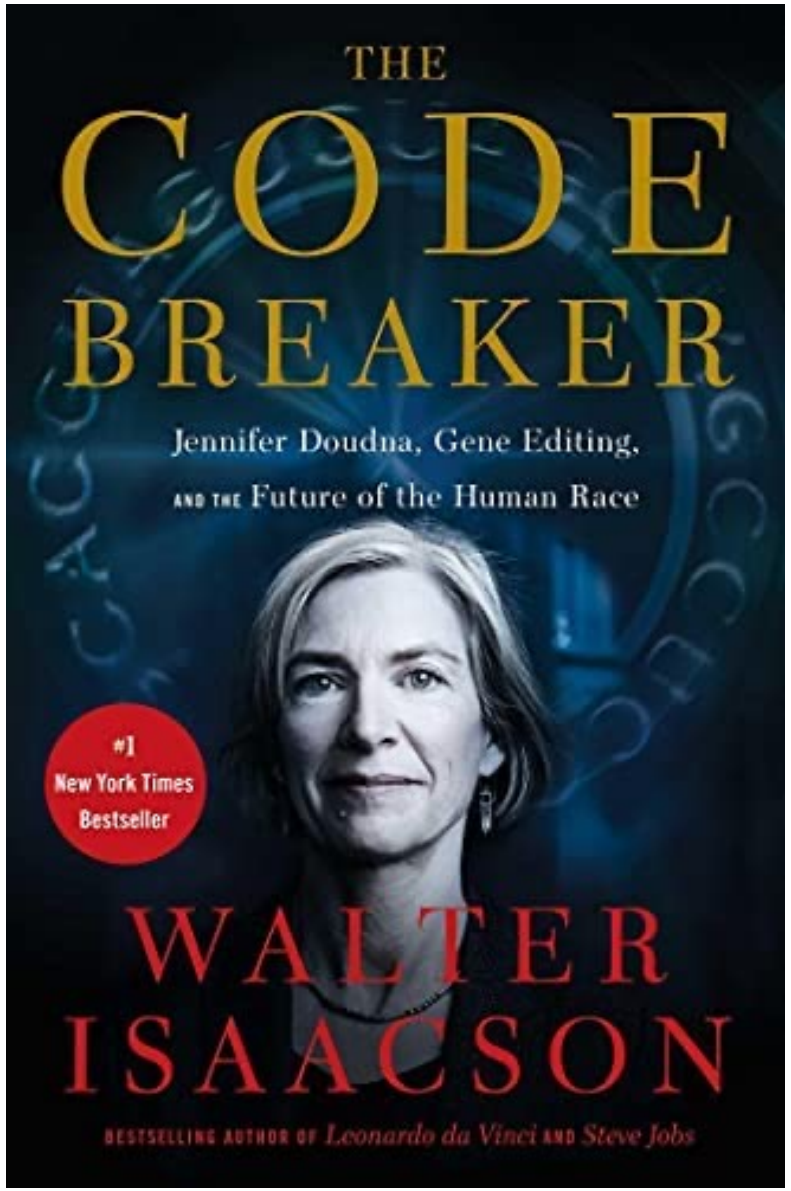
The Global Ocean Observing System

OCG-14 Hybrid Meeting
6-8 June 2023
Cape Town, South Africa

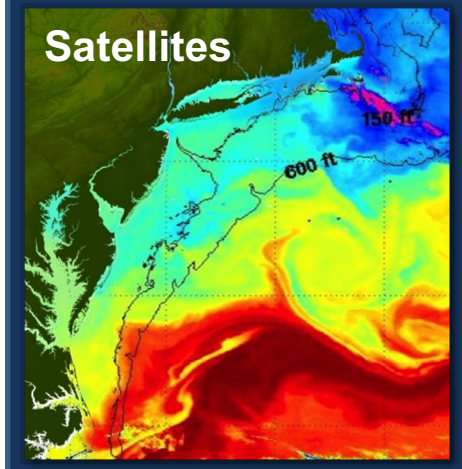
High Frequency Radar

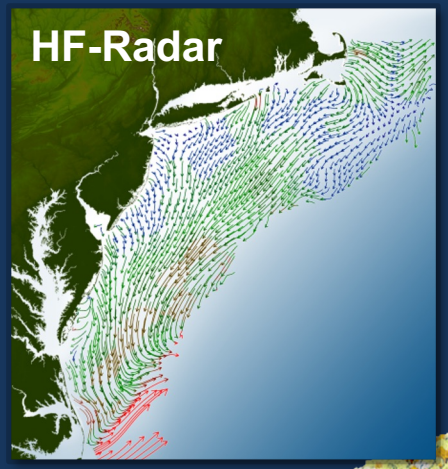
Dr. Hugh Roarty, Rutgers University, MARACOOS
Chair of the Global High Frequency Radar Network

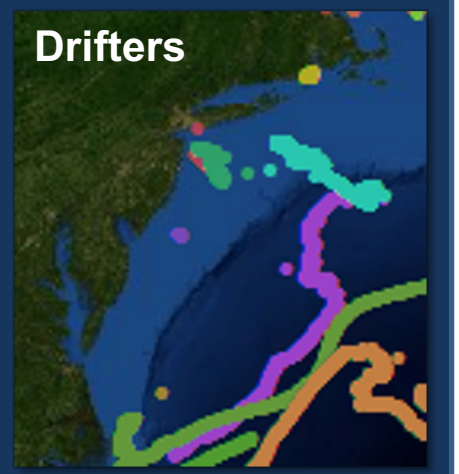


researcher with an affable personality and an eagerness to be involved in turning basic research into a tool.[2]

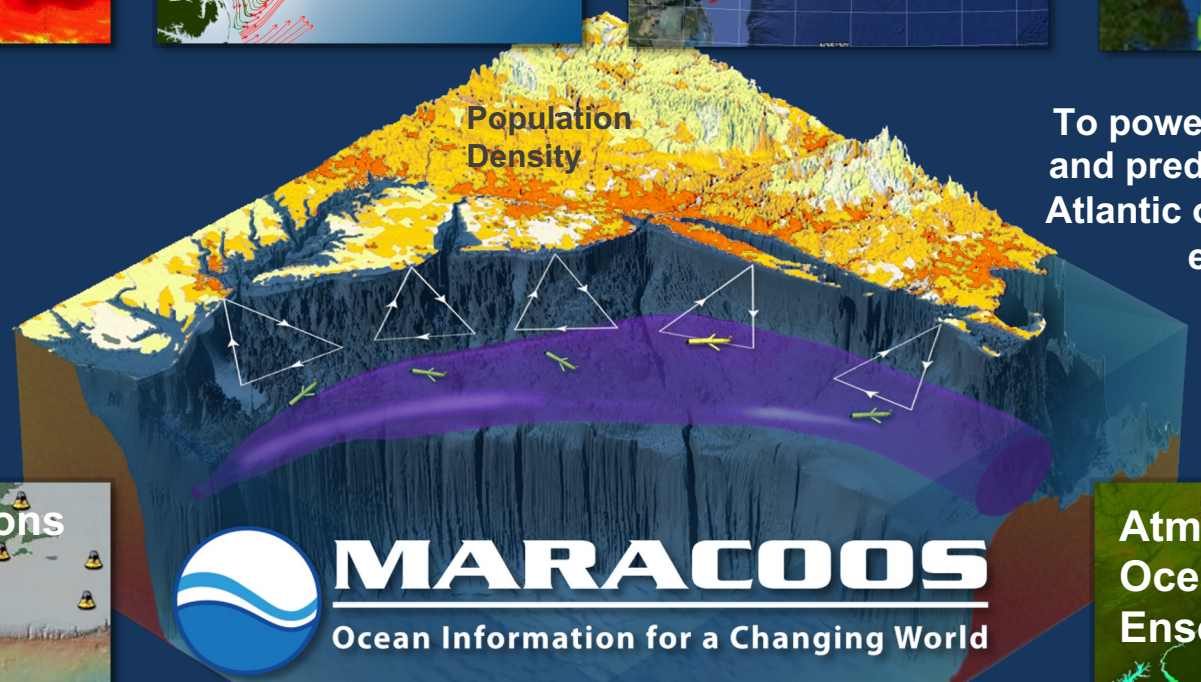
In-person meetings can produce ideas in ways that conference calls and Zoom meetings can't. That had happened in Puerto Rico, and it did so again when the four researchers got together for the first time in Berkeley. There they were able to brainstorm a strategy for figuring out exactly what molecules were necessary for a CRISPR system to



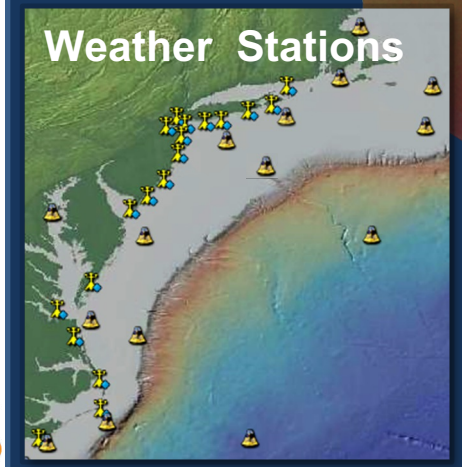




IOOS
Integrated Ocean Observing System



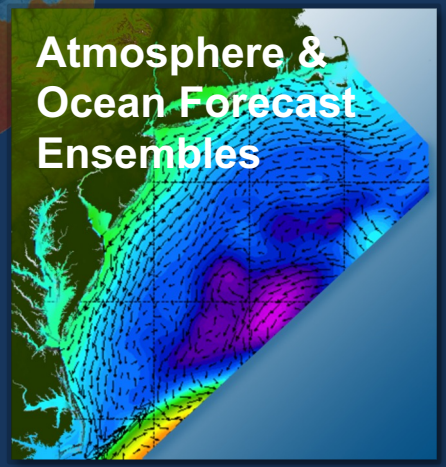
To power understanding and prediction of the Mid Atlantic ocean, coast and estuaries



