

Wave Data from HF Radar

Dr. Hugh Roarty

RUTGERS

Center for Ocean Observing Leadership

Mr. Chad Whelan

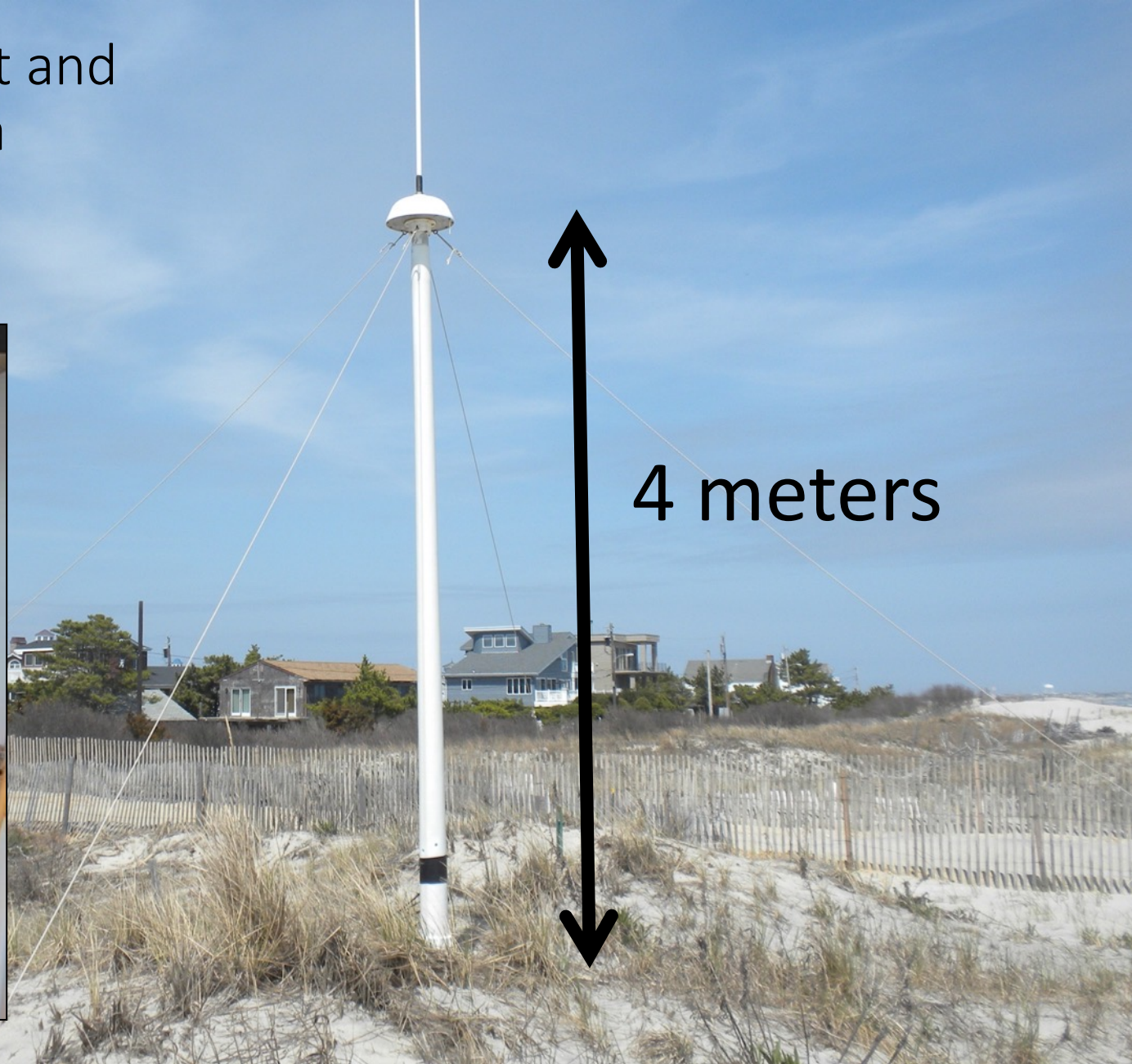


Outline

- Introduction to HF Radar
- IOOS HFR Wave Evaluation Program
- HFR Wave Data Use by Weather Services
- Individual Cases of HFR Wave Data

