

Integrated Nowcasting and Forecasting Operation System (INFOS) for Rip Currents in Lake Michigan



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AWRA's 39th Annual Conference, March 5-6, 2015



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Rip Currents

Characteristics

Occurrence: **Near-Shore**

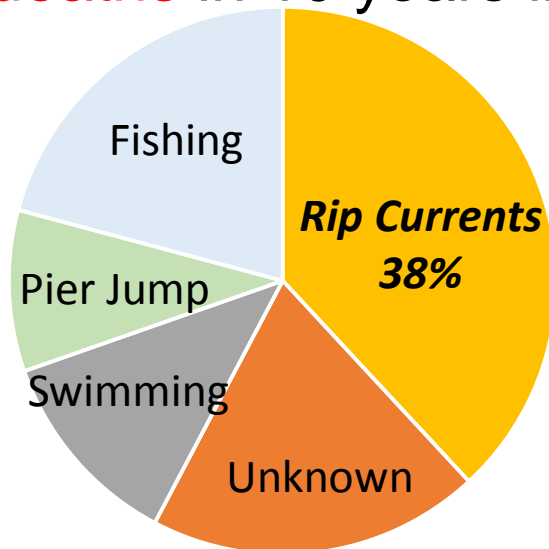
Speed: Typical- 1m/s High- **2m/s**

Width: 10m-30m



Grand Sable Dunes, MI

131 **deaths** in 10 years in Great Lakes due to rips



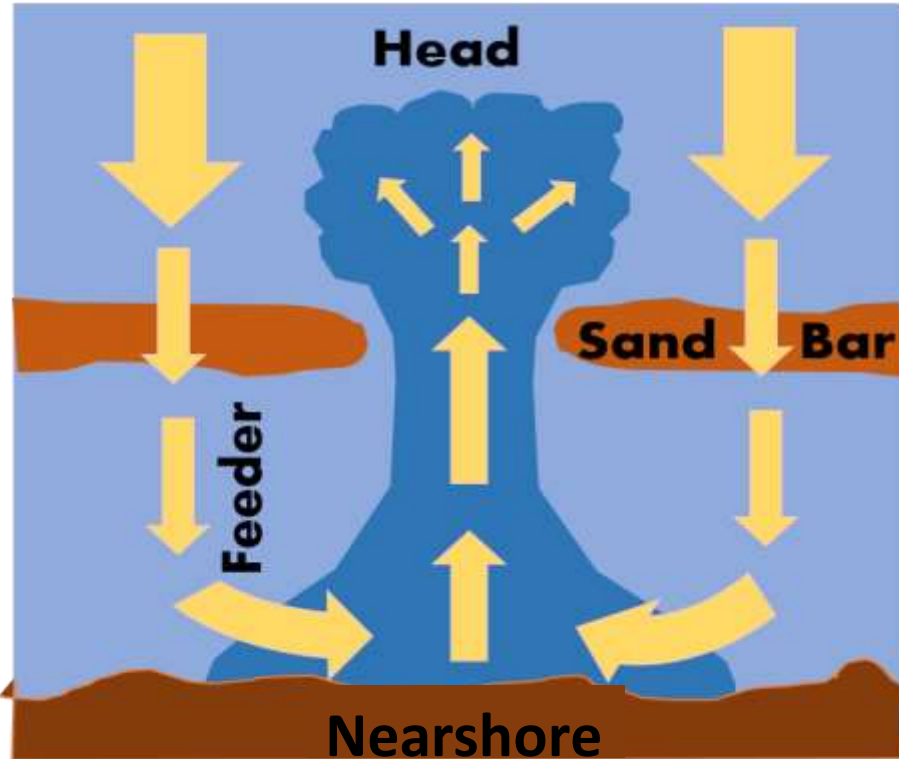
WATER RELATED DEATHS



Lack of an effective warning system

Causes

Wave Breaking



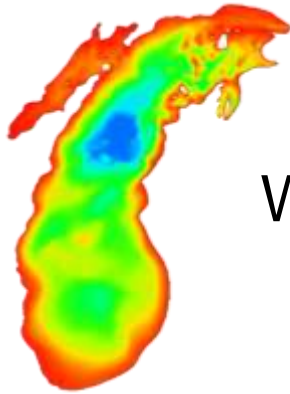
Obstruction of alongshore current



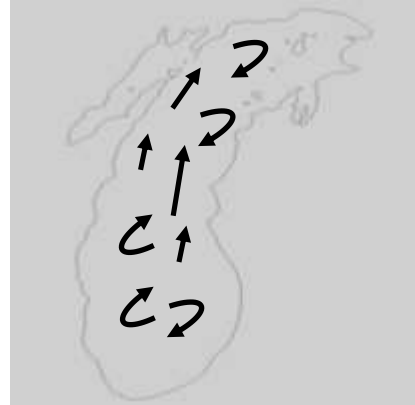
Rip current moving offshore at groin
at Cape Hatteras, North Carolina

Goals

1. Provide near-shore water information

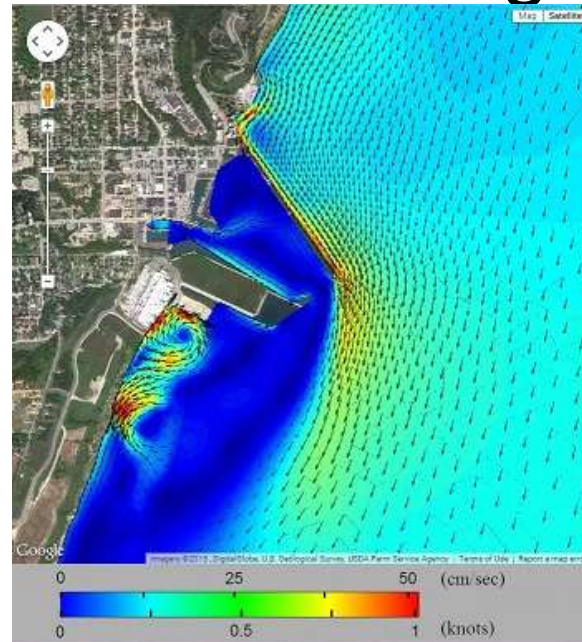


Waves



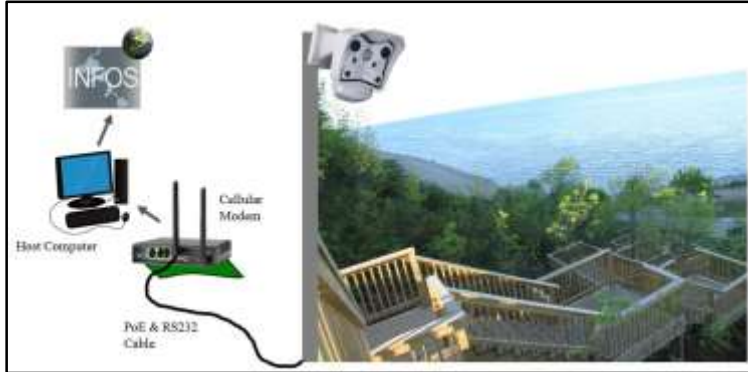
Currents

2. Provide rip current warning

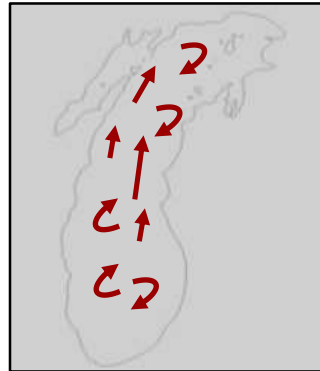
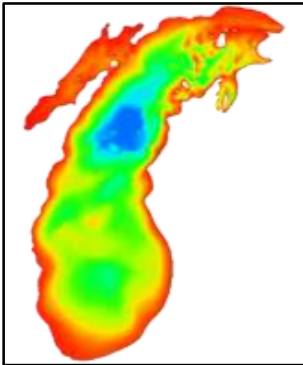


Methods

1. Use Video Imaging Observation Systems



2. Develop high resolution models for waves and currents in Lake Michigan

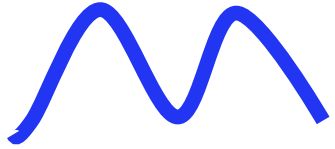


3. Design a website that

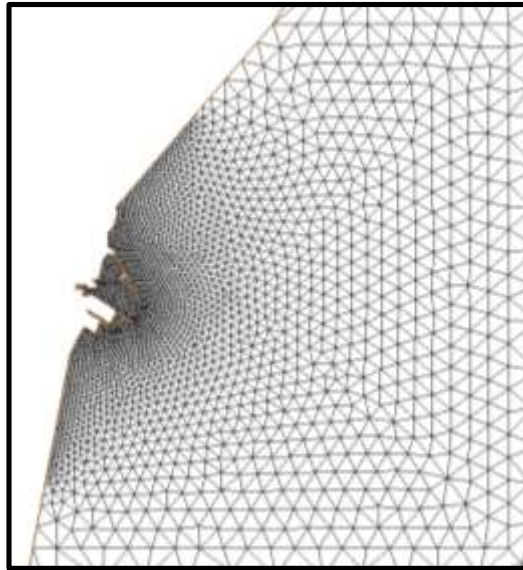
- A.) Provides model results
- B.) Combines it with real-time data

