

# Hydrodynamic Modeling

Dave Schwab

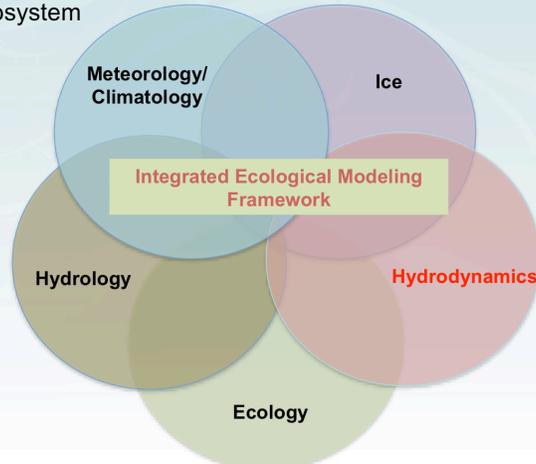


**Team Members:**

- Gregory Lang (GLERL)
- Dmitry Beletsky (CILER)
- Eric Anderson (CILER)
- Meng Xia (CILER)
- David Rockwell (CILER)

## Hydrodynamic Modeling Team

Develops, tests, integrates, and implements numerical models of lake circulation, water levels, waves, and lake thermal structure to understand and predict the effects of the physical environment on the ecosystem



## Key Scientific Questions

How can we better characterize the exchange of momentum and heat between the atmosphere and the lake because these are the primary forces that determine lake circulation?

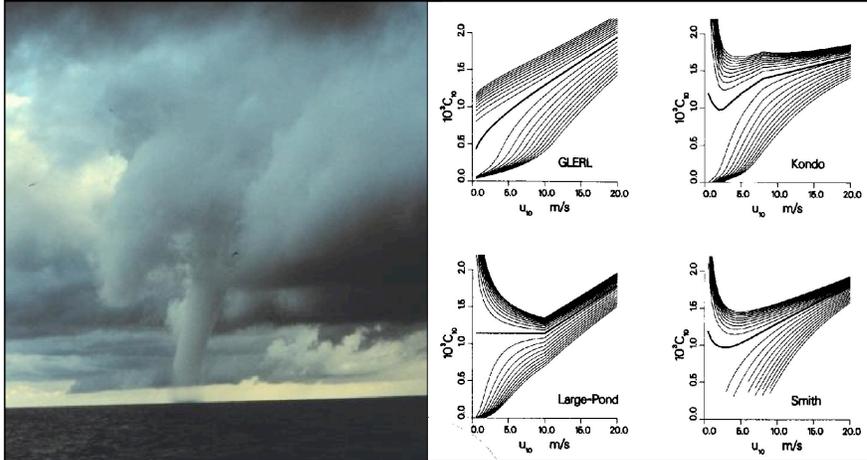
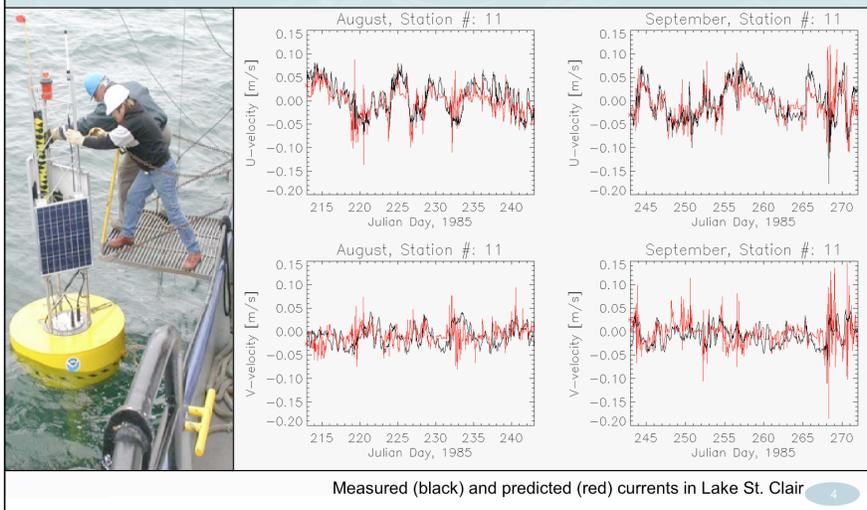


Fig. 2. Comparison of different bulk transfer coefficient formulas as a function of .10m wind speed for air-sea temperature differences from -20 degrees C to + 20 degrees C at a 1 degree C increment. The heavy line is the neutral case.

