OOIFB / DDCI 2019

User-defined Cyberinfrastructure

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Axiom Data Science
05/22/2019

Axiom
DATA SCIENCE

Company Background

- Founded in 2006
- 20 employees
- Offices in AK, OR and RI

- Mission driven: Build capabilities which accelerate the synthesis and re-use of earth science data

- Federal Partners: NSF, NOAA, USGS, BOEM, NASA, FWS, DARPA, ONR
- Other Partners: MBARI, Shell, UAF, UAA, Carnival, Smartfin, Leidos

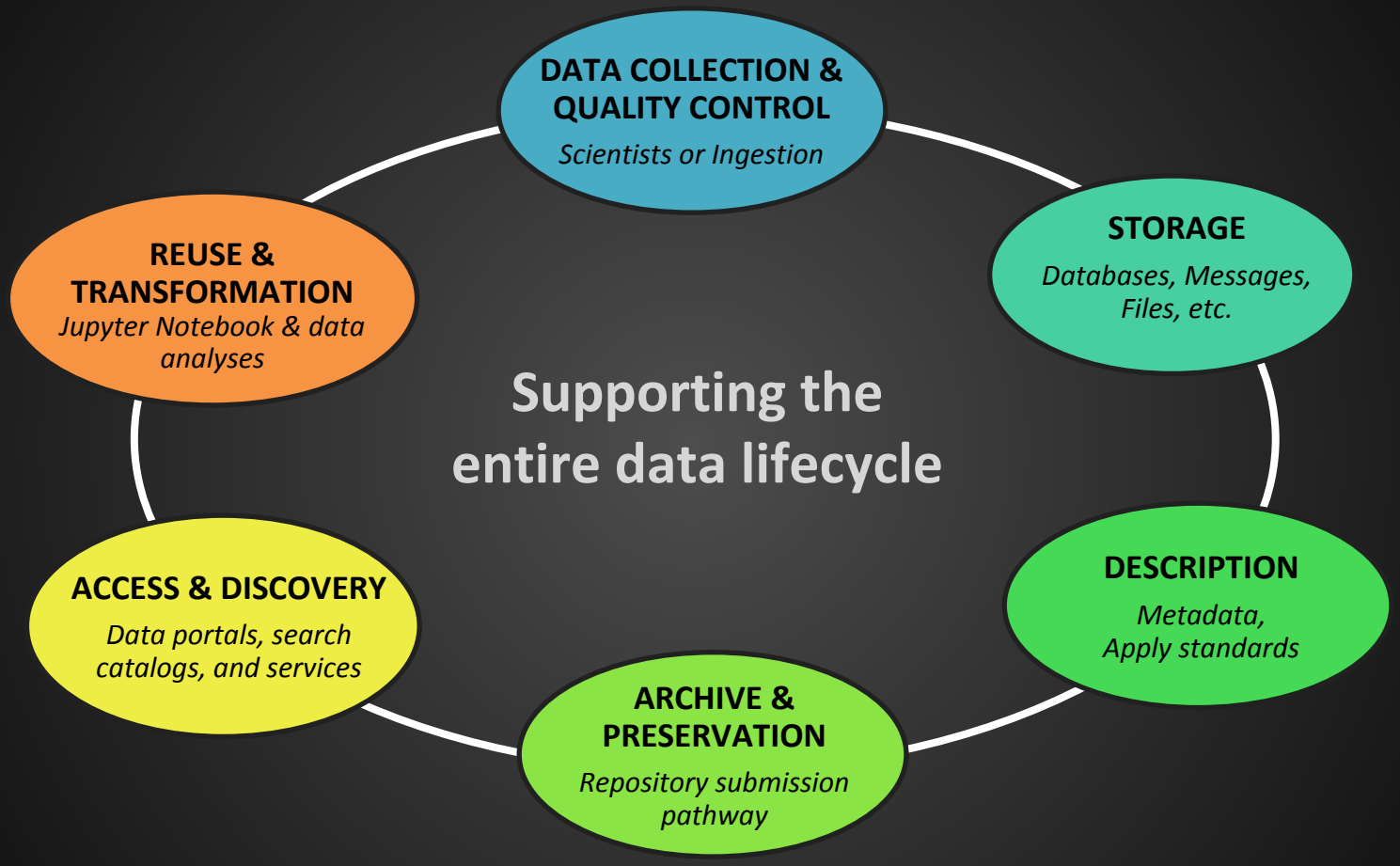
Cyberinfrastructure

The National Science Foundation defines cyberinfrastructure as:

In scientific usage, cyberinfrastructure is a technological and sociological solution to the problem of efficiently connecting laboratories, data, computers, and people with the goal of enabling derivation of novel scientific theories and knowledge.

- *Community developed software, standards and protocols*
- *Scalable compute and storage infrastructure (HPC)*
- *Human capacity - data scientists, data librarians, data coordinators, software engineers….*

Data Management Lifecycle



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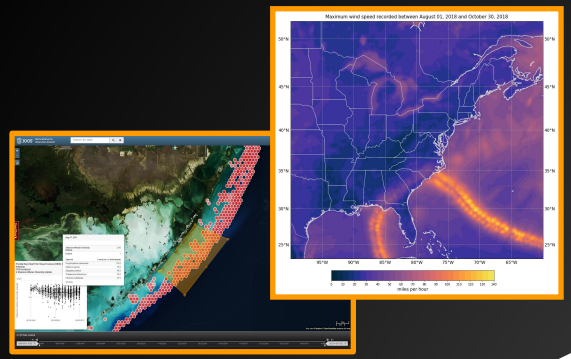
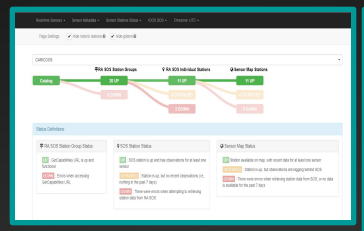
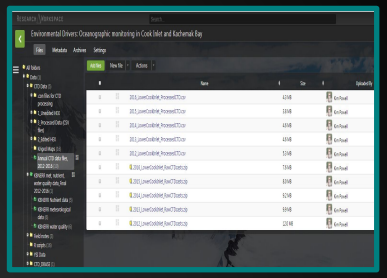






DATA COLLECTION & QUALITY CONTROL

Scientists or Ingestion

STORAGE

Databases, Messages, Files, etc.

