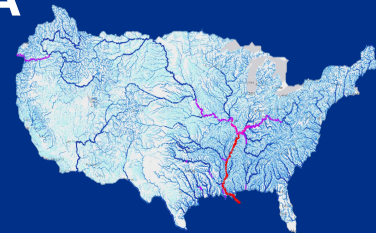




NOAA National Weather Service (NWS) + NOAA Open Data Dissemination (NODD) + Microsoft Office Hours



October 18, 2023 | 12-1:15 PM EDT | [REGISTER HERE](#)

- ◆ Share experiences on use and access of [National Water Model](#) via Microsoft
- ◆ Hear about data access via NOAA Open Data Dissemination (NODD)
- ◆ Connect with NOAA experts on data and model information changes



Tom Augspurger,
Geospatial Infrastructure
Engineer,
Microsoft



Adrienne Simonson, Patrick
Keown, Jenny Dissen, Kate
Szura,
NODD



Cindy Elsenheimer,
Partnership Engagement
Lead, NOAA NWS Office of
Organizational Excellence



Brian Cosgrove
Technical Director National
Water Model, NOAA NWS
National Water Center



Sudhir Shrestha,
Technical Director Web and
Data Services, NOAA NWS
National Water Center

GoogleMeet Webinar - Recorded

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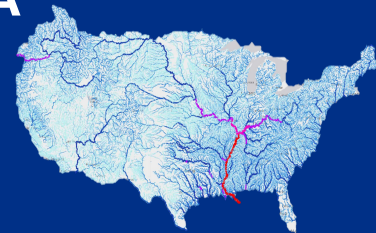
Disclosure: Voluntary; by joining and participating in the meeting consent is being given to the recording.

- Thank you for your registration and interest.
- Only hosts and presenters are asked to turn their video on.
- If do not wish to be part of the recording, please feel free to drop off.
- Meeting summary and presentation slides will be available on the NODD website
 - [NOAA.GOV/NODD](https://www.noaa.gov/nodd)





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Brian Cosgrove
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National Water Center

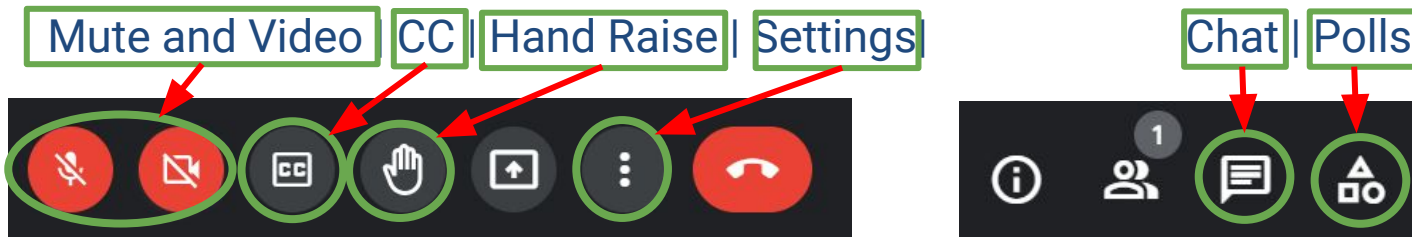


Sudhir Shrestha,
Technical Director Web and
Data Services, NOAA NWS
National Water Center

GoogleMeet Webinar Logistics

How to join the discussion!

- Keep yourself muted throughout (for call-in participants: to mute and unmute use *6) and videos off
- Raise your hand if you have a question and we'll respond in the order of the queue
- The following features of google meet:



- This webinar will NOT be recorded.
- You can also join by phone line only if you are having connectivity issues.
- (US) +1 508-687-4473 PIN: 297 789 966#

Guidelines for Discussion

- Keep it brief
- Keep it respectful
- Use the chat function for links, references and/or resources
- Submit questions through the chat function or raise your hand
- Identify who the question is directed to where possible



Quick Google Poll

POLL1

- How do you access National Water Model data today?
 - On-prem via NOAA
 - Cloud
 - Both/Either
 - 3rd party/Web-based Viewer
 - None/Other

POLL2

- My primary goal for attending today is:
 - Technical use and access of NWM data
 - To learn about cloud access to data (e.g. NODD Program)
 - Meet and engage with NOAA staff scientists
 - Learn about Microsoft Cloud access and tools



Open & Free

NODD Disseminates NOAA Line Office Data

NOAA data is growing exponentially...



TECHNOLOGY MODERNIZATION

Reduces stress on NOAA's on-premise dissemination systems

Improves services for Users

FULL & OPEN PUBLIC ACCESS

Supports Federal Data Strategy & Evidence Act
Open Data Requirements

No egress costs

- Open data with value to the public
- No use restrictions or user registration
- Appropriate Metadata included

ENABLES & ENGAGES USERS

Catalyzes innovation in environmental services

Enables interoperability





OWP | OFFICE OF
WATER
PREDICTION

National Water Model: Overview and Future Plans

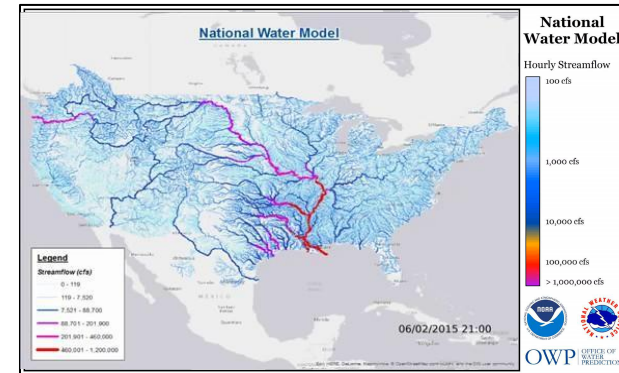
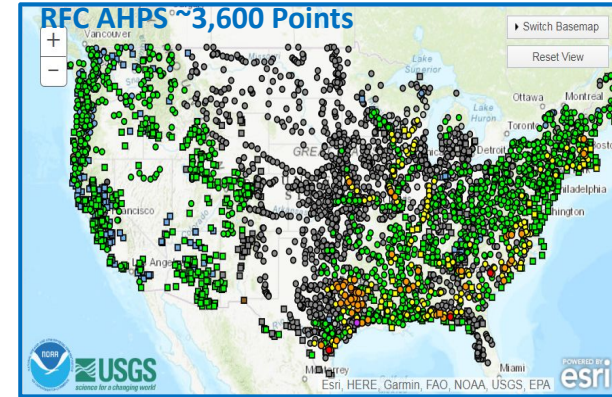
Brian Cosgrove and Sudhir Shrestha

