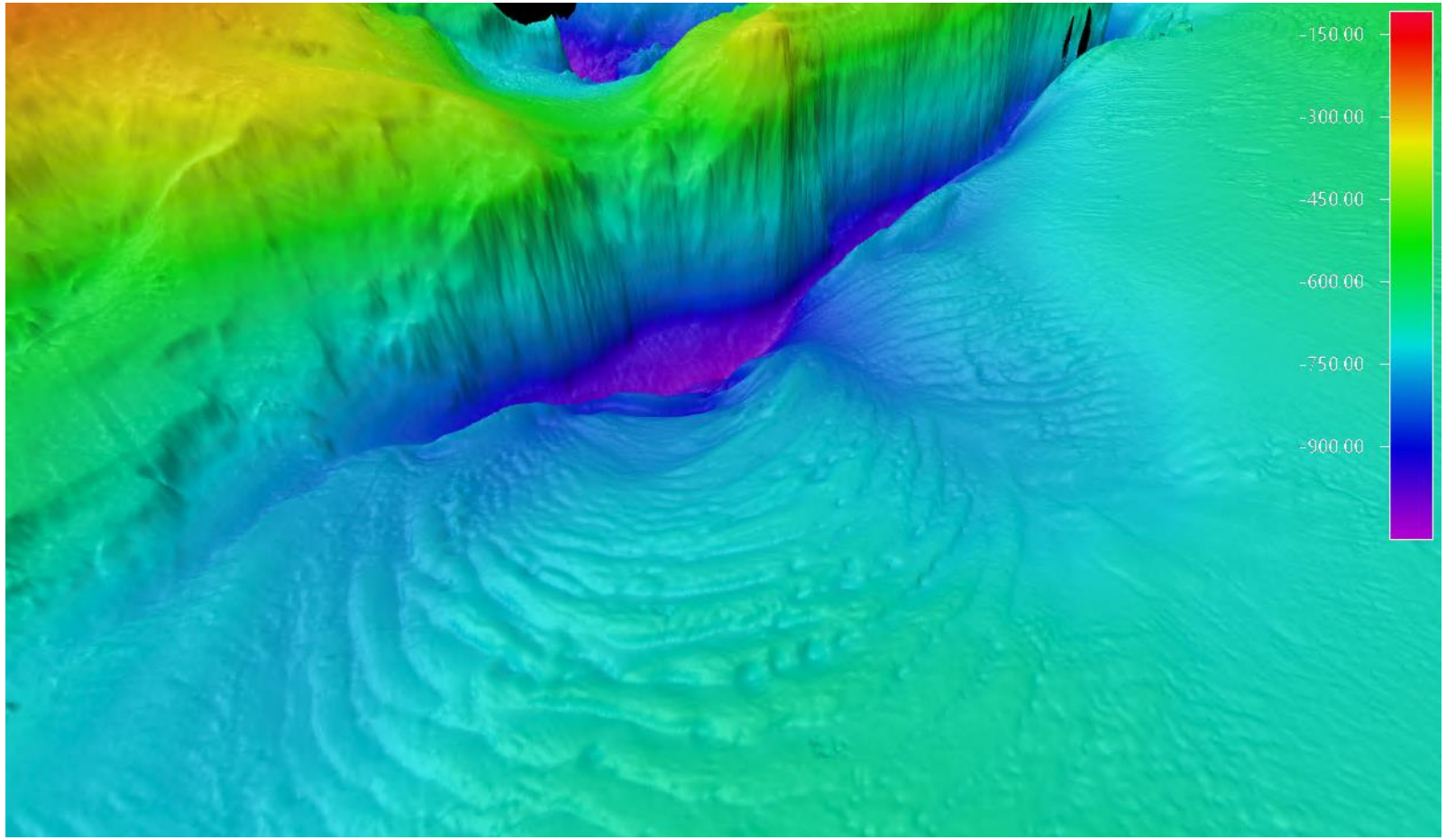
Future Ocean Mapping Using Autonomous Systems, Machine Learning, and High-bandwidth Satellite Communications

Brian Connon, VP Ocean Mapping

AGENDA

- The Vision
- How We Map Today
- How We Map Tomorrow
- Achieving the Vision
- Way Forward



