Development and Applications of Integrated Nowcast Forecast Operational System (INFOS) for Rip Currents in the Great Lakes

Presented at 16th Annual Great Lakes Beach Association

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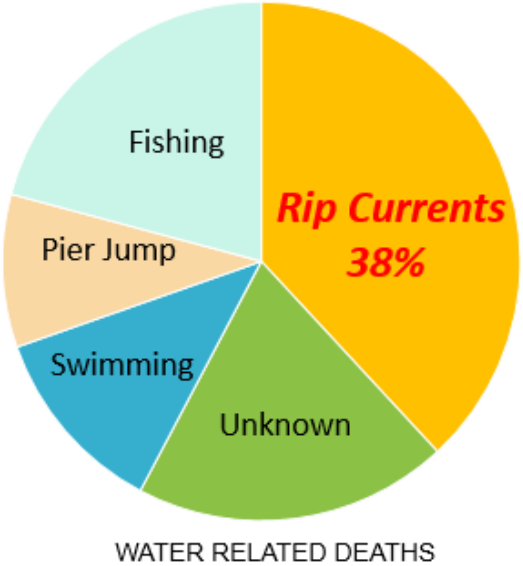
Todd Breiby, *WCMP*

Gene Clark, *Univ. of Wisconsin Sea Grant*

Jesse Schomberg, *Minnesota Sea Grant*

Motivations



- ***Rip Currents*** is one of the most dangerous beach hazards in the Great Lakes.
- If there is ***no lifeguard*** on duty, the ***safety*** of beachgoers cannot be guaranteed.
- ***Static signage*** or ***flag system*** provides no warning effects to visitors.

Project Objectives

1) **Develop** a **nowcast** (**observation**) and **forecast** (**modeling**) system for real-time **rip current warning**

2) **Enhance** the public rip current awareness through **risk communications** (**outreach** and **education**)

3) **Improve** **Great Lakes Coastal Forecasting System** with in-situ **nearshore wave** monitoring

Characteristics

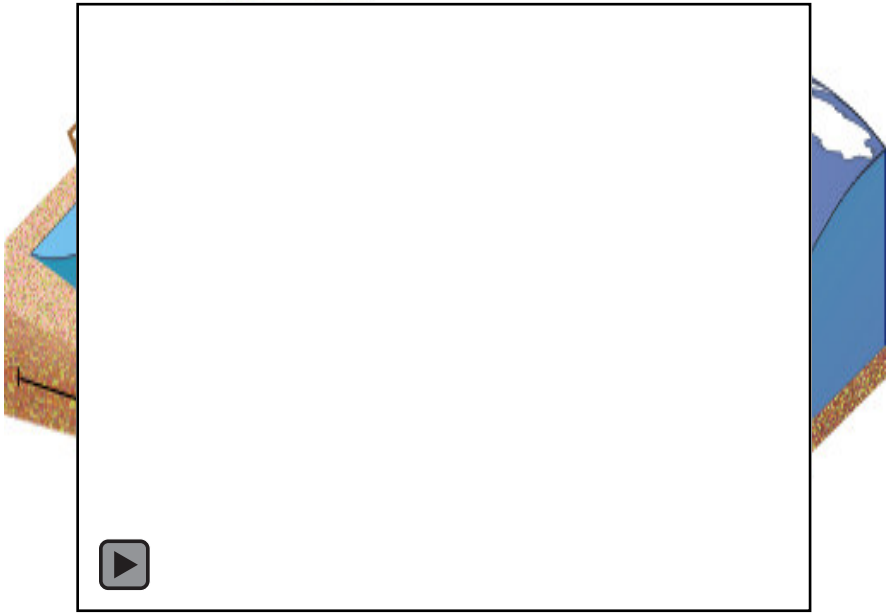
Occurrence: Wave Breaking

Speed: **0.3 ~ 2 m/s**

Width: **5 ~ 50 m**

Scale: **5 ~ 30 min**

Mechanisms

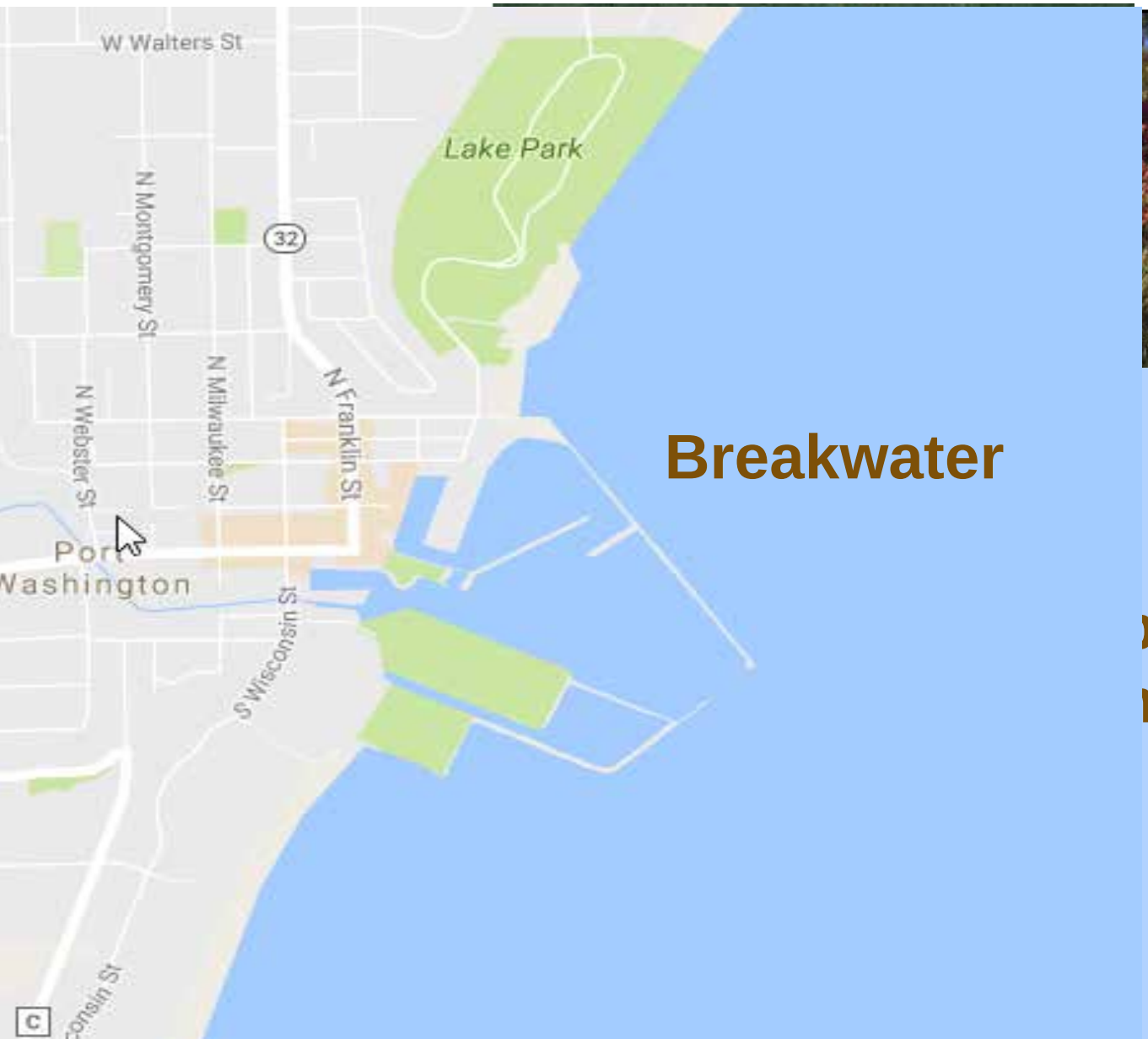


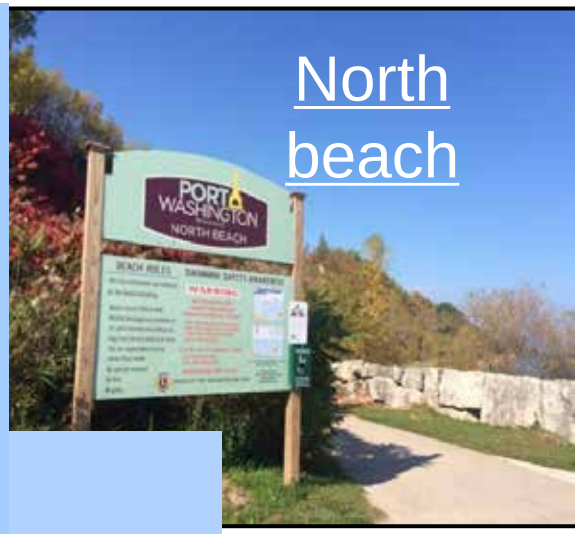
Bathymetry Caused

Structure Induced

Meteotsunamis (Seiches) Induced

Rip Current Sites





North beach

oar
netry

cKinley beach

Port Washington, WI

Rip Current Camera

Rip Current Cam

Aug 19th, 2015, when the wave height was 2.6 ft.

Cam Videos

Imaging Tracking (IT) technique

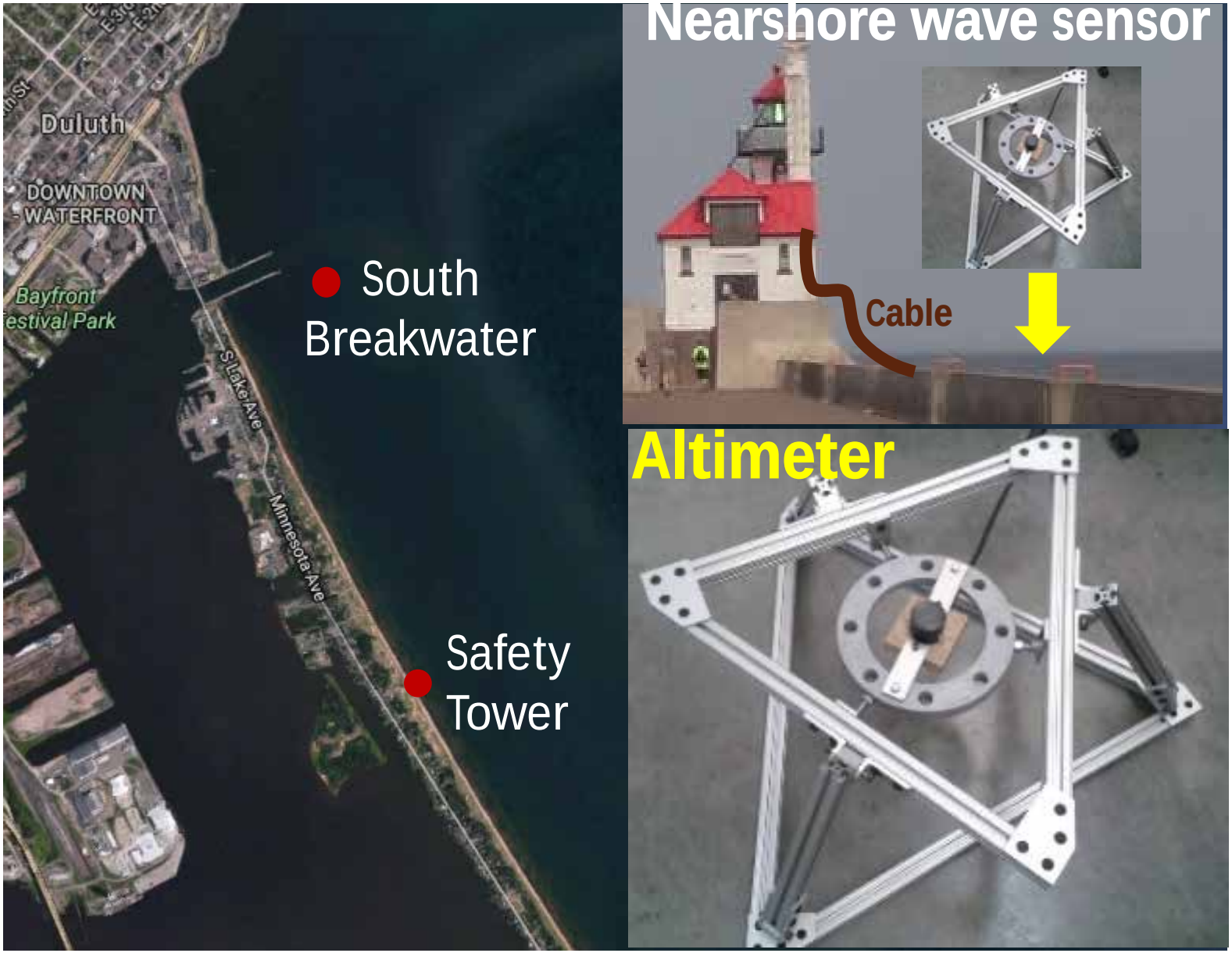
Current Speed & Direction

Duluth, Minnesota

WWW.MOBOTIX.COM
2016-06-09 CDT 15:48
Wide Angle for Rip Current

Wide Angle Imaging Tracking System (WAITS) for Rip Current

Duluth, Minnesota



Real-time Wave Observation

Real-time wave observations in Lake Superior are provided in both nearshore and offshore locations. The time series of wave height, period and water temperature for the last 72 hours are provided.

