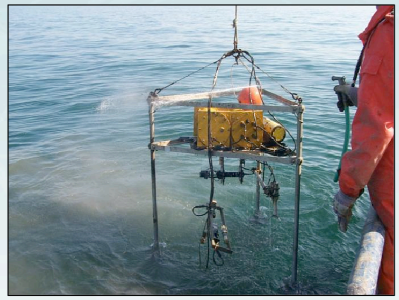
Physical Measurements in the Great Lakes

Nathan Hawley



This presentation is different as this is not a stand alone project.

Marine Instrumentation Laboratory

Steve Constant, John Lane, Ron Muzzi

Vessel Operations

Dennis Donahue, Steve Bawks, Beau Braymer, Tom Joyce, Mike Taetsch, Jack Workman, Andrew Yagiela\

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Environmental Protection Agency

Great Lakes National Program Office

Physical Measurements Program

Designs and deploys instrumented arrays to make time series measurements

These measurements are used to:

1) Document and quantify physical processes in the lakes
2) Calibrate and validate numerical models
3) Provide a context for other measurement programs

At present, measurements are a part of three programs:

1) Saginaw Bay Multiple Stressors
2) Lake Michigan Monitoring
3) Lake Erie Ice Study

The physical measurements program designs and deploys instrumented arrays to make time series measurements of physical (waves, currents, water temperature, water transparency, conductivity, PAR, sediment flux, ice thickness, and ice motion), chemical (dissolved oxygen, conductivity), and biological (fluorescence) parameters.

History

1970s - Currents and temperature (Saylor and Miller), waves (Liu and Schwab), sediment flux and composition (Eadie)

1980s - added water transparency (Hawley), radionuclides (Robbins), first coordinated deployments between chemists and physicists (Lake St. Clair*, Green Bay), first drifter studies (McCormick)

1990s - measurements begin to be systematically embedded in larger-scale programs – Saginaw Bay, Lake Michigan*

2000-2008 - time series measurements of PAR, fluorescence – Lake Erie*, Lake Huron

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* International program with Canada

Measuring circulation, wave climate, thermal structure, and sediment resuspension in Saginaw Bay

Key questions:

1) How do the thermal structure and circulation patterns in the bay affect water quality, human health, and fisheries dynamics?
2) What is the resuspension potential of sediments in the bay?
3) How does the resuspension of bottom material affect the growth and distribution of algae (muck) in the bay?

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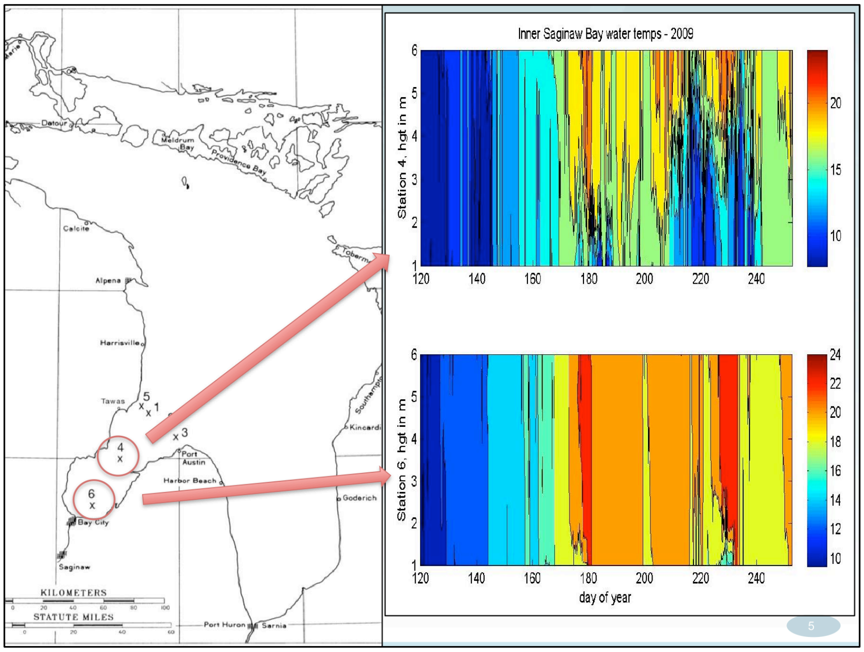
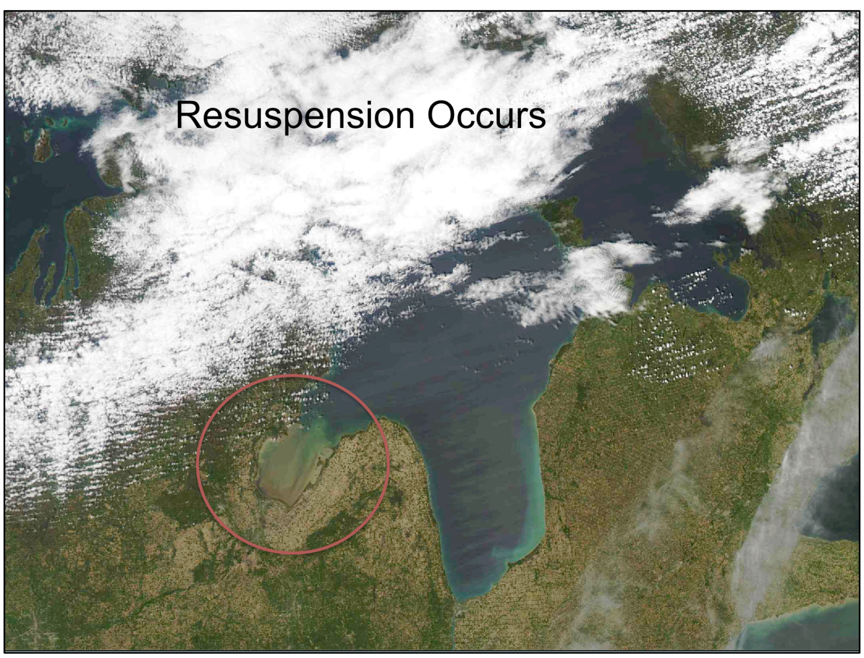
Co-investigator: Dmitry Beletsky (CILER)


