

U.S. Animal Telemetry Network

Serving Animal Borne Profiles to the GTS
NCEI Archival Services

IOOS DMAC Annual Meeting
September 26, 2023

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45 Years of Animal Tracking by Argos

150,000+ animals tracked since 1978

<https://www.noaasis.noaa.gov/POLAR/ARGOS/apps.html>

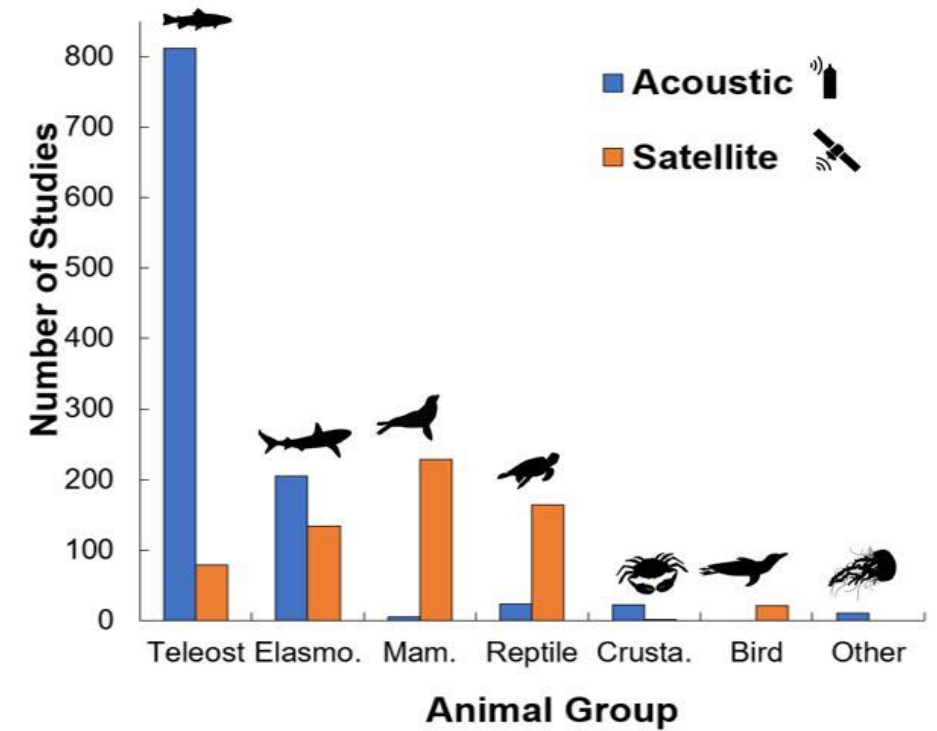
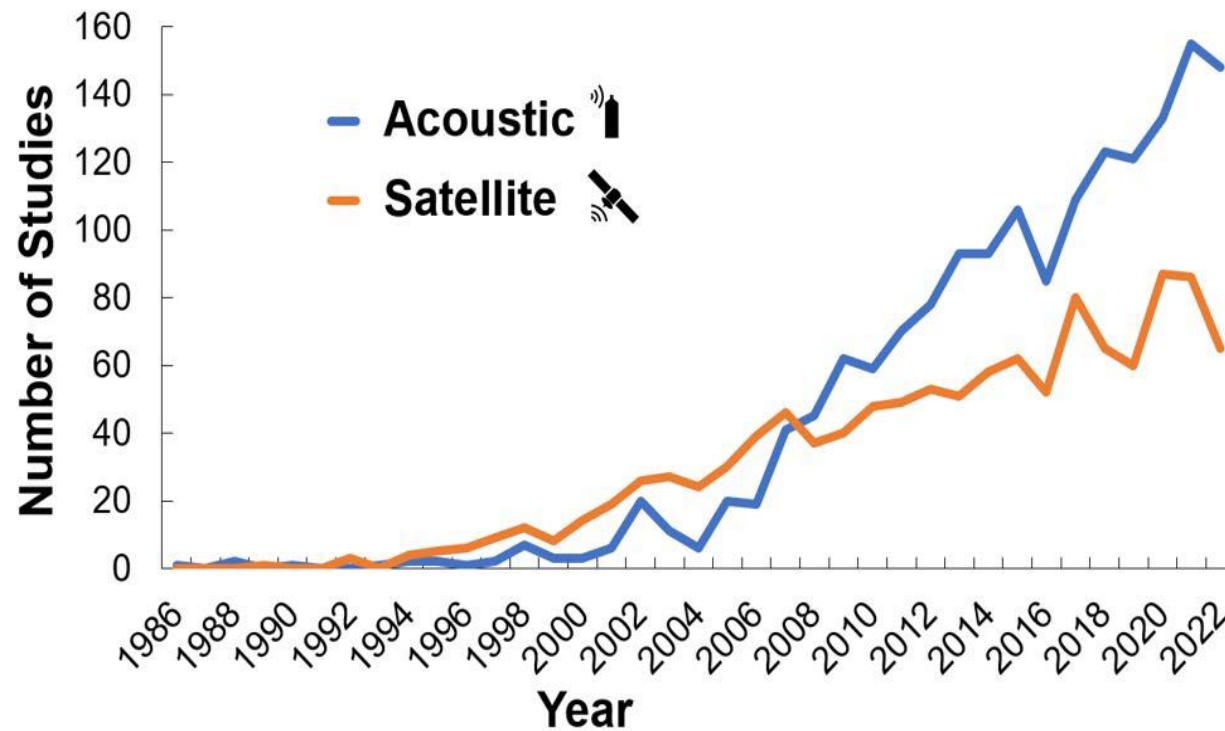


■ BIRDS

■ LAND
ANIMALS

■ MARINE
ANIMALS

■ FISH

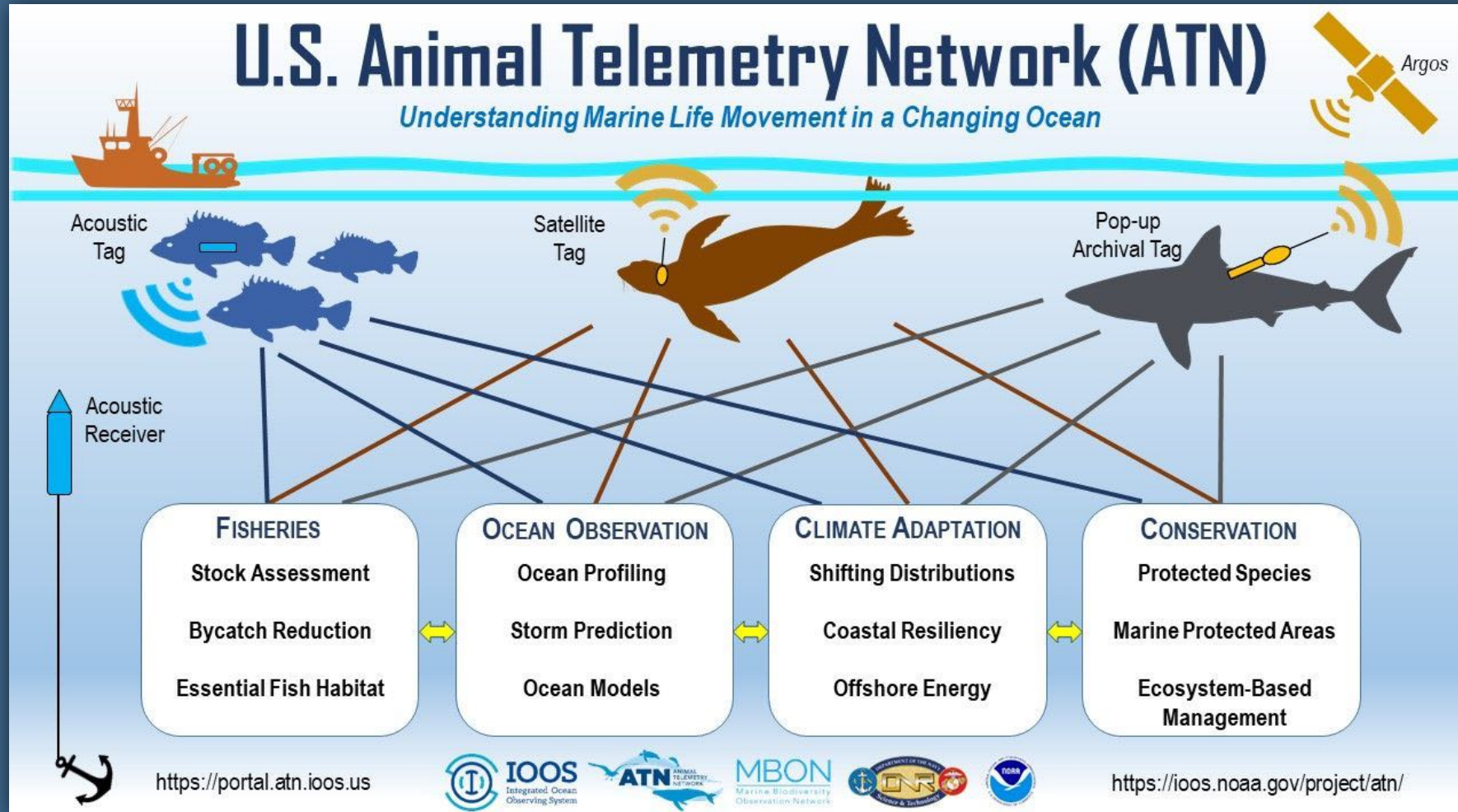


Kessel et al. (in prep), modified from Hussey et al. (2015) *Science*

- Telemetry is a tool, but an extremely powerful and adaptable tool for marine life observation
- The use of telemetry is expanding rapidly worldwide
- *The need for data management, products, and delivery is growing commensurately*