Large Collaborative NOAA/OWP and NCAR Team

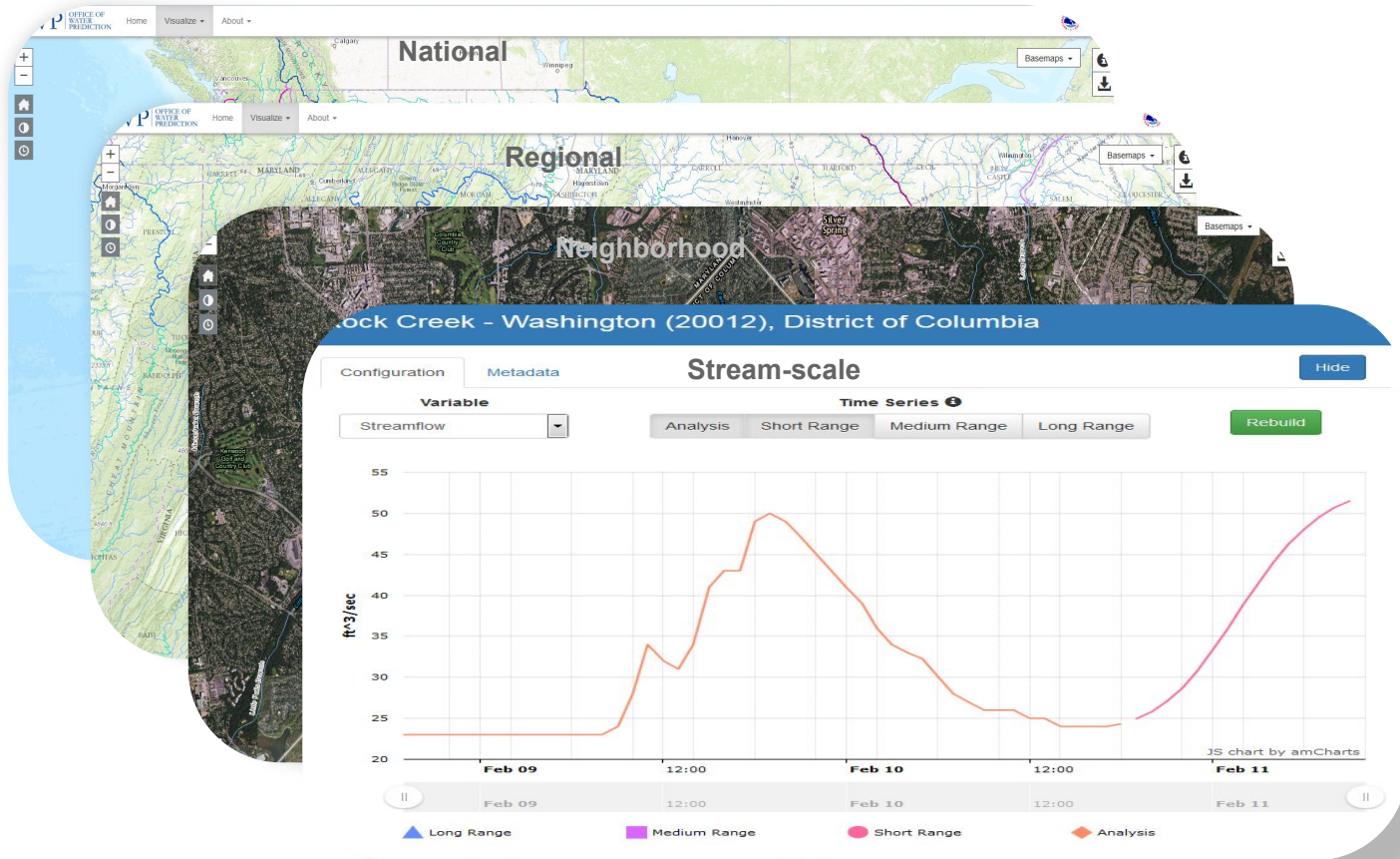


National Water Model Overview

- The NWM provides both complementary and first-time streamflow and other hydrologic guidance to NWS forecasters, emergency and water resource managers and others
- Most recent NWM upgrade, v3.0 in Sept 2023, v3.1 planned for early 2025



