NOAA Water Resources Prediction and IDSS

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Presentation Outline

- NWS Strategic Vision and Plan
- National Water Center
- National Water Model
- Flood Inundation Mapping
- Hydrologic Ensemble Forecast Service
- Summary

NOAA NWS Strategic Vision/Societal Outcome:
A Weather-Ready Nation

- **Society is prepared for and responds to weather, water, and climate dependent events**
- **Build community resiliency in the face of increasing vulnerability to extreme weather, water, and climate events**

Involves the entire US Weather, Water and Climate Enterprise working together

NOAA NWS Strategic Plan 2019-2022: Water-Specific Goals

- Deliver actionable water resources information from national to street-level and across all time scales;
- Provide minutes-to-months river forecasts that quantify both atmospheric and hydrologic uncertainty;
- Improve forecasts of total water in the coastal zone by linking terrestrial and coastal models in partnership with the National Ocean Service; and
- Deliver forecasts of flood inundation linked with other geospatial information to inform life-saving decisions.

https://www.weather.gov/media/wrn/NWS_Weather-Ready-Nation_Strategic_Plan_2019-2022.pdf

National Water Center



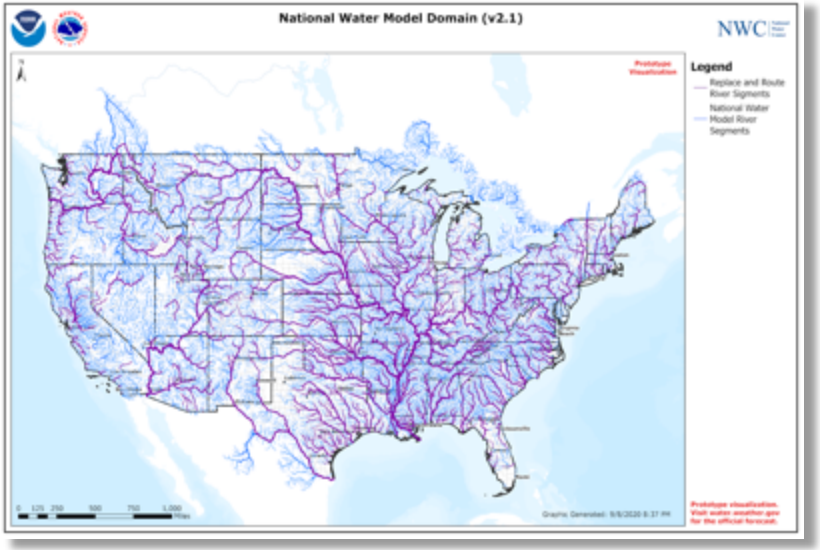

- **Center of excellence for water resources science and prediction and catalyst to transform water prediction through enterprise collaboration**
- **Water resources common operating picture and decision support services on all time scales**
- **Operations Center**
  - Initial Operating Capability (IOC) for Operations Center achieved on October 1, 2019; Full Operating Capability (FOC) planned for September 30, 2022
  - Routine coordination/collaboration with internal and external partners/stakeholders
  - Monitor/assess hydrologic conditions; generate/interpret model-based guidance
  - 20 Staff; 15 hours/day; 7 Days a week
  - Surge staffing for significant events

NWC has hosted more than 100 scientific meetings with over 3000 participants

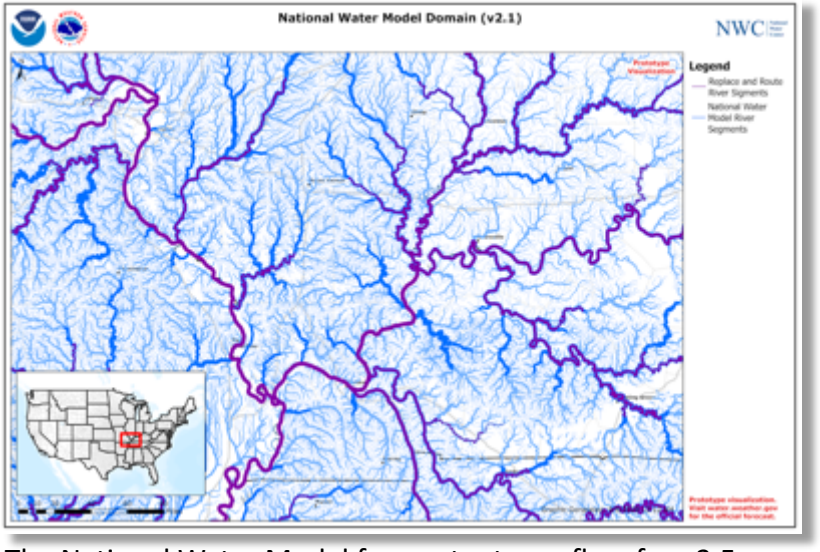
National Water Model

V1.0 Implemented August 16, 2016

- **Continental-scale water resources model providing high resolution, spatially continuous estimates of major water cycle components**
- **Operational forecast streamflow guidance for currently underserved locations: compliment 3,600 RFC forecast points with guidance for 2.7 million stream reaches (>700 fold increase in spatial density)**



