Ocean Sized Data

Wave, Current, Temperature, Salinity, and Acoustic Observations Collected at the Coastal Studies Institute

Coastal Studies Institute
A Multi-Institutional Research Partnership

UNC Coastal Studies Institute
https://www.coastalstudiesinstitute.org/

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Overview

- Introduction: NC Oceanography and Observations
- Motivation for Observations
- Long Term Observations
- Challenge, Questions, and Discussion

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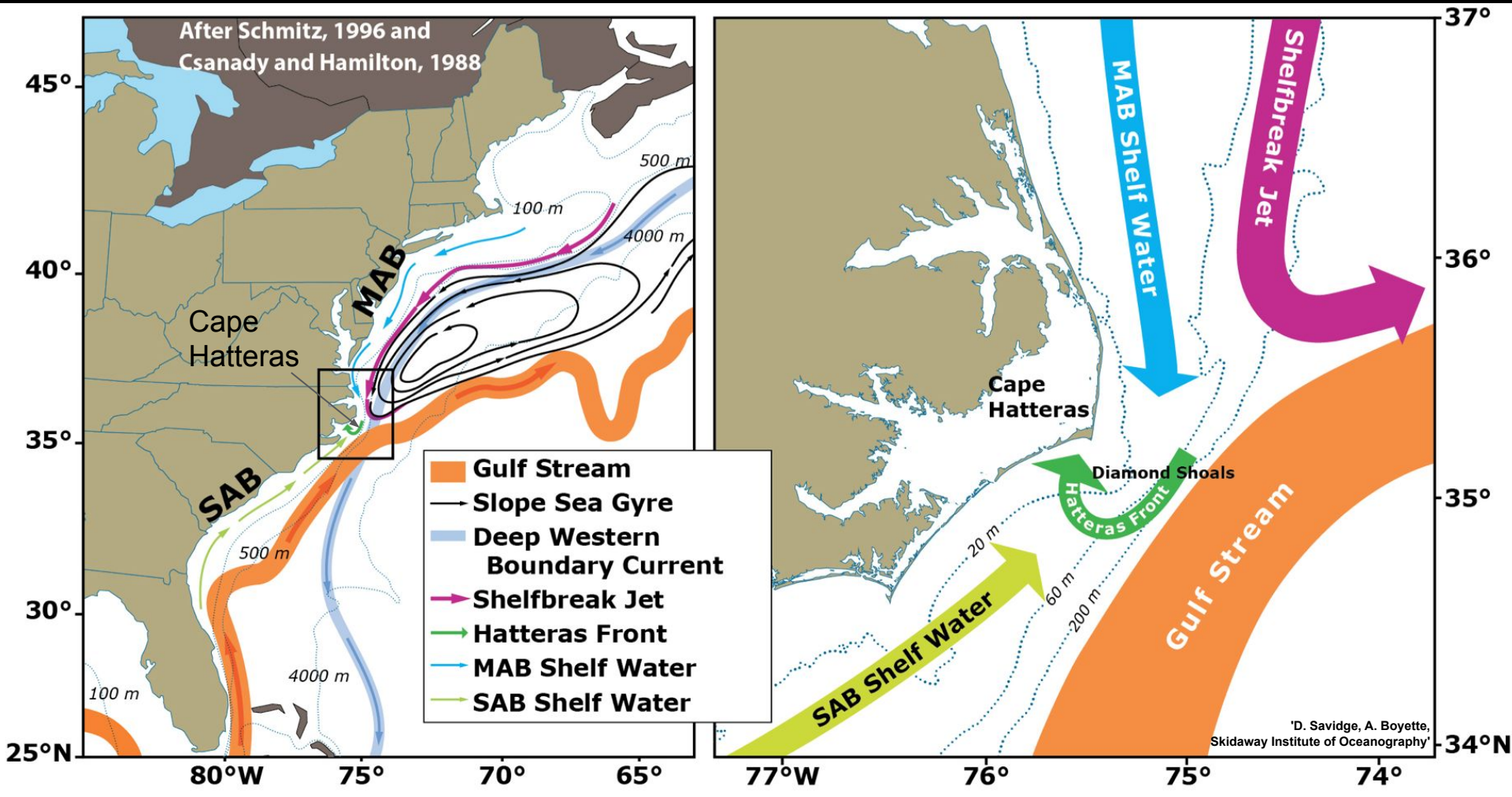
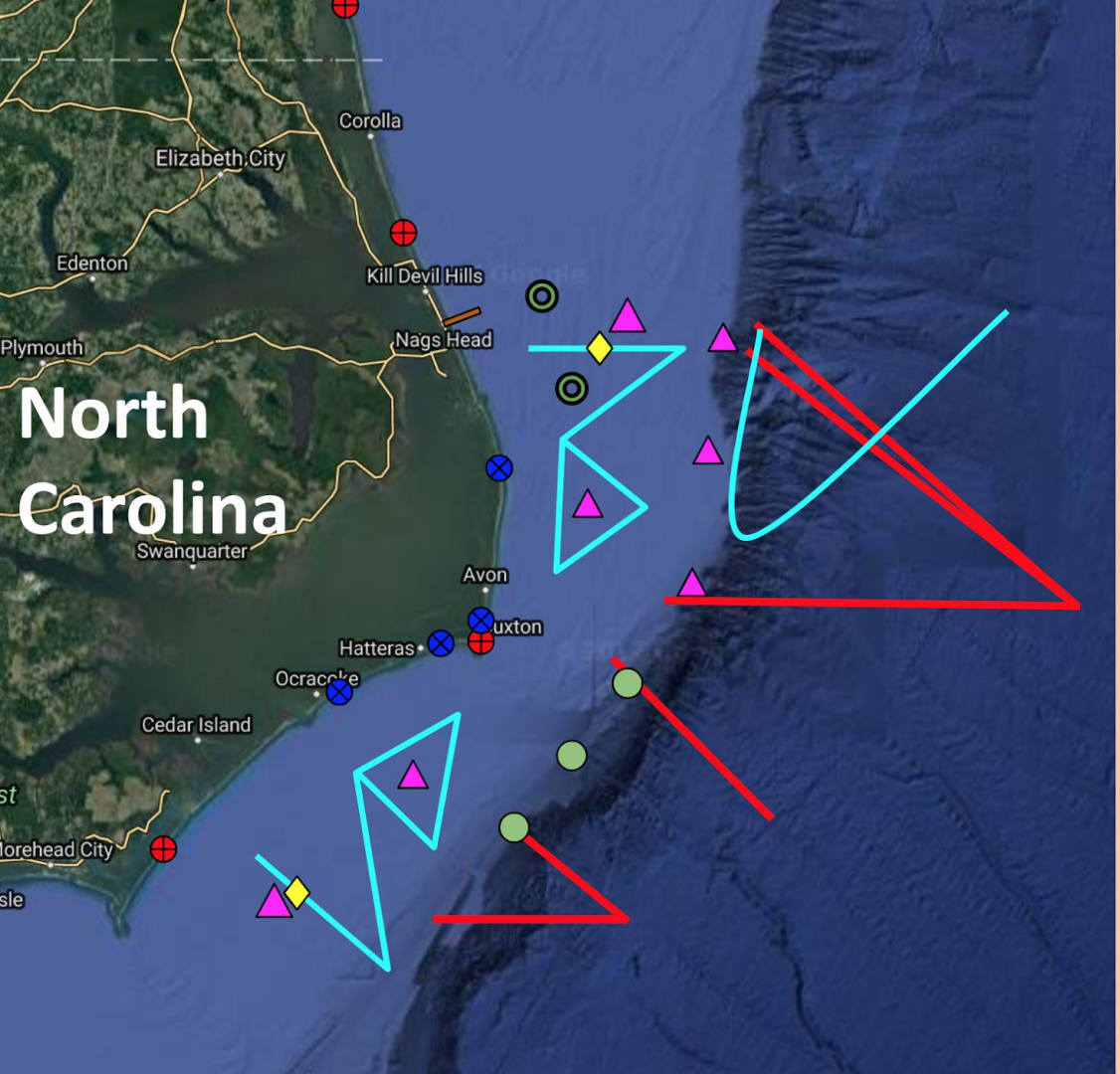

After Schmitz, 1996 and
Csanady and Hamilton, 1988
Cape
Hatteras
MAB
SAB
500 m
100 m
4000 m
Gulf Stream
Slope Sea Gyre
Deep Western
Boundary Current
Shelfbreak Jet
Hatteras Front
MAB Shelf Water
SAB Shelf Water
45°
40°
35°
30°
25°N
80°W
75°
70°
65°
MAB Shelf Water
Shelfbreak Jet
Cape
Hatteras
Diamond Shoals
Hatteras Front
20 m
60 m
200 m
Gulf Stream
SAB Shelf Water
'D. Savidge, A. Boyette,
Skidaway Institute of Oceanography'
37°
36°
35°
34°N
77°W
76°
75°
74°



Extensive Ocean Observations

- Jennette's Pier: Wave energy test site
- Waverider Buoy: Real time wave measurements
- CODAR HF Radar Site: Long distance ocean surface current measurements
- WERA HF Radar Site: High resolution ocean surface current measurements
- Moored 150 kHz ADCP: Long-term full water column ocean current measurements
- Moored 300 kHz ADCP: Long-term full water column ocean current measurements
- RV Neil Armstrong Transect: Benthic mapping, several ocean/atmospheric measurements
- METS Buoy
- Glider Path

