

# A patchwork of Potentiality: Developing a Global Network of Uncrewed Surface Vehicles for the Global Ocean Observing System

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6. CSIR – South Africa
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8. Viking Ocean Strategies

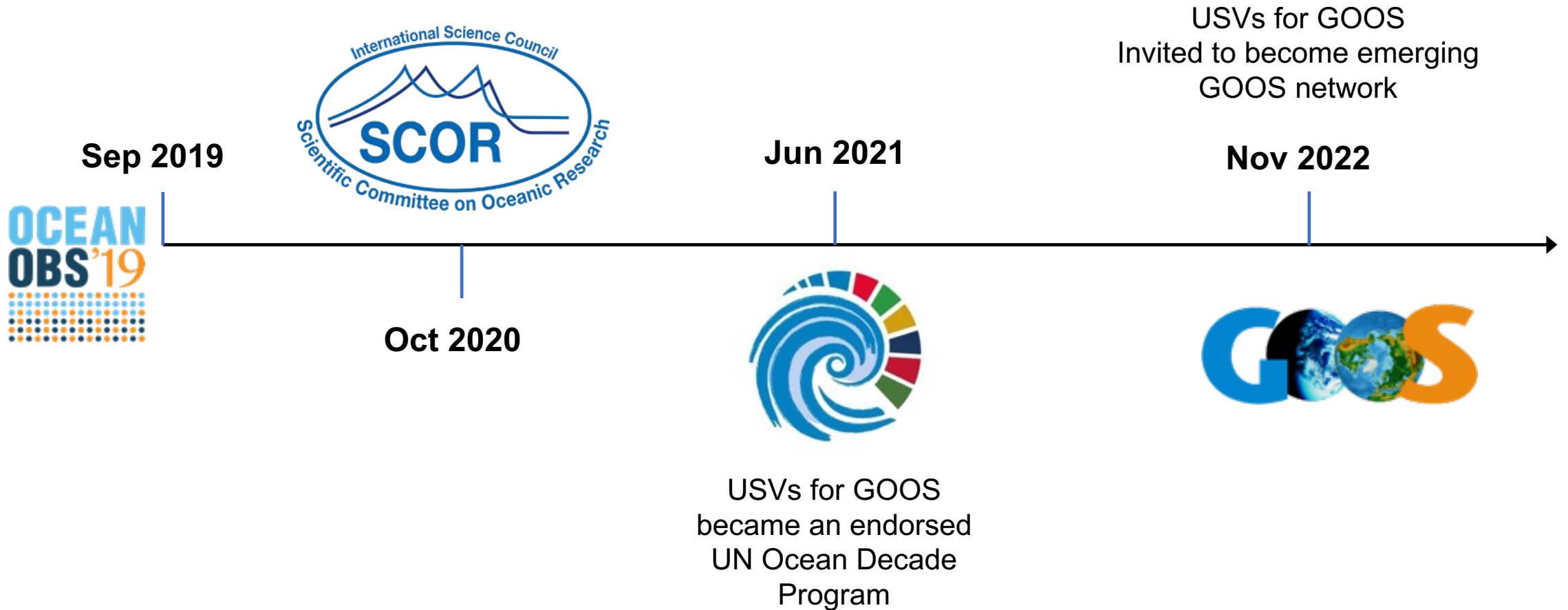
**OASIS**

*Observing Air Sea Interaction Strategy*

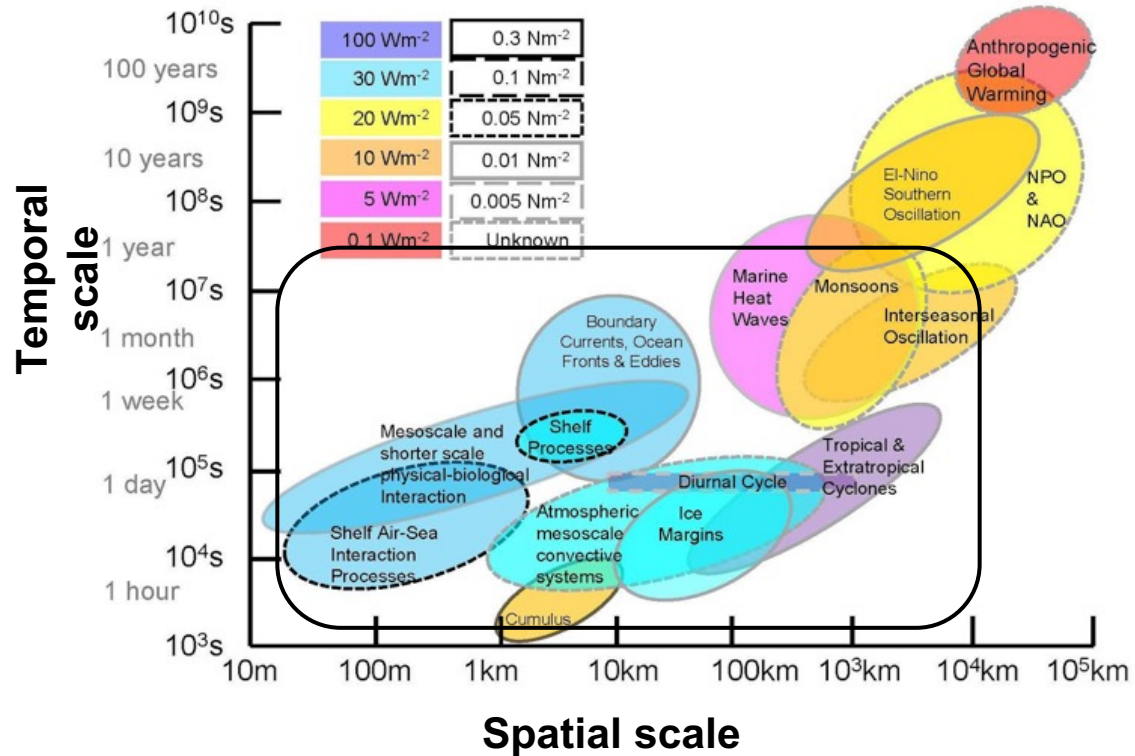
<https://airseaobs.org/>

SCOR #162