MARACOOS
Ocean Information for a Changing World

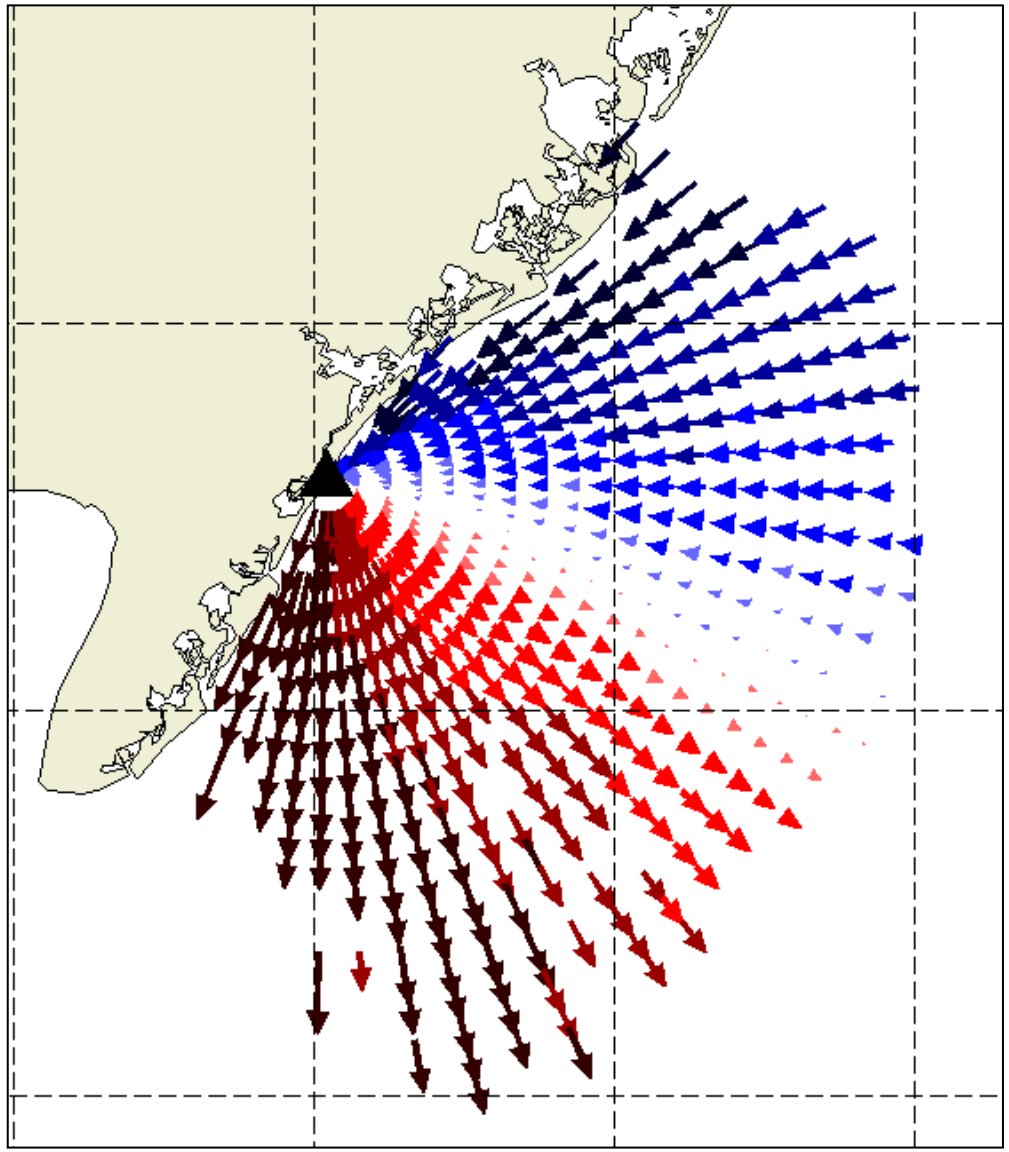
REGIONAL INFORMATION COORDINATION ENTITY
CERTIFIED
2016

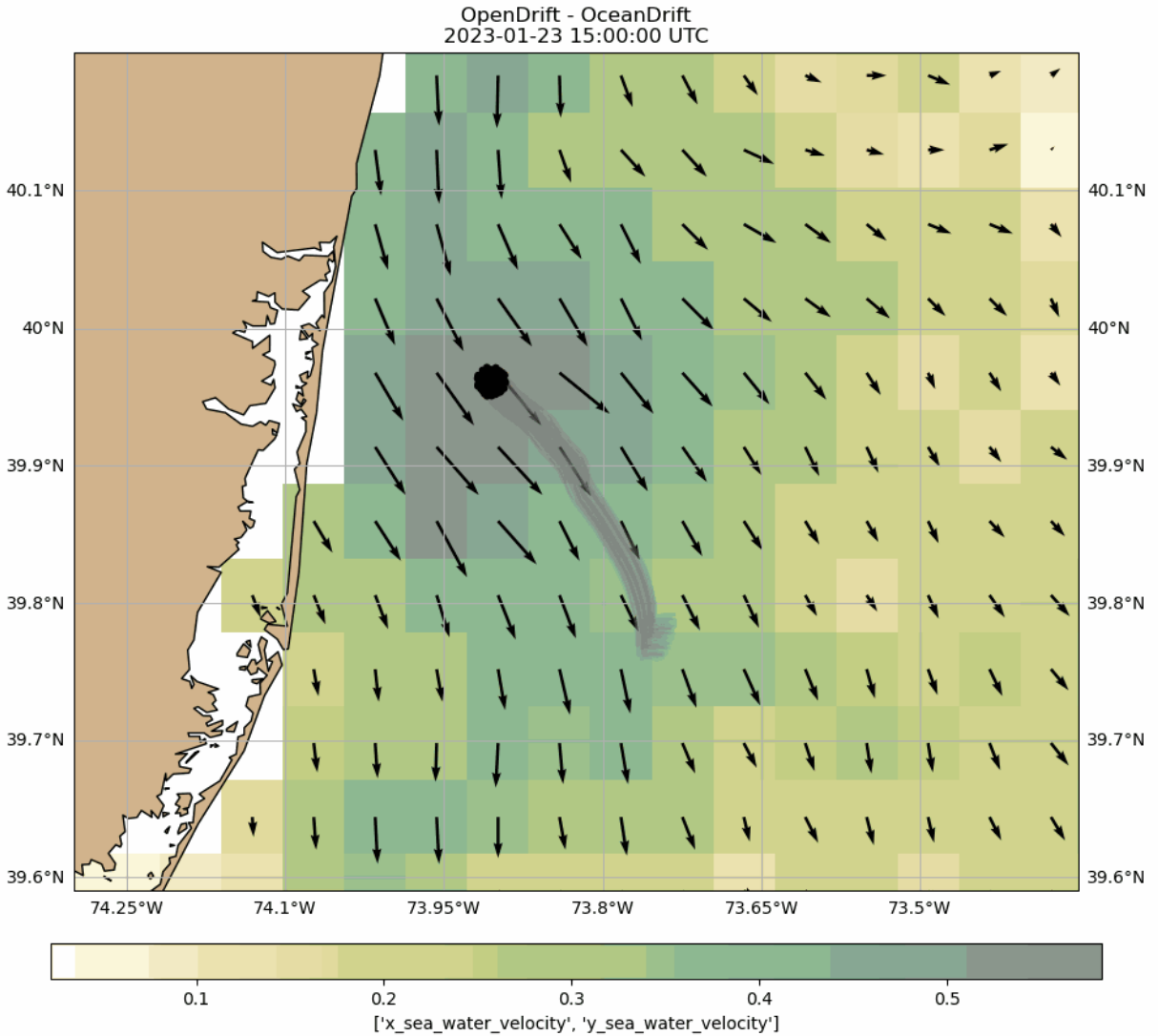
AMBASSADOR™
WRN
WEATHER-READY NATION



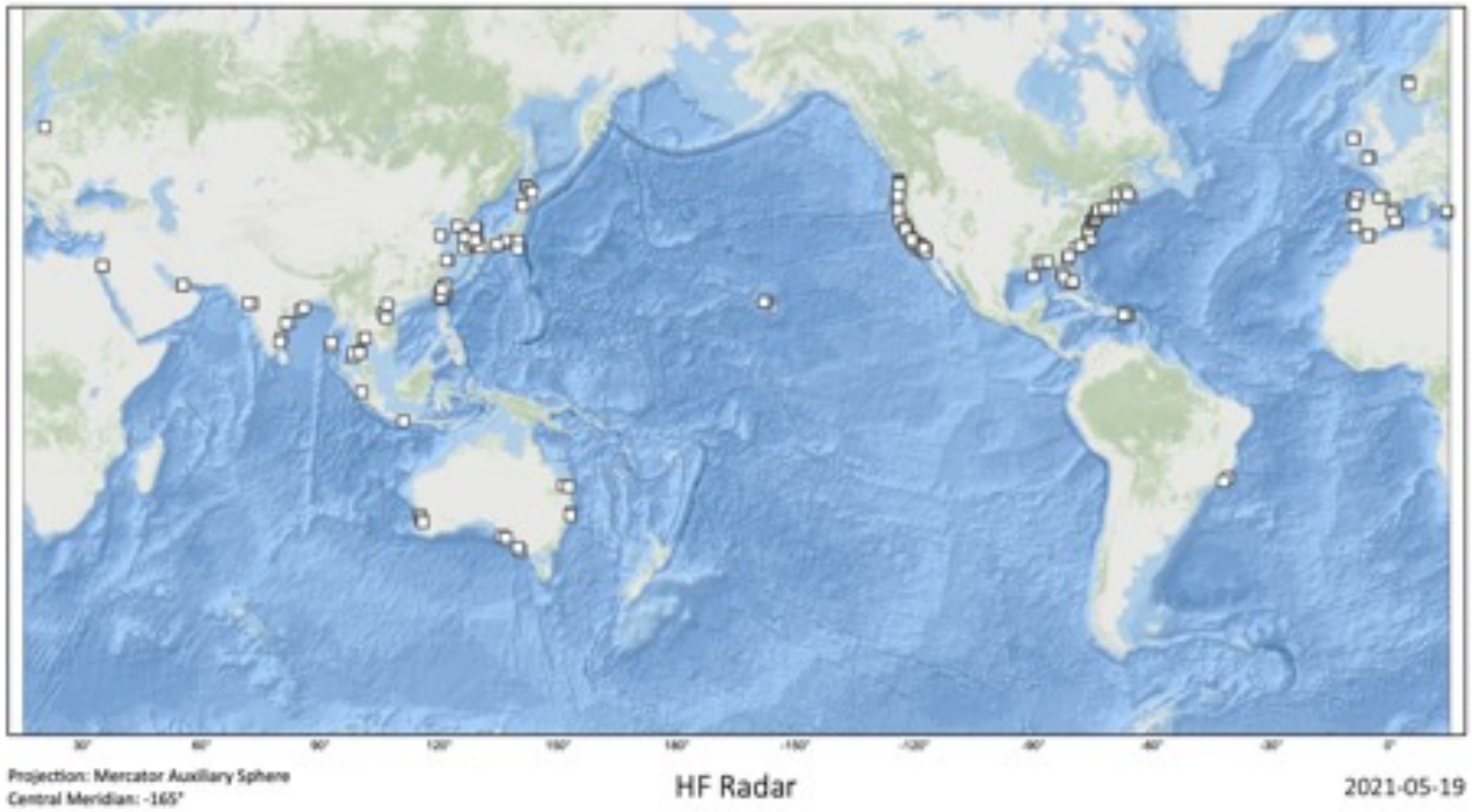
High Frequency Radar

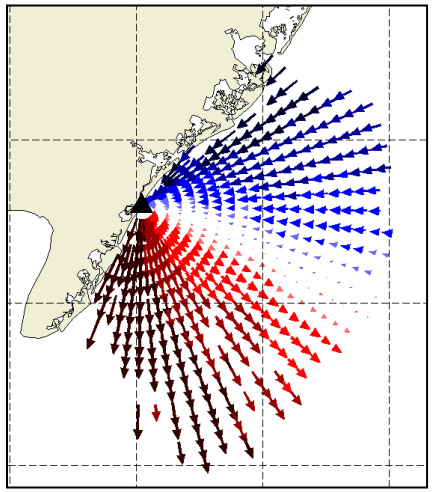
Dzvonkovskaya, Anna, Leif Petersen, Thomas Helzel, and Matthias Kniephoff. "High-frequency ocean radar support for Tsunami Early Warning Systems." *Geoscience Letters* 5, no. 1 (2018): 29.

