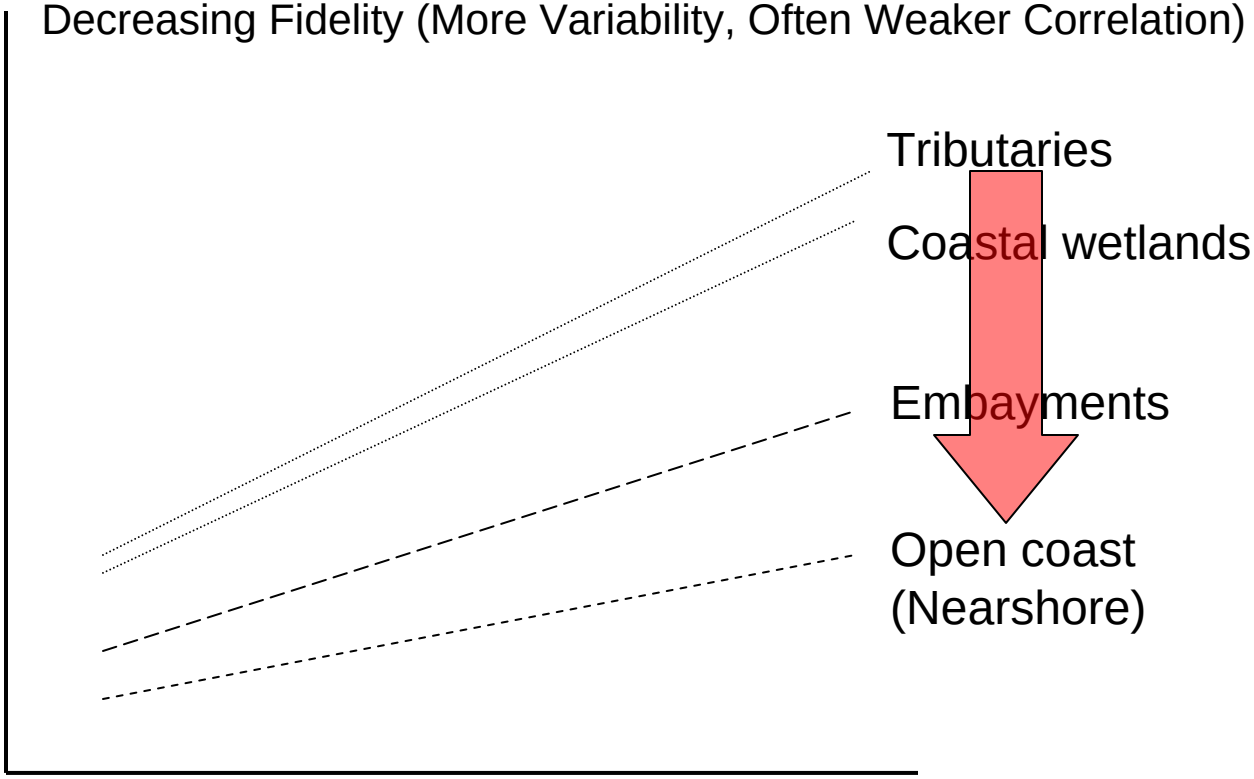
Landscape signal across coastal aquatic ecosystems

Patterns moving "downstream"

Decreasing Signal Strength, as well as Slope of Enrichment

Decreasing Fidelity (More Variability, Often Weaker Correlation)

Log (Nutrient Concentration) [or other WQ measure]