UN Decade program

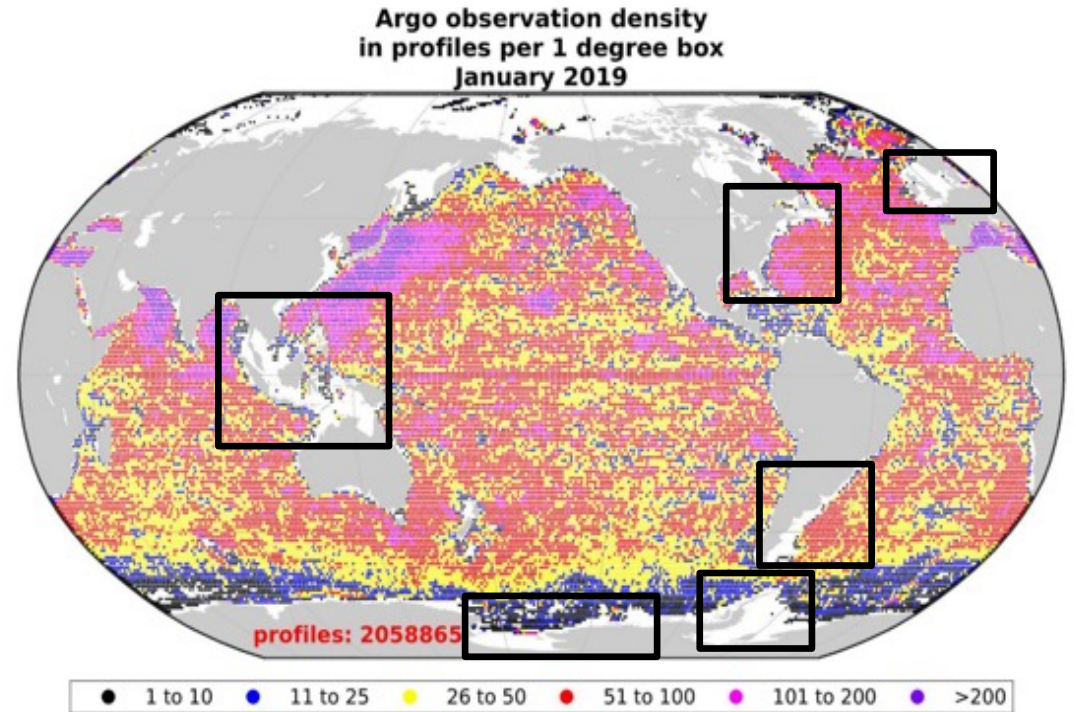


## Observing meso-scale processes



Cronin et al. (2019) "Air-sea fluxes with a focus on heat and momentum" FMARS

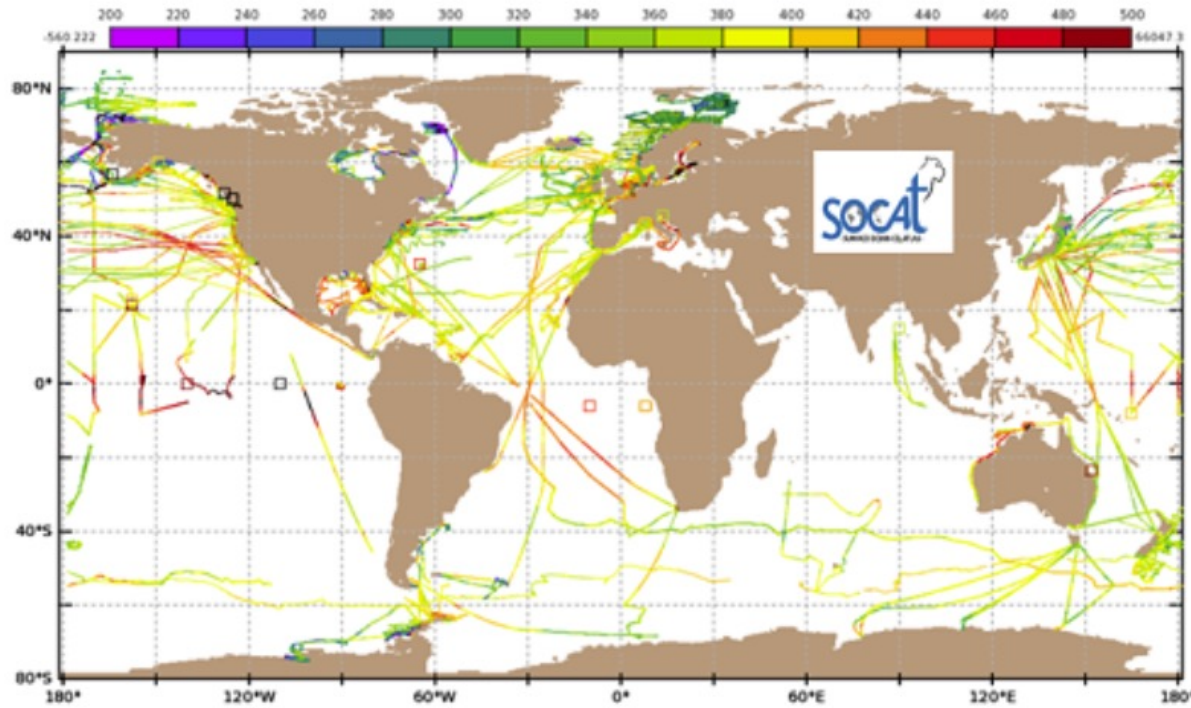
## Geographic gaps



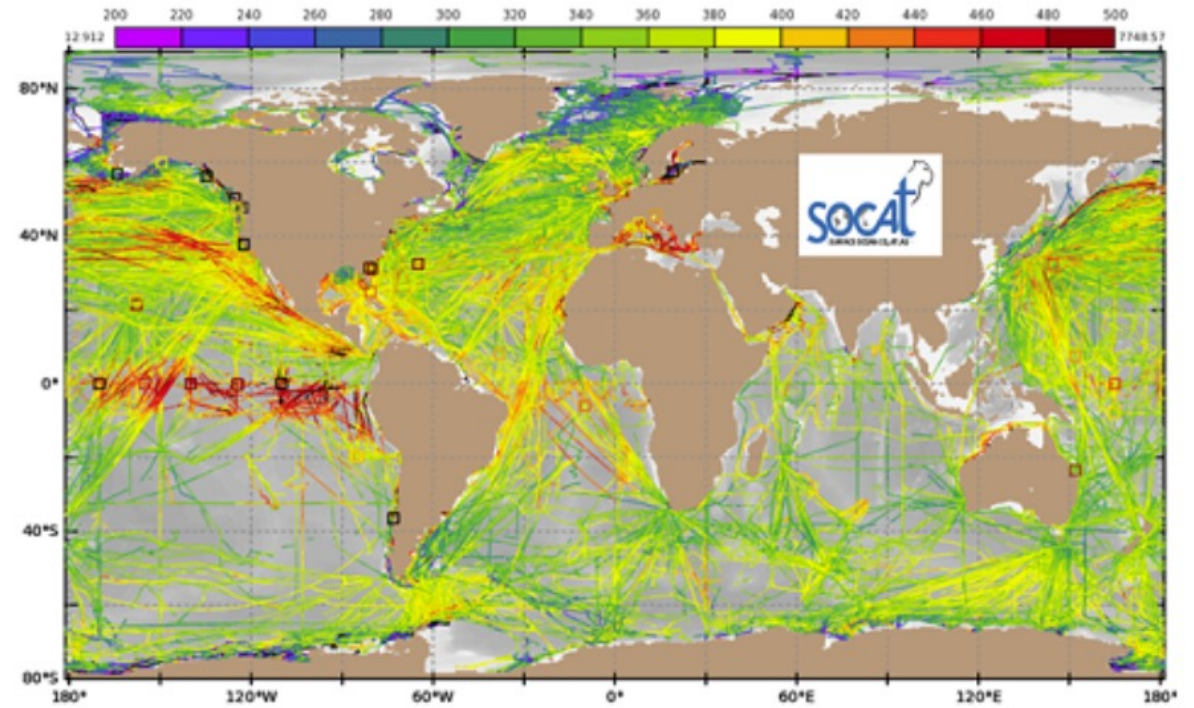
Wong, A. P., et al. (2020). "Argo data 1999–2019: two million temperature-salinity profiles and subsurface velocity observations from a global array of profiling floats." FMARS



