Compound Flood Hazard Mapper Webinar

June 11, 2026

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Jason Finkelstein, USGS NY Water Science Center

Welcome and Agenda

11:00-11:10	Project Overview
11:10-11:30	Compound Flood Hazard Assessment
11:30-11:55	Overview of the Mapper
11:55-12:00	Conclusion

Introductions

Kathleen Fallon, Coastal Hazards Specialist, NYSG

Liv Herdman, Hydrologist, US Geological Survey

Robin Glas, Hydrologist, US Geological Survey

Jason Finkelstein, Hydrologist, US Geological Survey

Please use link to submit feedback and questions

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Project

Credit: MyCoastNY Flood Watch Report by Kenneth Gould

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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 Mapper

Present

- Providing outreach 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

Credit: MyCoastNY Flood Watch Report by Trustee Dave Weber

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

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Flooding Impacts

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

Credit: Public domain

Flood Hazard:

- The potential for flooding to occur

Flood Risk:

- Probability of flood hazard interacting with society

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Flood Adaptation Strategies

Credit: New York Sea Grant

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

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Existing Tools

NOAA Coastal Flood Exposure Mapper

FEMA Flood Maps

NYC Stormwater Flood Maps

Credit: NOAA Coastal Flood Exposure Mapper

Credit: FEMA Flood Maps

Credit: NYC Stormwater Flood Maps

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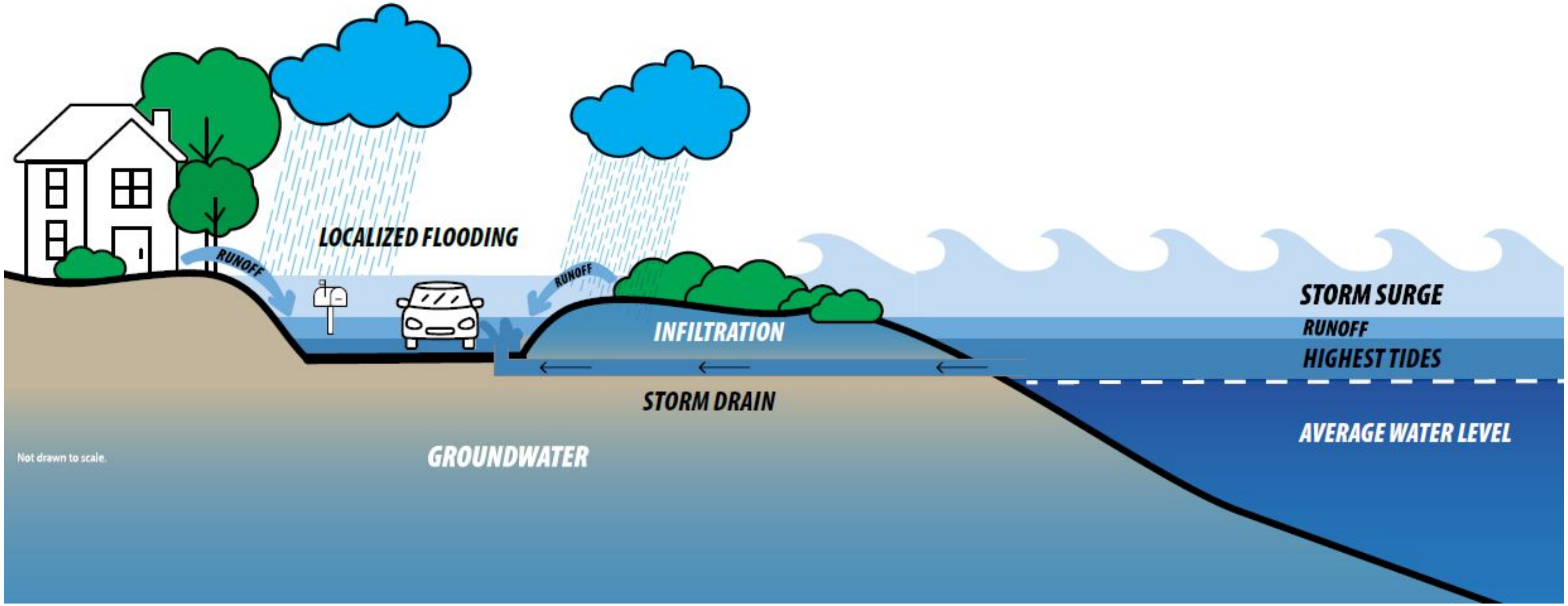
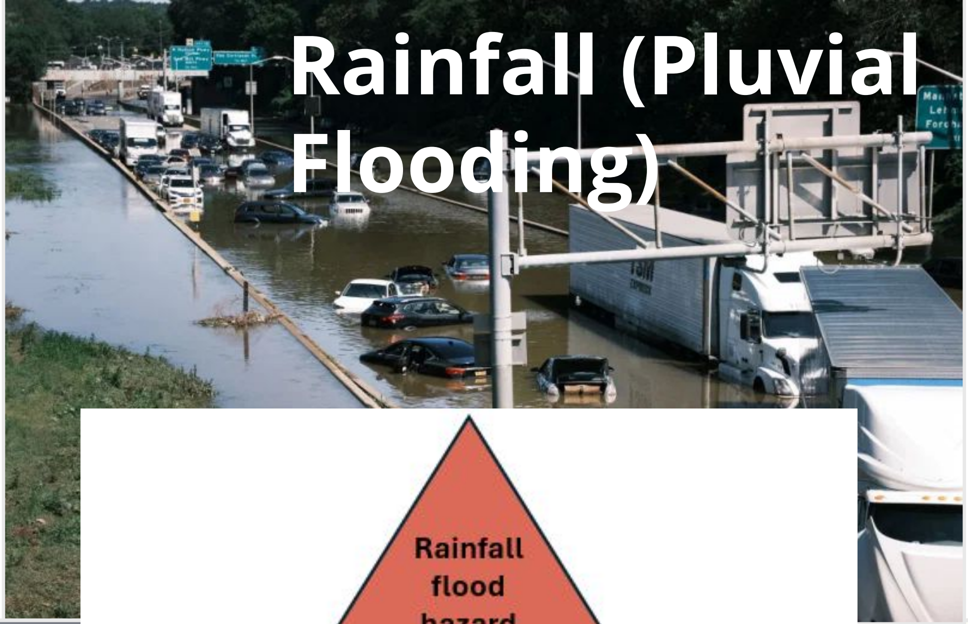
What is Compound Flooding?