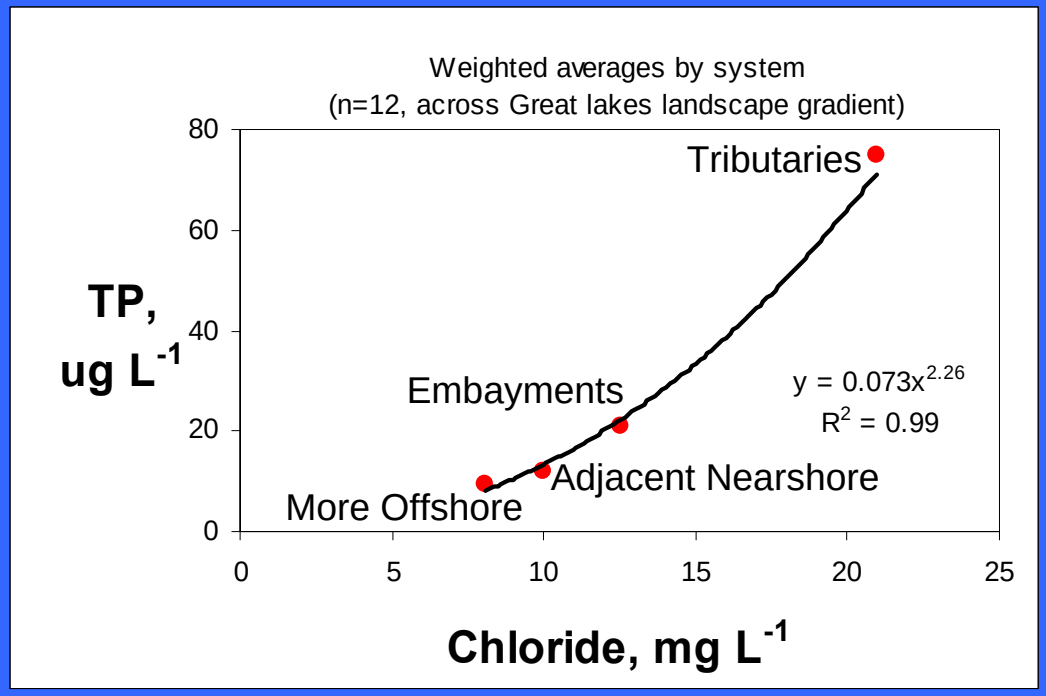


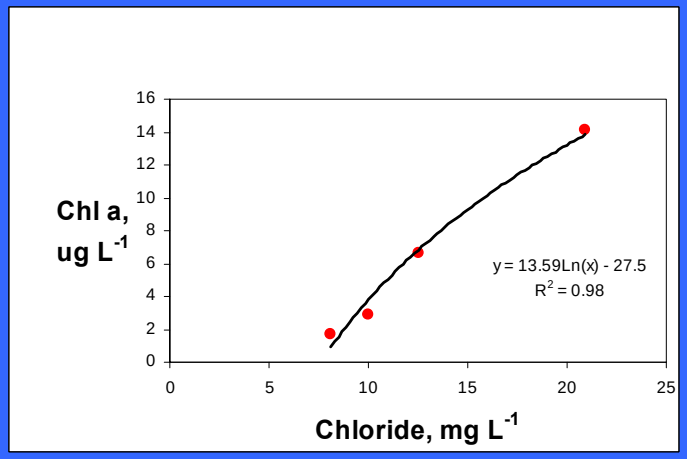
Landscape disturbance gradient

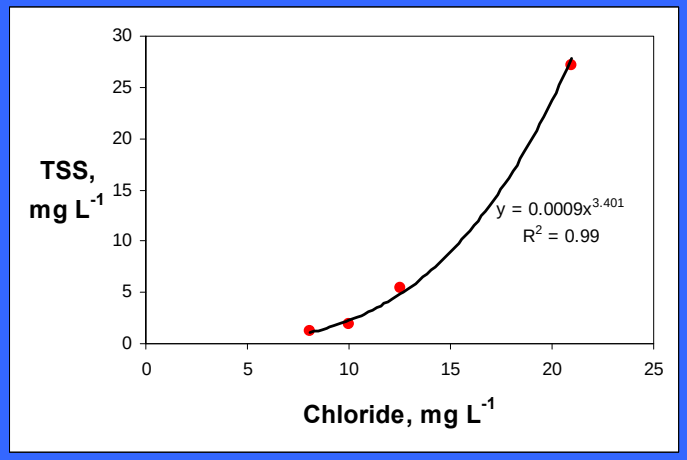
(e.g., Agriculture metric, or other multivariate metric)

Is this downstream pattern just dilution?

Do constituents follow chloride?…Conservative mixing plots

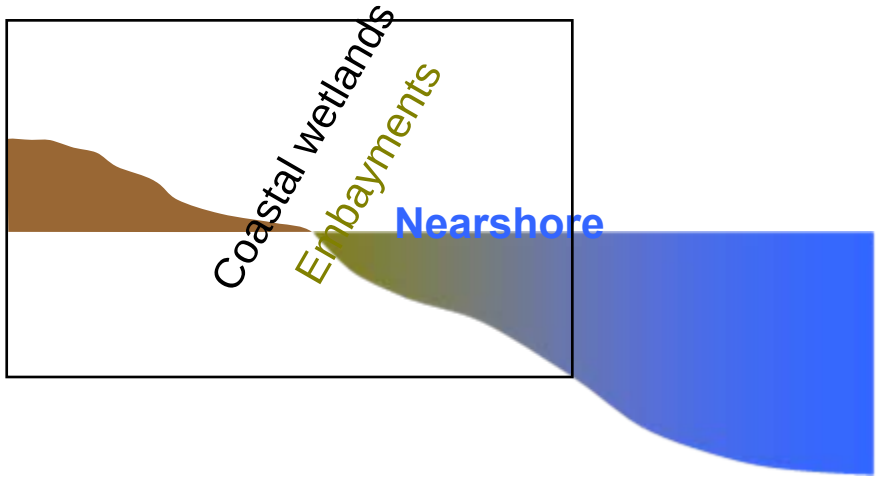






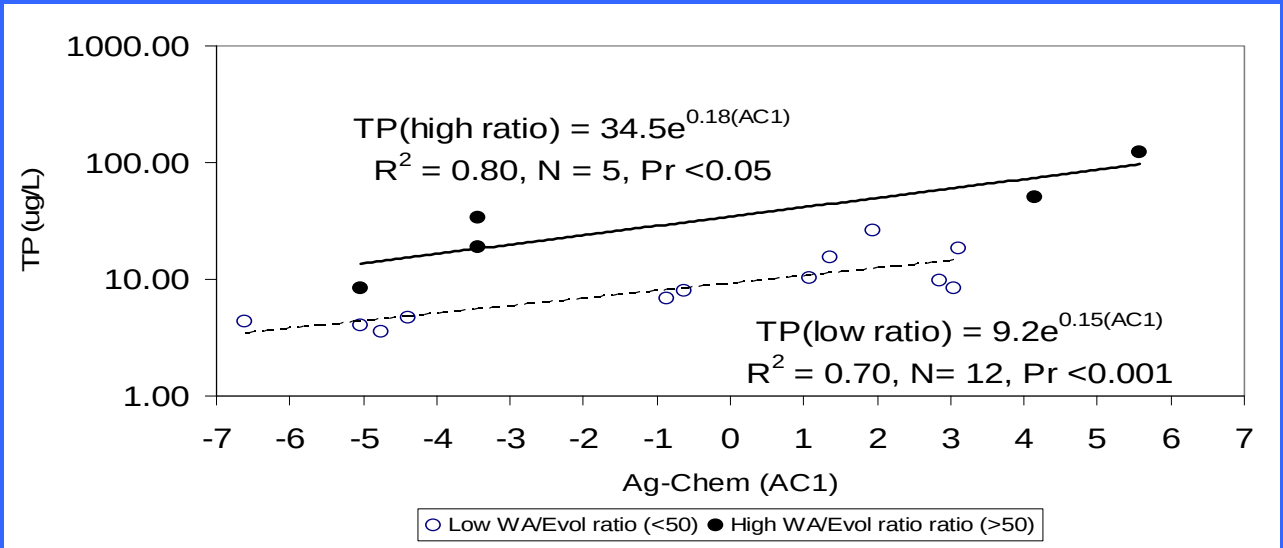
Through Studies Across Great Lakes Landscape Gradients …

