



Jumpstarting the NOAA UxS Data Enterprise

NOAA National Centers for Environmental Information

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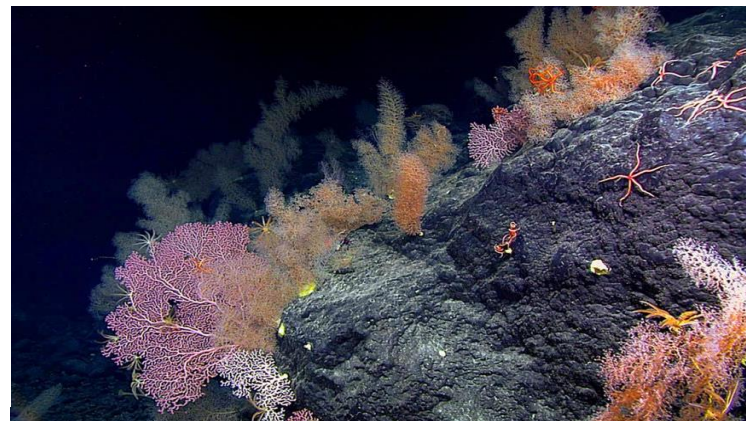
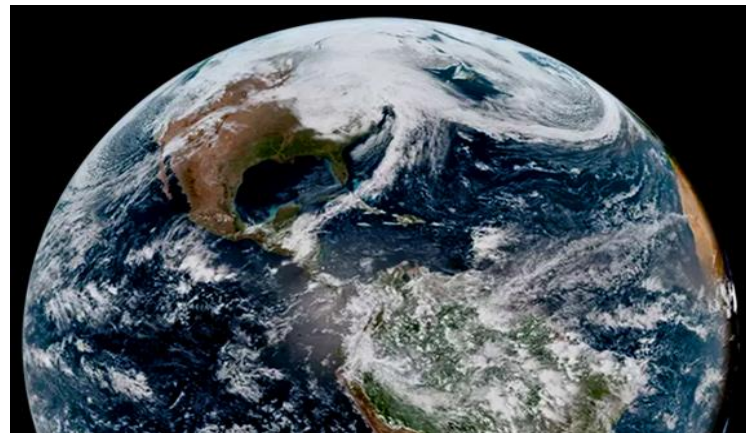
Oceans In Action

March 8, 2022

National Centers for Environmental Information

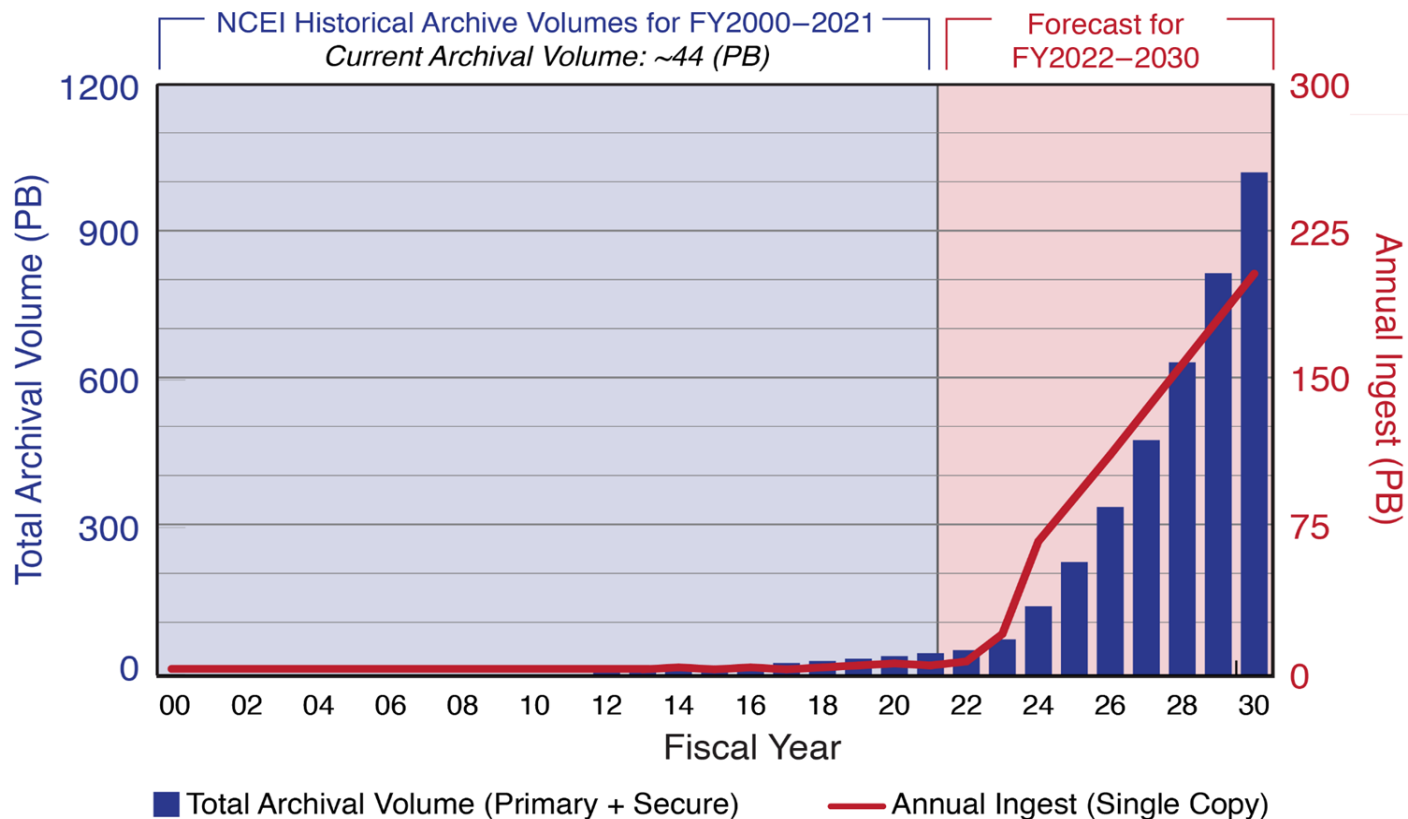
The Nation's leading authority for environmental information

- NCEI is responsible for hosting and providing access to one of the most significant environmental data archives on Earth
- From the depths of the ocean to the surface of the sun; from million-year-old sediment records to near real-time satellite images
- NCEI adds value to data for the benefit of people and the economy



How much data does NCEI have?