Inner Saginaw Bay water temps - 2009
Station 4. hgt in m
Station 6. hgt in m
day of year
KILOMETERS
STATUTE MILES
Datour
Calcite
Alpena
Harrisville
Tawas
Port Austin
Harbor Beach
Bay City
Saginaw
Goderich
Port Huron
Sarnia
Providence Bay
5

5


Resuspension Occurs

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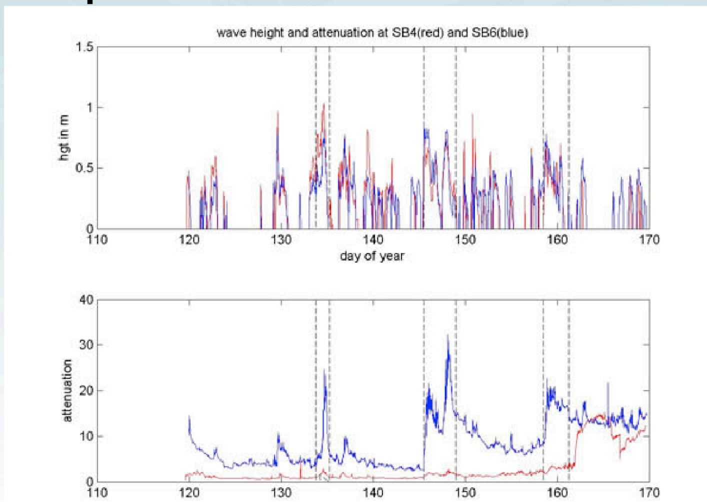
Assessing Sediment Resuspension



Possible differences:

1) Wave conditions are different.
2) Water is deeper at Saginaw Bay Station 4.
3) Our hypothesis: bottom sediment is different (mud at station X, sand at station y).

Measuring circulation, thermal structure, suspended sediment concentration, light, and fluorescence near Muskegon in Lake Michigan

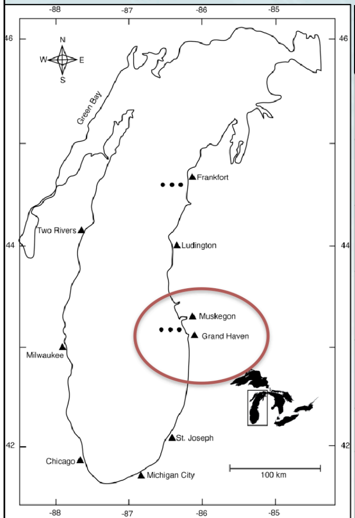
Key questions:

1) How do circulation, thermal structure, and light climate affect the spatial (both vertical and horizontal) structure of the new pelagic food web?
2) What is the short-term (hours-days) and medium-term (days-months) variability of the system?
3) How is material exchanged between the near shore and offshore regions?

Co-investigator: Cary Troy (Purdue)

Objective: Make time series measurements of circulation, thermal structure, suspended sediment concentration, light, and fluorescence at three monitoring sites near Muskegon in Lake Michigan.

2010 Lake Michigan Measurements



	15 meters	45 meters	110 meters
Currents	adcp	adcp	adcp
Waves	adcp		
Temps (# of depths)	6	18	20
Cond	+1 m -5 m		
Fluor	+1 m -5 m	-5 m	-5 m
Light	+1 m		-5 m
Trans	+1 m -5 m	-5 m	

