



# Mapping Out the Future: Development Initiatives for the National Weather Service Flood Inundation Mapping Program

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Flood Inundation Program Lead | Geo-Intelligence Division  
American Meteorological Society Conference  
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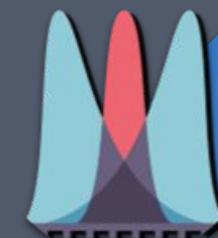
# FIM Project

- 30+ people directly on project
- 3 different contractors + federal employees
- ~20 GB of data generated every hour
- 74,000+ lines of code just for FIM Generation – if printed would be 500 feet taller than the Sears Tower...stacked on itself



## The Goal of FIM

What does the top of the mountain look like?



## Likelihood FIM

The first step towards ensemble inundation mapping



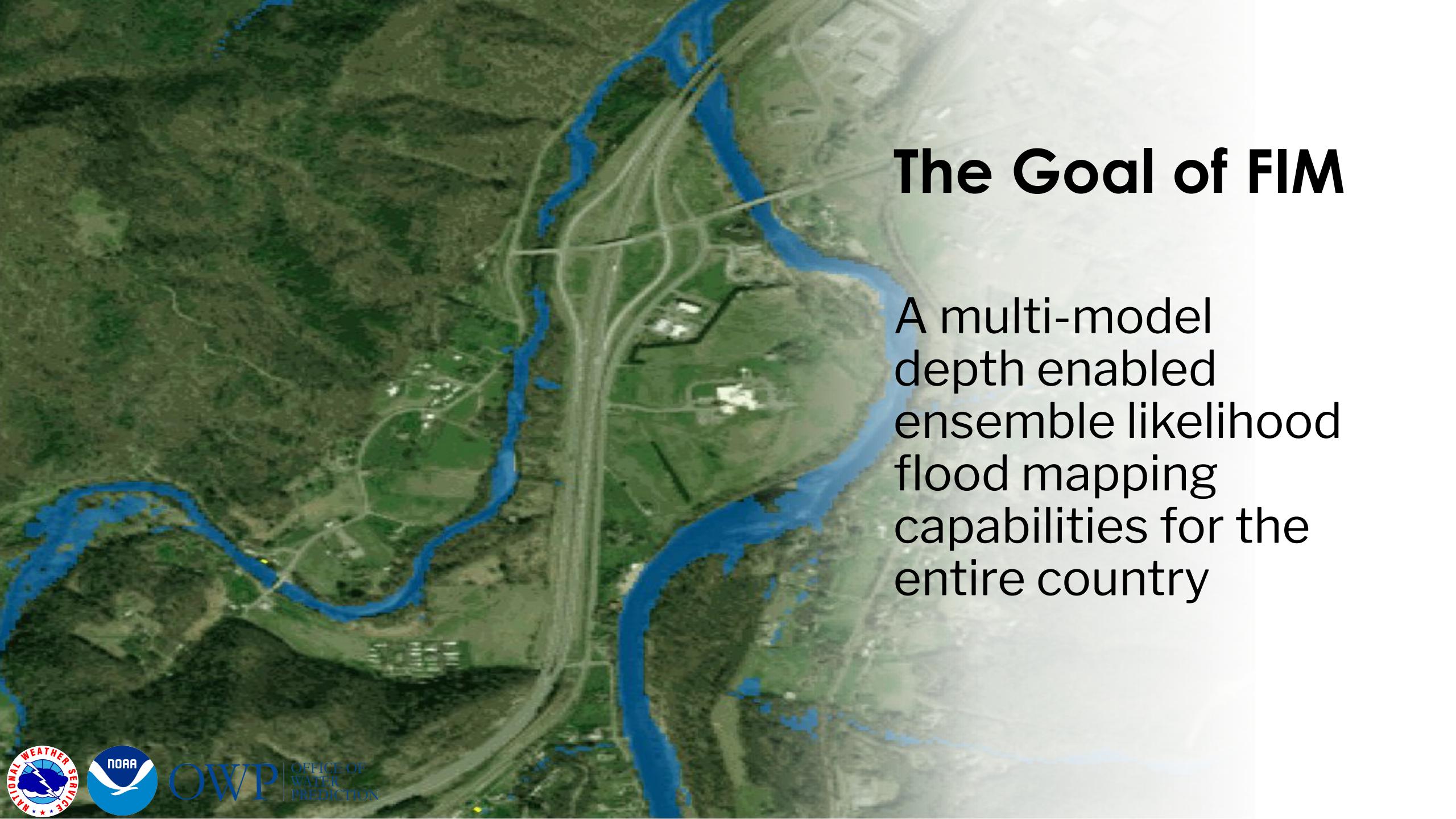
## Machine Learning FIM Enhancements

How machine learning methods will improve FIM accuracy



## From Map to Impacts

Plans for making flood mapping display more impactful information

An aerial photograph showing a river flowing through a valley. The river's path is highlighted in blue, indicating floodwaters that have inundated a significant portion of the surrounding green fields and some developed land near a highway interchange.

# The Goal of FIM

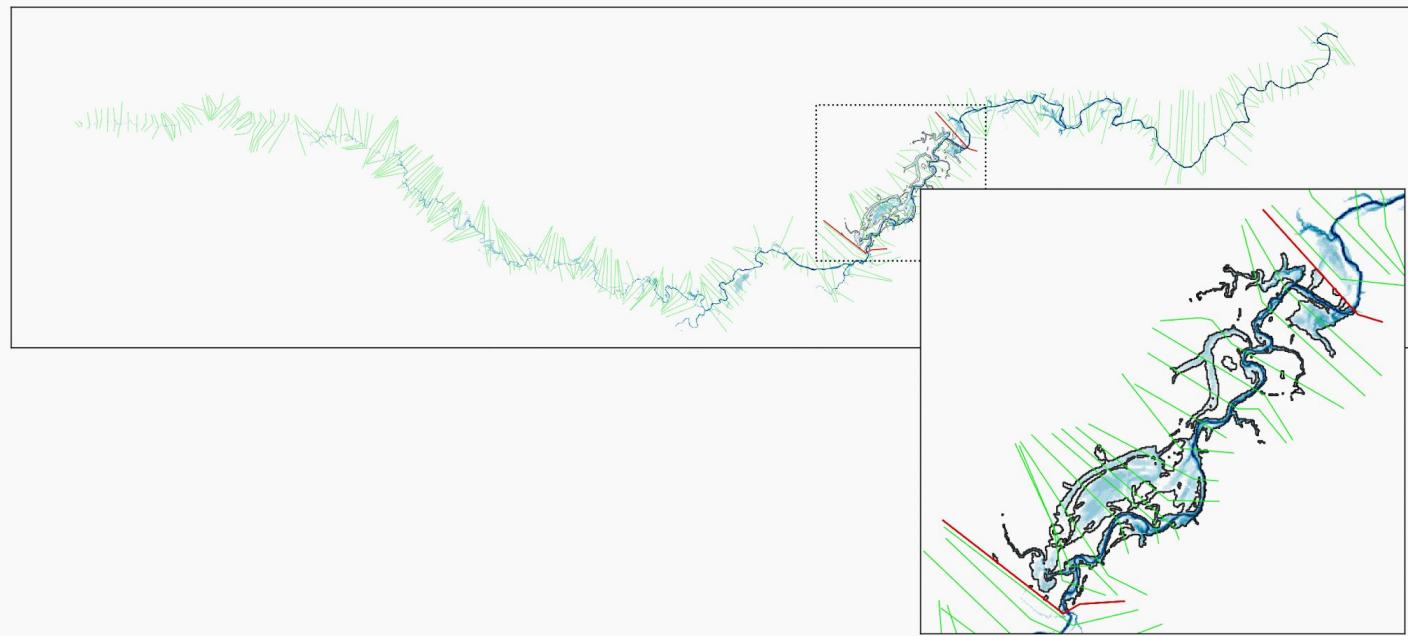
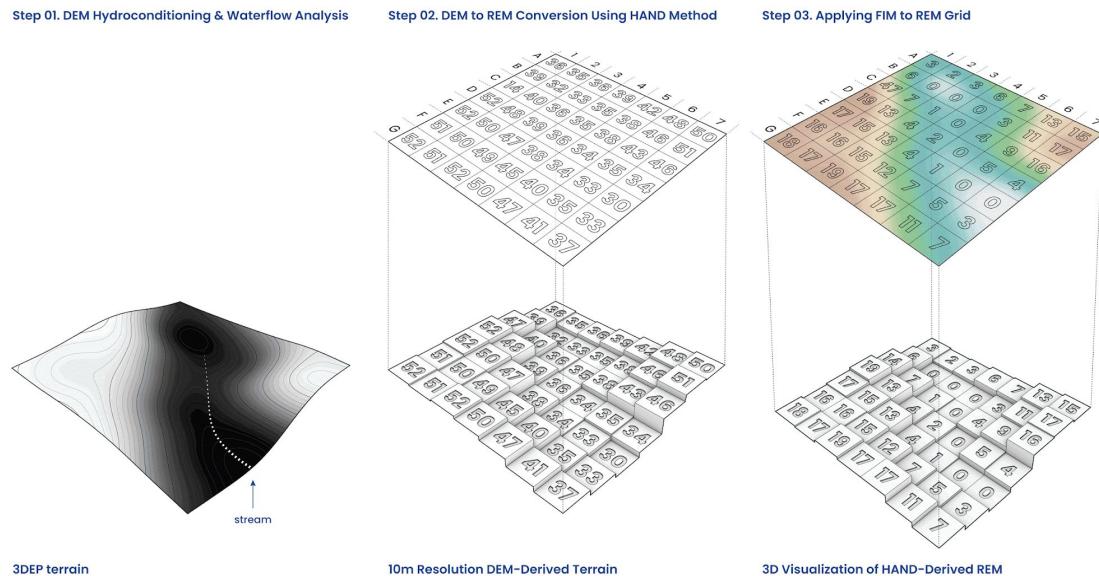
A multi-model depth enabled ensemble likelihood flood mapping capabilities for the entire country



