

# Challenges and Opportunities in Bridging Hydrology Research and Practice: Co-Developing FloodSavvy Through Interdisciplinary Collaboration and Community Engagement

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# Workshop Overview

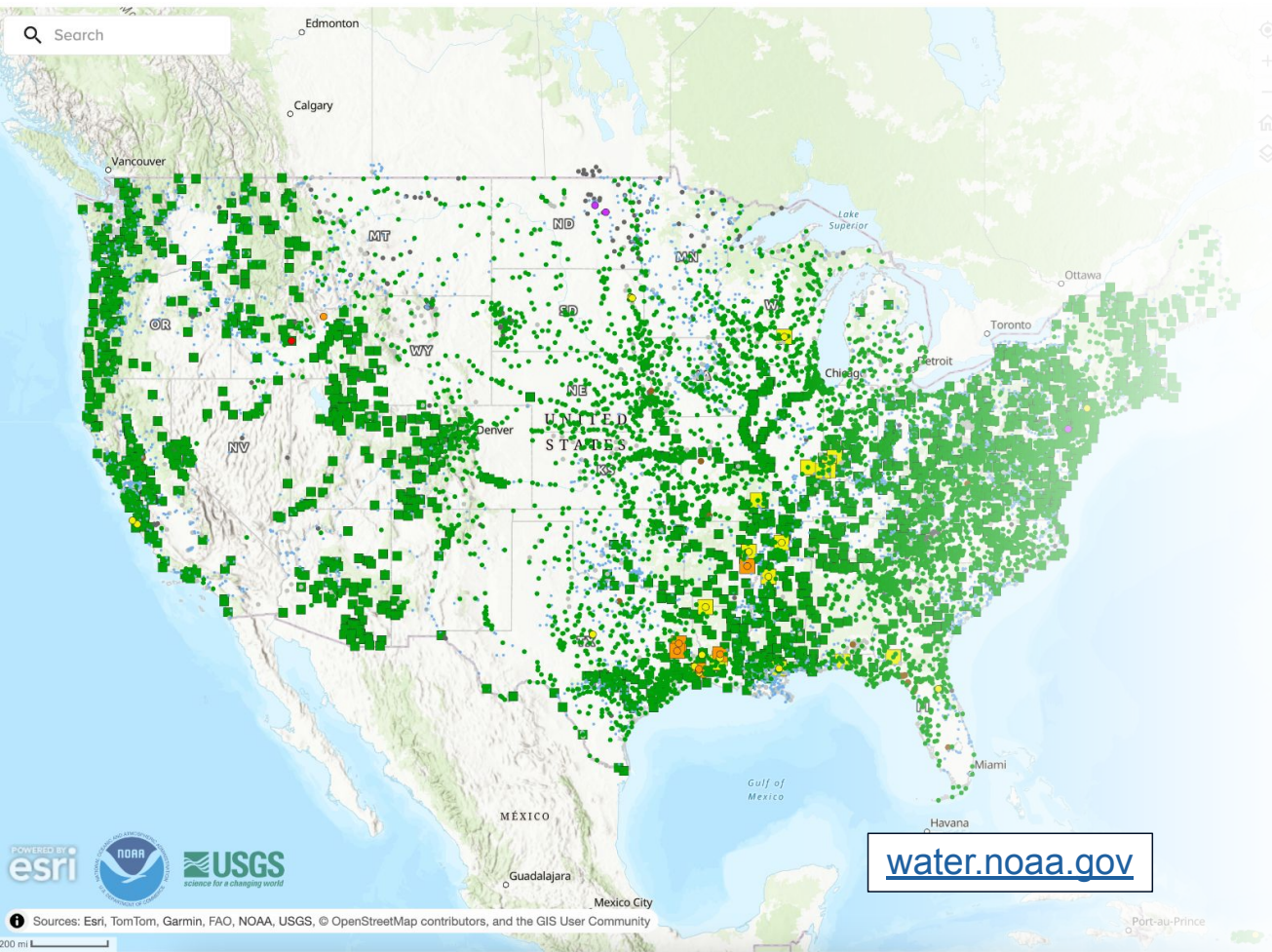
1. **Who needs streamflow data** - and why it's hard to access
2. **Activity** - NWM vs FloodSavvy
3. **Co-developing FloodSavvy** - process and team
4. **Brainwriting & Discussion** - your work, barriers, needs



A scenic view of a rocky coastline. The foreground is dominated by large, light-colored, jagged rocks. The ocean is a deep blue, with white foam from waves crashing against the rocks. In the distance, a dark line of trees marks the horizon under a clear, dark blue sky.

# Project Background

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## Research Question:

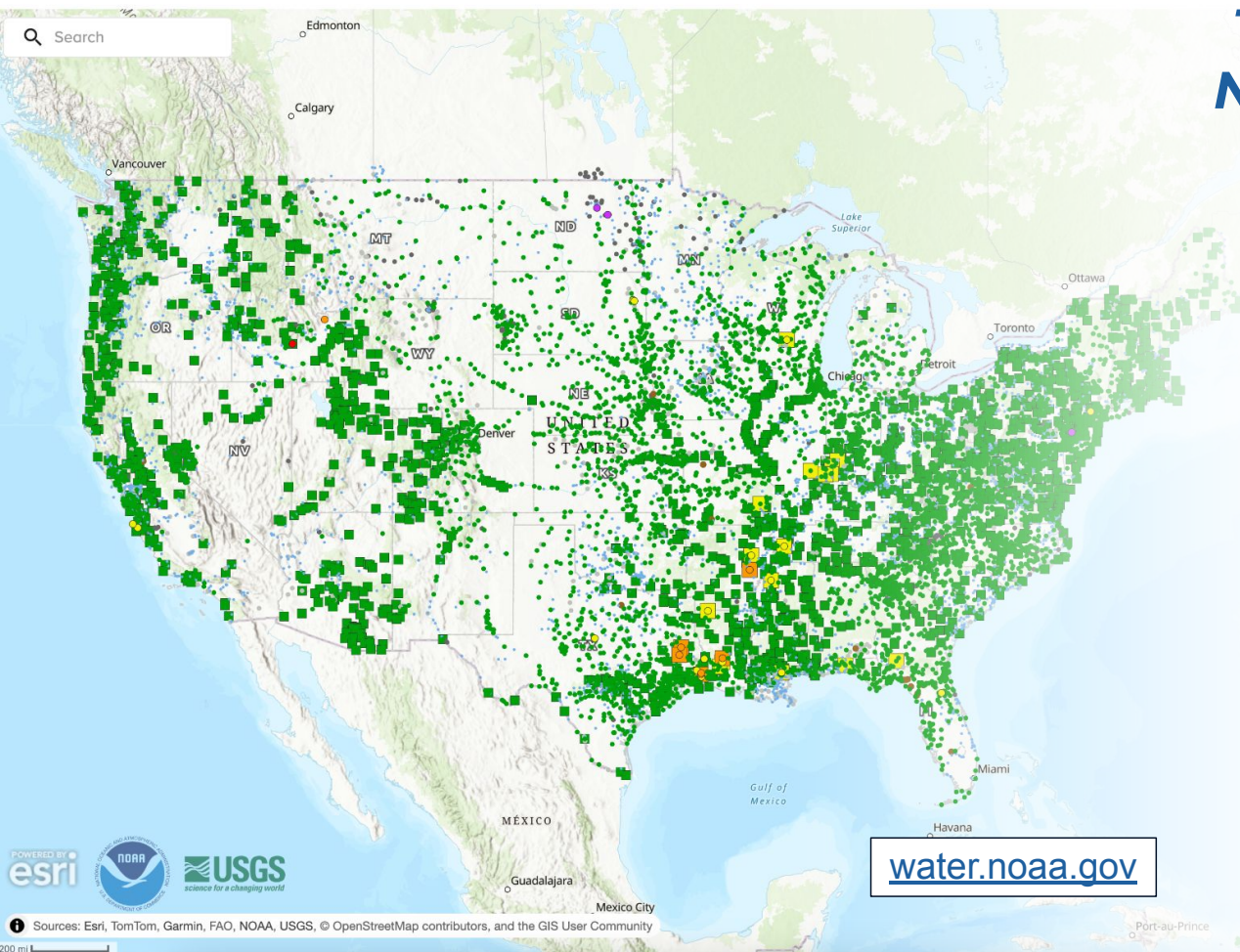
How can NOAA's National Water Model (NWM) be used to aid community resilience planning and water decision-making?

