



Modernizing Hydrologic Data Dissemination for The NOAA Office of Water Prediction : From Interoperable APIs to Decision Support Tools (Invited)

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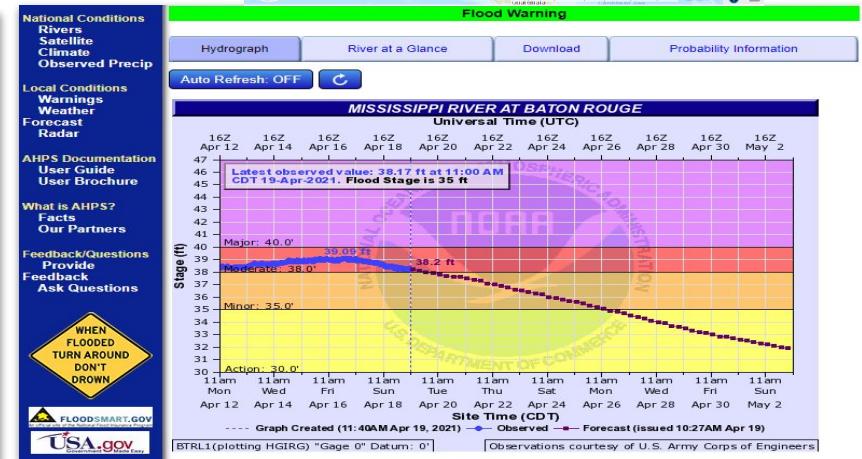
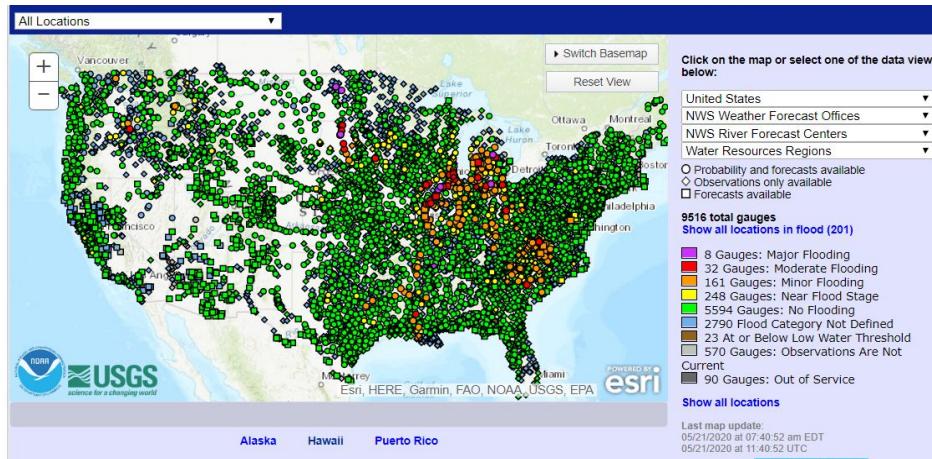
December 11, 2023

Journey from On-prem Advanced Hydrologic Prediction Services (AHPS) to the National Water Prediction Service (NWPS) in Cloud

AHPS is the main dissemination portal for WFO/RFC river forecast information - water.weather.gov

Main Functions

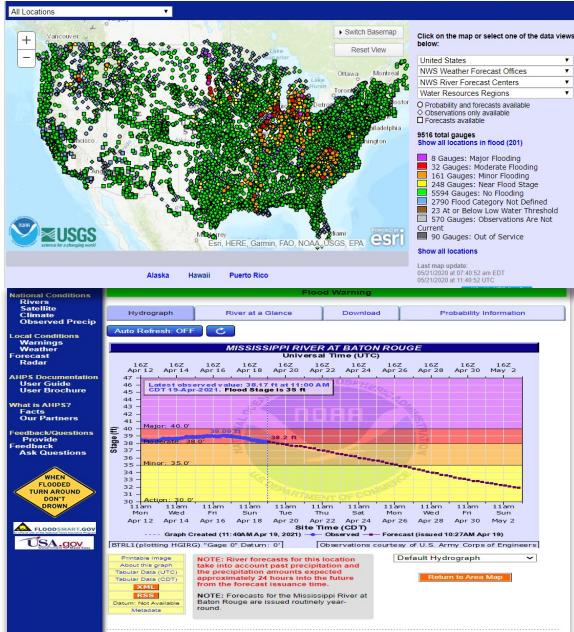
- Near Real-Time River Data and Forecast Information
- Probabilistic Information
- Static Flood Inundation Mapping (FIM) Libraries
- Precipitation Estimates (QPE)
- Data download