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# HAND Flood Mapping

# HECRAS Flood Mapping



## The Goal of FIM

A **multi-model** depth enabled ensemble likelihood flood mapping capabilities for the entire country

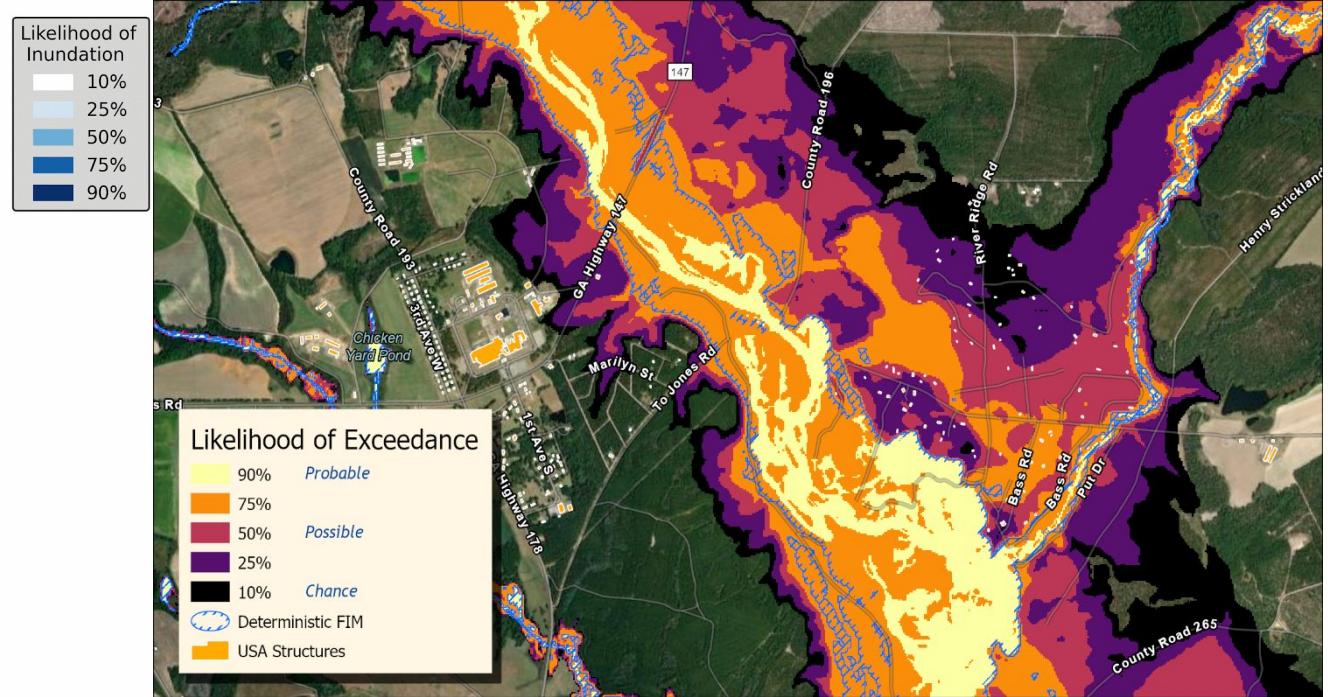
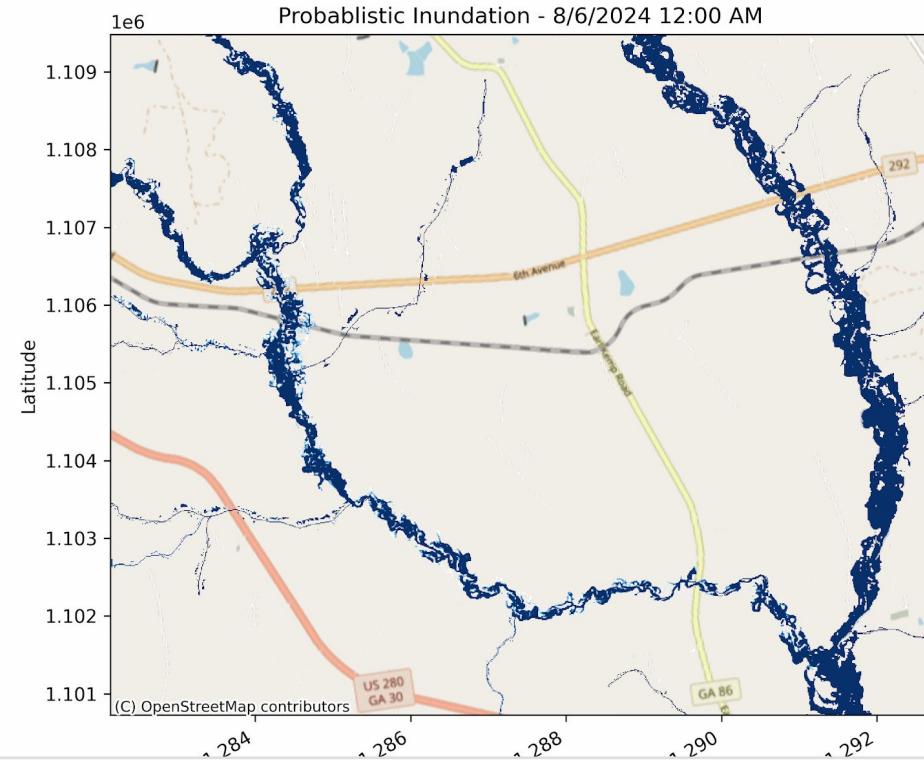