REUSE & TRANSFORMATION

Jupyter Notebook & data analyses

Supporting the entire data lifecycle

DESCRIPTION

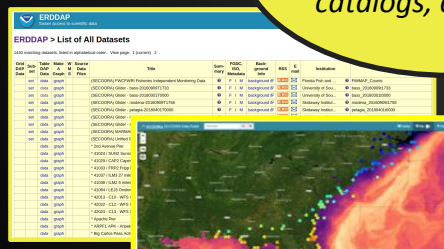
Metadata, Apply standards

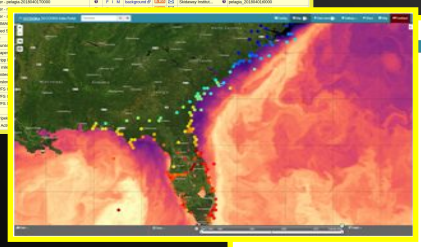
ACCESS & DISCOVERY

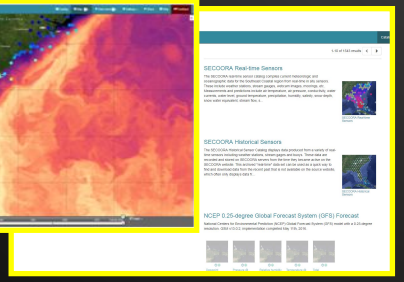
Data portals, search catalogs, and services

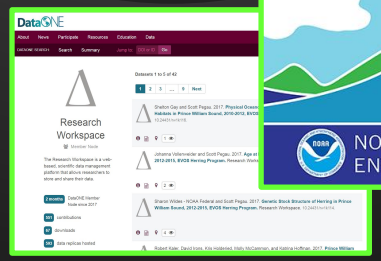
ARCHIVE & PRESERVATION

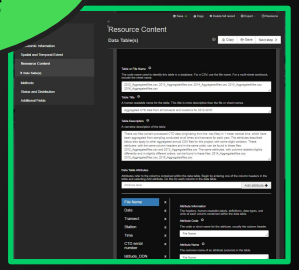
Repository submission pathway











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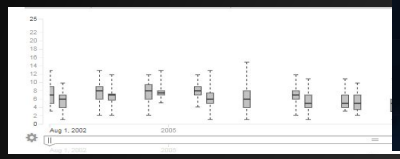
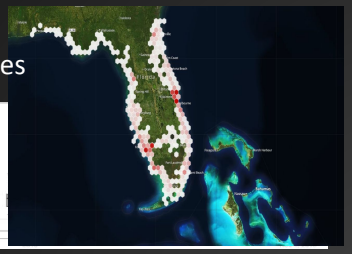
Data Categories

Biodiversity

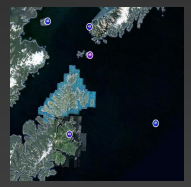
count, richness, diversity indices

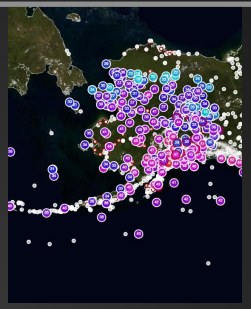




Platforms

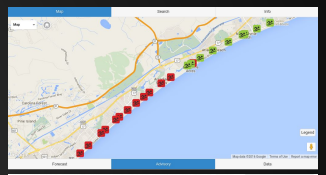
moorings, shore stations

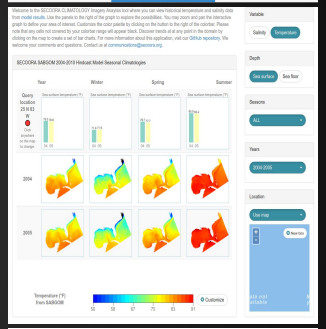


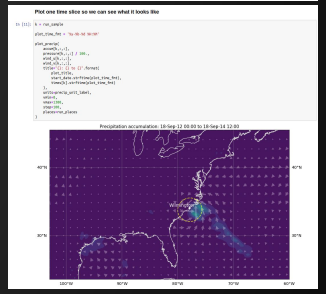


Products

skill assessment, shoreline change, etc.

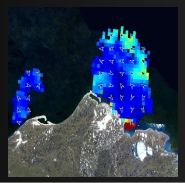


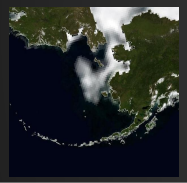


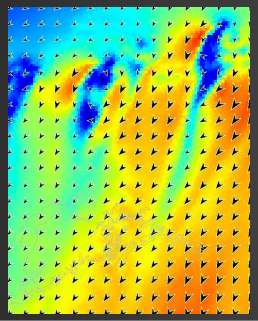


Grids

models, satellite, radar

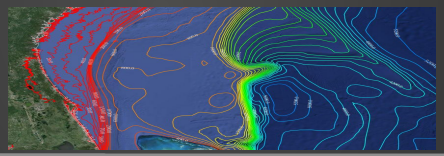


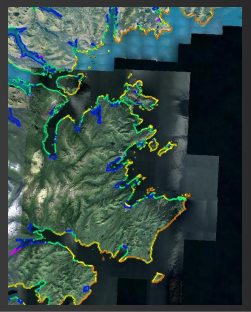




GIS

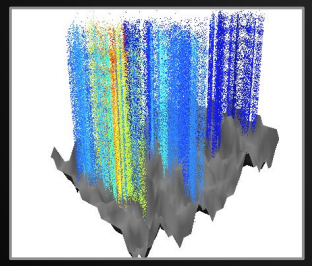
Habitat types, bathymetry, fishing zones, etc.