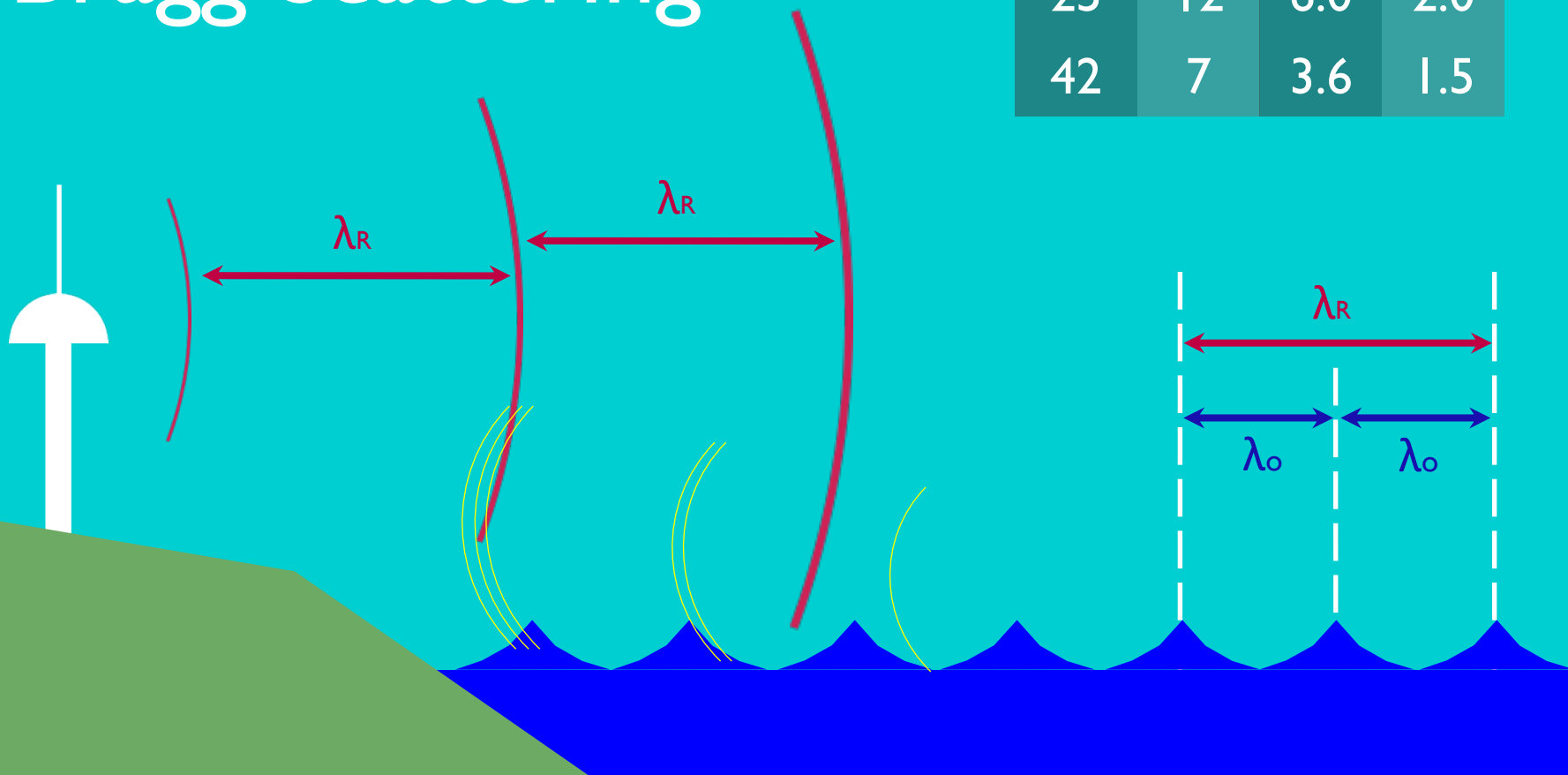
Introduction to HF Radar

13 MHz Transmit and Receive Antenna

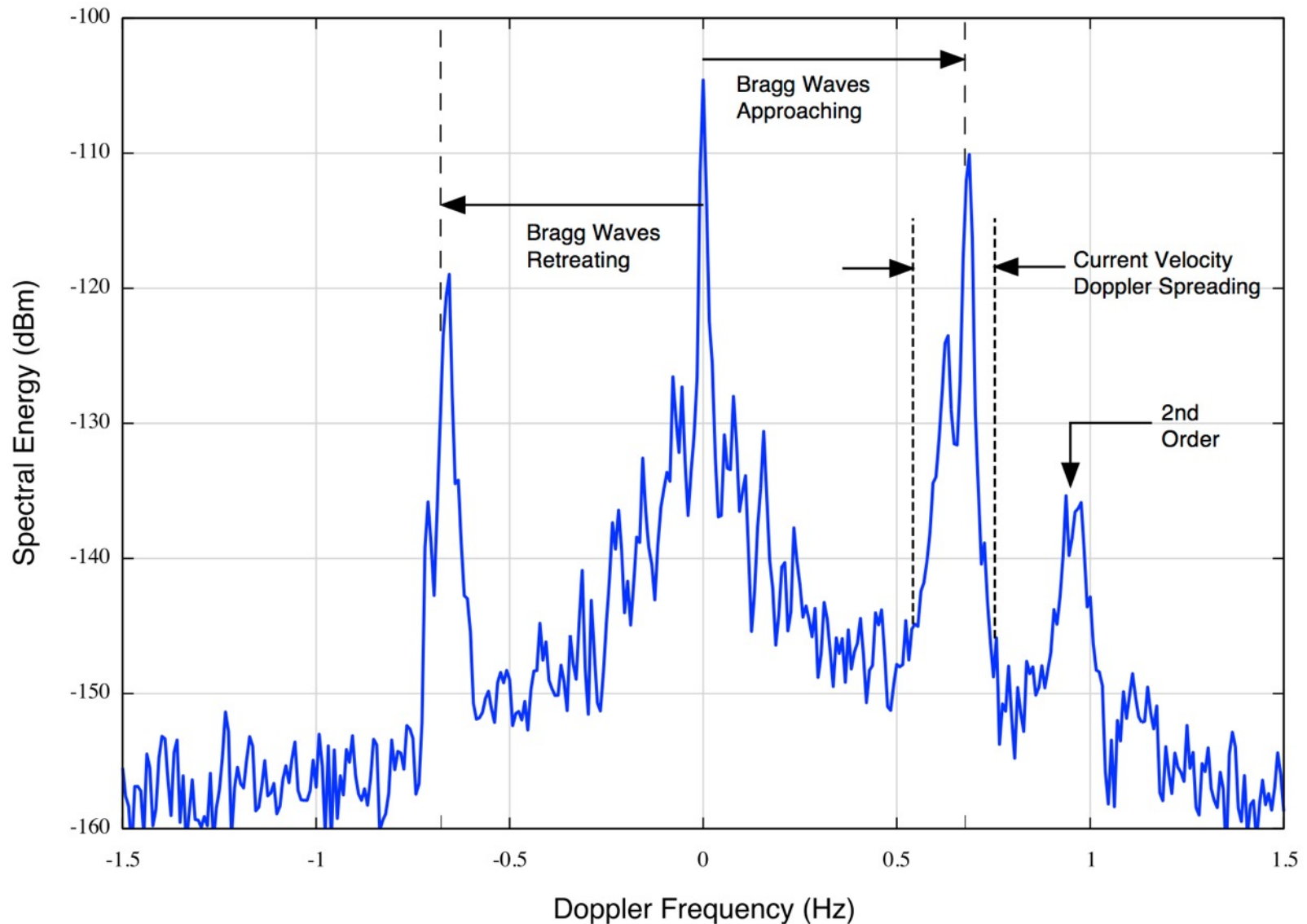


Bragg Scattering

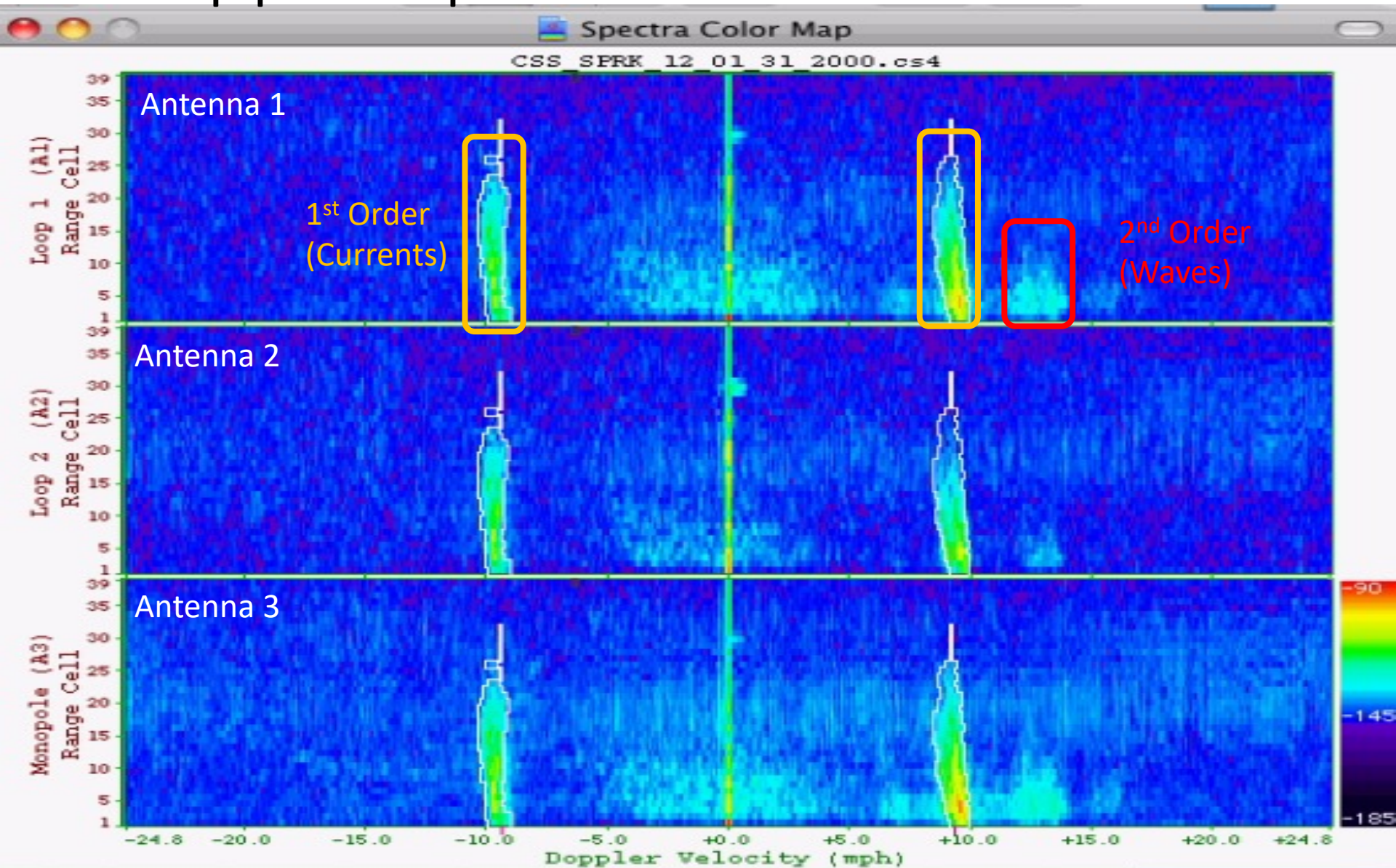
Freq mhz	λ_R meters	λ_o meters	T_o seconds
5	60	30.0	4.4
13	23	11.5	2.7
25	12	6.0	2.0
42	7	3.6	1.5



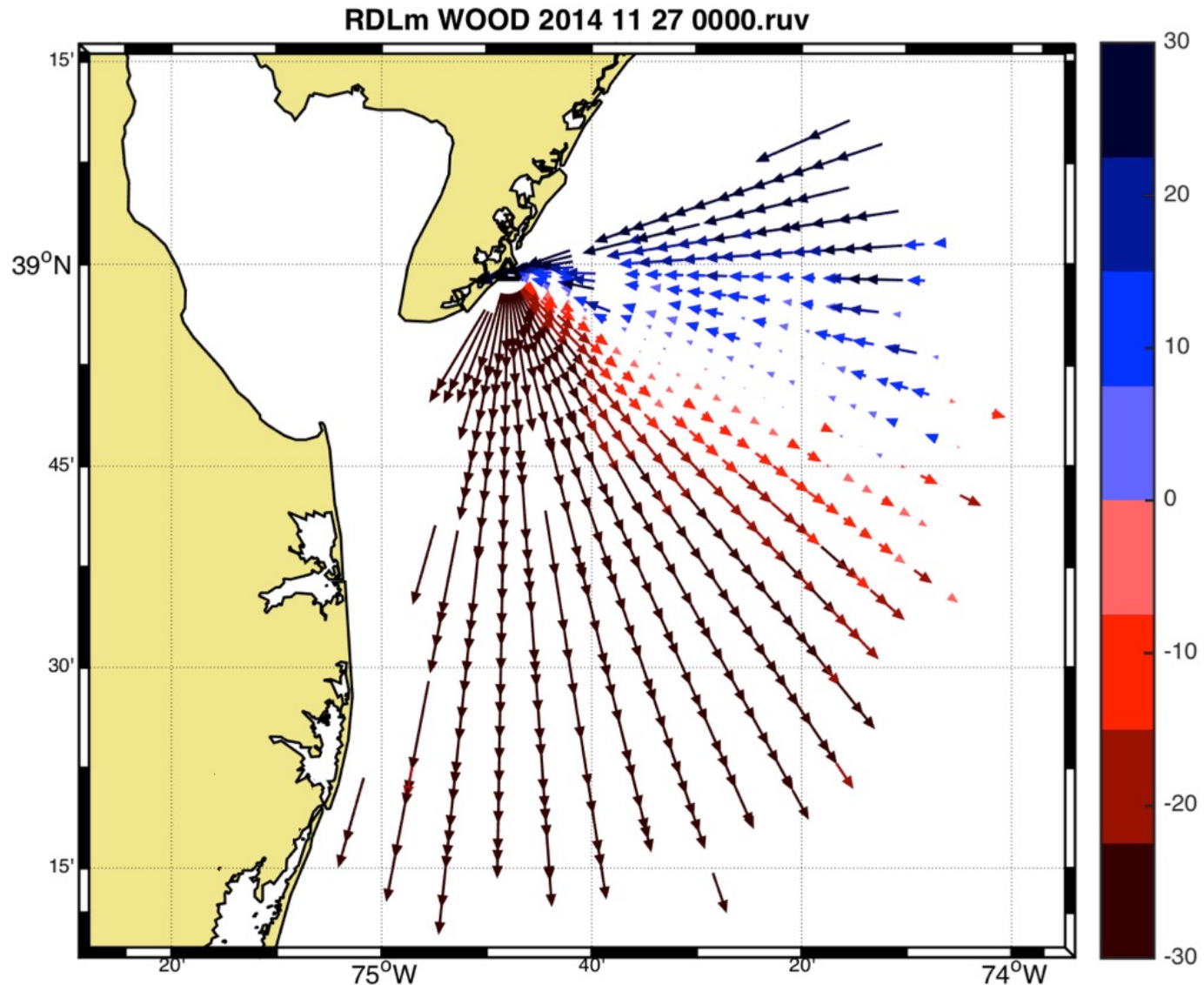
Doppler Spectra From the Radar



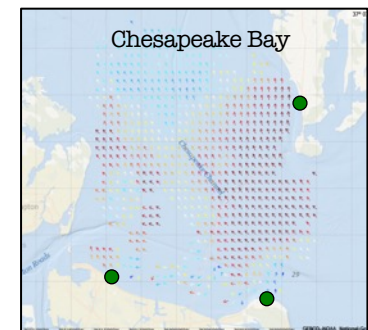
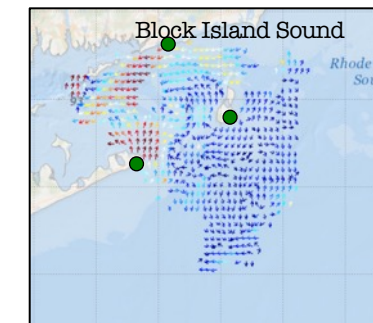
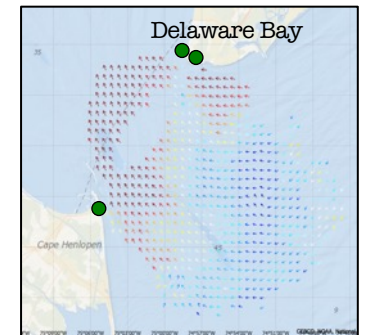
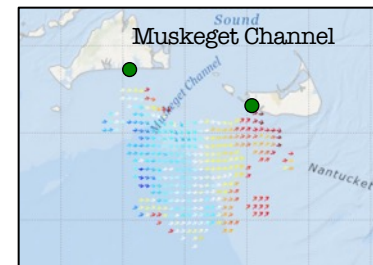
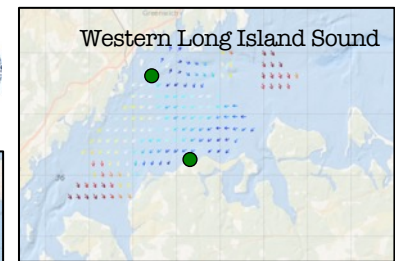
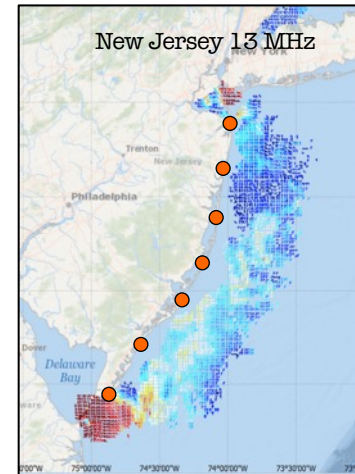
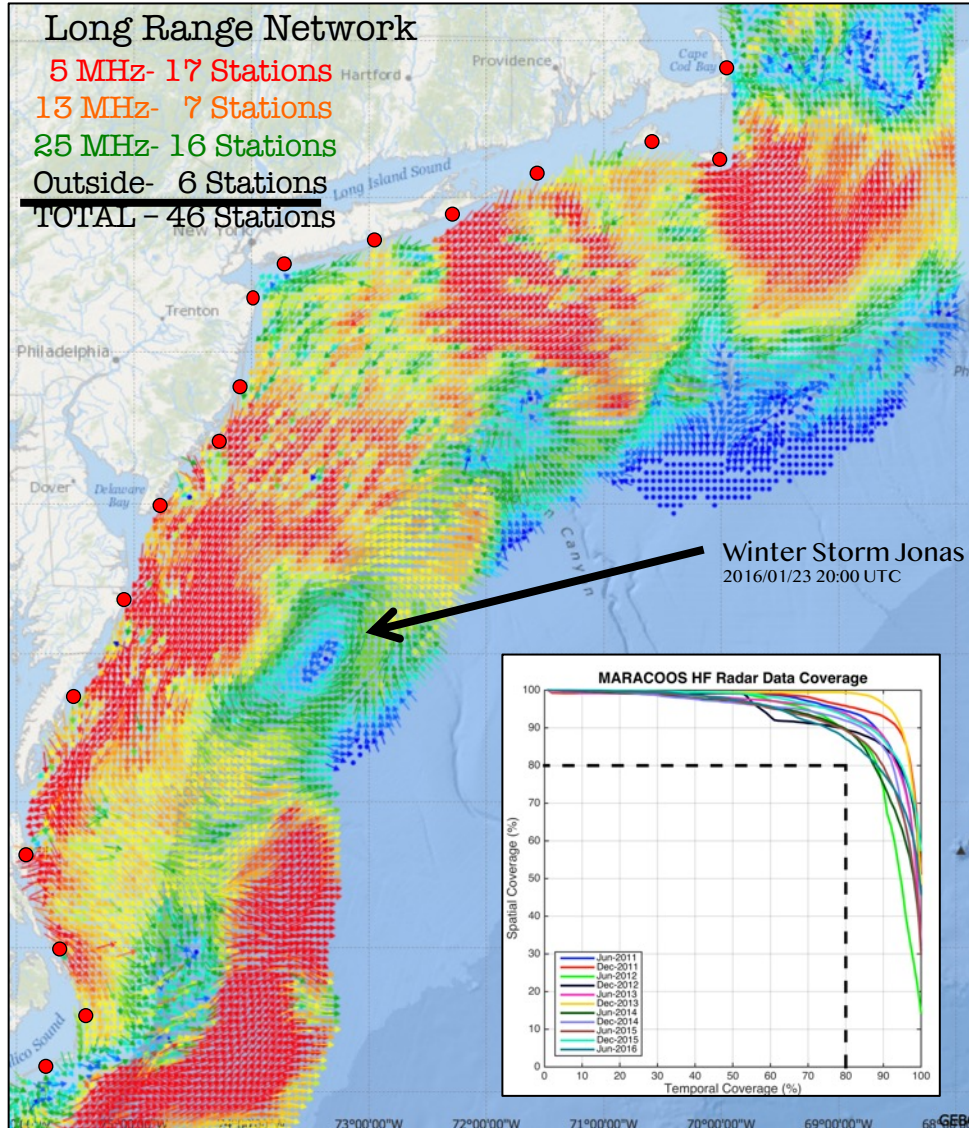
Doppler Spectra From the Radar



