

NOAA – UNH Joint Hydrographic Center

UPDATE ON SAILDRONE SURVEYOR



HYDROGRAPHIC SERVICES REVIEW PANEL





NOAA – UNH Joint Hydrographic Center

Joint



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PROGRAM PRIORITIES	THEMES	SUB-THEMES	TASKS	
ADVANCE THE TECHNOLOGY TO MAP US WATERS	DATA ACQUISITION	INTEGRATED SF MAPPING	ACOUSTIC BATHY AND BS	System Performance Assessment Underway Sensor Integration Monitoring Backscatter Calibration Environmental Monitoring New Sensors
			LIDAR WATER COLUMN AND SB	Lidar Systems, providing both bathymetry and reflectance Water Column Mapping Subbottom Mapping
		OPS and DEPLOYMENT OF USV	New Functionality in CAMP Camera Systems for Marine Situational Awareness ML Training Data for Marine Applications	
			Path Planning for Ocean Mapping Autonomous Sonars N>1 ASV with Operators <N Data Acquisition for Volunteer/Trusted Partner Systems	
	DATA VALUE	DATA FROM TRAD SOURCES	Bathymetry Data Processing Backscatter Data Processing Object Detection Chart Features	
		NON-TRAD DATA	sUAS Mapping for Safety of Navigation Millimeter Resolution Mapping with Frame Sensors Enhanced Underwater 3D Construction Volunteer Bathymetric Observations Alternative Uses for ICESAT-2 and other Laser Altimeter Data	
		AI/ML/CLOUD	Ocean Mapping Data Analytics Support of US ECS Efforts Offshore Marine Resources	
		RESOURCES OF CONT SHELF	TECHNOLOGIES IN SUPPORT OF BLUE ECONOMY	Management of Living Marine Resources from ECS and ICESat-2
	ADVANCE THE TECHNOLOGY FOR DIGITAL NAV SERVICES			Improvements in Change Detection Delivery of Bathymetric Data Services from Enterprise Databases Innovative Approaches to Support Precision Navigation Managing and Transforming Data to Navigation Products: Computer Assisted Cartography
				Spatial Data Technology in the Context of Charting and Ocean Mapping Application of Hydrodynamic Models to Navigation Products Tools for Visualizing Complex Ocean Data Sets General Semiotics
VISUALIZATION IN SUPPORT OF NAVIGATION AND OTHER APPLICATIONS		AI/ML/CLOUD	Artificial Intelligence and Machine Learning for Analysis and Filtering Hydrographic Data Manipulation Tools	
			Real-time Display of Ocean Mapping Data BathyGlobe Semantic Understanding of Nautical Charts for Autonomous Navigation Curriculum Development	
DEVELOP AND ADVANCE EXPERTISE MARINE GEOSPATIAL AND SOUNDSCAPE EXPERTISE			Contributions of Echoshounders to the Ocean Soundscape	
			Delivery of Results – Publications and Presentations Outreach	

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UNCREWED SURFACE VESSEL Research and Development Program at the NOAA – UNH Joint Hydrographic Center/Center for Coastal and Ocean Mapping

ASV Global CW-4



Seafloor Systems Echoboat



Teledyne Oceansciences Z-Boat

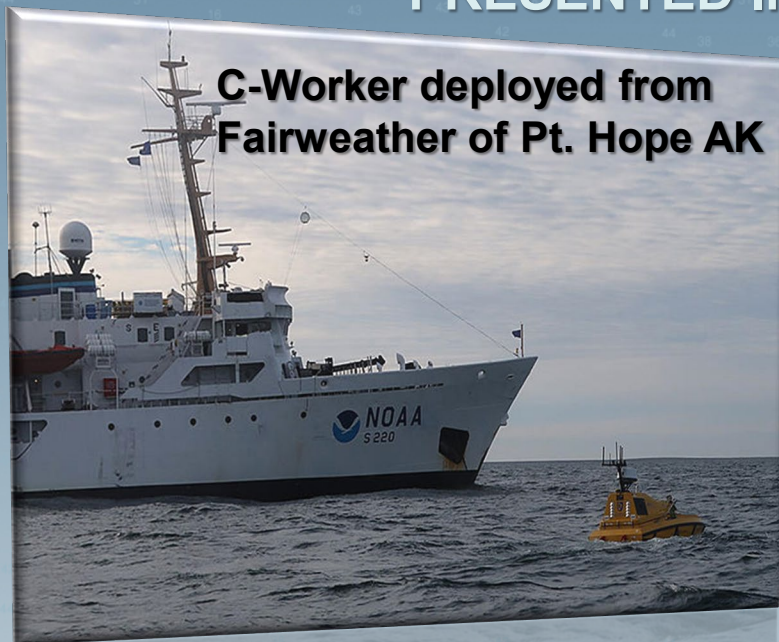


iXBlue DriX



The NOAA-University of New Hampshire Joint Hydrographic Center

PRESENTED IN NEW ORLEANS:



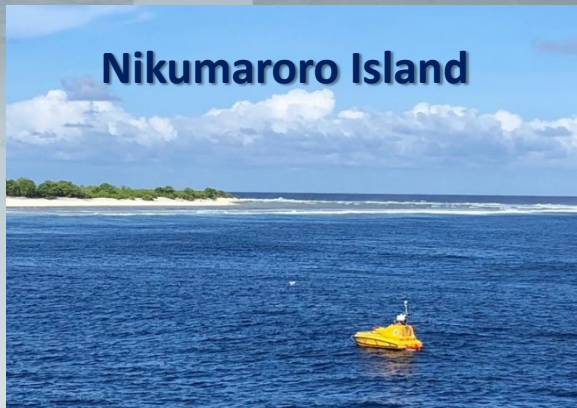
C-Worker deployed from Fairweather of Pt. Hope AK