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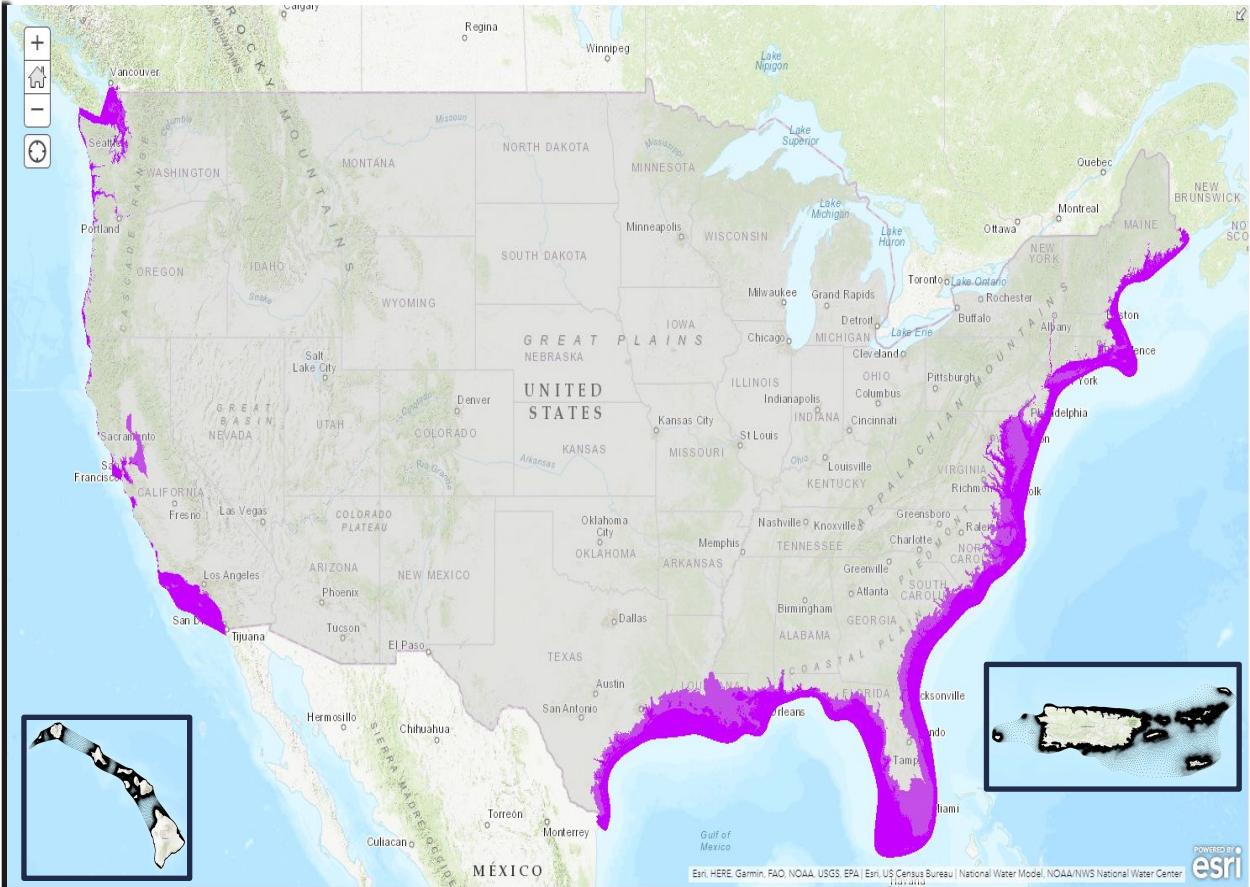
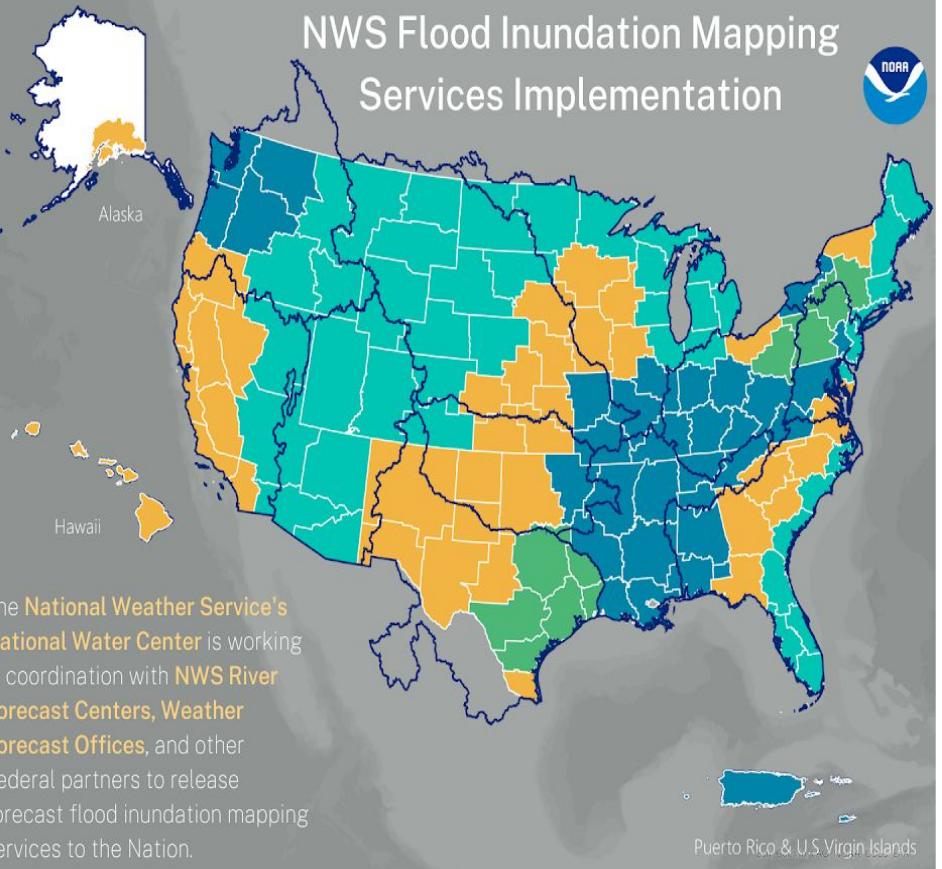
A **multi-model depth enabled** ensemble likelihood flood mapping capabilities for the entire country



# The Goal of FIM

A **multi-model depth enabled ensemble likelihood** flood mapping capabilities for the entire country

## Map Legend

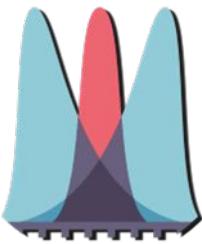


## The Goal of FIM

A **multi-model depth enabled ensemble likelihood** flood mapping capabilities for the **entire country**

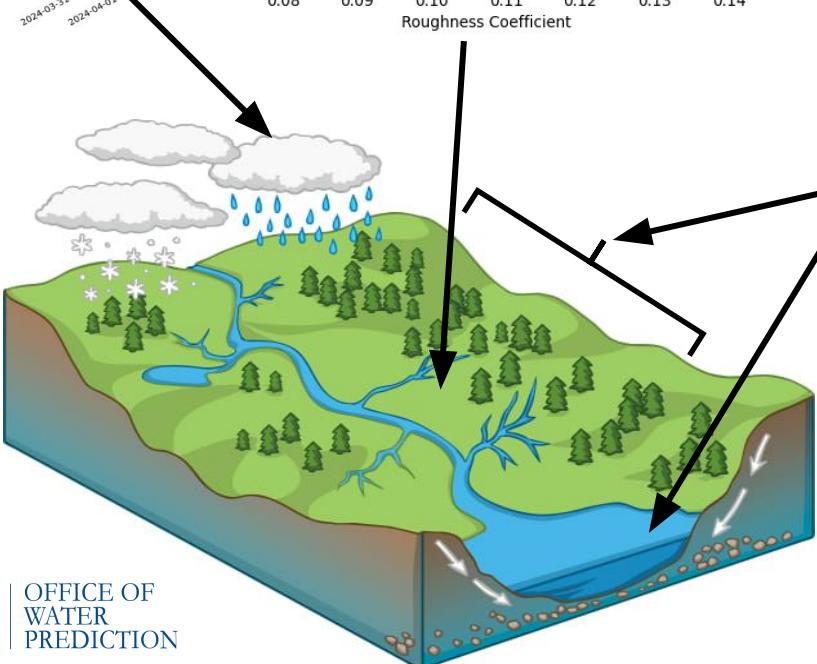
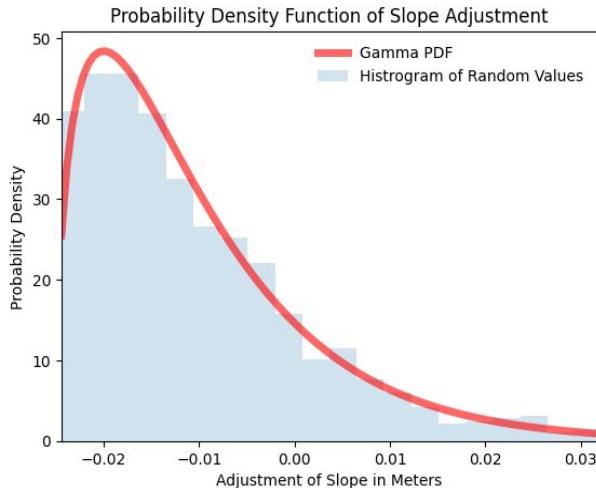
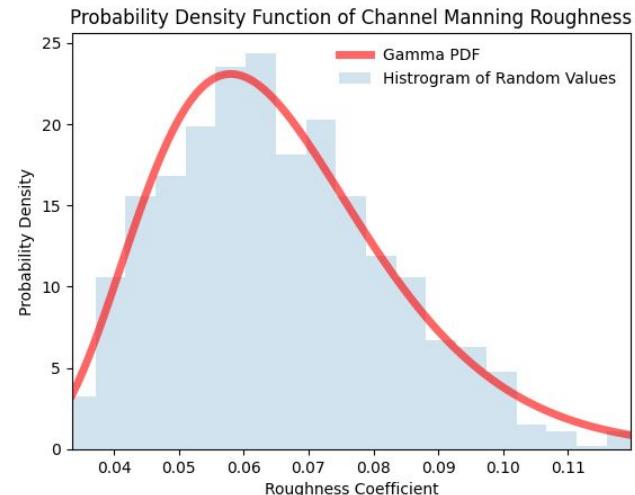
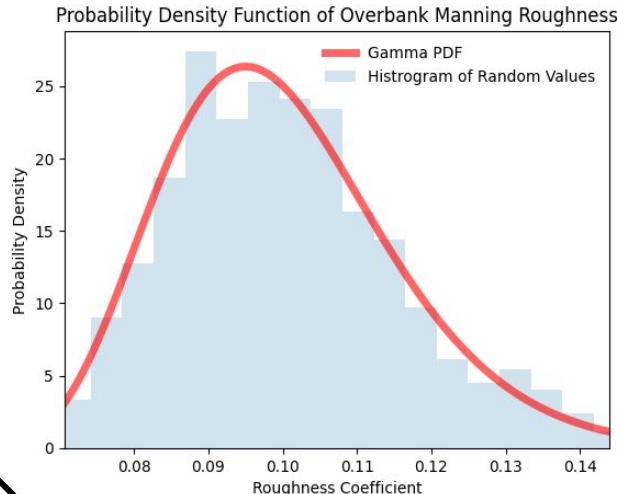
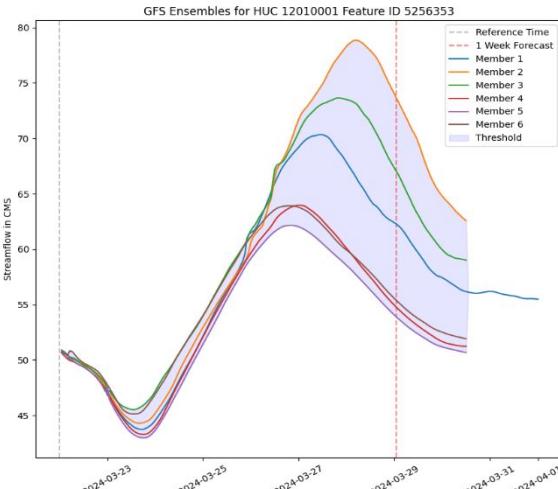