Expanding Observing Capabilities

NC STATE UNIVERSITY

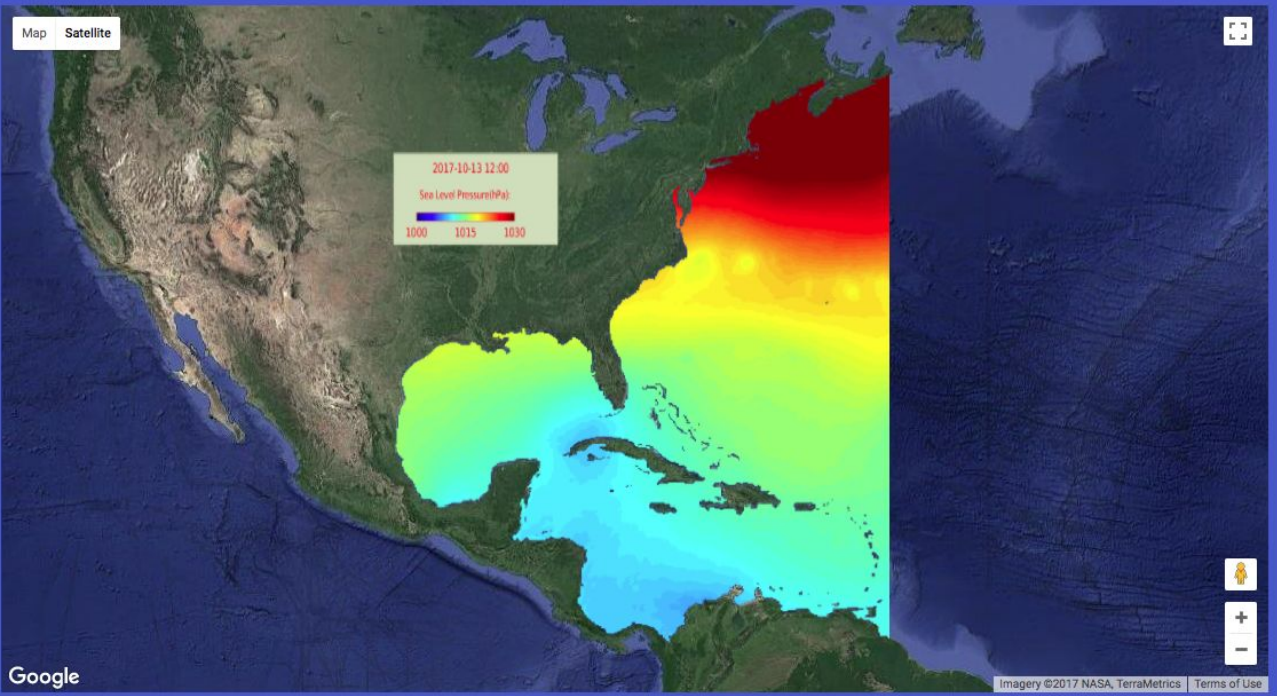
CNAPS

Coupled Northwest Atlantic Prediction System

NCSU: R. He group

- Ocean Weather
- Waves
- Circulation

CNAPS | Marine Weather | Ocean Waves | Ocean Circulation | Virtual Oceanographer | Model Validation | Methods



Options

Variable: Sea level Air Pressure

Date: 10/13/2017

Time: 12:00

Download data

Animation

Start Date: 10/13/2017

End Date: 10/13/2017

Start Animation | Stop Animation

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Motivations for our Ocean Observations

- Science: What are the ocean current and water mass exchange dynamics off North Carolina?

- Energy: How do we responsibly harvest Marine Hydrokinetic Energy (MHK) off NC?


PEACH PROJECT
Processes Driving Exchange at Cape Hatteras

Motivations for our Ocean Observations

- Science: What are the ocean current and water mass exchange dynamics off North Carolina?

- Energy: How do we responsibly harvest Marine Hydrokinetic Energy (MHK) off NC?


Studying the Gulf Stream
as an Energy Source

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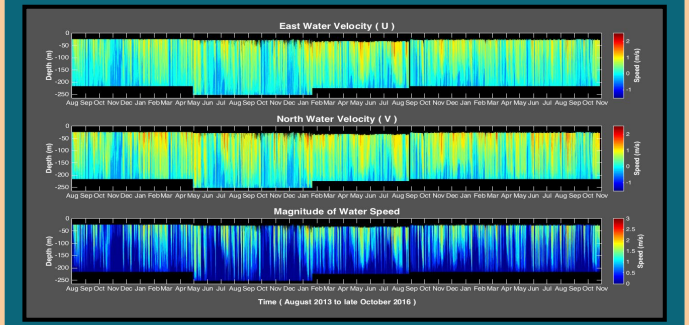
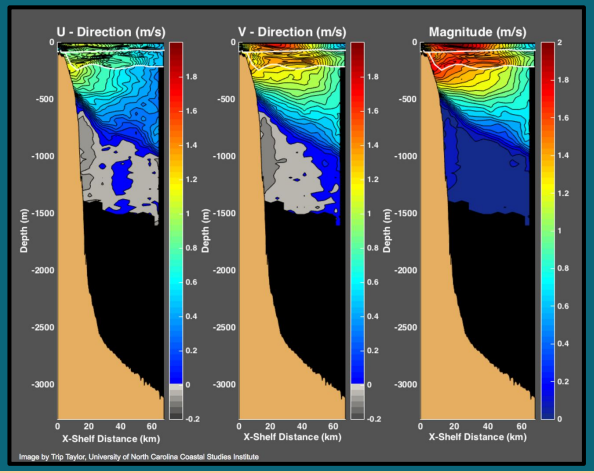
Notable Long Term Observations Collected

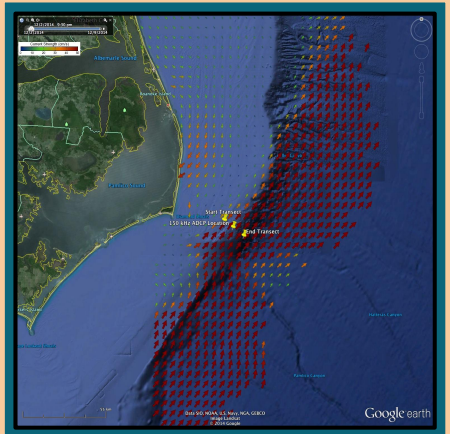
Moorings: 4 and 9 months of Gulf Stream currents over the entire water column, 3+ years of salinity and temp., 2+ years of passive acoustics



Buoys: 7+ years of wave spectra at 30m isobath, 2+ years of met, 1 year of water column temp. and salinity

Vessels: Multiple cross Gulf Stream current measurements to 1500m depths, CTD casts to 3000+ meters





Radars: 15+ years of ocean surface currents from CODAR direction finding radars

Jennette's Pier: 2 years of wave spectra at 11m isobath, 10 years of meteorological observations including wind speed and direction

Long Term Observations

- Waves
- HF Radar Ocean Surface Currents
- Moored Bottom Pod Measurements

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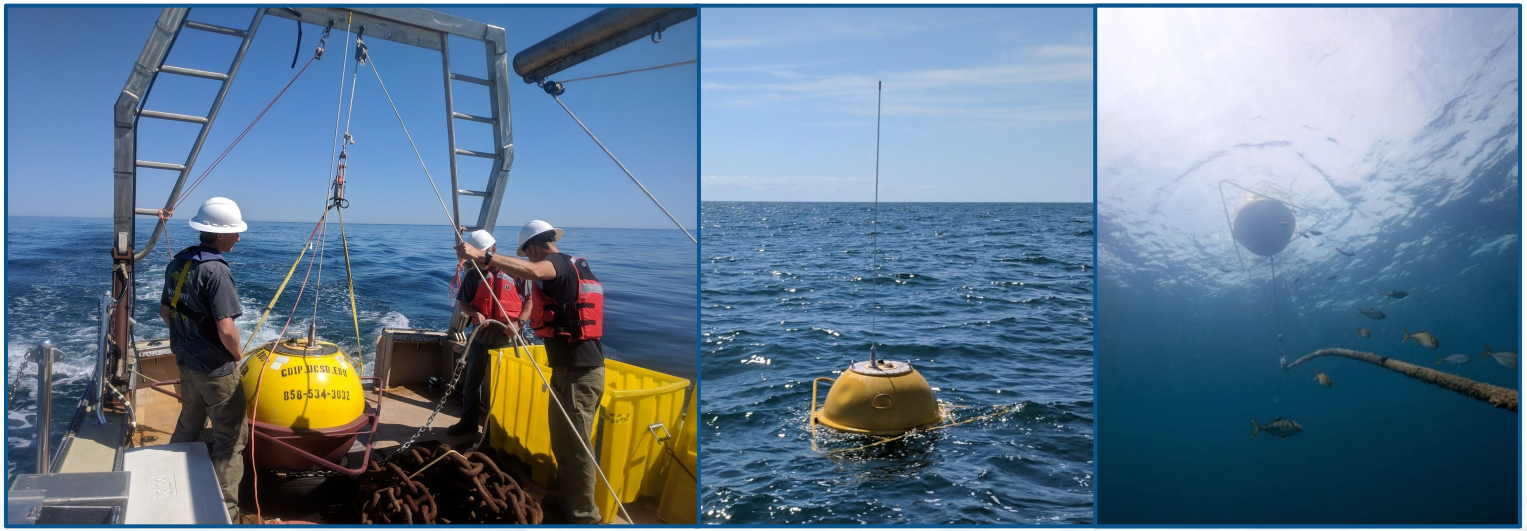
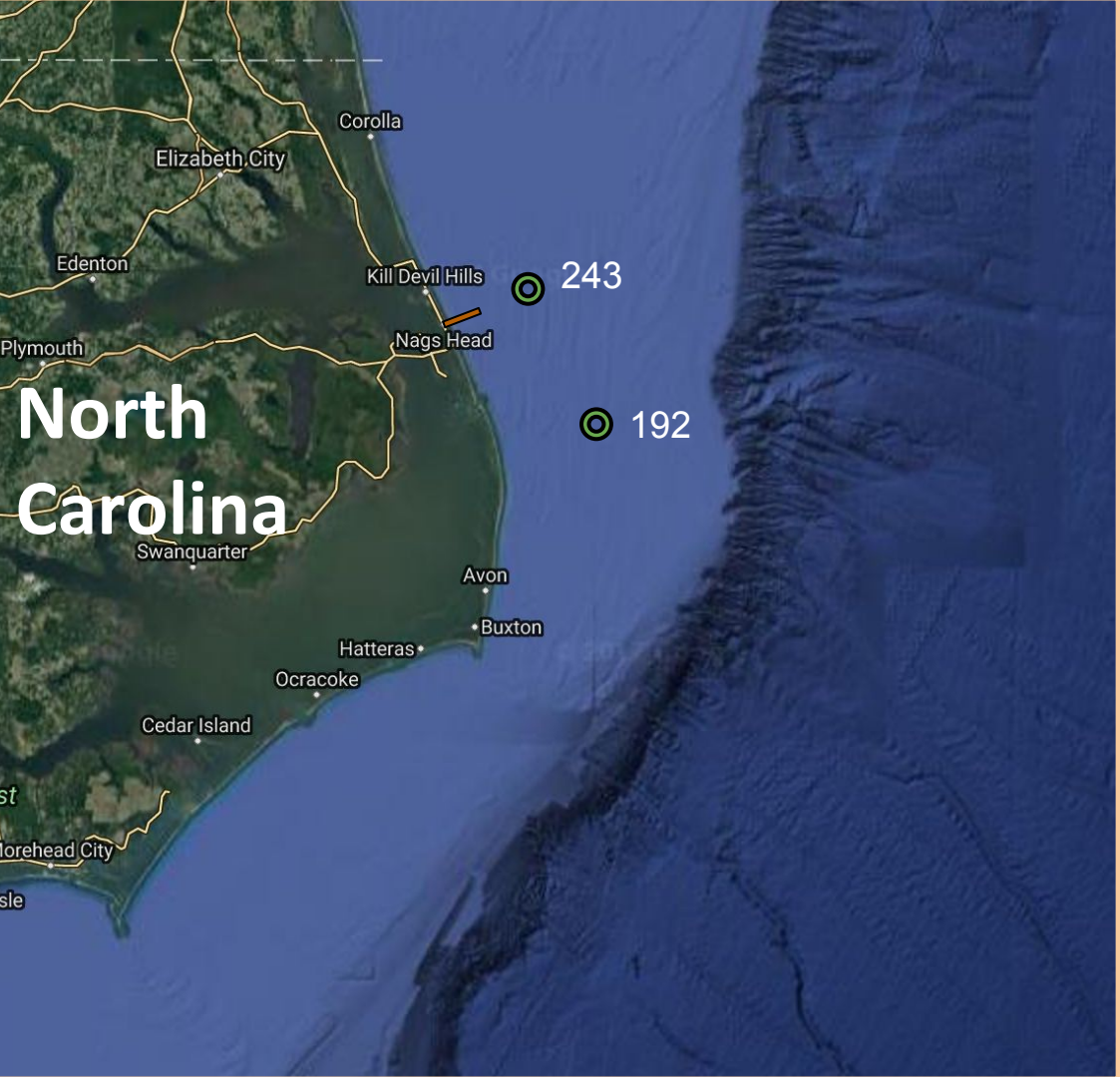
Long Term Observations

