IOOS Marine Life Data Network

Mathew Biddle, Laura Brenskelle, Gabrielle Canonico

April 29th, 2025

2025 IOOS DMAC Meeting

Silver Spring, MD

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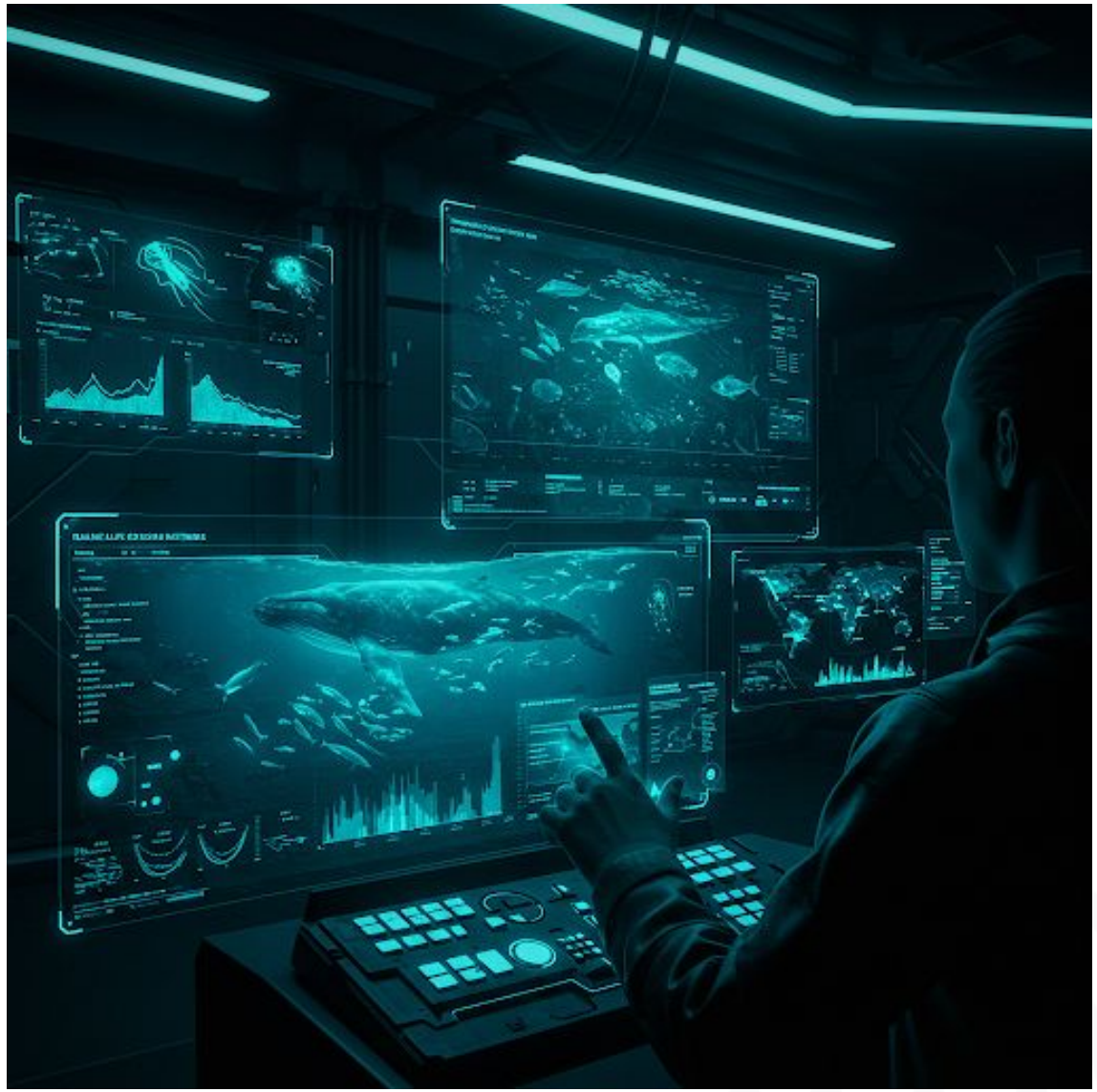
IOOS Marine Life Data Network

- Data
  - What are we working with?
- Goals
- Background on our approach
- Engaging with existing CoPs
  - Sharing best practices
- Future Directions



Source: Gemini Advanced (2.5 Pro)

Build on a strong foundation to fill gaps

Progress

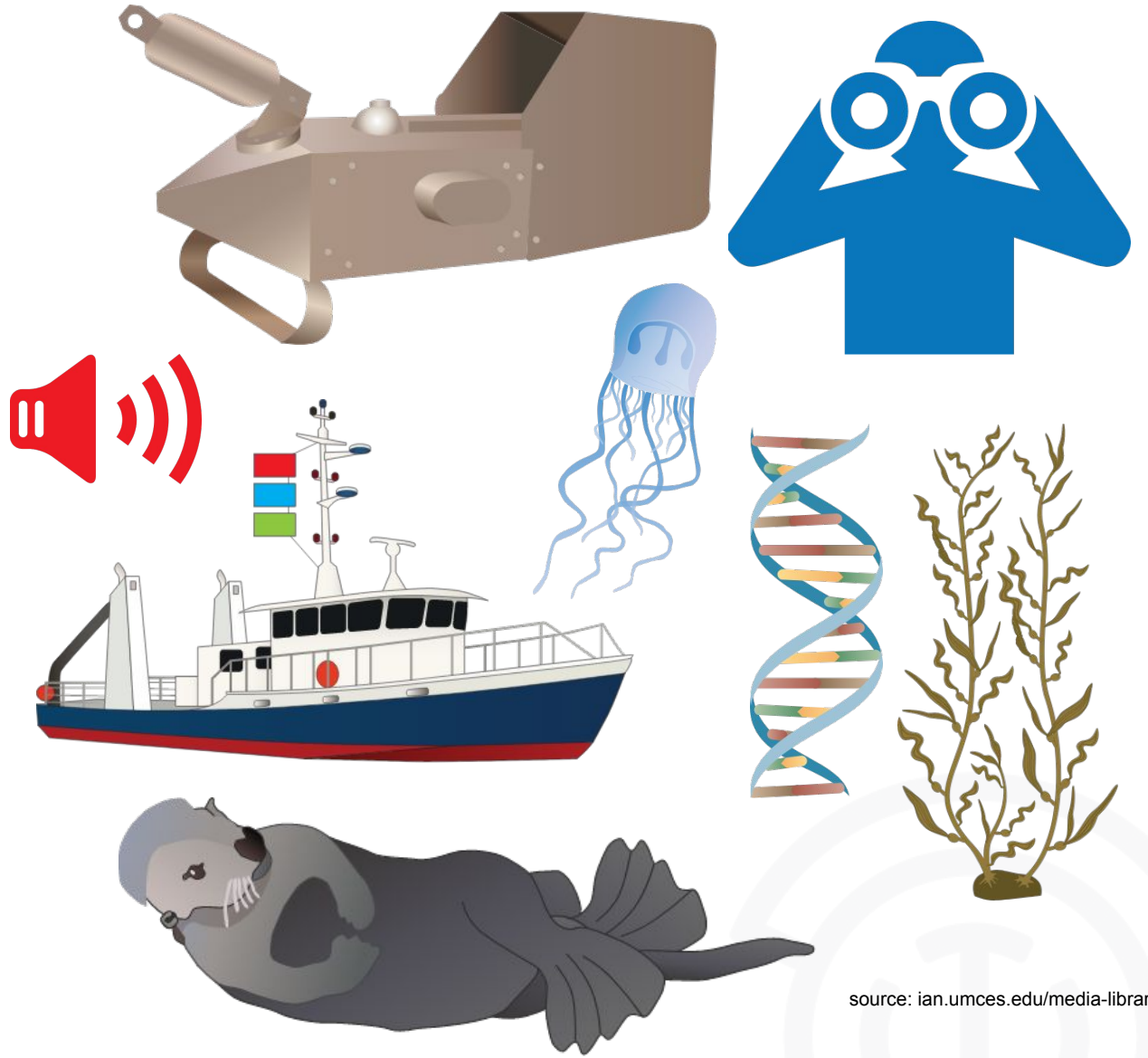
- 10+ years MBON, ATN, HABs include RA involvement
- 2018 Fall Meeting 'biology' theme
- Interagency, cross-NOAA investment and coordination
- Communities of practice, US and global
- Building robust partnerships

Vision

- Fill marine life gaps in sustained obs, appropriations
- Leverage, expand CoPs
- Communicate marine life relevance for U.S. commerce, jobs, security

Marine Life Data Network Scope

Marine life observations - **any observations of life across multiple trophic levels** (from plankton to whales, including habitat-formers such as corals, seagrasses, macroalgae, etc.) **in aquatic** (ocean, coast, and Great Lakes) **environments**.



