CENTER OF EXCELLENCE FOR GREAT LAKES AND HUMAN HEALTH

Fourth Annual Water Quality Forum
Ottawa County Michigan October 26, 2009

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OCEANS & HUMAN HEALTH INITIATIVE

Sea Grant Michigan

DEQ

Ottawa County Beach Forecasting Model Talk Outline

1. Need for Models
2. Statistical Models
3. Deterministic Models
4. Combined Forecast Models
5. Future Plans Beach Water Quality Forecasting

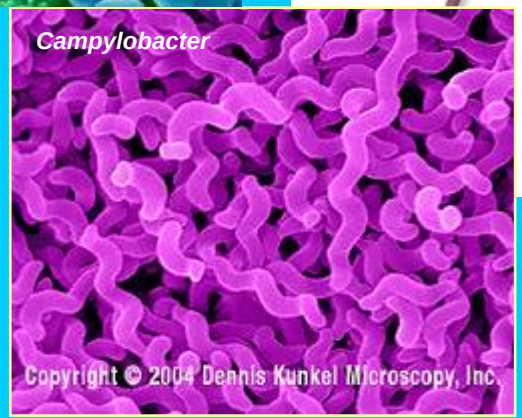
The National Park Service


WARNING

Head over heels in love with our water!

We just don't look at it or drink it, we play in it!

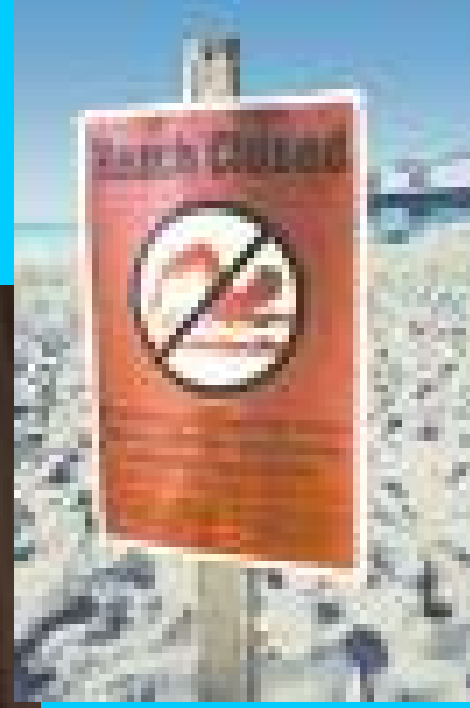
Recreational Water Illness




BEACH CLOSED
DANGEROUS
CONDITIONS


BEACH
CLOSED


NO SWIMMING
HAZARDOUS AREA
BEACH CLOSED
By Order Amity P.D.

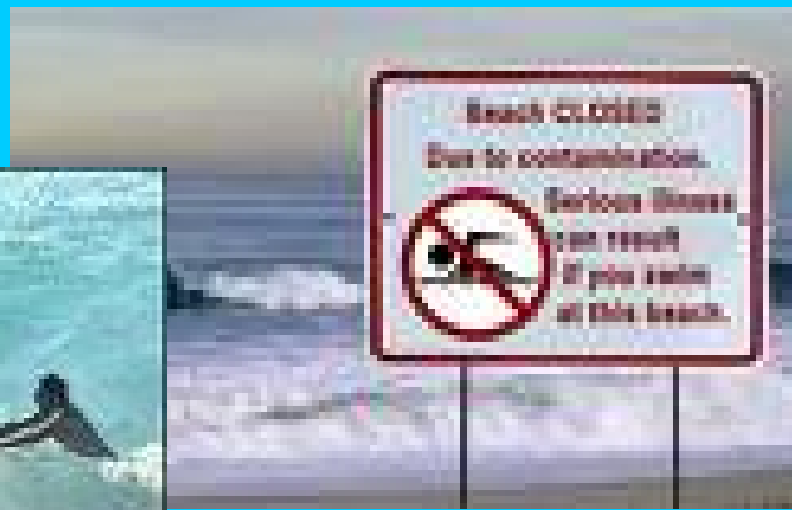



BEACH
CLOSED
FOR SWIMMING


STOP
CLOSED
Based on recent monitoring for E.coli bacteria
Serious Risk of illness may be present
THIS AREA IS CLOSED
TO SWIMMING


BEACH
CLOSED


BEACH
CLOSED


Beach CLOSED
Due to contamination.
Serious illness
can result
if you swim
at this beach.

DEO

The Public Demands Action!

Protect Swimmer Health

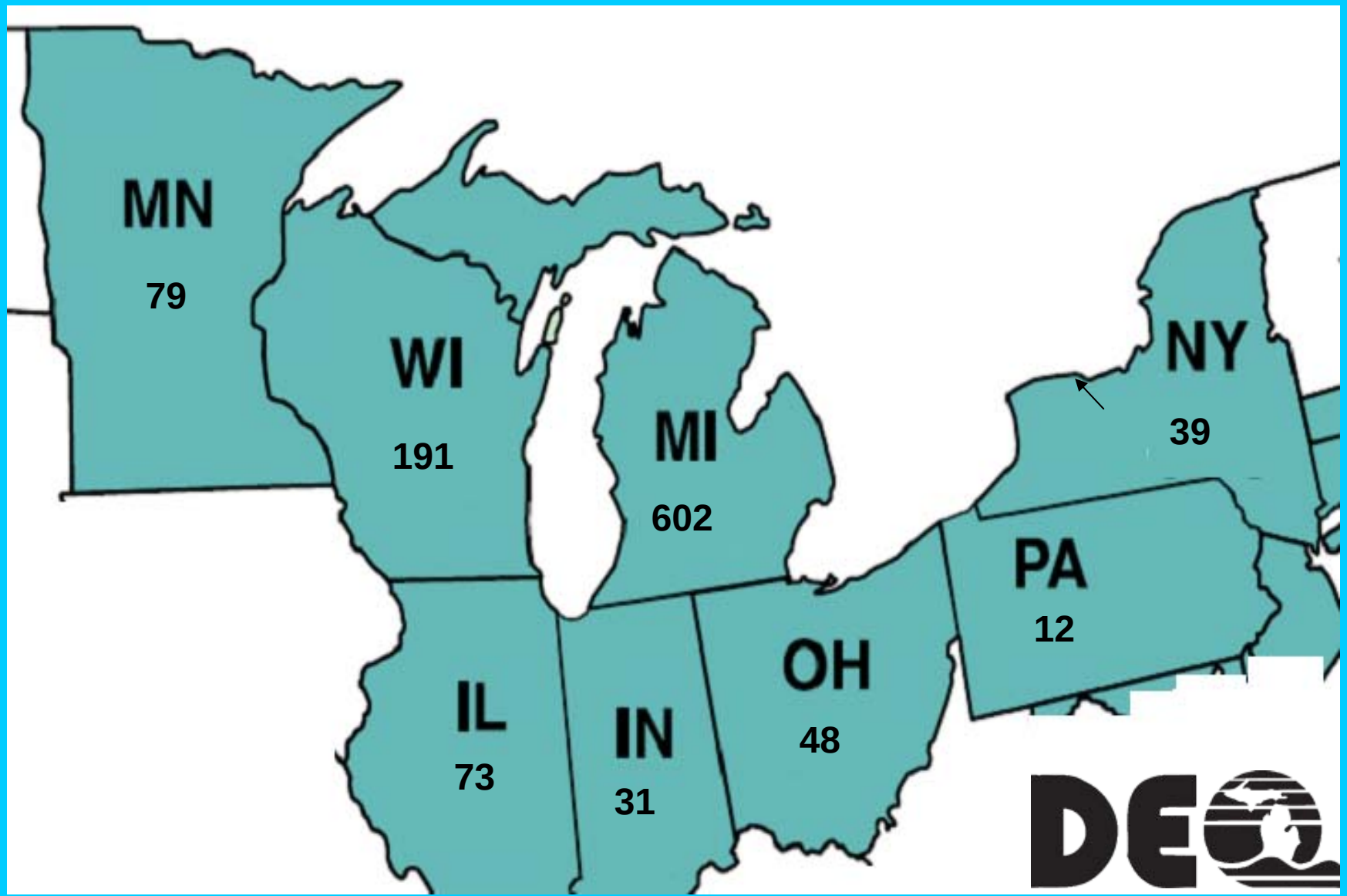
Great Lakes Beach Association

beachnet@great-lakes.net

Your link to 800 beach buddies!

We transfer our expertise and experience in successful collaborations.