ANIMAL TELEMETRY NETWORK

- ATN was established with these needs in mind
- Serving the missions of multiple agencies and the broader scientific community

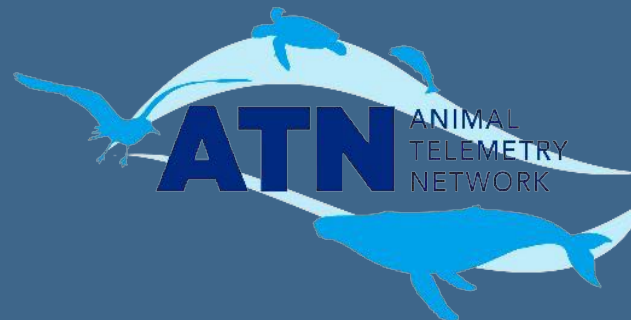
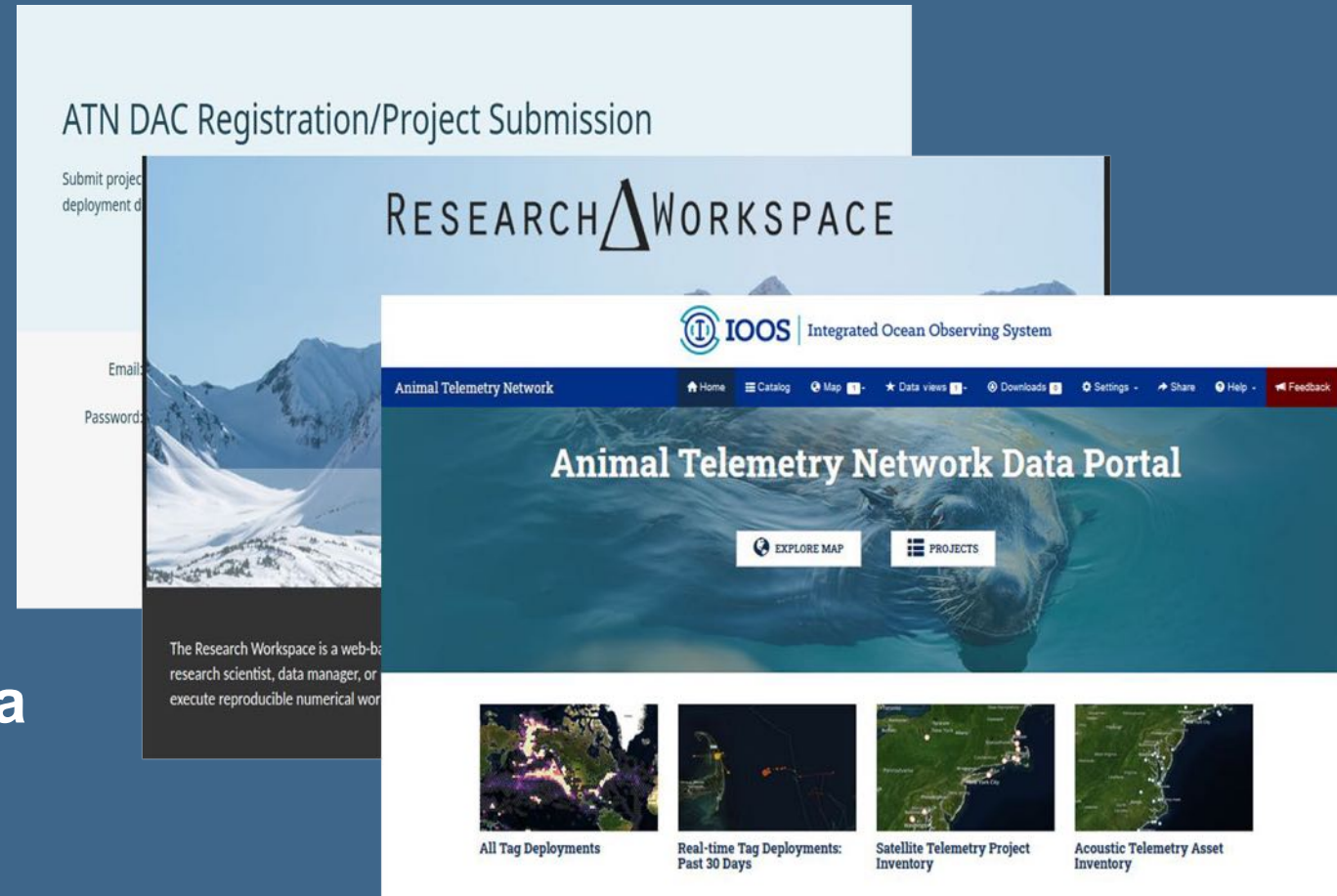


**Provide Unity, Stability and
Continuity to the U.S. Marine
Animal Telemetry Network and
Promote its Integration into the
Nation's Ocean Observing
System Capabilities**



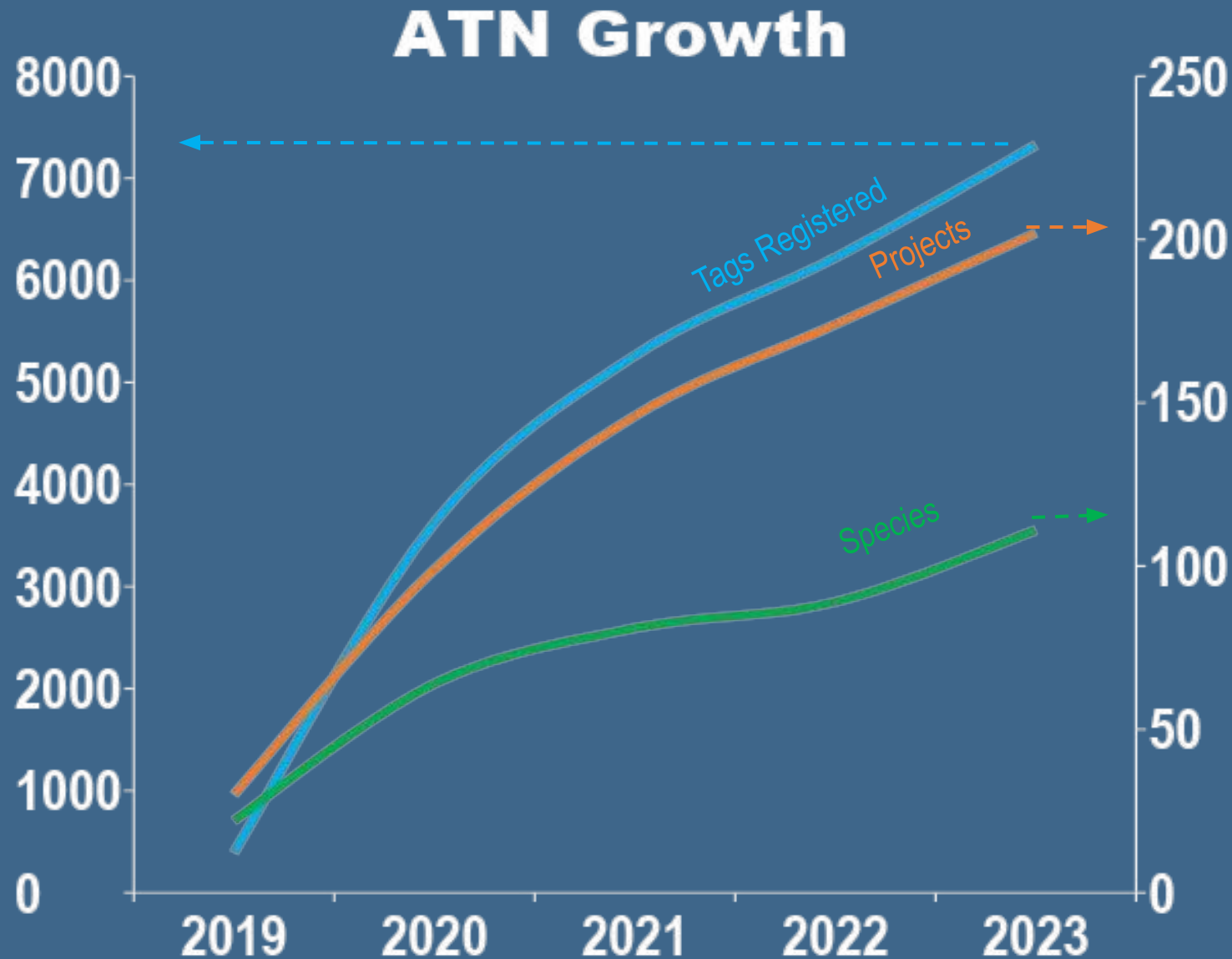
ATN DATA ASSEMBLY CENTER (DAC)

