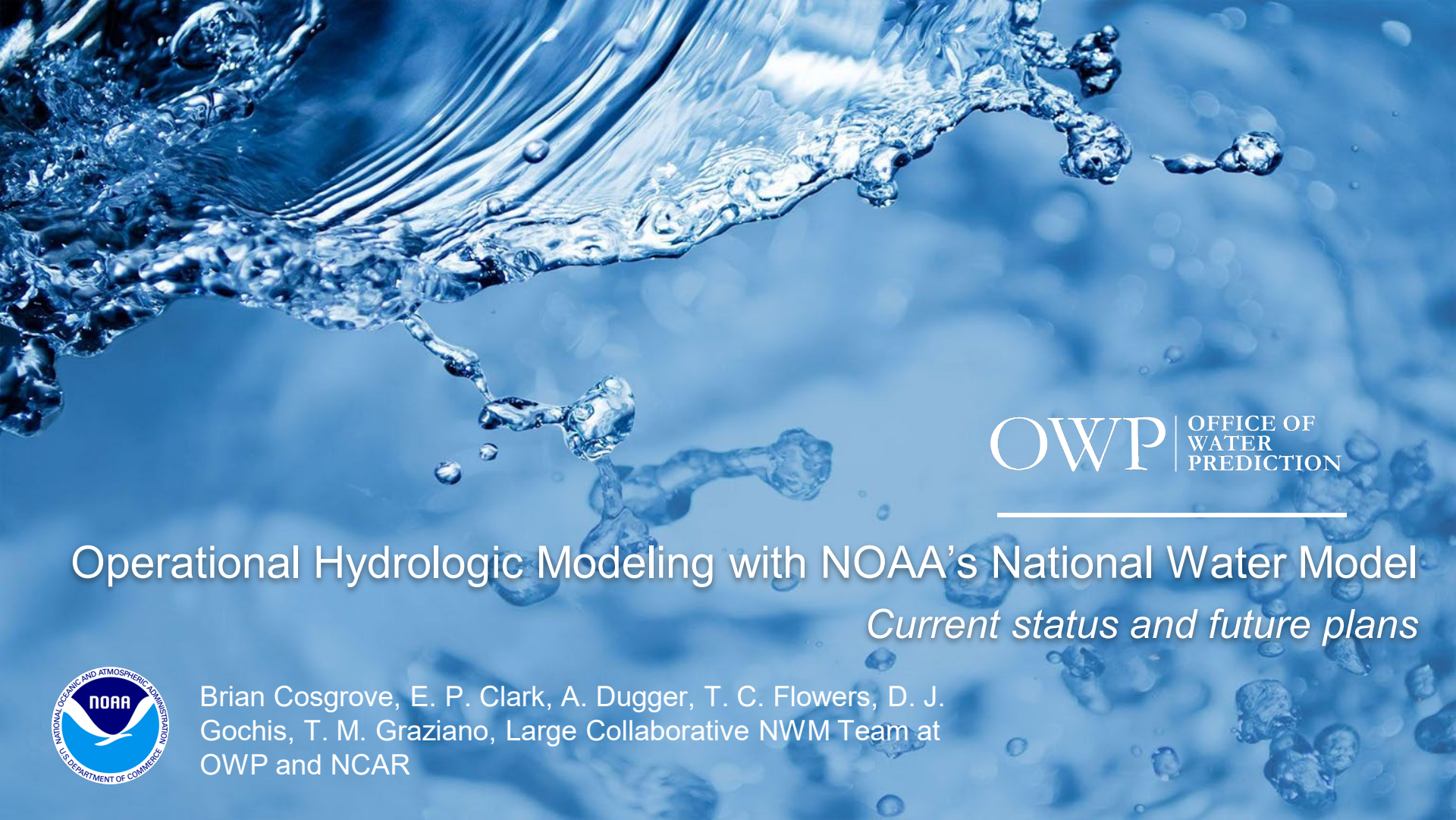


OWP | OFFICE OF WATER PREDICTION

Operational Hydrologic Modeling with NOAA's National Water Model

Current status and future plans

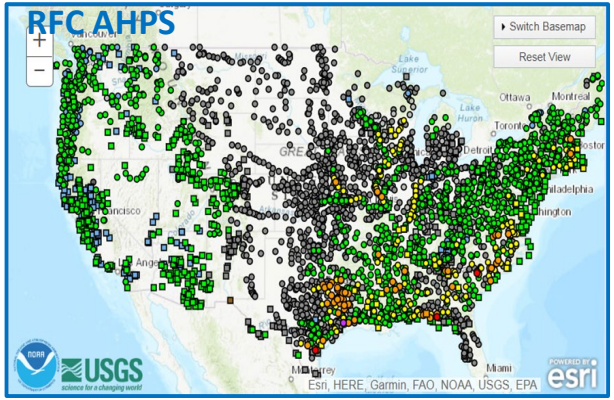
Brian Cosgrove, E. P. Clark, A. Dugger, T. C. Flowers, D. J. Gochis, T. M. Graziano, Large Collaborative NWM Team at OWP and NCAR