- Waves
  - 7 years of wave **height**, **period**, **direction** and **water surface temperatures** AND a 40-year model hindcast at these observing locations



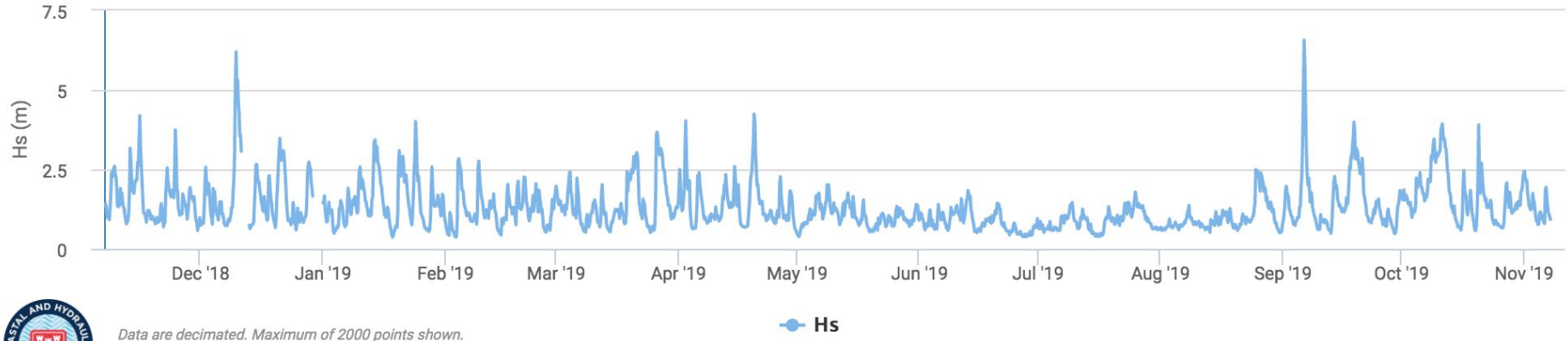
Deployed Observing Assets

Waverider Buoys



Oregon Inlet, NC Datawell Waverider Buoy

Realtime



Data are decimated. Maximum of 2000 points shown.
Data are provided by the U.S. Army Engineer Research & Development Center, Coastal & Hydraulics Laboratory, Field Research Facility, Duck, North Carolina.
These realtime data are provisional. Please use with appropriate caution!

Oregon Inlet, NC Datawell Waverider Buoy

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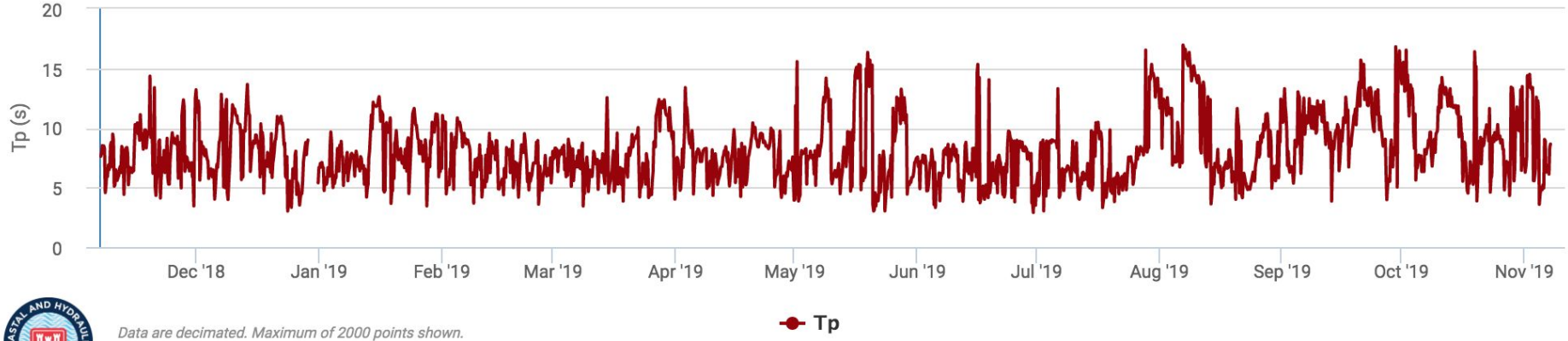

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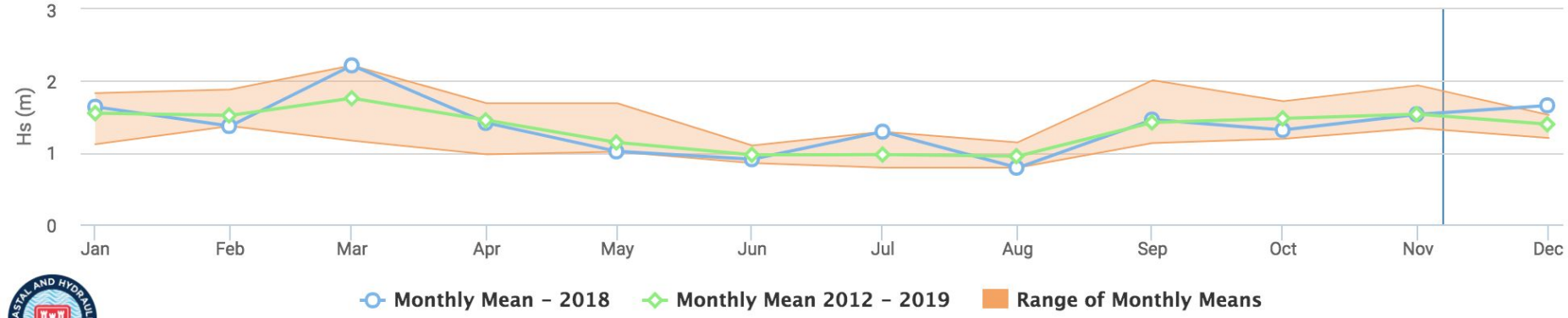
Oregon Inlet, NC Datawell Waverider Buoy