- Community resource
- Receives data from multiple sources/tag types
- Enables/promotes data availability and sharing among community partners
- Maximizes access to telemetry data
- Enhances and expands electronic tag data products
- Enables permanent archiving at NCEI, DataONE; DOI minting



ATN Registration App –
<https://dacregistration.atn.ioos.us>
Research Workspace –
<https://researchworkspace.com>
ATN Data Portal –
<https://portal.atn.ioos.us>

ATN DATA ASSEMBLY CENTER (DAC)



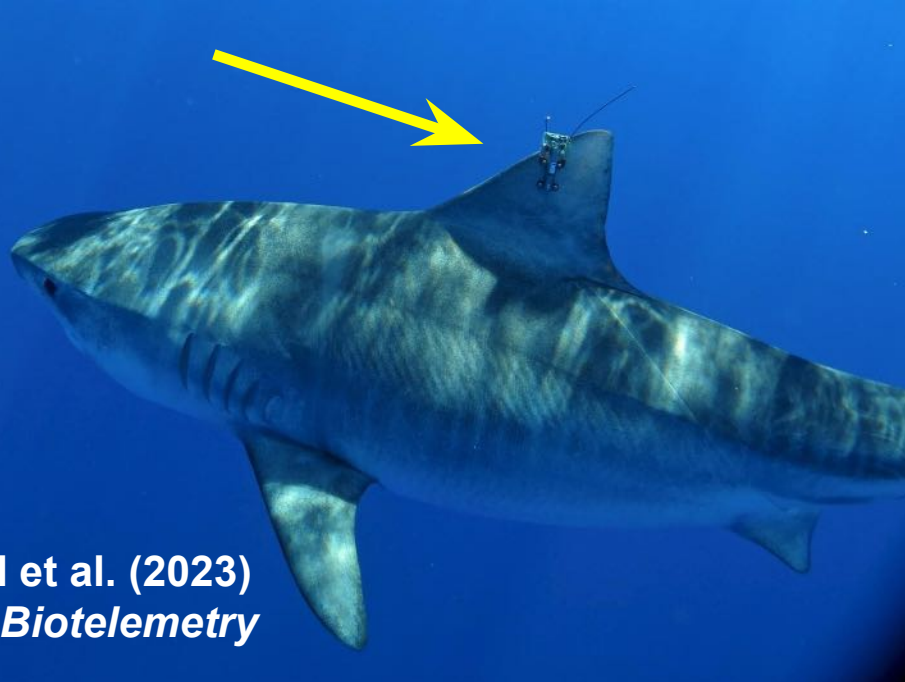
- Primarily satellite telemetry, from Argos platforms
- Projects = 202
- PIs = 94 (183 researchers including collaborators)
- Organizations = 70 (109 including collaborators)
- Species = 111
- Deployments = 7325
- Over 13 million tag locations

ATN DATA ASSEMBLY CENTER (DAC)

- Serving animal borne ocean profiles to the GTS
- Data archival services - NCEI

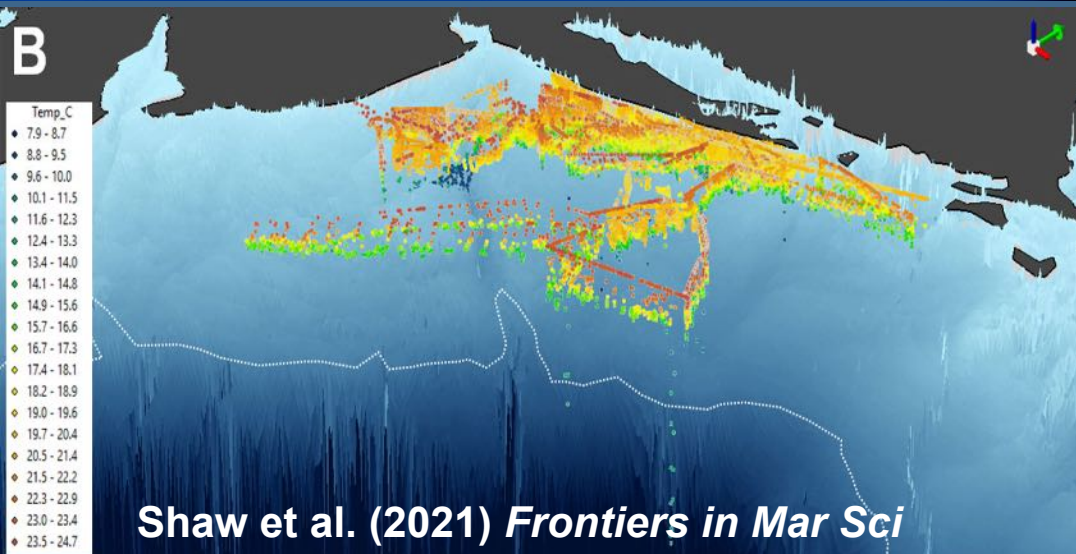


ANIMAL BORNE OCEAN PROFILES



Holland et al. (2023)
Animal Biotelemetry

- Leveraging Marine Life to enhance ocean observation
- One animal can provide hundreds of ocean profiles (CTD or TD) in under-sampled regions (Cost ~\$6,000)
- Shown to increase ocean model quality and decrease error, and improve storm/weather predictions
- Consider animal-borne platforms as part of **regional ocean heat content portfolios**

