

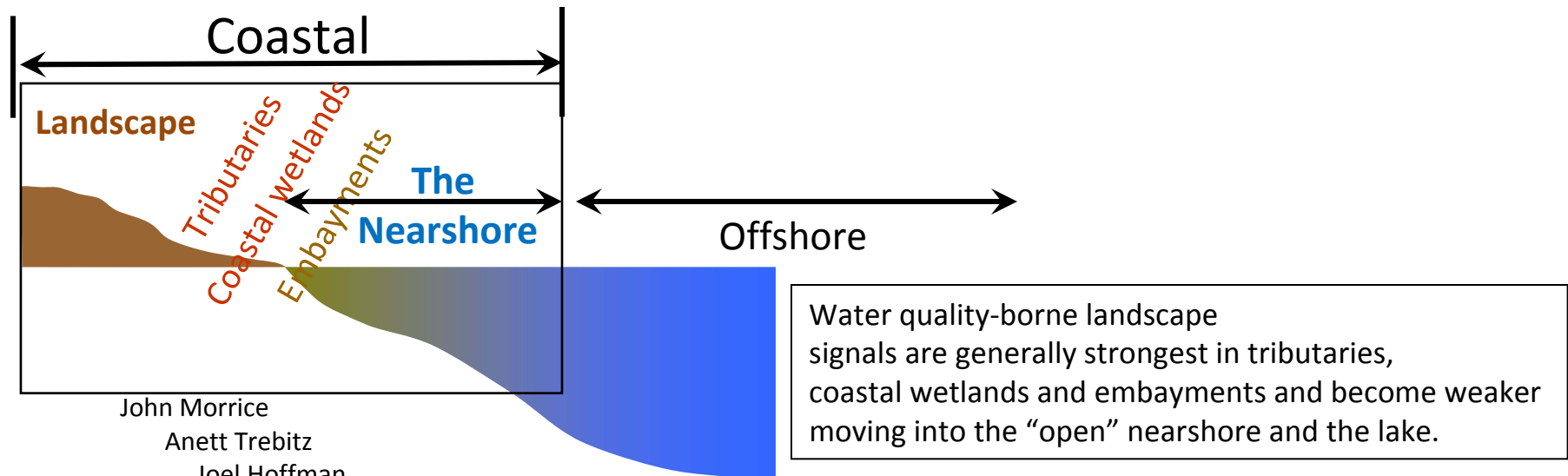
SYNOPTIC TOWING RESULTS, LAKE MICHIGAN (SUMMER 2010)

**Part of a Great-lakes Wide Effort to Develop an Integrated Set of Observations
to Assess the Nearshore and Link Conditions to Coastal Watersheds**



**Jack Kelly, Peder Yurista
Jon Van Alstine, Samuel Miller,
many others, and several research vessels
U.S. Environmental Protection Agency
Mid Continent Ecology Division
Duluth, MN, 55804, USA**

How do we efficiently assess the vast and diverse aquatic resources of the Great Lakes coastal zone?
Can we link conditions in watersheds and coastal receiving systems, to develop stressor/response relationships and to use coastal systems as lake sentinels?



John Morrice

Anett Trebitz

Joel Hoffman

Mike Sierszen

Mike Knuth

Greg Peterson

Jack Kelly

Peder Yurista

Jill Scharold

Anne Cotter, Tom Hollenhorst, Brian Hill, Tim Corry, **Jon Van Alstine, Sam Miller**

Matt Starry (SRI), Tony Olsen (WED), ORD NCCA Partners (GED, WED, AED)

Nick Danz , Gerry Niemi, Lucinda Johnson, George Host, Rich Axler, Euan Reavie (NRRI/UMD), Jan Ciborowski (U Windsor)

Paul Horvatin, Glenn Warren, James Schardt, Paul Bertram, Karen Rodriguez (Region 5/GLNPO)

EPA Office of Water, Regions 2, 3, 5, 9

USGS, USFW, Ontario Ministry of Natural Resources, 8 GL States, many Academics

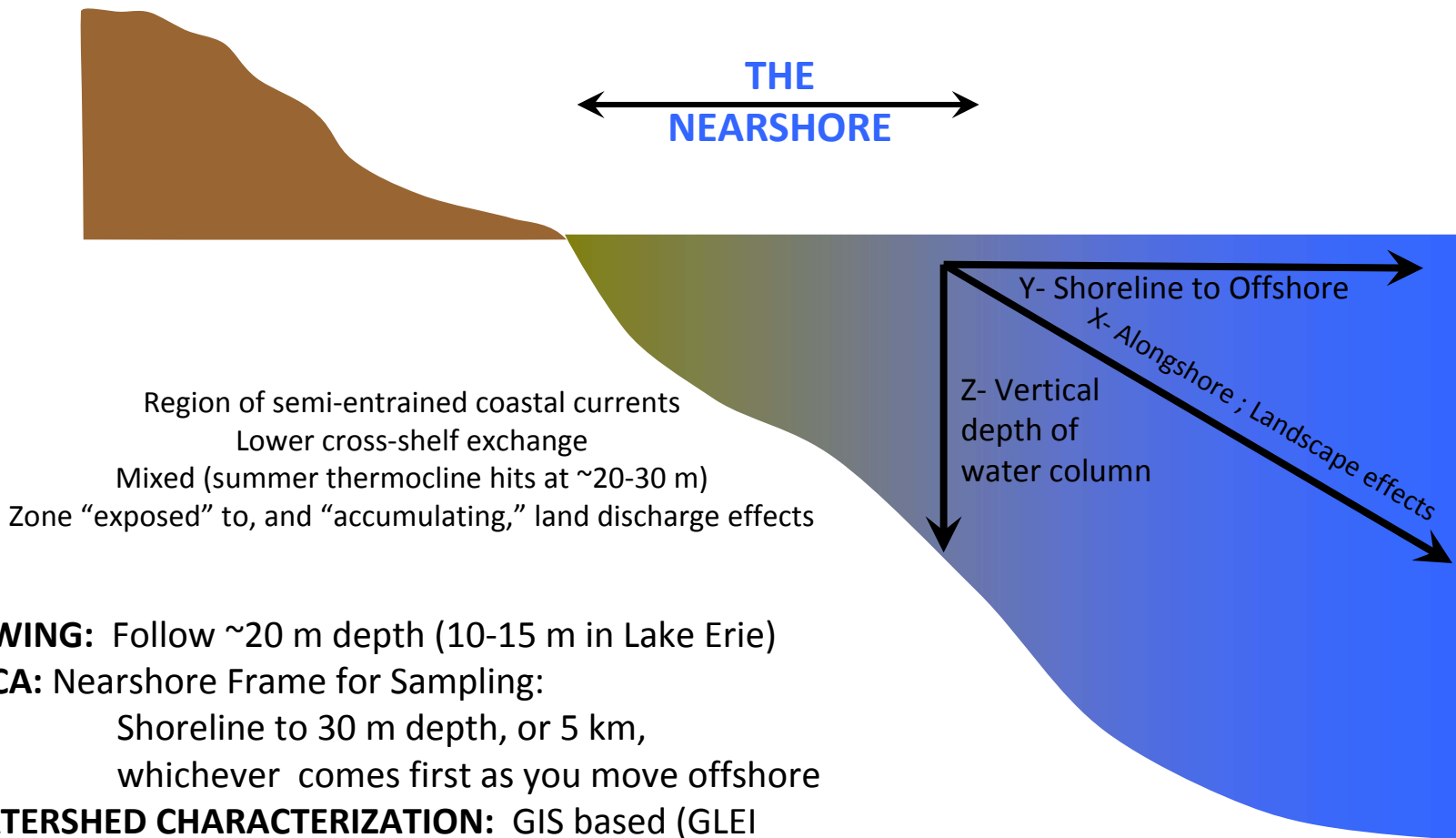
Bi-National Cooperation, Environment Canada, Division of Fisheries and Oceans

Lake Superior LaMP (EPA, States, Province), 5 Lakes Coordinated Science and Monitoring Initiative

“Nearshore” No unambiguous definition, but...

- Open, “fuzzy”, physically dynamic
- Significant cross-slope, vertical, and alongshore variability
- High “noise” to (landscape) “signal” ratio

Approach: Specify the resource of interest and throw sampling power at the problem



TOWING: Follow ~20 m depth (10-15 m in Lake Erie)

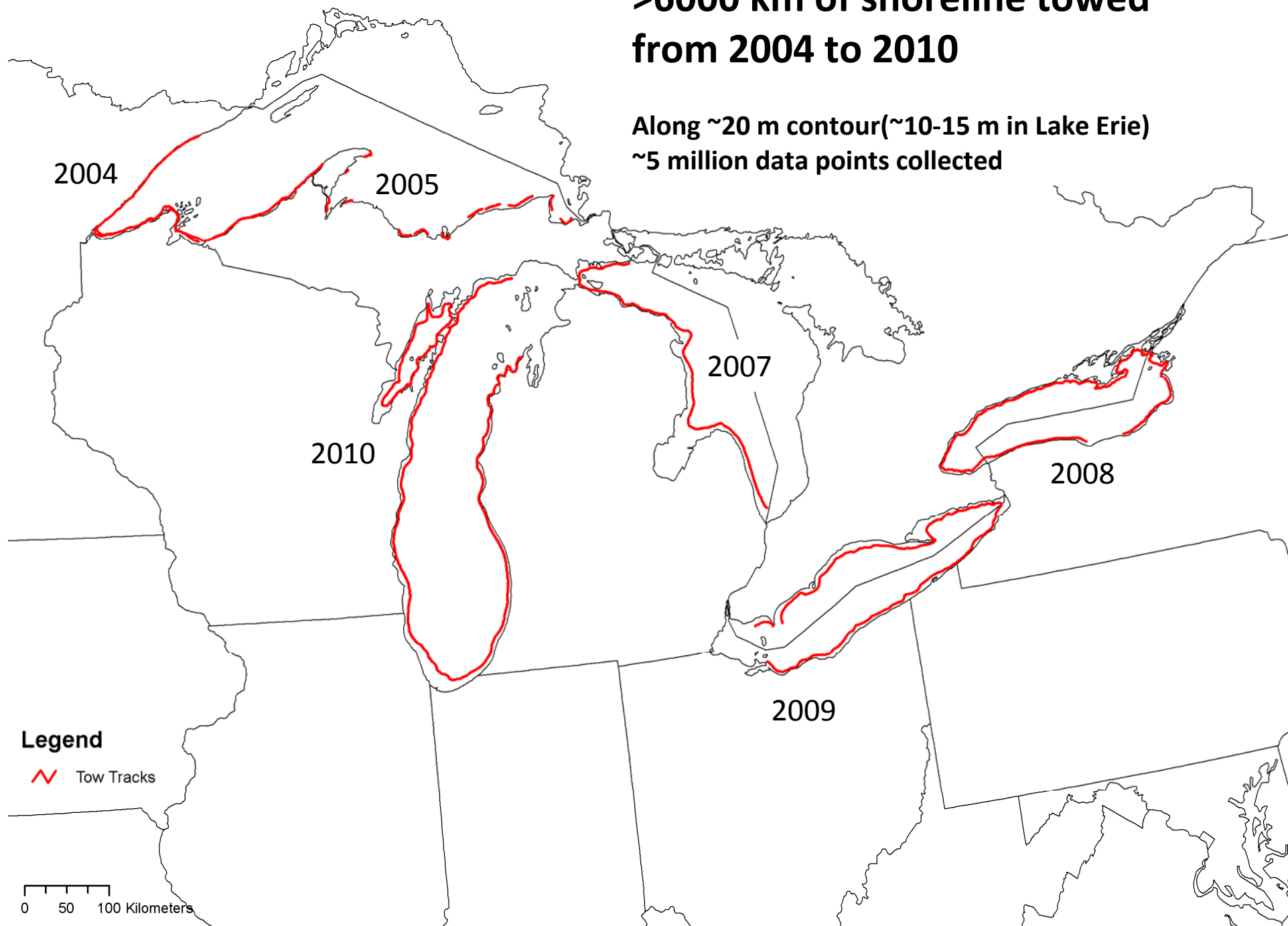
NCCA: Nearshore Frame for Sampling:

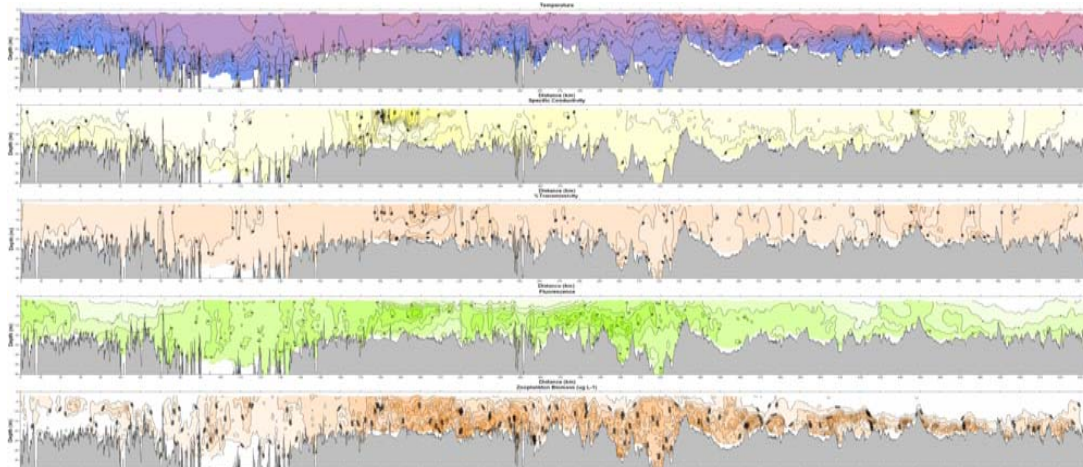
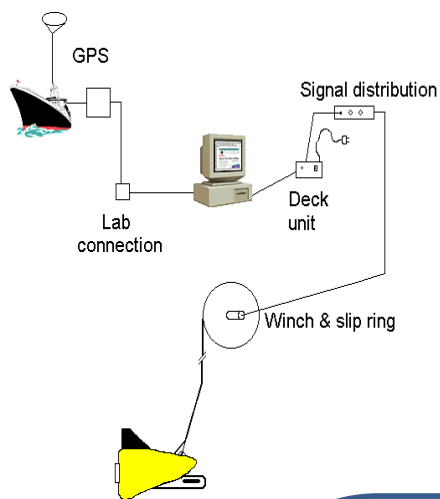
Shoreline to 30 m depth, or 5 km,
whichever comes first as you move offshore

WATERSHED CHARACTERIZATION: GIS based (GLEI project) 762 watersheds across the US Basin, PCA

>6000 km of shoreline towed from 2004 to 2010

Along ~20 m contour (~10-15 m in Lake Erie)
~5 million data points collected





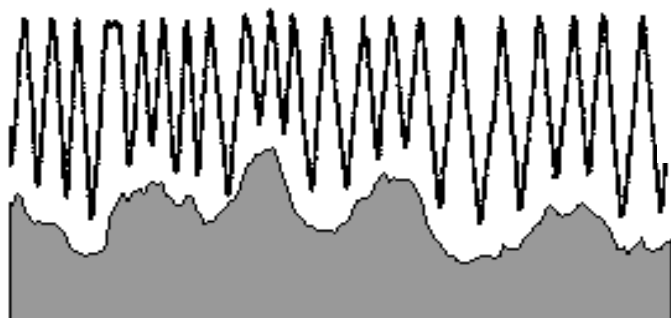
Sensors

CTD
 Fluorometer
 (calibrated to Chl *a*)
 Transmissometer
 Laser Optical Plankton Counter
 (Zooplankton >150 μ m)
 NO_3

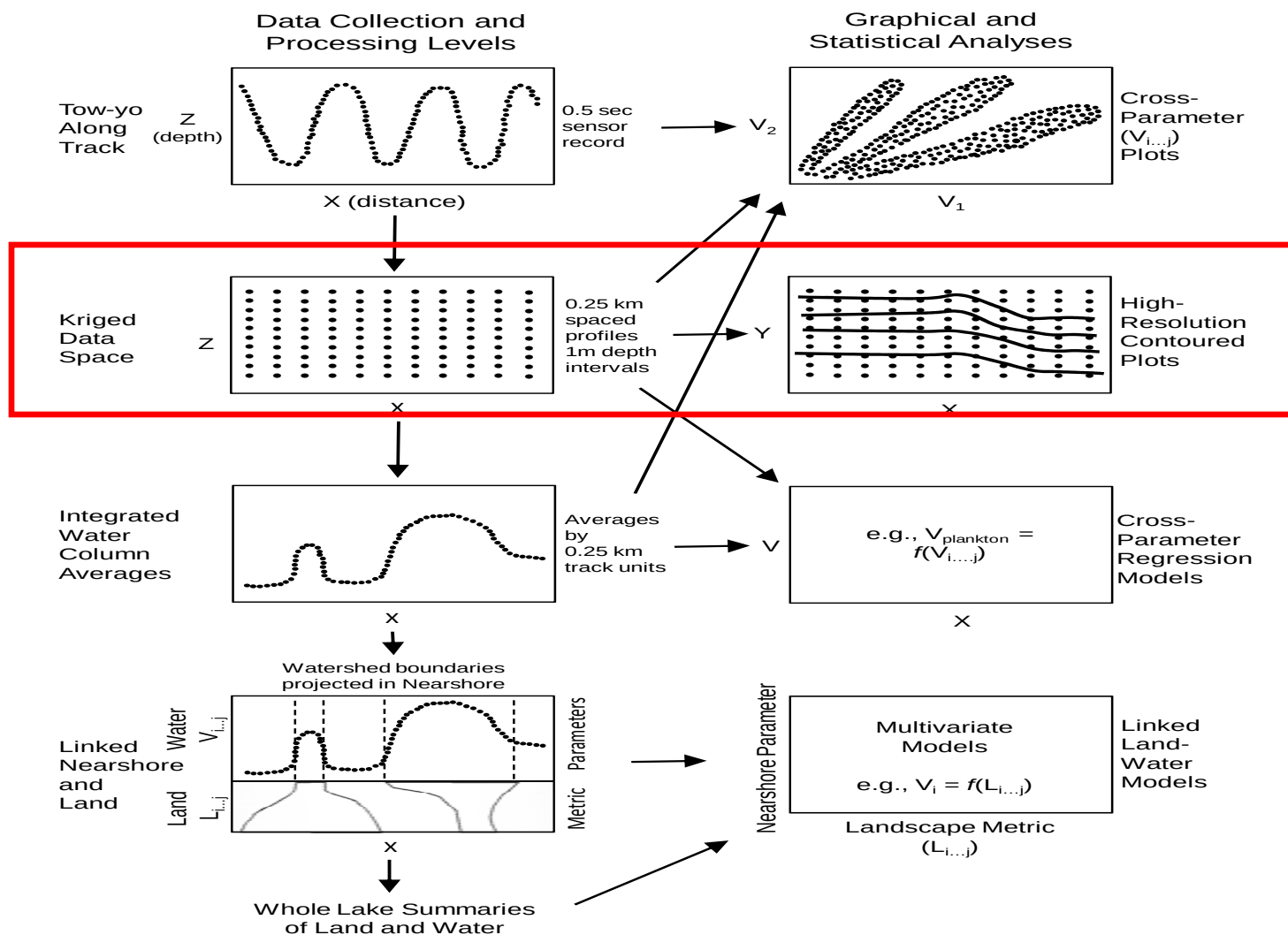
High-resolution data
 along 500 to 1000 km of shoreline

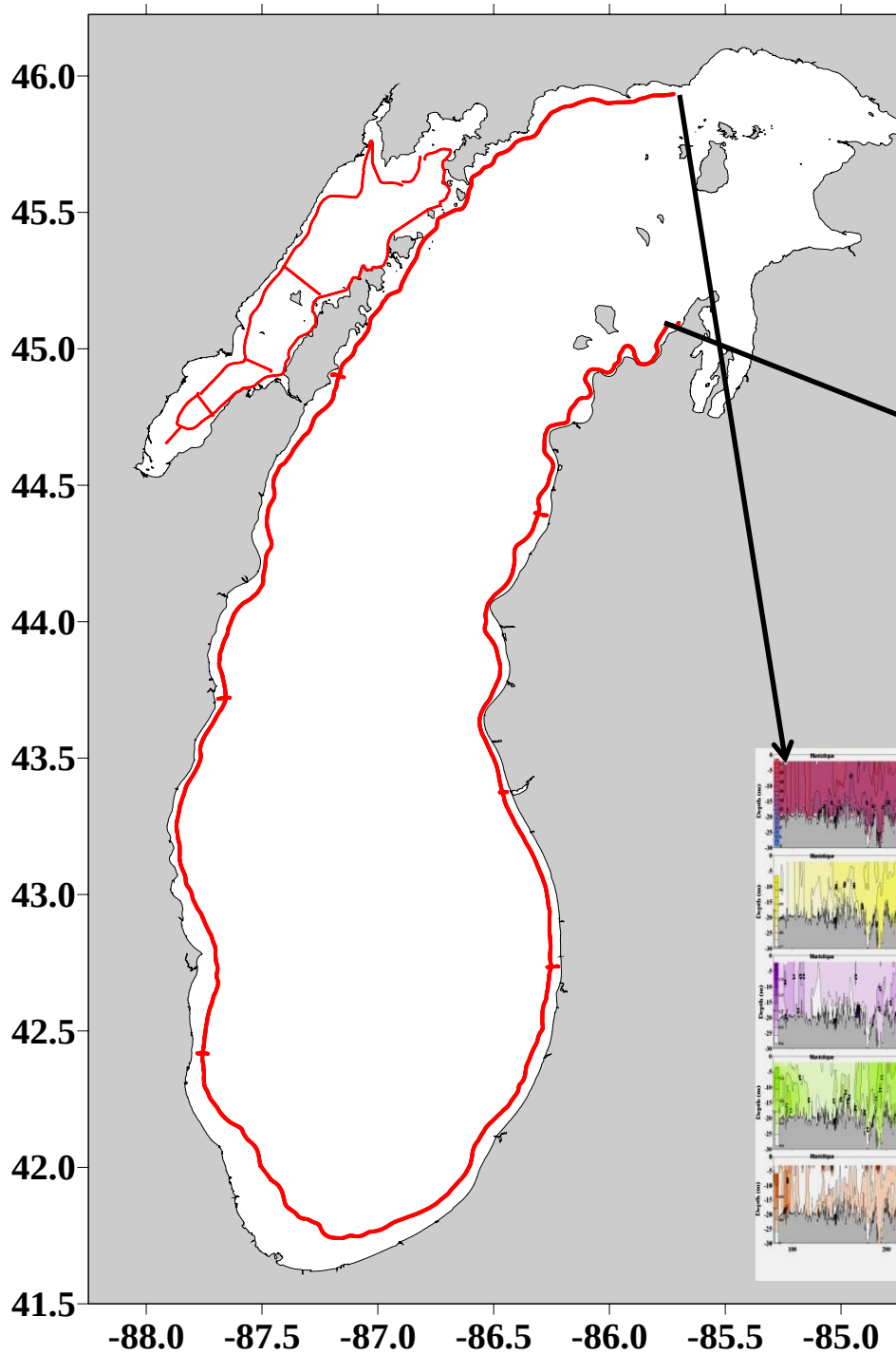


Alongshoreline towing
survey strategy
 Evolved to be along constant depth



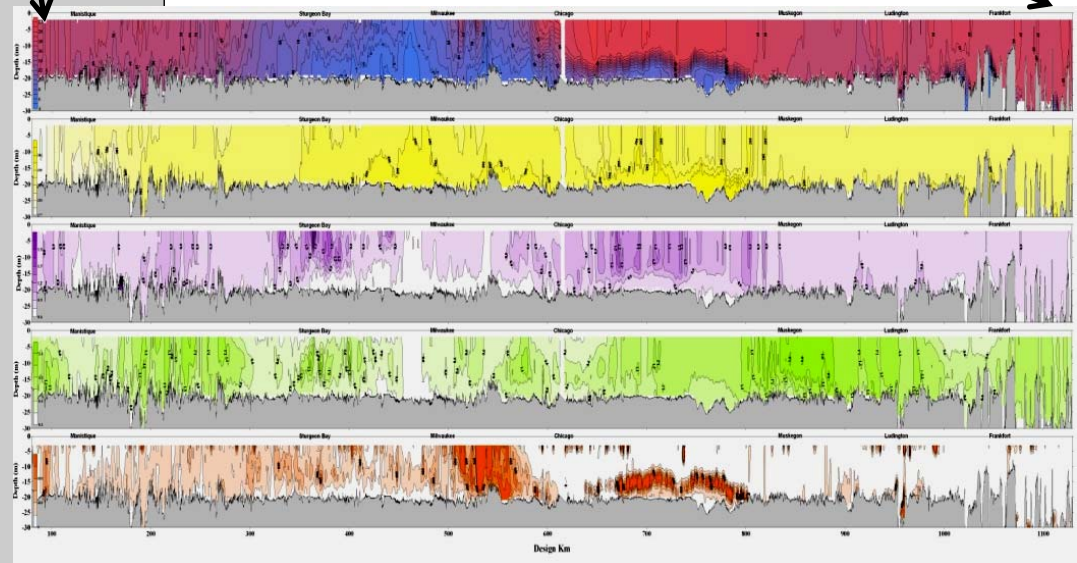
Collected data, processing, and example analytical uses