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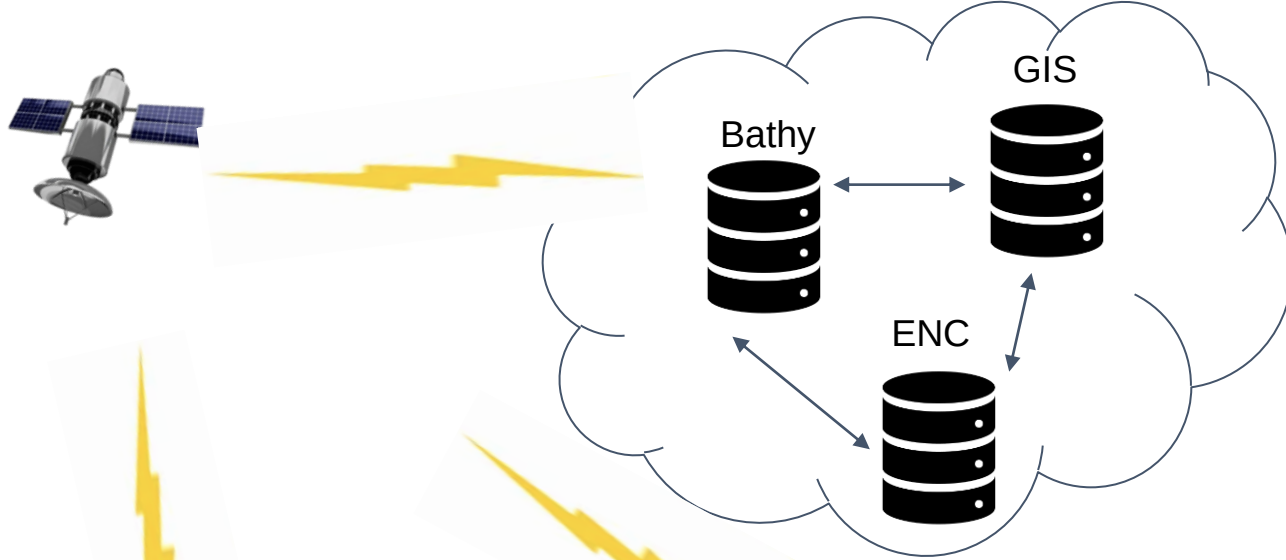
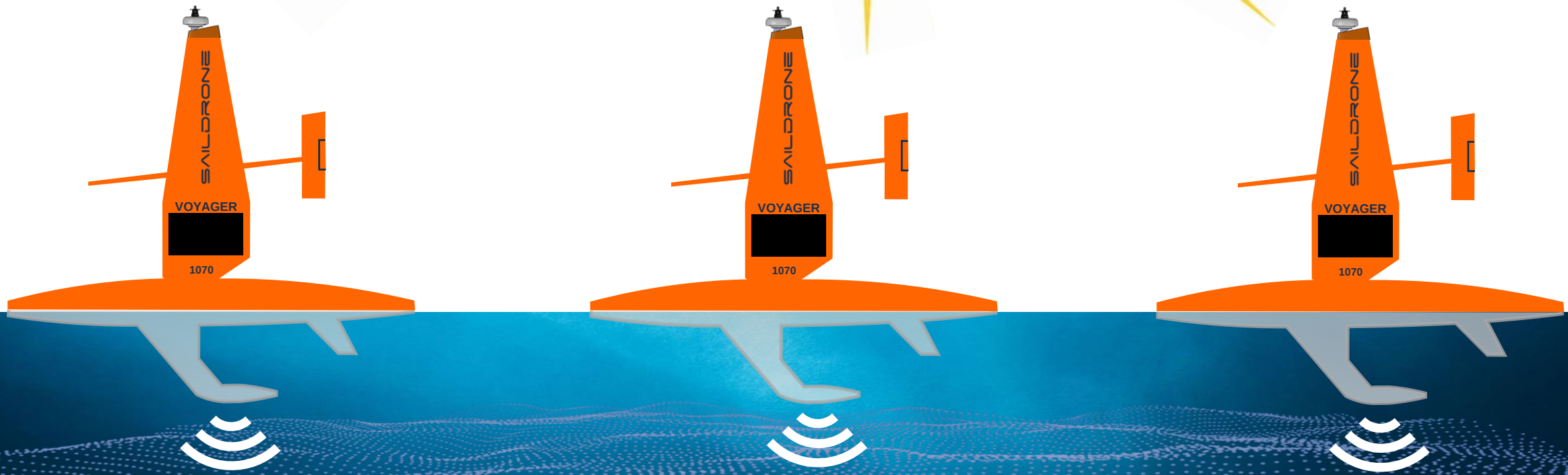
OCEAN MAPPING – THE VISION

Humans in the loop

- Fully Autonomous USVs mapping our oceans
- Data moves to the cloud as it is collected
- Data processing in the cloud via ML and AI
- Constant update of maritime products