U.S. rivers and streams downstream of NWS Advanced Hydrologic Prediction Service (AHPS) forecast locations (shown in purple), represent only 3% of the total U.S. rivers and streams accounted for in the NWM (shown in blue)



The National Water Model forecasts streamflow for ~3.5 million miles of rivers and streams across the continental U.S.

Enhancing the NWM: Development Trajectory

v1.0

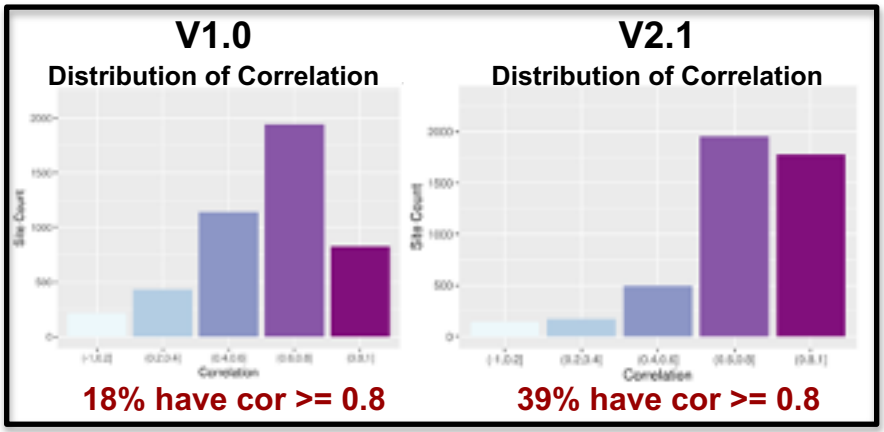
Foundation: 2016
Water resource model 2.7 million reaches

v1.1/1.2/2.0

Upgrades: 2017/2018/2019
OCONUS expansion to Hawaii, medium range ensemble, physics upgrades, improved modularity, MPE ingest, improved calibration; extension of the Short-Range forecast from 15 to 18 hours and an increase in the frequency of Medium-Range forecast cycling from one to four times per day

v2.1

4th Upgrade: Early 2021
Expansion to PR, US Virgin Islands, and Great Lakes, reservoir modules, forcing upgrades, open-loop, improved calibration, and improved Hawaii forcing



v3.0

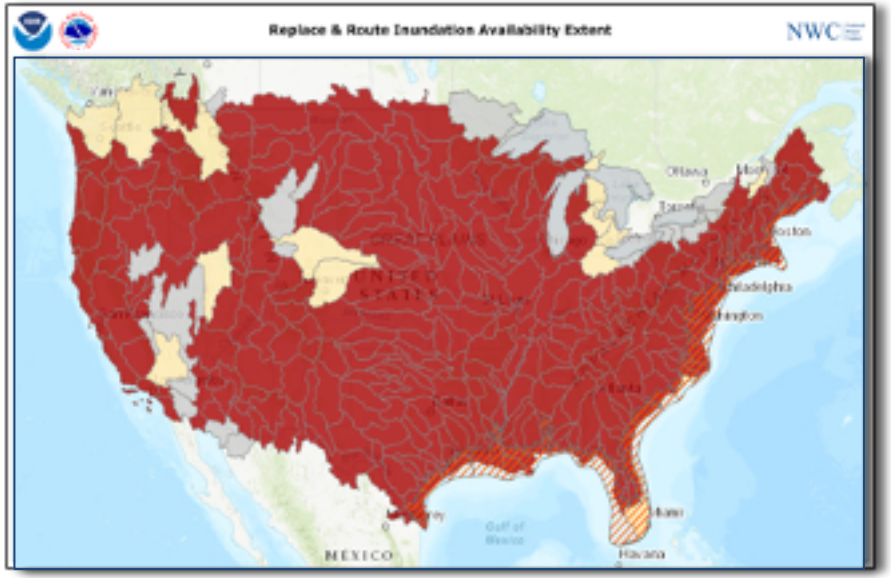
Future Upgrade: 2022
Coastal freshwater-estuary-ocean coupling, expansion to Alaska (Cook Inlet and Copper River Basin), improved runoff generation calculation and infiltration, improved channel representation, inland hydraulic routing, hydro-fabric upgrades