NWM Provides Multi-Scale Hydrologic Forecast Guidance

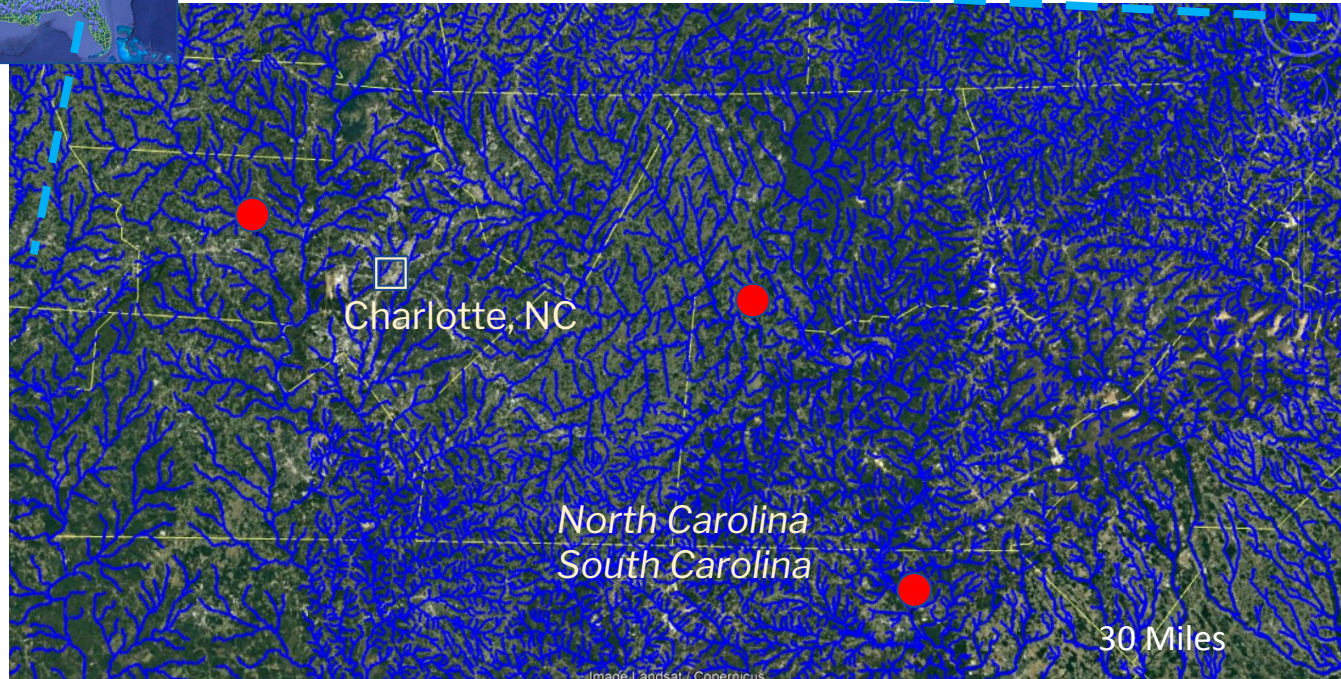


National Water Model: Filling in Coverage Gaps



Coverage example over the Carolinas

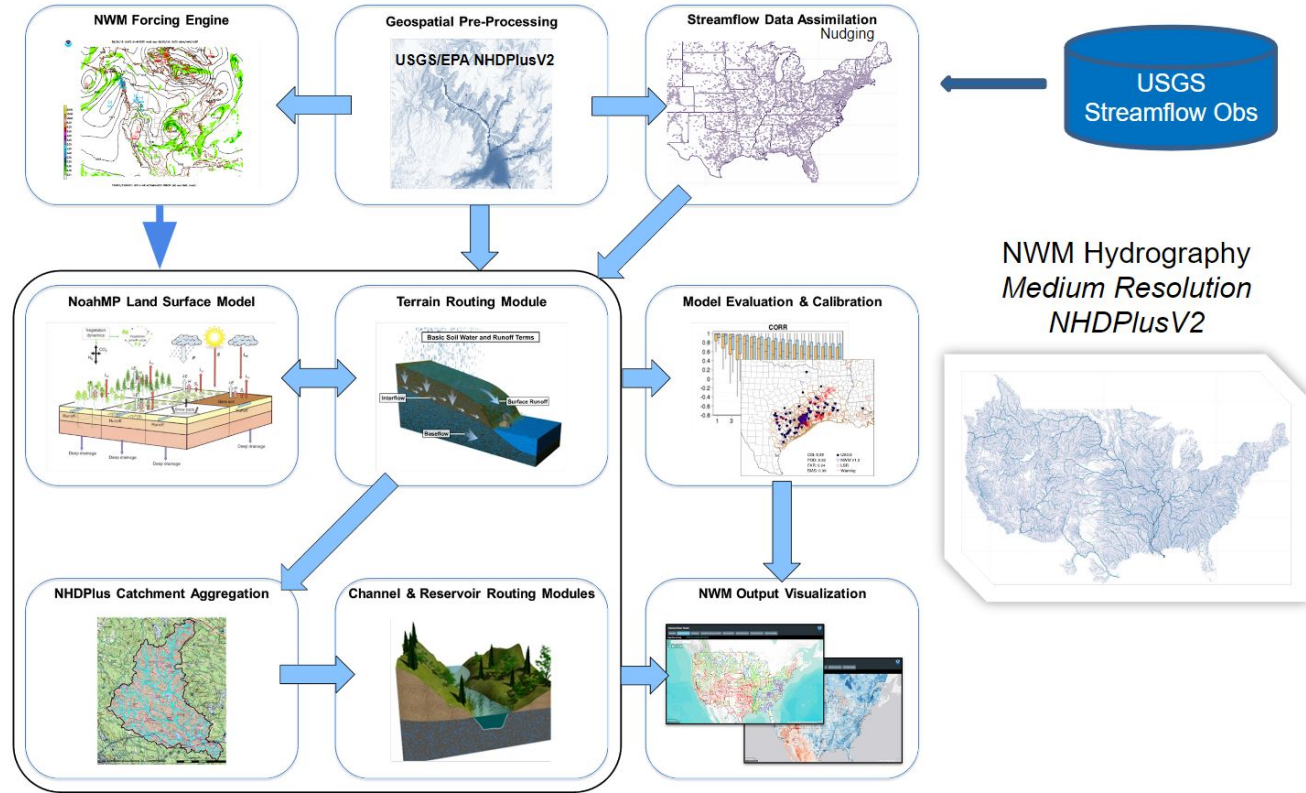
- Population > 3 million in this region, much of which is more than 30 miles away from the nearest RFC forecast point (circles at right)
- NWM complements existing RFC forecasts by providing guidance over a very dense set of stream reaches (blue at right)



National Water Model System Structure

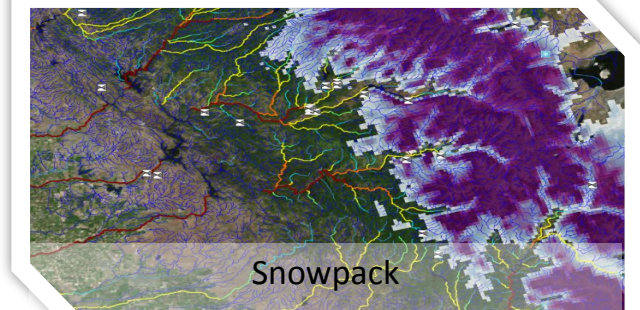
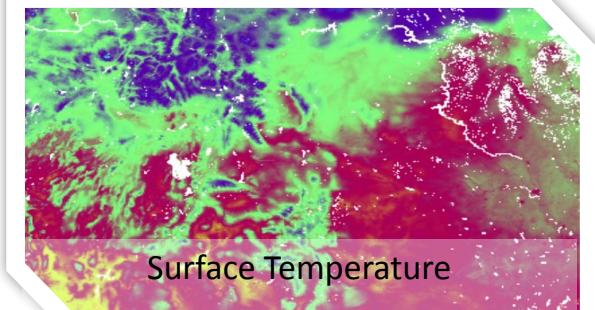
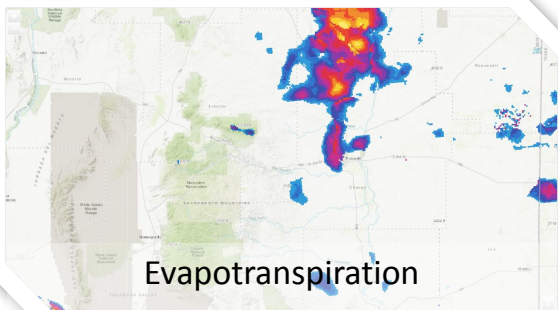
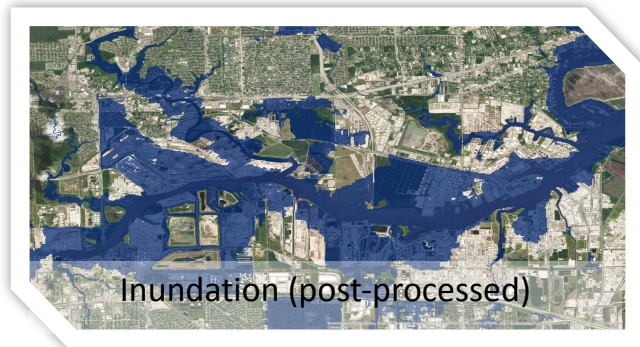
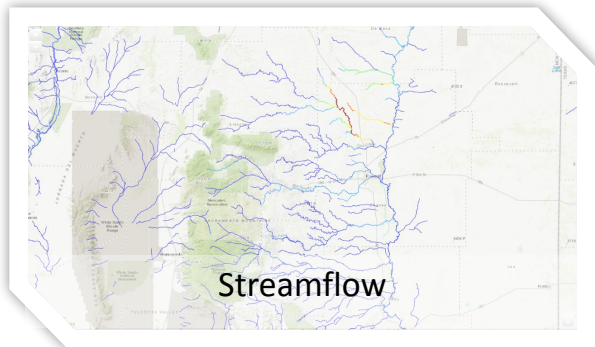
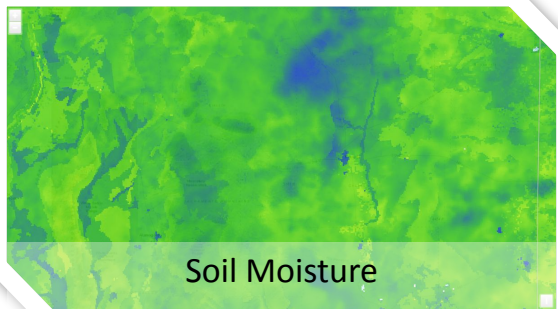
Fusion of column structure of land surface models, distributed structure of hydrologic models and national USGS/EPA NHDPlusV2 stream network. Supported by verification and visualization elements.