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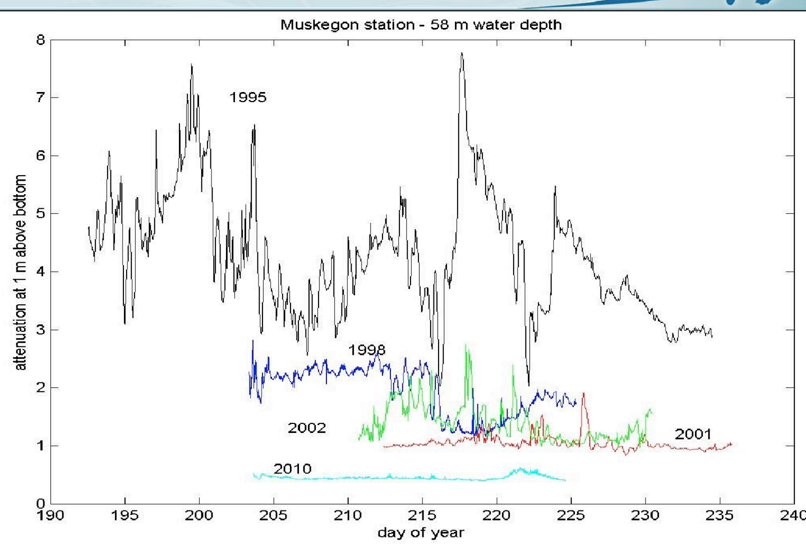
Increase in Water Clarity

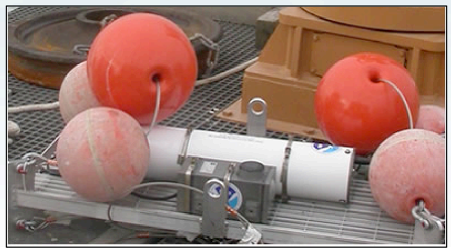


Increase in water clarity over time, most likely due to dreissenids.

Current velocity, water temperature, ice thickness, and ice velocity in the central basin of Lake Erie

Key questions:

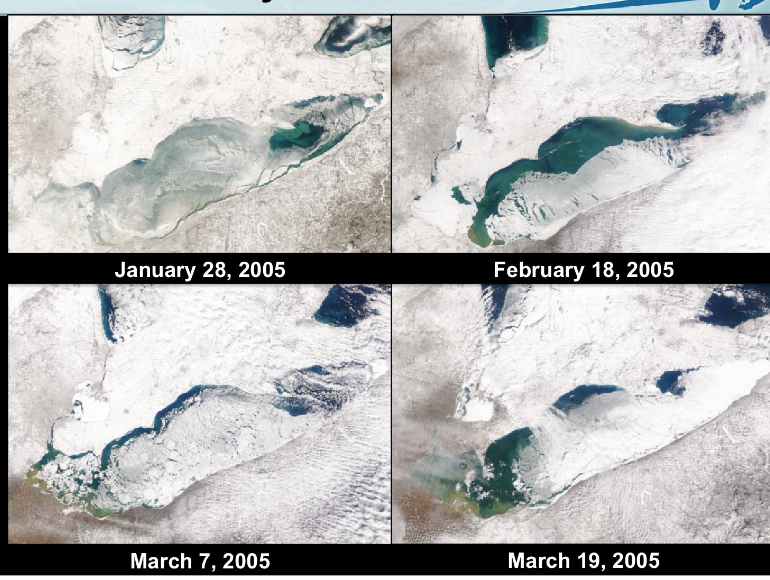
1) What is the impact of ice on circulation in the lake?
2) What is the impact of ice on spatial heterogeneity in the lake-atmosphere heat flux?
3) What is the impact of ice on mixing and thermal structure in the lake?



Co-investigators: Dmitry Beletsky (CILER), Jia Wang (GLERL)

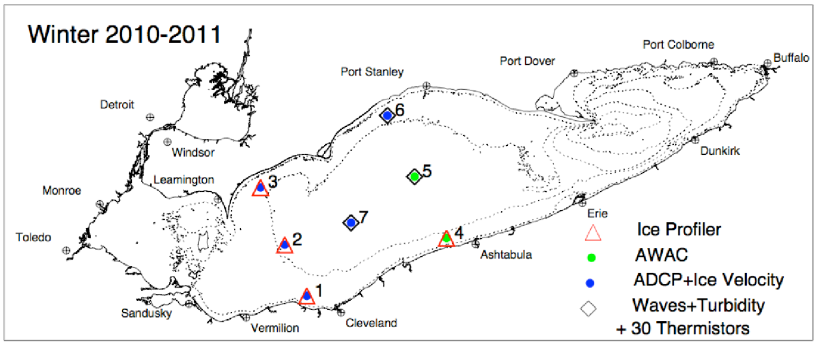
Objective: Make time series measurements of current velocity, water temperature, ice thickness, and ice velocity in the central basin of Lake Erie during the winters of 2010-2011 and 2011-2012.

Lake Erie Ice Dynamics



Ice is not static.

Sampling Plan



Mooring plan for 1010-2011.

Future plans

Short term (next 1-3 years)

- Continue or complete the three current programs

Long term (indefinite future)

- Emphasize the unstratified period - particularly winter and early spring – in Lake Michigan

- Long term, year round temperature measurements are needed in all of the lakes to monitor the effects of climate change

Questions?