



# Compound Flood Hazard Mapper Workshop

**Eastern Connecticut**

February 27, 2026

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# Welcome



# Agenda and Goal

9:35-10:00

Introduction

10:00-10:20

Compound Flood Hazard Mapper

– *10 min Break* –

10:30-11:00

Live Screen Demo

11:00-11:15

Independent Session

11:15-11:30

Assessment

## Goal:

- Learn about the new CFHM
- How to apply the tool to your community, work, and decision-making
- How this tool can integrate with others that you use
- Provide input and feedback

# Project

## History

- In 2021, with funding from LISP, USGS began a study to assess multiple flood drivers and their co-occurrence
- In 2025, launched the Compound Flood Hazard Assessment

## Present

- Providing outreach to target communities around LIS about the tool
- Gaining valuable feedback and input

## Future

- Developing a Toolkit to assist future users
- Modifying tool based on assessment

# Causes of Flooding



## Precipitation

*Stormwater runoff occurs when precipitation runs off land surfaces*

- Changes in precipitation rates and patterns
- Impervious surfaces preventing ground infiltration

## Groundwater

*Flooding that occurs as the water table rises above the ground's surface*

- Saltwater intrusion

# Causes of Flooding

## Coastal

*Coastal flooding occurs when low-lying land is submerged by seawater*

- Tidal flooding during spring tides (highest-high)
- Storm surge being pushed onshore resulting in flooding
- Sea level rise causing flooding during normal tides, unrelated to storms



Credit: MyCoastNY Flood Watch Report by Trustee Dave Weber

# Flooding Impacts

Communities are forced to consider how they react, plan, and manage coastal infrastructure and investments



## Flood Hazard:

- The potential for flooding to occur

## Flood Risk:

- Probability of flood hazard interacting with society

# Flood Adaptation Strategies



Communities often take action when faced with flooding

- Coastal adaptation includes steps to minimize flood risk, increasing a community's resilience to impacts
- Strategies need to be researched for applicability and often change over time