Radial Current Measurements from a Single Station



MARACOOS HF Radar Network



More
Information
On Use of
HFR
Currents

Watch these videos on  YouTube



HFR for Search and
Rescue (IOOS)

HFR Supporting Critical
Operations (IOOS)



Tour of Race Rocks
SeaSonde Site (ONC)

U.S. HF Radar Network

<https://ioos.noaa.gov/project/hf-radar/>

Google Earth

Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus



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IOOS-NWS Project to Evaluate HF Radar Derived Wave Data

Project Partners

Rutgers University

Dr. Hugh Roarty

HF Radar Network Coordinator



CODAR Ocean Sensors

Mr. Chad Whelan,

Chief Technology Officer



NWS WFO Mt. Holly

Mr. Alan Cope

Science and Operations Officer

Mr. Walt Drag,

Senior Meteorologist

IOOS

Dr. Jack Harlan,

HF Radar Project Manager



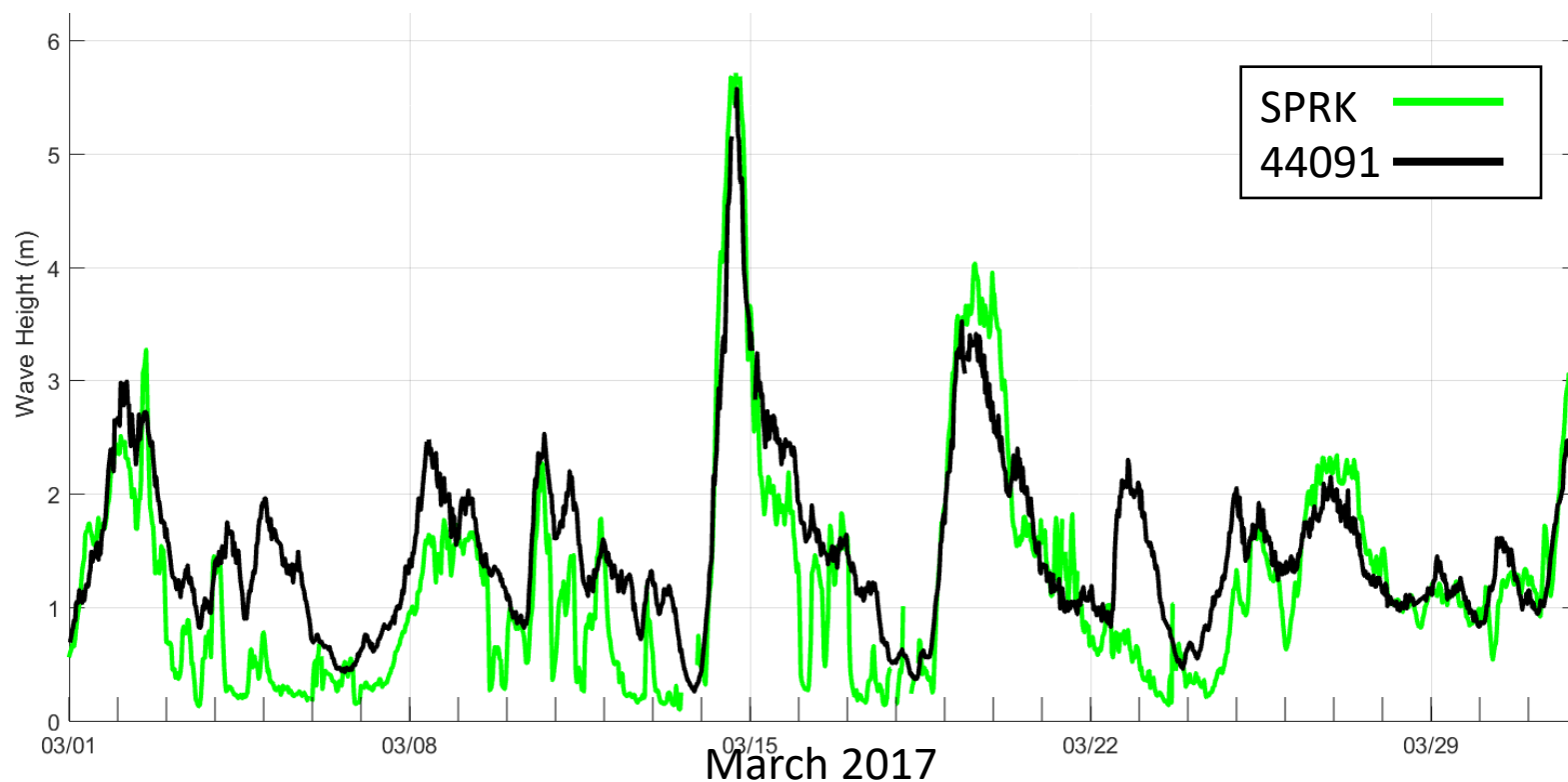
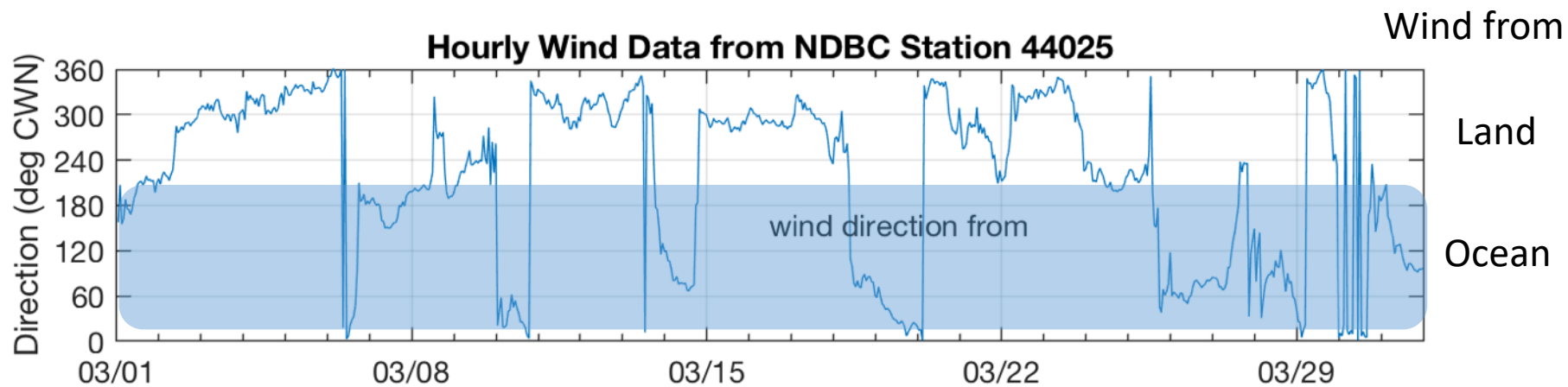
NWS Office of Science and Technology Integration

Mr. Dennis Atkinson

Meteorologist

The map displays the following airport codes by region:

- Northwest:** AFG, AFC, AJK, SEW, OTX, MSO, TFX, GGW, BIS, FGF, DLH, MQT, APX, GYX, BTX, ALY, BOX, BUF, BGM, OKX, PHI, CT, PBZ, LWX, AKQ, RAH, MEX, ILM, CAE, CHS, JAX, TAE, MOB, LIX, LCH, HGX, EWX, CRP, BRO.
- West:** EKA, MFR, BOI, PIH, RIW, CYS, LBF, OAX, DMX, DVN, LOT, IWX, CLE, ILN, RLX, JKL, MRX, OHX, HUN, BMX, FFC, TWC, EPZ, MAF, SJT, FWD, SHV, JAN, LUB, AMA, ABQ, FGZ, VEF, HNX, LOX, SGX, PSR, MTR, REV, LKN, SLC, GJT, BOU, GLD, TOP, EAX, LSX, PAH, MEG, LMK, JKL, MRX, OHX, HUN, BMX, FFC, TAE, MOB, LIX, LCH, HGX, EWX, CRP, BRO.
- Central:** PQR, PDT, BOI, PIH, RIW, CYS, LBF, OAX, DMX, DVN, LOT, IWX, CLE, ILN, RLX, JKL, MRX, OHX, HUN, BMX, FFC, TAE, MOB, LIX, LCH, HGX, EWX, CRP, BRO.
- South:** HFO, GUM, SJU, MFL, TBW, MLB, JAX, TAE, MOB, LIX, LCH, HGX, EWX, CRP, BRO.



Recommendations from

Atkinson, D., & Roarty, H. (2020). *Significant Wave Height Project - White Paper*. NOAA.

“the Significant Wave Height Project conclusion is a strong recommendation that the HF radar data be used for routine NWS operations”

“The Mt. Holly, San Juan, and Eureka WFOs concur on the significant value of the HF radar wave data”

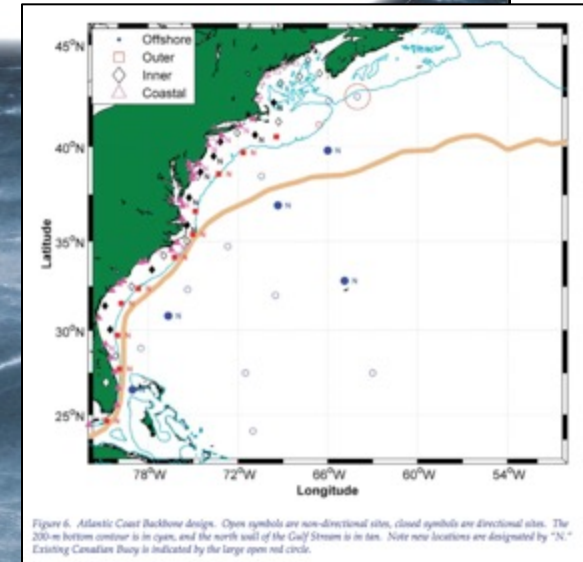
Impact

A National Operational Wave Observation Plan calls for 133 wave sensors in the Coastal Subnet while only 67 are currently deployed

Potential for some of the 160 HF Radars currently deployed to fill that gap

Surface gravity waves have a profound impact on navigation, offshore operations, safety and economic vitality of the nation's maritime and coastal communities

A National Operational Wave Observation Plan



An Integrated Ocean Observing System plan for a comprehensive, high quality surface-wave monitoring network for the United States, which addresses the requirements of the maritime user community.