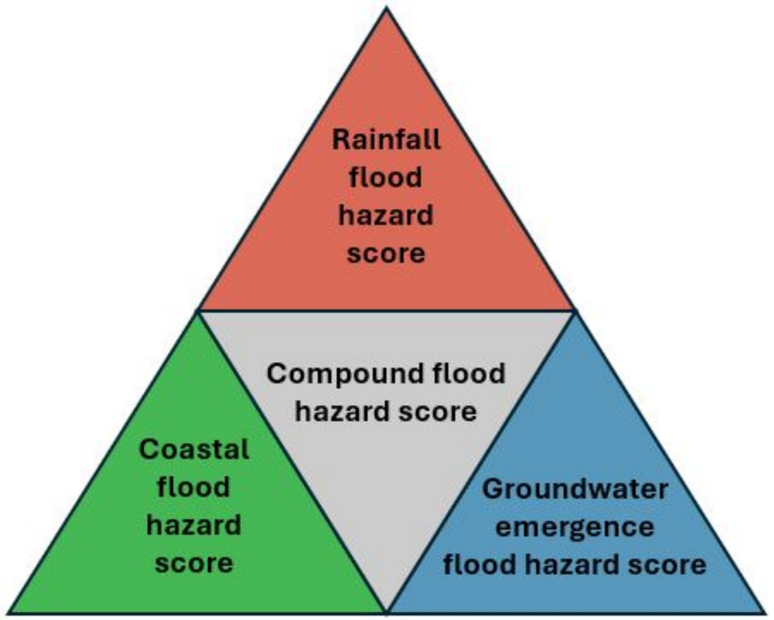
When two or more flood drivers occur together, impacts may be compounded

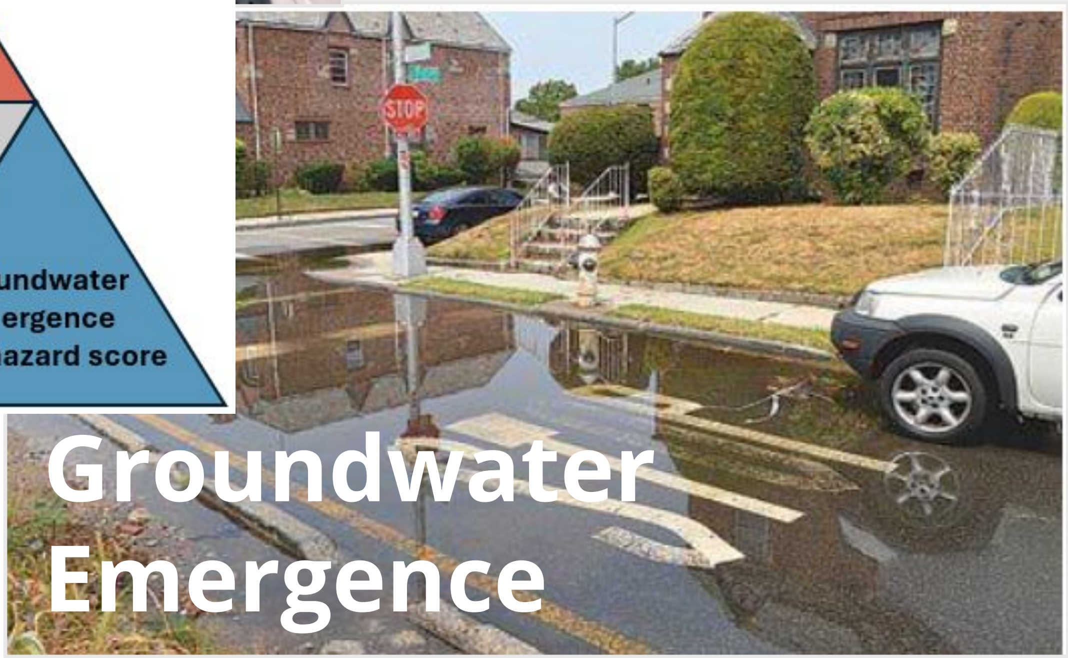


Credit: New York Sea Grant



Credit: USGS NY Water Science Center





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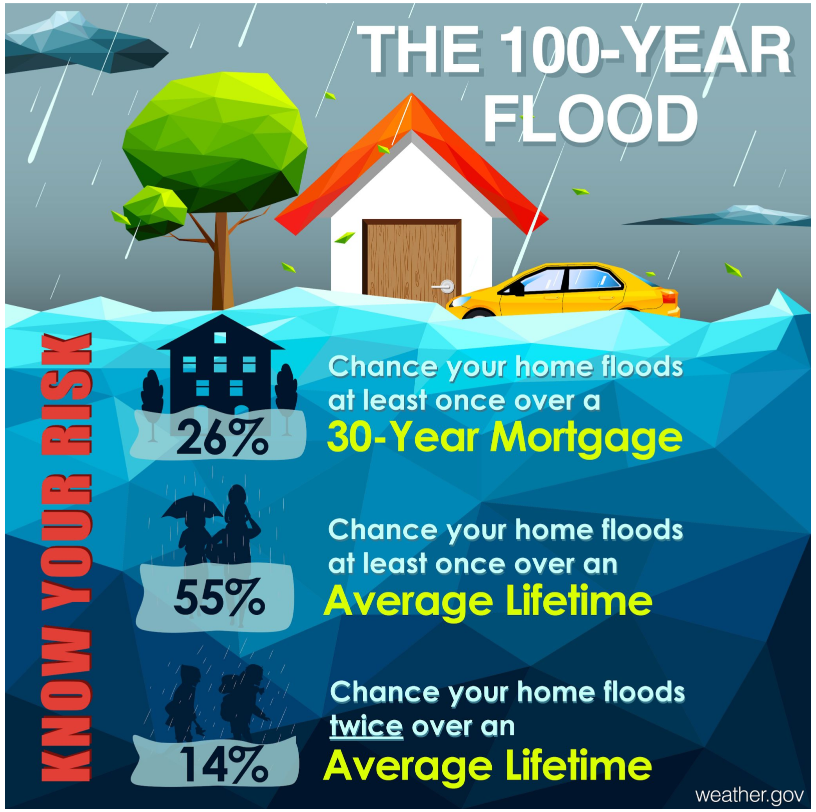
Flood Annual Exceedance Probability