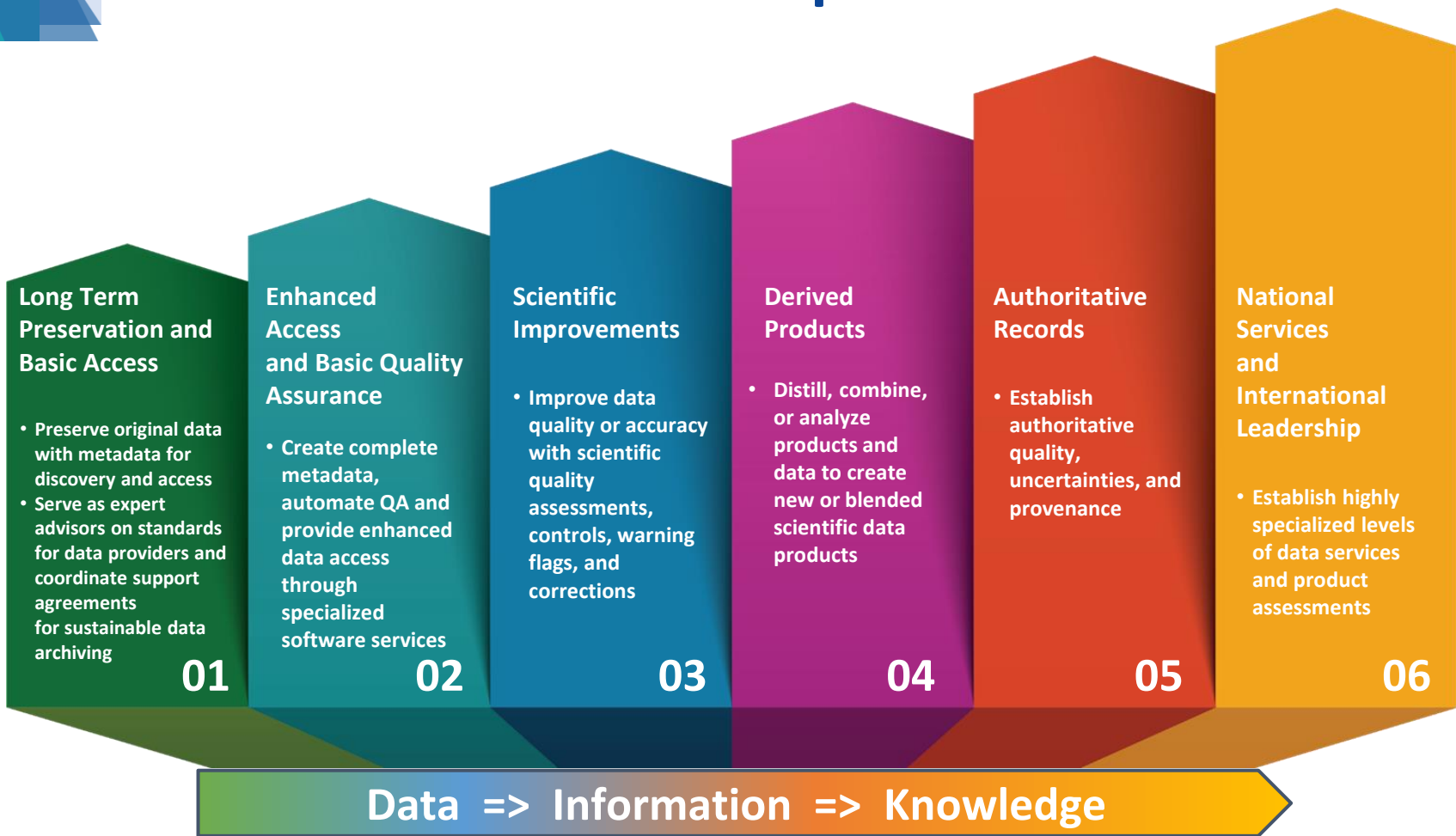
Archival Volume and Forecast



From less than 2 Petabytes (PB) in FY 2000 to about 43 PB through 2021

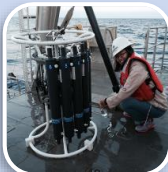
Increasing data volumes from UxS, Station, Model, Radar, Acoustics, 'Omics, and Satellite Sources

Tiers of Data Stewardship



From Data to Decisions

NOAA Observing Systems



Scientific Data Stewardship

Research-quality products for decision making

Climate & Weather

- Climate Assessments
- Climate Normals
- Billion \$ Disasters
- Drought Monitoring