Prepared for the Interagency Working Group on Ocean Observations

March 2009



US Army Corps of Engineers

HFR Wave Data Use by Weather Services

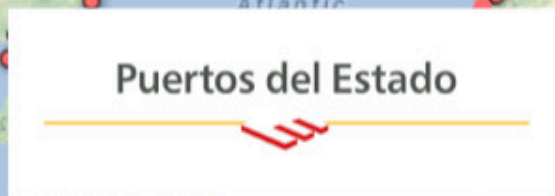


SeaSondes Worldwide



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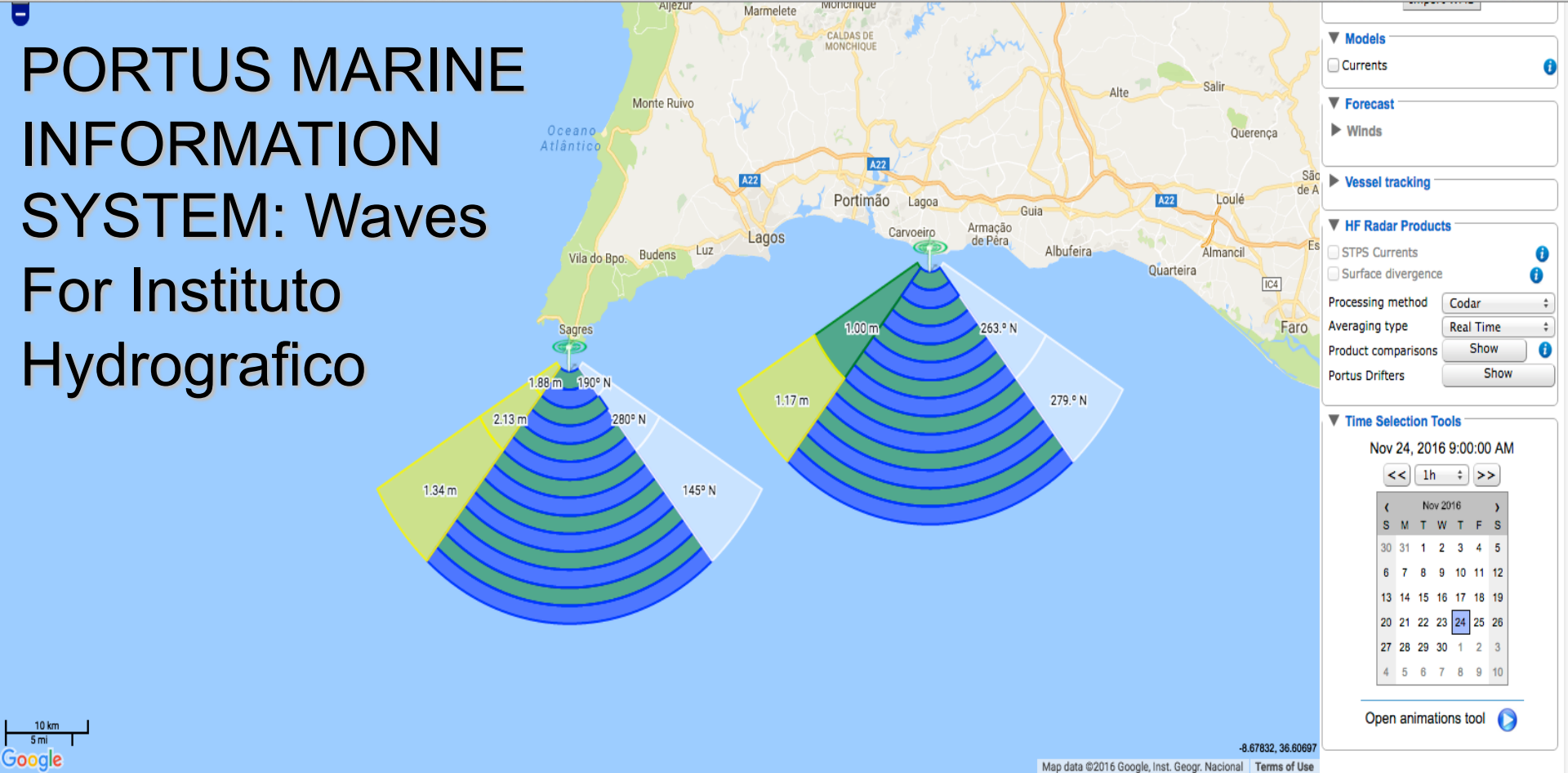




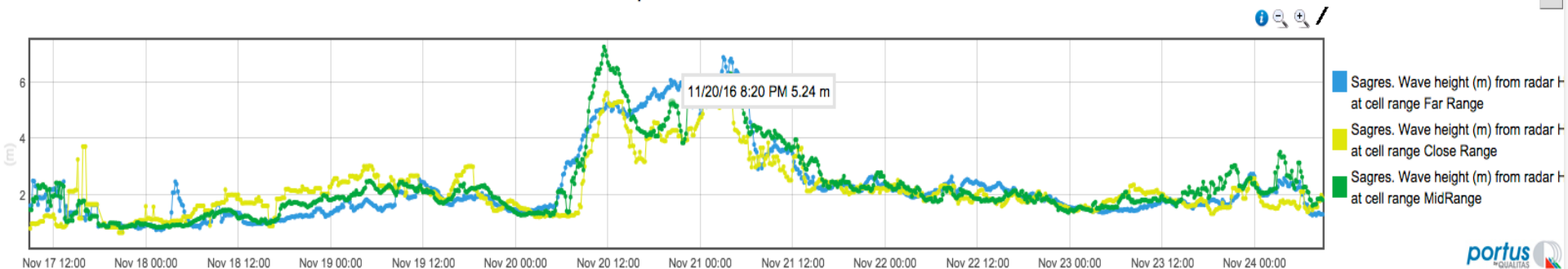
SeaSondes
Worldwide

Ocean/Met Agencies Using SeaSonde

PORTUS MARINE INFORMATION SYSTEM: Waves For Instituto Hydrografico



Comparison Plot



Wave Data Viewer



ERDDAP

Easier access to scientific data

English

Brought to you by NOAA NMFS SWFSC ERD

ERDDAP > List of All Datasets

12 matching datasets, listed in alphabetical order.

Grid DAP Data	Sub-set	Table DAP Data	Make A Graph	W M S	Source Data Files	Title	Summary	FGDC, ISO, Metadata	Back-ground Info	RSS	E mail	Institution	Dataset ID
	set	data	graph			* The List of All Active Datasets in this ERDDAP *	?	M	background			Rutgers Universit...	allDatasets
data			graph			bathymetry: GEBCO_2014 Grid	?	F I M	background	RSS		GEBCO, BODC .	bathymetry_gebco_2014_grid
	set	data	graph			Drifter Data - SLDMB - US Coast Guard	?	F I M	background	RSS		Rutgers Center fo...	uscg_slldb_drifters
data			graph	M		Palmer Deep Antarctica 0.5 km Sea Surface Currents	?	F I M	background	RSS		Center for Ocean ...	converge_reprocess
data			graph	M	files	Surface Currents - MARACOOS - 5MHz - Realtime with QARTOD radials	?	F I M	background	RSS		Center for Ocean ...	realtime_maracoos_6km_totals_qartod
data			graph	M	files	Surface Currents - MARACOOS - 5MHz - Realtime with raw radials							
data			graph	M		Surface Currents - SWARM - 25MHz - Reprocessed with QARTOD radials							
	set	data	graph		files	Wave Data - CODAR SeaSonde - 13MHz - Brant Beach, NJ							
	set	data	graph		files	Wave Data - CODAR SeaSonde - 13MHz - Brigantine, NJ							
	set	data	graph		files	Wave Data - CODAR SeaSonde - 13MHz - Cape May Point, NJ							
	set	data	graph		files	Wave Data - CODAR SeaSonde - 13MHz - Sea Bright, NJ							
	set	data	graph		files	Wave Data - CODAR SeaSonde - 13MHz - Seaside Park, NJ							

The information in the table above is also available in other file formats (.csv, .htmlTable, .itx, .json, .jsonCSV1, .jsonCSV, .jsonKVP, .mat, .nc, .nccsv, .tsv, .xhtml) [via a RESTful web service](#).

ERDDAP, Version 2.17

[Disclaimers](#) | [Privacy Policy](#) | [Contact](#)

ERDDAP
Easier access to scientific data

ERDDAP > tabledap > Make A Graph

Dataset Title: **Wave Data - CODAR SeaSonde - 13MHz - Seaside Park, NJ** [RSS](#)

Institution: Center for Ocean Observing and Leadership, Department of Marine & Coastal Sciences, Rutgers University (Dataset ID: realtime_waves_13mhz_sprk)

Range: longitude = -74.07255 to -74.07255°E, latitude = 39.9325 to 39.9325°N, time = 2017-06-07T15:00:00Z to 2022-05-06T16:00:00Z

Information: [Summary](#) | [License](#) | [FGDC](#) | [ISO 19115](#) | [Metadata](#) | [Background](#) | [Subset](#) | [Data Access Form](#) | [Files](#)

Graph Type: [markers](#)

X Axis: [time](#)

Y Axis: [wave_height](#)

Color: [wave_period](#)

Constraints

time: >= 2022-04-14T00:00:00Z <= 2022-04-21T00:00:00Z

Optional Constraint #1

>= <=

Optional Constraint #2

<= >=

Server-side Functions

distinct()

Graph Settings

Marker Type: [Filled Square](#) Size: [5](#)

Color: [Color Bar](#)

Continuity: [Scale](#)

Minimum: [Maximum](#)

Y Axis Minimum: [Maximum](#)

Redraw the Graph (Changes to dataset may take a while to get the data.)