National Water Model Overview

- The National Water Model (NWM) revolutionizes how hydrologic guidance is developed and delivered, providing both complementary and first-time spatial coverage and product types

River Forecast Centers: Authoritative forecasts at ~3,600 RFC Points

NWM: Guidance at 2.7 million NHDPlus river segments, filling in coverage



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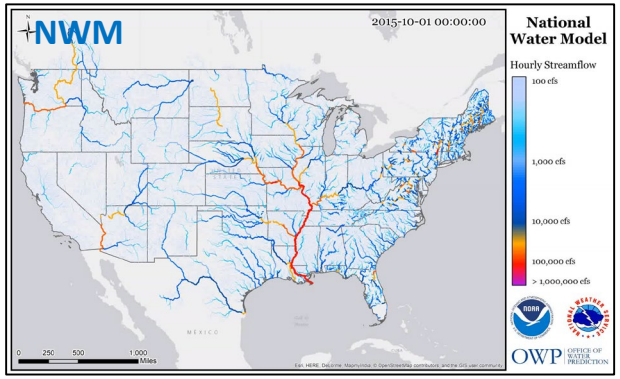
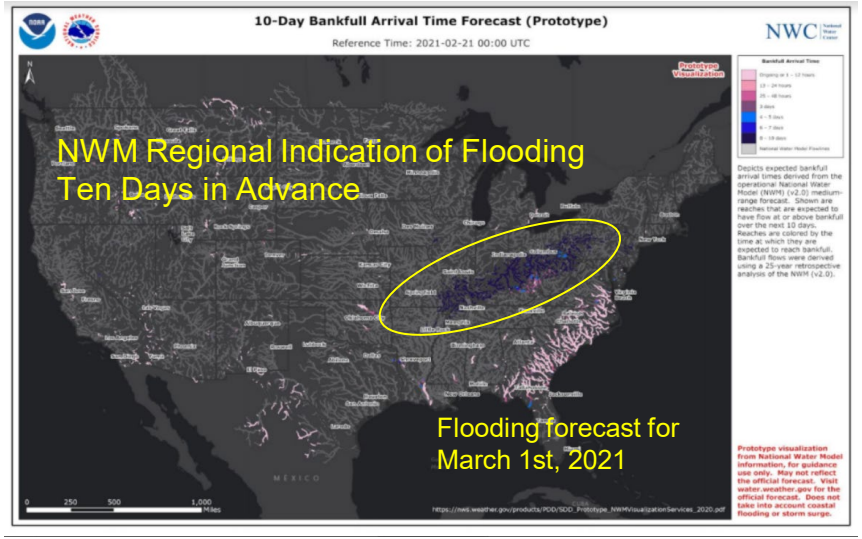
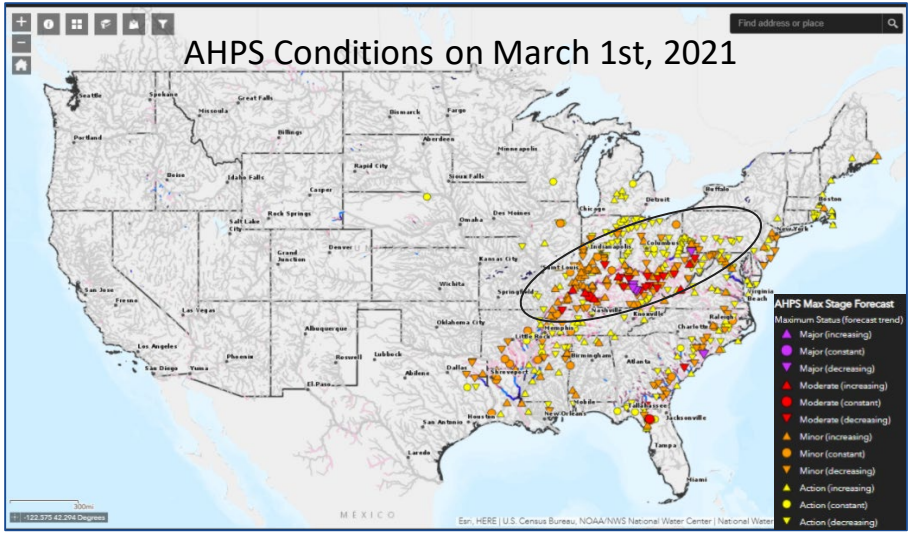


v1.0 2016 ● v2.1 2021 ● v3.0 2023 ● NextGen

NWM Core Capability: Complementary Guidance

- NWM provides coverage for areas where no traditional NWS river forecasts are available
- Regional NWM signals can be leveraged several days in advance