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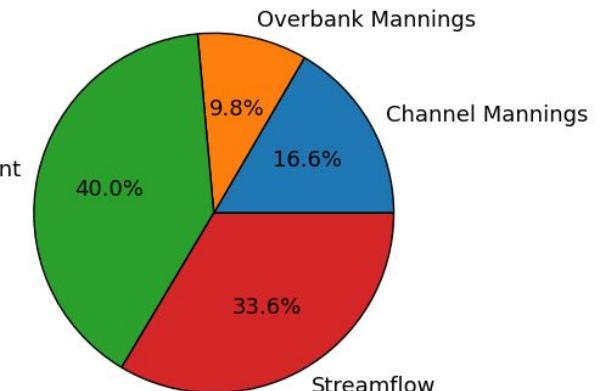
# Likelihood Flood Mapping

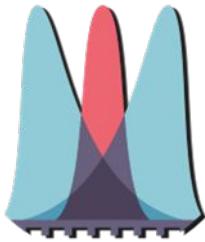
## More Than Just Changing Flow



Sensitivity Ratios of Input Parameters with Respect to Output

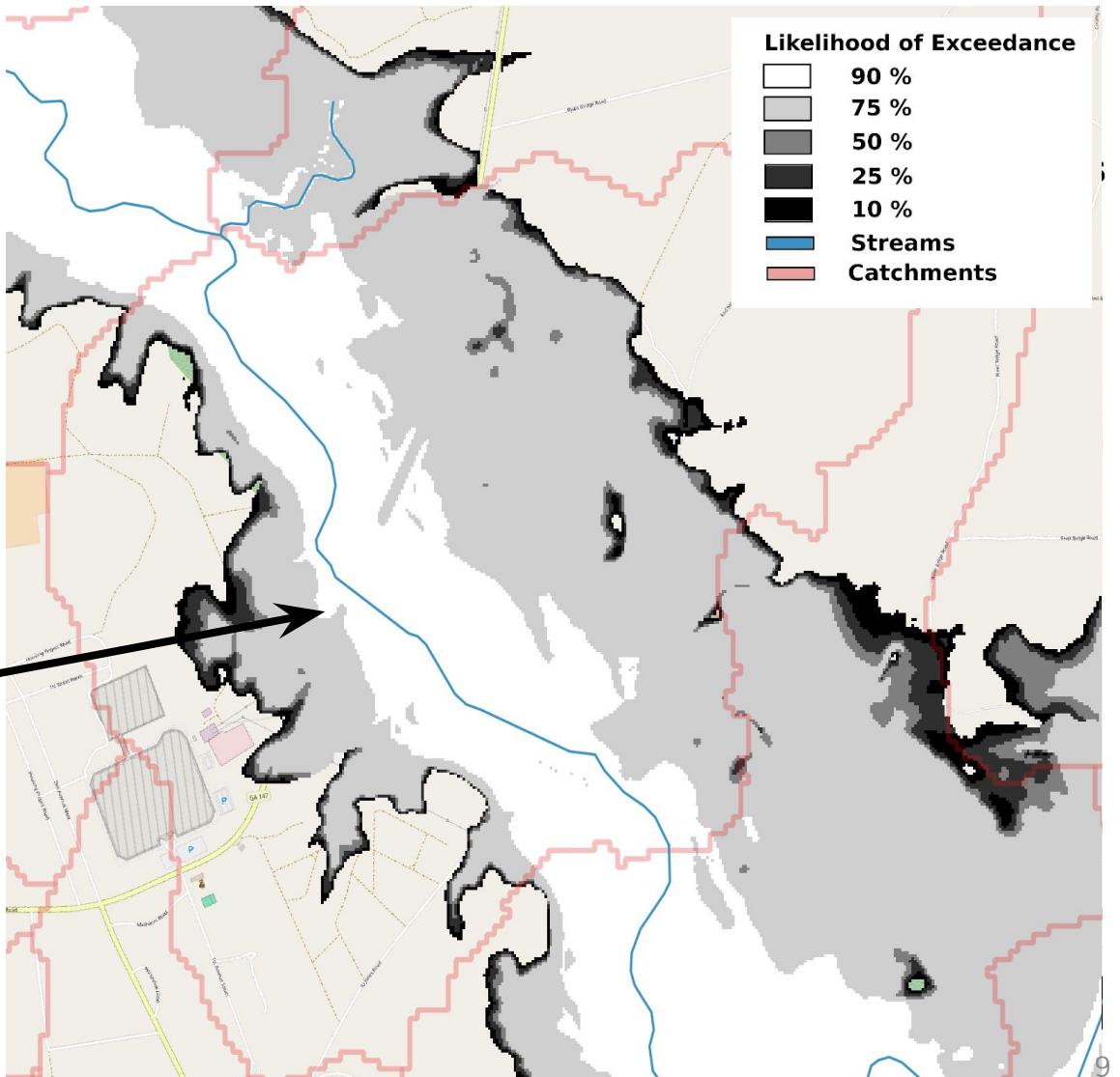
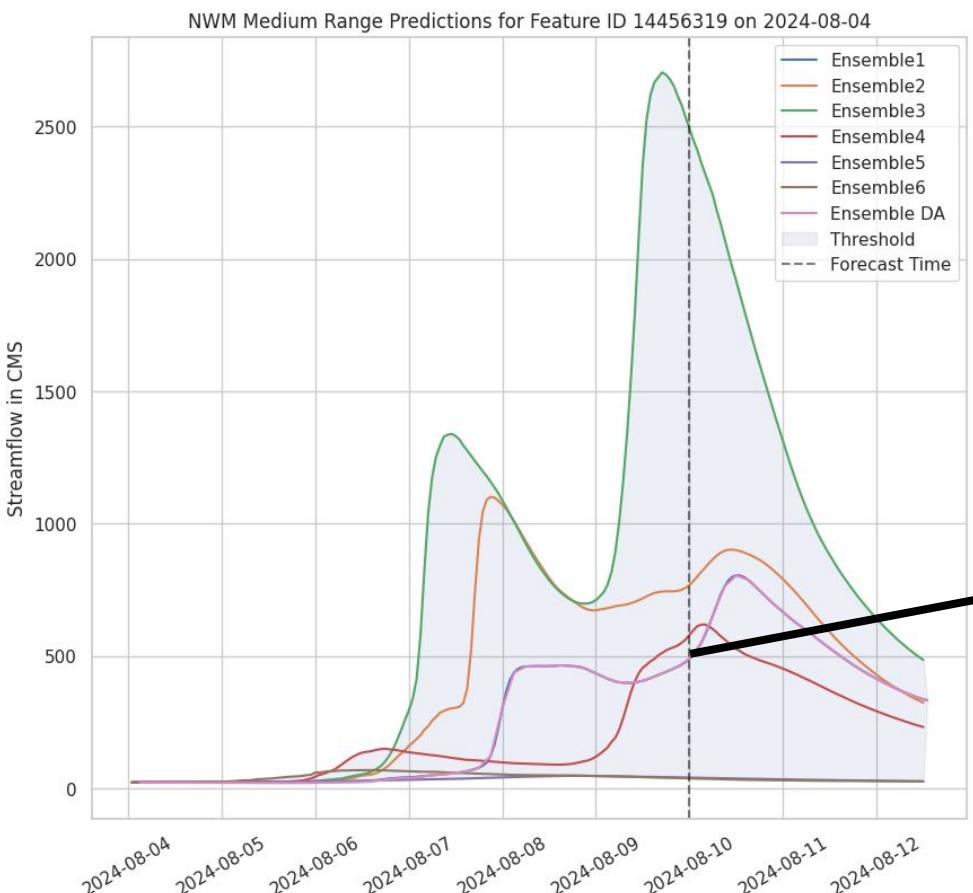
Slope Adjustment