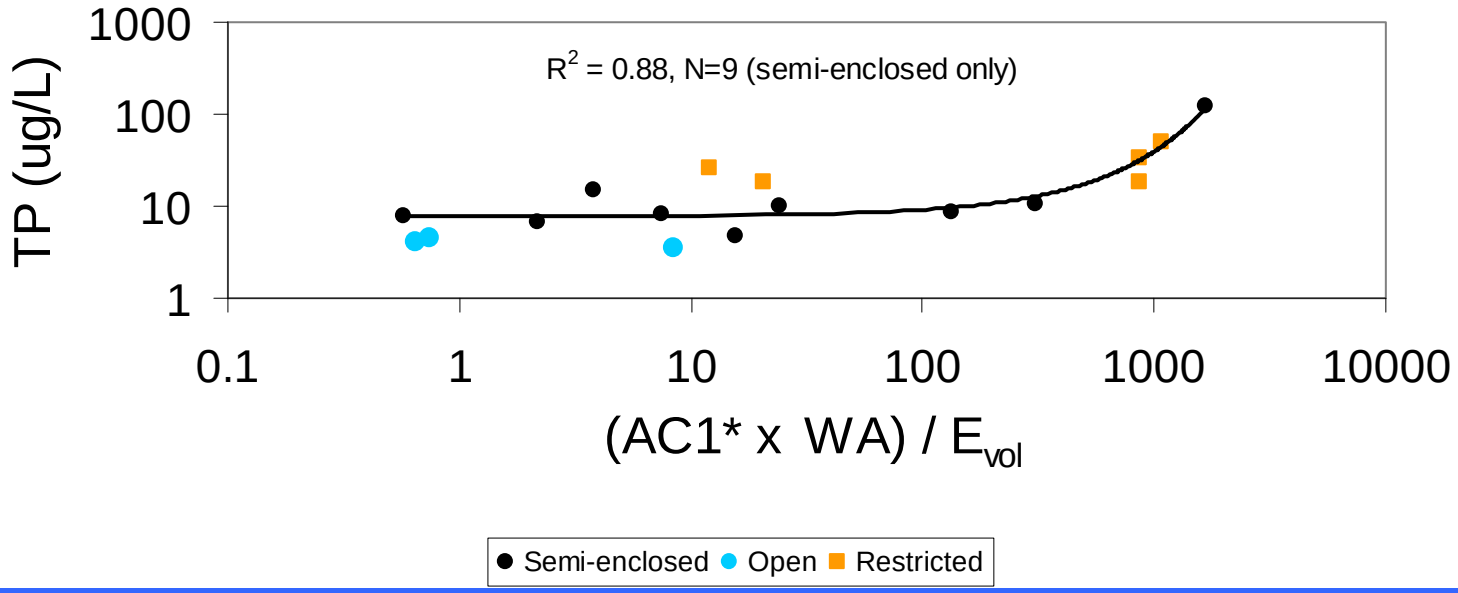
…A further brief exploration of landscape and embayments



One can formulate simple empirical landscape — embayment loading models.

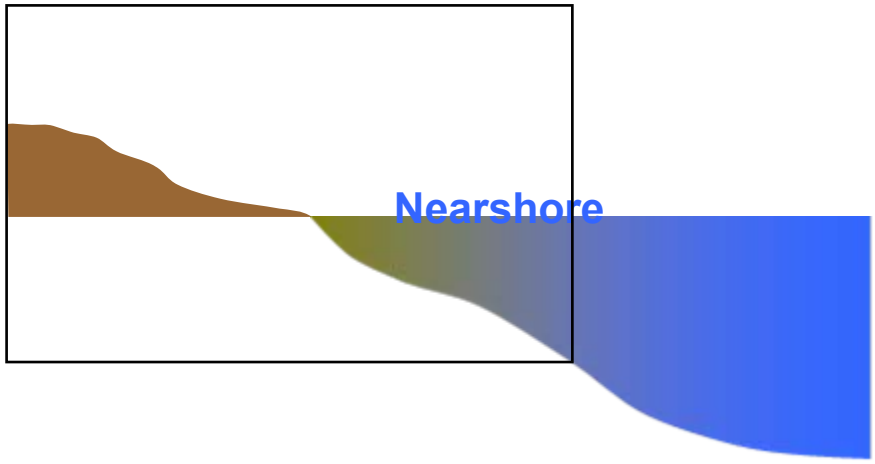
Manipulating the landscape metric, a TP loading model





Through Studies Across Great Lakes Landscape Gradients …

…Some powerful integrative and/or high-resolution sampling tools confirm landscape loading signals and responses over the inherent noise and variability in the nearshore.



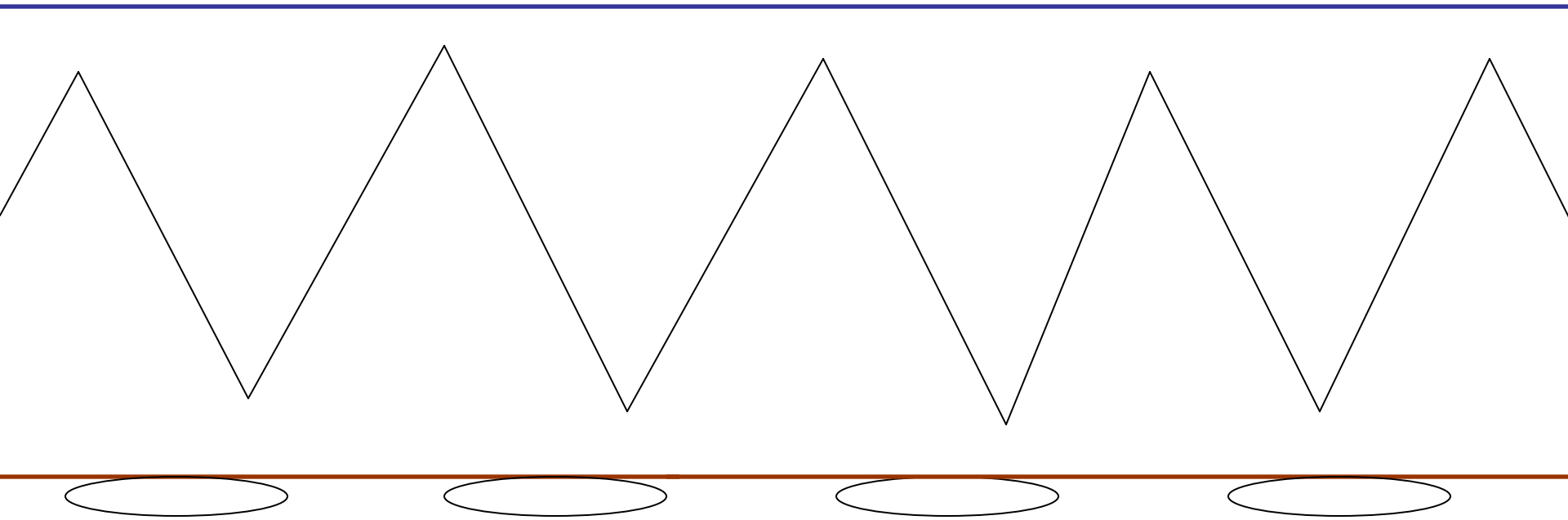
A new generation of nearshore sampling tools, capable of resolving some landscape linkages and at different scales.