Models

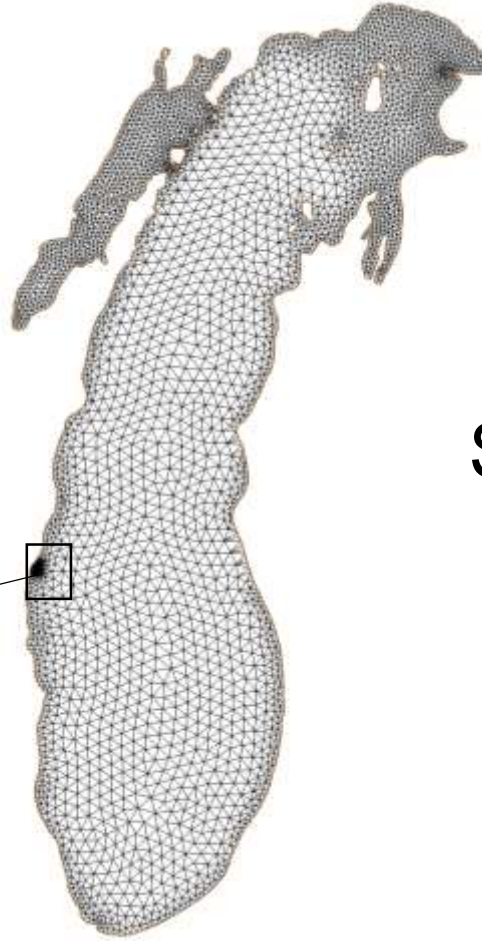
Wave Model



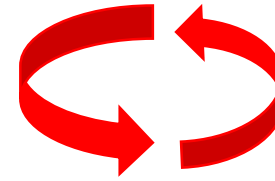
Phase averaged Spectral model
-Conservation of Wave Energy



Finely resolved
Near-shore



Hydrodynamic Model



Solves 3-D Navier Stokes

Grid

$\Delta x, \Delta y = 10\text{m}-5\text{km}$

Parallel : 6 cores

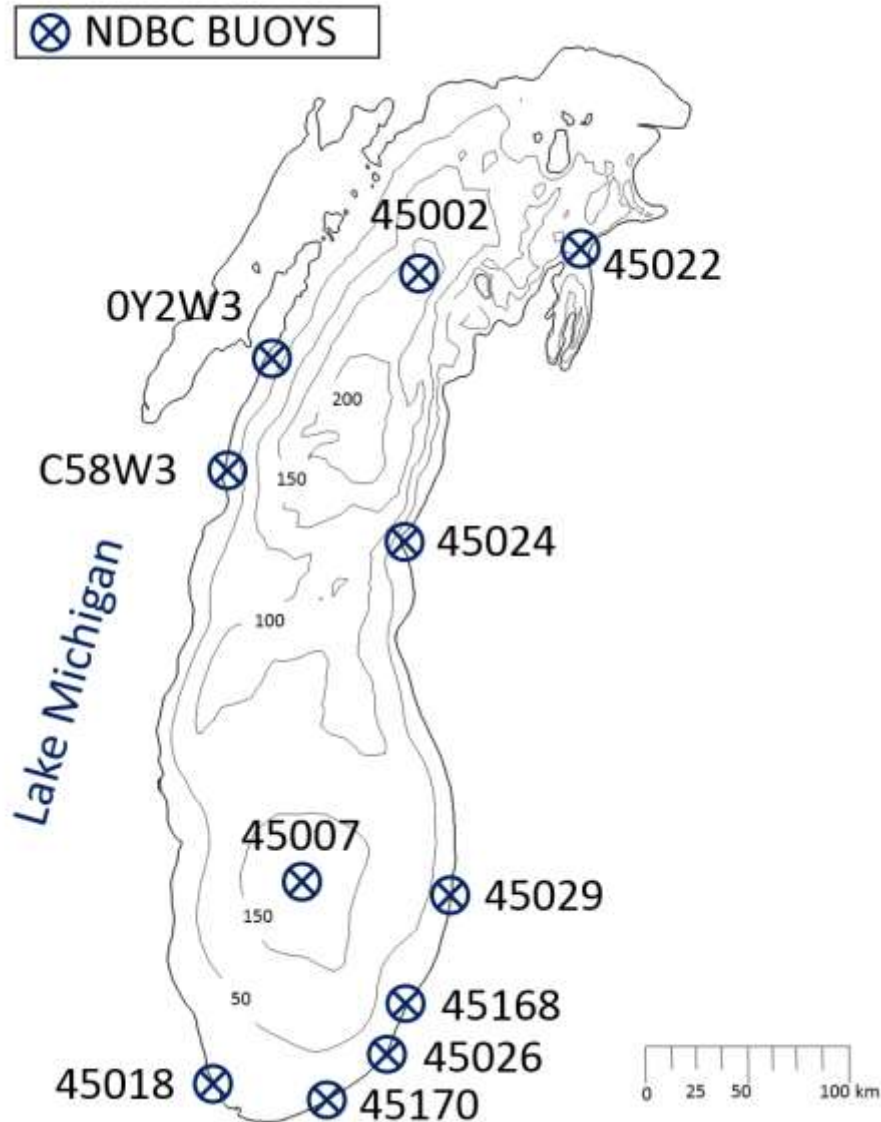
Time ratio : 70:1

Calibration

North Michigan

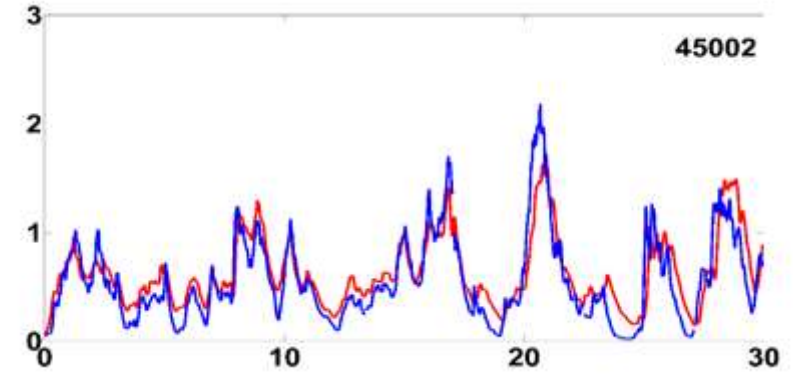
Holland, MI

Cook Nuclear Plant

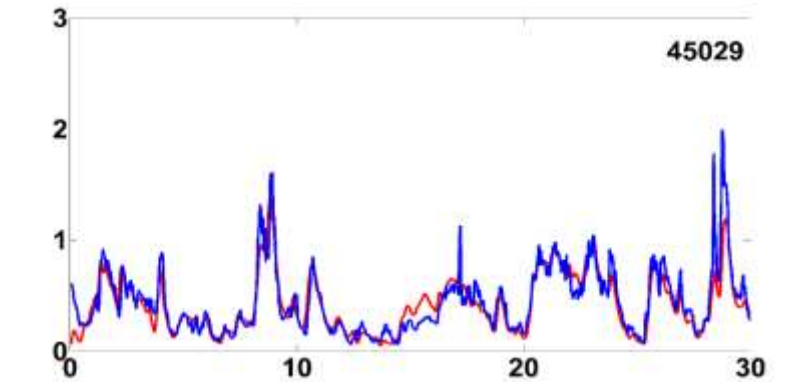


August 2013

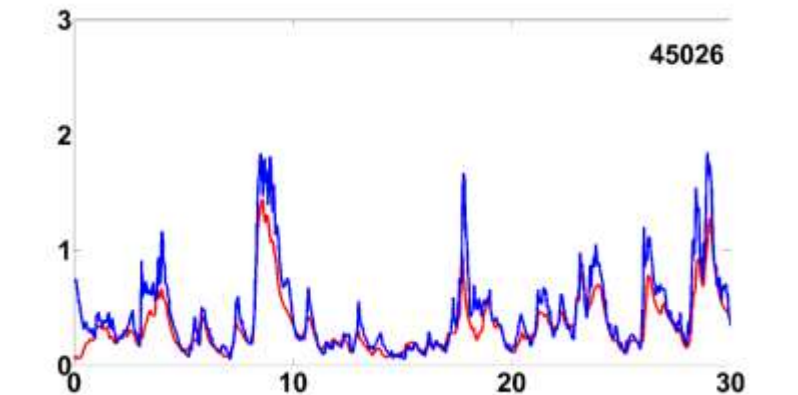
Wave Height (m)