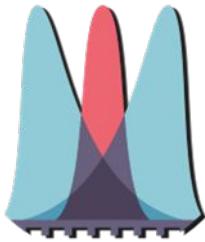




# Likelihood Flood Mapping

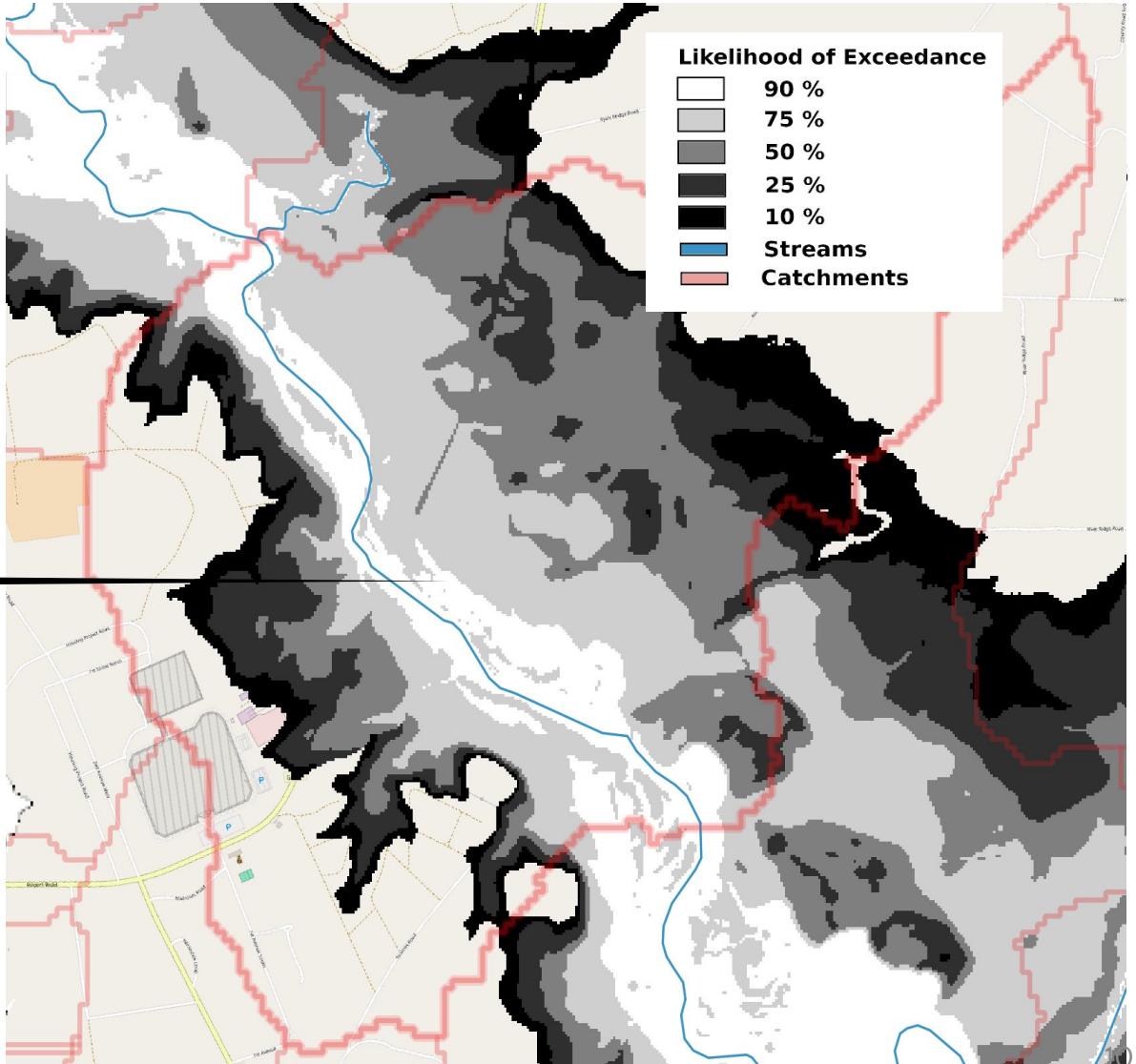
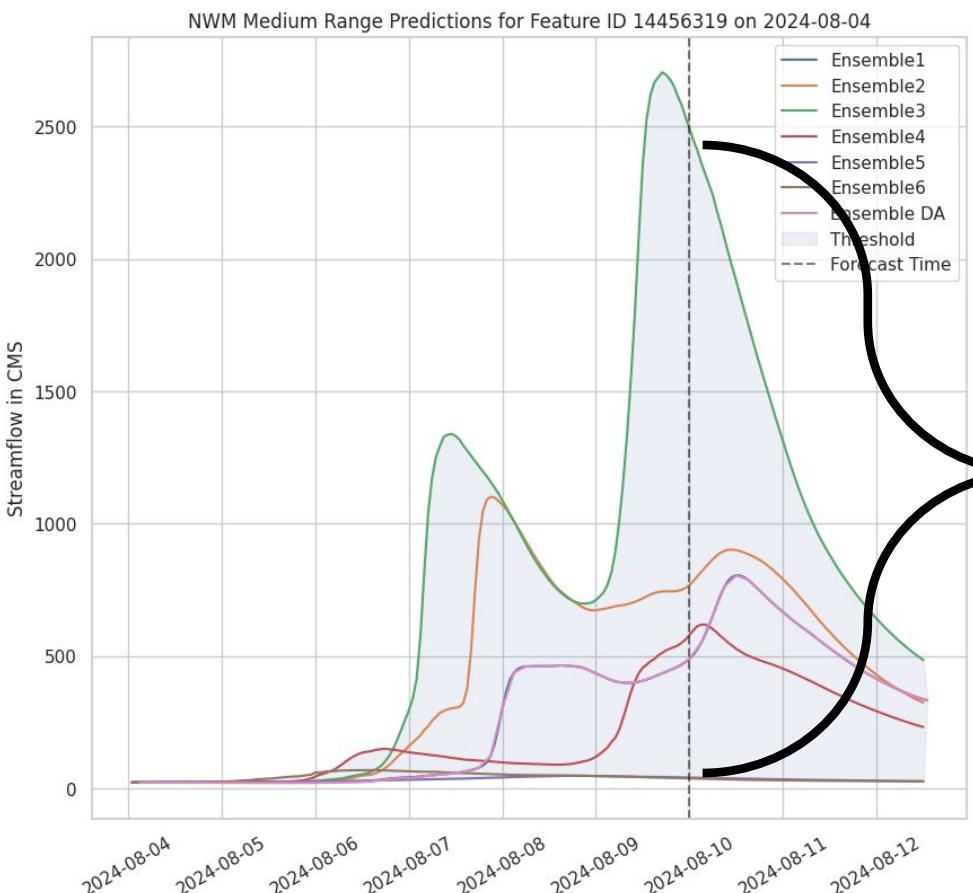
More Than Just Changing Rainfall Models