# Existing Tools

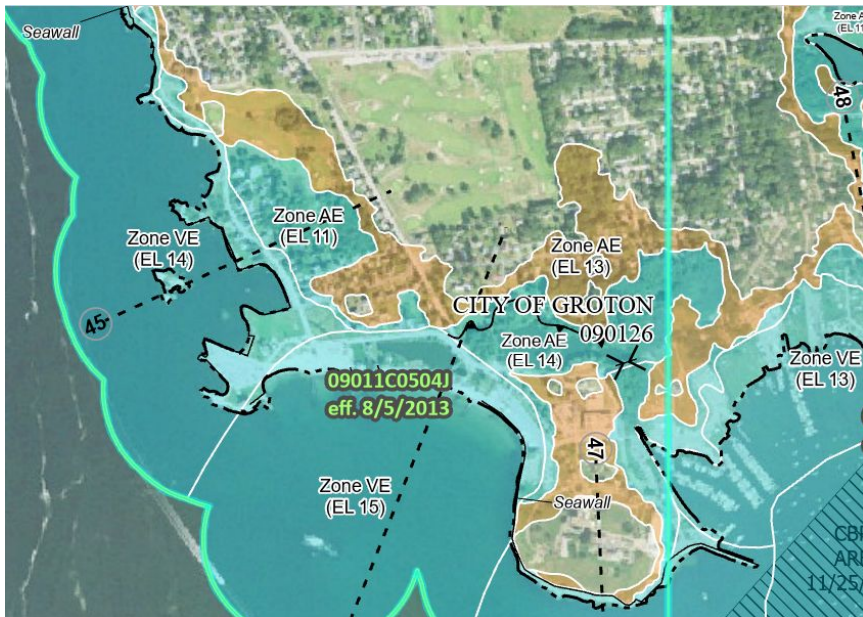
NOAA Coastal Flood Exposure Mapper

NOAA Sea Level Rise Viewer

FEMA Flood Maps



Credit: NOAA Coastal Flood Exposure Mapper



Credit: FEMA Flood Maps



Credit: NOAA Sea Level Rise Viewer

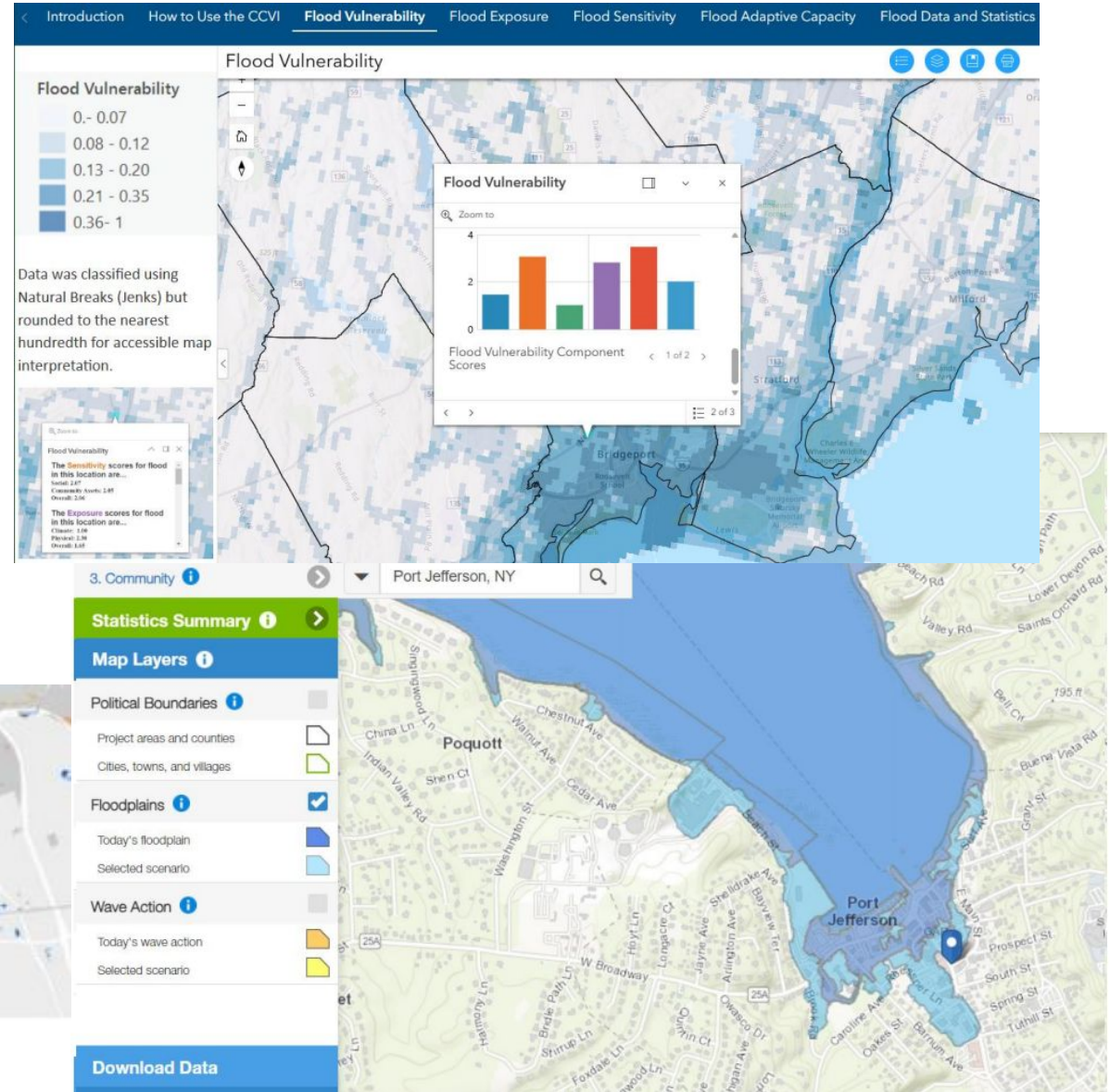
# Existing Tools

NYS Sea Level Rise Viewer

CIRCA Climate Change Vulnerability Index

NYC Stormwater Flood Maps

Credit: CIRCA Climate Change Vulnerability Index



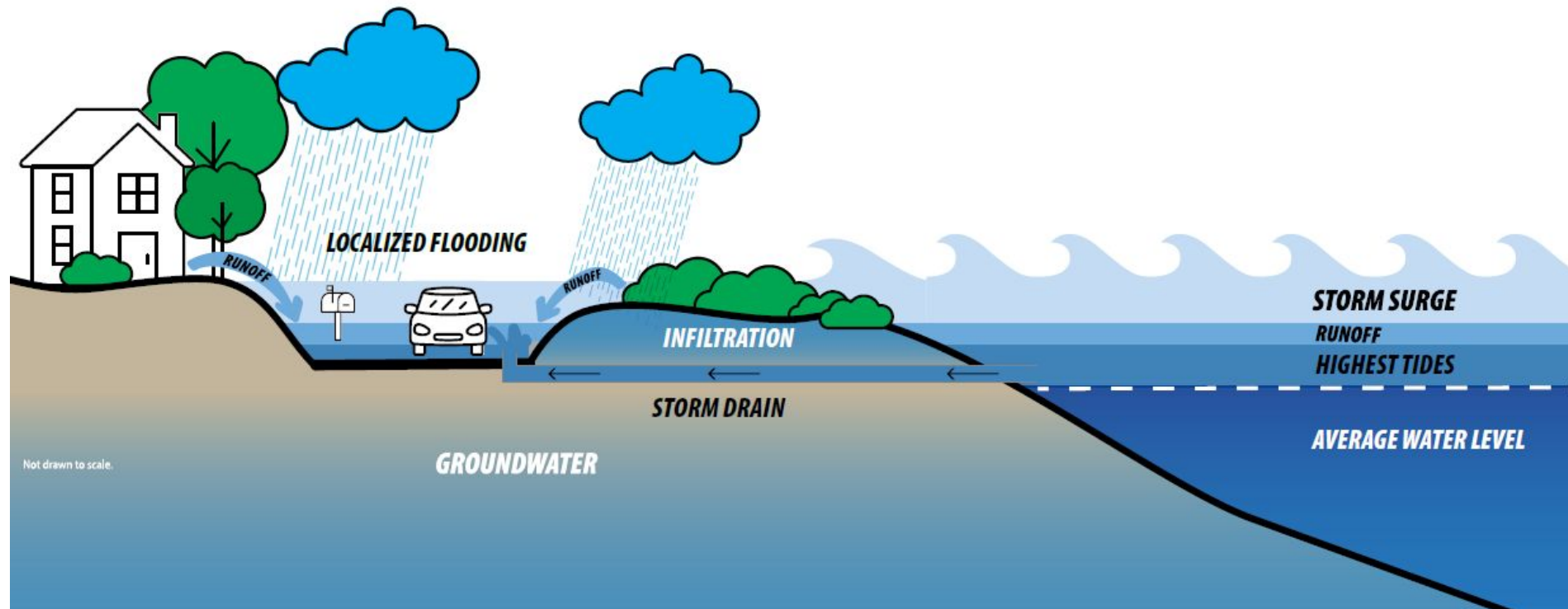
Credit: NYC Stormwater Flood Maps

Credit: NYS Sea Level Rise Viewer



# What is Compound Flooding?

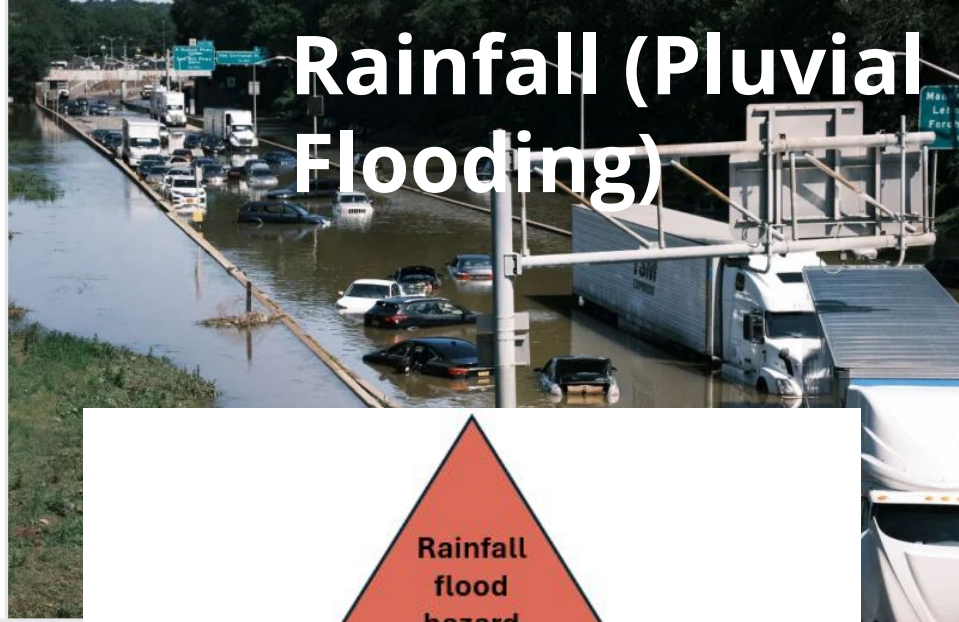
When two or more flood drivers occur together, impacts may be compounded



Not drawn to scale.

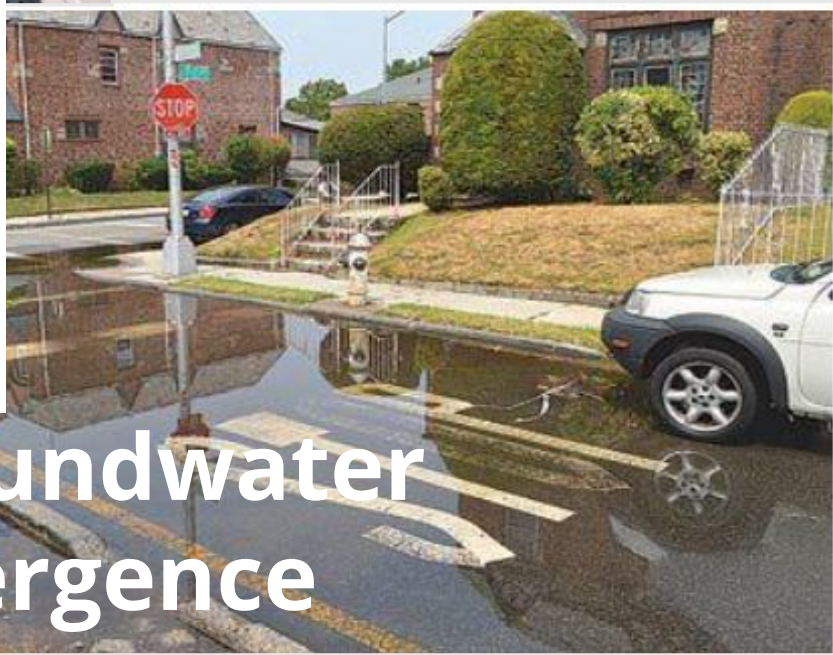
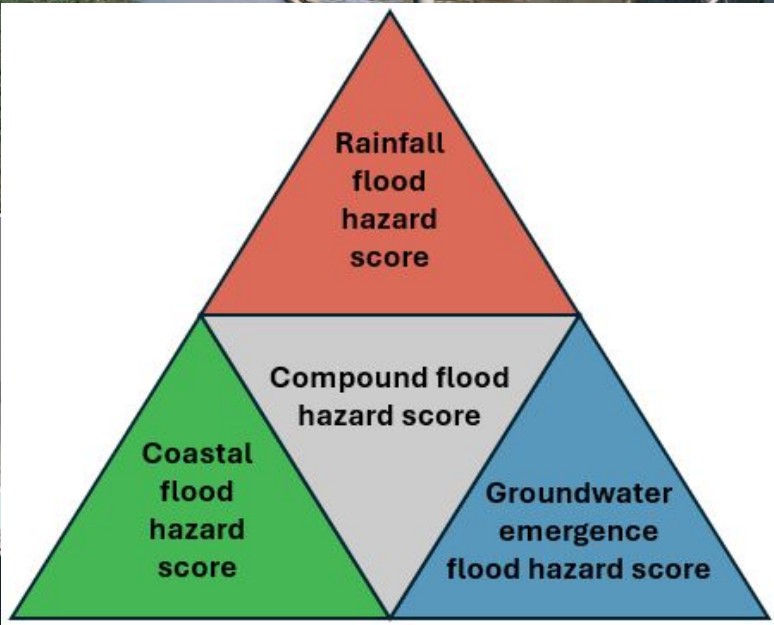
Credit: New York Sea Grant

