

A high-speed photograph of water splashing, creating a dynamic, blue-toned background. The water droplets and ripples are captured in sharp detail, with light reflecting off the surfaces.

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The National Water Model: Current Status and Evolution to the NextGen Framework

*Brian Cosgrove, Ed Clark, Aubrey Dugger, Trey Flowers,
David Gochis, Tom Graziano and Fred Ogden*

Large Collaborative NOAA/OWP and NCAR Team



National Water Model Overview

- The NWM revolutionizes how hydrologic guidance is developed and delivered, providing both complementary and first-time coverage and outputs
- Most recent NWM upgrade, v2.1 in April 2021, v3.0 planned for July 2023
- Major capability enhancements planned for v3.0

**v.1.0/
1.1/1.2**

**Foundation:
2016-2018**

**v.2.0/
2.1**

**Upgrades:
2019-2021**

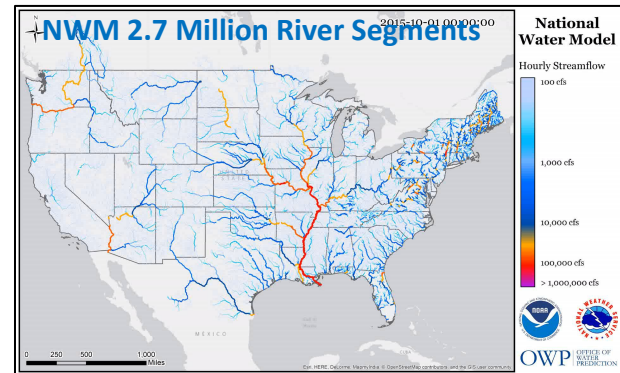
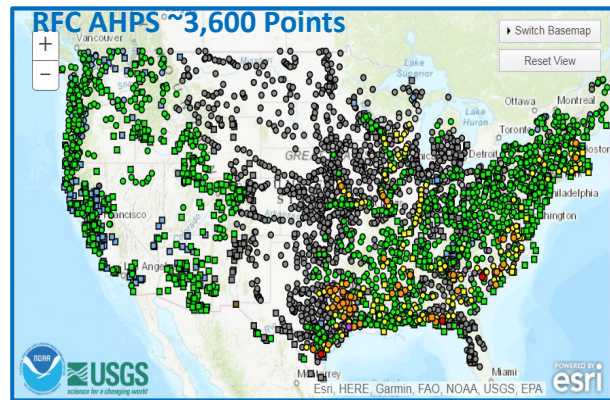
v.3.0

**Next Upgrade:
2023**

v.4.0

**Future Upgrade:
2025**

- Baseline NOAA water forecast model running on operational supercomputer
- Expansion to Hawaii and Puerto Rico, forcing and reservoir improvements
- Total water level, expansion to Alaska, NBM forcing, physics and calibration
- Use of NextGen - heterogeneous modeling, coastal coupling / river routing upgrades