Great Lakes Public Beaches



Michigan BeachGuard System - Home - Windows Internet Explorer

http://www.deq.state.mi.us/beach/

screen capture software

File Edit View Favorites Tools Help

Google michigan beach guard Search Bookmarks Check Translate AutoFill

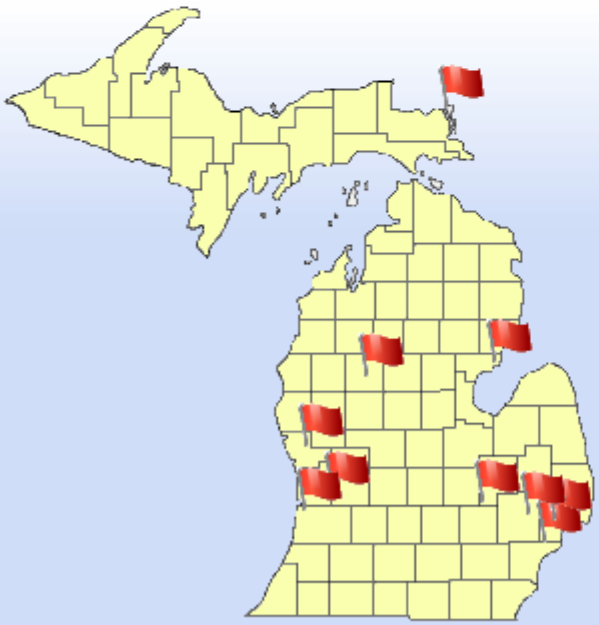
Favorites Michigan BeachGuard System - Home Page Safe

AVG michigan beach guard Search Total Protection AVG Info Get More

DEQ Department of Environmental Quality Michigan.gov

BeachGuard Home | Michigan.gov Home | Search | RSS | About | Log In

Welcome to the Michigan BeachGuard System. Select a county from the map below to see beach information for that county. Use the search box in the navigation bar to find by beach or waterbody by name.



Current closures and advisories are displayed above

Michigan Beaches

1178 Public Beaches

438 Private Beaches

11 Closures and Advisories

Waterbody and Location Name	County
Saginaw Bay-Lake Huron - Singing Bridge Beach	Arenac
Maplewood Lake - Maplewood Lake Park	Ottawa
Twin Lake - Twin Lake County Park Beach	Muskegon
Sunrise Lake - Sunrise Lake Park	Osceola
Lake Macatawa - Dunton Park	Ottawa
Fenton Lake - Township Hall	Genesee
Lake St. Clair - St. Clair Shores Blossom Heath Beach	Macomb
Stoney Creek Lake-Impoundment - Stoney Creek Metropark-Baypoint Beach	Macomb
Lake St. Clair - New Baltimore Park Beach	Macomb
St. Mary's River - Sugar Island Township Park	Chippewa
Stoney Creek Lake-Impoundment - Stoney Creek Metropark-Eastwood Beach	Macomb

Federal Agency Research

- **USGS Beach Health Initiative**
  Ocean Research Priorities Plan
- **EPA Advanced Monitoring Initiative**
  Research
- **NOAA Center of Excellence**
  Great Lakes and Human Health

Federal Collaboration on Beach Health in the Great Lakes

Remediation, Decision Support, & Environmental Research

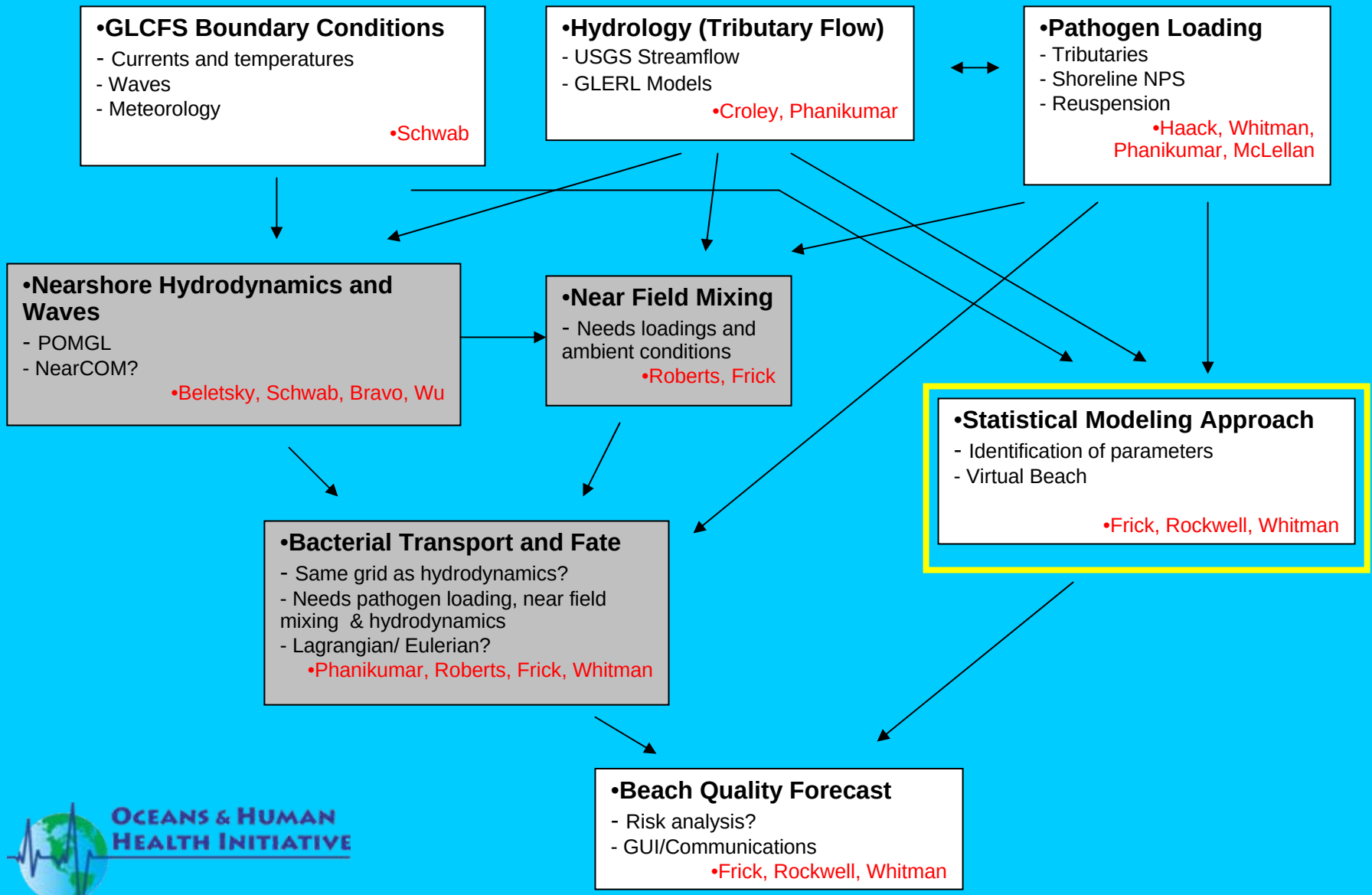
BEACH HEALTH INTERAGENCY COORDINATION TEAM

Operational Forecasting & Research

Beach Water Quality Forecasting Coordinator

Monitoring & Modeling Research

•Statistical Beach Quality Modeling Approach



OCEANS & HUMAN HEALTH INITIATIVE

•Predictive Variables for Statistical Beach Forecasting Models *(Mednick, 2009: Accessing Online Data for Building and Evaluating Real-Time Models to Predict Beach Water Quality)*

- ***Near Shore Conditions***
- - Wave height *
- - Turbidity
- - Lake current speed and direction *
- - Water temperature *
- - Lake level *
- ***Weather Conditions***
- - Antecedent rainfall *
- - Wind speed and direction *
- - Air temperature *
- - Sunlight *
- ***Onshore Conditions***
- - Number of bathers
- - Presence of algae
- - Number of gulls
- ***Watershed Conditions***
- - Stream flow *

- * Available from GLCFS

Home
Research Home ►

GLSC Initiatives
Beach Health
Project S.A.F.E.
About Project S.A.F.E.
Metadata
Huron/Erie Corridor ►
Thiamine ►

Project S.A.F.E.

Friday, May 25, 2007

Swimming Advisory Forecast Estimate

For Lake St., Marquette Park, WEIls St., and Ogden Dunes beaches

Project by US Geological Survey in cooperation with the City of Gary, Indiana Department of Environmental Management , and National Oceanic Atmospheric Administration (NOAA)

Recreational Water Quality

Project S.A.F.E. will begin it's daily updates on Memorial Day, May 28, 2007.

Beach	SAFE Estimate
Lake St.	
Marquette Park	
Wells St.	
Ogden Dunes	

Anticipated Beach Conditions
Rain 24 h total (in)
Wind Speed (kts)
Wind Direction
Air Temperature (°F)
Water Temperature (°F)
Wave Height (ft)
UV Index (forecast)
Burns Ditch Ogden Marshall (ft)

Predictive Modeling

- Refine and evaluate procedures for building water quality models used for notification and advisories/closures
- Virtual Beach Software for Statistical Modeling

- **Model Builder** for developing multiple linear regression models for indicator prediction and
- **Beach Advisor for** providing user friendly beach advisory decision support for non technical users

General | Empirical Model

Virtual Beach

Disclaimer:

This software has been reviewed in accordance with the U.S. Environmental Protection Agency's peer and administrative review policies and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

build

NOAA Center of Excellence for Great Lakes and Human Health

- Develop sustainable forecasting tools to minimize risk to human health in coastal environments.
- Identify sources and causes

- Water Quality
- Beach closures
- Harmful Algal Blooms

NOAA develops Great Lakes algal bloom forecasts

TRAVERSE CITY, Mich. - An experimental system that uses satellite data and computer modeling will help forecast the direction and intensity of ugly, smelly algae blobs in the Great Lakes.