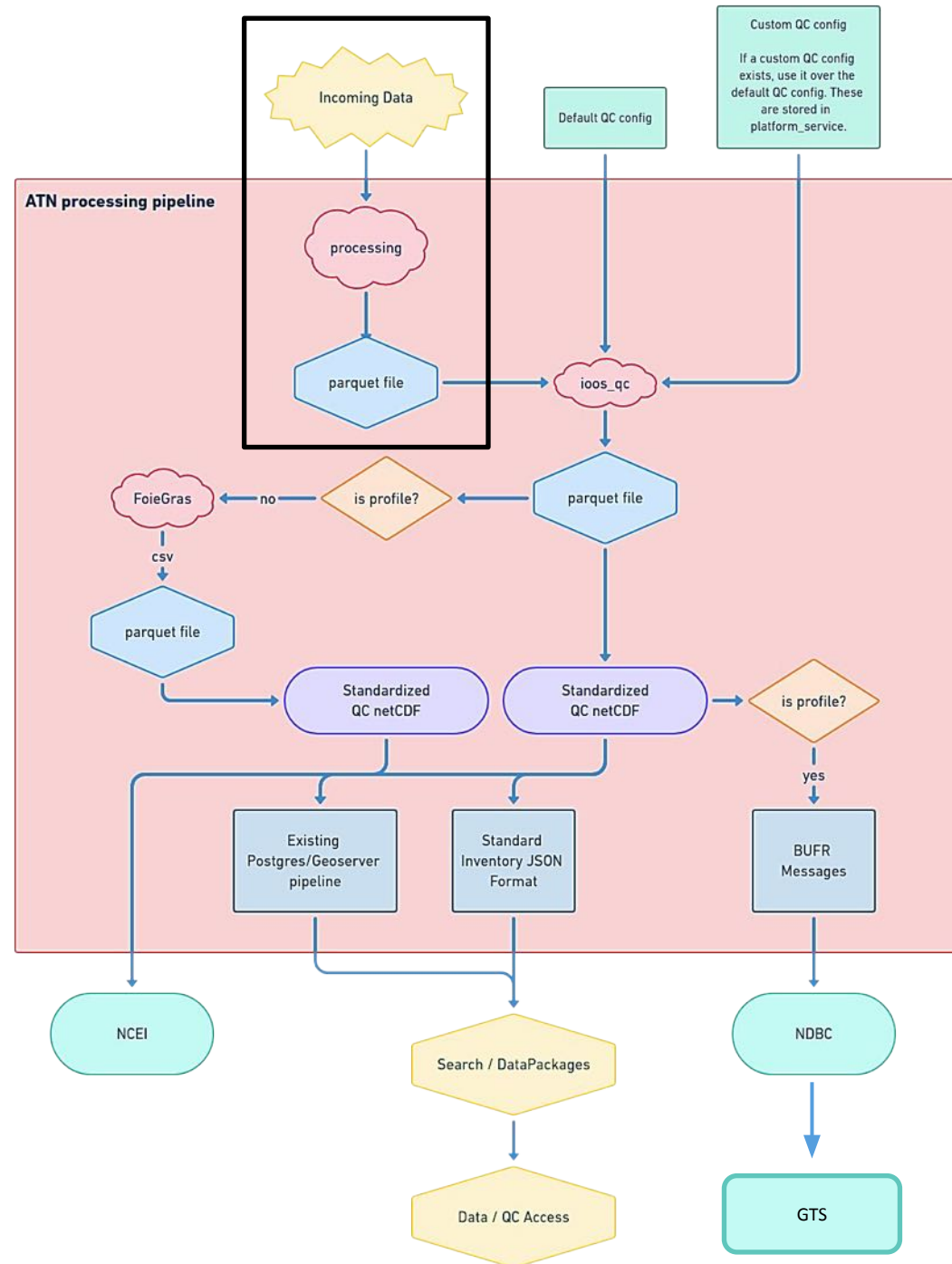


Shaw et al. (2021) *Frontiers in Mar Sci*

McMahon et al. (2021) *Frontiers in Mar Sci*

ATN SATELLITE DATA PROCESSING PIPELINE

SERVING
ANIMAL BORNE
OCEAN
PROFILES TO
THE GTS

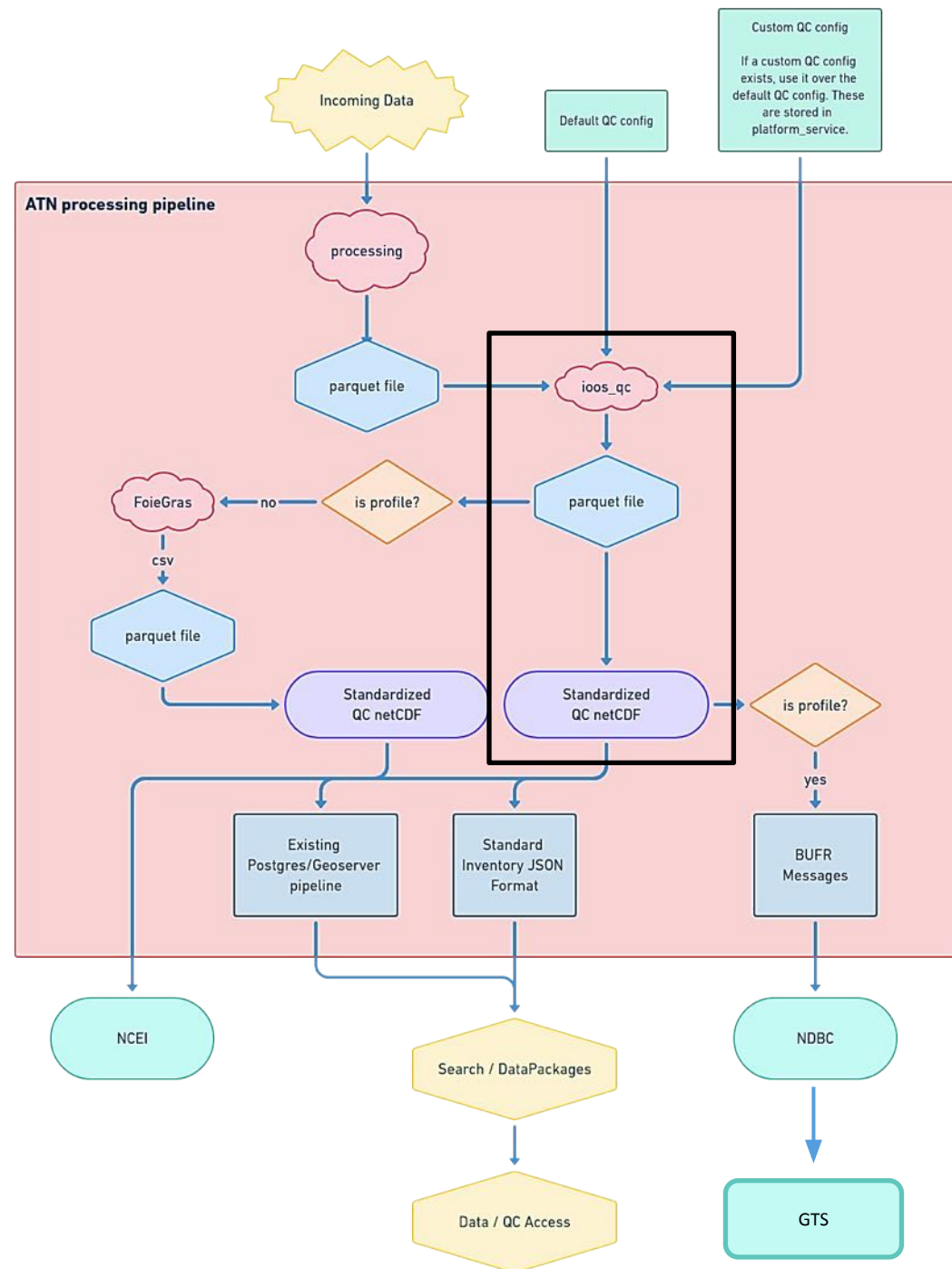


ACQUIRE DATA

- Metadata in ADR
- Near real-time data
- Auto-ingested
- Tag manufacturers
- Argos services
- Every 2 hr

ATN SATELLITE DATA PROCESSING PIPELINE

SERVING
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PERFORM QC

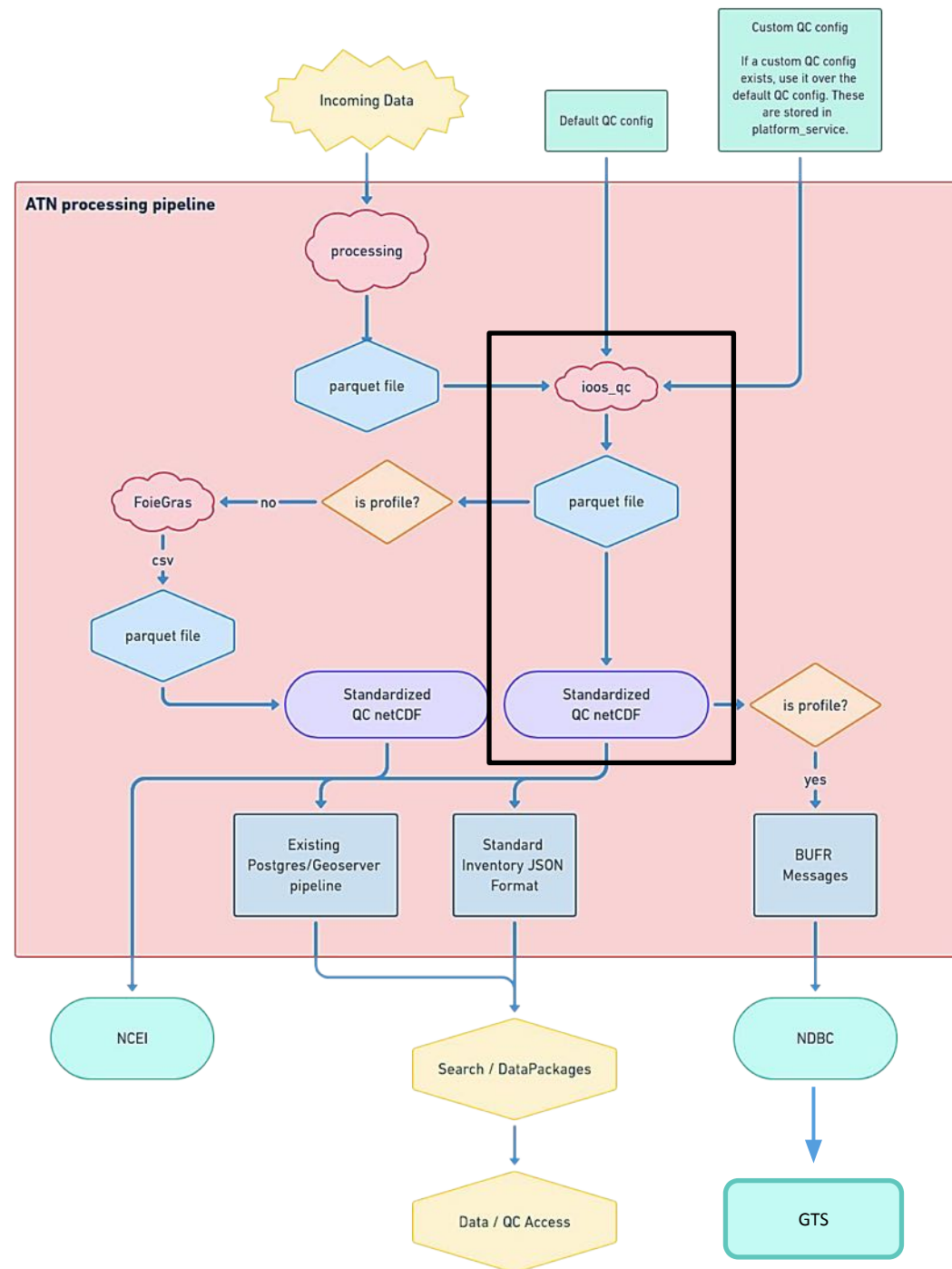
- Real-Time QC
- QARTOD
- Geolocations
- Sensor

