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

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**Characteristics**

**Occurrence:** Near-Shore

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

**Width:** 10m-30m

131 deaths in 10 years in Great Lakes due to rips

**Lack** of an effective warning system

**WATER RELATED DEATHS**

**Grand Sable Dunes, MI**
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

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

Hydrodynamic Model

Phase averaged Spectral model
-Conservation of Wave Energy

Solves 3-D Navier Stokes

Grid
Δx, Δy = 10m-5km

Parallel : 6 cores
Time ratio : 70:1

Finely resolved
Near-shore
Calibration

North Michigan

Holland, MI

Cook Nuclear Plant

August 2013
## Calibration

### Observed Wave Height (m)

<table>
<thead>
<tr>
<th>Station</th>
<th>ME</th>
<th>RMSE</th>
<th>SI</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Michigan</td>
<td>0.04</td>
<td>0.20</td>
<td>0.37</td>
<td>0.77</td>
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<tr>
<td>Holland</td>
<td>0.03</td>
<td>0.18</td>
<td>0.41</td>
<td>0.80</td>
</tr>
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<td>Cook Nuclear Plant</td>
<td>0.01</td>
<td>0.13</td>
<td>0.30</td>
<td>0.86</td>
</tr>
</tbody>
</table>

### Model Wave Height (m)

August 2013

### North Michigan

![North Michigan Station Map](image13x36.png)

### Holland

![Holland Station Map](image623x31.png)

### Cook Nuclear Plant

![Cook Nuclear Station Map](image365x499.png)
Validation

---Barred beach (Haller et al. 2000)

Cross-shore transect

Incoming wave direction

Hs = 4.5 cm
Tp = 1 s
Significant Wave Height (m)
(cross-shore transect)

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

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

Y(m)
X(m)
Current Field

X(m)
Y(m)
Formation of Rip Currents
Reports about loss of life

Body of Port Washington teen recovered from Lake Michigan

Updated: 2:54 PM CDT Sep 05, 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

Real Time Data
- Wave Sensor
- Webcam

NOWCAST & FORECAST Models
- NOAA Forcing
- Initial Conditions Nowcast
- Wave model WWM III
- Flow model SELFE

Update html files
Upload to WEBSERVER

Post Process Results
Website: [http://infosportwashington.cee.wisc.edu](http://infosportwashington.cee.wisc.edu)

Rip Current Watch

Webcam Watch

1 hour behind
1 hour ahead
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.
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Questions?