Enabling Precision Marine Navigation in the U.S.

Discover → Download → Visualize

Julia Powell, Christine Burns, John G.W. Kelley, and Jason Greenlaw

NOAA/National Ocean Service/ Office of Coast Survey

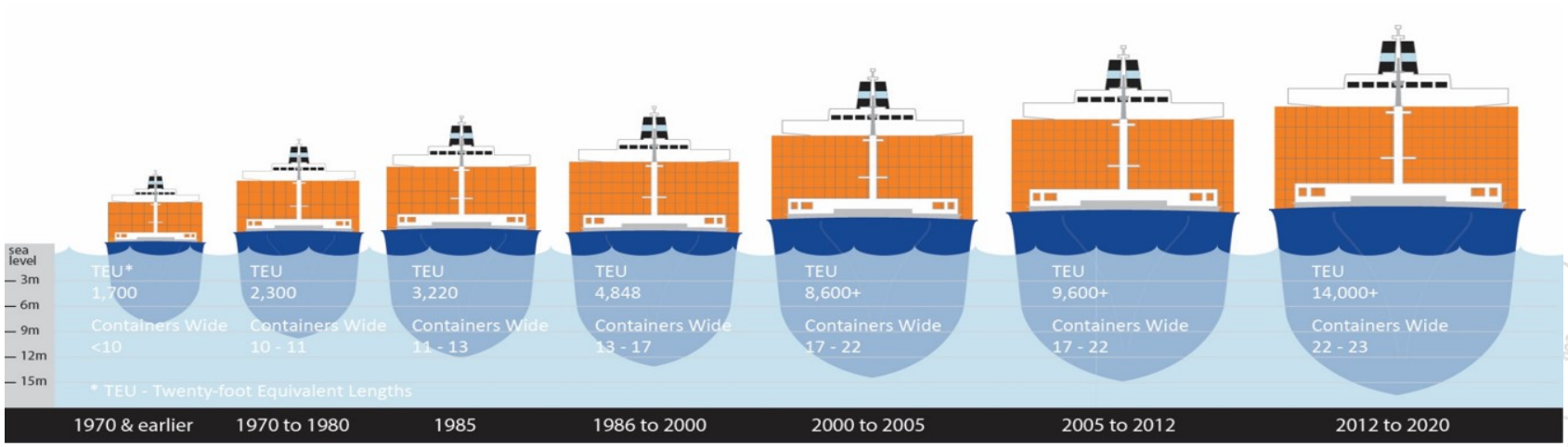
What is precision marine navigation?

…the ability of a vessel to safely and efficiently navigate within the U.S. EEZ and operate in close proximity to the seafloor, bridges, narrow channels, or other marine hazards.

Why do mariners need precision marine navigation?

For large vessels entering a seaport, where space is limited and time is critical, mariners examine many types of NOAA's data and information.

This information is needed to plan for potential impacts from rapidly changing ocean and weather conditions (e.g El Faro)



Why initiate the Precision Marine Navigation program?

To make critical decisions mariners use more than one device or system to get NOAA data:

- Portable Pilot Units
- Electronic Chart Systems
- Electronic Chart Display and Information Systems
- Cell phones

NOAA datasets are encoded in different data formats:
(none of these are navigation standards)