2018 - 2022



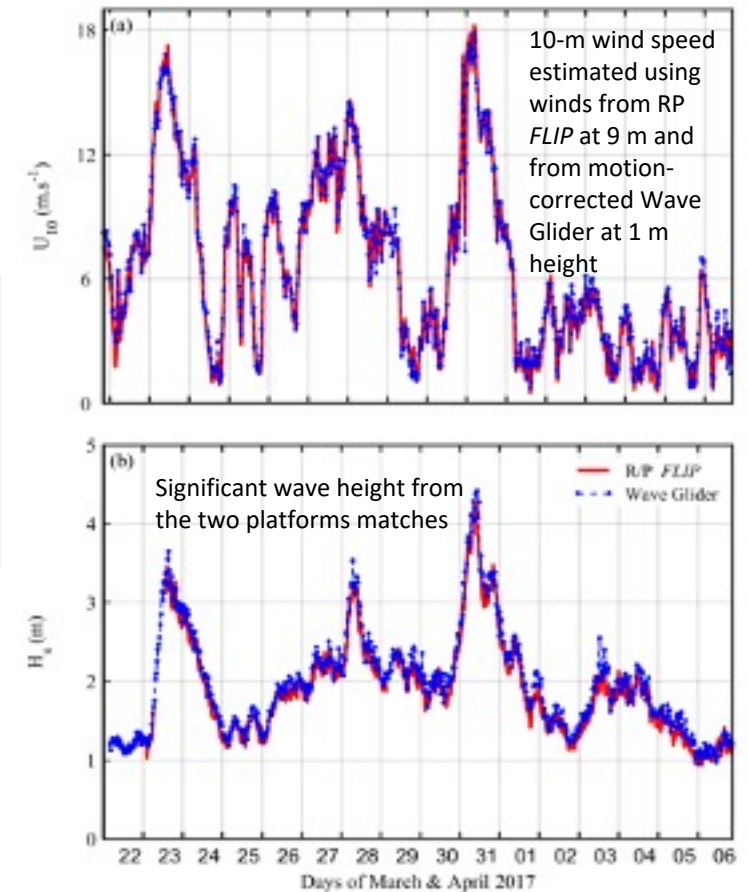
1957 - 2019





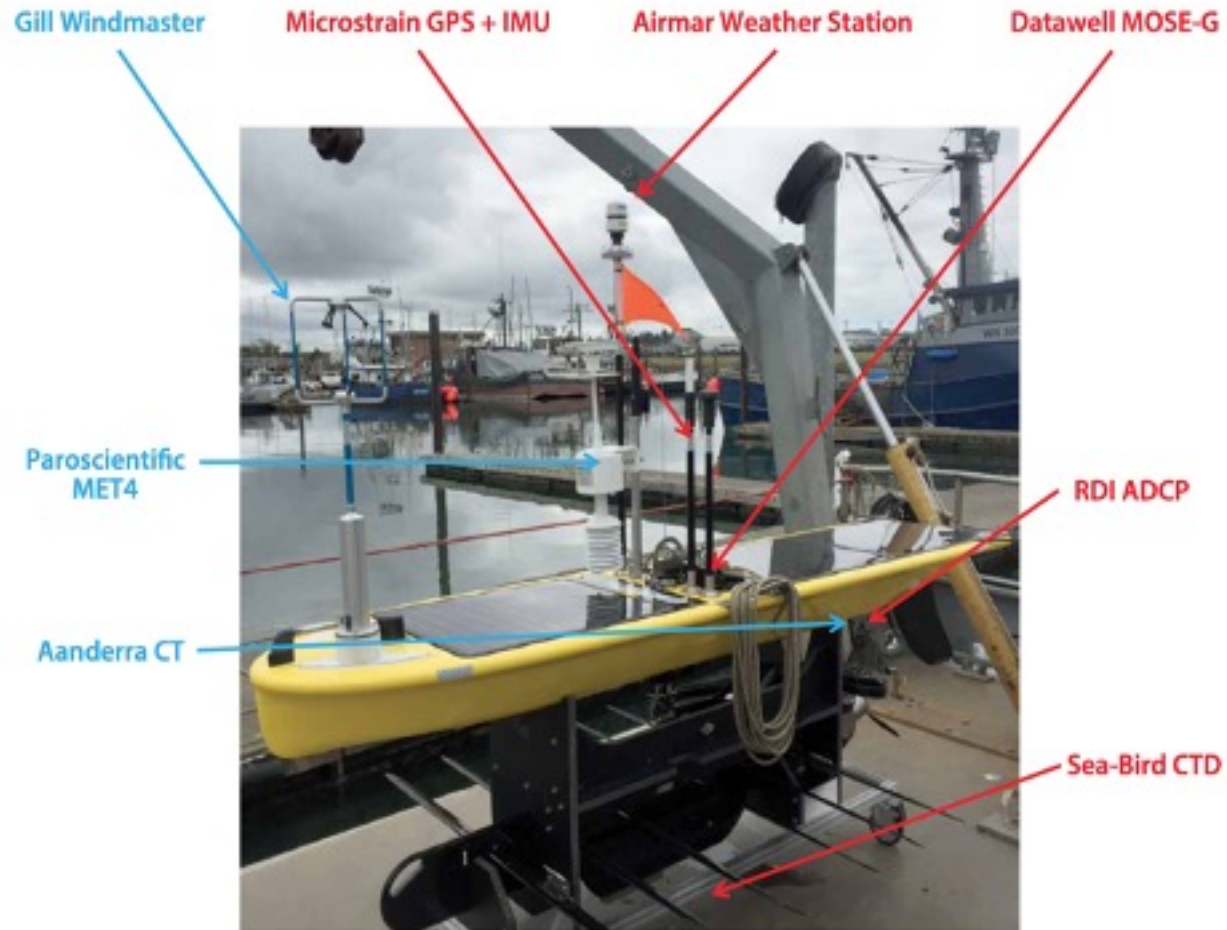
(Grare et al., 2021  
<https://doi.org/10.3389/fmars.2021.664728>)

## USV FLIP comparisons

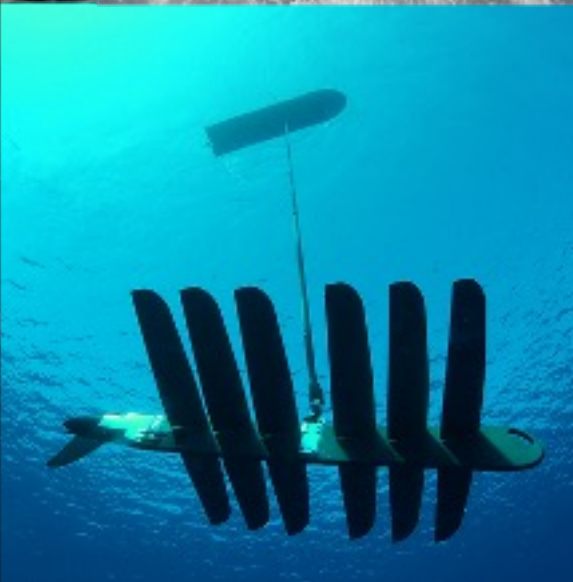




# USVs are multidisciplinary











# Webinar #5 USV for GOOS CoP

## TPOS USV

Tropical Pacific Observing System  
Uncrewed Surface Vehicles

Goals of the Tropical Pacific  
Observing System (TPOS):

- El Niño - Southern Oscil.
- Global Precipitation
- CO2 uptake
- New: Fisheries & Ecosystem?