Measurements

- Pressure
- Temperature
- Salinity

ATN SATELLITE DATA PROCESSING PIPELINE

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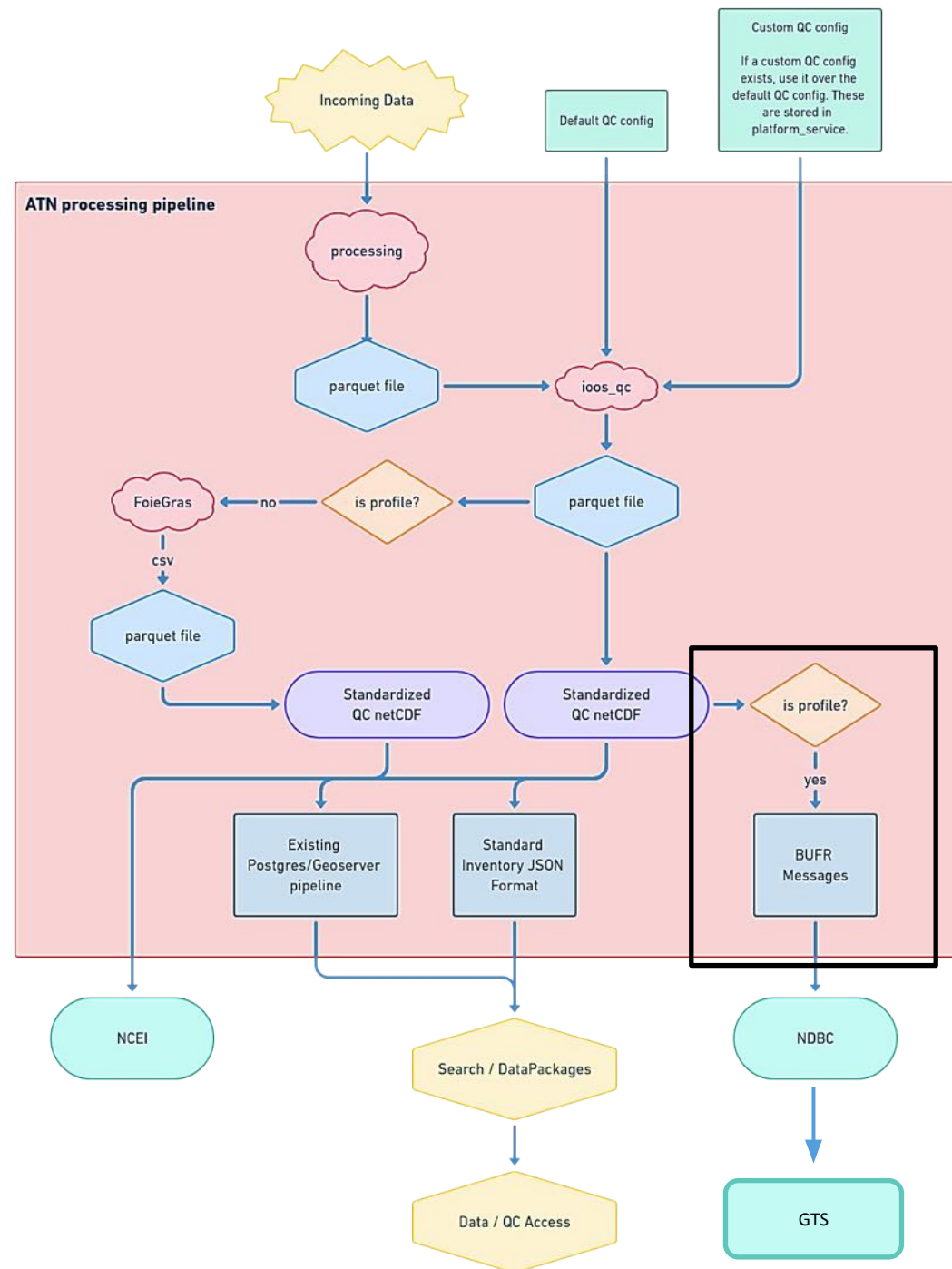


PERFORM QC

- QARTOD
 - Data test
 - Location test
 - Speed test
 - Range test
 - Spike test
- QC'd netCDF

ATN SATELLITE DATA PROCESSING PIPELINE

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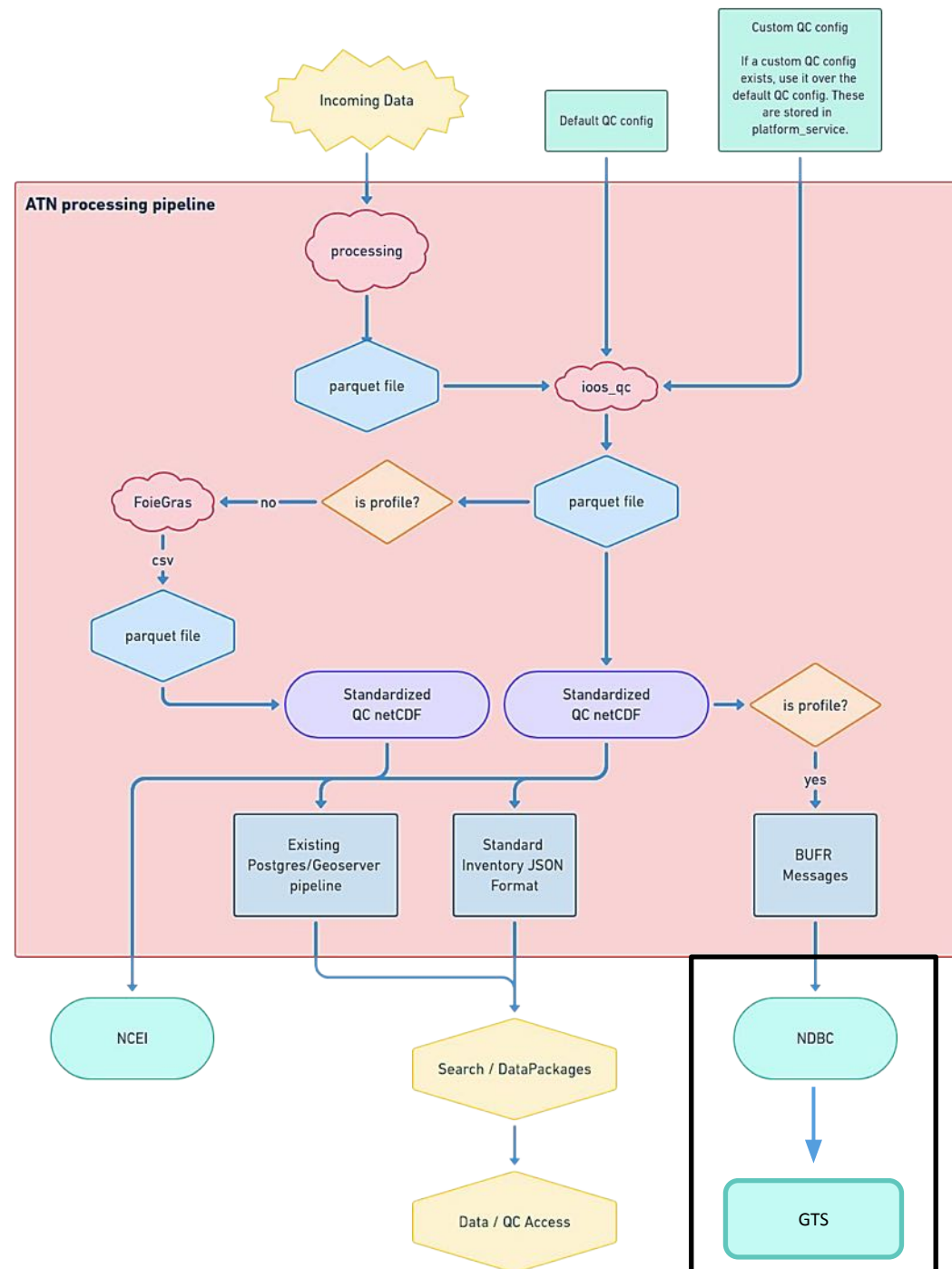


CREATE BUFR

- bufrtools used to encode BUFR tables
- v.39 tables
- TM 3-15-023
- Specific for animal borne profile data
- 1 profile = 1 BUFR message

ATN SATELLITE DATA PROCESSING PIPELINE

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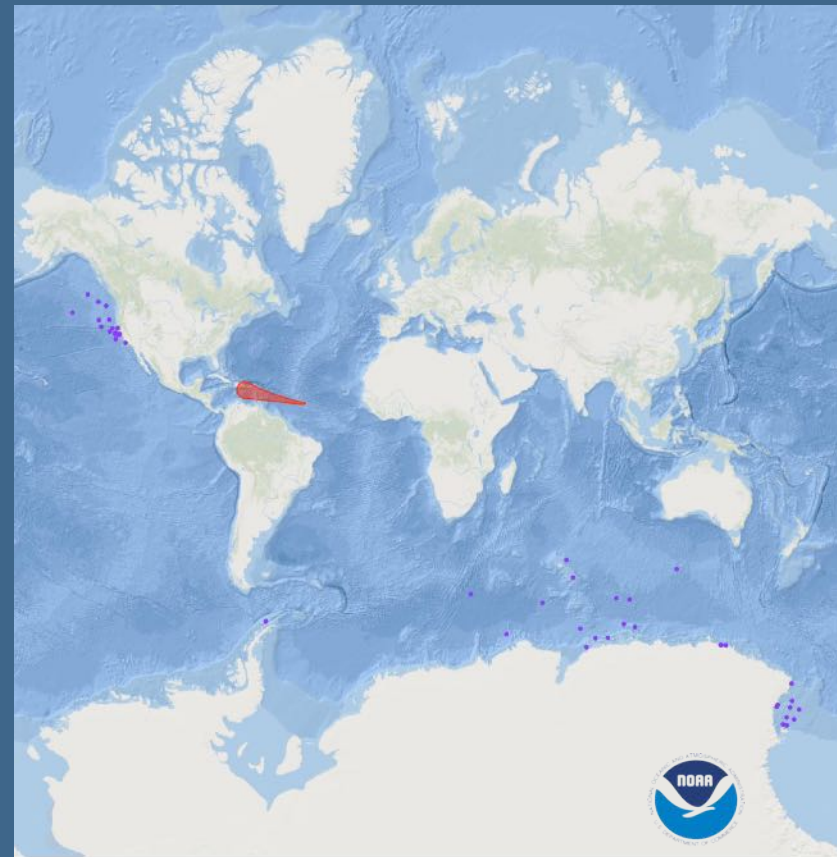
SUBMIT BUFR