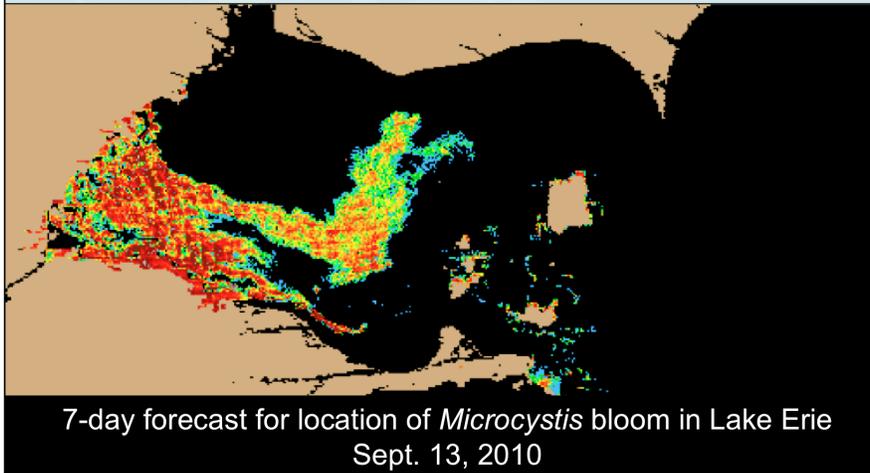
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## What are the critical factors that limit our ability to accurately predict physical phenomena in the lakes?



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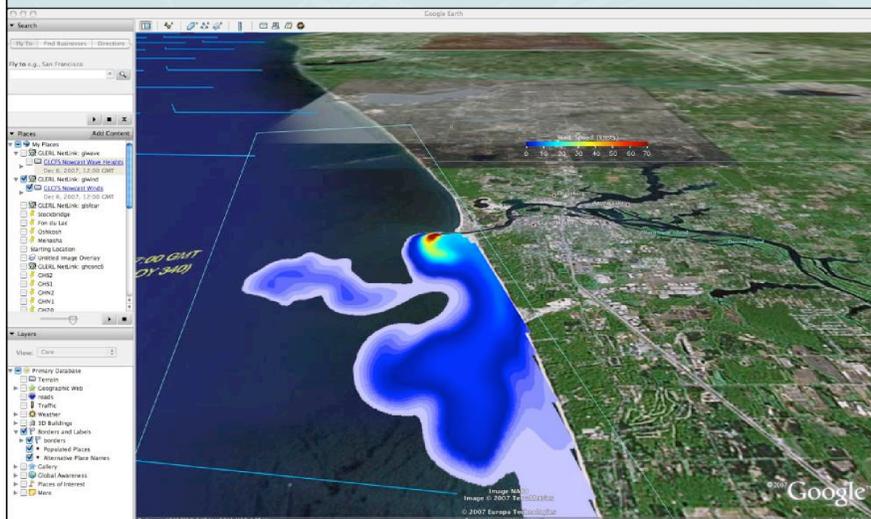
## What are the appropriate linkages between physics and biology for particular ecological processes?



We still don't know how scales of physical processes and biological processes interact.