High-resolution, semi-synoptic tools

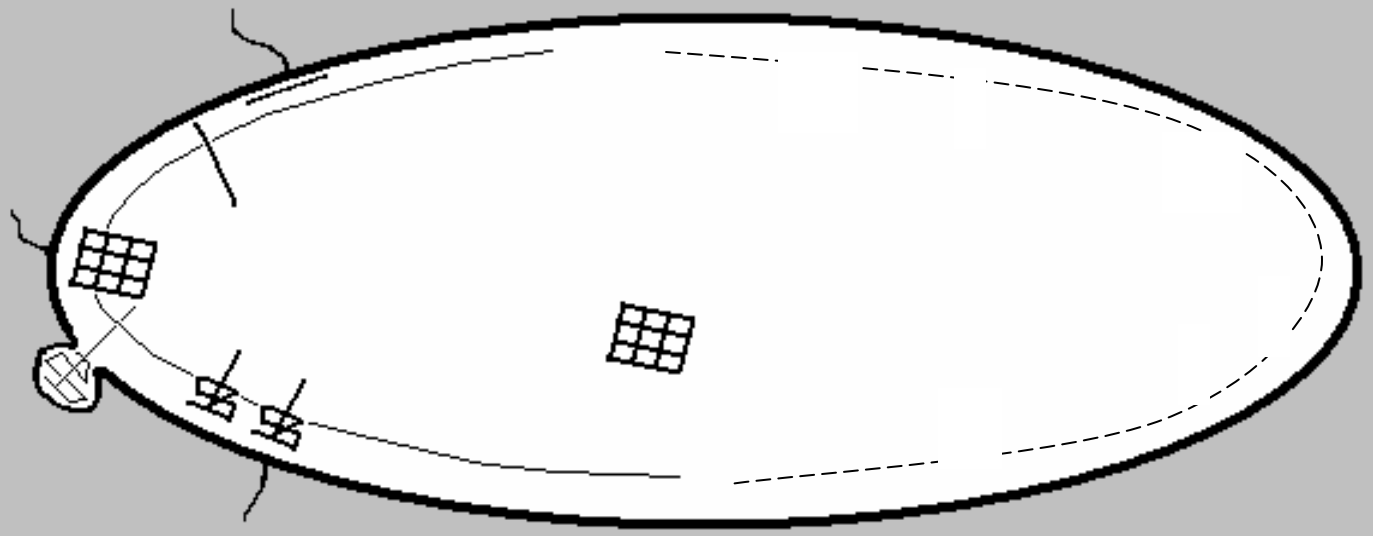
Water Sensors: CTD, Transmissometer, Fluorometer,
[Laser] Optical Plankton Counter (LOPC). (Others available)
Sediment Sensor: Acoustic seabed classification (QTC)
Also studies w/ USGS/UMD using Acoustics for Fish Stock Assessments

Result is semi-synoptic, spatially-referenced data to characterize:
Water properties (including biology)
Bathymetry and sediment character

Typically sample at 4-5 kts, to ~100 km per day

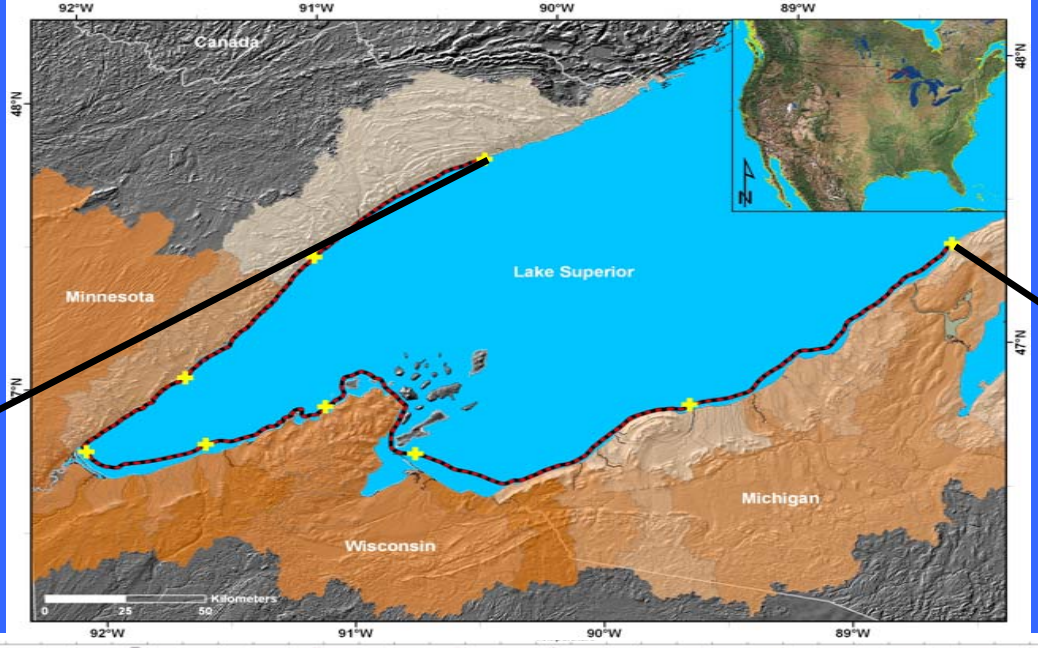


Styles of sampling for nearshore and embayments?



We have tried a few; we really like one.