# Who actually needs flood data - and can't get it

## Three real decision makers:

1. **The Regional Planner, Vermont** — Works with small towns to update Hazard Mitigation Plans and apply for FEMA grants. Relies on a single stream gauge for an entire watershed. When the gauge was removed, the region lost its only window into what the river was doing. Not a hydrologist.
  - a. Needs to know: where is flood risk highest, and how do I justify a mitigation project?
2. **The Park Superintendent, Missouri** — Manages 4,294 acres and over 1 million visitors a year at Roaring River State Park. Flash floods can reach campgrounds in minutes. He described himself as "the guy who has to get up in the middle of the night and get people out." Not a hydrologist.
  - a. Needs to know: is a flood coming, and do I evacuate now?
3. **The Floodplain Administrator, DeSoto MO** — Manages buyout programs and emergency notification for a small city on Joachim Creek. Flooding occurs outside mapped floodplains. Relies on a single USGS gauge and local knowledge. Not a hydrologist.
  - a. Needs to know: which areas are most at risk, and how does this event compare to past floods?

*All of them want NWM data.*



## ***This data exists - the National Water Model***

- 40 years of retrospective streamflow data
- Forecasts up to 30 days
- Coverage of gauged and ungauged rivers nationwide
- New FIM services

A scenic view of a rocky coastline. The foreground is dominated by large, light-colored, jagged rocks. The ocean is a deep blue, with white foam from waves crashing against the rocks. In the distance, a dark line of trees marks the horizon under a clear, dark blue sky.

# Activity 1: NWM vs FloodSavvy

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# Scenario Exercise: Part 1 - NWM

**Background:** Imagine you're an emergency manager who lives near the Black River, which flows through the town of Ludlow in southern Vermont (Mount Ascutney Region). Your region has very few stream gauges, so you can't rely on gauge data to know whether the river is at risk of flooding. You want to know what the river is likely to do over the next 8–10 days and whether you should prepare for a response.

## The Task:

1. Go to [water.noaa.gov](https://water.noaa.gov)
2. Locate a 8-10 day ensemble streamflow forecast for the Black River
3. Assess whether you think a flood response is warranted



**Background:** You are a regional planner with the Windham Regional Commission in southeastern Vermont, helping member towns update their Hazard Mitigation Plans. You want to understand the historical streamflow record for the Saxtons River, a stream with very limited gauge coverage, to identify past flood trends and inform which areas should be prioritized for mitigation investments.

## The Task:

1. Go to [water.noaa.gov](https://water.noaa.gov)
2. Locate historical streamflow data for the Saxtons River
3. Has the Saxton River had any flood events in the past 10 years may be notable for a HMP?



# DISCUSSION

1. What was your experience finding and using the information from the NWM and NWPS?
2. Were you able to find the information you sought for both scenarios?
3. What steps did you take to reach the information?

# Scenario Exercise: Part 2 - FloodSavvy

**Background:** Imagine you're an emergency manager who lives near the Black River, which flows through the town of Ludlow in southern Vermont (Mount Ascutney Region). Your region has very few stream gauges, so you can't rely on gauge data to know whether the river is at risk of flooding. It's July 1st 2025, and you want to know what the river is likely to do over the next 8–10 days and whether you should prepare for a response.

## The Task:

1. Go to FloodSavvy: <https://floodsavvy.cuahsi.io/#/>
2. Locate a 8-10 day streamflow forecast for the Black River in July 2025
3. Assess whether you think a flood response is warranted



**Background:** You are a regional planner with the Windham Regional Commission in southeastern Vermont, helping member towns update their Hazard Mitigation Plans. You want to understand the historical streamflow record for the Saxtons River from Jan 1, 2021 - Dec 31, 2025, a stream with very limited gauge coverage, to identify past flood trends and inform which areas should be prioritized for mitigation investments.

## The Task:

1. Go to FloodSavvy: <https://floodsavvy.cuahsi.io/#/>
2. Locate historical streamflow data for the Saxtons River
3. Has the Saxton River had any flood events between 2021-2025 that may be notable for a HMP?



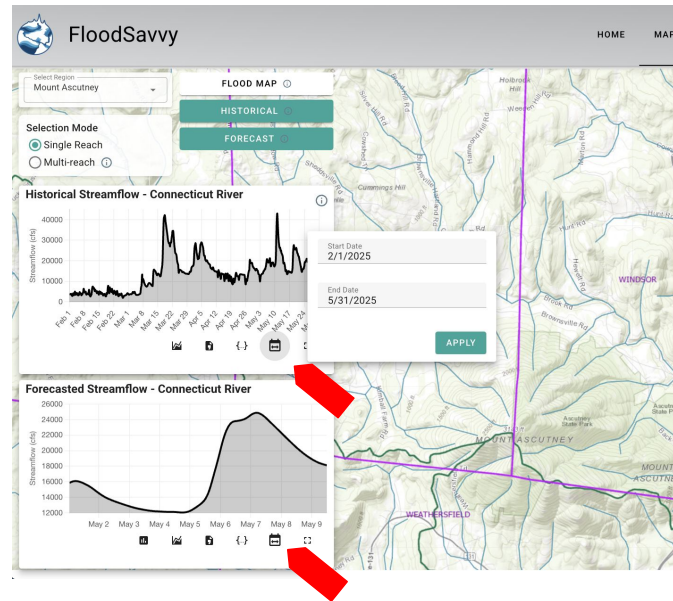
# Scenario Exercise: Part 2 - FloodSavvy

**Background:** Imagine you're a regional planner who lives near the Black River in southeastern Vermont (Mount Ascutney Region). The region has very few stream gauges, so you don't have gauge data to know whether the river is flooding. It's July 1st 2025, and you want to know what the river is likely to do over the next 8–10 days and whether you should issue a flood response.

## The Task:

1. Go to FloodSavvy: <https://floodsavvy.cuahsi.edu/>
2. Locate a 8-10 day streamflow forecast for the Black River in July 2025
3. Assess whether you think a flood response is warranted

**NOTE:** Adjust date range icon looks like this



regional planner with the Black River in southeastern Vermont. The region has very few stream gauges, so you don't have gauge data to know whether the river is flooding. It's July 1st, 2025, and you want to understand what the river is likely to do over the next 8–10 days, to identify past investments.

[floodsavvy.cuahsi.edu/](https://floodsavvy.cuahsi.edu/)  
Streamflow  
River  
had any  
2021-  
able for



# DISCUSSION

1. What was your experience finding and using the information on FloodSavvy?
2. What was different between using the NWM and using FloodSavvy when locating the information?
3. In your opinion, what decisions would the NWM better support and what decisions would the FloodSavvy better support?



# FloodSavvy Overview

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# FloodSavvy Overview: Landing Page



Disclaimer language - experimental product

Home page offers easy site selection

The screenshot shows the FloodSavvy website interface. At the top, there is a navigation bar with links for HOME, MAPS, RESOURCES, ABOUT, and CONTACT. The main heading reads "Translating NOAA's National Water Model data into easy-to-understand flood risk insights". Below this, a "Historical Streamflow - Roaring River" graph is visible, showing water level over time. A "Disclaimer" modal window is overlaid on the graph, containing the following text:

**Disclaimer**

FloodSavvy is an **experimental** application that visualizes potential **inundation flooding** based on forecasts from NOAA's National Water Model (NWM) and its associated Flood Inundation Mapping (FIM) services.

This tool **does not provide fluvial erosion information** or other flood-related hazards beyond inundation, as these processes are **not modeled by the NWM**.

While FloodSavvy offers useful insights into where inundation may occur, all outputs are estimates and include inherent uncertainty. These maps are **NOT official flood products** from NOAA or the National Weather Service, although they draw on similar methodologies to NOAA's experimental FIM services.