- BUFR to NDBC
- Bulletins generated
- Served to GTS
- Under header – IOXX01
- Node – KWNB

ANIMAL BORNE OCEAN PROFILES

Data Integrated into the
Observing System Monitoring
Center (OMSC) Dashboard
and ERDDAP Server

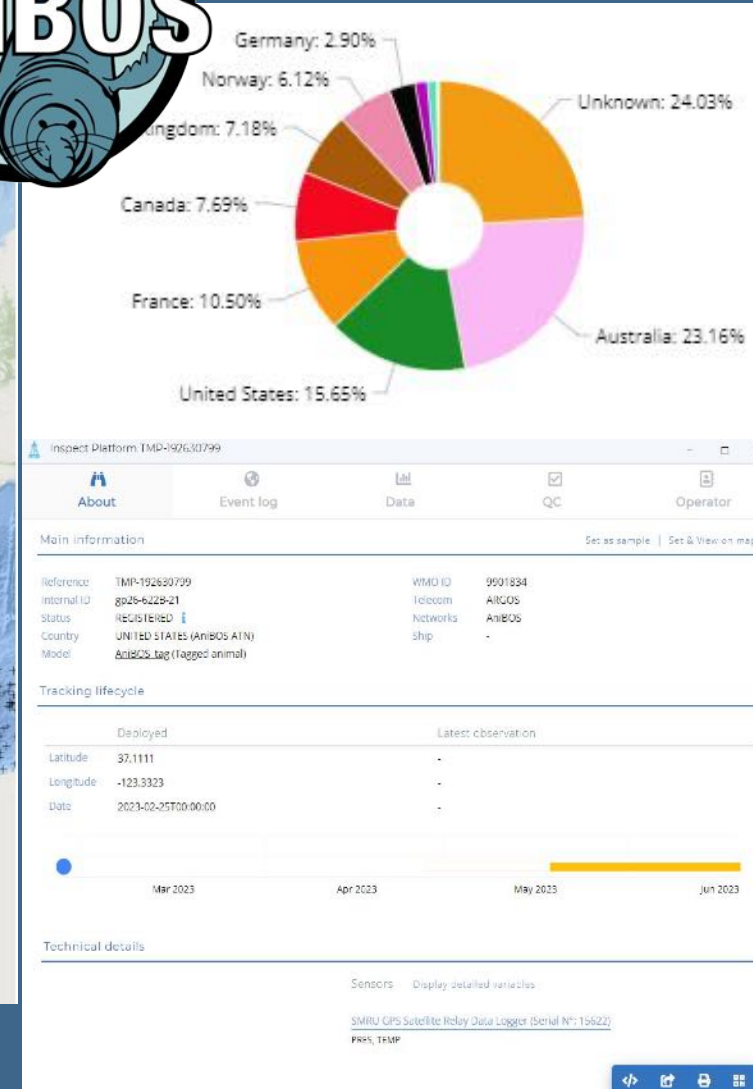
Metadata Integrated into the
OceanOPS Dashboard



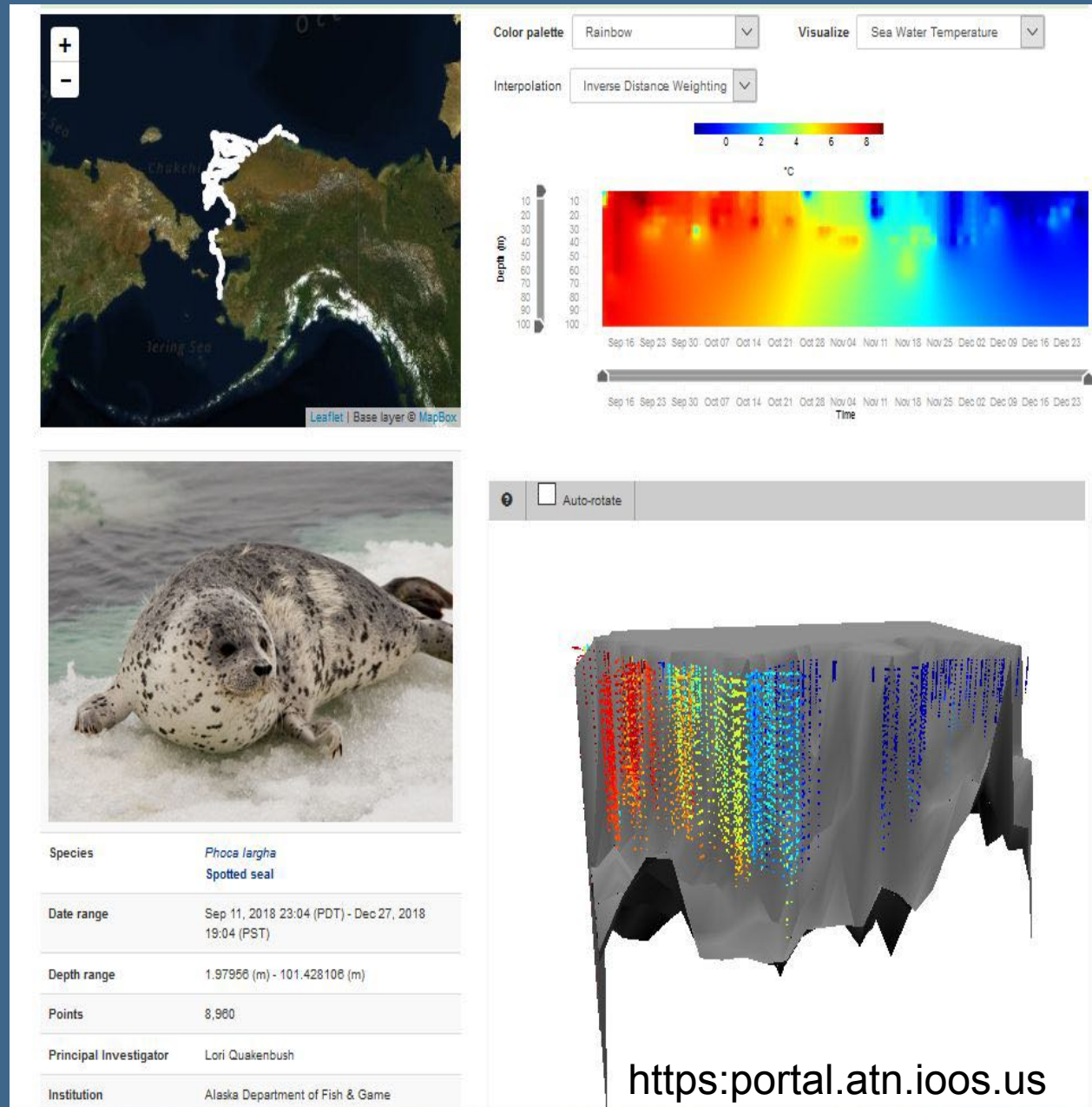
<https://viz.pmel.noaa.gov/omsc/>
<https://osmc.noaa.gov/erddap/index.html>