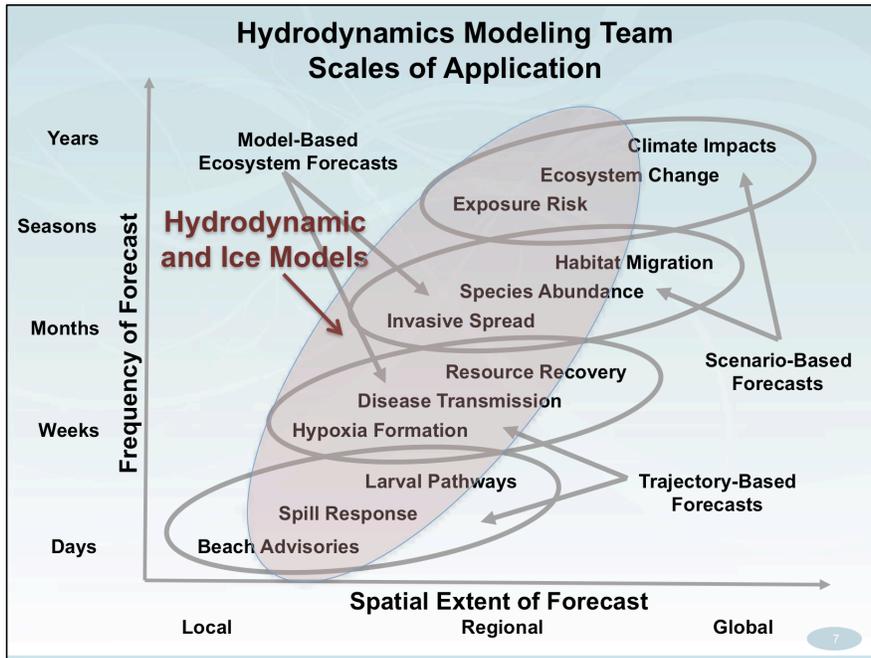
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## How do we effectively provide information from hydrodynamic models to our collaborators, users, and constituents?

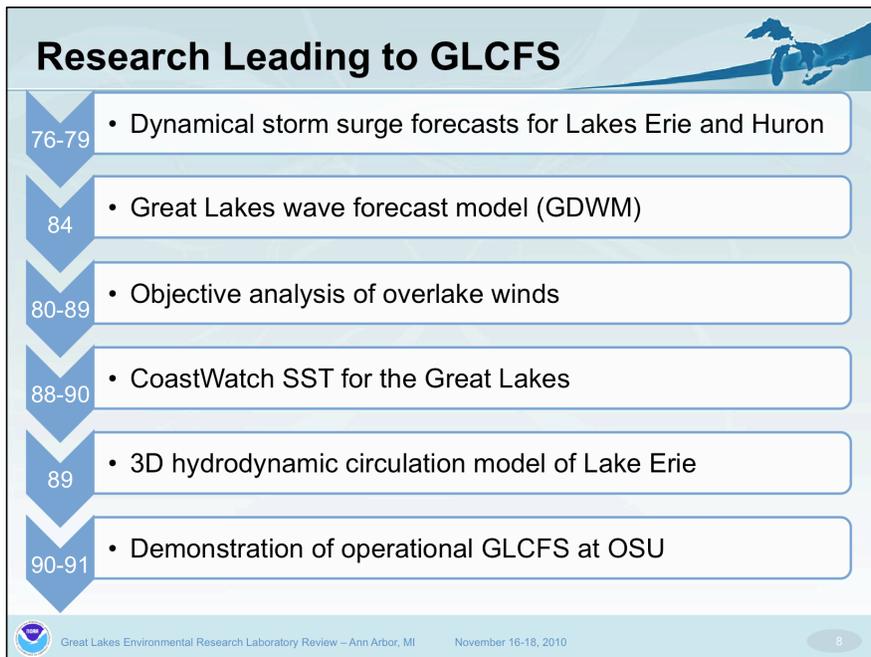


New tools like Google Earth can significantly improve information exchange.

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Hydrodynamics and ice models span all scales of ecosystem forecasting.



