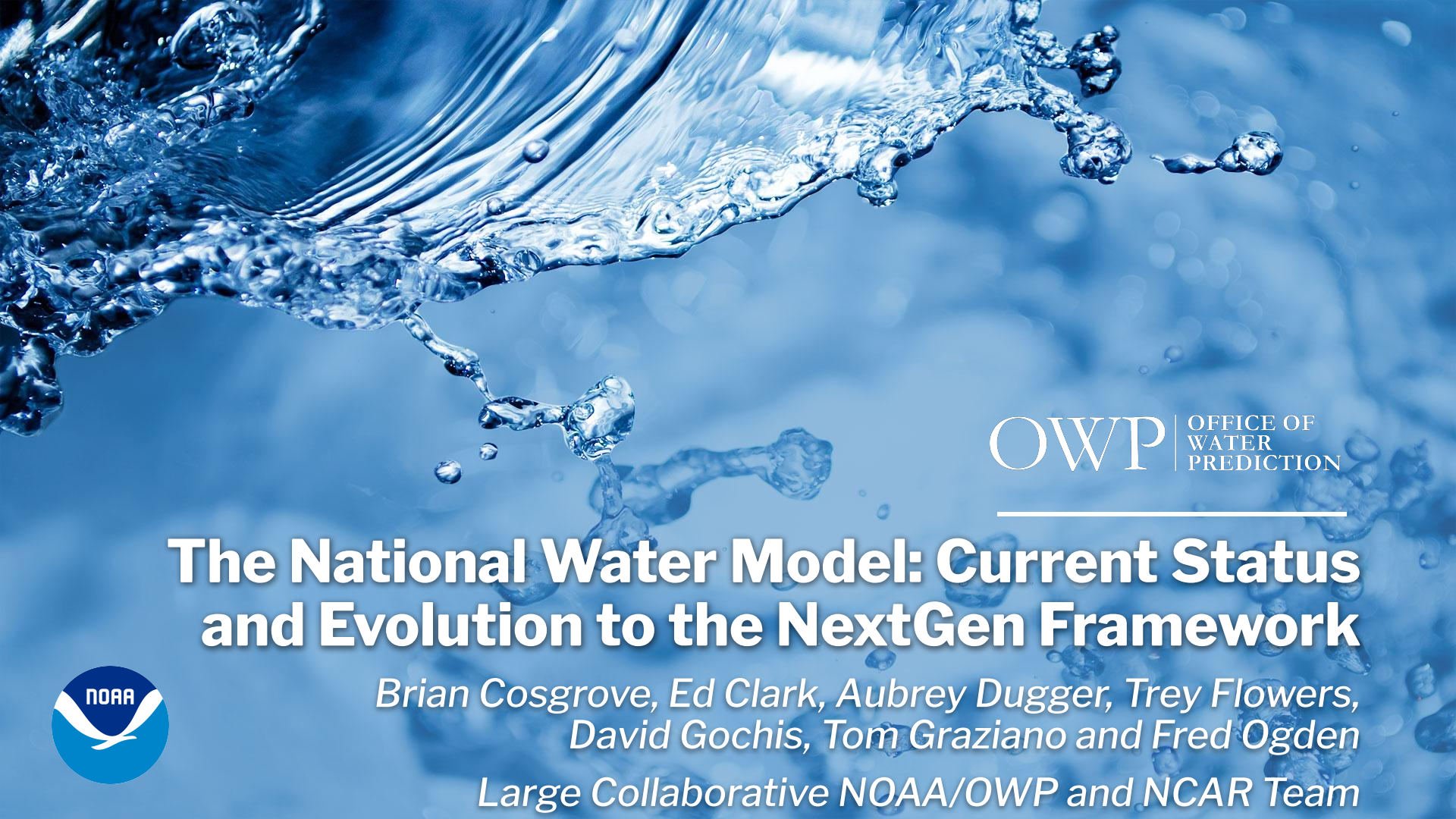

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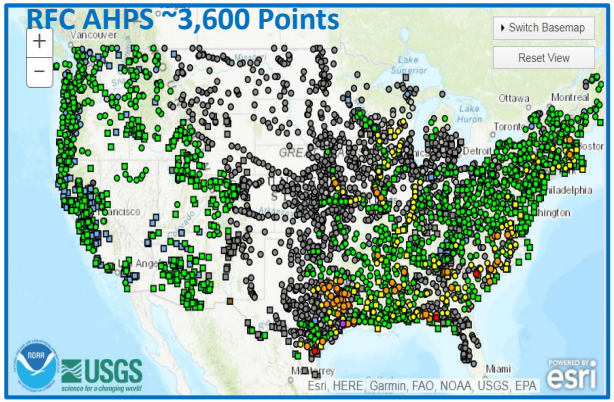
The National Water Model: Current Status and Evolution to the NextGen Framework

