NEIGHBORHOOD LEVEL FLOOD INUNDATION MAPS:

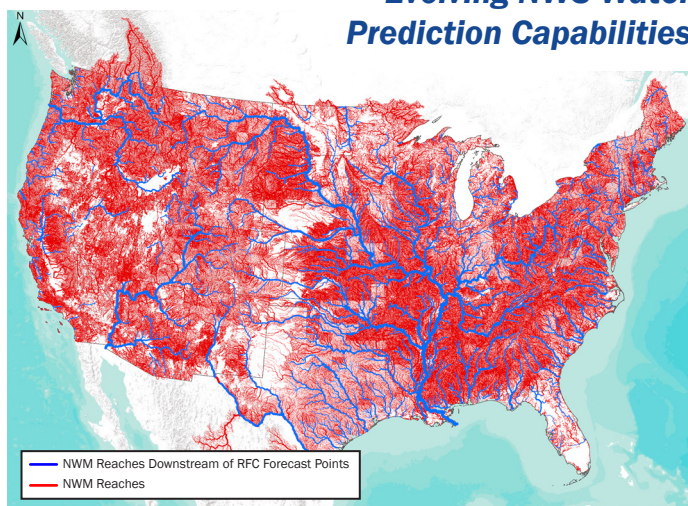## Transforming NWS Water Prediction Across the U.S.

The longstanding demand for event-driven flood inundation mapping (FIM) has increased dramatically in recent years as a high value source of actionable information for emergency and water resource managers to prepare, mitigate, and respond to flood impacts. In response, the National Water Center of the National Weather Service (NWS), in coordination with NWS River Forecast Centers (RFC) and Weather Forecast Offices along with Federal and other partners, has developed and demonstrated high-resolution inundation modeling capabilities providing geo-referenced visualizations of forecast flooding extent at the continental scale.

These capabilities complement and expand upon existing static FIM libraries derived from detailed engineering scale hydraulic models at approximately 200 RFC forecast locations. New inundation mapping capabilities translate analysis and forecasts of streamflow into operational maps that communicate impact by showing where flooding may occur. This prototype information is being generated in near real-time for the lower 48 states, Hawaii, Puerto Rico, and the U.S. Virgin Islands using RFC official forecasts as well as forecast guidance from the National Water Model (NWM).

The RFC-based inundation mapping covers about 110,000 river miles downstream from RFC forecast locations, while the NWM-based inundation mapping covers the roughly 3.4M river miles in the National Hydrography Dataset (NHD) catalog.

> **Had I had this tool in 2011, we would have had a larger evacuation area established earlier, would have moved emergency assets out of the flood zone, pre-positioned support resources and been able to provide better information to the residents of the affected area.**
>
> *New York state emergency manager from 2021 tabletop exercise*

NWM-based FIM uses both current NWM analyses and NWM forecast streamflow to map inundation extents. This results in FIM products based on three different model configurations:

1. the Analysis and Assimilation (AnA) FIM is updated hourly, showing expected inundation for current conditions.

2. the Short Range FIM is updated hourly, extending 18-hours into the future, showing expected maximum inundation over the 18-hour period.

3. the Medium Range FIM is updated every 6 hours, extending 10-days into the future, showing expected maximum inundation over the 10-day period.

The NWS FIM methods deploy a model agnostic approach to map the extent of inundation for rivers and streams cataloged in the NHD at a 10-meter spatial resolution. Synthetic rating curves and the application of the Height Above Nearest Drainage (HAND) method allow projection of the water surface elevation in the channel to neighboring cells in the digital elevation model (DEM).

Evolving NWS Water Prediction Capabilities

Legend:
— NWM Reaches Downstream of RFC Forecast Points
— NWM Reaches

1 : 1000 NWM provides one forecast point for every 1,000 river miles

Complementary NWS FIM Capabilities

STATIC

Advanced Hydrologic Prediction Service FIM Libraries (AHPS FIM)
< 1,000 river miles

Static maps at ~ 200 RFC forecast locations. Maps derived from engineering scale hydraulic models.
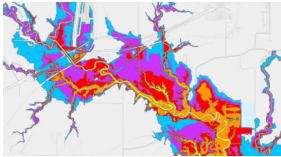
### NWS Flood Categorical HAND FIM Libraries (CatFIM)
~ 20,000 river miles

Static maps at ~3,600 RFC forecast locations. Maps derived from 10-m Height Above Nearest Drainage (HAND) solution.

DYNAMIC

River Forecast Center FIM (RFC FIM)
~ 100k river miles

Dynamic maps downstream of ~ 3,600 RFC forecast locations. Maps derived from RFC forecast and 10-m Height Above Nearest Drainage (HAND) solution.
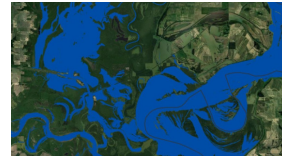
National Water Model FIM (NWM FIM)
~ 3.4M river miles

Dynamic maps along NHDPlus reach locations. Maps derived from NWM forecast and 10-m Height Above Nearest Drainage (HAND) solution.

Bringing NWS FIM To Operations

Through a formal demonstration project, NOAA has successfully demonstrated the FIM capability for over 20 million Texas residents in 2018 and 2019, and for an additional 95 million residents in the Northeast U.S. in 2020 and 2021. In the years that follow, NOAA will revolutionize U.S. water prediction capabilities by disseminating, for the first time, event-driven high spatial resolution forecast FIM for nearly 100% of the U.S. population. These FIM services will be disseminated along with services that depict the magnitude and timing of high water events. This is part of a programmatic expansion of hydrologic services and in particular focus on inundation services that:

- Expand coverage from < 1,000 river miles.
- Incorporate high resolution terrain (less than 10-meter spatial resolution) and stream network data among other model enhancements to increase accuracy.
- Enable total water prediction across the inland and coastal domains by coupling inland and coastal processes.
- Address the needs of previously underserved communities inland and along the coast.

Improvements to FIM techniques are supported by a collaboration with NOAA and other federal partners through a public GitHub repository:

https://github.com/noaa-owp/inundation-mapping

2017

NWC Summer Institute

- Demonstrated continental scale FIM capability using the Height Above Nearest Drainage (HAND) method.

2019

First DOC/NOAA Agency Priority Goal

- Near real-time demonstration in Texas.
- Completed two tabletop exercises with core stakeholders and emergency responders.

2021

Second DOC/NOAA Agency Priority Goal

- Near real-time demonstration in Texas and along the Atlantic Coast.
- Completed two tabletop exercises across the Northeast with core stakeholders and emergency responders.

2023

Operational FIM for 10% of the U.S. population

- Begin delivery of FIM services and Impact-based Decision Support Services (IDSS).
- Leverage cloud-based solution.

2026

Operational FIM for nearly 100% of the U.S. population

- Integrated FIM capabilities and services across the U.S.
- Total Water Level FIM forecasts along the coasts.

Check our Twitter feed for updates!
@nwsnwc