- NetCDF
- GRIB2
- SHEF
- GeoTIFF
- plain text

Navigation datasets are spread across various entities across Federal agencies

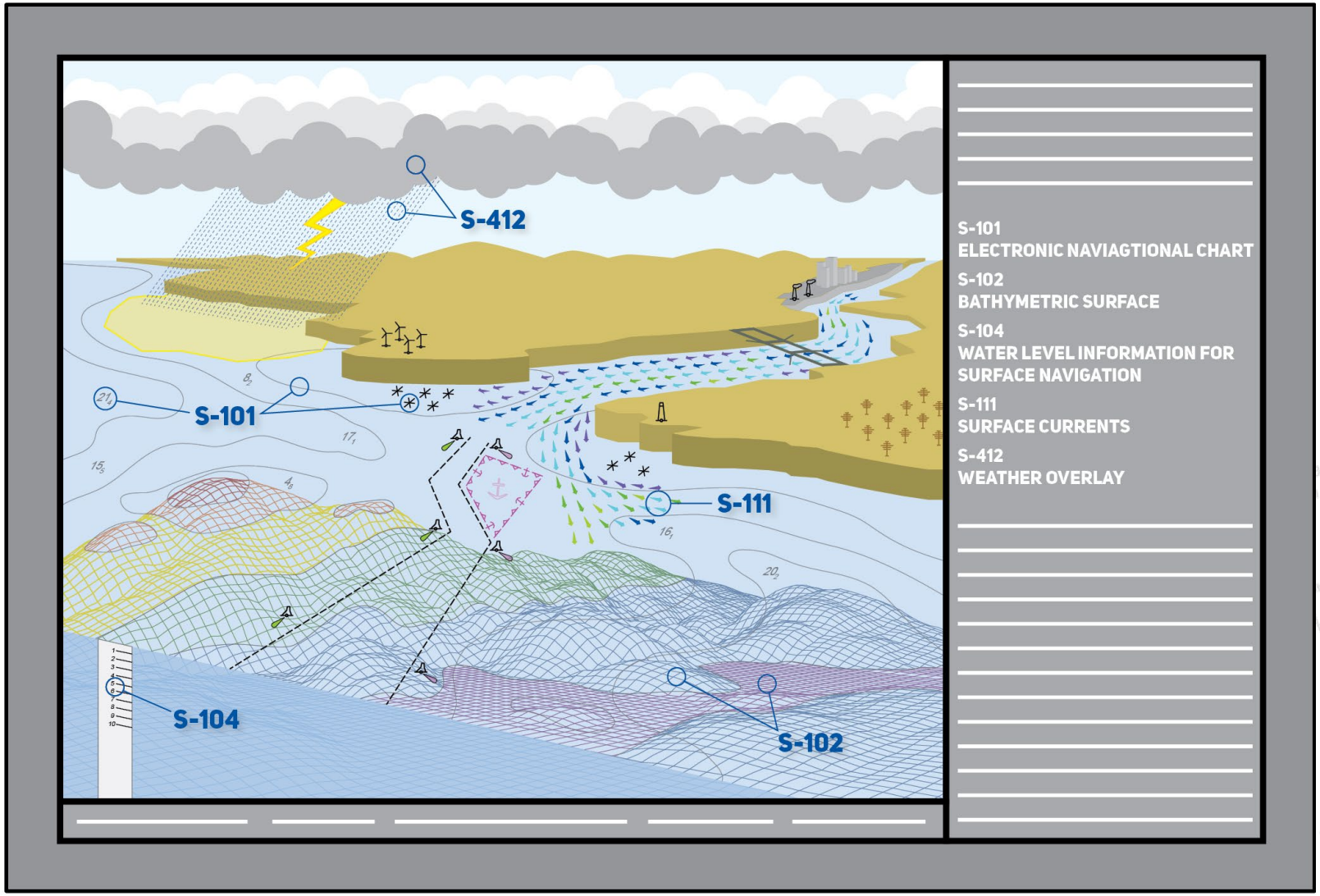
This presents challenges for navigation system manufacturers in acquiring & processing the NOAA data for distribution to their customers.

SOLAS mandate

“ensure the greatest possible uniformity in charts and nautical publications and to take into account, whenever possible, relevant international resolutions and recommendations”

“co-ordinate their activities to the greatest possible degree in order to ensure that hydrographic and nautical, information is made available on a world-wide scale as timely, reliably, and unambiguously as possible”

S-100 provides the framework for precision marine navigation



Project Goals:

- Develop a prototype data processing and dissemination system to *ingest, process, and disseminate* selected NOAA hydrographic, bathymetric, oceanographic, and weather in a internationally recognized uniform format (S-100 Framework)

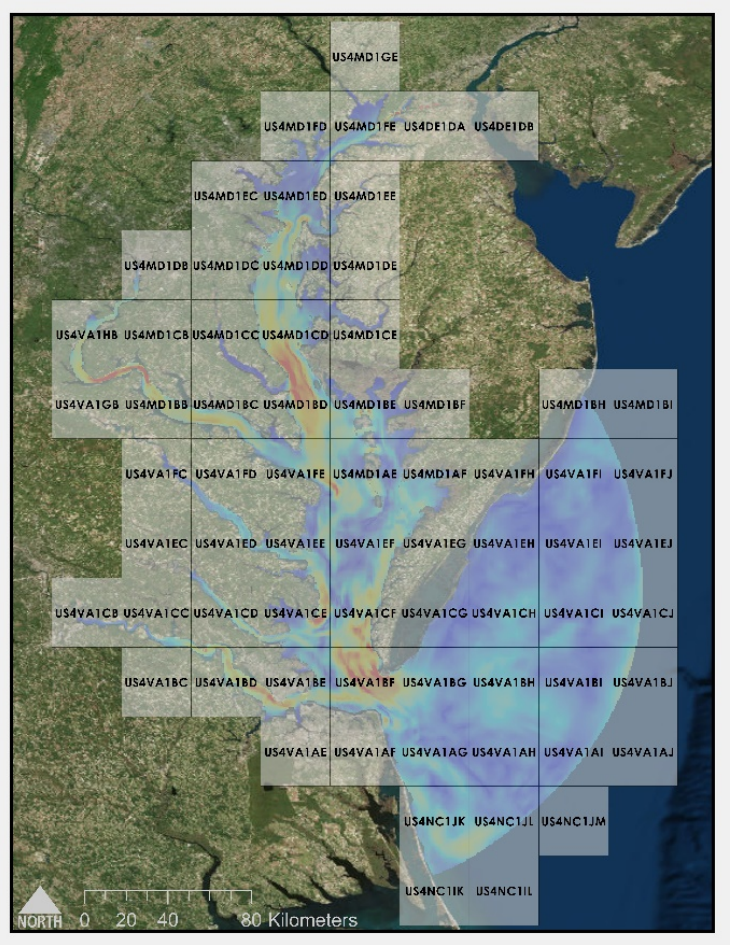
- Make S-100 datasets and map services available to Portable Pilot Units and Electronic Charting System manufacturers/Under-keel Clearance companies and obtain their feedback.