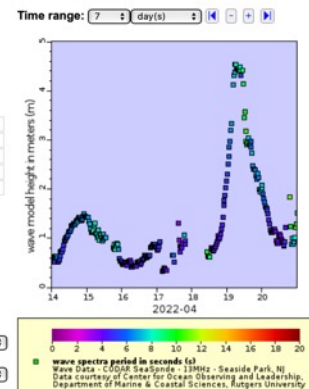
Optional: [Download the Data or an Image](#)

Then set the File Type: [.htmlTable](#) (File Type information)

and: [Download the Data or an Image](#)

or view the URL: http://hfr.marine.rutgers.edu/erddap/tabledap/realtime_waves_13mhz_sprk.html

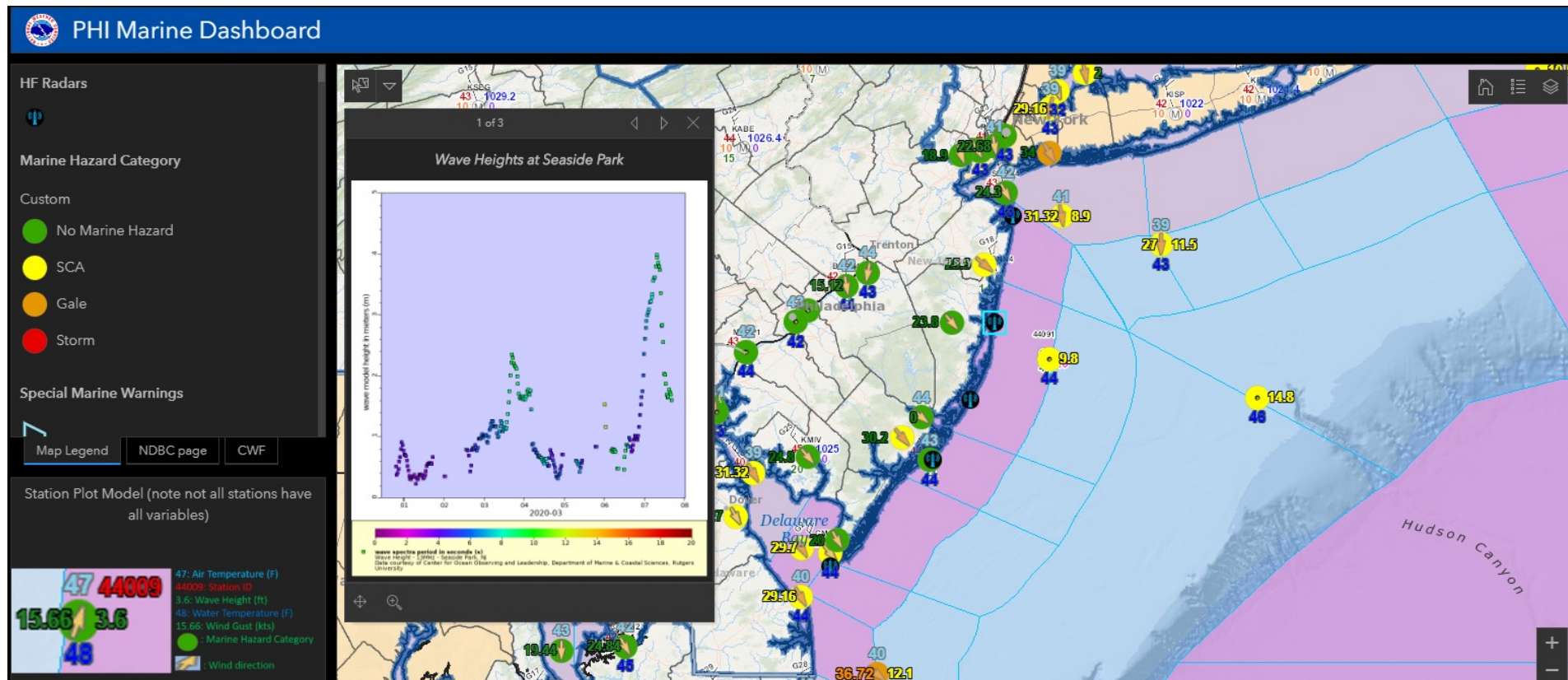
(Documentation / Bypass this form)



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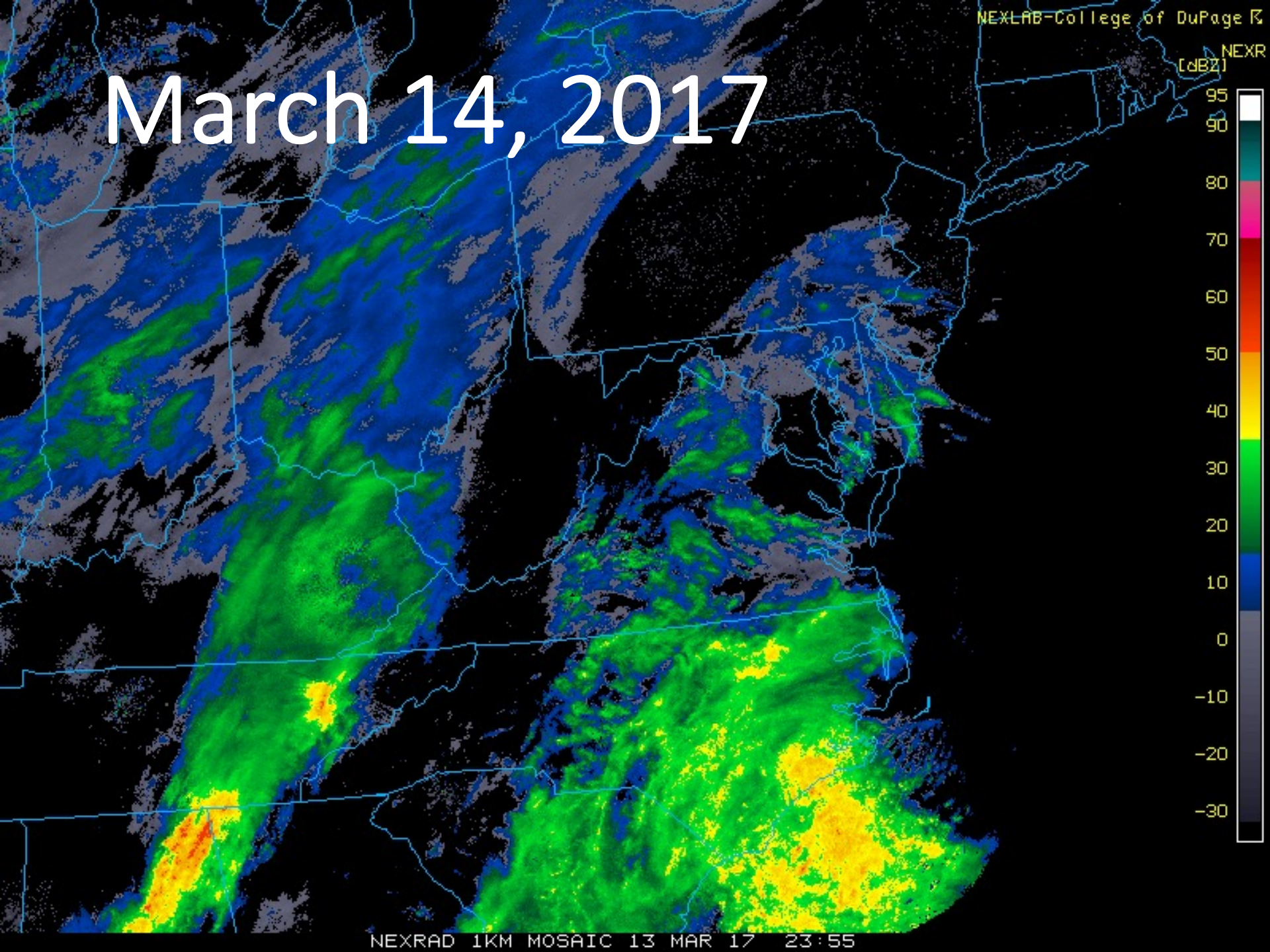


PHI Marine Dashboard



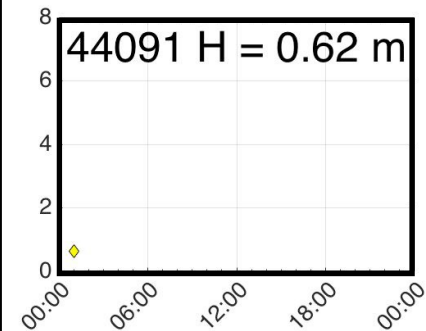
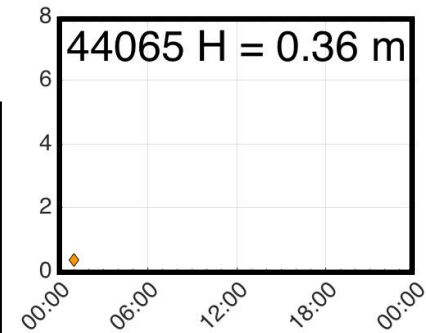
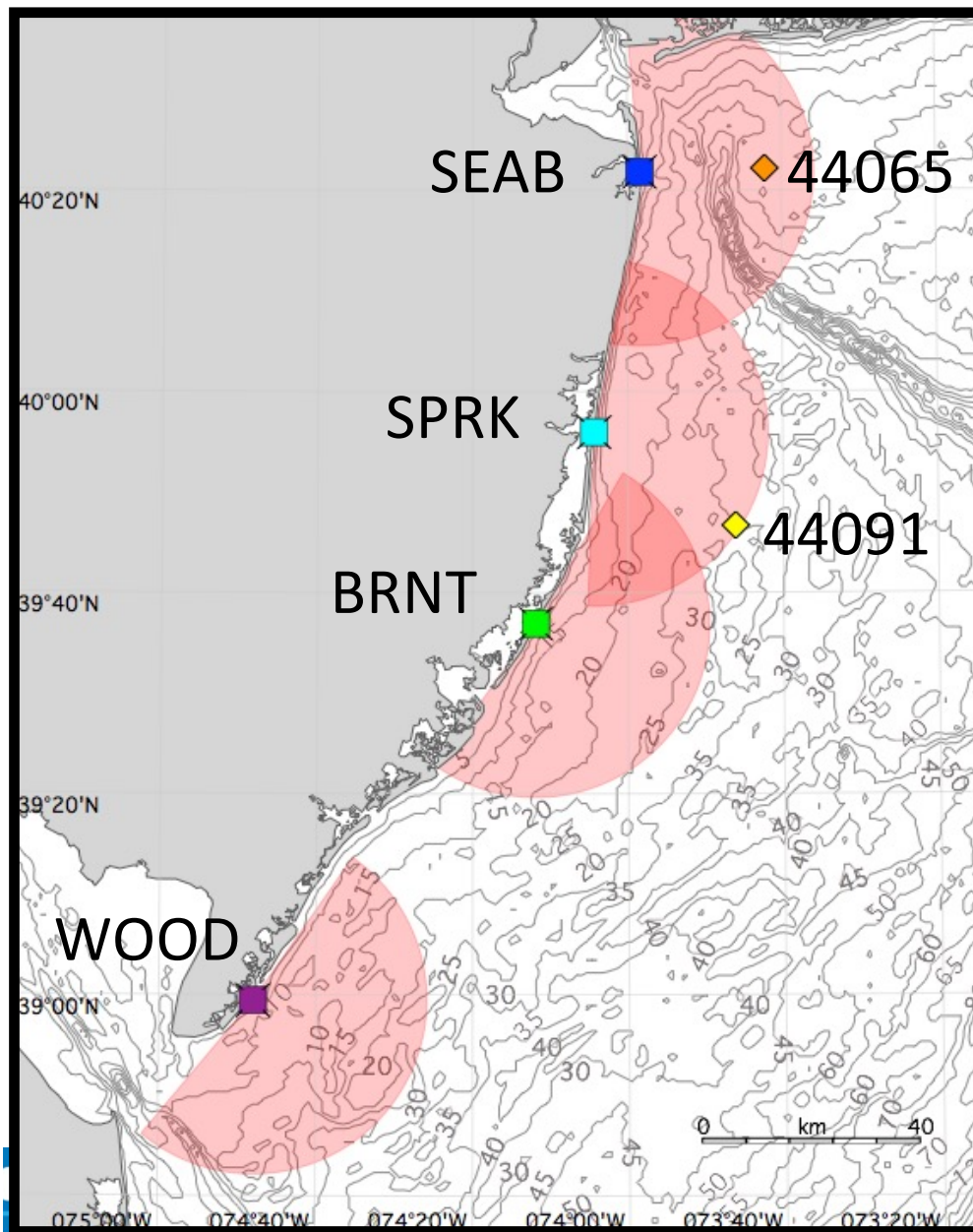
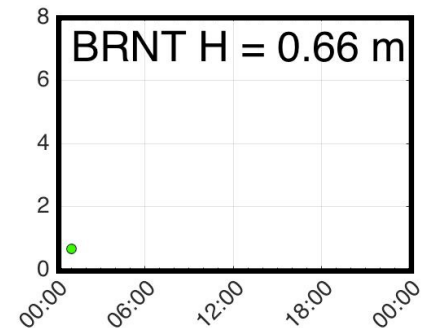
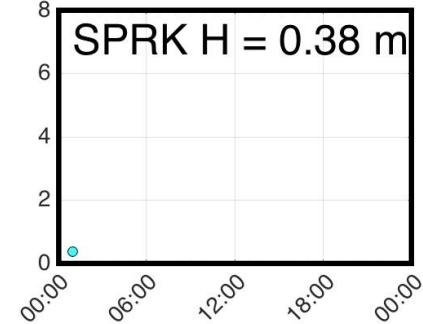
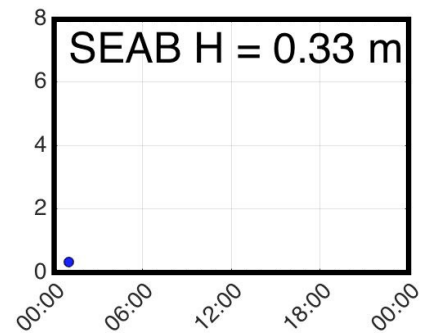
Individual Cases of HFR Wave Data

