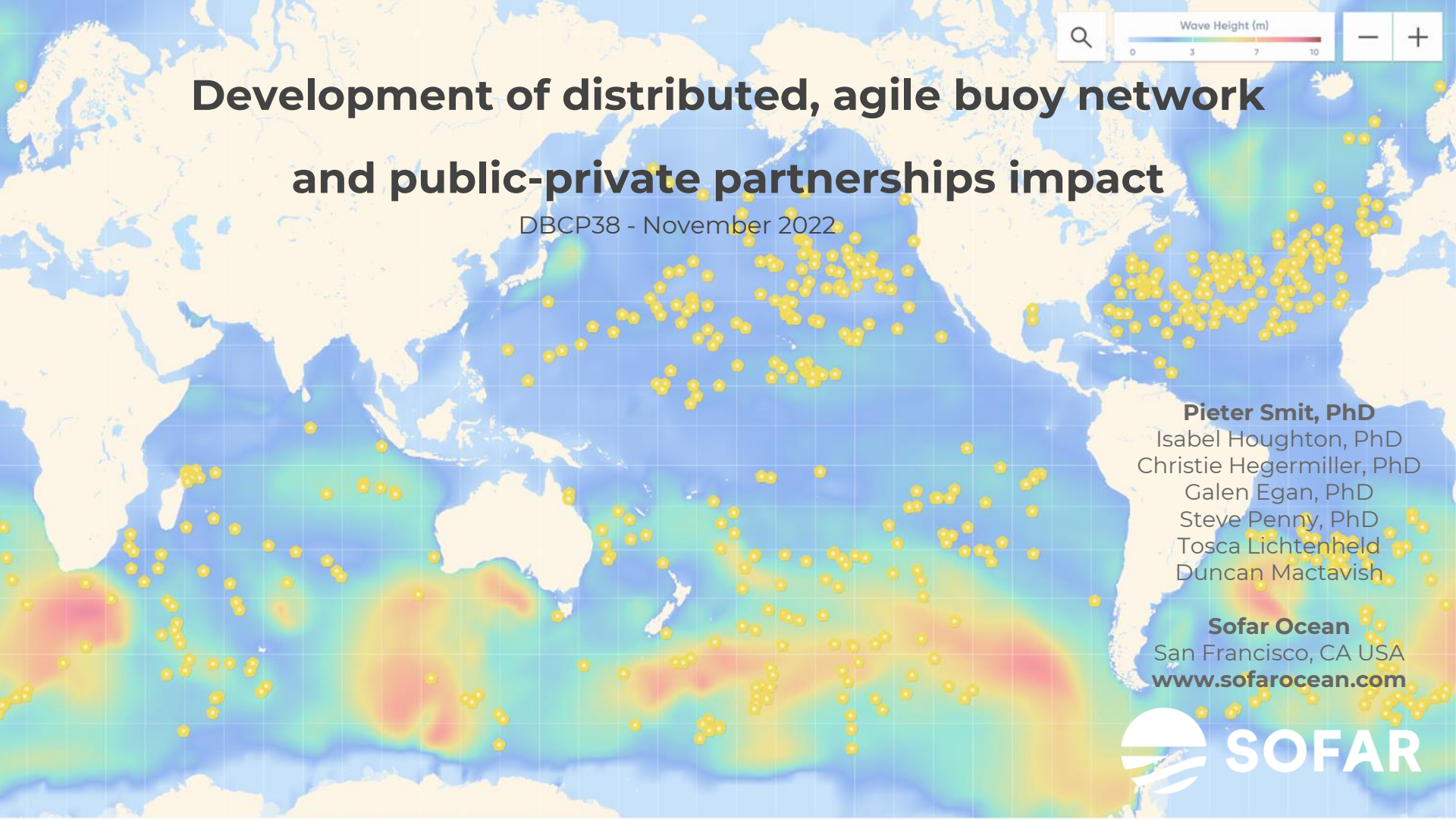
Development of distributed, agile buoy network and public-private partnerships impact

DBCP38 - November 2022



Pieter Smit, PhD
Isabel Houghton, PhD
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SOFAR

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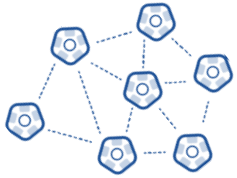
Spotter 3 Sensing Platform

Ideal platform for collaborative use cases.



Sensing Network

Deployment and current state of our global sensing network

Partnership Examples

NOPP, Ice Center, Backyard Buoys

Academic Research Program

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Sensing platform
Spotter 3

Sensors
SST, Barometer, GPS, microphone

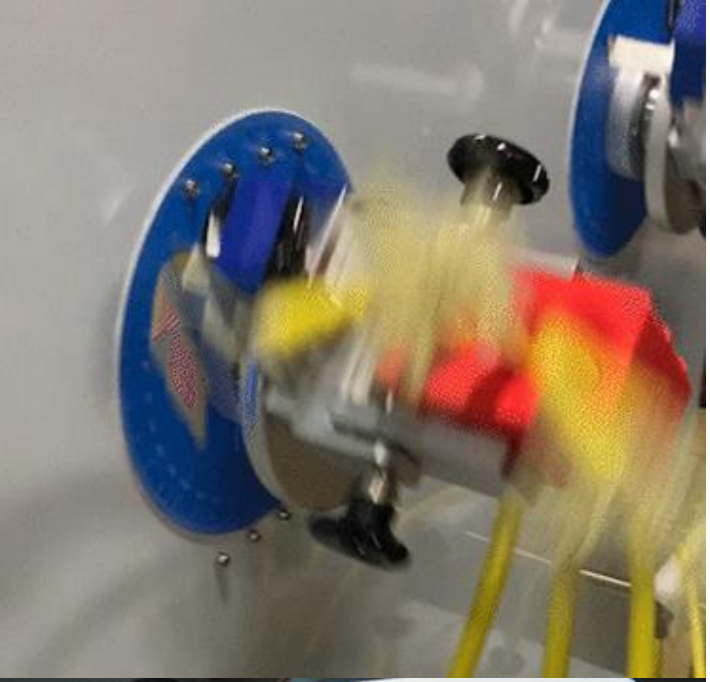
Direct observations
Waves, SST, Sea surface pressure

Proxy observations
Wind stress, surface currents, precipitation (in development)

Communication
2-way, real-time communication via Iridium and Cellular, over the air updates.