Wave Height (m)



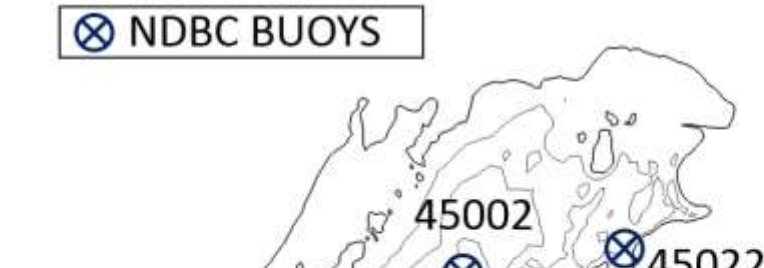
Wave Height (m)



Time (days)

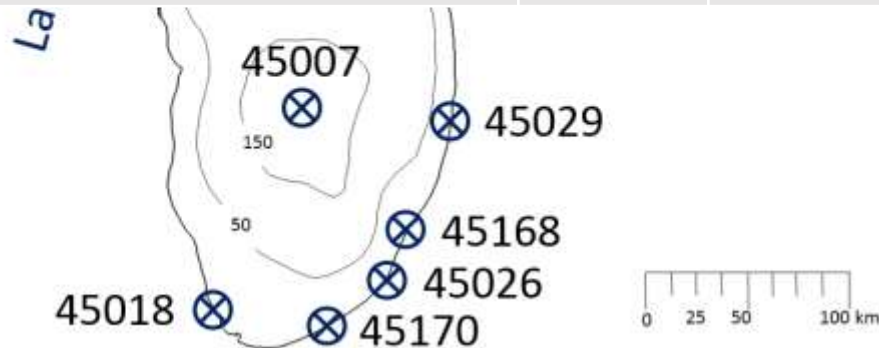
Calibration

North Michigan



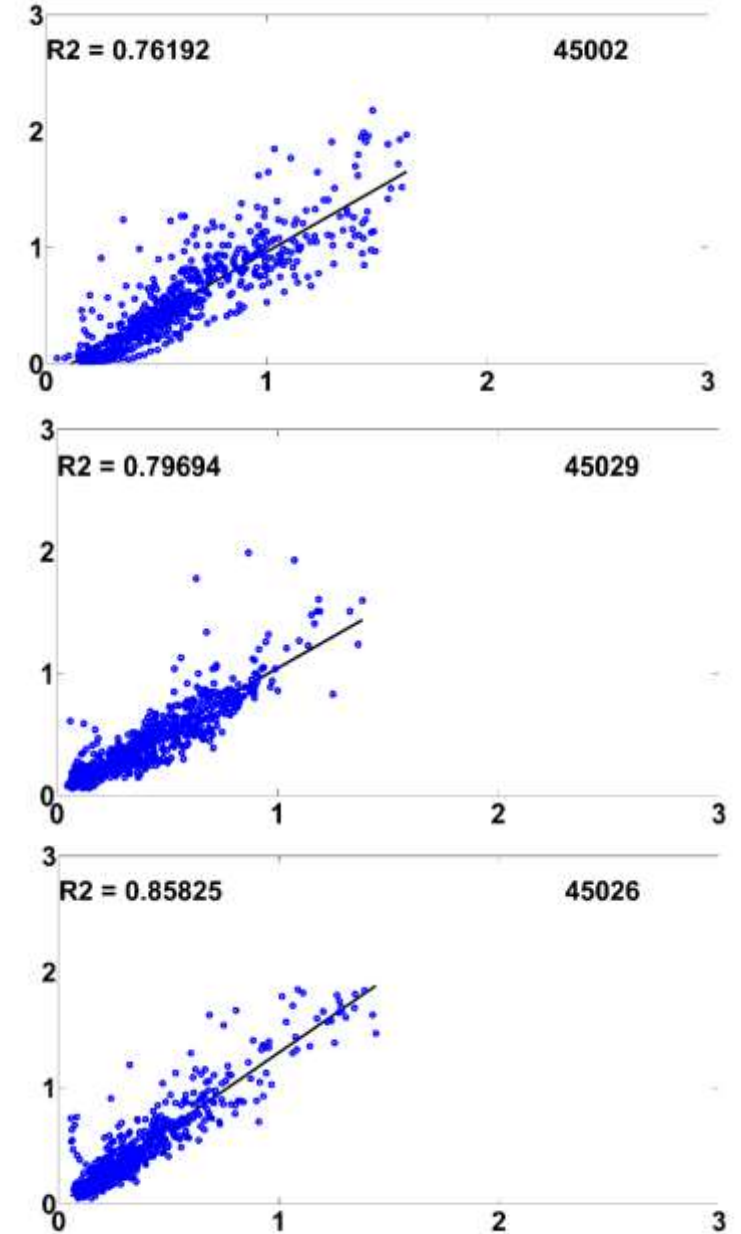
Station	ME	RMSE	SI	R ²
North Michigan	0.04	0.2	0.37	0.77
Holland	0.03	0.18	0.41	0.80
Cook Nuclear Plant	0.01	0.13	0.30	0.86

Cook Nuclear Plant



Observed Wave Height (m)

August 2013



Model Wave Height (m)

Validation

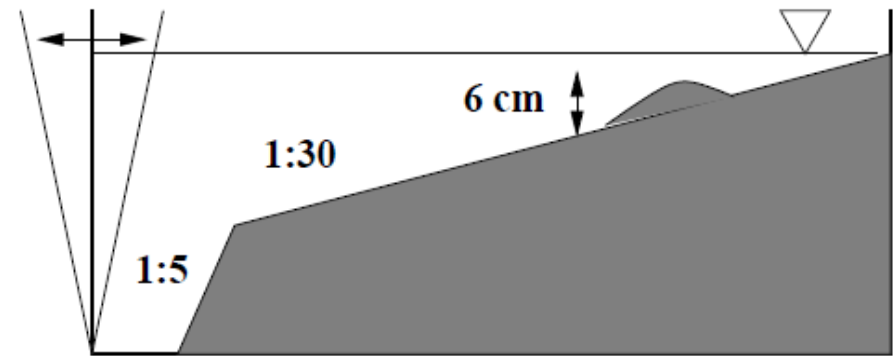
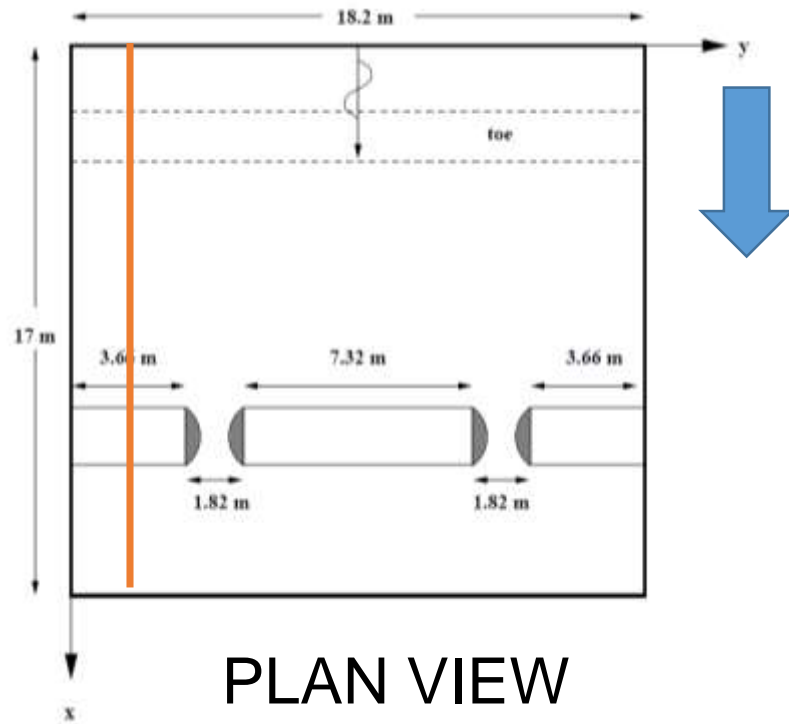
--Barred beach (Haller et al. 2000)