Uncrewed Surface Vehicles  
(USV) Integrated within the  
TPOS:

A Pilot Study for a  
new Go-USV program

The TPOS-USV Team:  
PI/Co-Is, Collaborators  
and Colleagues

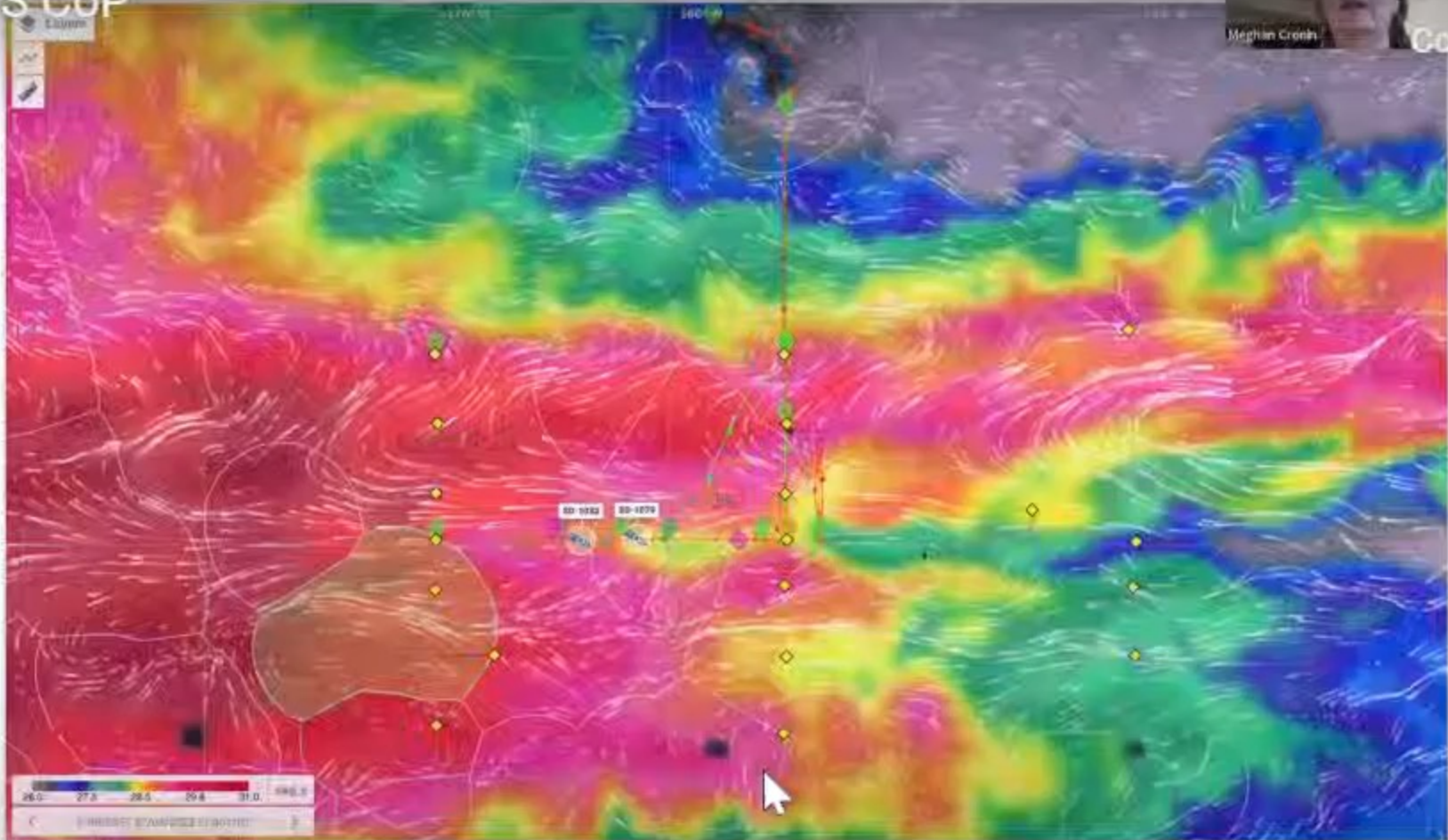
The 2023 Mission:  
2023 El Niño  
Mission Goals

MORE VIDEOS



Meghan Creah

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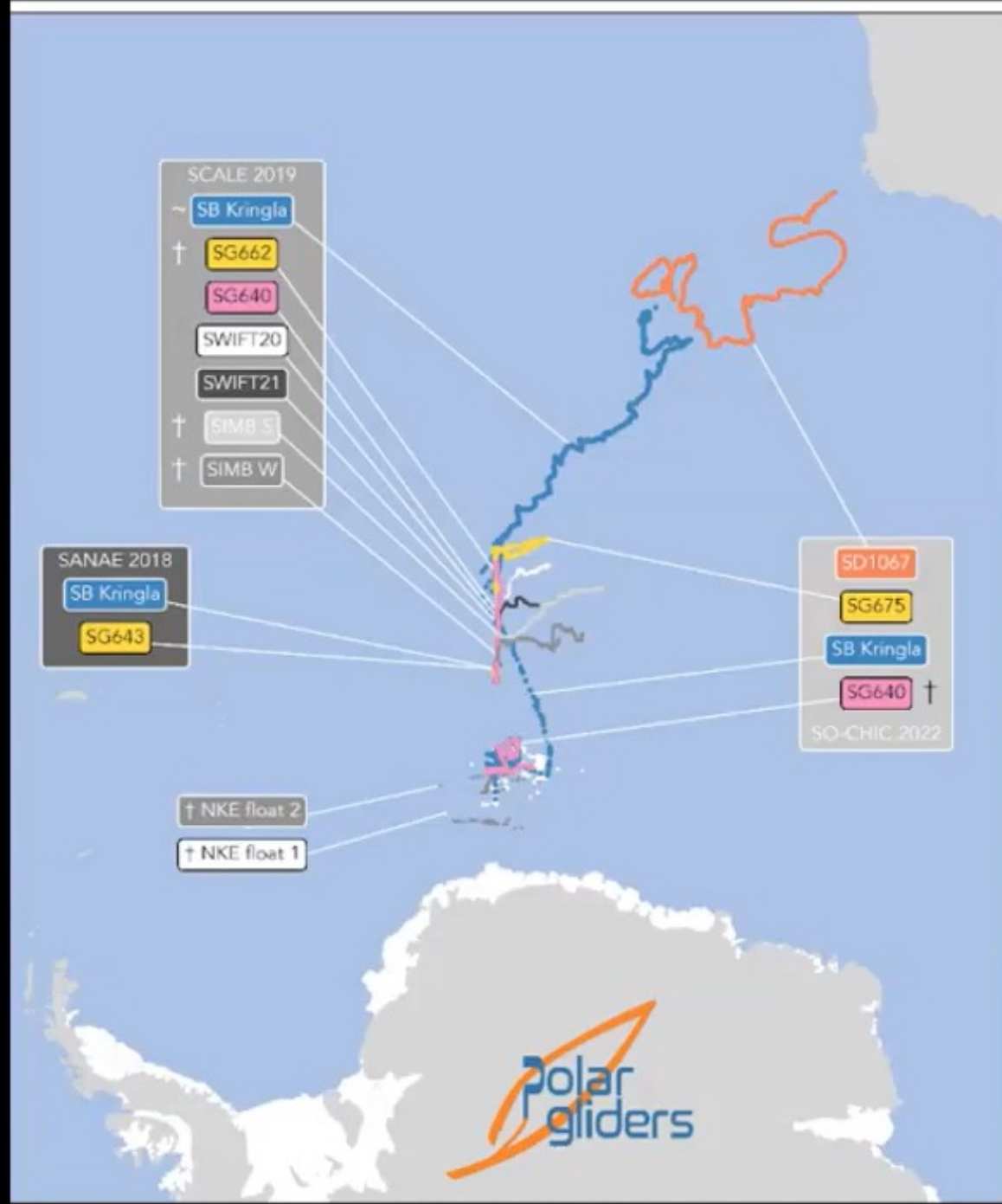


### 2023 Mission:

#### 3 Saildrones with full heat flux & ASVCO2 systems (1(2) w/ADCP & 1 w/EK80)

- Performed long meridional sections & 2 equatorial meridional sections
- Upwelling Experiment at 0,153W
- Zonal section along equator
- Saildrone vs. saildrone; saildrone vs. buoys; saildrone EK80 vs R/V ?





