



SAILDRONE Overview for Gulf States Marine Fisheries Commission

October 2022

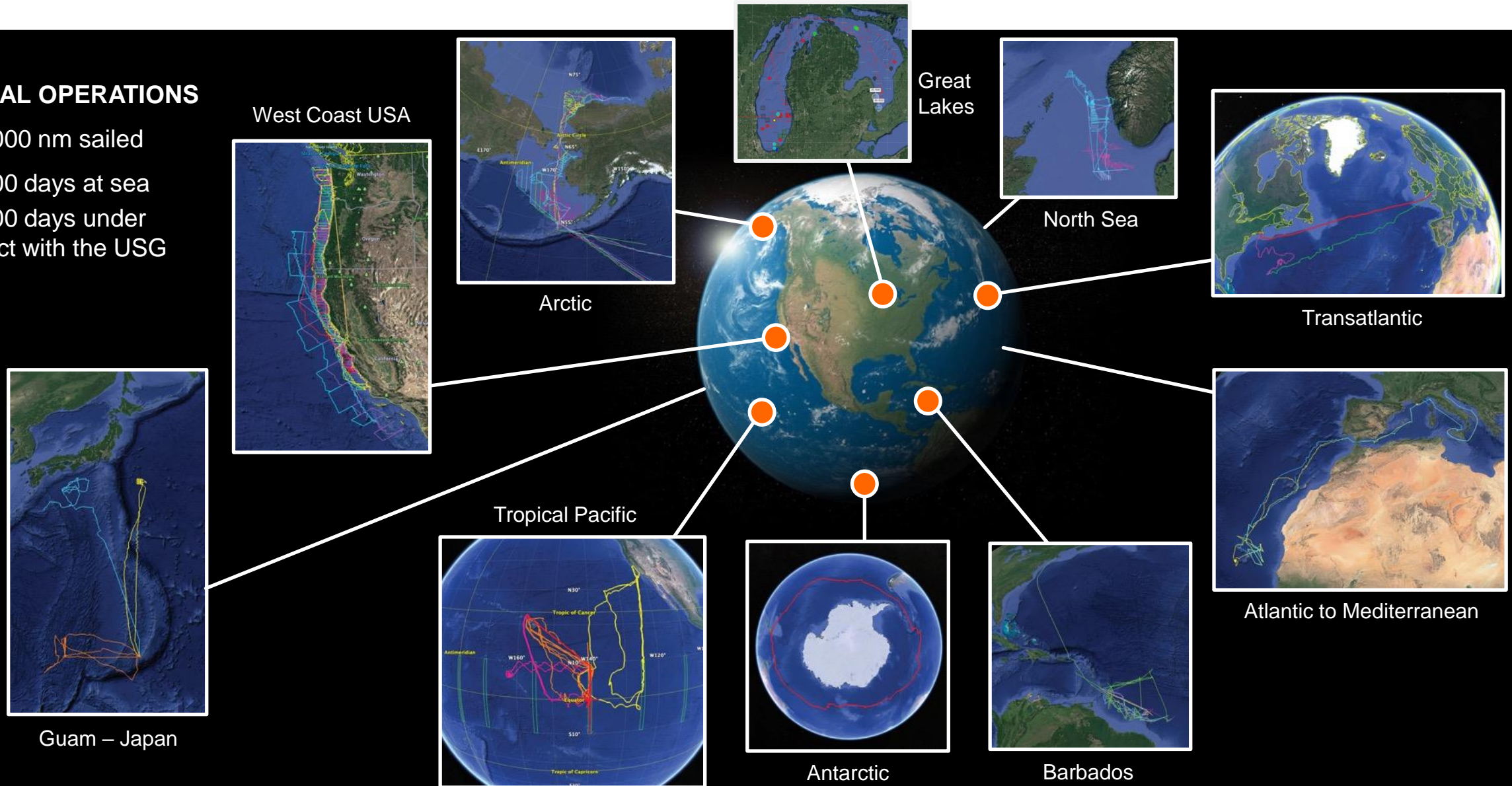
WHY SAILDRONE?

The world's most capable, proven, and trusted Uncrewed Surface Vehicles (USVs)



GLOBAL OPERATIONS

- >800,000 nm sailed
- >15,000 days at sea
- >10,000 days under contract with the USG



Unrivaled Endurance and Reliability

Overcomes spatial and temporal limitations of traditional ocean-monitoring assets



More

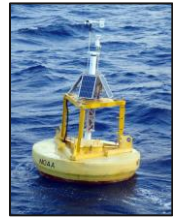


Low Time-Series,
High Spatial Coverage



Long Time-Series,
High Spatial Coverage

Long Time-Series,
Low Spatial Coverage



Less

Less

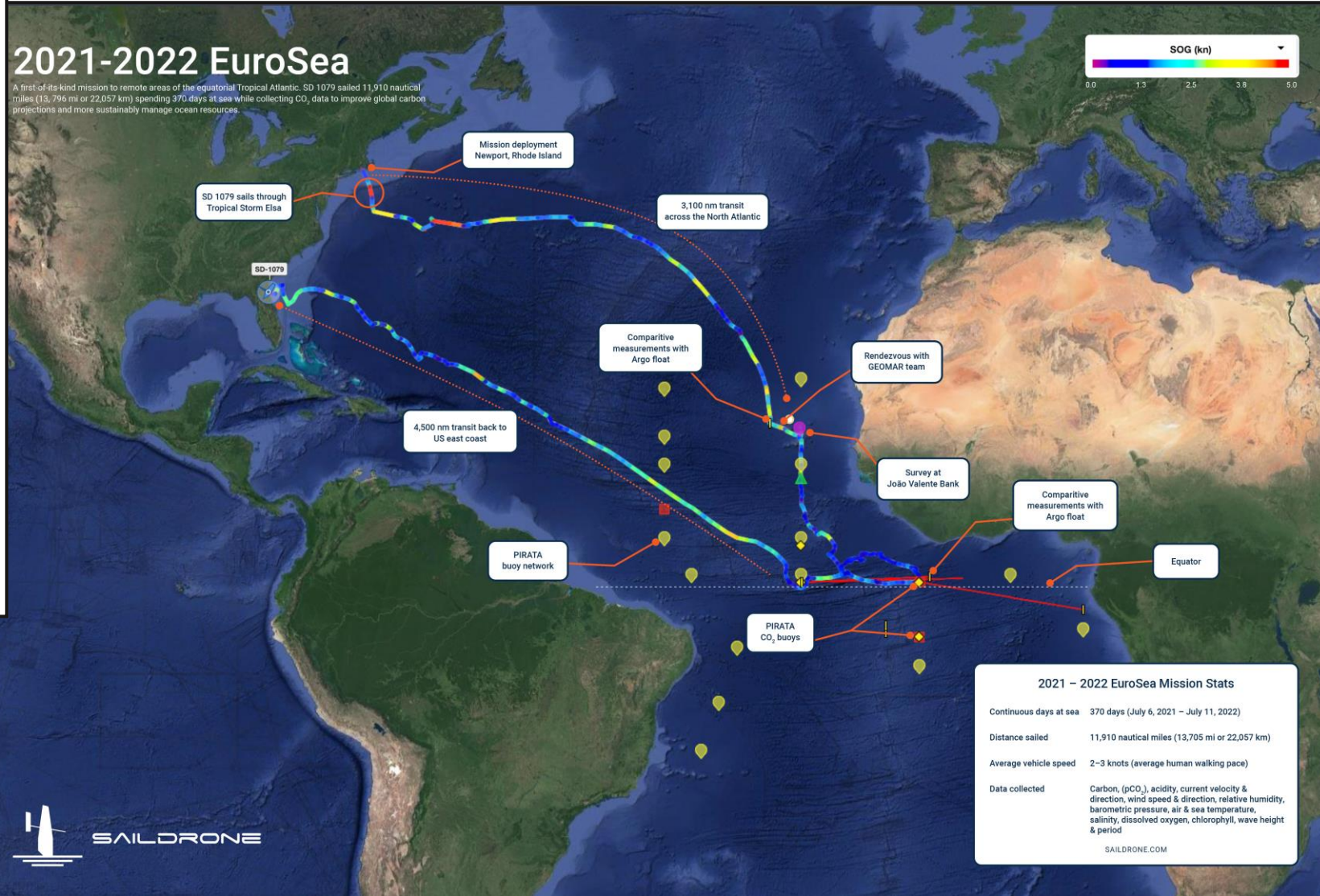
Temporal

More

Capable of missions of up to 365 days covering tens of thousands of nautical miles without returning to port for maintenance or refueling

2021-2022 EuroSea

A first-of-its-kind mission to remote areas of the equatorial Tropical Atlantic. SD 1079 sailed 11,910 nautical miles (13,796 mi or 22,057 km) spending 370 days at sea while collecting CO₂ data to improve global carbon projections and more sustainably manage ocean resources.

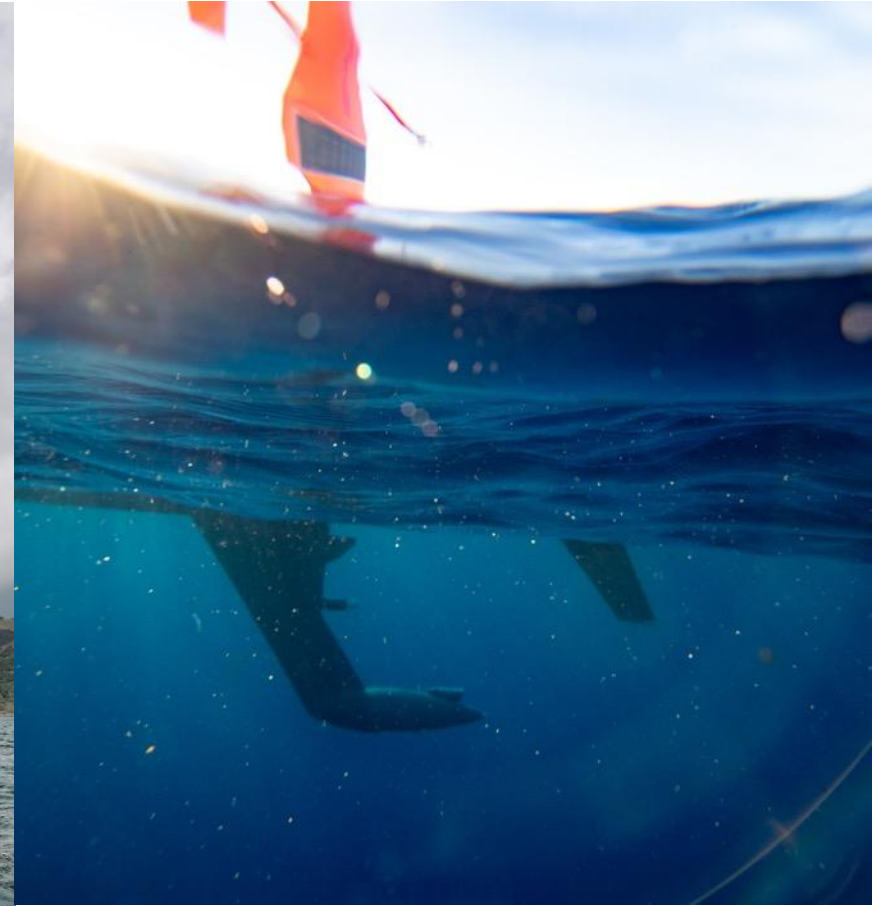


2021 – 2022 EuroSea Mission Stats	
Continuous days at sea	370 days (July 6, 2021 – July 11, 2022)
Distance sailed	11,910 nautical miles (13,705 mi or 22,057 km)
Average vehicle speed	2–3 knots (average human walking pace)
Data collected	Carbon, (pCO ₂), acidity, current velocity & direction, wind speed & direction, relative humidity, barometric pressure, air & sea temperature, salinity, dissolved oxygen, chlorophyll, wave height & period
SAILDRONE.COM	



A GLOBAL FLEET OF OCEAN DRONES

Wind and solar-powered, monitoring the planet in real time, above and below the surface.