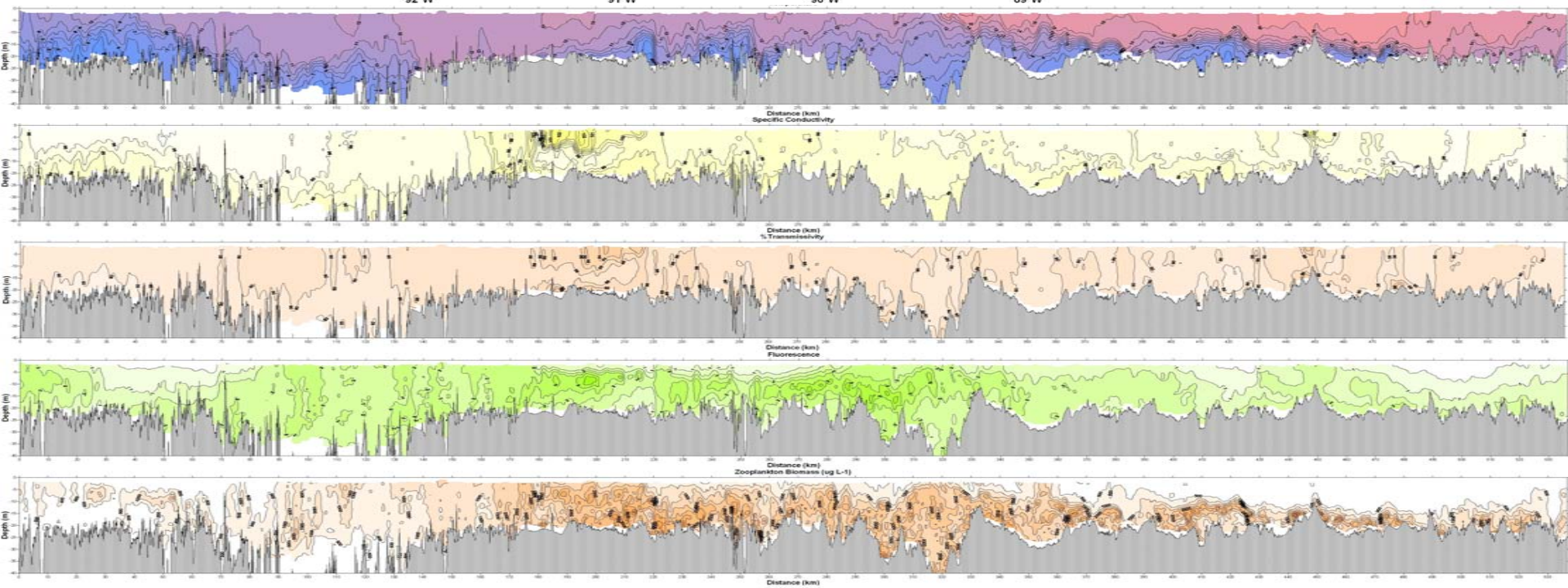
537-km transect in Lake Superior (2004)