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

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The CFHM Application

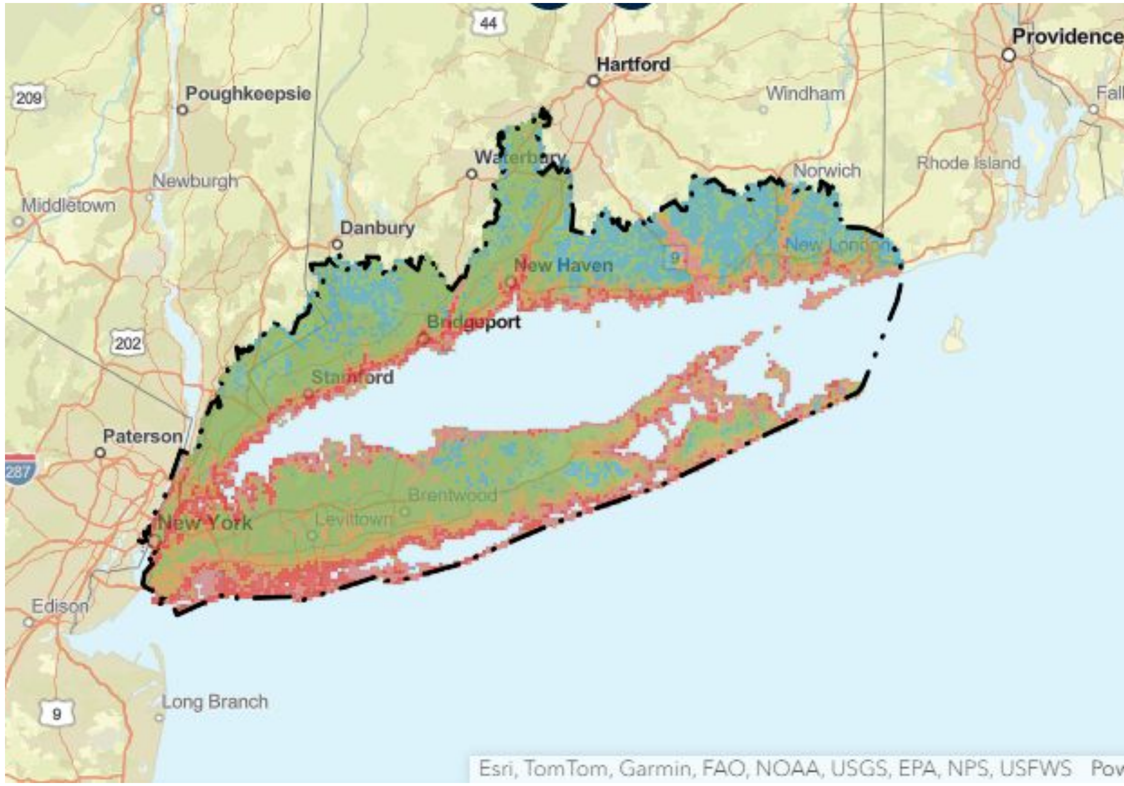
Mapper includes Long Island, NYC, Westchester and coastal areas of southern CT

Displays susceptibility to:

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

Includes supplemental maps

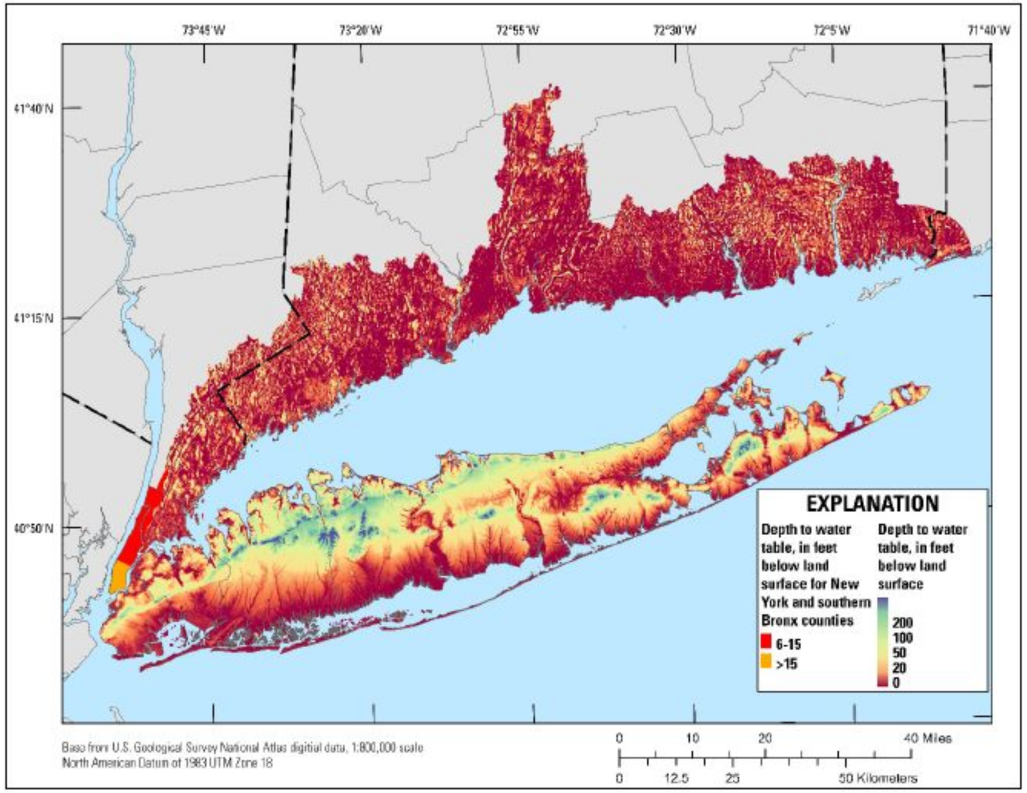
Tool will help communities understand areas that may be vulnerable to compound flooding



Credit: USGS Compound Flood Hazard Mapper

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.