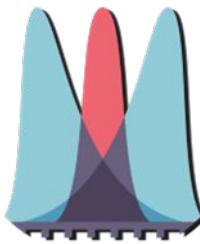




# Likelihood Flood Mapping

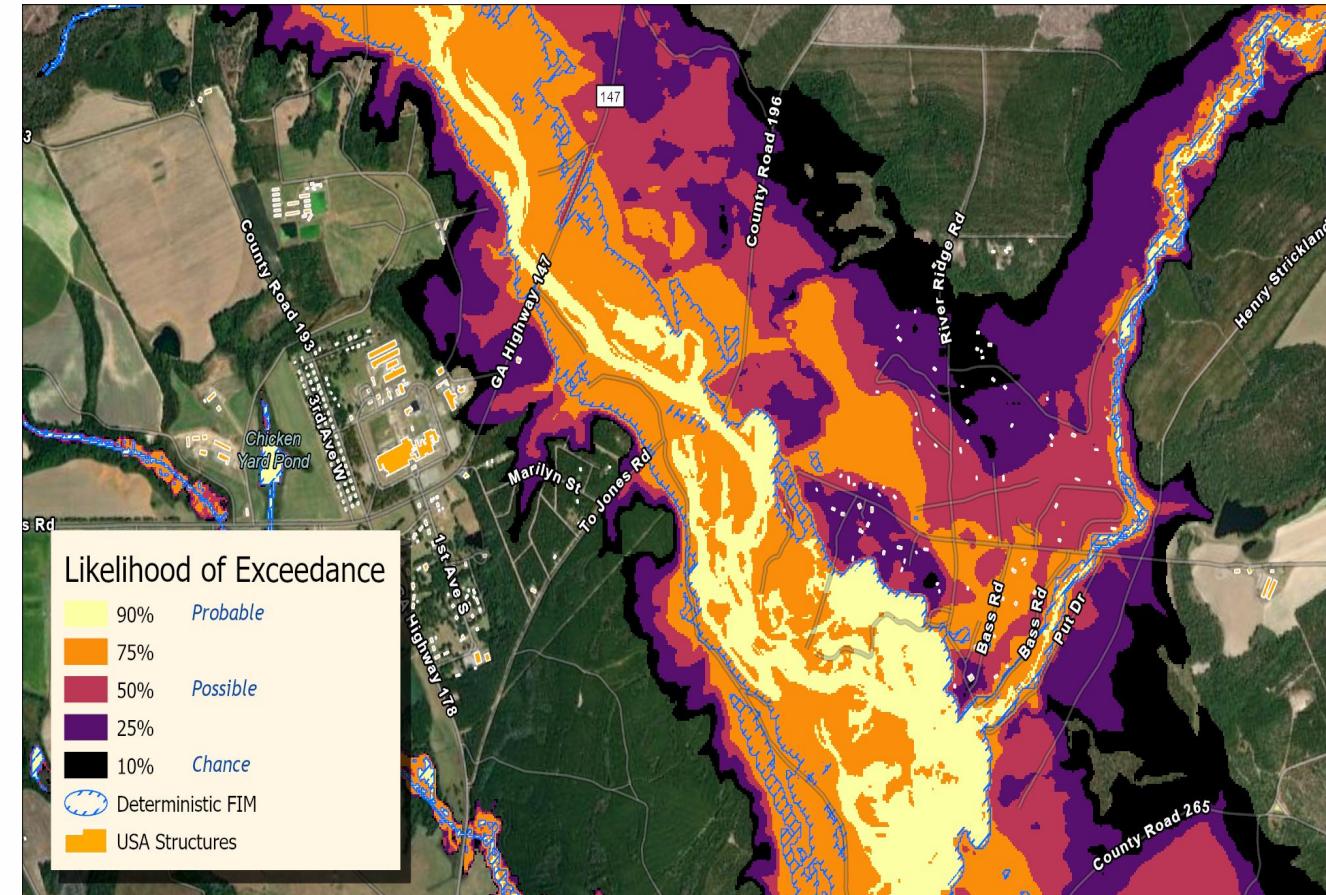
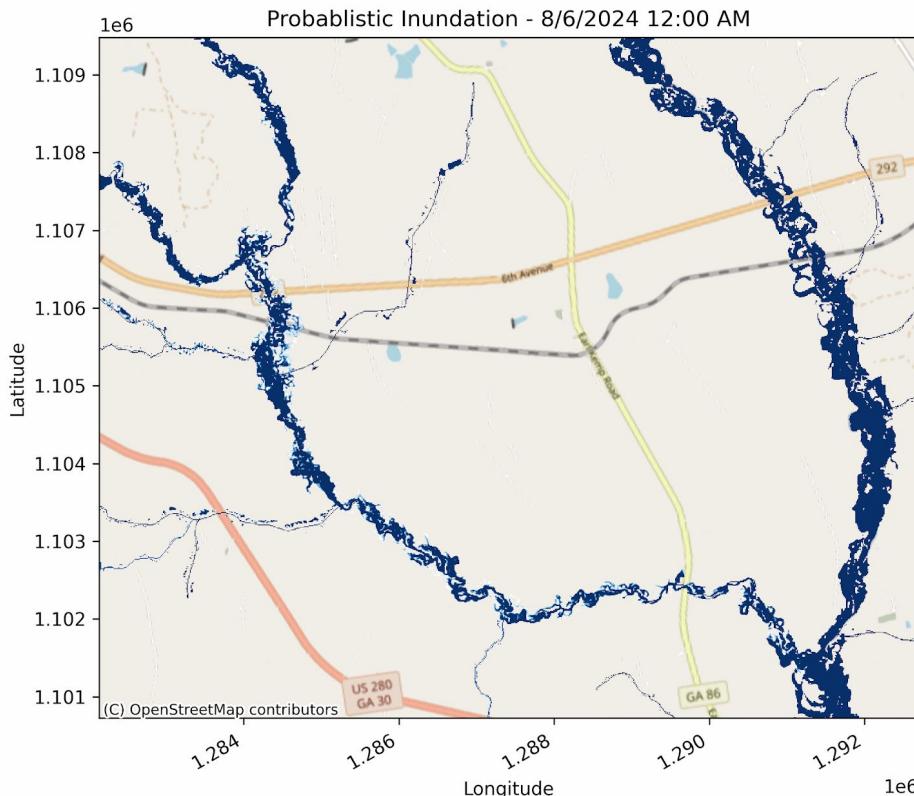
More Than Just Changing Flow





# Likelihood Flood Mapping

What Could the Visualization Look Like?





# Machine Learning FIM Enhancements

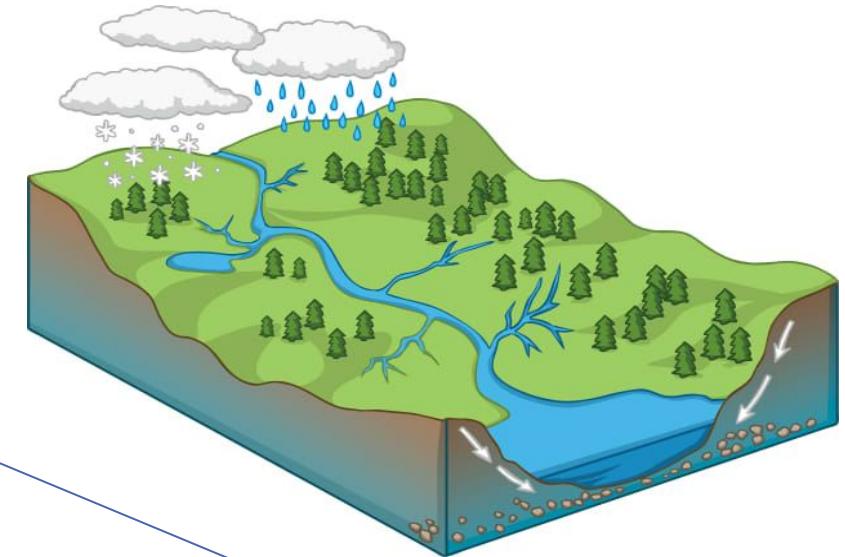
Optimizing the Parameters of the Manning's Equation

## Mannings Equation

$$Q = \frac{1.49}{n} A R^{2/3} S_o^{1/2}$$

**Mannings Coefficient:** Machine learning optimization to tune the water surface elevation for a flow

**Missing Bathymetry:** Machine learning bathymetry estimation to improve volume – a key factor in improving the area and hydraulic radius in Manning's calculation