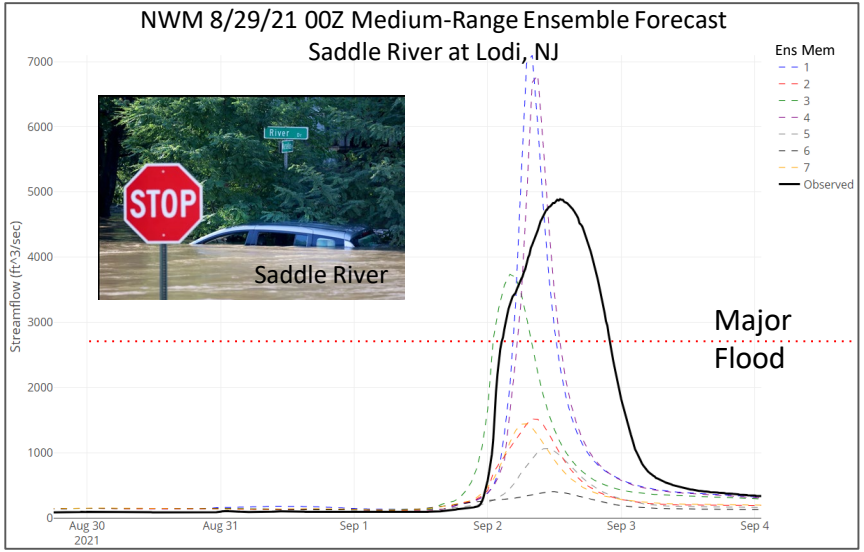


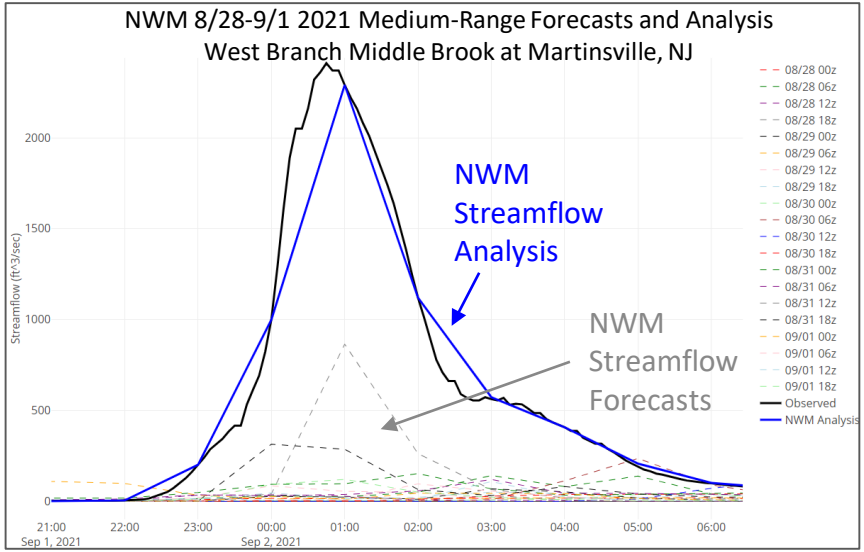


- Moderate to heavy rainfall associated with a front fell from east Texas through the Ohio Valley, creating widespread bankfull to isolated major flooding.
- NWM medium-range forecast showed indication of flooding with a 10-day lead time

Recent Example: Flooding from Hurricane Ida

Actionable, timely guidance from NWM … but only with an accurate precipitation forecast





- Three ensemble members depict major flood conditions with 4.5 day lead time

- Observed Precip → Accurate Streamflow
- Forecast Precip → Low-Biased Streamflow

Current Capabilities: NWM v2.1 Operational Forecast Cycling

Lookback Range 3-28 hrs

Normal+Open Loop (Non-DA)

18 Hour Forecast

Hawaii / Puerto Rico
3 Hour Lookback
48 Hour Forecast

HiRES ARW/NAM-NEST
(MRMS for Hawaii)
(Open Loop Configs)