Connectivity
Smart-mooring and Bristlemouth

Agile
Easy to deploy



Durability improvements mooring

New construction, new materials, and rigorous quality testing process for fatigue and strain failures.

System hardening

Internal hardening of electronics allows for agile deployment strategies

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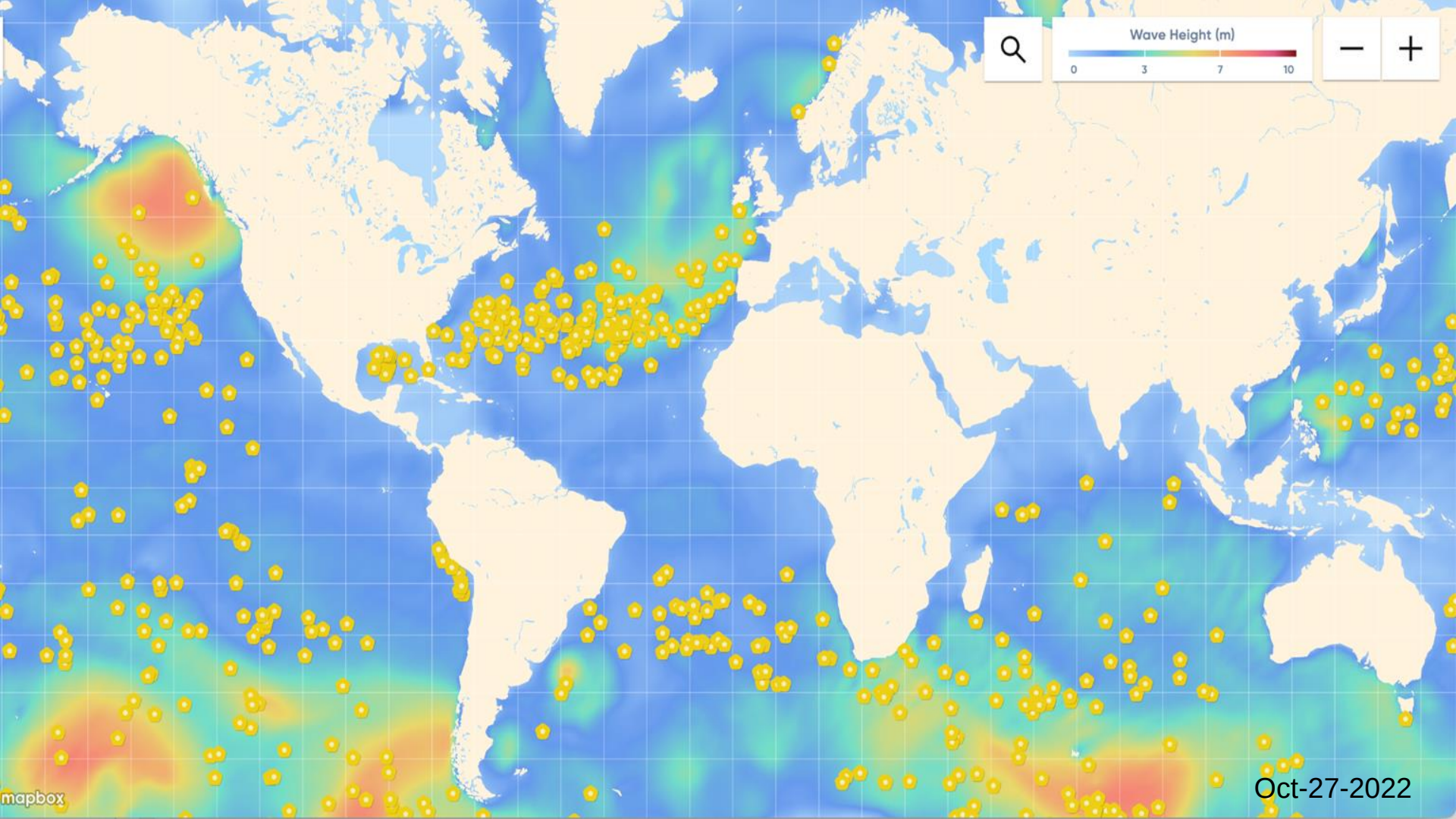
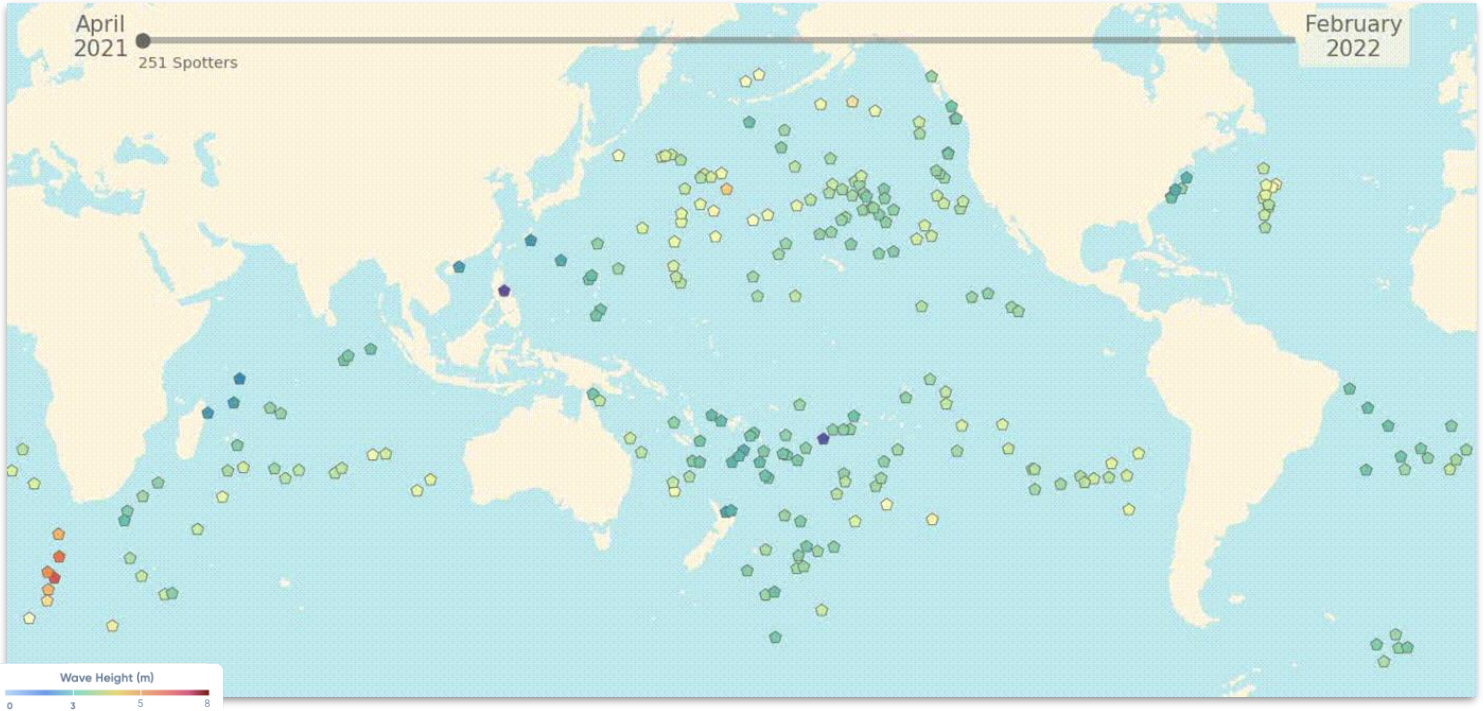