Cross-shore transect

Incoming wave direction

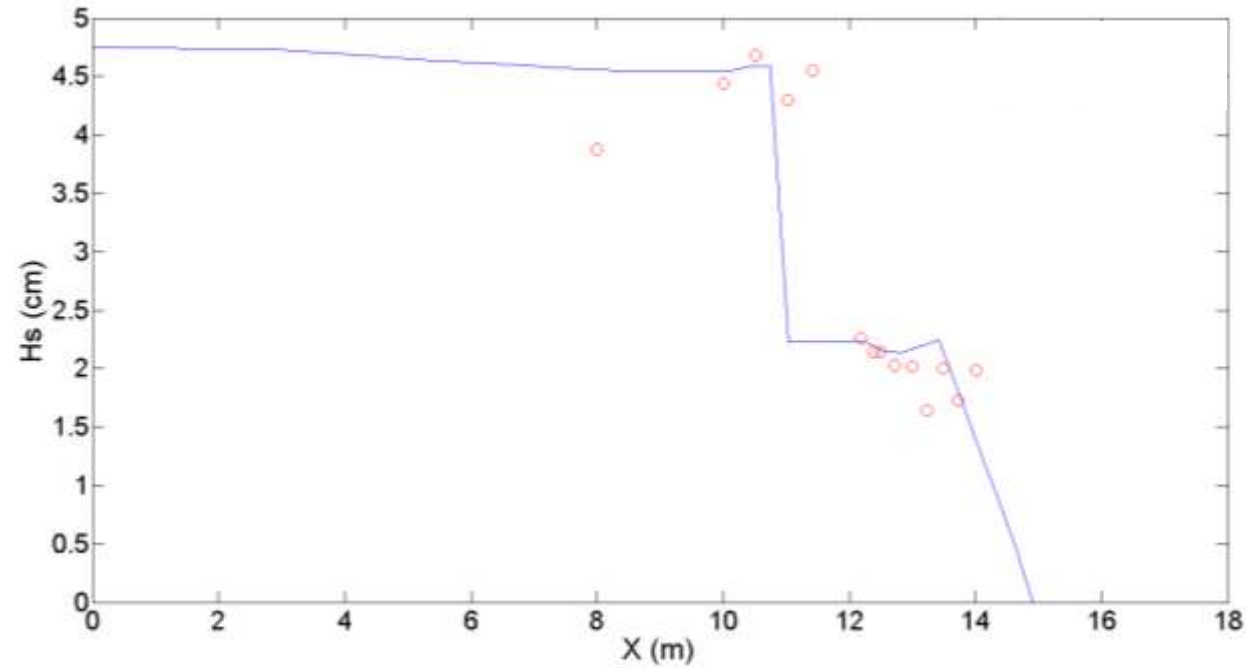
$H_s = 4.5$ cm

$T_p = 1$ s



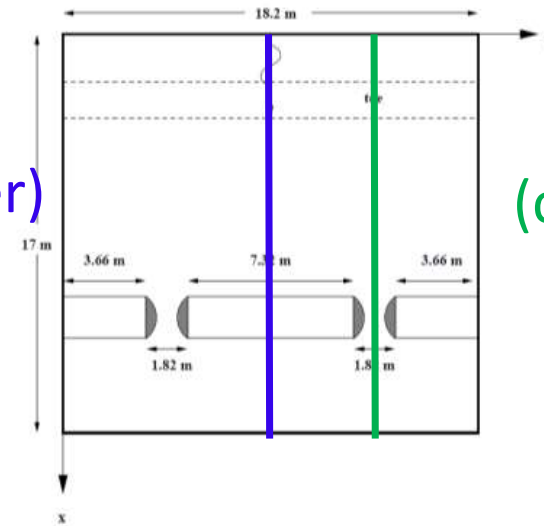
Significant Wave Height (m) (cross-shore transect)

— Model ○ Experimental

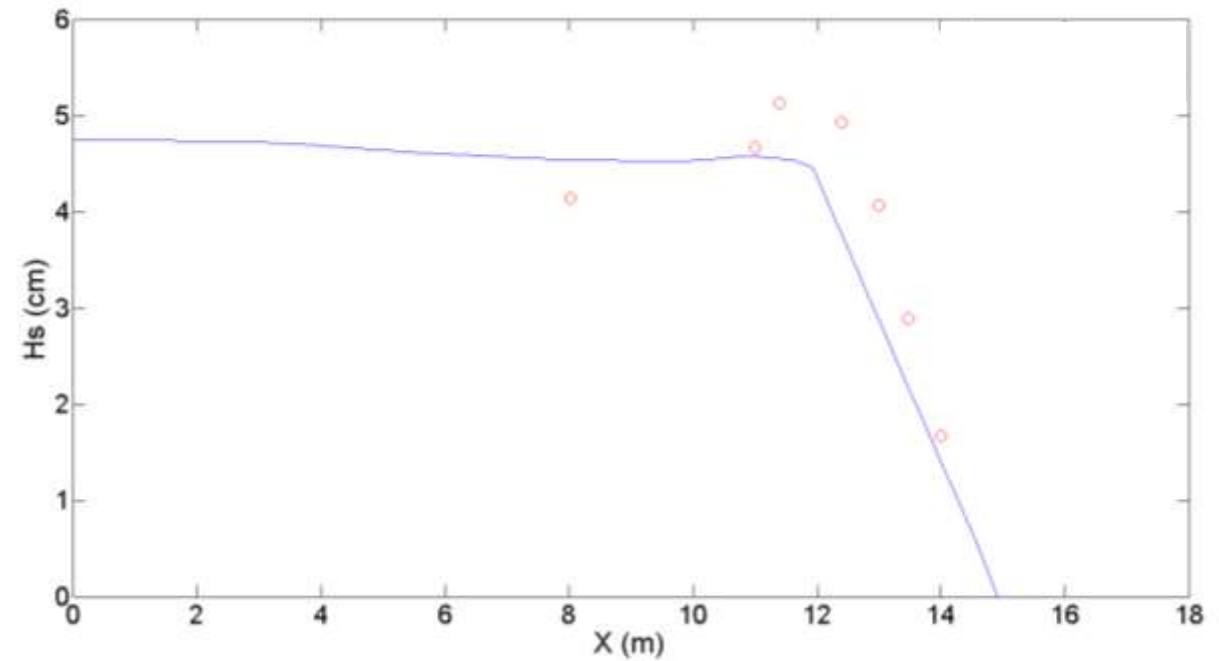


Significant Wave Height at $y = 9.2\text{m}$
(bar center)

(bar center)