# Rainfall (Pluvial Flooding)



Credit: USGS NY Water Science Center

# Coastal Storms



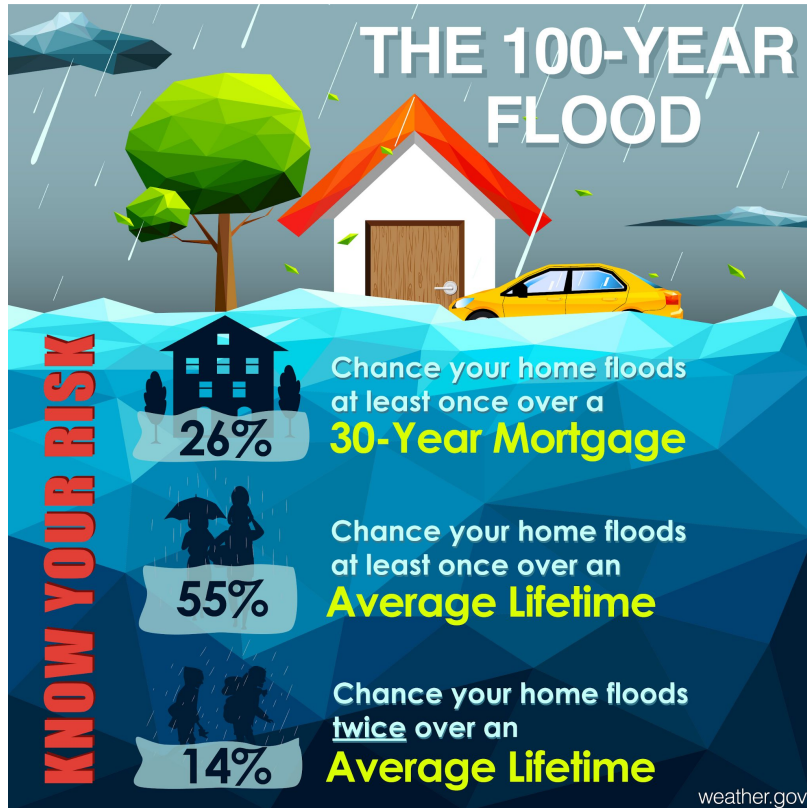
# Groundwater Emergence



# Coastal Nuisance Flooding



# Flood Annual Exceedance Probability



Credit: Public domain

What is the 100-year flood?

- Extreme flood event that has a 100 year recurrence interval
- According to historical data, the probability is once in 100 years
- Or a 1% chance of happening any year

# The CFHM Application

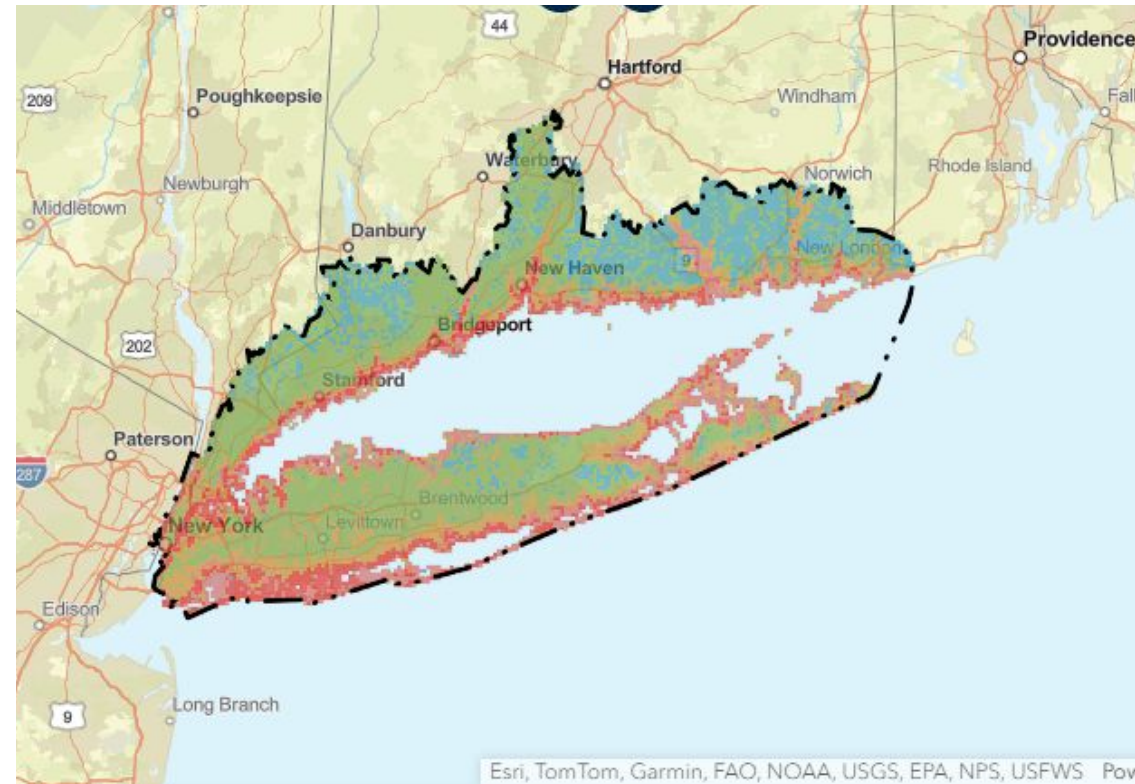
Mapper includes Long Island, NYC, Westchester and coastal areas of southern CT

Displays susceptibility to:

- Coastal flooding
- Flash flooding
- Groundwater flooding
- Compounding (Co-occurrence of drivers)

Includes supplemental maps

Tool will help communities understand areas that may be vulnerable to compound flooding

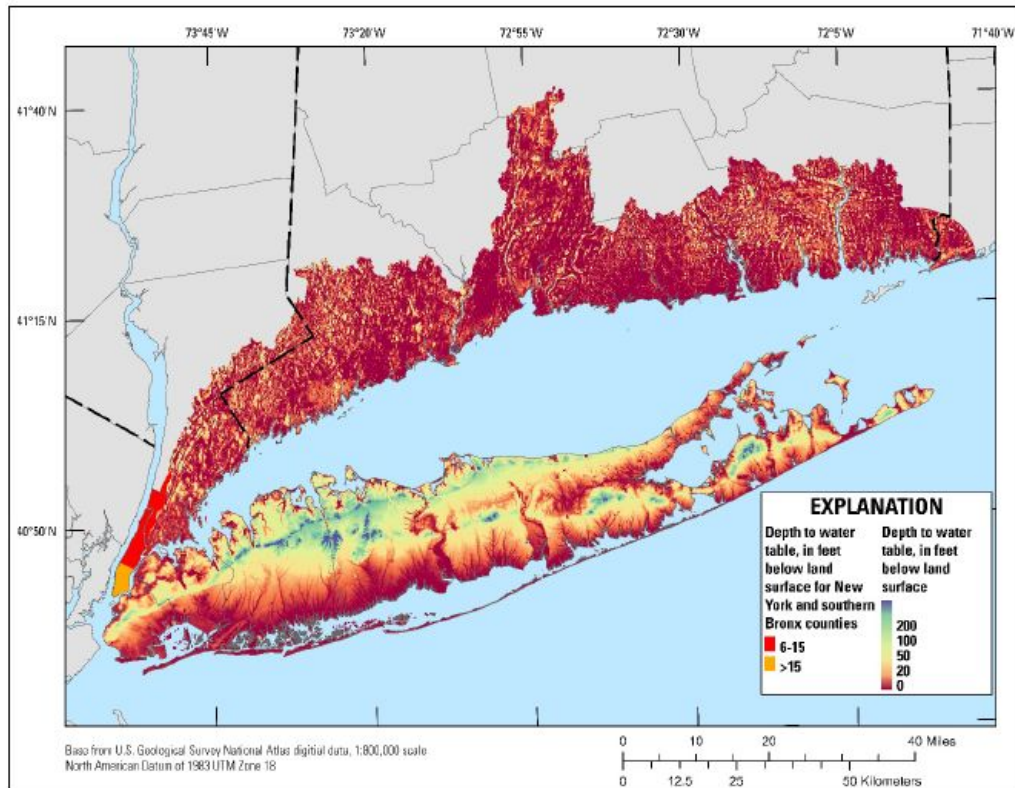


Credit: USGS Compound Flood Hazard Mapper

# Intro to the Web Map Application

# Groundwater Hazard Analysis

Figure 2a. Map showing depth to the water table in the study area as a digital elevation model of the depth to water table (Welk and others, 2025) developed from results presented in Walter and others (2024) and Barclay and others (2024a) and measurements at wells in New York and Bronx Counties.