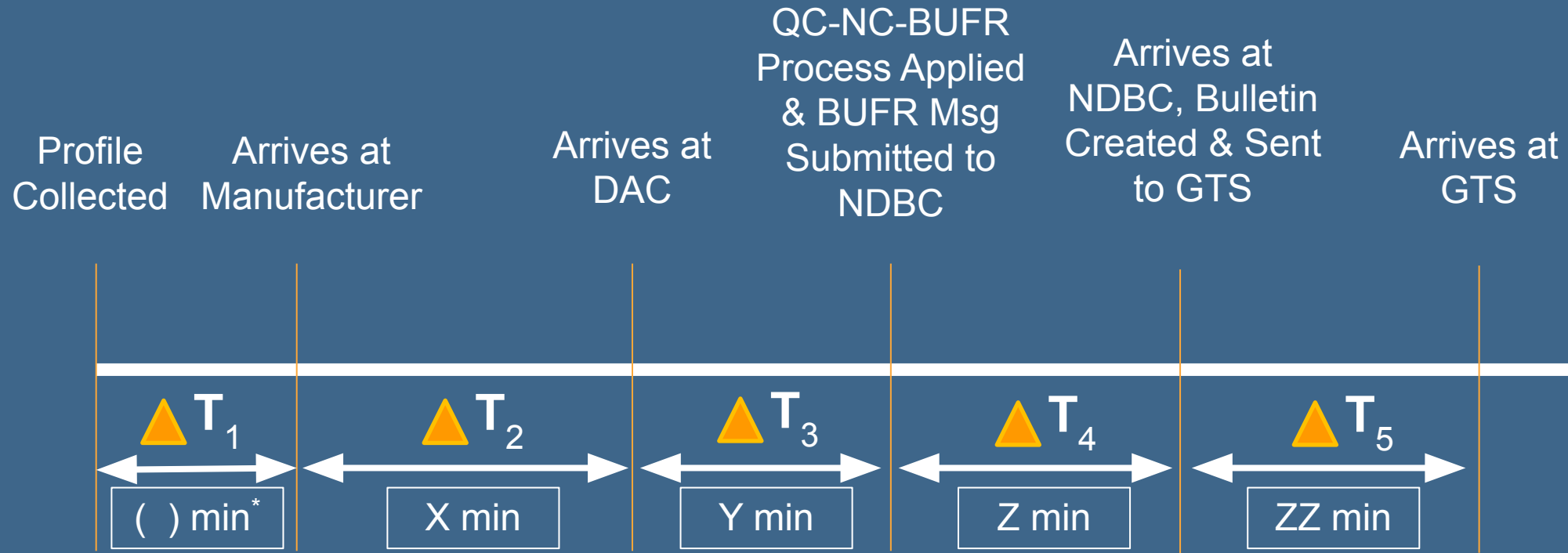
<https://www.ocean-ops.org/board>



ANIMAL BORNE OCEAN PROFILES



ATN GTS PIPELINE TIMELINE



* T_1 is a function animal behavior, and of availability of a satellites overhead and the proximity of a ground station, and will always be a range of time

ATN GTS PIPELINE UPDATES

Recent

- V. 39 tables
 - Allow for extra byte in WGIOS local identifier field, prevent WMO id truncation for ids starting with '99'

Manual on Codes

International Codes

Volume I.2

Annex II to the WMO Technical Regulations

Part B – Binary Codes

Part C – Common Features to Binary and Alphanumeric Codes

2019 edition

Updated in 2022

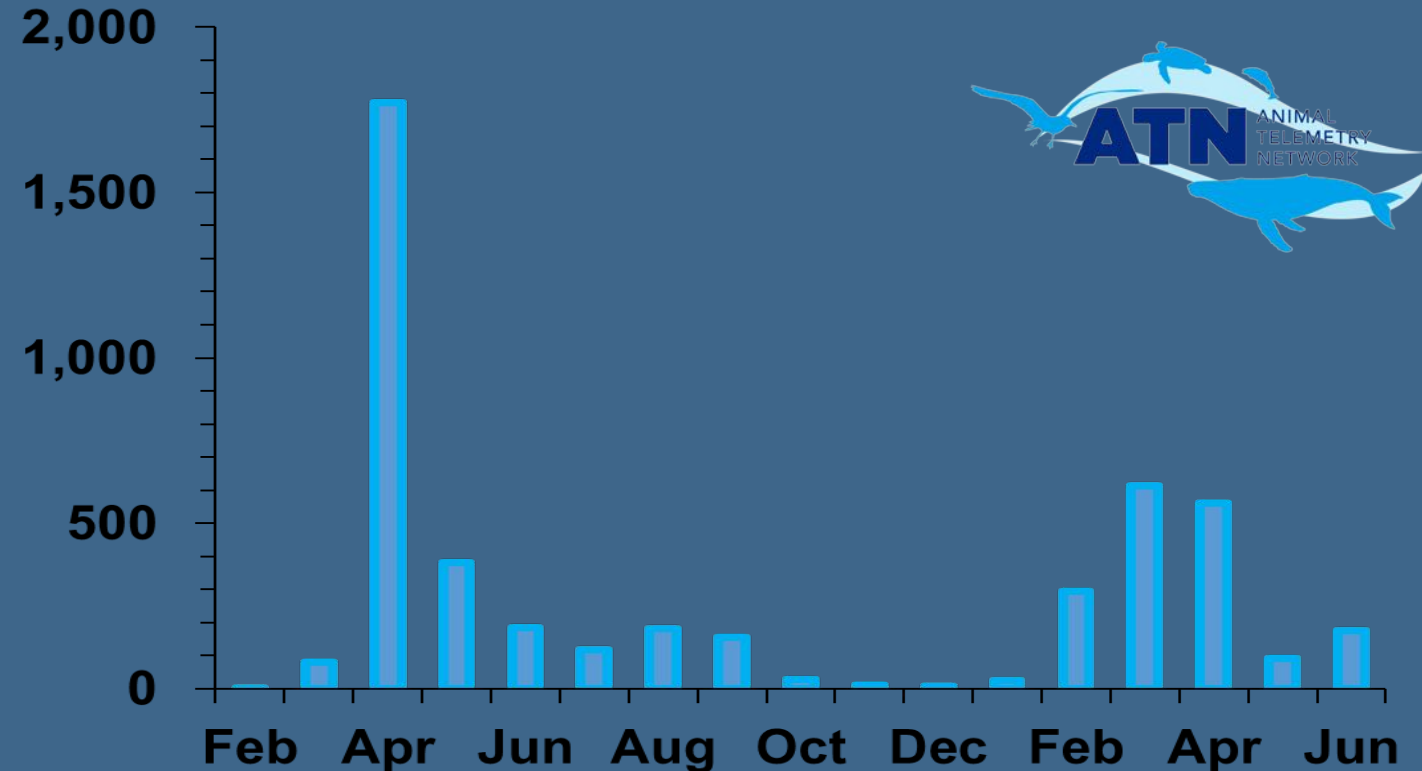


WORLD
METEOROLOGICAL
ORGANIZATION

WMO-No. 306



Profiles Submitted to GTS



ATN GTS PIPELINE UPDATES

Underway

- Update BUFR QC flags
 - Presently hard coded to 0 (Unqualified)
- QARTOD → Global GTSPF flags

QARTOD Flags

1 = pass

2 = not evaluated

3 = suspect

4 = fail

9 = missing data

GTSPF Flags

0 = unqualified

1 = correct, all checks passed

2 = probably good

3 = probably bad

4 = bad, impossible value

15 = missing value

ATN GTS PIPELINE UPDATES

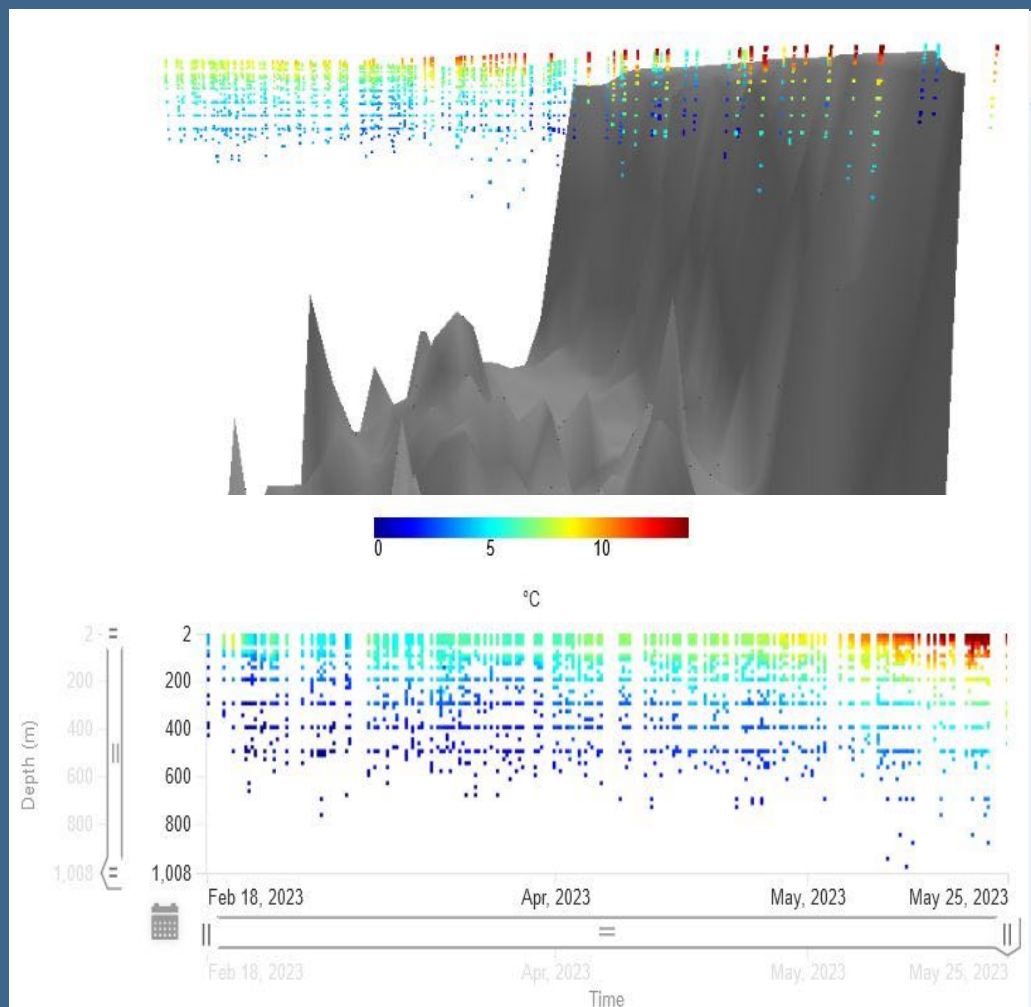
Proposed

- Updates to QC protocols
 - PI, taxon or region specific configurations
 - Additional tests
 - e.g., spike tests for locations
- Additional biogeochemical parameters (Chl-a, DO) in BUFR tables
- Expand services to new manufacturers and species

```
time:                                lon_lat:
axds:                                qartod:
  valid_range_test:                  location_test:
  valid_span:                        bbox: [-180, -90, 180, 90]
    - xxxx                           argo:
    - yyyy                           speed_test:
temperature:                         suspect_threshold: 8.0
qartod:                              fail_threshold: 10.0
gross_range_test:                    pressure:
  fail_span: [-2.5, 40]              argo:
salinity:                            pressure_increasing_test:
qartod:                              suspect_threshold: 8.0
gross_range_test:                    fail_threshold: 10.0
  fail_span: [0.0, 41.0]
```