Annual Climatology for 2018



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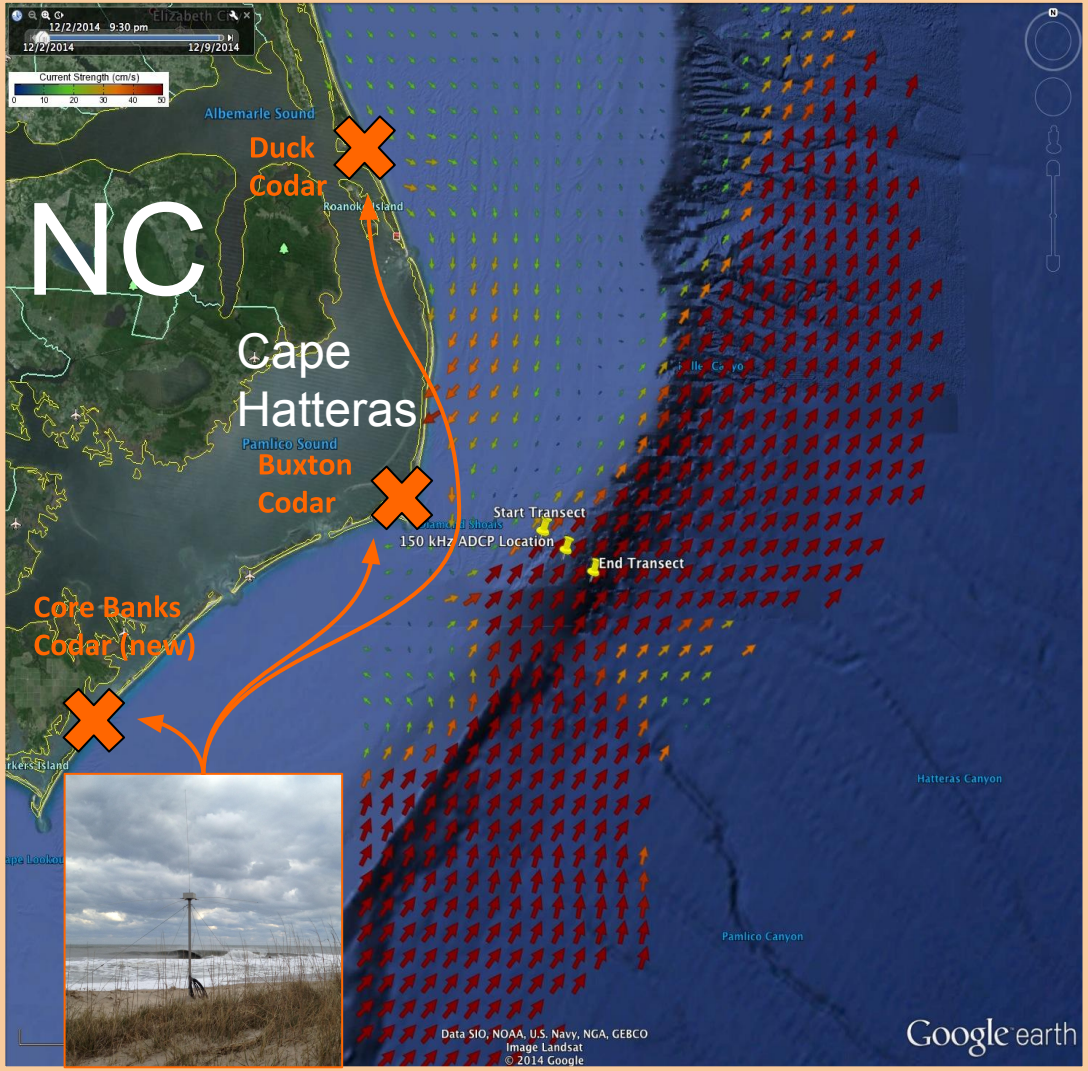
Long Term Observations

- HF Radar Ocean Surface Currents
  - 15 years of **hourly** measurements
  - 6 km resolution



Land Based HF Radar Network

CODAR 5 MHz High Frequency Radars

- Several years of hourly measurements
- ~ 6 km resolution
- Top 2-3 meters of the water column

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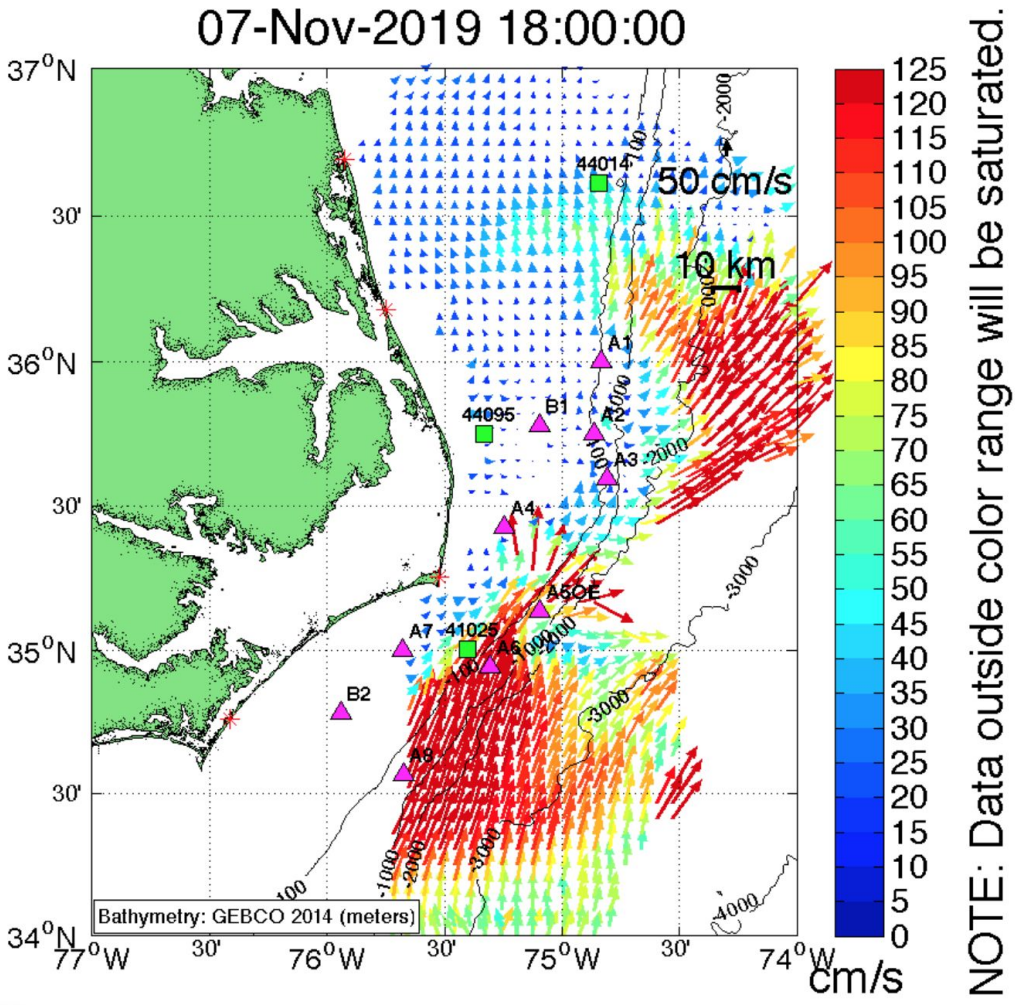
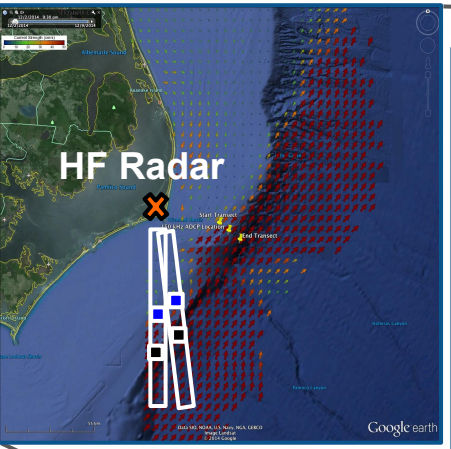
SECOORA

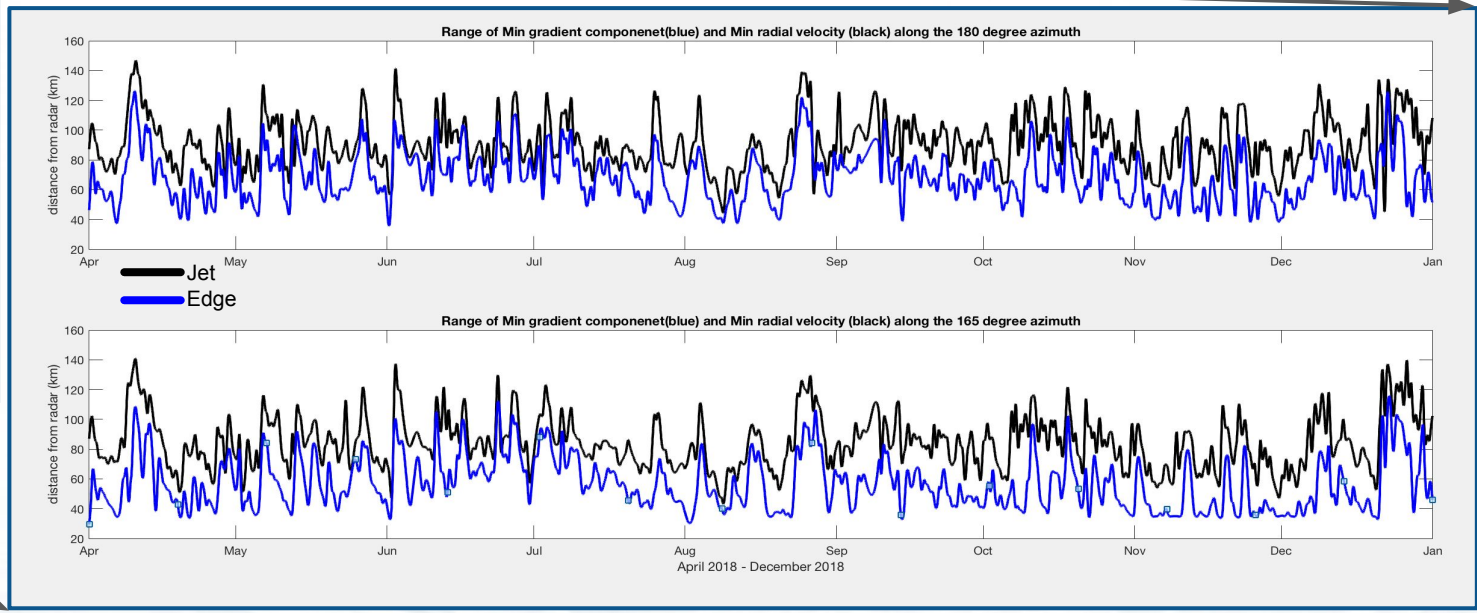

07-Nov-2019 18:00:00
37°N
30'
36°N
30'
35°N
30'
34°N
77°W
30'
76°W
30'
75°W
30'
74°W
50 cm/s
10 km
44014
44095
41025
A1
A2
A3
A4
A5
A6
A7
A8
A9
B1
B2
ASOE
Bathymetry: GEBCO 2014 (meters)
125
120
115
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
cm/s
NOTE: Data outside color range will be saturated.