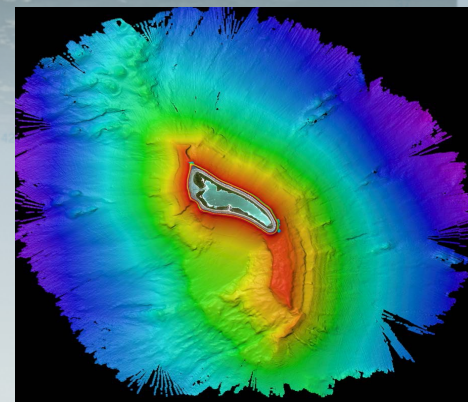
C-Worker working in high-risk environment off Channel Islands



Shore-based ops in Thunderbay NMS



Nikumaroro Island



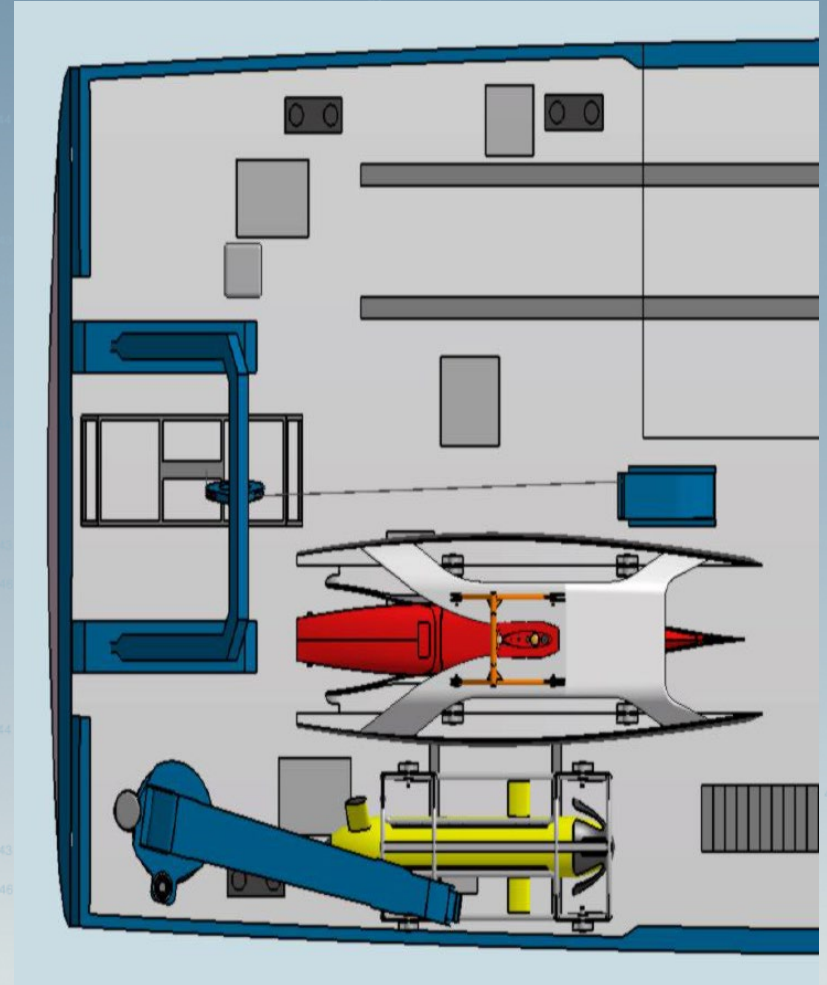
The NOAA-University of New Hampshire Joint Hydrographic Center

DrIX Trials on *Thomas Jefferson* Sea Trials



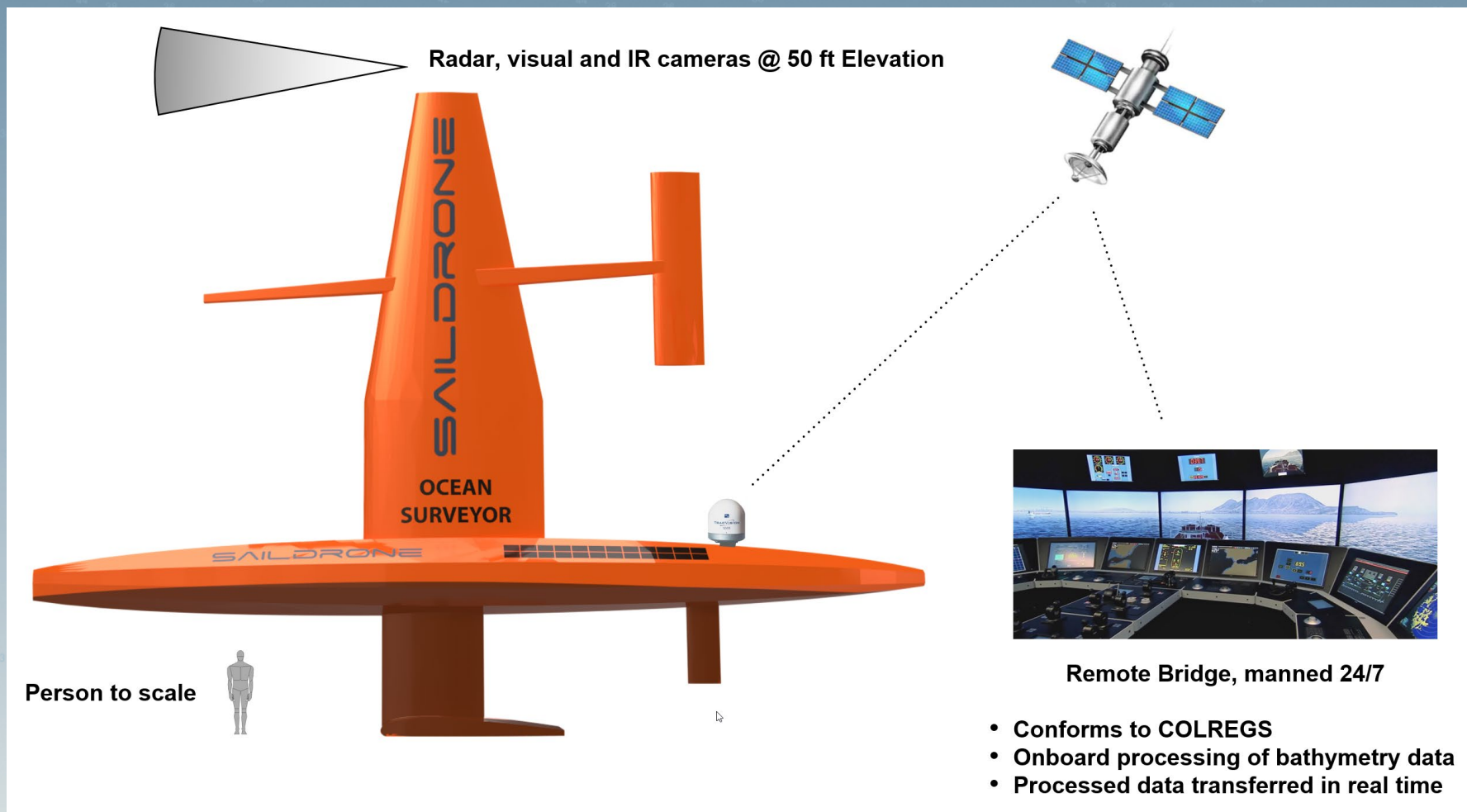
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From DDS → Universal Delivery System – Transportable Crane



