

# Unmanned Systems (UxS): Revolutionizing NOAA Missions

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# Purpose

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To provide the SAB examples of how unmanned aerial and marine systems are being developed and applied to meet NOAA airborne and at-sea requirements

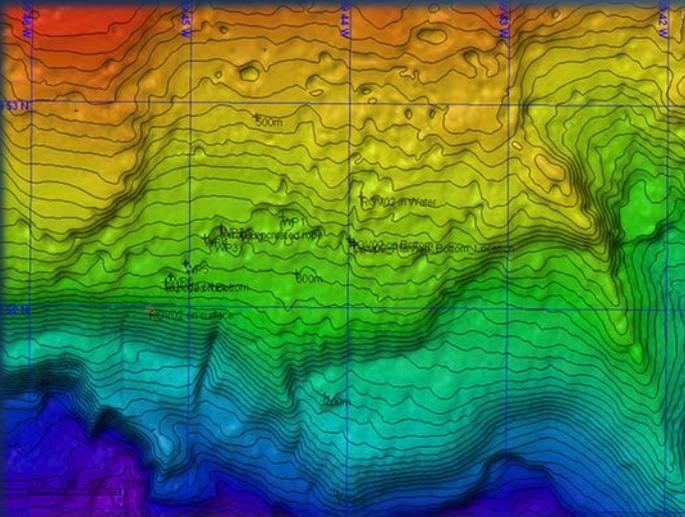


# UxS Serving NOAA Missions



## Fisheries:

- Acoustics
- Environmental sensors
- High-definition cameras



## Hydrographic Survey:

- Multibeam sonars
- Backscatter
- Water column data



# UxS Serving NOAA Missions



## Weather and Climate:

- Environmental sensors
- Instrument deployment
- Lidar
- Doppler radar



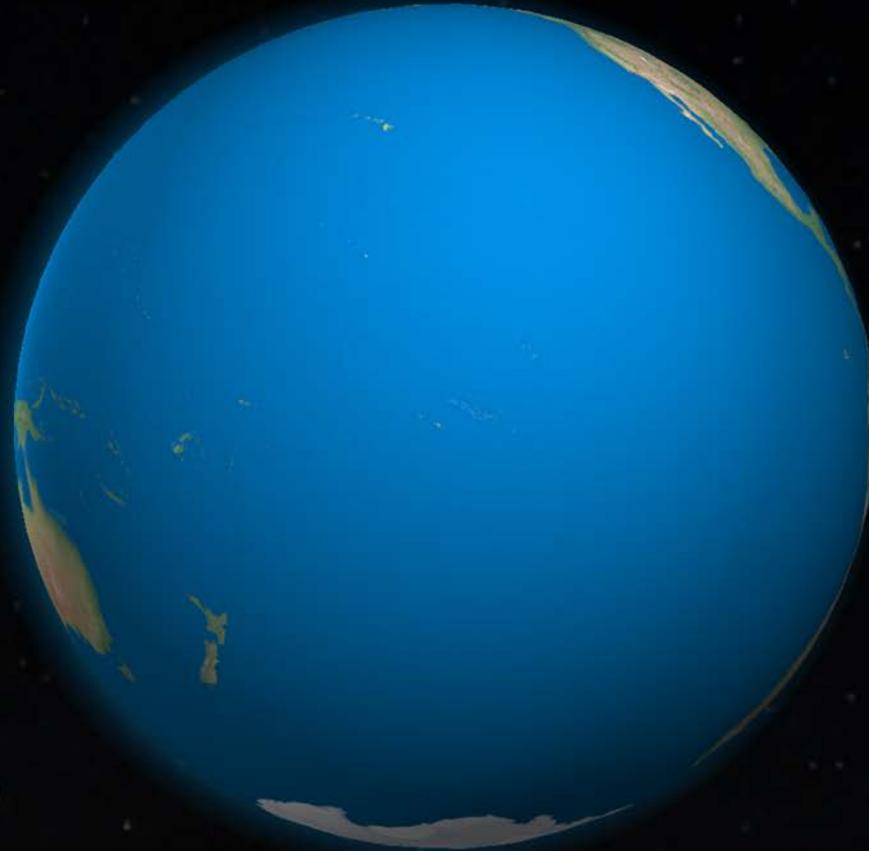
## Ecosystem Assessment:

- Sonar systems
- Environmental sensors
- High-definition cameras
- Sampling



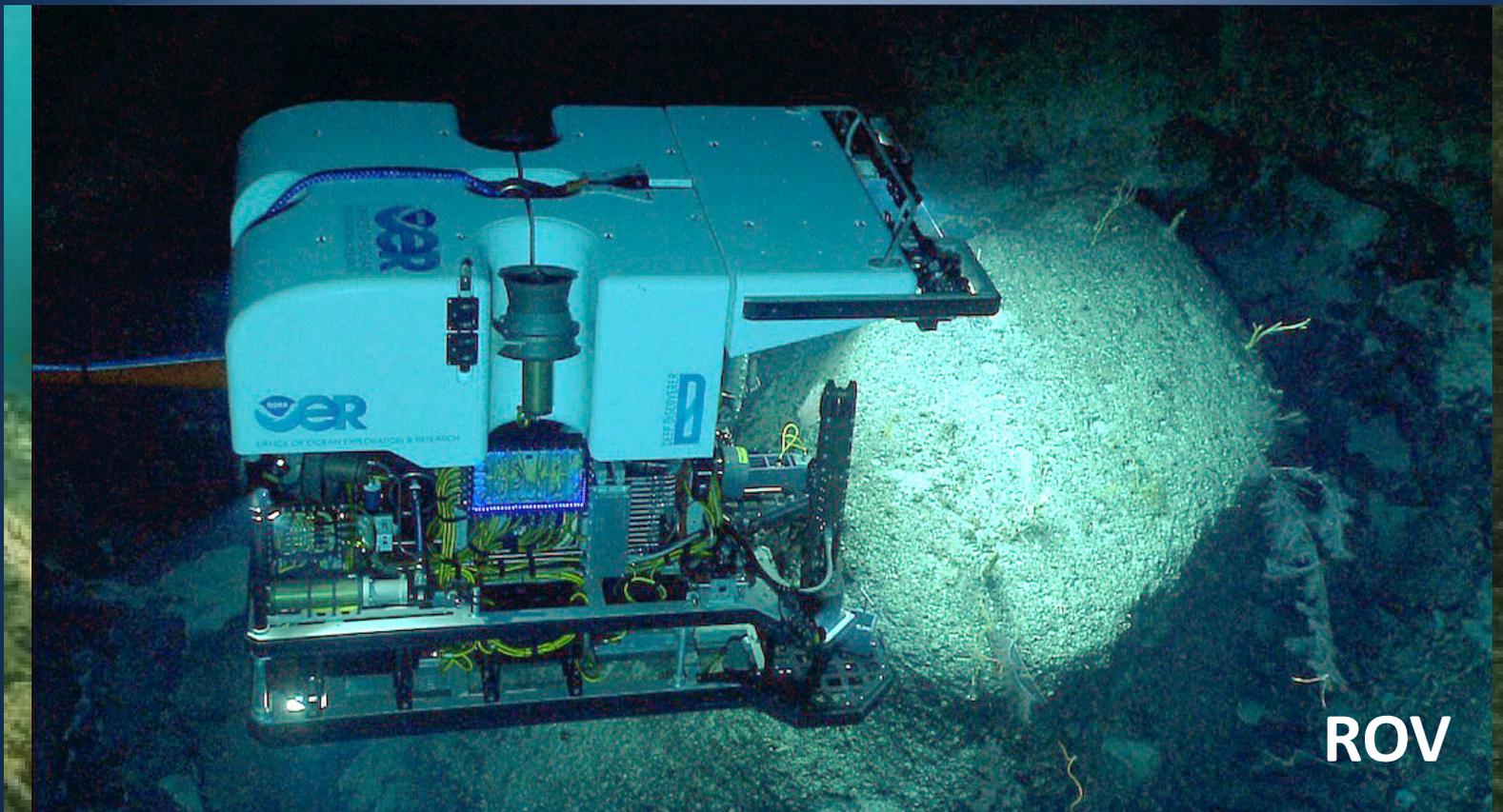
# Why UxS?

- **Augmentation**
- **Long Duration**
- **Remote Locations**
- **Hostile Environments**
- **Enforcement**