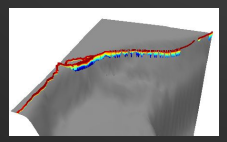


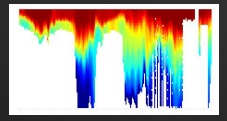


Moving Platforms

auv, wave glider, argo, particle trajectory models



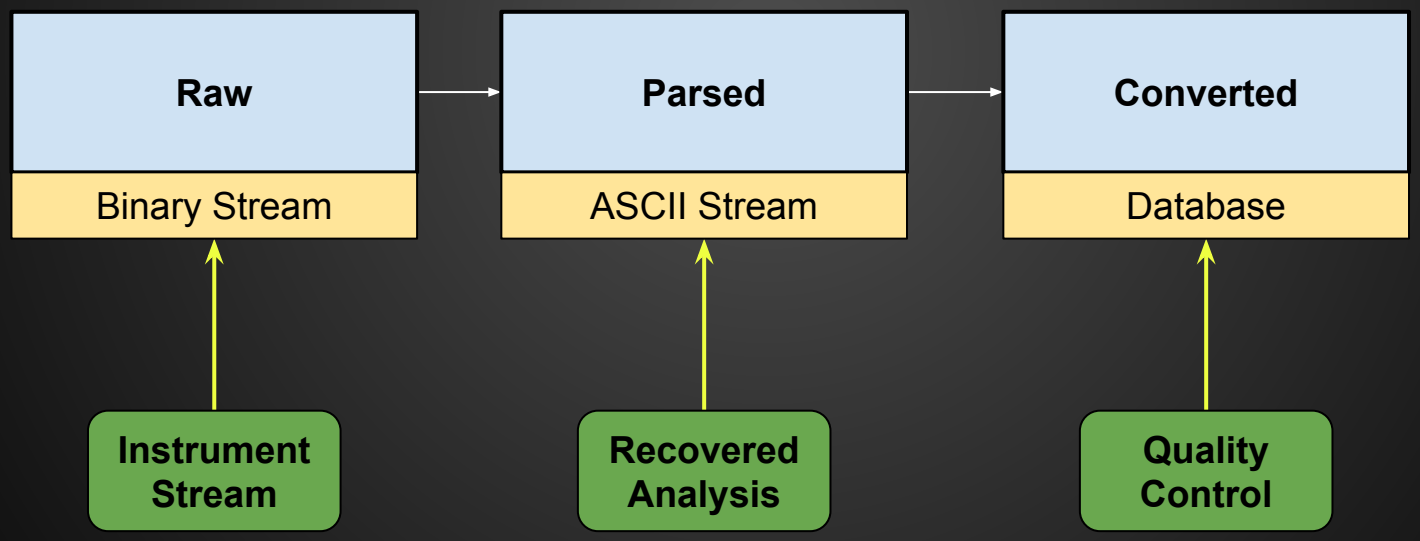




Unstructured Data

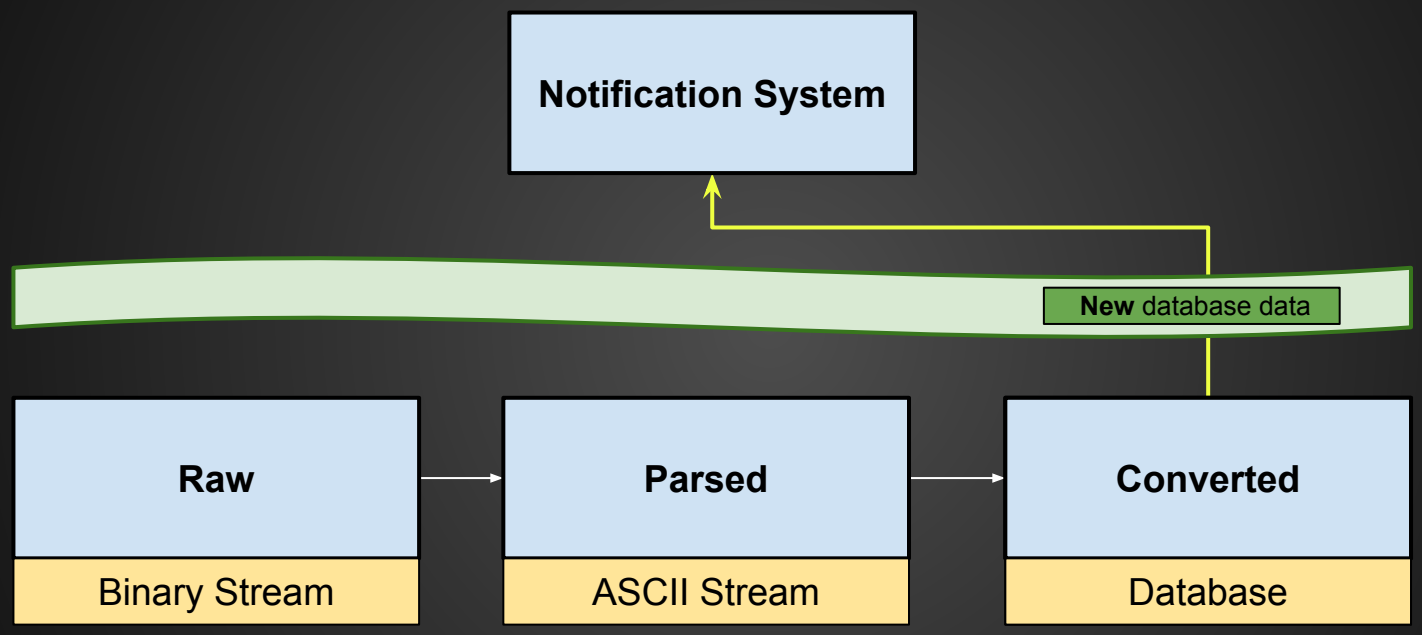
Data Pipelines

- Develop a set of **data pipelines**
- Keep a **streaming first** mentality
- Support multiple integration points (entry and exit)
- Targets can be anything (stream, file, database entry, etc.)



