EESM PI Meeting
August 06, 2024

EXTREME PRECIPITATION AND FLOOD RISK FOR NEW YORK CITY POST-IDA

CHALLENGES DUE TO SYSTEM COMPLEXITY

Naresh Devineni

Department of Civil Engineering, The City College of New York
Earth and Environmental Sciences, The Graduate Center
City University of New York, New York, NY 10031, USA
Email: ndevineni@ccny.cuny.edu

Students and Postdocs
Dr. Seon-Ho Kim
Fatemeh Yavari and Carolien Mossel

U.S. Department of Energy | Office of Science
HYPERFACETS
A Framework for Improving Analysis and Modeling of Earth System and Intersectoral Dynamics at Regional Scales

Urban Flooding in the Northeast Corridor

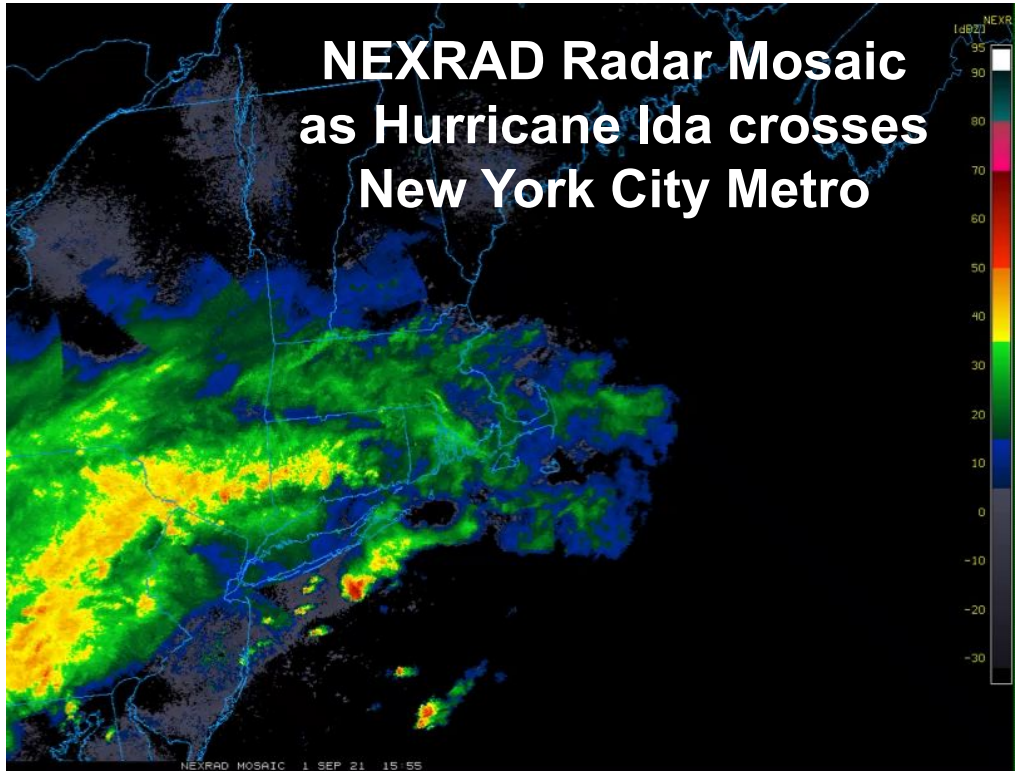
U.S. DEPARTMENT OF ENERGY | Office of Science

Scientists
Naresh Devineni, Donovan Finn, Kevin Reed, Melissa Bukovsky, Jiwen Fan, Andrew Jones, Yun Qian

Stakeholders
Nihar Samal (NYCDEP), Hayley Elszasz (NYC Mayors Office of Climate and Environmental Justice), Amanda Stevens (NYSERDA)