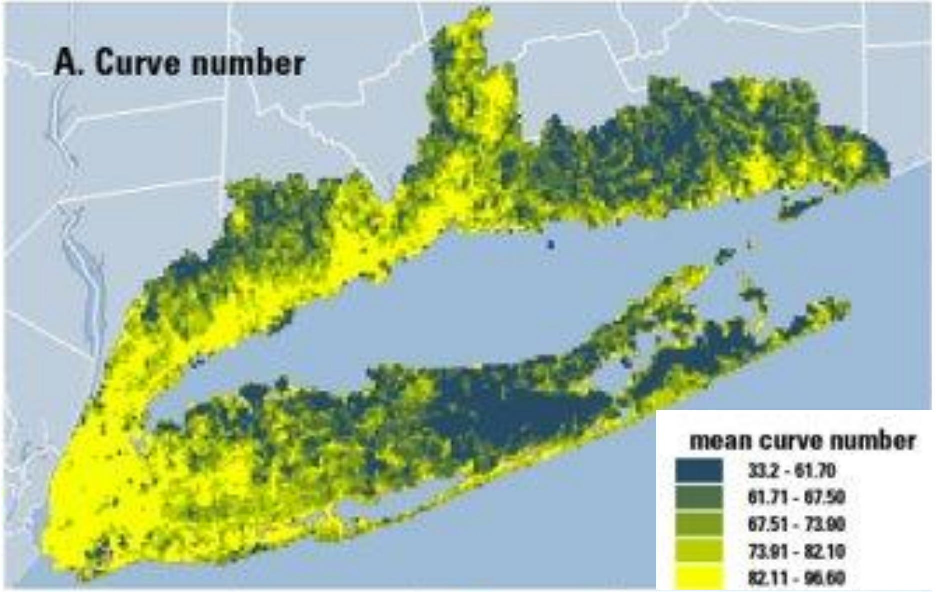
Credit: Masterson and others, 2025

- 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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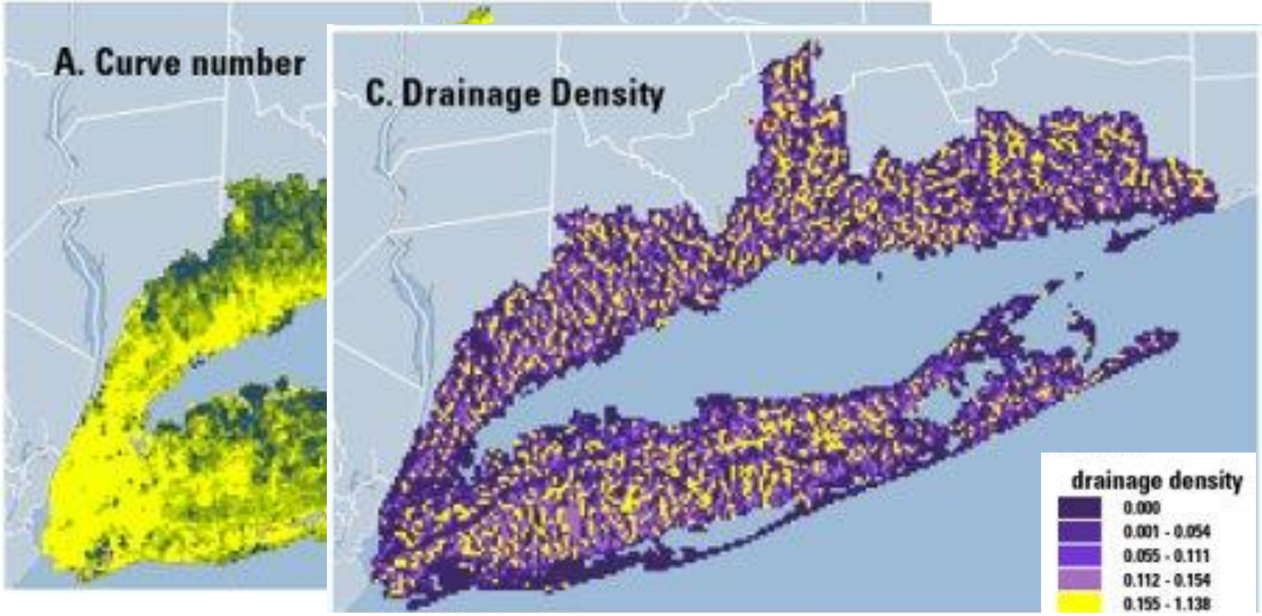
Rainfall Hazard Analysis



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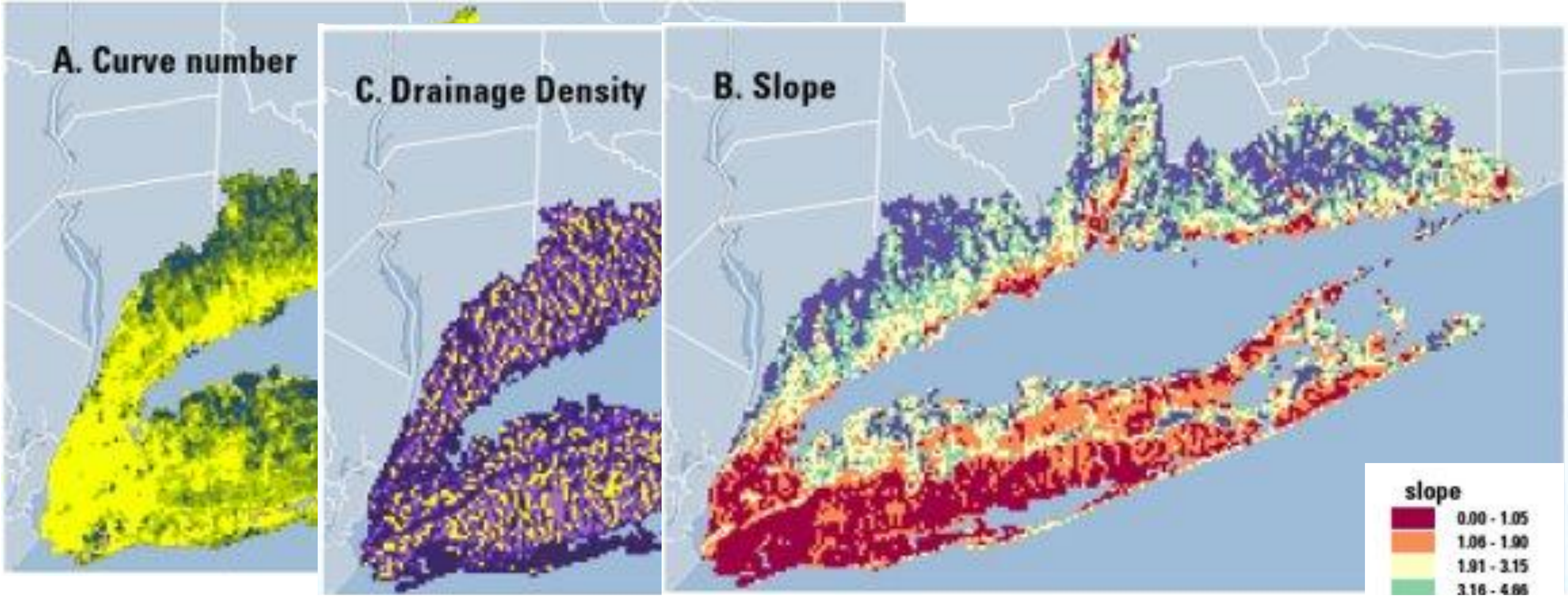

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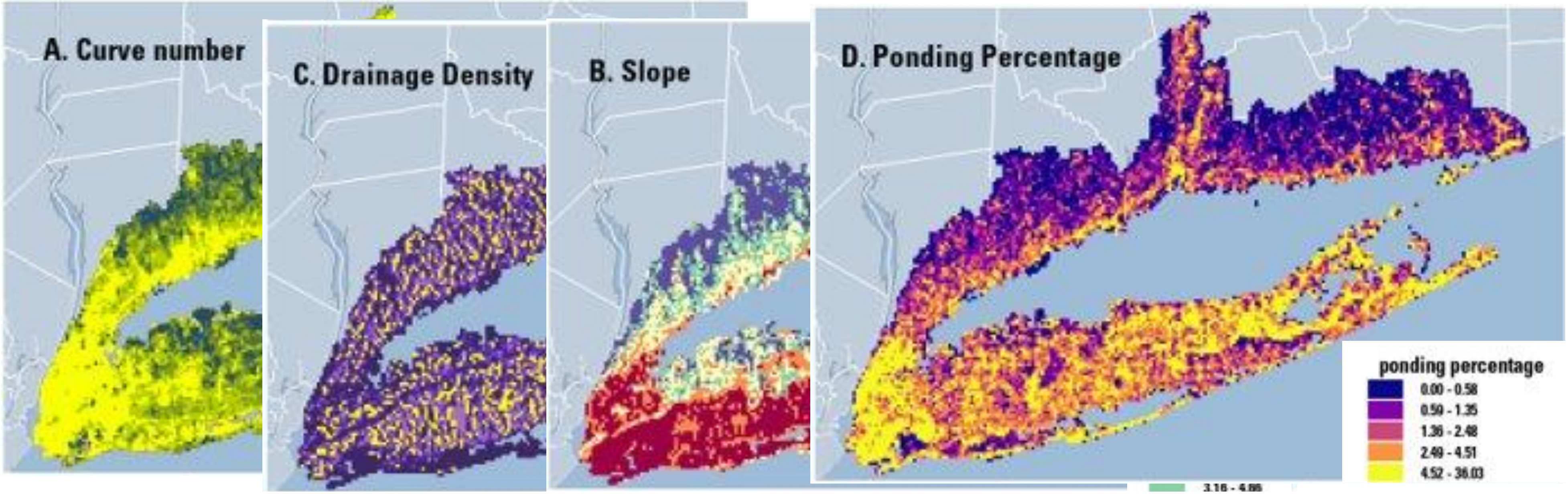