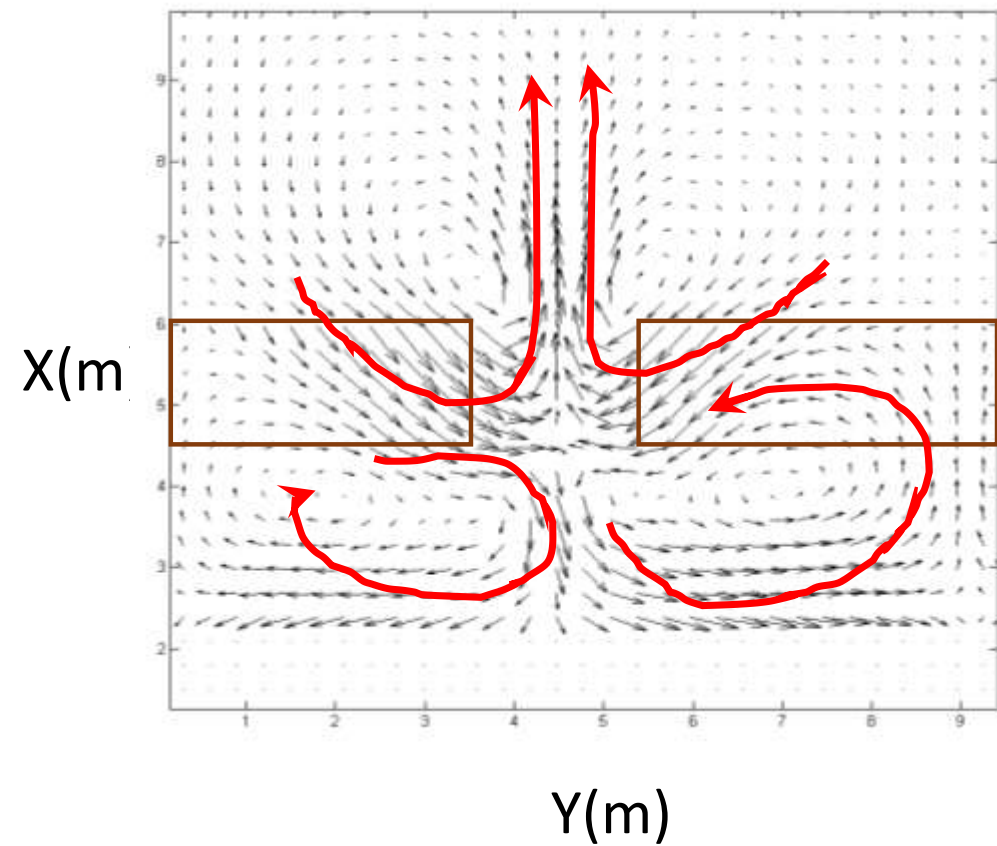
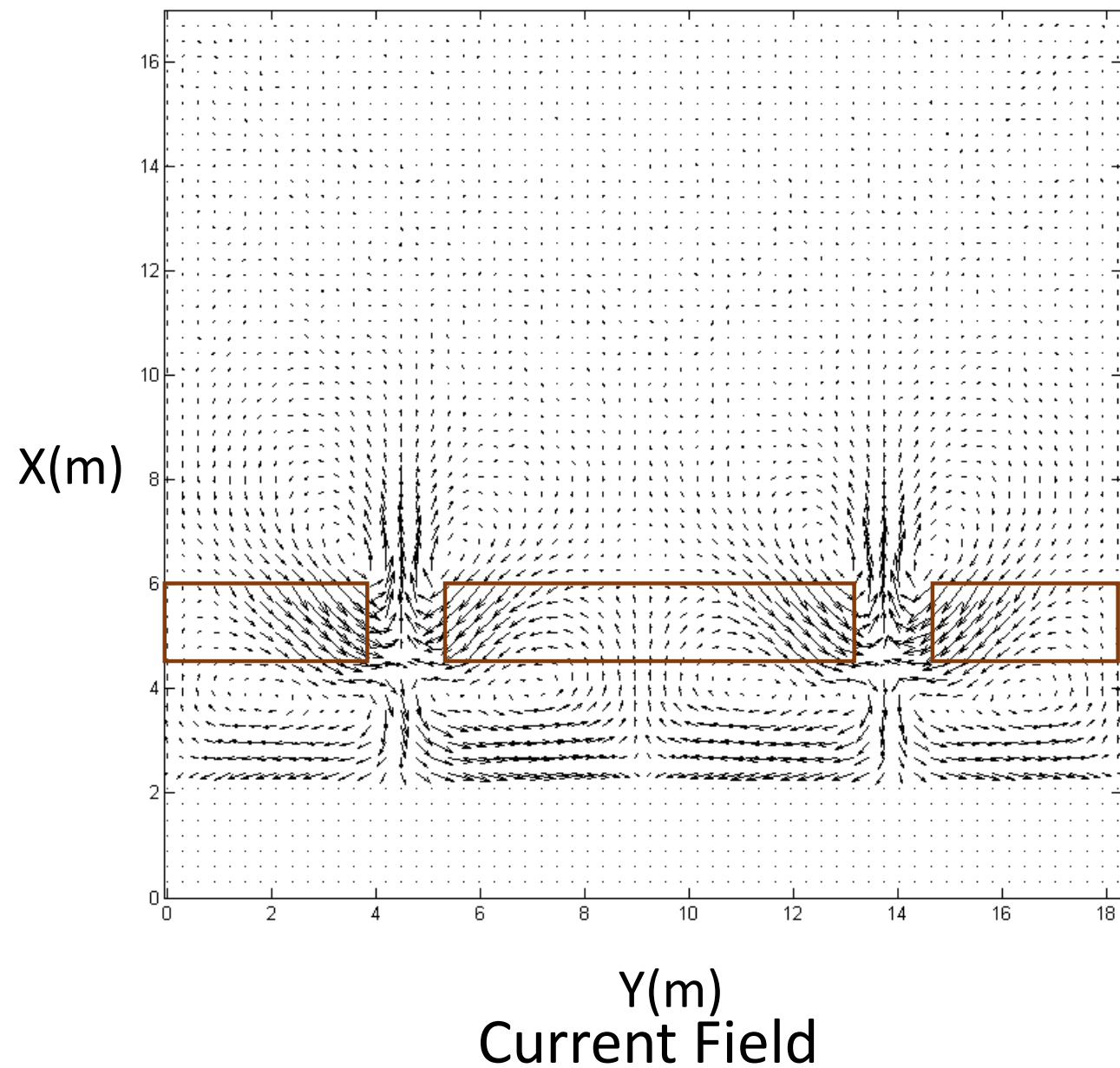


(channel center)



Significant Wave Height at $y = 13.6\text{m}$
(channel center)

Current Velocities



Site Selection

Reports about loss of life

Body of Port Washington teen recovered from Lake Michigan

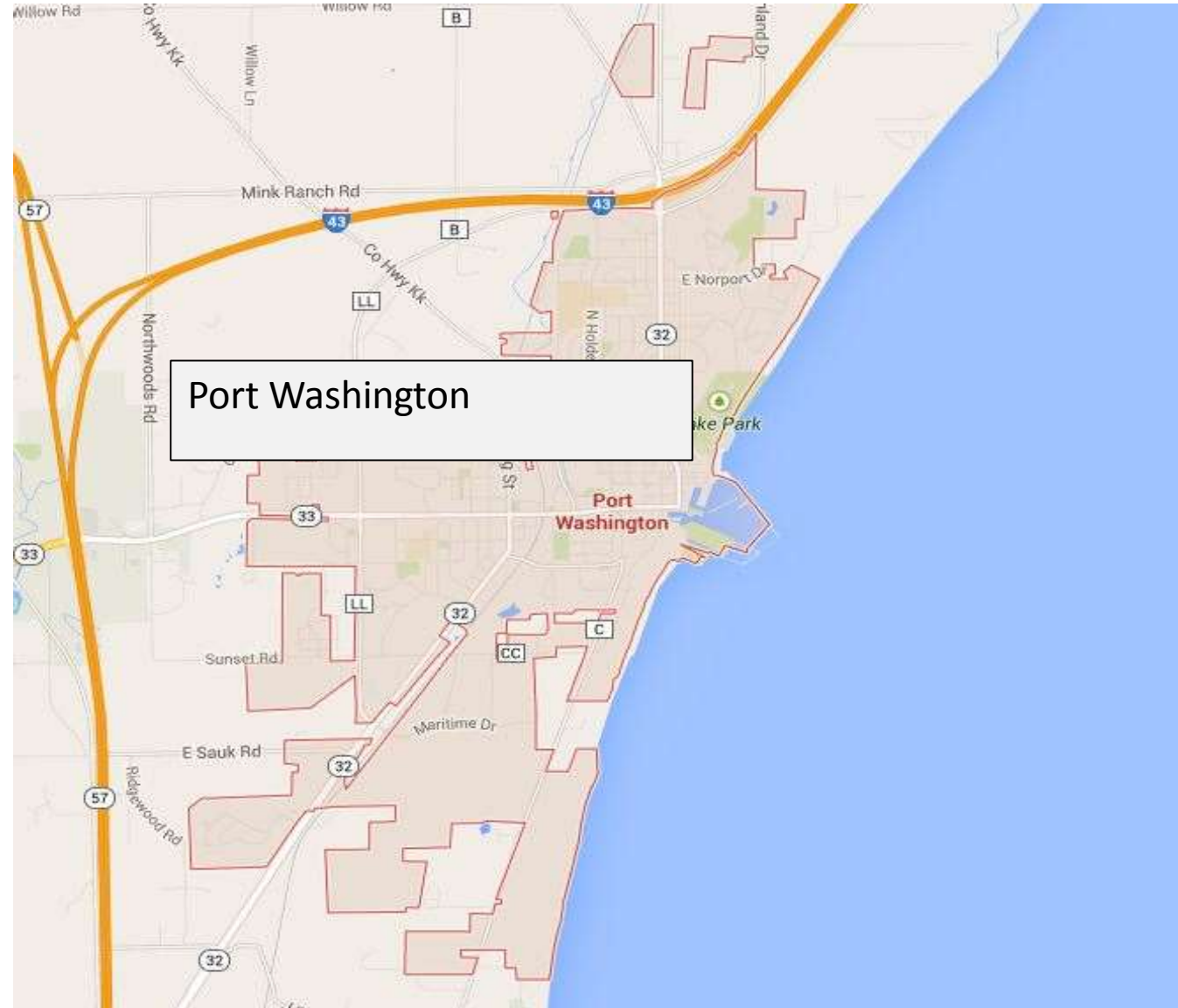
UPDATED 2:54 PM CDT Sep 06, 2012

National Weather Service issues warning for high winds, strong rip currents on Lake Michigan