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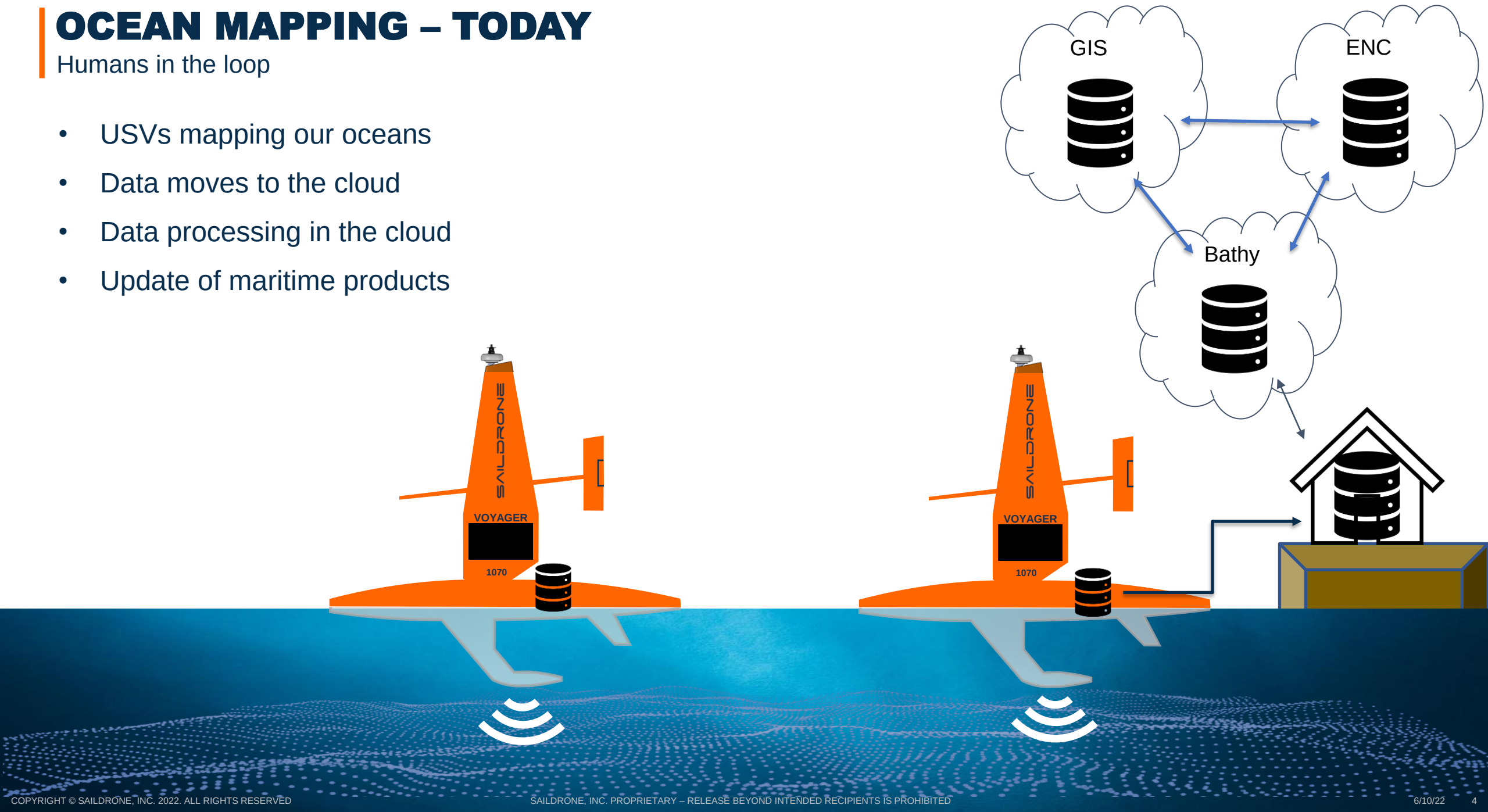
OCEAN MAPPING – TODAY

Humans in the loop

- USVs mapping our oceans
- Data moves to the cloud
- Data processing in the cloud
- Update of maritime products



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HOW WE MAP TODAY

Very similar to traditional ship surveys

Pilot

- 24/7 Operation – 1 per vehicle at a time
- High situational awareness from 360° camera, radar, AIS
- Extensive automated alerting of potential dangers