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Saildrone SURVEYOR– 72ft (22m) UNMANNED VEHICLE



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Saildrone SURVEYOR

Environmental Measurements

Atmospheric Measurements

- 1 **WIND** Gill Windmaster 3D 20Hz @ + 5.0 m
- 2 **AT / RH** Rotronic HC2 - S3 @ + 2.2 m
- 3 **PRESSURE** Vaisala BAROCAP PTB210 @ + 0.2 m
- 4 **RADIATION** LICOR LI-192SA @ + 2.2 m

Ocean Measurements

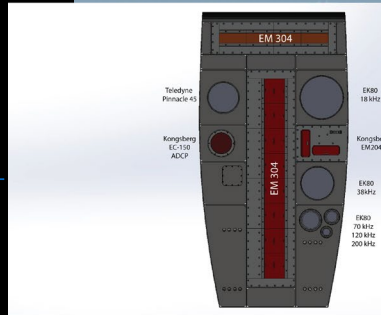
- 5 **CTD** SBE 37 & RBR Conductivity @ -0.5 m
- 6 **DO & TEMP** RBR Coda ODO & SBE 37 ODO @ -0.5m
- 7 **CHL-A** Wetlabs ECO-FL-S G4 & Turner Cyclops-7F
- 8 **SKIN SST** Heitronics CT15.2 @ +2.2 m
- 9 **WAVES** Dual GPS aided IMU - VN 300
- 10 **CAMERAS** Sky, Sea and Horizon Cameras

Acoustics

- 11 **ADCP** Teledyne RDI Workhorse 300 kHz @ -2.0 m
- OR
- 12 **ECHO-SOUNDER** SIMRAD WBT Mini (EK80) @ -2.0 m

Saildrone Surveyor Specifications:

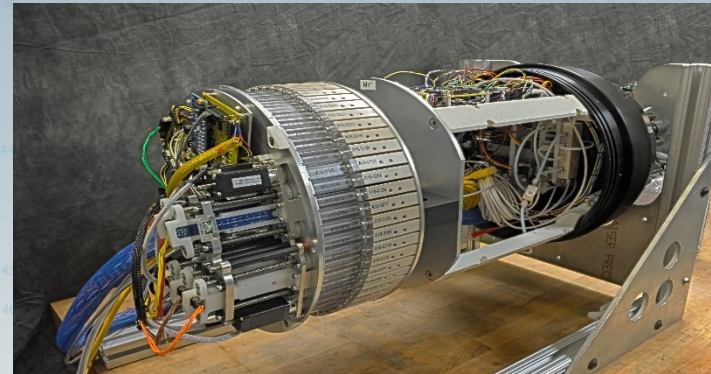
Length: 22m
 Draught: 3m
 Survey Speed: 10 Knots
 Transit Speed: 15 Knots
 Continuous Operation: 6 Months
 Depth Capability: 7000 meters



Mapping Sonars



MBARI ESP – eDNA Sampler



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Saildrone Surveyor Sea-Trials – Sonar SATs