source: ian.umces.edu/media-library

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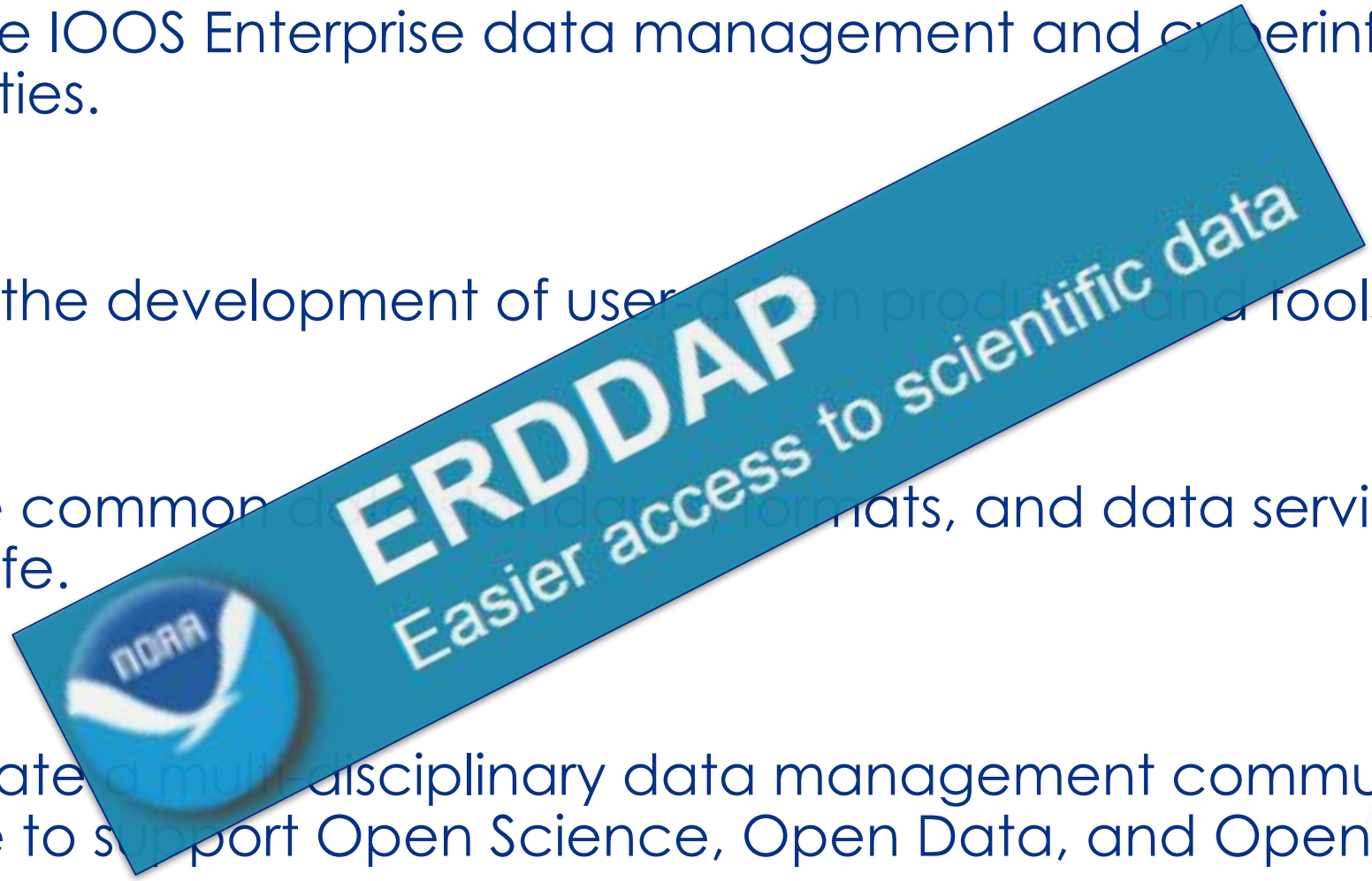
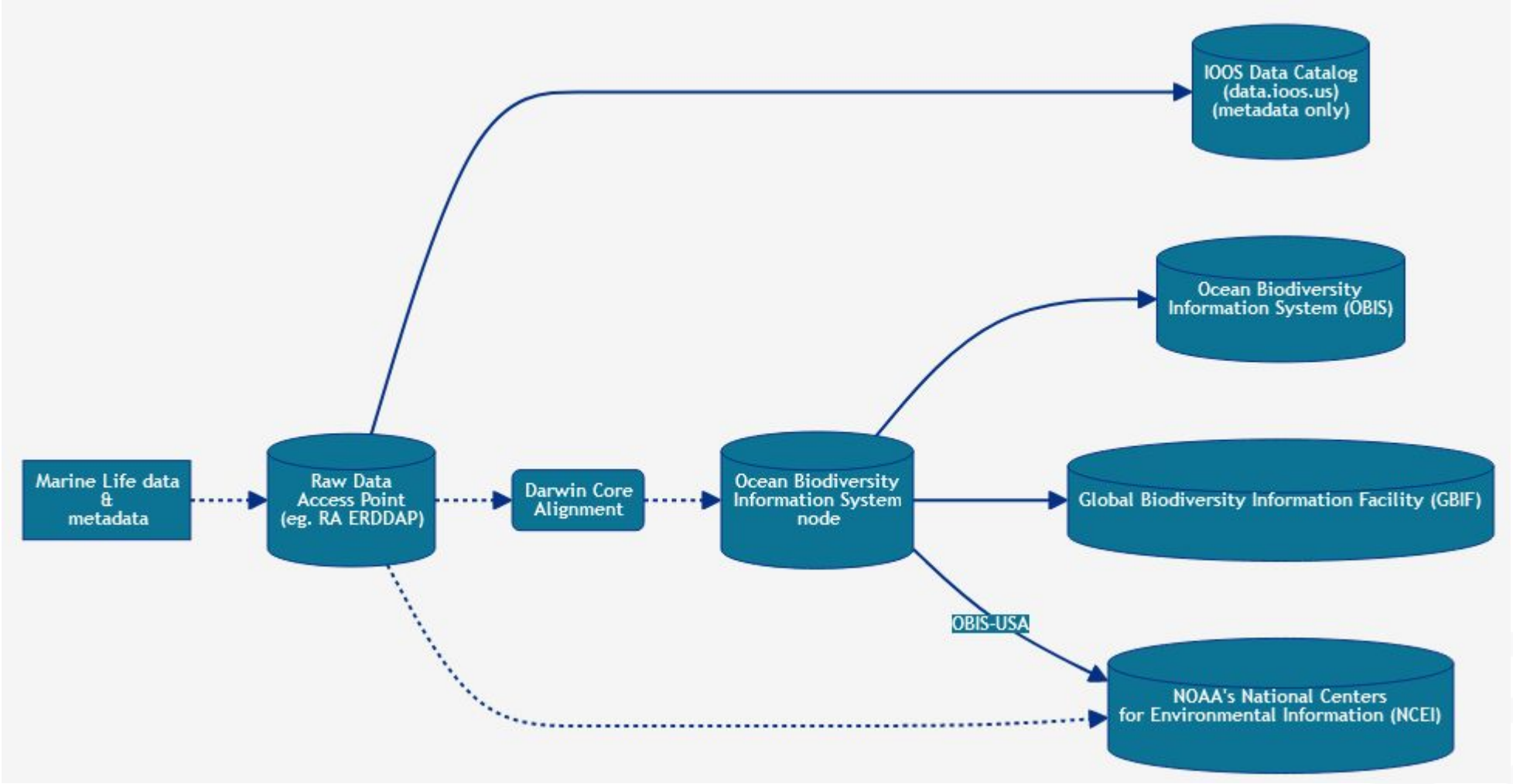
How do we do it all?!

- Leverage IOOS Enterprise data management and cyberinfrastructure capabilities.
- Support the development of user-driven products and tools.
- Promote common data standards, formats, and data services for marine life.
- Coordinate a multi-disciplinary data management community of practice to support Open Science, Open Data, and Open Software.



High level data flow



Documentation!!

Marine Life Data Recommendations | Nav | IOOS Resources | Data Standards & Formats | Software & Documentation | Data Use & Community | Feedback | search...

Categories of Marine Life observations

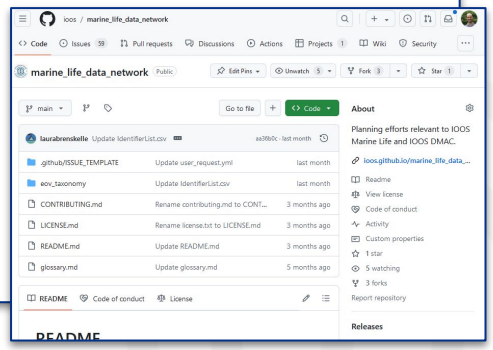
At its most simplistic state, observations of a **species at a place (latitude and longitude) and time** can be standardized to Darwin Core and shared to the Ocean Biodiversity Information System (OBIS) and/or the Global Biodiversity Information Facility (GBIF). The Marine Life Data Network recommends following that pathway regardless of the observing method by which the data were collected. For more information about aligning data to Darwin Core, see the Marine Biological Data Mobilization Workshop resources.

In some cases, there are additional pathways an observing method's data may take. Below is a short list of the various observing platforms and data management leading practices for those data types. Some are still in development and we encourage conversations on the topics by contributing issues to this repository.

- Species observation (high level data pathway)
  - See the MLDN data flow for sharing and standardizing any data that observes a species at a location and time to Darwin Core.
- Genetic make-up ('Omics, eDNA)
  - See the NOAA Omics Data Management Guide as the authoritative source for proper data management.
  - For lab protocols, see the NOAA Omics Technical Portal.
  - See the FAIR eDNA metadata checklist, which integrates existing data standards and introduces new terms tailored to eDNA workflows.
- Passive Acoustic Monitoring (PAM)
  - See NCEI's Passive Acoustic Data Best Practices as the authoritative source for proper data management.
- Satellite telemetry
  - See Integrated Ocean Observing System (IOOS) Animal Telemetry Network Data Assembly Center (ATN DAC).
- Acoustic telemetry
  - Work with the appropriate Ocean Tracking Network Node in your region. Below is a non-comprehensive list of the nodes which IOOS Regional Associations can work with:

Node	Region	Web Address
FACT	Southeast US	https://secoora.org/fact/
ACT	Mid-Atlantic to Northeast US	https://www.theactnetwork.com/
iTAG	Gulf of Mexico	https://myfwc.com/research/saltwater/telemetry/itag/
PIRAT	Pacific Islands	https://piratnetwork.org/
GLATOS	Great Lakes	https://glatos.glos.us/
N-PAcT	Northeast Pacific	https://npact.aoos.org/

- Plankton Imaging
  - Imaging Flow CytoBot (IFCB) - Prototype workflow from CeNCOOS to generate a Darwin Core archive.