Survey Watchstander

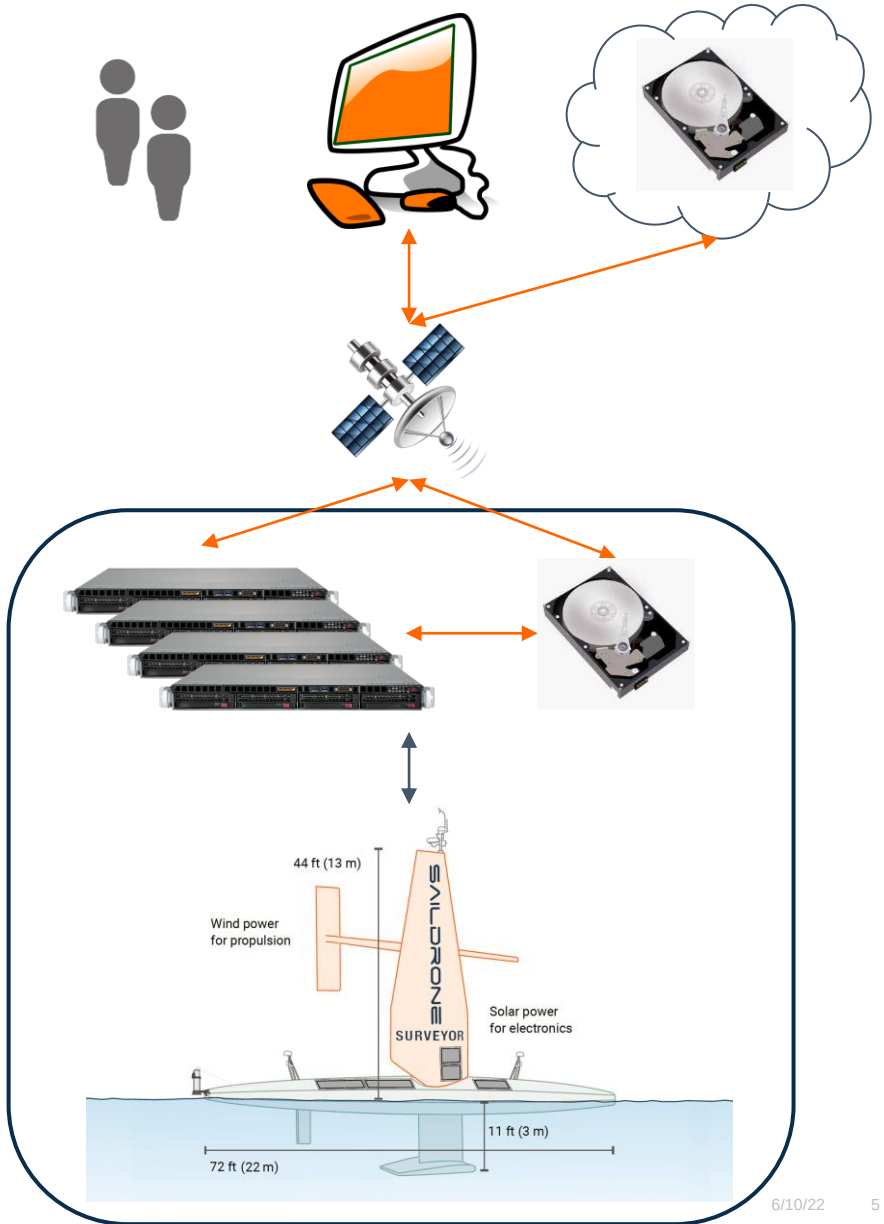
- 24/7 Operation – 1 per vehicle at a time
- Manual SVP sessions, line planning
- Remote desktop sessions to onboard VMs for sonar control, daily product processing, SVP

Automation

- Moving watchstander interaction off the vehicle
- Swath Coverage in Mission Portal
- Use of SIS Remote