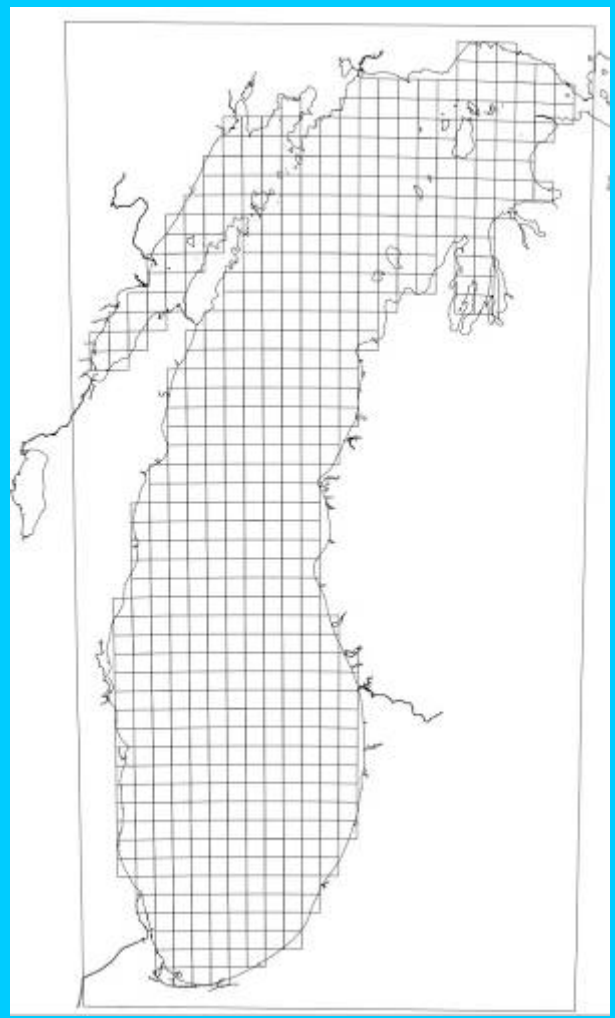
Chicago Tribune 9/17/2009.

Nested grid plume trajectory model

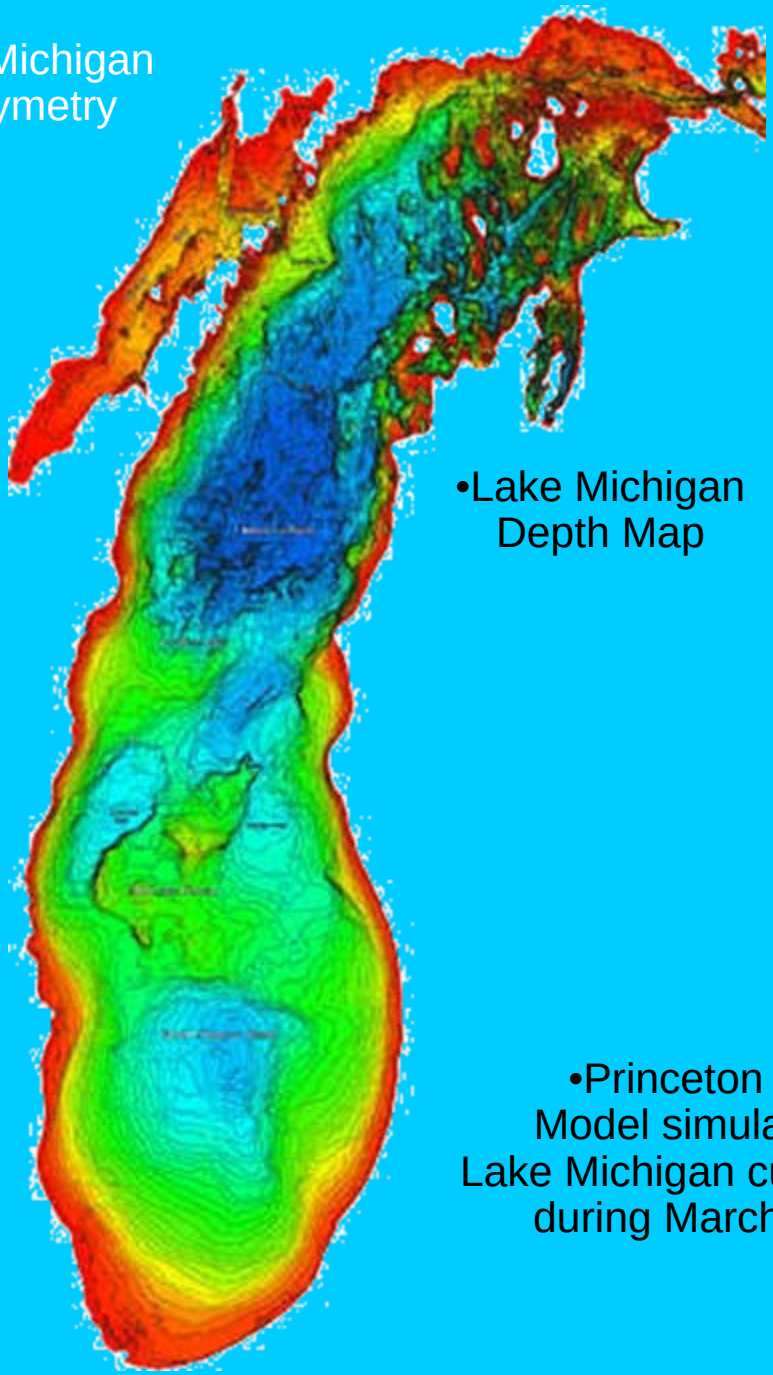
Factors Affecting Lake Circulation

- Wind stress
- Bottom topography
- Earth's rotation
- Temperature gradients

•Numerical Model



•Lake Michigan Bathymetry



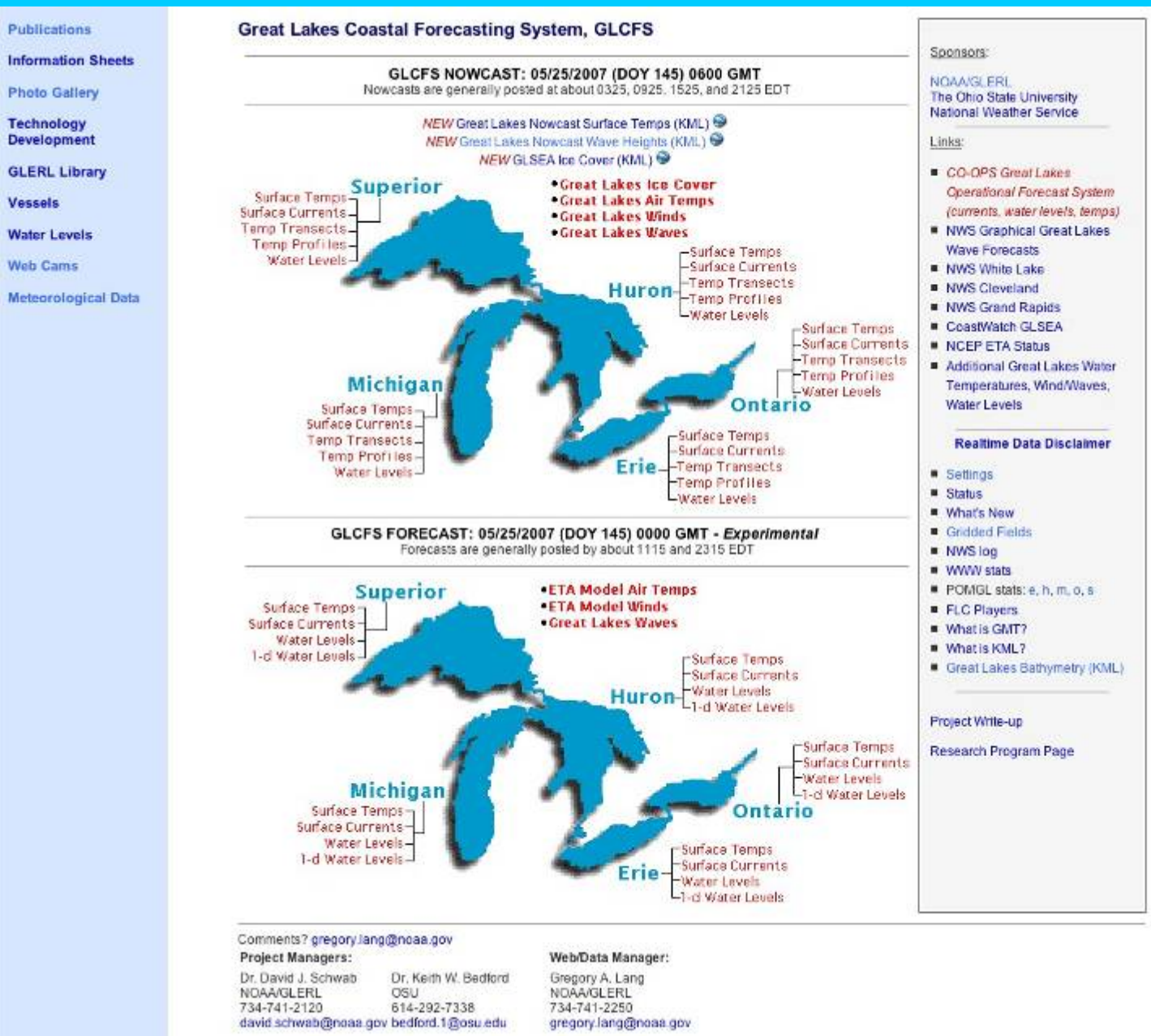
•Lake Michigan Depth Map

QuickTime™ and a
BMP decompressor
are needed to see this picture.