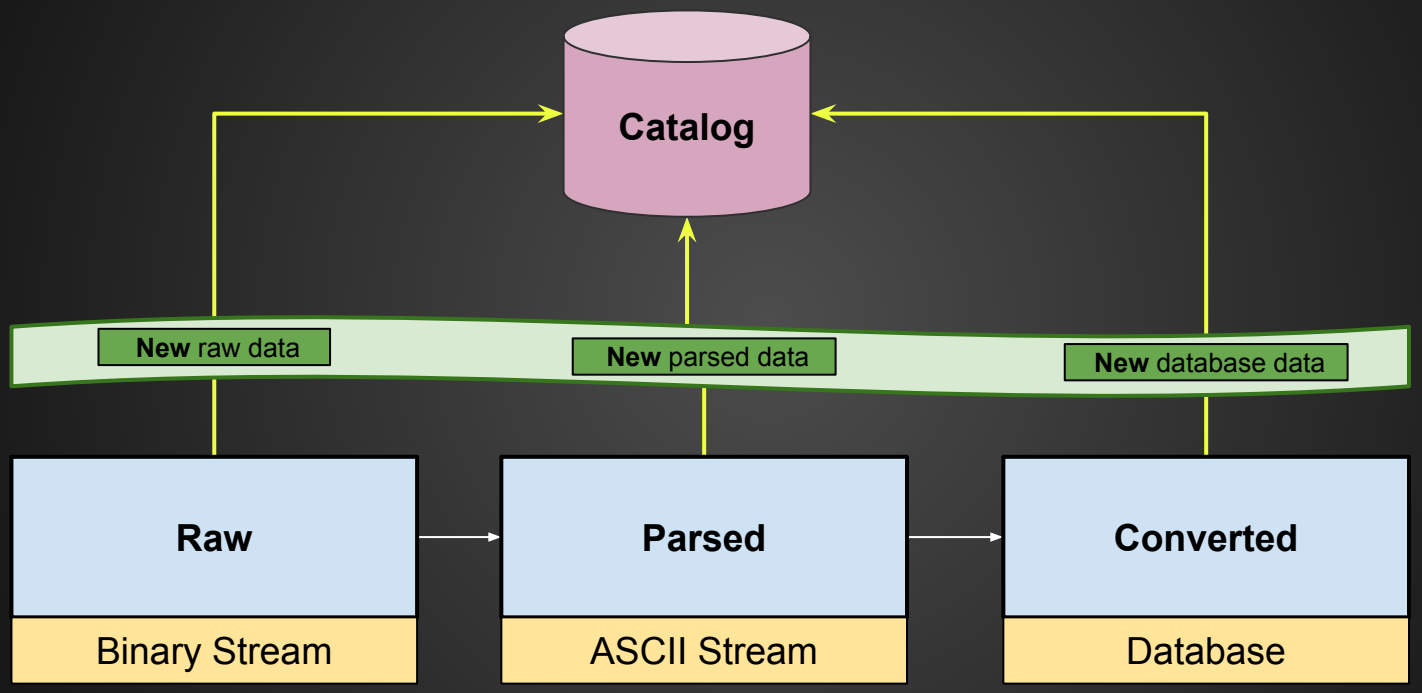
Data Pipelines

- Connect pipelines together with a messaging system



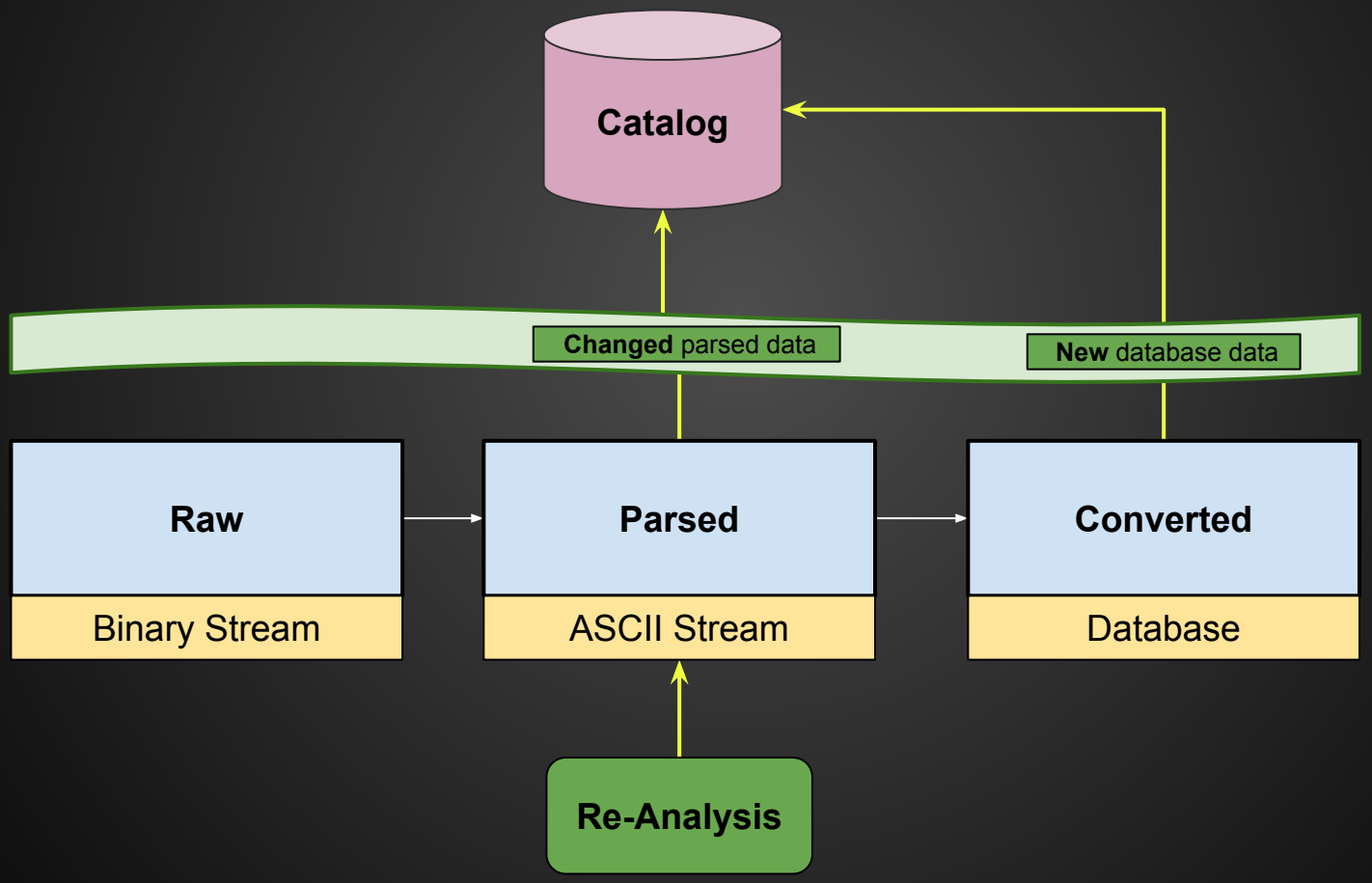
Data Pipelines - Enabling Discovery

- Catalog pipelines together with metadata updates



Data Pipelines

- Build in data **update and invalidation** at integration points