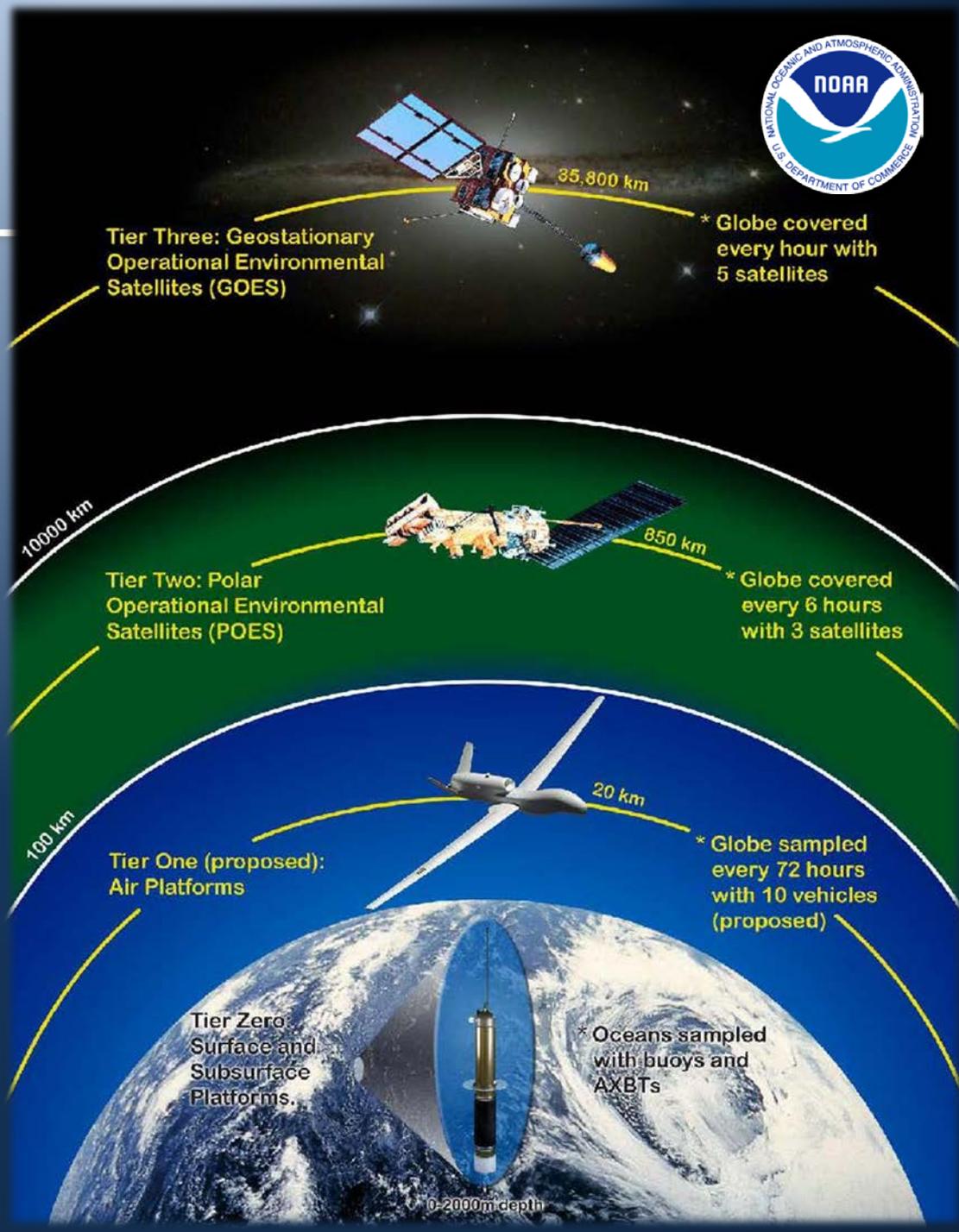


# UxS Types Currently Used by NOAA





# UAS: Unmanned Aerial Systems