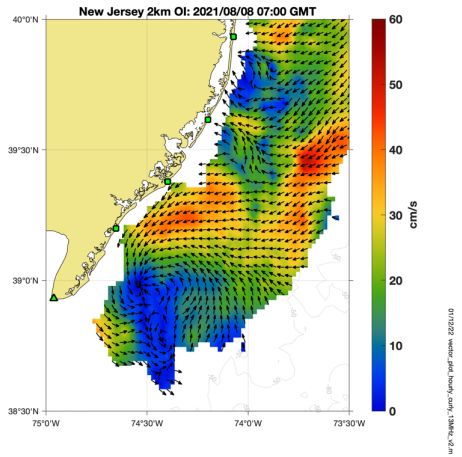



OpenDrift - OceanDrift
2023-01-23 15:00:00 UTC
40.1°N
40°N
39.9°N
39.8°N
39.7°N
39.6°N
74.25°W
74.1°W
73.95°W
73.8°W
73.65°W
73.5°W
0.1
0.2
0.3
0.4
0.5
['x_sea_water_velocity', 'y_sea_water_velocity']

Network Overview







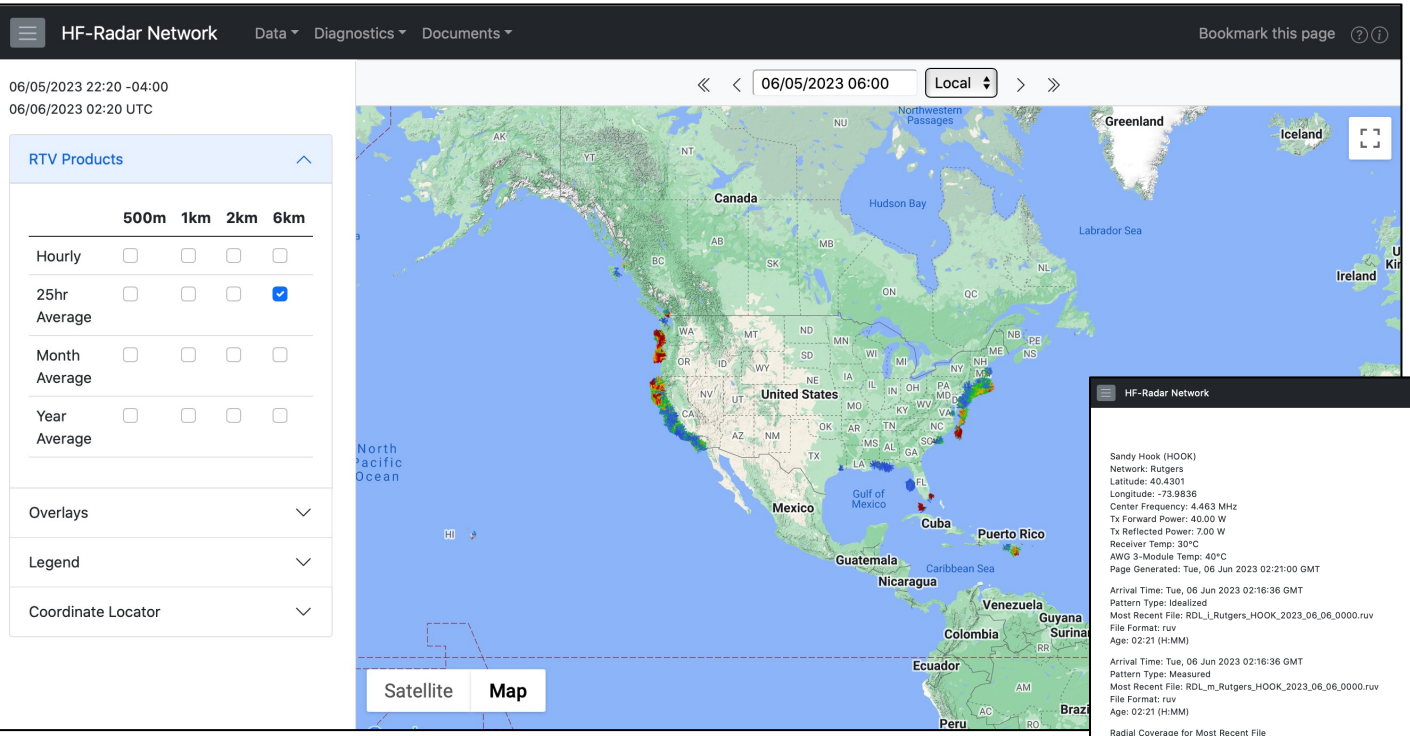
Region	Geographic Coverage	Number of Stations
1	Europe, Africa, Middle East	72
2	North and South America	195
3	Asia and Oceania	140

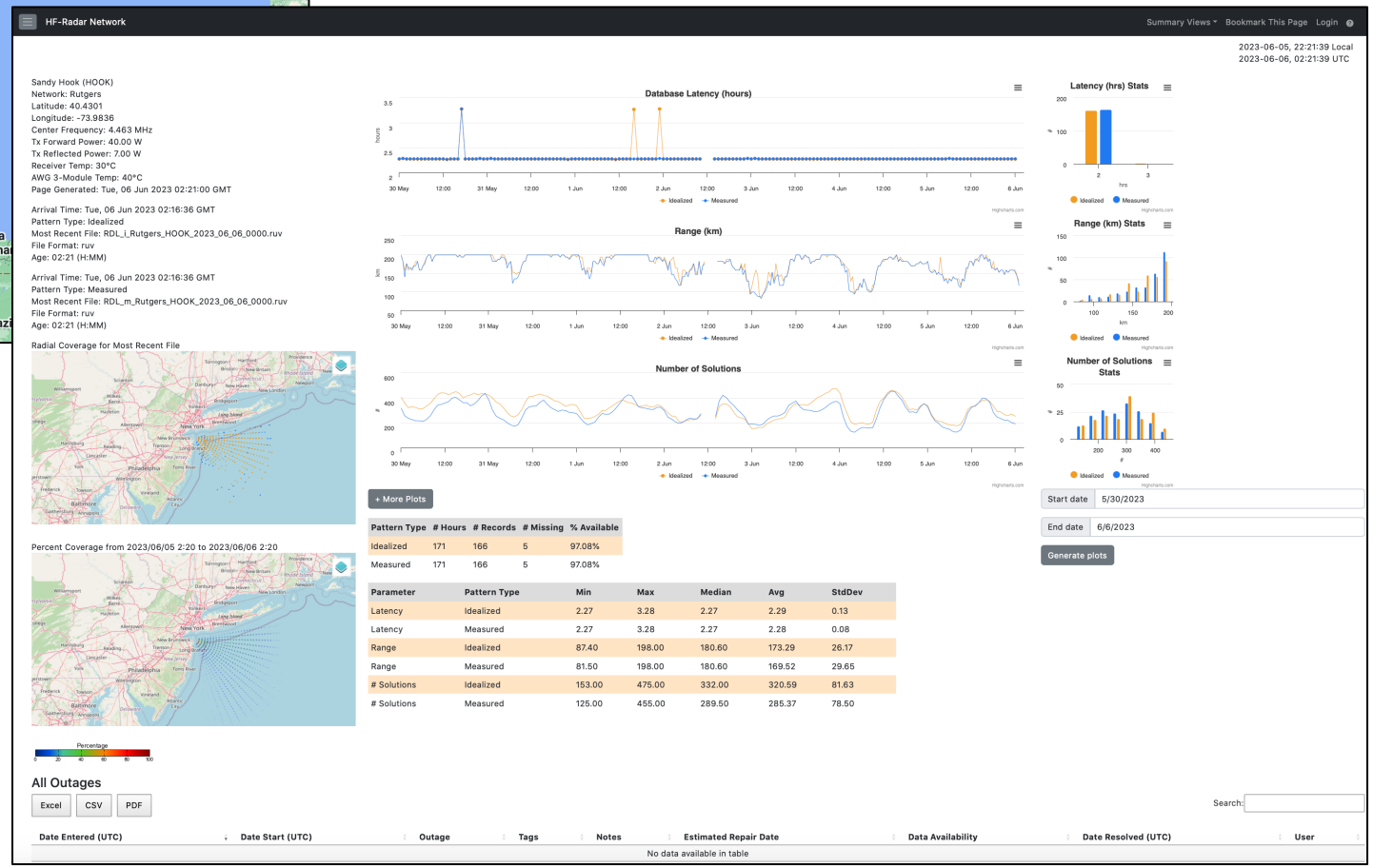
~ 407 Total

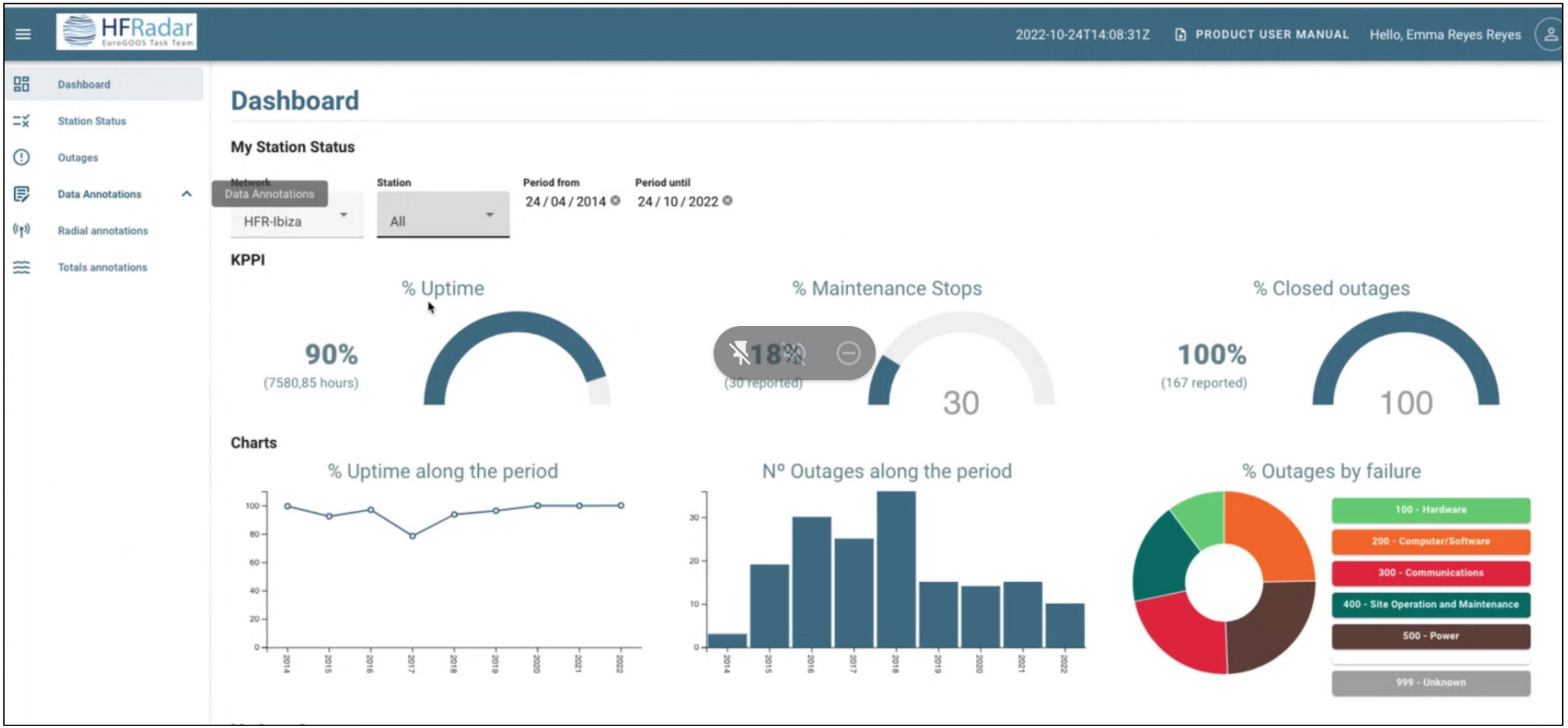
Developments and Achievements

18th HFR User Community of Japan
“Development and Application of Sea State Monitoring System using Ocean Radars”.

- Ongoing development of the web portal for the European HFR Node (hfrnode.eu to be launched before end of 2023)
- New significant systems planed for installation (Ireland, Spain, Italy)
- Implementation of the HFR Online Outage Reporting Tool (HOORT) of the European network developed in collaboration with MARACOOS colleagues: it is a web-based application to aid High-Frequency Radar (HFR) operations and maintenance and keep operators more aware of common problems, helping them to report them.