https://ioos.github.io/marine_life_data_network/

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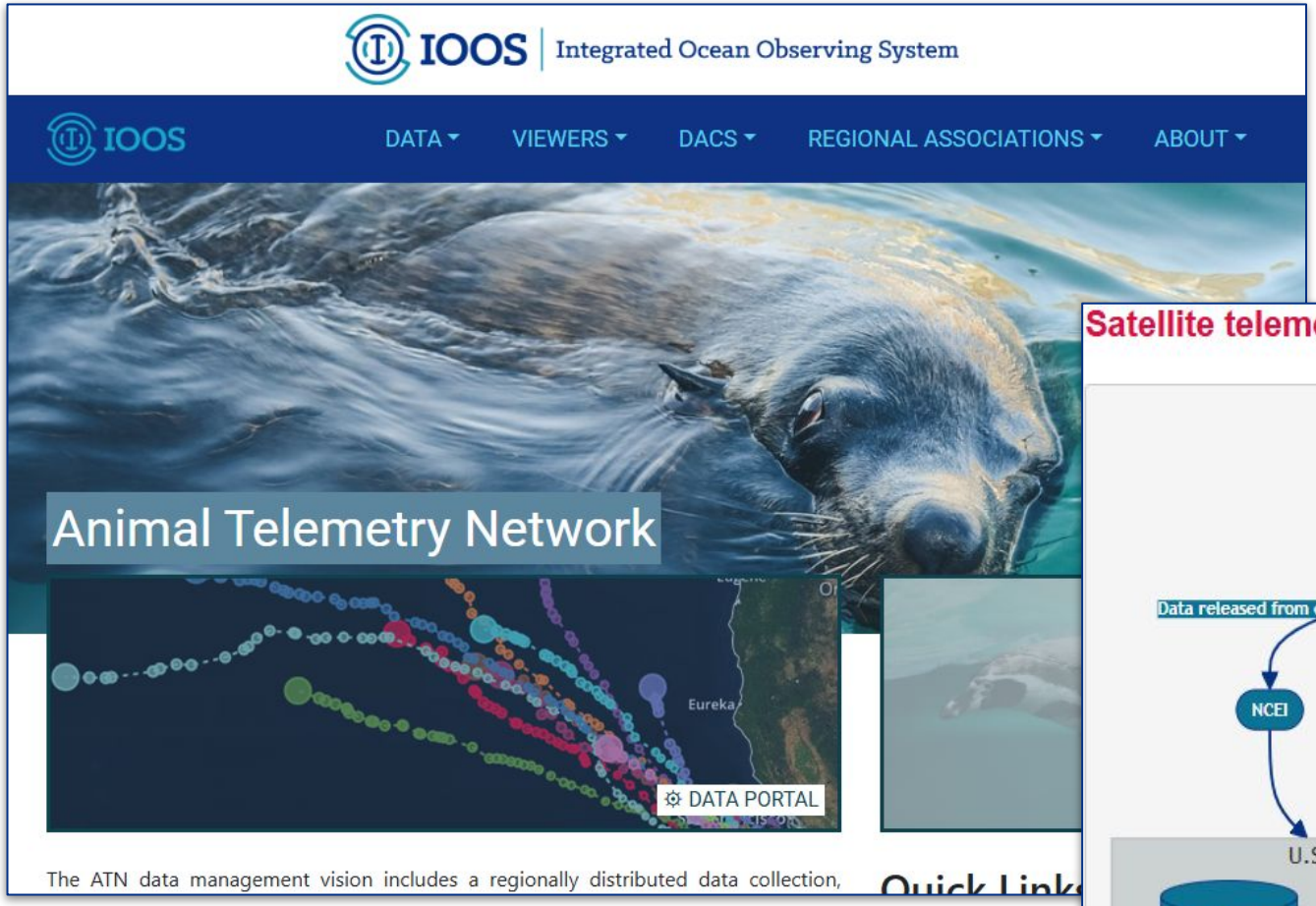
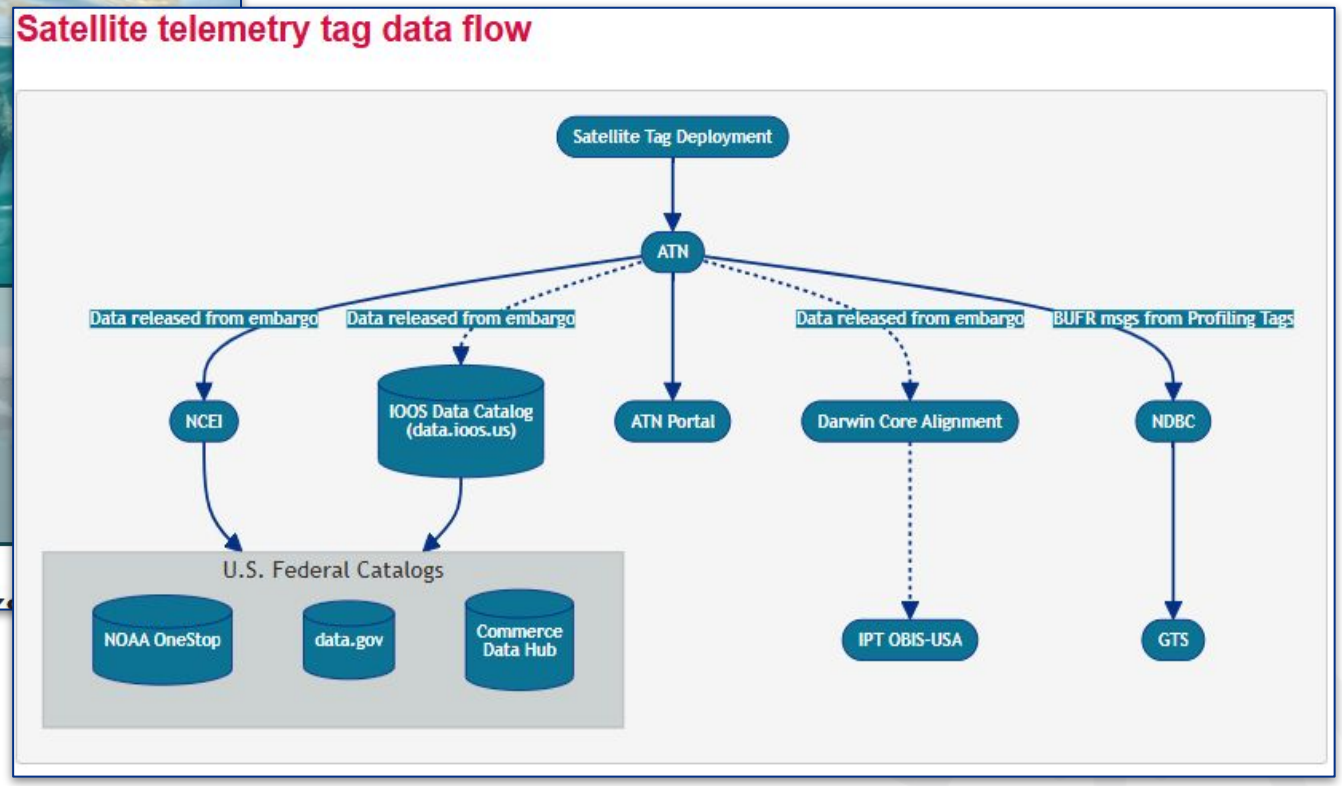
Satellite Telemetry





https://atn.ioos.us/

Acoustic Telemetry

- Acoustic telemetry
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PIRAT	Pacific Islands	https://piratnetwork.org/
GLATOS	Great Lakes	https://glatos.glos.us/
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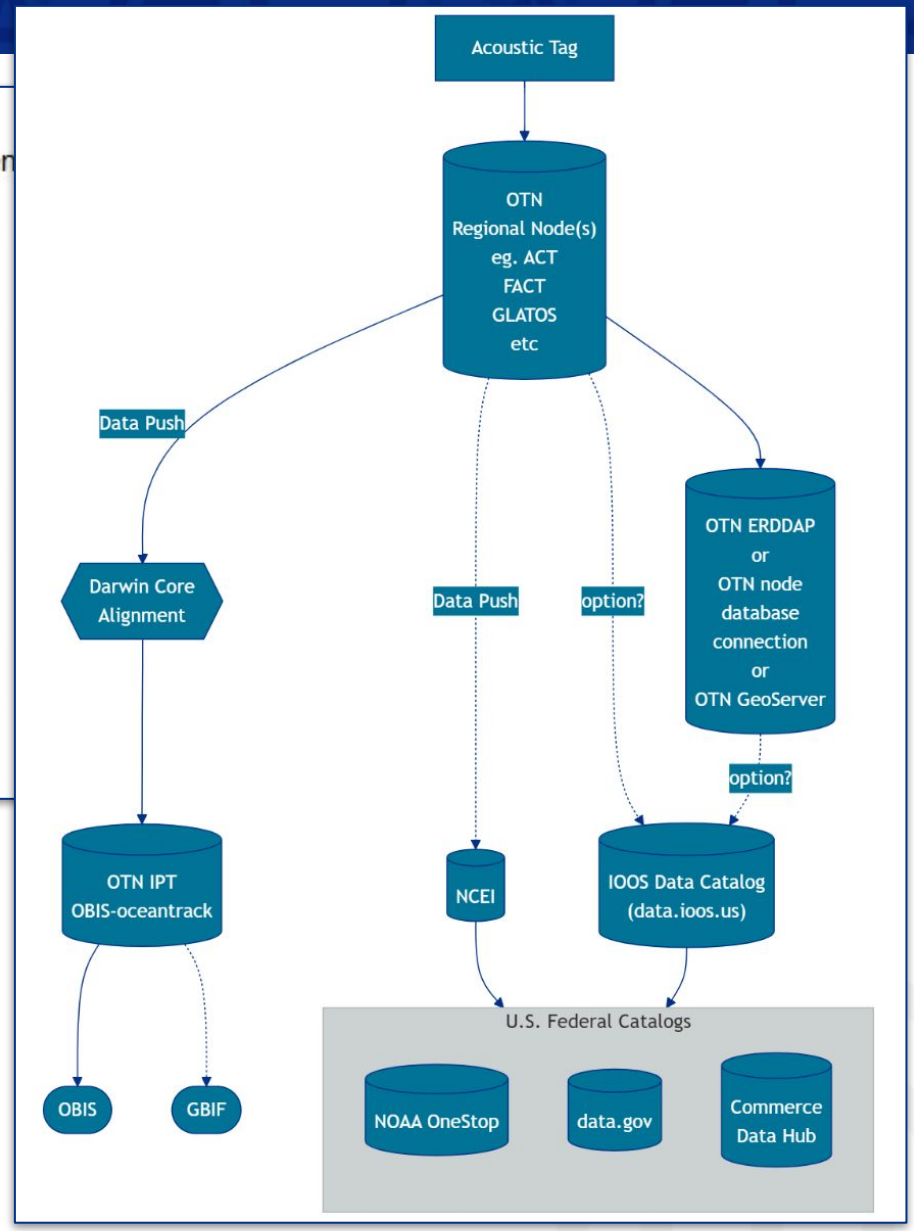