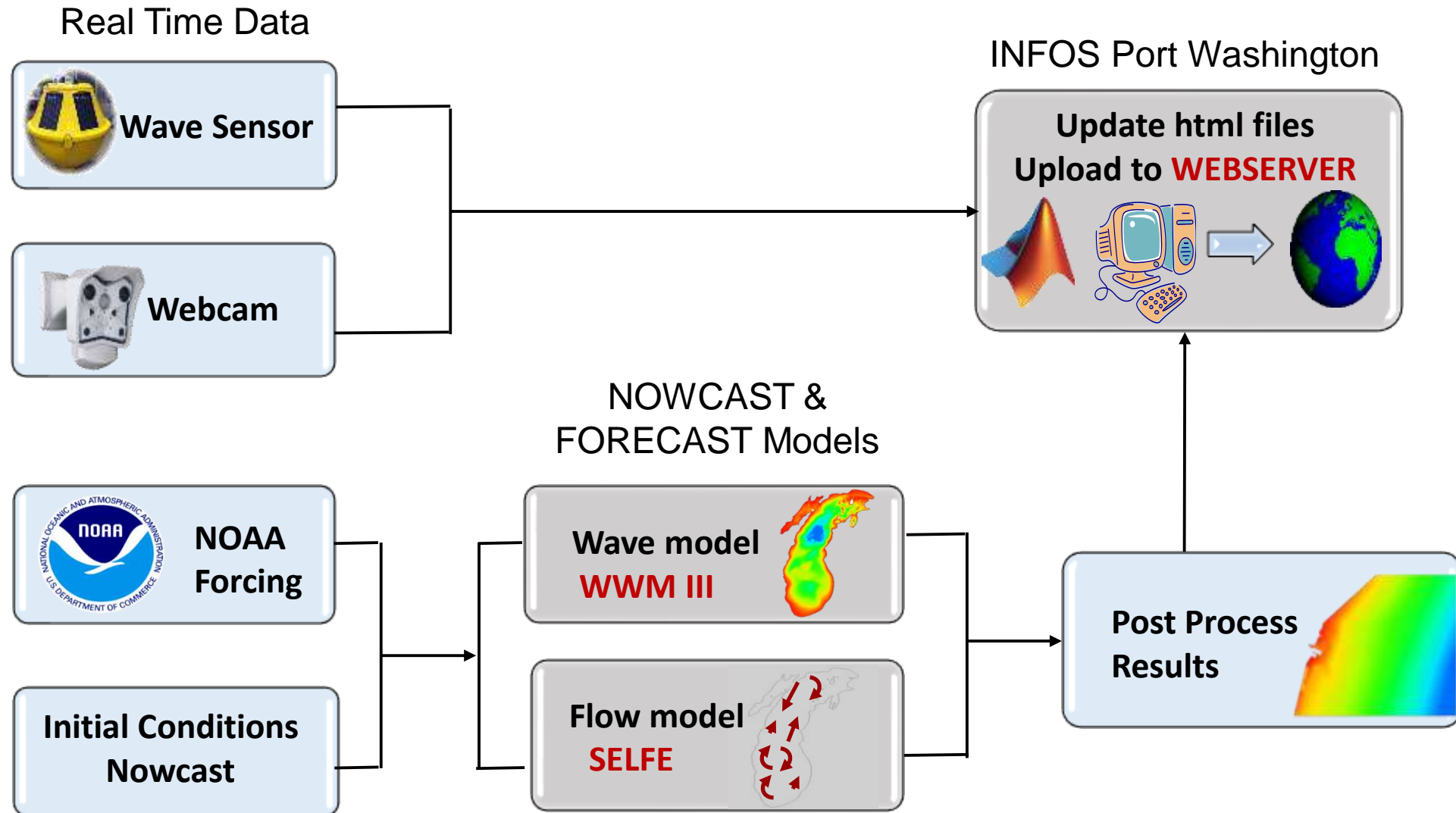
By Todd Hicks. CREATED Jul 23, 2014

PORT WASHINGTON - A warning surrounding the dangers of swimming in Lake Michigan was issued Wednesday.