# High Altitude UAS

## NASA Global Hawk UAS



~ 55,000-63,000 ft.

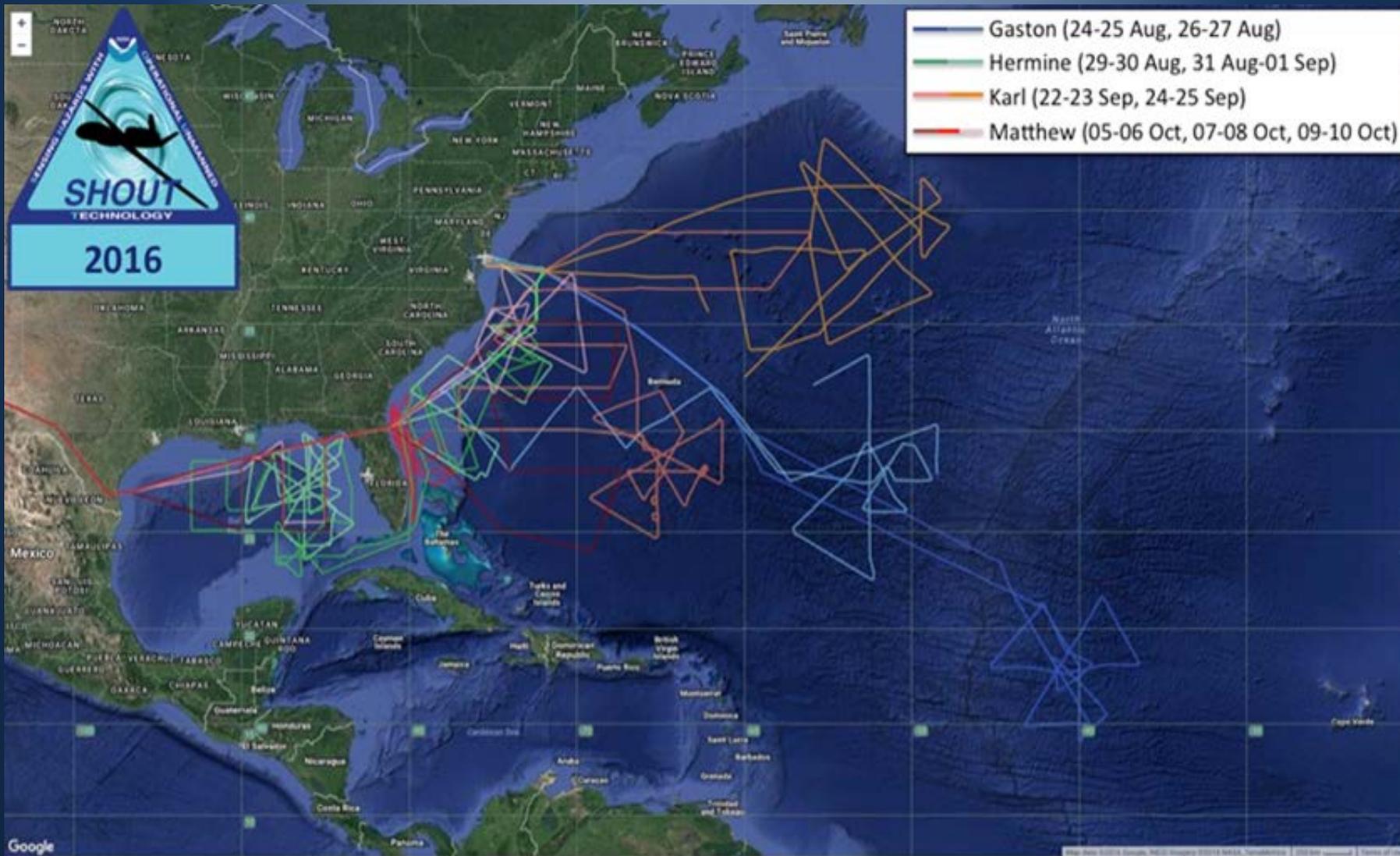
~26 hr.