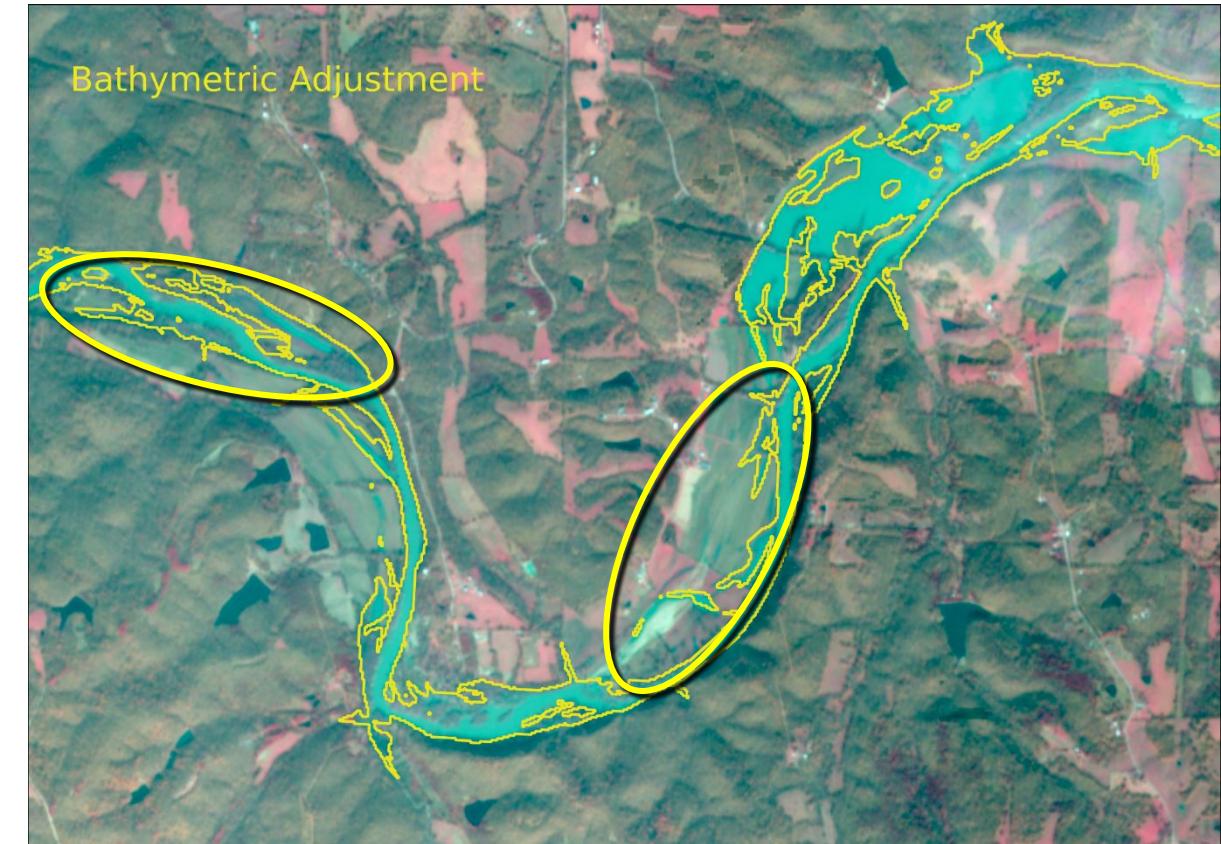
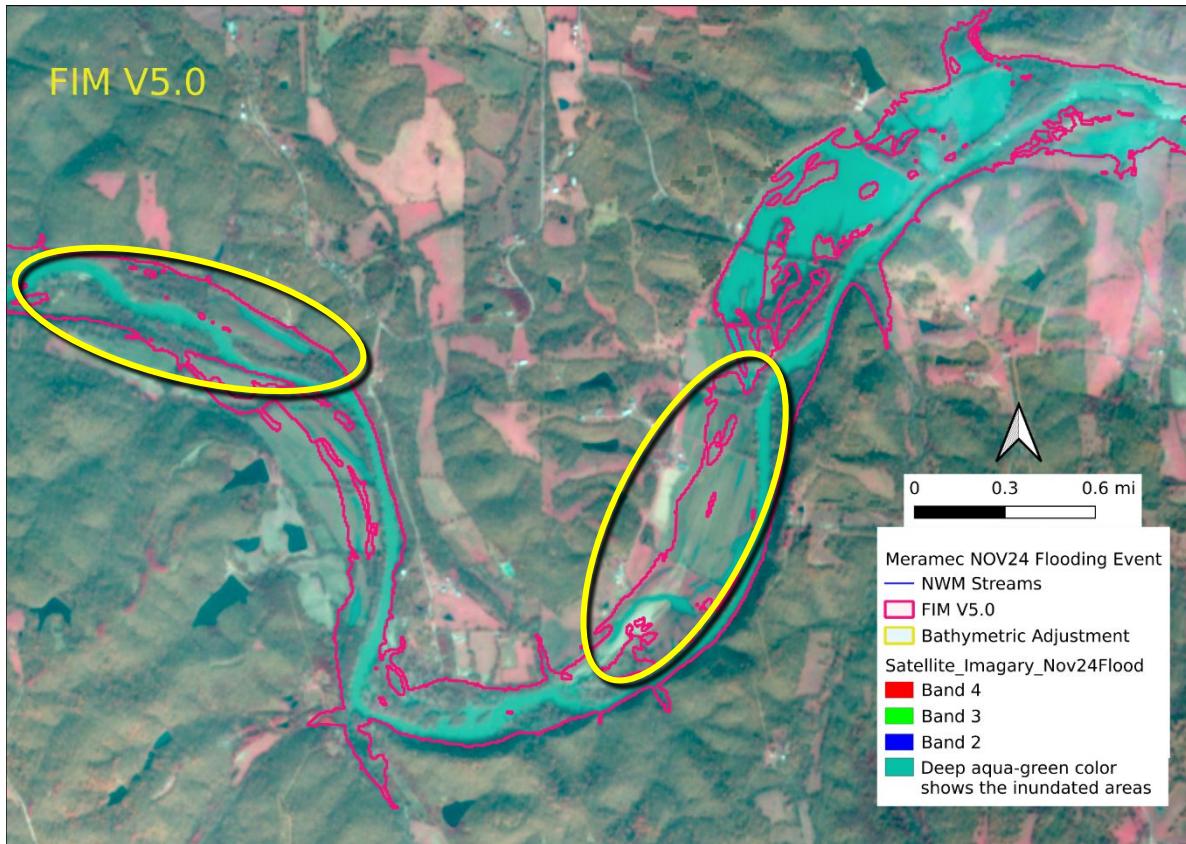
**Slope:** Utilizing hydrofabric to calculate more accurate slope representation



# Machine Learning FIM Enhancements

Optimizing the Parameters of the Manning's Equation

*November 8<sup>th</sup> St. Louis Flood Event Along Meramec River in Central Township, MO*





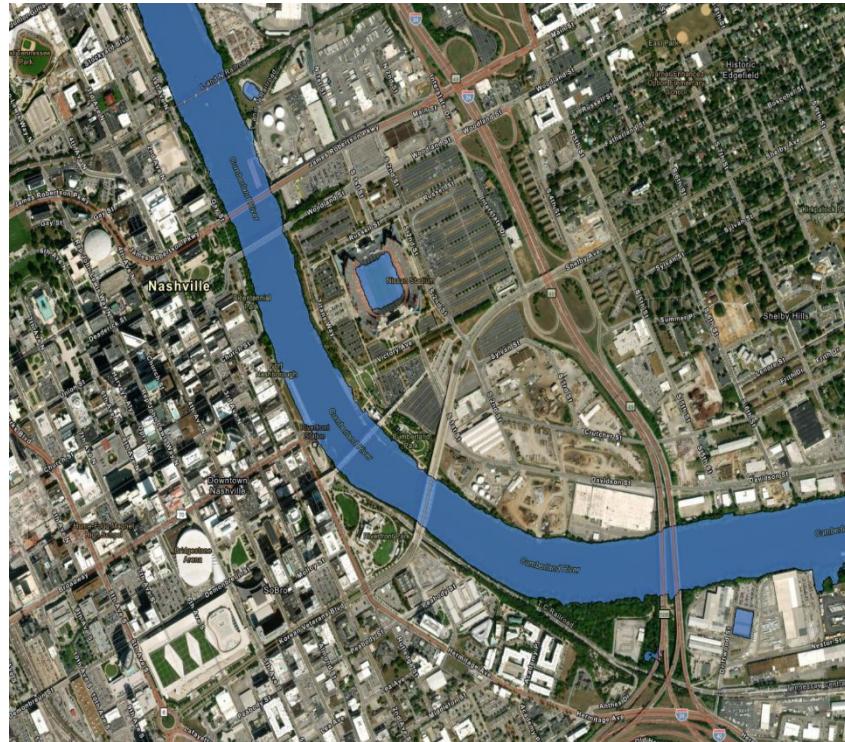
# Machine Learning FIM Enhancements

Optimizing the Parameters of the Manning's Equation

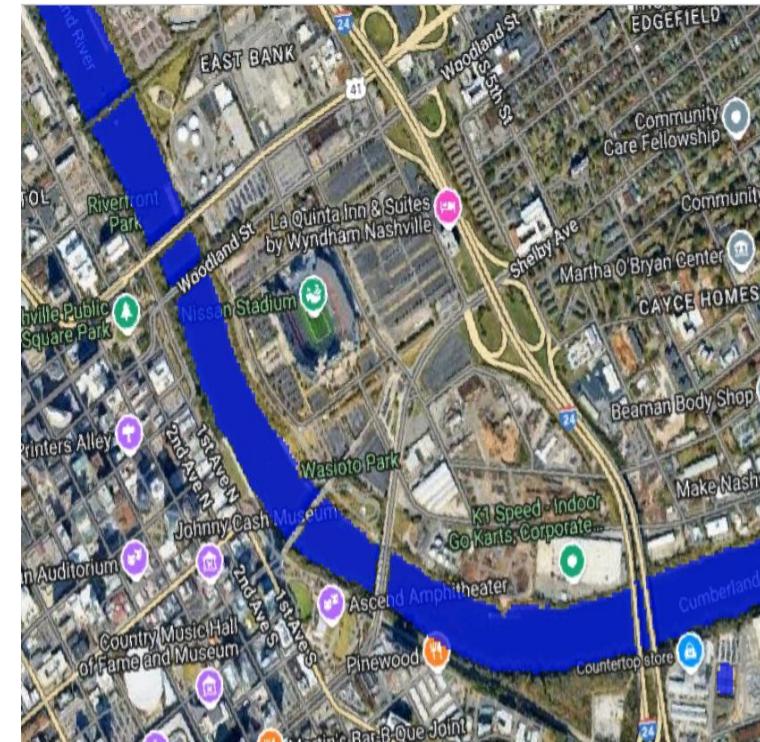
*May 10<sup>th</sup> Cumberland River Flooding in Nashville, TN*