April - December

2018

Gulf Stream edge and jet location determined by HF Radar





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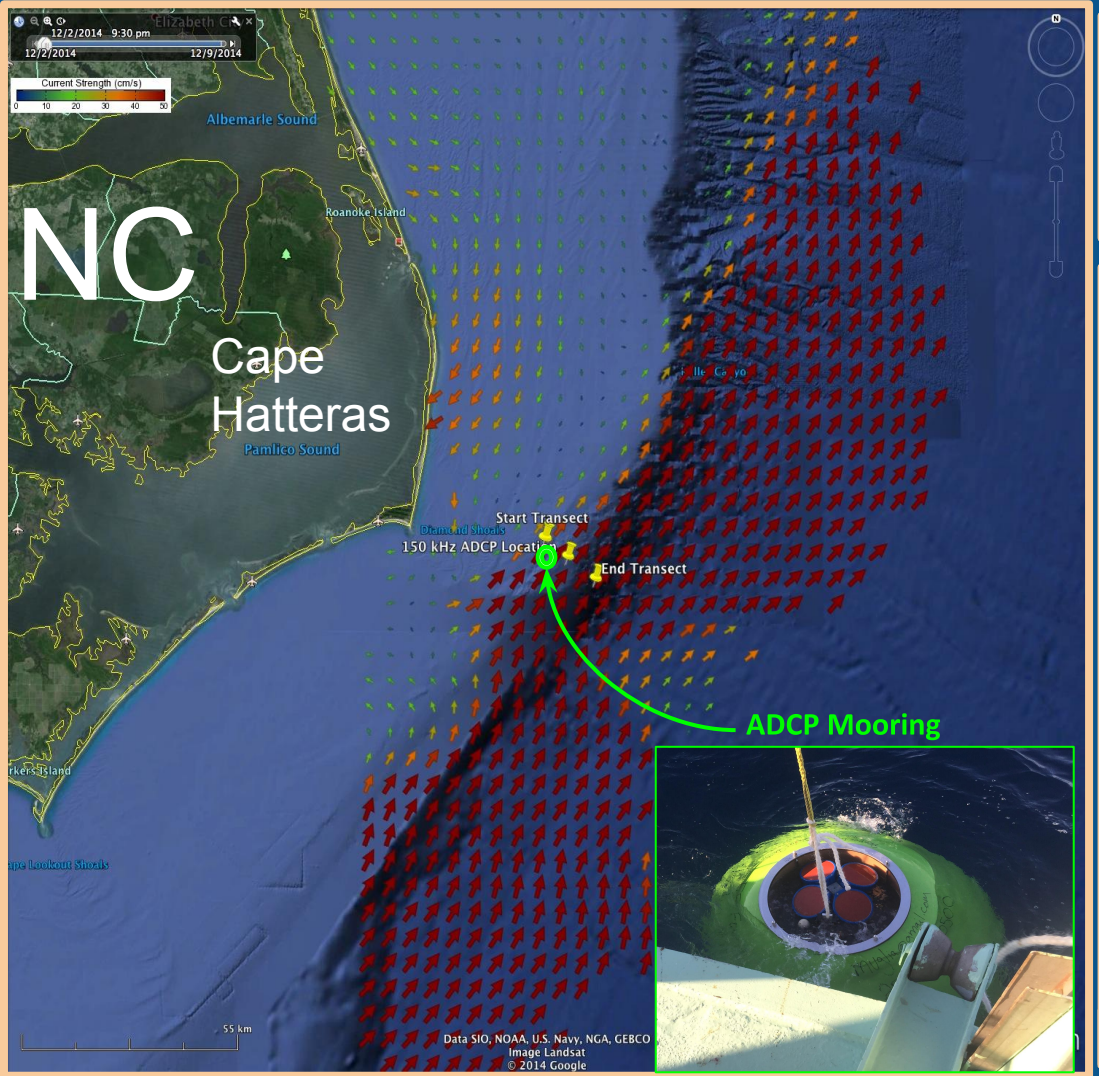
GS Energy Observations

- **Bottom Mooring**
  - ~230m water depth
  - Conductivity, Temp., and Depth (CTD)
  - Passive Acoustic Hydrophone
  - one location, 3 years and 9 months



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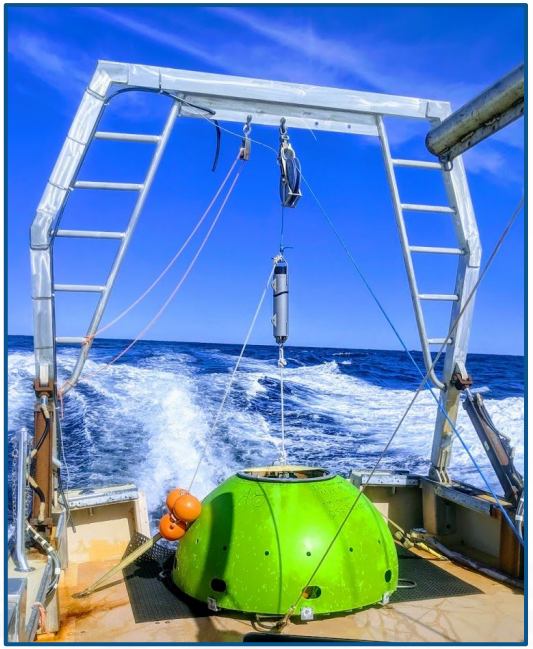
SECOORA

Bottom Pod Measurements

- Bottom Mooring
  - ADCP measures currents over the water column
  - CTD measures temperature and salinity
  - Passive Acoustic Hydrophone measures sound



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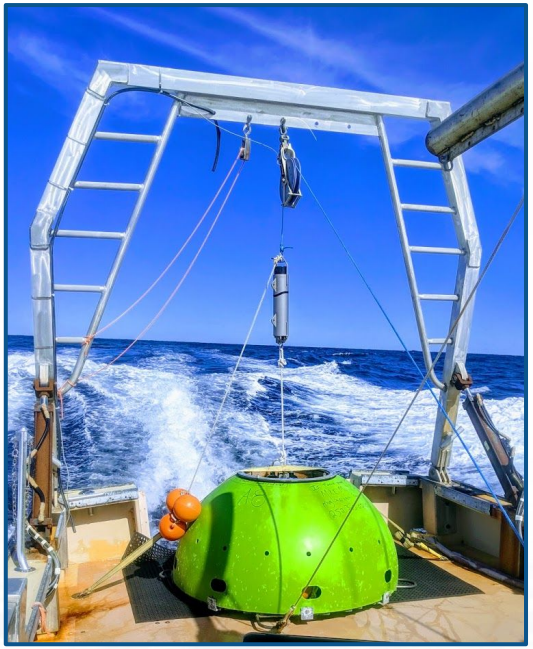
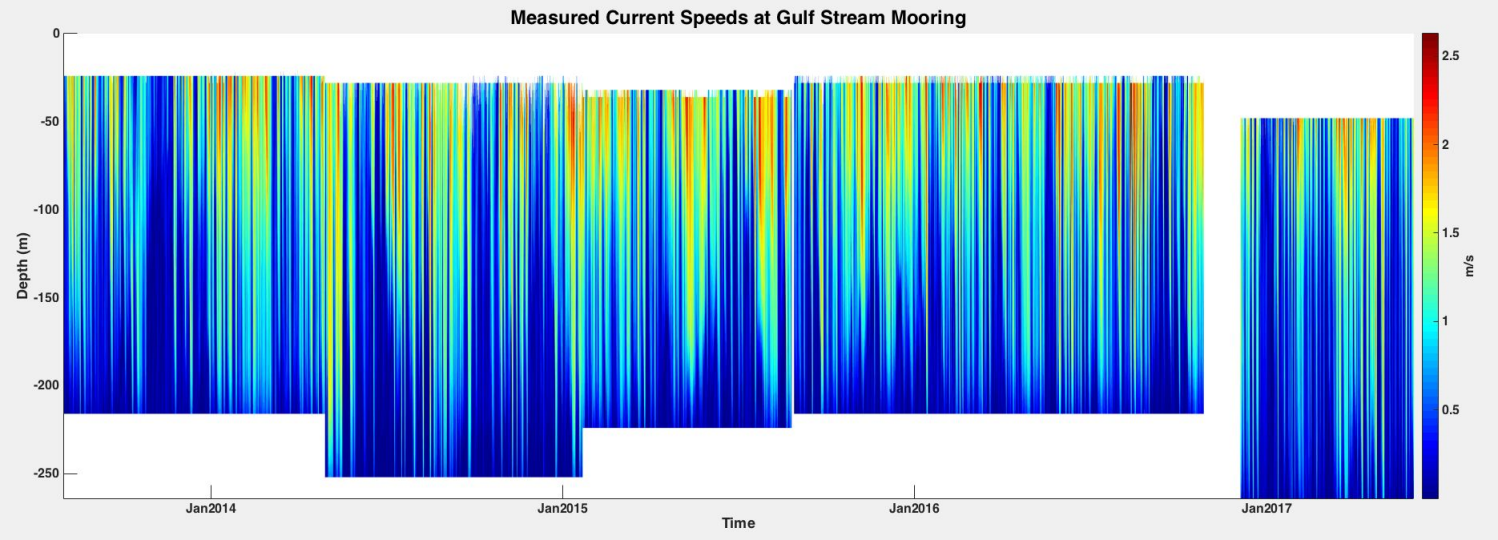