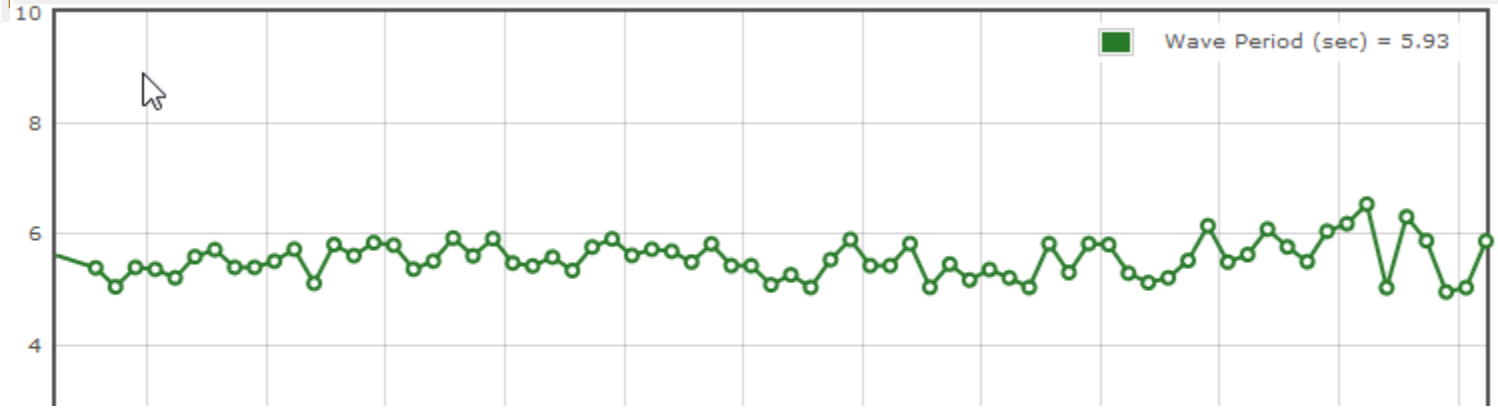
Nearshore Wave Offshore Wave

Wave Observation Locations in Lake Superior

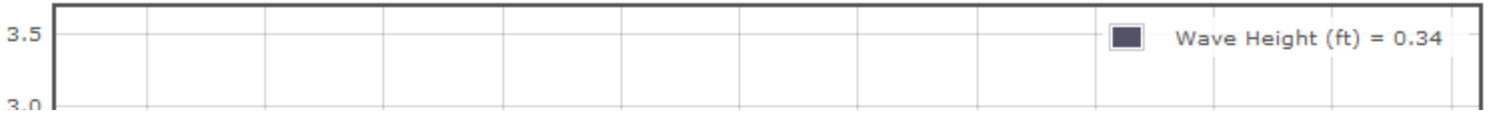
Nearshore Wave Observation

Offshore Wave

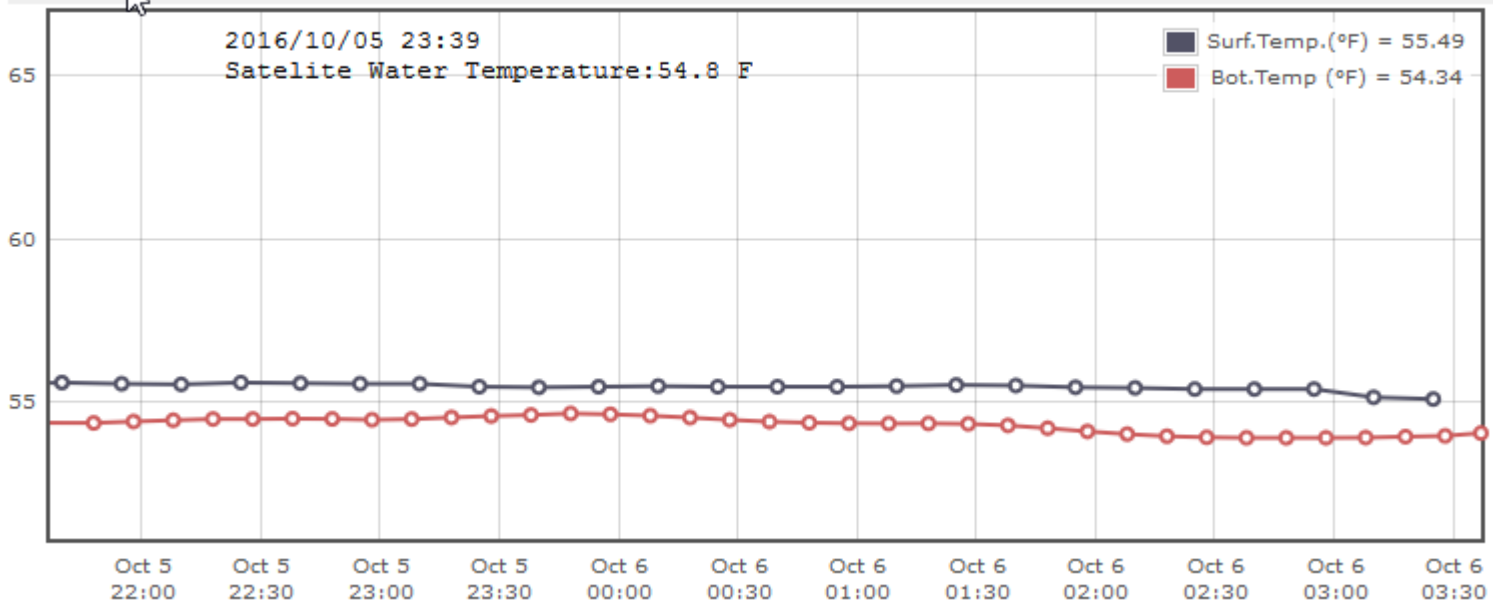
Water Period in Second



Wave Height in Feet



Water Temperature in Degrees Fahrenheit



Project Objectives

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2) **Enhance** the public rip current awareness through **risk communications** (**outreach** and **education**)

3) **Improve** **Great Lakes Coastal Forecasting System** with in-situ **nearshore wave** monitoring