HF-Radar Network
Data
Diagnostics
Documents
Bookmark this page
06/05/2023 22:20 -04:00
06/06/2023 02:20 UTC
RTV Products
500m 1km 2km 6km
Hourly
25hr Average
Month Average
Year Average
Overlays
Legend
Coordinate Locator
06/05/2023 06:00
Local
Satellite
Map
Canada
United States
Mexico
Cuba
Puerto Rico
Guatemala
Nicaragua
Caribbean Sea
Venezuela
Colombia
Ecuador
Peru
Greenland
Iceland
Ireland
Hudson Bay
Labrador Sea
Gulf of Mexico
North Pacific Ocean


HF-Radar Network
Summary Views
Bookmark This Page
Login
2023-06-05, 22:21:39 Local
2023-06-06, 02:21:39 UTC
Sandy Hook (HOOK)
Network: Rutgers
Latitude: 40.4301
Longitude: -73.9836
Center Frequency: 4.463 MHz
Tx Forward Power: 40.00 W
Tx Reflected Power: 7.00 W
Receiver Temp: 30°C
AWG 3-Module Temp: 40°C
Page Generated: Tue, 06 Jun 2023 02:21:00 GMT
Arrival Time: Tue, 06 Jun 2023 02:16:36 GMT
Pattern Type: Idealized
Most Recent File: RDL_i_Rutgers_HOOK_2023_06_06_0000.ruv
File Format: ruv
Age: 02:21 (H:MM)
Arrival Time: Tue, 06 Jun 2023 02:16:36 GMT
Pattern Type: Measured
Most Recent File: RDL_m_Rutgers_HOOK_2023_06_06_0000.ruv
File Format: ruv
Age: 02:21 (H:MM)
Radial Coverage for Most Recent File
Percent Coverage from 2023/06/05 2:20 to 2023/06/06 2:20
Percentage
Database Latency (hours)
Range (km)
Number of Solutions
Latency (hrs) Stats
Range (km) Stats
Number of Solutions Stats
Idealized
Measured
+ More Plots
Start date 5/30/2023
End date 6/6/2023
Generate plots
Pattern Type # Hours # Records # Missing % Available
Idealized 171 166 5 97.08%
Measured 171 166 5 97.08%
Parameter Pattern Type Min Max Median Avg StdDev
Latency Idealized 2.27 3.28 2.27 2.29 0.13
Latency Measured 2.27 3.28 2.27 2.28 0.08
Range Idealized 87.40 198.00 180.60 173.29 26.17
Range Measured 81.50 198.00 180.60 169.52 29.65
Solutions Idealized 153.00 475.00 332.00 320.59 81.63
Solutions Measured 125.00 455.00 289.50 285.37 78.50
All Outages
Excel
CSV
PDF
Search:
Date Entered (UTC)
Date Start (UTC)
Outage
Tags
Notes
Estimated Repair Date
Data Availability
Date Resolved (UTC)
User
No data available in table

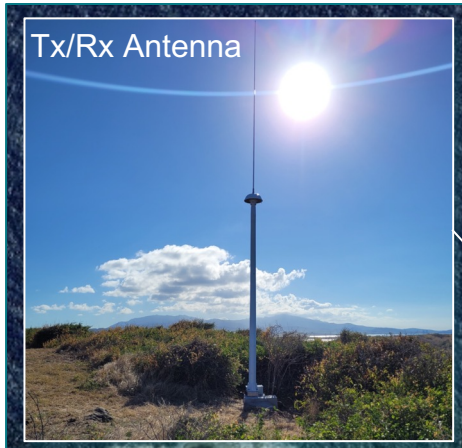

HFRadar
EuroGOOS Task Team
2022-10-24T14:08:31Z
PRODUCT USER MANUAL
Hello, Emma Reyes Reyes
Dashboard
Station Status
Outages
Data Annotations
Radial annotations
Totals annotations
Dashboard
My Station Status
Network
Data Annotations
HFR-Ibiza
Station
All
Period from
24 / 04 / 2014
Period until
24 / 10 / 2022
KPPI
% Uptime
90%
(7580,85 hours)
% Maintenance Stops
18%
(30 reported)
30
% Closed outages
100%
(167 reported)
100
Charts
% Uptime along the period
100
80
60
40
20
0
2014
2015
2016
2017
2018
2019
2020
2021
2022
N° Outages along the period
30
20
10
0
2014
2015
2016
2017
2018
2019
2020
2021
2022
% Outages by failure
100 - Hardware
200 - Computer/Software
300 - Communications
400 - Site Operation and Maintenance
500 - Power
999 - Unknown

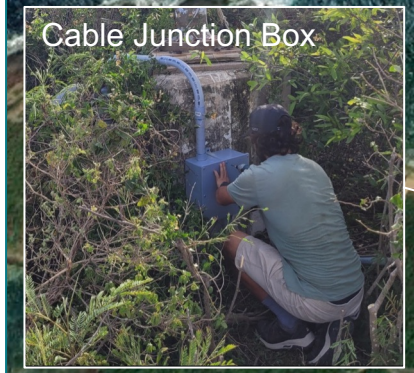

5 MHz Tx/Rx Antenna
Key West, FL USA
UNIVERSITY of
SOUTH FLORIDA
ST. PETERSBURG CAMPUS


5 MHz Tx/Rx Antenna
Gulf of Maine, USA
WOODS HOLE
OCEANOGRAPHIC
INSTITUTION

CARICOOS FRDO 13.5 MHz Low Power System

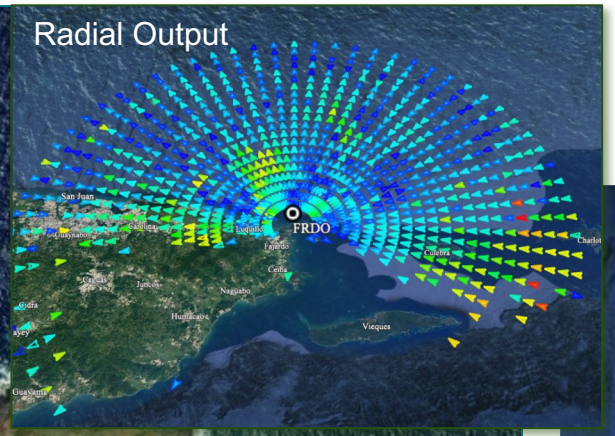
Las Cabezas de San Juan, Fajardo PR



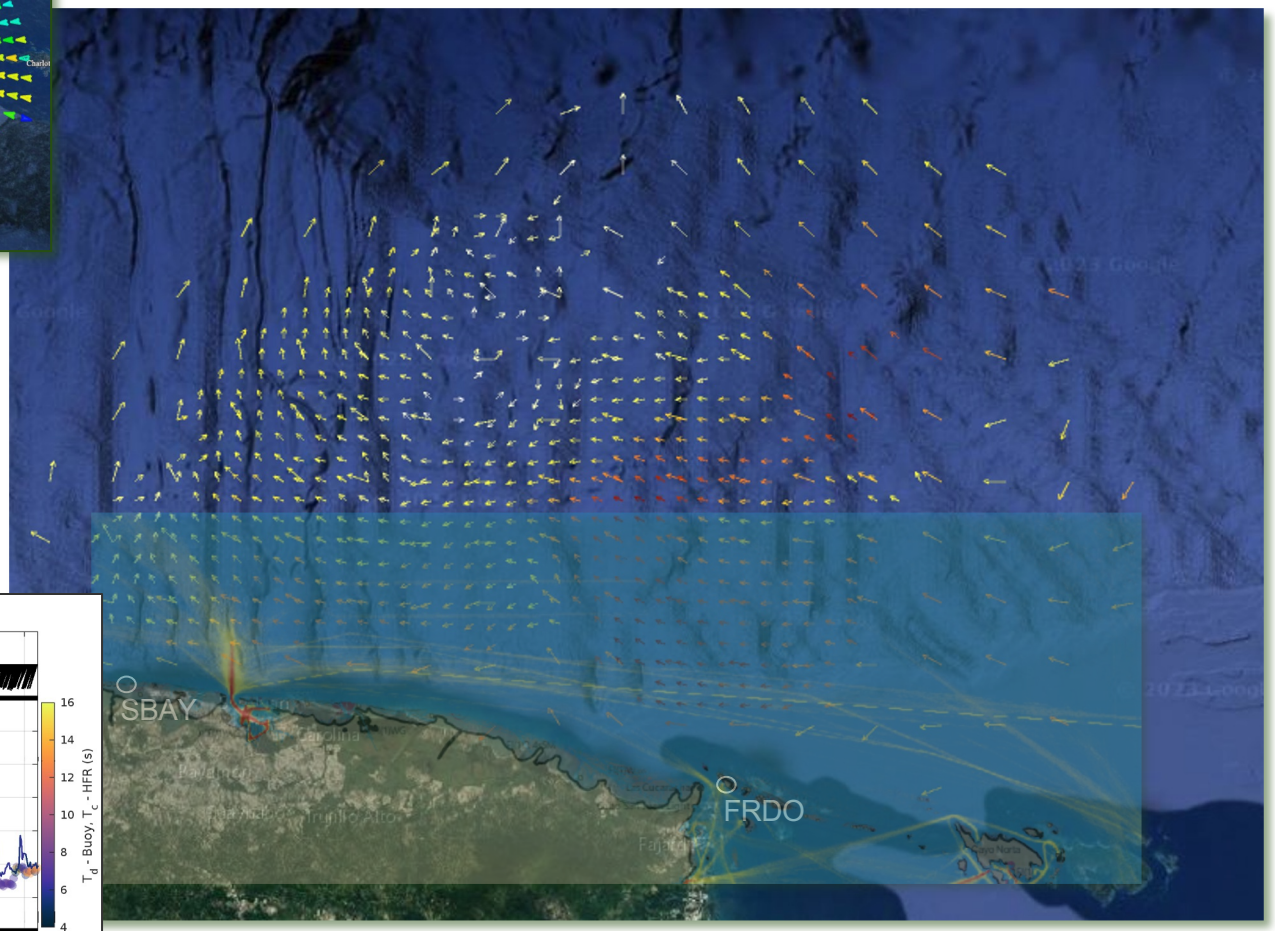


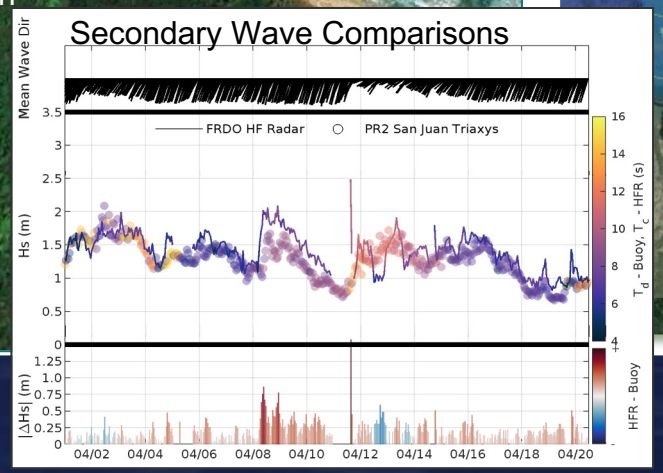
450 ft cable run

275 ft cable run



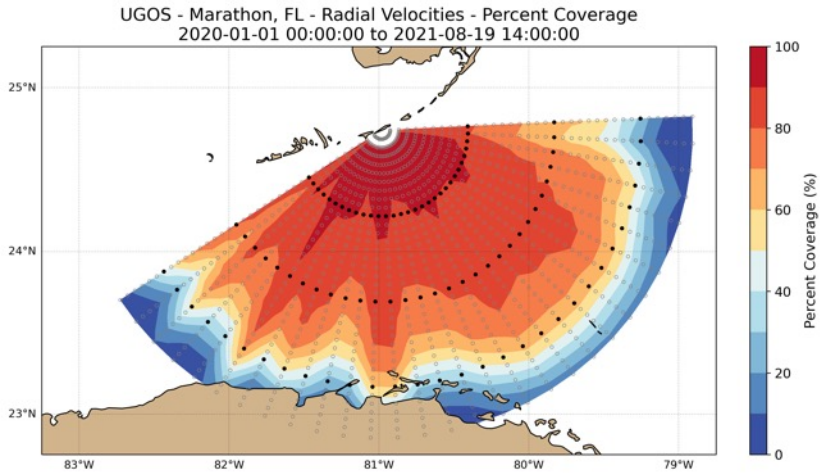
New FRDO site paired with SBAY (Isla de Cabras, PR) covers most of the sea lanes, an area of concern for the Coast Guard Sector San Juan