September 1, 2021

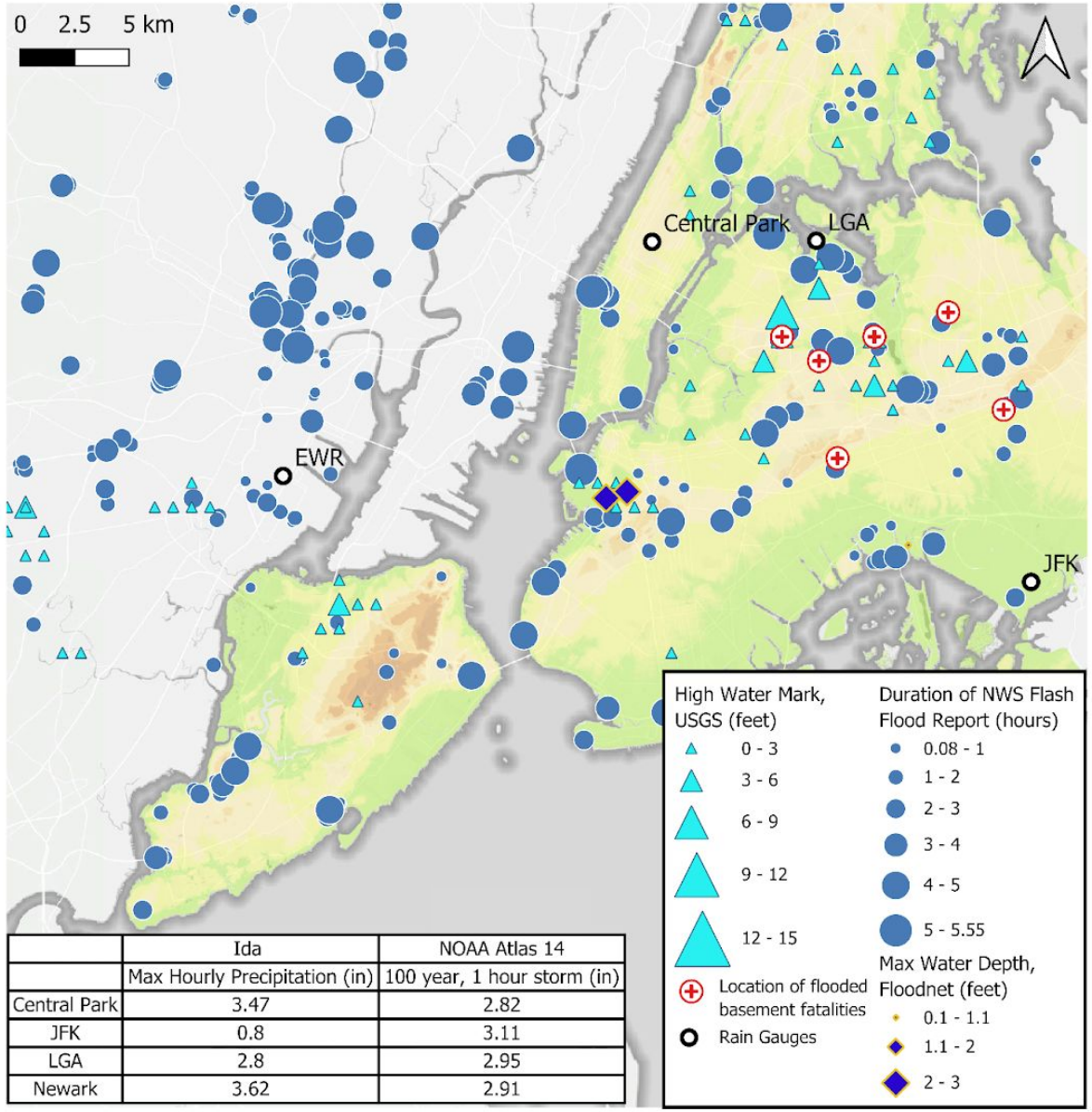
Remnants of Ida: New York City was put under a Flash Flood Emergency for the first time