•Princeton Ocean Model simulation of Lake Michigan currents during March, 1998


Grand Haven, MI
Milwaukee, WI
Indiana Dunes, IN

•Great Lakes Coastal Forecasting System: www.glerl.noaa.gov/res/glcfs



- Five separate models based on POM with 2-5 km horizontal resolution and 20 sigma layers
- Provides nowcasts and forecasts of water level, currents, temperature, and waves (GL wave model)
- Runs automatically 4 times per day for nowcasts, 2 times per day for forecasts (out to 60 hrs)

Publications
Information Sheets
Photo Gallery
Technology Development
GLERL Library
Vessels
Water Levels
Web Cams
Meteorological Data

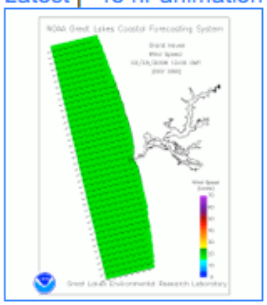
Grand Haven Area Nowcast

Check out Grand River Plume: Aerial Photos vs Model Simulation (updated Jul 20, 2007)
See also Forecast

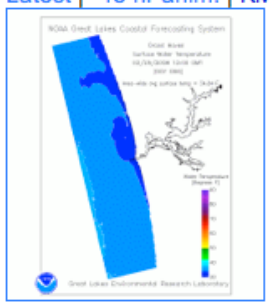
Timestamp: 02/25/2008 (DOY 056) 12:00 GMT

The products on this page are updated 4x per day at about 0345, 0945, 1545, and 2145 EDT

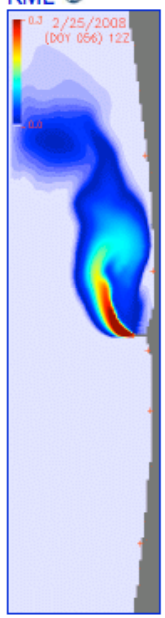
Winds:
Latest | -48 hr animation



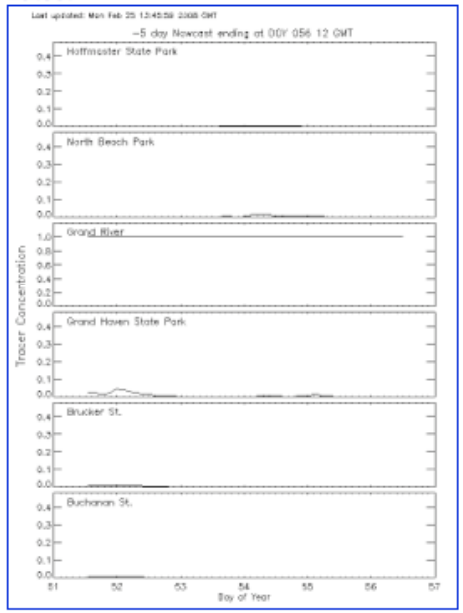
Surface Water Temps:
Latest | -48 hr anim. | KML



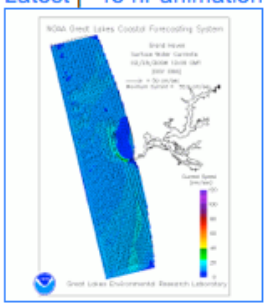
Tracer Concentration:
Latest | -5 day anim. | KML



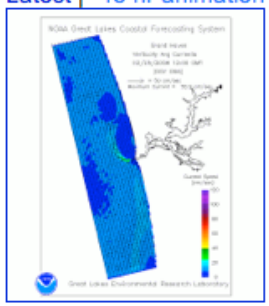
Timeseries at Beaches:
Latest



Surface Currents:
Latest | -48 hr animation



Vertically Avg Currents:
Latest | -48 hr animation



See also: grid1 | grid2 | grid3 (KML)
Bathymetry: jpg | KML Beach Locations: jpg | KML

Sponsors:
NOAA/GLERL
NOAA CEGLHH

Links:
- GLCFS
- USGS Grand River Realtime Obs

Log
bc_stats
pomgl_stats
Notes
FLC Players
What is GMT?
What is KML?

Project Write-up

Research Program Page

Comments? gregory.lang@noaa.gov

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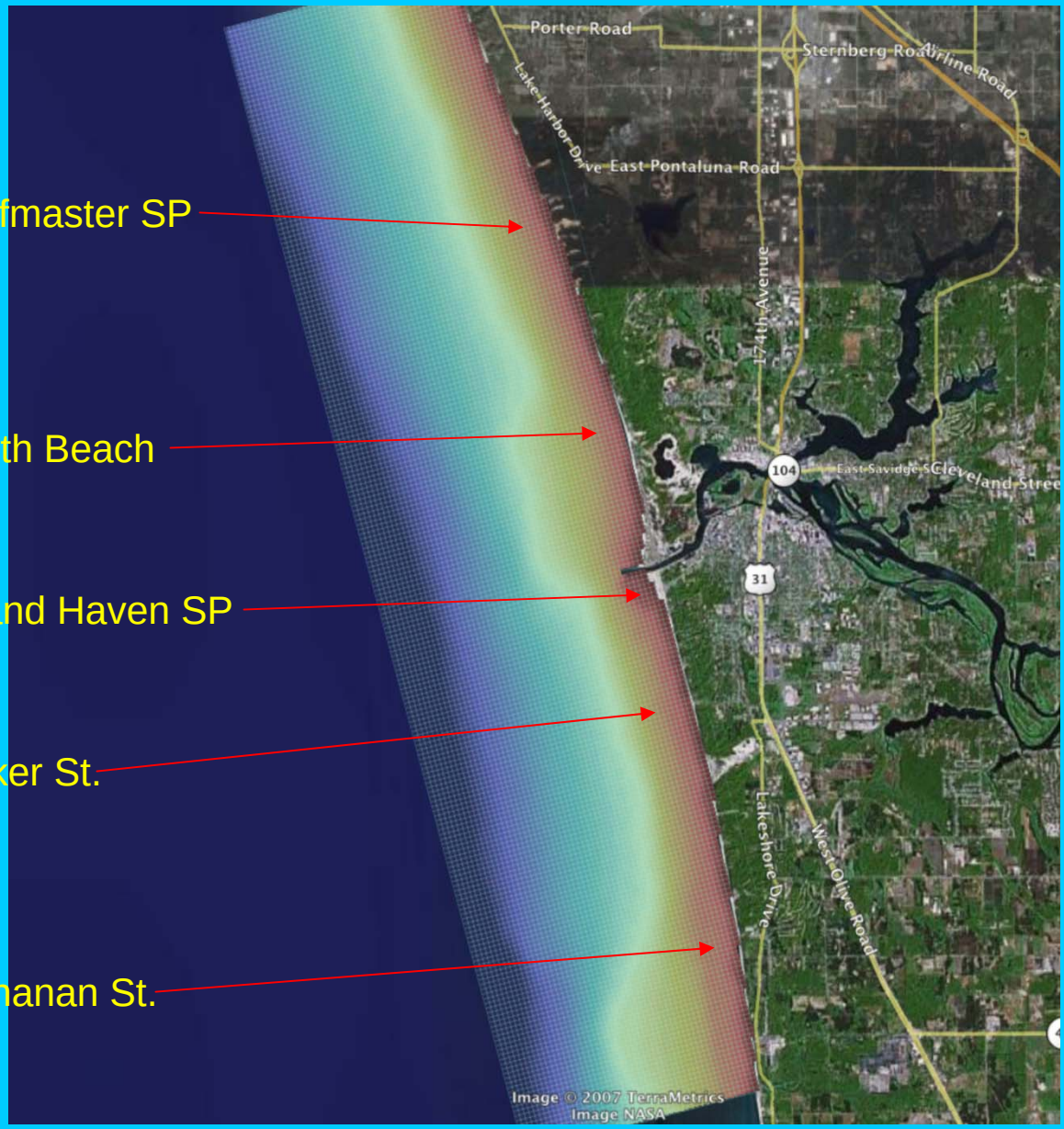
gregory.lang@noaa.gov