Development of Quality Control Tools

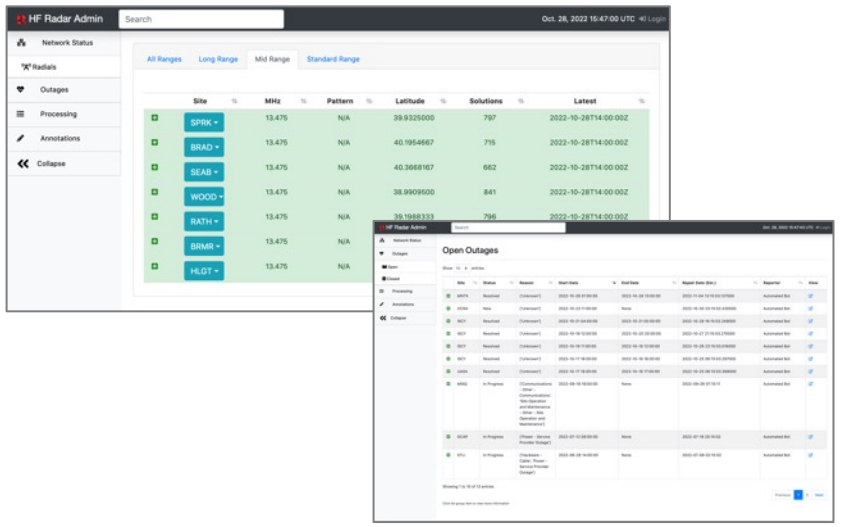
Gulf of Mexico Loop Current and Eddy Observations from HF Radar Systems
2018-2022



NATIONAL ACADEMY OF SCIENCES

NATIONAL ACADEMIES Sciences Engineering Medicine

MARACOOS (Mid-Atlantic IOOS): Powering Understanding and Prediction of the Mid-Atlantic Ocean, Coast, and Estuaries
2021-2026

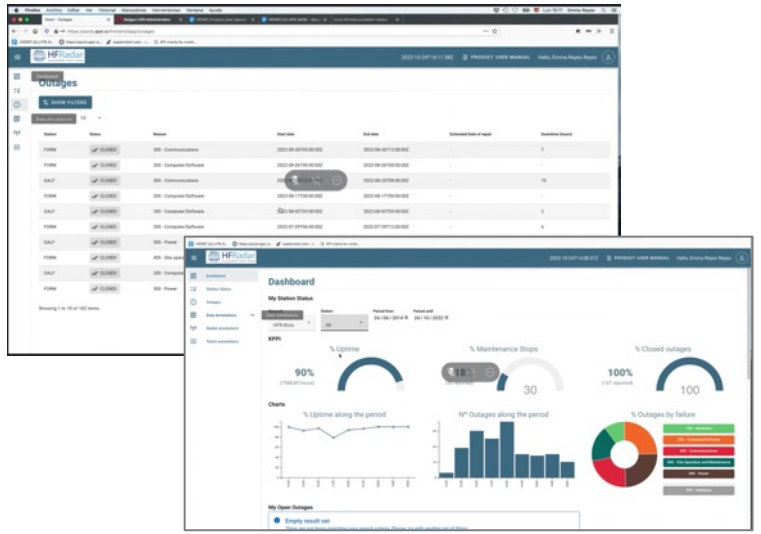


MARACOOS Ocean Information for a Changing World

NOAA National Oceanic and Atmospheric Administration U.S. Department of Commerce

IOOS Integrated Ocean Observing System

Improving and Integrating the European Ocean Observing and Forecasting System
2019-2024



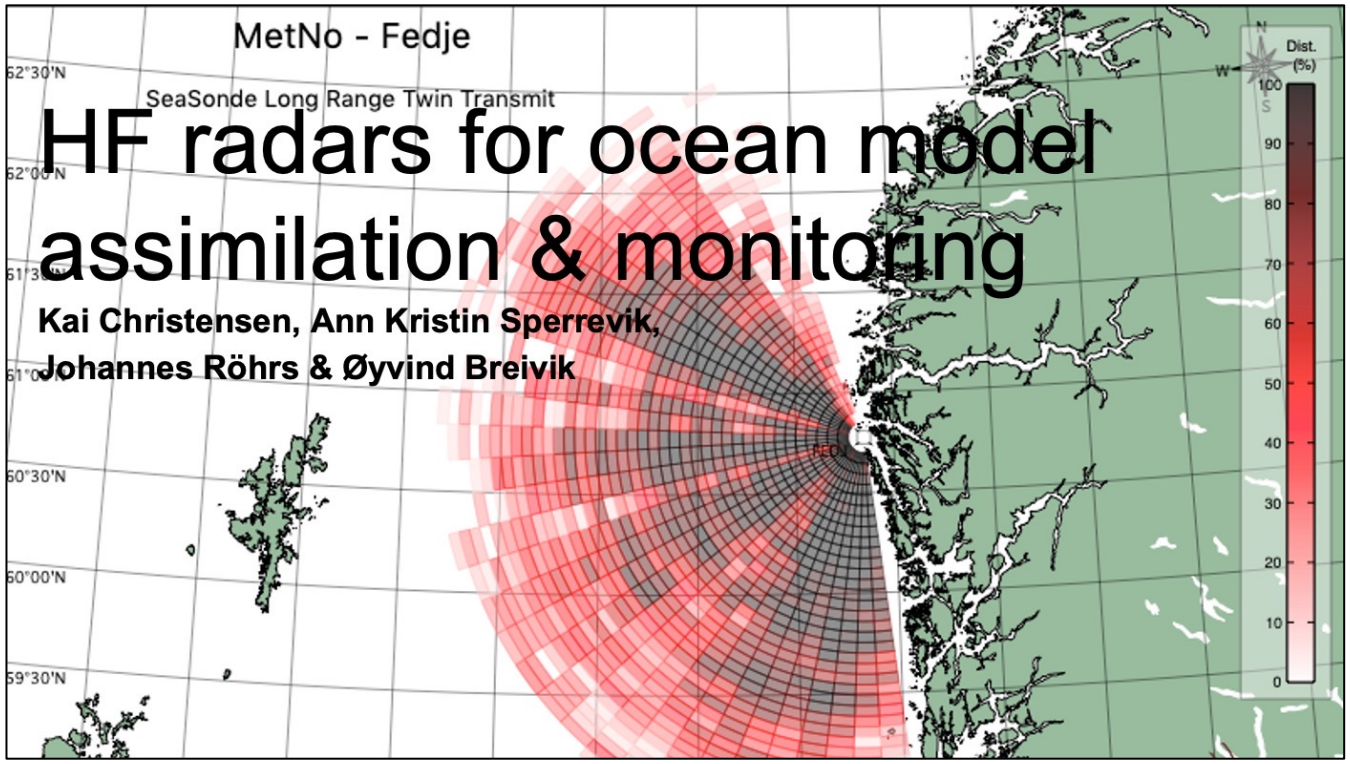
EuroSea

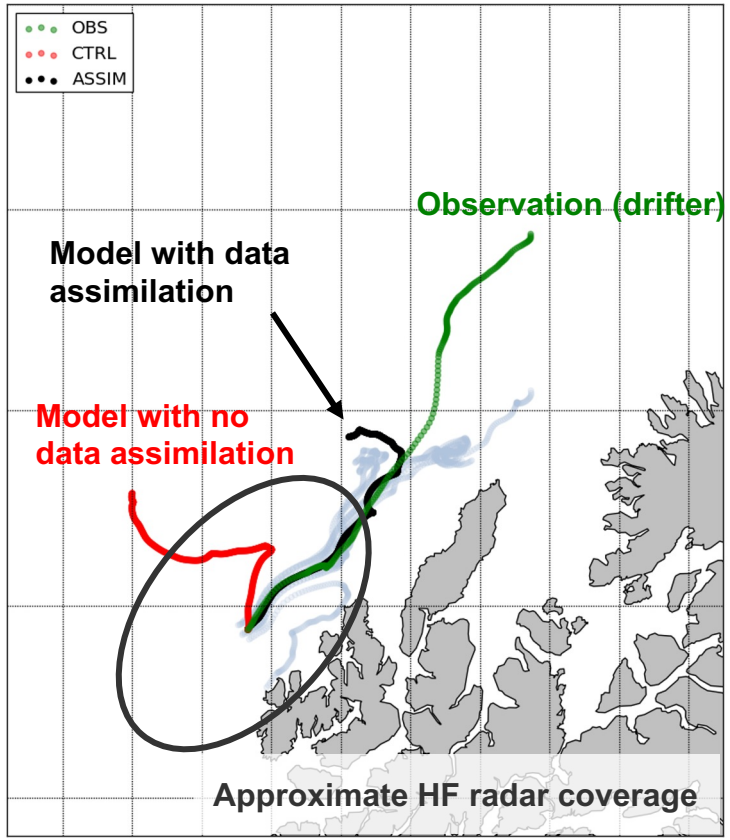
EuroGOOS European Global Ocean Observing System

GOOS

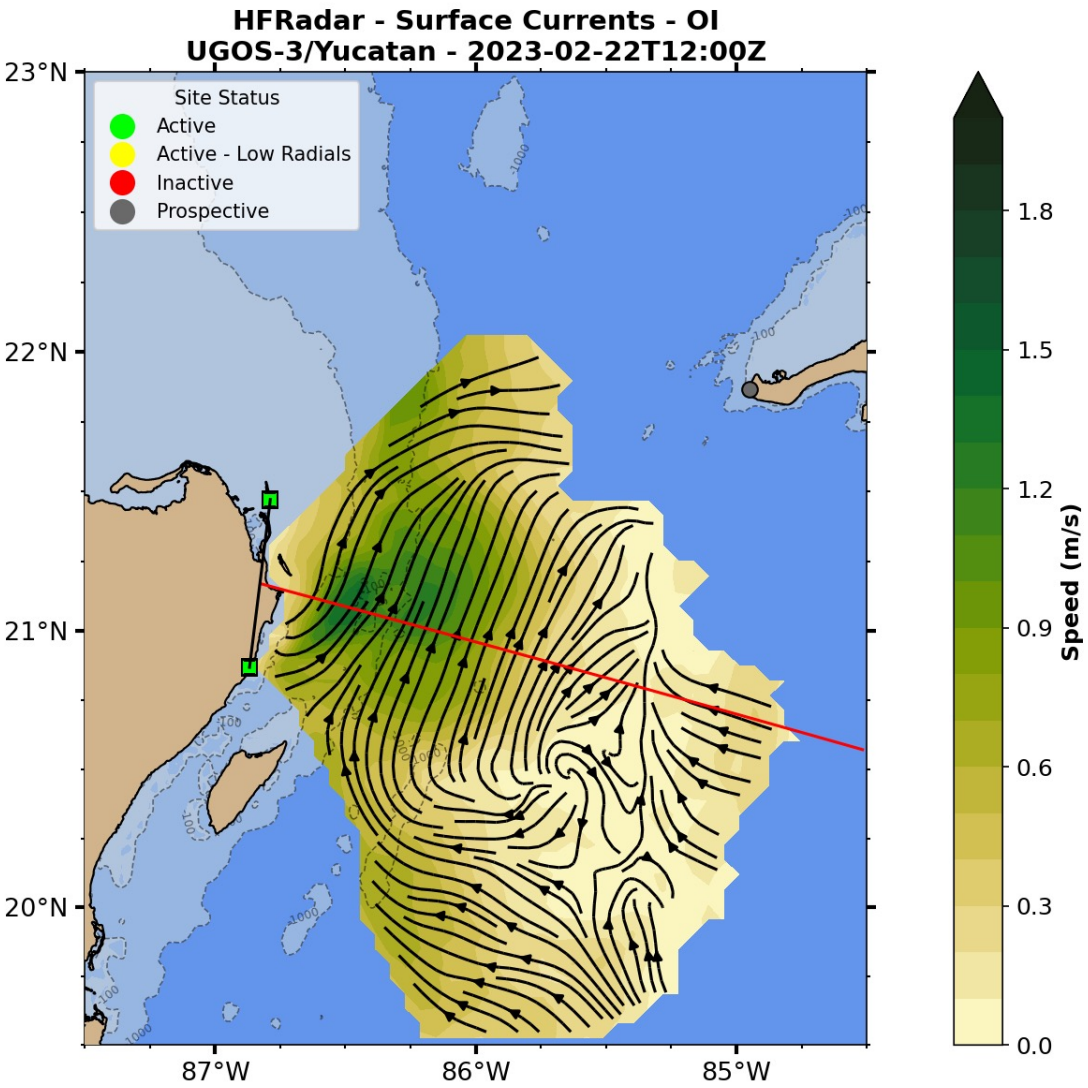
HF radars for ocean model assimilation & monitoring