~11,000 nm

~1,500+ lbs.



# High Altitude UAS





# Mid Altitude UAS

## Boeing ScanEagle UAS

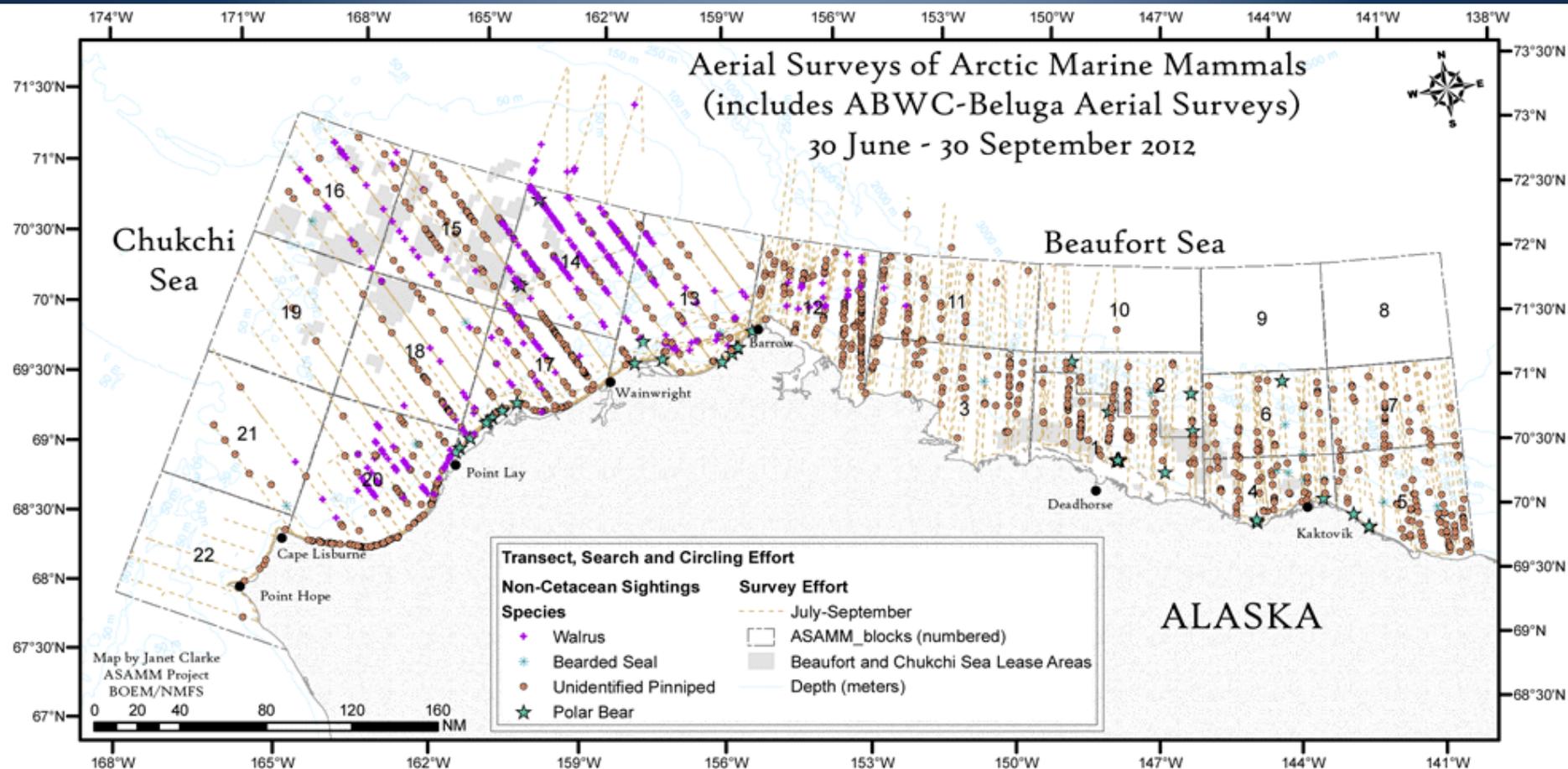


- Assess marine mammal population distribution and abundance (routinely used to estimate abundance of whales and seals)
- Investigate relationships between animals and their environment
- Monitor the effects of human activities on animals



# Mid Altitude UAS

## Marine Mammal Observation Area





# Low Altitude UAS





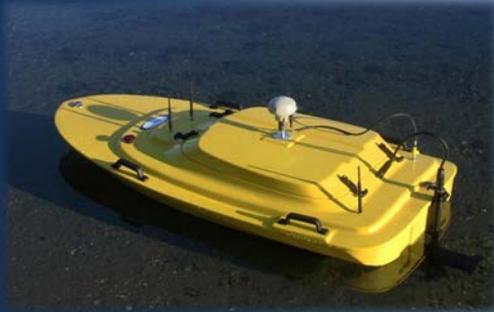
# NOAA UAS Inventory

NOAA's UAS Inventory	
2016	2017
13 Models	22 Models
42 UAS	58 UAS

UAS Model		April 2016	July 2017
NWS	DJI Phantom <sup>1</sup>	7	7
	3DR Iris	1	1
	Skywalker X8	3	1
	DJI-s1000	1	2
	Skywisp		3
OAR	Easystar		2
	Raytheon Coyote	8	7
	Sensitel Manta <sup>1</sup>	1	1
	Penguin BE		1
	Altavian Nova <sup>2</sup>		1
NMFS	DJI Phantom <sup>1</sup>	1	2
	DJI Inspire <sup>1</sup>	1	1
	APH-17	1	1
	APO-18	2	2
	APH-22	12	15
	APO-42		1
	DJI Matrice 201 RTK <sup>2</sup>		2
FireFly6 Pro <sup>2</sup>		1	
NOS	md4-1000	1	1
	Sensefly eBee RTK		1
	Sensefly eBee Plus		1
	DJI Phantom 2 <sup>1</sup>		1
OMAO	WMD-59 Quad	1	1
	AV Puma AE	2	2
<b>Total UAS</b>		<b>42</b>	<b>58</b>



# UMS: Unmanned Marine Systems



Surface Vehicles (USV)



Buoyancy Gliders



Underwater Vehicles (UUV)