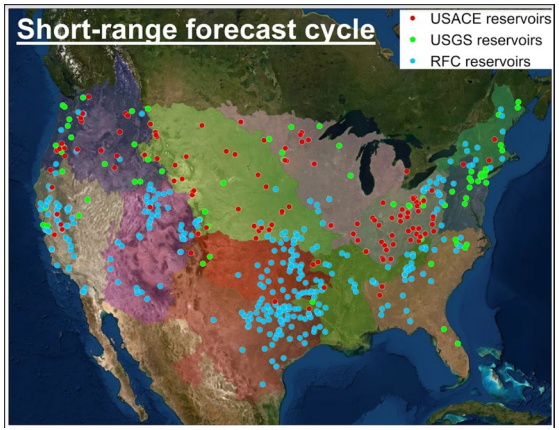
~10 Day Ensemble Forecast

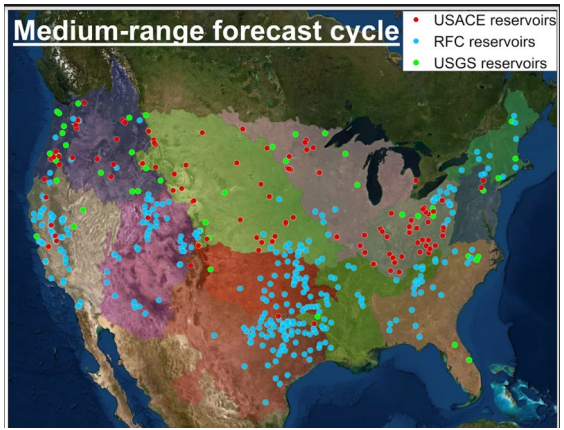
Normal + Open Loop (Non-DA)

30 Day Ensemble Forecast

NWM v2.1 Highlights: Reservoirs and Domain Expansion

Key Link to Field and Skill Improvement: Improved treatment of reservoir outflow via ingest of River Forecast Center (RFC)-provided forecasts, application of reservoir persistence approach leveraging USACE and USGS observations, and improved reservoir physics.

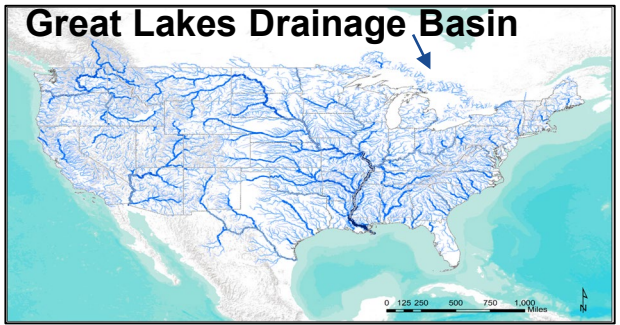


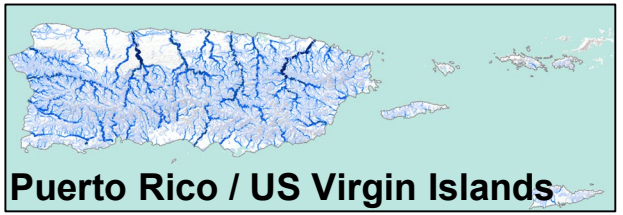


Short-range forecast cycle:
number of USGS sites: 74
number of USACE sites: 122
number of RFC sites: 316
Total number of sites: 512

Medium-range forecast cycle:
number of USGS sites: 46
number of USACE sites: 106
number of RFC sites: 308
Total number of sites: 460

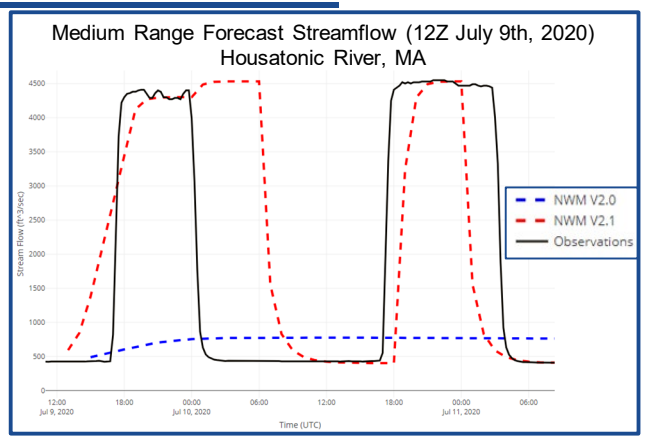
Domain Expansion:



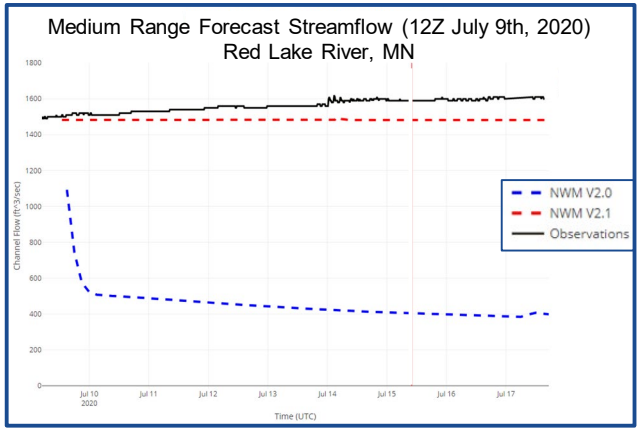


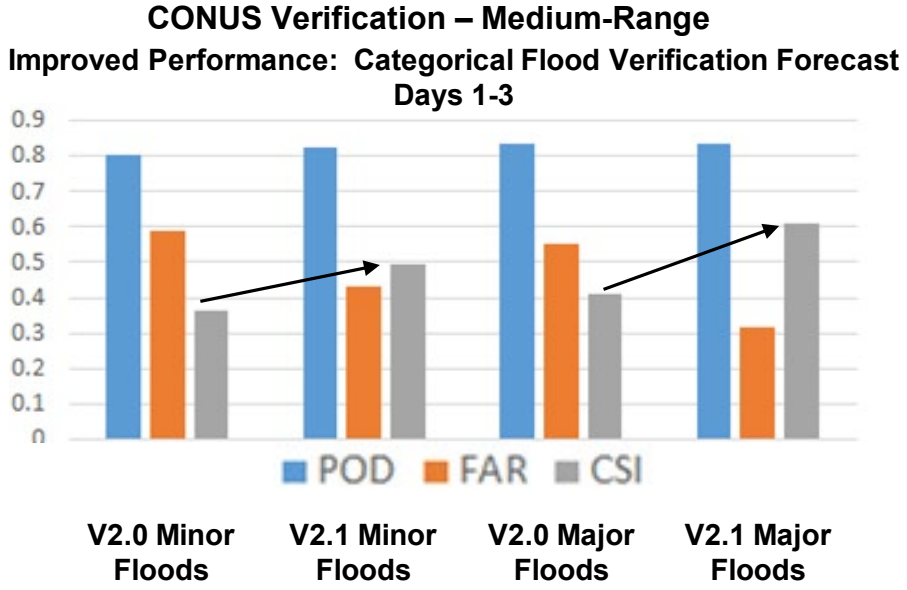
Performance Improvements in NWM v2.1: Highlights

RFC-Provided Forecasts



USGS Obs-Based Persistence

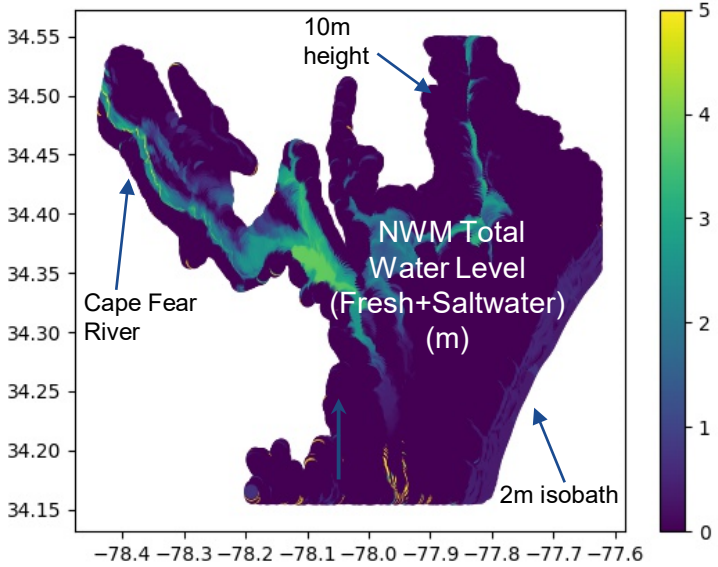




- **Left**: NWM v2.1 ingest of RFC (top), USGS (bottom) and USACE (not shown) data greatly improves streamflow forecast downstream of reservoirs
- **Right**: Categorical flood forecast skill is greatly improved in v2.1. Similar results for days 4-10. Ensembles exhibit higher scores.