Maritime Domain Awareness

Intelligence, Surveillance & Reconnaissance (ISR)
Force Protection | Law Enforcement & Maritime Safety
Ecosystem Monitoring

Ocean Mapping

Single-beam and multibeam bathymetric data collection for navigation and charting, telecommunications, offshore energy, and physical oceanography to 23,000 feet (7,000 m) depth.

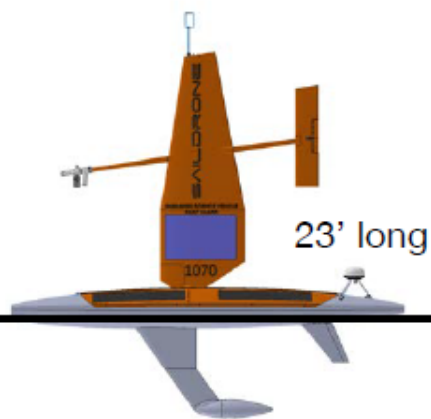
Ocean Data

Collecting essential ocean and climate variables.
Fisheries | Metocean Data Collection | Ecosystem monitoring | Satellite Calibration/Validation

Different Size Vehicles for Different Roles



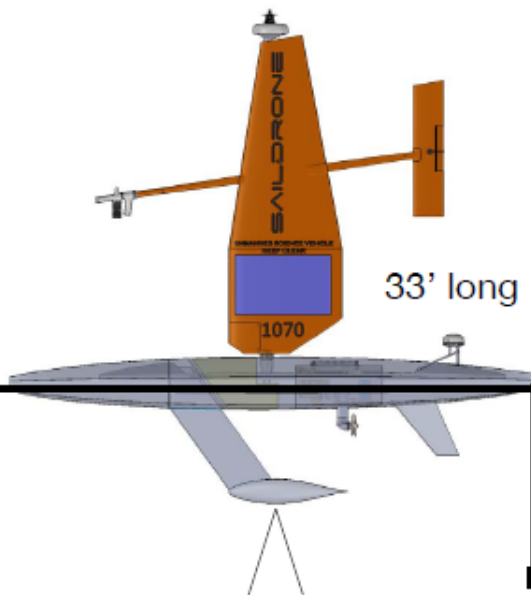
Explorer



23' long

Metoc
Fisheries

Voyager



33' long

MDA / ISR
Shallow Multi-Beam

Surveyor



72' long

Deep water Multi-beam

CTD - SVP
to 150 m



CTD - SVP
to 500 m



EXCEPTIONAL DATA QUALITY

Rigorously tested by external collaborators



“Comparisons with shipboard measurements showed good agreement, inspiring confidence in these new instrument platforms.”

THE USE OF SAILDRONES TO EXAMINE SPRING CONDITIONS IN THE BERING SEA: INSTRUMENT COMPARISONS, SEA ICE MELTWATER AND YUKON RIVER PLUME STUDIES. OCEANS 2015

“The saildrones performed well in the harsh conditions of the Bering Sea and demonstrated the potential of this innovative platform to advance ecosystem research.”

ADVANCES IN ECOSYSTEM RESEARCH: SAILDRONE SURVEYS OF OCEANOGRAPHY, FISH, AND MARINE MAMMALS IN THE BERING SEA. OCEANOGRAPHY 30(2):113-115

“A platform that is ready for ocean research missions from the tropics to the Arctic.”

THE USE OF SAILDRONES TO EXAMINE SPRING CONDITIONS IN THE BERING SEA: VEHICLE SPECIFICATION AND MISSION PERFORMANCE. OCEANS 2015

THE MISSION PORTAL

A fully managed ocean data service to keep you in control



Saildrone provides:

- A secure application for real-time data access and visualization with external data integrations
- The ability to manage your fleet
- A user-friendly secure web portal
- Advanced collaboration features
- Comprehensive mission planning tools.



On-the-fly
Analysis



Adaptive
sampling

Email-free
collaboration

Your data
your way



FISHERIES

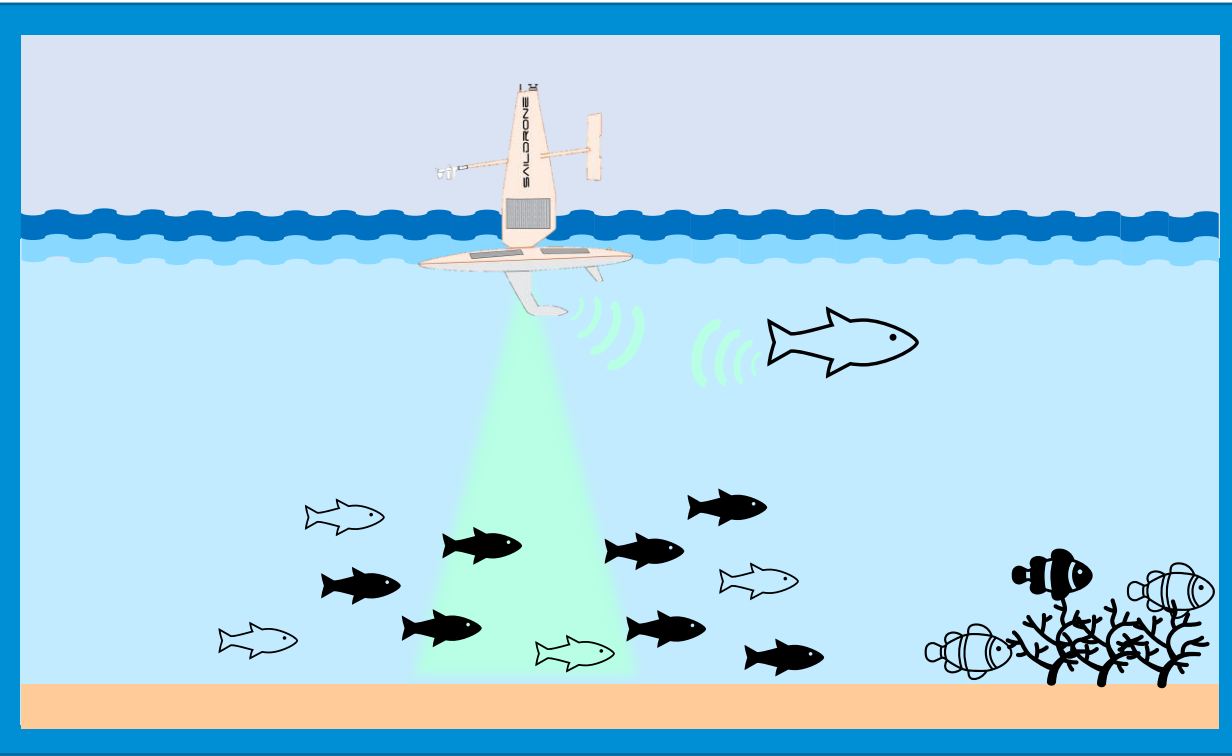
FISHERIES SURVEY METHODOLOGY

Two: Components: Acoustics and Trawling



ACOUSTICS

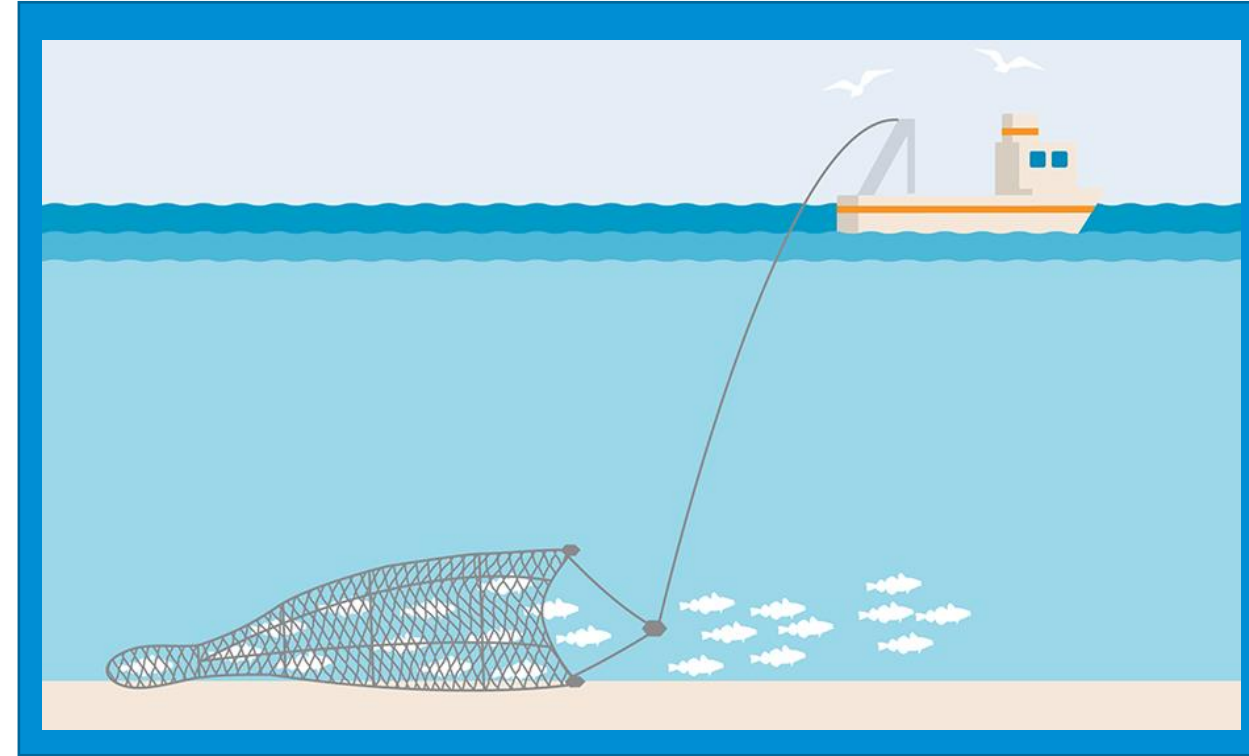
- Valuable for determining presence and abundance, seasonal changes in presence and abundance, migration patterns, and predator/prey relations.



- **Platform agnostic.** Robots can do acoustic surveys and monitoring cheaper, more efficiently, and more accurately than ships.

TRAWLING

- Valuable for species identification, population dynamics (age, sex), and health.



- **Platform specific.** Ships are necessary to trawl, and humans are needed on-board to perform biological assessments

1. PRECISION

Continual work since 2019 conducting acoustic surveys for hake and coastal pelagic species off the U.S. West Coast.