INFOS Technology

Forecast Data

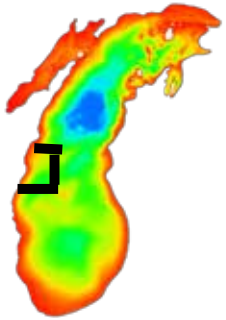
Wave Sensor

NOAA Forcing

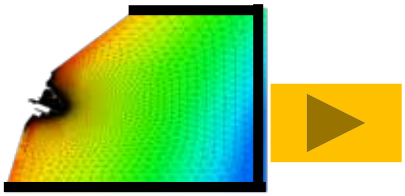
Wave model

Flow model

Wave Current Interactions



Nested Region



Real-time Nearshore Wave

Wide Angle Imaging Tracking System

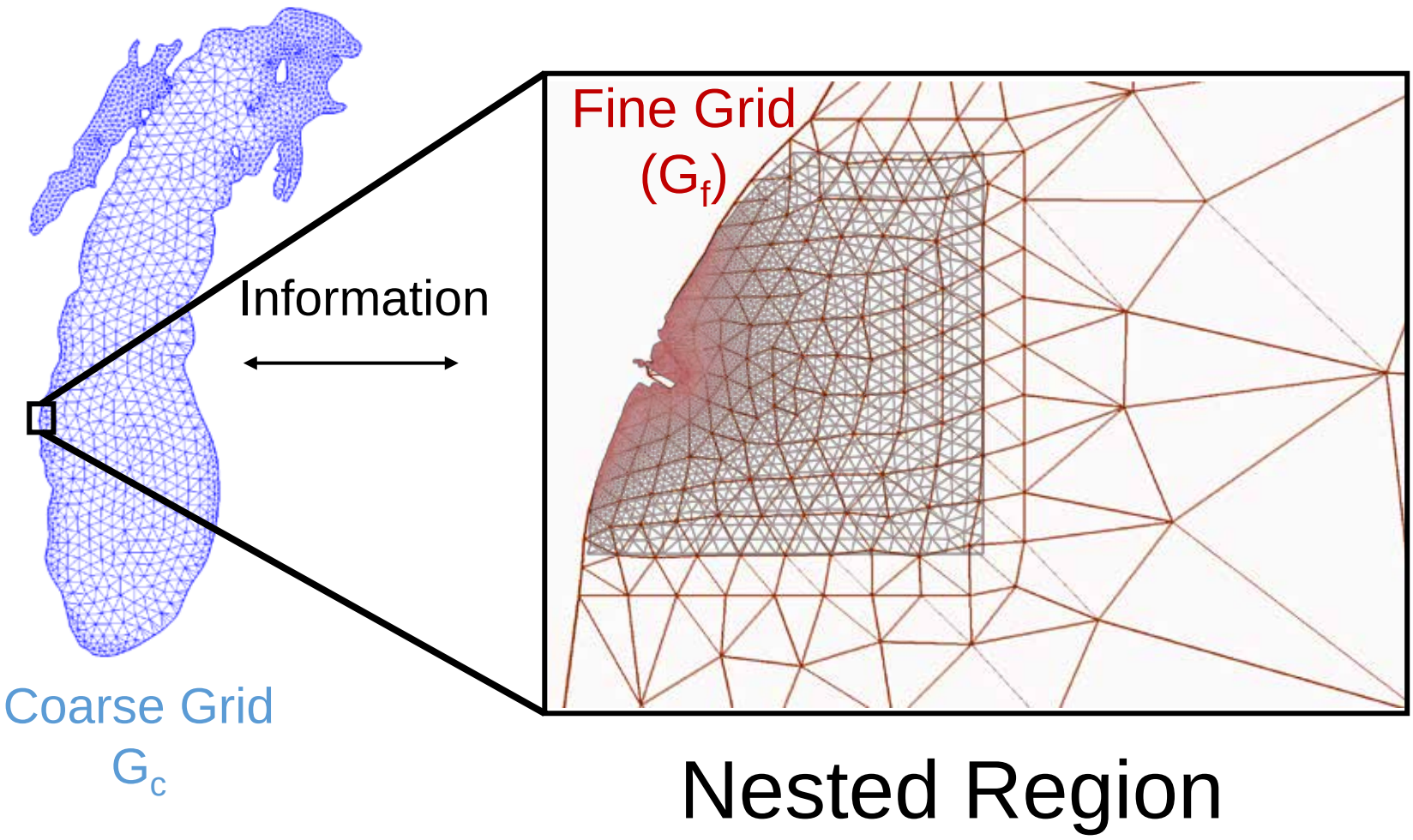
WAITS for Rip Current

WEBSERVER Portal

Life Guards + Local Stakeholders

Seamless Mesh Automated Regridding Technique

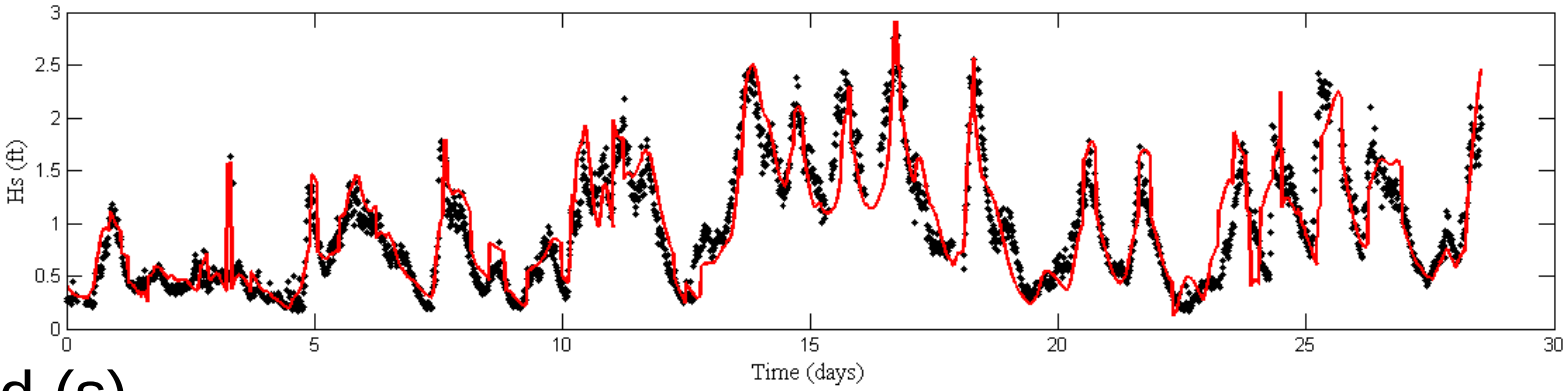
SMART (High Performance Fidelity Computing)



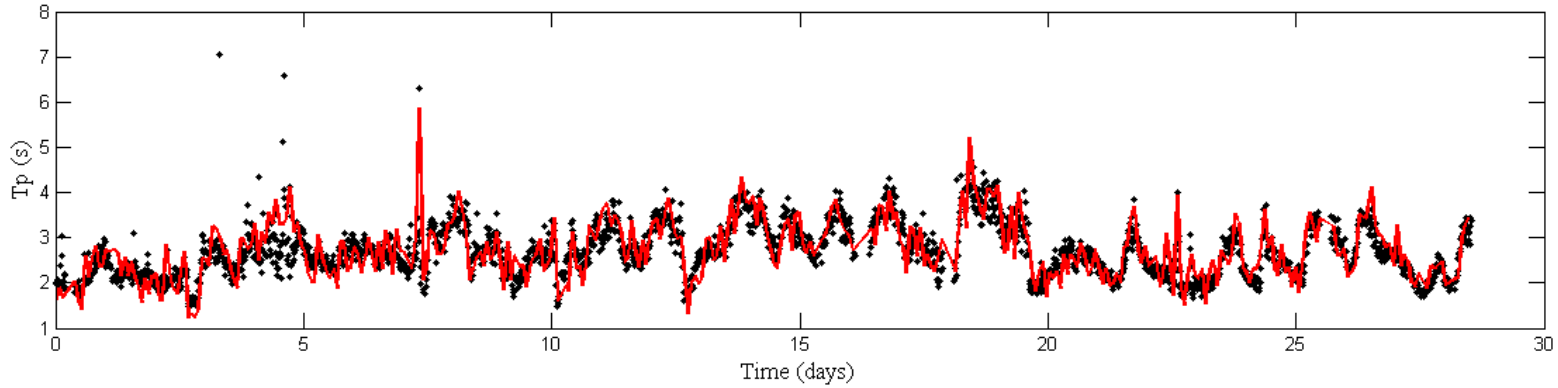
Comparisons

Wave Height (m)

● Observations — SMART



Wave Period (s)



Model	Bias	RMSE	R	SI
SMART	0.0116	0.2635	0.8868	0.2778

Rip Current Modelling

http://infosportwashington.cee.wisc.edu/new_model_surfcurr.html

INFOS Port Washington

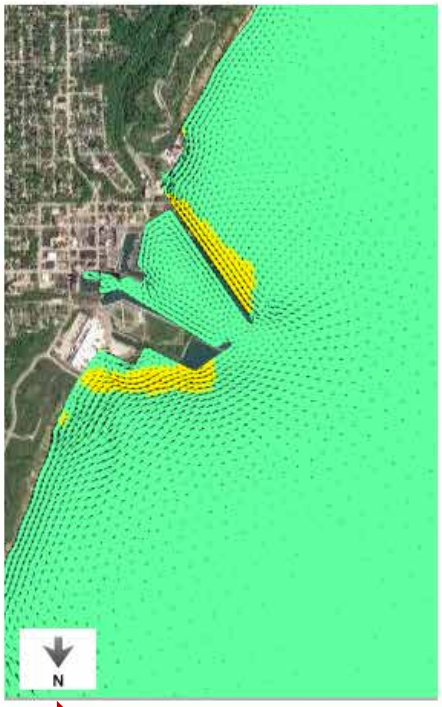
Integrated Nowcast/Forecast Operation System for Port Washington

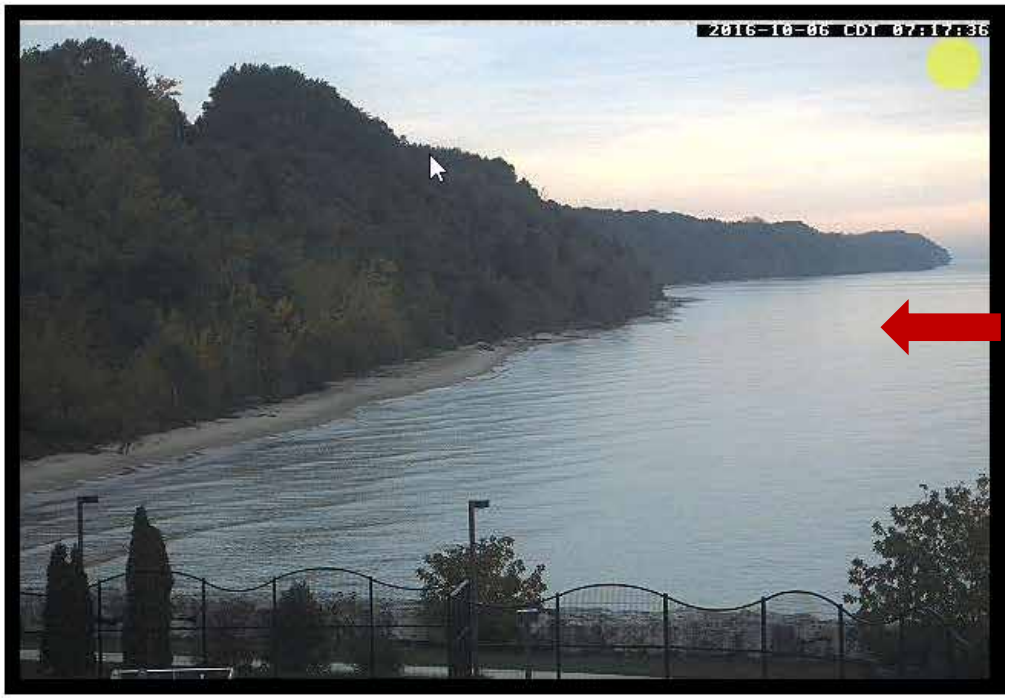
Home | About INFOS

Current Condition Table

Real-Time Rip Current Watch at Port Washington, Wisconsin

Update at: ***2016/10/06 7:21 AM***	**Wave Height**	N/A ft	**Wind Speed**	3.4 mph	**Air Pressure**	30.1 in Hg	**Water Temp. (surface)**	59.1 °F
	Wave Period	N/A sec	**Wind Direction**	N	**Air Temp.**	56.3 °F	**Water Temp. (bottom)**	N/A °F





Live camera view

Risk level & explanation

Rip Current Risk Levels

< 1 ft	1-2 ft	> 2 ft

INFOS Duluth

Integrated Nowcast/Forecast Operation System for Duluth

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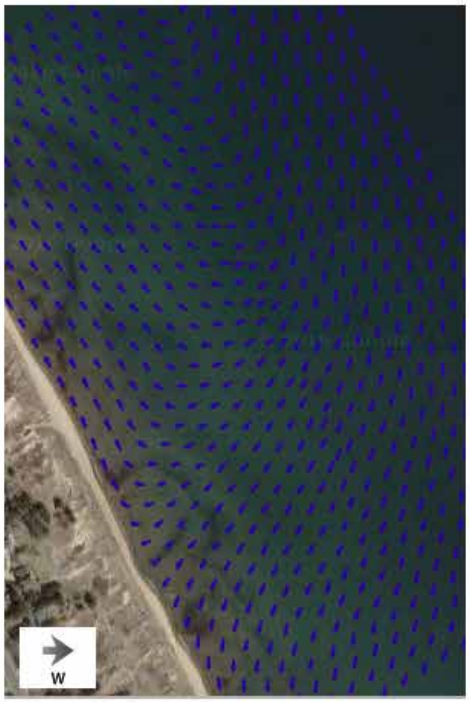
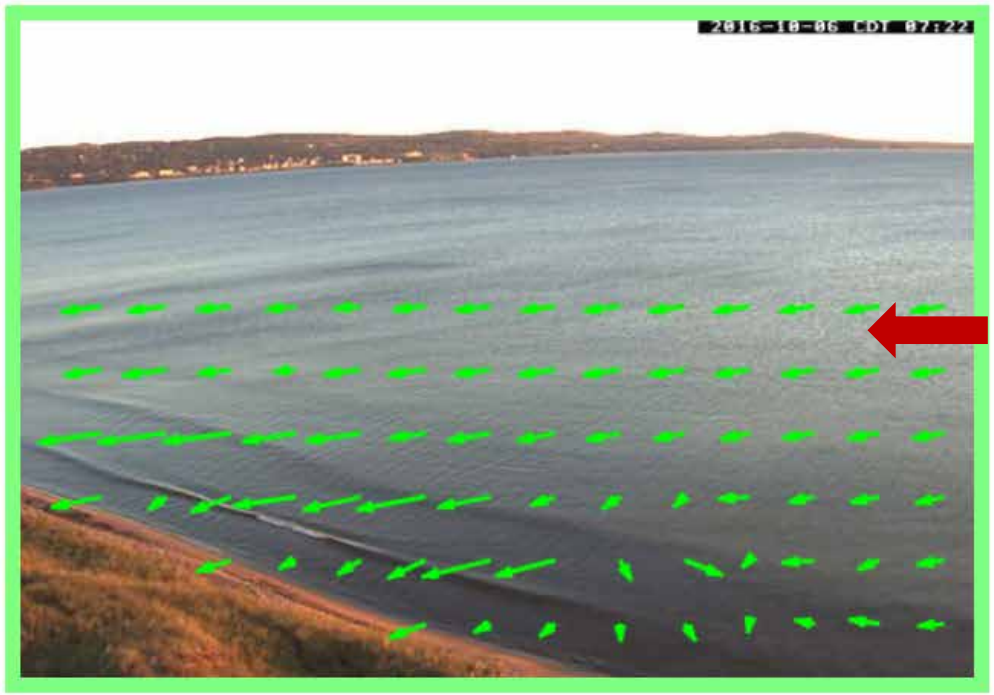
Current Condition Table

Real-Time Rip Current Watch at Duluth, Minnesota

Update at: ***2016/10/06 7:23 AM***	**Wave Height**	0.2 ft	**Wind Speed**	9.2 mph	**Air Pressure**	30 in Hg	**Water Temp. (surface)**	55.6 °F
	Wave Period	6.6 sec	**Wind Direction**	W	**Air Temp.**	48 °F	**Water Temp. (bottom)**	54.7 °F