Wave Height (m)
0
3
7
10
mapbox
Oct-27-2022

Global coverage by Sofar Spotter network

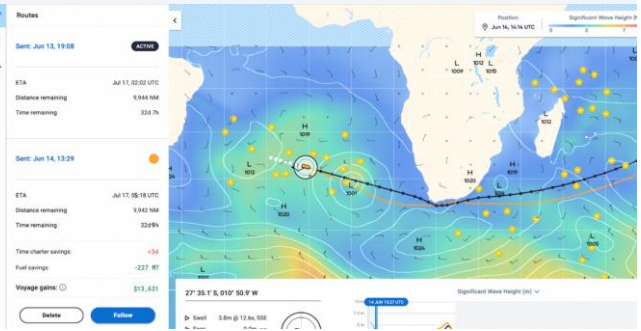
Scalable hardware, network of deployment partners and ships of opportunity, and buoy longevity allow for persistent distributed sensing of global ocean conditions.



Applications of the Sofar Spotter network

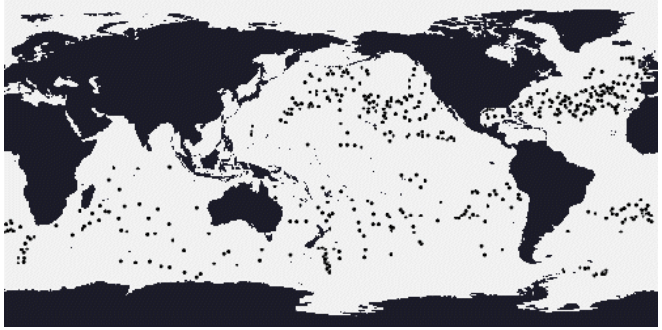
Navigation

Buoy information is actively used to inform mariners of inclement weather.



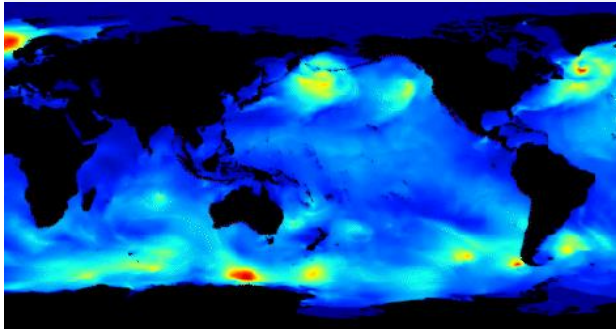
Science

Access to our global network is freely available for academic users.
https://www.sofarocean.com/products/data-services



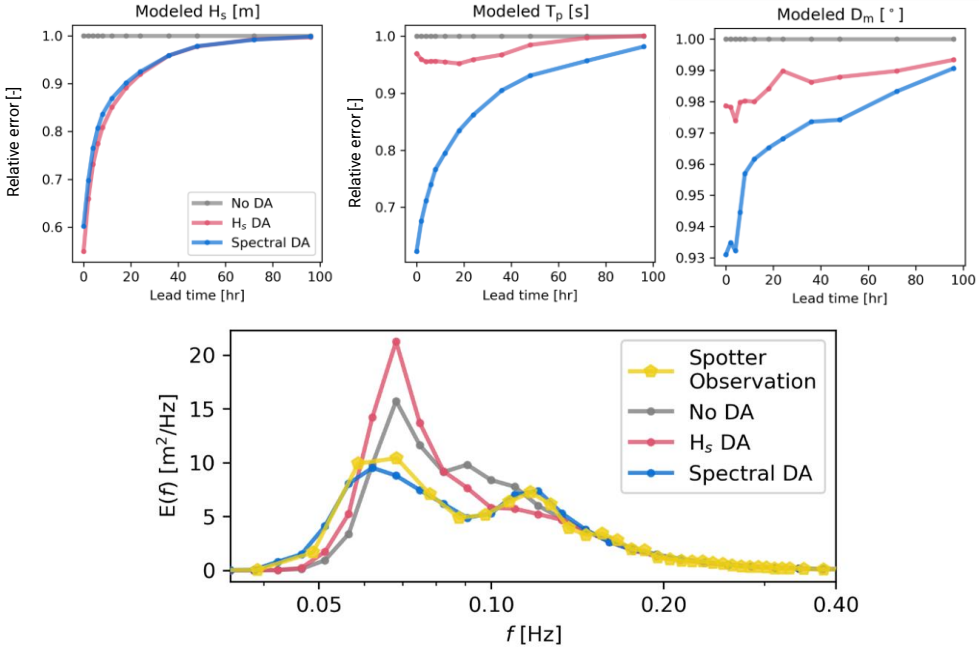
Forecasting

Network is used in global operational forecasts.