Oceans & Coasts

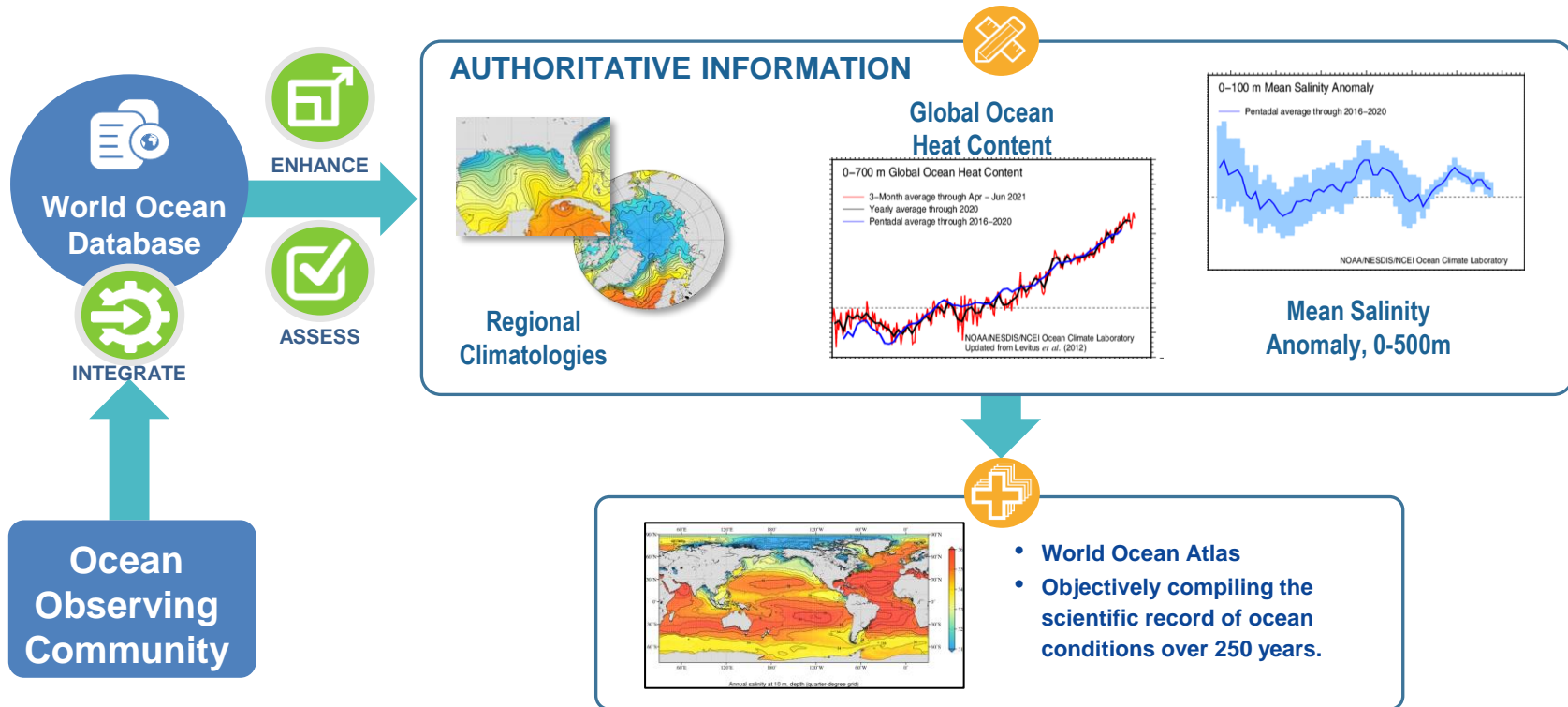
- World Ocean Database
- Regional Climatologies
- Gulf Data Atlas
- Tsunami Warning
- Digital Elevation Models
- Extended Continental Shelf

Geophysics

- Space Weather
- World Magnetic Model

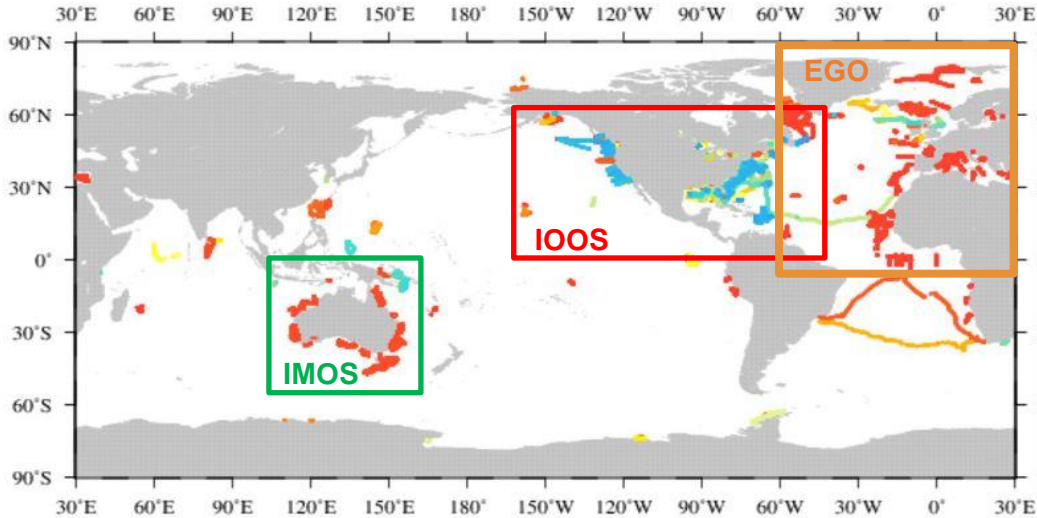
NCEI Ocean Climate Lab: *World Ocean Database*