A record **3.5 inches of rainfall in one hour**

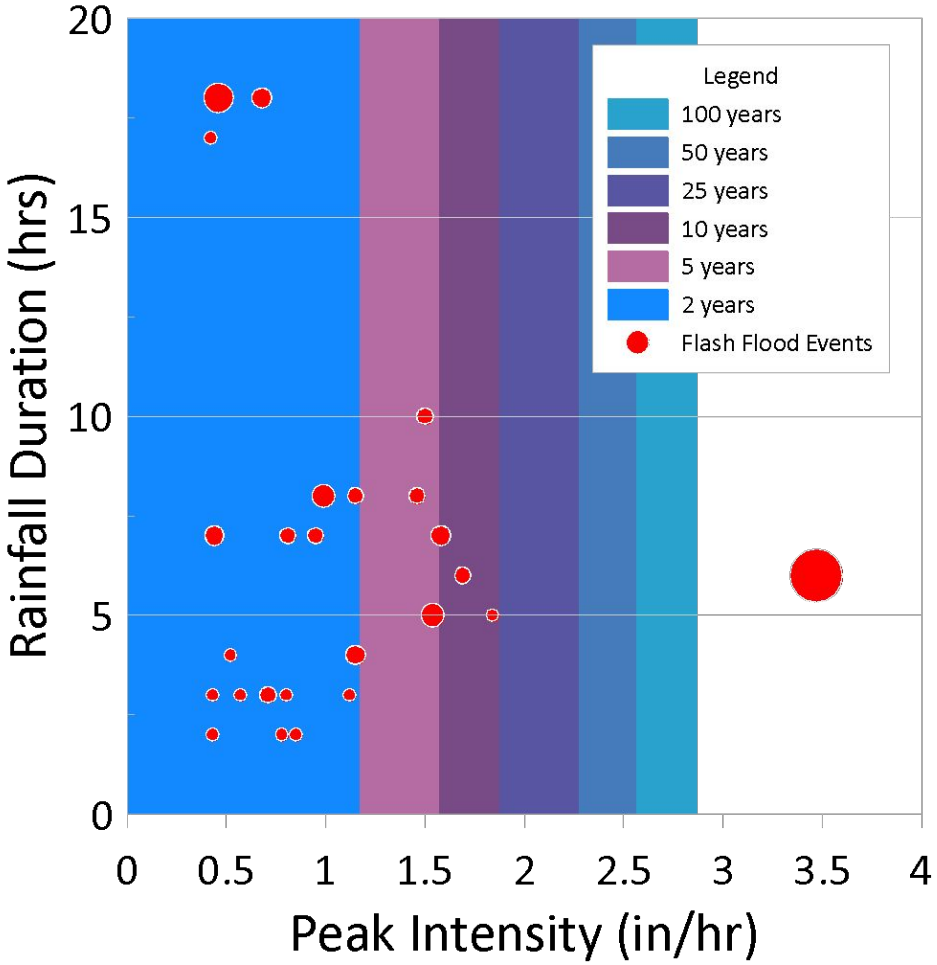
It is the wettest hour in history

44 deaths from this event in urban New York Area, including 11 deaths from apartment basement flooding



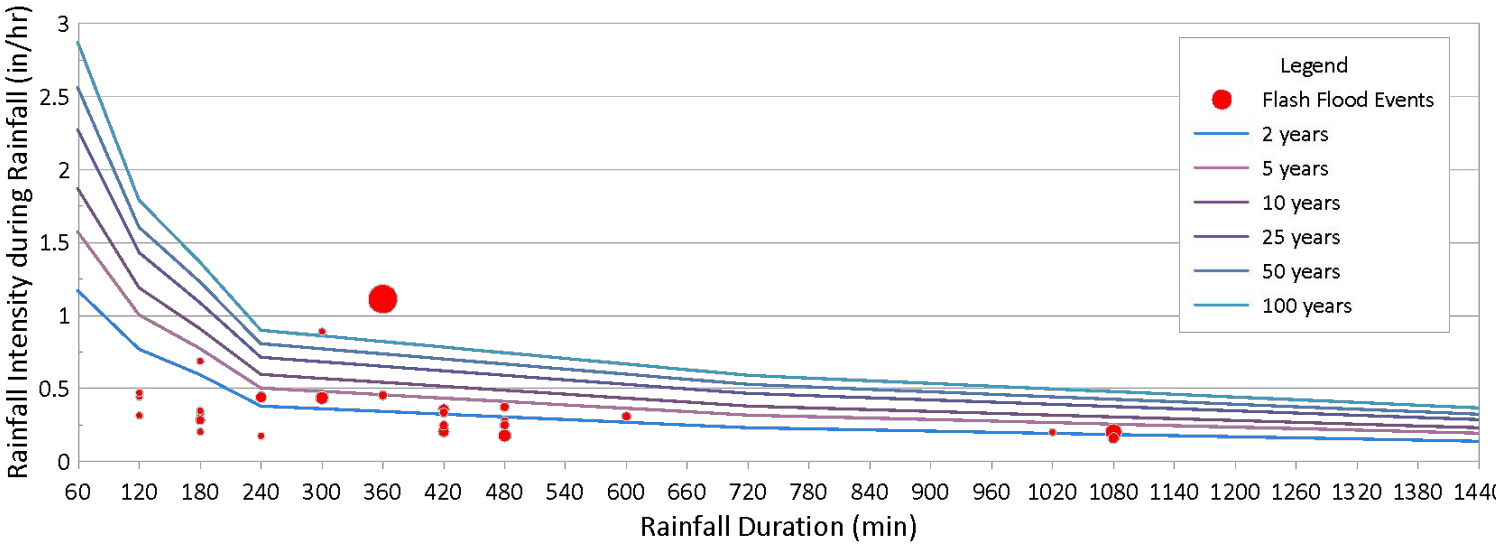
	Ida	NOAA Atlas 14
	Max Hourly Precipitation (in)	100 year, 1 hour storm (in)
Central Park	3.47	2.82
JFK	0.8	3.11
LGA	2.8	2.95
Newark	3.62	2.91