Assimilation of wave spectra observations in WW3

- *Large scale distributed sensing networks (e.g. Spotters) substantially improve wave forecasts*
  - Large improvements in the short term (~ 24 hours)
  - Long-term relaxation towards forcing
  - Swell updates persist
- *Spectral observations are vital to reach additional impact on forecasts*
  - Improvement to frequency and direction characteristics (spectral shape) are persistent on medium timescales

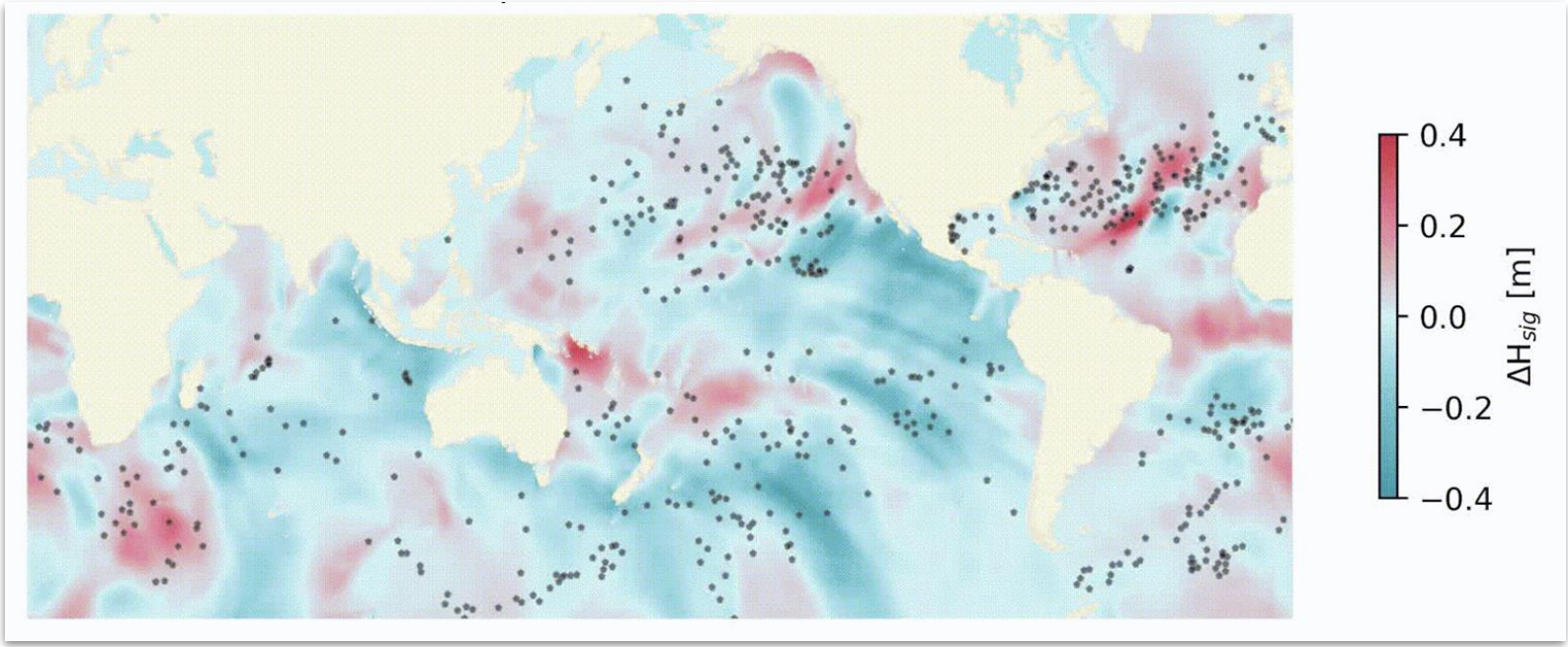


Upper: Assimilation of spectral information improves Hs, Tp, and Dm over assimilation of Hs alone.
Lower: Spectral information modifies the model spectrum to best align with observations.

Houghton, et al. (2022). Operational assimilation of spectral wave data from the Sofar Spotter network. *Geophysical Research Letters*, 49
Smit, P. B., et al. (2020). Assimilation of distributed ocean wave sensors. *Ocean Modelling, 159*