Sustainable Integration of Hydro Program's Web Presence in NWPS

AHPS

water.weather.gov



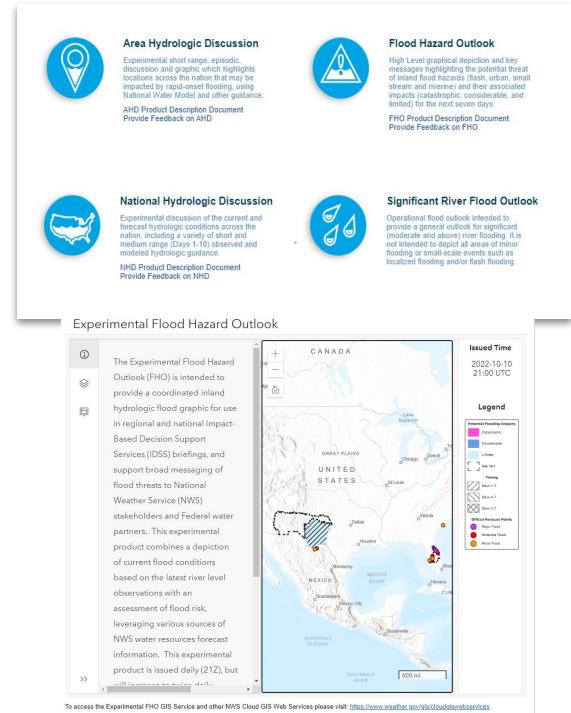
Office of Water Prediction

water.noaa.gov



NWC Experimental Products

weather.gov/owp



Experimental National Water Prediction Service (NWPS)

The screenshot shows the NWPS homepage with a large central map of North America. Overlaid on the map are various data layers including streamflow, soil moisture analysis, and snow accumulation. A prominent banner in the center reads "One-stop shop for water resources services" and provides the website address "www.preview.water.noaa.gov". To the right of the map are several interactive panels:

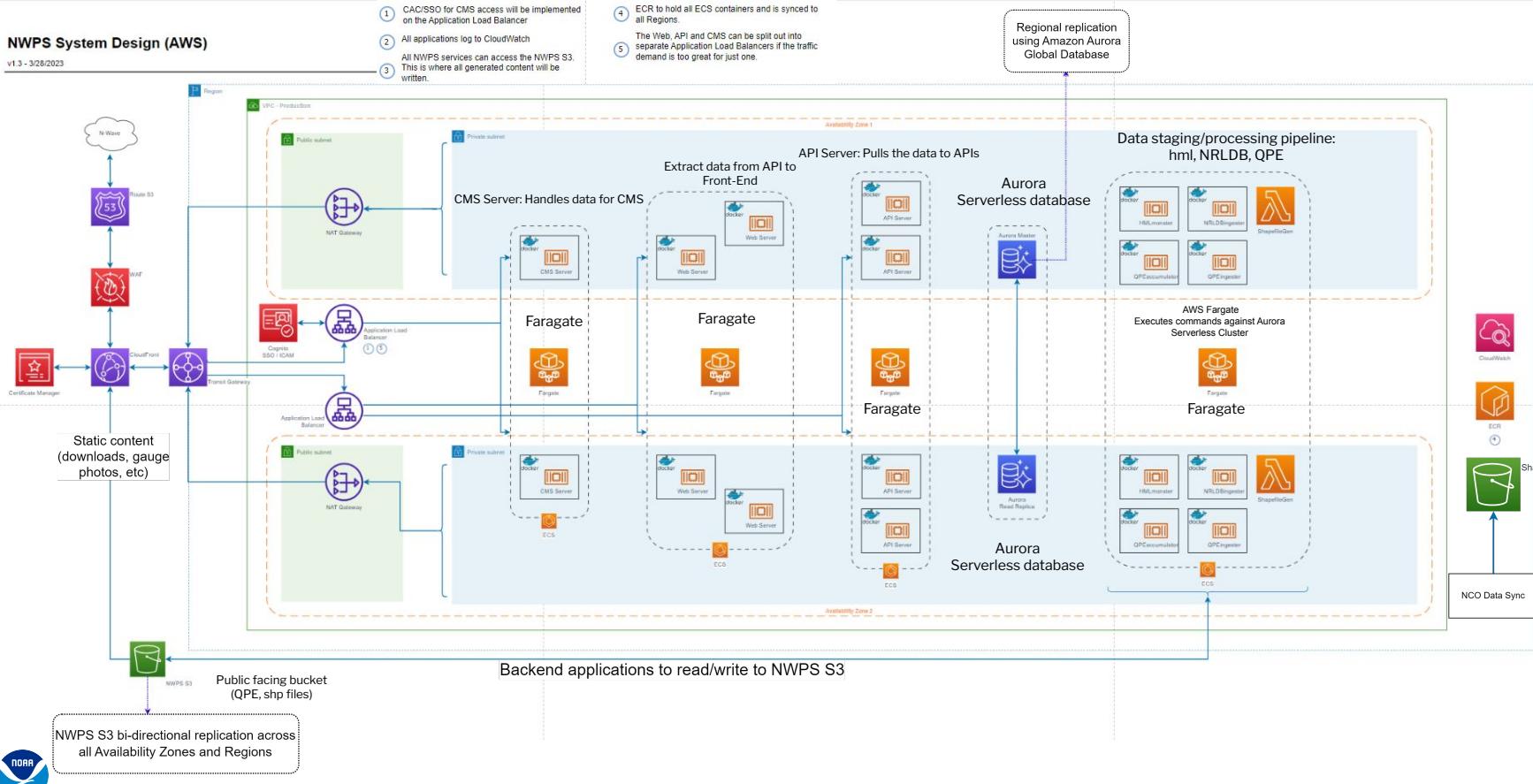
- River Gauge**: A table showing observations and forecasts for river gauges across the country. It includes columns for Observation, Forecast, Category, and Status.
- National Water Model**: Settings for the Stream Reach layer, including opacity and color options, and checkboxes for National Soil Moisture Analysis and National Stream Analysis Anomaly.
- National Snow Analysis**: A section for flood inundation analysis.
- Flood Inundation**: A table with guidance options and a legend for river flow levels (2%, 4%, 10%, 20%, 50%) and a note about high water thresholds.