P(Rainfall Attributes | Flash Floods)

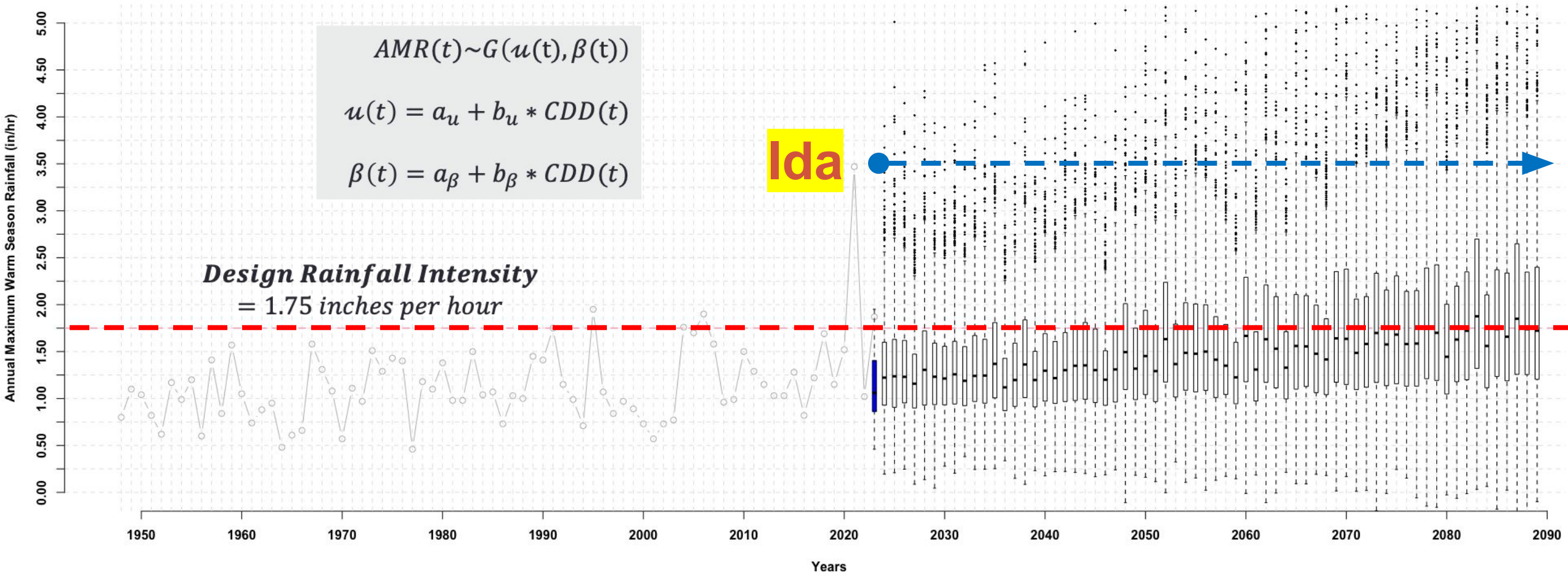


Flash Floods happened even for smaller intensity than the design intensity –

- duration of the rainfall matters
- other sewer infrastructure constraints matter



Changing Annual Maximum Hourly Precipitation



Need for adaptive designs and risk analysis

[exceedances may happen with greater probability]

Mossel et al., 20xx, Extreme hourly precipitation risk for New York City post-Ida, *Nature Sci.Reports* (under revision)