- Public endpoints that OTN and regional Nodes are creating are already feeding into independently-curated maps of scientific effort (eg. https://rwsc.org/map)
- OTN encourages more regions and the national efforts to collaborate and benefit from that harvest and discovery activity

Environmental DNA (eDNA, 'Omics)

https://noaa-omics-dmg.readthedocs.io/en/latest/

NOAA Omics Data Management Guide

Search docs

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Getting Started

Data M

Study D

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Omics

Open S

Contrib

Citatio

»Home

Overview

Management of data generated in research is cri

https://noaa-omics-technical-portal.readthedocs.io/en/latest/

NOAA Omics Technical Portal

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Home

What is 'Omics?

Technical Portal Description

Contents

Data Management and Standards

Omics Protocols

Bioinformatics Sequence Processing Protocols

Aggregated Relevant NOAA Line Office GitHub Repositories

Training Resources

Missing NOAA GitHub Repositories?

Contributors

Omics Glossary

Discussion Forum (external)

»Home

NOAA 'Omics Technical Portal

This site contains repositories and protocols used by NOAA 'Omics.

What is 'Omics?

'Omics describes a suite of cutting-edge tools used to analyze DNA, RNA, proteins, or metabolites. Many 'Omics approaches are faster, less invasive, and more comprehensive than traditional methods. Advances in 'Omics have revolutionized biological study, benefitting many fields including public health, medicine, agriculture, and conservation. For NOAA, techniques such as high-throughput DNA sequencing and subsequent bioinformatics analyses can be harnessed to benefit a myriad of national priorities including fisheries management, aquaculture development, food and water safety, species and habitat conservation, seafood consumer protection, biodiversity monitoring, and natural products discovery. Continued investment in NOAA 'Omics will aid operational efficiency, ecosystem assessments and forecasts, and the U.S. Blue Economy.

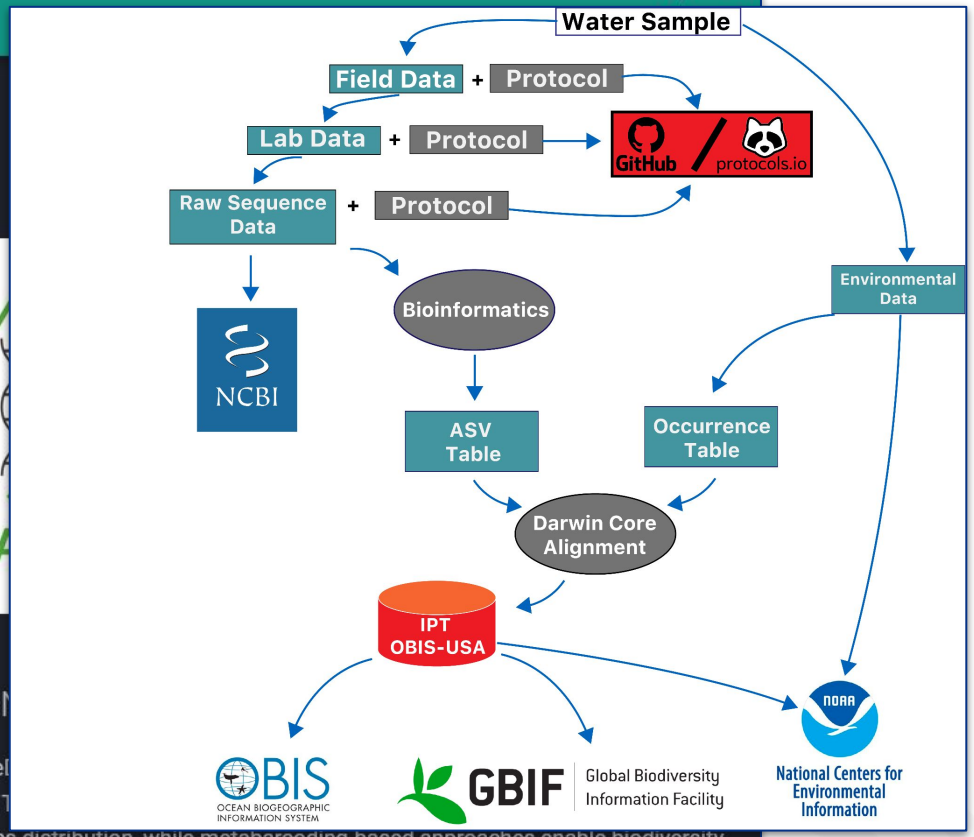
Learn more about the NOAA 'Omics program here.

See a detailed list of all NOAA 'Omics resources here.

https://fair-edna.github.io/index.html

FAIR eDNA

Making eDNA FAIR



FAIR eDN

ntal DNA (el

n mapping. T

ng of species distribution, while metabarcoding-based approaches enable biodiversity

nted scales and taxonomic resolution. eDNA datasets, however, are often scattered

consistent formats, varying access restrictions, and inadequate metadata; this limits

and overall impact. Adopting FAIR (Findable, Accessible, Interoperable, Reusable) data