- Use a DevOps, Cloud Computing, Open Source Software approach to develop & implement prototype

Prototype NOAA Data Processing & Dissemination System

- **Functioning prototype system running on the Cloud**
  - Automatically generates tiles of forecast guidance of surface water currents for the next 3 days (4 times/day) from NOAA models into S-111 file format.
  - Publically available via the NOAA Big Data Project for free
    - Initial Operating Capability for early adopters
  - Provides sample OFS forecast guidance data optimized for web mapping services
  - Utilize small tiles (<10 MB) to ensure the data can be downloaded even using low bandwidth environment

- **Map viewer for users to discover/visualize/download Surface Water Currents Guidance & Bathymetric Surface Overlay Tiles**



NOS Chesapeake Bay Operational Forecast System (CBOFS) BAND4 Tiles

(access restricted to NOS IP Address Range)

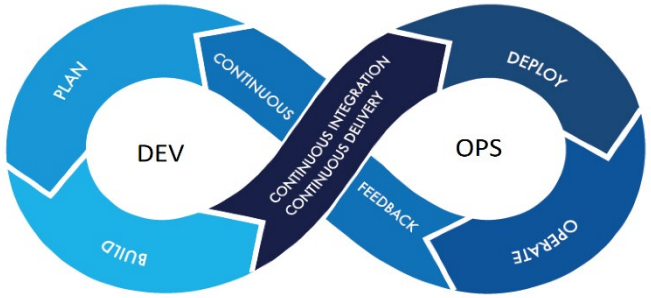
NOAA Navigation Services

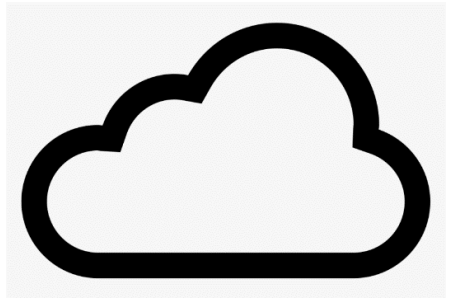
Prototype NOAA Data Processing & Dissemination System

Project Goals (cont.):

- **Use a *DevOps*, Cloud Computing, Open Source Software approach to develop & implement prototype**

Why?





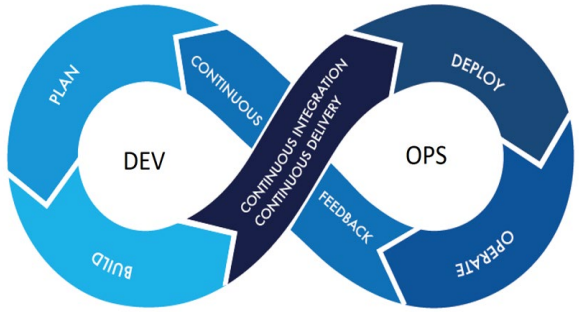
- ❑ **Lessons learned from +15 years with Development & Operation of NOAA nowCOAST** @ OCS & then IDP Data Centers

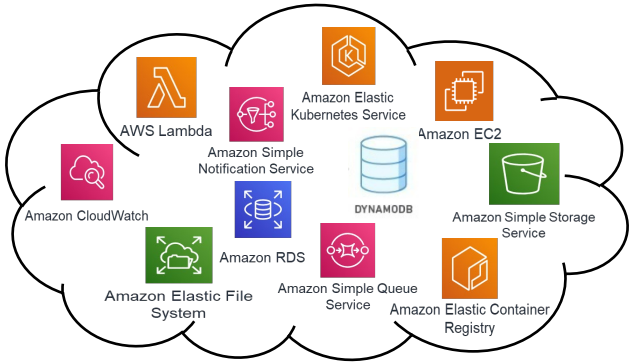
- ❑ **DOC Strategic Plan 2018-2022***: *"Modernize & consolidate IT….maximize secure use of commercial cloud computing"*
- ❑ **NOAA Cloud Strategy 2019-2024+** (Draft): **"***Desired end state for all NOAA IT services – hosted in a multi-tenant commercial cloud computing environment, absent a justifiable and deliberate decision to host the service using an alternative architectural approach."*