# Summary

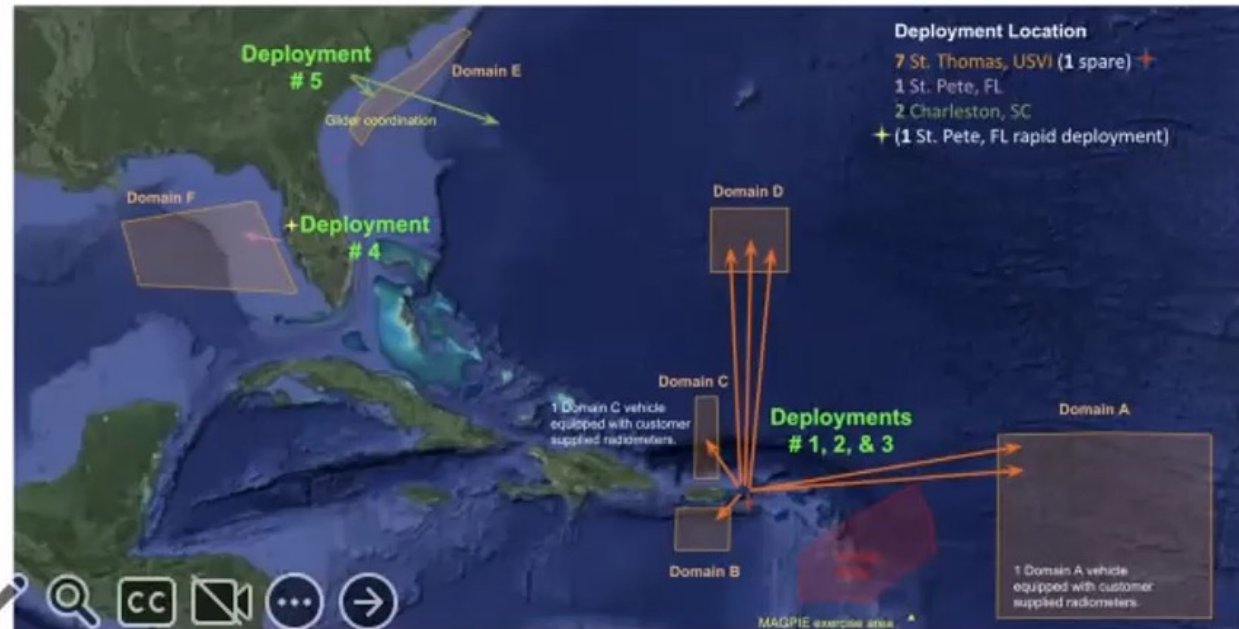
USV saildrones have successfully demonstrated their capability for hurricane observation in 2021 and 2022: intercepted 5 Tropical Storms and 3 major hurricanes, sending data in real time to GTS and coordinating with subsurface and airborne measurements ....

Captured by SD 1045's onboard camera during Category 4 Hurricane Sam, Sept. 30 2021



## Mission Overview

Current as of 5/10



## NOAA Saildrone Hurricane Observation 2023

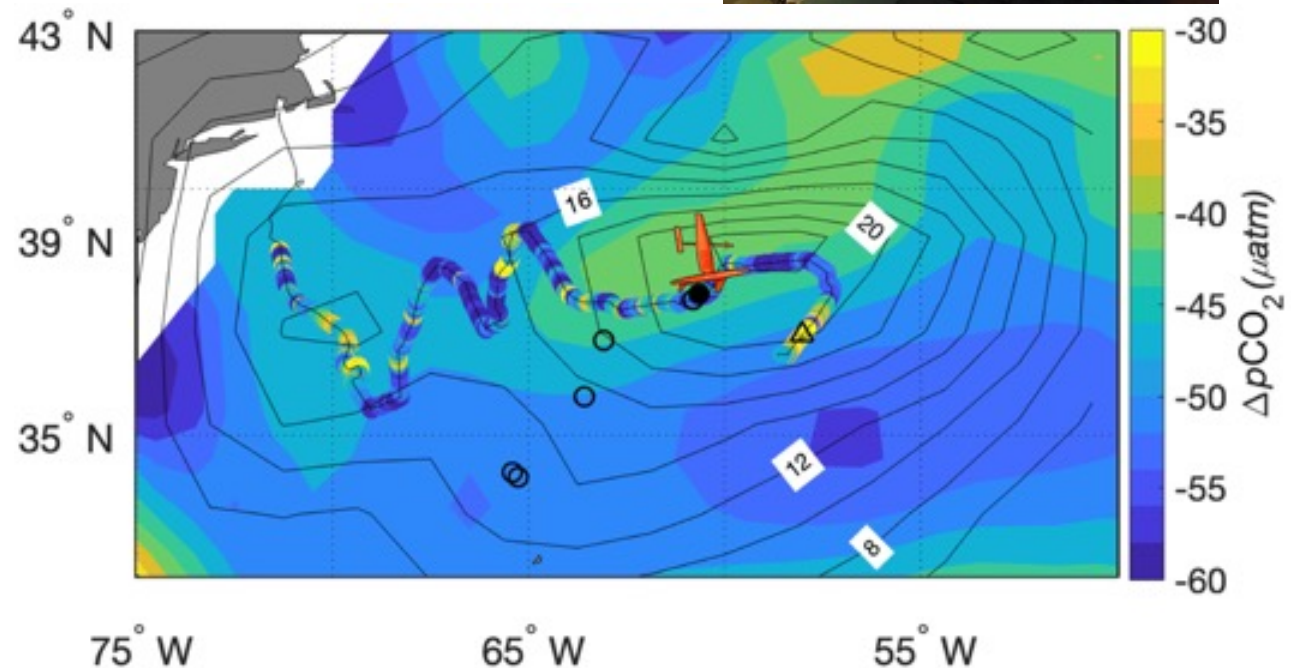
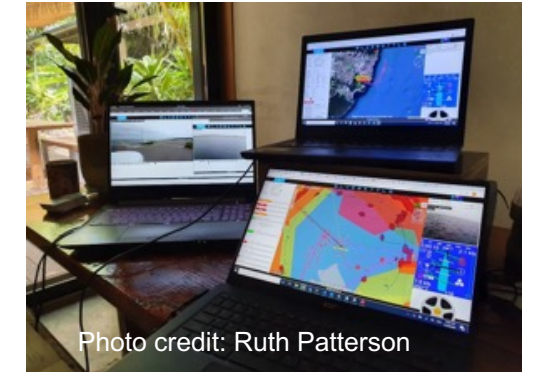
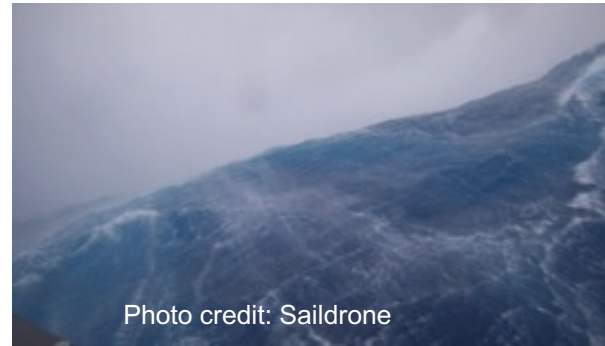