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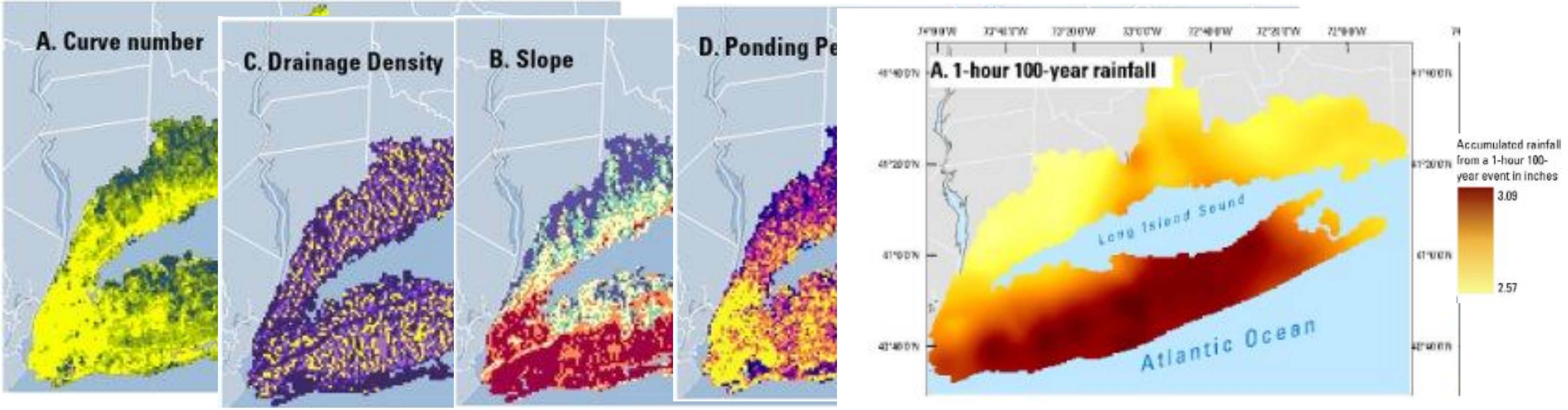

Credit: Welk and others, 2025

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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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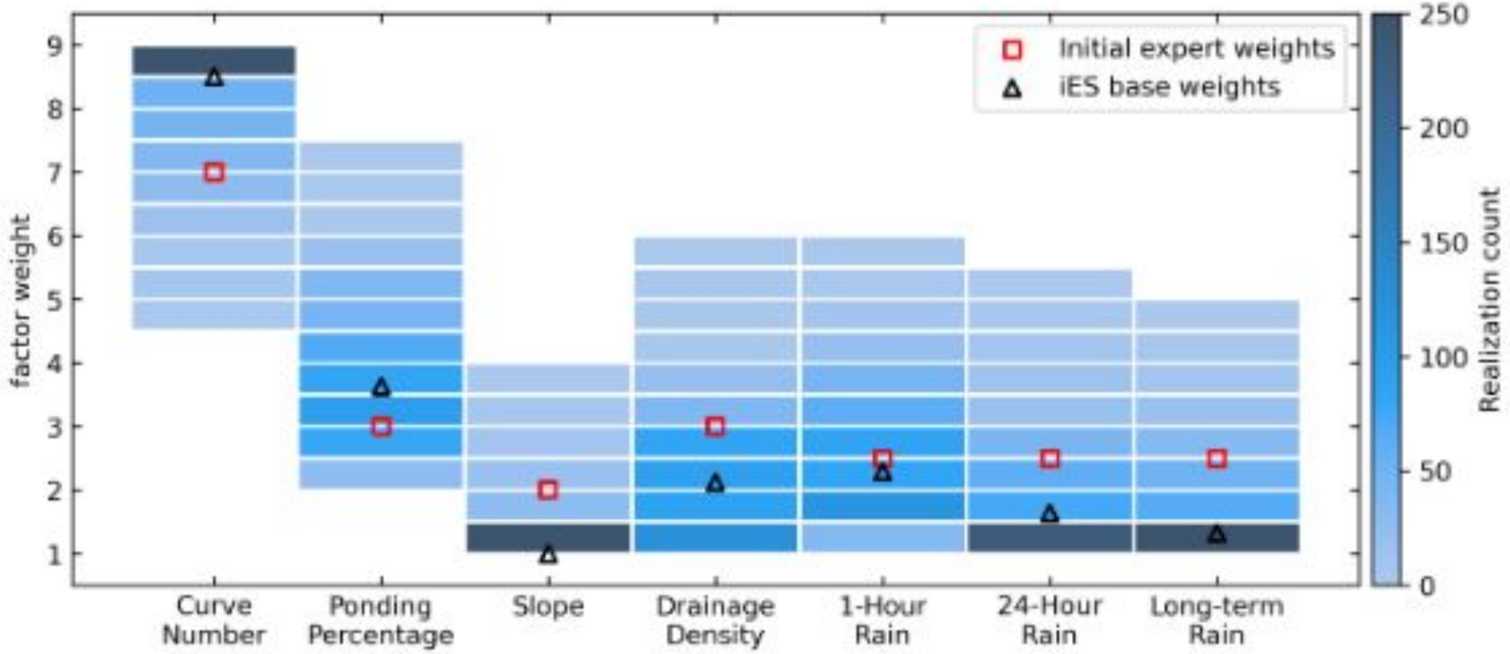