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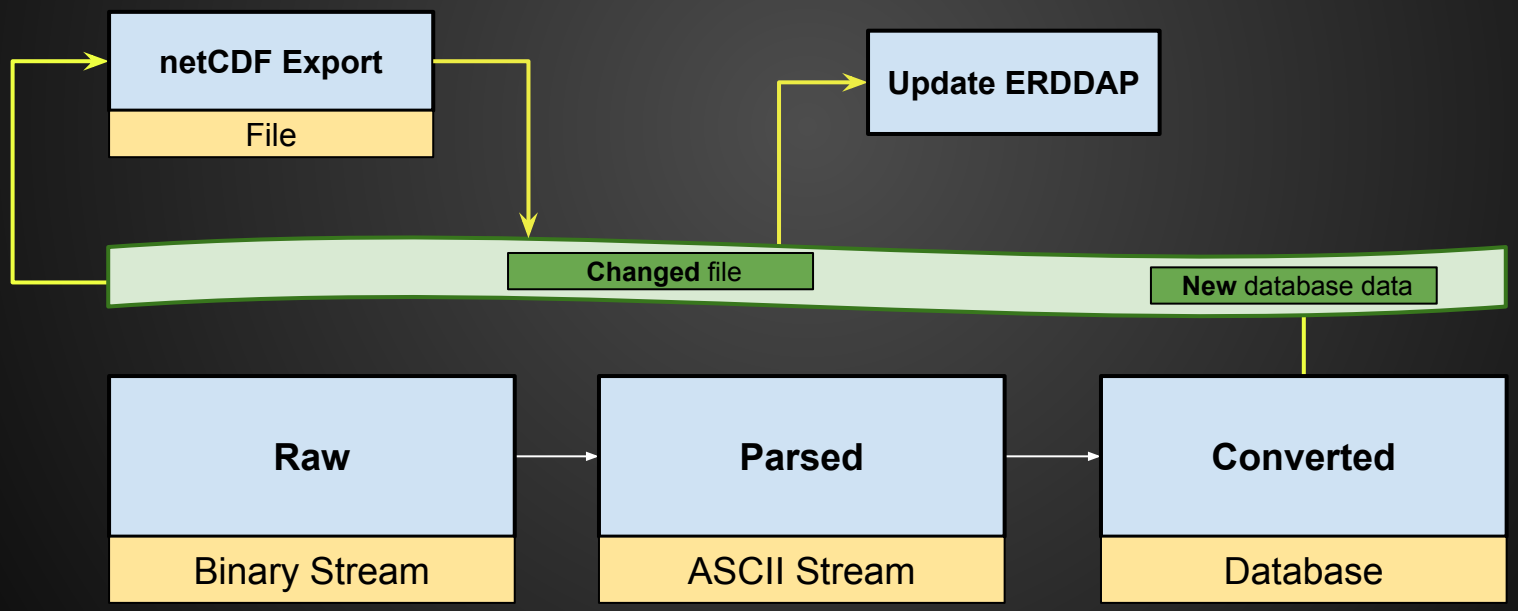
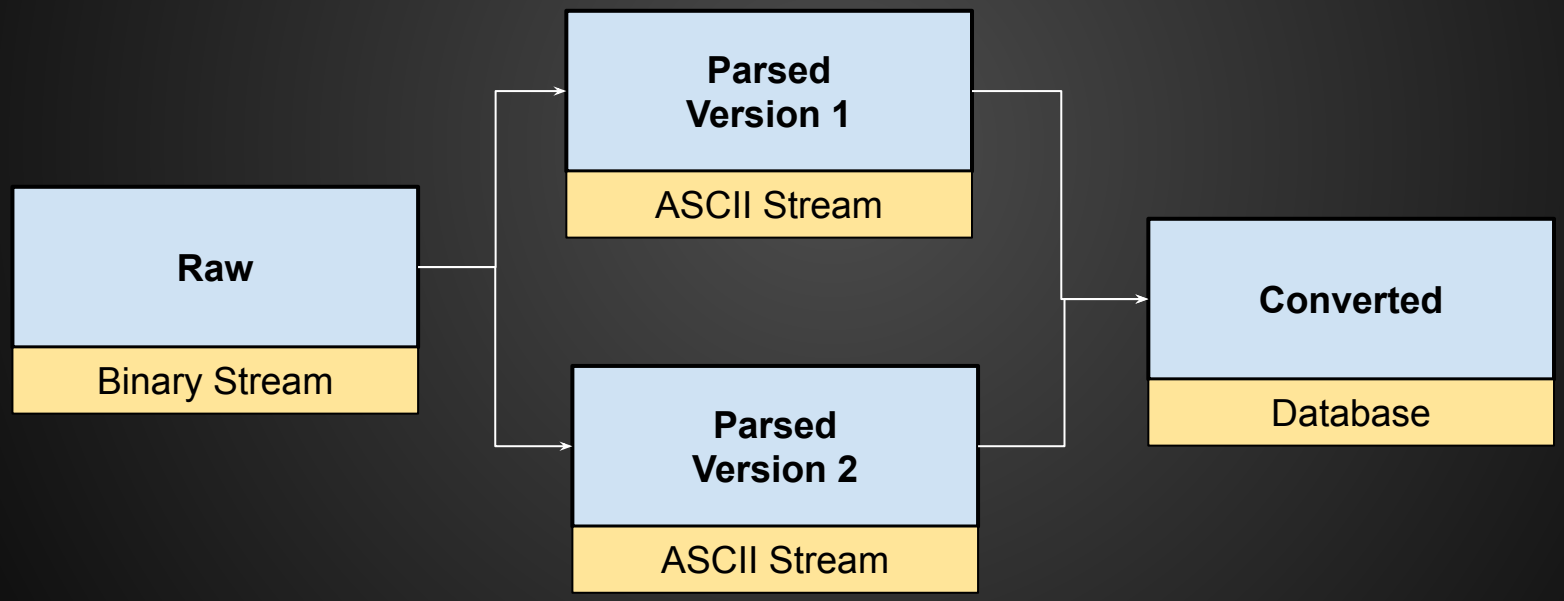
Data Pipelines

- Design pipelines and targets to meet **user needs**
- Develop targets around **community standards** for interoperability