Communications

- Iridium Certus
- LTE
- WIFI



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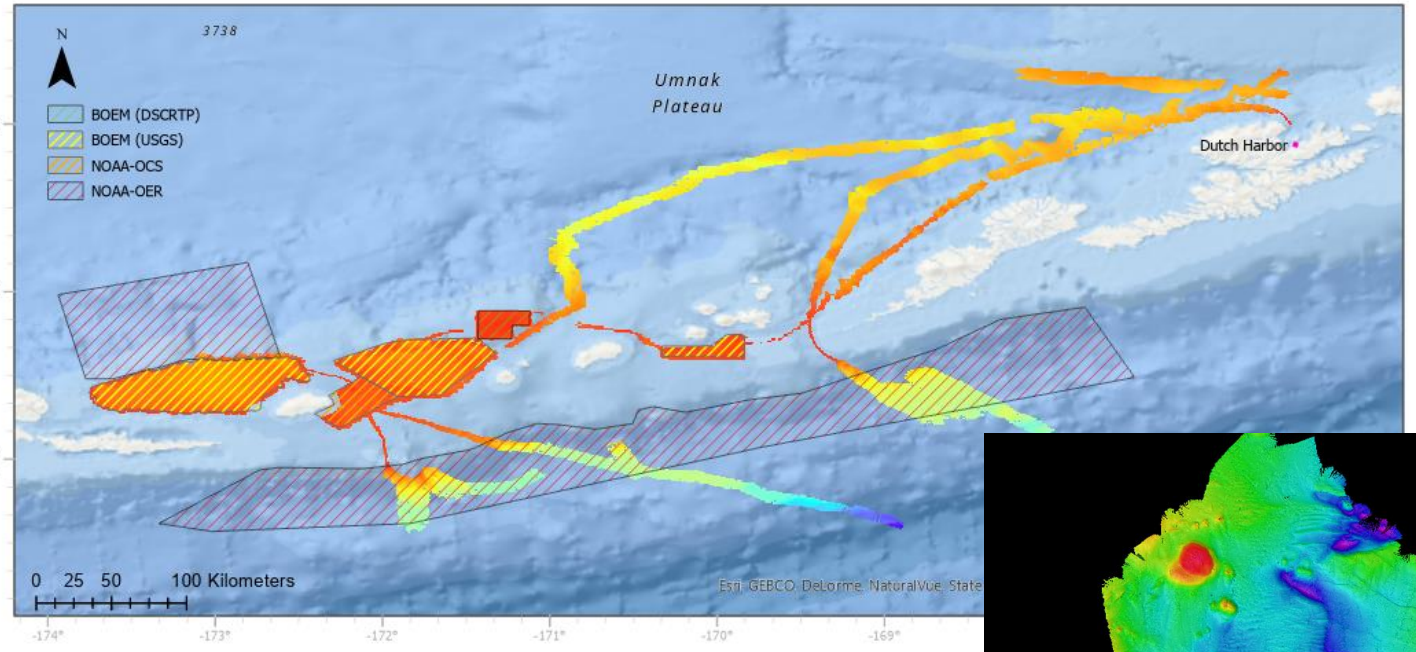