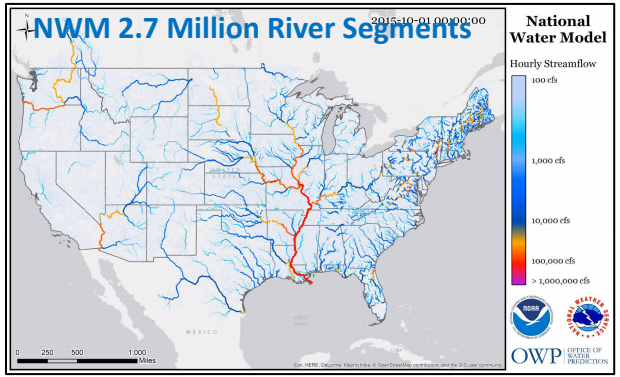
Brian Cosgrove, Ed Clark, Aubrey Dugger, Trey Flowers, David Gochis, Tom Graziano and Fred Ogden

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 mid-2023
- Major capability enhancements planned for v3.0





v.1.0/ 1.1/1.2 — **Foundation: 2016-2018**

- Baseline NOAA water forecast model running on operational supercomputer

v.2.0/ 2.1 — **Upgrades: 2019-2021**

- Expansion to Hawaii and Puerto Rico, forcing and reservoir improvements

v.3.0 — **Next Upgrade: 2023**

- Total water level, expansion to Alaska, NBM forcing, physics and calibration

v.4.0 — **Future Upgrade: 2025**

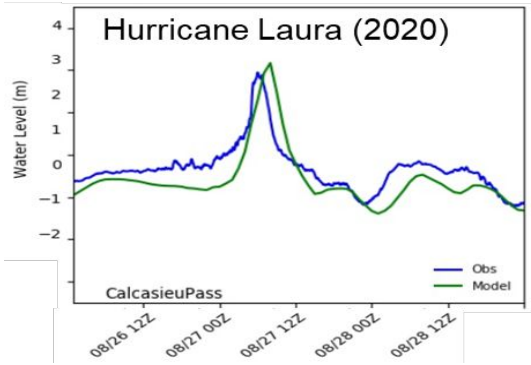
- Use of NextGen - heterogeneous modeling, coastal coupling / river routing upgrades

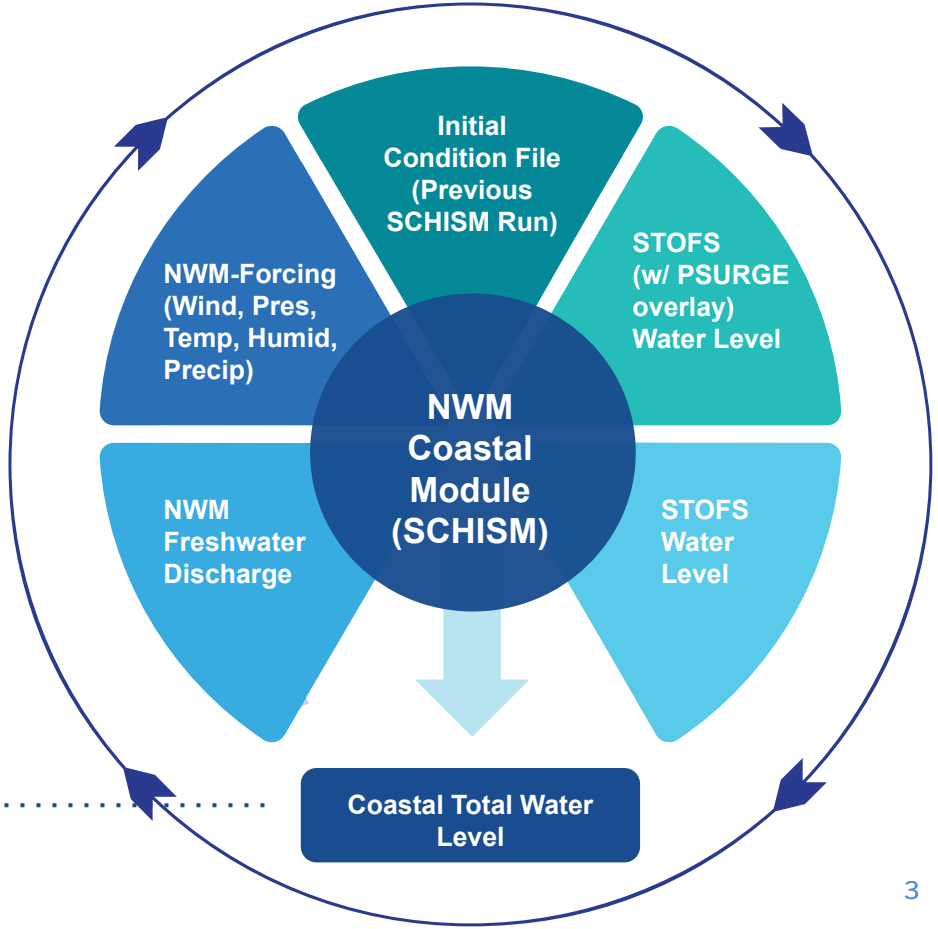
NWM v.3.0 (2023): New Total Water Level Forecasting Capability