Global forecasting with assimilation of wave spectra observations in WW3

Difference in 48-hour forecast with data assimilation vs. without



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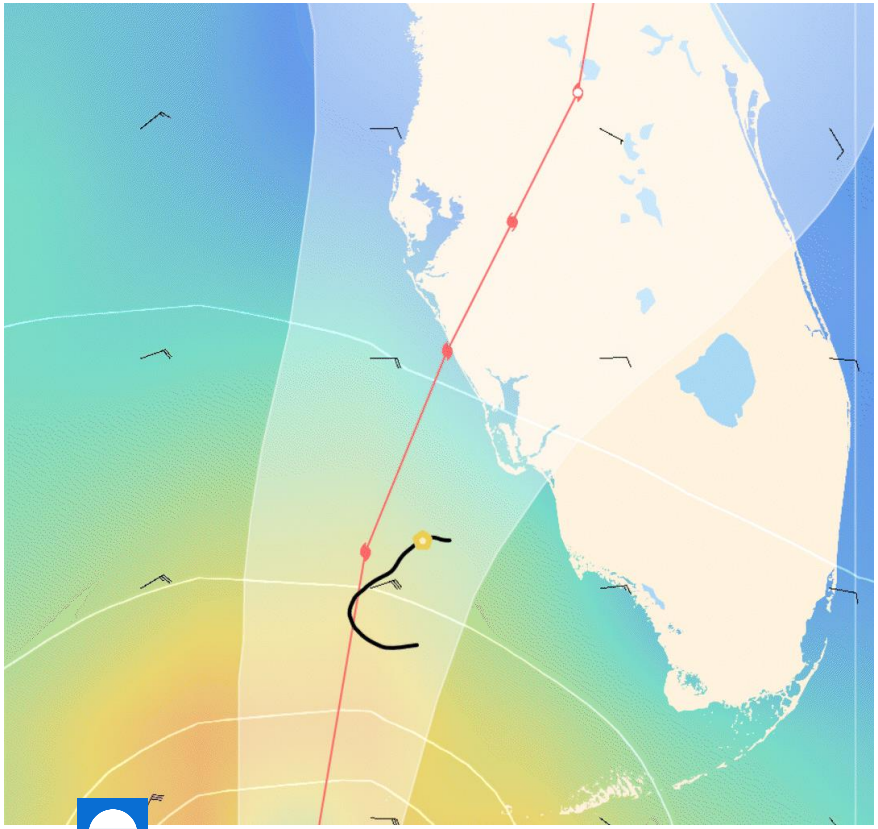
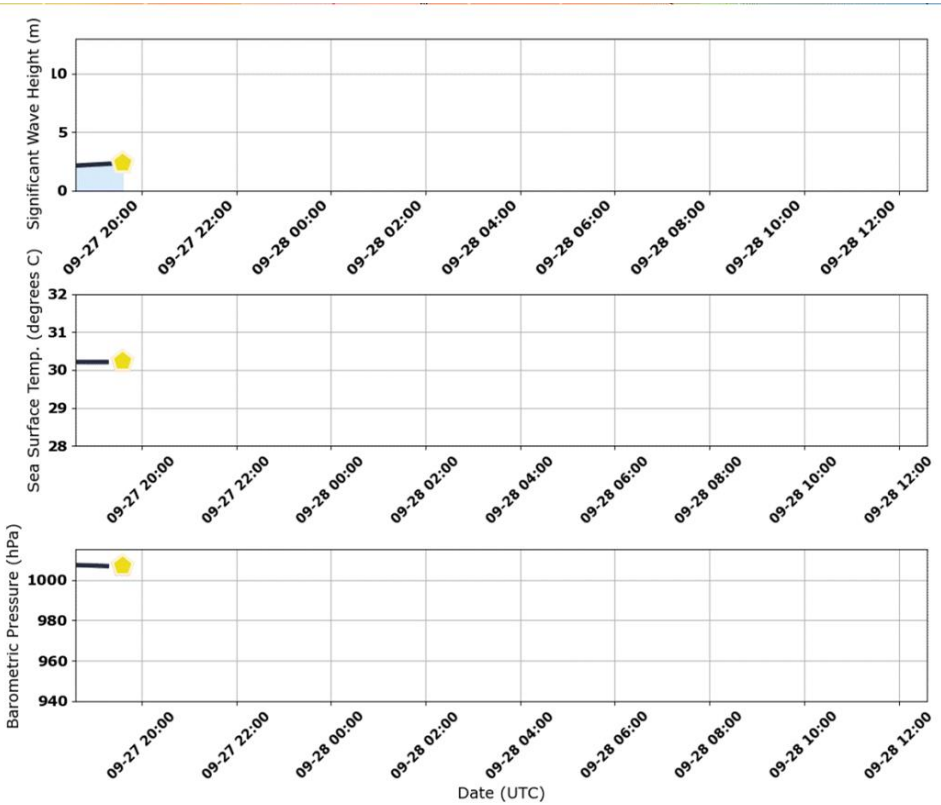
SPOTTER

NOPP Hurricane Coastal Impact

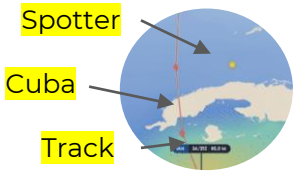
https://nopphurricane.sofarocean.com/

Hurricane Ian



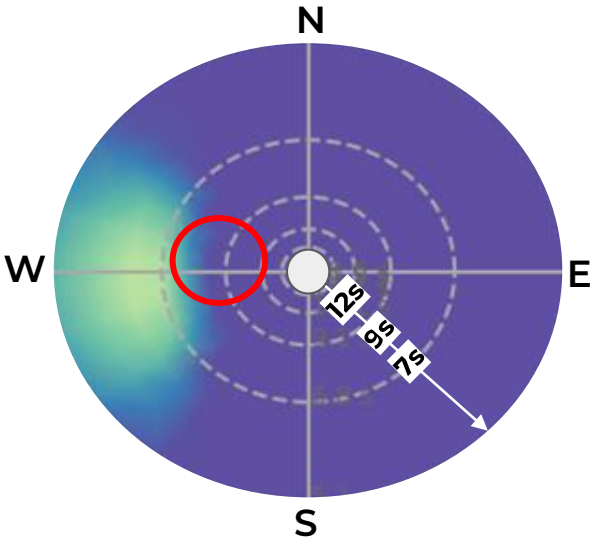


Data assimilation Spectral DA during Ian



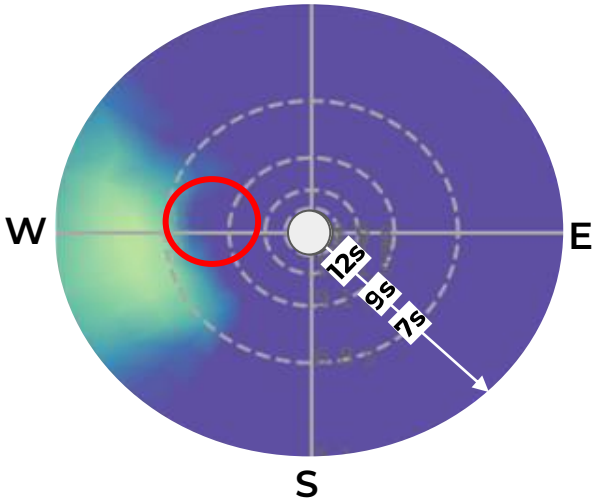
Observation

Spotter directional spectrum
(MEM2 estimate, Kobune and Hashimoto, 1986)