Credit: Welk and others, 2025

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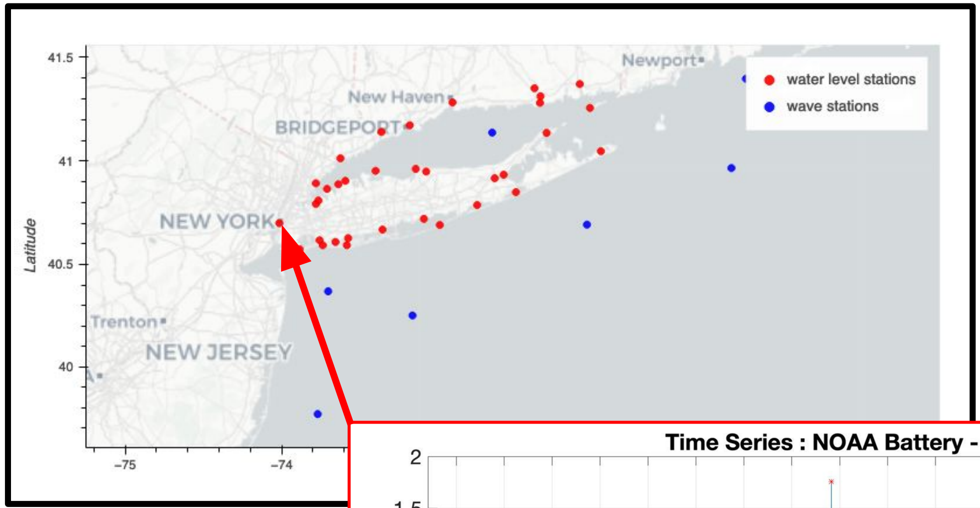
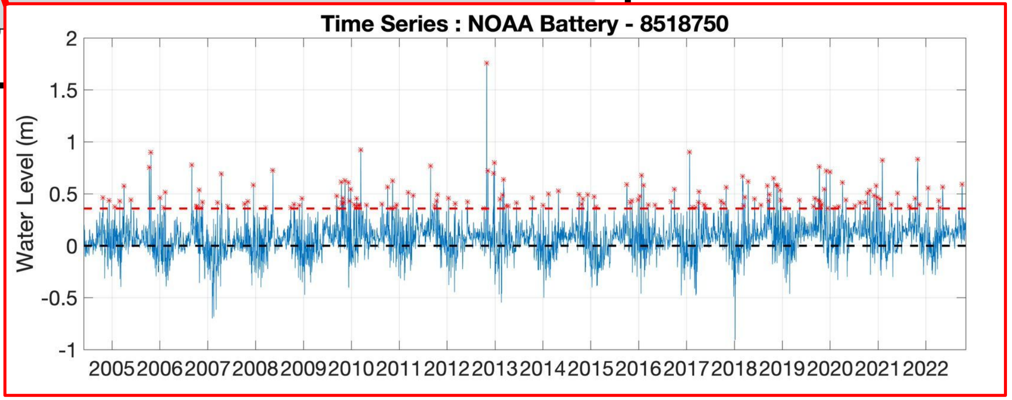
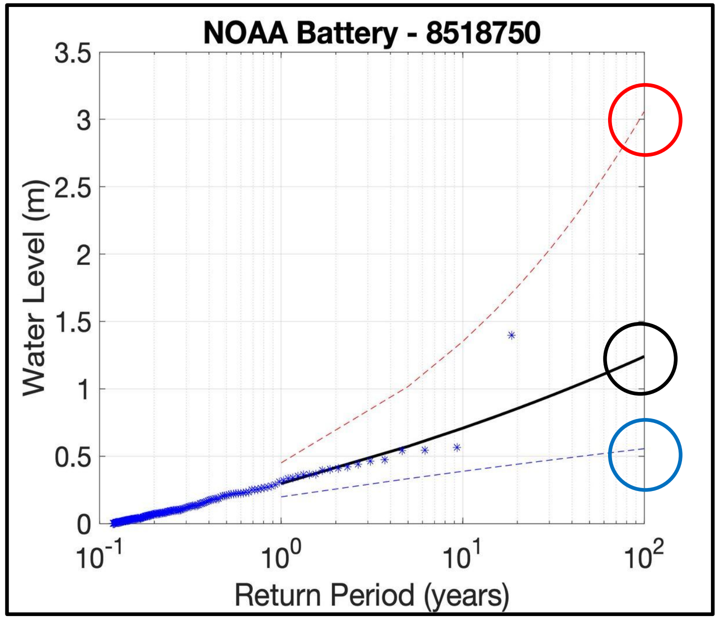
Coastal Hazard Analysis

- 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





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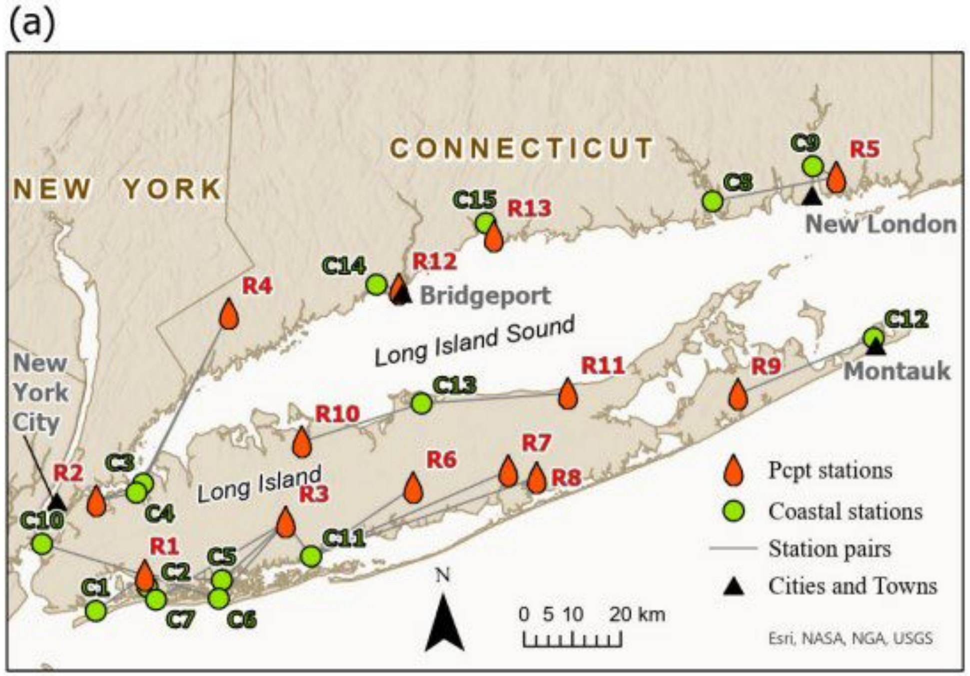
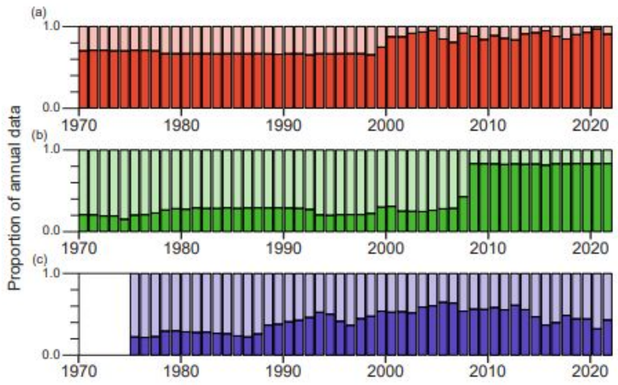
Co-occurrence of Drivers

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.