FloodSavvy is intended to support public understanding and exploration of historical and potential future flood scenarios using publicly available data. For **official and authoritative flood forecasts, warnings, and maps**, please refer to the **NWPS Resources** available under the **Resources** tab.

FloodSavvy is for **informational and educational use only** and should **NOT** be relied upon for emergency decision-making or as a substitute for official guidance.

At the bottom of the disclaimer, logos for CIRCH, CUAHSI, and Northeastern University Global Resilience Institute are displayed.

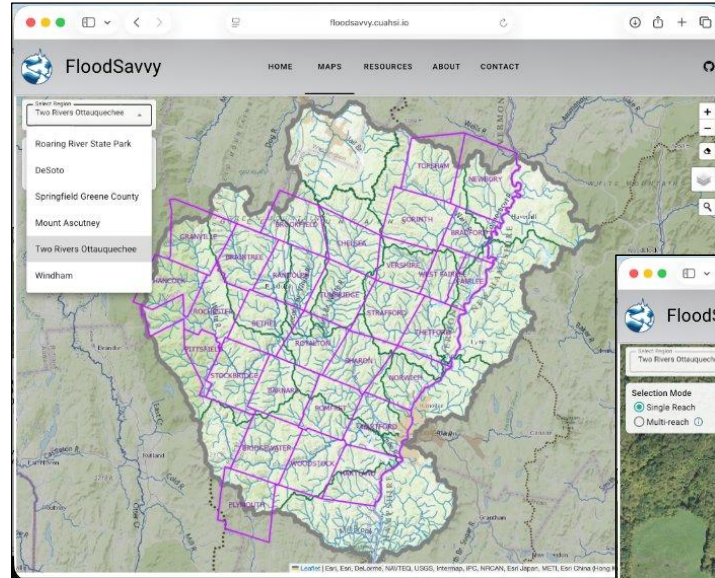
This screenshot shows the FloodSavvy website home page. It features the same navigation bar and heading as the previous screenshot. Below the heading, there is a "Historical Streamflow - Roaring River" graph and a map. A "Monitor Streamflow through interactive graphs that show historical conditions and forecasts." caption is present. Below the graph, a paragraph describes the tool's purpose: "FloodSavvy is a resource that pilots new ways to access and visualize information available from NOAA's National Water Model. The web-based interface offers the ability to assess water-related risks, monitor streamflow, and visualize flood inundation extents. It was developed in partnership with six communities across Vermont and Missouri: in Missouri, City of De Soto, City of Springfield-Greene County, Roaring River State Park, in Vermont Mt. Ascutney, Two Rivers-Ottawaquechee, and Windham."

The "Choose Your Region" section is highlighted, showing "Missouri Regions" with three options: Roaring River State Park, DeSoto, and Springfield Greene County. Each option includes a map and a brief description. Below this, "Vermont Regions" are listed with three options: Mount Ascutney, Two Rivers-Ottawaquechee, and Windham, each with a map and description.

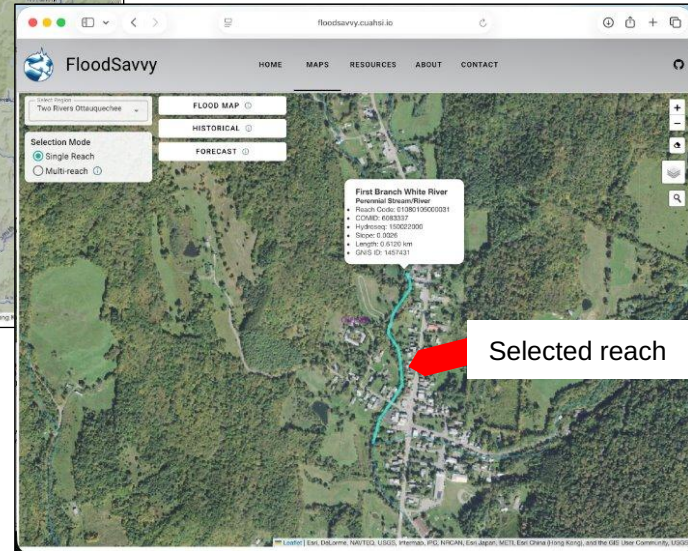
# FloodSavvy Overview: Localized Data

Site-specific map interface provides focused, relevant, and actionable information.

River metadata is made available through web services.



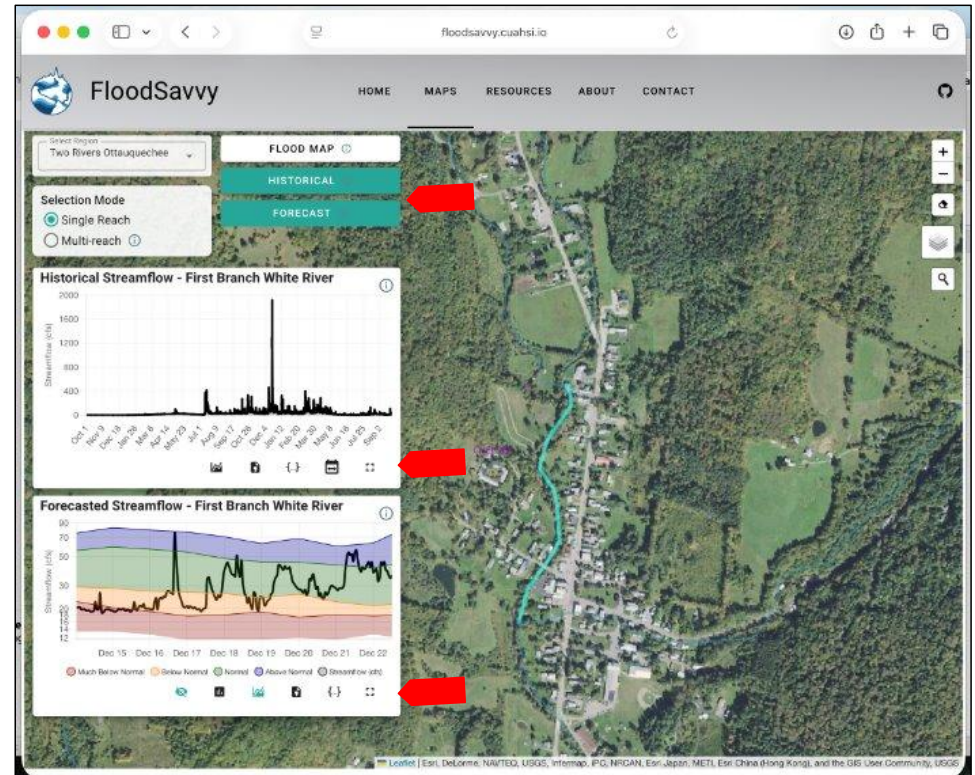
First Branch White River  
Length: 0.6km



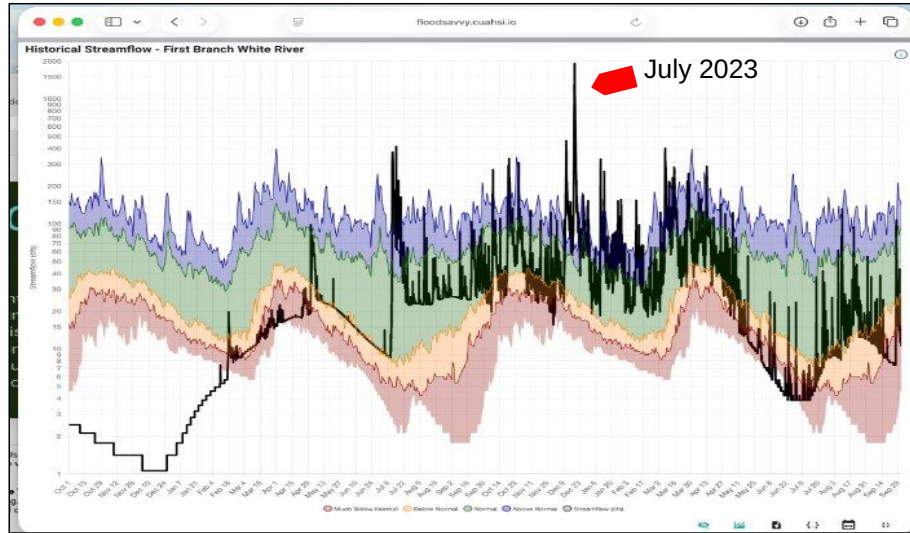
# FloodSavvy Overview: Time-Series Data

Interactive time series visualizations helps understand past, current, and future conditions.