At the bottom left, there is a list of bullet points summarizing the service's features:

- Rewrite of legacy Web pages
- Migration from AHPS NIDS environment to IDP
- Web GIS framework
- Modern platform for data dissemination (e.g. APIs)



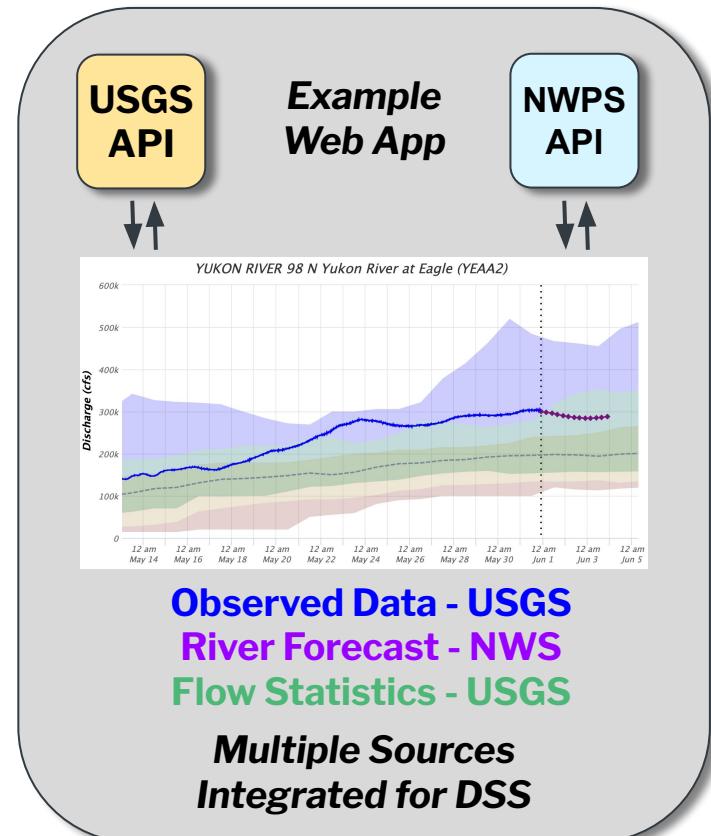
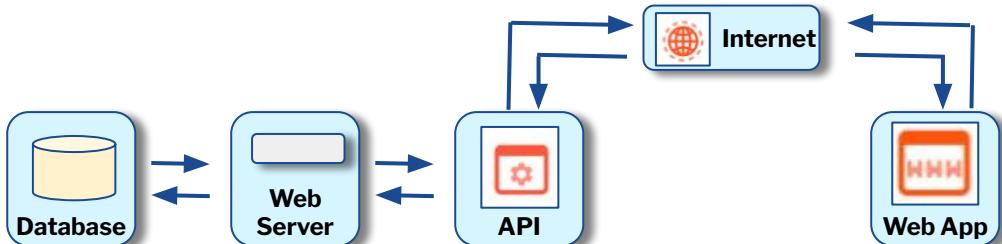
NWPS Framework: Scalable Resilient System in AWS Cloud



Building sustainable API Framework

**NWPS is an API-driven Web App
for the dissemination of integrated
water information across the NWS**

Core Partners, Third Party APIs and Web Apps can leverage the NWPS API to integrate observations and forecast data into their own decision support tools.