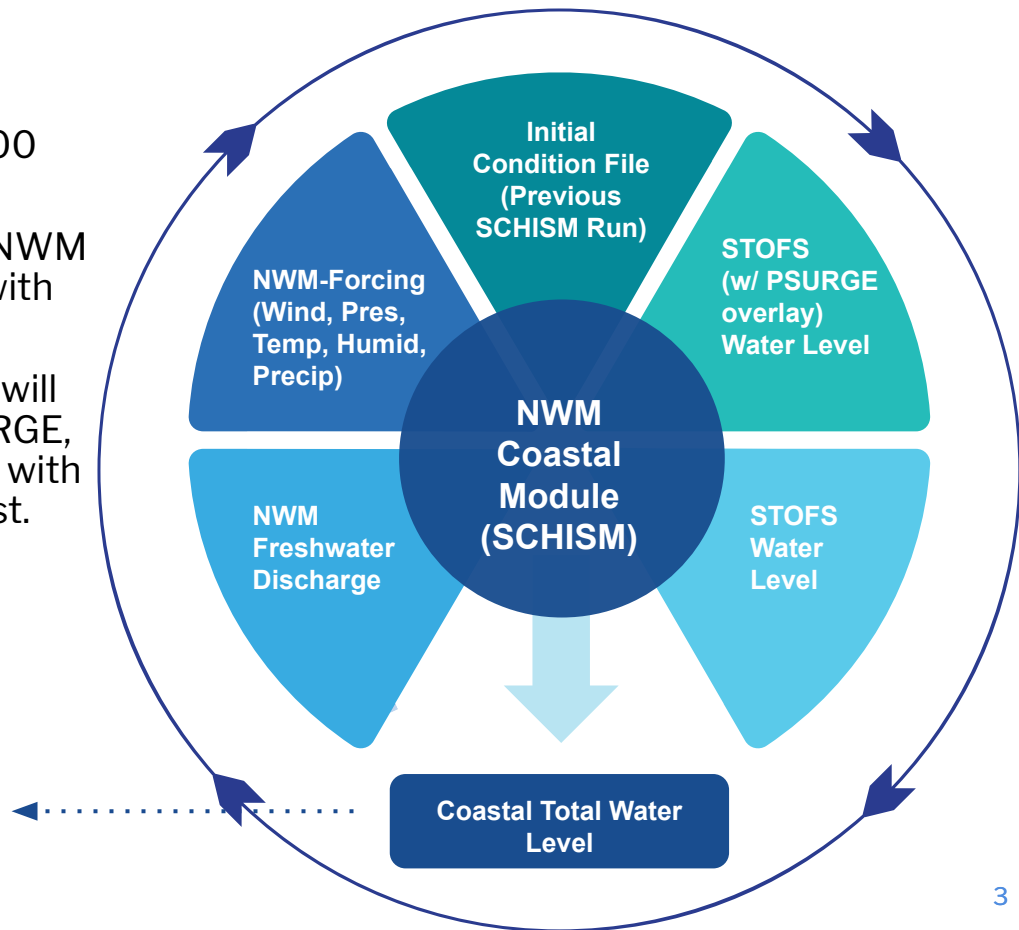
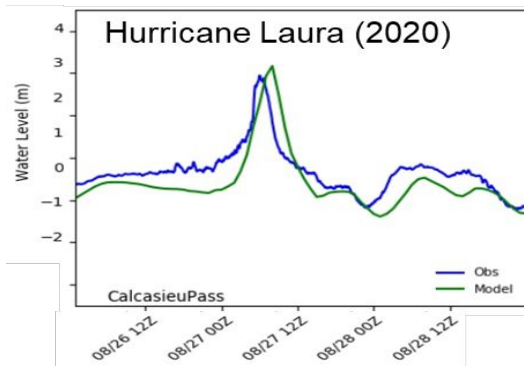


NWM v.3.0 (2023): New Total Water Level Forecasting Capability

Looking Ahead: Filling the capability gap

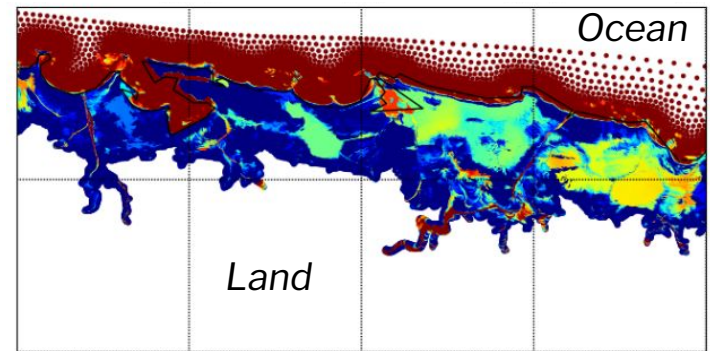
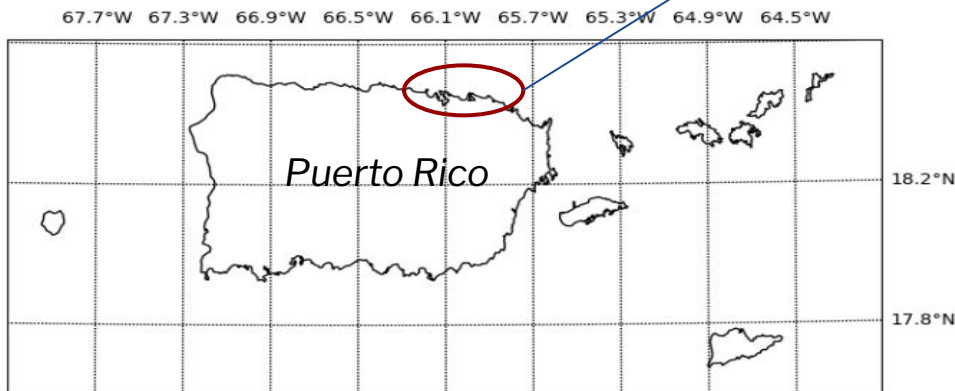
- TWL guidance is increasingly critical to the 100 million+ people living near the coast
- National total water level forecasts from the NWM will complement existing regional forecasts with *CONUS-wide, Hawaii, and PR/VI guidance*
- This new freshwater-estuary-ocean coupling will leverage the NWM, SCHISM, ESTOFS & PSURGE, execute in both Analysis and Forecast modes with output format optimized for operational ingest.