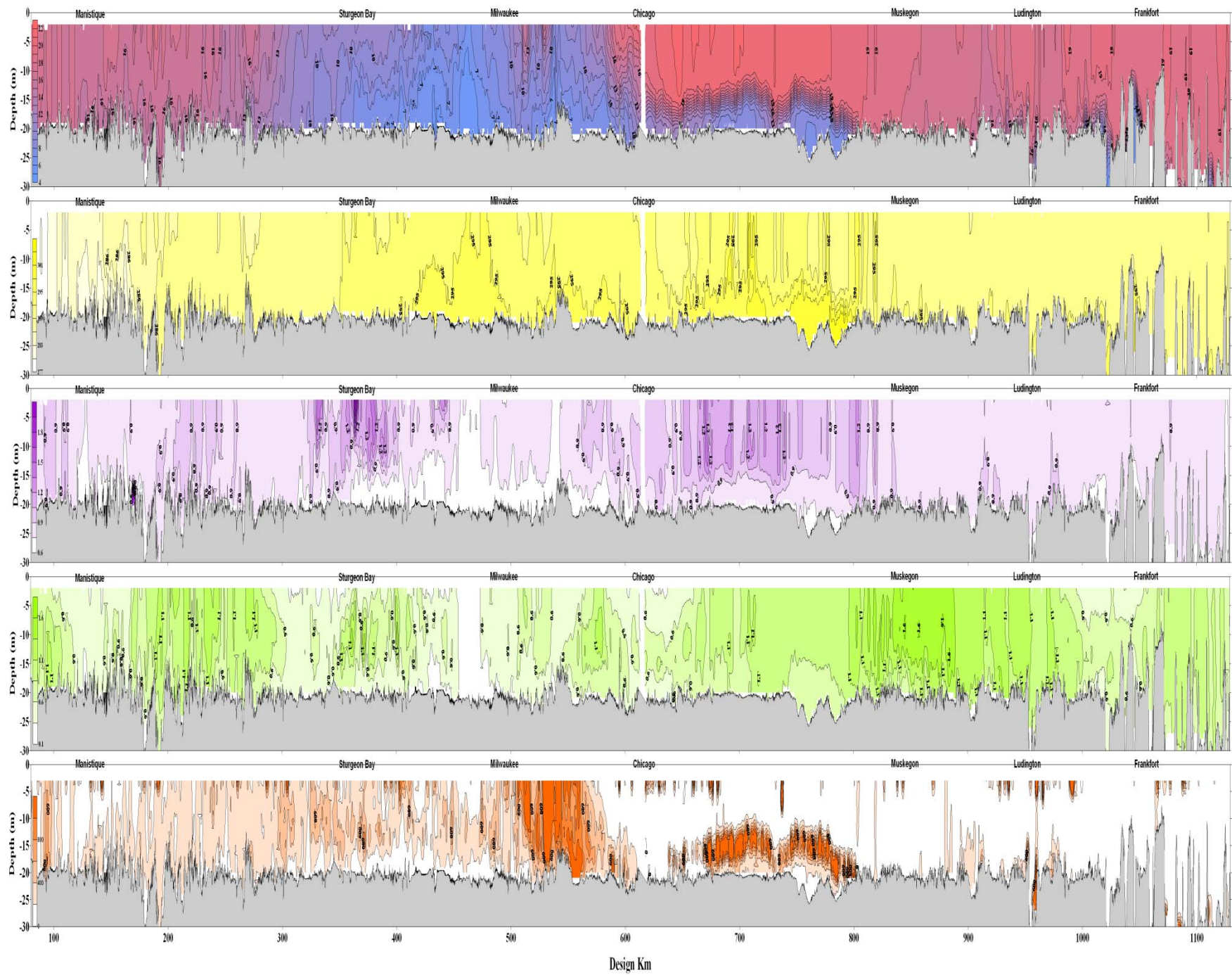




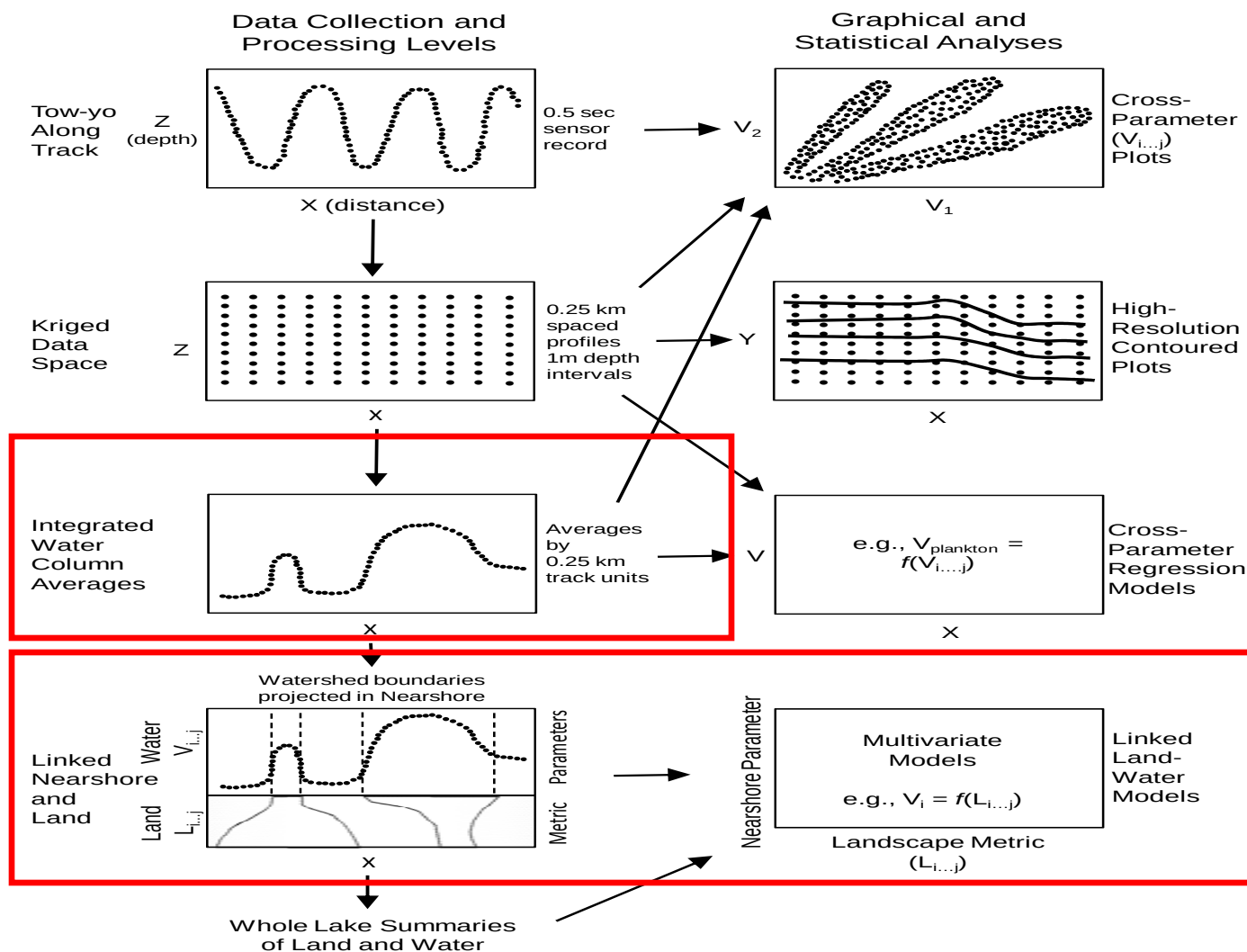
Lake Michigan Tracks August-Sept 2010

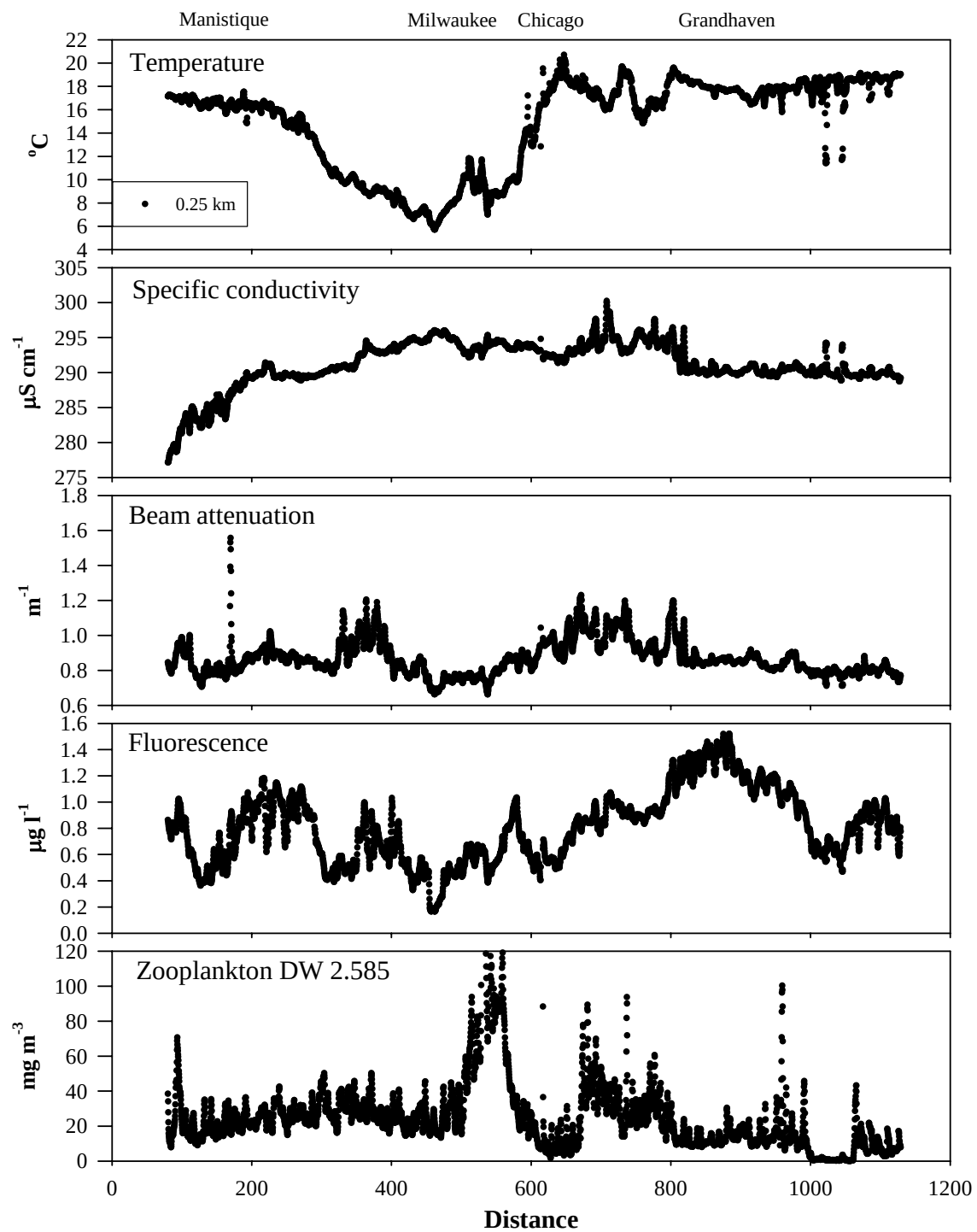
Towing in situ sensors
to produce an environmental
“CAT” scan along the shore