Spectral Data Assimilation

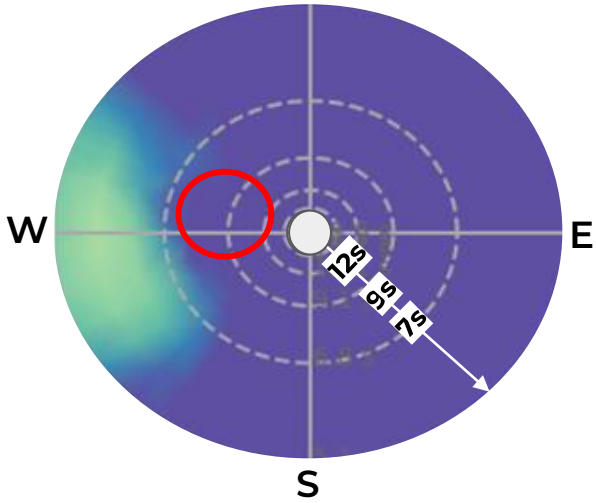
Sofar ¼ degree WW3 model with DA (ECMWF wind forcing)
(Houghton et al, 2022)



Assimilation of data improves the westward Sea/Swell peak.

No Data Assimilation

Sofar ¼ degree WW3 control model (ECMWF wind forcing)



This peak is unresolved in a model without data assimilation degrading forecasts.

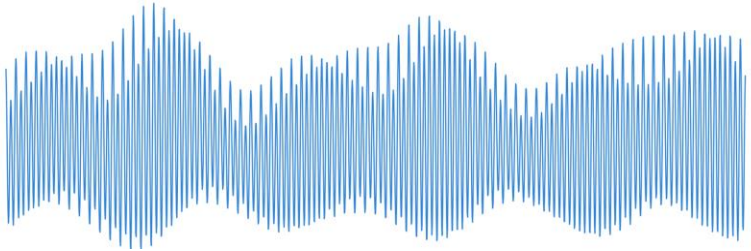
WEATHER

Storm Surge Research

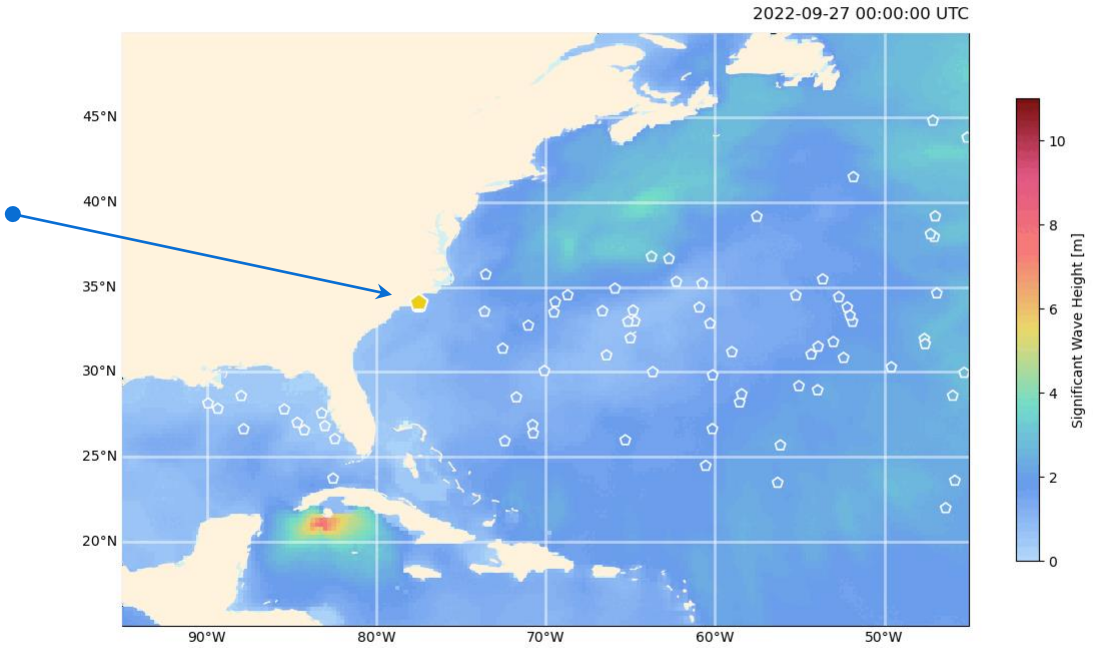
Smart Mooring array with Pressure Sensors