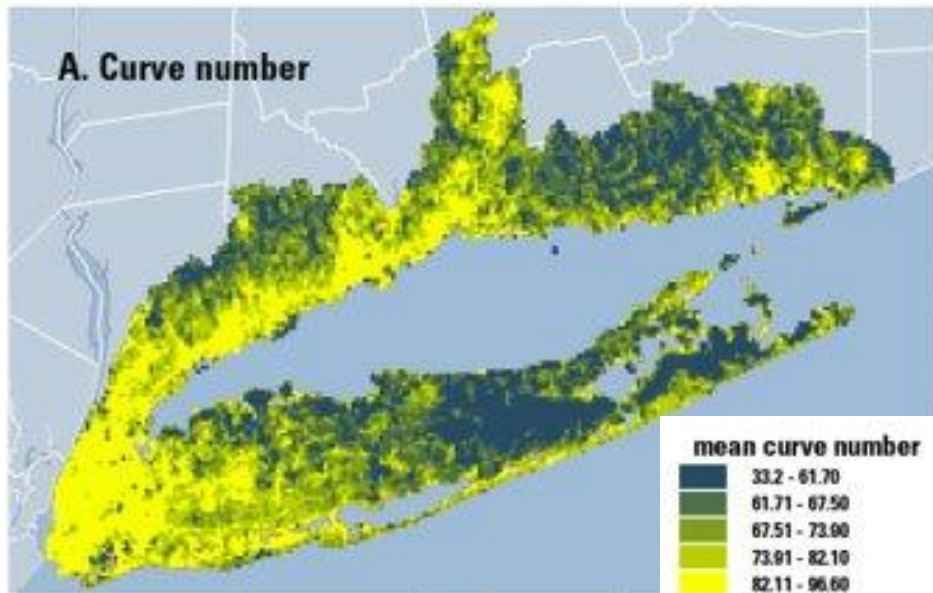


- Within each 900m x 900m risk mapping cell, extract maximum simulated water table altitude (average conditions)
- Hazard calculated based on depth to water and presence of near surface infiltration-limiting soils.

Table 2. Rules for calculating groundwater emergence flood hazard ranks.

Groundwater Emergence Flood Hazard Rank	Depth to Groundwater (Feet)	Hydrologic Soil Group B C D Occurrence in Grid Cell
5	≤6	> 50%
4	≤6	≤ 50%
3	> 6 to 15	> 50%
2	> 6 to 15	≤ 50%
1	> 15	> 50%
0	> 15	≤ 50%

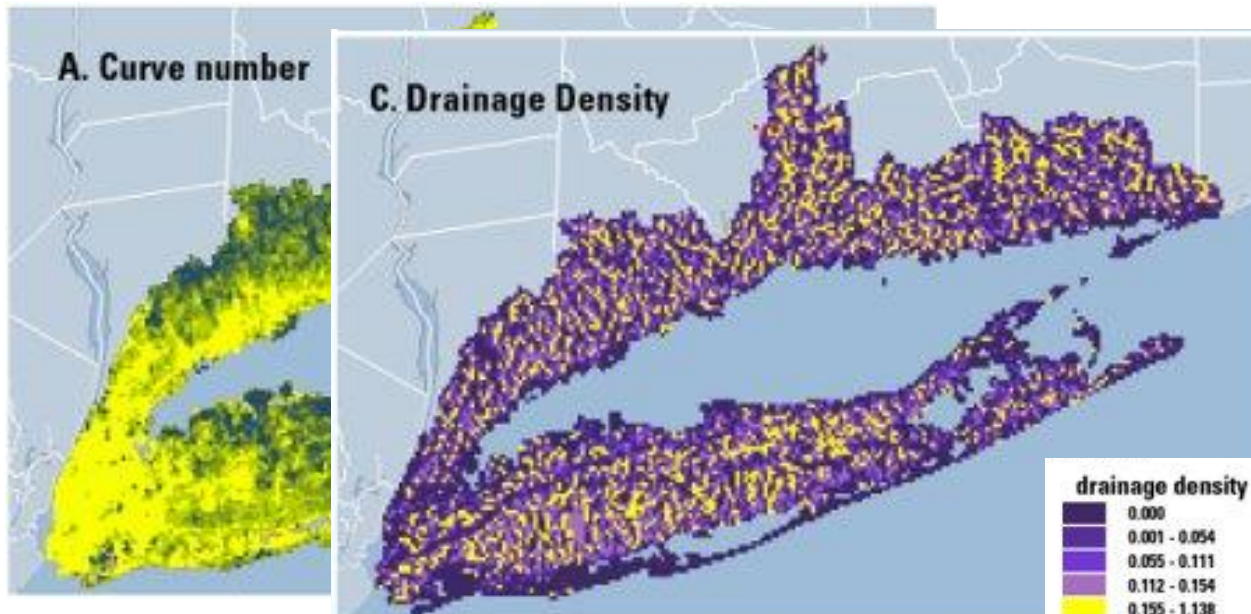
# Rainfall Hazard Analysis



Credit: Welk and others, 2025

The rainfall flood hazard is determined based on the following land surface characteristics: curve number (describing stormwater runoff potential), drainage network density, topographic slope and closed depression or ponding fraction. Additionally, rainfall frequency and durations were included.