GIS processing essential to forcing engine, hydrofabric, data assimilation, Noah-MP parameter grids, reservoir mapping, evaluation and visualization

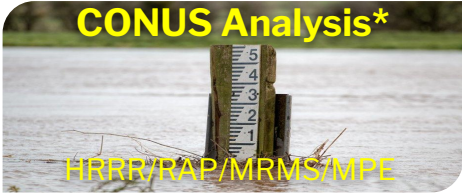


NWM Model Output

Select NWM Output Fields



Putting it all Together in Operations: NWM v3.0 24x7 Cycling



Lookback Range 3-28 hrs

Including open loop
(non-DA) members



18 Hour Forecast

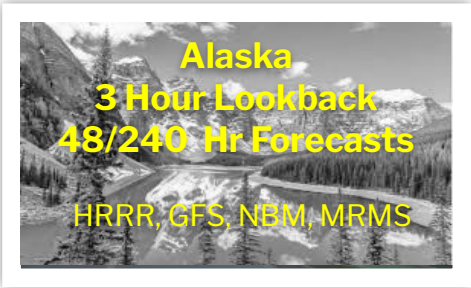


~10 Day Ens Forecast

Including open loop
(non-DA) member



30 Day Ensemble Forecast



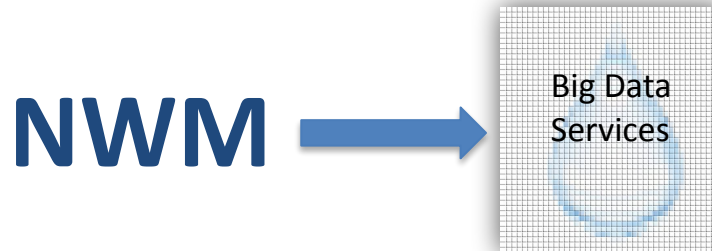
NWM Operational Computing Environment

- The NWM runs on the NOAA Weather and Climate Operational Supercomputing System (WCOS2)
 - The operational model runs in a fully automated fashion with no interactive user modifications allowed
 - Main data ingest sources should be operational themselves
- NWM Compute and disk usage
 - NWM V3.0 reaches a high water mark of ~105 nodes (overlapping jobs)
 - Daily disk footprint of > 6 TB, with more than 1TB posted for dissemination
- Annual upgrade cycle targeted, but varies with internal/external factors



National Water Model Output Dissemination and NODD

- **The National Water Model outputs massive amounts of data**
 - NWM V3.0 Real-time Operations: > 1 TB / Day
 - 44-Year Retrospective Simulation: >50 TB for model output (forcing more)
- **NWS NCEP Central Operations handles distribution of real-time operational data via NOMADS distribution service**
- **NOAA Open Data Dissemination (NODD) makes possible the provision of real-time and retrospective NWM data available via three Cloud Service Providers: AWS, Microsoft, and Google Cloud**

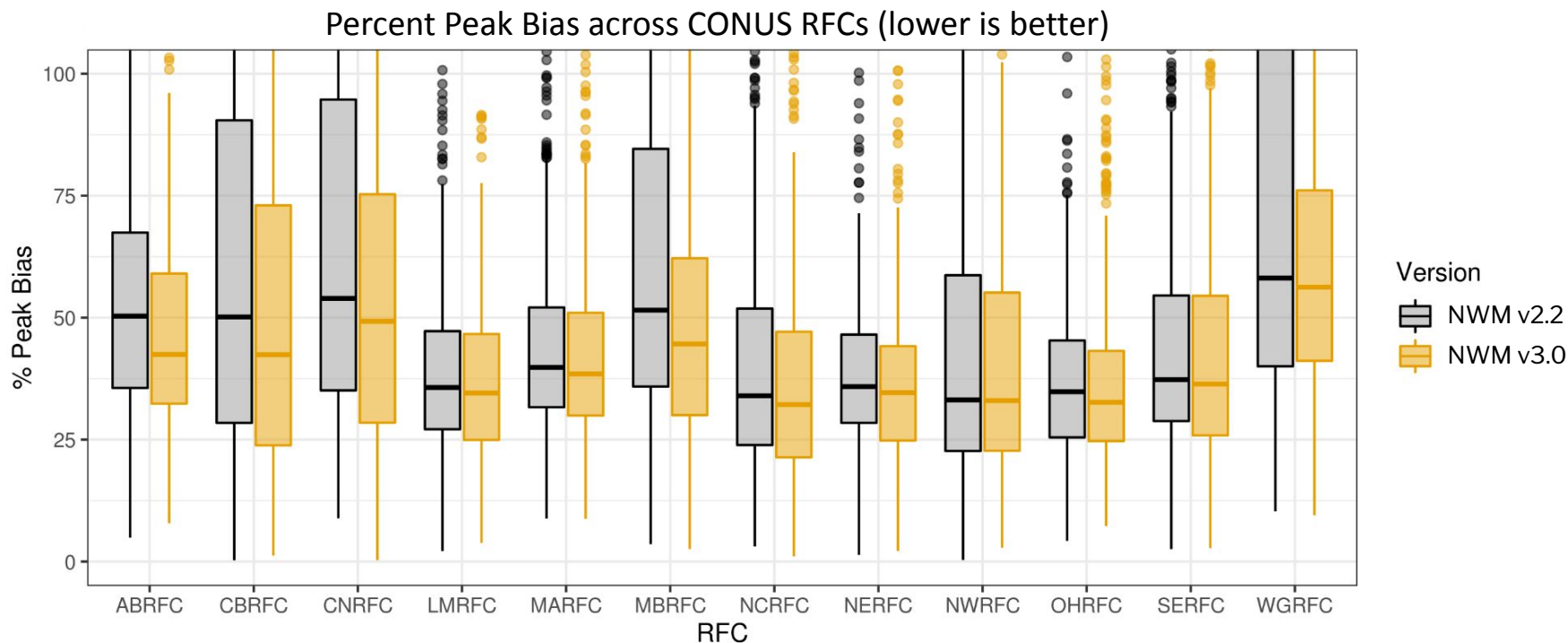


National Water Model v3.0 Upgrade Highlights:

Providing improved guidance for flood and hydrologic forecasts

- With this version, NWM is supporting congressional direction from the Coordinated Ocean Observations and Research Act of 2020
 - Provides first-time NWM Total Water Level (TWL) guidance for coastal areas of the CONUS, Hawaii and Puerto Rico / USVI
 - Supports nationwide flood inundation mapping
- Other major elements which improve hydrologic guidance
 - Expansion of domain to cover south-central Alaska
 - Addition of National Blend of Models as a forcing source for NWM CONUS medium-range and Alaska forecasts
 - Ingestion of MRMS precipitation forcing over NWM PR/VI domain
 - NWS Field-Driven Enhancements: Field input into calibration/regionalization, inclusion of additional RFC reservoir sites, and design of SHEF-formatted TWL output files