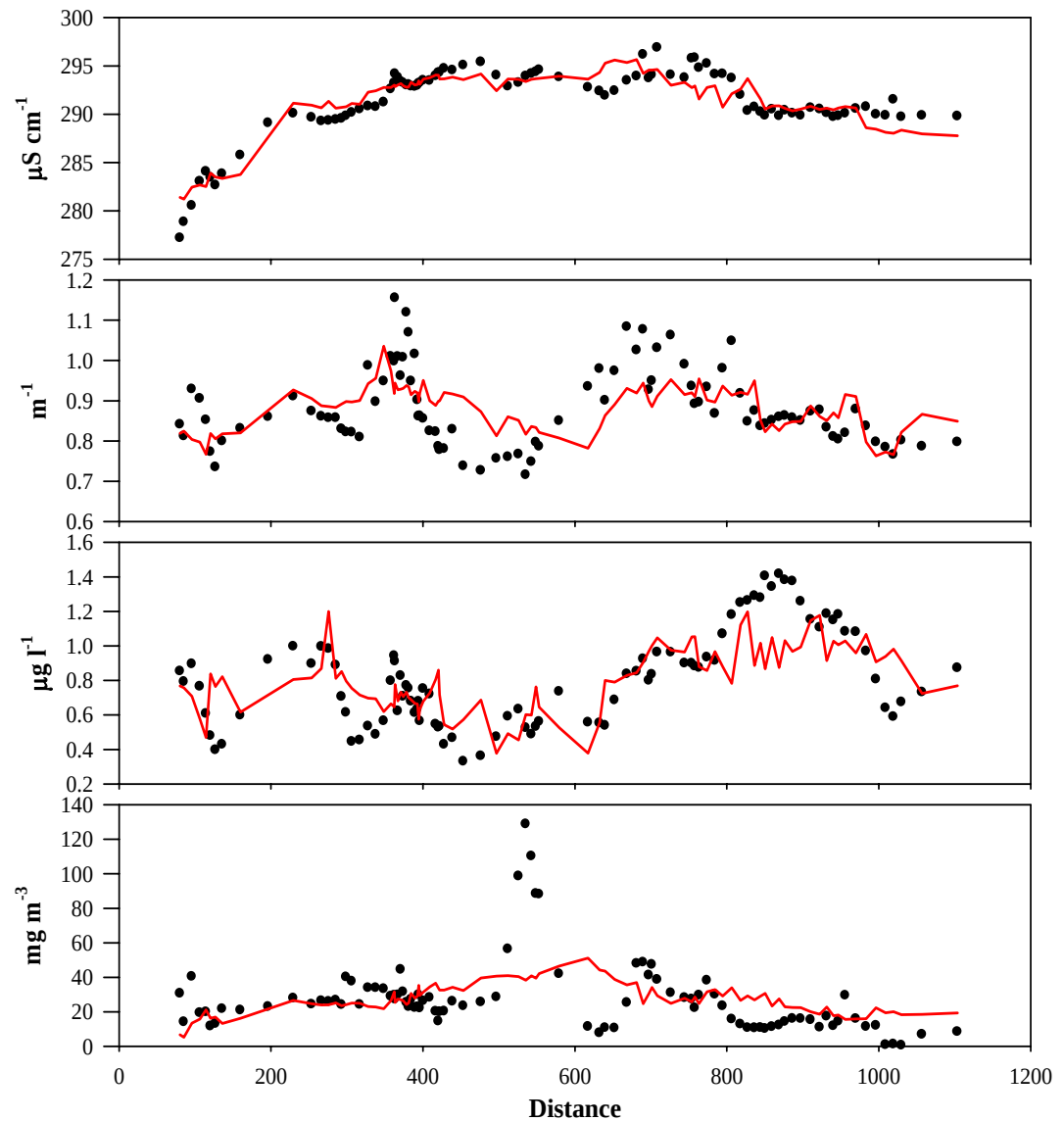
Collected data, processing, and example analytical uses

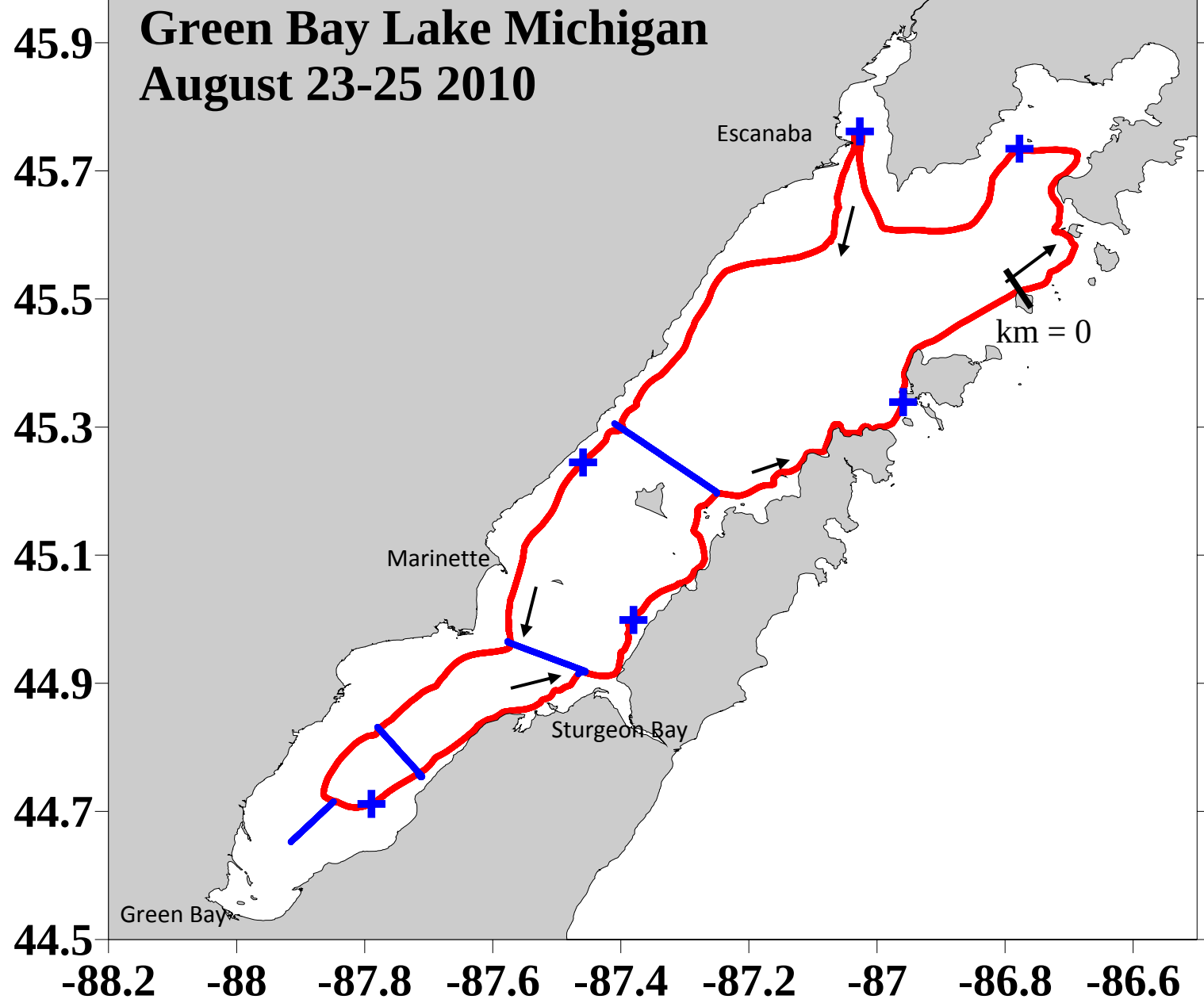




Multivariate
Regression Models (High R^2):
Nearshore properties
predicted by GLEI
Landscape metrics as
independent
variables

Usually,
agriculture and
land use,
often population
and/or point sources metrics
play prominently
(some variation by parameter
and by lake)