Yurista and Kelly (2007) *State of Lake Superior, Munawar and Heath (eds.)*

Grand Marais MN

Gratiot River MI

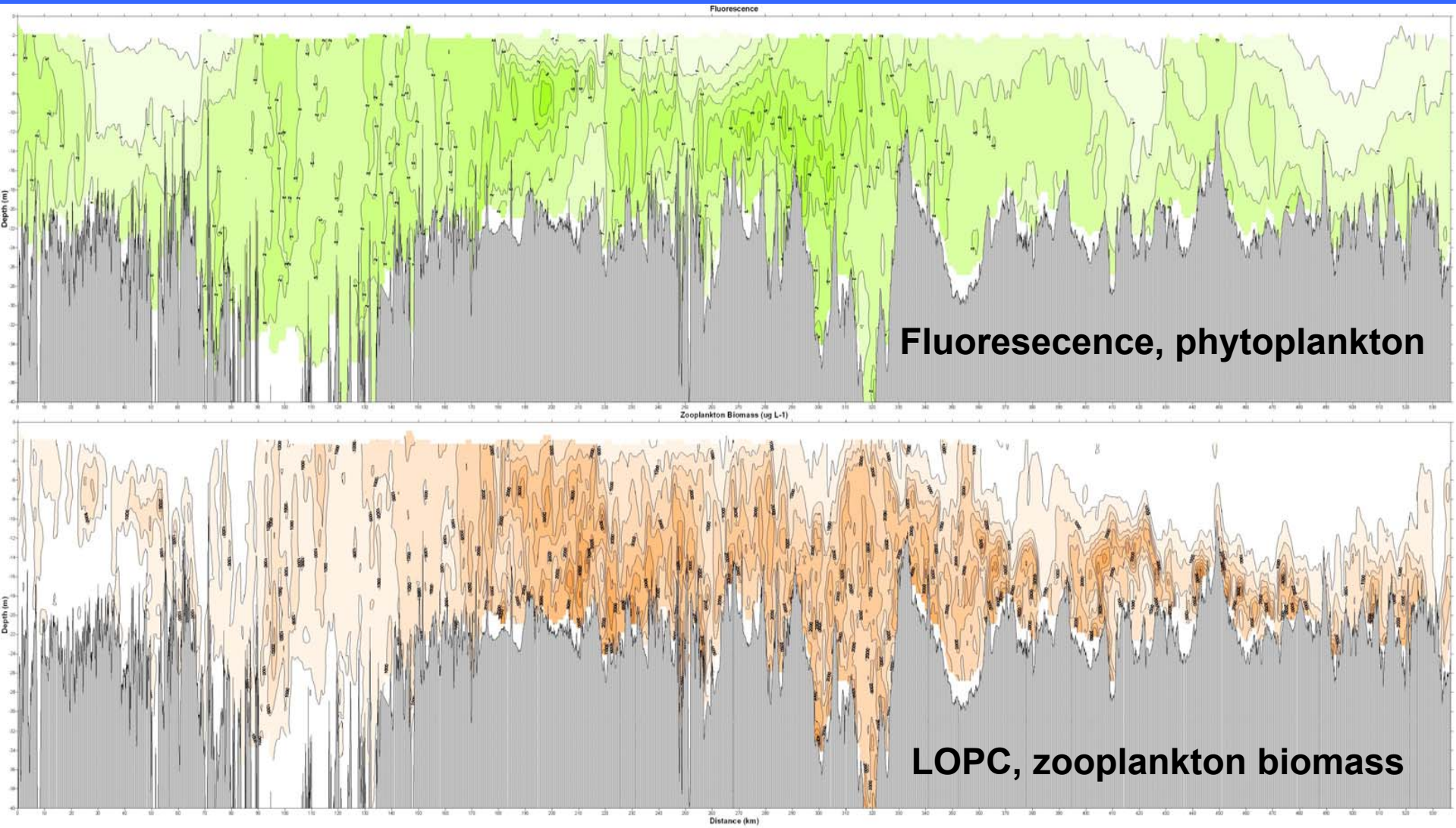


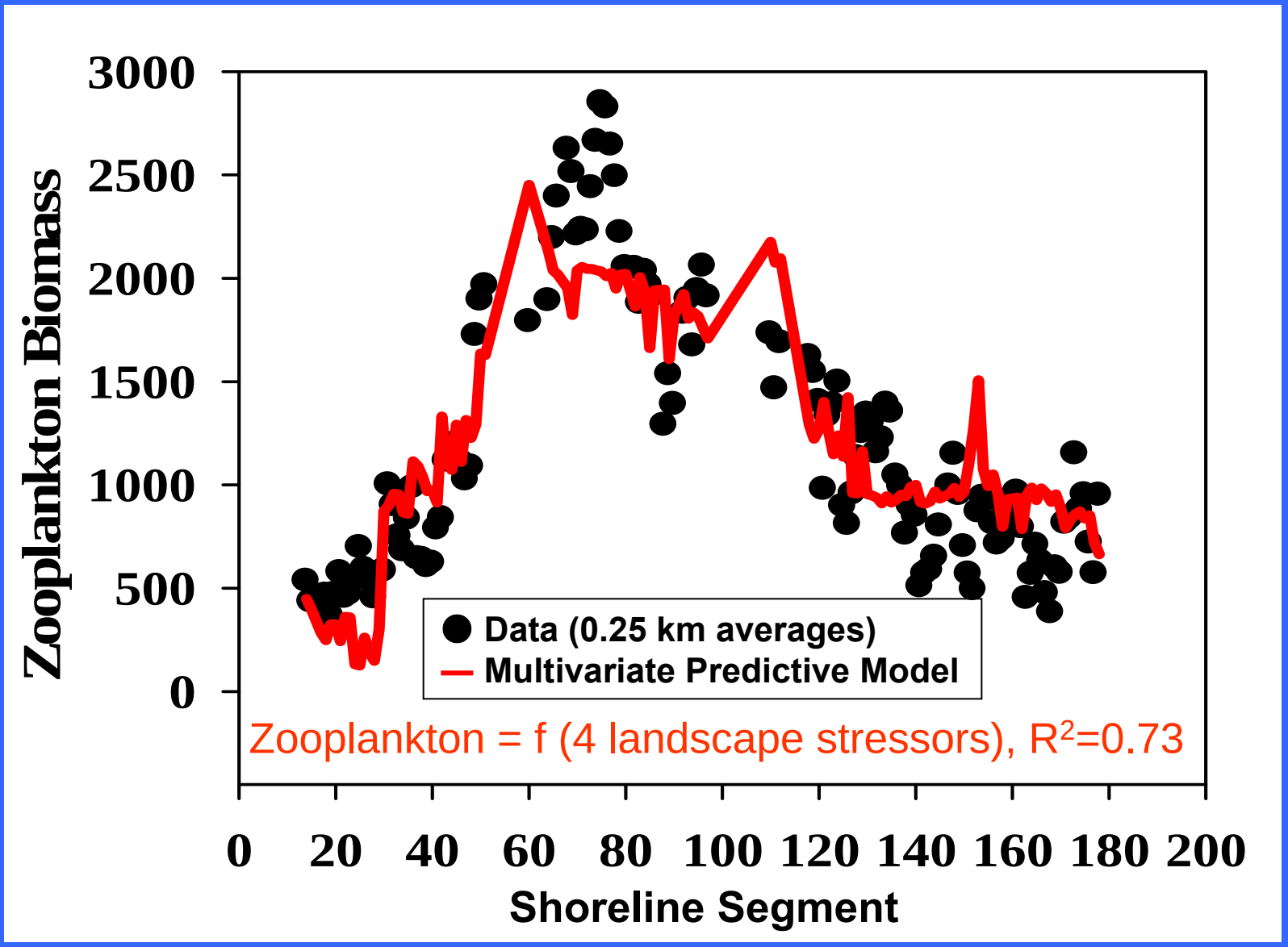
Duluth/Superior

Bayfield WI

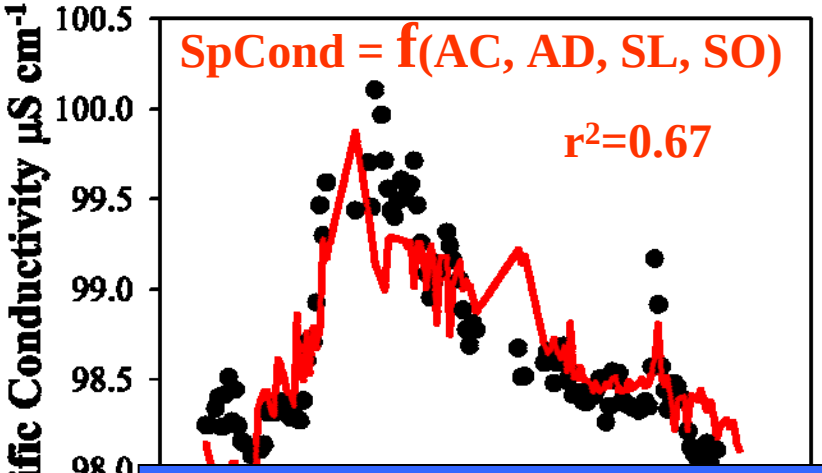
Ontonagon MI

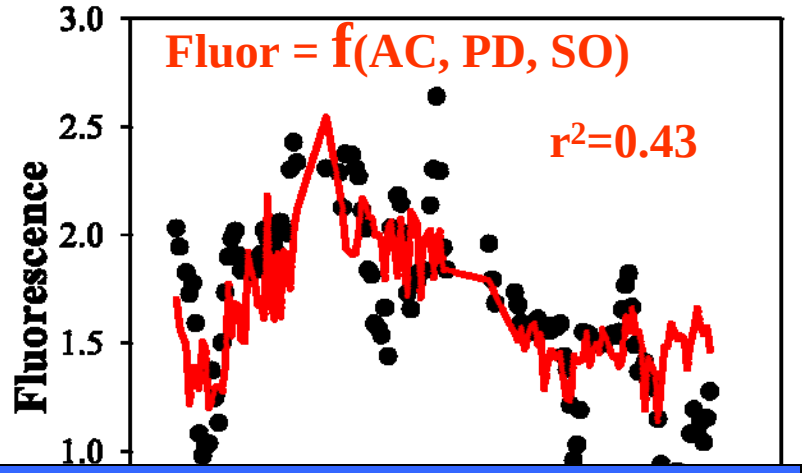
537-km Continuous Shoreline Track Along Lake Superior