March 14, 2017



Significant Wave Height (m) Versus Time

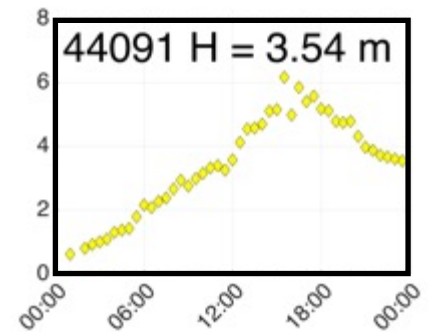
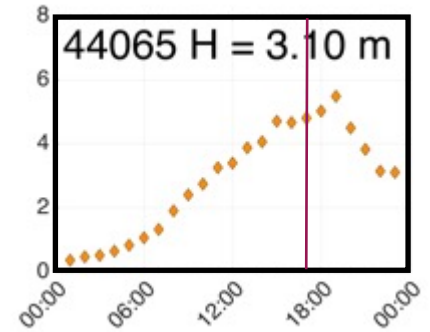
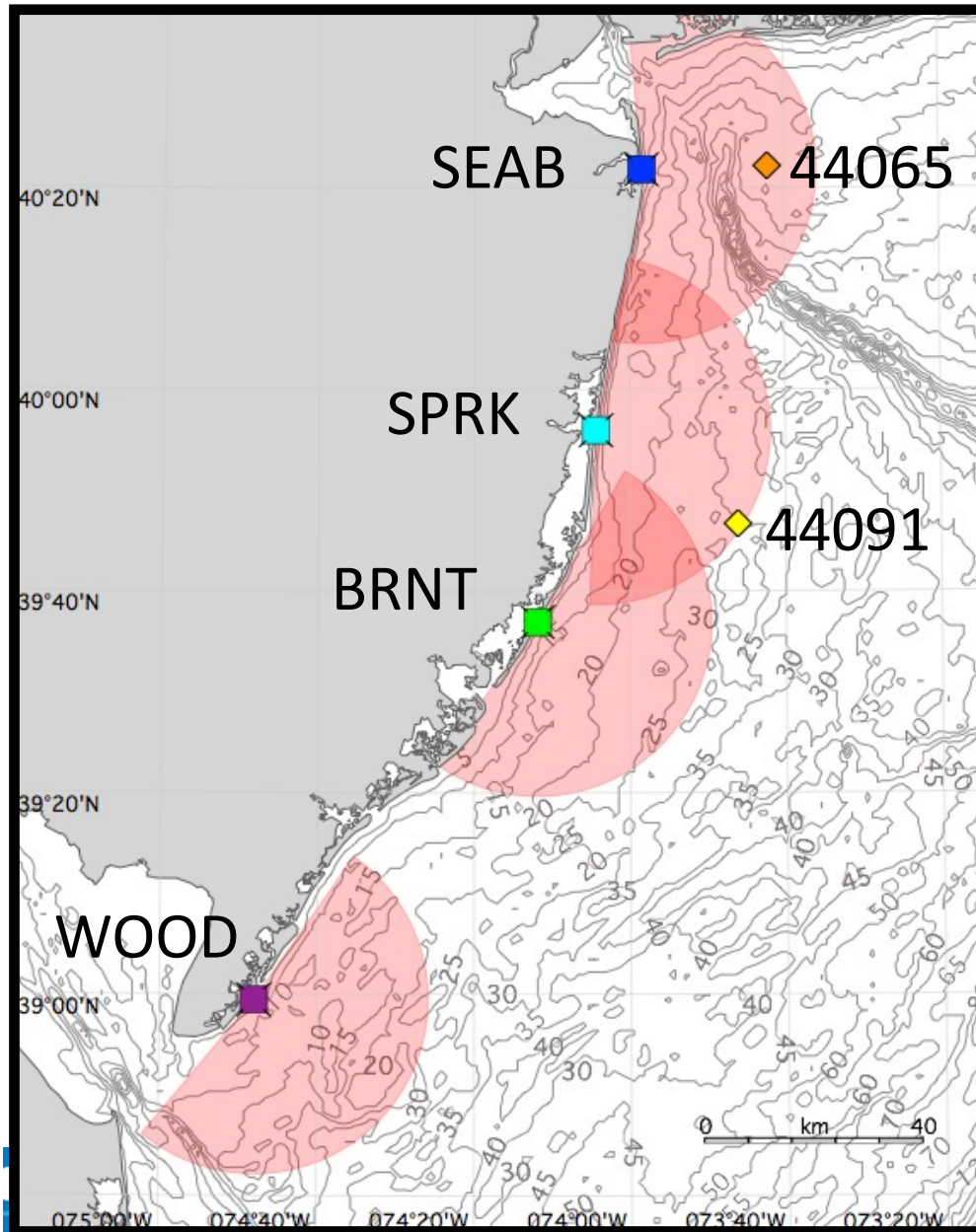
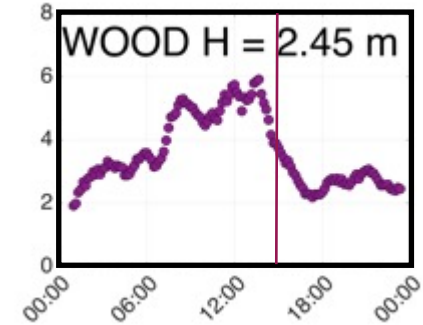
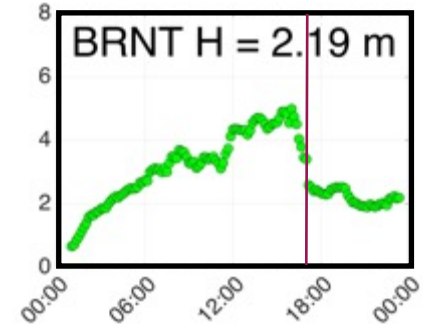
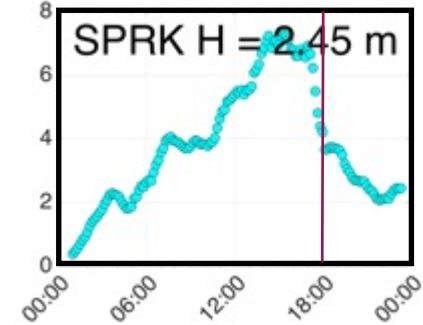
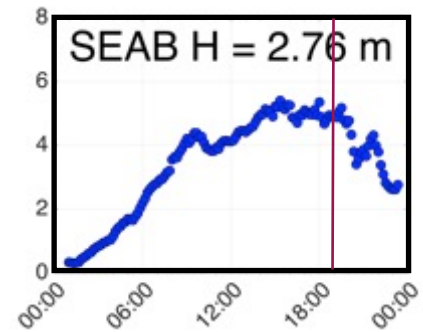
Landward Winds For First Half+ of March 14, 2017



- Significant wave height data are displayed for RC10 (left panel) and for buoys (right panel). SeaSonde dt=10 min, 44065 dt=60 min, 44091 dt=30 min.
- Winds are landward for the first part of this event.

Significant Wave Height (m) Versus Time

Landward Winds For First Half+ of March 14, 2017

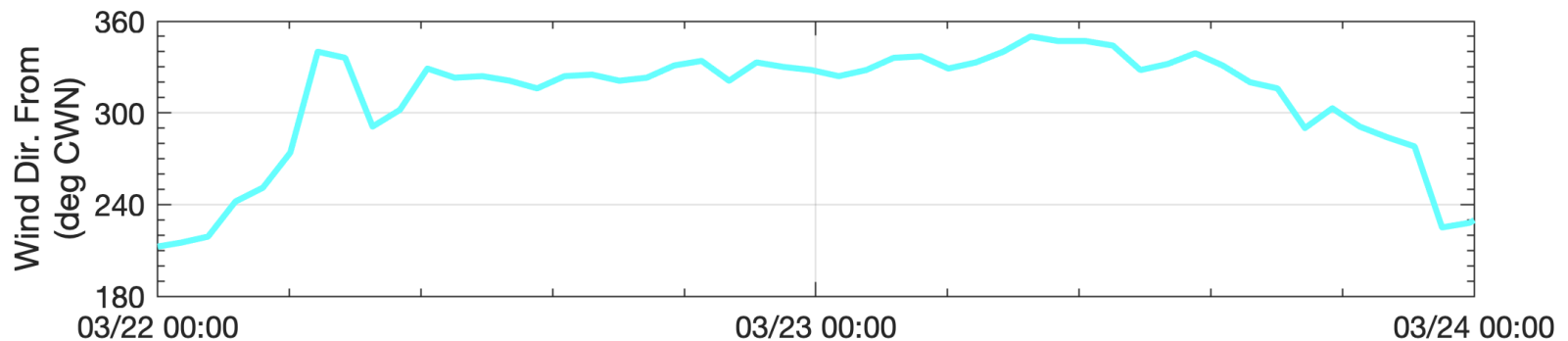
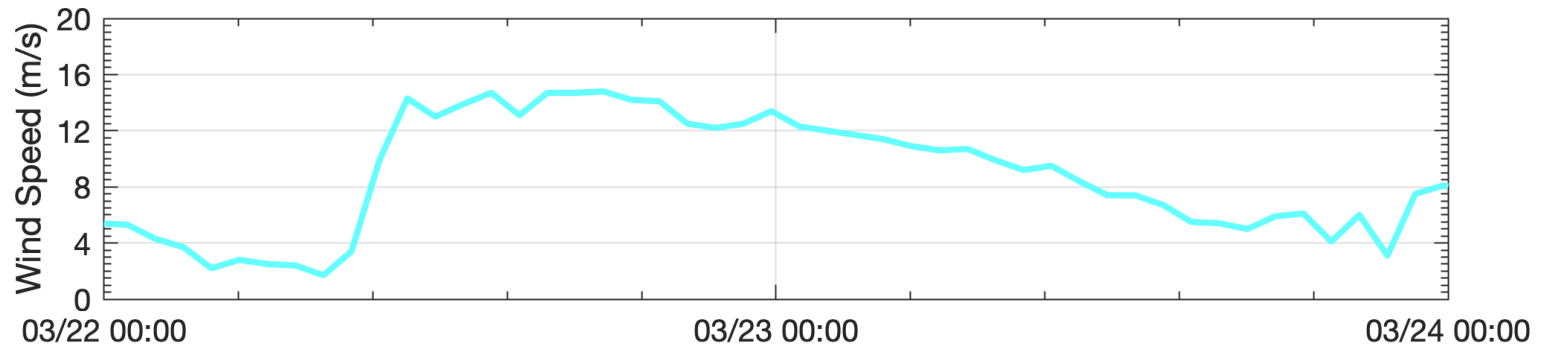
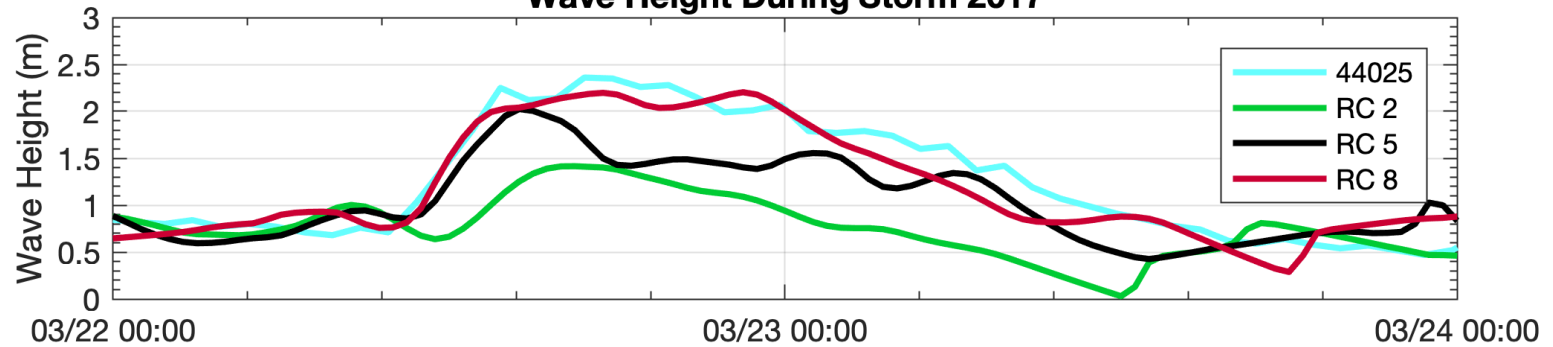