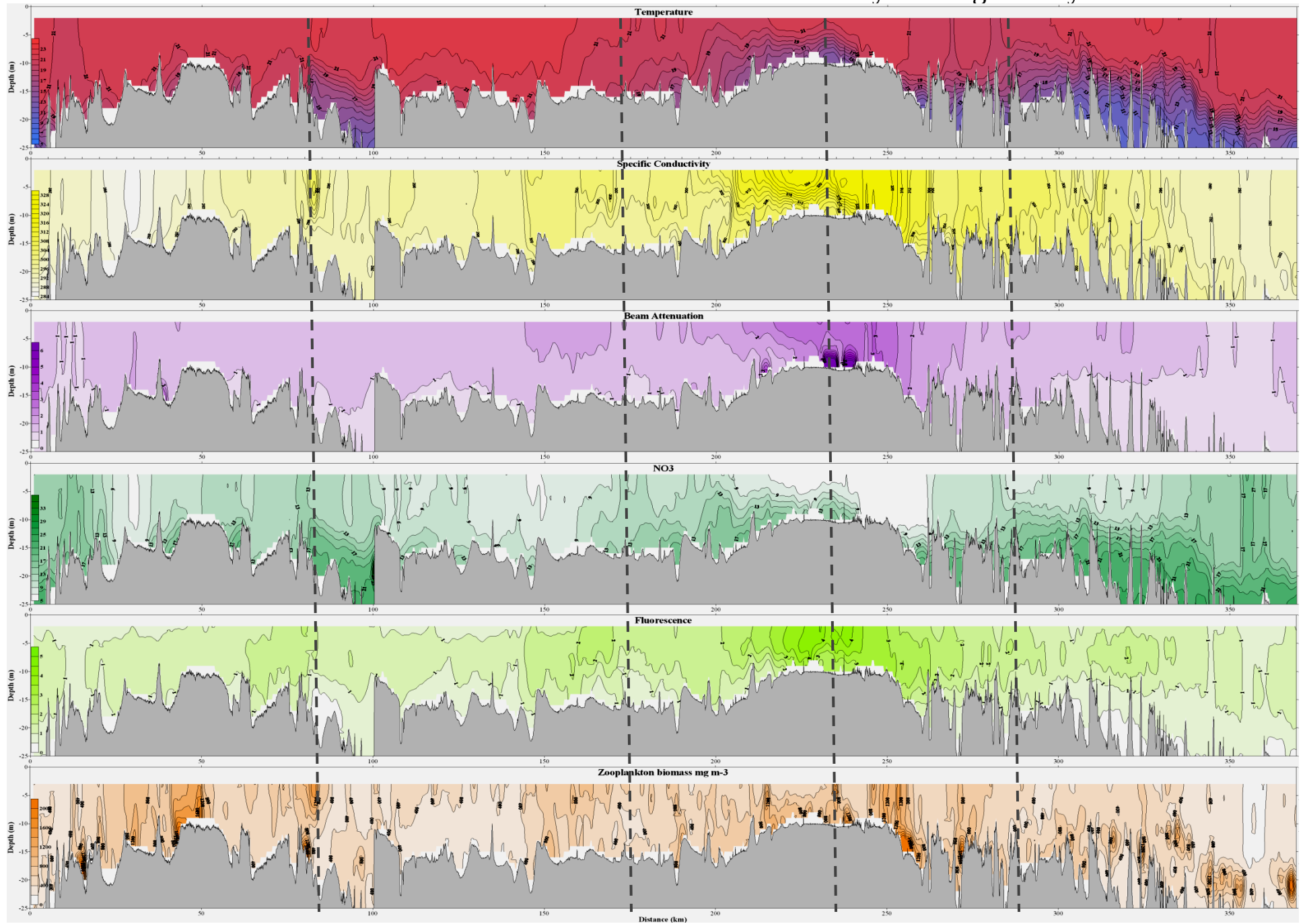


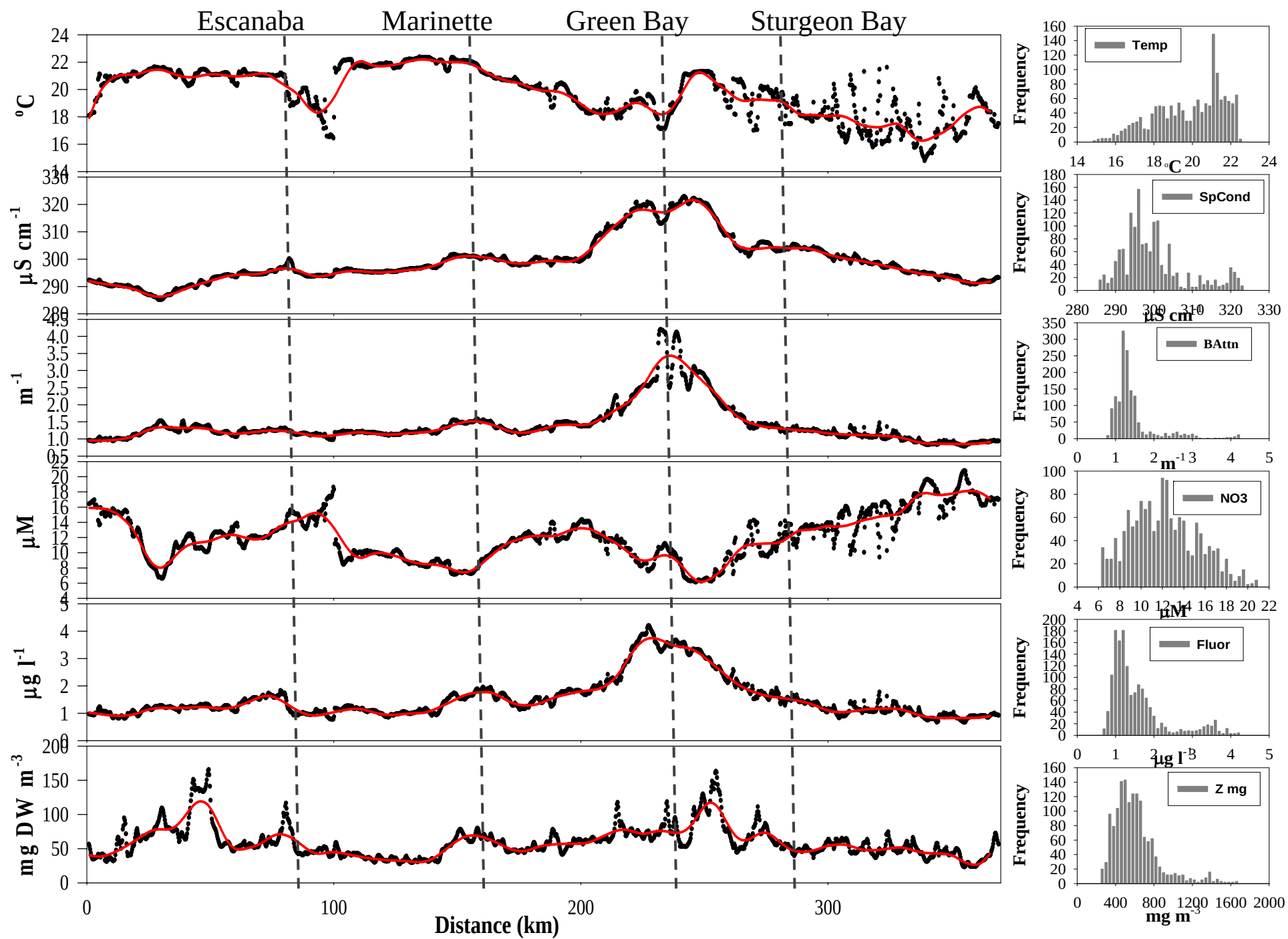
Escanaba

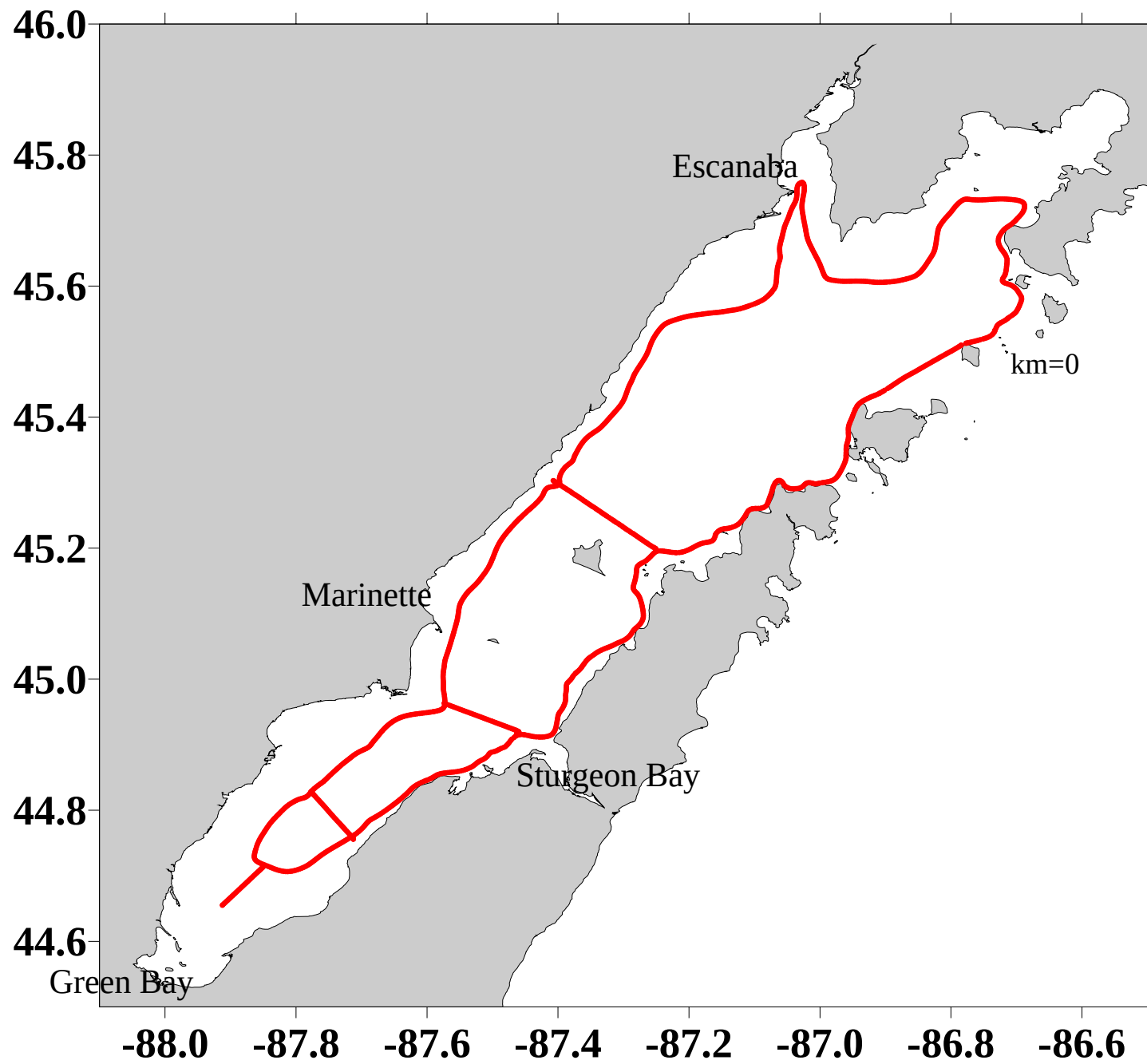
Marinette

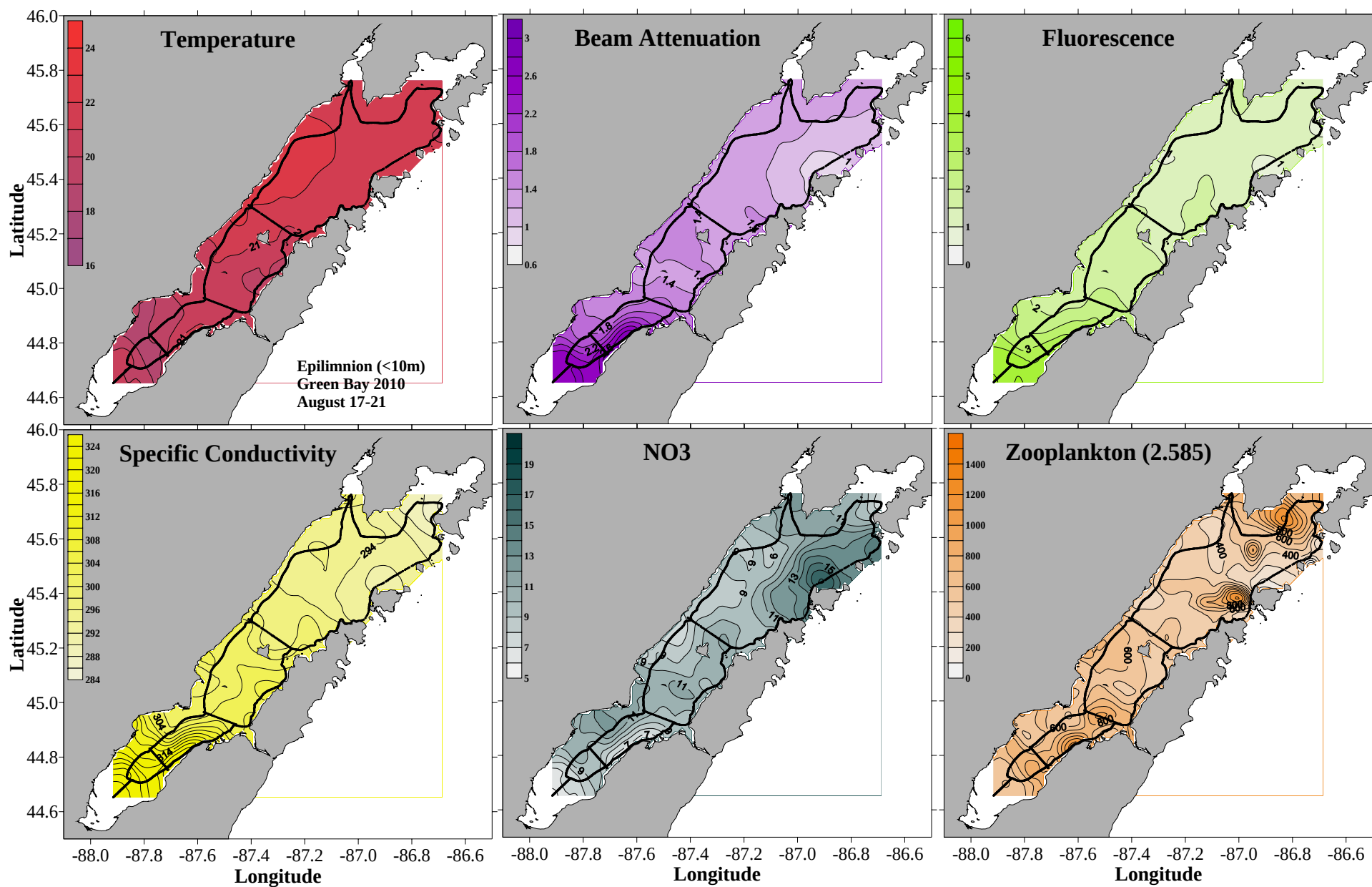
Green Bay

Sturgeon Bay

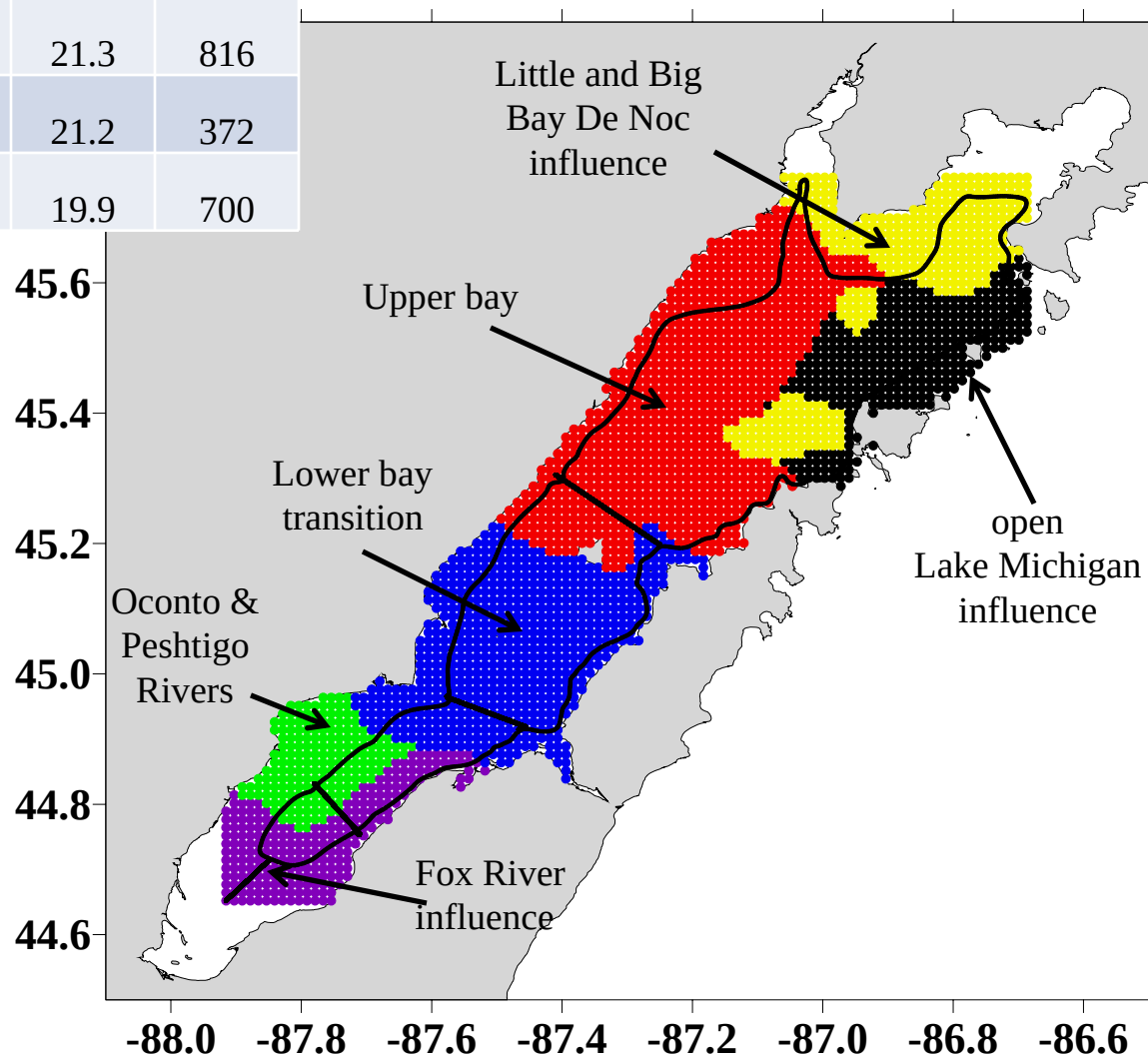




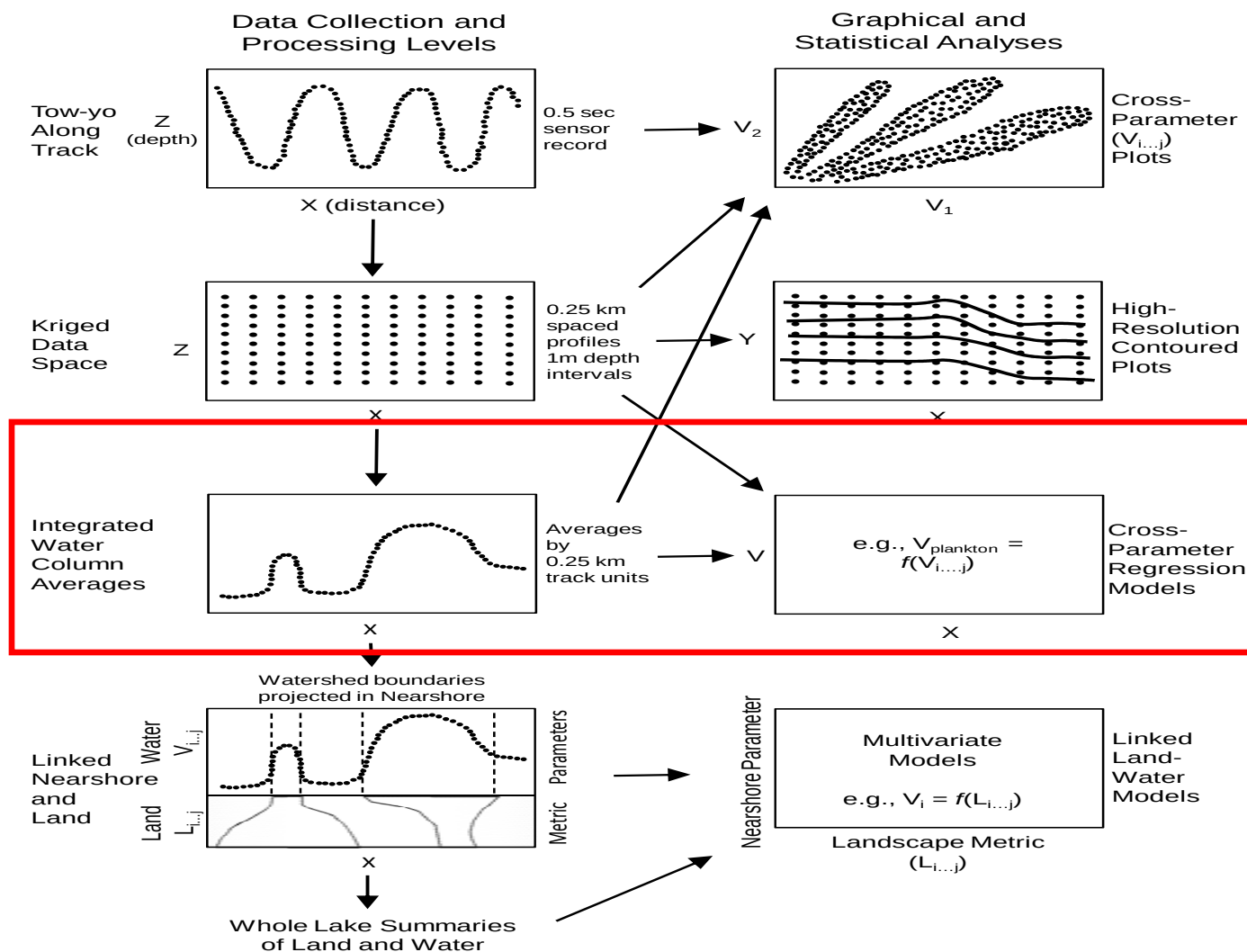




Clusters (6)	BAttn m ⁻¹	Fluor μg L ⁻¹	NO3 μM	SpCond μS cm ⁻¹	Temp °C	Zoop mg m ⁻³