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Mission Portal

SALDRONE Mission Portal

OER NOPP Bathymetry 2020

Data Comms Nav Layers

SD-1200

Time Series Sensors Vehicles Saved Views

Filters **LIVE UPDATES** Updated just now Save

Argus Forward Mast Head

03/01 - 00:56:39 UTC 03/01 - 12:55:19 UTC 03/02 - 00:55:00 UTC



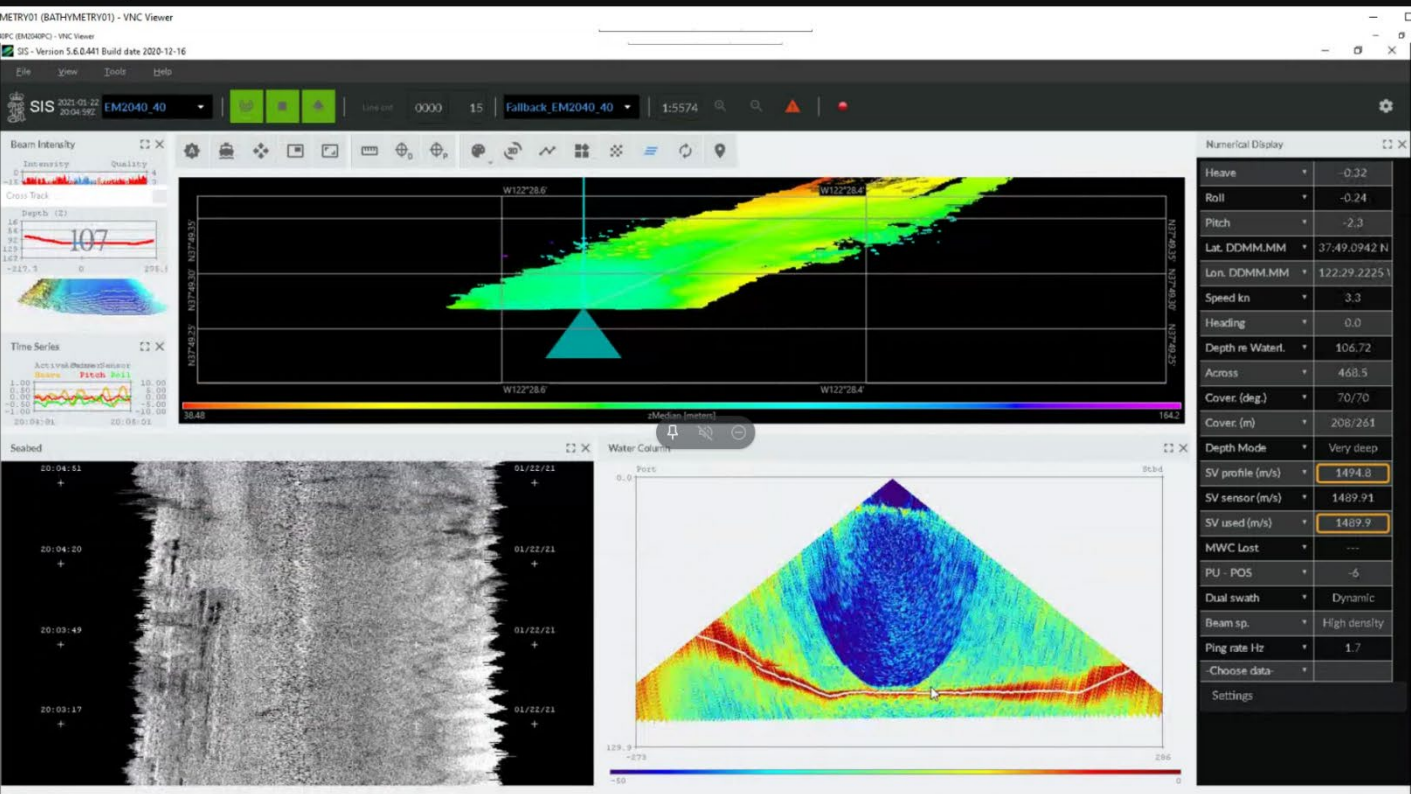
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Remote SIS....

Kevin Jerram is presenting

BATHYMETRY01 (BATHYMETRY01) - VNC Viewer

SIS - Version 5.6.0-441 Build date 2020-12-16



Heave	-0.32
Roll	-0.24
Pitch	-2.3
Lat. DDMM.MMM	37:49.0942 N
Lon. DDMM.MMM	122:29.2225 W
Speed kn	3.3
Heading	0.0
Depth re. Waterl.	106.72
Across	468.5
Cover. (deg.)	70/70
Cover. (m)	208/261
Depth Mode	Very deep
SV profile (m/s)	1494.8
SV sensor (m/s)	1489.91
SV used (m/s)	1489.9
MWC Lost	---
PU - POS	-6
Dual swath	Dynamic
Beam sp.	High density
Ping rate Hz	1.7
Choose data	
Settings	

Windows taskbar: 12:04 PM 1/22/2021

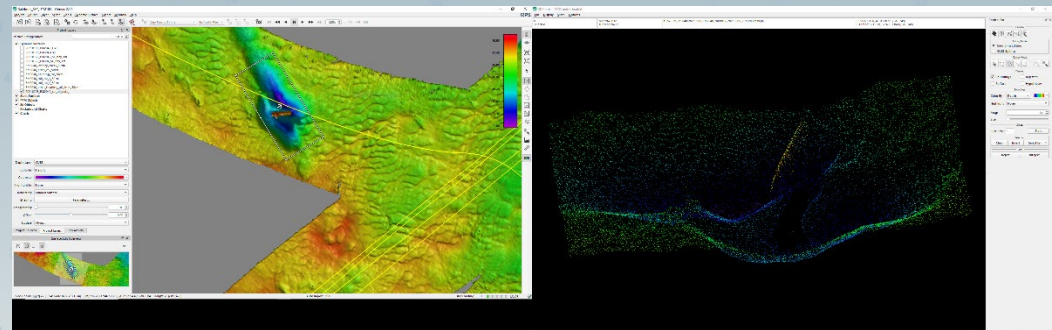
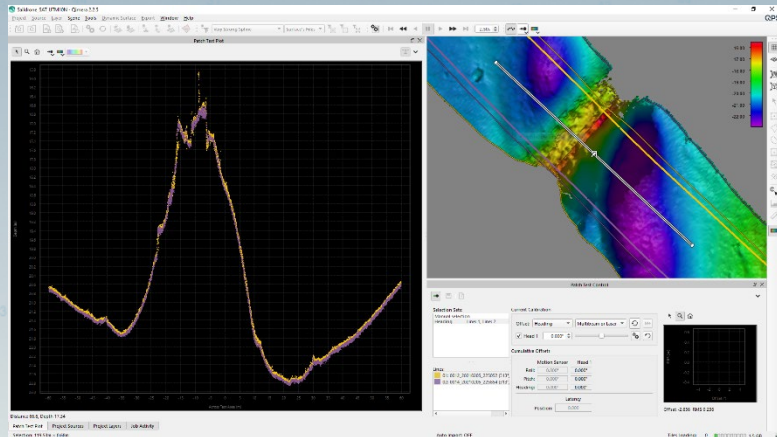
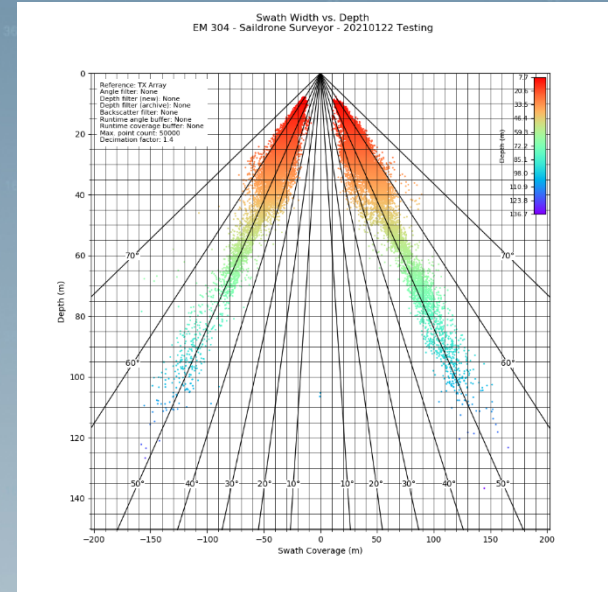
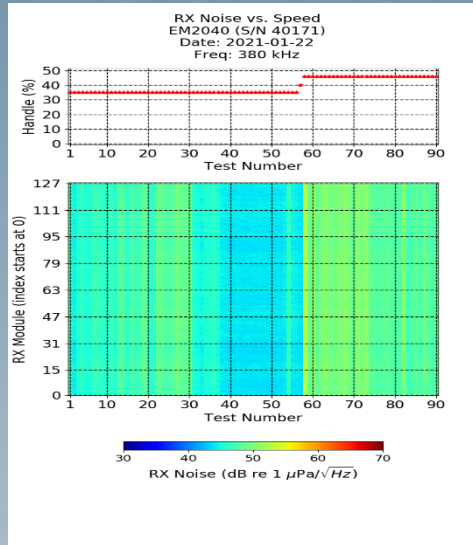
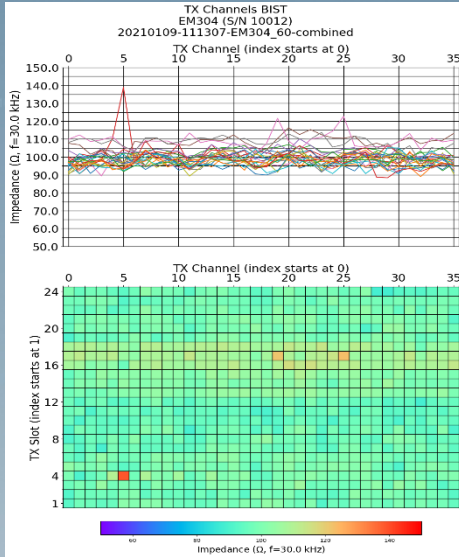
Zoom Meeting: 2:55 PM