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.

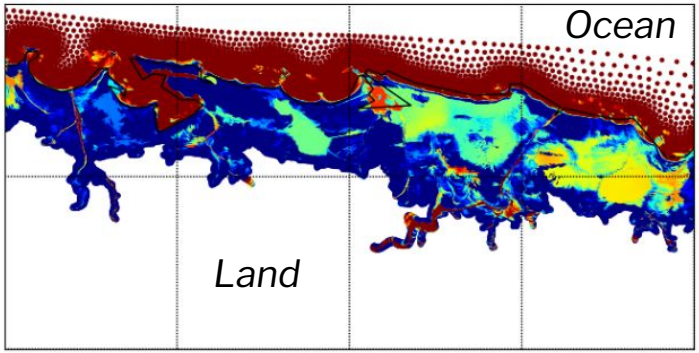
For more details: TWL talk by Qi Shi, 11:50am (H53B-06)



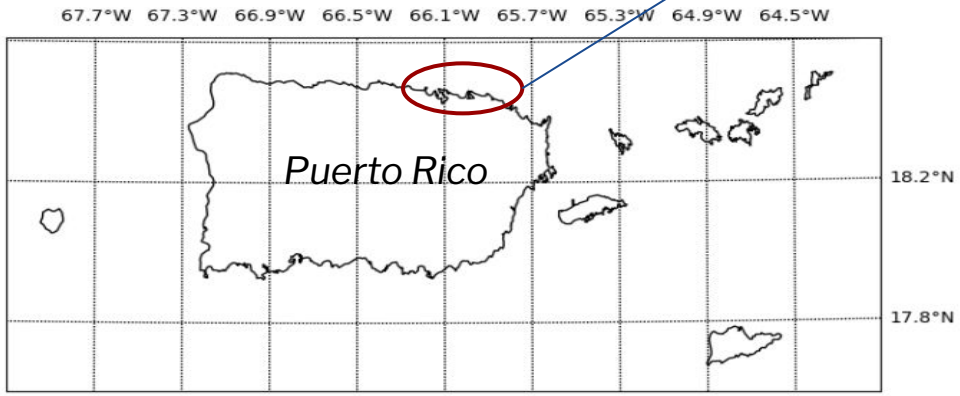


NWM Total Water Level: Hurricane Maria Test Case

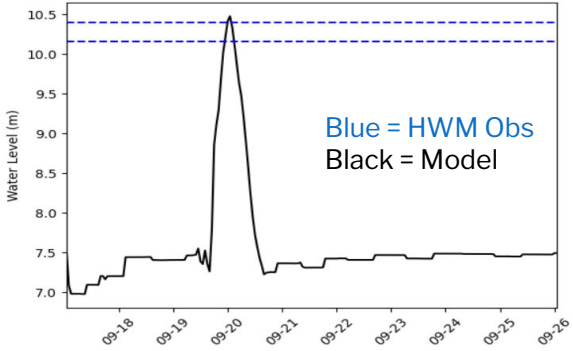
- Hurricane Maria caused catastrophic inundation of coastal communities in Puerto Rico
- New NWM total water capability simulates inundation due to combined impact of freshwater ***plus*** Maria's storm surge, tide and wind.