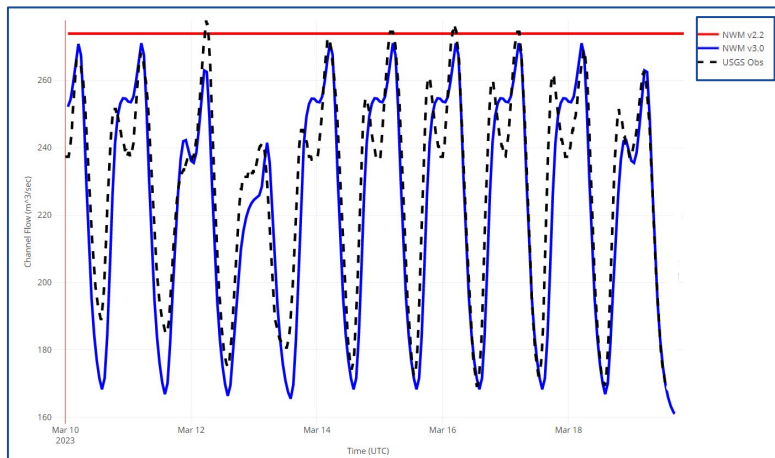
NWM v3.0: Improved CONUS Performance, Region-by-Region



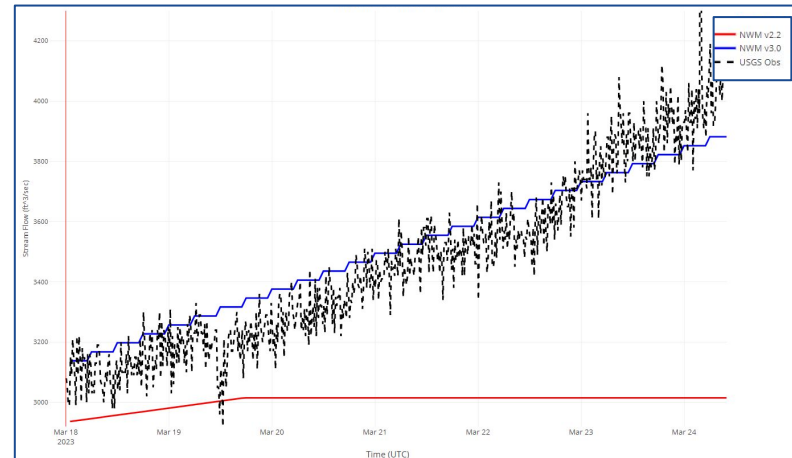
- Median peak bias improves across all River Forecast Center domains in NWM v3.0

NWM v3.0 Real-time Improvement: Additional RFC Data Ingest

Streamflow Downstream of
Lake Powell Reservoir, Arizona



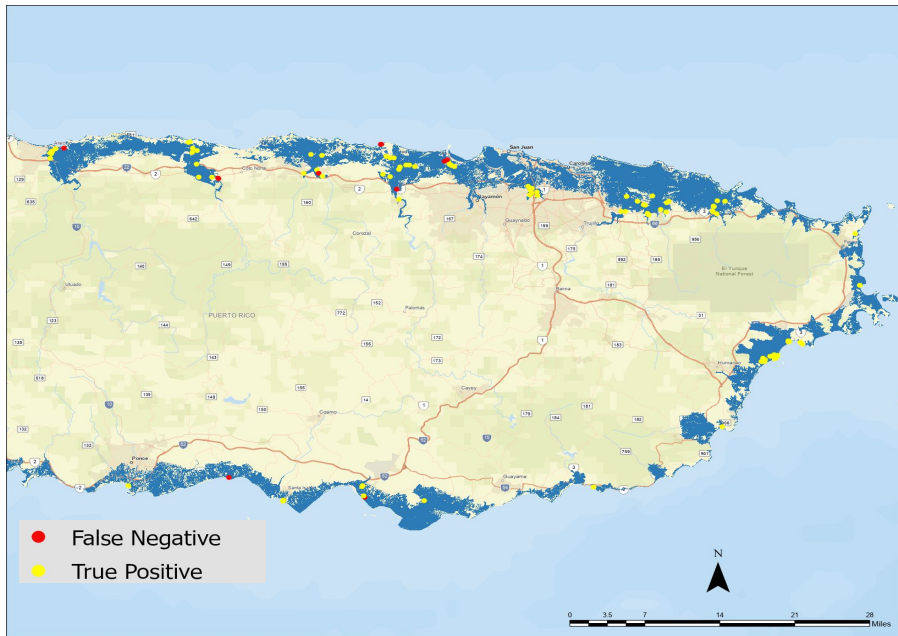
Streamflow Downstream of
Coeur D'Alene Lake, Idaho



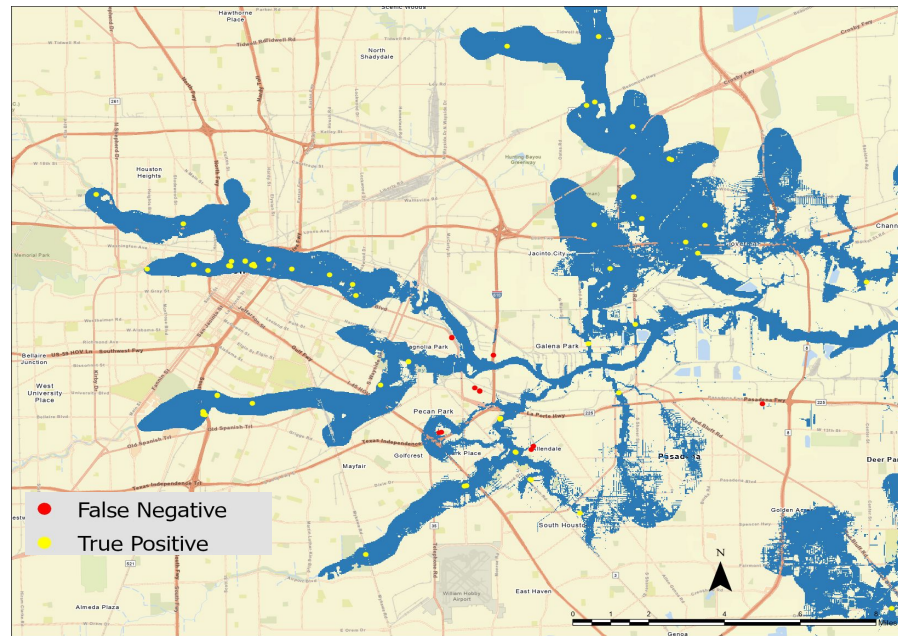
- NWM v3.0 assimilates RFC outflow forecasts at additional reservoir locations, improving downstream forecast accuracy, versus persistence or no-DA treatment in NWM v2.2

Example NWM Data Use Cases: Supporting Coast-to-Coast Flood Inundation Mapping at the National Water Center

NWM-Driven Maximum FIM, Hurricane Maria (PR)



NWM-Driven Maximum FIM, Hurricane Harvey (Houston, TX)



- **A critical advance: total water level output from NWM-SCHISM will be joined with NWM inland streamflow forecasts to create national summit-to-sea flood inundation maps**