For more details: TWL talk by Qi Shi, 11:50am (H53B-06)

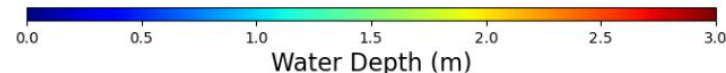


NWM Total Water Level: Hurricane Maria Test Case

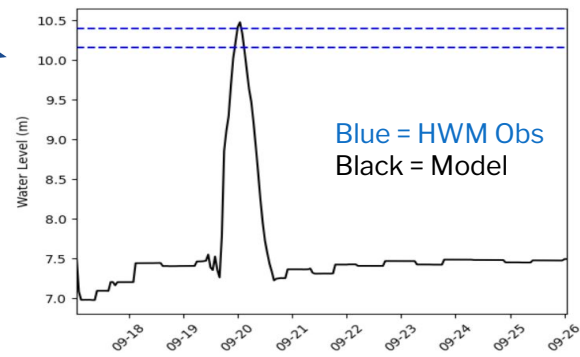
- Hurricane Maria caused catastrophic inundation of coastal communities in Puerto Rico
- New NWM total water capability simulates inundation due to combined impact of freshwater *plus* Maria's storm surge, tide and wind.



Hurricane Maria - 16Z on 9/20/17



Time Series of Water Elevation

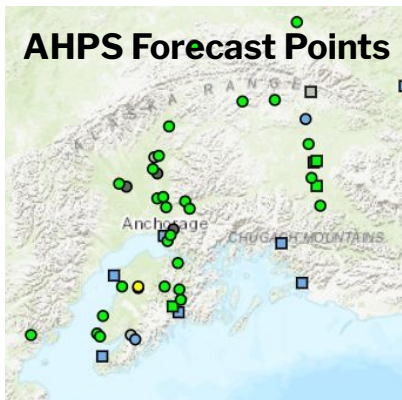
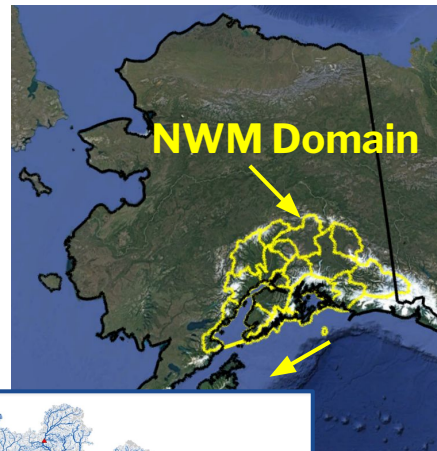


NWM v.3.0 (2023): New Alaska Domain

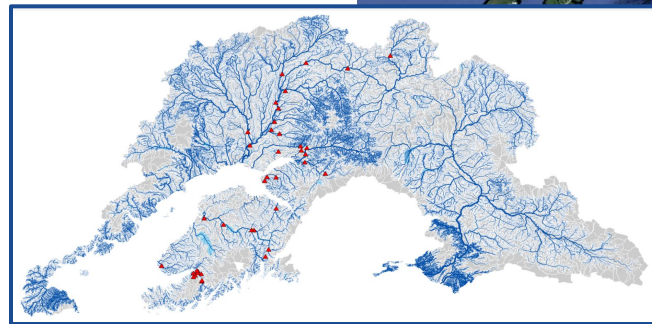
Overarching Goal: Implement NWM Alaska domain to provide augmented streamflow and distributed water cycle guidance to help protect Alaskan communities and infrastructure.