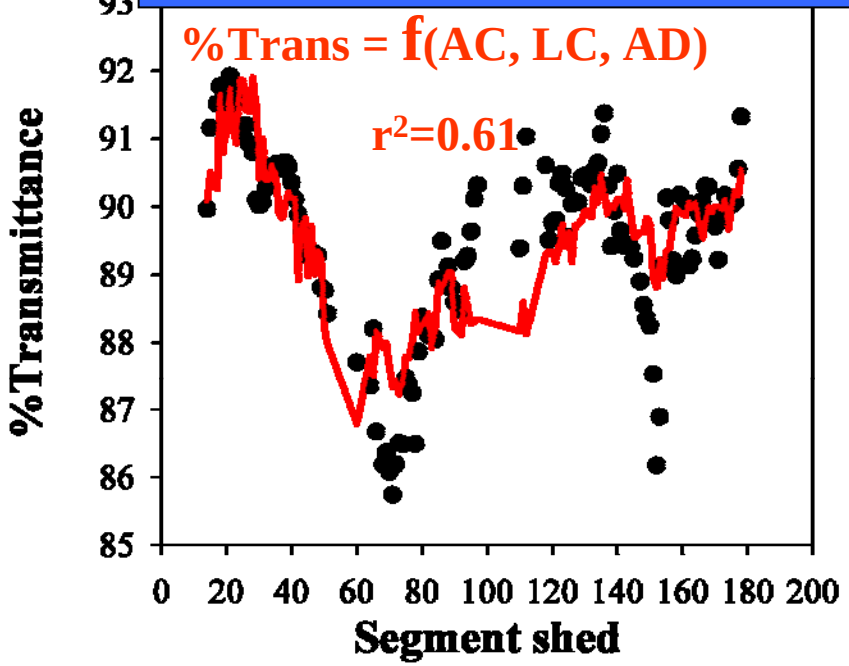
Yurista and Kelly (2007), *State of Lake Superior, Munawar and Heath (eds.)*

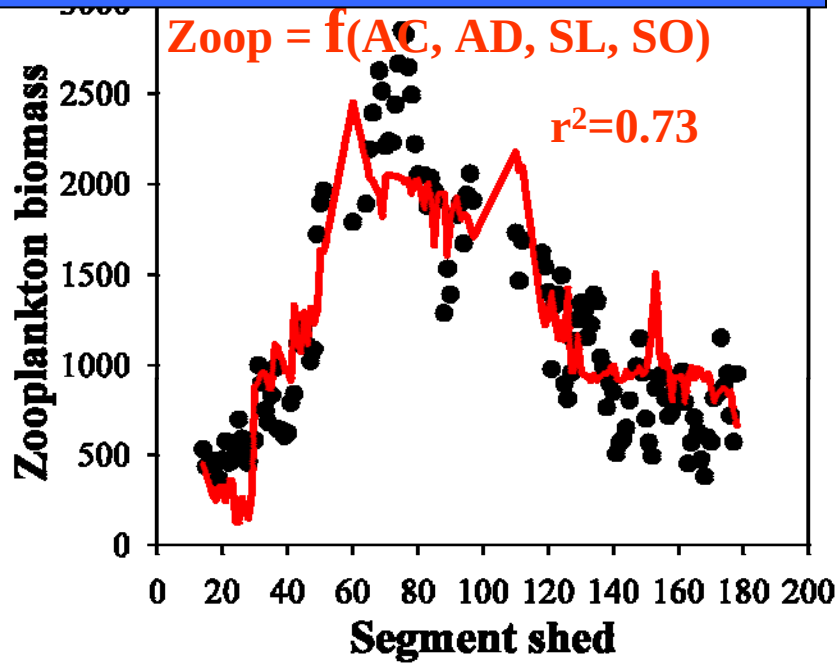


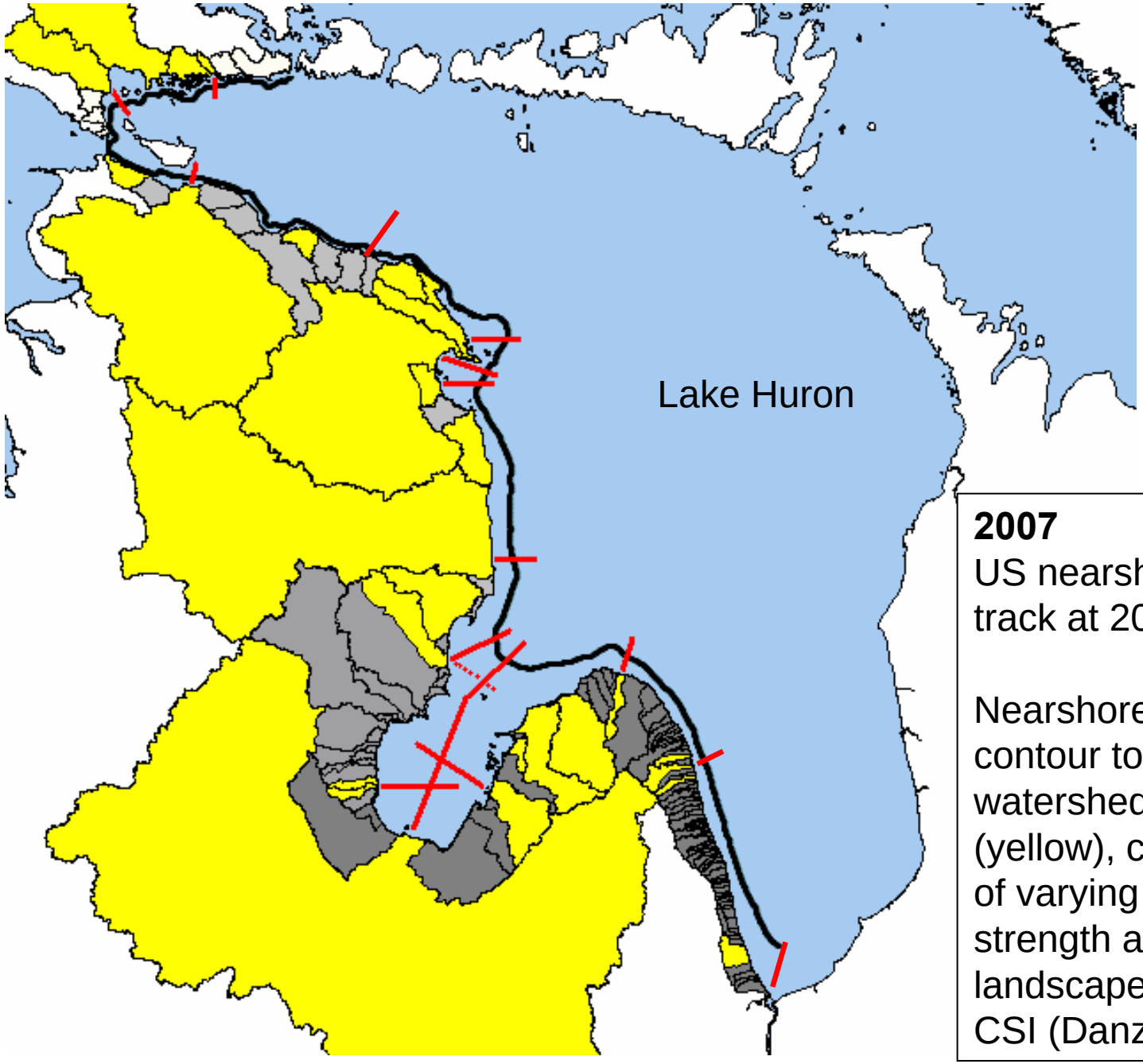


Spectacular and encouraging results…

Do we now have a tool with synoptic power to read the signals as expression of landscape influence?