- ❑ **NOAA Science Advisory Board (DAARWG) 2019#:** *"recommend that NOAA focuses on supporting open source software libraries and promote cross-domain cloud-based communities of practice…"*

*https://www.decsocal.org/NewsEvents/us_department_of_commerce_2018-2022_strategic_plan.pdf
+https://nrc.noaa.gov/Portals/0/Draft%20NOAA%20Cloud%20Strategy_11.13.2019.pdf?ver=2019-11-14-004732-880
#https://sab.noaa.gov/sites/SAB/Meetings/2019_Documents/Dec_Meeting/SAB_Mtg_Dec19_Report_DAARWGReport_final_121319.pdf?ver=2019-12-13-101129-307

Prototype NOAA Data Processing & Dissemination System





DevOps

- Shorten the system's development life cycle
- Improve quality, reduce cost and risk
- Continuously update/deliver new incremental changes to users

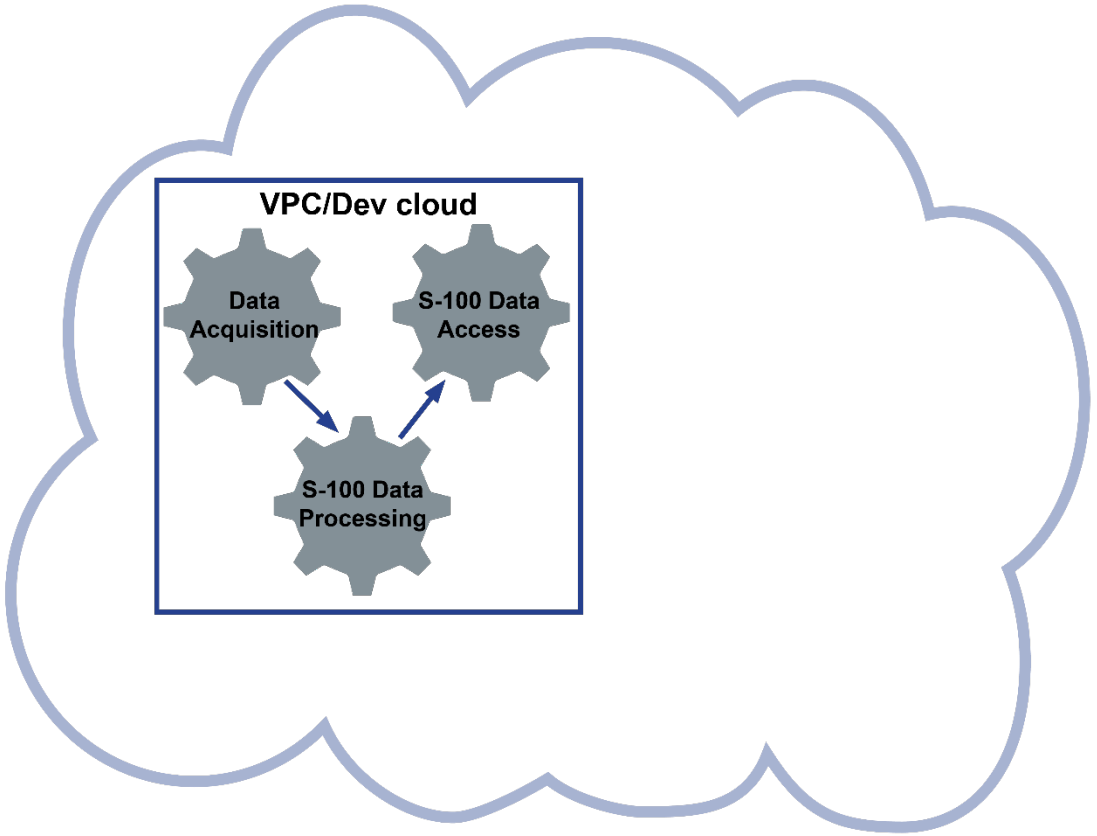
Cloud Computing

- Reduce costs on purchasing/maintaining equipment
- Provide scalability and redundancy
- Use cloud services & "cloud native" tools to enable efficient *DevOps-style workflows* which makes development, testing, & maintenance more efficient