# GLCFS Transition to Operations

**Great Lakes Coastal Forecasting System, GLCFS**

GLCFS NOWCAST: 08/12/2009 (DOY 224) 0600 GMT  
 Nowcasts are generally posted by about 0630, 0830, 1230, and 1630 GMT (subtract 4 for EDT)

See also KML files:  Select Parameter:

NEW! See also NetCDF files:  Most Recent NOWCAST: L20092400...  5-day Archive

GLCFS FORECAST: 08/12/2009 (DOY 224) 0600 GMT - Experimental  
 Forecasts are generally posted by about 0155 and 1955 GMT (subtract 4 for EDT)

NEW! See also NetCDF files:  Most Recent FORECAST: L20092400...  2-day Archive

**GLERL Great Lakes Coastal Forecasting System**

1991 / 2003

**CO-OPS**

**National Digital Forecast Database**

Great Lakes Coastal Forecasting System Prototype developed in 1991-92 with Ohio State University  
 Operational at NOS CO-OPS in 2003  
 National Ocean Service - Center for Operational Oceanographic Products and Services

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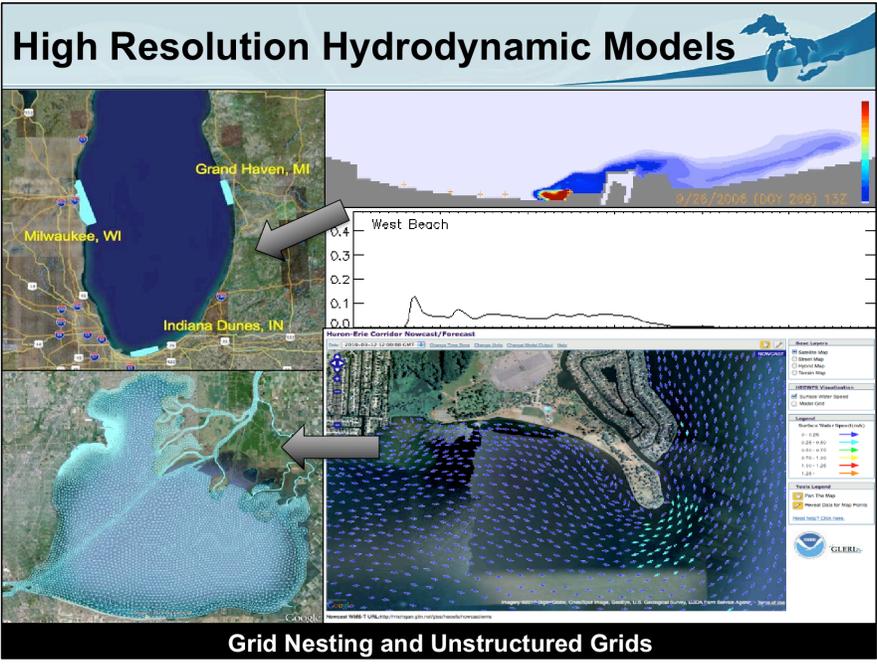
## Huron-Erie Connecting Waterways Forecasting System

Lake St. Clair

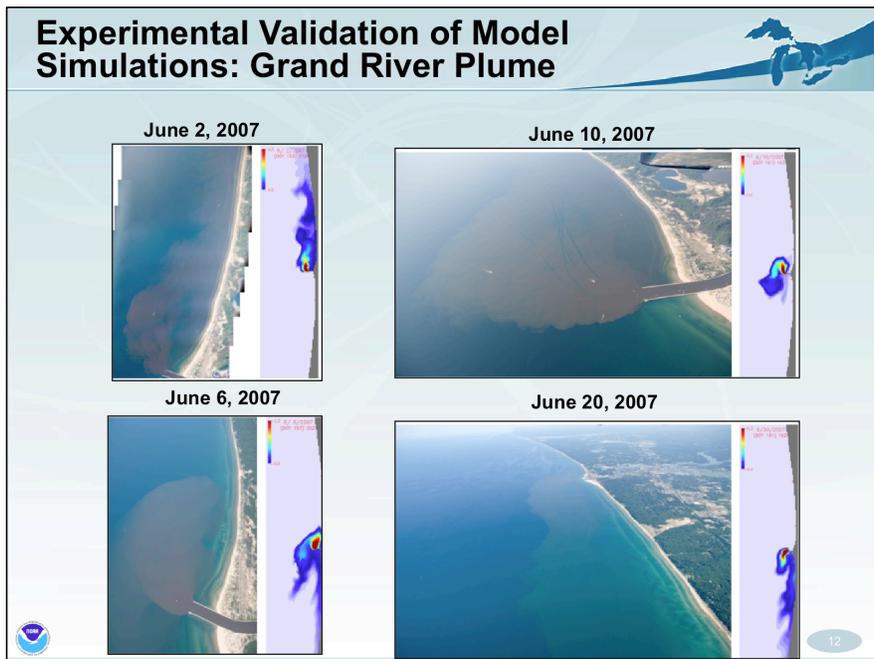
- Finite Volume Coastal Ocean Model unstructured grid
- Nowcasts / forecasts of hourly water levels and currents
- Link model with output from GLCFS
- Updated every 6 hrs