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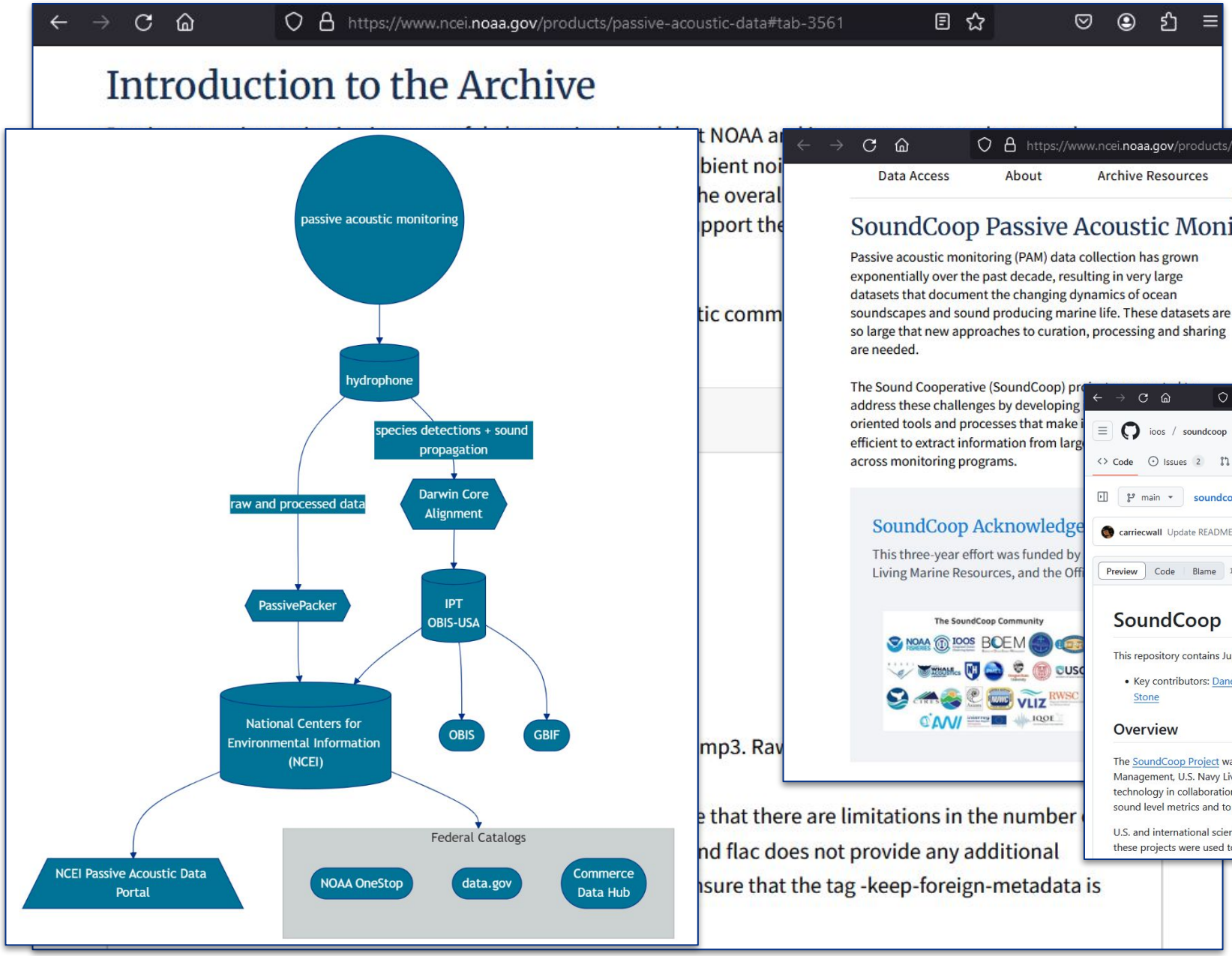
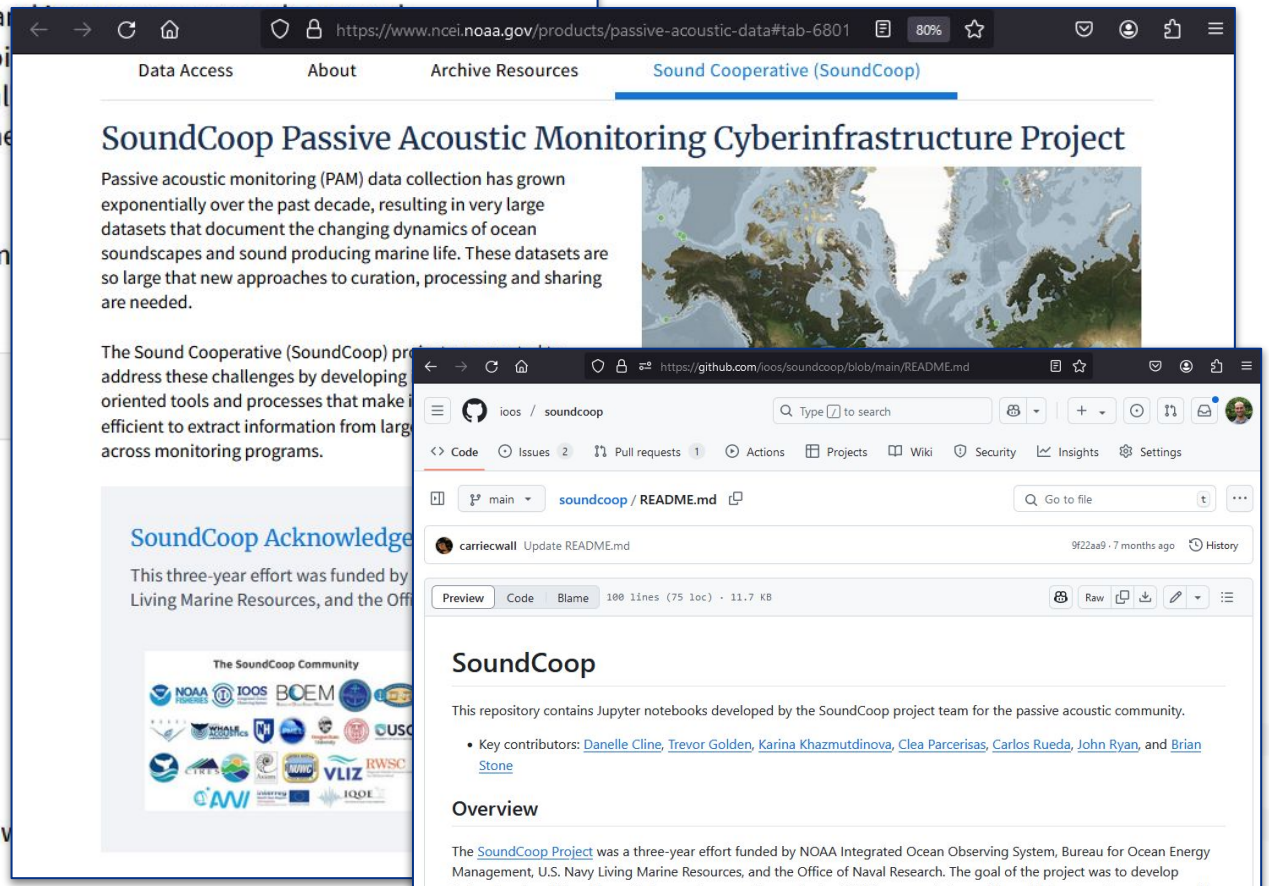
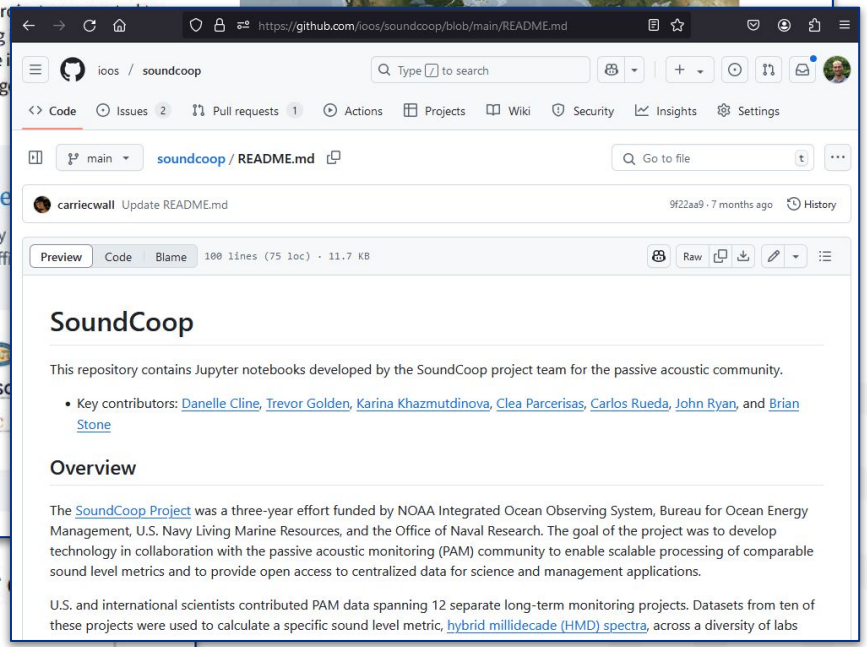
Passive Acoustic Monitoring (PAM)







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Plankton

DMAC Tech Webinar - "Identifying Challenges and Solutions for Advancing IOOS Plankton Observation Data"

CeNCOOS / OBIS_workshop_2024_IFCB

Type / to search

Code Issues Pull requests Actions Projects Security Insights

main OBIS_workshop_2024_IFCB / README.md Go to file

sbeaulieu Update README 2024 workshop participants 7f2b9da · 9 months ago History

Preview Code Blame 70 lines (61 loc) · 3.84 KB Raw

Prototype OBIS-ENV-Data package for HABDAC IFCB data products from Santa Cruz Municipal Wharf

Prepared for 2024 OBIS IOOS Marine Biological Data Mobilization Workshop.

Participants: Frederick Bahr (CeNCOOS) and Stace Beaulieu (WHOI), with pre- and post-meetings with Patrick Daniel (U

This is a prototype for testing purposes only. A protocol is being developed to determine if and when appropriate to su products from automated classification to OBIS.

Sponsored by NOAA PCMHAB20 project "Harmful Algal Bloom Community Technology Accelerator"

Background

This is a repository for CeNCOOS at the 2024 OBIS IOOS Marine Biological Data Mobilization Workshop. The plan is to take by Axiom and Ian Brunjes (SCCOOS) from previous workshops and create a full workflow to an OBIS-ENV-Data ready outpu already been created to generate Event and Occurrence tables. The plan is to supplement these with the EMoF table follow practices (http://dx.doi.org/10.25607/OBP-1955). Pre-workshop coding is being done to translate Ian's magnificent work from R to Python.

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Other engagements

IOOS | Integrated Ocean Observing System

Sanctuary Watch | WebCRs | Conservation Issues | About

Sanctuary Watch
Web-Enabled Information for Sanctuary Management

WebCRs - Ecosystem Tracking Tools for Condition Reporting

The web-enabled Condition Reporting (WebCR) platform pairs artwork with information to make it easy to explore and track how ecosystem conditions are changing at a sanctuary. Select a sanctuary below to start exploring that sanctuary's ecosystem. Navigate by clicking on icons representing major habitats, species of interest, climate and ocean drivers, and human connections. Interactive icons and silhouettes are linked to status and trend data, images, web stories and other related content. The goal of WebCRs are to help us keep our finger on the pulse of these dynamic ecosystems and to help us to better understand and manage our sanctuaries together. Tiles for other sanctuaries will be added below as those tools become available.

Channel Islands | Florida Keys | Olympic Coast

IOOS | Integrated Ocean Observing System

SanctSound | Questions | Sanctuaries | Sounds | Stories | Software | Data Portal

Sanctuary Soundscape Monitoring

S. national marine

Code of Conduct | Setup | Episodes | Extras | License | Improve this page | Search...

Marine Biological Data Mobilization Workshop

Harmful Algal Blooms (HABs)

Background | HABs Projects

Background

The marine and fresh waters of the United States are increasingly impacted by the growing environmental problem of harmful algal blooms (HABs), high densities of microscopic algae most noted for their production of potent toxins. HABs are known to occur in all 50 states. HABs can adversely affect human and animal health, and cause significant economic impacts to coastal communities, losses to aquaculture enterprises, and long-term ecosystem changes. While HABs are naturally occurring phenomena, they are increasing in frequency and duration, and geographically expanding due to human-influenced ecosystem changes such as excessive levels of nutrients and extreme weather events.

IOOS and the Regional Associations (RA) have responded to these impacts by developing a Natio (NHABON) implementation strategy, implementing a series of Congressionally mandated HAB pil Technology Transition (OTT) and Coastal and Ocean Modeling Testbed (COMT) grants and via a spending was approximately $4.2M in FY22.

https://ioos.github.io/bio_data_guide/

BioDataGuide

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1 Introduction
Applications
2 Aligning Data to Darwin Core - Event Core with Extended Measurement or Fact
3 Darwin Core Salmon Data Remap
4 Seagrass Density to DWC eMoF format
5 trawl_catch_data
6 dataset-edna
7 Converting ATN netCDF file to Darwin Core
Appendices
A FAQ
B Tools

BioDataGuide

Darwin Core Marine Example Compendium

Scaling multiple dimensions of diversity in biological data

AUTHOR: Standardizing Marine Biological Data Working Group
PUBLISHED: 2025-04-09

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Edit this page

Preface

This book cor
mobilizing ma
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Biological Dat
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If you would l