NWM Alaska Summary

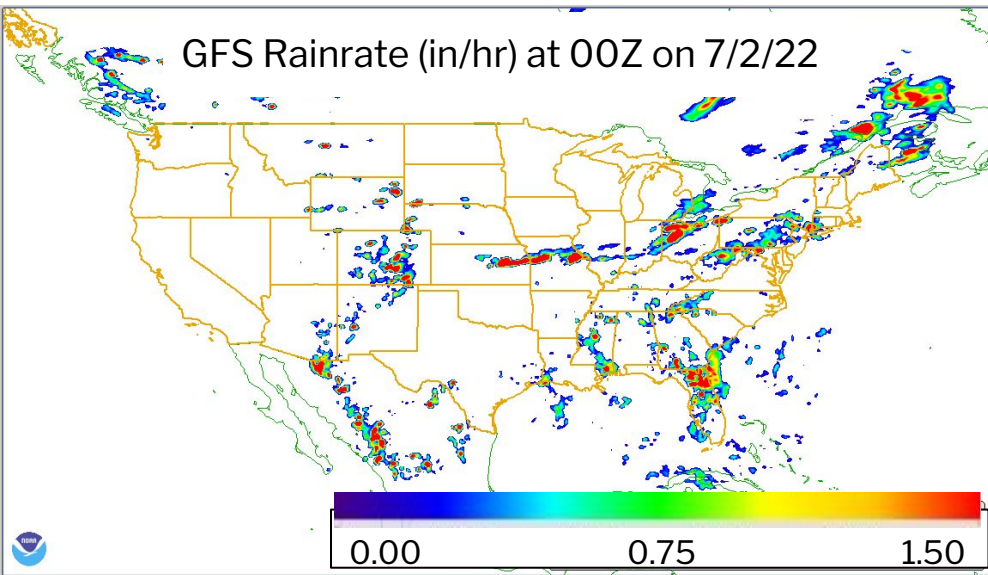
- Close configuration/forcing coordination with Alaska Pacific RFC
- Ingest of APRFC glacial dam lake (GDL) outflow forecasts
- Customized model and forcing configurations
- Guidance for 390k stream reaches complements RFC AHPS sites



Dense network of NWM
hydrologic guidance



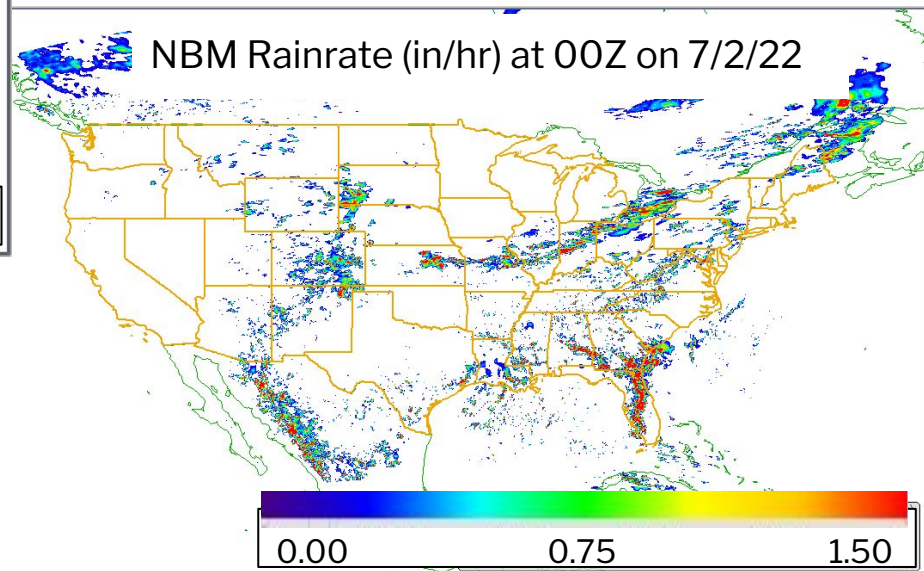
NWM v3.0 Additional Enhancements: National Blend of Models Forcing



- NWM v3.0 will feature first-time use of the NBM as forcing
- Implemented for both CONUS and Alaska domains



- New 10-day CONUS forecast configuration forced by NBM will be added, complementing existing GFS-forced members
- Use of NBM will enhance coordination with NWS Centers and Field offices, increase model skill



NWM v3.0 (2023): Additional Enhancements

Land Surface Enhancements

- Improved representation of impervious conditions via NLCD data-based adjustment of precipitation available for infiltration
- Integrated new runoff module (Xinjiang) to improve partitioning of runoff and infiltration

Improved Calibration

- Revised multi-option spatially-varying regionalization approach
- Updated calibration objective function to use Kling Gupta Efficiency (KGE) metric
- Leveraged NWS River Forecast Center (RFC) expertise
 - RFC-suggested calibration basins and RFC-derived parameters
 - RFC-specified donor-receiver pairings, regionalization guidelines

Improved Forcing and Data Assimilation

- Implemented use of MRMS QPE over Puerto Rico / US Virgin Islands
- Ingest of RFC-supplied reservoir outflow forecasts at 57 additional locations, bringing total to 392.