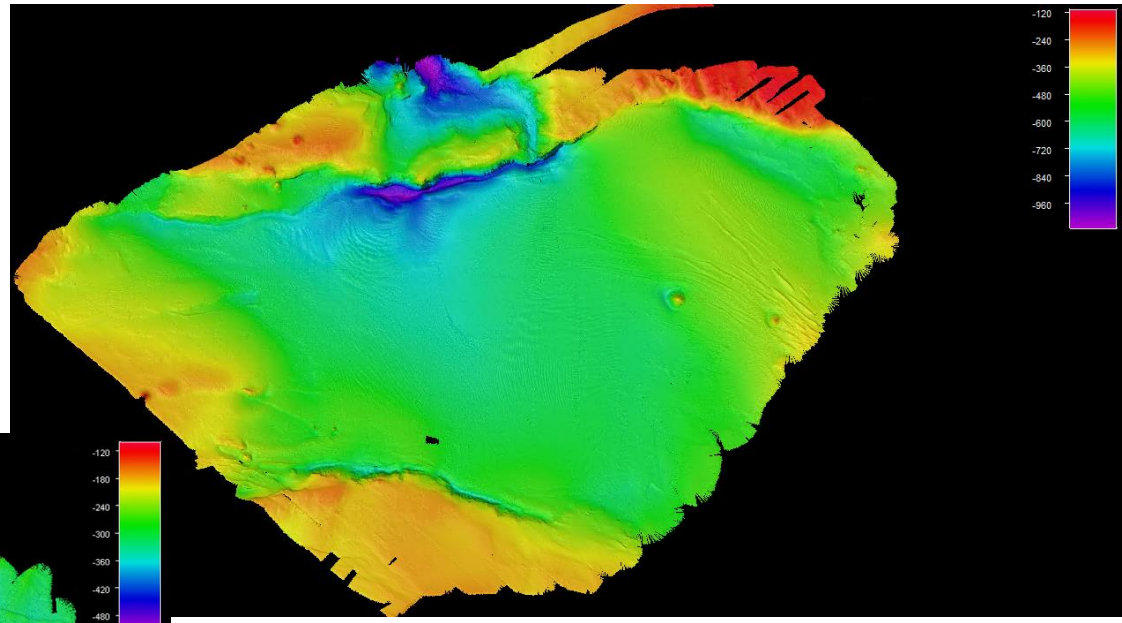
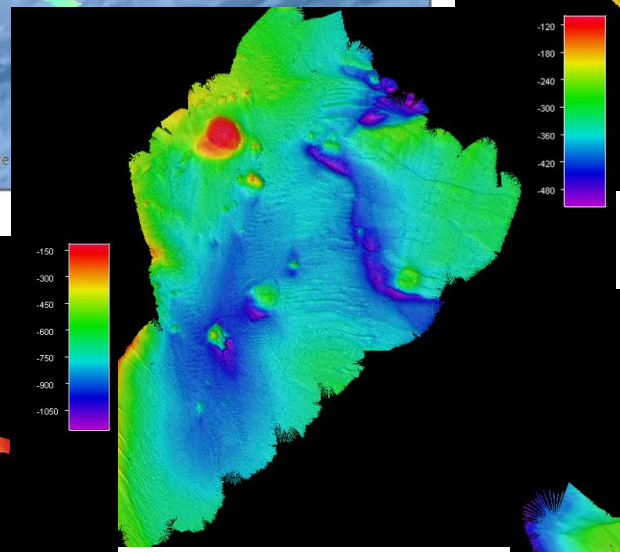
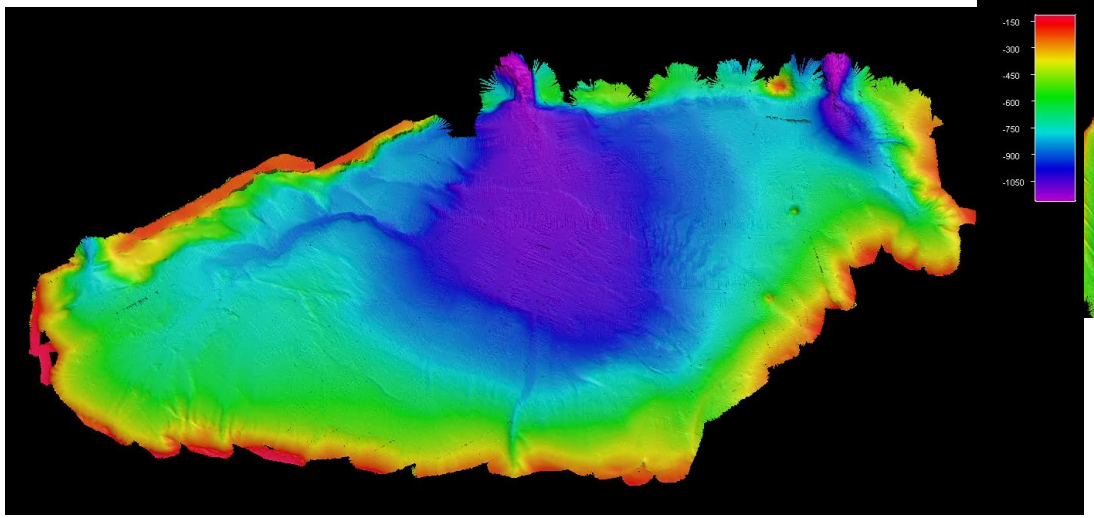
ALEUTIAN ISLANDS UNCREWED EXPLORATION