- Tourist Centre
- Recreational Activities



INFOS Port Washington



Website: <http://infosportwashington.cee.wisc.edu>

Rip Risk Watch



Observation Data



Model Results



Webcams



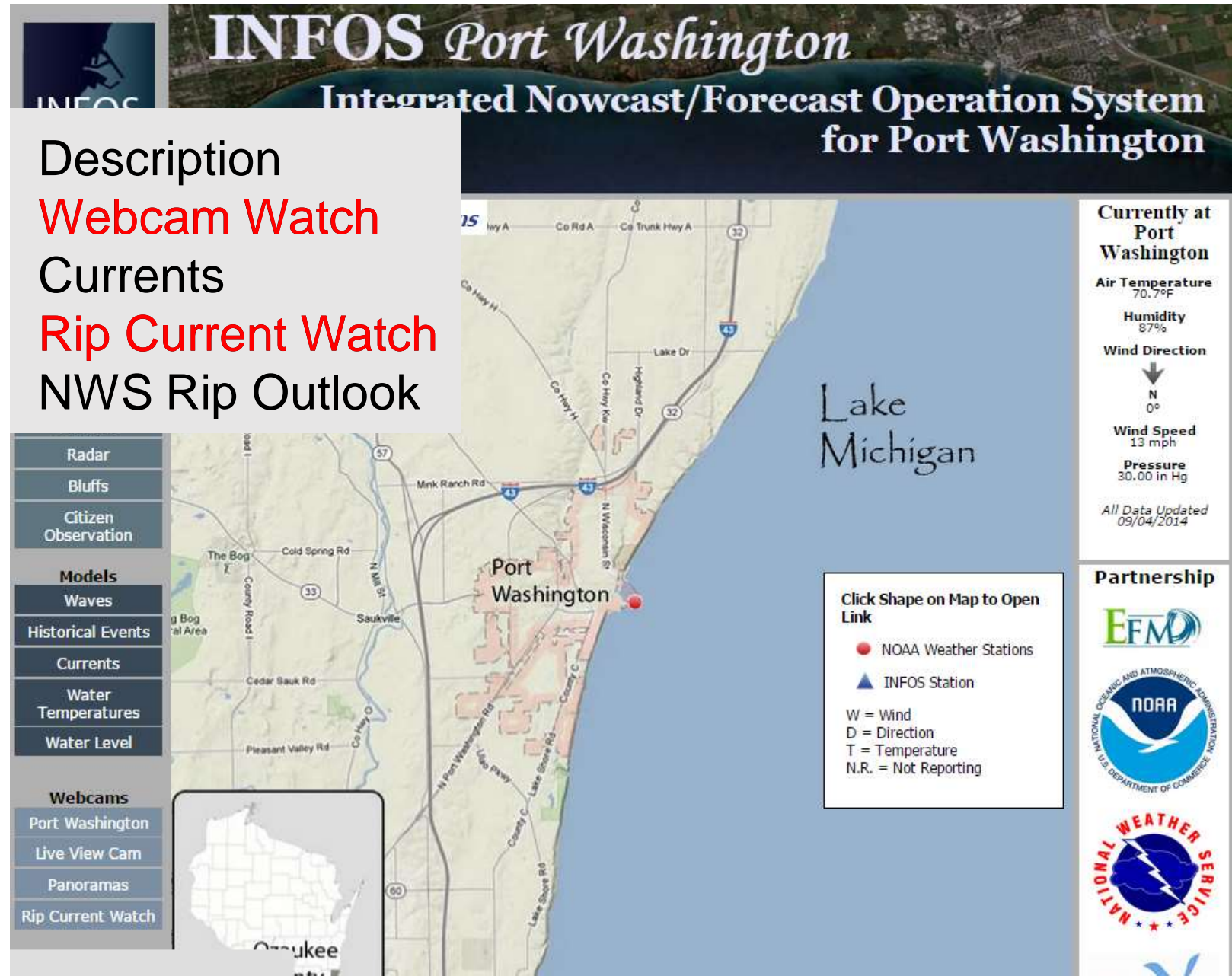
Description

Webcam Watch

Currents

Rip Current Watch

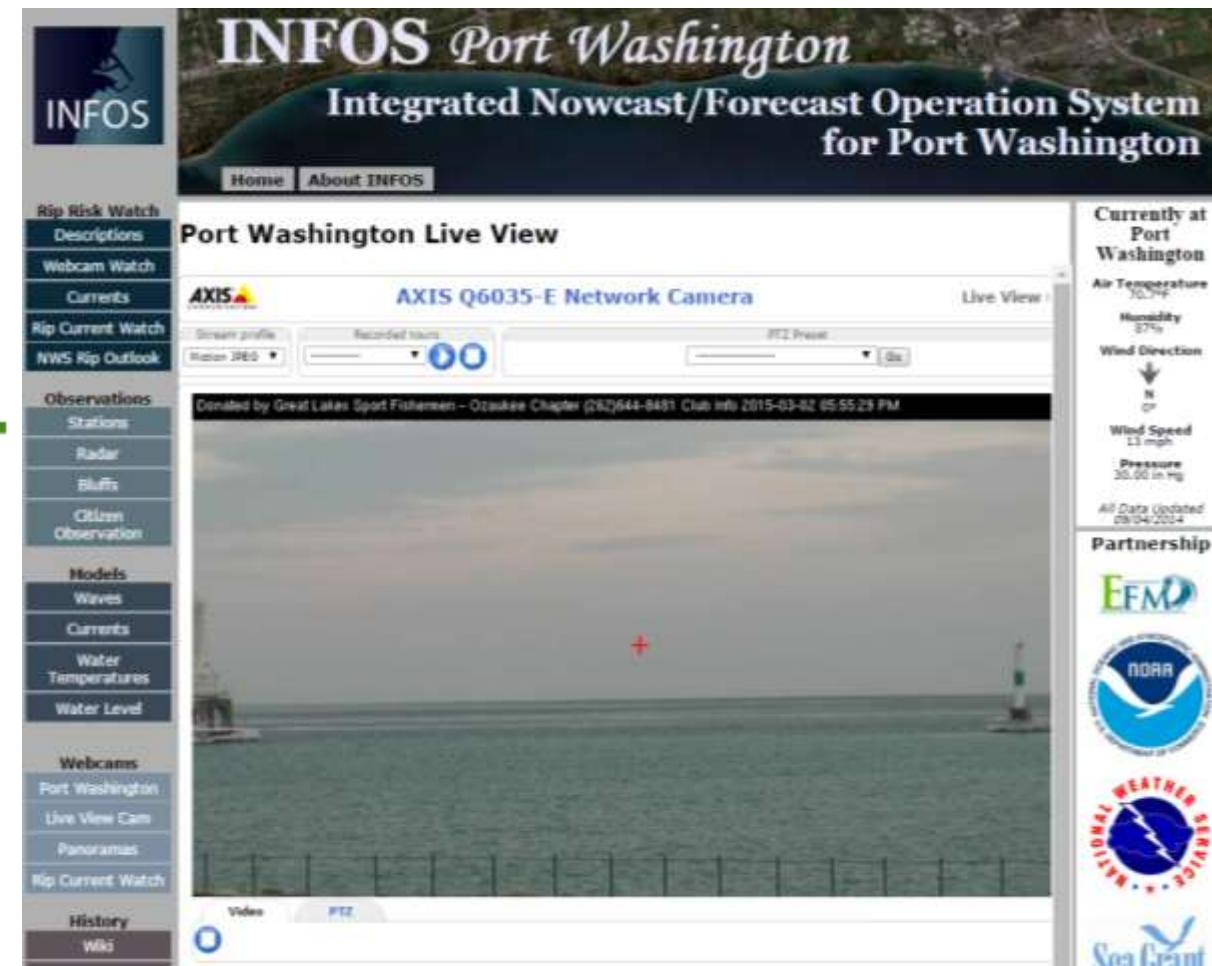
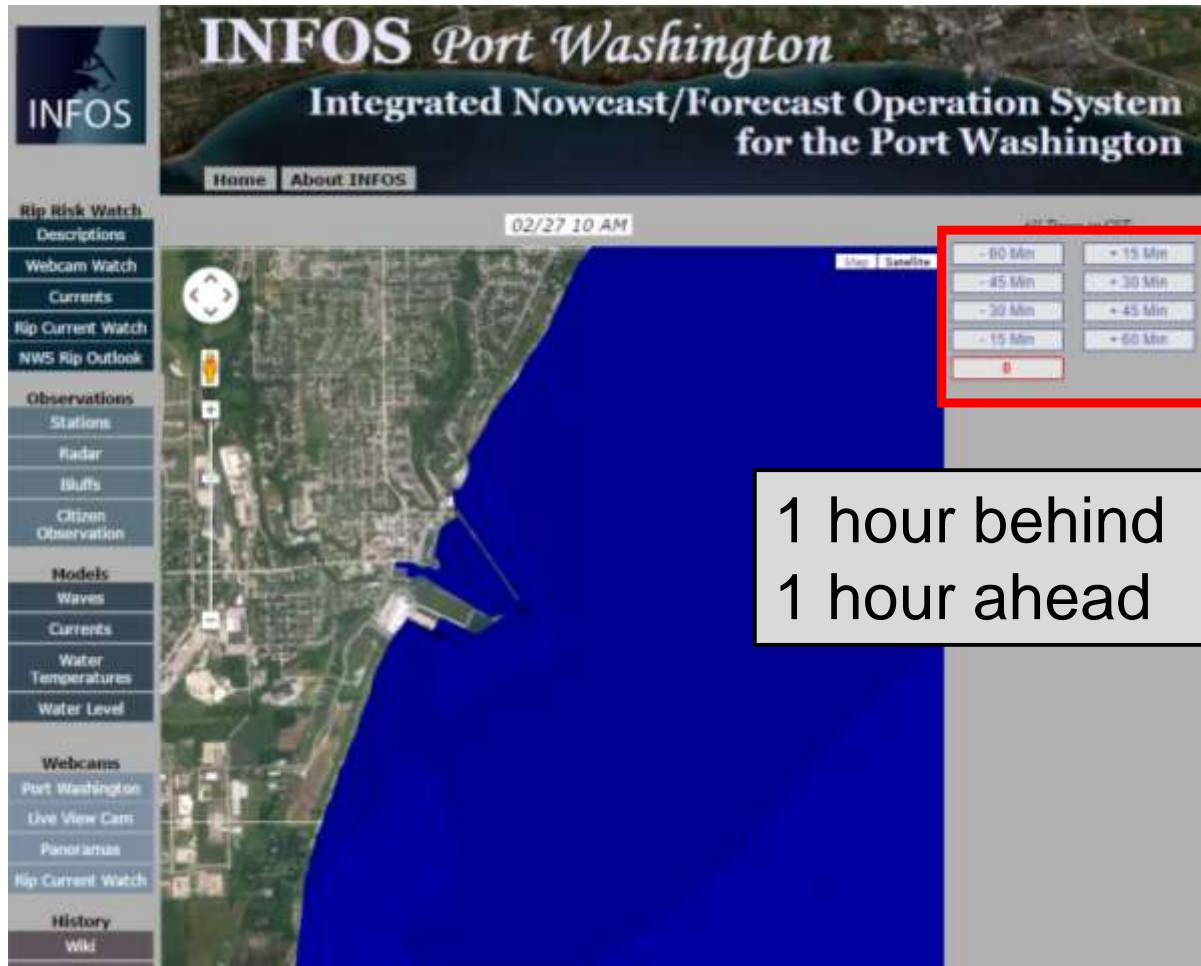
NWS Rip Outlook



Website: <http://infosportwashington.cee.wisc.edu>

Rip Current Watch

Webcam Watch



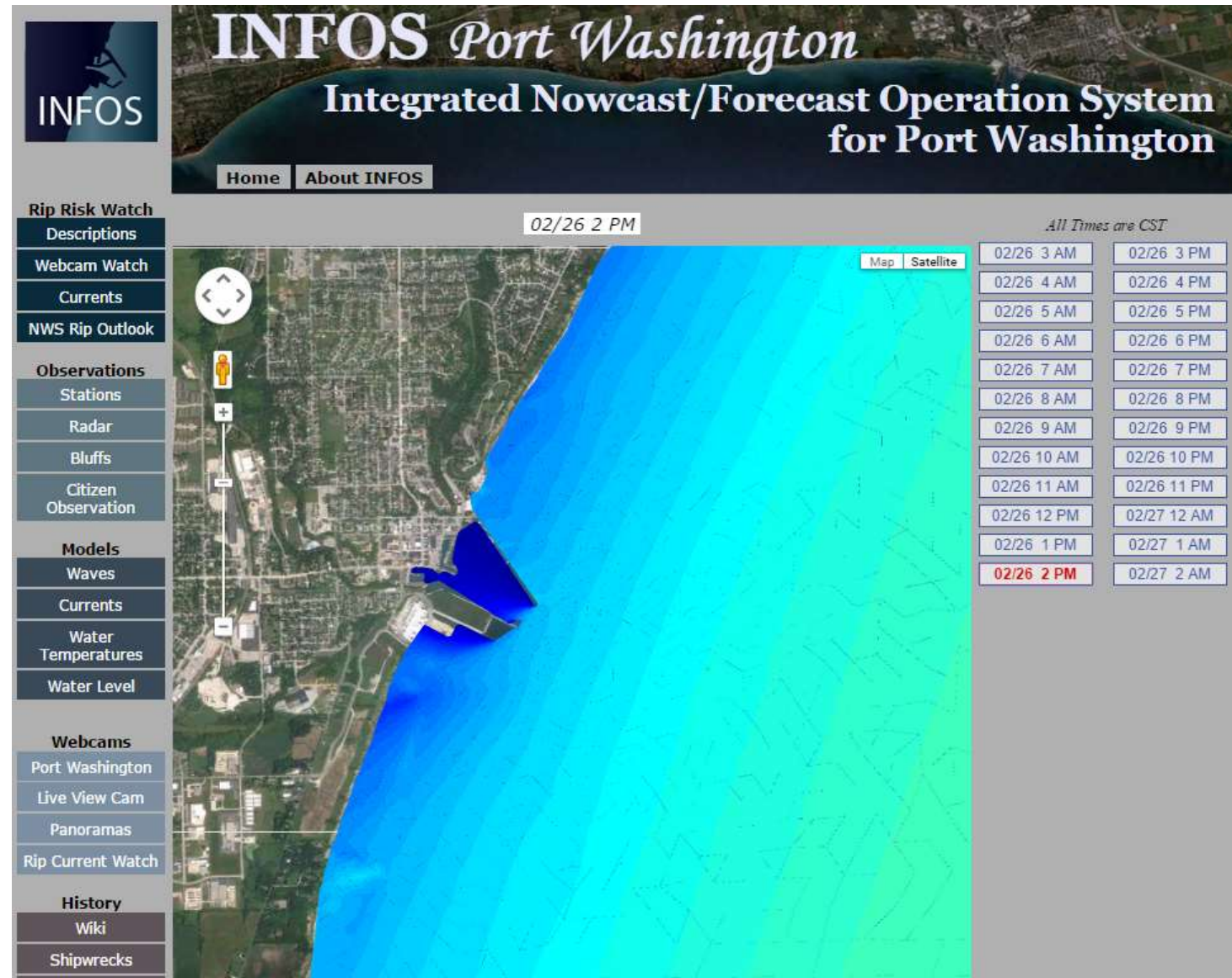
Website: <http://infosportwashington.cee.wisc.edu>