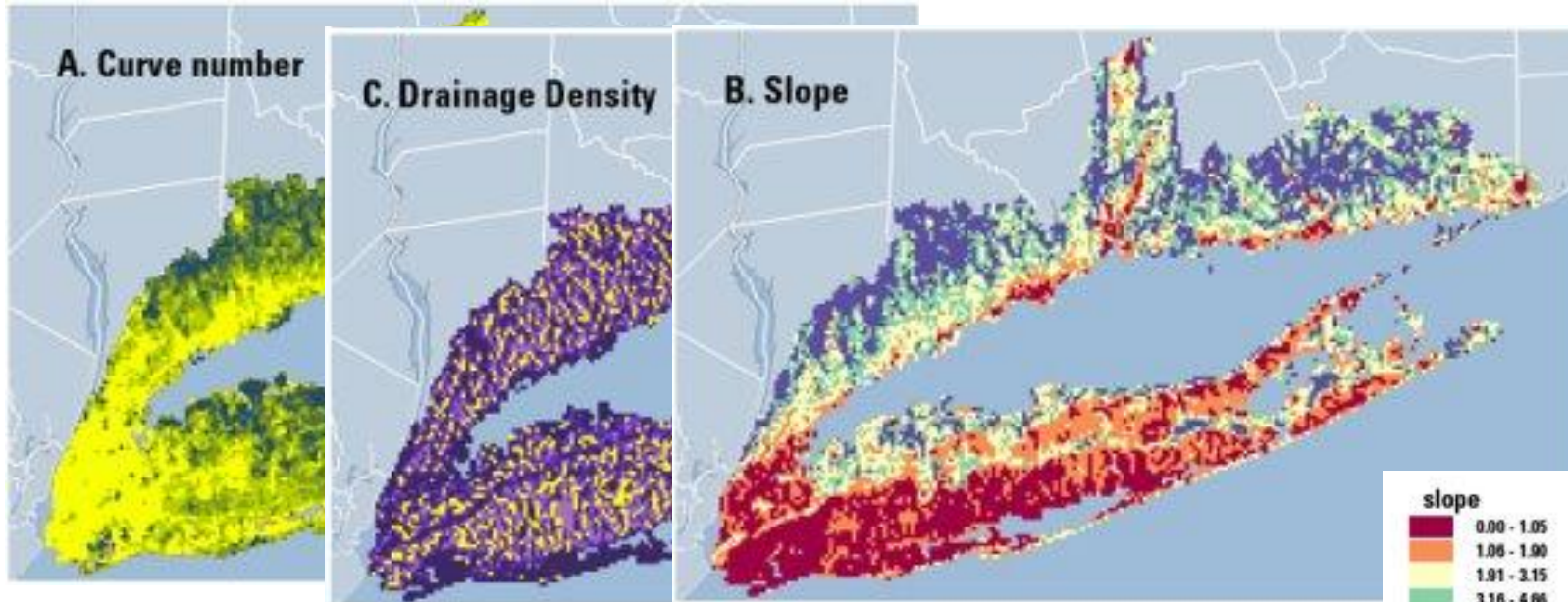
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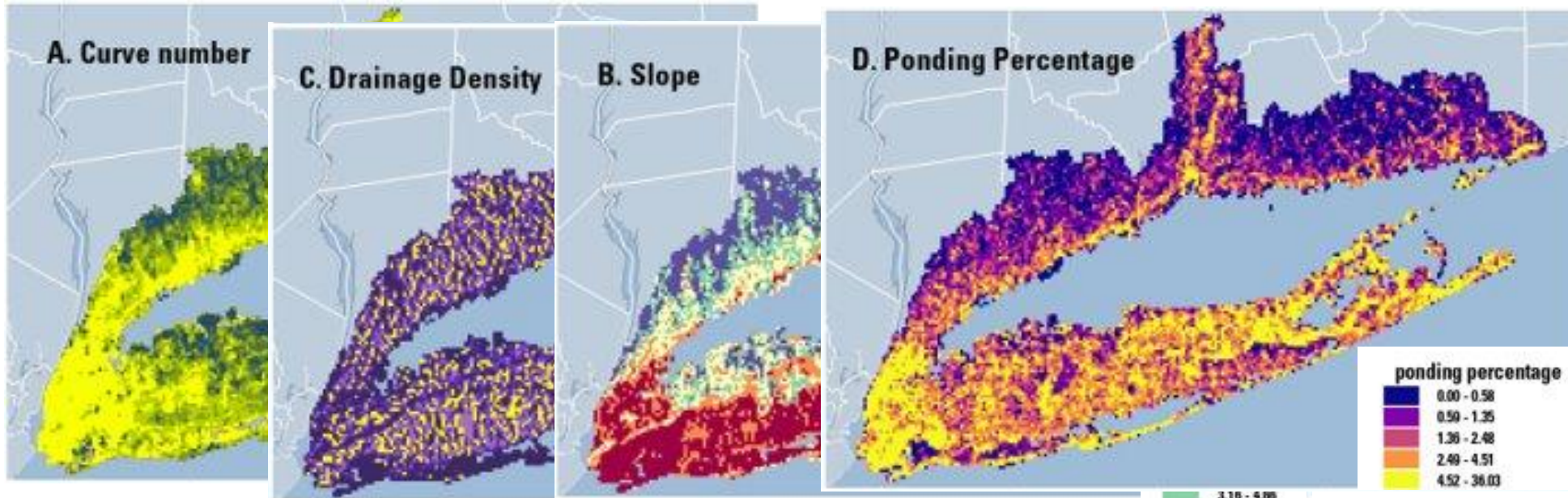
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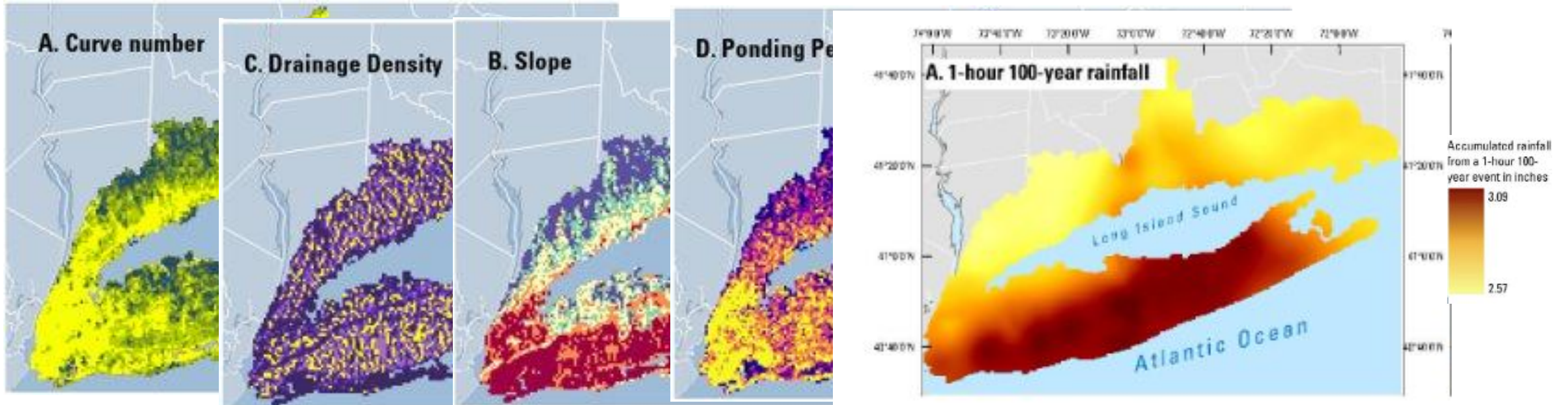
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Credit: Welk and others, 2025

# Rainfall Hazard Analysis

Using observations of recorded floods as a predictor we find that the most important factors in predicting rainfall hazard are:

- Curve Number
- Ponding Percent
- 1 hour rainfall
- Drainage Density

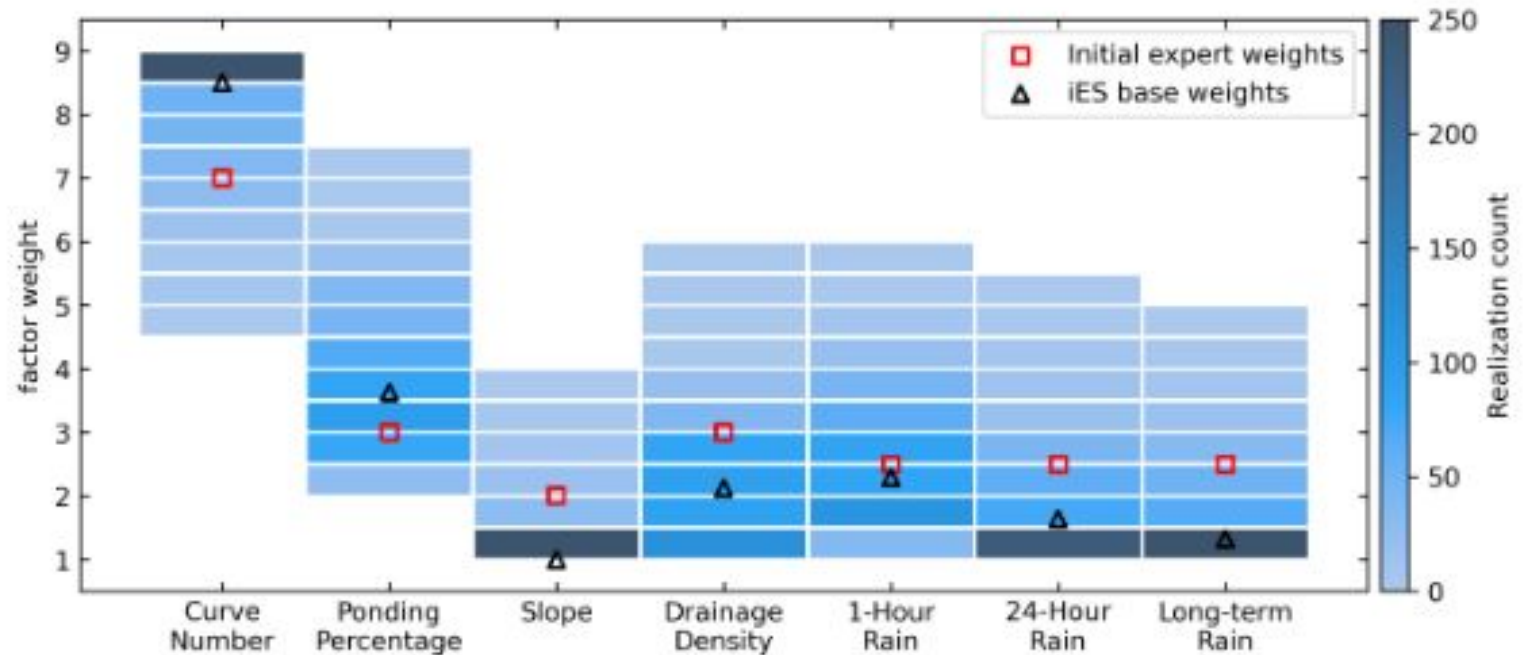


Credit: Welk and others, 2025

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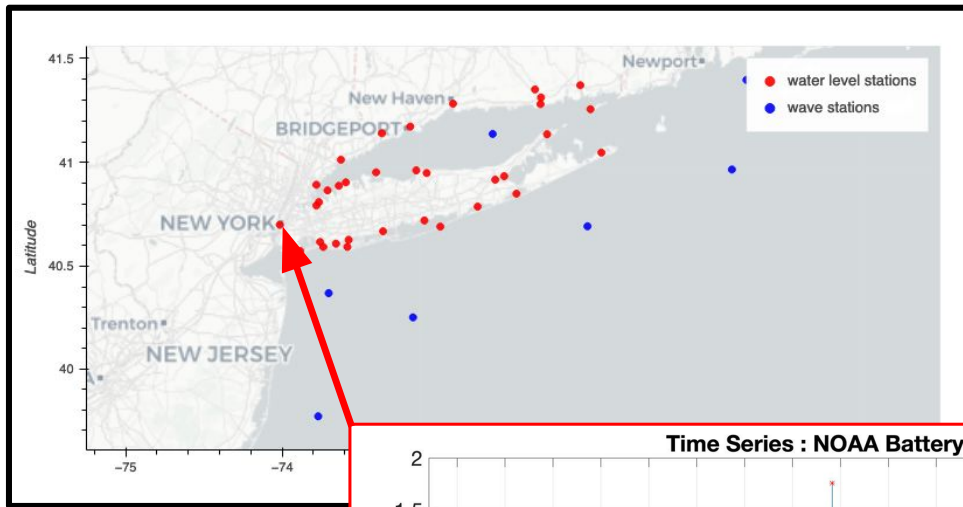
- Curve Number
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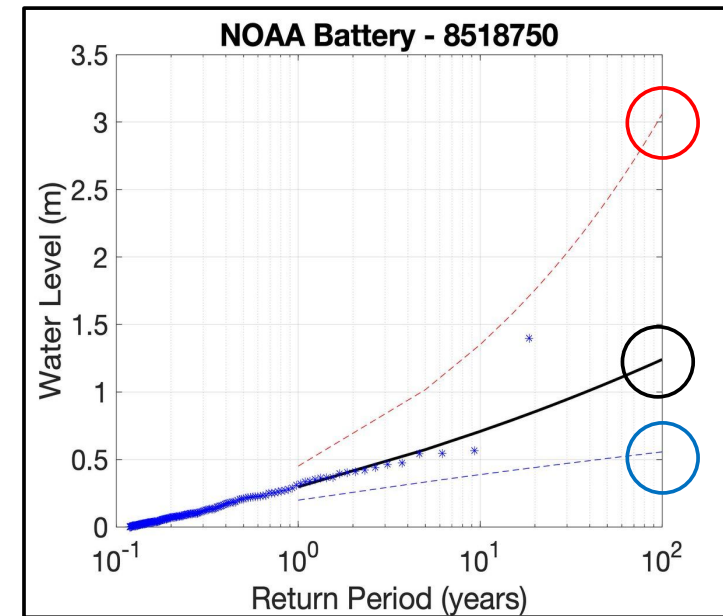
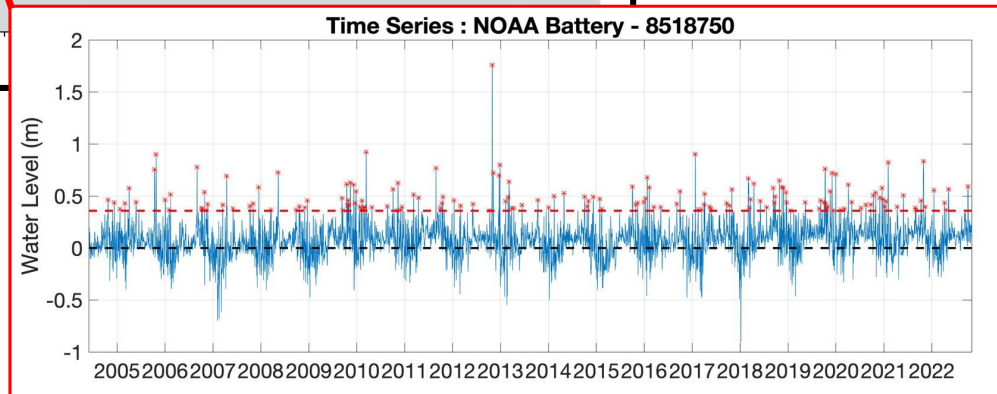
Credit: Welk and others, 2025

# Coastal Hazard Analysis

- At observation points around the study area a statistical model is fit to storm surge to develop a waterlevel frequency relationship.
- Water Levels are projected onto the DEM via a smart bathtub algorithm
- A hazard score is assigned based on the frequency and area of inundation in a 900m grid cell

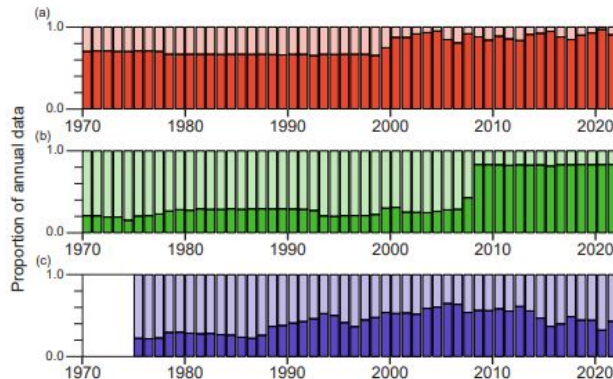


Credit: Cook and Herdman, 2025

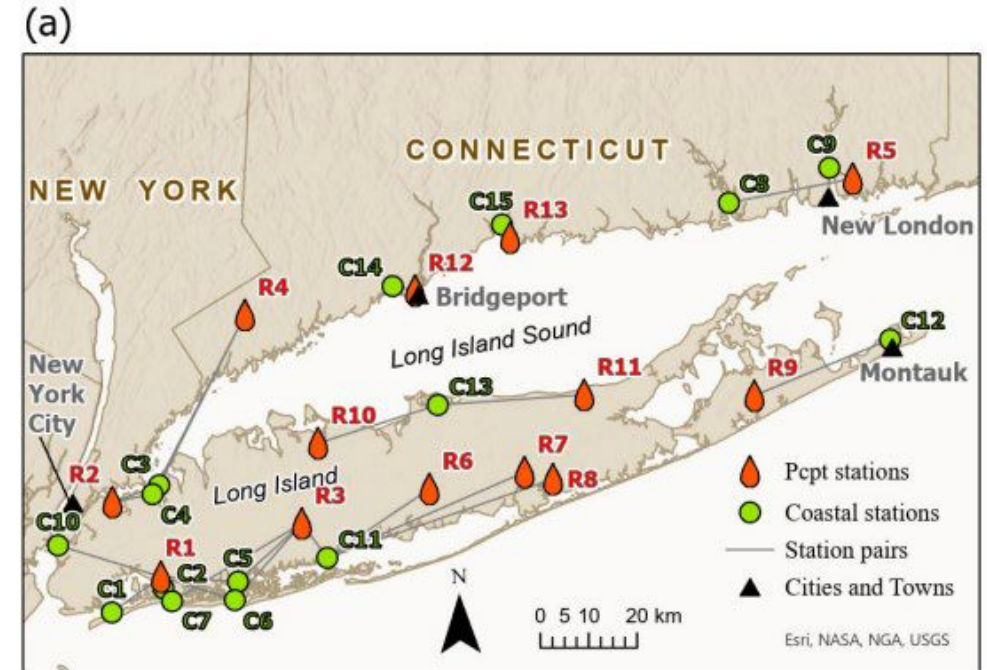


# Co-occurrence of Drivers

Analyzed historical records at 24 triads that each have an observation of rainfall, coastal water level, and groundwater elevation to understand relationships between flood drivers.