Historical streamflows are available from 2018 - 2025.

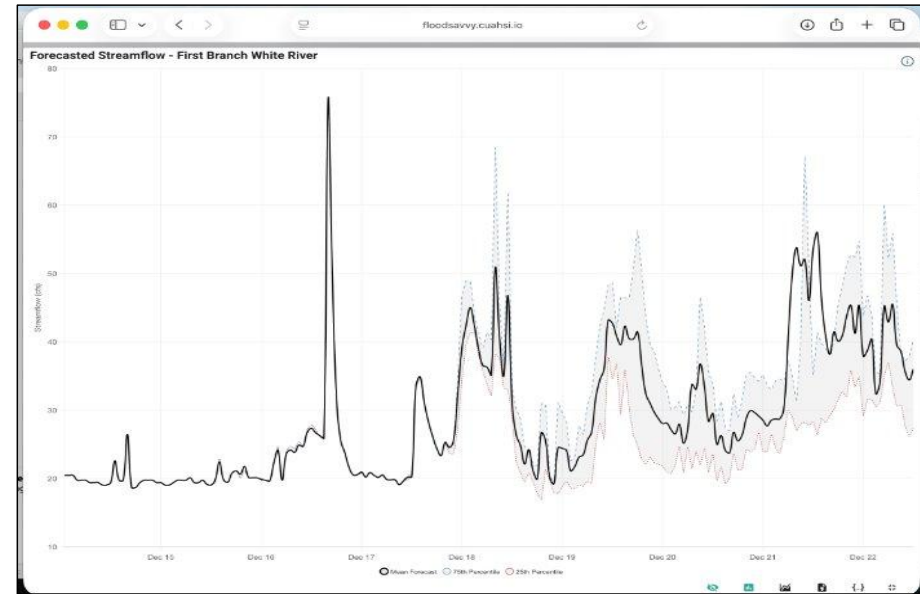


# FloodSavvy Overview: Time-Series Data



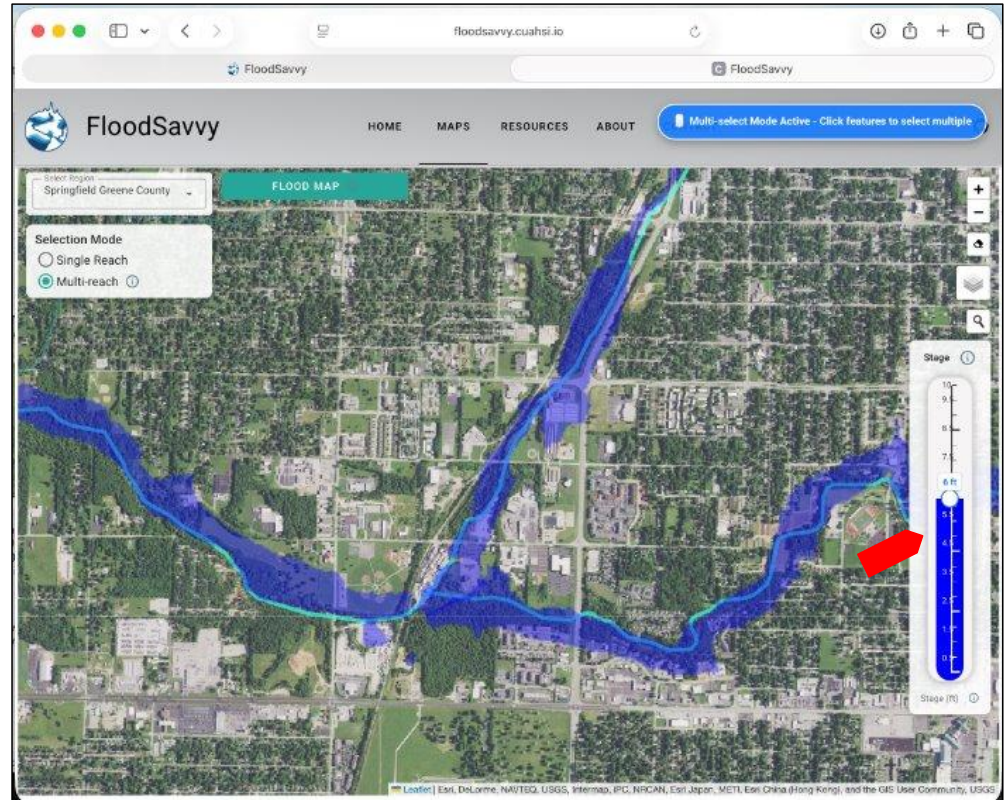
Users can view how modeled streamflow compares to past, modeled, streamflow trends.

A measure of statistical dispersion, representing the range which middle 50% of the ensemble data lie.

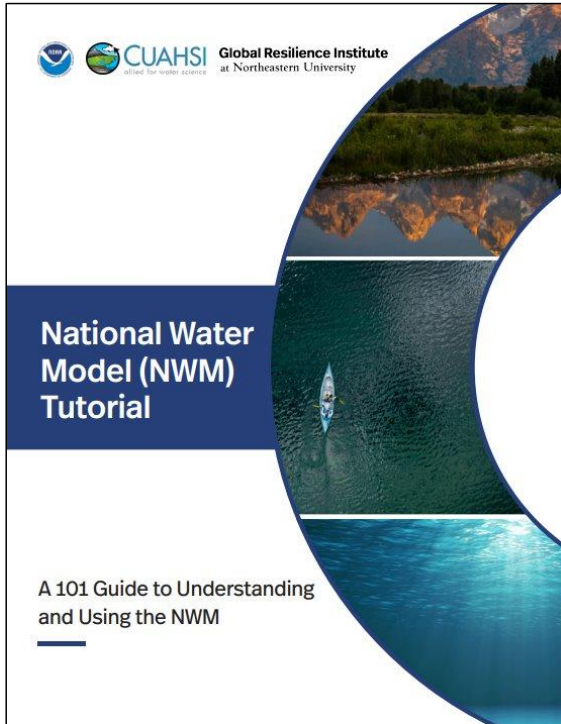


# FloodSavvy Overview: Flood Maps

Interactive, on-demand visualization of pre-generated flood extents for scenario analysis and identification of vulnerable areas.



# FloodSavvy Overview: Tutorials & Resources



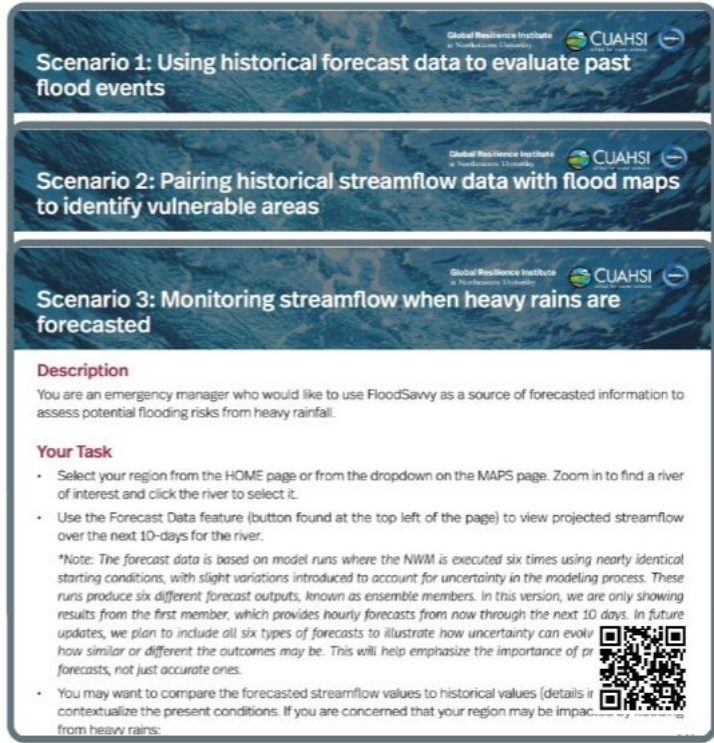
The tutorial cover features a large circular graphic on the right side, divided into three horizontal sections. The top section shows a landscape with a river and trees. The middle section shows a person in a kayak on a river. The bottom section shows a close-up of water. On the left side, there is a dark blue horizontal bar with white text. At the top left, there are logos for NOAA and CUAHSI, along with the text 'Global Resilience Institute at Northeastern University'. The main title 'National Water Model (NWM) Tutorial' is centered in the blue bar. Below the bar, the subtitle 'A 101 Guide to Understanding and Using the NWM' is displayed.