•Web site: www.glerl.noaa.gov/res/glcfs/gh

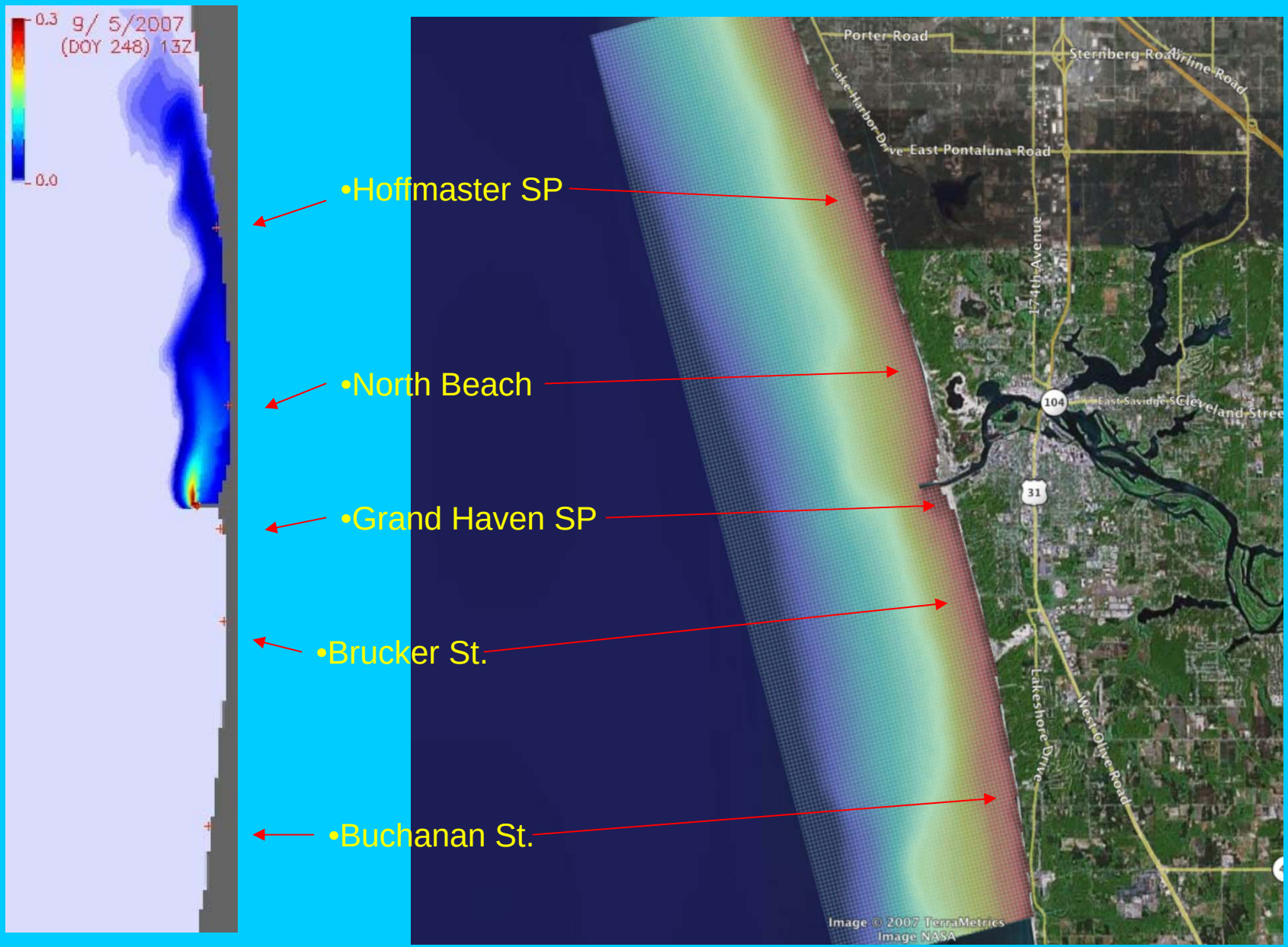
•48 hr Forecast: /ghf

•Grand Haven, MI 100 m nested grid (high flow)

QuickTime™ and a
BMP decompressor
are needed to see this picture.



•Grand Haven, MI 100 m nested grid (low flow)



Model validation

•Grand River Plume Tracking Experiments, 2006-2007

•Rhodamine-WT dye release

•Moorings

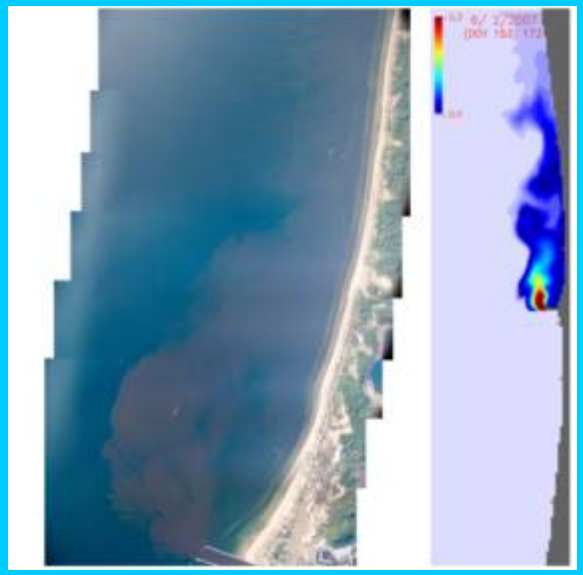
•Aerial Photography

•Dye tracking, CTD mapping and bacterial sampling

•GPS drifter buoy release

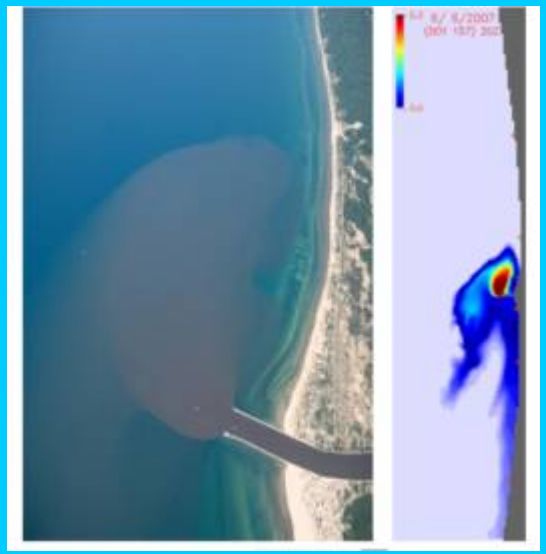
•Grand River Plume Aerial Photography and Model Simulations