60-40mi Long
Transects from
Port Flattery, WA,
to U.S/Mexico
Border



2022 WEST COAST SURVEY

- Total vehicles deployed: 2
- Cumulative mission days: 100 days
- Carbon emission: zero
- Continuously measured fish acoustics backscatter with Simrad AS echosounder
- High quality measurements at wind speeds less than 25 knots

** Data collected and disseminated in real time*



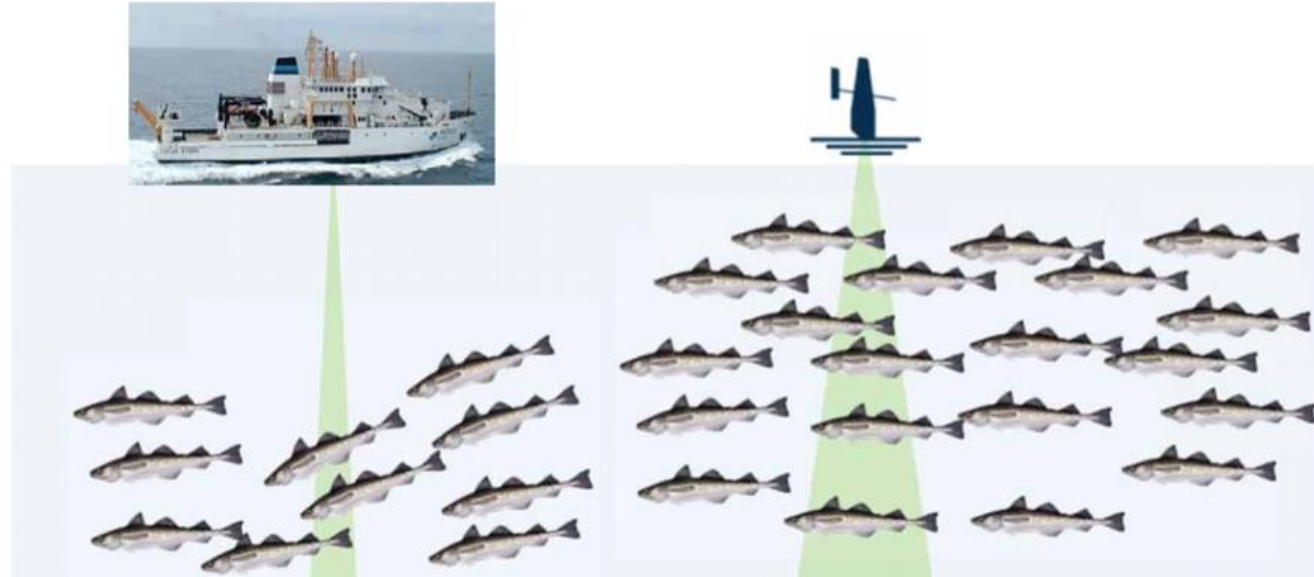
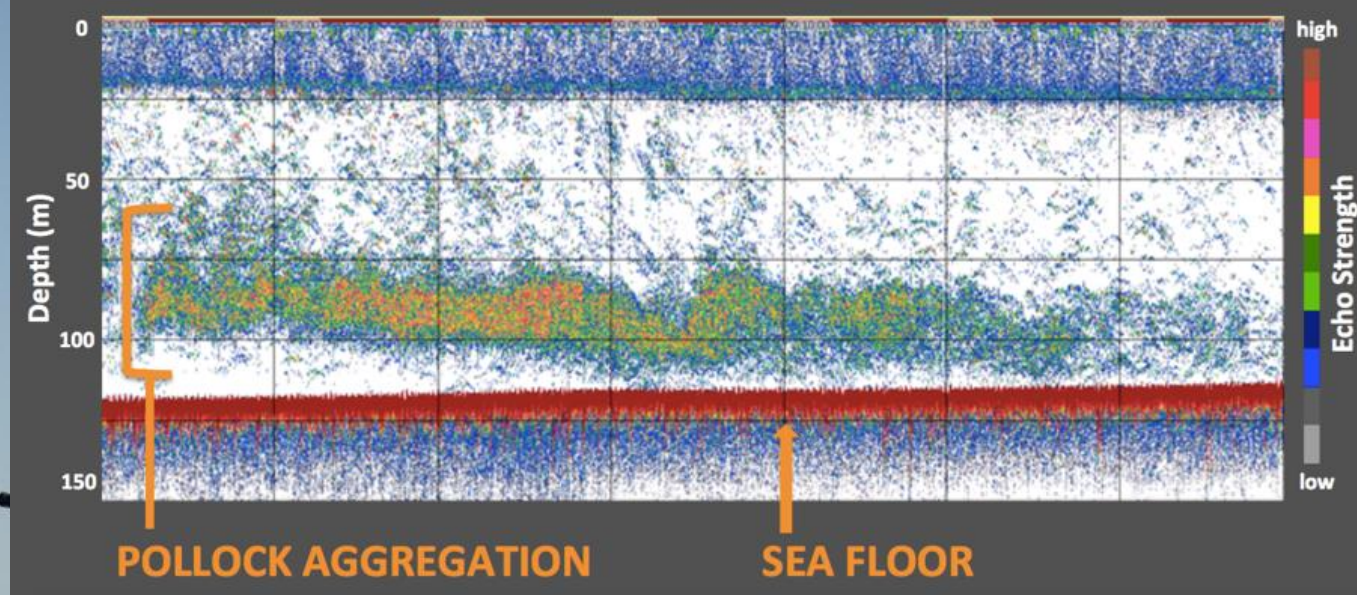
2. CALIBRATION/VALIDATION

Comparisons with research vessel indicate shallow pollock react to ship noise



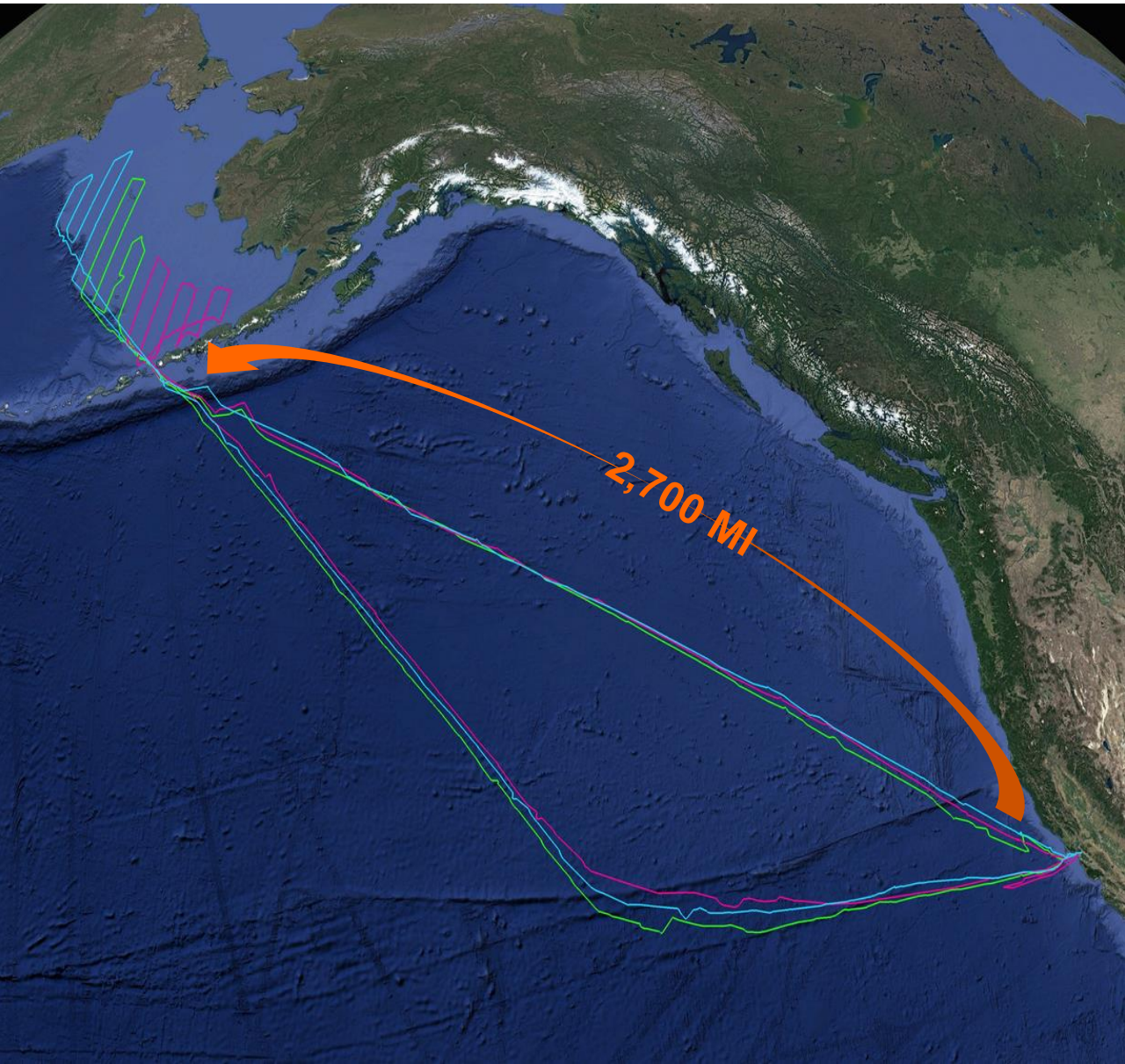
SAILDRONE HAS BEEN CONDUCTING POLLOCK SURVEYS IN THE BERING SEA SINCE 2015

- Total vehicles deployed in 2020: 4
- Carbon emission: zero
- Continuously measured fish acoustics backscatter with Simrad AS echosounder
- High quality measurements at wind speeds

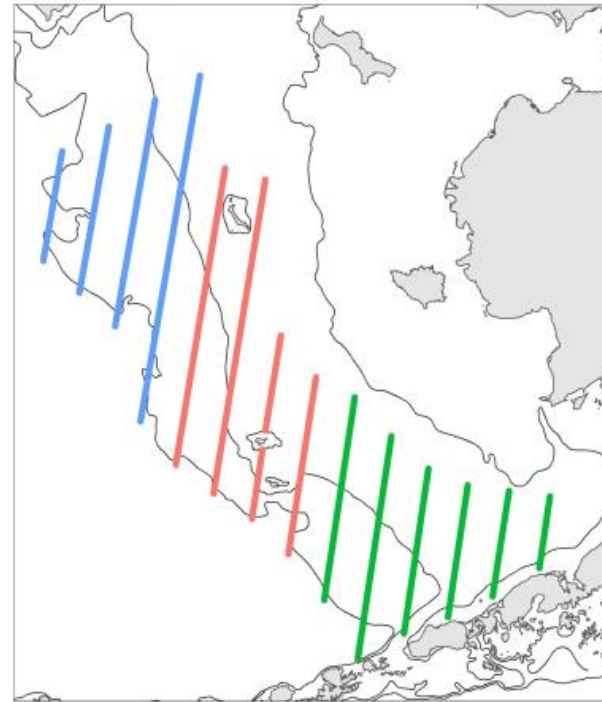


3. REGULATORY

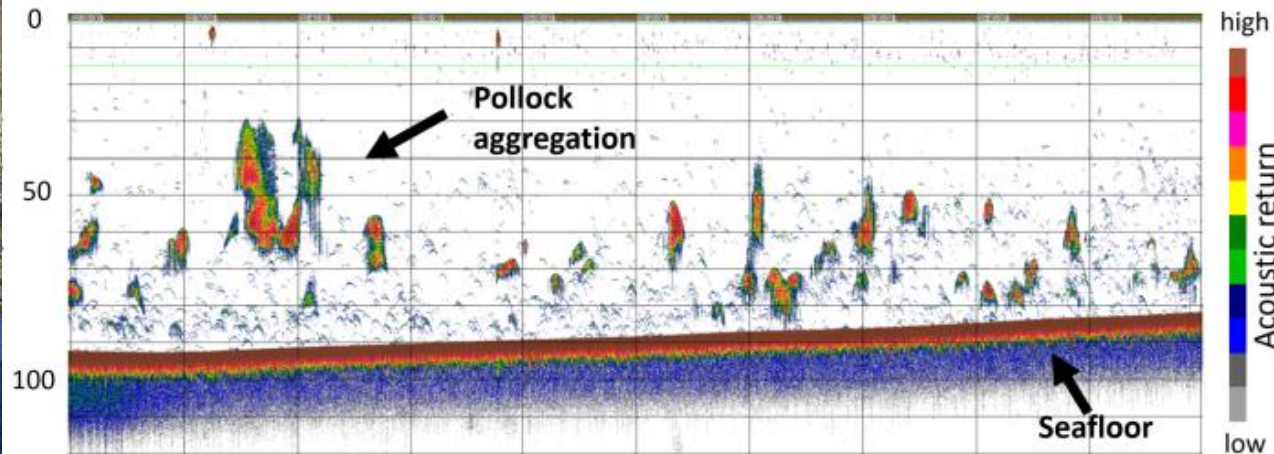
First time data from uncrewed surface vehicles were used to help produce an annual estimate of abundance for a commercial fish stock



2020 survey (40 nmi spacing)



Typical survey (20 nmi spacing)