ARCHIVAL PATHWAYS

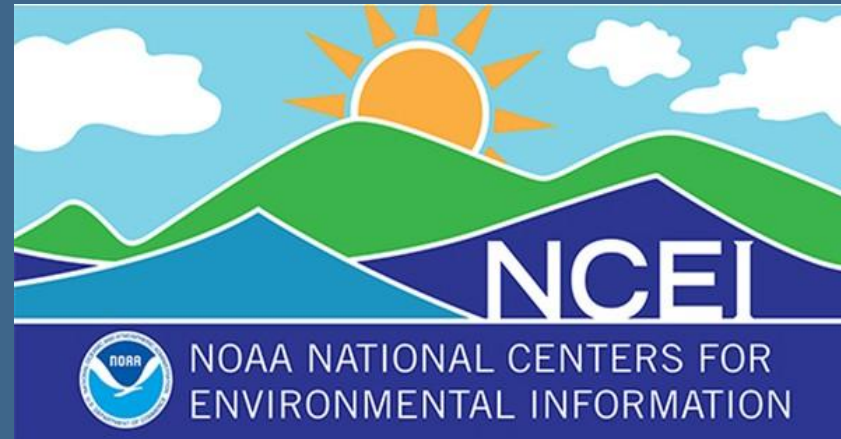


☐	Status	Tag ID	Species	Deployment	Info
☐	Complete GTS Data Package	PTT ID 210335	northern elephant seal (<i>Mirounga angustirostris</i>)	S: Feb. 6, 2021, midnight UTC E: March 22, 2021, 3:56 a.m. UTC	PI Email Address: costa@ucsc.edu Data Manager Email Address: rholser@ucsc.edu Tag Manufacturer: SMRU Tag Model: GPS SRDL Tag Serial Number: 15423 Sensors: PTT GPS Depth Temperature Argos Program Number: 21372 WMO Number/Platform Code: 9901485 Deployment ID: gp24-423-20 Deployment Latitude: 37.11 Deployment Longitude: -122.33 Deployment Location: ANNU Animal Aphia ID: 255018 Animal ID: 4495 Animal Sex: Female Animal Life Stage: Adult Comments: 2021004

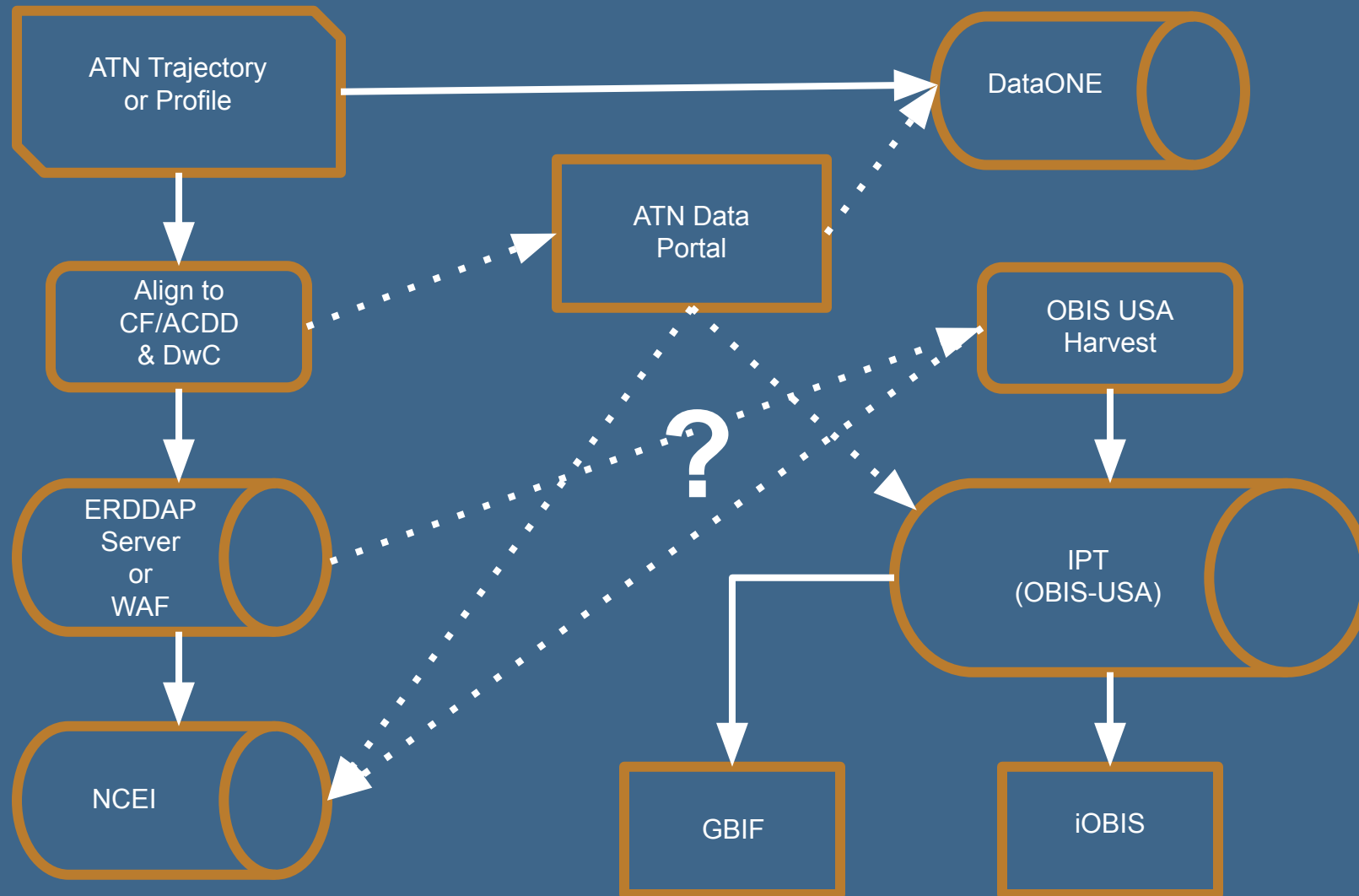
A map of the Pacific Northwest of the United States, showing the deployment location of the northern elephant seal. The map highlights the coastal region from San Francisco to Vancouver, with labels for San Francisco, Los Angeles, Houston, Vancouver, and Calgary. The deployment location is marked with a white outline.

ARCHIVAL PATHWAYS - NCEI

- ATN Collection – pipeline OPEN
- NCEI Dataset Readiness Review (DSRR) Board approval
- Submission agreement finalized
- Standardized QC'd NetCDF trajectory template approved
 - Contributor attributes (project vs dataset)
 - Sea names (exclude outliers)
- Next: Profile template approval



FUTURE ARCHIVAL PATHWAYS



Have Questions, Get in Touch

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Michelle Lander, ATN **Network** Coordinator
michelle.lander@noaa.gov



ATN SEAL OF APPROVAL

THANK YOU !



Photo: Dan Costa



METADATA in the ATN DAC

...is used to describe 3 things:

1. **Projects** (template)
2. **Deployments** (template, data dictionary)
 - ISO 8601, decimal degrees, WGS84, WoRMS, vocabularies
3. **Datasets**
 - ISO 19115

QARTOD

Quality Control Tests

1. Impossible date test
2. Impossible location test
3. Position on land*
4. Impossible speed test
5. Global range test*
6. Pressure increasing test*

Quality Control Flags

- 1 = pass
- 2 = not evaluated
- 3 = suspect or of high interest
- 4 = fail
- 9 = missing data

* CTD (profile) data only



Axiom Data Science
Spike Test

QARTOD — <https://ioos.noaa.gov/project/qartod/>

Argo QC Manual — <https://cdn.ioos.noaa.gov/media/2020/03/Argo-QC-for-CTD-and-Trajectory-Data.pdf>
Flags — https://cdn.ioos.noaa.gov/media/2020/07/QARTOD-Data-Flags-Manual_version1.2final.pdf