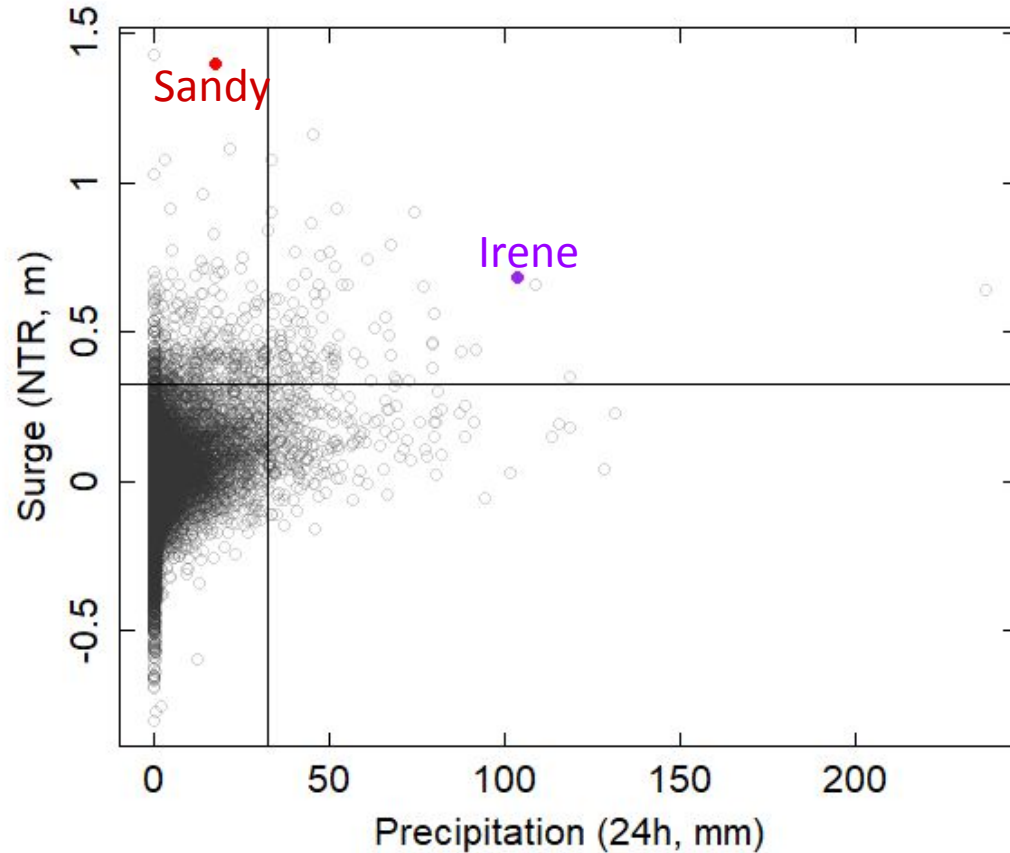
Credit: Glas and others, 2025



Credit: Glas and others, 2025

A complete record is needed so interpolation was performed to have complete data from 1970 to 2020.

# Co-occurrence of Drivers



Credit: Glas and others, 2025

This analysis focuses on the relationship between extreme events.

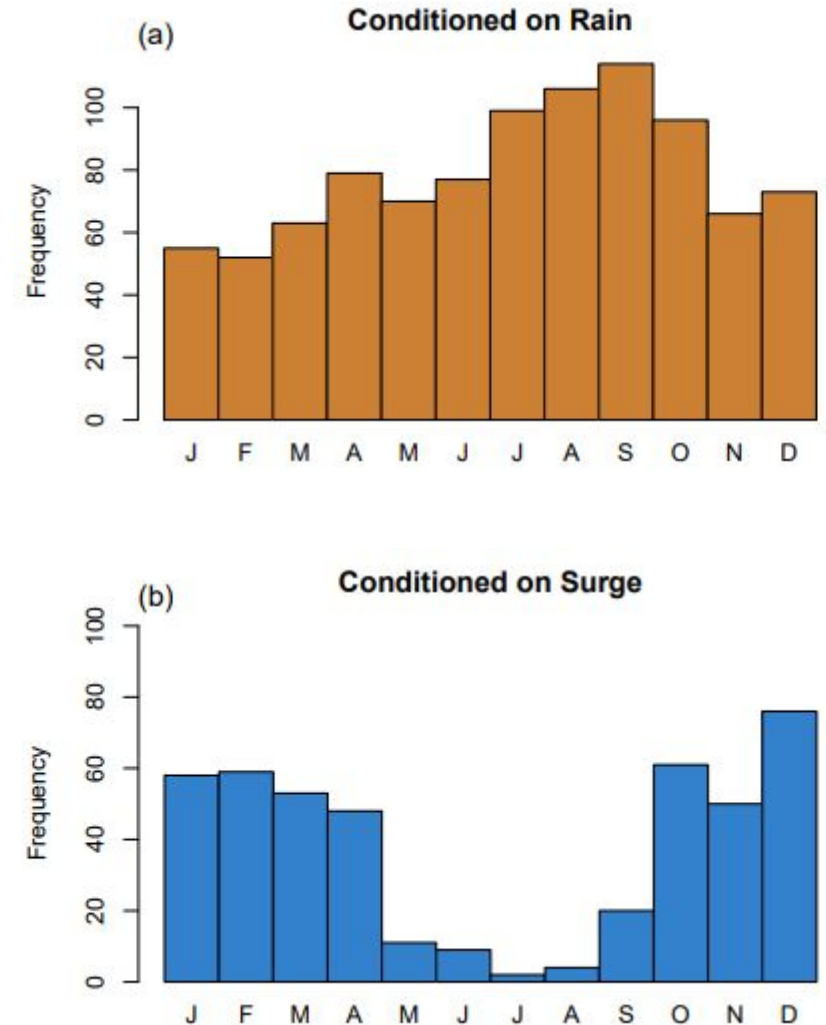
Extreme events are chosen in a statistical sense (e.g. 95th percentile) and do not necessarily indicate conditions will cause flooding.

# Co-occurrence of Drivers

There is a clear seasonality in the frequency of extreme events.

High storm surges occur predominantly between October and April and are associated with tropical and extratropical cyclones (Nor'easters)

Rainfall can be elevated during summer months with local convective storms that don't tend to generate storm surge.

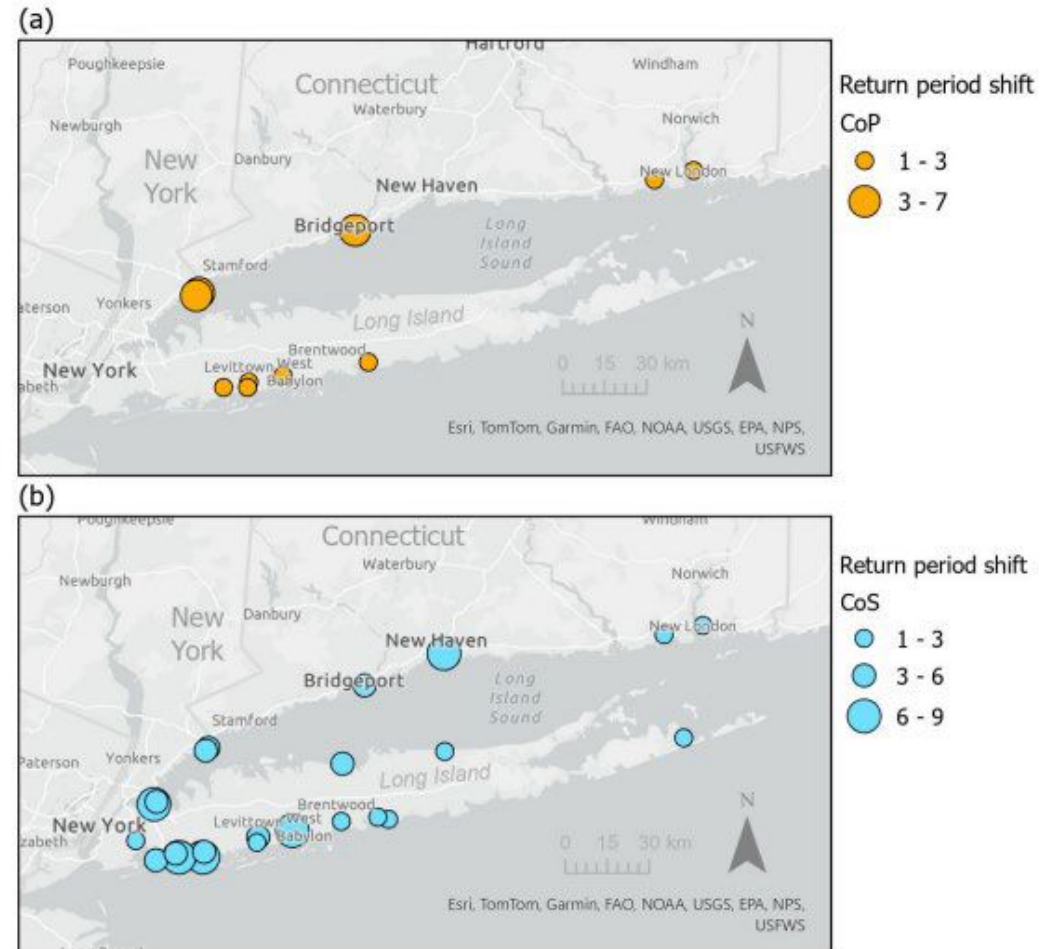


Credit: Glas and others, 2025

# Co-occurrence of Drivers

The dependence is stronger between surge and rainfall when selection is done based on high surge events.