Live camera view

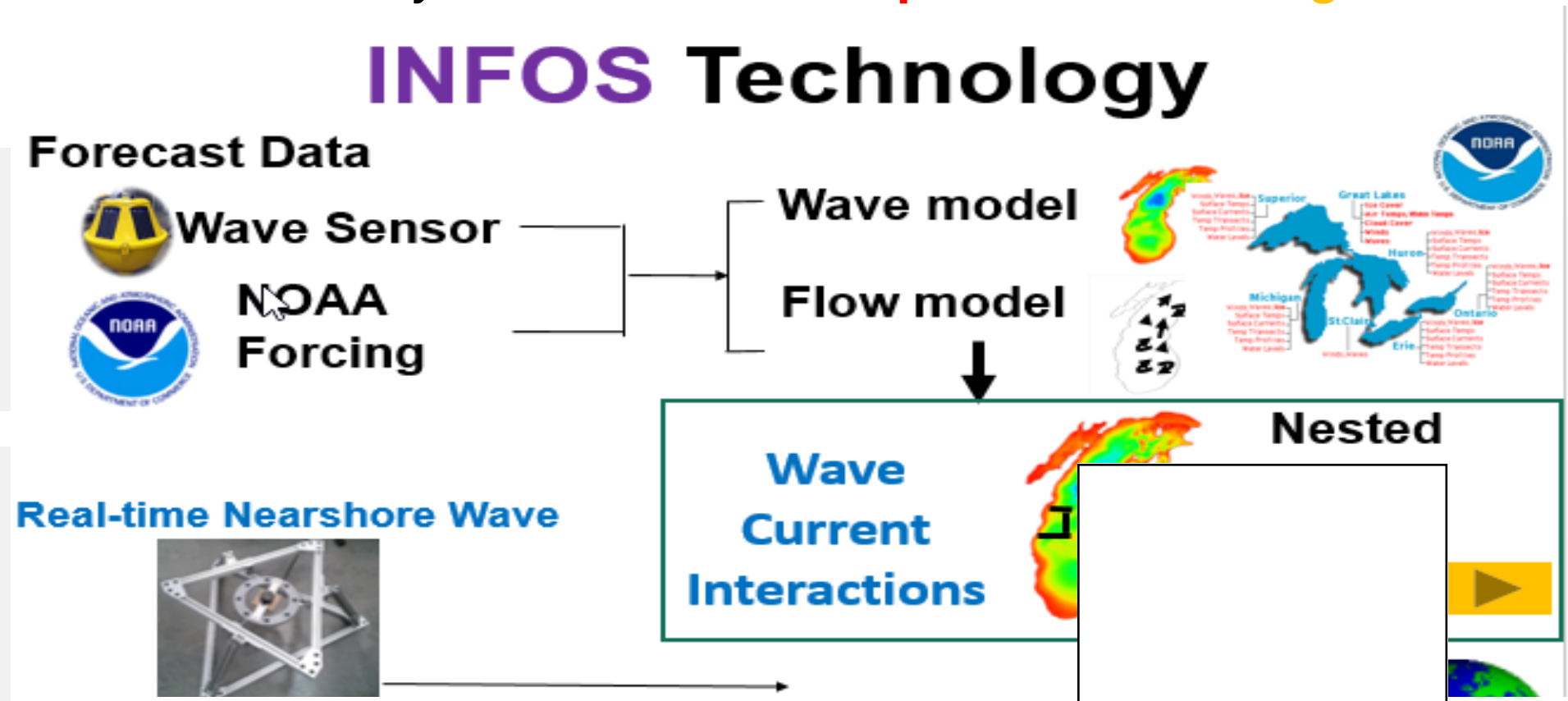
Risk level & explanation

Rip Current Risk Levels

< 1 ft	1-2 ft	> 2 ft

Summary

- **Develop** a **nowcast** (**observation**) and **forecast** (**modeling**) system for real-time **rip current warning**

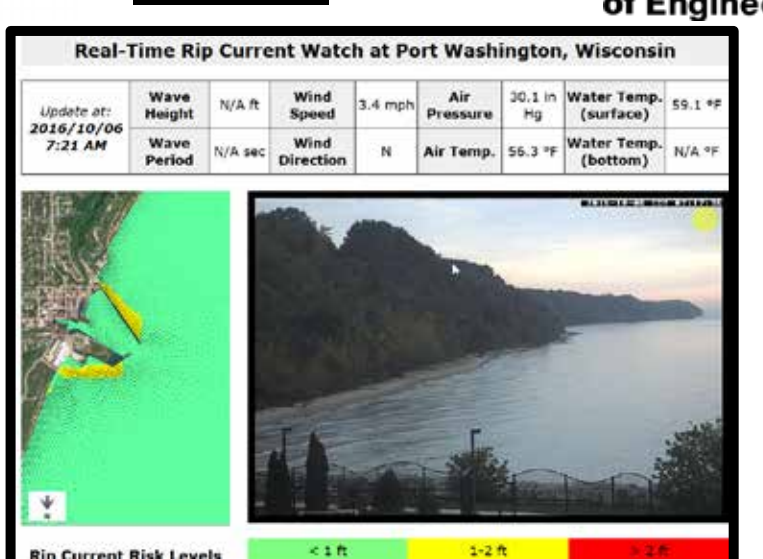


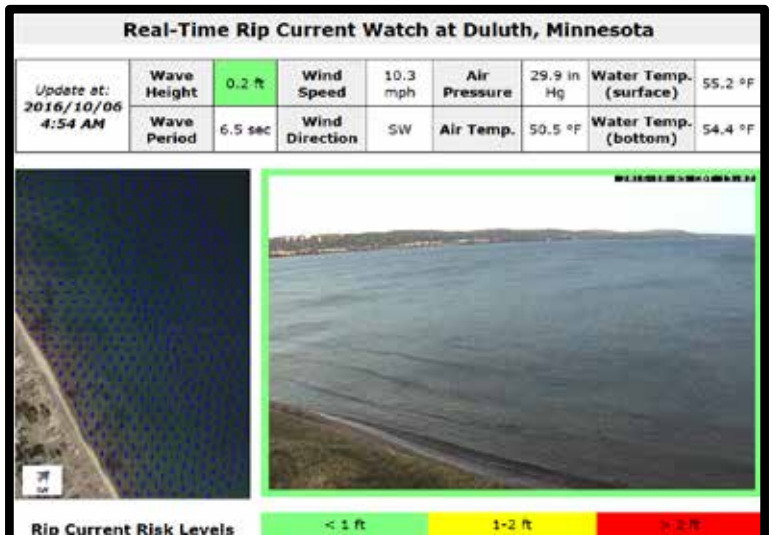
- **Improve** Great Lakes Coastal Forecasting S

with in-situ **nearshore wave** m

Summary

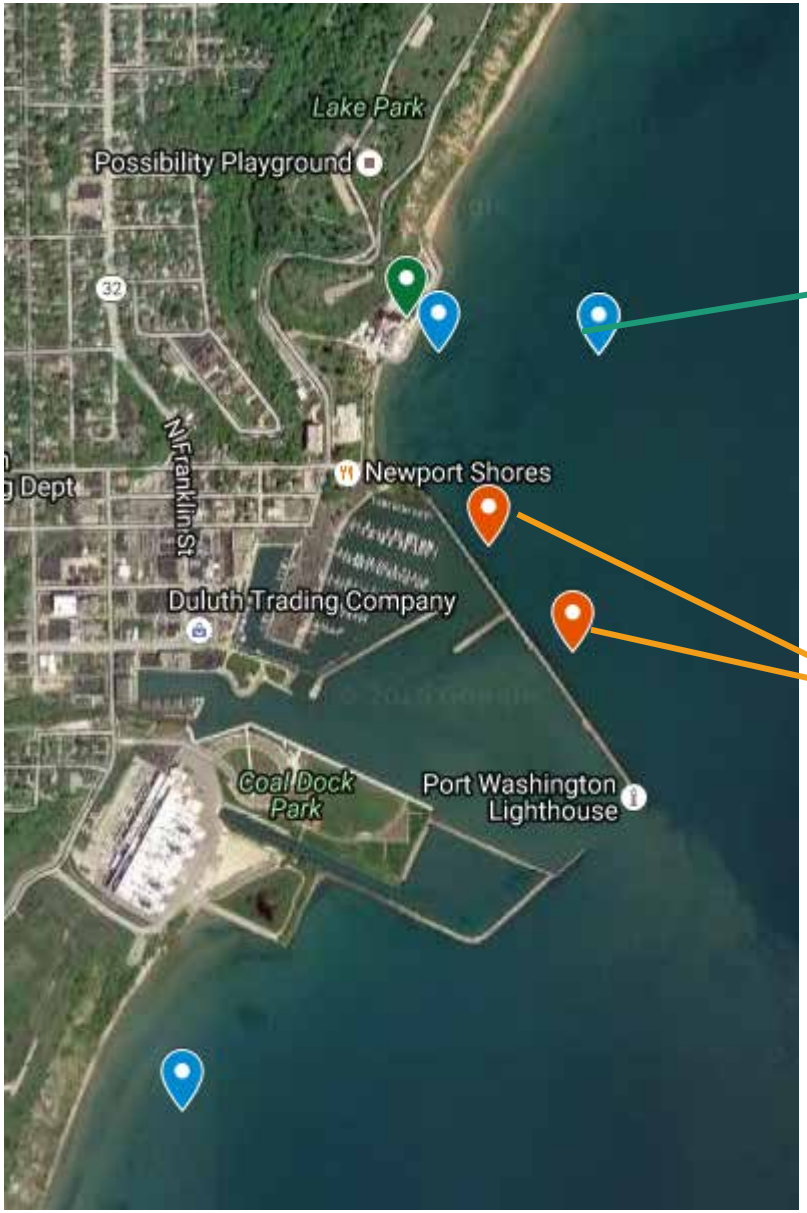
- **Enhance** the public rip current awareness through **risk communications** (**outreach** and **education**)