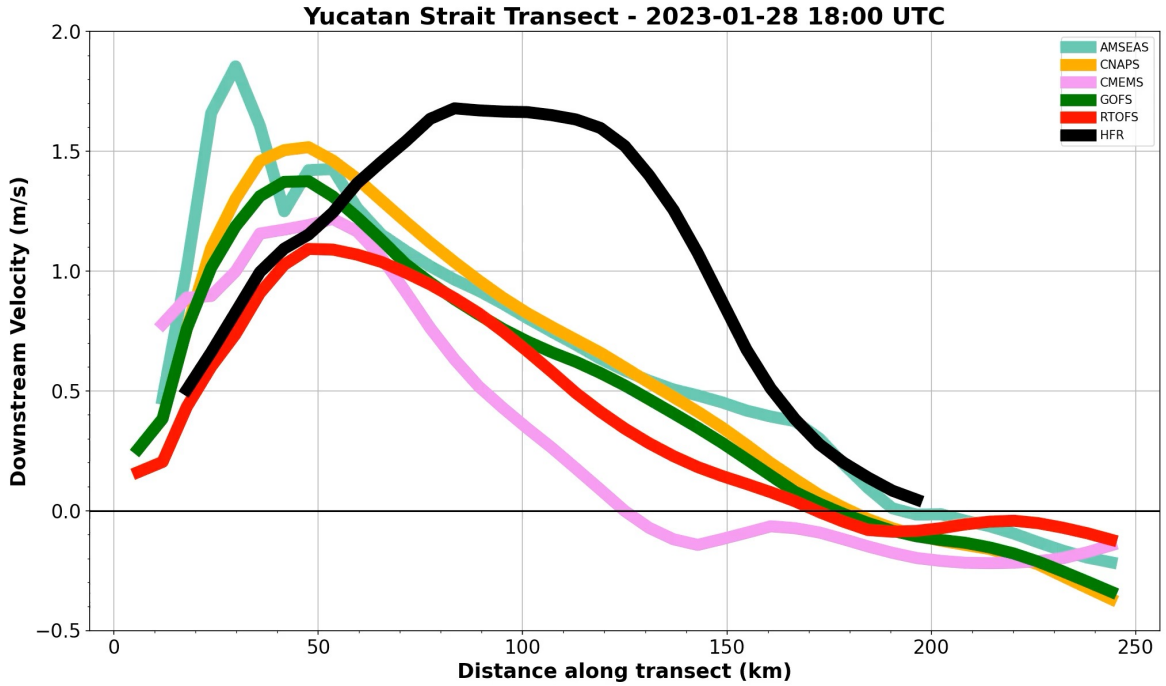
Kai Christensen, Ann Kristin Sperrevik, Johannes Röhrs & Øyvind Breivik



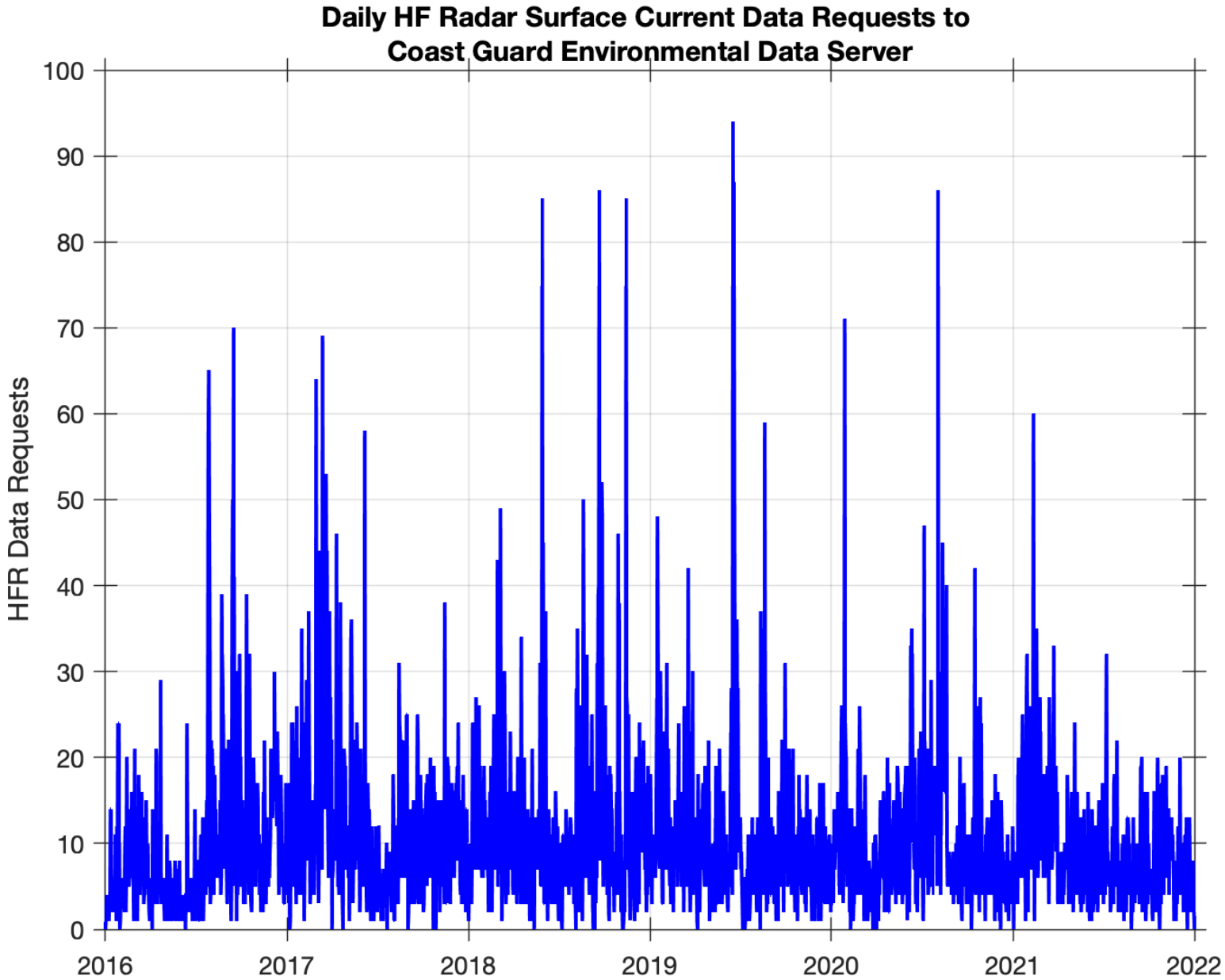


- When used in data assimilation, HF radars have impact also outside their coverage area (e.g. Christensen *et al.*, 2015).
- HF radars play a central role in MET Norway's strategy for ocean observations.