NYC Sewer Systems

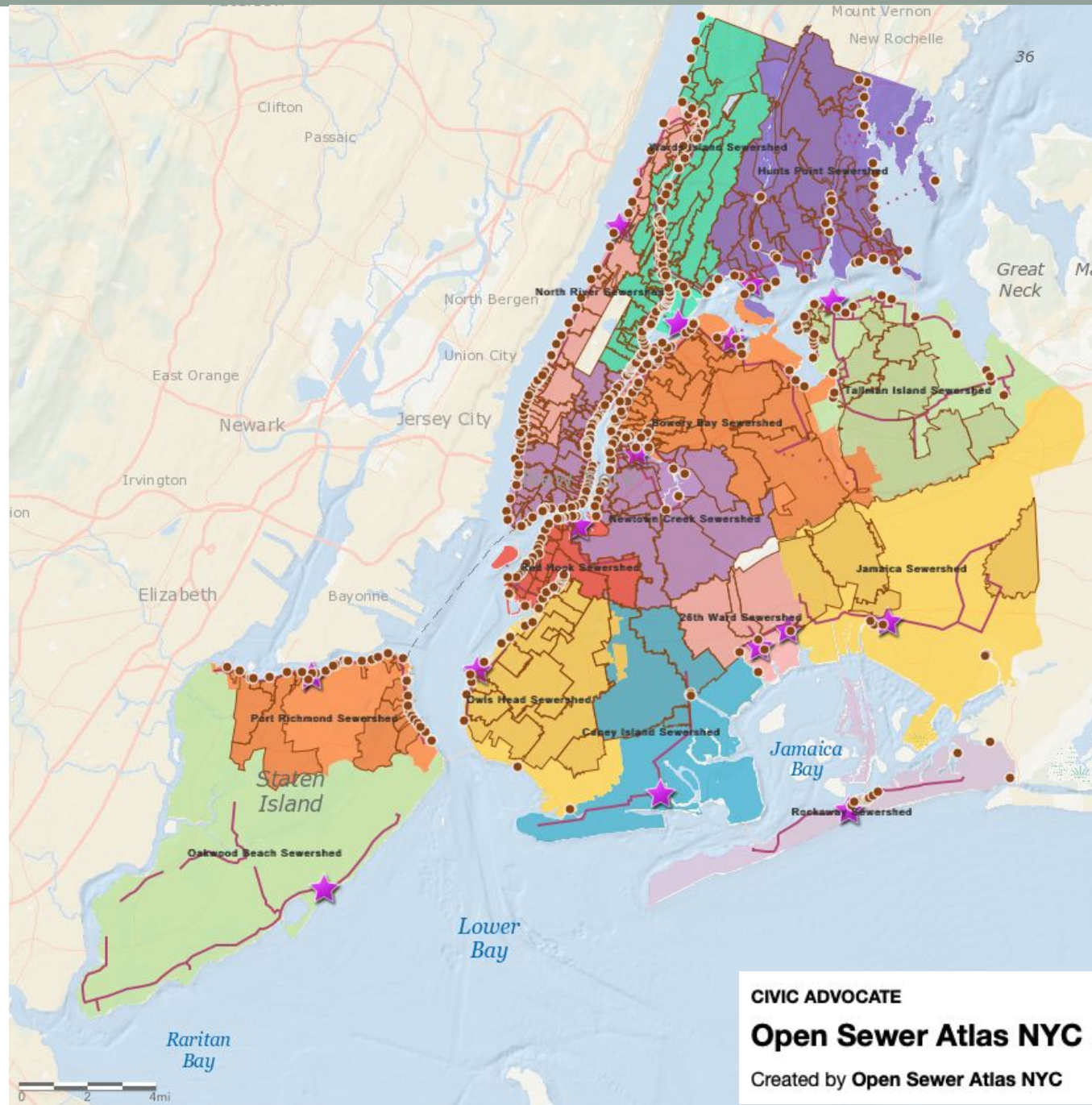
This network consists of over 7,400 miles of sewer pipes, 152,000 catch basins, and 95 wastewater pumping stations

Combined Sewer System

Approximately 60% of New York City has a combined sewer system. This system uses a single pipe or a “combined sewer” to carry the flow of wastewater and stormwater to the local wastewater treatment plant. Managing stormwater in this system can pose challenges because during heavy rainstorms, combined sewers receive higher than normal amounts of stormwater. When flows surpass twice the design capacity of the wastewater treatment plant, a mix of stormwater and untreated sewage flows directly into local waterways to prevent damage to our wastewater infrastructure. These events are called **Combined Sewer Overflows**.