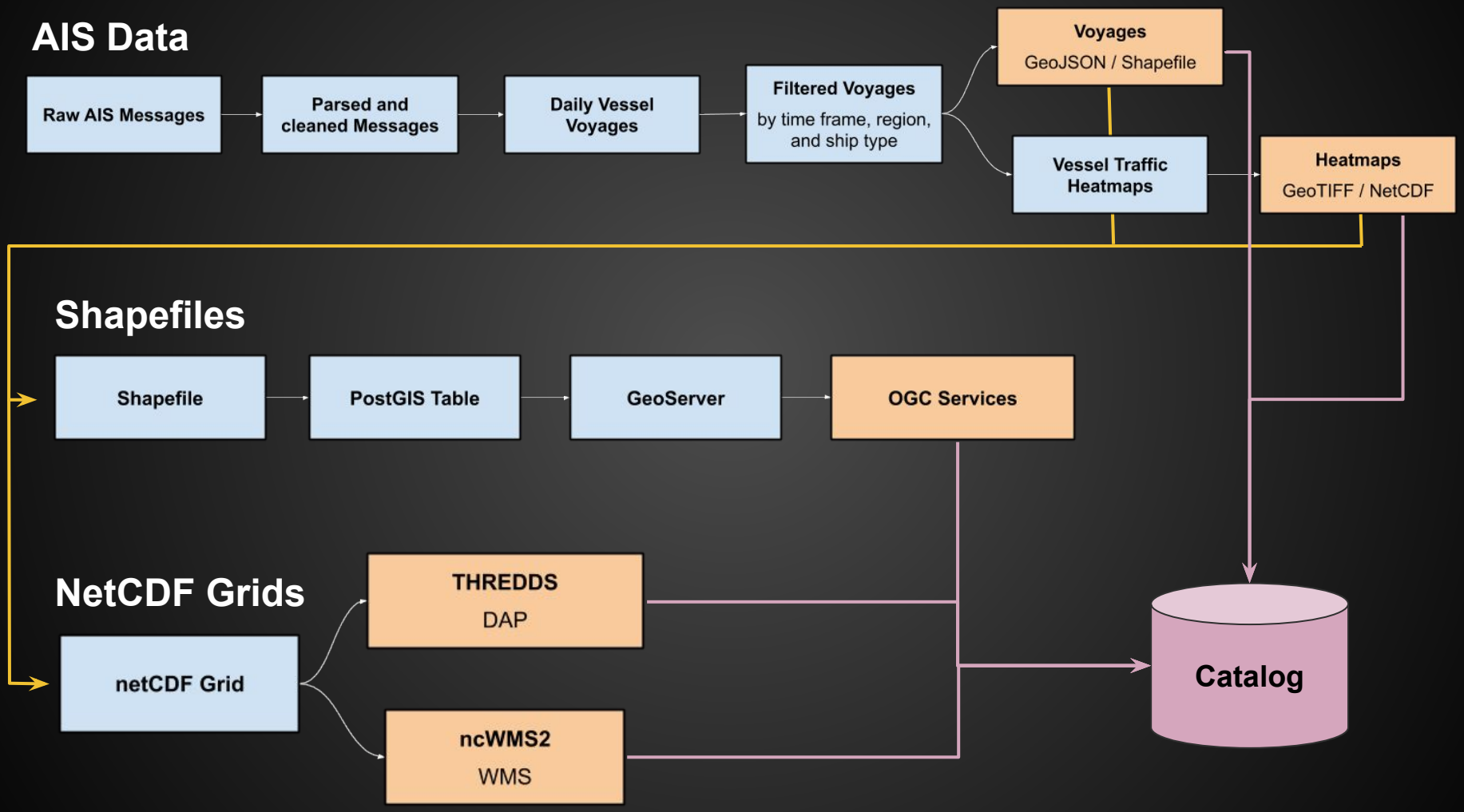


Data Pipelines

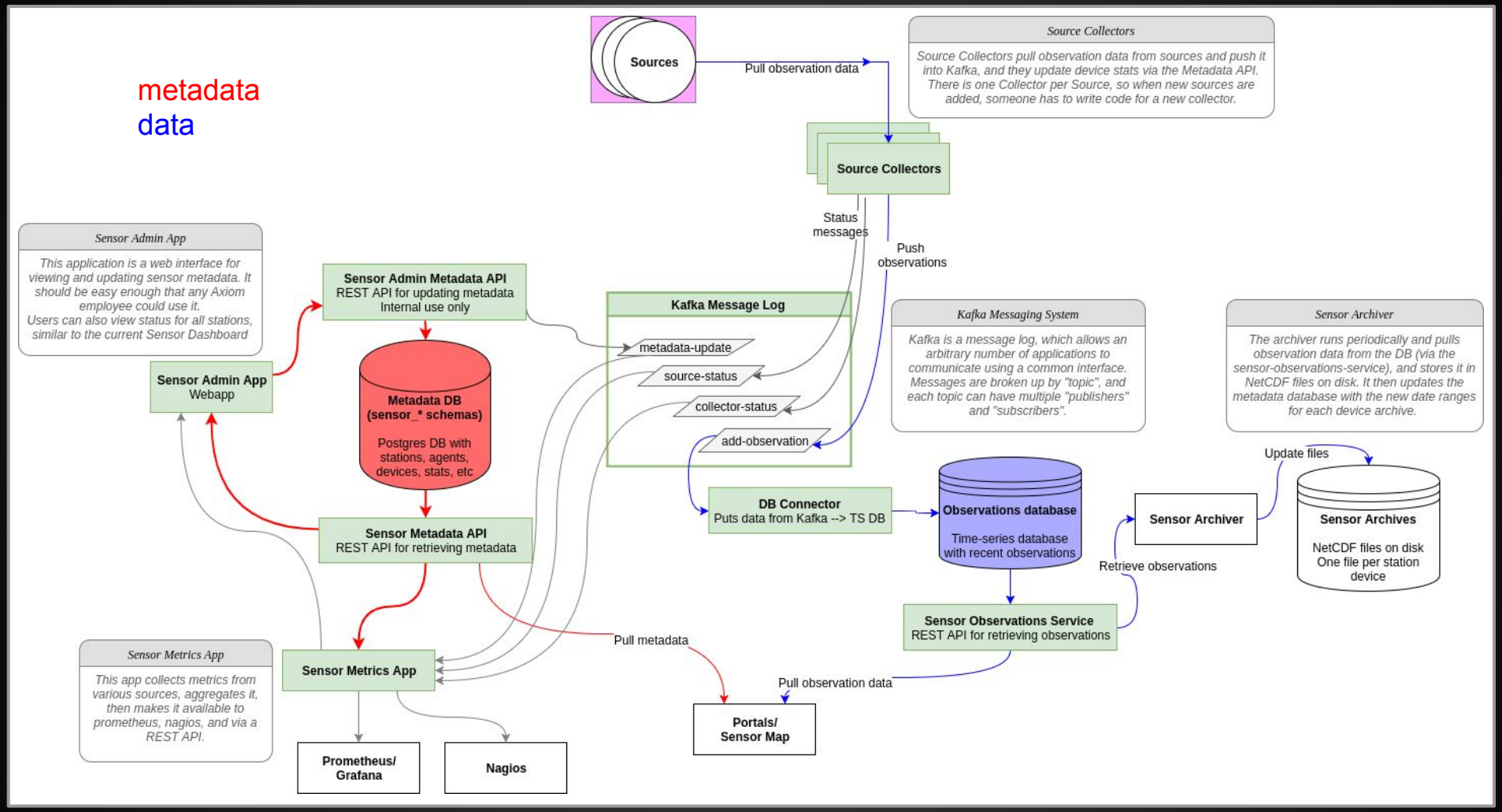
- Well defined integration points helps migrate and transition systems



Example Pipelines - AIS



Example Pipelines - Sensors



Eye Candy

Catalog

- General filtering, tagging, full-text search: https://portal.secoora.org/#search
- Regional grouping by parameter: https://portal.secoora.org/#metadata/7/sensor/list
- Global grouping by parameter: https://sensors.ioos.us/#metadata/14/sensor/list
- Source grouping (CO-OPS): https://portal.aoos.org/?sensor_version=v2#metadata/9/sensor_source/list
- Filter by type (gliders): https://data.cencoos.org/#search?type_group=all&tag%7Ctag=gliders&page=1

Data Inventories

- Provider: https://portal.secoora.org/?sensor_version=v2#metadata/144/sensor_source/inventory
- Station: https://portal.secoora.org/?sensor_version=v2#metadata/60387/station/inventory