Example NWM Data Use Cases: NWC Experimental Products

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

- **NWC Visualization Services**

- Probability of high flow
- Arrival time
- Other value-added products

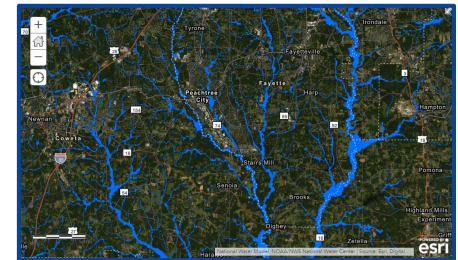
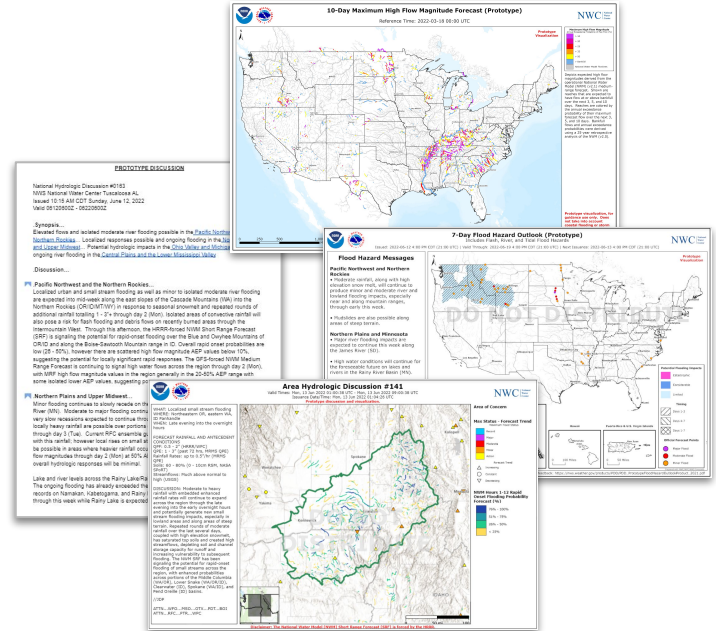
- **National Hydrologic Discussion (NHD)**

- **Area Hydrologic Discussion (AHD)**

- **Flood Hazard Outlook (FHO)**

- **Note:** Flood Inundation Mapping (FIM) Services are targeted for public release --

(10% of country as of Sept., ~100% by Q4 FY26)

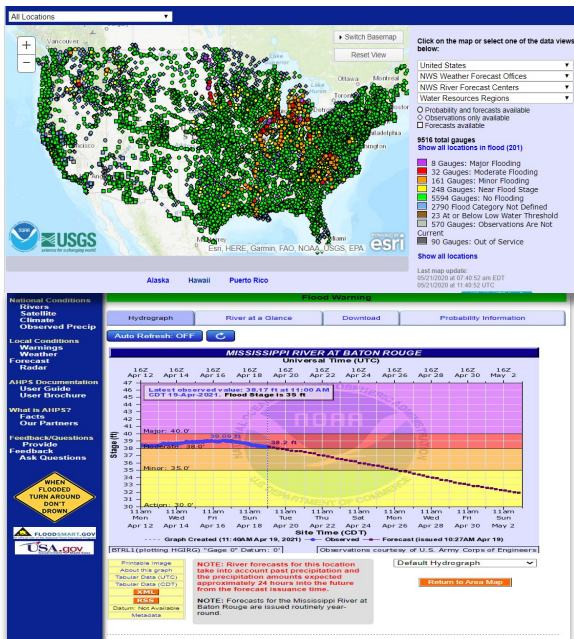


Integration of Hydro Program's Web Presence in National Water Prediction Service (NWPS)

AHPS
water.weather.gov

Office of Water Prediction
water.noaa.gov

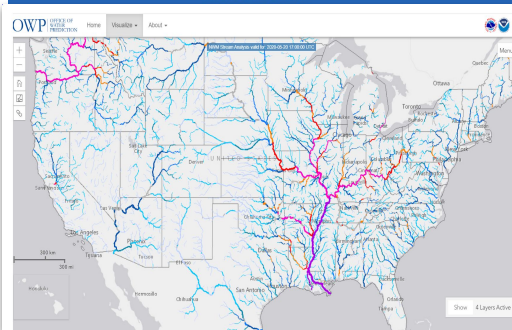
NWC Experimental Products
weather.gov/owp



Welcome to the
Office of Water Prediction

Vision
OWP envisions a Nation strengthened by equitable and actionable intelligence that informs water-related decisions, which enhances safety, resilience, security, and our economy.

Mission
Collaboratively research, develop and deliver timely and consistent, state-of-the-science national hydrologic analyses, forecast information, data, guidance, and equitable decision-support services to inform essential emergency management and water resources decisions across all time scales.



Area Hydrologic Discussion
Experimental short range, episodic discussion and graphic which highlights locations across the nation that may be impacted by rapid-onset flooding, using National Water Model and other guidance.
AHD Product Description Document
Provide Feedback on AHD

Flood Hazard Outlook
High Level graphical depiction and key messages highlighting the potential threat of inland flood hazards (flash, urban, small stream and riverine) and their associated impacts (catastrophic, considerable, and limited) for the next seven days.
FHO Product Description Document
Provide Feedback on FHO

National Hydrologic Discussion
Experimental discussion of the current and forecast hydrologic conditions across the nation, including a variety of short and medium range (Days 1-70) observed and modeled hydrologic guidance.
NHD Product Description Document
Provide Feedback on NHD

Significant River Flood Outlook
Operational flood outlook intended to provide a general outlook for significant (moderate and above river flooding). It is not intended to depict all areas of minor flooding or small-scale events such as localized flooding and/or flash flooding.

Experimental Flood Hazard Outlook

The Experimental Flood Hazard Outlook (FHO) is intended to provide a coordinated inland hydrologic flood graphic for use in regional and National Impact-Based Decision Support Services (IDSS) briefings, and support broad messaging of flood threats to National Weather Service (NWS) stakeholders and Federal water partners. This experimental product combines a depiction of current flood conditions based on the latest river level observations with an assessment of flood risk, leveraging various sources of NWS water resources forecast information. This experimental product is issued daily (21Z), but will be issued as needed.

