OWP | OFFICE OF WATER PREDICTION

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THE NATIONAL WATER MODEL

This water prediction model creates forecast guidance for over 3.4 million miles of rivers and streams across the United States and its territories. The NWM also guides NWS field offices to support the delivery of expanded water services, as part of NOAA's integrated environmental intelligence and prediction capabilities.

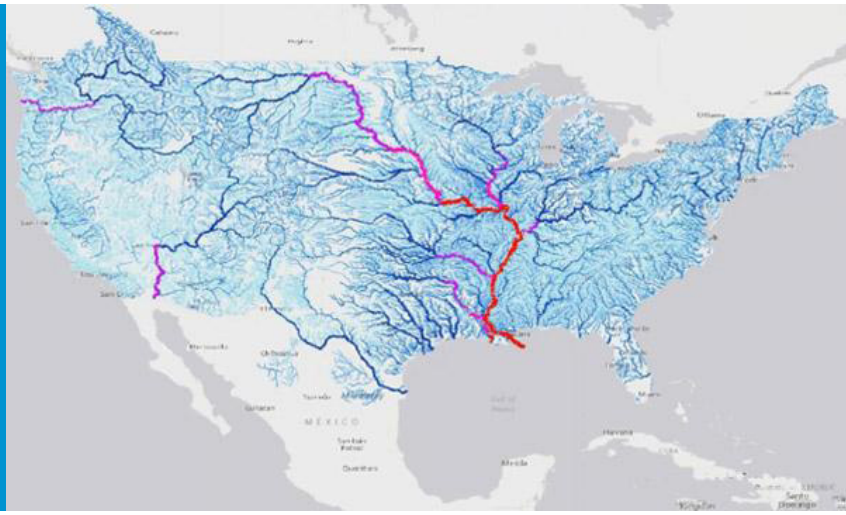

Image: National Water Model Streamflow output points.

WHERE WE STARTED

After rapid development, and following an initial demonstration during the Summer Institute at the NWC in 2015, NOAA released Version 1 of the National Water Model (NWM) in August of 2016. Through continued investments the NWM has been expanded and updated on a regular release cycle.

WHERE WE ARE TODAY

VERSION 2.1 OF THE NWM

With an implementation date of January 2021, V2.1 features several significant upgrades that emerged from the development efforts of the joint OWP-NCAR (National Center for Atmospheric Research) development team.

Highlights include:

- First-time NWM coverage for Puerto Rico and USVI, complementing River Forecast Center (RFC)-sourced streamflow forecasts with island-wide hydrologic guidance
- Expansion of modeling domain to include Great Lakes and Lake Champlain drainage basins
- Forcing, physics and calibration improvements for the Hawaii domain
- A new treatment for reservoirs which leverages RFC, USGS, and USACE data feeds
- New open loop (no-data-assimilation) configurations requested by RFC partners to support interpretation of NWM output
- Improvements to the model's snow and runoff parameters along with the parameter calibration procedure
- Expansion of the NWM V2.1 domain to include Puerto Rico, USVI and the Great Lakes Drainage basin will enhance forecast services for the ~30 million Americans living in those regions

WHERE WE'RE GOING

1.0

2016
- First-ever CONUS Water Modeling Capability
- 2.7 million rivers reaches

2.0

2019
- Expansion to Hawaii
- Medium Range Ensembles
- Multi-sensor Precipitation Estimation Ingest
- Improved Forecast Initiation

2.1

2021
- Expansion to Puerto Rico, US Virgin Islands and the Great Lakes Drainage Basin
- Improved Reservoir Treatment
- Improved Hawaii Forecast Performance

3.0

2023
- Total Water Forecasting
- Expansion to Alaska (Cook Inlet and Cooper River Basin)
- Continental-scale Hydraulic Routing

NextGen Framework

2024
- Flexible Modeling Framework
- Heterogeneous Process Representation
- Collaborative Community Development (GitHub.com/NOAA-OWP)

NEXTGEN FRAMEWORK

Improvements in NWM performance from version to version, by calibration, are beginning to plateau. Whereas the current NWM applies the same formulation everywhere, the hydrologic literature suggests improvements can be made through use of specific model formulations tailored regionally for individual streamflow generation processes. The Office of Water Prediction (OWP) proposed the development of an interagency "Next Generation Water Resources Modeling Framework" or NextGen. The Next Generation National Water Model (Nextgen NWM) will represent a particular configuration of the NextGen framework. The NextGen framework promotes model interoperability, standardizes data and model setup workflows, and eases implementation and evaluation of different modeling approaches. The potential of the NextGen framework has led OWP to work with other federal water science and modeling partners, including the U.S. Army Corps of Engineers, U.S. Geological Survey, and the U.S. Bureau of Reclamation, as well as the academic research community.

An interagency requirements meeting led to the following set of “design tenets” in establishing the NextGen framework:

- Maximum flexibility (model agnostic)
- Common architecture to promote interoperability
- Open source and standards-based development
- Friendly to domain scientists and engineers to facilitate community development
- Two-week target to allow graduate students or new employees to add functionality supported by clear and concise documentation and step-by-step examples/tutorials and training

A second interagency meeting produced agreement on a two-pronged approach for model coupling standards. The first uses the existing Basic Model Interface (BMI) standard for model coupling, and extends it to allow more efficient use of models on supercomputers. The second involves developing a component library of standard flux calculators, integrators, and numerical solvers, to enable the framework to apply standard methods for calculation across the many potential hydrological models deployed in the framework.

The NextGen framework is in the early stages of development and OWP expects that the NextGen prototype will serve as the starting point for development. Together with our federal partners, academic and research centers, the NextGen framework offers the potential to create a powerful research, development, testing, and operational system to advance hydrologic and water resources prediction at temporal scales ranging from sub-hourly to decadal, and spatial scales ranging from catchments to continents.

OWP will identify the features included in the NextGen configuration that replaces the current operational NWM in 2024. The reliance on open source development practices, data and model coupling standards enhances interoperability between federal agencies, speeds the adoption of advances from the research community, and creates a new and exciting opportunity to stop reinventing models, and a framework to advance successful formulations.

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STAY UPDATED ON THE LATEST NEWS ABOUT THE NEXTGEN MODEL BY VISITING OUR GITHUB

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The Next Generation Water Resources Modeling Framework promotes model interoperability on a common data model through use of established geoscience standards. Implementing standards-based development in an open-source environment is transformative for hydrologic prediction; it advances model developers beyond the need to invent data models and model coupling strategies. This new framework offers unprecedented opportunities for collaboration with federal partners and the broader research community to enhance modeling to meet water resource challenges of the 21st century.

- Fred Ogden
OWP Chief Scientist