17.4m profiles from over 90 countries, from 1772 - present era

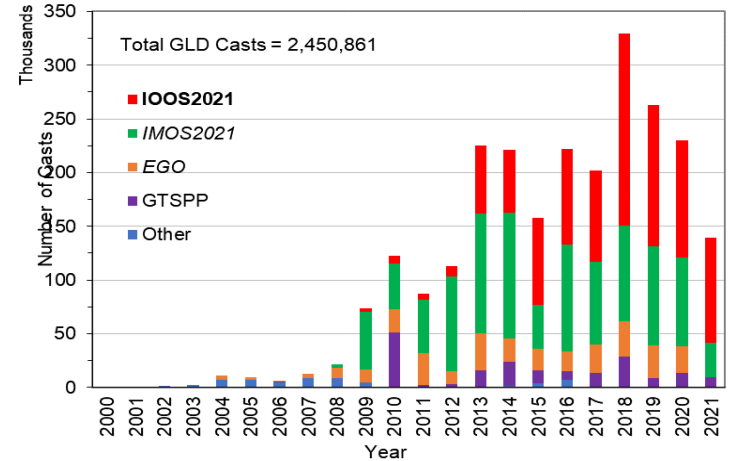


WOD: Focus on Glider Data Holdings

Spatiotemporal Distribution

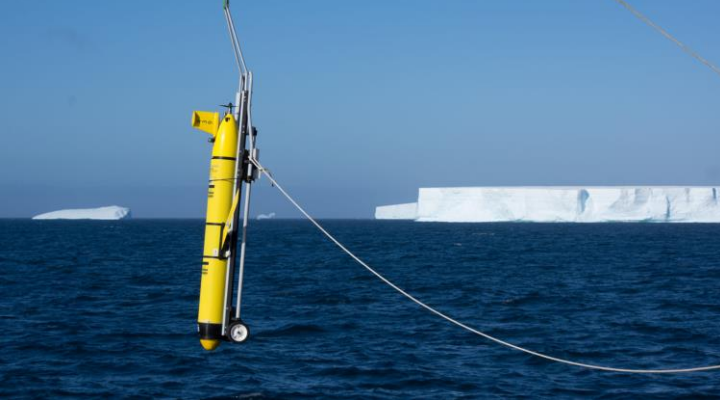


Boxes denotes geographical locations of data submitted by the major contributors. Other data submitted via GTSP & other sources



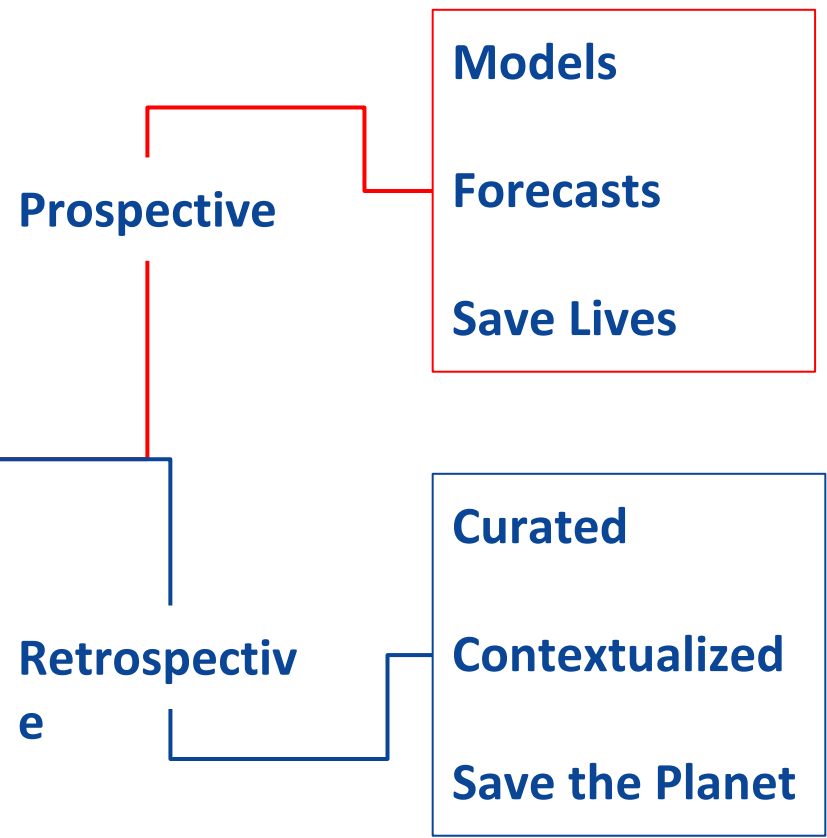
Temporal Distribution of Glider Data in WOD as of Dec 2021

UUV (Glanders) contributed more than 30% of all WOD data 2010-present;
>46% for 2020 (complete year)



DATA

Summary:



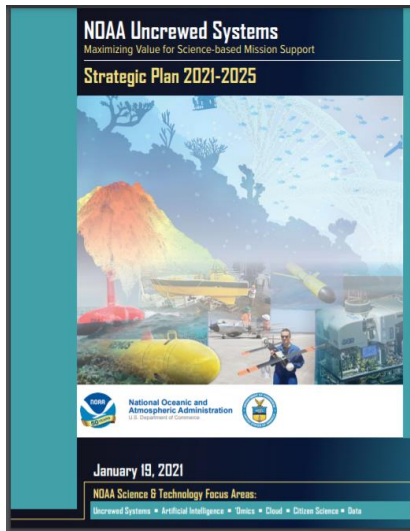
Glider Data Management: Success Story

➤ Key questions

- Can mature data management methods be applied to other - less mature - UxS data management needs?
- How can known methods couple with innovation to inform a robust and encompassing UxS Data Enterprise?