Model Results Use
Google Maps

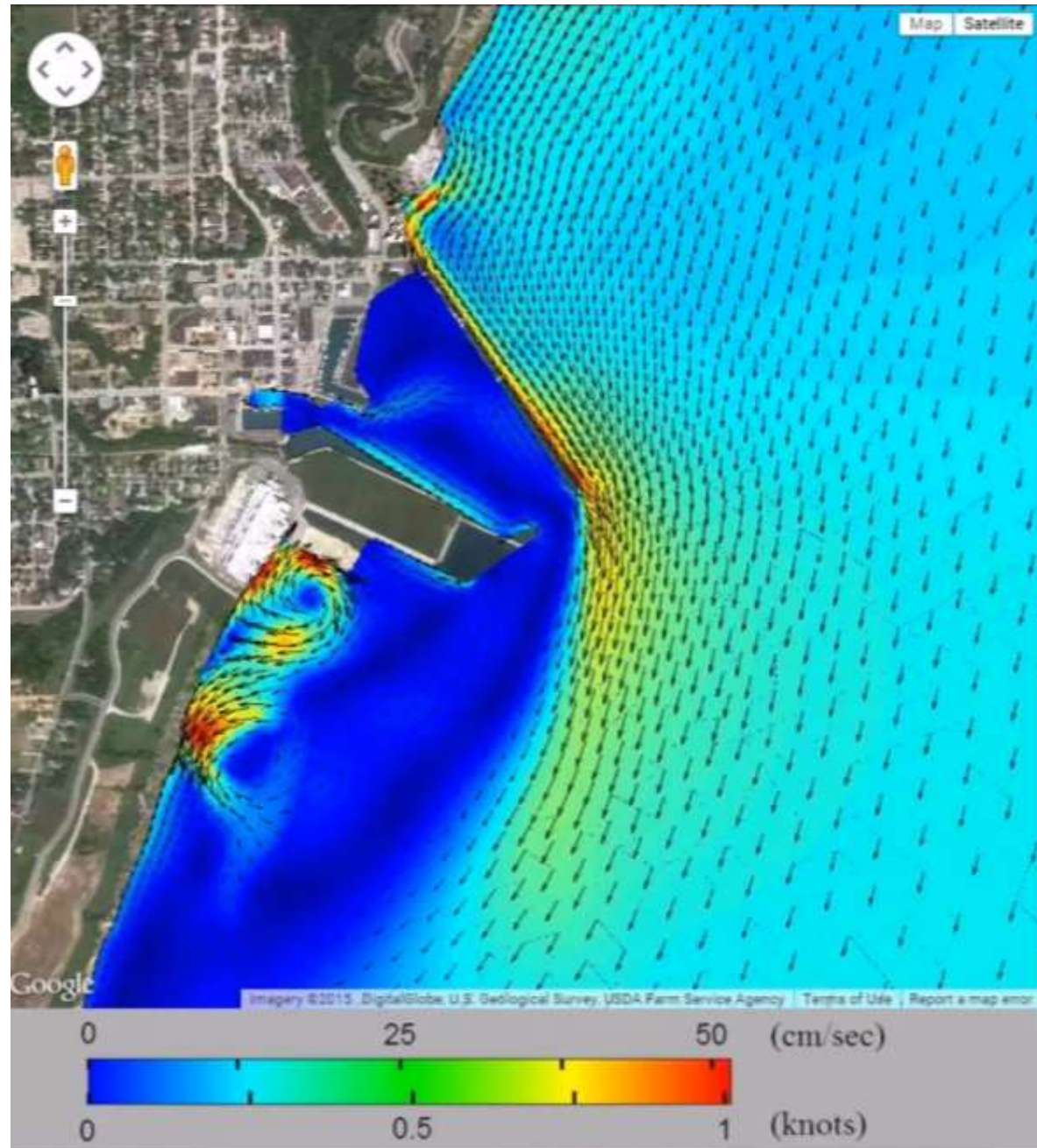
12 Hours Nowcast
12 Hours Forecast

Display:

- Significant Wave Height
- Currents

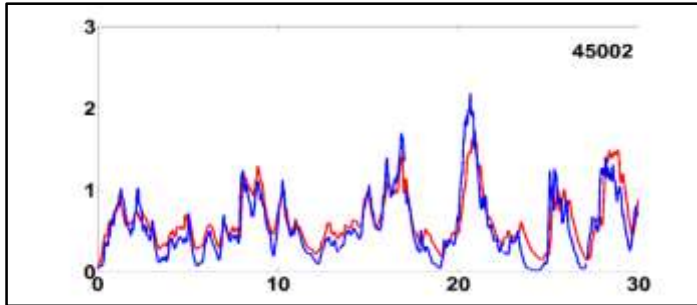


Animation of Currents

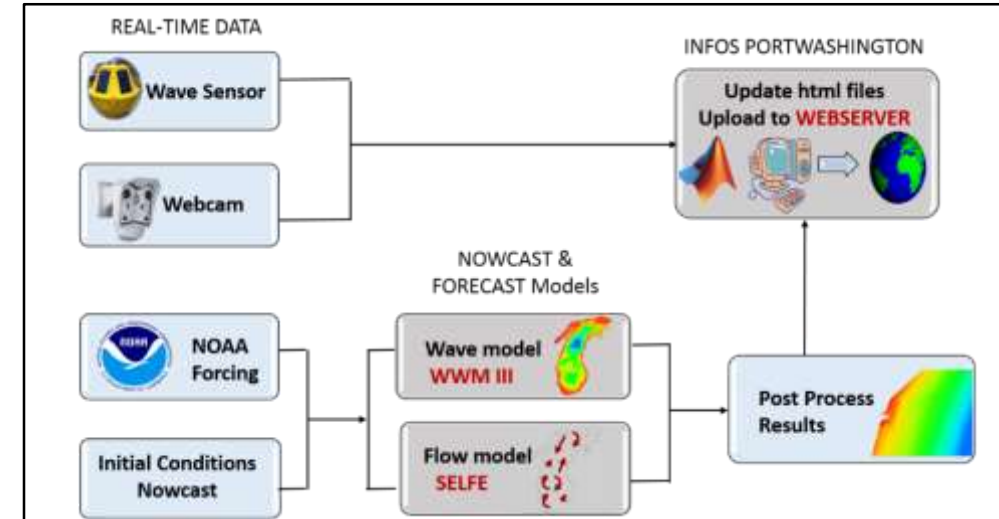


Summary

- Model calibrated against NDBC Buoy data.



- Experimental Rip Current Cases Validated
- INFOS- Port Washington
<http://infosportwashington.cee.wisc.edu>
- 12 hours Nowcast and Forecast
 - Significant Wave Height
 - Current Velocity
- Model and Observation data merged to give rip current forecasts.



Acknowledgements

Josh Anderson, Yuli Liu, Nate Gerdt, Alvaro Linares



NOAA Sea Grant
Coastal Storms Program



Questions?