Dongxiao Zhang



## Benefits

- Manoeuvrable
- Self-retrieve
  - Realtime
  - Meso-scale
- Severe weather
  - Persistent
- Renewable powered
- Cheap (relatively)

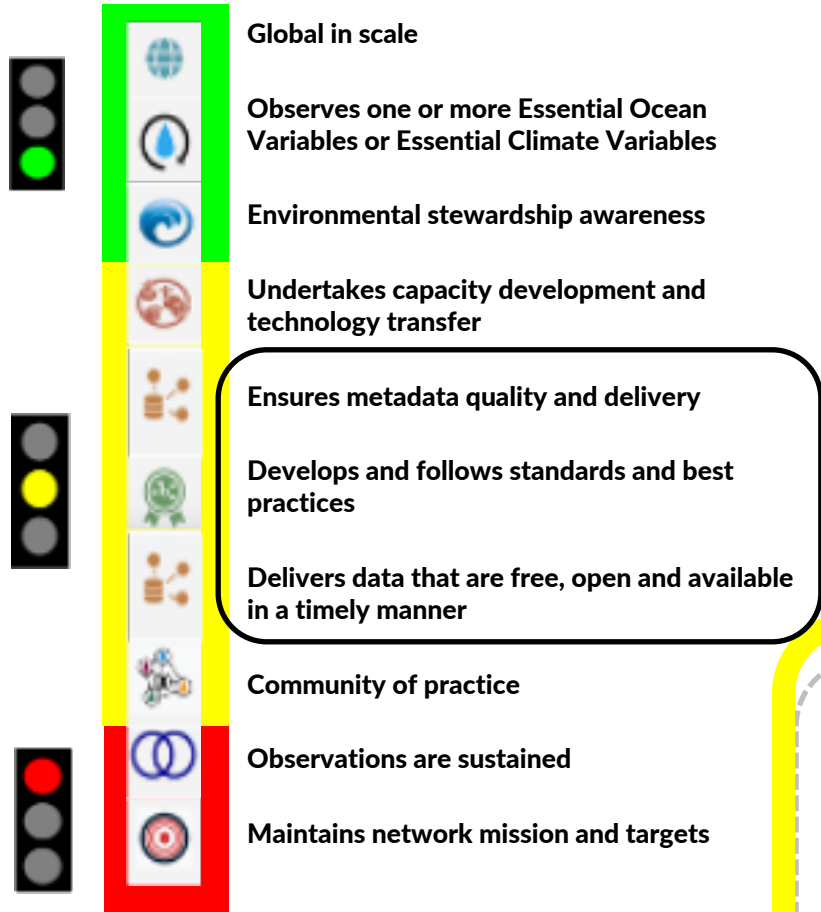


Patterson et al (2022), Uncrewed Surface Vessel Technological Diffusion Depends on Cross-Sectoral Investment in Open-Ocean Archetypes: A Systematic Review of USV Applications and Drivers, FMARS

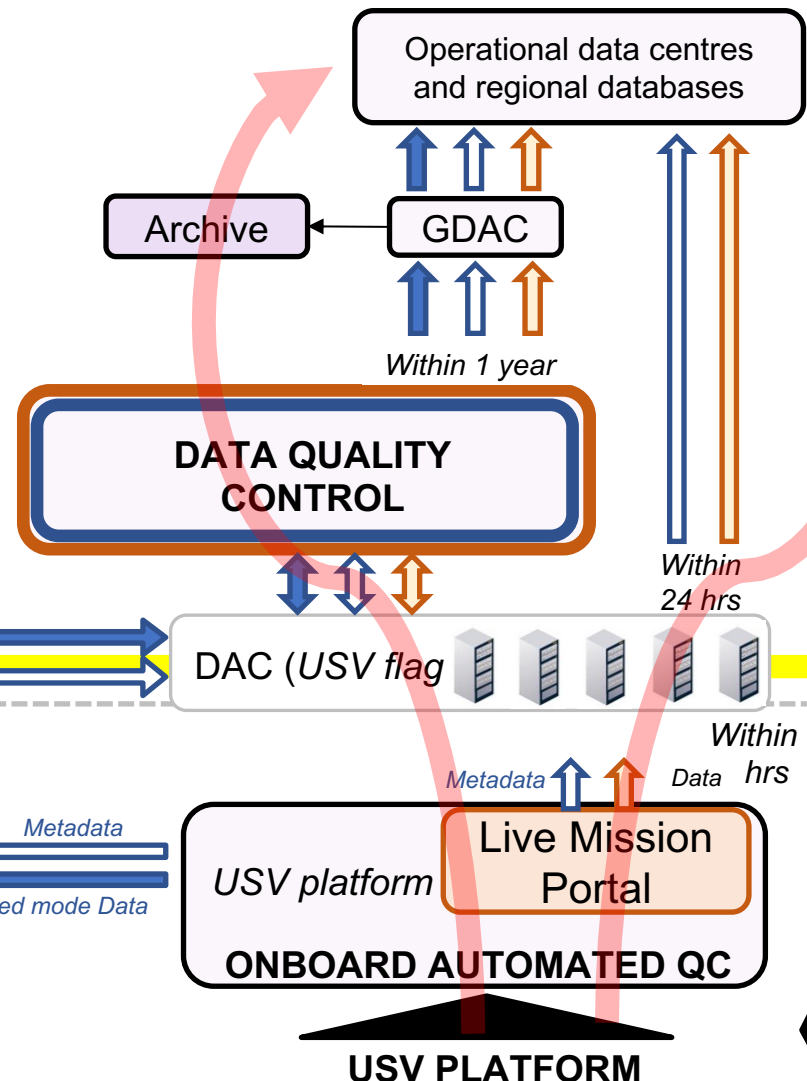
Nickford, S., et al. (2022) "Autonomous Wintertime Observations of Air-Sea Exchange in the Gulf Stream Reveal a Perfect Storm for Ocean CO<sub>2</sub> Uptake." AGU

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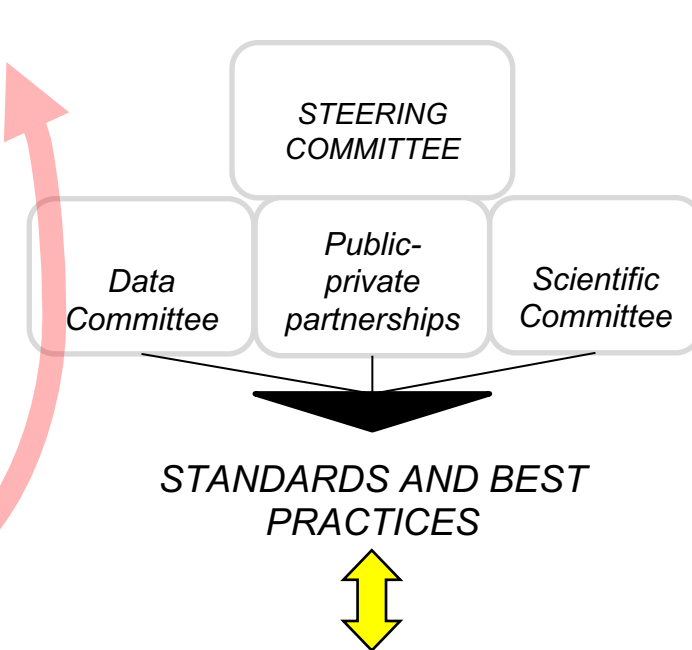
## GOOS Attributes