MHK: Current Speed Percent Exceedance

Water Speed (m/s)		0	0.25	0.5	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Depth (m)	40	98.72	94.41	86.82	76.43	63.96	50.15	35.37	20.62	7.84	1.87	0.26
	76	98.22	90.94	79.49	64.44	54.31	38.96	23.57	9.45	2.52	0.42	0



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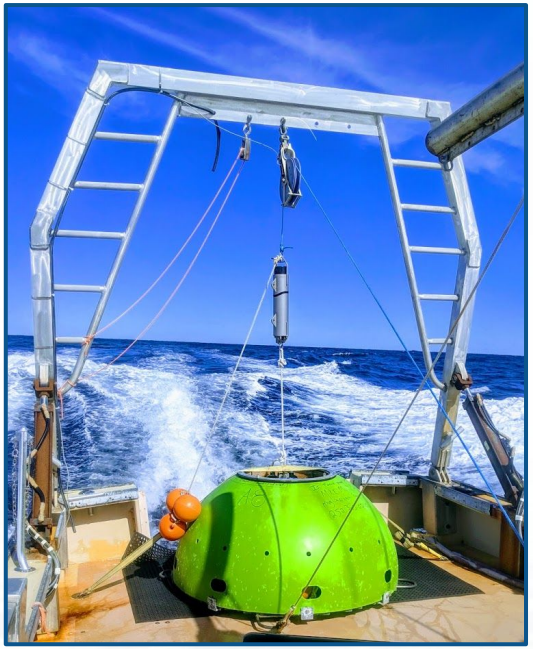

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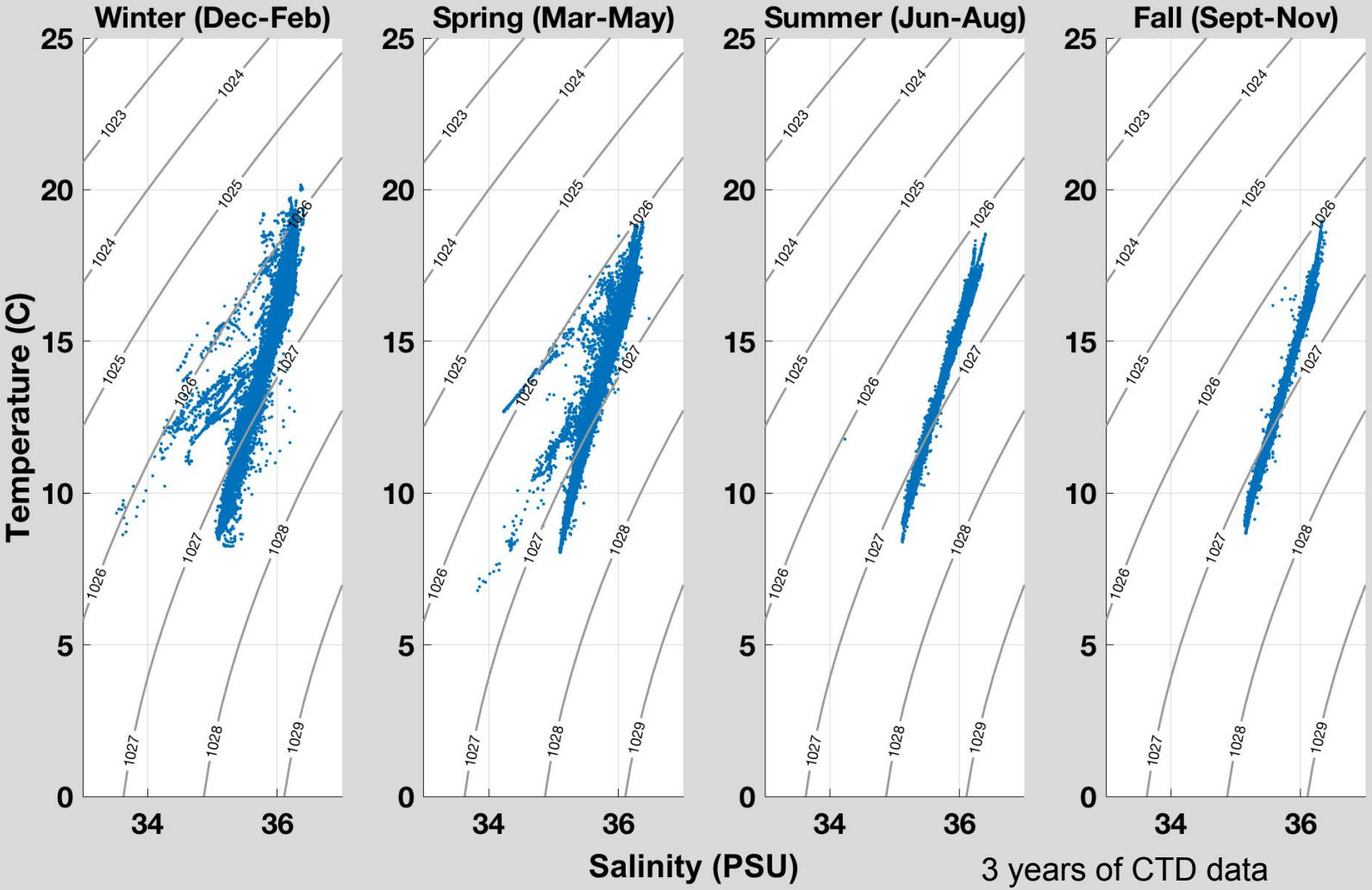
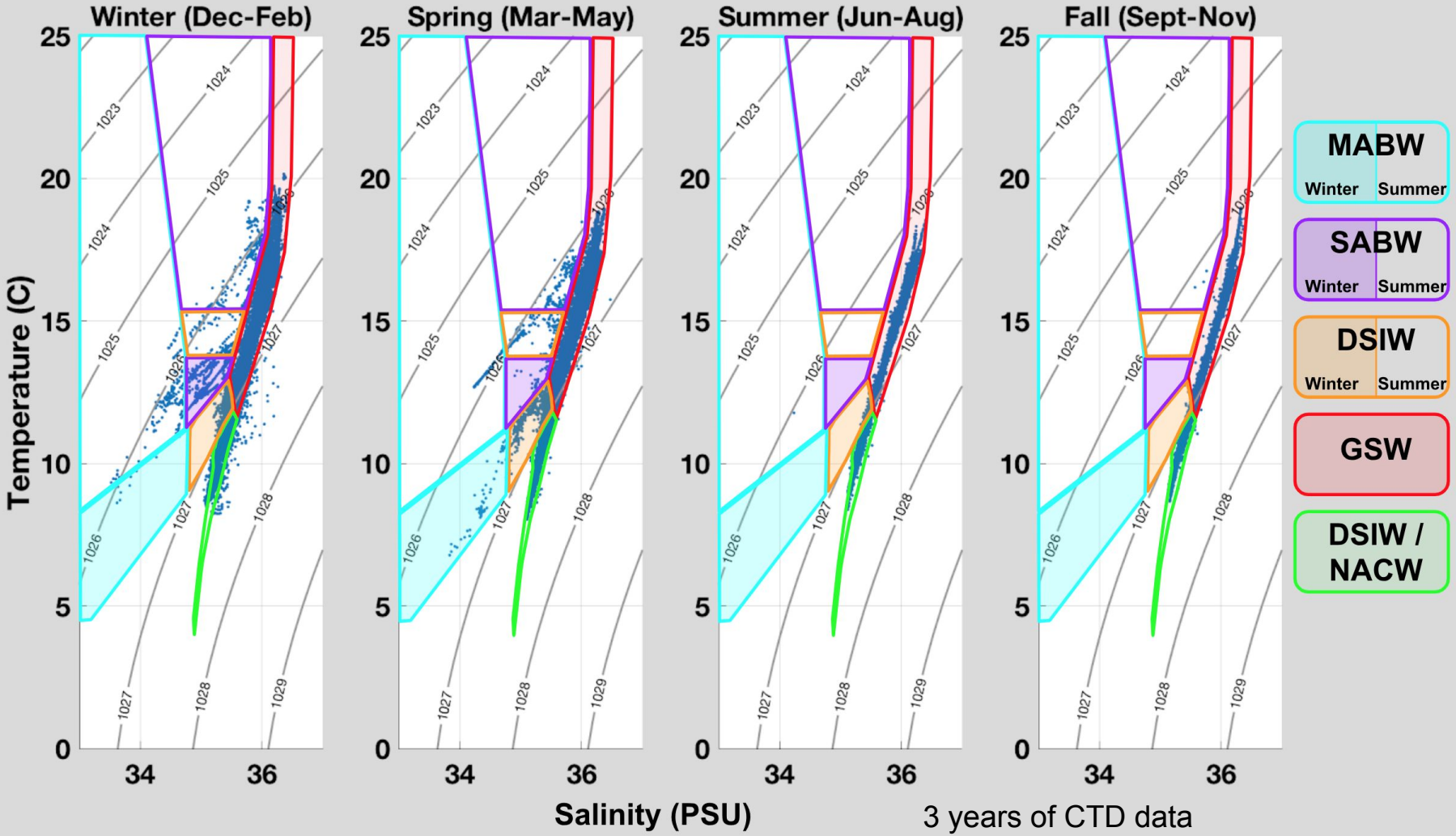


3 years of CTD data


Winter (Dec-Feb)
Spring (Mar-May)
Summer (Jun-Aug)
Fall (Sept-Nov)
Temperature (C)
Salinity (PSU)
MABW
Winter
Summer
SABW
Winter
Summer
DSIW
Winter
Summer
GSW
DSIW / NACW
3 years of CTD data