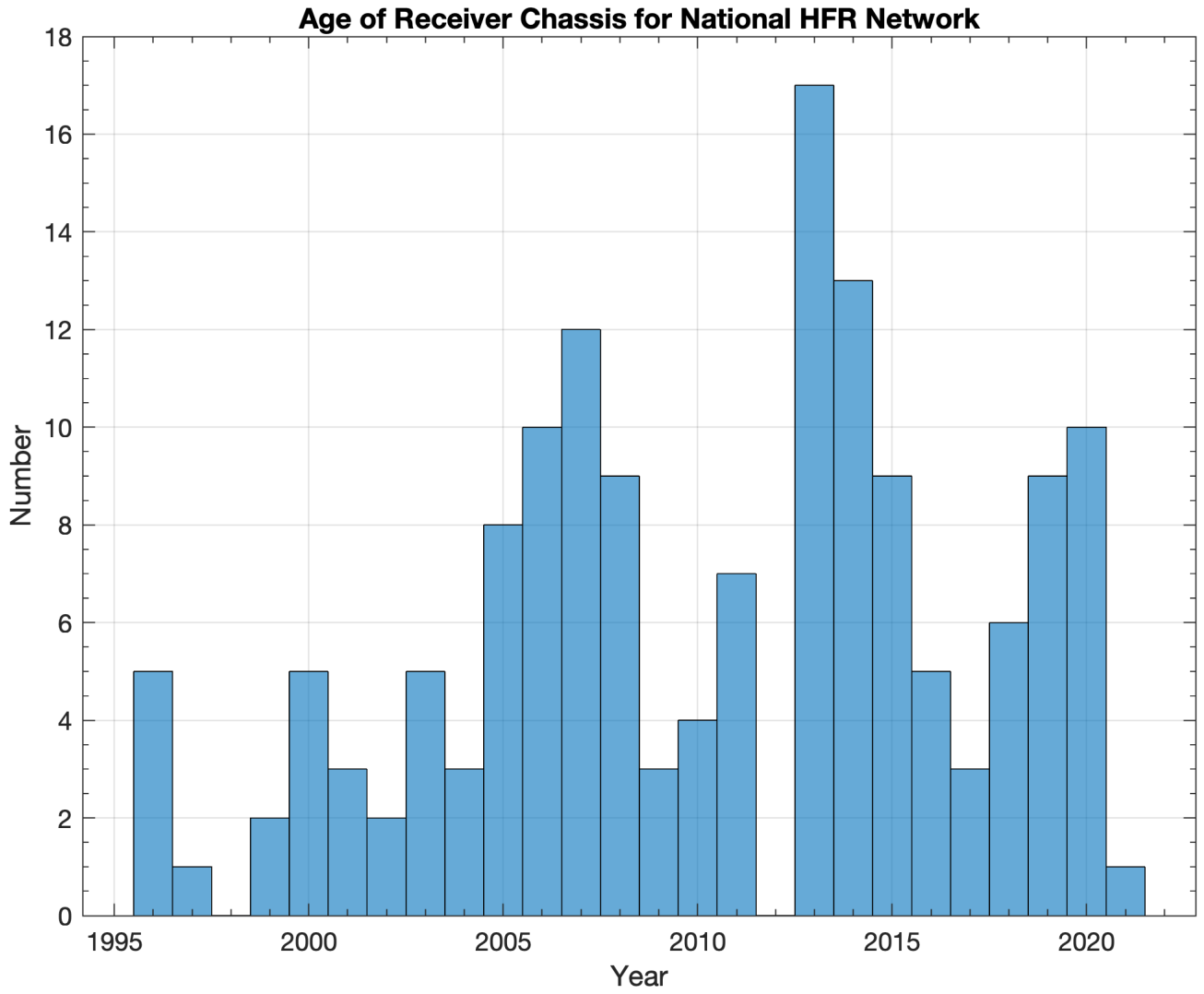




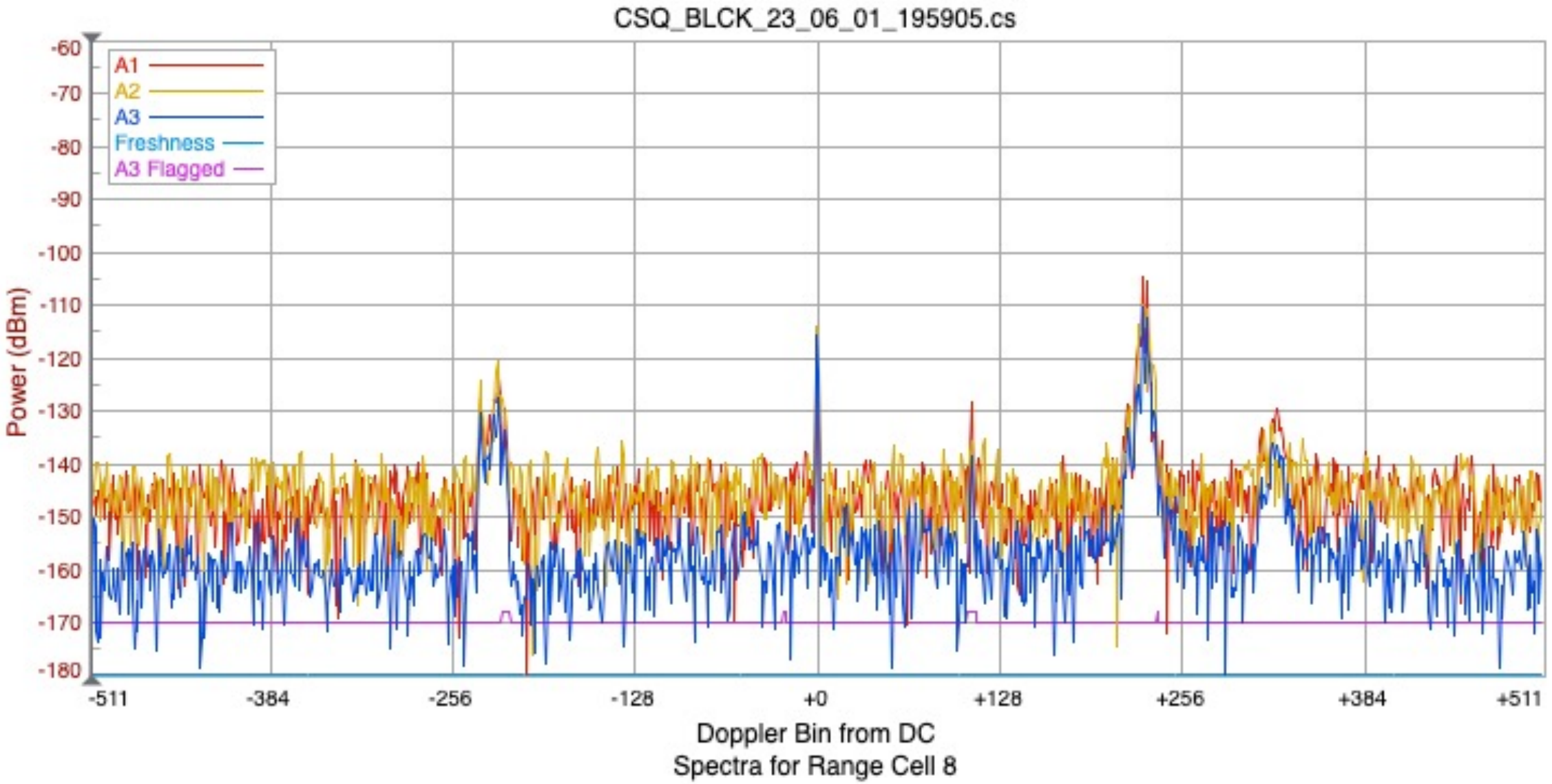
https://rucool.marine.rutgers.edu/ugos-hfr/


Daily HF Radar Surface Current Data Requests to
Coast Guard Environmental Data Server
HFR Data Requests
0
10
20
30
40
50
60
70
80
90
100
2016
2017
2018
2019
2020
2021
2022

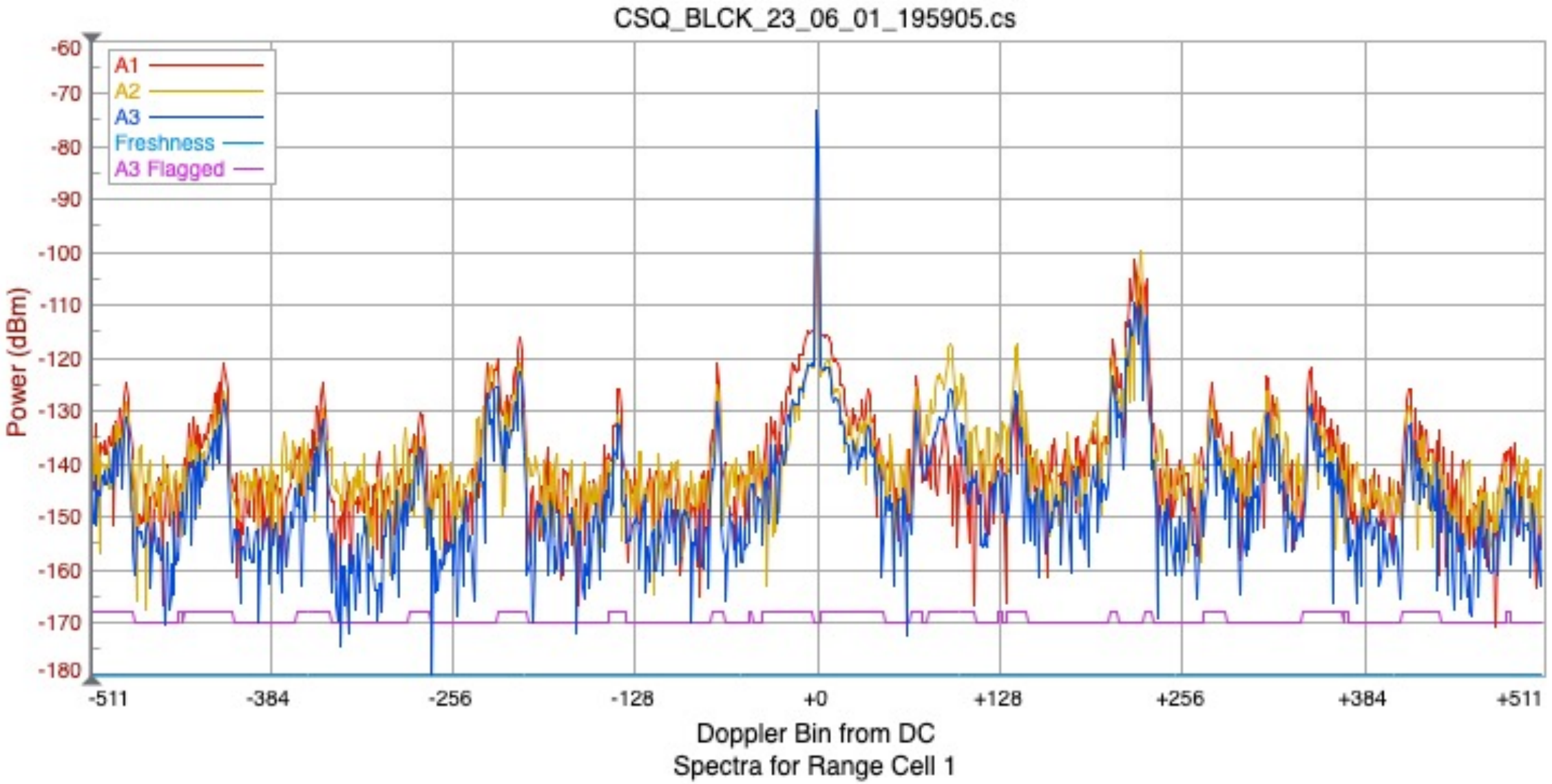
Challenges and Concerns



Challenges and Concerns



Challenges and Concerns



Attribute Report out

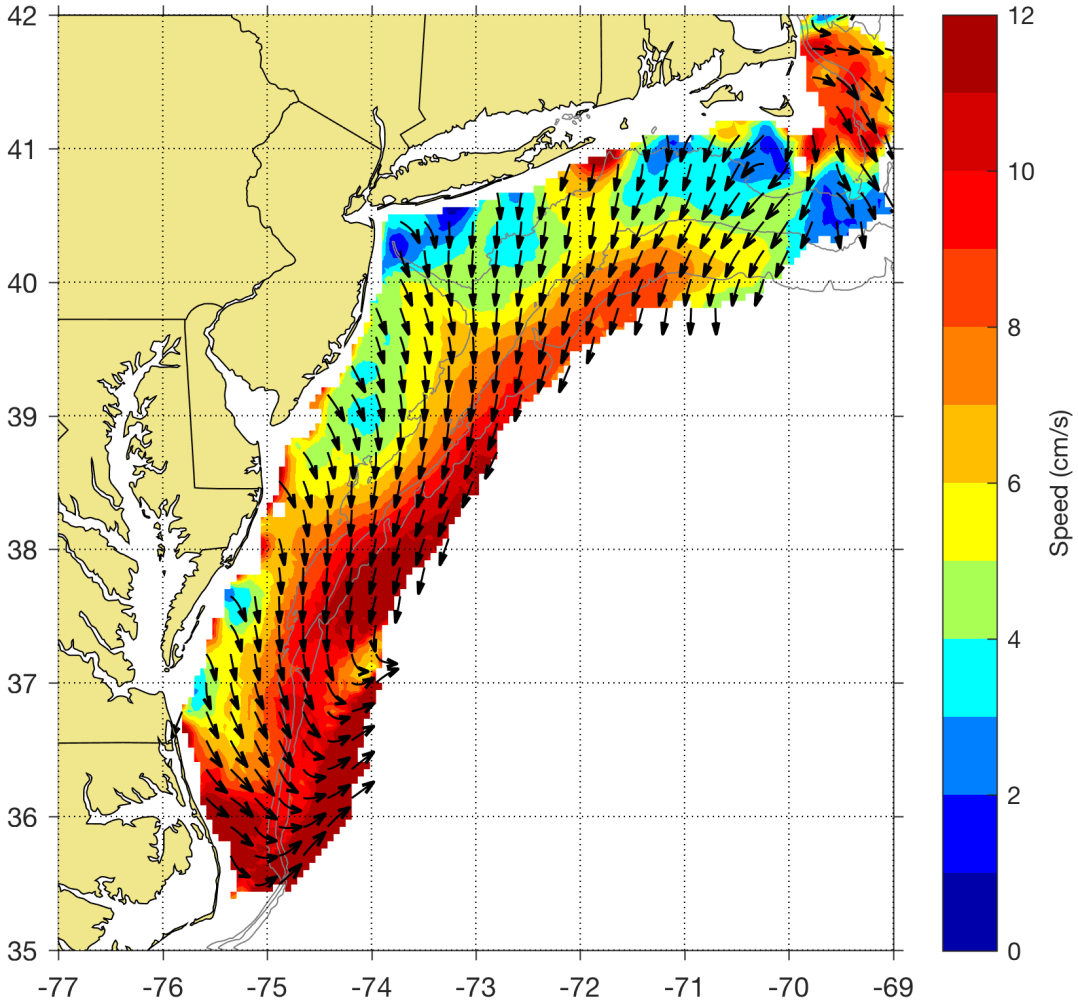
OCG Network attributes

	**Global in scale -** Greater than regional, and as far as feasible, intention to be global.
	**Observes one or more EOVs or ECVs -** Contributes to meeting requirements through observing one or more of the GOOS Essential Ocean Variables or GCOS[1] Essential Climate Variables.
	**Observations are sustained -** Sustained over multiple years, beyond time-span of single research or experimental projects, undertaking routine, systematic and essential ocean observations
	**Community of Practice -** Has an identified governance structure that provides a means of developing a multi-year strategy and implementation plan.
	**Maintains network mission and targets -** A role in the GOOS is defined and progress towards targets can be tracked and progress assessed.
	**Delivers data that are free, open, and available in a timely manner -** Has a defined data management infrastructure that provides data on a free and unrestricted basis, in real time where possible, as well as FAIR-compliant[2] data services for real time and delayed mode data.
	**Ensures metadata quality and delivery -** Complete platform metadata is submitted to OceanOPS in a timely manner.
	**Develops and follows Standards and Best Practices -** Make accessible, develop, document, follow, and update best practices encompassing the observation lifecycle[3].
	**Undertakes capacity development and technology transfer -** Development of activities that enable new (developing and disadvantaged) communities of ocean observers and supports inclusivity and diversity in its members.
	**Environmental stewardship awareness -** Actively develops ideas to minimize environmental footprint and contributes positively towards a healthy ocean.