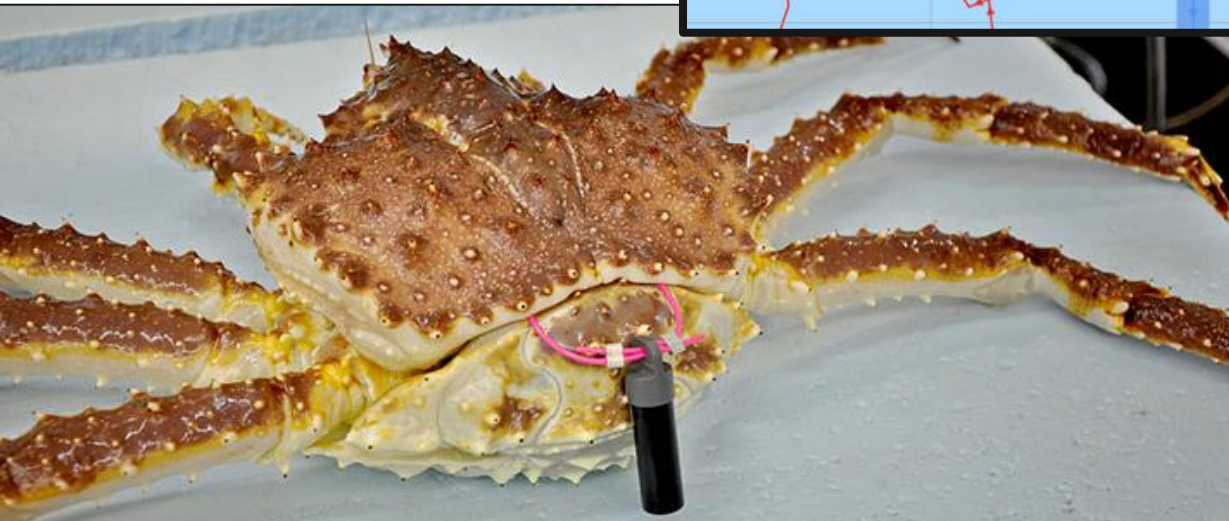
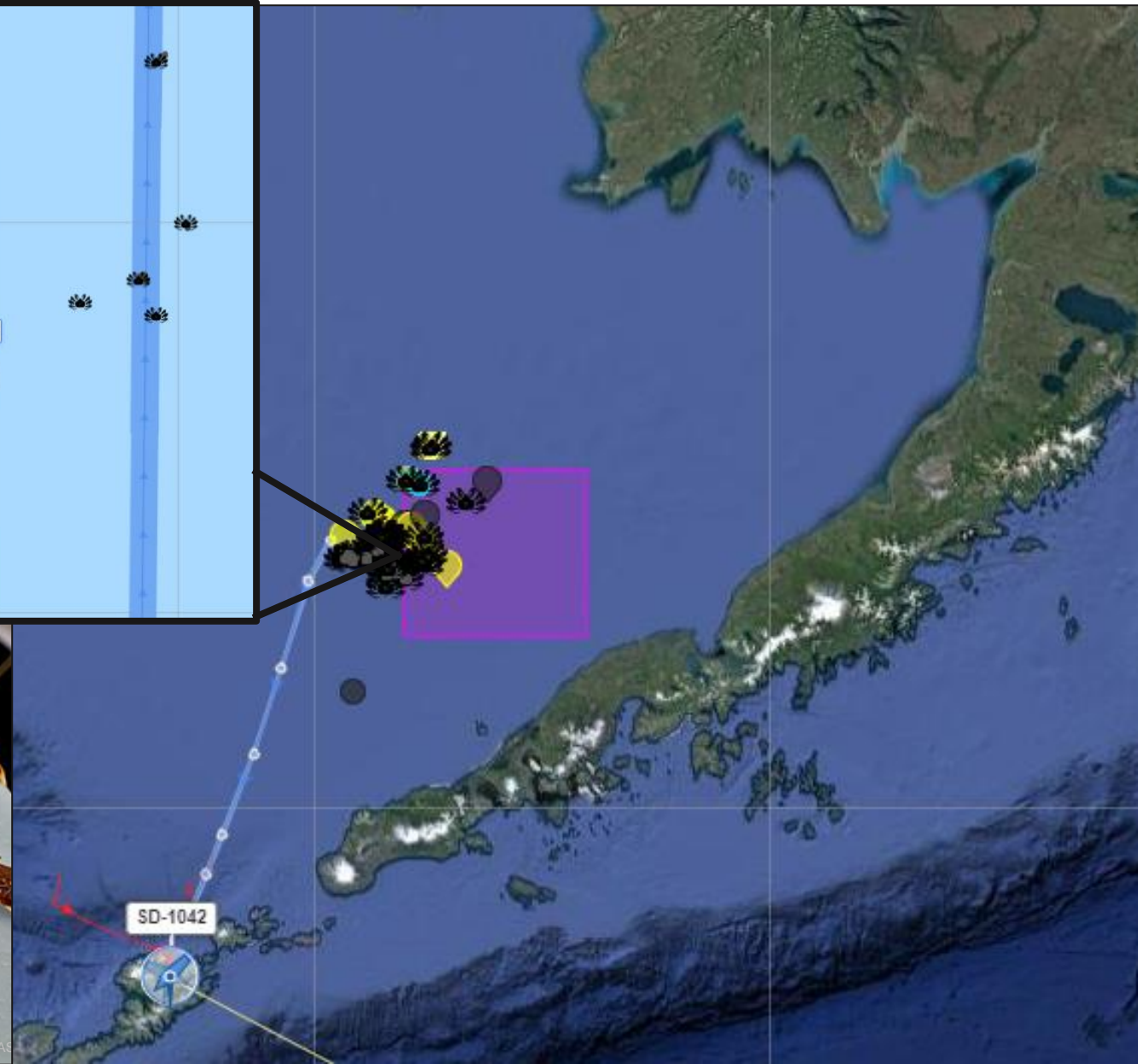
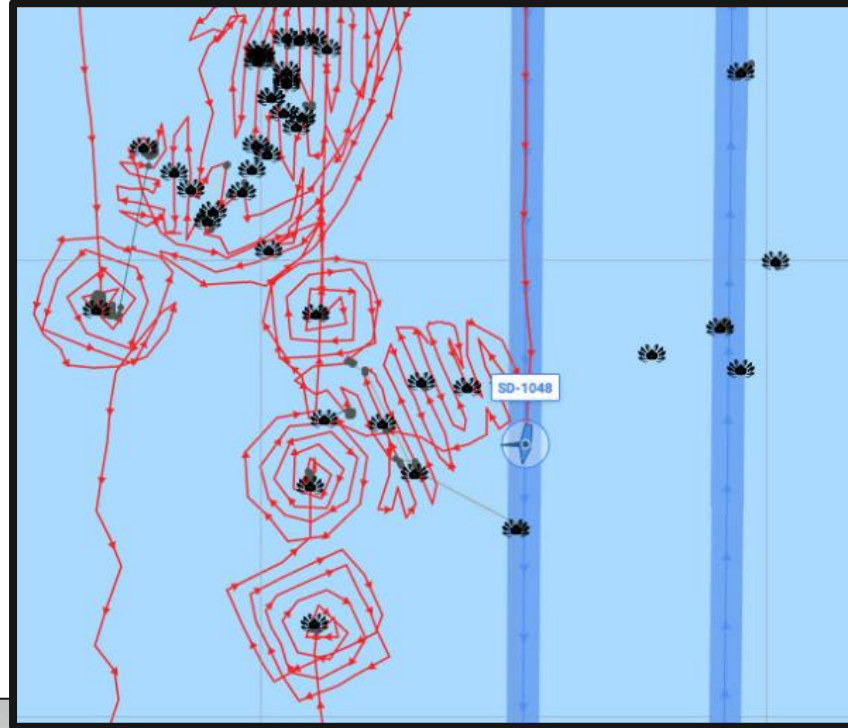


Tracking Alaska Red King Crabs Using Sailable Drones

track seasonal movements of Alaska red king crab using a Sailable Drone USV equipped with an acoustic receiver.



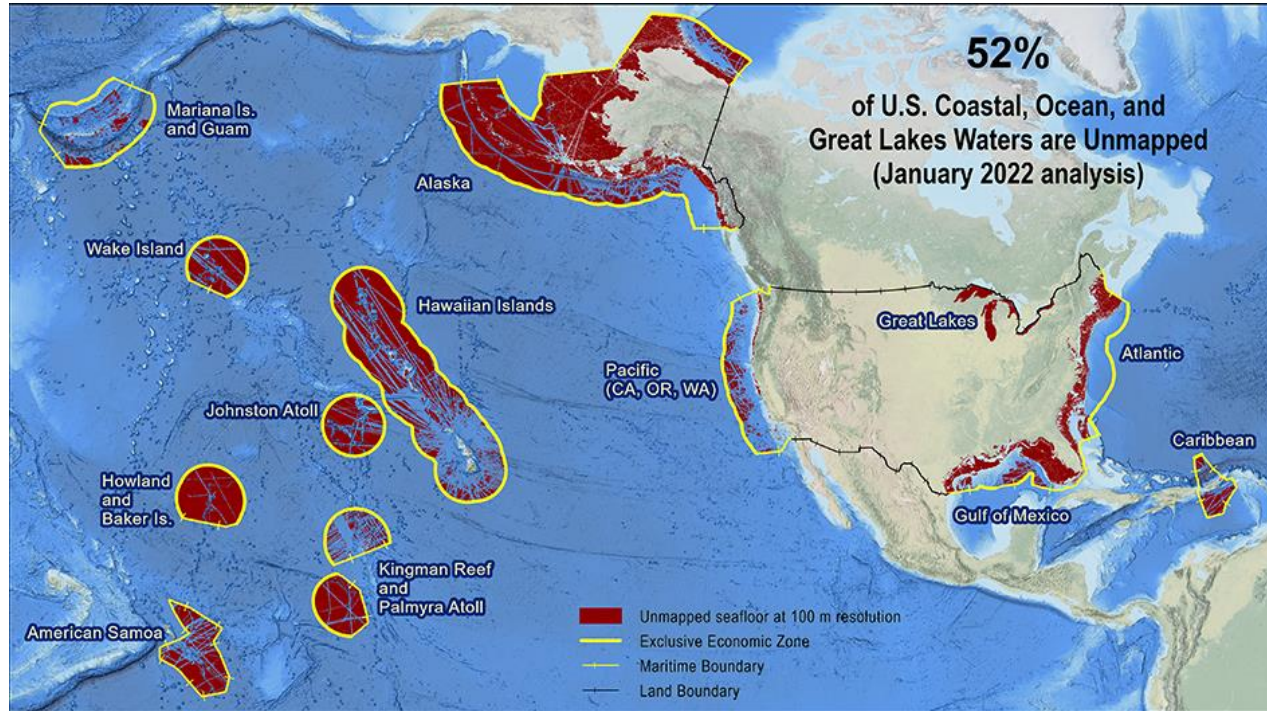
- Two Sailable Drones equipped with VEMCO acoustic receivers **located 34% of the Alaska red king crabs that were tagged** by NOAA Fisheries in June.



OCEAN MAPPING & EXPLORATION

THE NEED FOR OCEAN MAPPING & EXPLORATION

The Depth, Shape, and Composition of the seafloor are foundational data elements that are needed to explore, sustainably develop, conserve, and manage our coastal and offshore ocean resources.