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allied for water science

## National Water Model (NWM) Tutorial

A 101 Guide to Understanding and Using the NWM



The scenario page has a dark blue background with a river scene. At the top right, there are logos for Global Resilience Institute and CUAHSI. The main title 'Scenario 1: Using historical forecast data to evaluate past flood events' is in white. Below it, there are two more scenario cards with similar titles. The 'Description' section explains the user's role as an emergency manager. The 'Your Task' section lists two main steps: selecting a region and using the Forecast Data feature. A note explains that the forecast data is based on model runs with slight variations. A QR code is located at the bottom right.

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### Scenario 1: Using historical forecast data to evaluate past flood events

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### Scenario 2: Pairing historical streamflow data with flood maps to identify vulnerable areas

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### Scenario 3: Monitoring streamflow when heavy rains are forecasted

**Description**


You are an emergency manager who would like to use FloodSavvy as a source of forecasted information to assess potential flooding risks from heavy rainfall.

**Your Task**

- Select your region from the HOME page or from the dropdown on the MAPS page. Zoom in to find a river of interest and click the river to select it.
- Use the Forecast Data feature (button found at the top left of the page) to view projected streamflow over the next 10-days for the river.

*\*Note: The forecast data is based on model runs where the NWM is executed six times using nearly identical starting conditions, with slight variations introduced to account for uncertainty in the modeling process. These runs produce six different forecast outputs, known as ensemble members. In this version, we are only showing results from the first member, which provides hourly forecasts from now through the next 10 days. In future updates, we plan to include all six types of forecasts to illustrate how uncertainty can evolve how similar or different the outcomes may be. This will help emphasize the importance of or forecasts, not just accurate ones.*

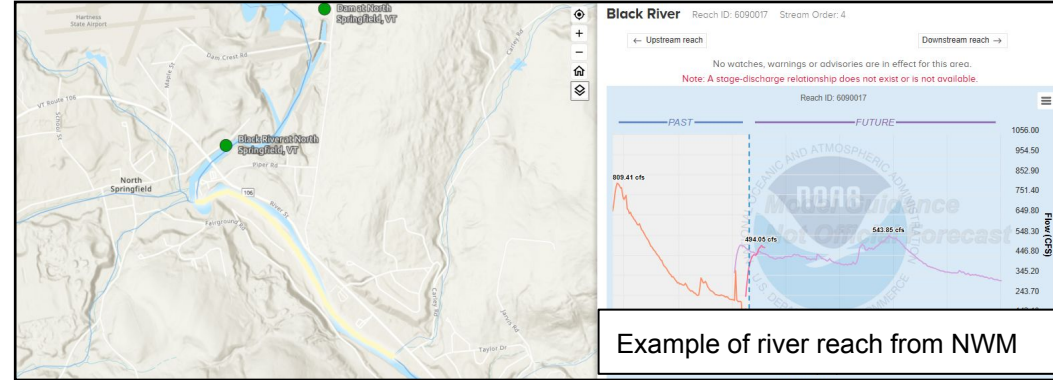
- You may want to compare the forecasted streamflow values to historical values (details in contextualize the present conditions. If you are concerned that your region may be impacted from heavy rains:



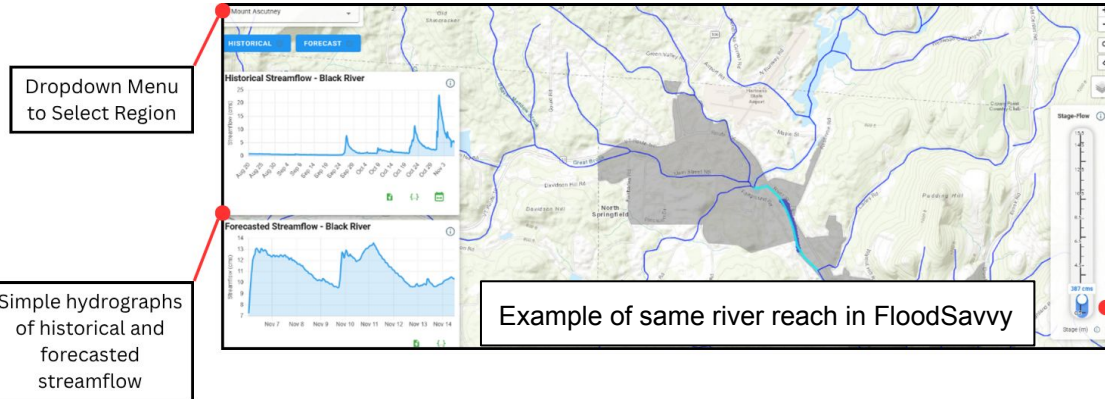
# We did not simplify the NWM, we translated it.

The same rigorous data. A different format designed for how local decision-makers actually make decisions.

How did we do this and how might you be able to do something similar in your work?



Example of river reach from NWM



Dropdown Menu to Select Region

Simple hydrographs of historical and forecasted streamflow

Example of same river reach in FloodSavvy

Adjustable streamflow scenarios to visualize flood inundation scenarios

# Project Background



## PHASE 1

How does resilience planning operate in practice?

How can the NWM support this work?

**Main finding:** 65% of stakeholders had never heard of the NWM, but after they had, many had ideas for how they could use it.



## PHASE 2

How could outputs from the NWM be utilized by six stakeholder groups in their resilience planning work?

**Main finding:** There was a range of uses and users. Accessibility challenges arose when users desired technical applications of NWM data but did not have the expertise.



## PHASE 3

How can accessibility challenges to using NWM data in community resilience planning be overcome?  
Investigate, co-develop, and pilot solutions

**Main finding:** Two co-developed supplementary resources were needed for diverse users to access NWM data: *FloodSavvy* & a NWM Tutorial.