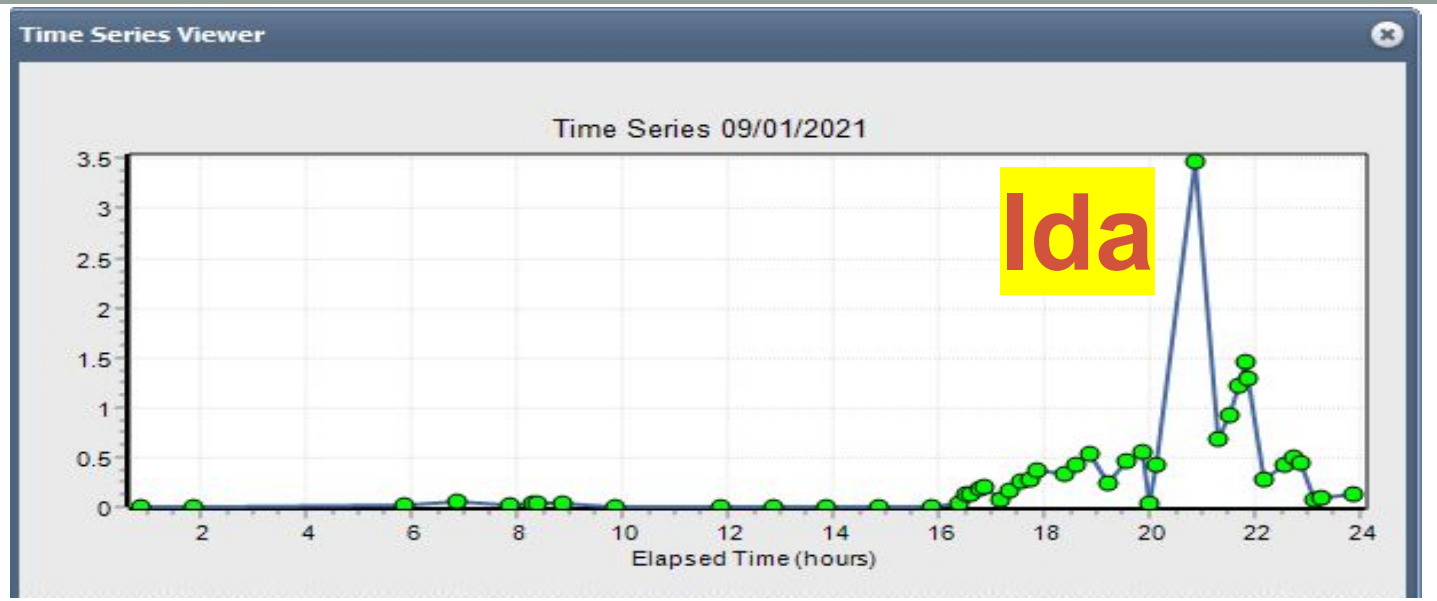
Separate Storm Sewer System

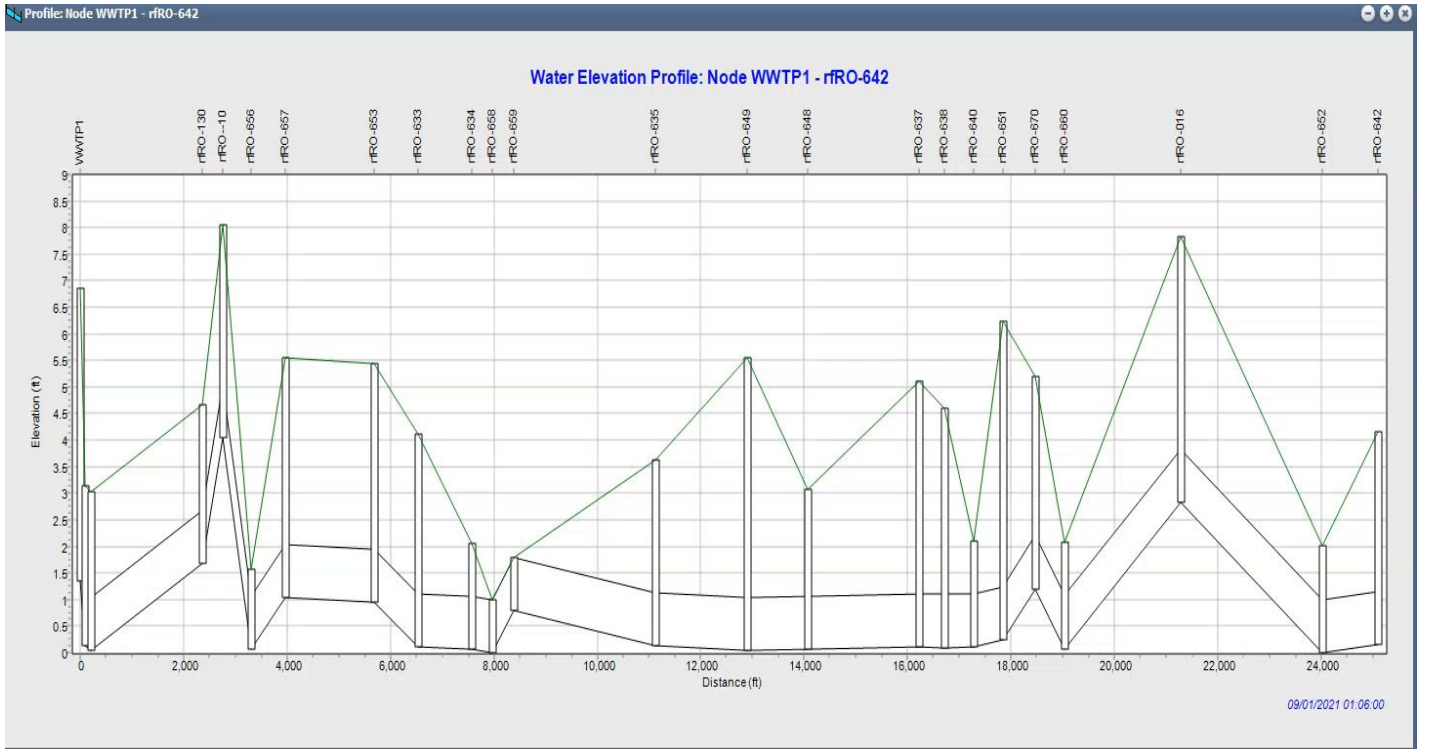
Approximately 40% of New York City uses a separate sewer system. This system is often referred to as a **Municipal Separate Storm Sewer System (MS4)**. It uses separate pipes to carry wastewater and stormwater. The pipes for wastewater connect directly to the wastewater treatment plant for futher processing, while the pipes for stormwater connect directly to local waterways. Managing stormwater in this system can pose challenges because stormwater picks up pollutants (such as oil, trash, and fertilizers) from the street and carries it directly into local waterways without receiving any treatment.