Green	1.75	2.4	10.7	309.8	19.1	635
Blue	1.47	1.8	10.1	302.1	20.6	603
Red	1.29	1.3	9.6	296.5	21.8	471
Yellow	1.22	1.3	11.4	292.0	21.3	816
Black	1.03	1.1	14.0	292.2	21.2	372
Purple	2.44	3.4	7.9	318.2	19.9	700



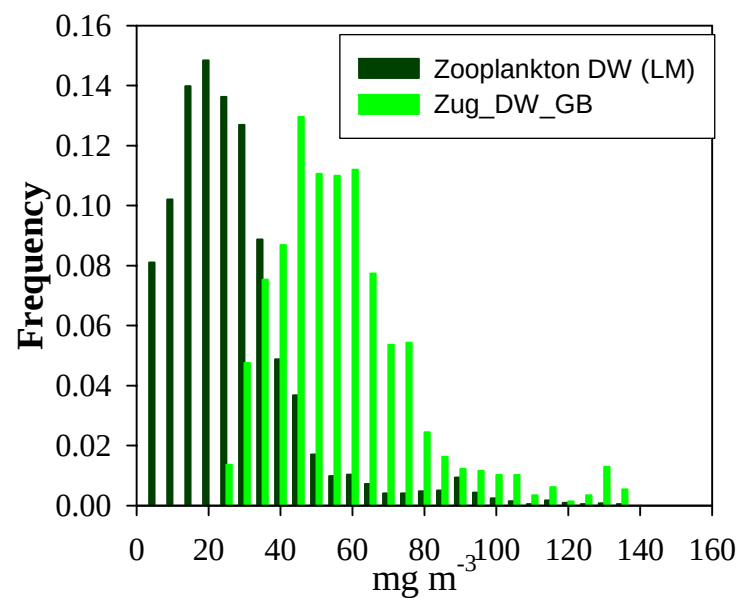
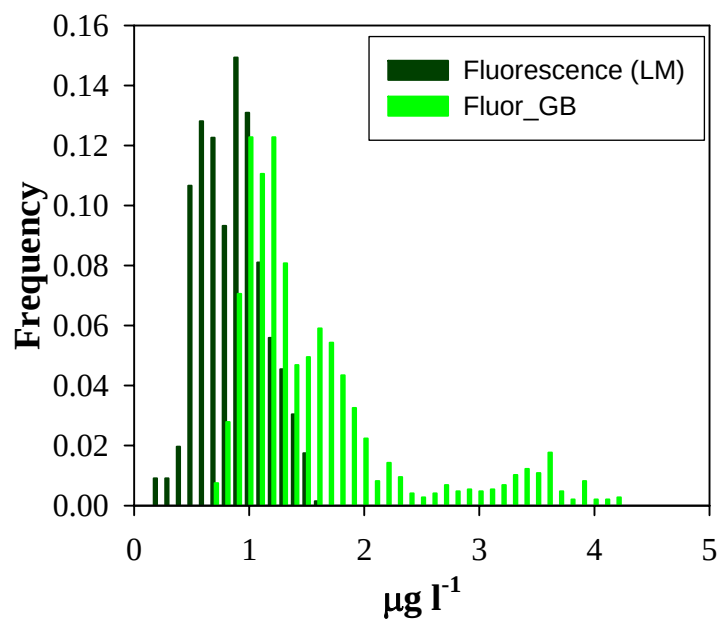
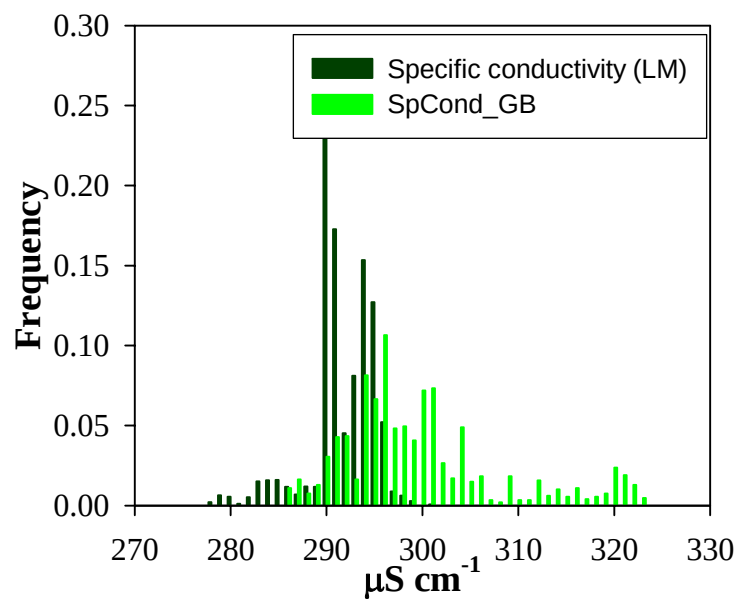
Collected data, processing, and example analytical uses