•June 2, 2007



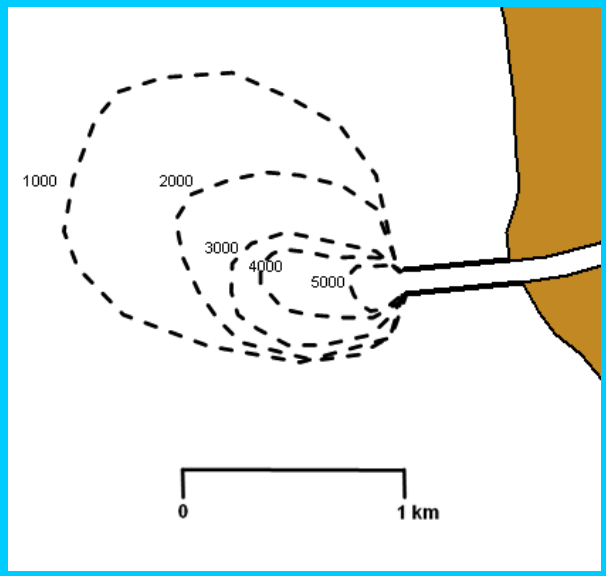
•June 10, 2007

•June 6, 2007

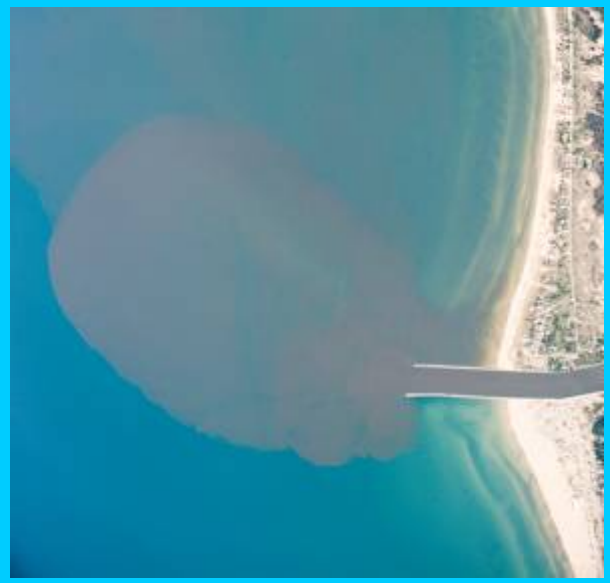


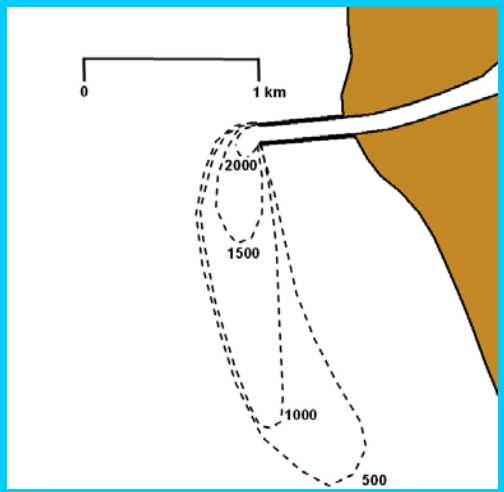
•June 20, 2007

•Sulfur Hexaflouride Tracer Measurements Compared to Aerial Photography



•6/22/2006

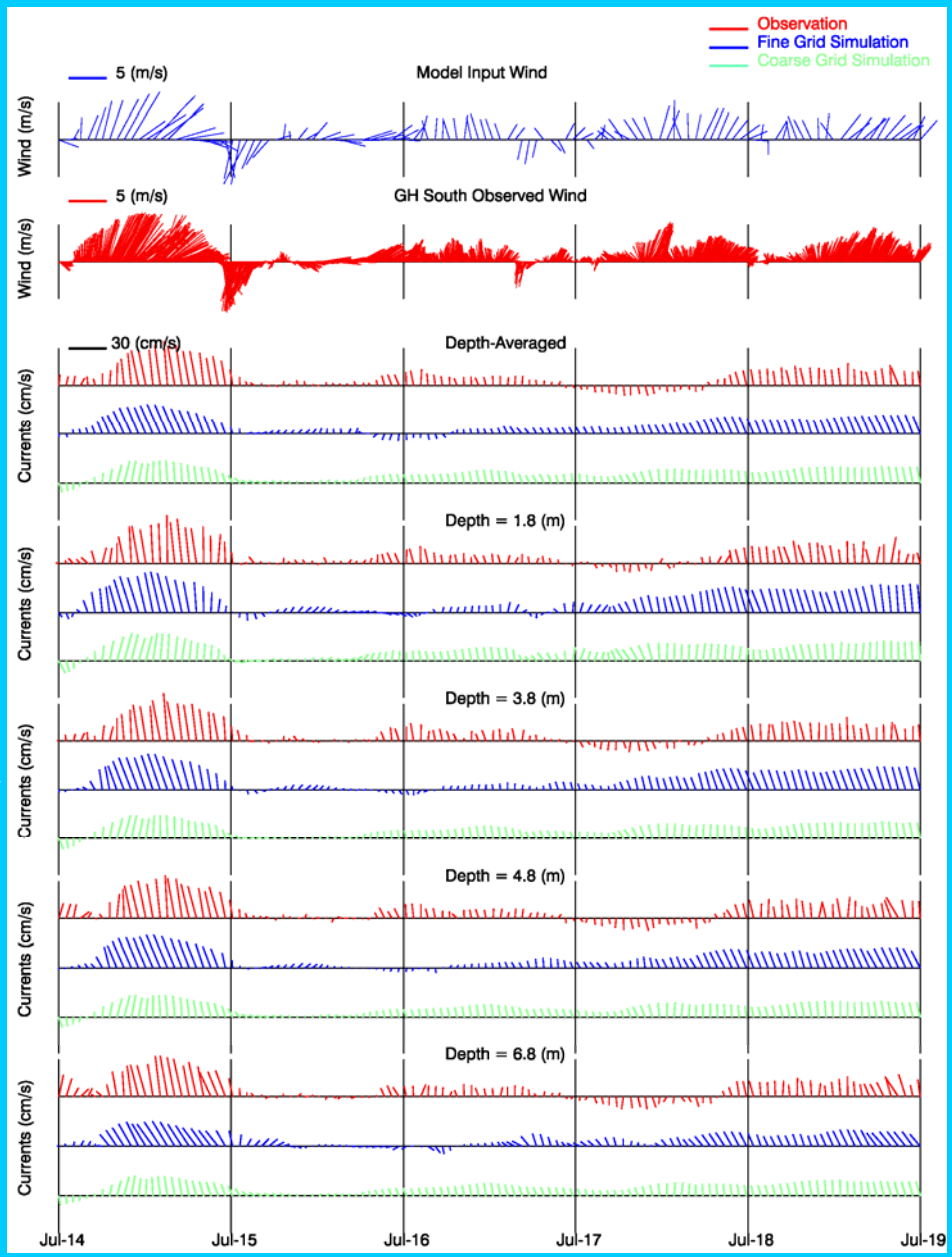




•8/8/2006

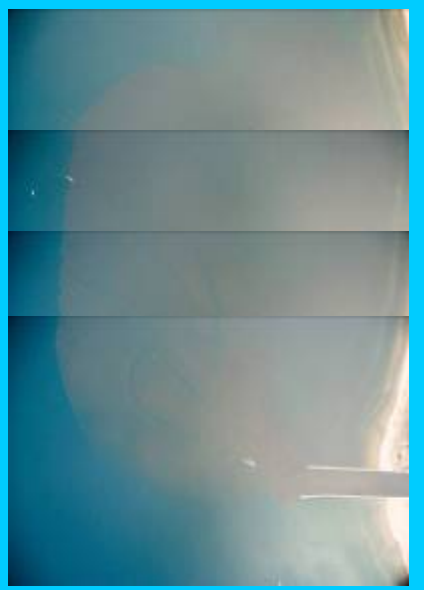
•Model Evaluation with ADCP Measurements