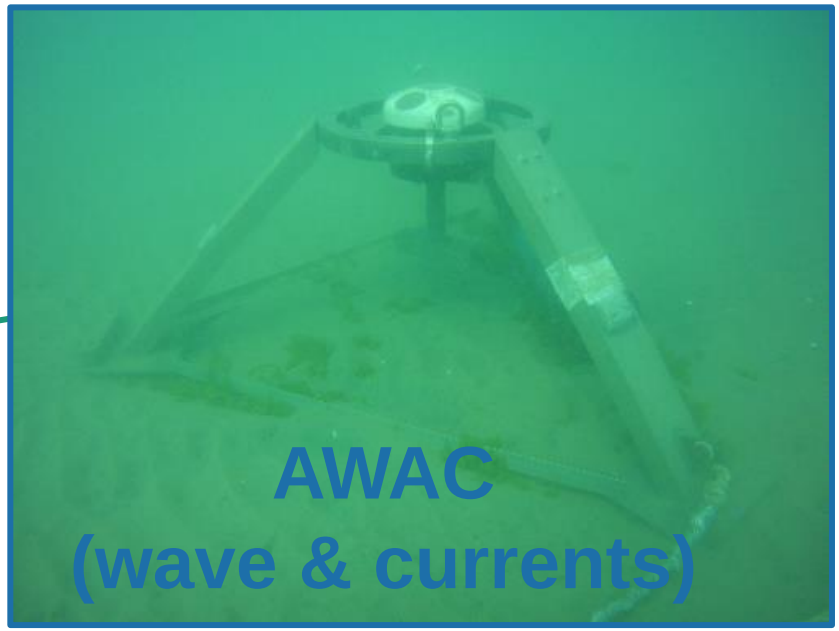


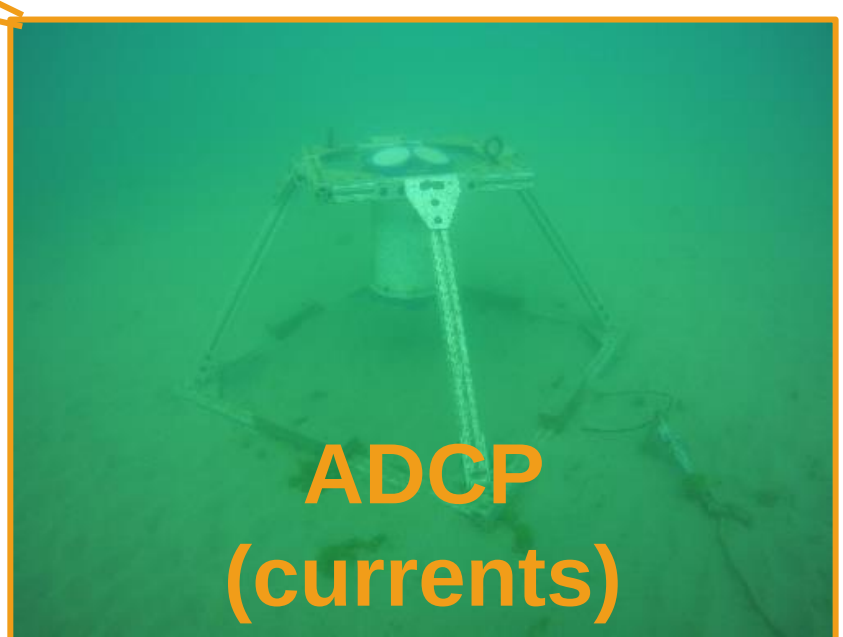


Port Washington, WI

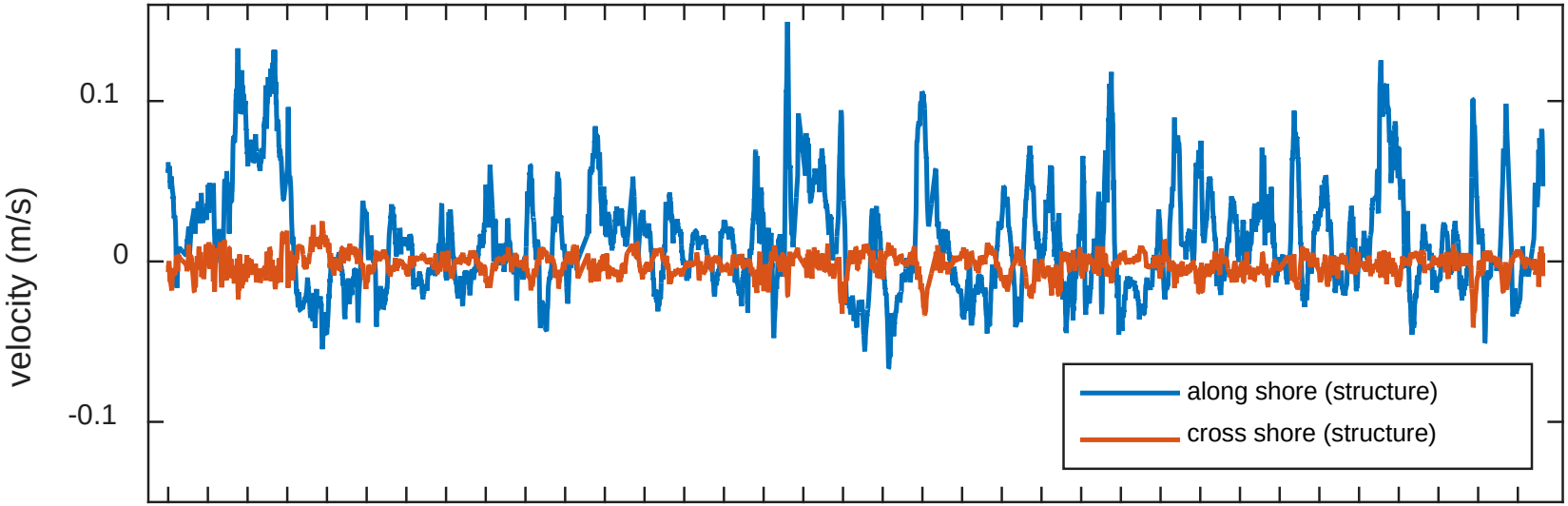
Field Measurements



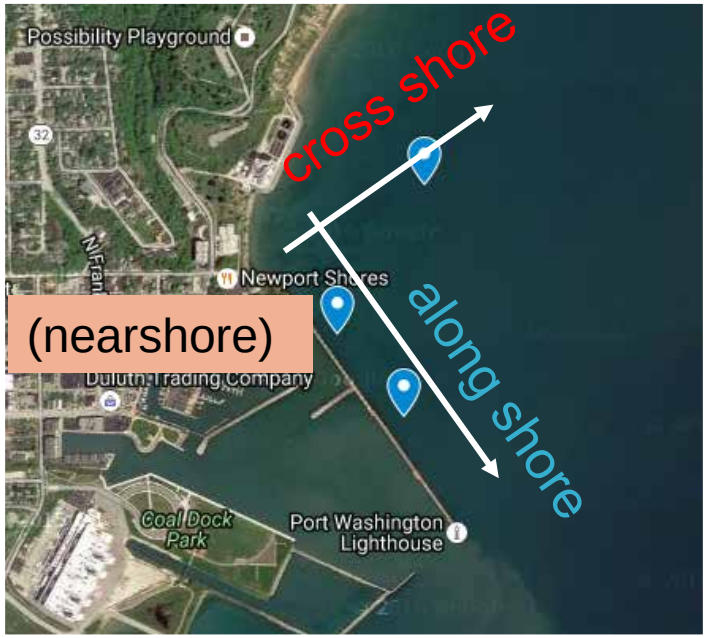




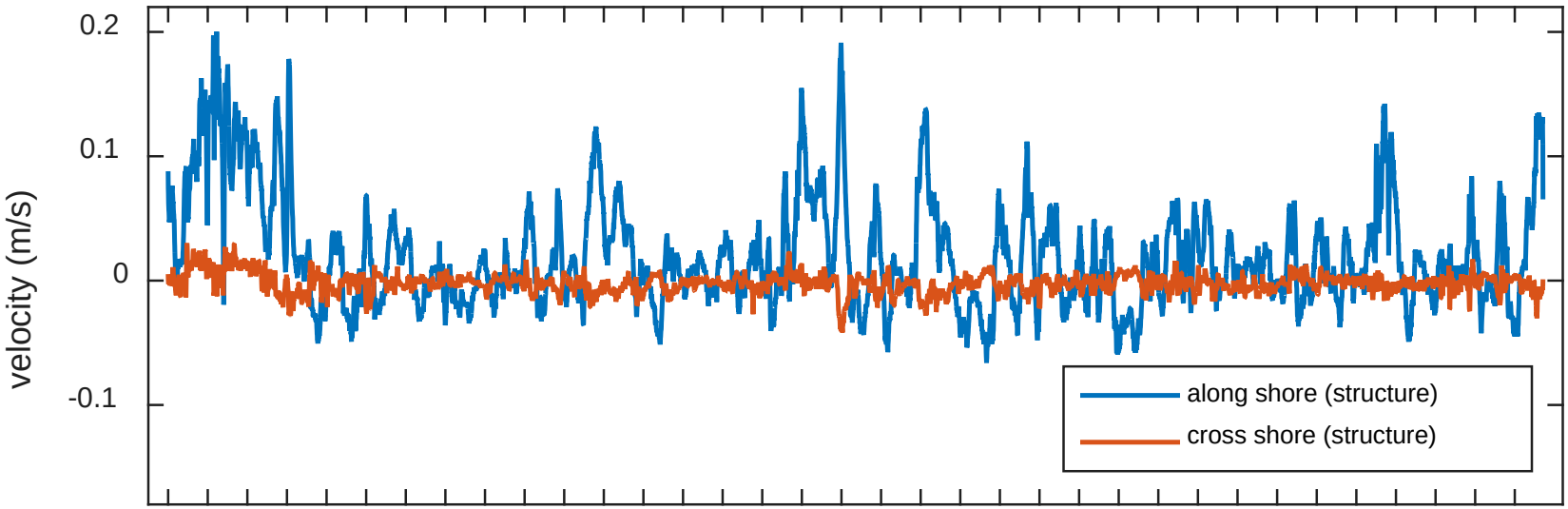
Nearshore Currents



2016

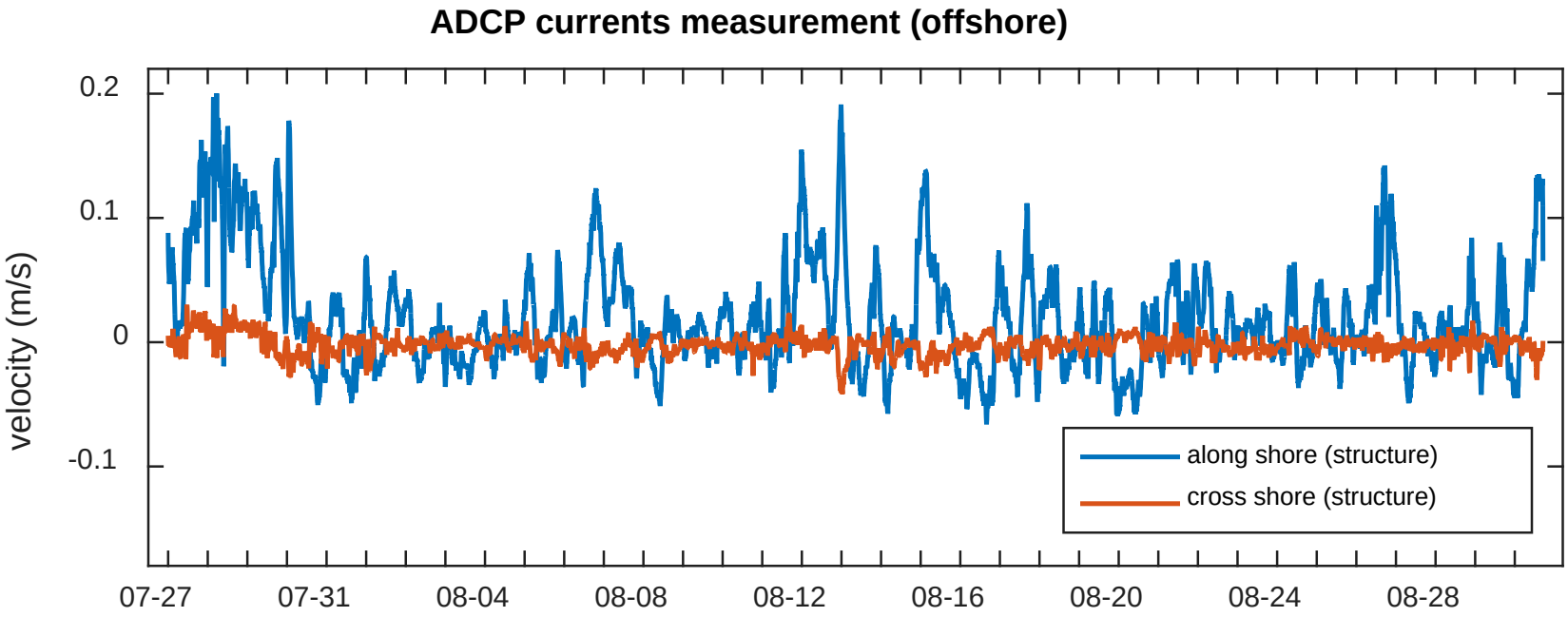


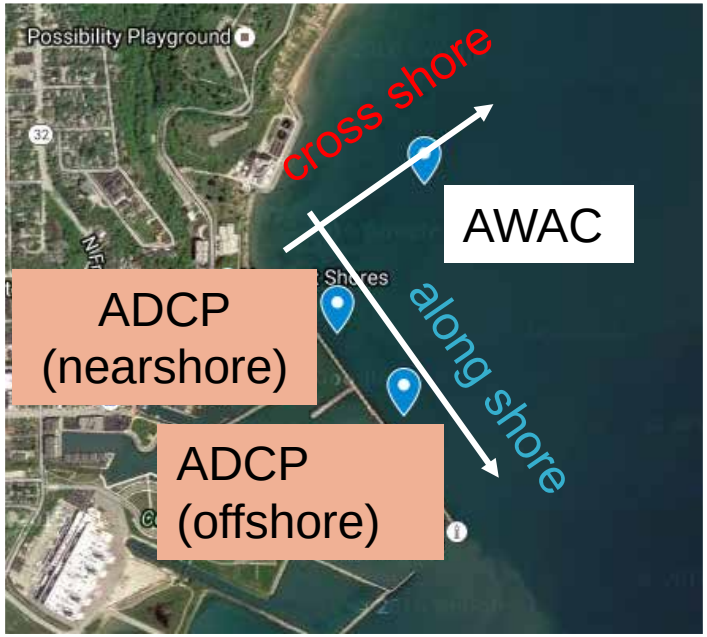