- Costly to Operate
- Costly to Scale
- Requires People & Operations are Time Bound
- High Carbon Footprint
- Requires Acquisition and Maintenance \$\$

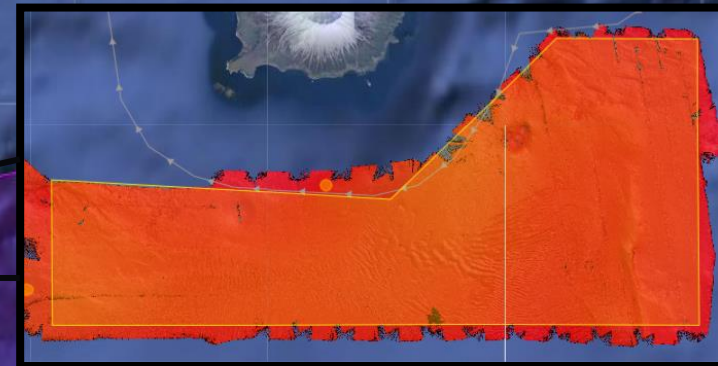
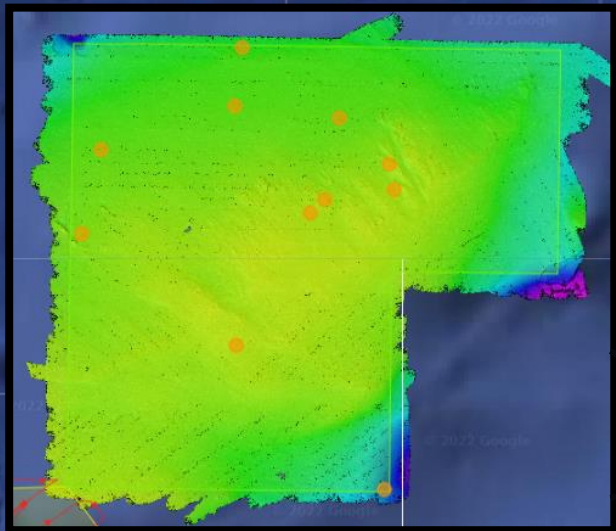
\$5M would fund ~200 days of continuous Ocean Mapping by long-endurance uncrewed systems.



- Reduced Cost
- Easily Scalable
- Autonomous 24/7, 365-day p/year operations
- Primarily Renewable Powered
- Requires NO Acquisition and Maintenance \$\$

2022 ALEUTIAN ISLANDS MAPPING

- Since start of second survey period: 2580km
- Total for the Aleutian Mission so far: 5460km
- On Average 1.37 l/hr
- 42 days on survey

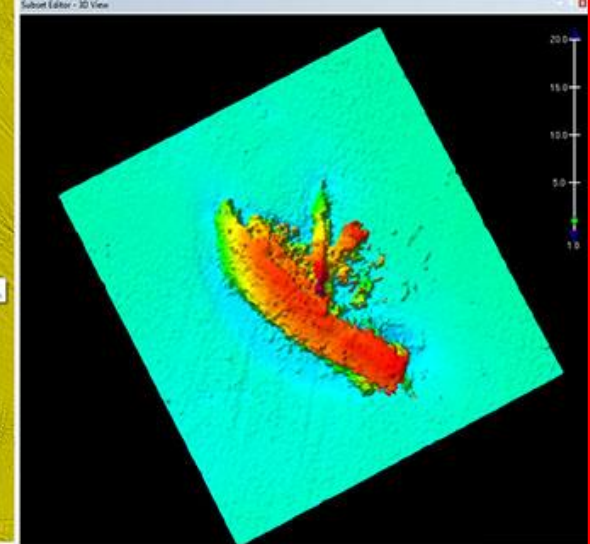


SD-1200

2019 GULF OF MEXICO BATHYMETRY

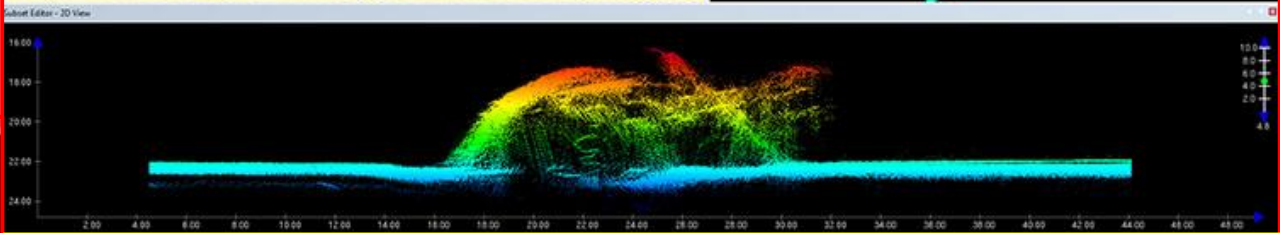
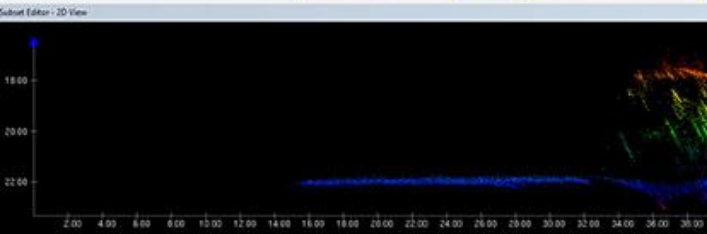
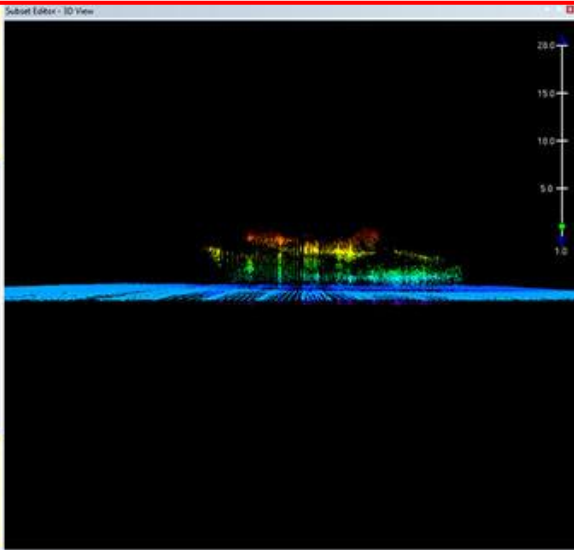
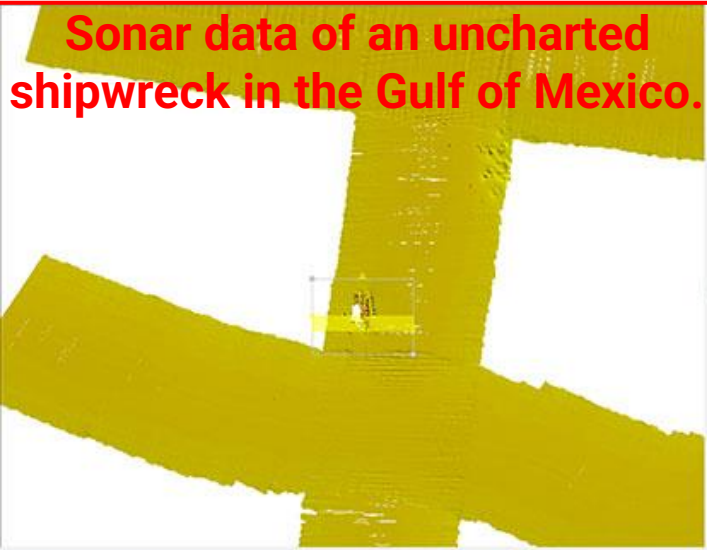
Partnered with the University of Southern Mississippi and NOAA to complete our first shallow-water multibeam bathymetry mission in the Gulf of Mexico.

- Spent 10 days sailing narrow transects (60 – 80 meters (197 – 262 feet) apart) in the Gulf of Mexico surveying areas that were approximately 20 meters (65 feet) deep.



Down views of a known shipwreck in the Gulf of Mexico

Sonar data of an uncharted shipwreck in the Gulf of Mexico.



GULF OF MEXICO MISSIONS

NOAA -- 2021 & 2022 ATLANTIC HURRICANE MISSIONS

Improving intensification forecasting to mitigate hurricane damage in coastal areas



GLOBAL TROPICAL CYCLONES 1985-2005

NOAA has funded 7 vehicles for 90 mission days each

Collecting data including air, surface, and water temp, humidity, barometric pressure, wind speed and direction, salinity, and wave height and period

Initial findings from 2021 mission suggest salinity a key factor in rapid intensification

COST OF UNITED STATES HURRICANE DAMAGE*

Ida (2021) **\$64.5B, 96 lives**

Laura (2020) **\$1.9B, 42 lives**

Dorian (2019) **\$1.7B, 10 lives**

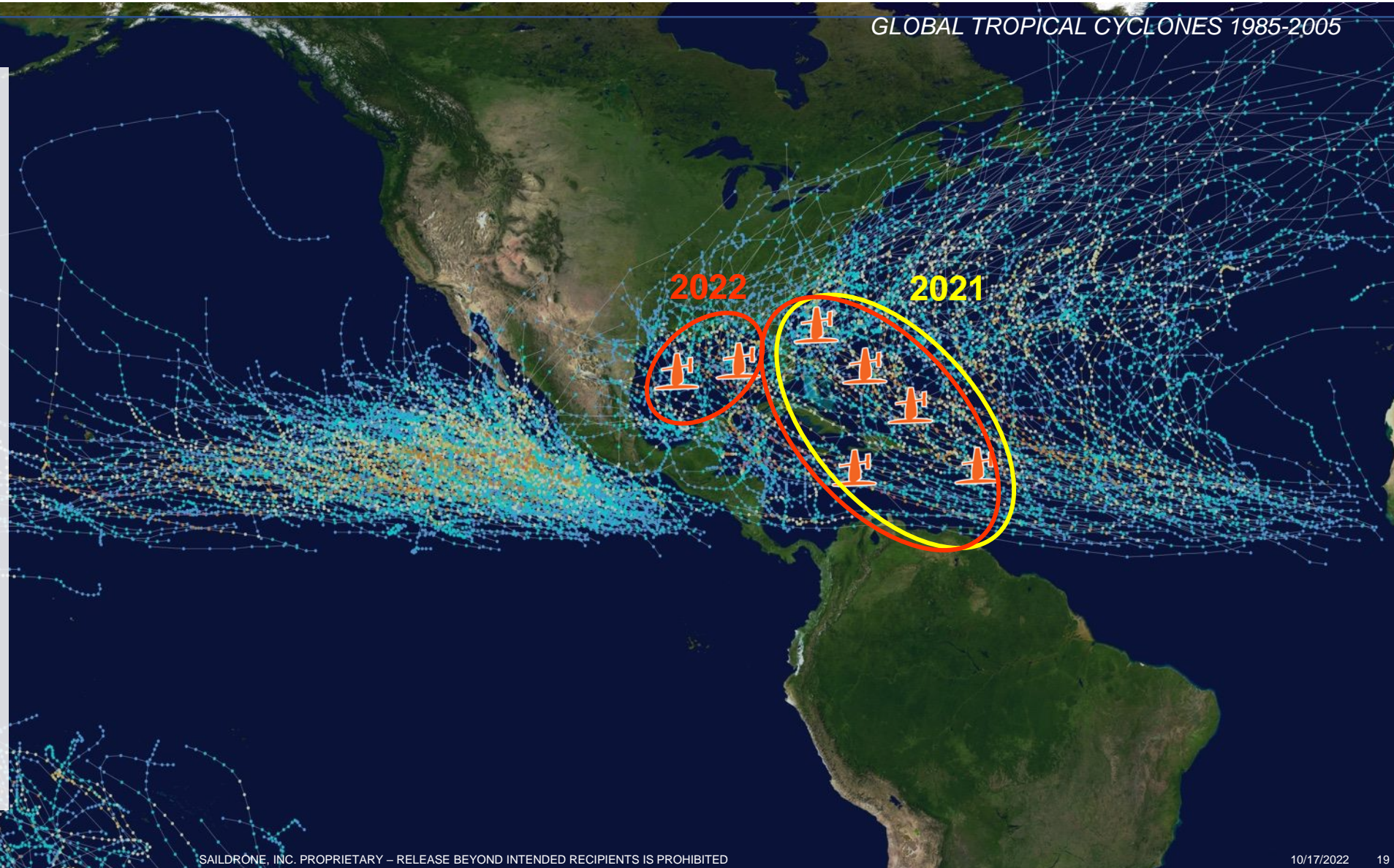
Michael (2018) **\$27.B, 49 lives**

Harvey (2017) **\$138.8B, 89 lives**

*NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2021).