# USV – Hydrographic Survey



ASV Global C-Worker



Teledyne Zboat



# USV: Unmanned Surface Vehicles

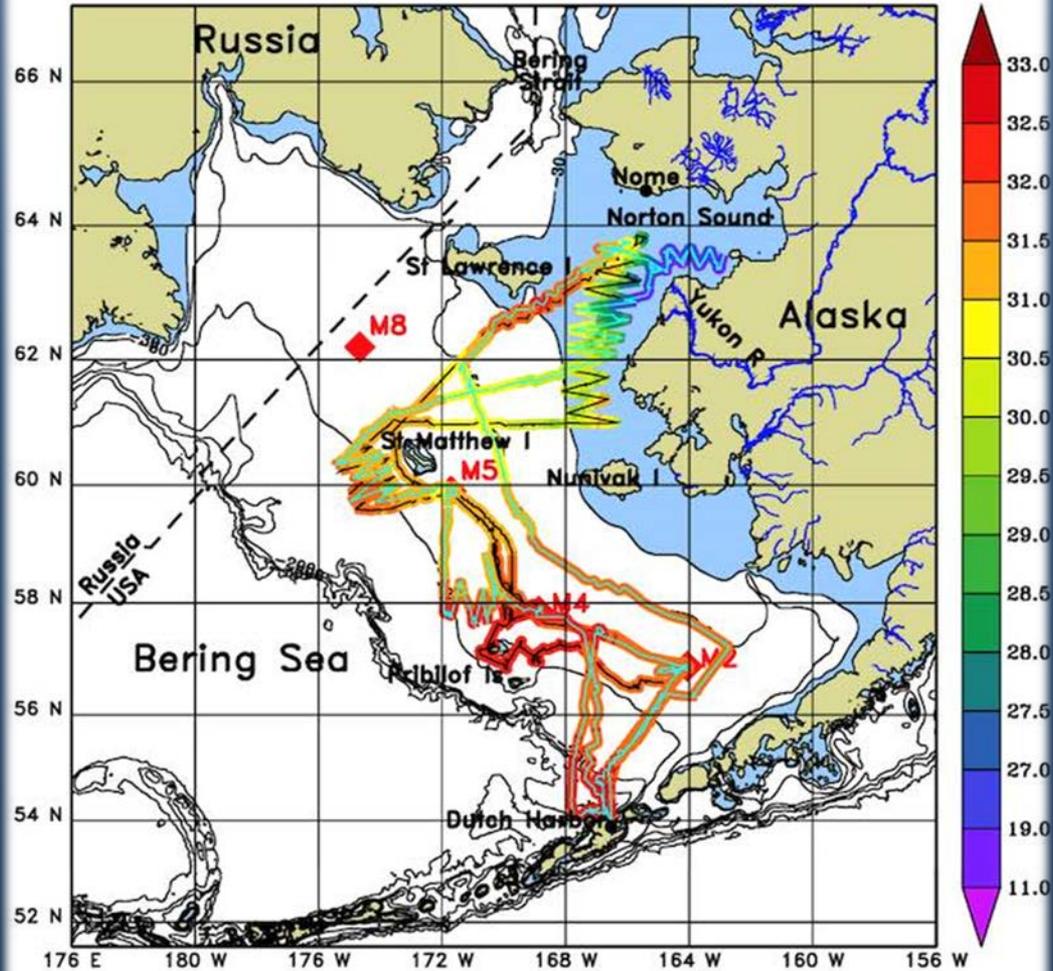
## Research Applications





# USV: Unmanned Surface Vehicles

Saildrone sd-126 (black) & sd-128 (cyan) Salinity  
23-APR-2015 22:00:00 to 28-JUL-2015 18:00:00 UTC



Depths contoured at 30, 50, 100, 200, 500, 1000, 2000 m  
NOAA/PMEL/EcoFOCI Mooring sites M2, M4, M5 & M8 shown

§ (PSS78)



# USV: Buoyancy Glider

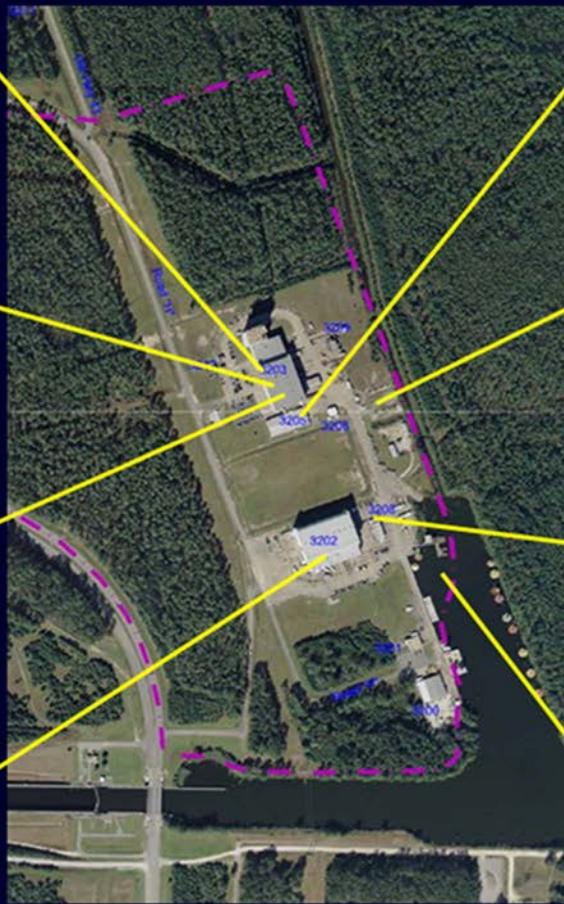
An ocean glider is autonomous: it travels through the ocean without human help.