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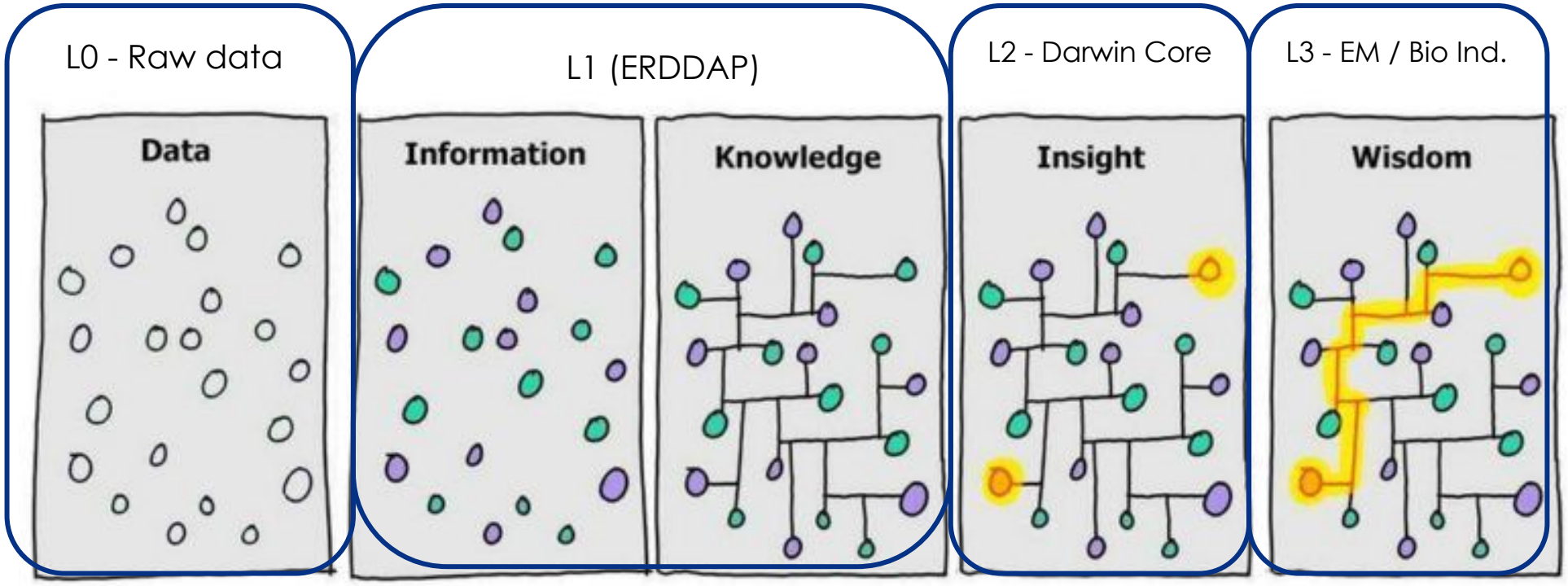
Standardizing Marine Biological Data Working Group (SMBD)

Purpose

The purpose of the SMBD is to facilitate a community of practice for aligning marine biological data to Darwin Core for sharing to OBIS. We do this by empowering our community members - which consist of federal, state, local, tribal, and private data managers, scientists, computer programmers, and everything in between - with the tools and knowledge to mobilize marine biological data.

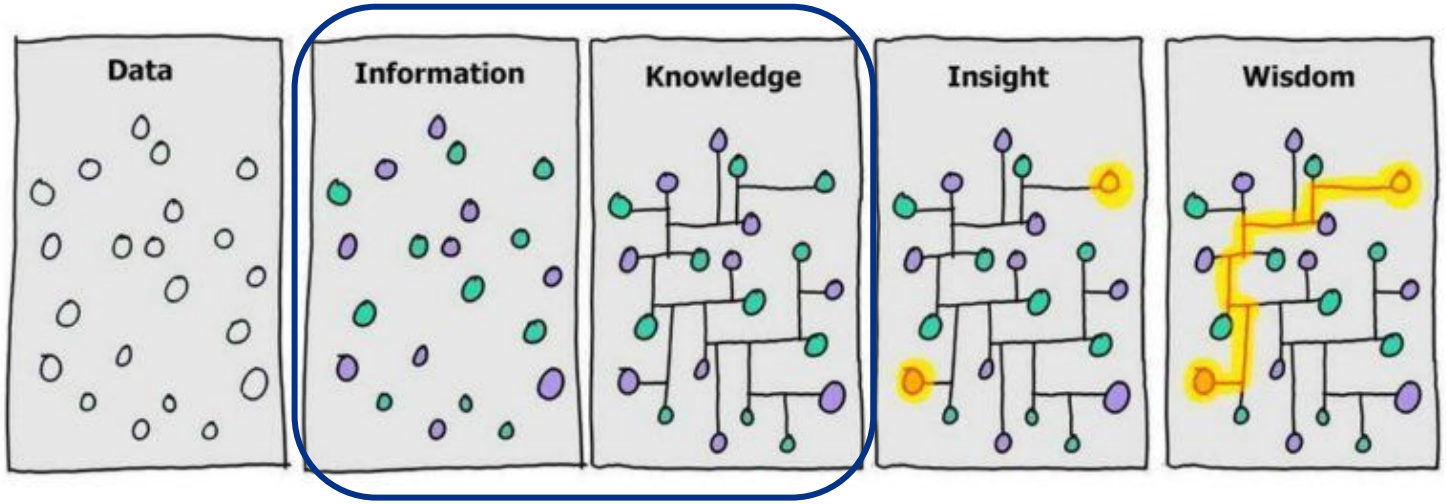
Taking the unorganized and making it organized



DIK(I)W hierarchy

Sharing data through ERDDAP

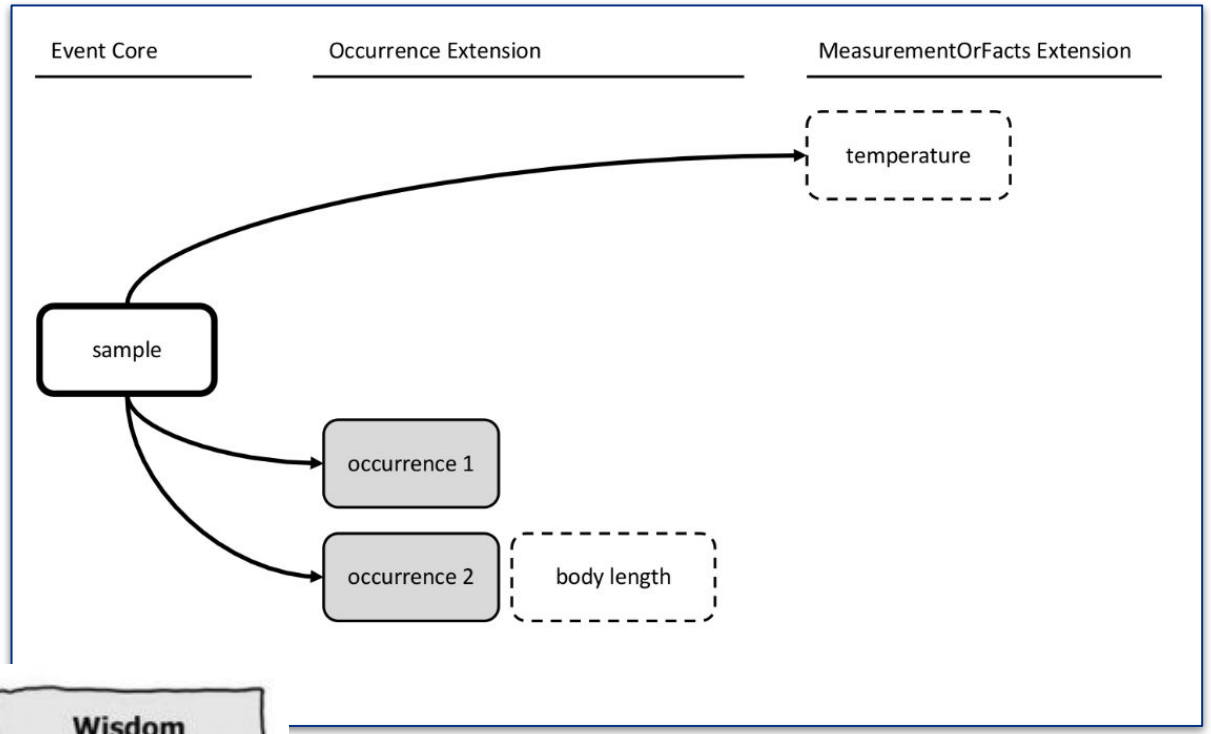
ERDDAP
Easier access to scientific data



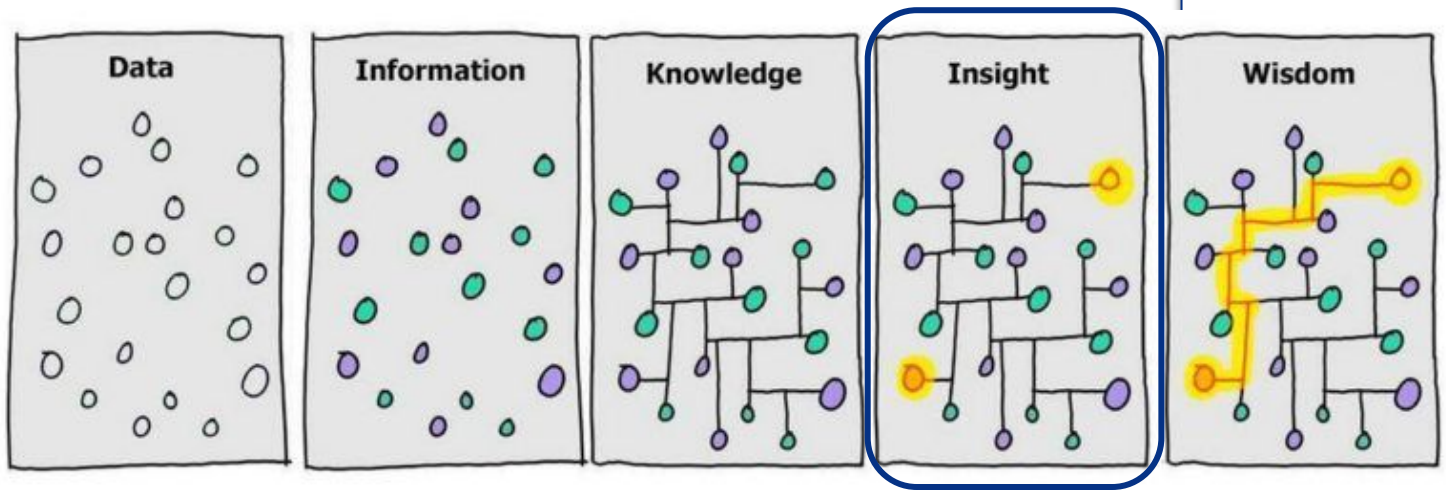
Aligning to existing data standards

Darwin Core

- csv text files
- metadata convention
- data model "star schema"
- standardized naming
- WoRMS/Aphia ID