## GLOBAL PRODUCTS



## GOVERNANCE









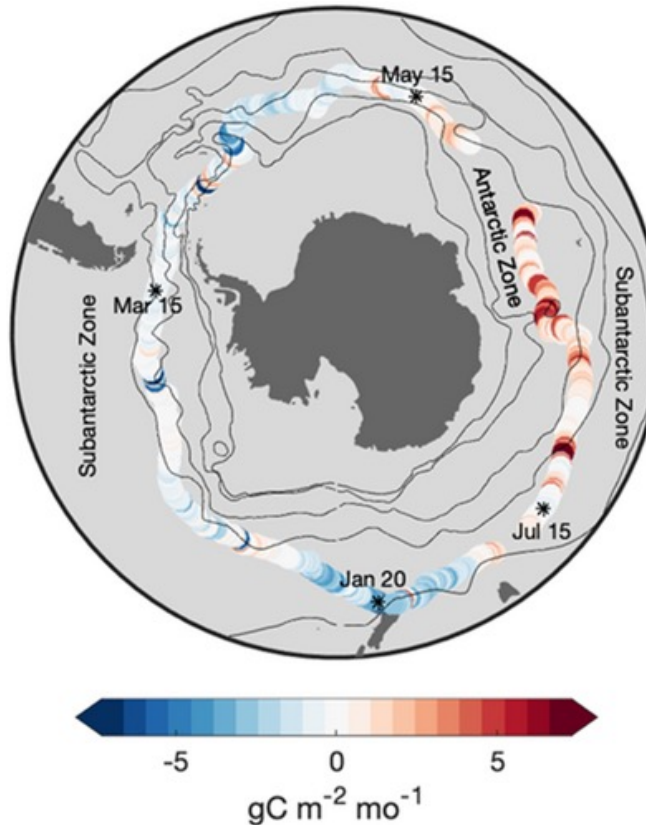
## PUBLIC PRIVATE PARTNERSHIPS

**USV DEVELOPERS AND OPERATORS**

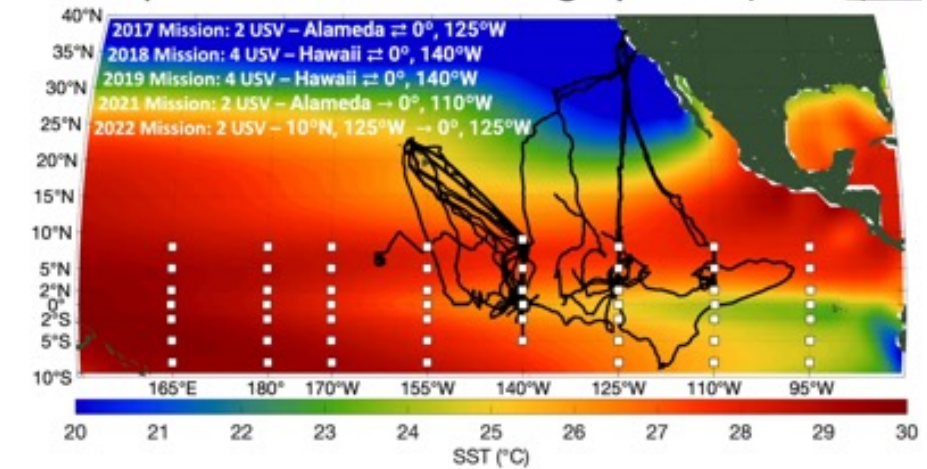


## GOOS Attributes

-  
  -  Global in scale
  -  Observes one or more Essential Ocean Variables or Essential Climate Variables
  -  Environmental stewardship awareness
-  
  -  Undertakes capacity development and technology transfer
  -  Ensures metadata quality and delivery
  -  Develops and follows standards and best practices
  -  Delivers data that are free, open and available in a timely manner
  -  Community of practice
-  
  -  Observations are sustained
  -  Maintains network mission and targets



Sutton et al. (2019) "Constraining Southern Ocean CO<sub>2</sub> flux uncertainty using uncrewed surface vehicle observations" *Geophysical Research Letters*



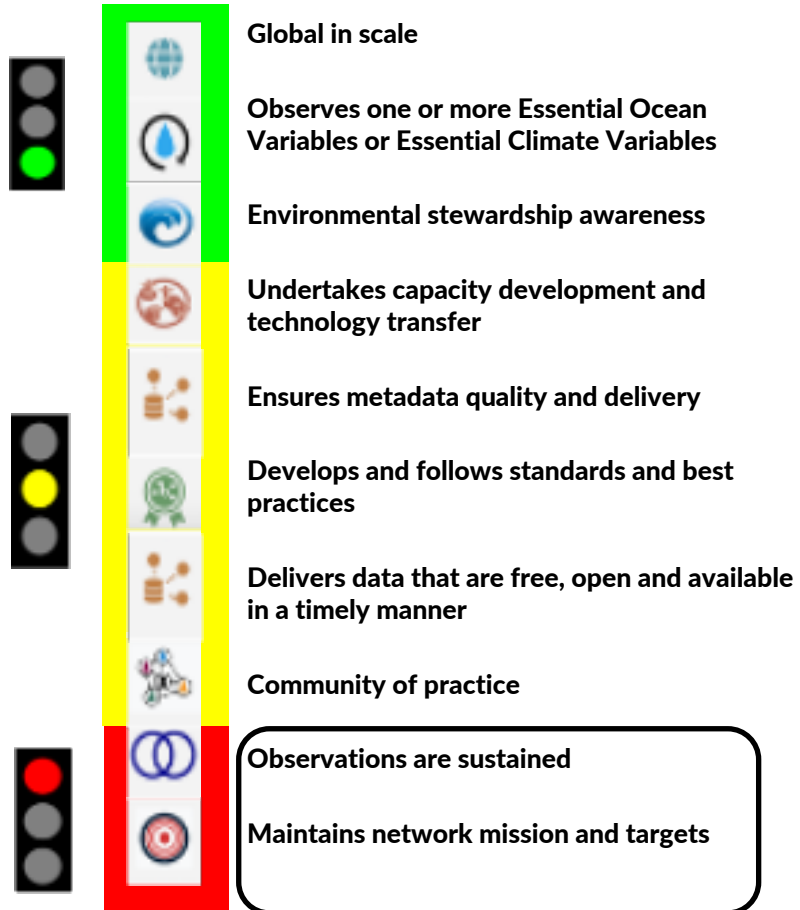
### Autonomous Surface Vehicles (ASV) Network



OASIS Webinar Series: Developing a Community of Practice for the Uncrewed Surface Vehicle (USV) Network for a Global Ocean Observing System (GOOS) April 20th, 2023