Many of the stations did not have a statistically significant relationship when selecting events based on precipitation.

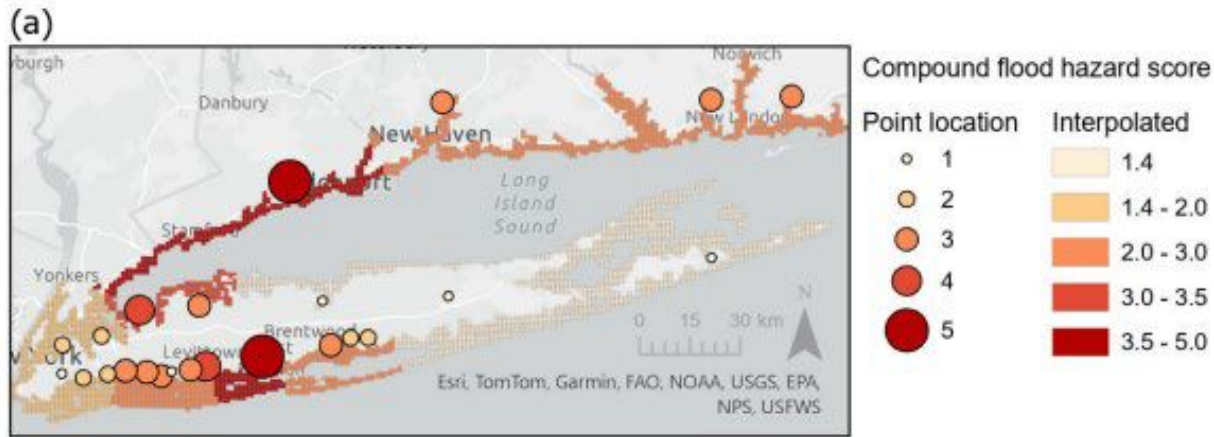


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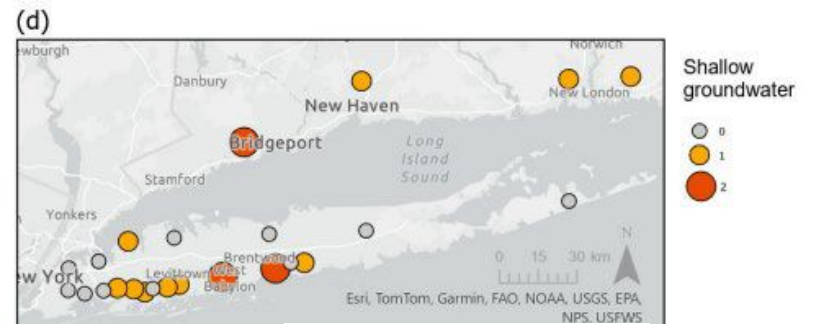
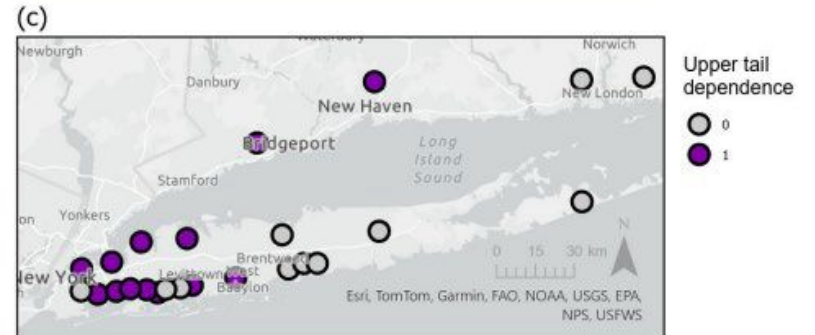
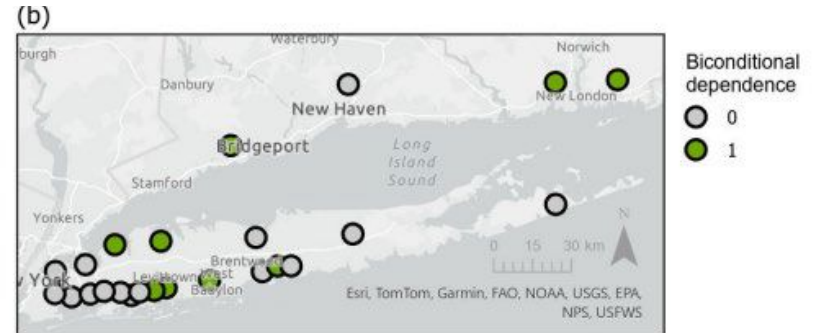
# Co-occurrence of Drivers

## Compound Hazard Score

The final compound score depends on the dependence between surge and precipitation and the presence of shallow groundwater.



Credit: Glas and others, 2025

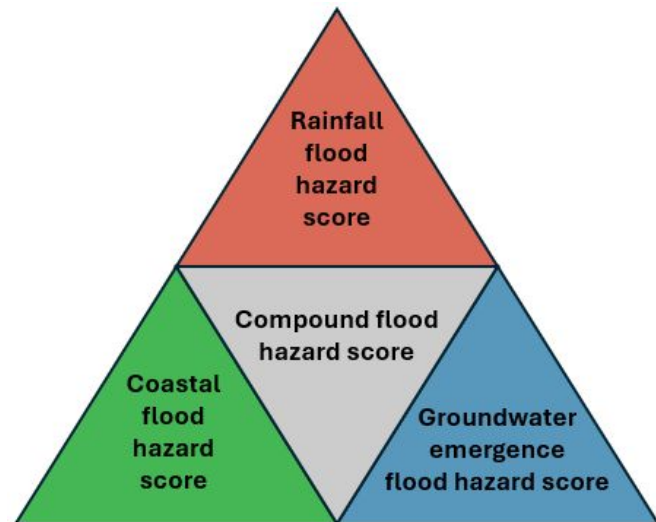


Credit: Glas and others, 2021

# Interpretation FAQ's

Why is the compound score high when all the other scores are low?

The compound score is indicating how linked the three flooddrivers are. A high compound score reflects a stronger chance of co-occurring drivers but does not reflect an absolute hazard level. The scores for the individual drivers reflect a relative rating of hazard.



# BREAK

Grab your laptops or tablets to follow along with the demonstration!

<https://ny.water.usgs.gov/maps/compoundflooding/>

Wifi: COMO Guest

Password: 8605352476



# LIVE DEMO



# Next Steps

Continuing workshops throughout the LIS watershed

- including a virtual workshop

Conducting formal assessment of the CFHM

- interest in being part of a more in-depth analysis?

Developing CFHM Toolkit

- interest in being part of a pilot period?

Presenting products at a final workshop



Credit: Kathleen Fallon

# Assessment

Thank You!  
Questions?

Contacts:

- Kathleen Fallon [kmf228@cornell.edu](mailto:kmf228@cornell.edu)
- Liv Herdman [lherdman@usgs.gov](mailto:lherdman@usgs.gov)
- Jason Finkelstein [jfinkels@usgs.gov](mailto:jfinkels@usgs.gov)



[https://cornell.ca1.qualtrics.com/jfe/form/SV\\_bO6MiD1FiAKscAK](https://cornell.ca1.qualtrics.com/jfe/form/SV_bO6MiD1FiAKscAK)