Offshore Currents

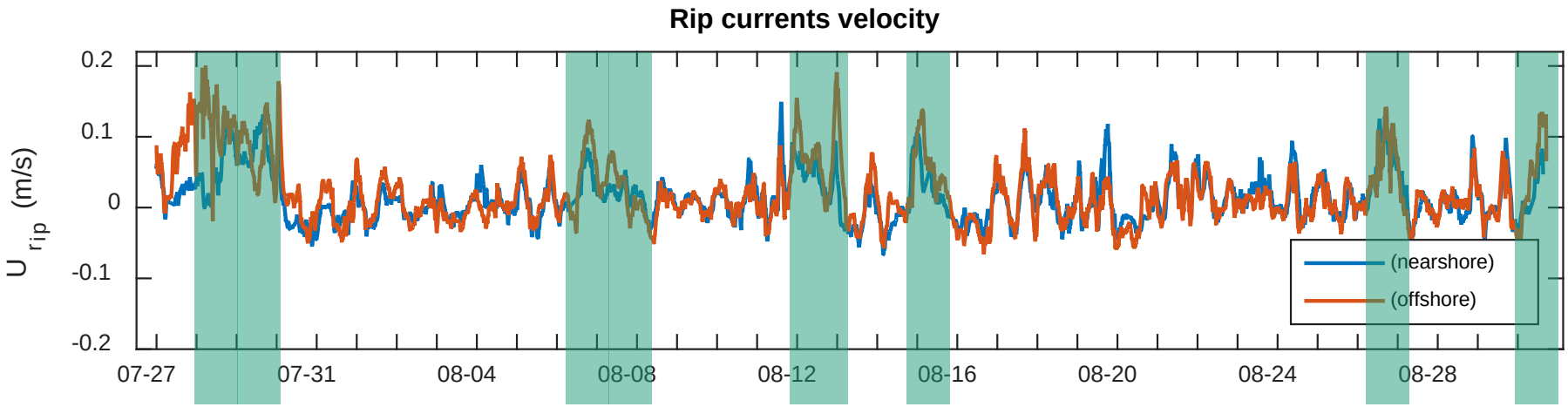


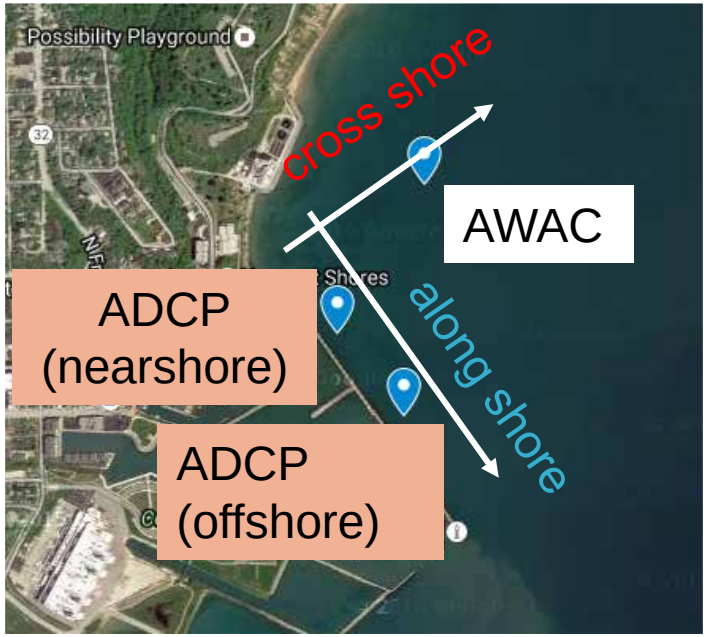
2016

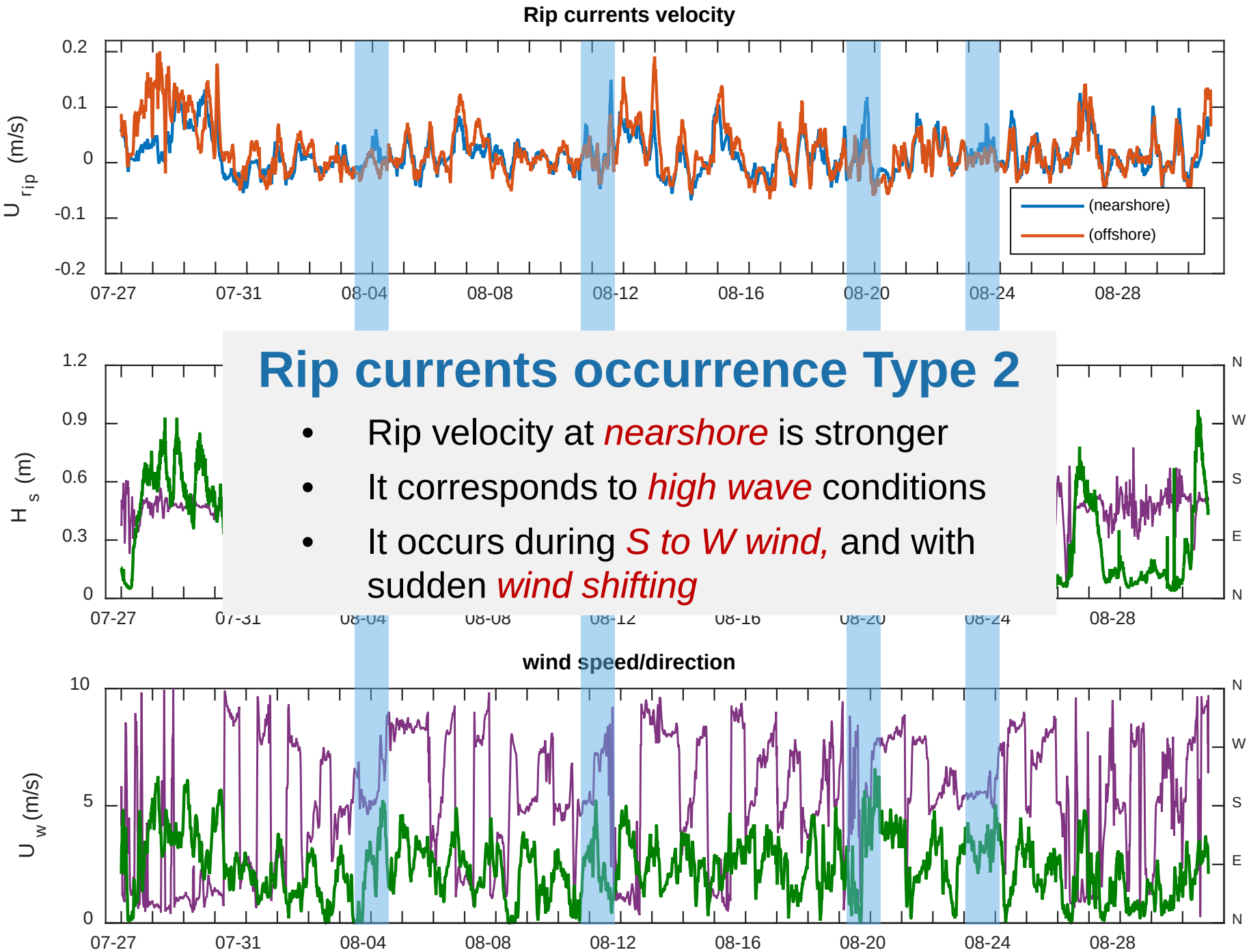
Field measurements of rip currents





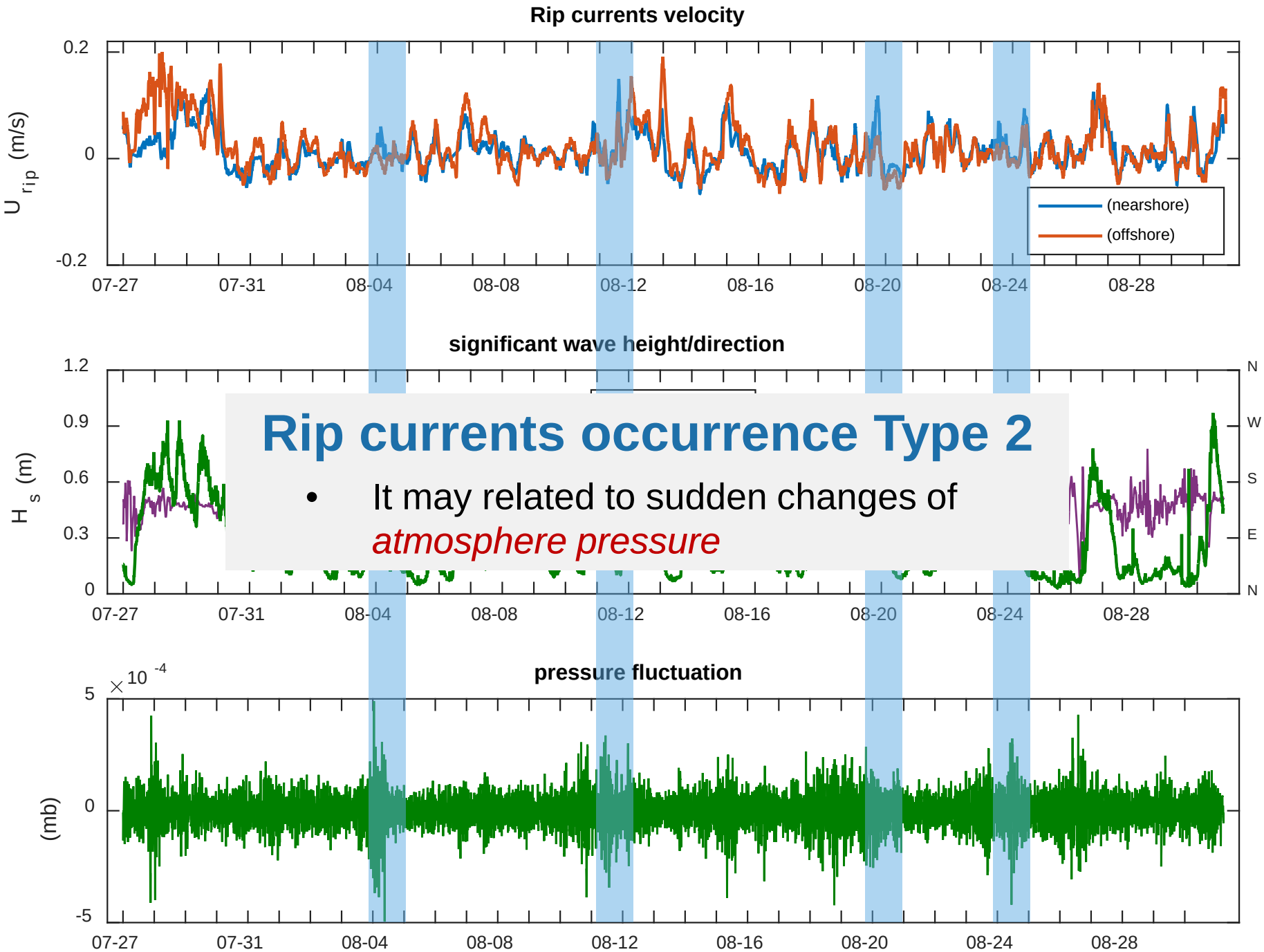

Rip currents velocity
U rip (m/s)
0.2
0.1
0
-0.1
-0.2
07-27
07-31
08-04
08-08
08-12
08-16
08-20
08-24
08-28
(nearshore)
(offshore)