NOAA UxS Strategic Plan (2021-2025)



NOAA UxS Strategic Plan Goals

Goal 1: Coordinate and Support UxS Operations at an Enterprise Level.

Goal 2: Expand UxS Applications Across NOAA's Mission Portfolio.

Goal 3: Accelerate transition of UxS Research to Operations.

Goal 4: Strengthen and Expand UxS Partnerships.

Goal 5: Promote Workforce Proficiency in UxS Use and Operations.

1.1 Adaptive Infrastructure

1.2 Core Services

1.3 UxS Data Enterprise

Goal 1.3 UxS Data Enterprise:

An Innovative, Robust and Encompassing Data Management Enterprise

Goal 1.3: UxS Data Enterprise

- A. Establish standards for UxS data structures, formats, documentation and data exchange protocols.
- A. Define specific quality assurance and quality control protocols to improve and strengthen the overall integrity of UxS observations and measurements.
- A. Improve access and use of data from partners providing mission support.
- A. Establish a data management system that integrates research and performance data to enable better transition decision-making.

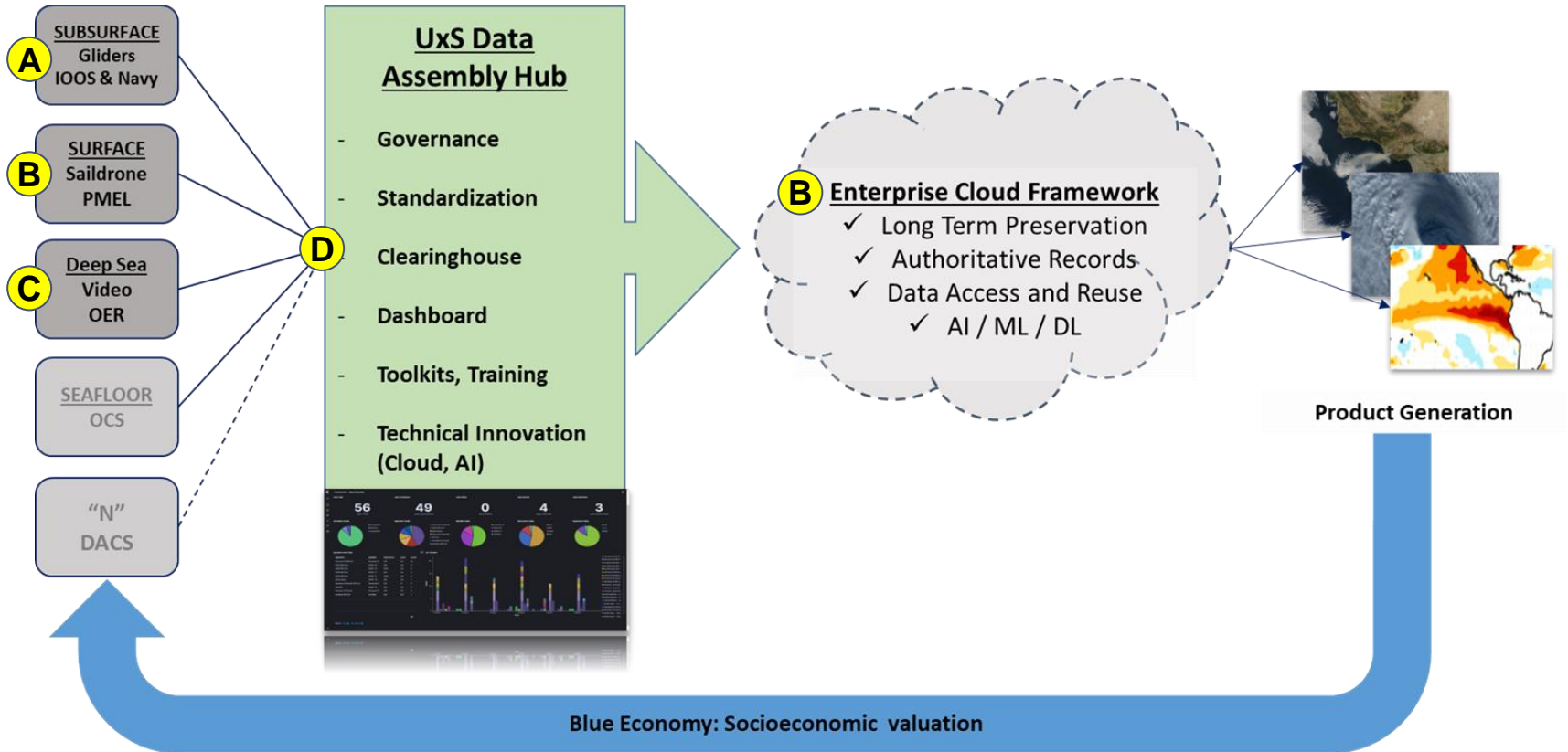


UxS Data Management Success Stories

- Key questions
 - Can mature data management methods be applied to meet other - less mature - UxS data management needs?
 - How can known methods couple with innovation to inform a robust and encompassing UxS Data Enterprise?
- Cross-NOAA team formulated a notional UxS Data Enterprise framework based on “Yes”
 - Broad stakeholder meetings supported this premise