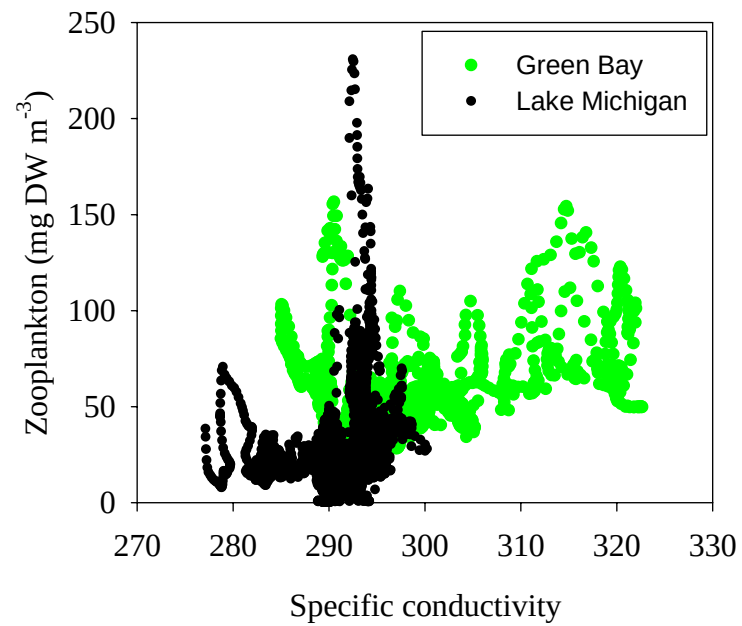
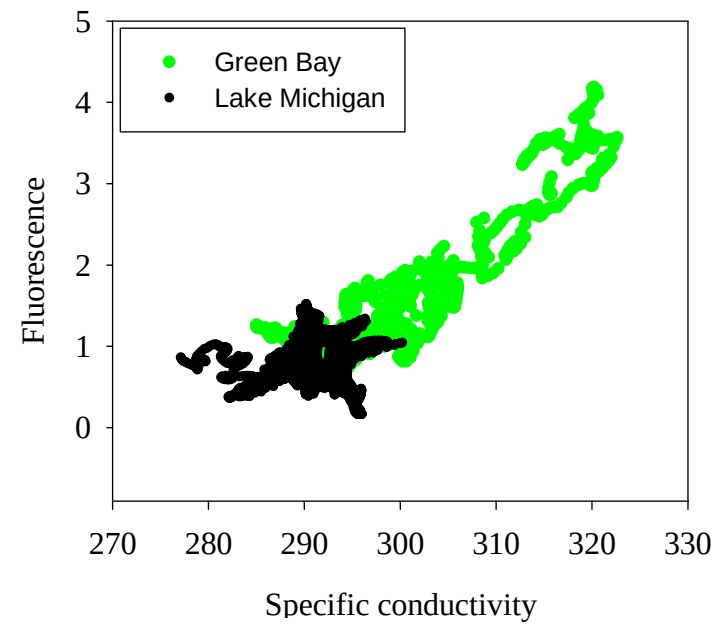
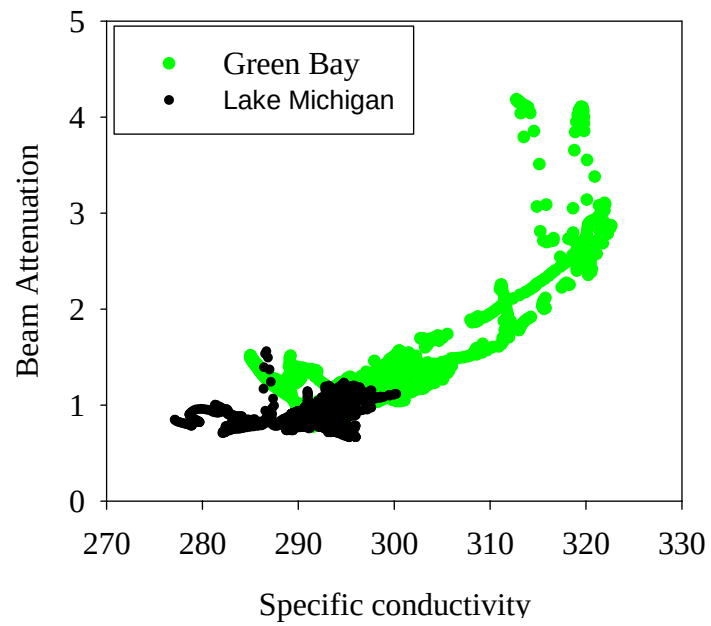