Sharing with OBIS/GBIF



ed from De Pooter et al. 2017: https://doi.org/10.3897/BDJ.5.e10989.figure4

OBIS OCEAN BIODIVERSITY INFORMATION SYSTEM

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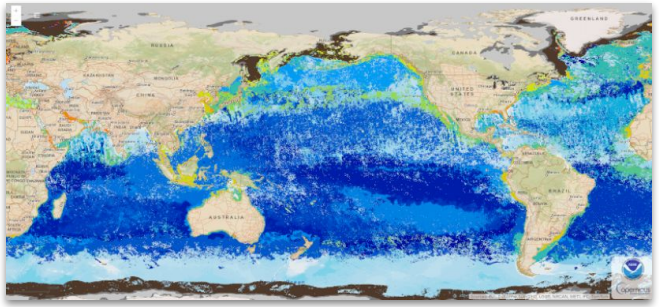
Bringing the value

ERDDAP
Easier access to scientific data

+

+ Darwin Core +

OBIS OCEAN BIODIVERSITY INFORMATION SYSTEM



Gridded Products

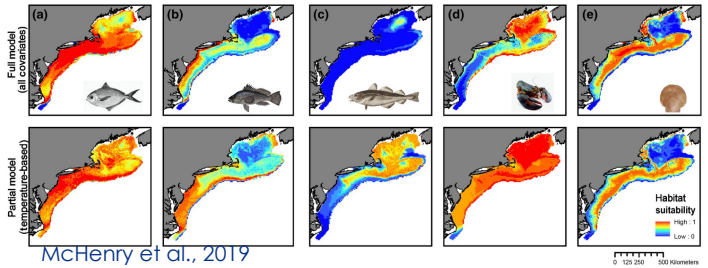
MBON Data Portal

EXPLORE MAP | SEARCH 270+ DATASETS

Animal Telemetry Network Data Portal

EXPLORE MAP | PROJECTS

Data Portals



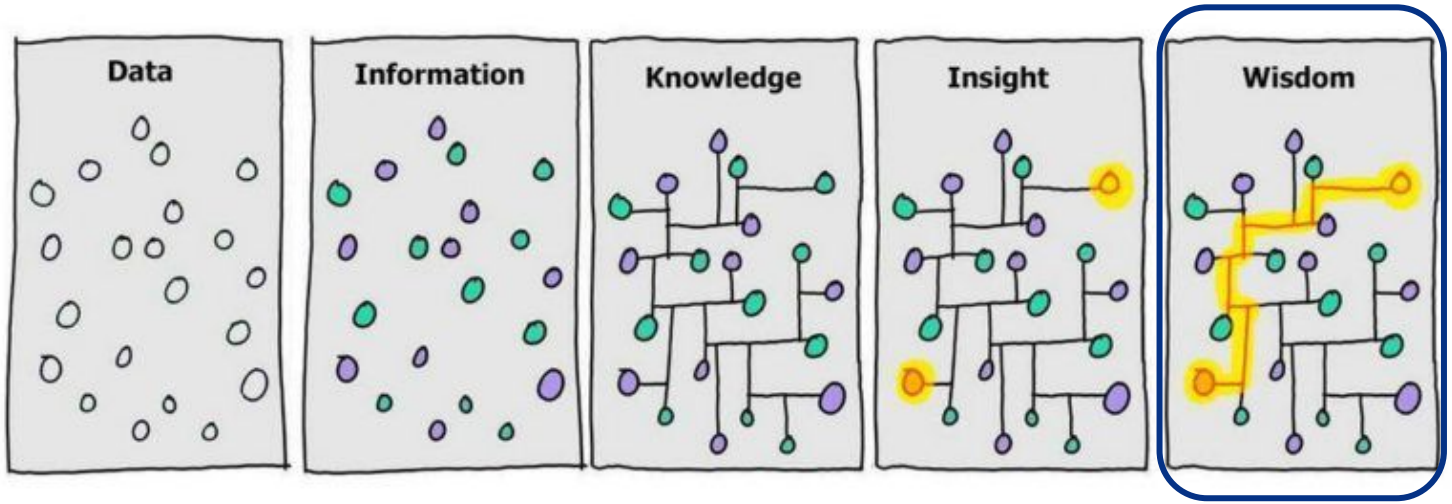
McHenry et al., 2019

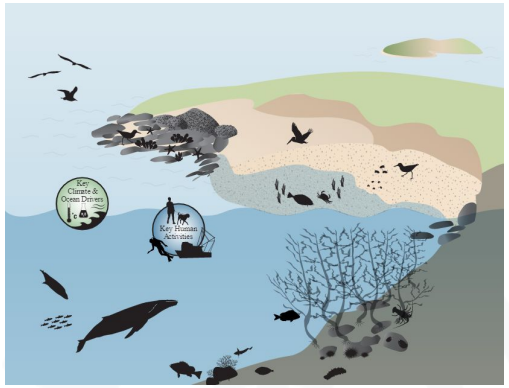
Modeling

Biology and Ecosystems

Phytoplankton biomass and diversity
Zooplankton biomass and diversity
Fish abundance and distribution
Marine turtles, birds, mammals abundance and distribution
Hard coral cover and composition
Seagrass cover and composition
Macroalgal canopy cover and composition
Mangrove cover and composition
Microbe biomass and diversity (*pilot)
Invertebrate abundance and distribution (*pilot)

EOVs





Infographics

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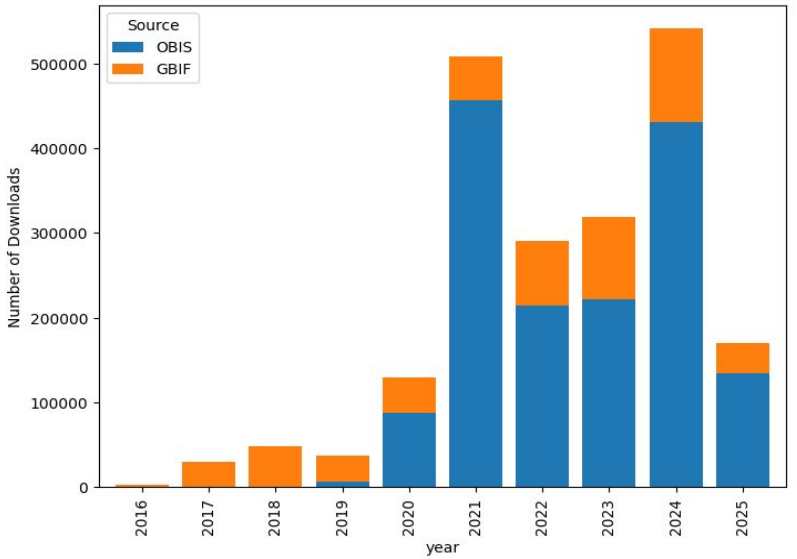
Data use beyond original intent: U.S. MBON example

https://obis.org/institute/23070

1,620,870 occurrences!

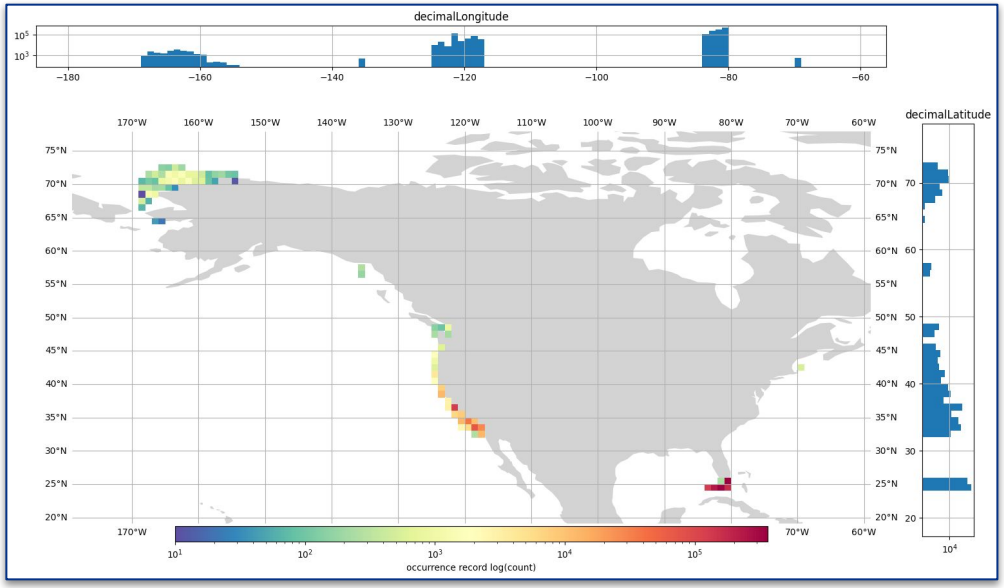
Observing methods include:

- diver survey
- fisheries indep. mon.
- metabarcoding
- photo plot
- transect survey
- trawl survey
- bongo net
- quadrat survey