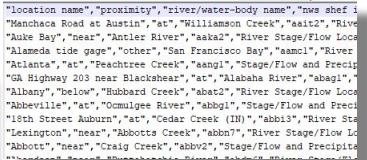
Building sustainable API Framework

AHPS - old system

Variety of endpoints or
not available

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XML



CSV

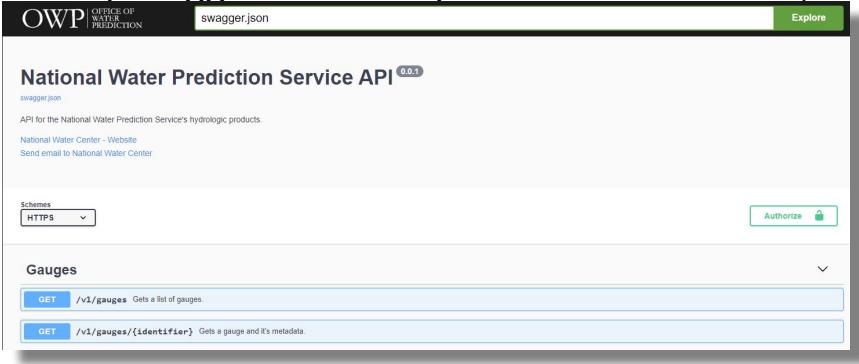
WEB X



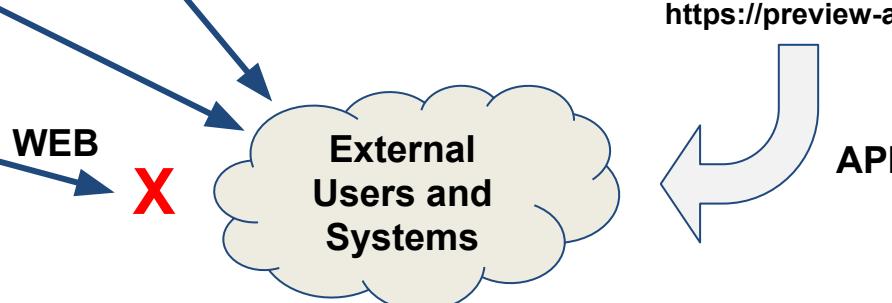
If you notice any errors or have any information, please contact our Webmaster.
19.91 Impacts are along Chena Hot Springs Road (CHSR). All impacts from stages of 18.73 ft up to 19.40 are more severe, plus Water flowing over road at 19.50 ft (Bankfull). Granite Tors, Silver Creek and Chena River flooding areas are flooded. (8/12/13)
19.79 Impacts are along Chena Hot Springs Road (CHSR). All impacts from stage of 18.40 are more severe, plus River access at 19.25 ft closed, water flowing over road at 19.30 ft (Bankfull), west end of Granite Tors Parking Lot begins to flood. (8/12/13)
19.80 Impacts along Chena Hot Springs Road (CHSR) starting at stage of 19.20 ft. River access at 19.25 closed. Granite Tors flooding areas flooded. (8/12/13)
Photos
(1) Geog
(2) CHSR at 19.25 ft (Bankfull)
Comments: Chena River at a stage of 19.50 ft.
(3) Chena River (Granite Tors parking lot). Stage of 19.50 ft.
(4) Chena River (Granite Tors parking lot). Stage of 19.50 ft. Water impacts at parking area for stage = 20.4 m. page datum: on 06 June 2013
Chena River flooding areas flooded. (8/12/13)

NWPS - new system

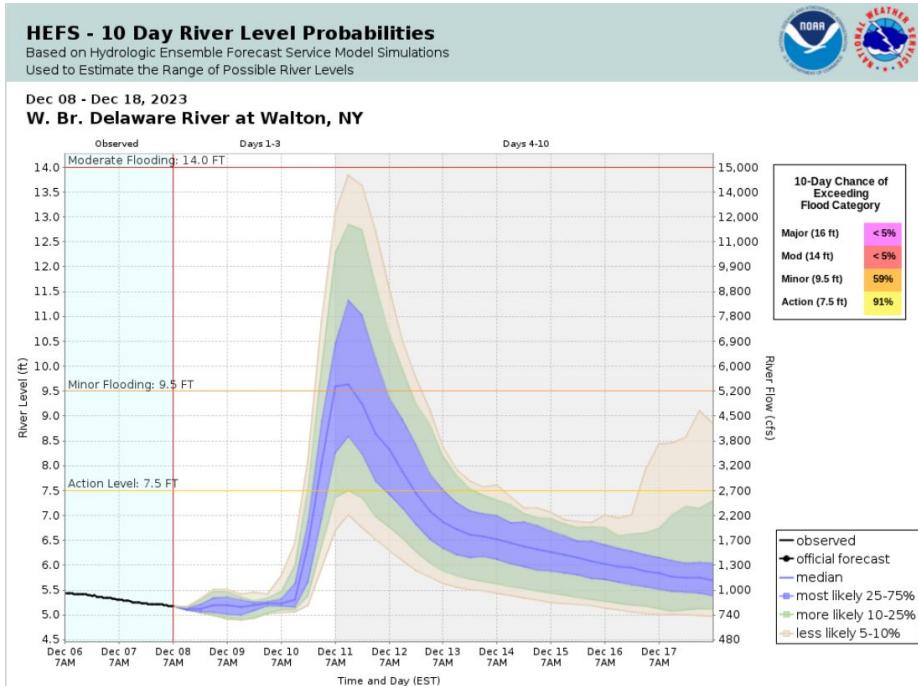
Full API Access to Data and Metadata
(Swagger for Interoperable RESTful Service)



The screenshot shows the Swagger UI for the National Water Prediction Service API. At the top, there's a navigation bar with 'OWP OFFICE OF WATER PREDICTION' and a 'swagger.json' link. Below it is the main title 'National Water Prediction Service API 0.0.1'. A large button labeled 'Authorize' is visible on the right. The interface includes sections for 'Schemes' (set to HTTPS), 'Gauges' (with two GET methods listed), and a sidebar with an 'Authorize' button.