Possibility Playground
cross shore
AWAC
along shore
ADCP
(nearshore)
ADCP
(offshore)



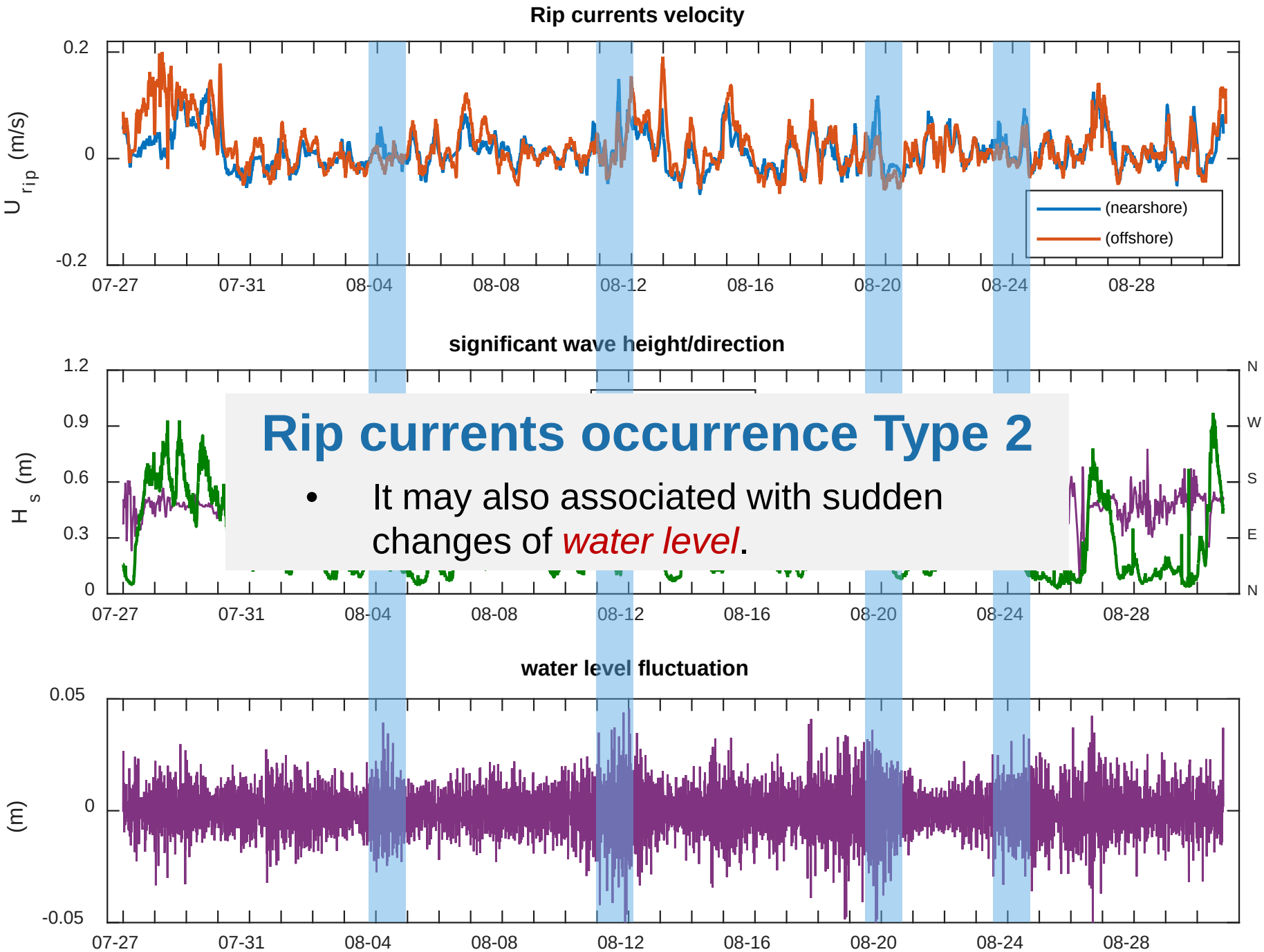
Rip currents occurrence Type 2

- Rip velocity at *nearshore* is stronger
- It corresponds to *high wave* conditions
- It occurs during *S to W wind,* and with sudden *wind shifting*



Rip currents occurrence Type 2

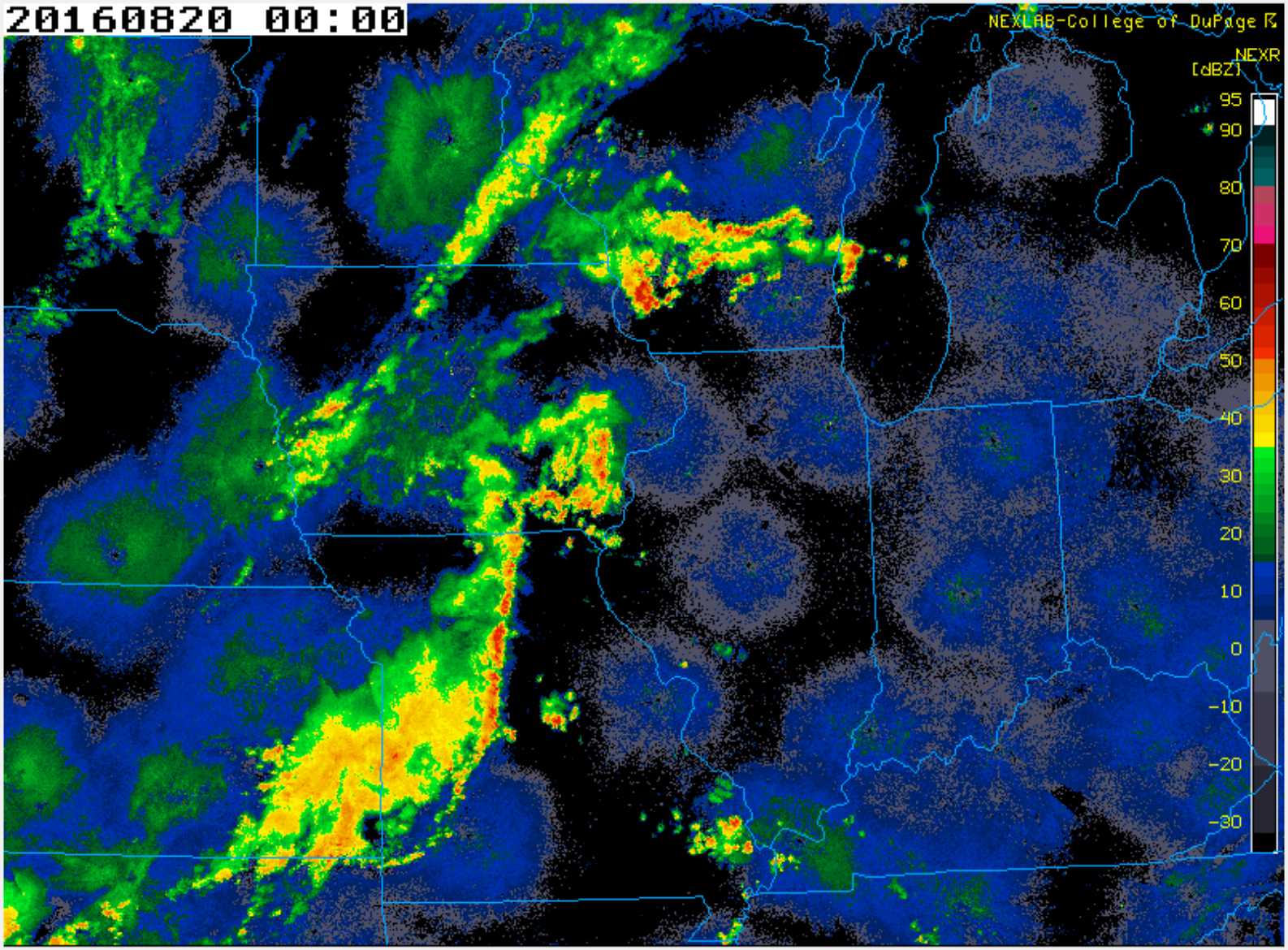
- It may related to sudden changes of *atmosphere pressure*



Rip currents occurrence Type 2

- It may also associated with sudden changes of *water level*.

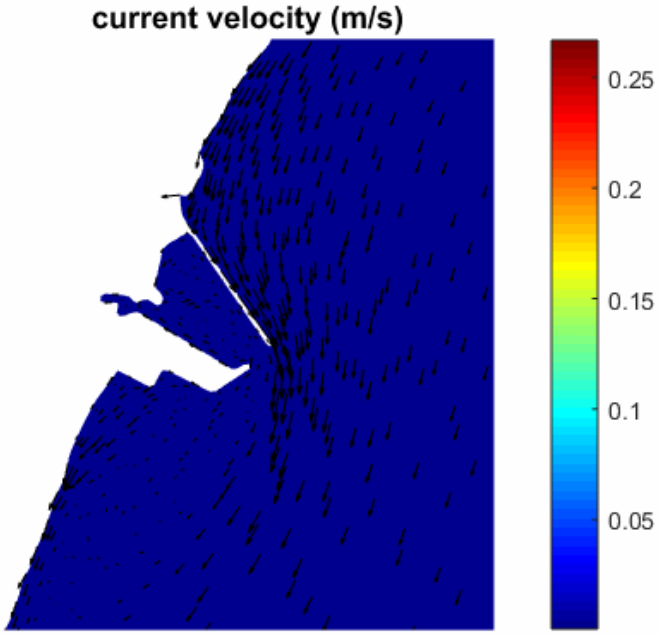
SW storm occurring on Aug 20th, 2016

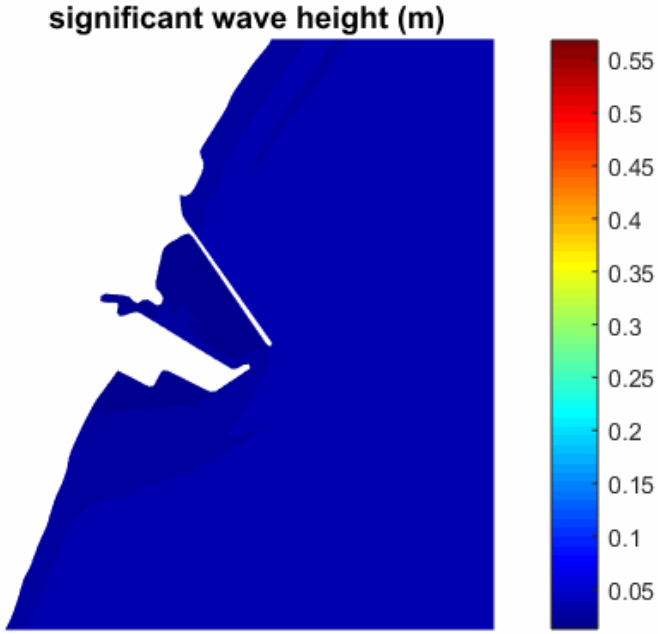


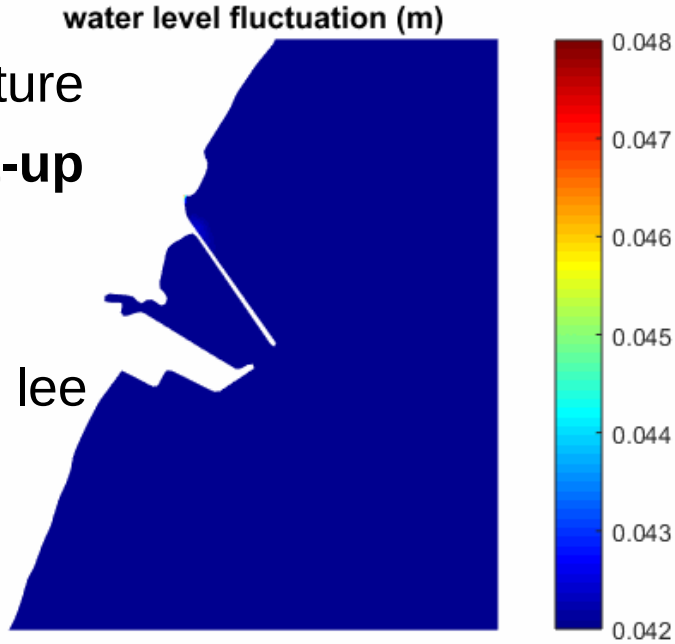
Wave and currents coupled model

NE

Sce
– t







- Longshore currents move towards the structure
- Rip currents are generated due to **wave set-up**
- ***Rip currents become stronger as propagating offshore***
- A *wave shadowing zone* is developed at the lee side of the structure