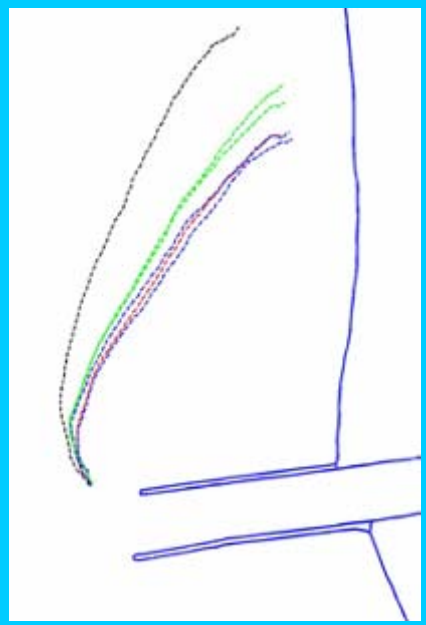
•July 14-19, 2007



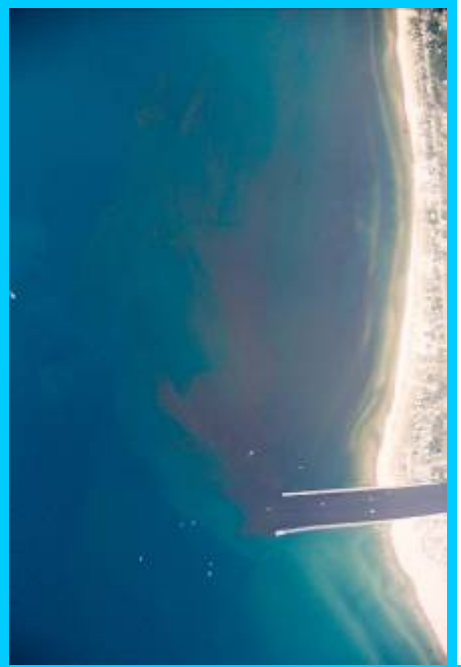
•Drifter Buoy Tracks and Aerial Photos

•July 17, 2007

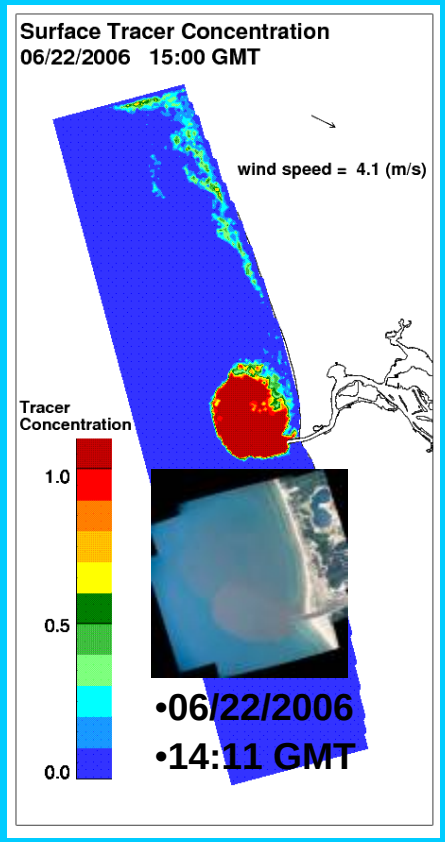


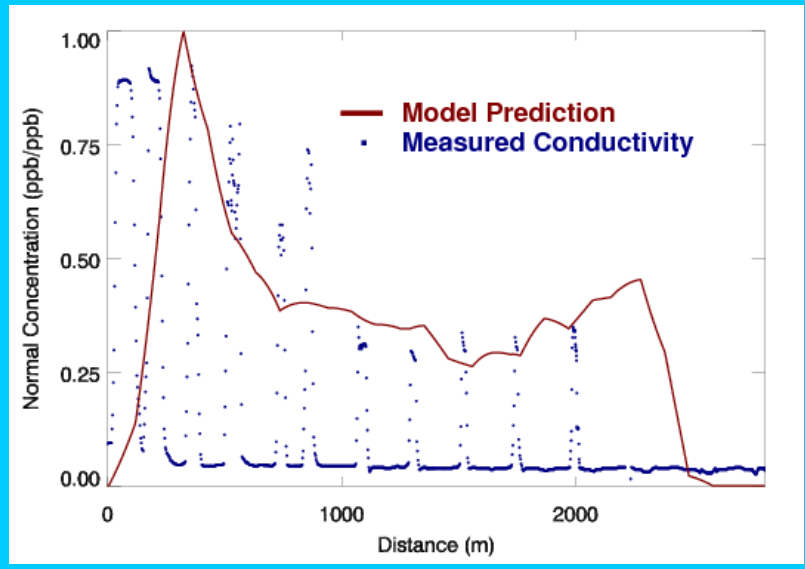


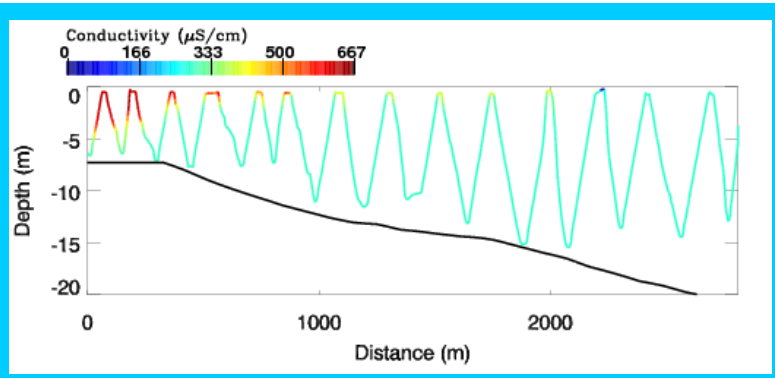
•July 18, 2007



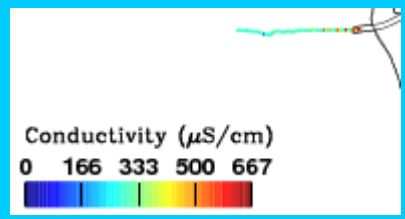
•CTD Transect 6/22/2006



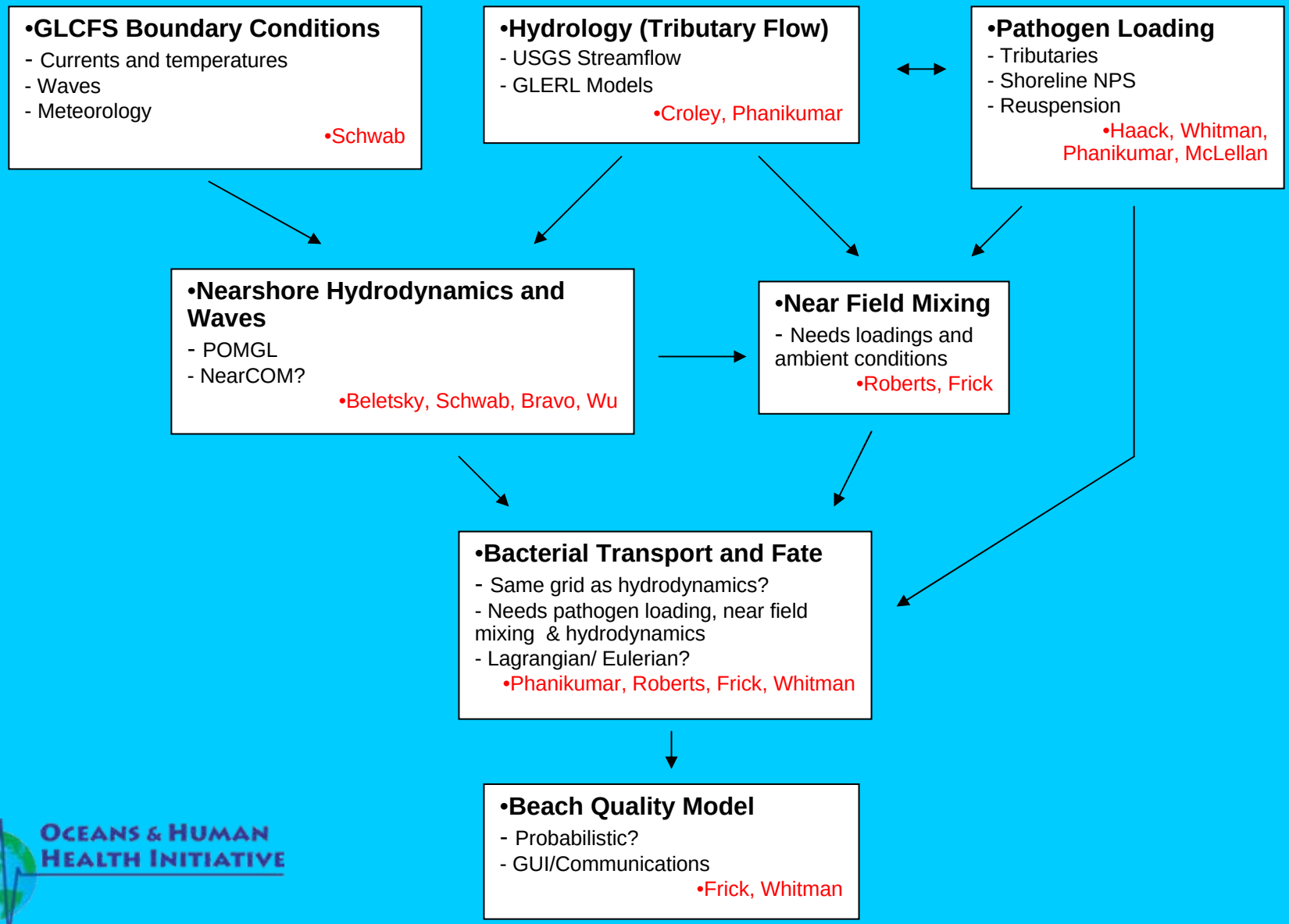




•14:44-15:04 GMT



•Deterministic Beach Quality Modeling Approach



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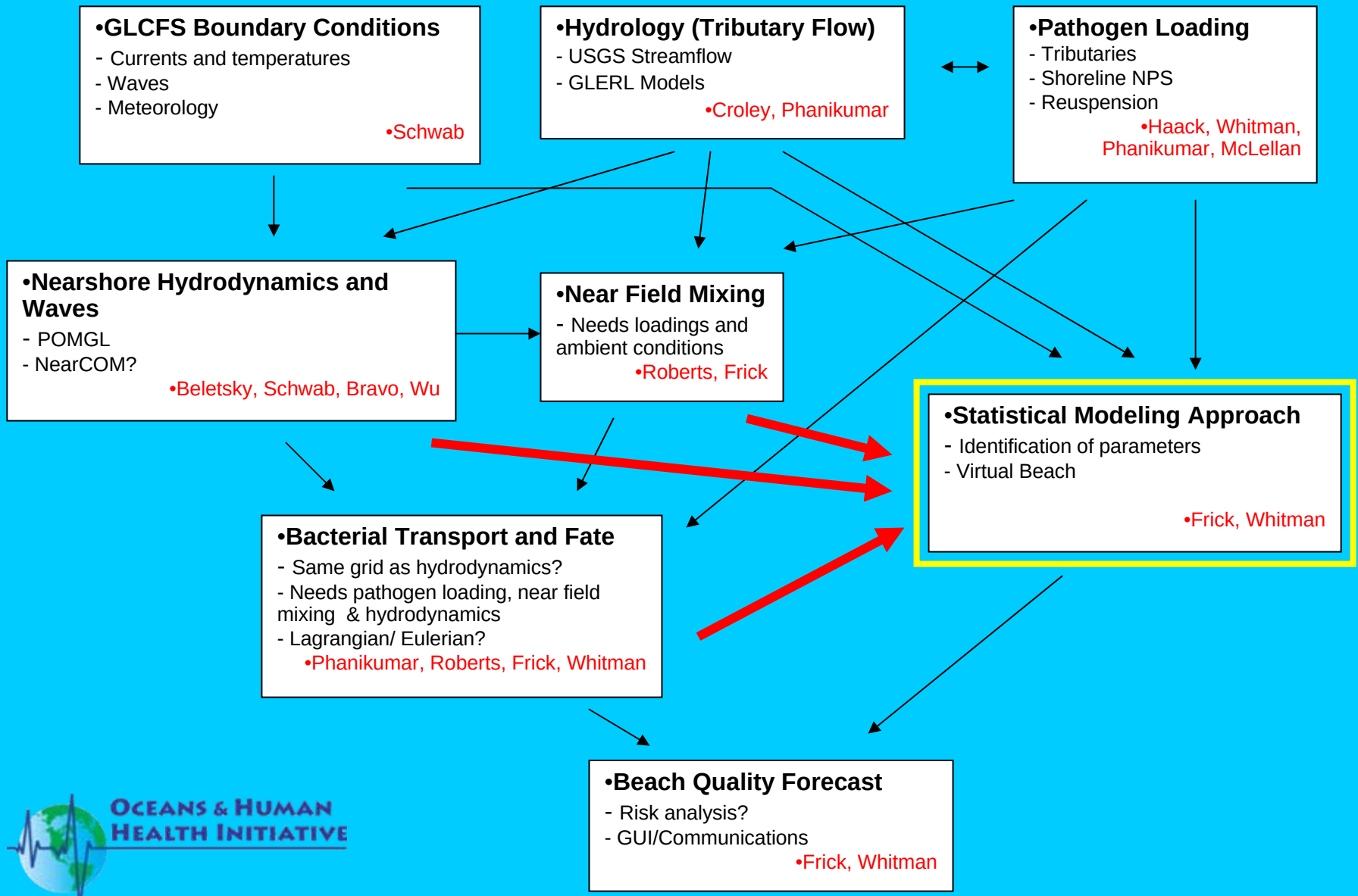
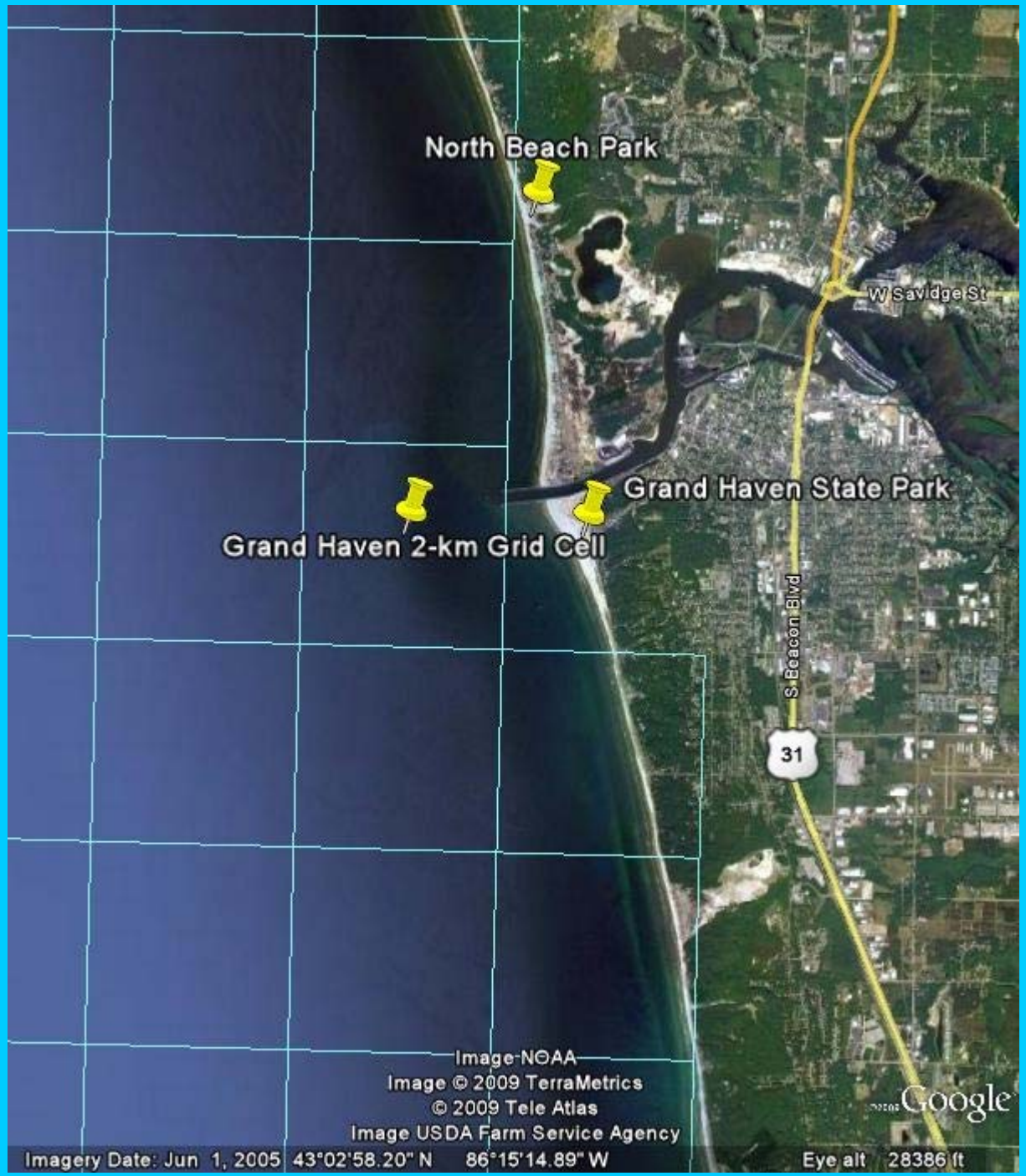
•Combined Beach Quality Modeling Approach