Issue Time
2022-10-10
21:00 UTC

Legend
Flood Hazard
Major
Moderate
Minor
Flood Risk
High
Medium
Low
Flood Forecast
Major
Moderate
Minor

To access the Experimental FHO GIS Service and other NWS Cloud GIS Web Services please visit <https://www.weather.gov/owp/owp/owp.html>

Modernizing Hydrologic Data Dissemination in Office of Water Prediction

- National Water Prediction Service (NWPS): Authoritative, unified dissemination Platform

One stop Access to Data, APIs and Web Services

Improving Data Discovery, Access and Interoperability:

Analysis Ready data (ARD)

Cloud Optimized

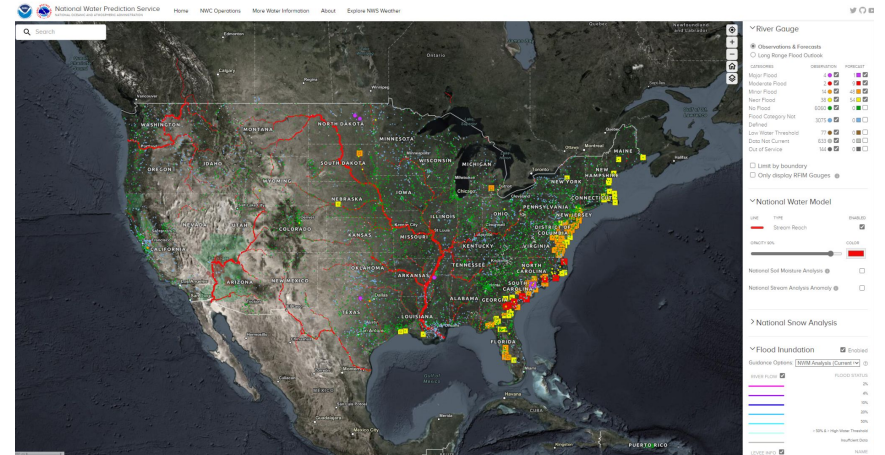
Towards Cloud-native formats and libraries [netcdf --> Zarr, COG,

Future: Kerchunk]

Indexed Metadata

Where are we going?

Cloud-native data allowing improved Data Discovery, Processing, Analytics and Visualization promoting Scalability and Reproducibility



National Water Prediction Service (NWPS)

Data Dissemination in Cloud: Cloud Service Providers (CSPs)

- NOAA Open Data Dissemination



S

Y

National Weather Service (NWS) <https://www.noaa.gov/nodd/datasets#NWS>

[Climate Forecast System \(CFS\)](#) » [Amazon Web Services](#) » [Google](#) » [Microsoft Azure](#)

[CFS Reanalysis](#) » [Google](#)

[Global Forecast System \(GFS\)](#) » [Amazon Web Services](#) » [Google](#) » [Microsoft Azure](#)

[Global Ensemble Forecast System \(GEFS\)](#) » [Amazon Web Services](#)

[High Resolution Rapid Refresh Model \(HRRR\)](#) » [Amazon Web Services](#) » [Google](#) » [Microsoft Azure](#)

[Hurricane Analysis and Forecast System \(HAFS\)](#) » [Amazon Web Services](#)

[National Blend of Models \(NBM\)](#) » [Amazon Web Services](#)

[National Digital Forecast Database \(NDFD\) \[Historical\]](#) - [Cornell University, Earth & Atmospheric Sciences \(EAS\) Data Lake](#) » [Amazon Web Services](#)

[National Digital Forecast Database \(NDFD\)](#) » [Amazon Web Services](#)

National Water Model

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

[Short Range Forecast](#) » [Amazon Web Services](#) » [Google](#)

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

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

Next Generation Weather Radar (NEXRAD)

[NEXRAD Level 2 Real-Time and Archive Data](#) » [Amazon Web Services](#) » [Google](#)

[NEXRAD Level 3 Real-Time and Archive Data](#) » [Google](#)

[Space Weather Prediction Center \(SWPC\) Forecasts](#) » [Amazon Web Services](#)

[Rapid Refresh \(RAP\)](#) » [Amazon Web Services](#) » [Google](#) » [Microsoft Azure](#)

[Real-Time Mesoscale Analysis \(RTMA\) / Unrestricted Mesoscale Analysis \(URMA\)](#) » [Amazon Web Services](#) » [Google](#)

[Yesterday's Storm Reports](#) » [Google](#)



Data Dissemination in Cloud: National Water Model (NWM) Data



National Water Model

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

Short Range Forecast » [Amazon Web Services](#) » [Google](#)

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

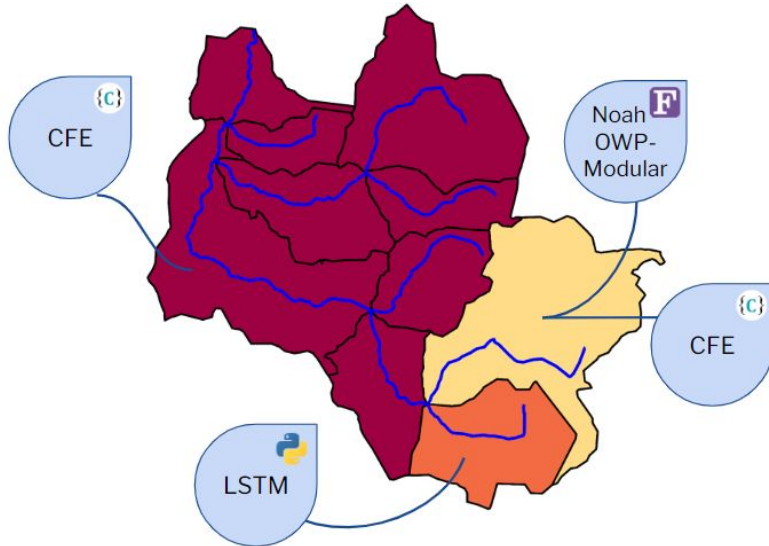
Reanalysis V 2.0 » [Amazon Web Services](#) » [Google](#)

Data in the pipeline:

NWM V3.0, Analysis of Record for Calibration (AORC)

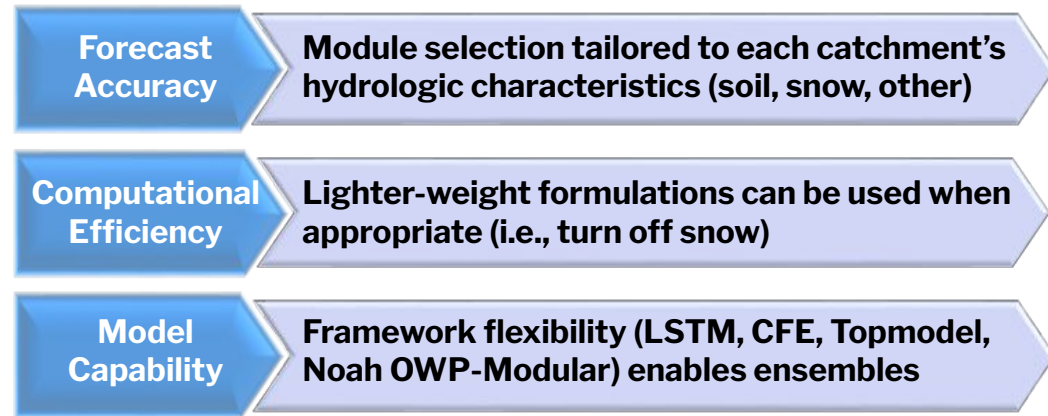
NWM v4.0 (2026): Advancing Operations with NextGen Framework

- The NWM software architecture is being rewritten from the ground up - Next Generation Water Resources Modeling Framework (NextGen)
- A core feature of the community-oriented Nextgen framework is the ability to vary model components by hydrologic catchment...