Future Plans and Opportunities

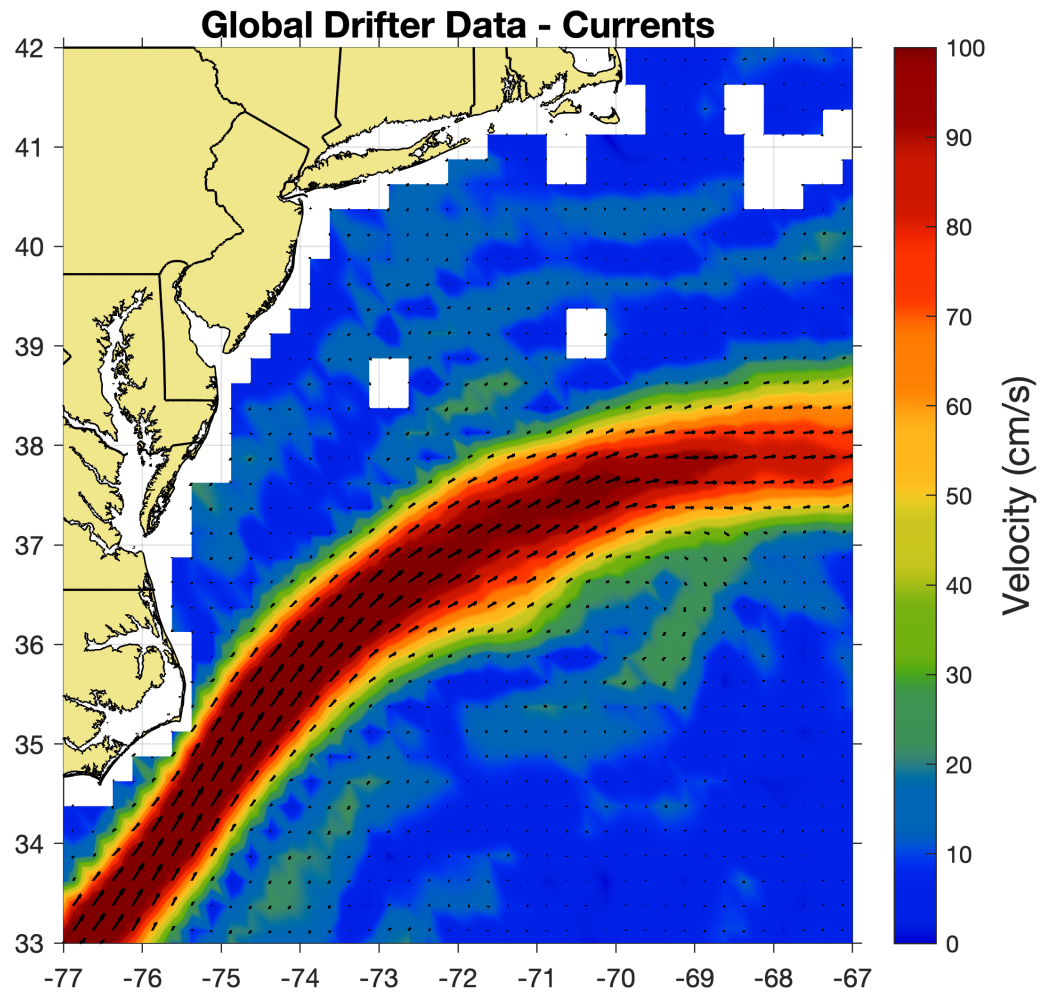
- Future plans and developments, for example
  - Contributions to UN Decade of Ocean Science, SDGs, GOOS strategy, WMO Strategy .....
  - Opportunities to collaborate with other networks
  - Third party/private sector engagement

MARACOOS HFR Surface Current
2007-2016



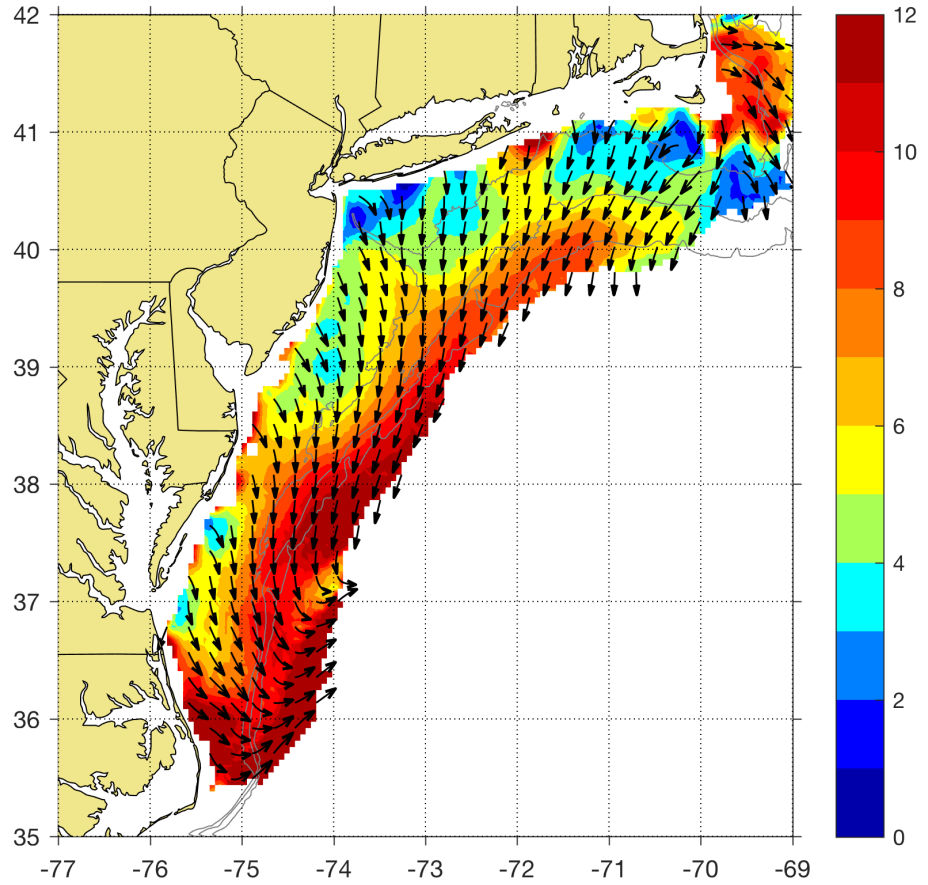
Roarty, H.et al. "Annual and seasonal surface circulation over the Mid-Atlantic Bight Continental Shelf derived from a decade of High Frequency Radar observations." *Journal of Geophysical Research: Oceans* 125, no. 11 (2020): e2020JC016368.

Northwest Atlantic Surface Currents
1979-2015



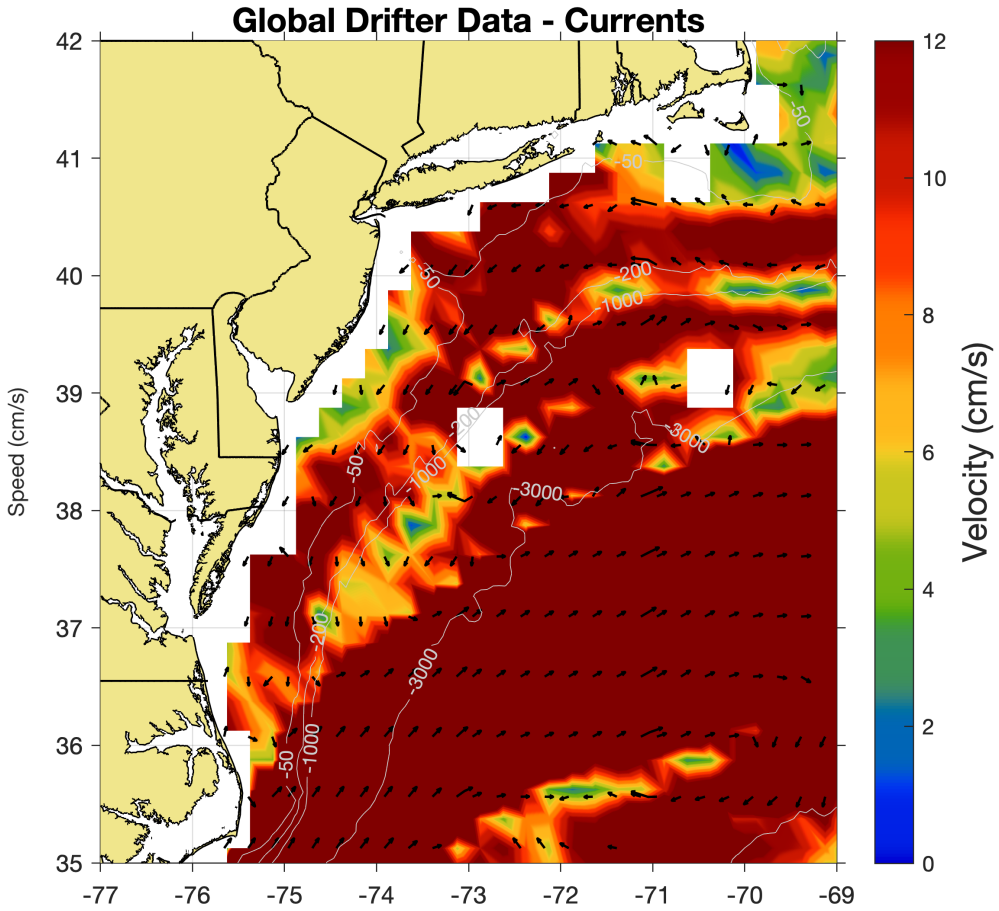
Laurindo, L., A. Mariano, and R. Lumpkin, 2017: An improved near-surface velocity climatology for the global ocean from drifter observations *Deep-Sea Res. I*,**124**, pp.73-92, doi:10.1016/j.dsr.2017.04.009 .

MARACOOS HFR Surface Current
2007-2016



Roarty, H.et al. "Annual and seasonal surface circulation over the Mid-Atlantic Bight Continental Shelf derived from a decade of High Frequency Radar observations." *Journal of Geophysical Research: Oceans* 125, no. 11 (2020): e2020JC016368.

Northwest Atlantic Surface Currents
1979-2015



Laurindo, L., A. Mariano, and R. Lumpkin, 2017: An improved near-surface velocity climatology for the global ocean from drifter observations *Deep-Sea Res. I*,**124**, pp.73-92, doi:10.1016/j.dsr.2017.04.009 .

Asks from OCG

- Increased spectral bandwidth. Can OCG endorse a request for more spectral bandwidth at an upcoming World Radiocommunication Conference.

- As HFR operators move onto dedicated bands for oceanographic radars, can OCG play a role in helping synchronize systems across countries to avoid radio interference.

- Facilitate discussions with the ocean modelling community on the value of HFR surface current and wave data for assimilation into and validation of operational forecast models.

- When radial measurements cross country borders, can OCG help foster the generation of total vector products.

The Global Ocean Observing System

Thank you

goosocean.org

unesco
Intergovernmental Oceanographic Commission

WORLD METEOROLOGICAL ORGANIZATION

UN environment programme

International Science Council