# USV: Buoyancy Glider

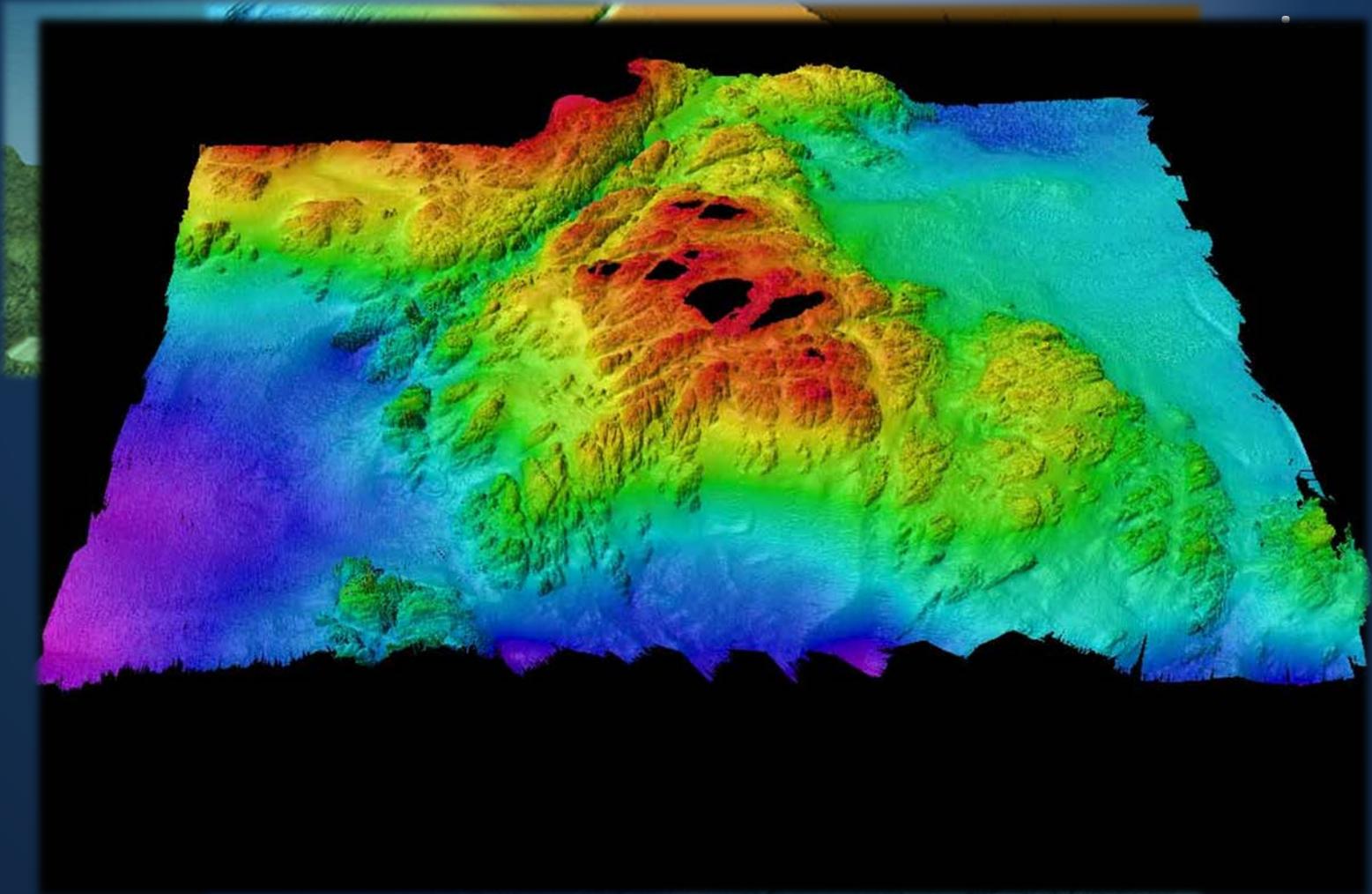
## National Data Buoy Center Facilities at SSC, MS





# UUV: Unmanned Underwater Vehicle

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	UMS Name	UMS Type	Number of Platforms Used as of FY16
<b>NMFS</b>	SeaBed	UUV	1
	Emily	USV	3
	Iver2	UUV	1
	Slocum Glider	Glider	4
	Saildrone	USV	1
<b>NOS</b>	Kongsberg-Hydroid Remus 100	UUV	1
	Kongsberg-Hydroid Remus 600	UUV	1
	ASV Global C-Worker 5	USV	1
	ASV Global C-Worker 4	USV	1
	Bluefin 12	UUV	1
	Slocum Glider	Glider	5
	Teledyne Z-boat	USV	2
	Gliders (variety)	Glider	39
<b>OAR</b>	Seaglider	Glider	4
	Wave Glider	Glider	2
	Slocum Glider	Glider	1
	Iver2	UUV	2
	Slocum Glider	Glider	2
	Oculus Underwater Glider	Glider	2
	Spray Underwater Glider	Glider	3
	Wave Glider	Glider	1
	Saildrone	USV	5
	Sentry	UUV	1
	Spray Gliders	Glider	12
	Spray Gliders	Glider	2
	Emily	USV	10
	Liquid Robotics	Glider	1
	Athena-Nike vessel	USV	1
<b>Total</b>			<b>110</b>