NWM v3.0 (2023): New Coupled Total Water Forecasting Capability

Over 100 million people live near the coast who don't get national total water guidance today

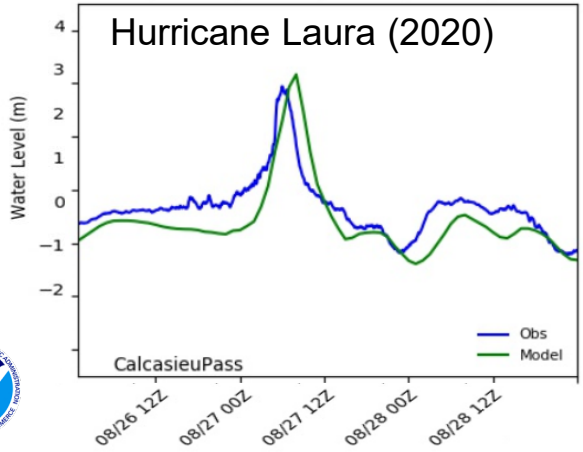


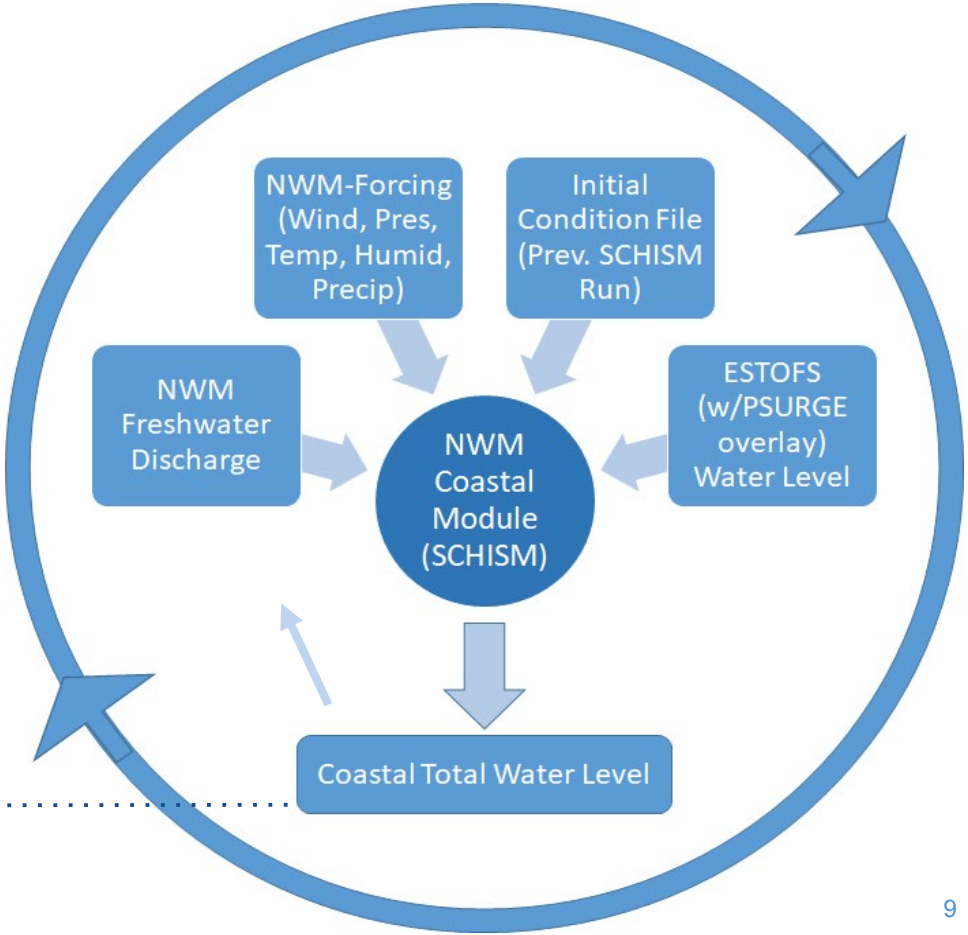
Key Goal: Fill this capability gap by enabling NWM to simulate compound flooding driven by freshwater/surge/tides

NWM v3.0 (2023): New Coupled Total Water Forecasting Capability

Filling the Capability Gap

- National total water level forecasts will complement existing regional forecasts with first ever CONUS-wide, Hawaii, PR/VI guidance
- This new freshwater-estuary-ocean coupling will leverage the NWM, a new inland hydraulic routing module, SCHISM, ESTOFS & PSURGE
- Further details later in this session – Camaron George, Presentation 7A.4