Visualization

- Station page: https://sensors.ioos.us/#metadata/57301/station
- ~18 year profiling time-series: https://sensors.ioos.us/#metadata/75365/station
- Sensor QC (with config) https://portal.aoos.org/?&sensor_version=v2#metadata/75367/station/25/sensor
- Provider supplied QC: https://sensors.ioos.us/?sensor_version=v2#metadata/63965/station/36/sensor
- West-coast Glider deployment: https://data.cencoos.org/#platform/4e3d20cf-d3fe-4646-b1bb-b89f38d9597d
- East-coast Glider deployment: https://portal.secoora.org/#platform/444930ed-5077-481c-9f27-832922478050
- Research Cruise (ECOA1): https://portal.secoora.org/#platform/81ad3445-24fc-489b-a6c0-0628dbdea009
- Hurricane Tracker: https://hurricane.portal.secoora.org/#map-view/hurricane-florence-2018/data/2018-09-14T17:00:00Z/8

Sites

- AIS Pipeline - https://ais.axds.co
- IOOS Sensor Map - https://sensors.ioos.us
- Northern Gulf of Alaska NSF LTER Site - https://nga.lternet.edu

Remote Compute

- Not all data can be analyzed from a web browser
- Data volumes are growing, especially at DACs
  - NOAA Big Data Project, GOES-R, etc.
  - Availability of audio/video
- Downloading all data no longer viable

- What are the options?
  - Produce analyses and products users request
  - Give **users** fast access to the data without downloading

Remote Compute - Examples

WebCAT - https://secoora.org/webcat/

- Private/public partnership between SECOORA and Surfline
- 8 streaming video cameras
- 1 year of raw video data hosted at SECOORA
- Access to raw video streams was “too much”

AIS Histograms - Notebook

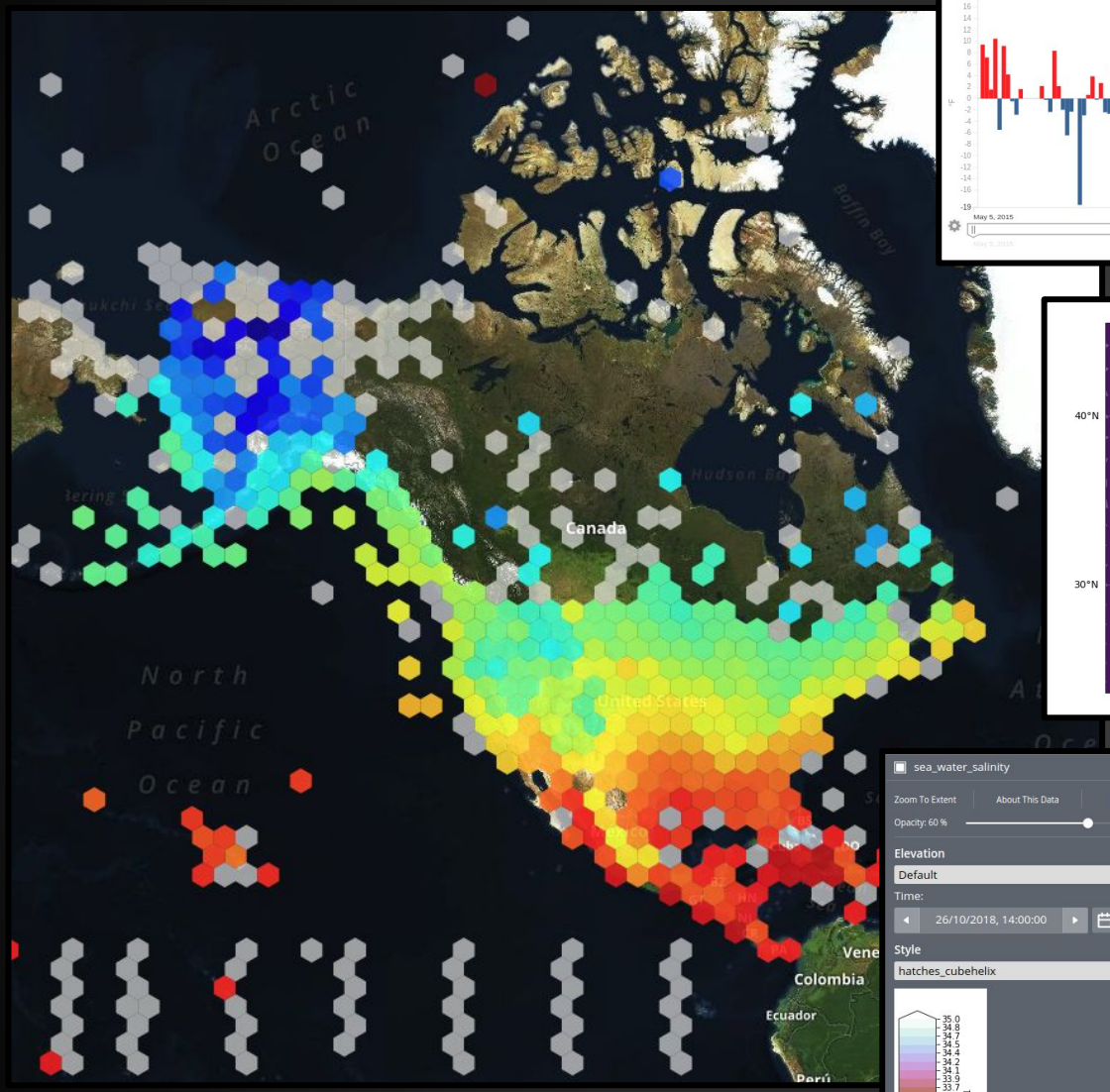
- Analyze the Daily Vessel Voyages (CSV) for a specific region
- Access to a Dask cluster

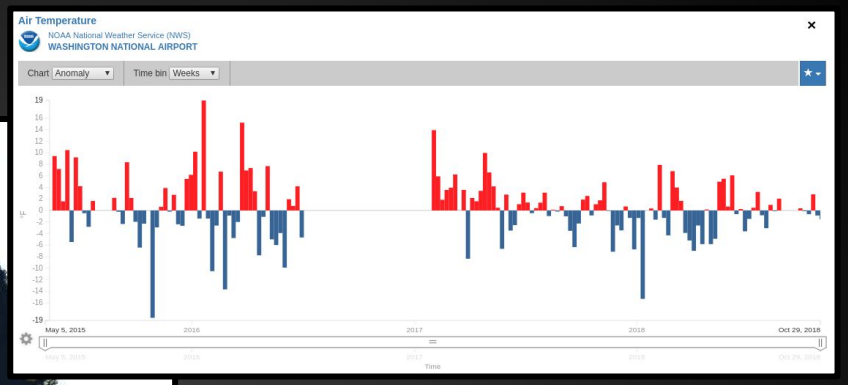
Passive Acoustic Spectrograms - Notebook