Participants: You, Matt Paulson, Tony Dahlheim, Paul, Kevin Jerram



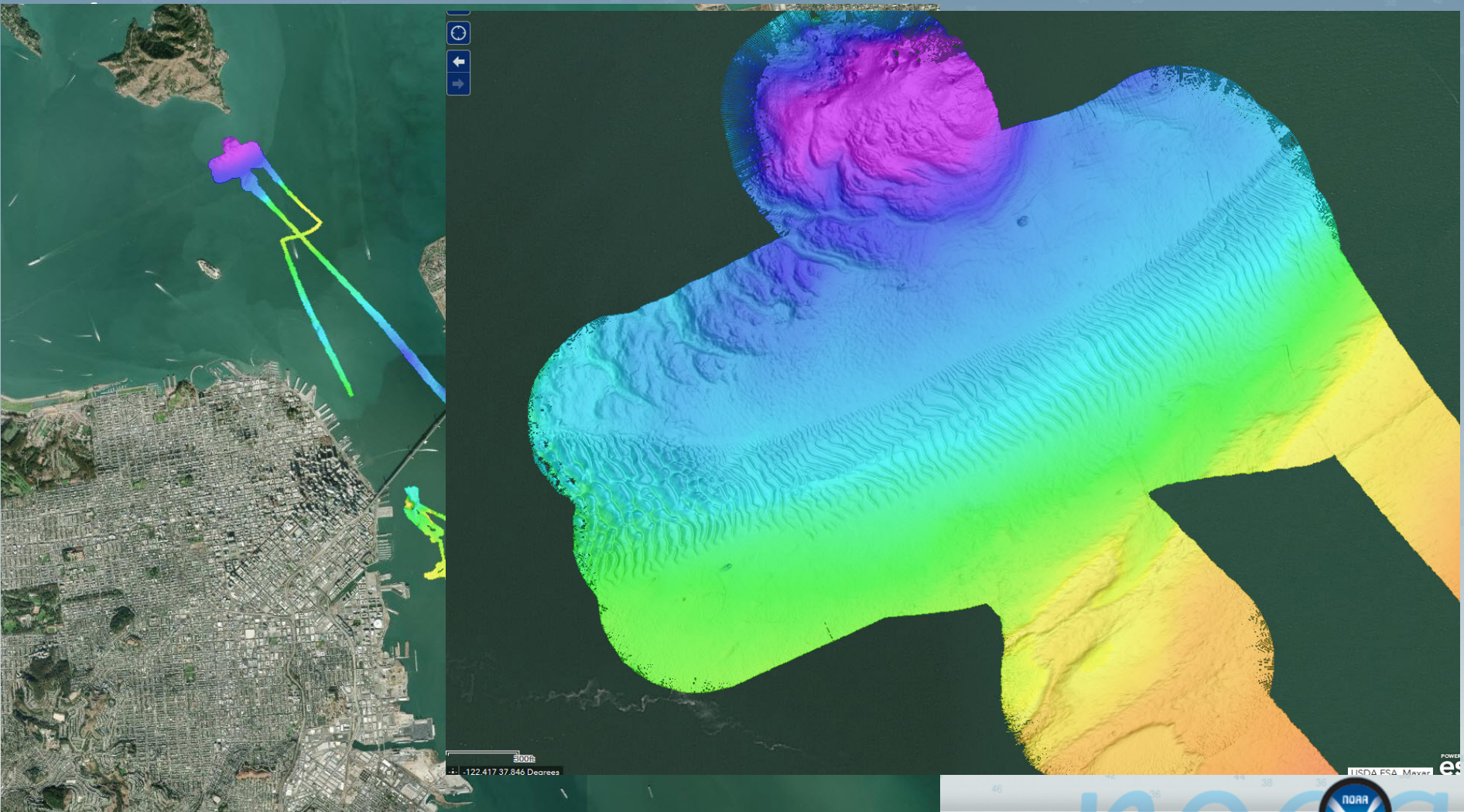
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Remote System Checks