API Future: Extending API Framework (HEFS)

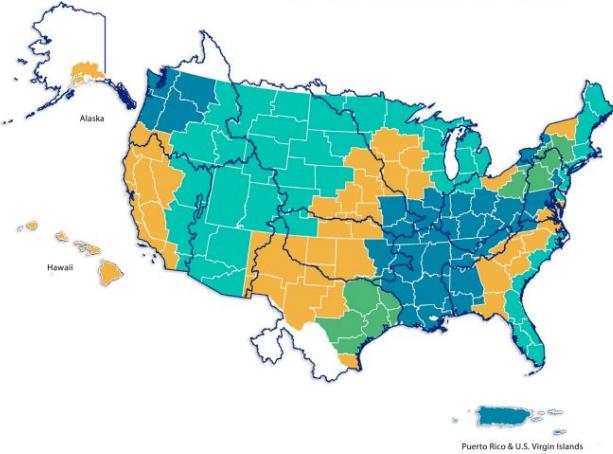


HEFS API
(On Development)



Flood Inundation Mapping (FIM)

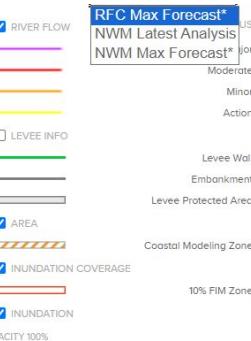
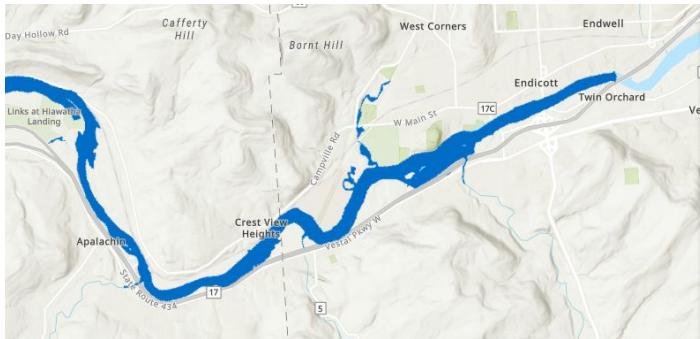
NWS Flood Inundation Mapping Services Implementation



*100% is approximate. Does not include all parts of Alaska, American Samoa, and Guam. Implementation areas are subject to change.

www.preview.water.noaa.gov

FIM- RFC Max Forecast



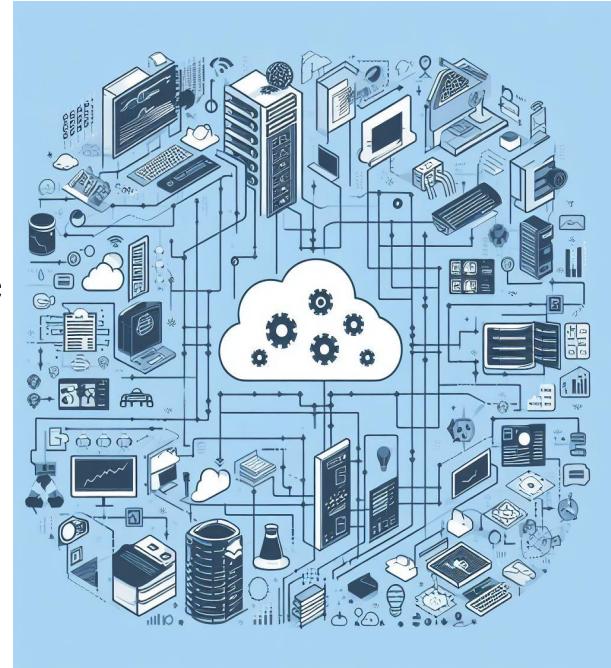
<https://www.weather.gov/owp/operations>

OWP
Operations



Modernizing Cloud based Data Delivery Mechanism: Improved Access & Interoperability following FAIR Principle

- Findable, Accessible, Interoperable, Reusable
- Improved data structure and standardized metadata and centralized repository for Finadable data
- Cloud-based *data services and cloud native data* can make data more accessible to users and improve data interoperability and reusability
- Work in Progress: *Tackling Data Formats and Access limitations in Cloud*
 - i. *Moving towards Analysis-Ready Cloud Optimized (ARCO)/ Cloud native geospatial data format (e.g. zarr)*
 - ii. *Developing scalable RESTful API*



Why Analysis-Ready Cloud Optimized (ARCO) Data ?

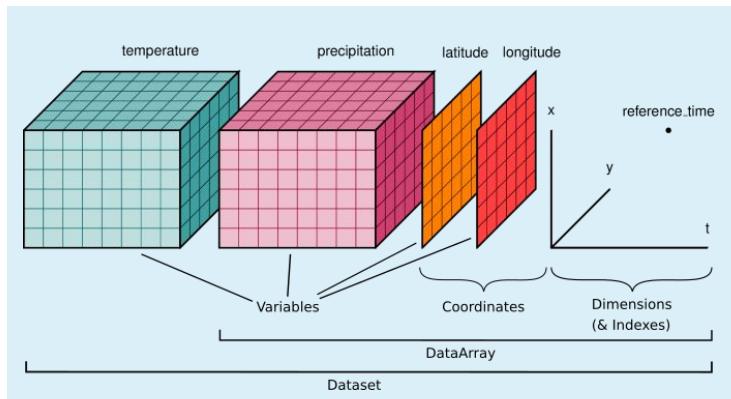
Data Proximate Model - Bring the compute to the data

- ARCO data removes the need to subset and download the data for analysis
- Allows for TB scale analysis without an HPC system
- Historically difficult to generate - Custom ETL pipelines



Why Zarr ?