Wave and currents coupled model

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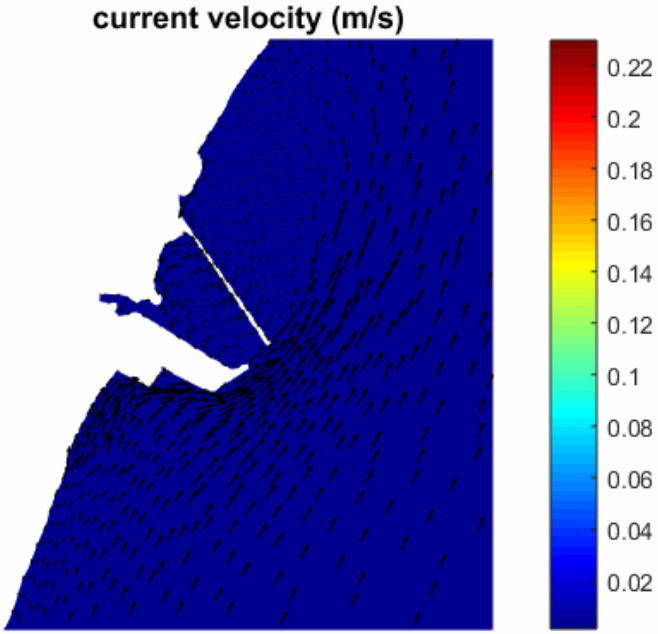
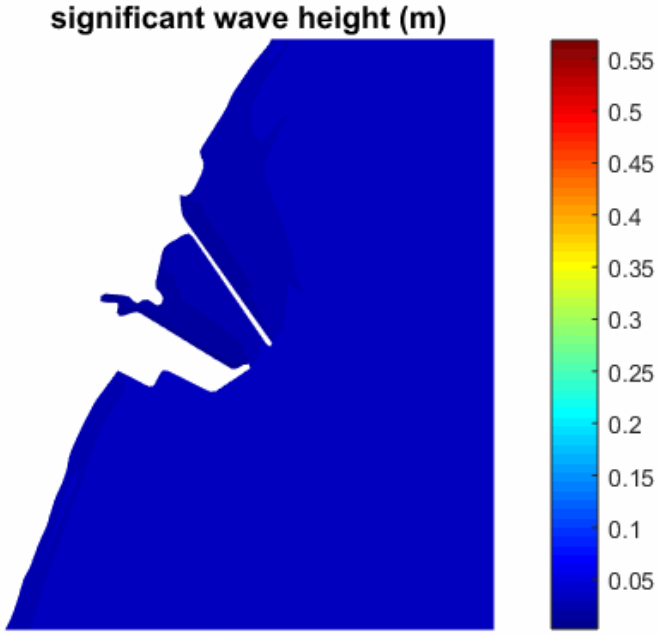
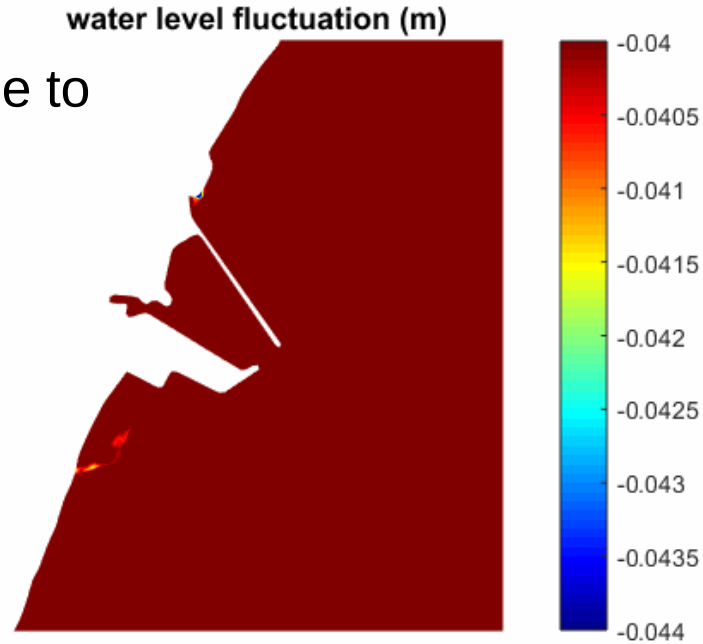
– t





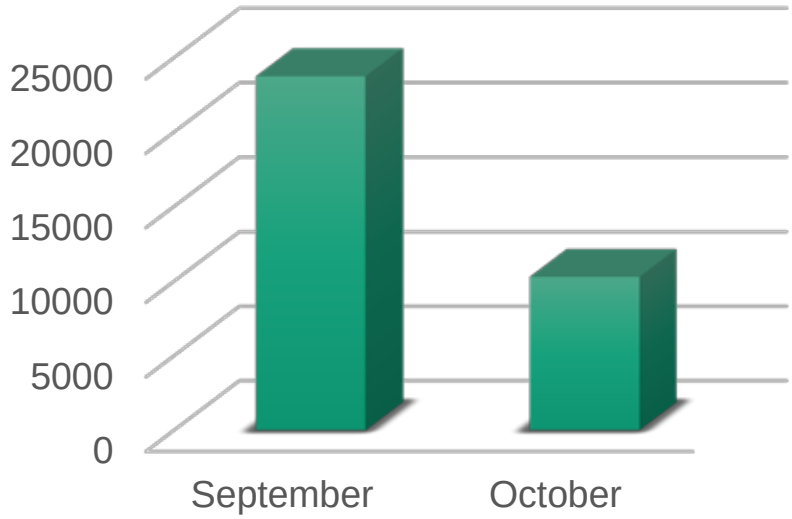


- Rip currents on north side are generated due to **lee-side recirculation**
- ***Rip currents are stronger at nearshore location***

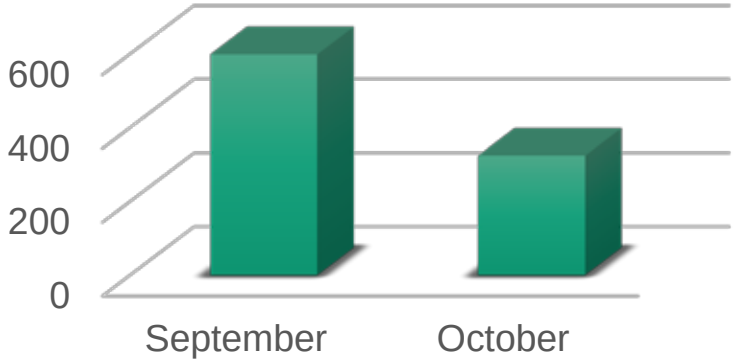
2015 Outreach Activities Summary

INFOS Web Traffic

Page Views



Number of Visitors



Public release during summer 2015

For Immediate Release
September 15th, 2015

University of Wisconsin-Madison, City of Port Washington unveil groundbreaking real-time rip-current identification technology

PORT WASHINGTON, WI: The City of Port Washington, in partnership with the University of Wisconsin-Madison, the University of Wisconsin Sea Grant Institute, Wisconsin Coastal Management Program, and the NOAA Coastal Storms Program, has formally unveiled to the public a groundbreaking real-time rip-current identification technology. The development of the online

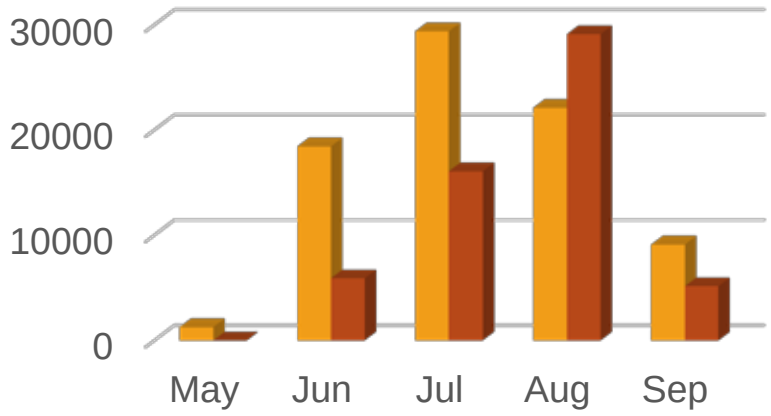
Port Washington installs **rip** tide monitor system
WISN Milwaukee - Sep 21, 2015
—**Port Washington** announces a new tool in fighting a hidden Lake Michigan danger. ... **Rip currents** are not typically seen, but can be deadly.

Lake Michigan death spurs action on **rip current** awareness
Milwaukee Journal Sentinel - Aug 25, 2014
A new warning sign stands at the **Port Washington** beach where a 15-year-old drowned two years ago in a **rip current**. A UW-Madison ...

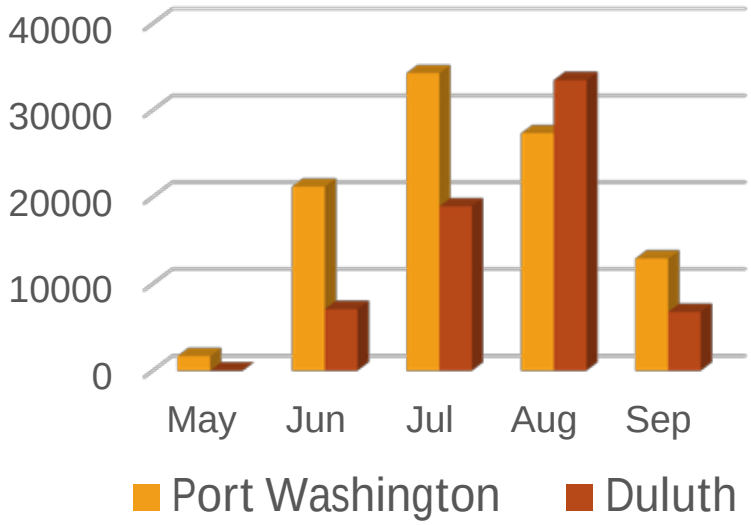
2016 Outreach Activities Summary

INFOS Web Traffic

Number of Visitors



Page Visits



Public releases

Underwater sensor may detect deadly **rip currents**
Duluth News Tribune - Jun 3, 2016
The wave sensor, underwater off the South Pier of the **Duluth** Ship ... There are incidents nearly every year in **Duluth** when **rip currents** are ...

High risk of **Rip Currents** on Park Point beaches
Northland's NewsCenter - Jun 22, 2016
Duluth, MN (NNCNOW.com) -- Due to the High Risk of **Rip Currents** Wednesday, the **Duluth** Fire Department is issuing a warning for ...

Red Flag warning issued for Park Point beaches
Northland's NewsCenter - Jul 27, 2016
Duluth, MN (NNCNOW.com) -- Due to a high risk of **rip currents**, a red flag warning has been issued for all Park Point beaches until 10 a.m. ...

Red Flag Warning Issued 07-27-16
FOX 21 Online - Jul 27, 2016

View all

Rip current webcam and wave gauge coming soon to Park Point ...
Northland's NewsCenter - Jun 1, 2016
Duluth, MN (NNCNOW.com) -- The University of Wisconsin Sea Grant is now halfway done with a two year project to make three beaches along ...

Information sharing

Project Team

Yuli Liu

Pranshasa

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UW-Madison

Gene Clark
UW Sea Grant

Todd Breiby
WCMP

Jesse Schomberg
Minnesota Sea Grant

Great Lakes Coastal Storms Program

Brent Schleck

Julia Noordyk

Jerry Henneck

Tom Mlada

Acknowledgement

Partners