Winds become seaward at the times listed below, shown in time series plots with vertical lines. The first transition occurs at WOOD and progresses northward:

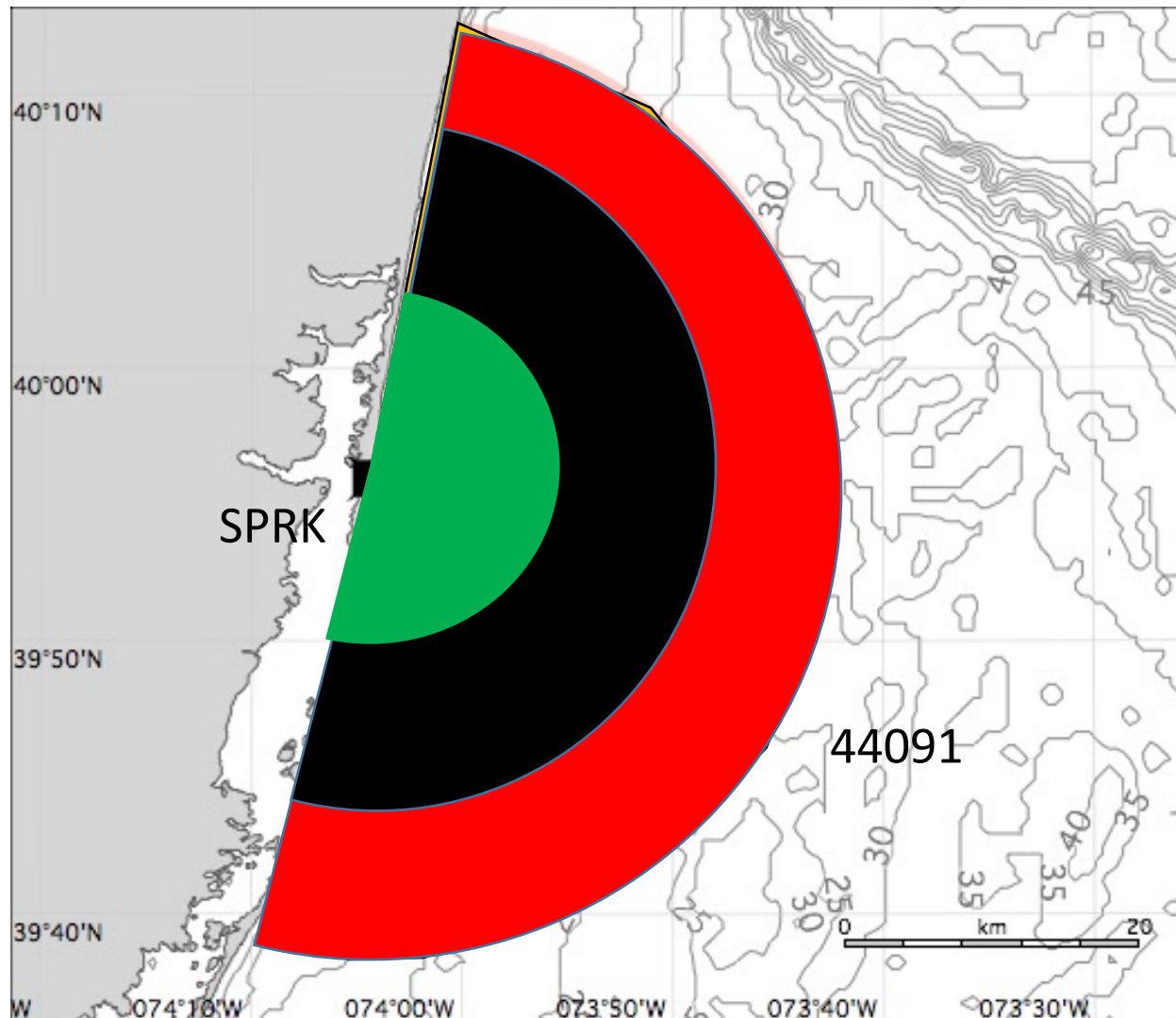
- SEAB (19:00)
- SPRK (18:00)
- 44065 (17:00 / 18:00)
- BRNT (17:00)
- WOOD (14:00)

March 2018

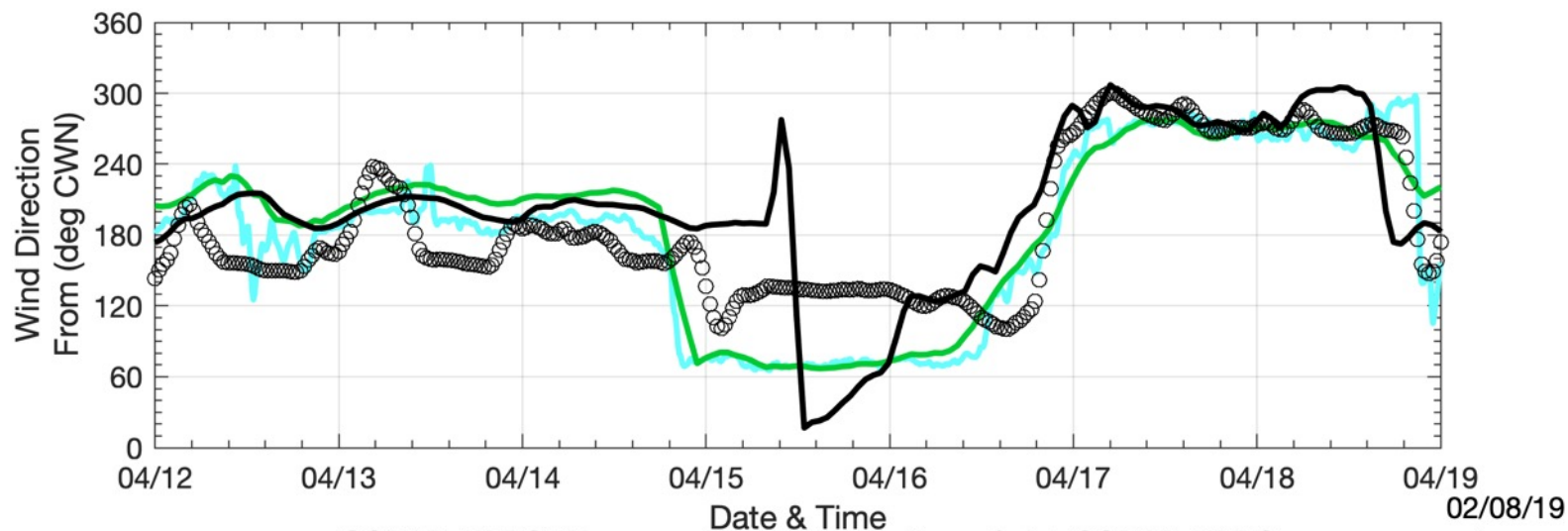
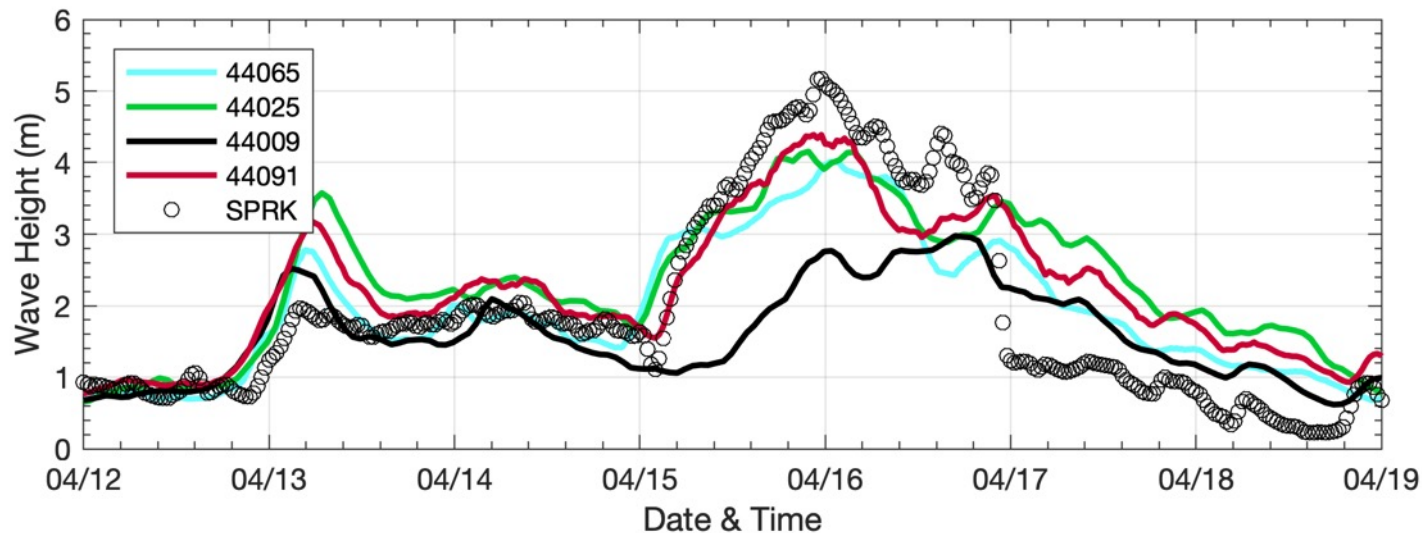
Wave Height During Storm 2017



SeaSonde Wave Measurement



April 2018

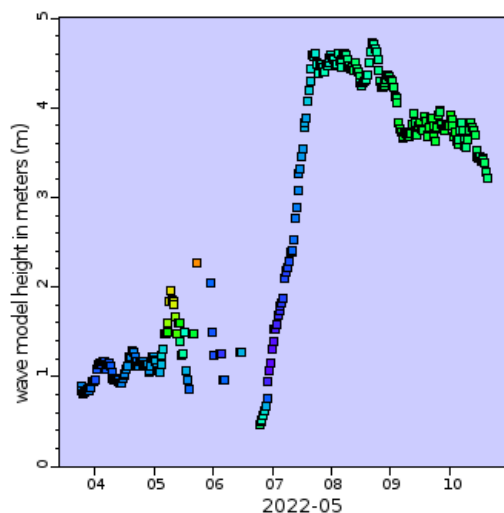


CODAR_NDBC_Waves_multiple_2018_April.png / plot_CODAR_NDBC_wave_comparison.m

Mothers' Day Nor'easter

data  

Seaside Park, NJ Wave Measurements

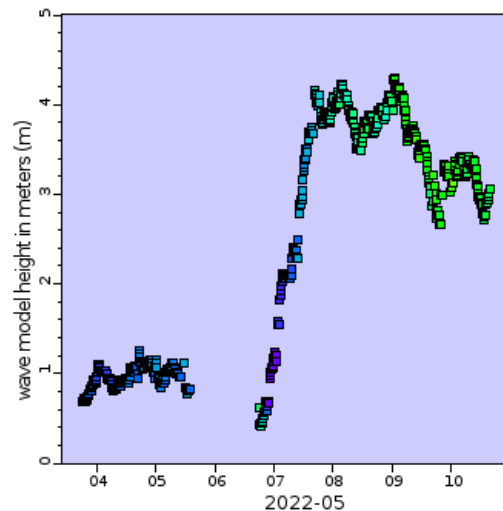


■ wave spectra period in seconds (s)
Wave Data - CODAR SeaSonde - 13MHz - Seaside Park, NJ
Data courtesy of Center for Ocean Observing and Leadership,
Department of Marine & Coastal Sciences, Rutgers University