- Chunked, Compressed
- Great for n-dimensional data structures
- Concurrent read/write
- Simple metadata
- File-based hierarchy and chunking
- ARCO (Analysis-Ready Cloud-Optimized)



MultiDim Array Scientific data



Disseminating Cloud native Data in the Cloud

The screenshot shows the NOAA Open Data Dissemination (NODD) website. At the top, there's a navigation bar with icons for weather (sun, clouds, thermometer), a search bar, and links for News, Tools, and About. Below the header, the NOAA logo and "National Oceanic and Atmospheric Administration U.S. Department of Commerce" are displayed. A secondary navigation bar includes links for Home, Offices, Office of the Chief Information Officer, OCIO programs, and NOAA Open Data Dissemination (NODD). The main content area features a large blue banner with the NODD logo and a dropdown menu for "Office of the Chief Information Officer home". To the right, there are links for NOAA Open Data Dissemination home, Evolution of NODD, Data Community Resources, NODD in the news, Frequently Asked Questions, and NODD Program Datasets. A search bar labeled "Search NOAA sites" is also present.

List of NOAA Open Data Dissemination Program Datasets

NOAA data in cloud: <https://www.noaa.gov/nodd/datasets>

Example notebook Microsoft:

<https://nbviewer.org/github/microsoft/AIforEarthDataSets/blob/main/data/noaa-nwm-example.ipynb>

National Water Model

Analysis & Forecast » [Amazon Web Services](#) » [Google](#) » [Microsoft Azure](#)

Reanalysis V 1.2 » [Amazon Web Services](#) » [Google](#)

Coupled Model Intercomparison Project Phase 5 (CMIP5) University of Wisconsin-Madison Probabilistic Downscaling Dataset

climate coastal disaster response environmental meteorological oceans sustainability water weather

Reanalysis V 2.0 » [Amazon Web Services](#) » [Google](#)