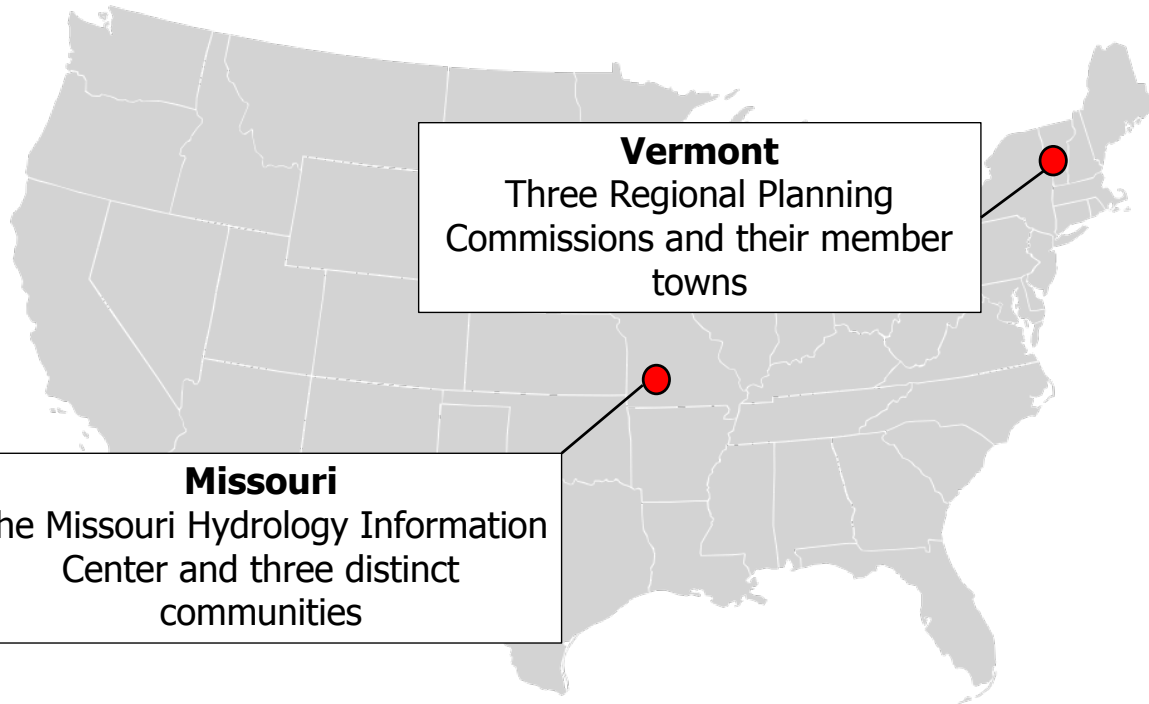


# Co-Developing FloodSavvy

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# Who did we work with?

## Community Partners



## Research Partners



# Co-Development Process

## 1.) Interviews

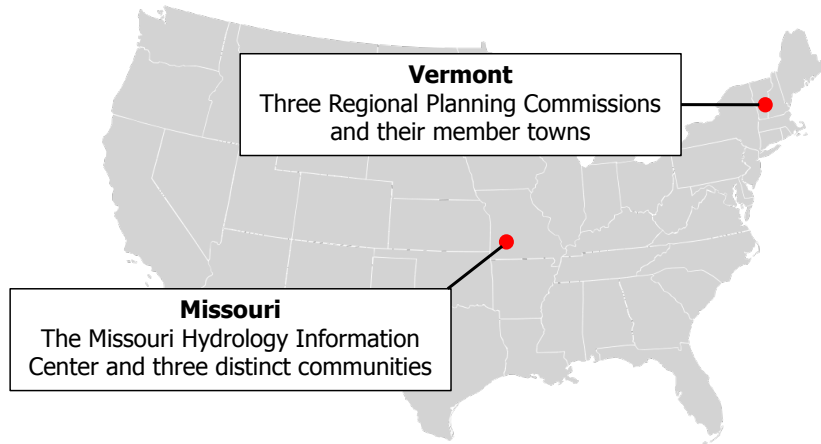
Conducted interviews to understand local water hazards, decision-making contexts, information gaps, as well as opportunities to use the NWM.

## 2.) NWM Deep Dive

Organised a virtual training session to establish a baseline understanding of the NWM and its potential applications.

## 3.) Collaborative Sessions

Facilitated community discussions to refine ideas for how the NWM could be used and what supplementary resources could enable this use.



# Matching Community Needs with Key Capabilities

Capability		Tailored Map Interface	Flow Time Series	Flood Extents	Other Hydro - Information	Download Results	Vulnerable Areas	Tutorials	Compare Other Sources
Missouri	DeSoto								
	Roaring River								
	Springfield								
Vermont	Mt Ascutney								
	Two Rivers								
	Windham								



**Requested Capability**

# Introducing FloodSavvy



A web interface that translates NOAA's National Water Model data into easy-to-understand flood risk insights.

The screenshot displays the FloodSavvy web application. At the top, there is a navigation bar with links for HOME, MAPS, RESOURCES, ABOUT, and CONTACT. The main content area is titled "Choose Your Region" and is divided into two sections: "Missouri Regions" and "Vermont Regions".

**Missouri Regions:**

- Roaring River State Park:** A popular outdoor destination nestled within the rugged terrain of the Ozark Plateau's karst landscape, Roaring River State Park is located eight miles south of Cassville in Berry county, Missouri, spanning 4,294 acres.
- DeSoto:** De Soto is a small city in Jefferson County, Missouri, located about 45 miles south of St. Louis. The surrounding terrain features rolling hills and a network of creeks and streams that ultimately drain into the Mississippi River.

**Vermont Regions:**

- Mount Acutney:** The region in southeast-central Vermont covers ten towns, with terrain that shifts from steep, forested slopes in the west to rolling foothills and the broad Connecticut River valley in the east.
- Two Rivers Ottauquechee:** The Two Rivers-Ottawquechee region lies in east-central Vermont, covering 30 member towns across Windsor and Orange counties. The region is bordered by the Green Mountains to the west and the Connecticut River valley to the east.

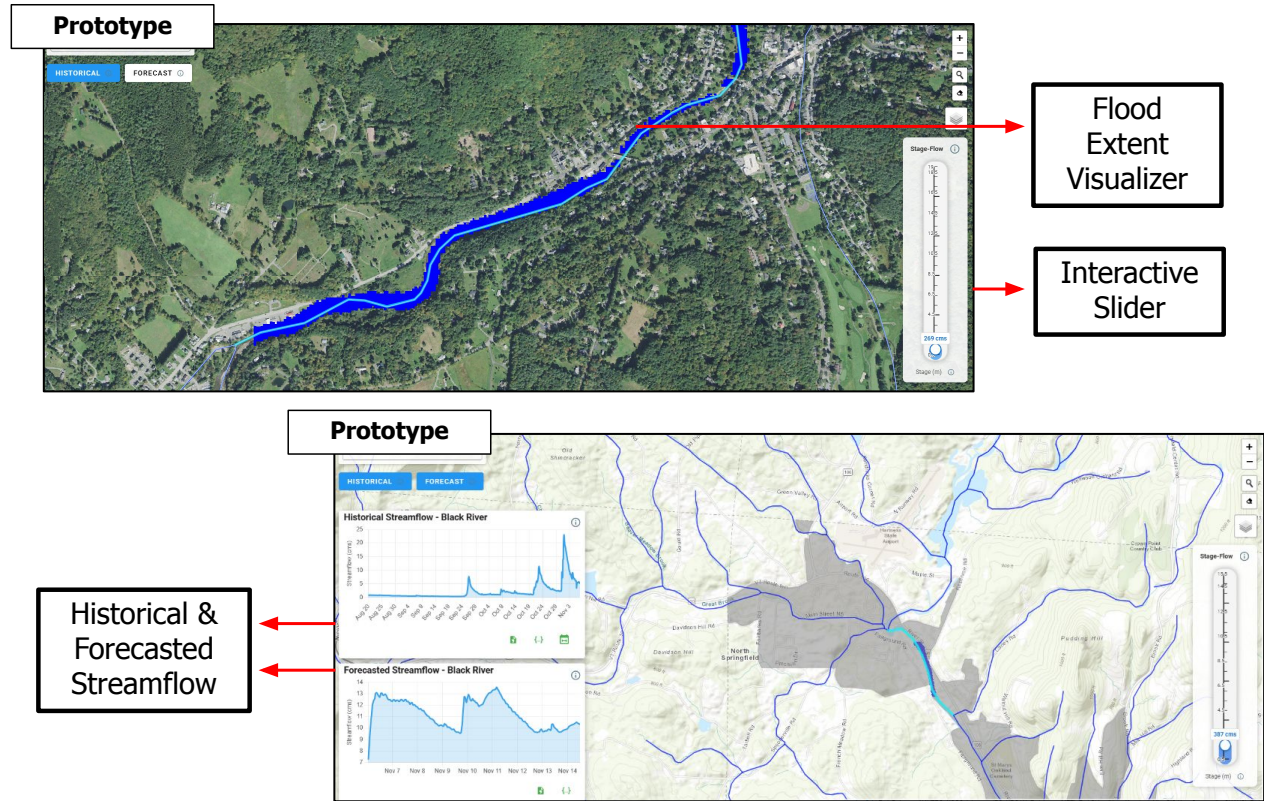
The right side of the screenshot shows a detailed map view for the Mount Acutney region. It includes a "FLOOD MAP" overlay with "HISTORICAL" and "FORECAST" options. A "Selection Mode" dropdown is set to "Single Reach", and a "Select Region" dropdown is set to "Mount Acutney". The map shows a network of rivers and streams, with a specific reach highlighted in green.