Data Management System Framework

Notional Design ©2020



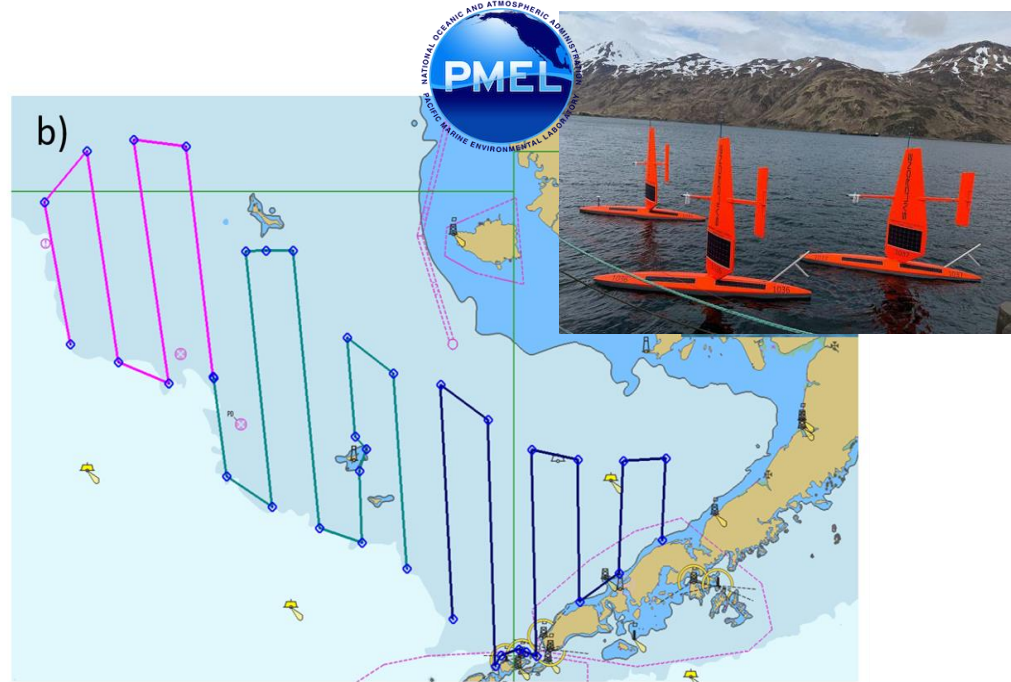
- **Define data exchange standards for UxS**
 - Identify existing interface and exchange standards for UxS sensors
 - Identify minimum requirements for platform health tracking
 - Develop **Logical Data Model for Acquisition and Curation**
- **Identify common UxS vocabularies used in data exchanges**
 - Inbound/raw data and
 - Outbound / processed data
- **Next Steps**
 - **Test logical data model with use cases**
 - Community of practice socialization
 - Enable cross-agency UxS data exchange



UxS Use Case : USV Covid response mission

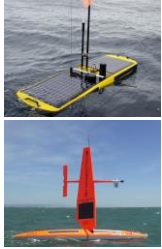
USV deployment mitigates COVID impact on NMFS research

- Time critical Walleye Pollock survey in the east Bering Sea. Pollock comprise the Nation's largest fishery.
- USVs augment planned NOAA ship survey due to COVID.
- Ensure critical sonar data are acquired and incorporated into fisheries management.
- **NESDIS-Cloud Data Management Pilot**



B

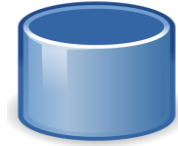
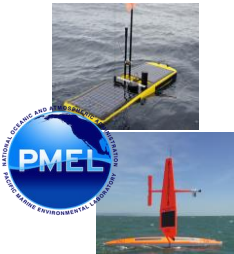
UxS Use Cases: USV METOC to NESDIS Cloud

BEFORE

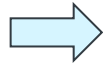
USV Field Campaigns

Manual Data
Submission

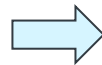
NCEI Archive System

Data QA/QC &
Synoptic Products**AFTER**

USV Field Campaigns

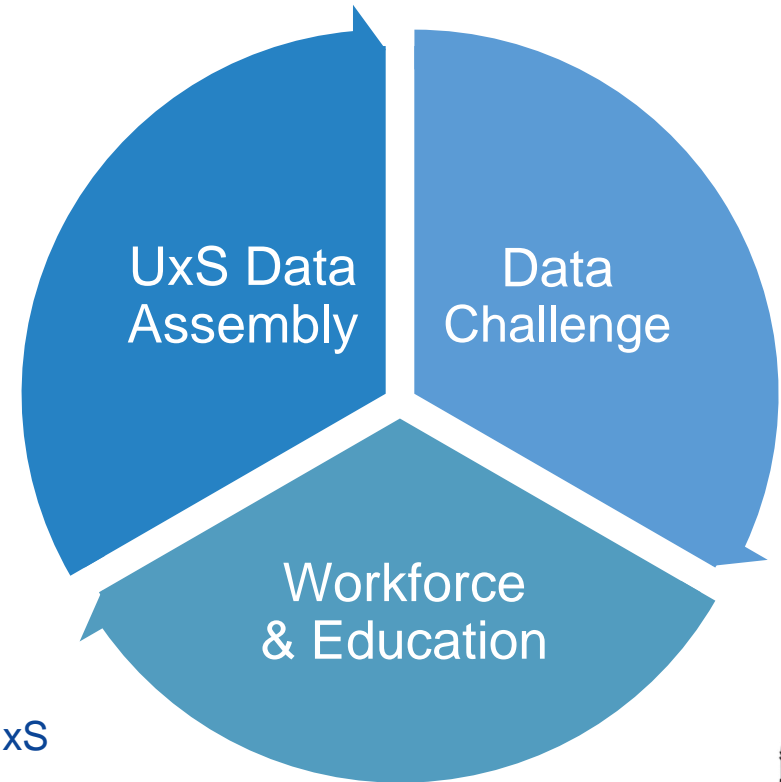


Automated Data Ingest

NEDSIS Cloud
Data QA/QC & Synoptic DB => Archive

BERACOUDA: *BlueTech Economy Research and Applications of Coastal and Ocean Uncrewed Systems Data Assembly*