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Passive Acoustic Hydrophone

Acoustic data collection using a Aural M2 hydrophone

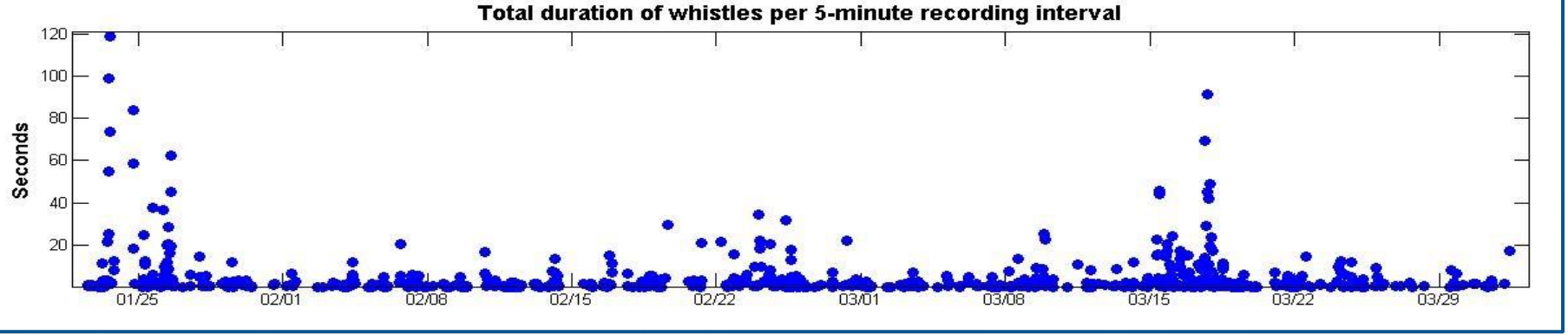
- Sampling rate - 32,768 samples per second
- Recordings – for 5 min every 0.5 hr → 38 days of audio over 1.5 years


PHOTOGRAPH BY Claire Johnson

Objectives:

- Investigate the presence and use of GS by marine mammals
- Characterize the soundscape
- Explore relationships between marine mammal vocalizations and GS position

Passive Acoustic Hydrophone

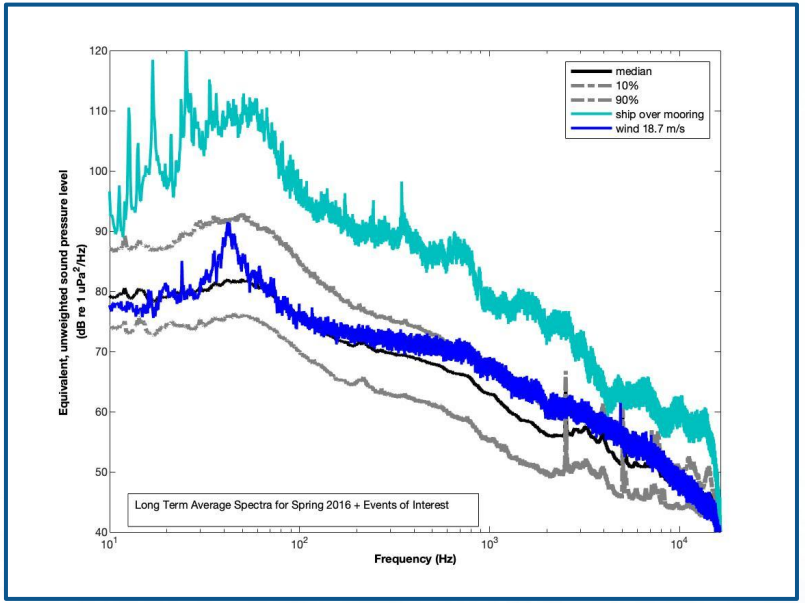


- 16 months of recordings
- >11,000 x 5 minute recording intervals
- Can be compared to data from 150 kHz RDI ADCP and CTD

- **Processed data to date:**
  - QC and whistle, click, and quack detection completed
  - Low frequency sound analysis
  - Preliminary comparisons to oceanographic data revealing interesting patterns

Passive Acoustic Hydrophone

Technical Guidance for Assessing the Effects of Anthropogenic Noise on Marine Mammal Hearing (NOAA 2016)	Impulsive	Continuous
Permanent hearing damage (PHD) - low-frequency cetaceans	183 dB	199 dB
PHD - mid-frequency cetaceans	185 dB	198 dB
PHD - high-frequency cetaceans	202 dB	173 dB
Behavioral disruption	160 dB	120 dB



Anthropogenic noise at our site does not exceed thresholds established as nuisance or harmful to marine mammals (at the seabed at least)

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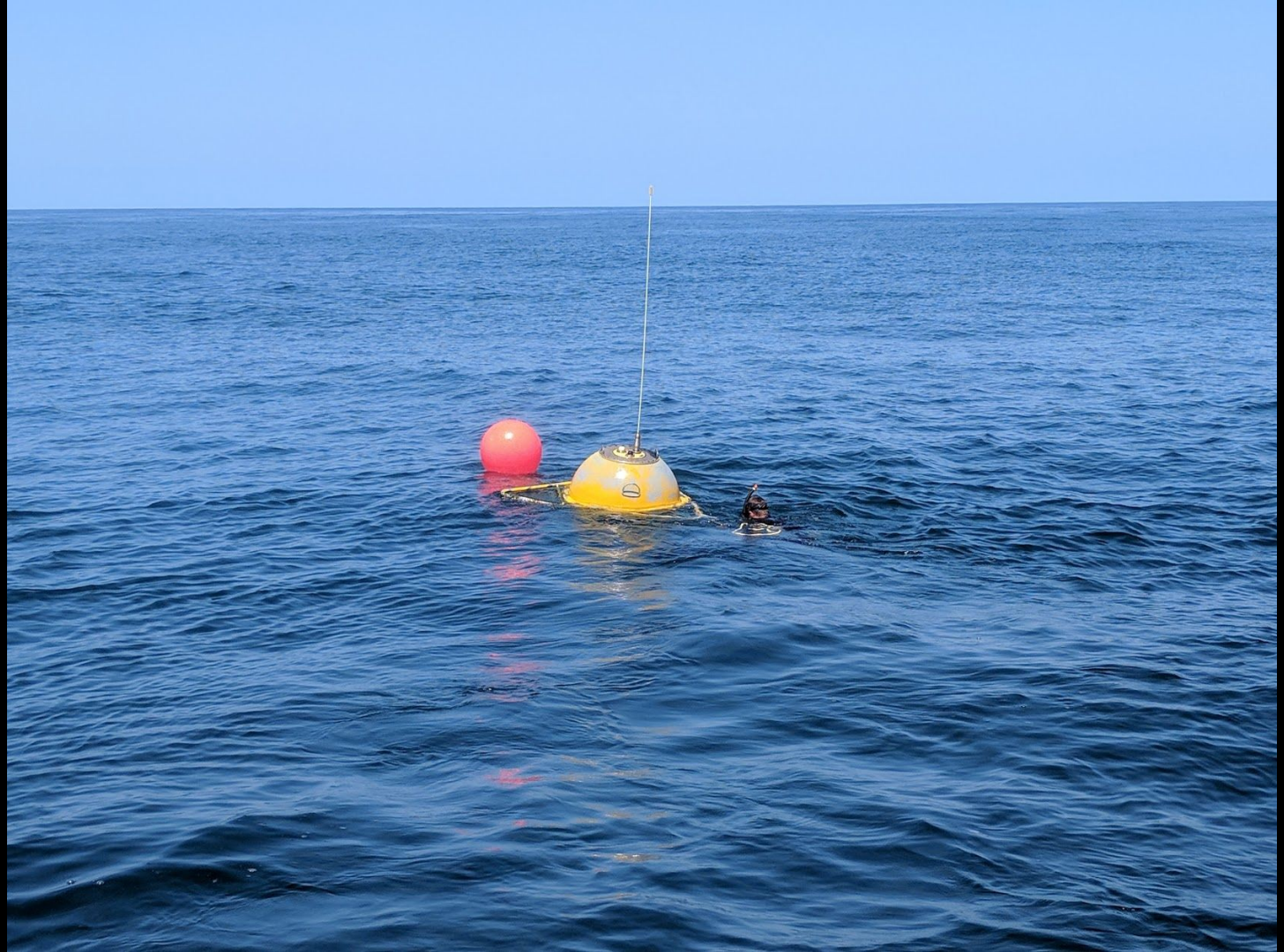
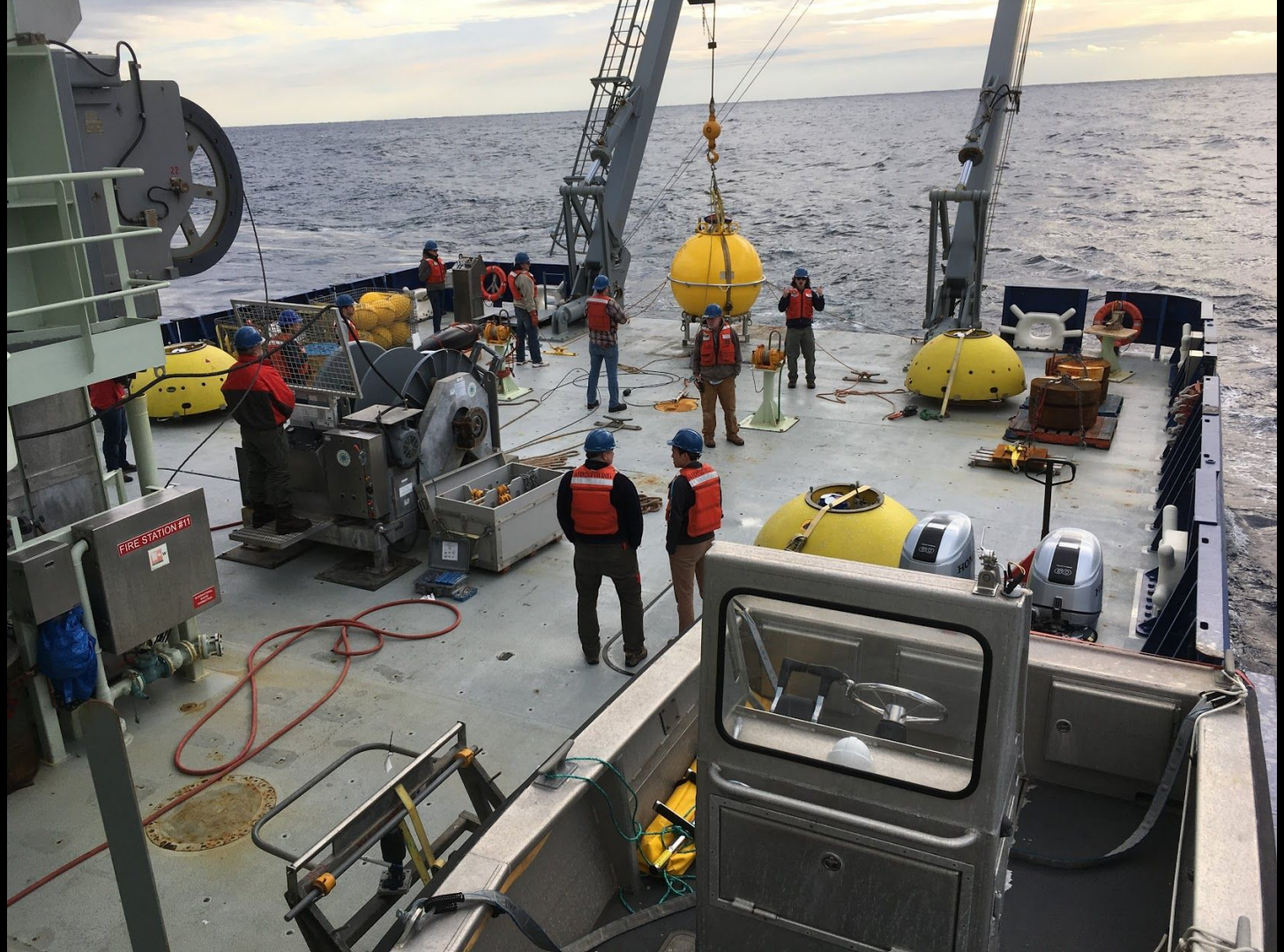
Challenge, Questions, and Discussion