→

Tidal estimates and storm surge calculations

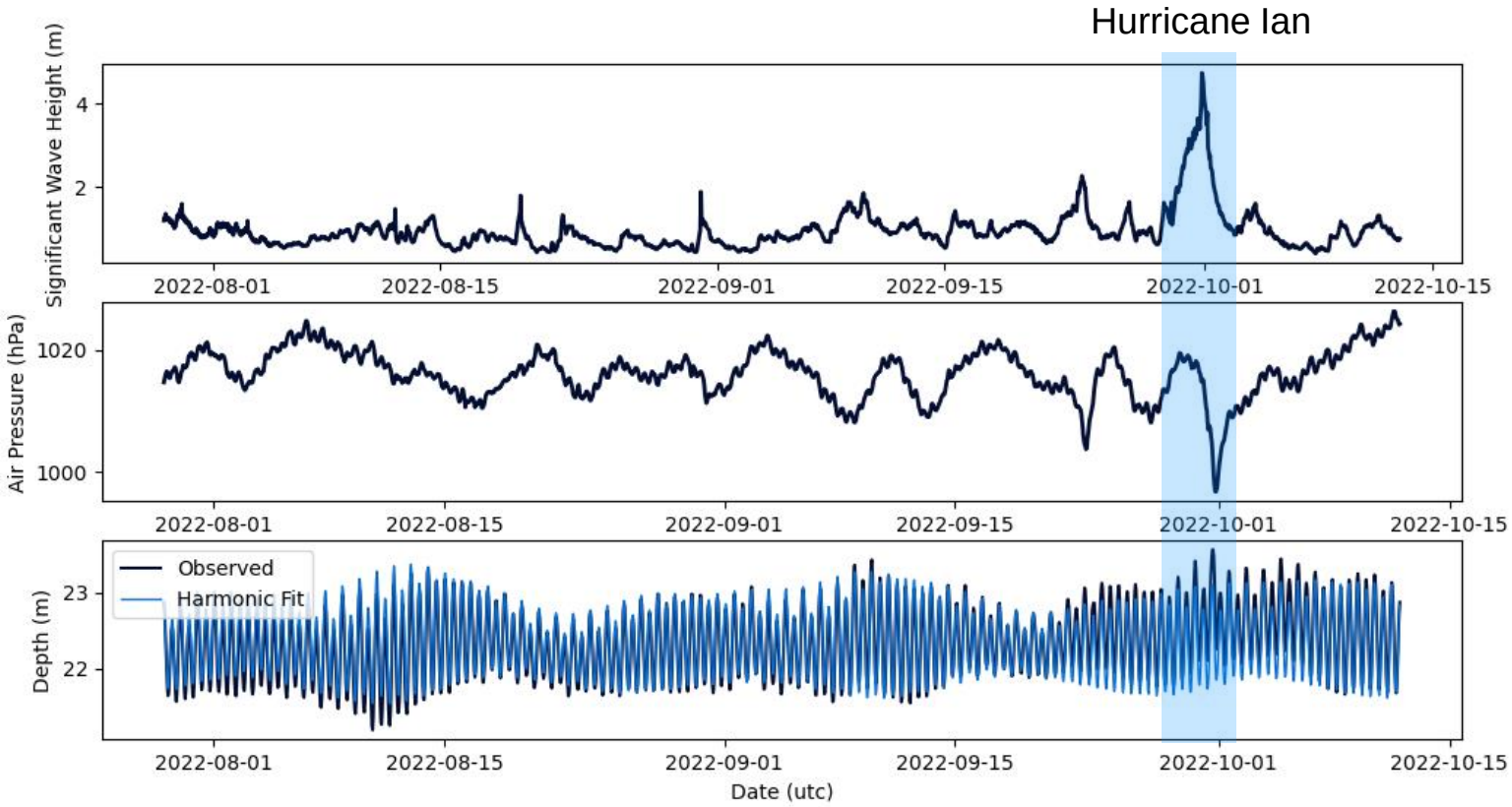


Smart Mooring approximately 20 miles offshore Wilmington, NC records data during Hurricane Ian



WEATHER

Storm Surge Research



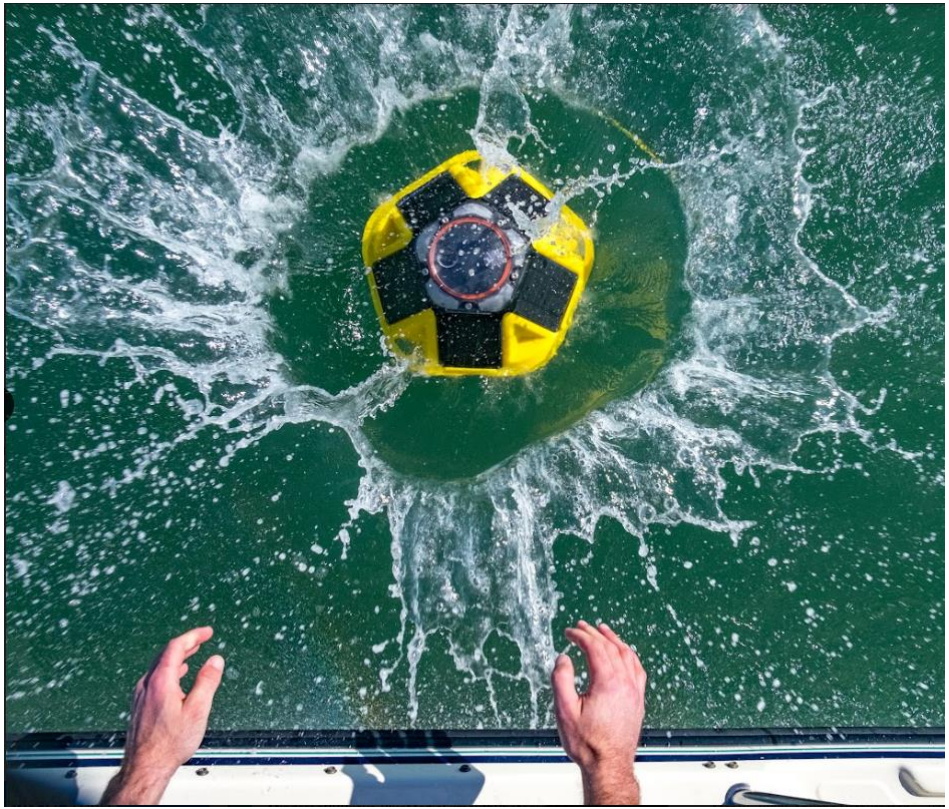
U.S. National Ice Center • Arctic Marine Weather Conditions

5 Spotters deployed in the Chukchi Sea to provide long-dwell data about waves and SST in a previously data-sparse environment.