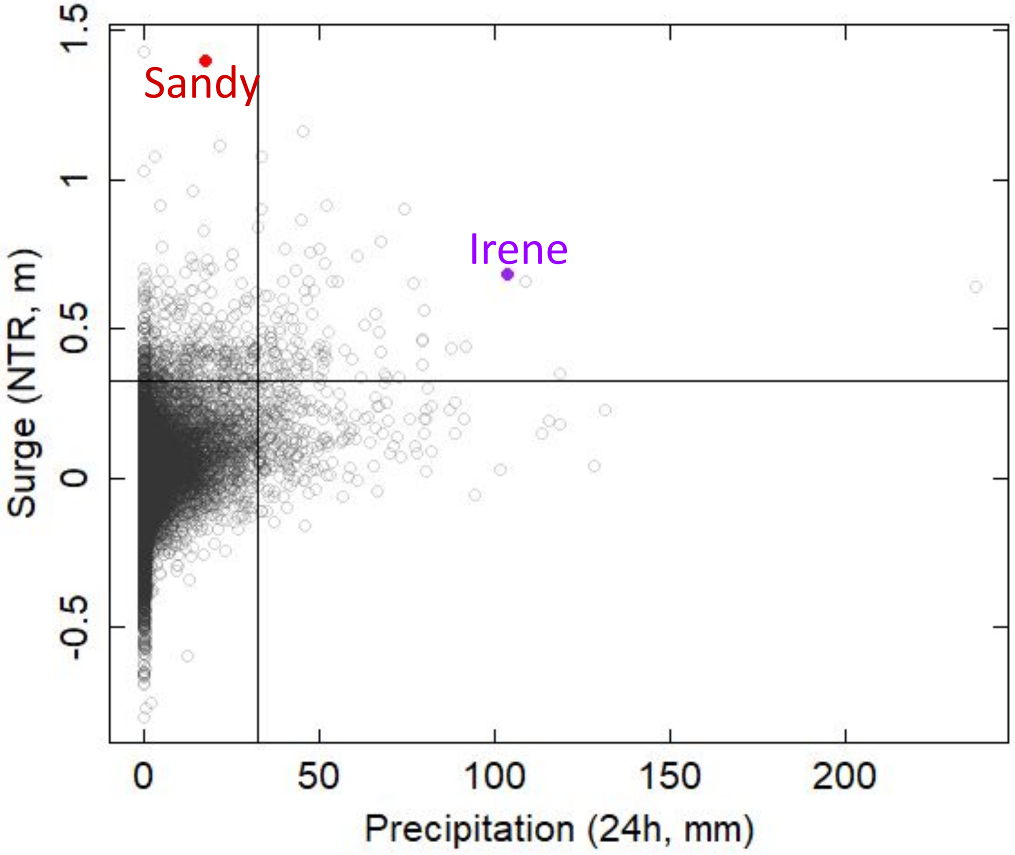
Credit: Glas and others, 2025



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.

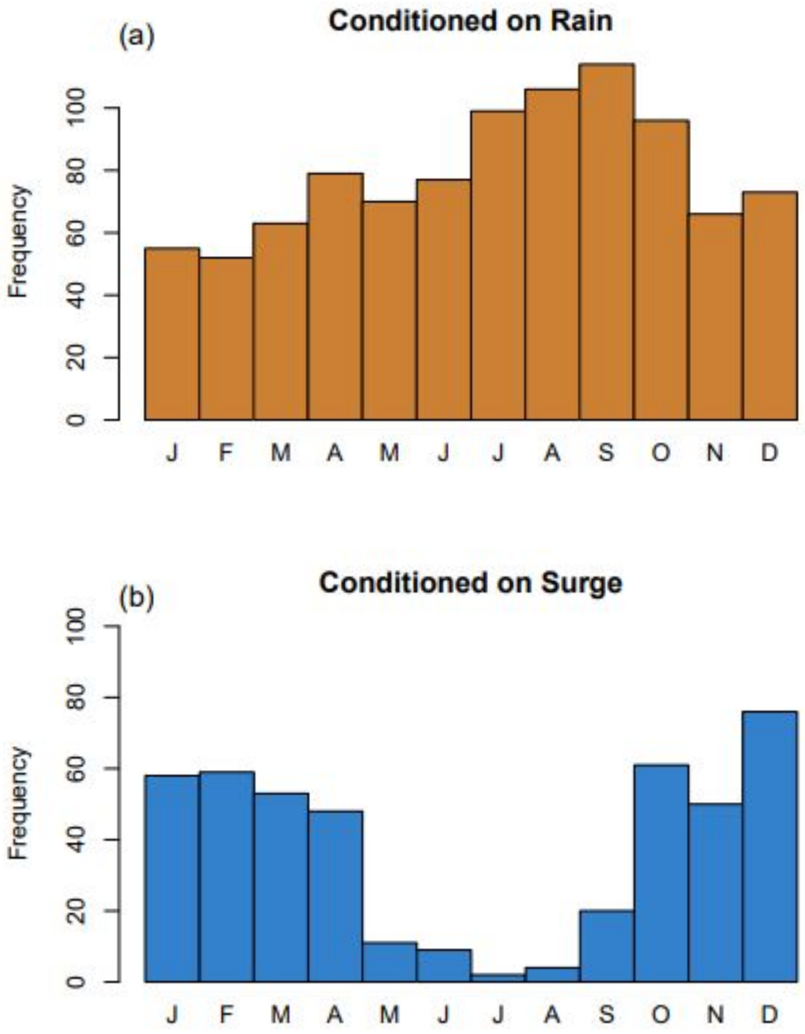
Extreme events are chosen in a statistical sense (e.g. 95th percentile) and do not necessarily indicate conditions will cause flooding.

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

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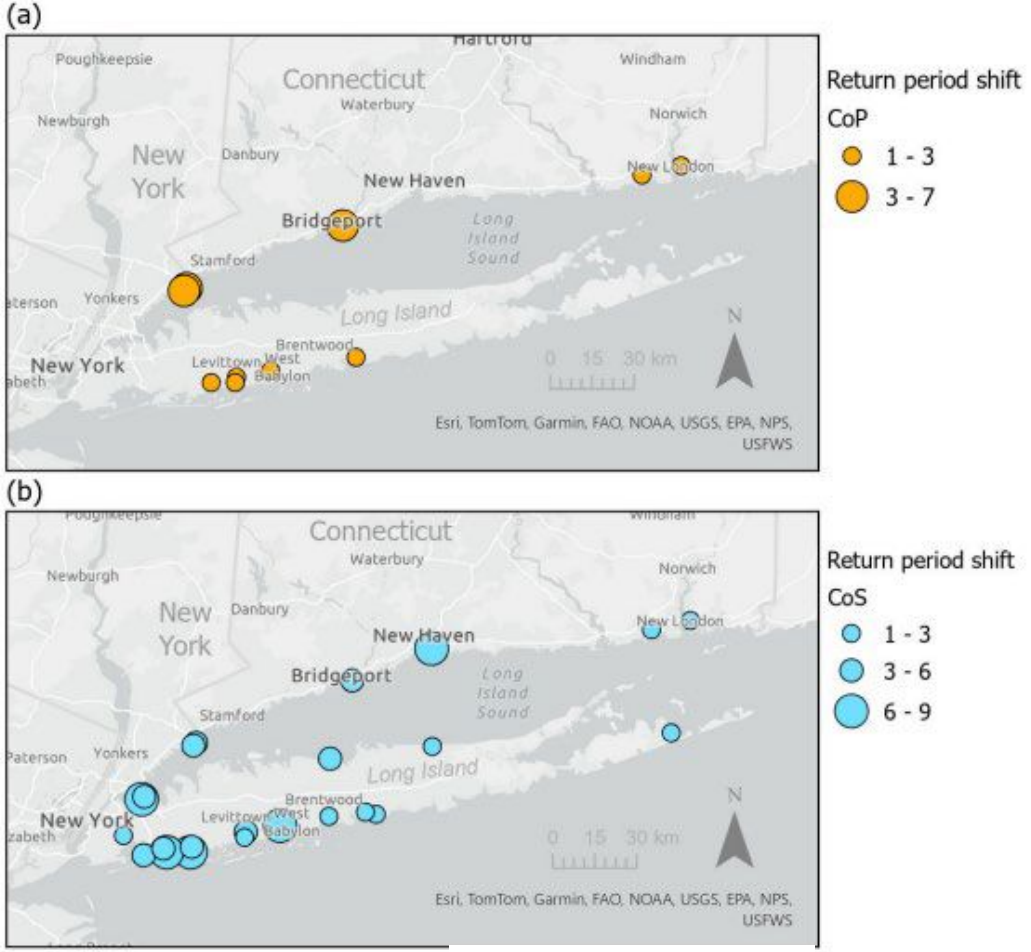
Co-occurrence of Drivers

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.