- **UxS Data Assembly Hub:**
Turning UxS Data into actionable Information.
Open access to UxS data for analysis and decision support.
 - Video data use case
- **Ocean Data Challenge:**
Assess User needs. Understand how UxS data resources can address environmental threats and meet new economic opportunities
- **Workforce Development:**
Build a “talent pipeline” - a foundation of expertise to prepare students for success in UxS data enterprise operations and related fields



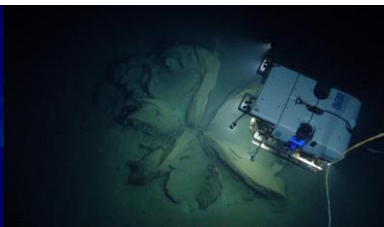


UxS Use Case: Deep Sea Video Data Management

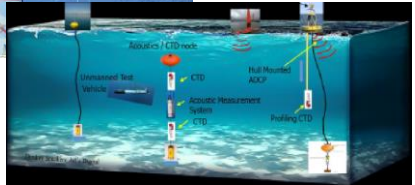
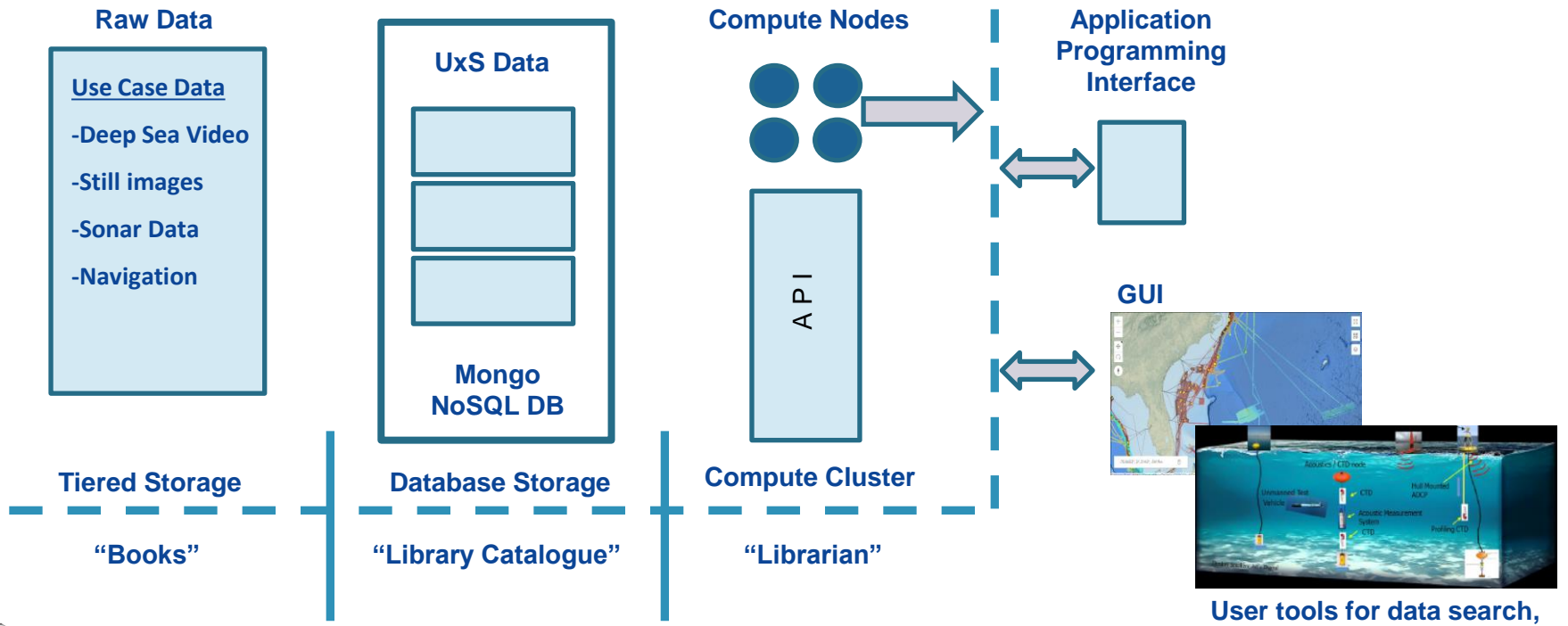
Video data management presents challenges that require novel, technologically advanced solutions such as cloud, artificial intelligence, and machine learning technologies.



- **Large volumes of qualitative data**
 - Diverse platforms and sensors
 - Lack of standardization
 - Low levels of metadata (Not FAIR)
- **Resource intensive to process & manage**
- **Complex Archive and Access Model**



UxS Data Assembly Hub - Minimum Viable Product



User tools for data search, access & visualization

UxS Data Challenge: *Capturing Stakeholder Feedback*

➤ **Data Producers and Analysts**

- Is this a good structure for the data?
- Is this a good location for the data?
- Are the data access points sufficient?
- Are the results communicated effectively?