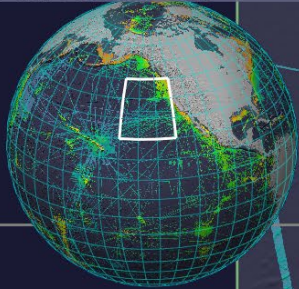


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Initial Patch Tests and SAT



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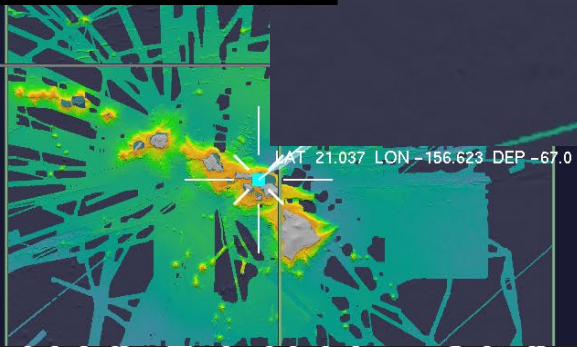
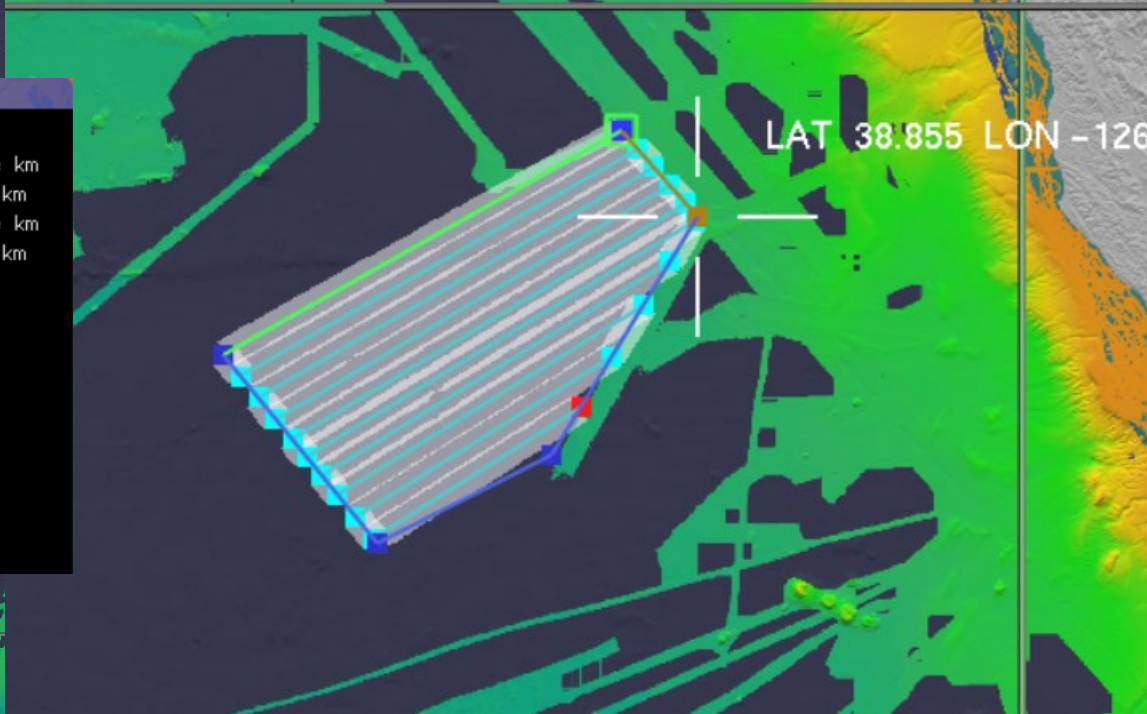
NEW GAP-FILLER TOOL

Plan Stats

Close

Total Mapped Area	: 42072.44 square km
Overlap GEBCO 2020	: 1910.86 square km
New Mapping	: 40161.59 square km
Self Overlap	: 7790.85 square km

Distance 1478.75 nm at 9.00 kts
Mapping Time : 6 days, 20.31 hr



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Uncrewed → Autonomous

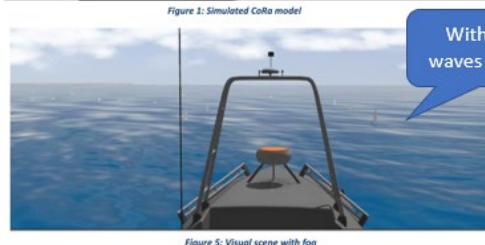
CCOM/JHC TEAM WON COMPETITION



Team	Affiliation	Total	Ranking
TeamCCOM ¹	University of New Hampshire	8	1
the_italian_job	None	9	2
bumblebee	National University of Singapore	12	3
gt-mrg	Georgia Institute of Technology	13	4
teamKanaloa	University of Hawaii at Manoa	18	5

Sponsored by:
 ONR
 Naval Postgraduate School
 Open Robotics

Simulation with Lidar



With wind, waves and fog.



Buoys to navigate, obstacles to avoid, and a "ping" to localize.