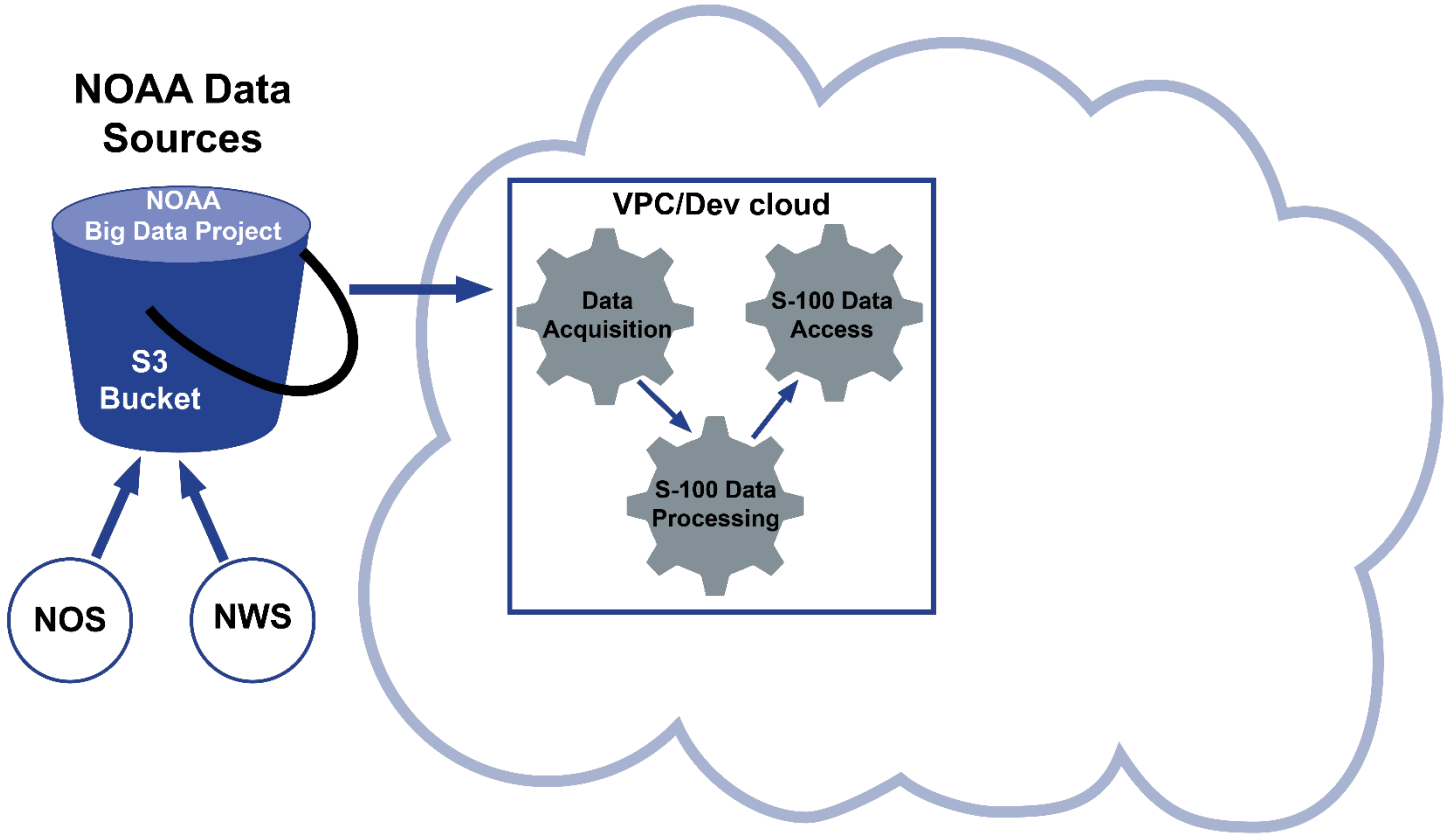
Open-source Software

- Reduce cost, avoid vendor lock-in, increase flexibility for developers and promote collaboration internationally
- Foster a community of developers around code which increases/improves bug fixes, testing, documentation, feature requests, contributions, & overall quality