Credit: Glas and others, 2025

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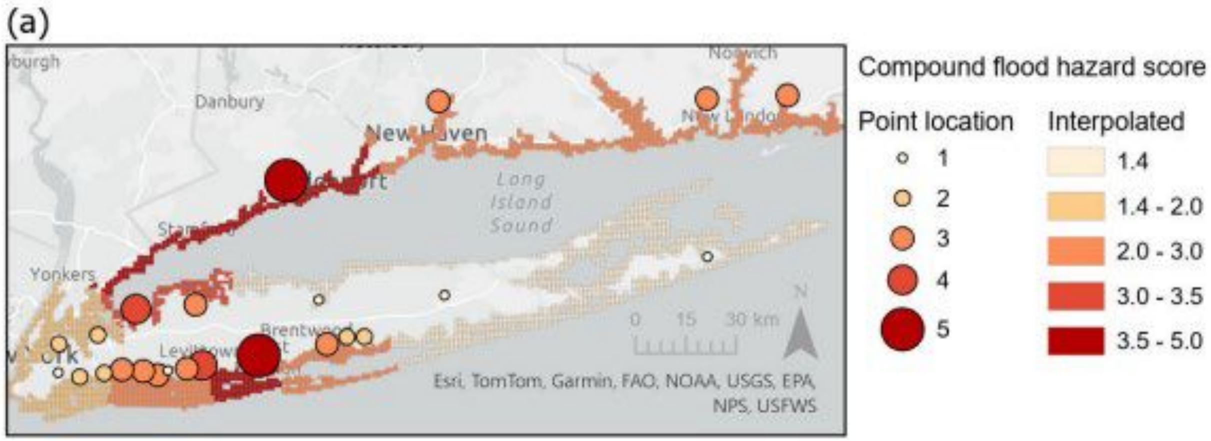
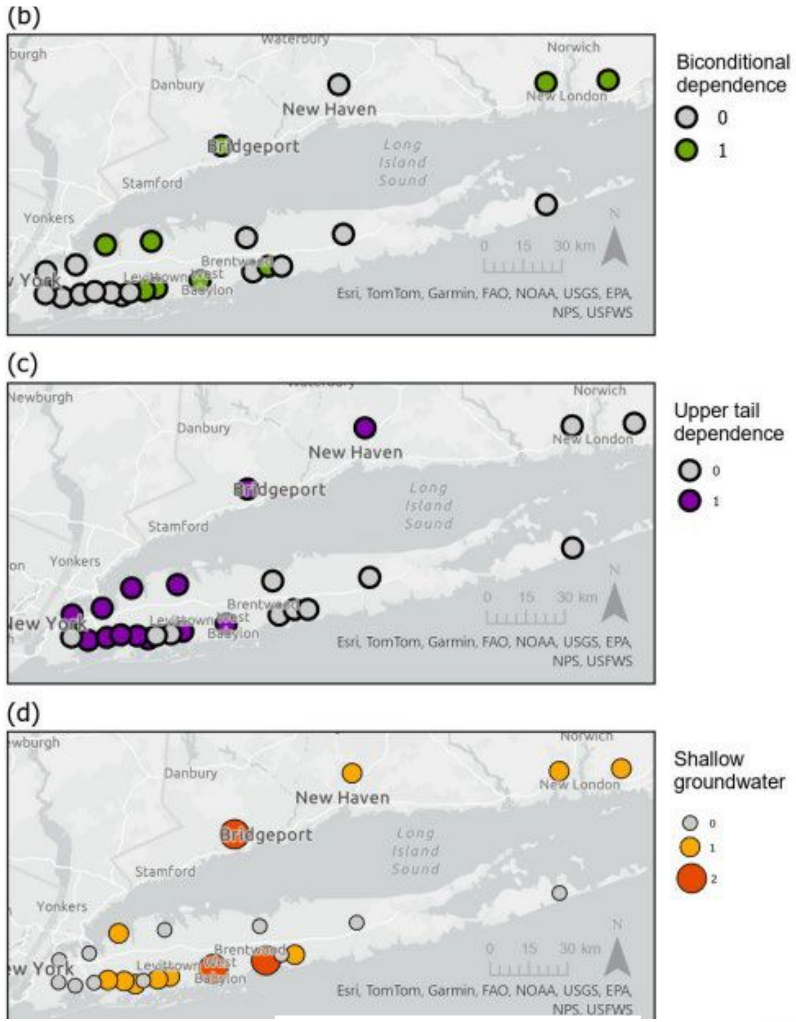
Co-occurrence of Drivers

Compound Hazard Score

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



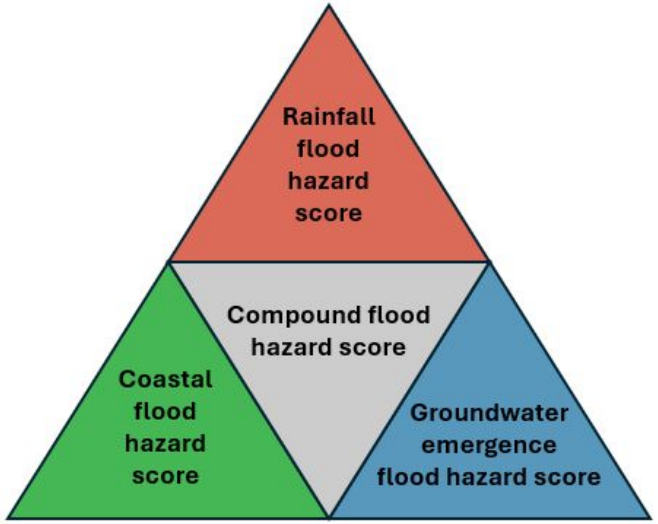
Credit: Glas and others, 2025



Credit: Glas and others, 2025

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 flood drivers 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.

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Overview of the CFHM

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

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

Please use link to submit feedback and questions

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Conclusion

Contacts:

- Kathleen Fallon kmf228@cornell.edu
- Liv Herdman lherdman@usgs.gov
- Robin Glas rglas@usgs.gov
- Jason Finkelstein jfinkels@usgs.gov

Next Steps

Gather and respond to your feedback and questions

Conducting a formal assessment

Developing an associated outreach toolkit