**Multiple catchments -
Multiple formulations**

This will lead to key operational improvements



Closing Thoughts

- The coverage and breadth of the operational NWM drives operational forecasting, research, and commercial applications
- What exists now is a foundation that will continue to be built upon
- v3.0 implemented September 2023 with NextGen-based v4.0 2026
- Parallel upgrades to visualization products and flood inundation mapping techniques
- Partnership with the Big Data providers enhances data access for end users, benefiting research, commercial and government applications, and model development



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PREDICTION

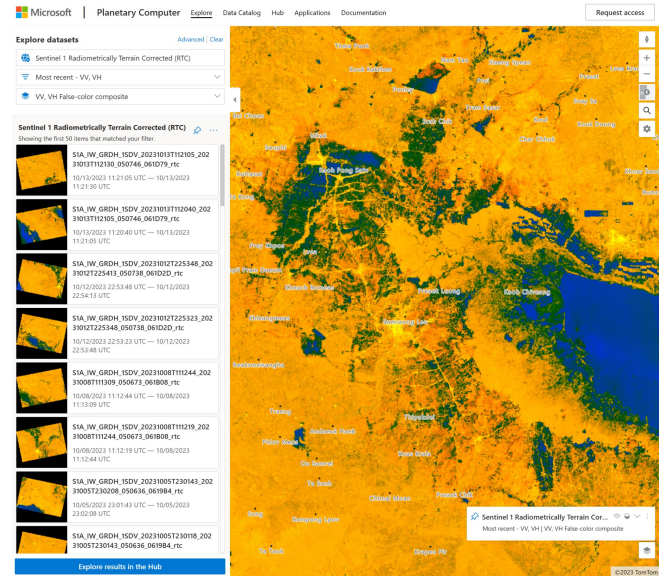
Microsoft Planetary Computer

- About 60 PB of publicly available Earth Systems data
- STAC API for querying the data

```
catalog = pystac_client.Client.open(
    "https://planetarycomputer.microsoft.com/api/stac/v1/",
)

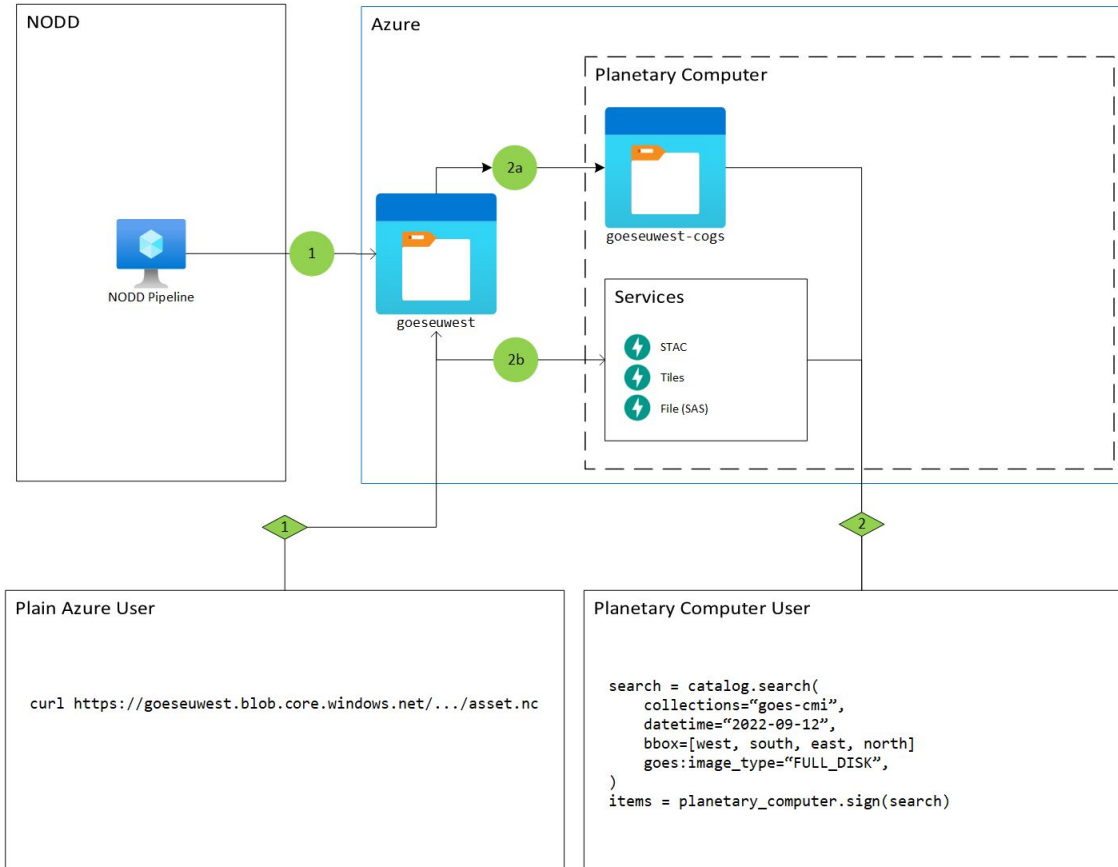
search = catalog.search(
    collections="noaa-mrms-qpe-24h-pass2",
    datetime="2022-07-23T01:00:00Z",
    query={"noaa_mrms_qpe:region": {"eq": "CONUS"}},
)

items = search.item_collection()
```



The screenshot displays the Microsoft Planetary Computer web interface. The top navigation bar includes "Microsoft | Planetary Computer" and links for "Explore", "Data Catalog", "Hub", "Applications", and "Documentation". A "Request access" button is visible in the top right corner. The main content area is titled "Explore datasets" and shows a search for "Sentinel 1 Radiometrically Terrain Corrected (RTC)". The search results are displayed in a list on the left, showing the first 10 items. Each item includes a thumbnail image and a list of metadata fields: "S1A_IW_GRDH_1SDV_20231013T12105_20231013T12130_050746_061079_etc", "10/13/2023 11:21:05 UTC - 10/13/2023 11:21:30 UTC". The right side of the interface shows a map view of the data, with a yellow and orange color scale representing the terrain. The map includes labels for various geographical features and cities, such as "Rocky Mountain", "Great Salt Lake", "Great Lakes", "Mississippi River", "Gulf of Mexico", "Caribbean Sea", "Atlantic Ocean", "Indian Ocean", "Pacific Ocean", "Arctic Ocean", "Antarctica", "North America", "South America", "Africa", "Europe", "Asia", "Australia", and "Oceania". The map also shows a "Request access" button in the top right corner.

Planetary Computer & NODD



Questions and Discussion

- Please be brief in your questions / comments
- Use the chat or raise your hand for questions
- Identify who the question is directed to where possible
 - As questions are answered, we will go to the next in the chat queue and call on you to unmute yourself and ask your question.
 - We appreciate there may be questions that cannot be answered immediately and even those that we won't have an opportunity to get to: please be patient as we build our understanding and summary responses.



Resources

We invite you to stay engaged with NOAA!

- **NOAA National Water Model References**
 - <https://water.noaa.gov/about/nwm>
 - <https://www.weather.gov/owp/operations>
- **NOAA NWS Office of Organizational Excellence**
 - Email: cindy.elsenheimer@noaa.gov
- **NOAA Open Data Dissemination**
 - Email: NODD@noaa.gov
- **Microsoft NWM Resources:**
 - <https://microsoft.github.io/AlforEarthDataSets/data/noaa-nwm.html>
 - <https://planetarycomputer.microsoft.com/>