In-Situ Wave Data & Wave Effects on Sea Ice Breakup

- Melting sea ice is leading to more fetch
- Changing climate → changing waves, changes in erosion and coastal change
- Increased shipping and naval activity in the arctic, more of a need to characterize the wave climate
- Ice Center partnership will build on previous ice research performed with Spotters

Bringing community solutions



Ocean Data At Scale: The Backyard Buoys Project

BACKYARD BUOYS

Indigenous / Community Partners | *Educational / Technical Partners* | *Ocean Observing Partners*

Quinault Indian Nation

ANSEP

Sea Grant University of Hawai'i

NANOOS

AOOS Alaska Ocean Observing System

PacIOOS Pacific Islands Ocean Observing System

UAF University of Alaska Fairbanks

MIES Marshall Islands Conservation Society

Conservation International Hawai'i

Western Washington University

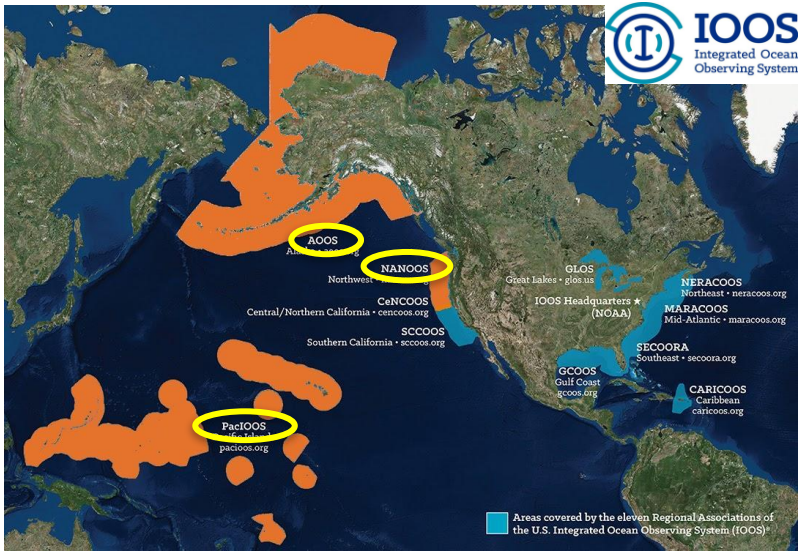
Weston Solutions

Alaska Department of Natural Resources

National Park Service

Alaska Eskimo Whaling Commission

SOFAR



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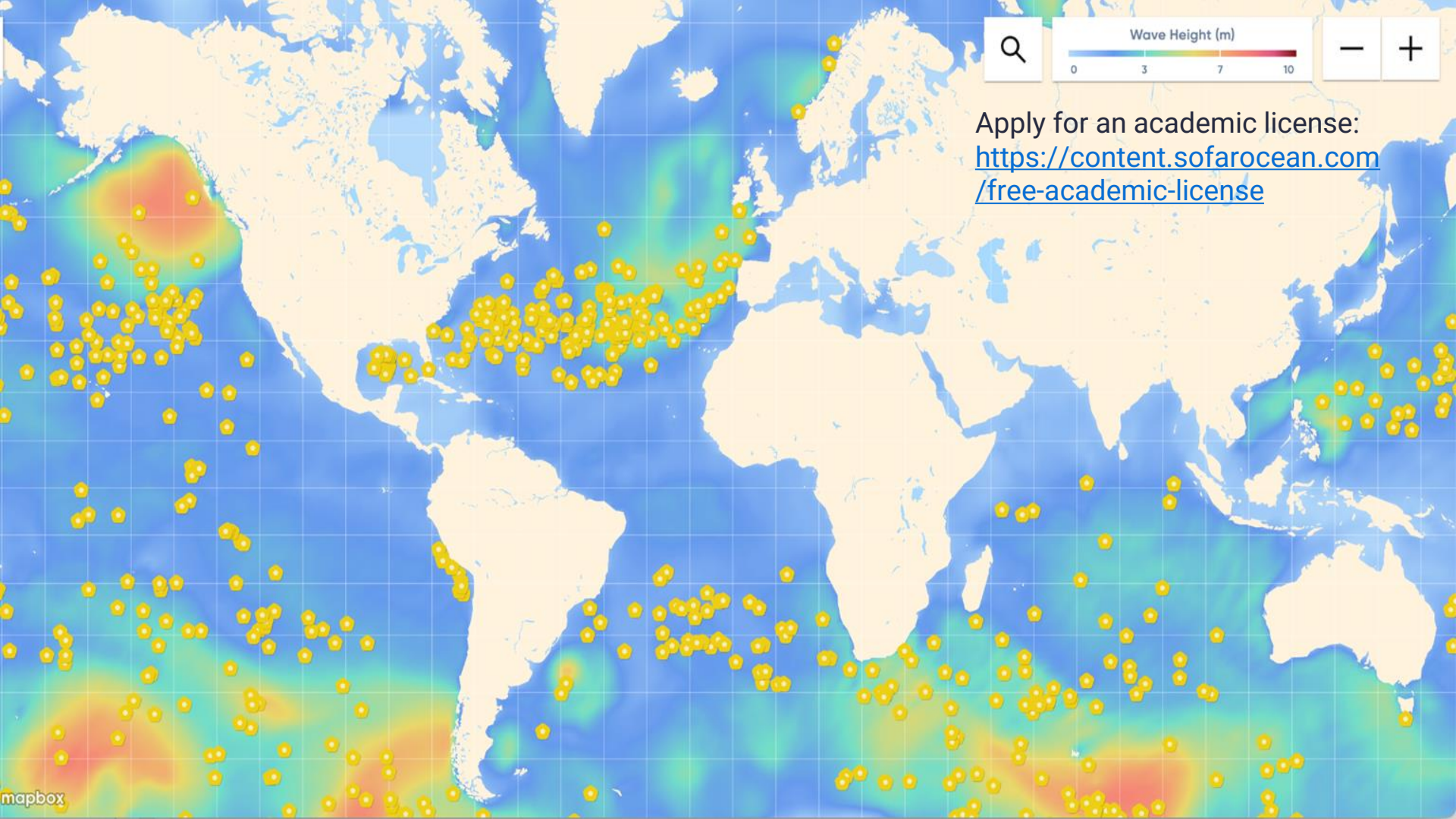
Wave Height (m)
0
3
7
10
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QUESTIONS?

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Head of Ocean Research

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