<https://www.ncdc.noaa.gov/billions/>, DOI: 10.25921/stkw-7w73

†Cost data from Hurricane Nicholas in Sept. 2021 is still being calculated.



Saildrone Studying Hurricanes to understand rapid intensification

Picture from 135mph winds inside Hurricane Fiona

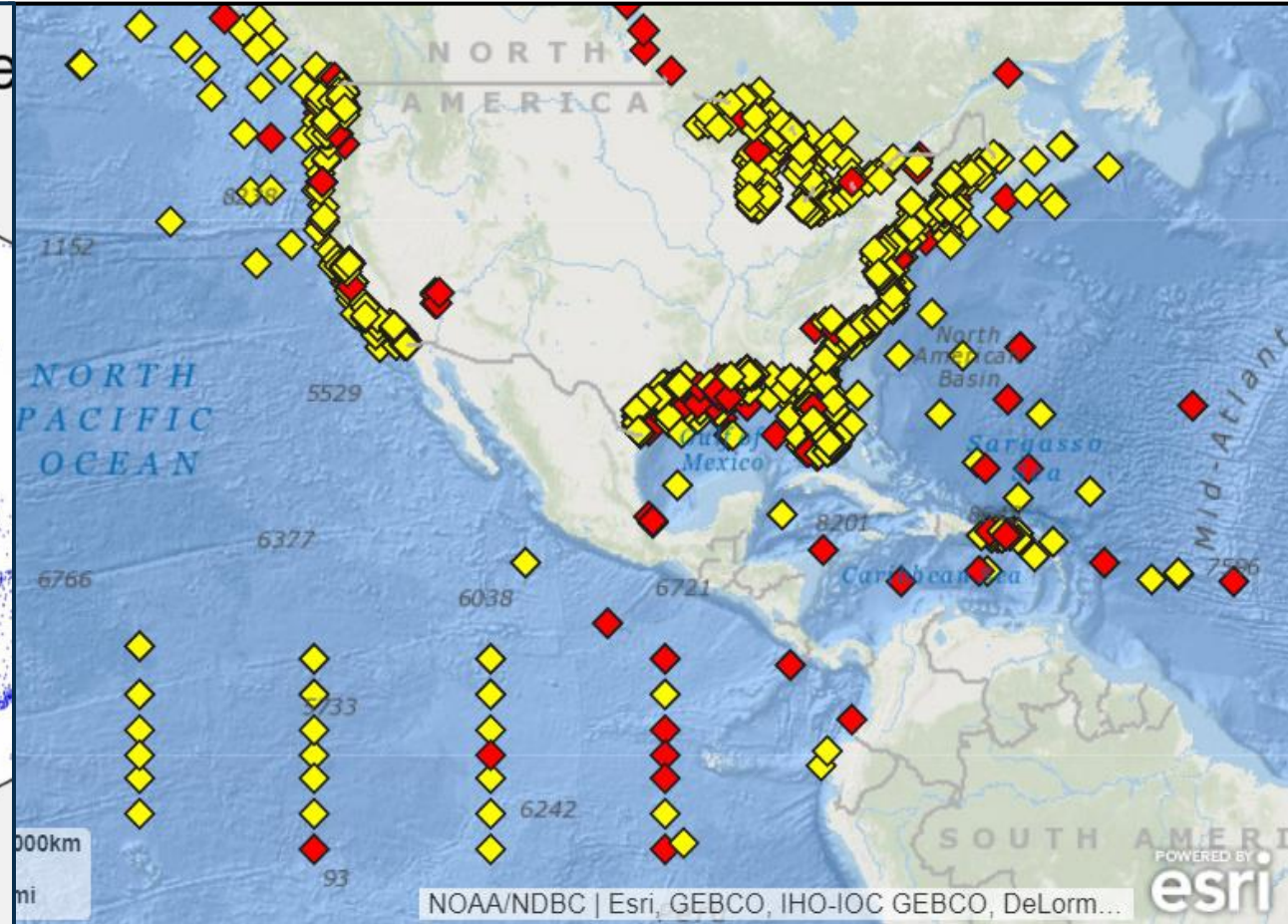
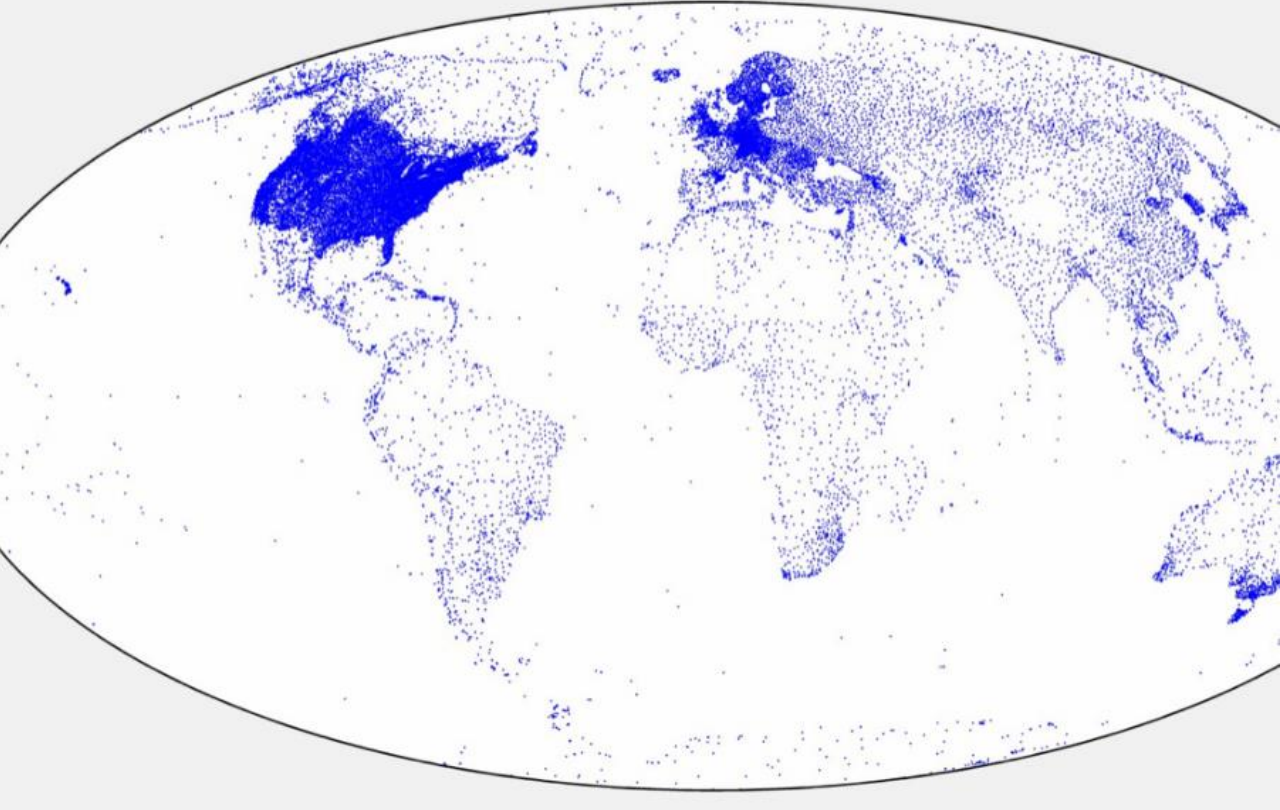


OCEANS DRIVE GLOBAL WEATHER

Yet, the density of met/ocean observations is both lacking and hard to maintain

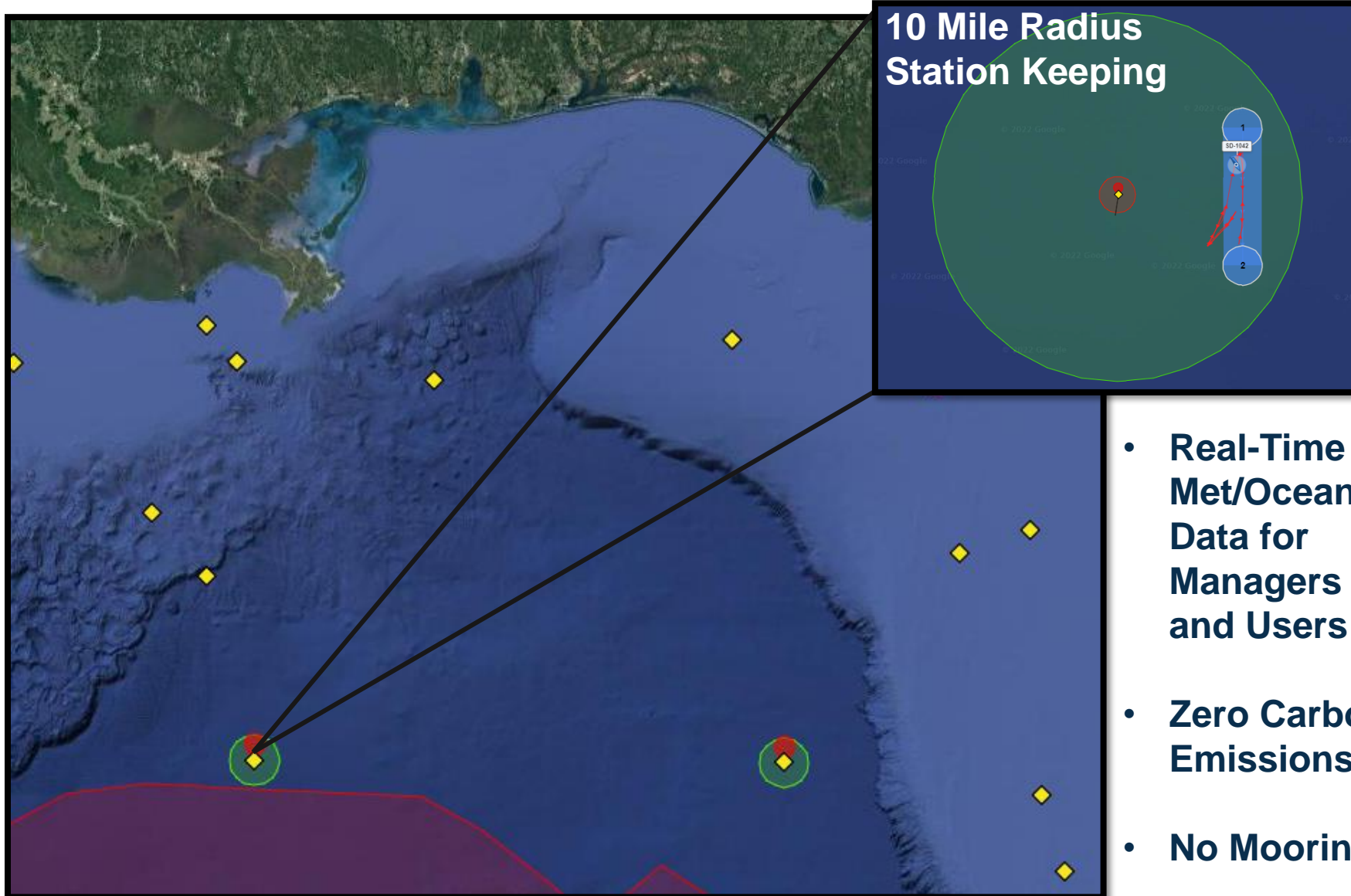


Map of Weather Stations (and nothing else)



OCEAN METEOROLOGICAL OBSERVATIONS

Augmenting Buoy Measurements for the National Data Buoy Center



- Real-Time Met/Ocean Data for Managers and Users
- Zero Carbon Emissions
- No Moorings

National Oceanic and Atmospheric Administration's
National Data Buoy Center
 Center of Excellence in Marine Technology

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NDBC is adding additional data to its .drift file format on or about August 17. For more info, see the [Drift File Format Change Notice](#).