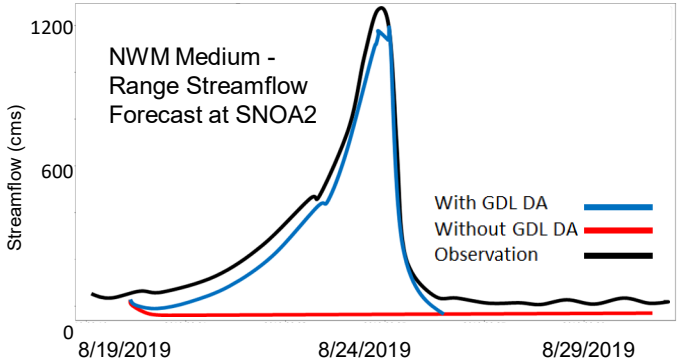
NWM v3.0 (2023): New Alaska Domain

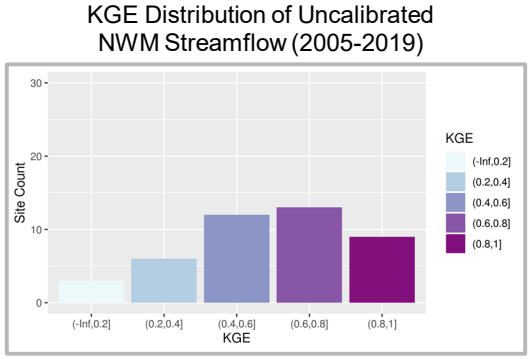
Overarching Goal:

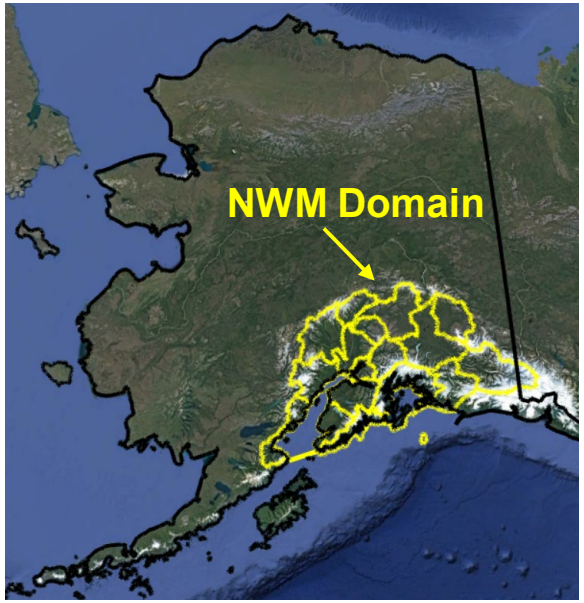
Implement NWM Alaska domain to provide augmented streamflow and distributed water cycle guidance to help protect Alaskan communities and infrastructure.

NWM Alaska Summary:

- Close coordination with Alaska Pacific RFC (APRFC)
- Ingest of APRFC glacial dam lake (GDL) outflow forecasts
- Customized model and forcing configurations (APRFC MPE (Stage IV), MRMS, HRRR-AK, GFS, NBM)







NWM v3.0 (2023): Additional Enhancements

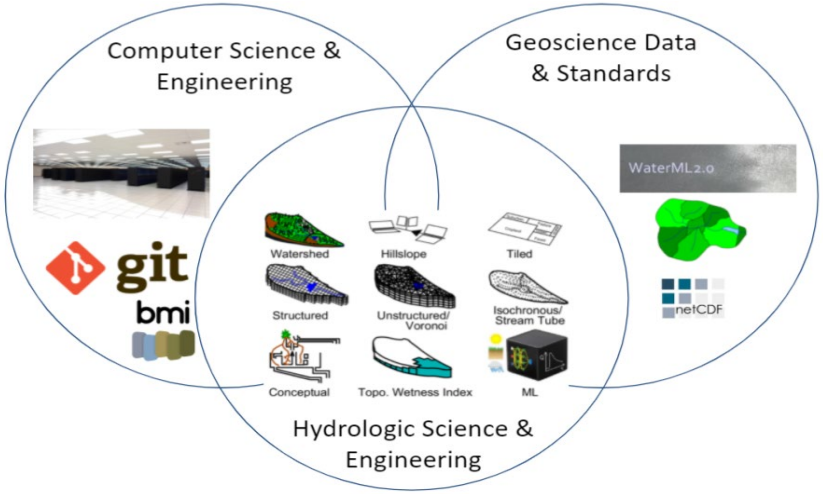
- **Land surface**
  - Updated land cover dataset (NLCD 2016)
  - Added capability for dynamic parameter updates (wildfires and beyond)
  - Improved representation of impervious conditions via NLCD data-based adjustment of precipitation available for infiltration
  - Use of a new runoff module (Xinanjiang)
- **Improved Calibration**
  - Revised regionalization approach
  - Updated calibration objective function (Kling Gupta Efficiency (KGE))
- **Improved forcing**
  - Use of National Blend of Models precip to force medium-range ensemble member
  - Use of MRMS QPE over Puerto Rico / US Virgin Islands

NWM v4.0 (2024): Using the NextGen Modeling Framework

- The NWM software architecture is being rewritten from the ground up
- This will support spatially heterogeneous modeling approaches and will also feature enhanced modularity to underpin accelerated community development.