Frequency Distributions

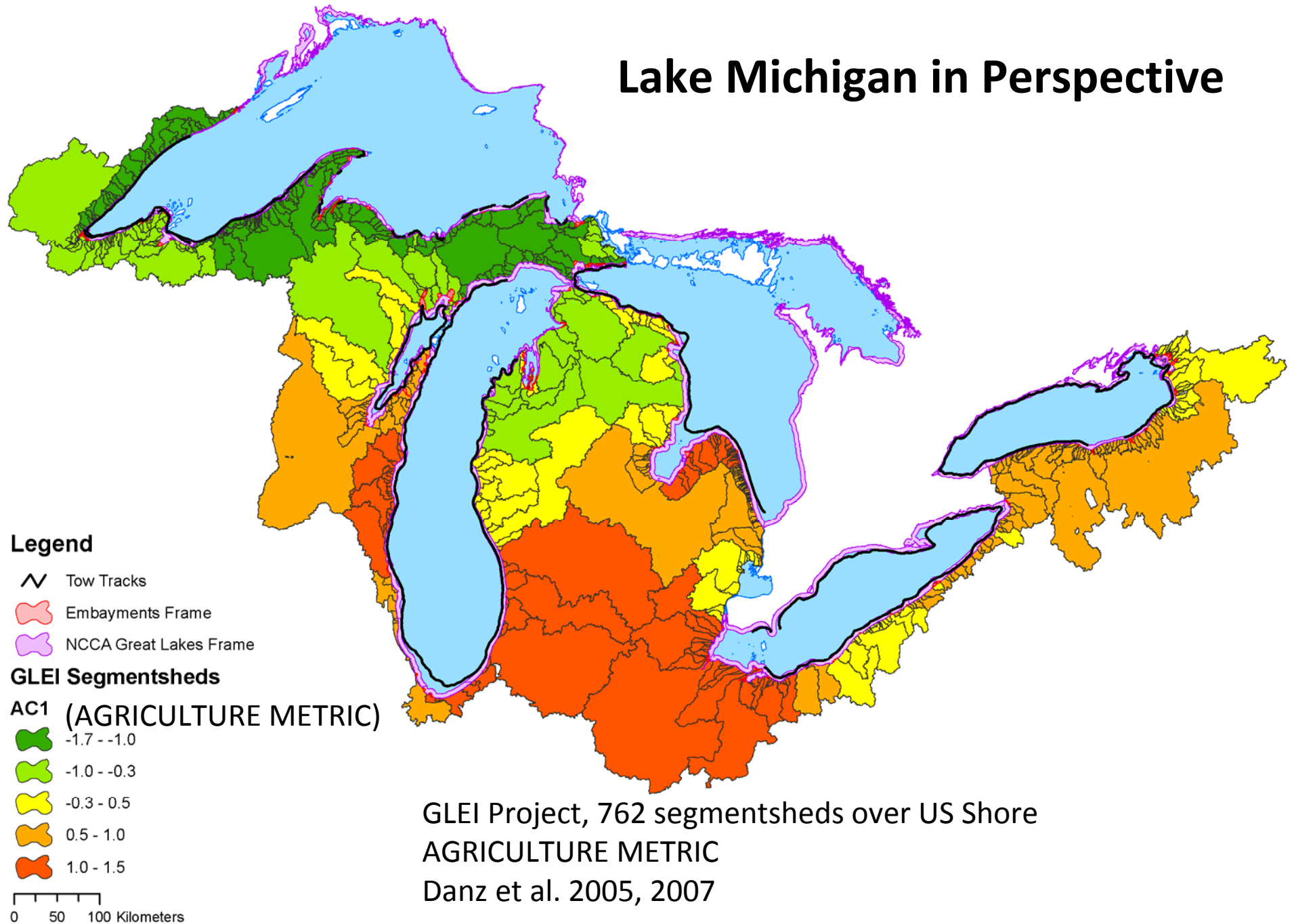
Main lake nearshore
and GB nearshore

Based on 0.25km averages

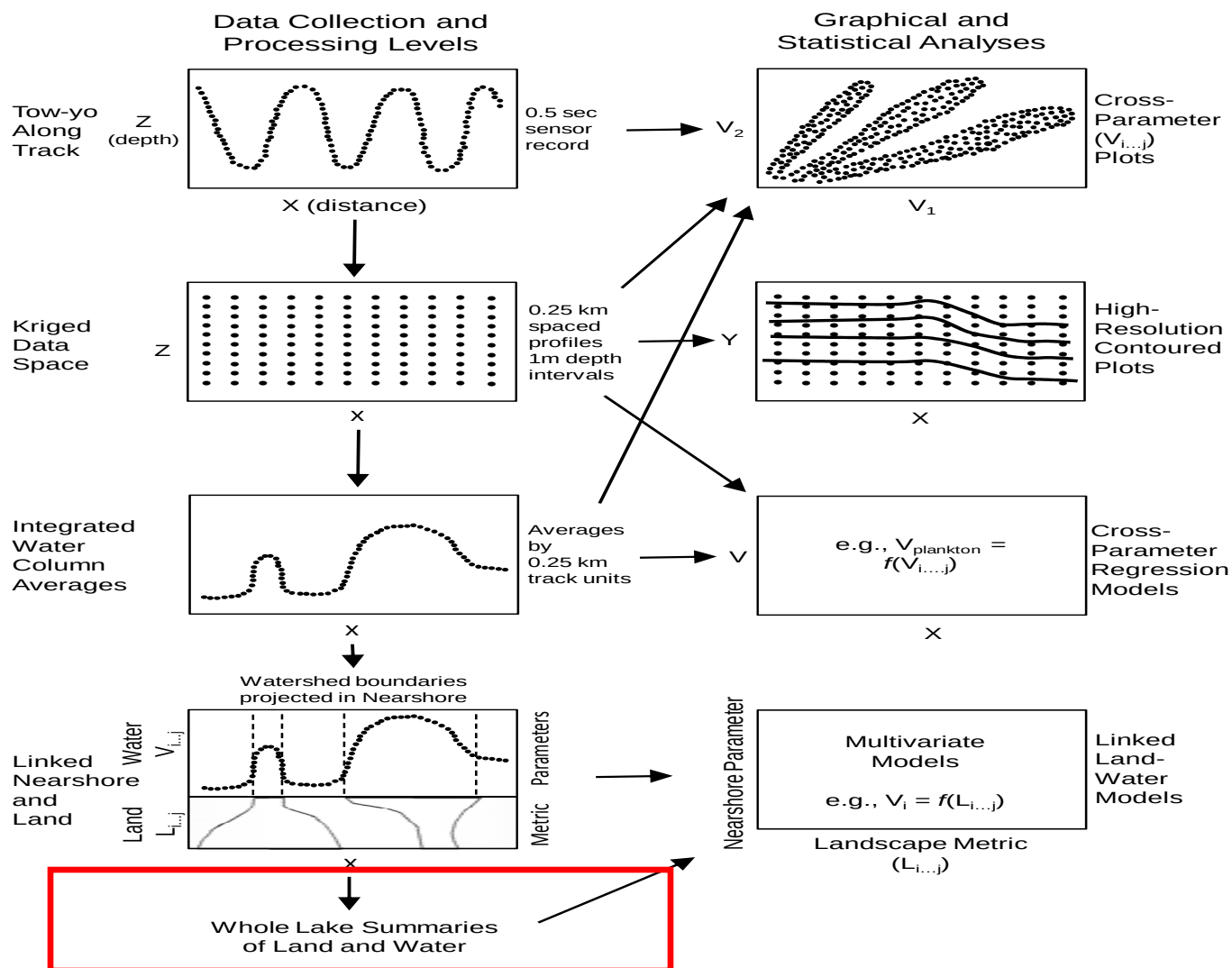




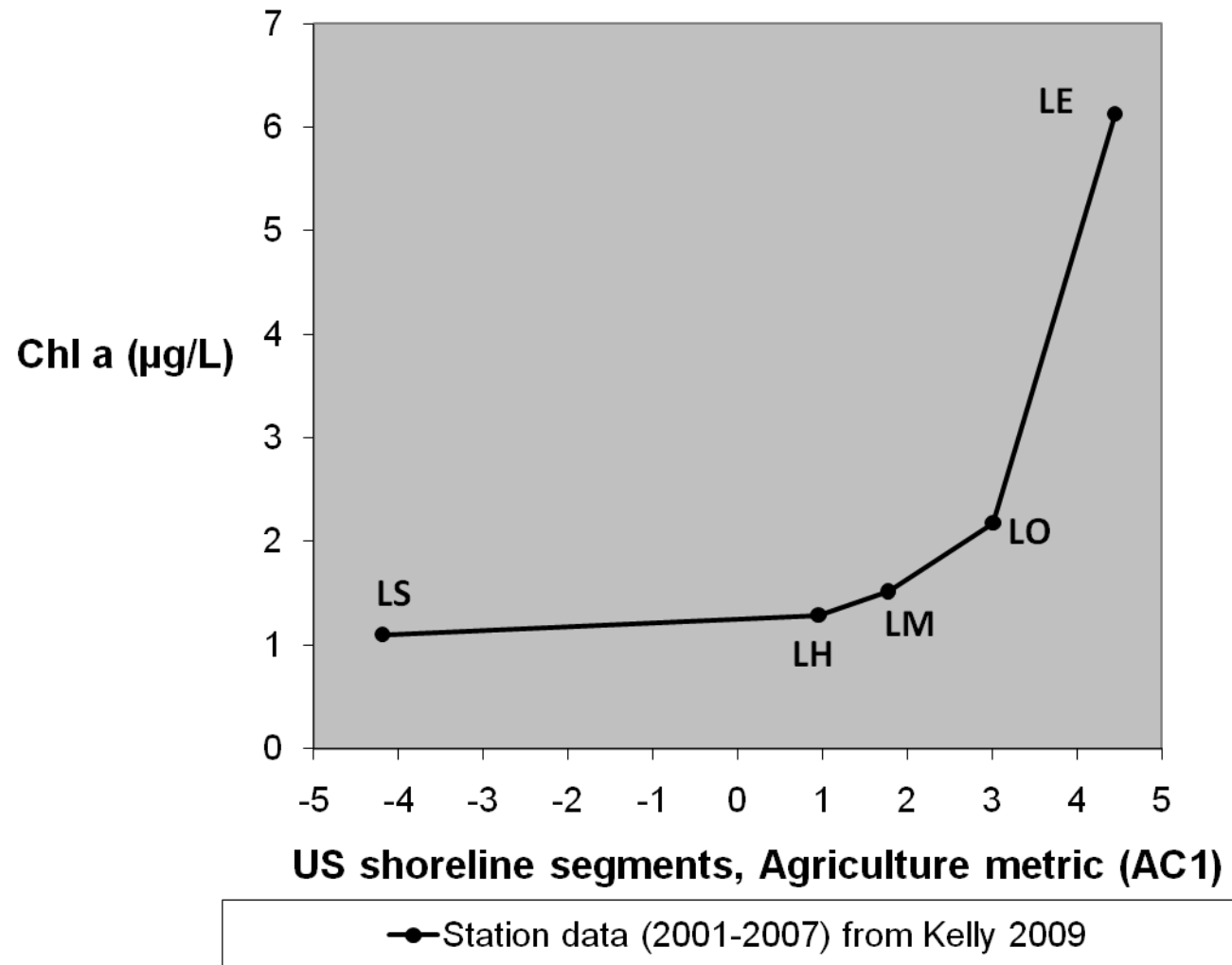
Lake Michigan in Perspective



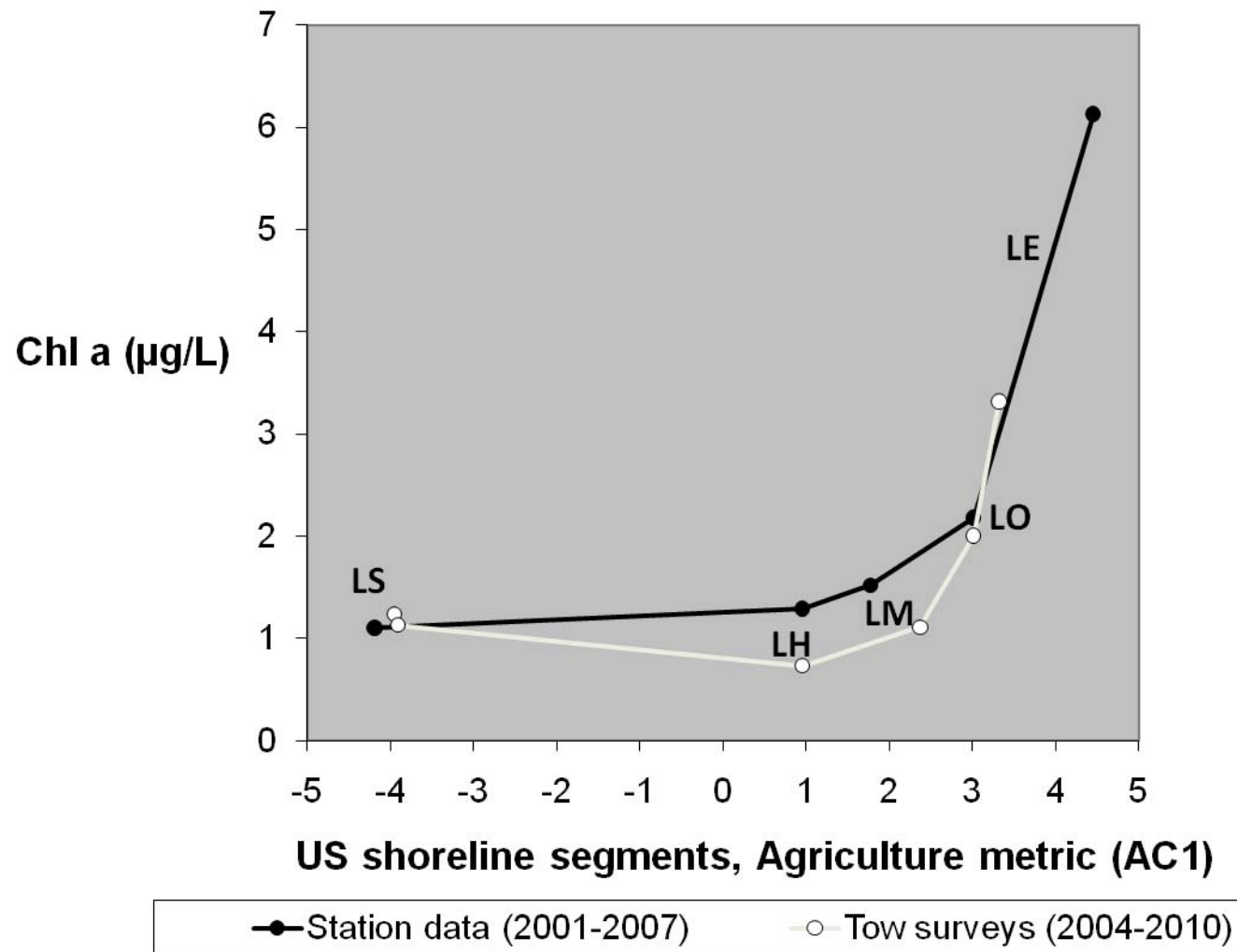
Collected data, processing, and example analytical uses



Nearshore Chl a as related to watershed agricultural metric



Preliminary tow summary averages for each lake



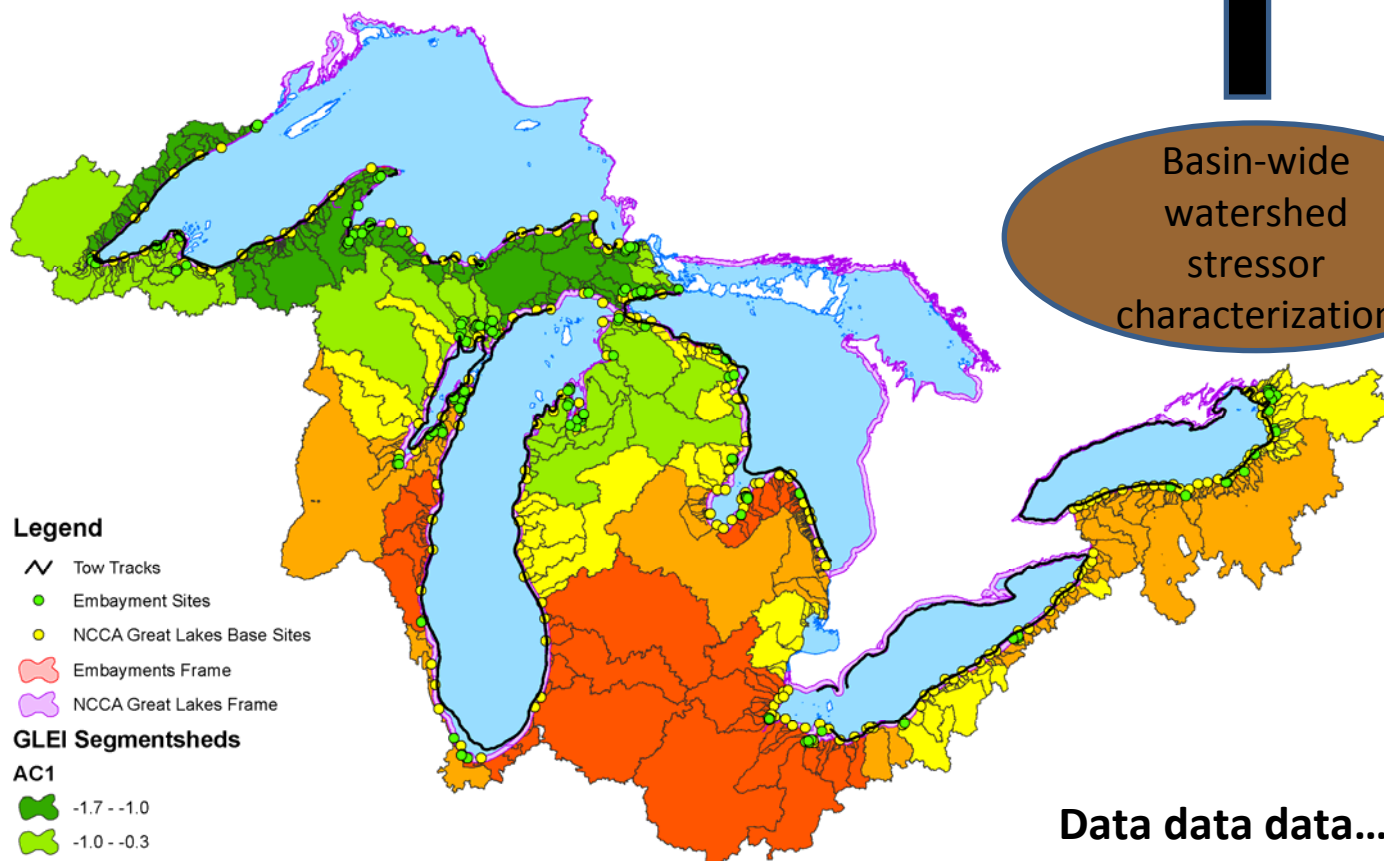
Triad of coastal observation sets developed in the last decade relevant to Nearshore

High-resolution
towing "census"
along ~20-m
depth contour

Probabilistic survey
National Coastal
Condition
Assessment

Basin-wide
watershed
stressor
characterization

Data data data...results coming



0 50 100 Kilometers