<http://hfr.marine.rutgers.edu/erddap/tabledap/realtime>

data  

Brant Beach, NJ Wave Measurements

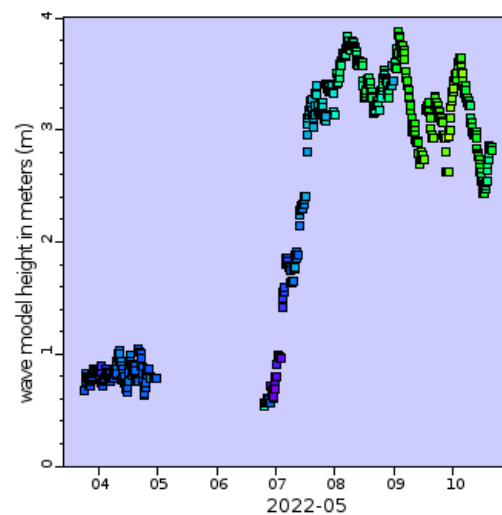


■ wave spectra period in seconds (s)
Wave Data - CODAR SeaSonde - 13MHz - Brant Beach, NJ
Data courtesy of Center for Ocean Observing and Leadership,
Department of Marine & Coastal Sciences, Rutgers University

<http://hfr.marine.rutgers.edu/erddap/tabledap/realtime>

data  

Brigantine, NJ Wave Measurements



■ wave spectra period in seconds (s)
Wave Data - CODAR SeaSonde - 13MHz - Brigantine, NJ
Data courtesy of Center for Ocean Observing and Leadership,
Department of Marine & Coastal Sciences, Rutgers University

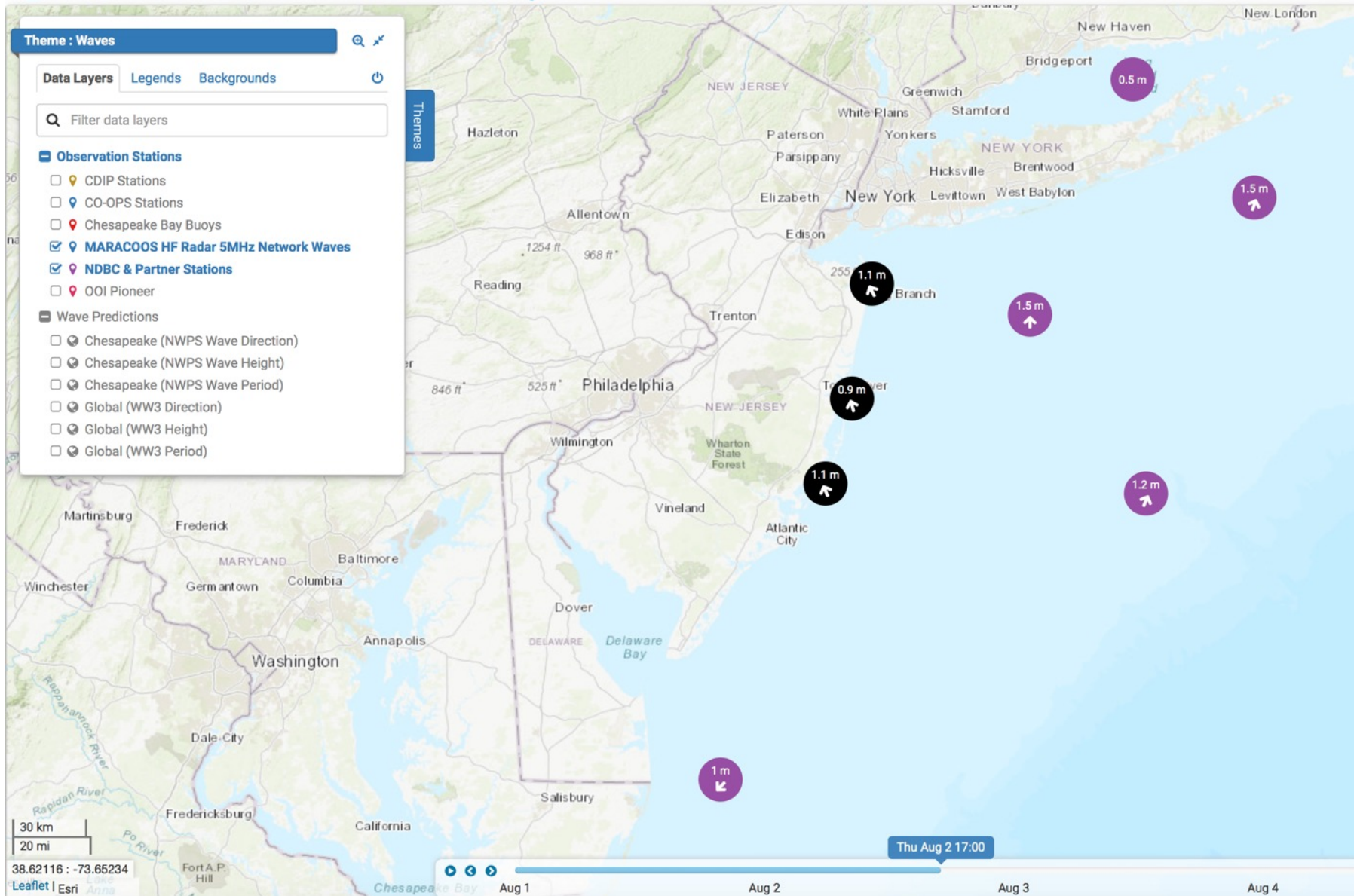
<http://hfr.marine.rutgers.edu/erddap/tabledap/realtime>

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THANK YOU





Comparison of CODAR SeaSonde HF Radar operational waves and currents measurements with Puertos del Estado buoys. Final report.

Marta Alfonso, Enrique Álvarez and José Damián López.
Puertos del Estado.

March 2006.

SILLEIRO scatter plot. Waves - sig. wave heig

Period: 20051119 - 20060223

X axis: Hm0 (m) Sil Int Buoy

Corr. Index: 0.94

Y axis: Hm0 (m) Radar sec.: 01

Dispersion: 0.50

Reg. Line: $H_{\text{Radar}} = 0.24 + 1.23 H_{\text{Buoy}}$

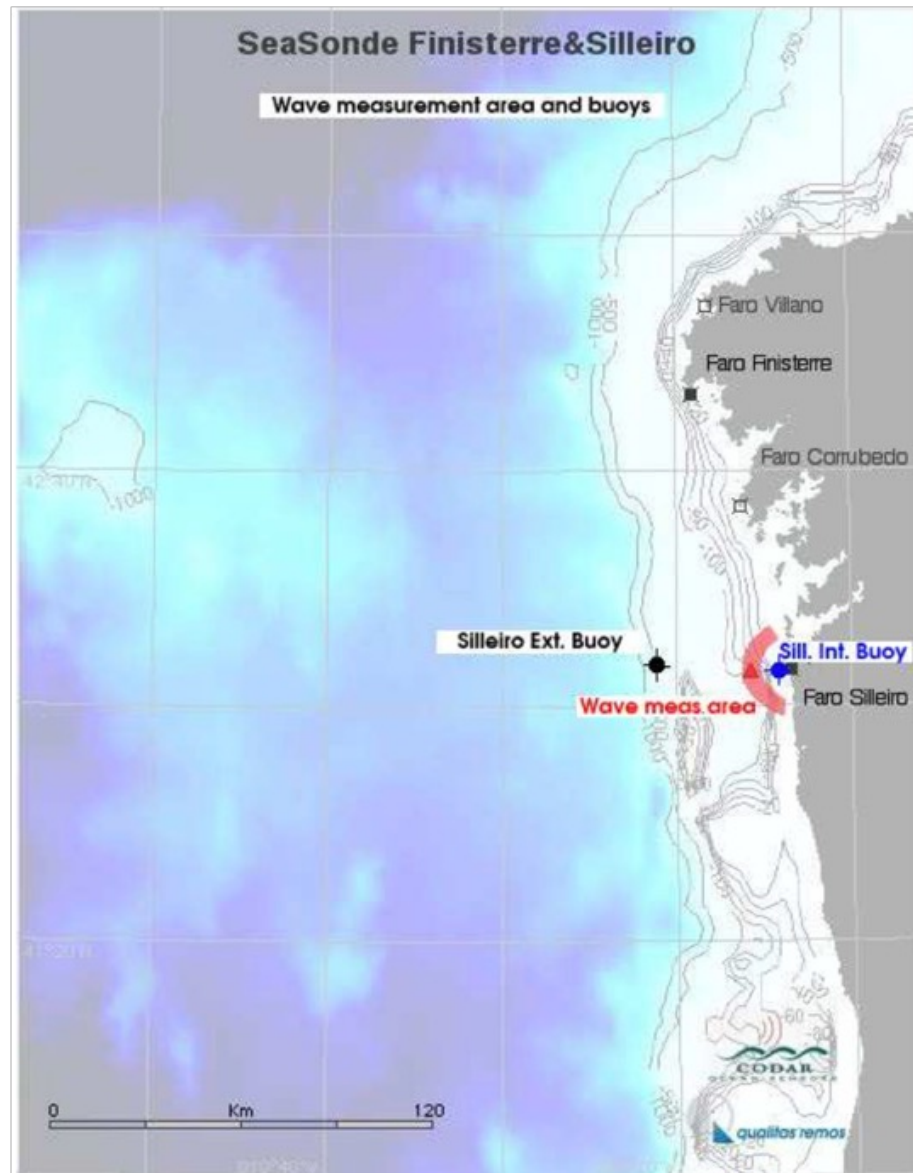
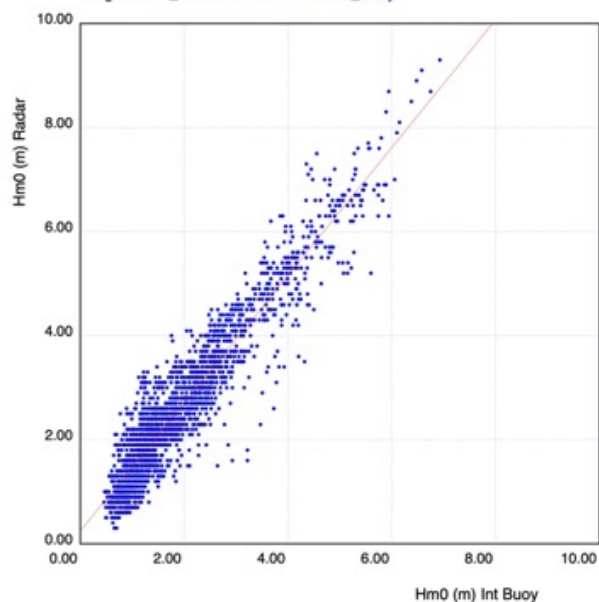


Figure 2. Location of buoys and waves measurement area.