# Co-Development Process

## 4.) Co-Development ~ Initial Prototype

After proposing the idea of *FloodSavvy*, the web interface was developed with frequent stakeholder input through:

- virtual meetings,
- biweekly update emails,
- a soft launch where access to the tool was shared.

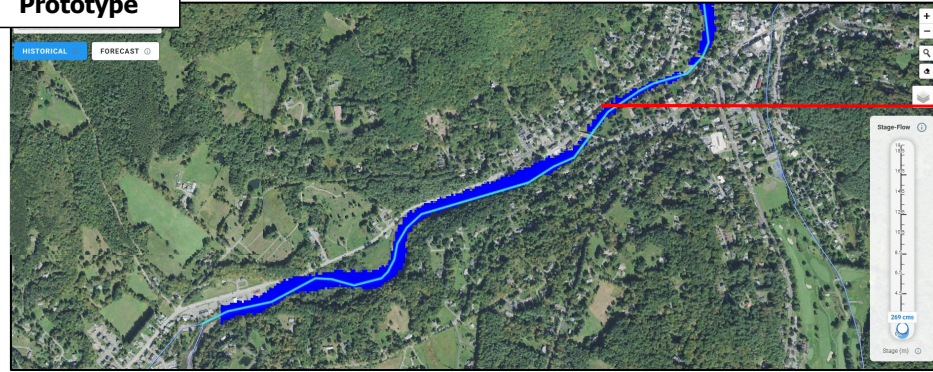


# Co-Development Process

## 5.) Co-Development ~ User Testing

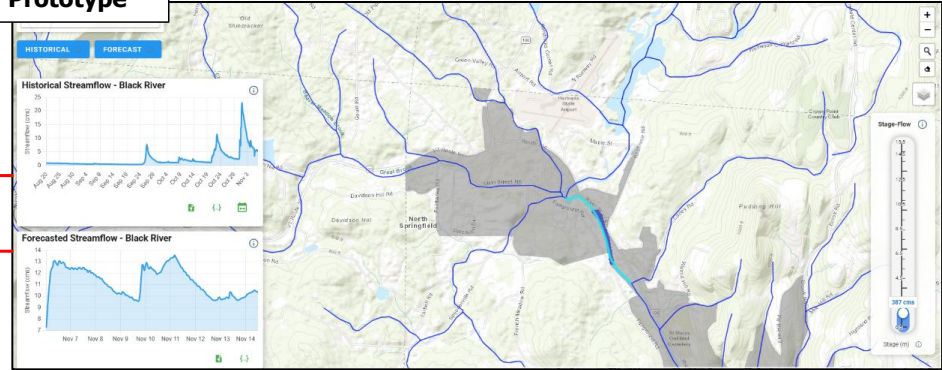
We conducted semi-structured user testing to refine *FloodSavvy's* capabilities and improve the website's usability. After incorporating this feedback, *FloodSavvy* was formally launched at an online event.

Prototype



Non-transparent flood extent + can only select one segment.

Prototype

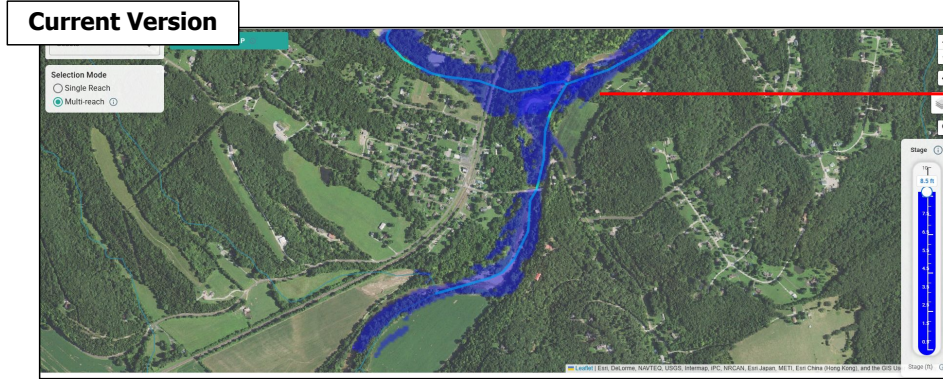


Lack of context on what these streamflow values mean

# Co-Development Process

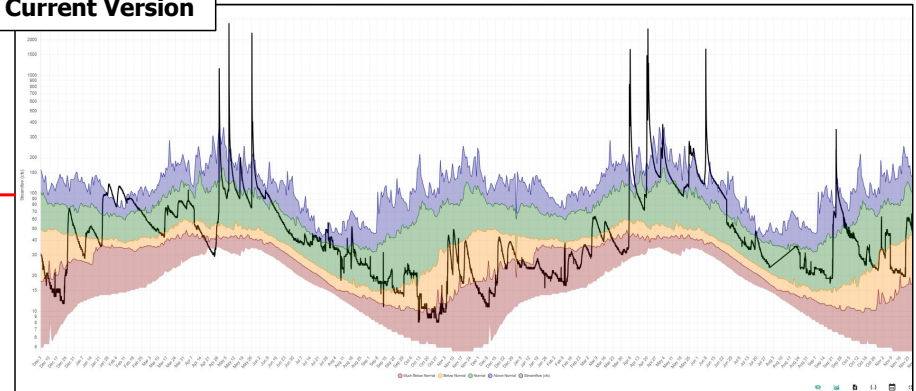
## 5.) Co-Development ~ User Testing

We conducted semi-structured user testing to refine *FloodSavvy's* capabilities and improve the website's usability. After incorporating this feedback, *FloodSavvy* was formally launched at an online event.



Current Version

Option to view historical quantiles to provide context



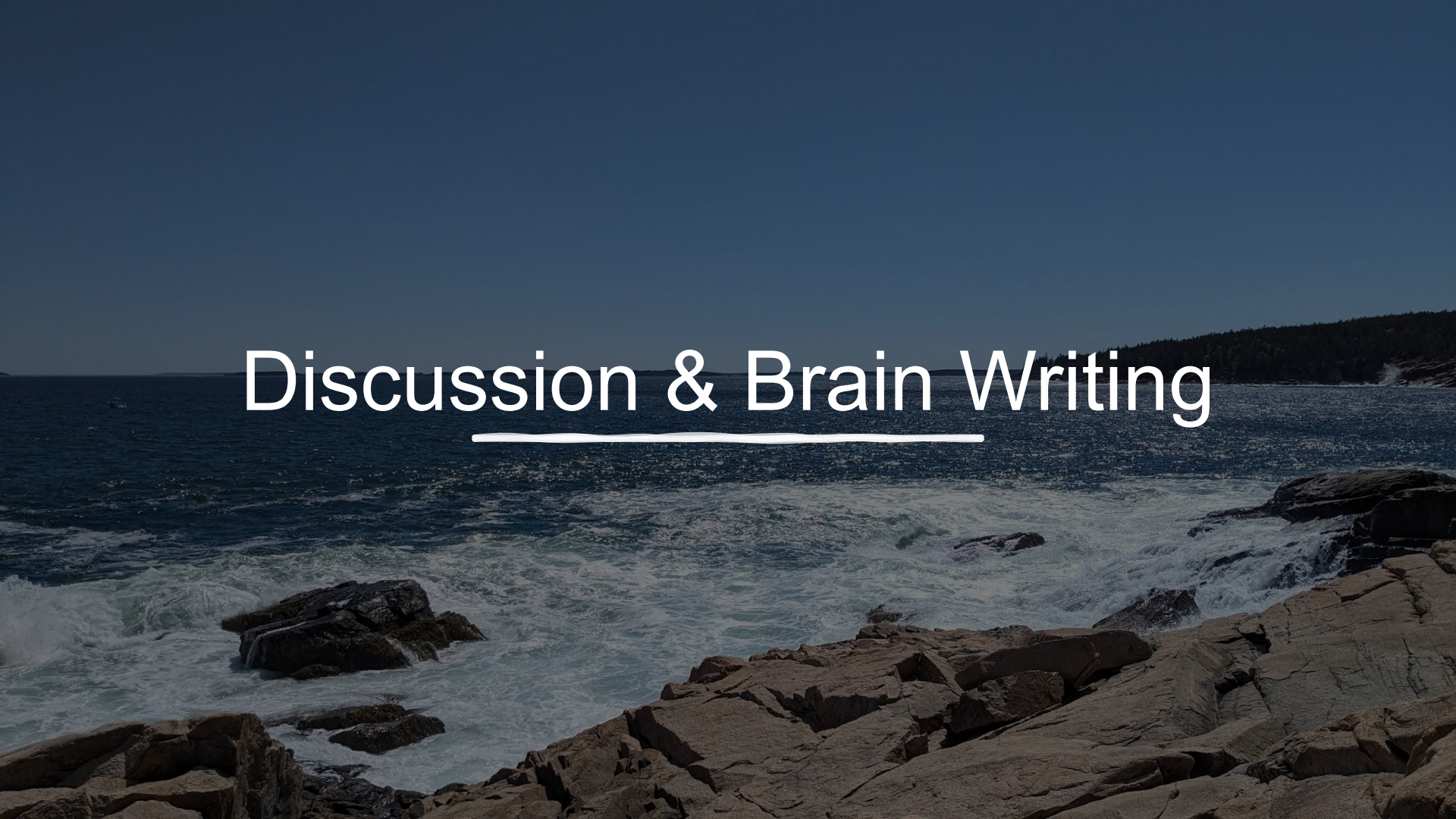
# Why this project required two (really 4) kinds of expertise?