Hurricane Maria - 16Z on 9/20/17



Time Series of Water Elevation

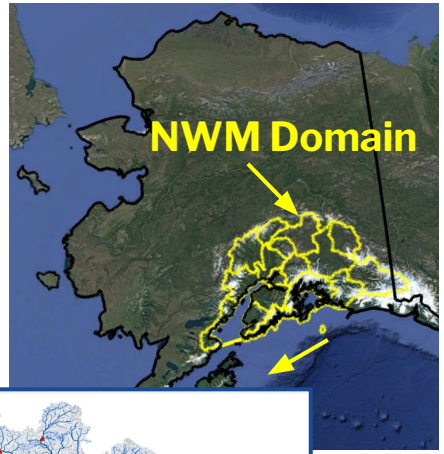


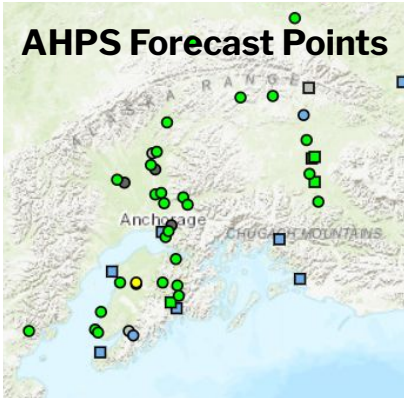
NWM v.3.0 (2023): New Alaska Domain

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

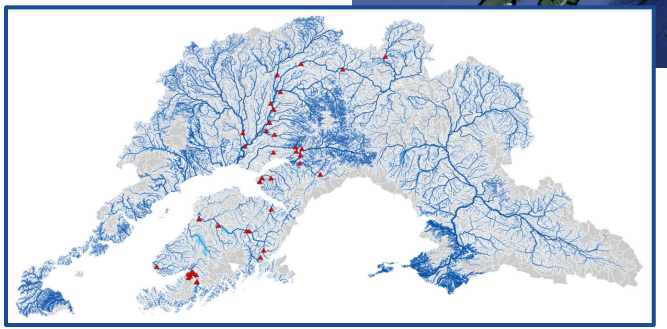
NWM Alaska Summary

- 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

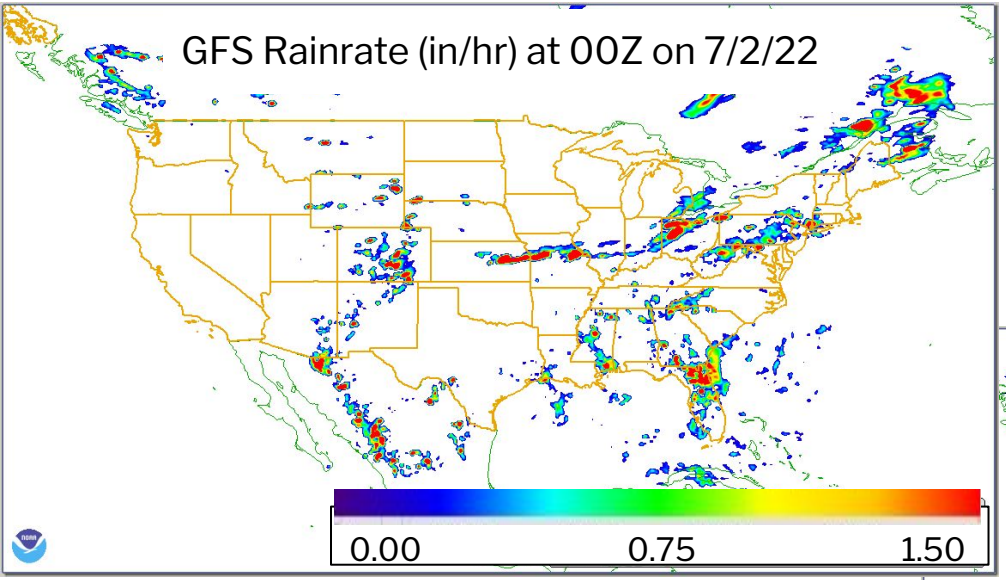




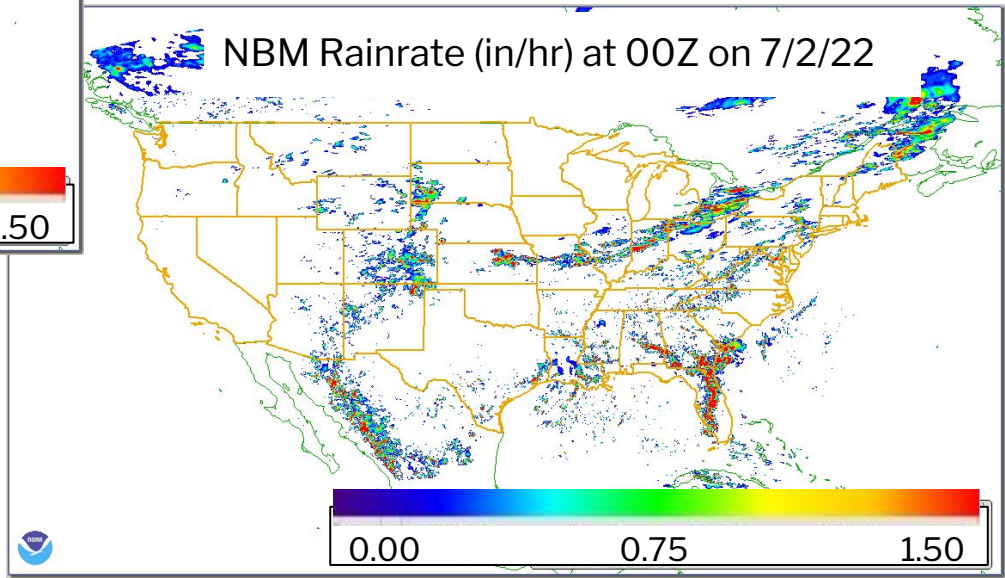
Dense network of NWM hydrologic guidance



NWM v.3.0 Additional Enhancements: National Blend of Models Forcing



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

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 (Xinanjiang) to improve partitioning of runoff and infiltration

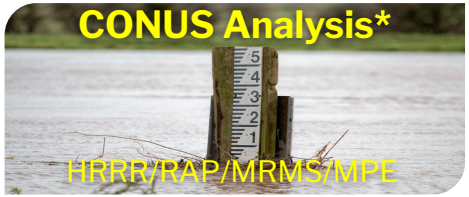
Improved Calibration

- Revised multi-option spatially-varying regionalization approach
- Updated calibration objective function to use Kling Gupta Effienciency (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