# UUV: Unmanned Underwater Vehicle

## Unique Applications – Hybrid ROV/UUV





# ROV: Remotely Operated Vehicle

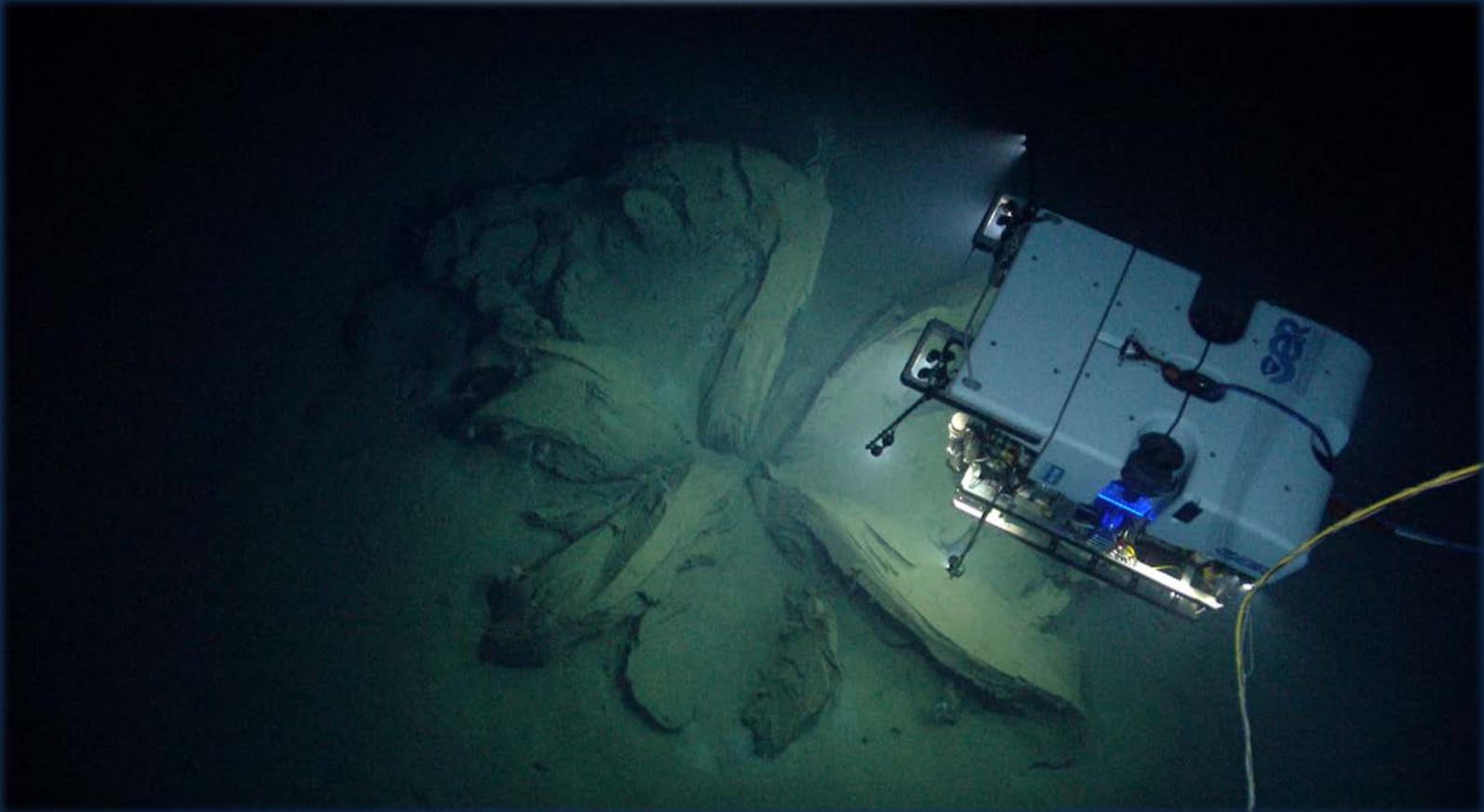
## Comprehensive Characterization





# ROV: Remotely Operated Vehicle

## Adapt to Observations





# Key Considerations

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## Unmanned Systems

- provide new capabilities or mission profiles
- require the development of new enabling technologies
- require skilled personnel to operate and maintain
- require unique infrastructure
- require supervision
- are part of a broad network of platforms



# NOAA Management Framework

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## UxS Executive Oversight Board

- Implement NOAA UxS Roadmap
- Priority setting
- Enhance collaboration & resource sharing
- R2O
- Governance & policy development
- Initial focus on UAS
- Initiating action on UMS

*The Board reports to the NOAA Fleet Council*



# NOAA UxS Partners

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- Other Federal Agencies
- State and Regional Government Institutions
- Academia
- Industry
- Non-Profit Organizations

# The UxS Landscape is Evolving. . .

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. . .Rapidly