Latest FIM Version



Corps Of Engineers  
Hydraulic FIM Modeling



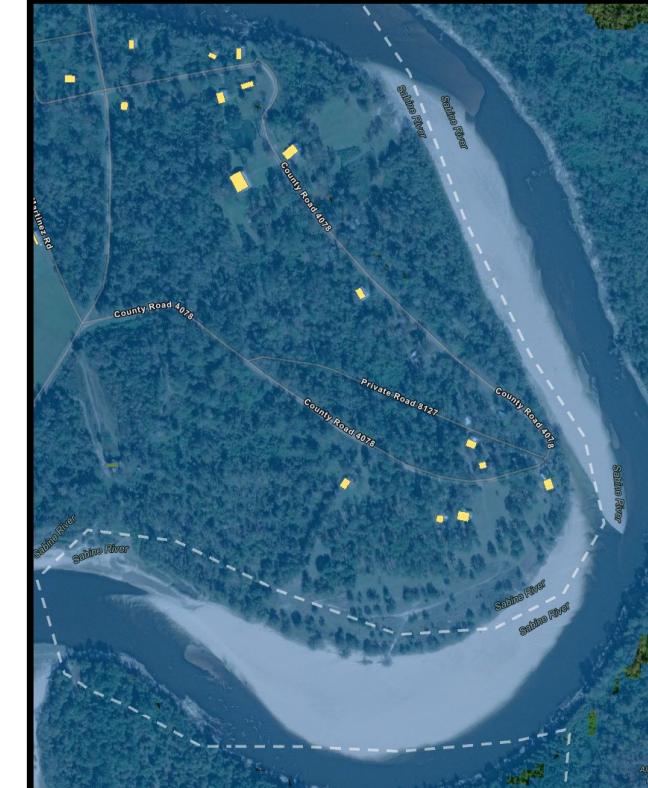
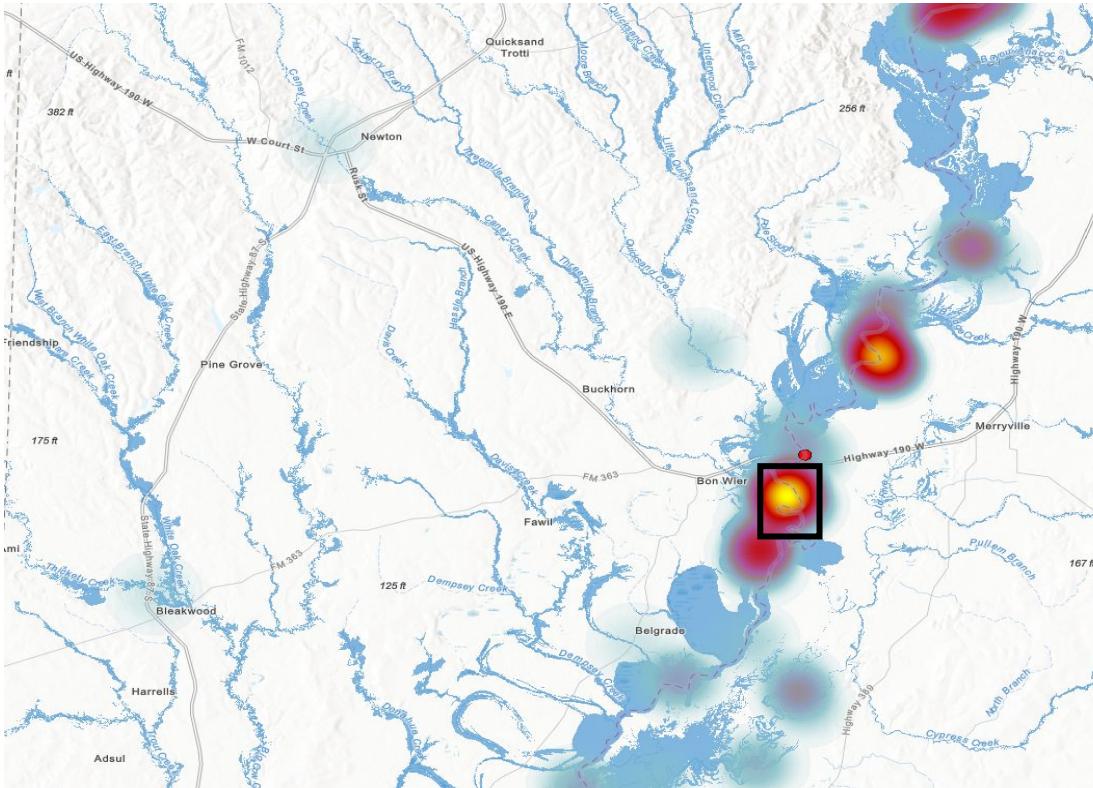
Adding Machine Learning  
Bathymetry



# From Map to Impacts

Displaying the Impacts from the Flood Mapping

## *Where Do You Start?*





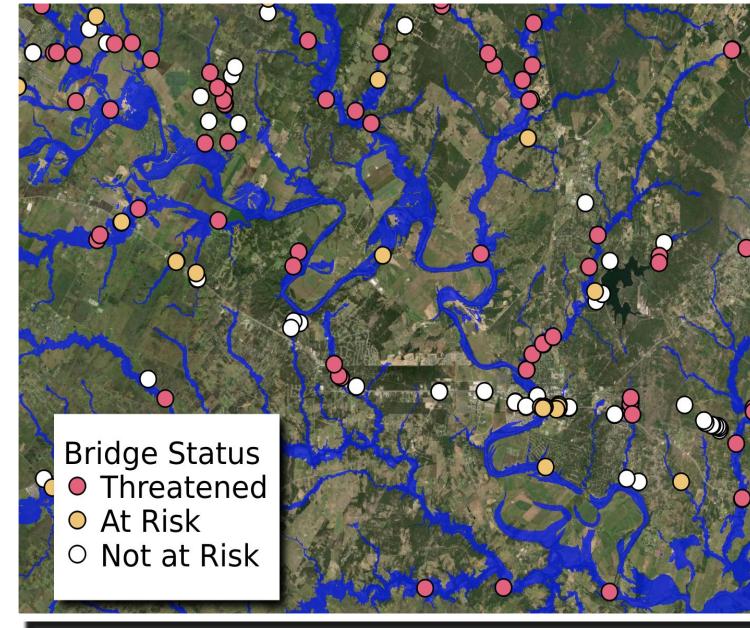
# From Map to Impacts

Displaying the Impacts from the Flood Mapping

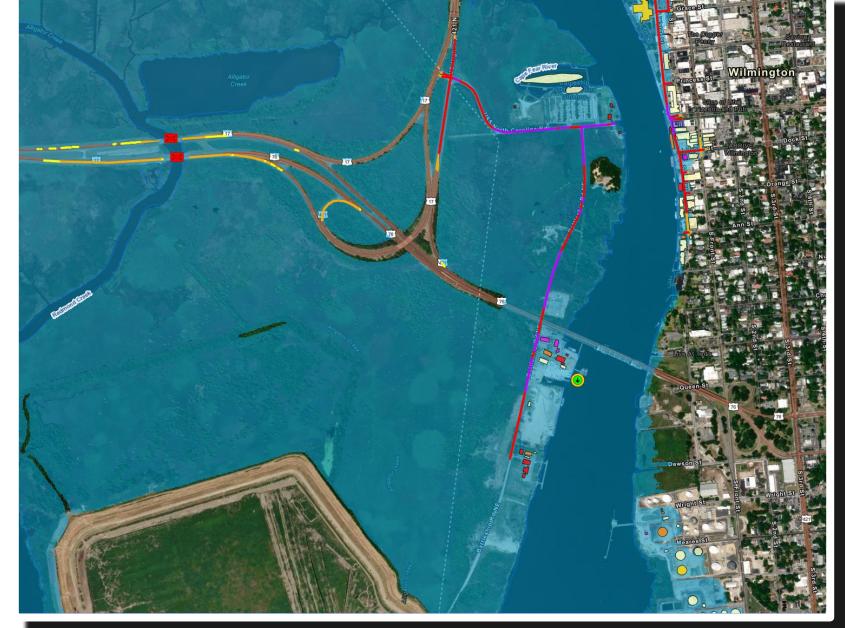
*What Does The Future of FIMPact Look Like*



Improve the  
Infrastructure Data  
Layer



Develop a Bridge Impact  
Threat Service (BITS)



Add the Threatened Road  
Network to Flood  
Mapping



# *Thank You FIM* Team!



Carson Pruitt, Fernando Salas, Nick Chadwick, Mike Johnson, Greg Petrochenkov, Hamideh Safa, Shawn Crawley, Catherine Fitzpatrick, Monica Stone, Don Liesure, George Rought, Lorne Leonard, Katherine Powell, Drix Tagliban, Edison Orellana, Michael Doria, Ryan Grout, Riley McDermott, Rob Hanna, Matt Luck, Ali Forghani, Emily Deardorff, Ryan Spies, Zahra Ghahremani, Arash Rad, Dami Eyeladi, Alemayehu Midekisa, James Coll, Justin Singh-Mohudpur, Angus Watters



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<https://water.noaa.gov>

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