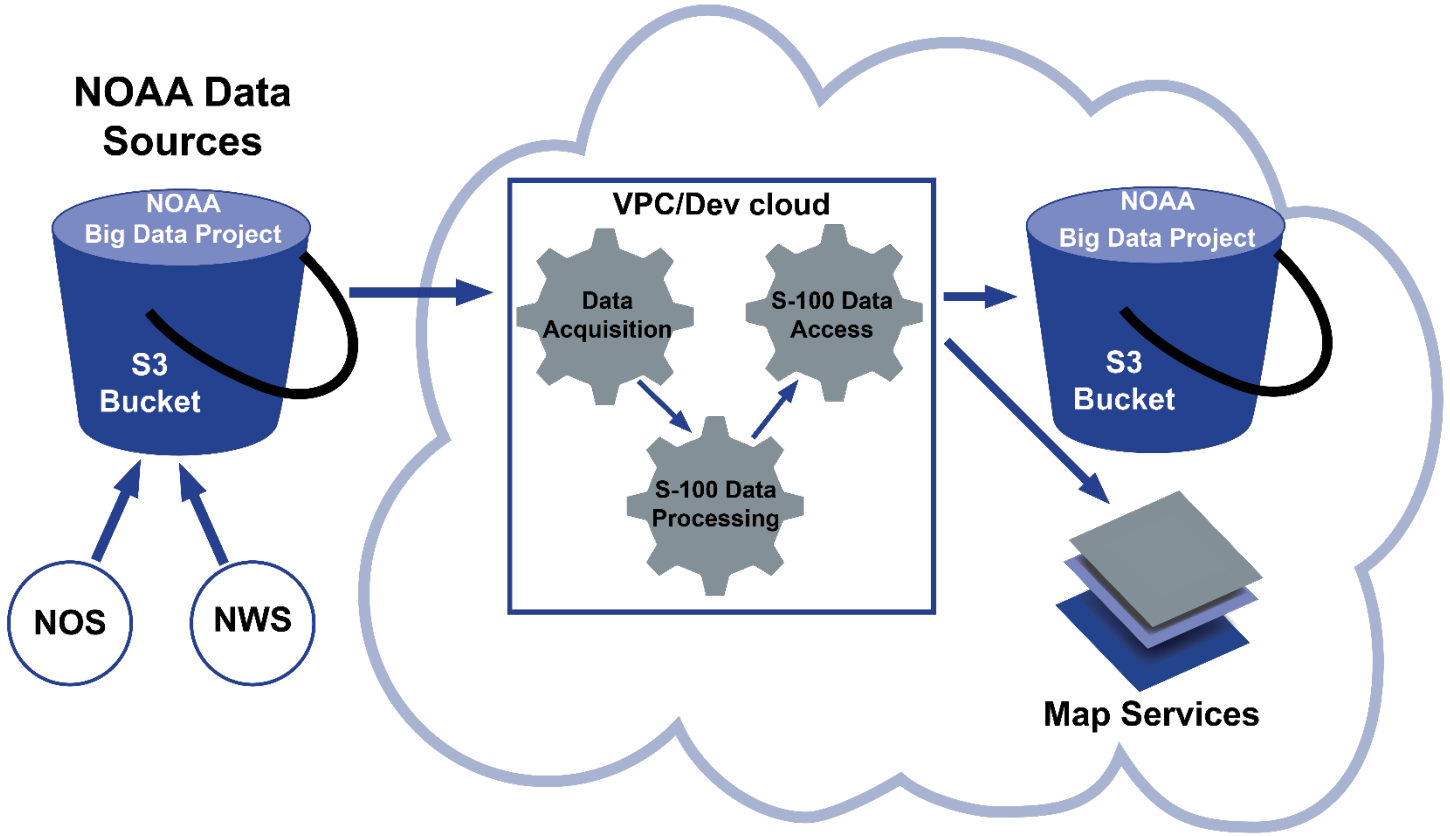
High-Level Schematic of Prototype on AWS