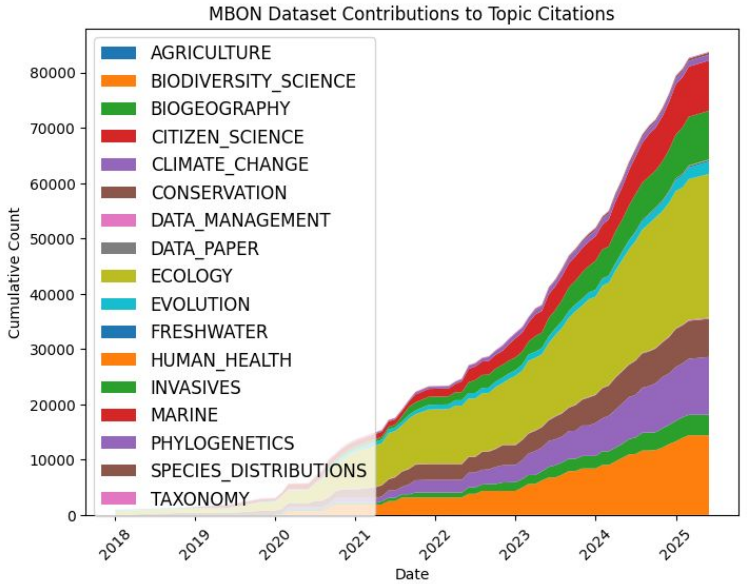


Downloads of US MBON data

- OBIS: 1,552,636
- GBIF: 524,631



https://ioos.github.io/ioos_code_lab/content/code_gallery/data_access_notebooks/2022-11-23_pyobis_example.html



Citations from GBIF

- 41 dataset DOI's
- 3,120 total citations

https://github.com/ioos/ioos_metrics/blob/main/notebooks/mbon_citation_visualizations.ipynb

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H3 indicators

IOOS Code Sprint

2022 Topics | 2022 Agenda | 2022 Registration

Home / 2022 / Topics / Open source biodiversity indicator development from open data

Topic 4:

Open source biodiversity indicator developmer

Open source biodiversity indicator development from open data. Initial ideas for this topic found here

Team

- Tylar Murray, USF-IMaRS, MBON
- Ben Best, EcoQuants
- Sonja Giardina, PacIOOS
- Hassan Moustahfid, IOOS
- Abby Benson, USGS, OBIS-USA

The group identified several avenues for investigation:

- Analyzing ES50 globally at decade time steps on a subset small enough for GitHub actions vignette
- Detecting Range Shifts for an Individual Taxa using OBIS data
- MPAs ES50 using OBIS data

A huge amount of work went into developing the R package obisindicators by Ben Best to provide us a great foundation to work fr

If you're interested to get involved please see the issues we have here issues yourself.

Future directions

- Continue to meet and further development of the R package and
- Consider continuing this work at OceanHackWeek 2022

NOAA-GIS4Ocean / H3_indicators

Code | Issues 3 | Pull requests | Actions

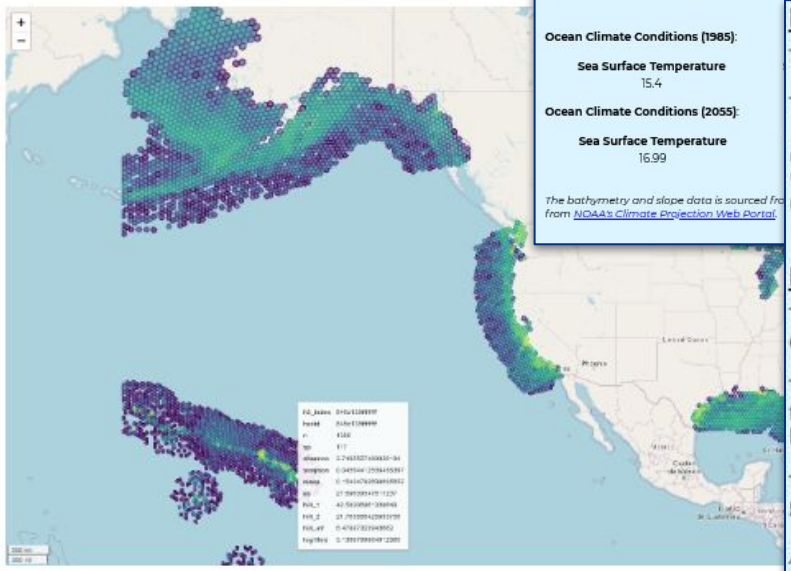
main | H3_indicators / README.md

MathewBiddle Update README.md

Preview | Code | Blame | 38 lines (30 loc) · 2.37 KB

H3_indicators

Notebooks and documentation about computing biodiversity snapshots (periodic full exports of the OBIS database) on H3



Source data

The data sourced for this effort comes from the publicly available OBIS snapshots, which can be found at https://api.obis.org/export.

Seascape Explorer

Additional Information

Coastal Economies

The following coastal counties fall within 25km of this hex bin. The total Gross Domestic Product (GDP) for all marine economy sectors is listed below.

Alameda County (Total: $2,437,065,573)
Contra Costa County (Total: $960,187,573)
Marin County (Total: $707,074,031)
Napa County (Total: $50,290,181)
San Francisco County (Total: $3,349,213,897)
San Mateo County (Total: $1,968,406,899)
Santa Clara County (Total: $612,073,519)
Solano County (Total: $293,837,741)
Sonoma County (Total: $361,544,076)

The predominant marine economy sector in these counties is: Tourism and Recreation
The total population of these counties is 7,765,640.
The following ports are within 200 km of this selection:

Richmond, CA (Total Tonnage: 28,529,178)
Oakland, CA (Total Tonnage: 46,094,797)
San Francisco, CA (Total Tonnage: 47,894,848)

The marine economic data used in this map is from NOAA's ENOW Explorer. See the derived feature layer here. More data about U.S. Ports can be found at Marine Cadastre. General county population data is referenced here.

Ocean Conditions

The average bathymetry value in this area can be classified as **Land**. The maximum slope can be classified as **Moderate Slope**.

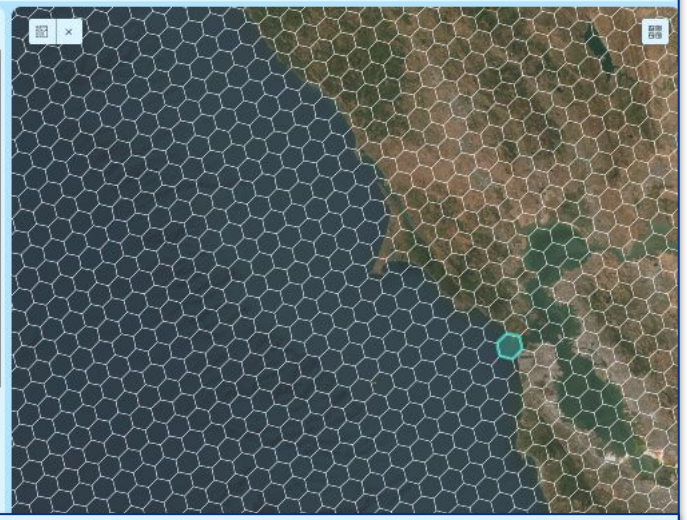
Ocean Climate Conditions (1985):

Sea Surface Temperature
15.4

Ocean Climate Conditions (2055):

Sea Surface Temperature
16.99

The bathymetry and slope data is sourced fr from NOAA's Climate Projection Web Portal.



Productive Fisheries

The level of fishing protection is **Low** (2.01).

There were **355** hours spent fishing in this area according to Global Fish Watch.

More information on fishing protections can be found in the ProtectedSeas database here. Global Fish Watch data for fishing hours is derived from activity recorded by AIS for the year 2020. The layer can be found on the Living Atlas of the World.

Ecosystem Services

There are **23** deep sea corals within this hex bin. The majority deep sea coral species is **Stylatula elongata**.

There are **22,198** observations in this area recorded in OBIS. There are **1,212** unique species found in these observations. The Shannon Biodiversity Index value is **5.91** this indicates a **High** level of biodiversity.

This hex bin contains **159** square kilometers of designated blue carbon habitat, which represents **5.4**% of the selected area.

Additional information on deep sea corals can be found on NOAA's Deep Sea Corals Portal. Observation data comes from the Ocean Biodiversity Information System (OBIS). More information on specific biodiversity indicators can be found here. Data on blue carbon habitat is from the Commission for Environmental Cooperation (CEC), full layer here.

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Engaging & advancing biological data standards community

- Ensure IOOS Enterprise doesn't reinvent the wheel. These communities already exist!
  - Darwin Core - TDWG - https://www.tdwg.org/community/
  - Ocean Biodiversity Information System (OBIS) - https://obis.org/contact/
  - Global Biodiversity Information Facility (GBIF) - https://www.gbif.org/training
  - Environmental DNA (eDNA) - NOAA 'Omics Guide
  - Harmful Algal Blooms / Plankton -
  - Passive Acoustic Monitoring (PAM) - NCEI Data Guidance
  - Acoustic Animal Tracking - Ocean Tracking Network (OTN)
  - Satellite Animal Tracking - Animal Tracking Network (ATN)

Thank you!

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Additional Resources

Background	Training	Guidance	Community Support	Examples
OBIS	Data Formatting for OBIS: Video Playlist	IOOS Marine Life Data Network	Standardizing Marine Biological Data Working Group (SMBD)	Prototype OBIS-ENV-Data package for HABDAC IFCB
OBIS-USA	OceanTeacher Global Academy (OTGA): Contributing and publishing datasets to OBIS	OBIS Manual	Slack: • IOOS • SMBD • OBIS • GBIF-NA	ATN netCDF to DarwinCore
GBIF	GBIF: Training and Learning Resources	Guide: Publishing DNA-derived data through biodiversity data platforms	MBON DMAC Working Group	dataset-edna
GBIF-US	TOPs: Open Science 101	GBIF IPT Manual	ERDDAP Discussions	SanctSound Passive Acoustic Monitoring
GBIF-North America	SMBD: Marine Biological Data Mobilization Workshop	IOOS Bio Data Guide		Creating event core with an occurrence and extended measurement or fact extension using Python
GBIF and DNA	MBON Data Mobilization Workshop	NOAA Omics Data Management Guide	GBIF Discourse	
GBIF Tech Support Hour: DNA data publishing (video)			helpdesk@gbif.org	
OBIS Genetic Data Webinar (video)			helpdesk@obis.org	

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