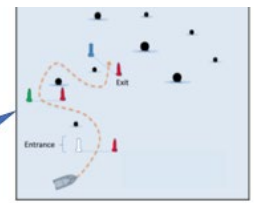
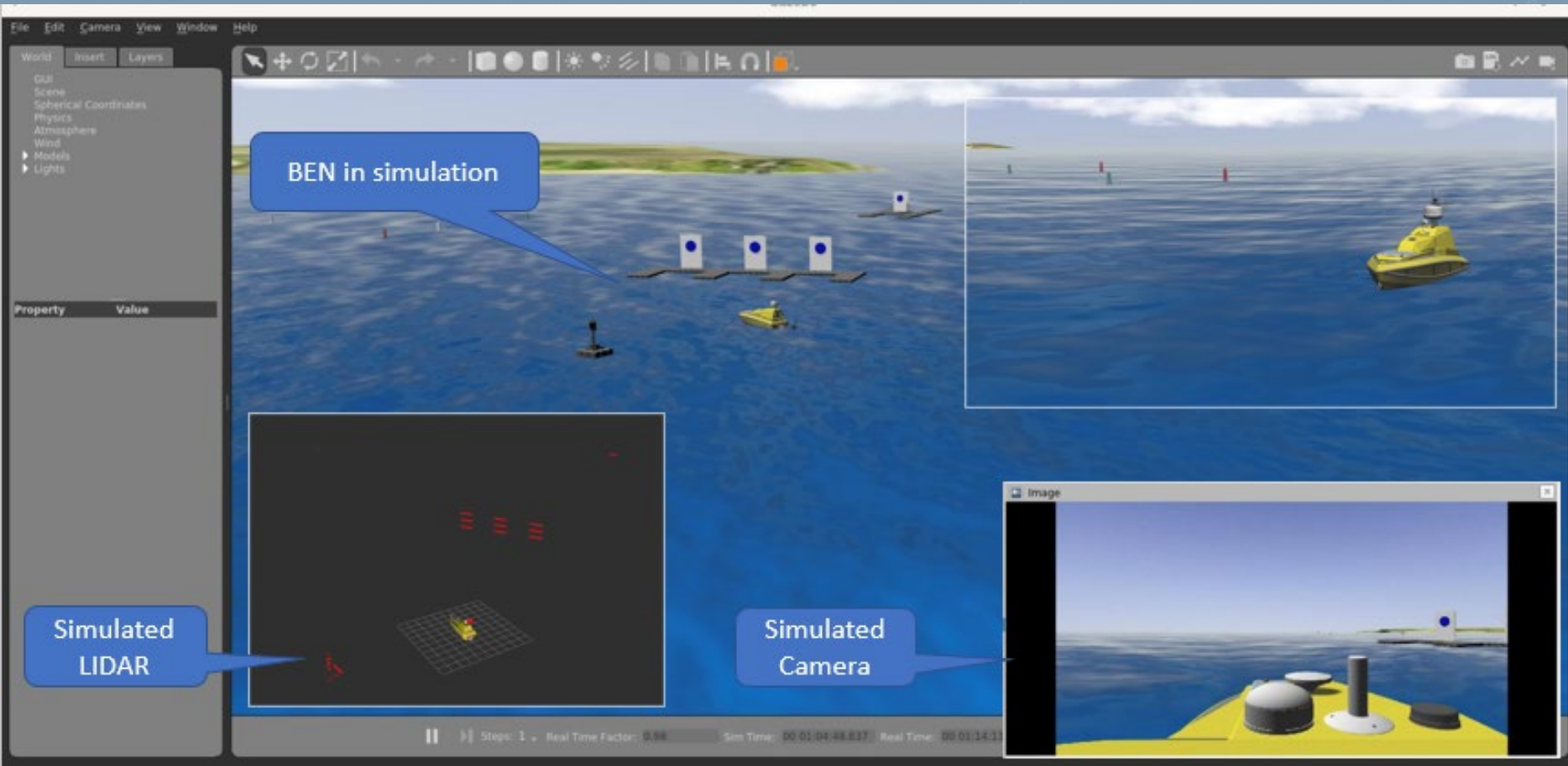


Figure 5: Visual scene with fog



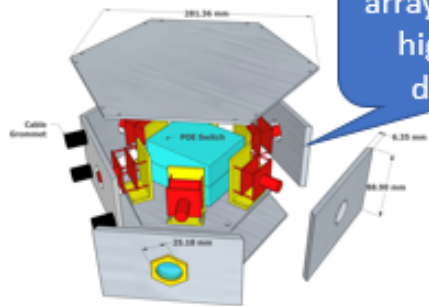
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Uncrewed → Autonomous

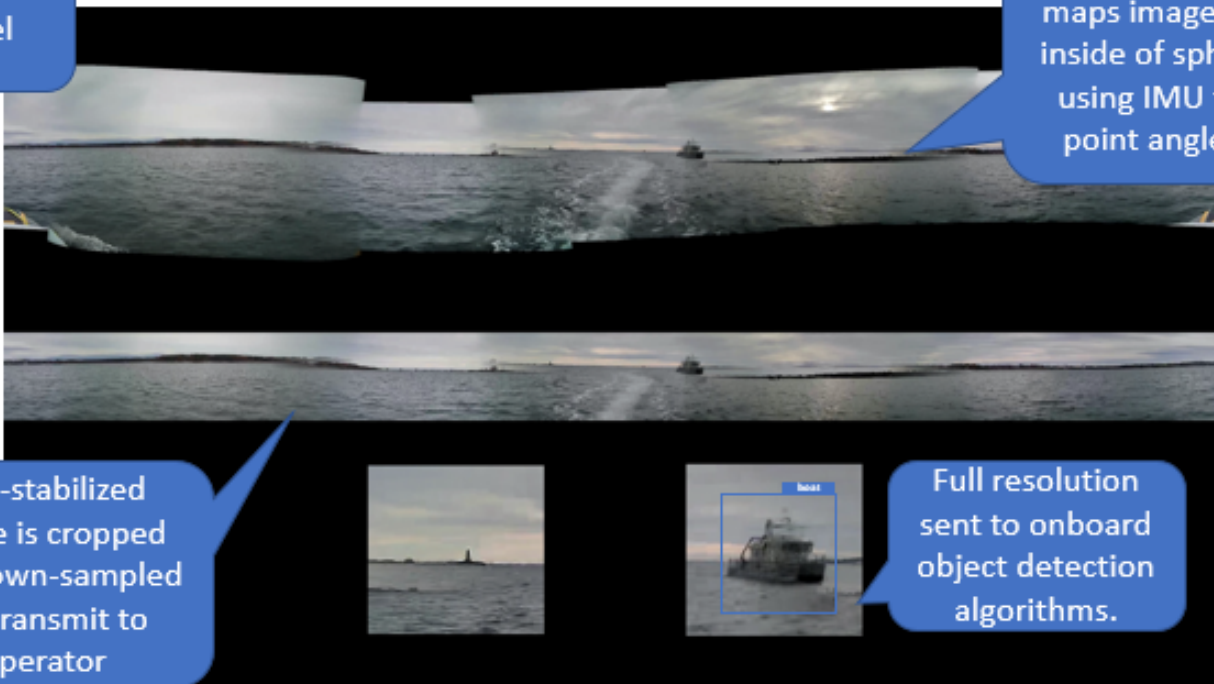


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Prototype Multi-Camera with POS/MV Stabilization



Six camera array provides high pixel density.