Flood Inundation Mapping Services Demonstration

- **Department of Commerce Agency Priority Goal**
  - 2018-2019; Domain of West Gulf River Forecast Center (WGRFC) – serving ~25 US million residents
  - 2020-2021: Domain of Northeast River Forecast Center (NERFC) and downstream of River Forecast Center (RFC) forecast locations – serving ~115 million US residents
- **NOAA High-resolution Flood Inundation Mapping (FIM) includes:**
  - NWS River Forecast Center (RFC) forecast flows routed downstream ("Replace-and-Route")
  - National Water Model (NWM) forecast flows for each model reach, leveraging different model configurations:
    - Analysis (current conditions)
    - Short-Range (to 18-hours)
    - Medium-Range (to 10 days)
  - Available as demonstration service to NWS RFCs and Weather Forecast Offices (WFOs) in near-real-time
- **Collaboration across USACE, USGS, NOAA, and FEMA on integrated Flood Inundation Mapping (iFIM)**
  - Leverage the best available maps from each agency for real-time authoritative inundation map
  - Based on review and coordination among federal agencies as part of the Science for Disaster Reduction (SDR) federal interagency collaboration group

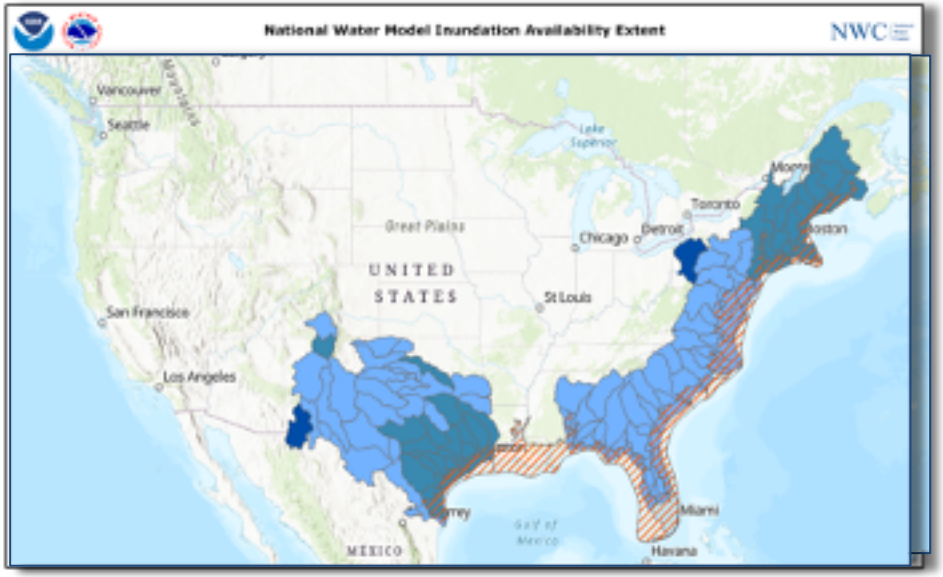
FIM Service Demonstration Areas - August 2020

Model Source: NWS River Forecast Center
(mapping downstream of forecast locations)



FIM v2.X MS
FIM v2.X FR
FIM v1.0 FR
None

Model Source: NOAA National Water Model
(mapping on full resolution NHDplus network)



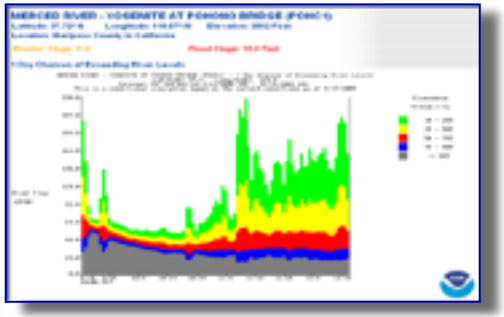
Version Key:
FR = full resolution
MS = main stem
(downstream of AHPS)

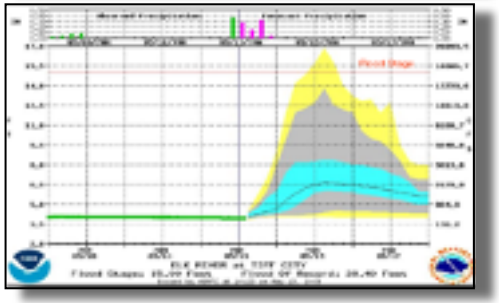
FIM v2.Xc
FIM v1.0c
FIM v2.X FR
FIM v2.X MS
FIM v1.0 FR
None