Station 42503 - SD 1036 - 208 NM West of Naples, FL (Site of 42003)

Leased by National Data Buoy Center
 Uncrewed Surface Vehicle
 Saildrone Explorer
 Currently located at 25.97 N 85.66 W

Site elevation: sea level
 Air temp height: 2.3 m above site elevation
 Anemometer height: 5.2 m above site elevation
 Barometer elevation: 0.2 m above mean sea level
 Sea temp depth: 1.5 m below water line
 Water depth: 3265 m
 Watch circle radius: 20254 yards

Courtesy Saildrone. Used with express permission.

Map Type: Oceans

The highly endangered **Rice's whale**, a newly identified species, inhabit the northeastern Gulf of Mexico year-round along the continental shelf-break between 100m and 400m depth. Vessels can kill or injure whales - please use slow speeds and be prepared to avoid surfacing whales. To report sightings call 1-877-WHALE-HELP.

Latest NWS Marine Forecast

Meteorological Observations from Nearby Stations and Ships

Large icon indicates selected station.
 ♦ Stations with recent data
 ♦ Stations with no data in last 8 hours (24 hours for tsunami stations)

Conditions at 42503 as of (2:00 pm CDT) 1900 GMT on 08/09/2022:

Note: This report is more than two hours old

Unit of Measure: Imperial Time Zone: Station Local Time Select

Click on the graph icon in the table below to see a time series plot of the last five days of that observation.

Wind Direction (WDIR):	SE (128 deg)
Wind Speed (WSPD):	11.1 kts
Wave Height (WVHT):	3.0 ft
Dominant Wave Period (DPP):	5 sec
Atmospheric Pressure (PRES):	30.07 in
Air Temperature (ATMP):	82.9 °F
Water Temperature (WTMP):	85.3 °F
Dew Point (DEWP):	75.6 °F

Previous 25 observations

MM	DD	HHMM	LAT	Lon	WDIR	WSPD	GST	WVHT	DPD	PRES	PTDY	ATMP	WTMP	DEWP
		CDT	deg	deg		kts	kts	ft	sec	in	in	°F	°F	°F
08	09	1:00 pm	25.98	-85.66	SE	11	-	3.3	5	30.09	-	80.2	85.3	74.1
08	09	12:00 pm	25.99	-85.66	SE	11	-	3.0	6	30.11	-	82.9	85.5	76.1
08	09	11:00 am	26.01	-85.65	SE	11	-	3.0	5	30.09	-	85.3	85.5	77.5
08	09	10:00 am	26.02	-85.65	SE	11	12	3.0	6	30.10	-	85.1	85.3	76.1
08	09	9:00 am	25.97	-85.67	SE	12	13	3.0	5	30.08	-	84.9	85.5	76.6
08	09	8:00 am	25.95	-85.68	ESE	11	12	2.6	6	30.08	-	84.9	85.3	77.4
08	09	7:00 am	25.95	-85.67	E	11	12	3.0	6	30.05	-	84.0	85.3	78.1
08	09	6:00 am	25.95	-85.67	E	10	13	3.0	6	30.03	-	84.0	85.3	77.7
08	09	5:00 am	25.96	-85.66	ESE	10	12	3.0	6	30.02	-	84.4	85.3	77.5
08	09	4:00 am	25.96	-85.66	ESE	8	9	3.0	6	30.02	-	83.8	85.3	77.4
08	09	3:00 am	25.96	-85.66	ESE	9	10	3.0	6	30.03	-	83.7	85.3	76.6
08	09	2:00 am	25.97	-85.65	ESE	9	10	3.3	6	30.04	-	83.7	85.5	77.4
08	09	1:00 am	25.98	-85.64	ESE	13	15	3.0	6	30.05	-	83.7	85.6	74.5
08	09	12:00 am	25.99	-85.63	E	14	16	3.0	6	30.08	-	83.7	85.6	77.4
08	08	11:00 pm	26.00	-85.62	E	10	11	2.6	6	30.09	-	83.7	85.6	74.8
08	08	10:00 pm	26.01	-85.62	ENE	11	13	3.0	6	30.08	-	82.8	85.6	76.6
08	08	9:00 pm	26.01	-85.63	ESE	2	3	3.0	6	30.07	-	79.9	85.6	73.4
08	08	8:00 pm	26.01	-85.62	S	15	17	3.0	6	30.07	-	79.5	85.8	72.9
08	08	7:00 pm	26.02	-85.62	NE	10	10	3.3	5	30.03	-	83.8	85.8	78.4
08	08	6:00 pm	26.03	-85.63	NE	7	9	3.0	5	30.02	-	84.0	85.8	77.9
08	08	5:00 pm	26.03	-85.64	NE	6	8	3.0	6	30.03	-	84.0	85.8	77.7
08	08	4:00 pm	26.02	-85.65	E	7	8	3.0	6	30.03	-	84.4	86.0	77.5
08	08	3:00 pm	25.99	-85.66	ESE	11	12	3.0	5	30.04	-	84.6	86.0	77.5
08	08	2:00 pm	26.00	-85.65	ESE	10	11	2.6	6	30.06	-	85.3	85.8	76.6



SAILDRONE

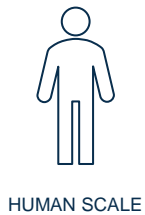
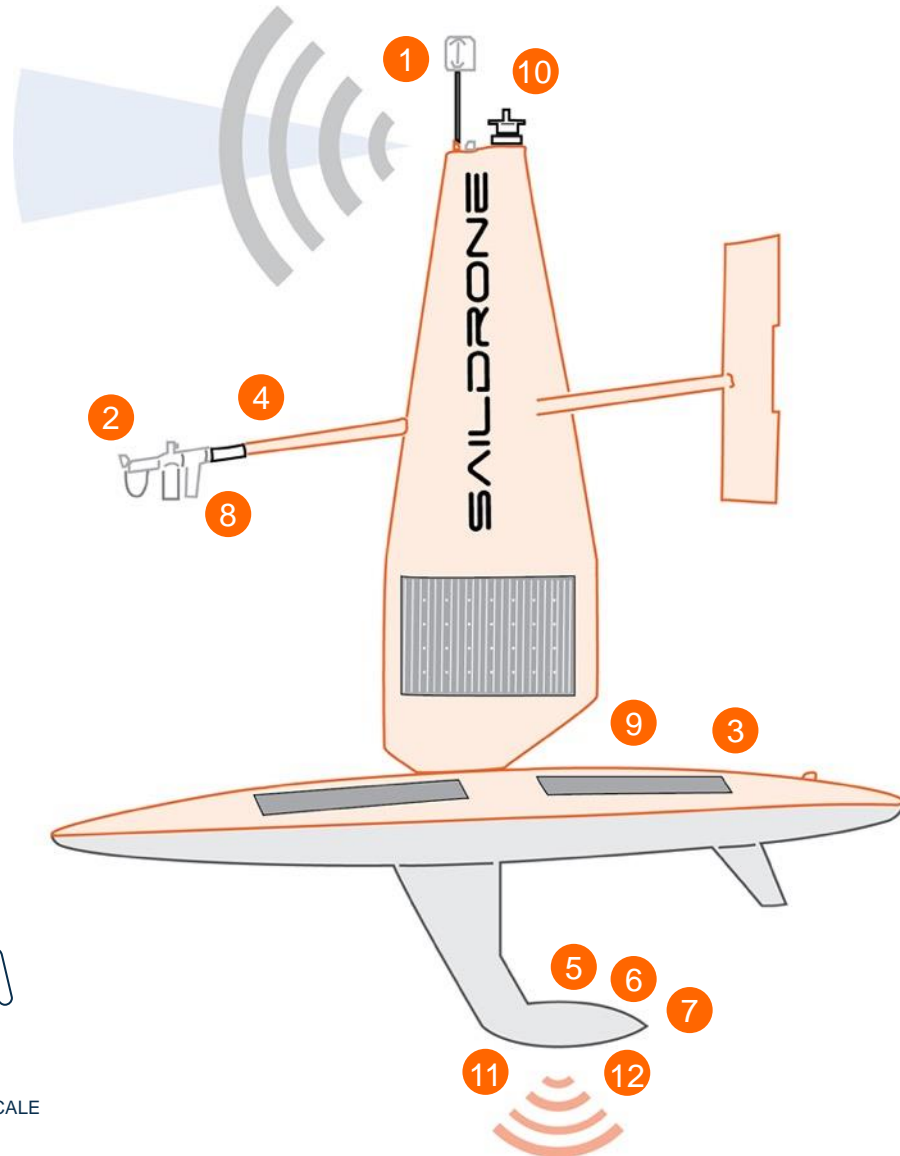
Matt Womble
Director, Ocean Data Programs
228.235.5964
Matt.Womble@saildrone.com

SAILDRONE VEHICLES

Vehicle Sensor Suites

SAILDRONE EXPLORER – METOCEAN

Metocean sensor suite: Critical scientific data for understanding climate change



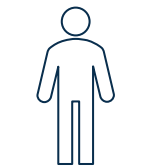
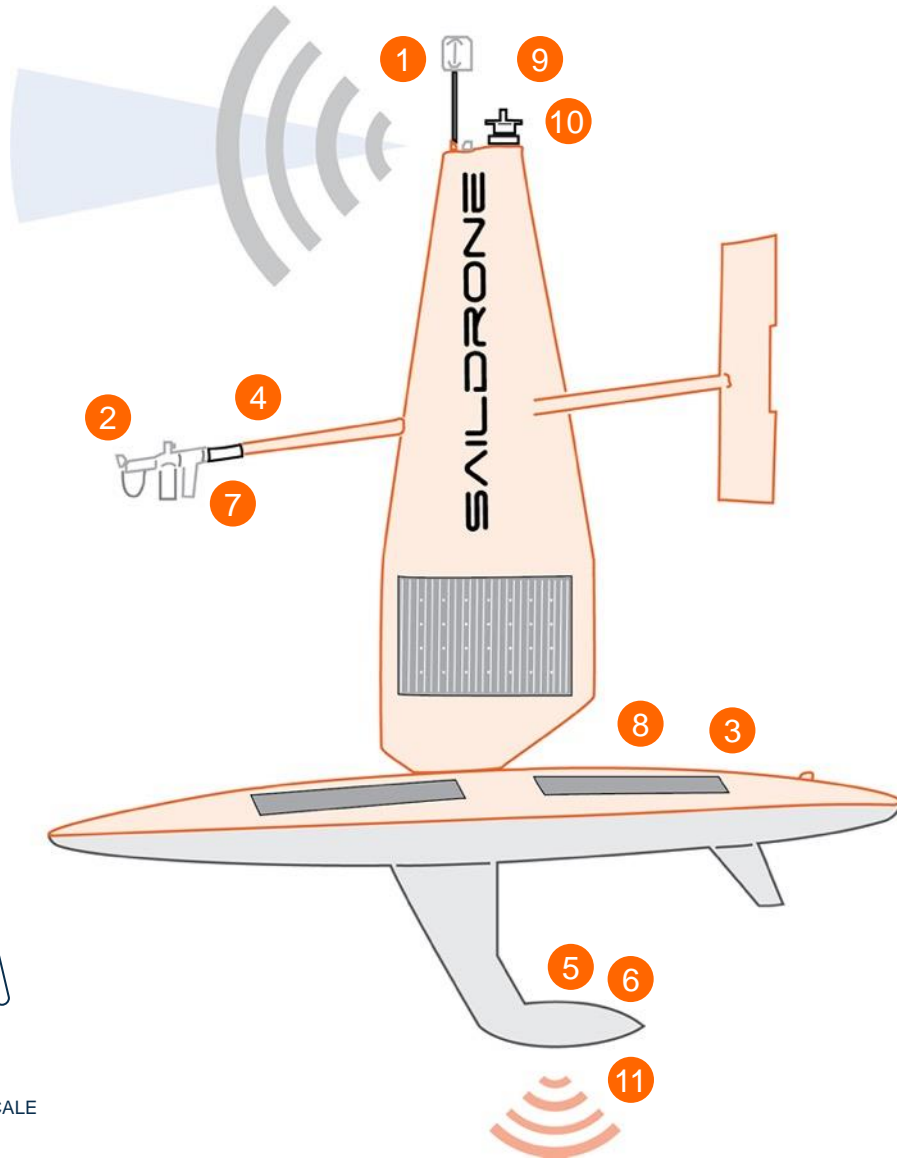
PAYLOAD OPTIONS