<b>Social Science (GRI)</b>	<b>Hydrology (CUAHSI)</b>
Led stakeholder engagement	Built the technical platform
Conducted interviews and collaborative sessions	Ensured hydrologic science rigor and data integrity
Shaped narrative content and user guidance	Translated NWM outputs into accessible formats
Understood how decisions are actually made	Understood what the data could and couldn't do

*Neither alone would have been sufficient. Neither would have known what to build without the community partners. And none of it would have been possible without NOAA.*

# Discussion & Brain Writing

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# Brain Writing Session

Type answers to the following questions in the following document. The Google Doc has a separate tab for each question.

**Link:** <https://tinyurl.com/bwtciroh>

# Discussion Questions

1. What is your experience with community or end-user engagement? Who were those groups, what level of engagement did you employ? What went well or not so well?
2. What has been your experience with interdisciplinary collaboration, especially across the social and hydrologic sciences? What went well or not so well?
3. What are the biggest challenges, barriers, or questions you have — or have seen others have — about engaging communities and end-users or collaborating across disciplines?
4. Given those challenges — what could CIROH do to better support you in doing this kind of work?

**Link:** <https://tinyurl.com/bwtciroh>

A scenic view of a rocky coastline. The foreground is dominated by large, light-colored, jagged rocks. The ocean is a deep blue, with white foam from waves crashing against the rocks. In the distance, a dark line of trees marks the horizon under a clear, dark blue sky.

Want to learn more?

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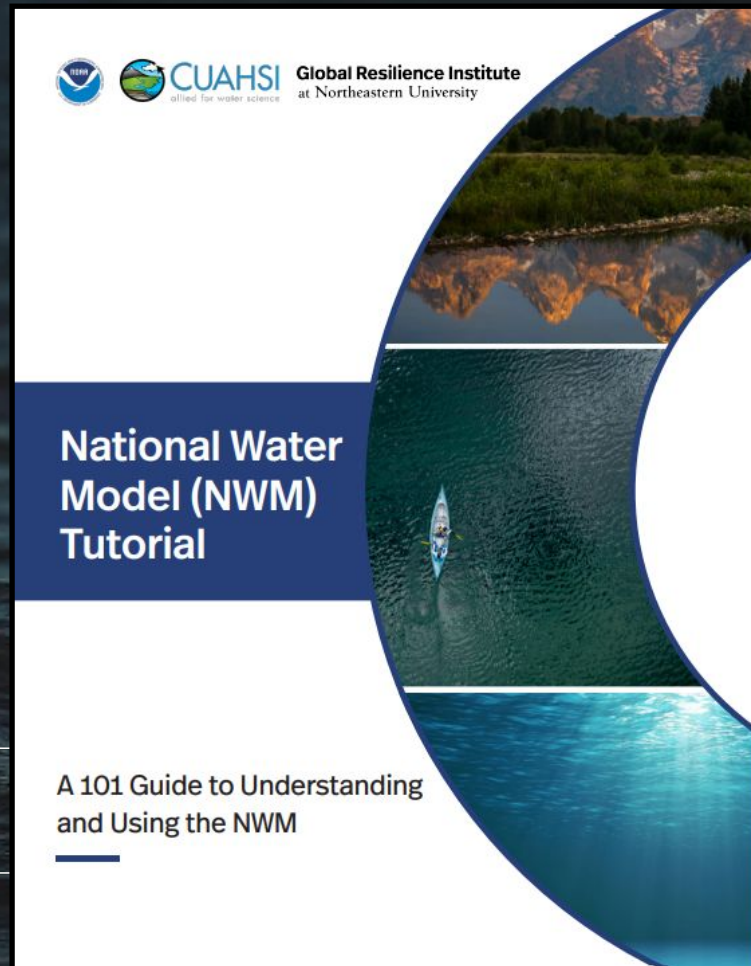
# FloodSavvy



<https://floodsavvy.cuahsi.io/#/>

# NWM Tutorial

[Link](#) to the tutorial



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at Northeastern University

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A CIROH Funded Project

# An Analysis and Demonstration of the National Water Model's Applicability to Community Resilience Planning

 CUAHSI

Funded by CIROH, this 3-Phase study investigates how NOAA's National Water Model could be used in community resilience-related planning and provides guidance on how NOAA and the National Water Center can support this use.



### Phase 1: Landscape Analysis

Working with communities in Burlington, VT; Cincinnati, OH; Portland, OR; Charlotte, NC; Boulder, CO; and Minneapolis, MN, our team has investigated the landscape of community resilience planning, how the NWM could be leveraged in this work, and how NOAA and the NWC could increase the accessibility of this use.



### Phase 2: Use Cases

Working with stakeholders from Vermont, Mecklenburg County, NC; Denver, CO; Minnesota, the Ohio/Kentucky/Indiana tri-state area, and Missouri, we have co-developed a set of use cases that demonstrate the NWM's application to resilience-related work.



### Phase 3: Capacity Building

Anticipated to begin in the summer of 2024, Phase 3 will build from the results of Phases 1 and 2 to investigate a special use case that captures a central challenge for resilience planning: a lack of capacity. This Phase will investigate how the NWM can be used to increase the capacity of communities and can provide data and information in areas where it is otherwise limited.

# Study Website



<https://tinyurl.com/NWM-ResilienceStudy>

# Thanks to our team!

PI (GRI): Dr. Kristin Raub  
Co-PI (CUAHSI): Dr. Anthony Castronova  
Co-PI (GRI): Dr. Stephen Flynn

CUAHSI Collaborators: Dr. Irene Garousi-Nejad  
Devin Cowan

GRI Collaborators: Dr. Robin White  
Daniela Rincon-Reyes  
Emma Hibbert  
Shivangi Basu  
Nalini Gunawardena

Thank you to our collaborators from NOAA for contributing their time and expertise!

NOAA Collaborators: David Vallee  
Brian Cosgrove  
Juzer Dhondia  
Cecelia Batterbee  
Emily Crisci  
& many more!

Funding for this project was provided by the National Oceanic and Atmospheric Administration (NOAA), awarded to the Cooperative Institute for Research on Hydrology (CIROH) through the NOAA Cooperative Agreement with The University of Alabama, NA22NWS4320003.

*A special thank you to our community collaborators in Vermont and Missouri - this project would not have been possible without you!*

Thank you!

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