- Challenge:
  - Collaboration between CSI research groups and ECU Computer Science Department?
  - Application of computer science and machine learning techniques?

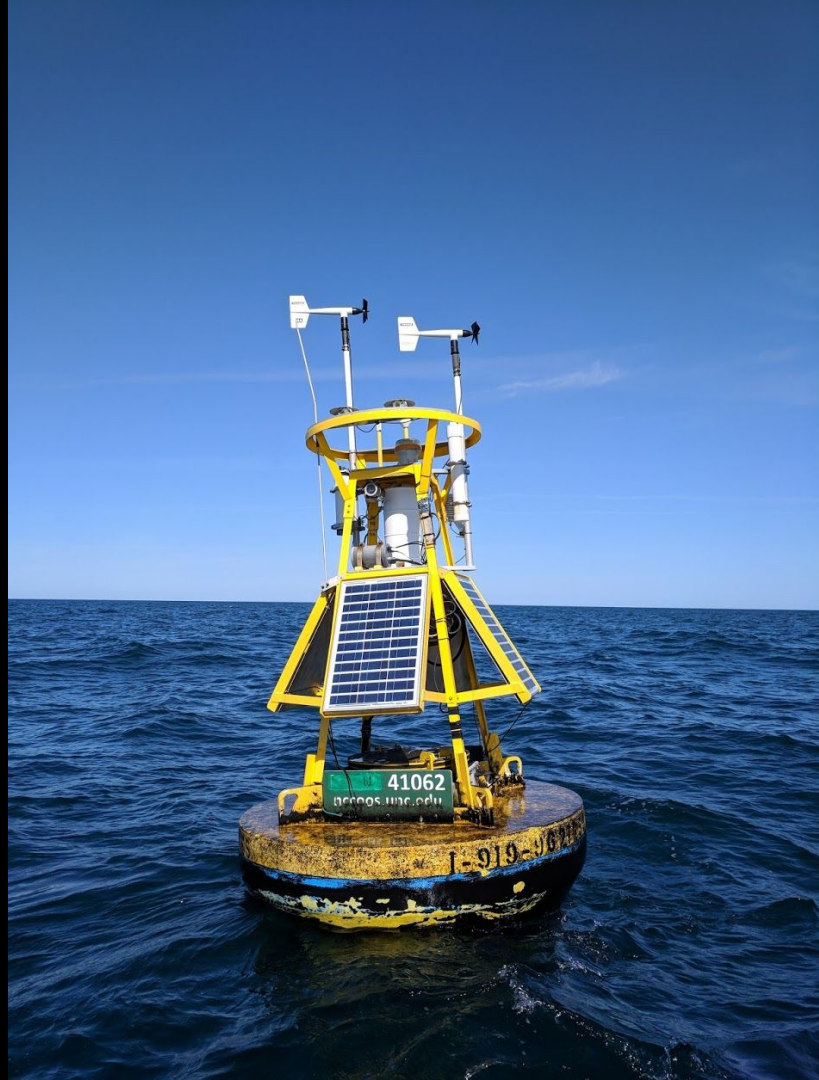
- Questions and Discussion




IF FOUND PLEASE
0500


FIRE STATION #11


41062
nccoos.unc.edu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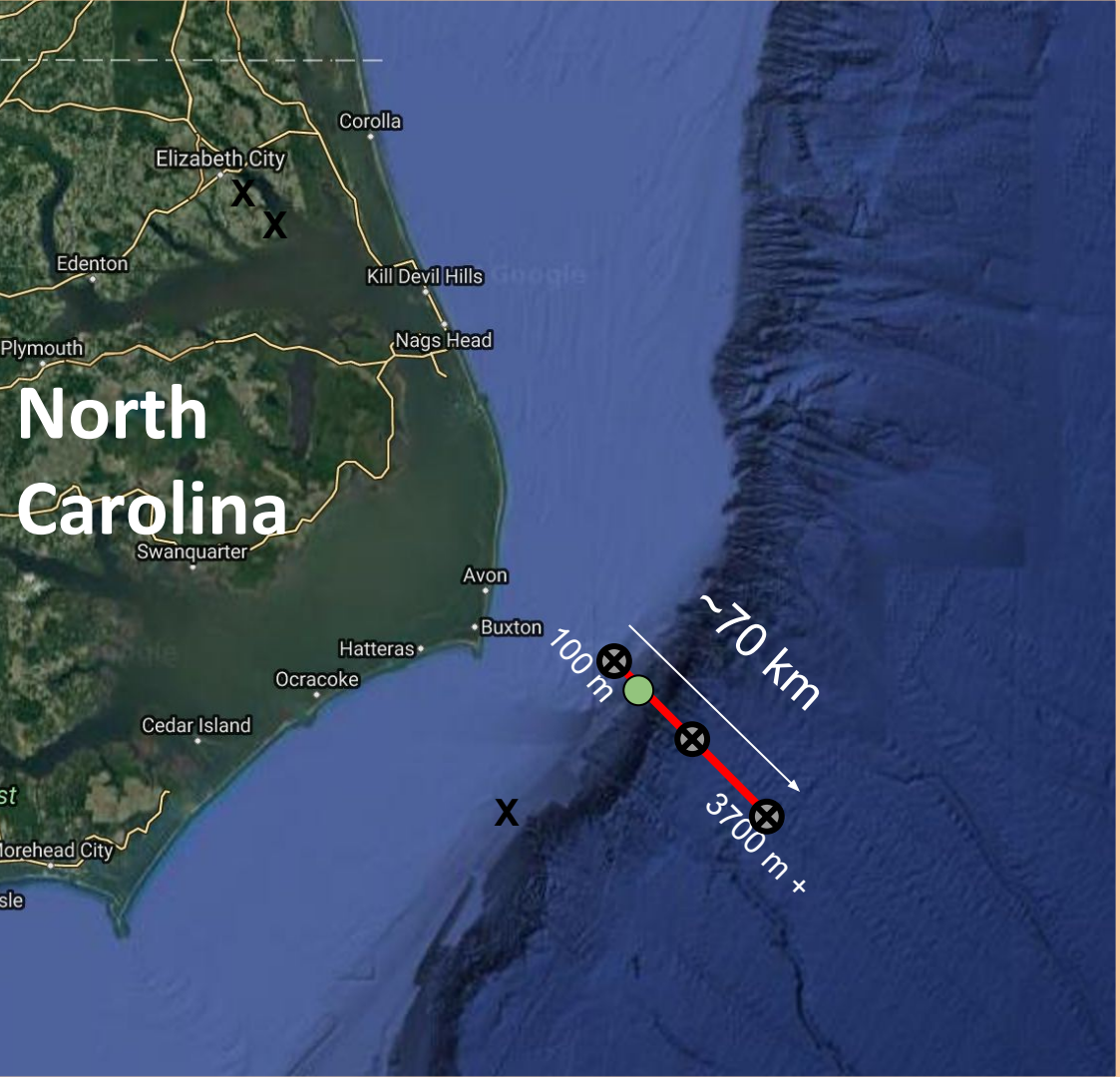

Cape Hatteras Transect

- Moored 150 kHz ADCP
- Repeated Miss Caroline Transects
- RV Neil Armstrong ADCP Transects
- Several CTD casts along the line