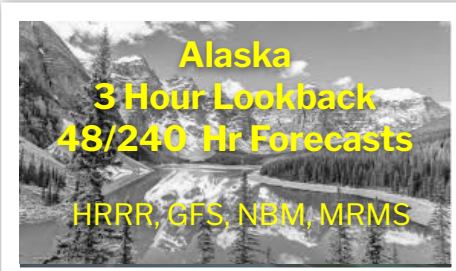
Lookback Range 3-28 hrs

Including open loop (non-DA) members

18 Hour Forecast

~10 Day Ens Forecast

Including open loop (non-DA) member

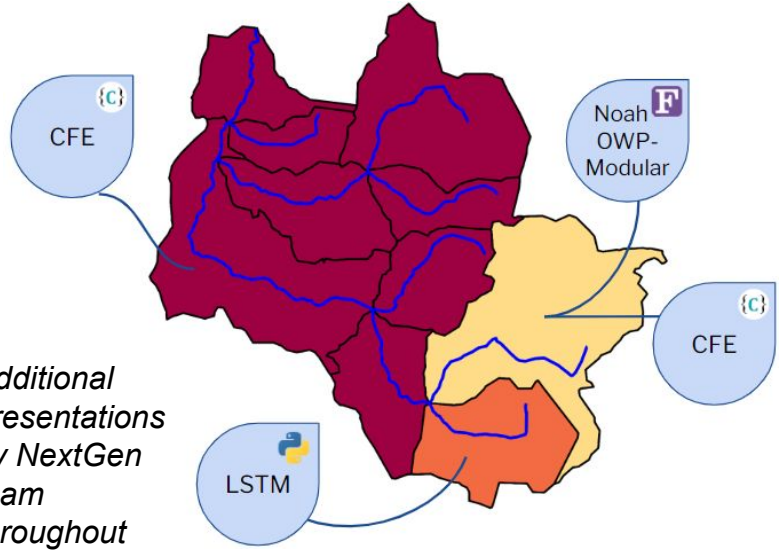


*Coastal Total Water Level

30 Day Ensemble Forecast

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

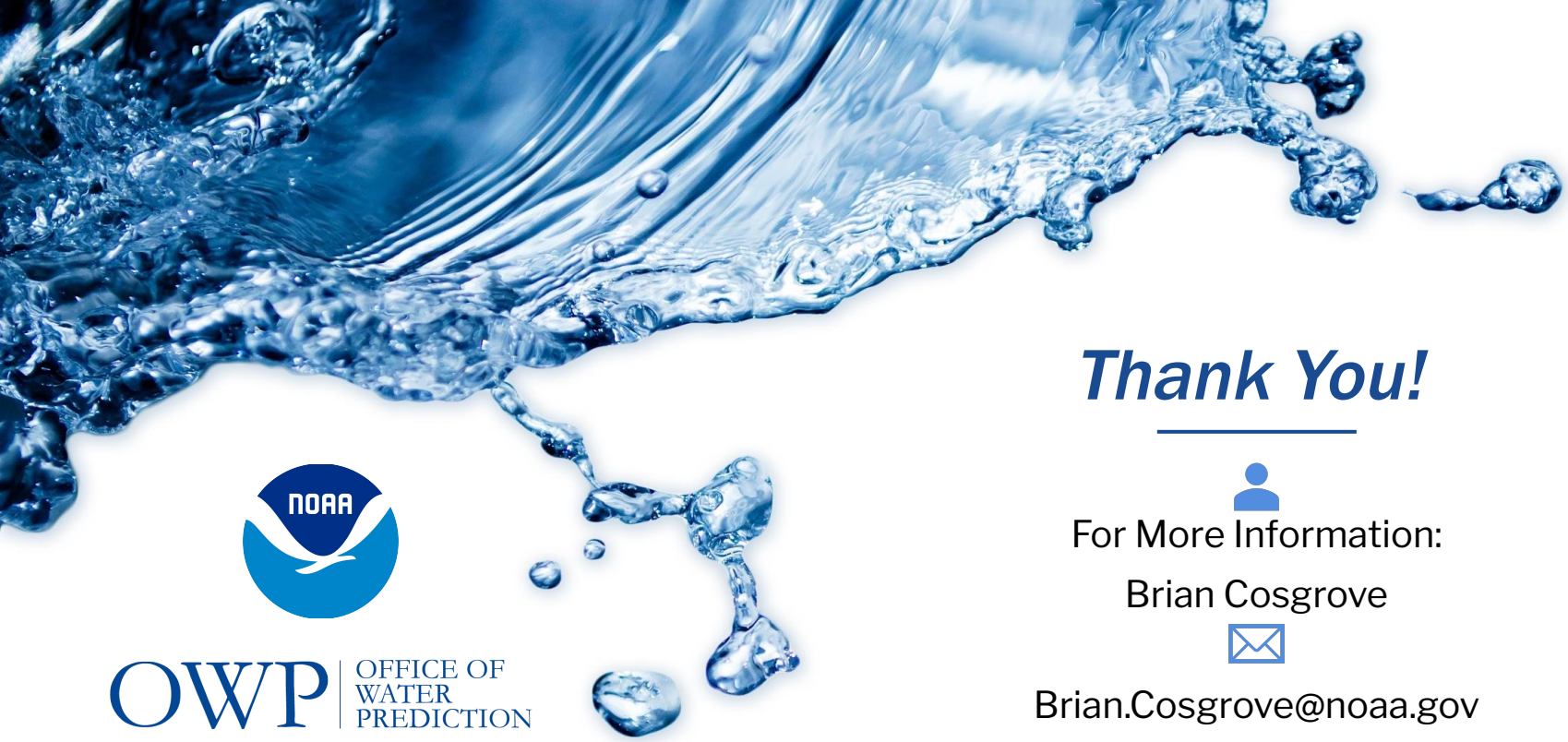
Multiple catchments - Multiple formulations

This will lead to key operational improvements

Forecast Accuracy	**Module selection tailored to each catchment's hydrologic characteristics (soil, snow, other)**
Computational Efficiency	**Lighter-weight formulations can be used when appropriate (i.e., turn off snow)**
Model Capability	**Framework flexibility (LSTM, CFE, Topmodel, Noah OWP-Modular) enables ensembles**

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



Thank You!

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For More Information:

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https://water.noaa.gov

Presentation Schedule