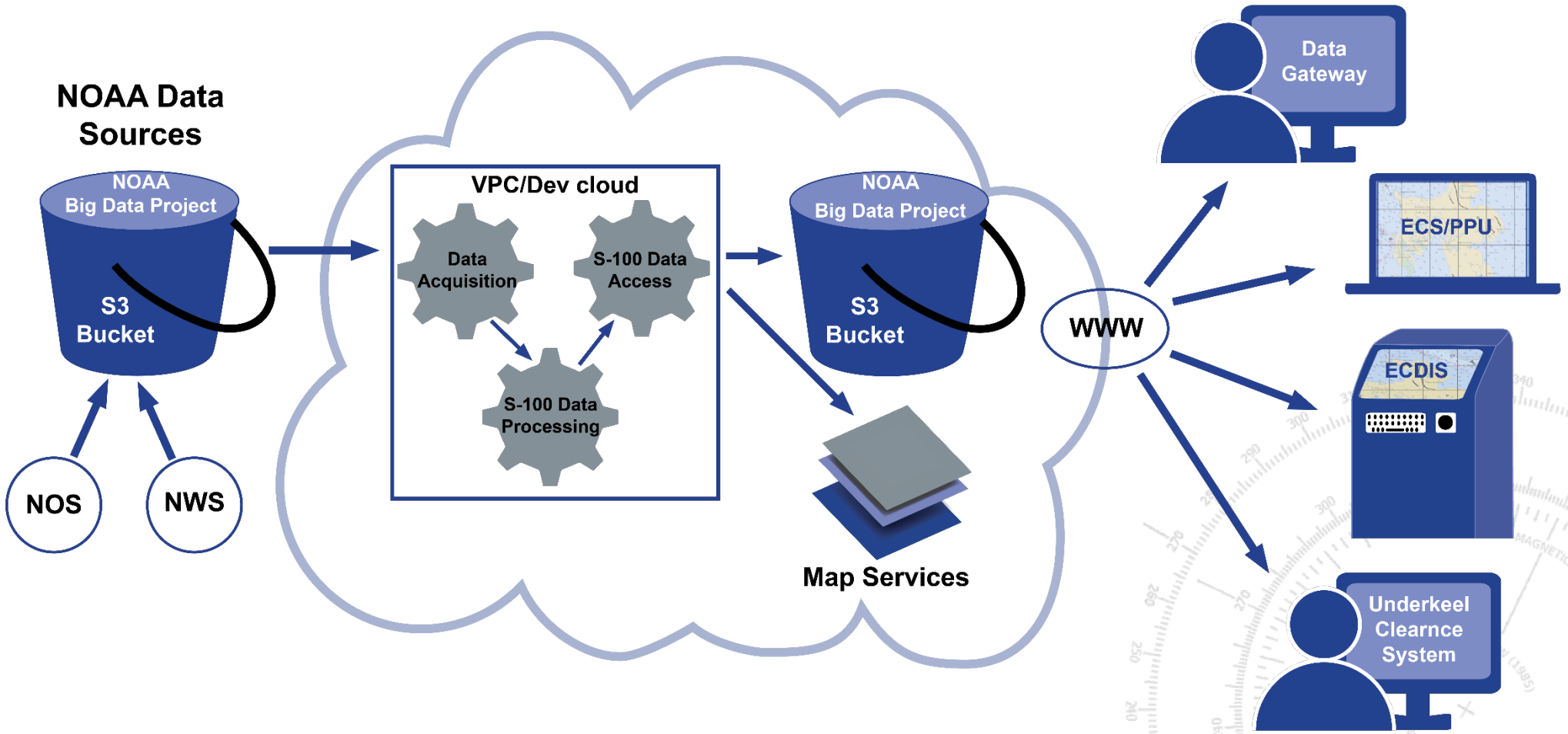
High-Level Schematic of Prototype on AWS



High-Level Schematic of Prototype on AWS



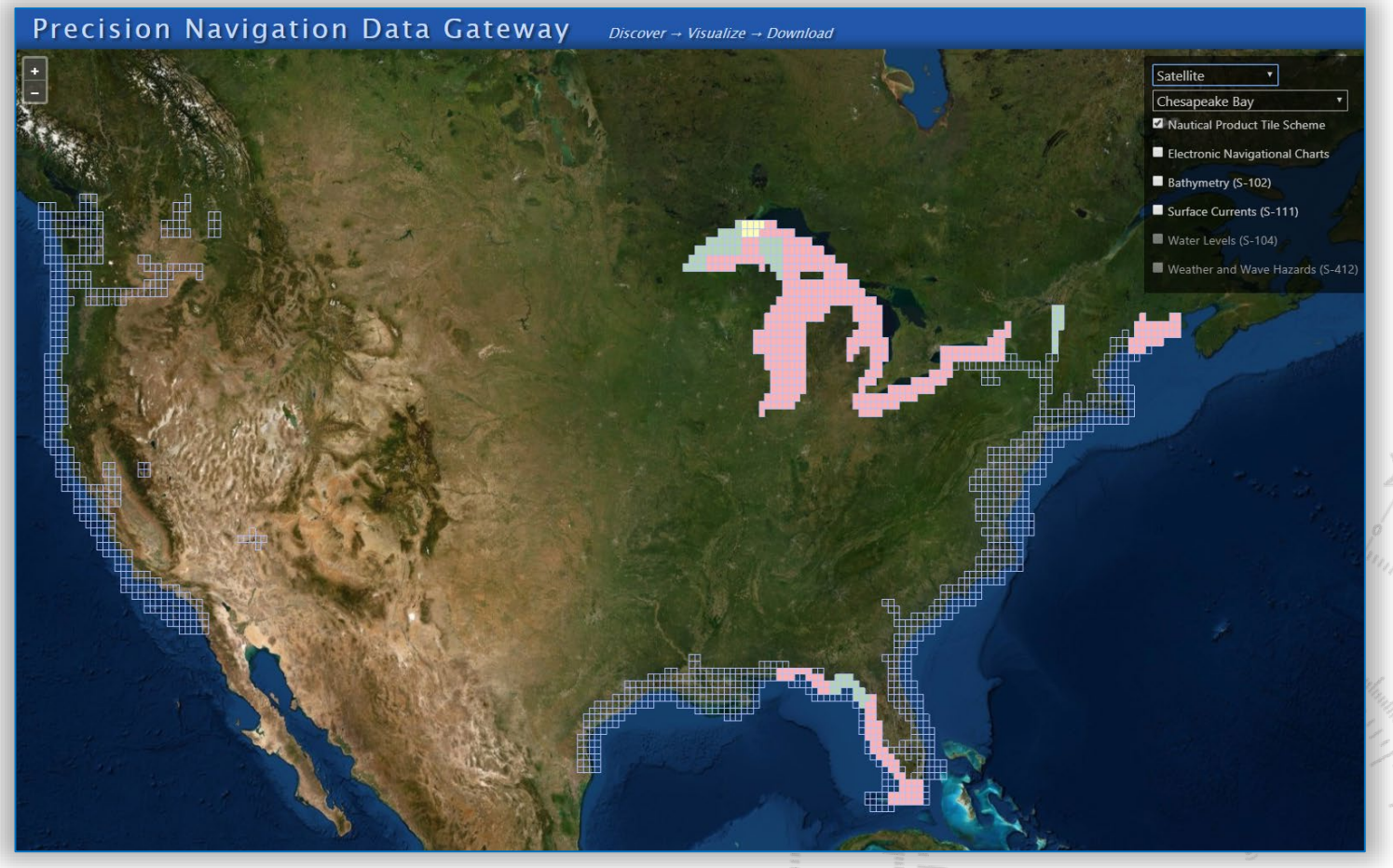
High-Level Schematic of Prototype on AWS