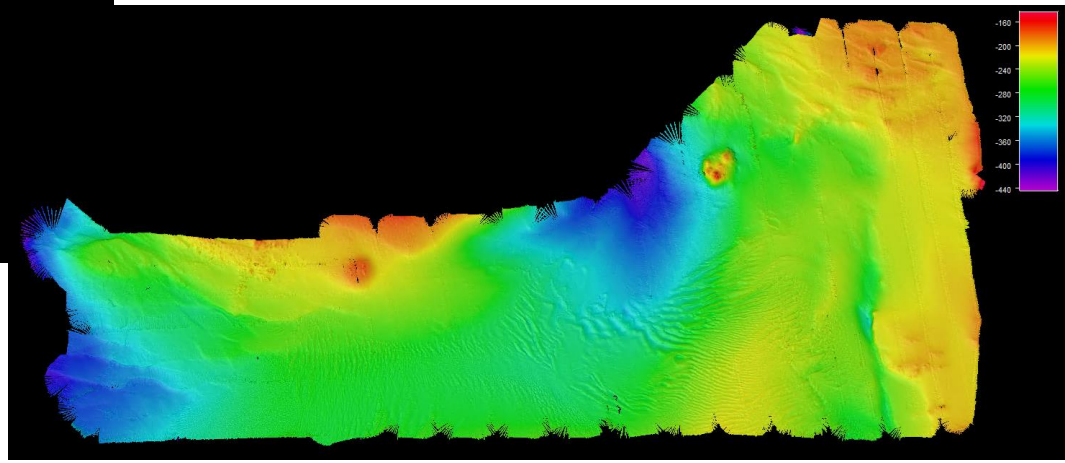
Challenging environment











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HOW WE WANT TO MAP TOMORROW

At a fraction of the cost of traditional methods

Pilot

- 24/7 Operation – 1 per **multiple** vehicles
- High situational awareness from 360deg camera, Radar, AIS
- Extensive automated alerting of potential dangers

Survey Watchstander

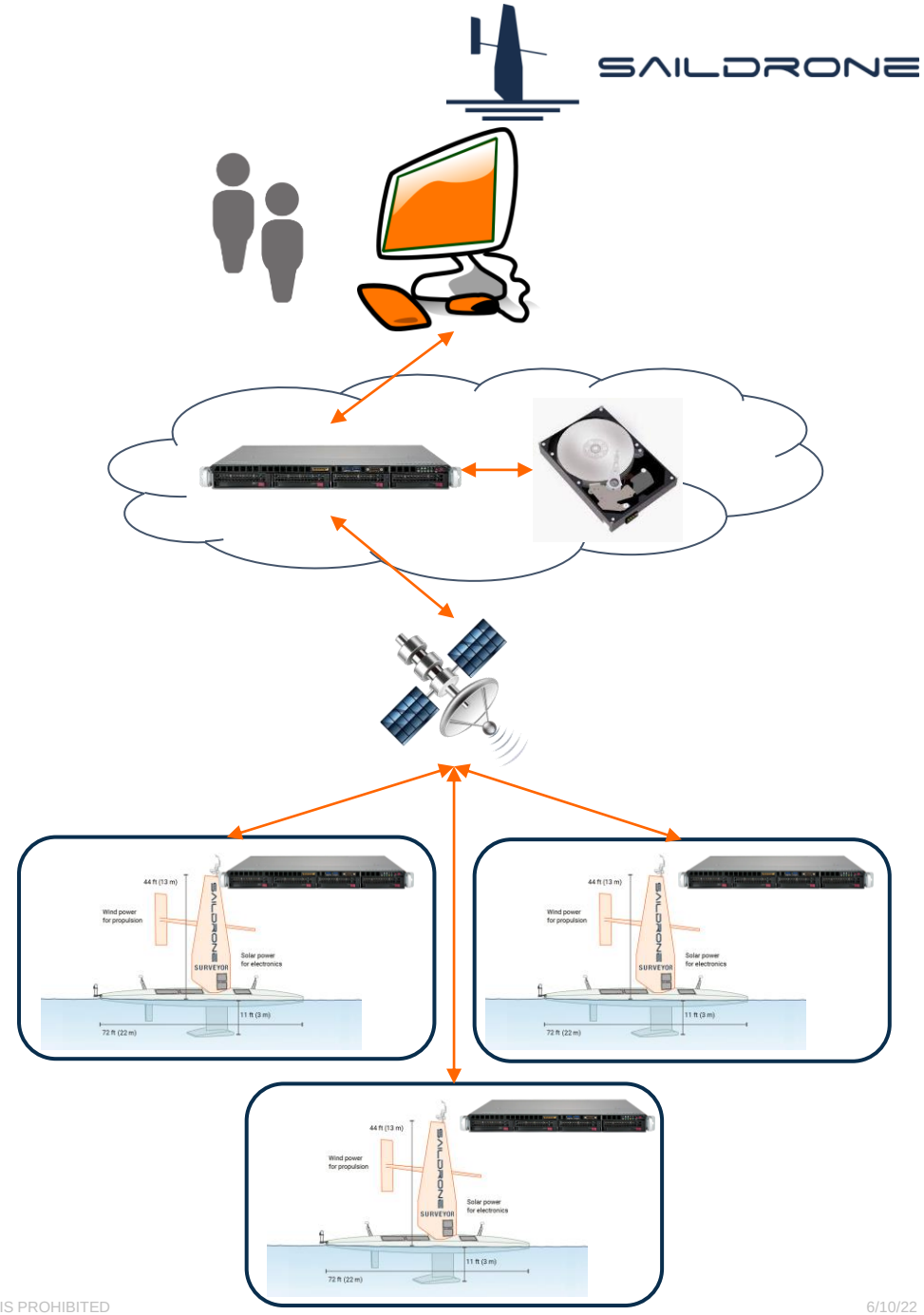
- 24/7 Operation – 1 per **multiple** vehicles
- Remote desktop connections limited
- Monitoring dashboard providing alerts and errors