SWMM Test Case – Simplified block in Rockaway

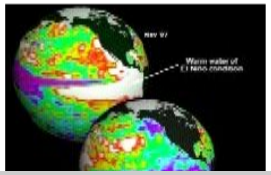
Utilization of Storm Water Management Model (SWMM) and HEC-RAS 2D model to generate detailed urban flood maps

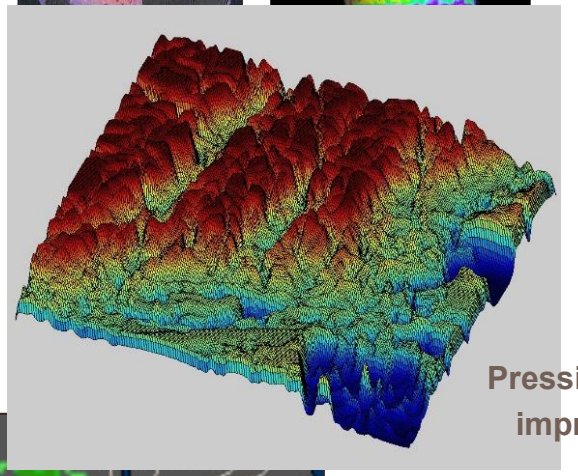




Science Action
Stakeholders Engagement
&
Co-produced Research

Climate Change and LULC change Data Curation





Extreme Rainfall Modeling

Urban Flood Scenarios

Infrastructure Performance Analysis under Climate Change

Thank you!

Pressing need for improved urban stormwater modeling/management systems to handle higher intensity rainfall as climate change continues to impact the weather and urban cosmos