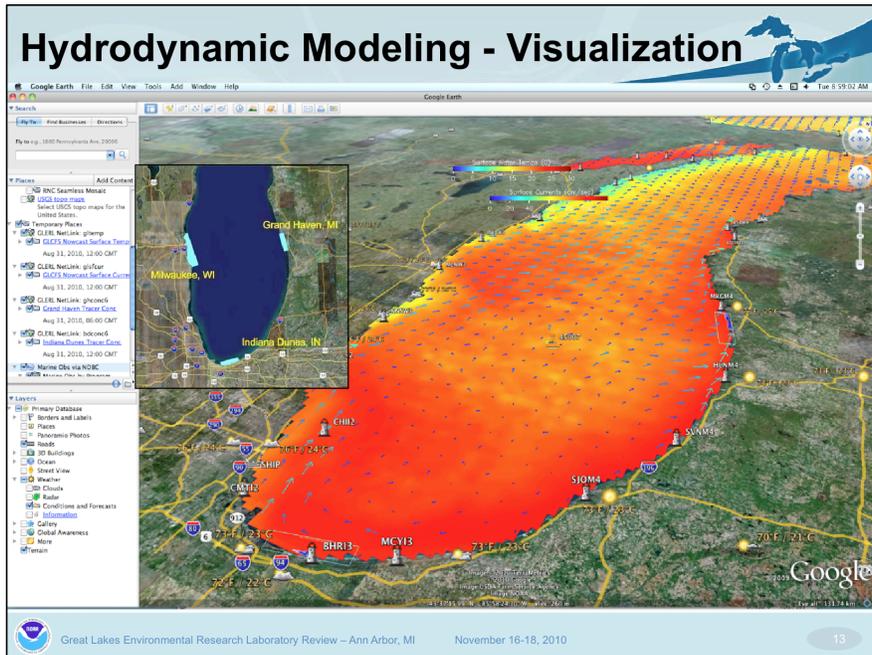
The new direction is toward unstructured, high resolution hydrodynamic models, such as FVCOM.

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Some examples of high resolution hydrodynamic models used for beach quality forecasting.





Lake-wide surface currents from Great Lakes Coast Forecasting System, coastal observations from Great Lakes Observing System/Integrated Ocean Observation System, and Oceans and Human Health Initiative nested grid hydrodynamic models in Lake Michigan.

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## Hydrodynamic Modeling - Customers

- NOAA NWS Great Lakes Offices - Marine forecasts
- NOAA NWS - North Central River Forecast Center - Water Levels
- NOAA NOS CO-OPS - Coastal forecasts
- NOAA NOS/OHHII - Harmful Algal Blooms in Lake Erie
- National Ice Center - Water temperature and ice
- USCG SAR - Search and rescue planning
- NOAA HAZMAT - Spill response
- U.S. Geological Survey - Spill Response
- Northeast Ohio Regional Sewer District - Water temperature
- Niagara River Control Center - Water Levels
- UW-Milwaukee/SUNY Buffalo - Nested Grid Modeling
- Recreational users: sport fishing, boating, swimming

**In addition, dozens of academic, private sector, and other public agencies make requests for various archived products from GLCFS**

Great Lakes Environmental Research Laboratory Review - Ann Arbor, MI November 16-18, 2010 14

Customers are specific to GLCFS

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