Automation

- Manual data interaction occurs off-vehicle
- Survey operations utilize ML to drive survey lines, drop SVP
- Onboard data QC and reporting
- Automated cloud processing

Communications

- Higher bandwidth, consistent throughput
- Optimized for offloading system status, interaction
- Direct offload of bathymetry data to cloud



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HOW DO WE ACHIEVE THE VISION

It’s closer than we think

Autonomy

- Navigation, collision avoidance
- Bathymetry acquisition
- Onboard QC and Processing

Data Transfer

- Maritime satellite networks

Data Processing and Delivery

- Increase in data with increased USV use
- ML data processing onboard and cloud-native

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OTHER FACTORS

USV Market

- Over 180 types of Surveying and Mapping USVs

Onboard systems

- Multiple operating systems
- Heavy hardware requirements
- Requires multiple VMs, complex network

Acquisition

- Multiple programs needed
- Reliance on third-party software

Processing

- Need to be fully cloud native
- Accelerate ML efforts

Communications

- Starlink/OneWeb/etc. not the full solution

> ***"The most dangerous phrase in the language is, 'We've always done it this way.'"***
>
> — RADM Grace Hopper (1906 – 1992)

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WHAT'S NEXT

Accept that USVs are here to stay

Accept that USVs are here to stay

- No ocean is out of reach
- Endurance, capability, and acceptance is on the rise

Develop systems optimized for USV operations

- Reduce power, simplify, and containerize
- Interoperability and standardization
- Self-healing and resiliency—leads to multi-USV operations with fewer personnel

Personnel requirements will increase and change

- Deploying hundreds of USVs will require a diverse, skilled workforce
- Opportunities for people previously unqualified

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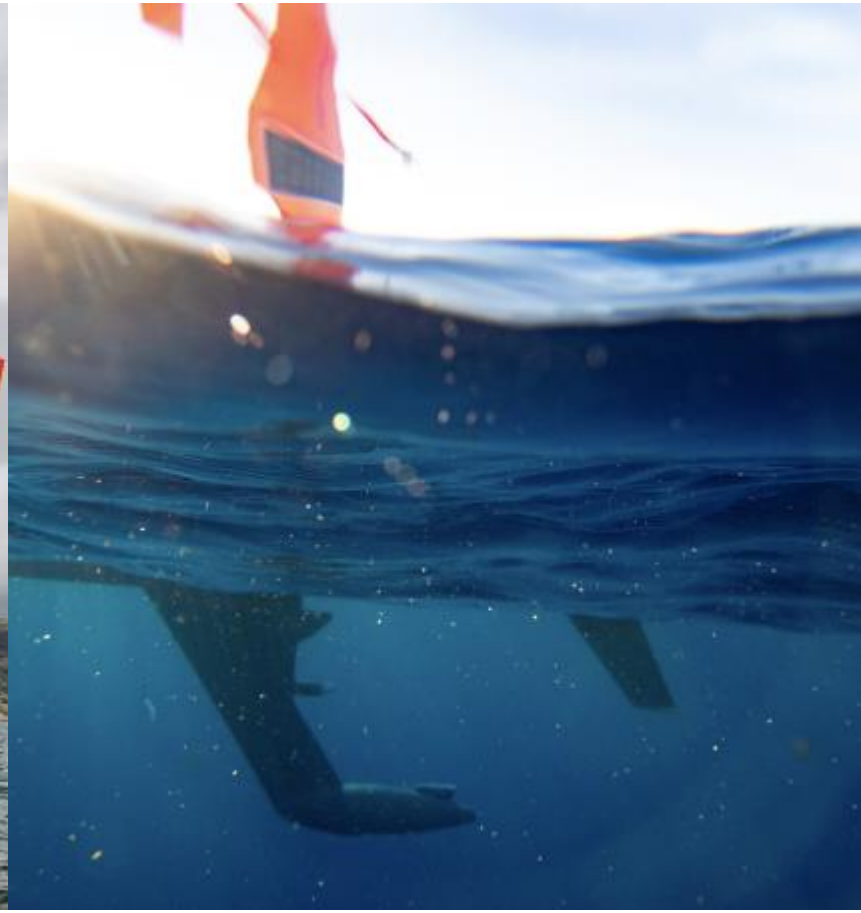

Maritime Domain Awareness

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

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