Custom software maps images to inside of sphere using IMU for point angles.

Geo-stabilized image is cropped and down-sampled for transmit to operator

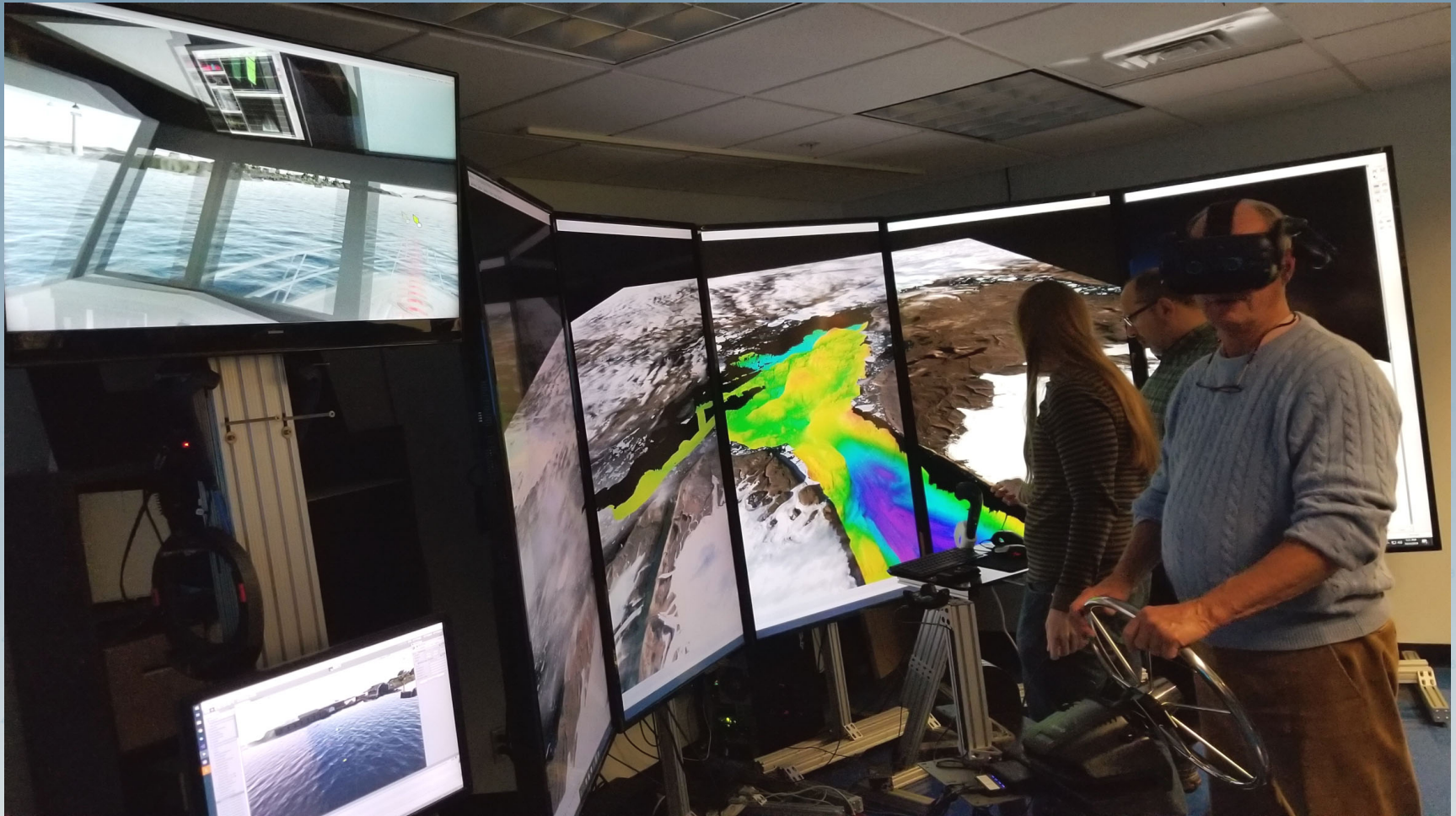
Full resolution sent to onboard object detection algorithms.

This is important because it will be a big step toward reducing the telemetry bandwidth while retaining high operator situational awareness.



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Enhanced Operations through AR and VR visualization



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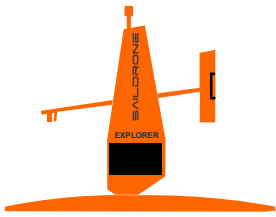
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SAILDRONE BATHYMETRY PLATFORMS

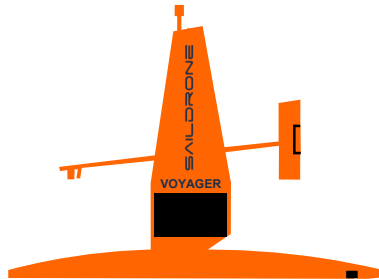
USVs capable of global reach

Explorer
RECON SINGLE-BEAM
Airmar DT800



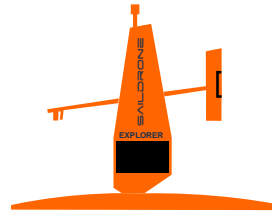
<100 meters

Voyager
MEDIUM MULTIBEAM
Norbit i77h + SVP



<300 meters

Explorer
DEEP SINGLE-BEAM
Teledyne Echotrac E20



<500 meters

Surveyor
FULL OCEAN MULTI-BEAM
Kongsberg EM2040 & EM304



<7,000 meters

Near-shore and open-ocean bathymetry solutions that meet or exceed International Hydrographic Organization (IHO) standards