Precision Marine Navigation Data Gateway map viewer

A web mapping application to make it easy for users to discover, visualize and download datasets from the NOAA S-100 Product Suite as it grows

DEMO



(access restricted to NOS IP address range)

Project Milestones FY21-22

Disseminate additional NOAA S-100 Products

- Forecast guidance of surface water currents from new and upgraded models (e.g. West Coast OFS) encoded in S-111 file format.
- Forecast guidance of water levels into the S-104 *Water Level* file format
- Provide S-102 *Bathymetric Surface* Tiles for Hudson River, NY Harbor & Coastal New England in the cloud
- Post S-41x *Weather and Wave Hazards Overlay* products

Version 1 of *marinenavigation.noaa.gov*

- website focused on NOAA's navigation related products

Stakeholder Engagement

- **May 2020**
  - Stakeholder Invitation Letter and Blog Post
- **June 2020**
  - Blog posts on upcoming release of prototype surface current data
  - Joint meeting of U.S. CMTS Interagency Action Teams
- **July 2020**
  - Briefed the U.S. CMTS Coordinating Board
- **August 2020**
  - Announced initial release of the dissemination system via letter and blog post
  - Navigation Services Newsletter
  - Brief Federal Partners
    - RDML Okon, Oceanographer of the Navy
    - RADM Buzby, MARAD Administrator
    - RDML Timme, Assistant Commandant for Prevention Policy, U.S. Coast Guard
- **September/ October – Workshop**
- **October**
  - Workshop follow-up, post recordings, release workshop report
- **November***
  - Release improvements to dissemination system based on feedback from workshop
  - Establish connections with training academies
- **February/March***
  - Congressional briefing

***Dates are subject to change**

First Annual Precision Marine Navigation Workshop

- August 2019
- Hosted at UNH Joint Hydrographic Center
  - Approximately 50 people
  - NOAA, UNH, Software companies, and Pilots
- Established goals of the program and requirements of the users

What can you expect from the next two days?

September 30

9:00 - 11:00 a.m. Opening Plenary

12:00 - 2:00 p.m. Software Systems and Distributors

3:00 - 4:30 p.m. End Users

October 1

9:00 - 11:00 a.m. Federal Agencies

12:00 - 2:00 p.m. Wrap up and Next Steps

All times EST**

Summary

Prototype **dissemination system** has been developed on **AWS Cloud**

- *processes and disseminates* surface water currents forecast guidance +48 hours from 15 NOS OFSs on ENC tiles using IHO S-111/HDF5 compliant standards (file size)

Coming up

- S-102 High Resolution Bathymetry
- S-104 Water Level Forecast Guidance
- Public access to the PMN Gateway Map Viewer
- Provide OGC web mapping services of bathymetry and latest OFS water currents forecast guidance
- Begin development of *marinenavigation.noaa.gov*