Putting it All Together: NWM Operational Cycling

CONUS Analysis*

HRRR/RAP/MRMS/MPE

Lookback Range 3-28 hrs

Including open loop
(non-DA) members

CONUS Short-Range*

HRRR/RAP

CONUS Med-Range Ens*

GFS, NBM

CONUS Long-Range Ens

GFS

18 Hour Forecast

~10 Day Ens Forecast

Including open loop
(non-DA) member

30 Day Ensemble Forecast

Hawaii* /
Puerto Rico USVI*
3 Hour Lookback
48 Hour Forecast

HiRES ARW/NAM-NEST/MRMS

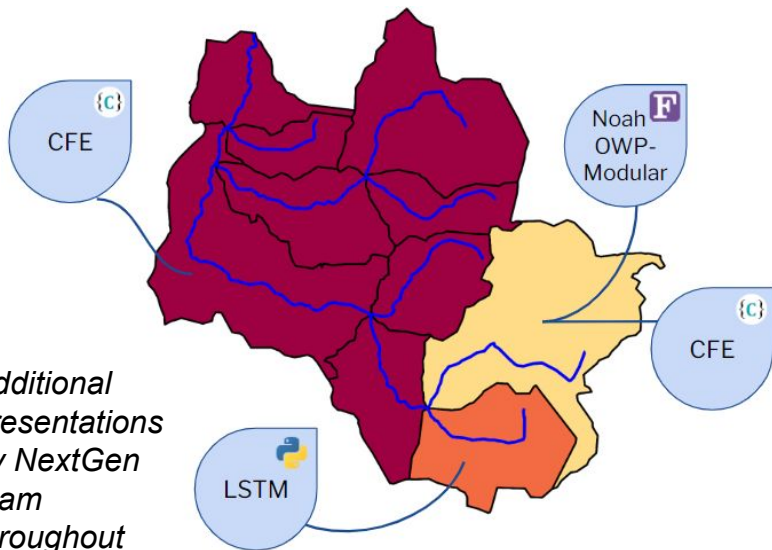
Alaska
3 Hour Lookback
48/240 Hr Forecasts

HRRR, GFS, NBM, MRMS

*Coastal Total Water Level

NWM v4.0 (2025): Advancing Operations with NextGen Framework

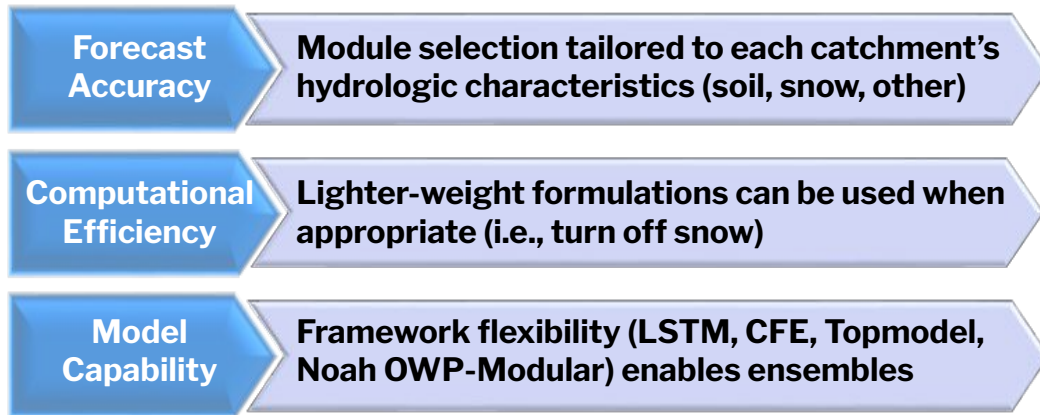
- The NWM software architecture is being rewritten from the ground up - Next Generation Water Resources Modeling Framework (NextGen)
- A core feature of the community-oriented NextGen framework is the ability to vary model components by hydrologic catchment...



Additional presentations by NextGen team throughout this session

Multiple catchments - Multiple formulations

This will lead to key operational improvements



A close-up, high-speed photograph of water splashing, creating a dynamic pattern of droplets and ripples in shades of blue.

Closing Thoughts

- The coverage and breadth of the operational NWM drives operational forecasting, research, and commercial applications in a way not before possible - Total Water Level and Alaska.
- What exists now is a foundation that will continue to be built upon
- v3.0 in mid-2023 with NextGen-based v4.0
- Parallel upgrades to visualization products and flood inundation mapping techniques
- Steady upgrades to model skill, partnerships with end users and community development will continue to advance the system





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Thank You!



For More Information:

Brian Cosgrove



Brian.Cosgrove@noaa.gov



<https://water.noaa.gov>

Presentation Schedule