Collaborators

## GOOS Attributes



Network engagement: [\$ 300 K to develop network mission and targets]			
Value assessment: [1 FTE - workshop, gap analysis and engagement with USV companies]			
User engagement: [1 FTE to coordinate]			
<b>Pilot USV instrumentation fit-out</b> \$X m for implementation 2 FTE for coordination and management	<b>Data product and services</b> \$X m for implementation 2 FTE for coordination and management	<b>Best practices and data delivery</b> 2 FTE for coordination and management	<b>Scaling and tracking</b> \$X m for implementation 4 FTE

- ### USVs for GOOS proposition
- Equal contribution opportunities in data-limited locations
  - Improved data for weather and climate forecasters and modellers
  - Global coverage of annual carbon measurement promise (Paris agreement)
  - Satellite calibration and verification data in data-limited areas



SYSTEMATIC REVIEW article

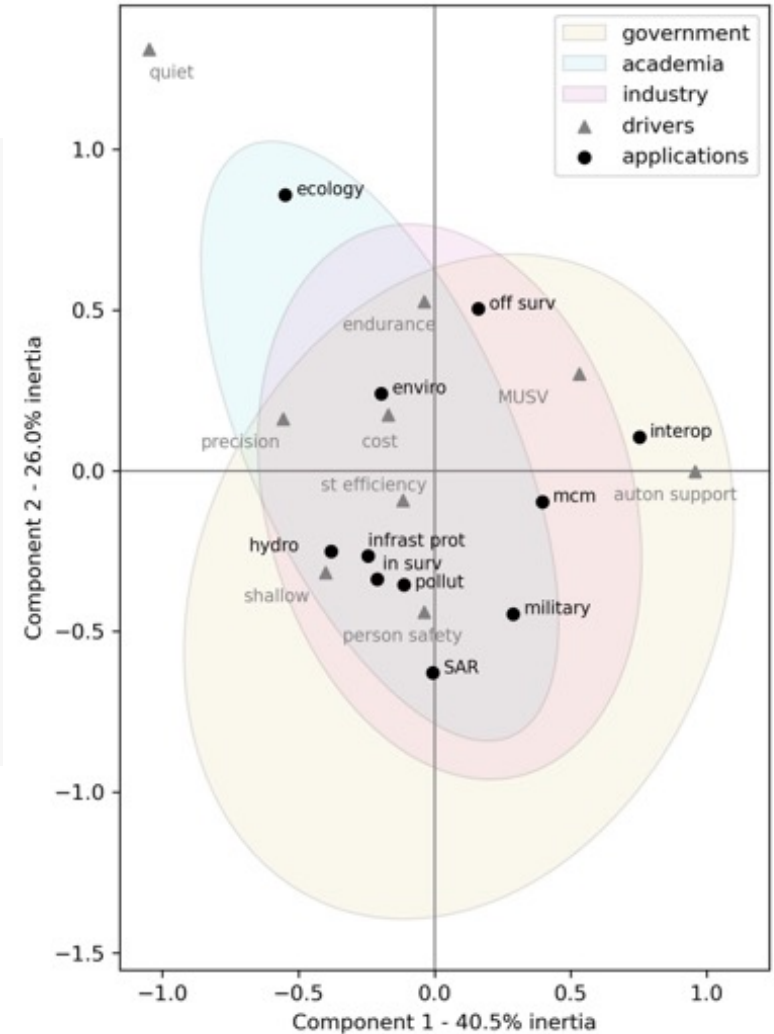
Front. Mar. Sci., 06 January 2022

Sec. Ocean Solutions

Volume 8 - 2021 | <https://doi.org/10.3389/fmars.2021.736984>

## Uncrewed Surface Vessel Technological Diffusion Depends on Cross-Sectoral Investment in Open-Ocean Archetypes: A Systematic Review of USV Applications and Drivers

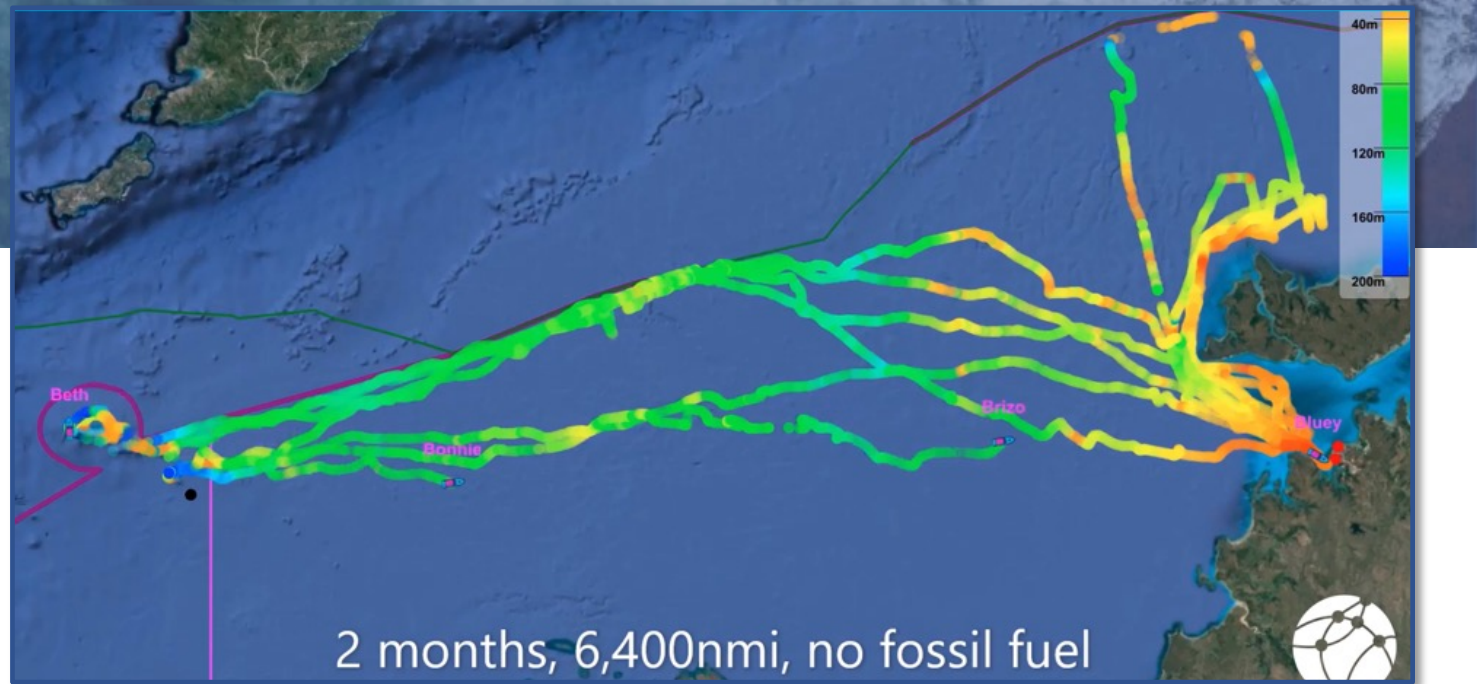
Ruth G. Patterson<sup>1\*</sup>
 Emily Lawson<sup>2</sup>
 Vinay Udyawer<sup>3</sup>
 Gary B. Brassington<sup>4</sup>
 Rachel A. Groom<sup>3,5</sup>











***“The health and safety benefits of using the USV... are significant. It removes 50 people from the field, associated weekly crew change, helicopter and fixed wing seats.... Fuel reduction of 3.5 tonnes”***



The USV with a remotely operated vessel (ROV) attached.





**Thank you!**

**Interested in**  **?**

Contact us: <https://airseaobs.org/get-involved>

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