➤ **Data Consumers and Analysts**

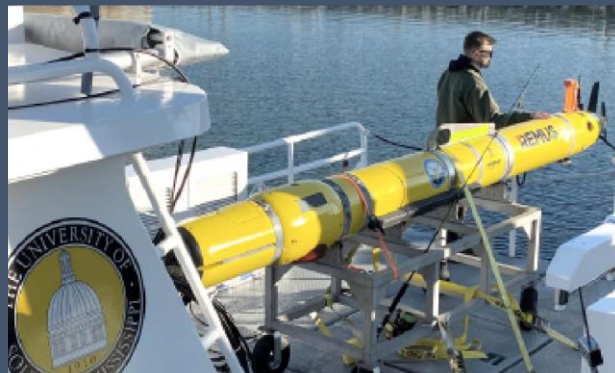
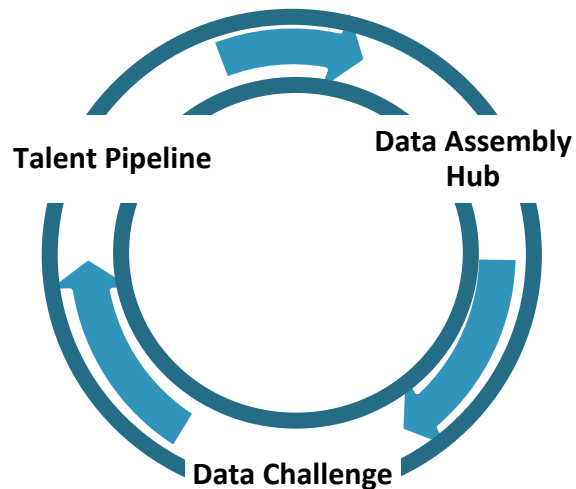
- Is this analyzed data useful?
- Is it timely, accurate, valuable, novel?
- Can you easily access data and information?



User Understanding Sparks Synergy

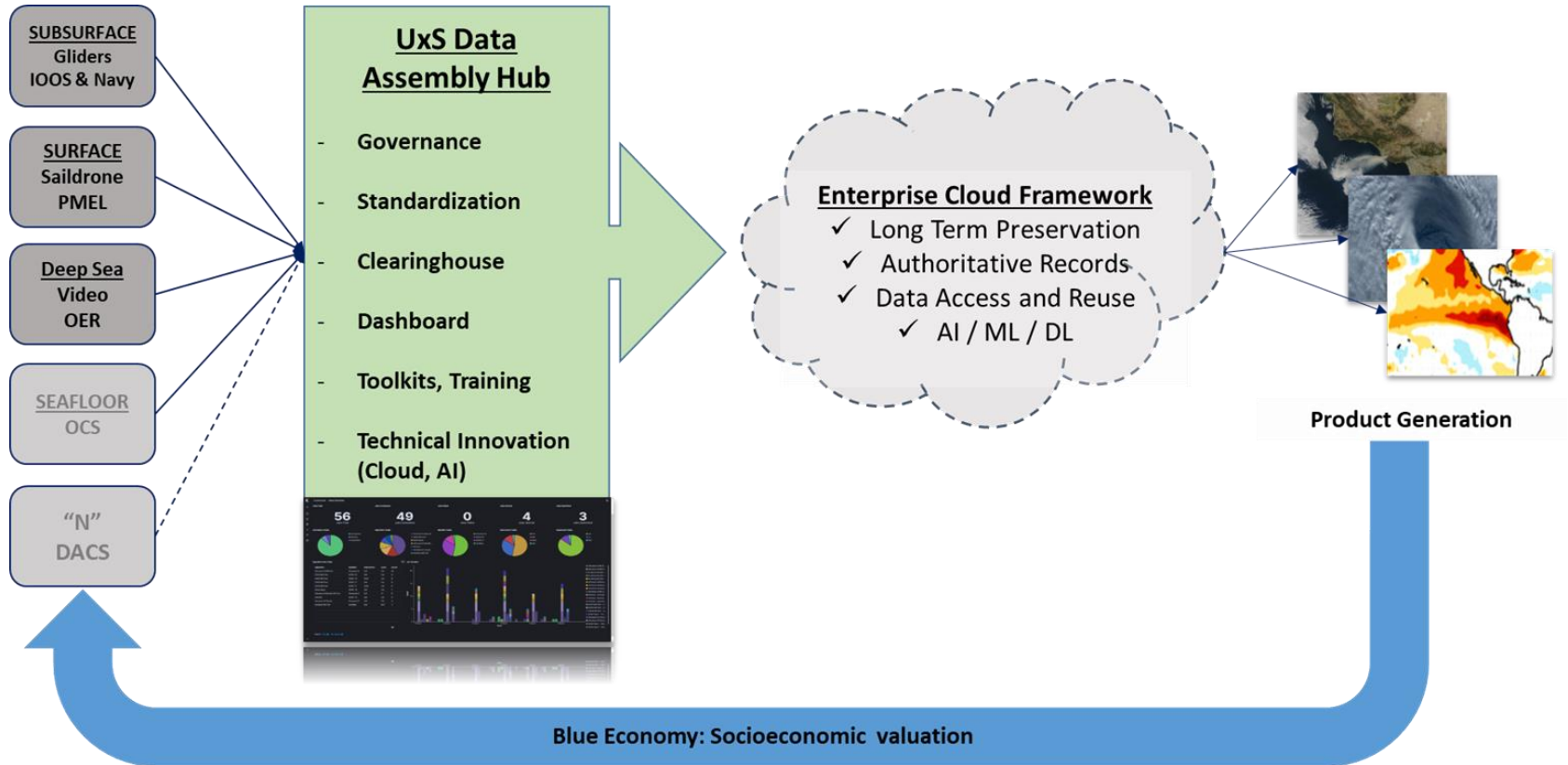
Workforce & Education: *Building a talent pipeline*

- Develop mentors, instructors, and research leaders
- Establish and nourish a talent pipeline
 - Cybersecurity
 - Data analytics
 - Cloud / AI DevOps
 - Machine / Deep Learning



A Federated System

Combining experience with innovation to build the UxS Data Enterprise



Thanks to our Partners !

Vision: The real power of UxS data will be realized when they are shared as massive sets of global 'big data' and analyzed with big data techniques, via Artificial Intelligence and Machine Learning.