OCEANS & HUMAN HEALTH INITIATIVE


North Beach Park
W Savidge St
Grand Haven State Park
Grand Haven 2-km Grid Cell
S Beacon Blvd
31
Image-NOAA
Image © 2009 TerraMetrics
© 2009 Tele Atlas
Image USDA Farm Service Agency
Imagery Date: Jun 1, 2005 43°02'58.20" N 86°15'14.89" W
Eye alt 28386 ft
Google

Grand Haven State Park Beach Ottawa Co. Michigan 2002-2009

MLR model : E[Ln(E. Coli)]=Const + Coef1 x Var1+… + Coef4 x Var4

Variable	Coefficient	Standard Error	t-Statistic	p-Value*
Const	- 0.29	0.49	- 0.48	0.64
1. SWT9	0.12	0.031	3.88	0.00018
2. OSC	5.21	1.88	2.77	0.0067
3. WVH0	1.23	0.51	2.41	0.018
4. CC0	0.89	0.37	2.42	0.017

R-square = 26.0% Adj. R-square = 25.2% Model standard error = 1.24 N=114

- **SWT9 Surface Water Temperature Average of Preceding 9 Hours**
- **OSC On Shore Current (positive East)**
- **WVH0 Wave Height at time of Sampling**
- **CC0 Cloud Cover fraction at time of Sampling**

- **SWT9 + coefficient => higher temperatures increase *E. coli* conc.**
- **OSC + coefficient => onshore current increases *E. coli* conc.**
- **WVH0 + coefficient => larger waves increase *E. coli* conc.**
- **CC0 + coefficient => less sun light increases *E. co*li conc.**

North Beach Park Beach Ottawa County, Michigan 2002-2009
MLR model: E[Log10(E. coli)]=Const + Coef1 * Var1 + …+ Coef6 * Var6

Variable	Coefficient	Standard Error	t-Statistic	p-Value*
Const	179.39	41.98	4.27	4.01E-5
1. AT24	0.064	0.015	4.22	4.93E-5
2. OSC	1.81	0.72	2.52	0.013
3. WVH0	0.43	0.21	2.04	0.043
4. CC24	0.78	0.21	3.64	0.00040
5. DATE	- 0.089	0.021	-4.29	3.80E-5
6. GRD	0.0074	0.0031	2.37	0.020

R-square =38.7% Adj. R-square =35.6% Model standard error = 0.5062 N=123

AT24 Interpolated Air Temps average of sample & preceding 23 hourly readings
OSC On Shore Current (positive East)
WVH0 Wave Height at time of Sampling
CC24 Cloud Cover fraction average of sample & preceding 23 hourly readings
DATE Calendar Year (not Julian Date)
GRD Grand River Flow Measured at Grand Rapids

AT24 + coefficient => higher temperatures increase *E. coli* conc.
OSC + coefficient => onshore current increases *E. coli* conc.
WVH0 + coefficient => larger waves increase *E. coli* conc.
CC24 + coefficient => less sun light increases *E. co*li conc.
DATE - coefficient => *E. coli* conc. declining at NBPB over time.
GRD + coefficient => more runoff increases E. *co*li conc.

NOAAWatch

NOAA's All Hazard Monitor

Current Conditions

Local forecast by City, State

City, St Go

Weather Warnings

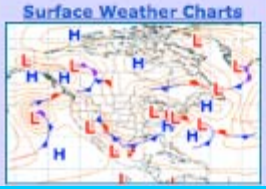
Doppler Radar

River and Lake Levels

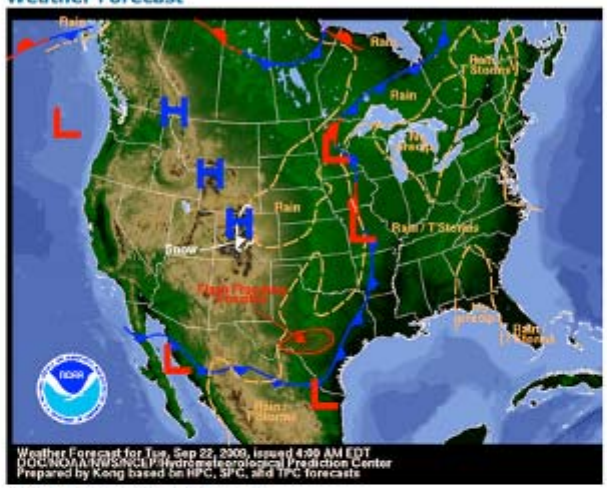
Event Imagery

Drought Outlook

Surface Weather Charts



Weather Forecast



Weather Map - Click to Enlarge

Weather Outlook for Tuesday

Tue, 22 Sep 2009 06:45:00 EDT

An upper level low is forecast to move into the central High Plains today where it is expected to remain for the next several days, producing chilly conditions across much of the central and southern Intermountain West and Rockies, with dry and windy conditions along the West Coast. Showers and thunderstorms with some embedded heavy rains area forecast to occur along or near this low's associated frontal boundary which is forecast to push out through the Mid and Lower Mississippi Valley while extending back across southern Texas before stalling and gradually weakening. More scattered rains are forecast from the central Appalachians northward through the Northeast as a string of weak upper level disturbances interact with an axis of above normal moisture. Along the Southeast and Mid-Atlantic coasts, a landfalling tropical wave will produce scattered showers and thunderstorms across the region. Latest local weather forecasts, warnings, watches, and advisories...

Deadly Flooding Across Southeast

Tue, 22 Sep 2009 07:10:48 EDT

Heavy rains from a stationary storm system across the Southeast since last weekend have caused widespread flash, river and stream flooding, and at least 7 fatalities. Rainfall amounts in central Georgia reached as much as 15.2 inches, with a broad area of 4 to 6 inches from central Mississippi across Alabama, Georgia into Tennessee. Major flooding is reported on several creeks and the Chattahoochee River

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- Questions?