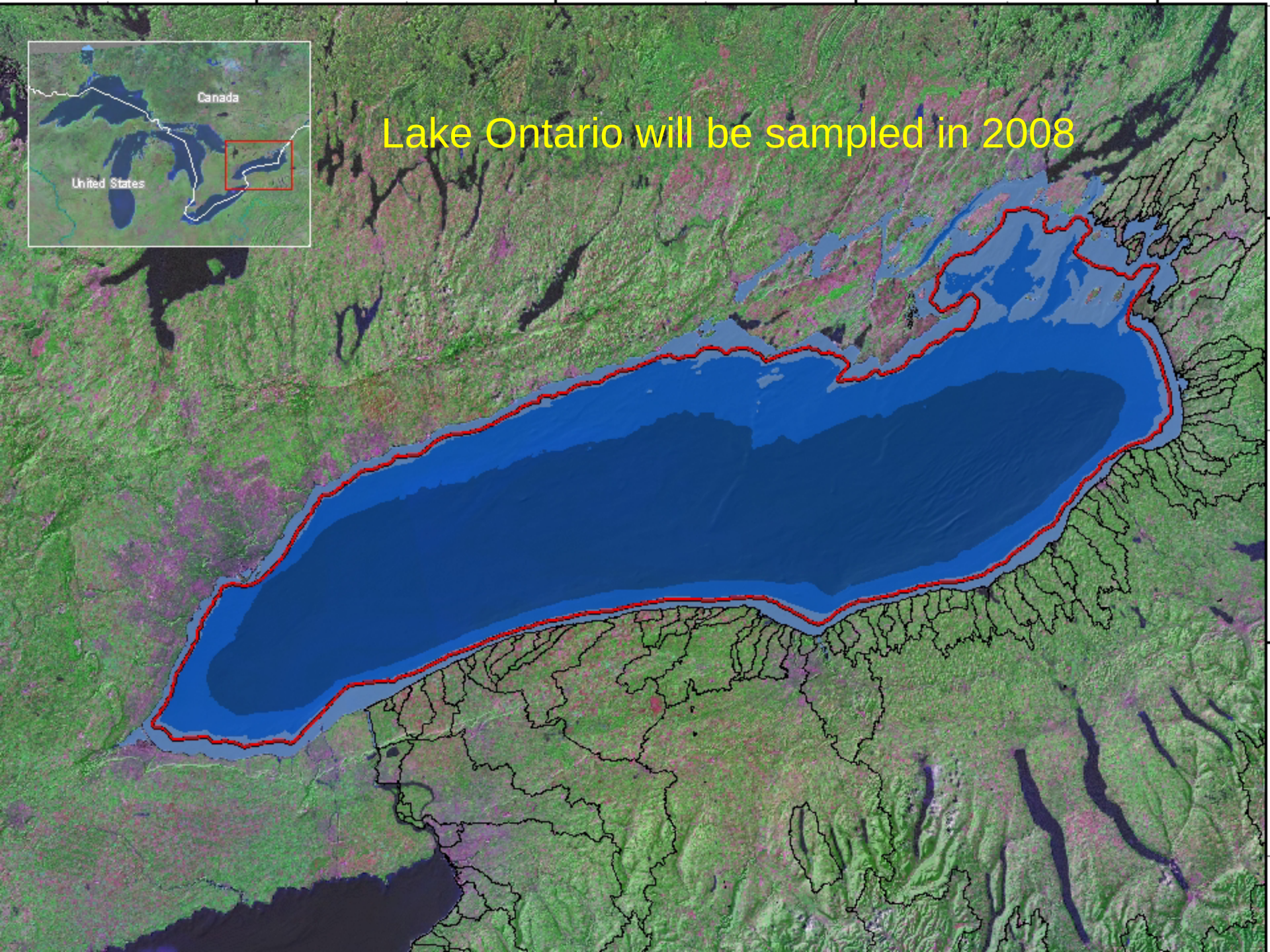




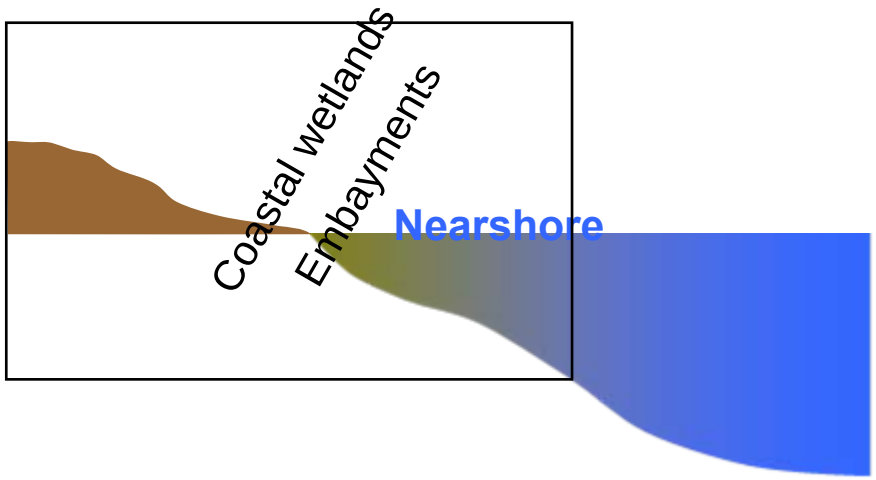


2007
US nearshore tow track at 20 m contour

Nearshore cross-contour tows at watershed tributaries (yellow), chosen to be of varying tributary strength and have landscape gradient in CSI (Danz et al. 2007)


Canada
United States
Lake Ontario will be sampled in 2008

Concluding Thoughts



Water quality and plankton indicators,

Linkages across aquatic systems,

Landscape indicators/loading models,

Sampling tools to overcome variability

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and their watersheds

Special Issue on

Coastal Indicators

Guest Editors: Gerald J. Niemi and
John R. Kelly

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