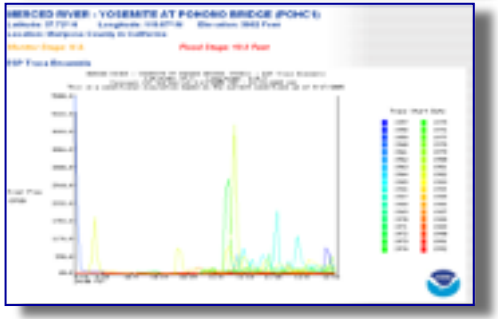
Hydrologic Ensemble Forecast Service (HEFS)

Produce ensemble streamflow forecasts that:

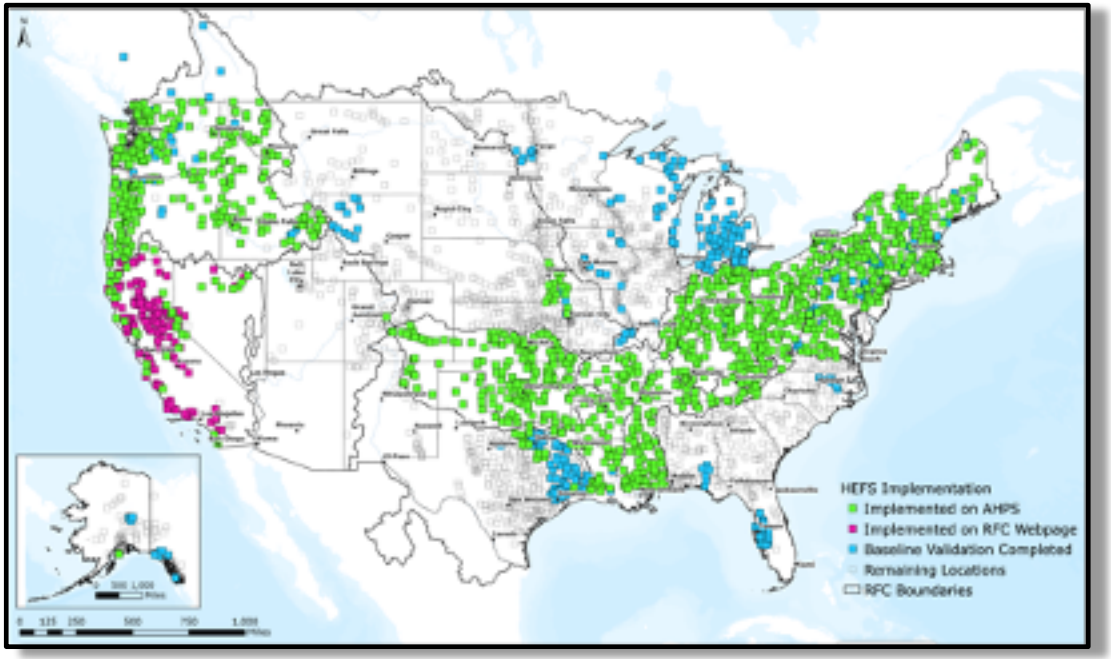
- Seamlessly span lead times from one hour to one year
- Account for total uncertainty and corrects for biases in forcings and streamflow (unbiased with reliable spread)
- Are consistent across time and space
- Utilize short, medium, and long range weather forecasts to effectively capture information in NWS weather/climate models
- Are dependable (consistent with retrospective forecasts) and adequately verified
- Inform user's decisions (compatible with/support Decision Support Systems, e.g., NYCDEP, FIRO)







HEFS Implementation Status



water.weather.gov

- 1390 river locations display HEFS experimental short and/or long-range products
- Baseline validation completed at 1761 river forecast locations
- Over next couple of years, goal is to expand the number of HEFS river service locations to ~2500
- Near term enhancements include beginning the use of Global Ensemble Forecast System (GEFS) v12 model forcings in 2021
- GEFS v12 implemented on Sep 23, 2020
  - Expands the number of ensemble members from 21 to 31
  - Forecast to 16 days for 06, 12 and 18 cycles and 35 days for 00 cycle
  - Uses the latest Global Forecast System (GFS) model with the Finite Volume Cubed Sphere (FV3) dynamical core
  - Increases model horizontal resolution from 0.5 to 0.25 degree (~25 km) and maintains the same resolution throughout the forecast period

Summary

- NOAA/NWS continues to develop and evolve the NWM and HEFS and have developed a broad spectrum of experimental high resolution water resources data services
- We are committed to working across the NWS and NOAA and with our deep core partners to transform water prediction and related IDSS
- This will take time and we are committed to collaboration and transparency