- Multi-language/platform support with Basic Model Interface (BMI)
- Will have a strong open source link to hydrologic community and advance operations and research

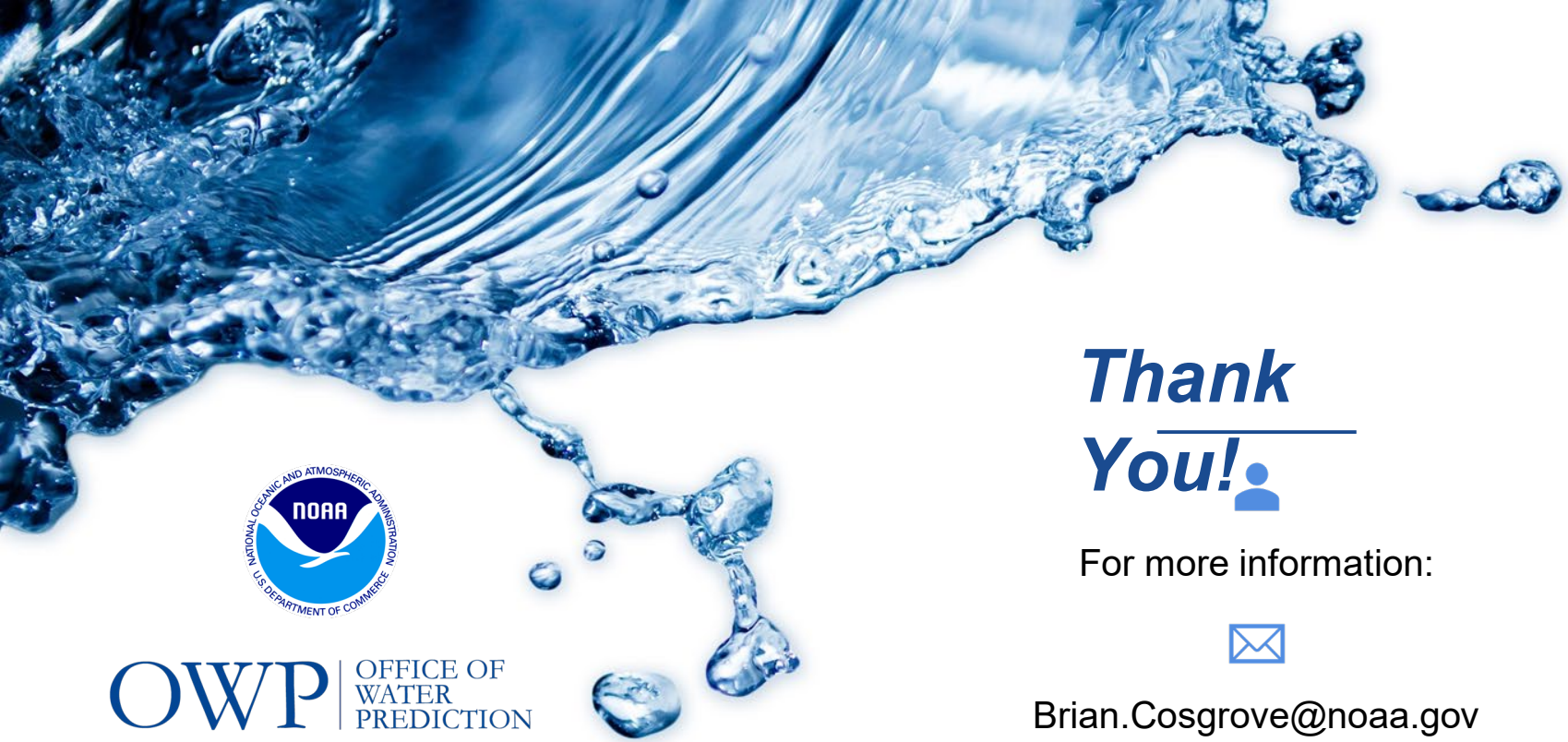
Enabling Technologies



NWS NOS USACE-ERDC USGS
USBR DOE NCAR Academia/CUAHSI

Closing Thoughts

- The coverage and breadth of the operational NWM drives forecasting, research, and commercial applications in a way not before possible
- NWM v3.0 due out in early 2023
- Significant version-over-version increases in skill will be accelerated by use of NextGen framework in NWM v4.0.
- Together with these steady upgrades in model skill, value-added visualization products, partnerships with end users and community development will continue to advance the system



Thank You!

For more information:

Brian.Cosgrove@noaa.gov

https://water.noaa.gov

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