No.	Variable	Sensor	
1	Wind speed & direction	Gill Windmaster 3D Ultrasonic 20Hz @ + 5.2 m	ATMOSPHERIC
2	Air temp & humidity	Rotronic HC2 - S3 with rad shield @ + 2.3 m	
3	Barometric pressure	Vaisala Barocap PTB210 @ +0.2 m	
4	Photosynthetically active radiation	LI-COR LI-192SA @ +2.6 m	
5	Salinity & temperature	Seabird SBE 37 @ -1.5 m	OCEAN
6	Dissolved oxygen	Seabird SBE 37 ODO @ -1.5 m	
7	Chlorophyll-a	Wetlabs ECO-FL-S G4 @ -0.5 m	
8	Skin temperature	Heitronics CT 15.10 @ +2.3	OCEAN
9	Wave height & period	Dual GPS aided IMU	
10	Smart camera array	360° High-resolution optical cameras with ML target detection	OPTIONS
11	Ocean currents	Teledyne RDI Workhorse ADCP 300 kHz @ -1.9 m	
12	Echo sounder	Simrad WBT Mini (EK80) @ -1.9 m 120 kHz or 38-200 kHz	

OR

SAILDRONE EXPLORER – FISHERIES

Fisheries sensor suite



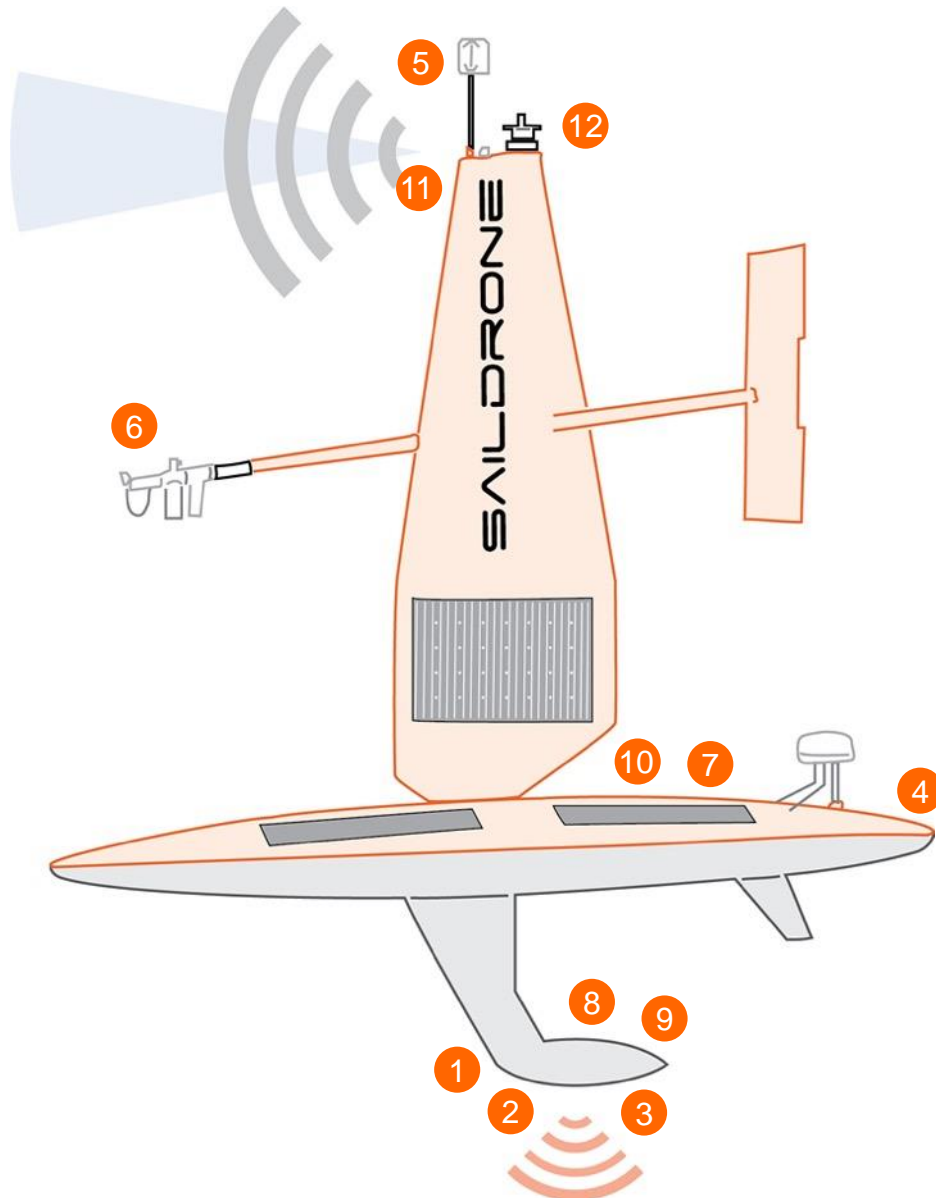
HUMAN SCALE

PAYLOAD OPTIONS

No.	Variable	Sensor	
1	Wind speed & direction	Gill Windmaster 3D Ultrasonic 20Hz @ + 5.2 m	ATMOSPHERIC
2	Air temp & humidity	Rotronic HC2 - S3 with rad shield @ + 2.3 m	
3	Barometric pressure	Vaisala Barocap PTB210 @ +0.2 m	
4	Photosynthetically active radiation	LI-COR LI-192SA @ +2.6 m	
5	Salinity & temperature	Seabird SBE 37 @ -1.5 m	OCEAN
6	Dissolved oxygen	Seabird SBE 37 ODO @ -1.5 m	
7	Skin temperature	Heitronics CT 15.10 @ +2.3	
8	Wave height & period	Dual GPS aided IMU	MDA
9	AIS transceiver		
10	Smart camera array	360° High-resolution optical cameras with ML target detection	ACOUSTIC
11	Fish biomass	Simrad WBT Mini (EK80) @ -1.9 m 120 kHz or 38-200 kHz	

SAILDRONE VOYAGER – BATHYMETRY

Uncrewed shallow-water multibeam mapping vehicle

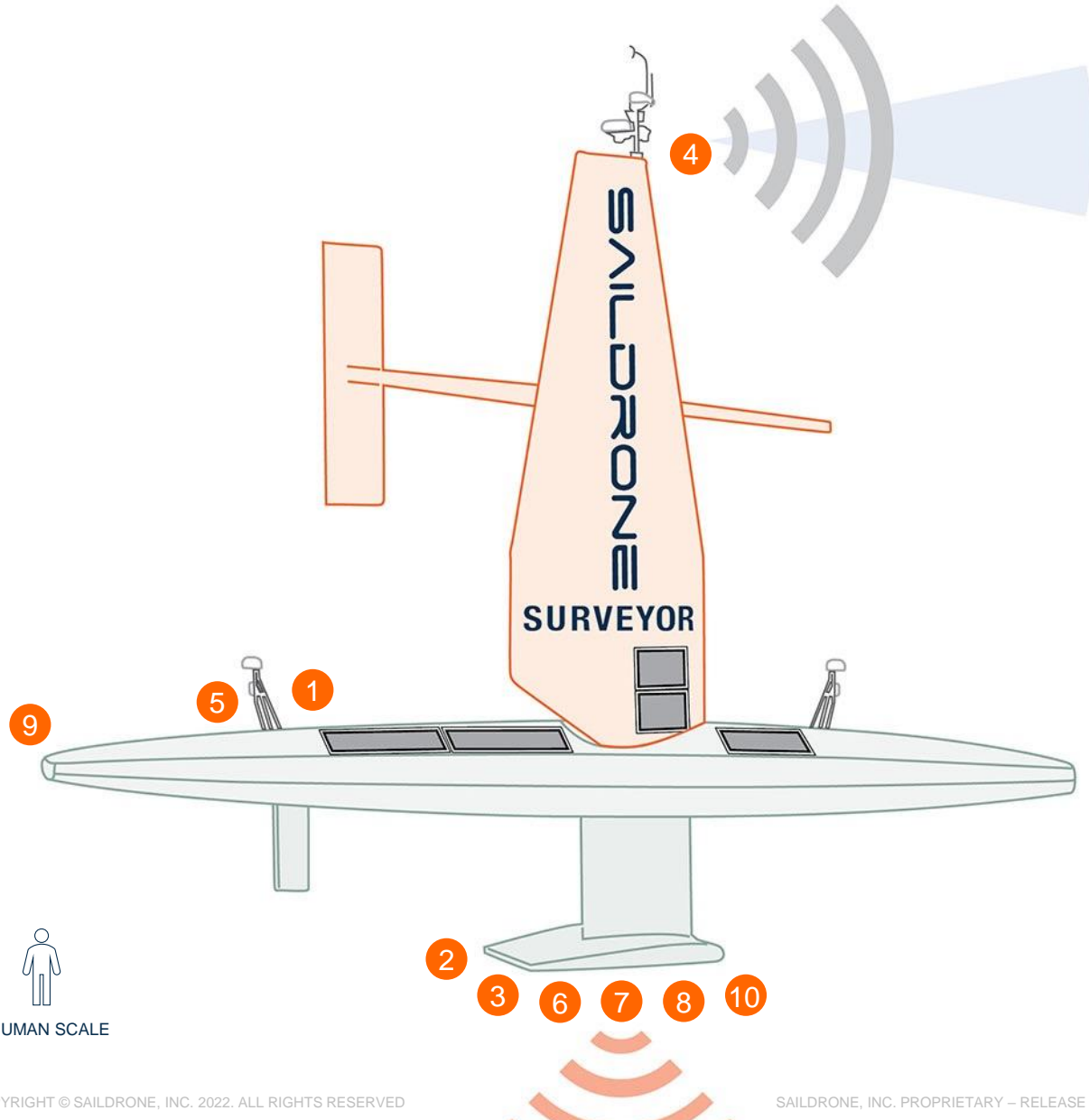


PAYLOAD OPTIONS

No.	Variable	Sensor	
1	Bathymetry	Norbit Winghead i77h 300 meters	ACOUSTIC
2	Positioning	Integrated POS MV OceanMaster	
3	Sound velocity	Integrated sound velocity profiler	
4	Sound velocity & winch	Integrated sound velocity profiler to 150 m depth	ATMOSPHERIC
5	Wind speed & direction	Gill 1405-PK-038	
6	Air temp & humidity	Rotronic HC2-S3 with rad shield @ + 6.4 m	
7	Barometric pressure	Vaisala Barocap PTB210 @ +0.2 m	OCEAN
8	Salinity & temperature	Seabird SBE 37 @ -1.5 m	
9	Dissolved oxygen	Seabird SBE 37 ODO @ -1.5 m	
10	Wave height & period	Dual GPS aided IMU	MDA
11	AIS transceiver		
12	Smart camera array	360° High-resolution optical cameras with AI/ML target detection	

SAILDRONE SURVEYOR

World's largest and most advanced, uncrewed surface vehicle for ocean mapping and exploration



PAYLOAD OPTIONS

No.	Variable	Sensor
1	Positioning	Seapath 380+ GNSS/INS system
2	Deep-water bathymetry	Kongsberg EM 304 multibeam sonar
3	Shallow-water bathymetry	Kongsberg EM 2040 multibeam sonar
4	Wind speed & direction	B&G WS730S
5	Barometric pressure	Yacht Devices YDBC-05N
6	Ocean currents	Simrad EC150 ADCP
7	Ocean currents	Teledyne Pinnacle 45 ADCP
8	Fish biomass	Simrad EK80 echo sounder
9	Sound velocity profiler	Valeport sound velocity profiler (cast depth: 500 m)
10	Surface sound	Teledyne SVP 70 (fixed on bottom of gondola)