Analysis of Record for Calibration V1.1, CMIP6in pipeline

Reanalysis V 2.1 » [Amazon Web Services](#) V3.0 in pipeline

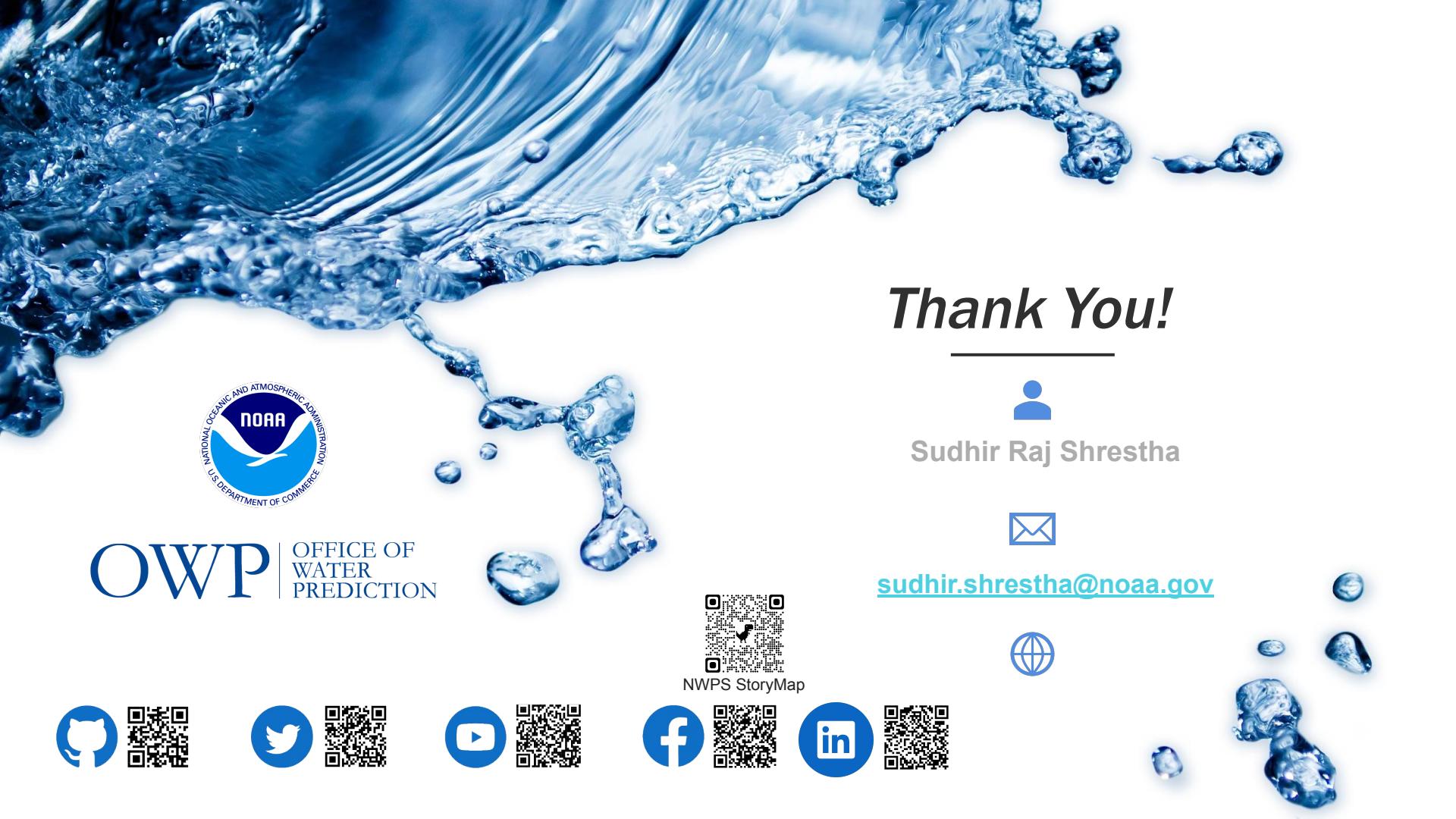


Take Away

- NOAA Office of Water Prediction is moving towards Standardized Scalable Cloud Infrastructure Framework that allows to:
 - National Water PReProvide a common foundation for optimized cloud ready data storage and services.
 - Standardized frameworks ensure consistent and reliable data access across different cloud platforms improving data access, interoperability, and user experience
 - Promote the use of common data formats and protocols, facilitating data exchange and collaboration.
 - Elevated user experience



OWP | OFFICE OF
WATER
PREDICTION



Thank You!



Sudhir Raj Shrestha



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NWPS StoryMap

Flood Inundation Mapping (FIM)

Enhancing Water Resources Data Delivery Service

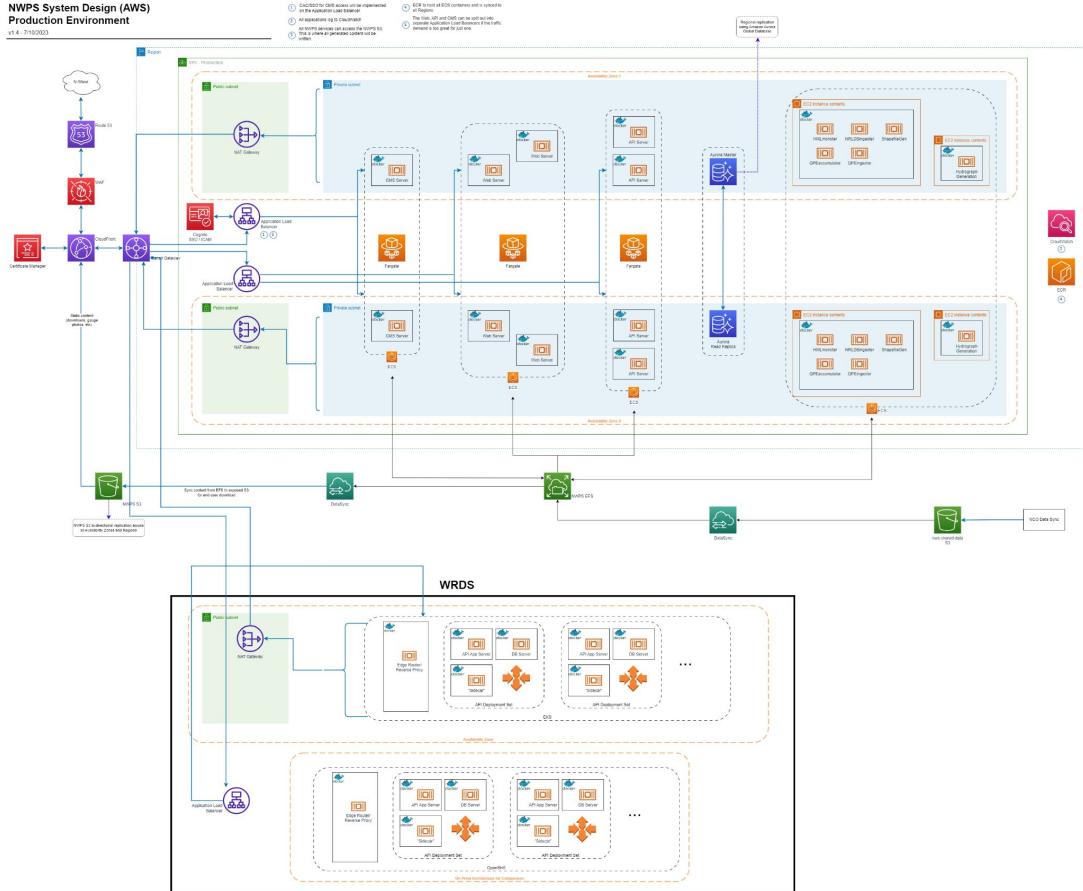
WRDS is the expanding collection of feature-rich data services from the Office of Water Prediction (OWP) including:

- Hydrologic Location API
- River Forecast Center (RFC) Forecast API
- Stream Observation API
- National Water Model Forecast API
- Analysis of Record for Calibration (AORC) ERDDAP API
- Hydrologic Ensemble Forecast System (HEFS) API
(upcoming)
- Analysis Ready Cloud Optimized (ARCO) data
(netcdf → Zarr)

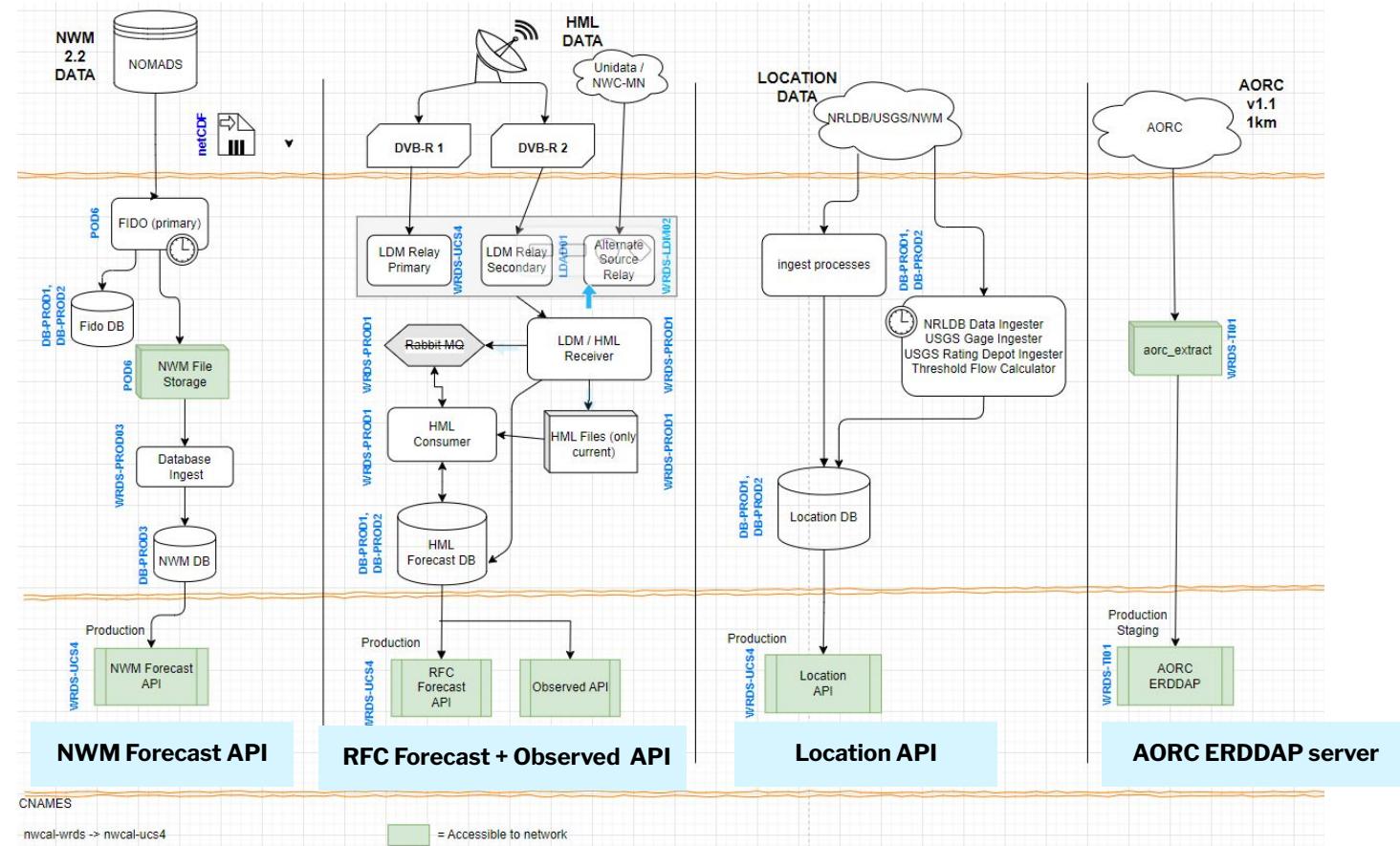


**NWPS System Design (AWS)
Production Environment**

v14_7000000



Current Data Services Overview (Internal user)



Disseminating FIM

HydroVIS FIM web services power the NWPS FIM presentation

NWPS FIM Guidance Options determine prepackaged layer sets.

- RFC Max Forecast

- NWM Analysis

- NWM MRF using GFS

The RFC option is oriented around flood categories.

The NWM options are oriented around estimated annual exceedance probabilities.



NWPS Flood Inundation Mapping

NWM Max Forecast*
RFC Max Forecast*
NWM Latest Analysis
NWM Max Forecast*