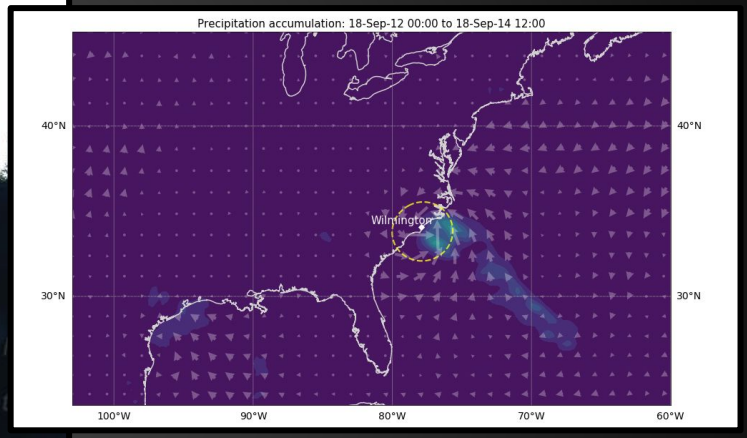
- Hydrophones in Bering Sea from 2009-2013
- Raw access to .wav files

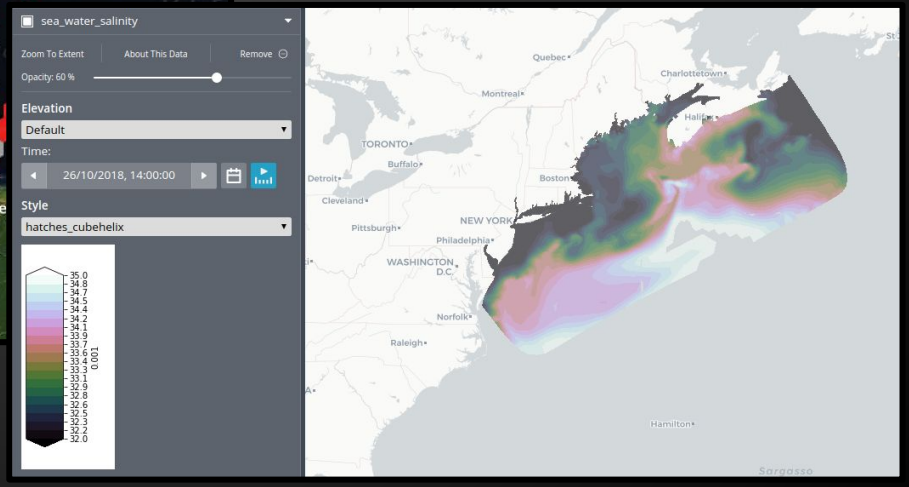
Extra Slides

Results









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Partners

NOAA

NATIONAL SCIENCE FOUNDATION
LTER NETWORK
LONG TERM ECOLOGICAL RESEARCH

BOEM
Bureau of Ocean Energy Management

UAA
Alaska Natural Heritage Program
University of Alaska Anchorage

North Pacific Research Board

U.S. Fish & Wildlife Service
Department of the Interior

Aleut International Association
Алеутская международная ассоциация

Northwest Arctic Borough
Incorporated June 2, 1986

AOOS
Alaska Ocean Observing System

NSF

Exxon Valdez Oil Spill Trustee Council

CeNCOOS

GulfWatch Alaska

NASA

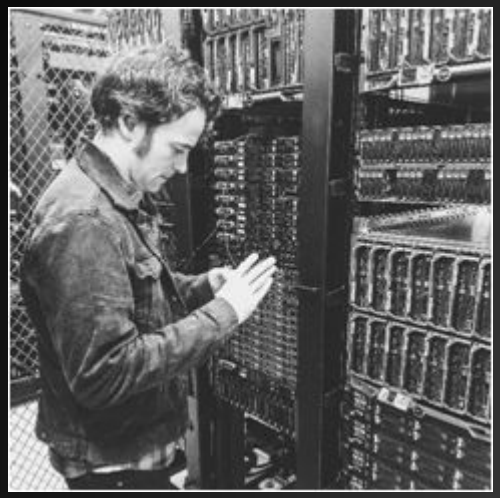
USGS
science for a changing world

MBARI

Integrated Ocean Observing System

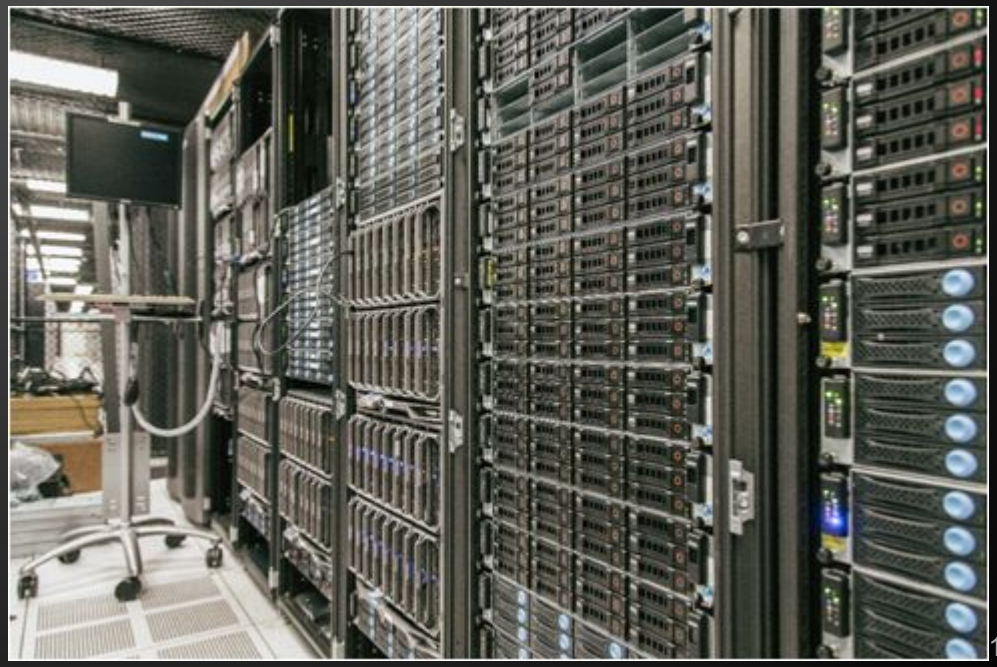
SECOORA
Southeast Coastal Ocean Observing Regional Association

High Performance Computing (HPC)



- Ocean data is BIG DATA (models, sensors, hydroacoustics, satellite imagery, etc…)
- Requires scalable compute and storage infrastructure

- ~5,000 processor cores
- ~1.5 petabytes of functional storage/5 petabytes of actual storage (~1,500 hard drives)
- Level 2 Fat Tree Infiniband Network, 40 Gb/Sec node to node). 240 Gb/Sec cluster to cluster



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