Climate Change and New York City's Flood Risk - Summary

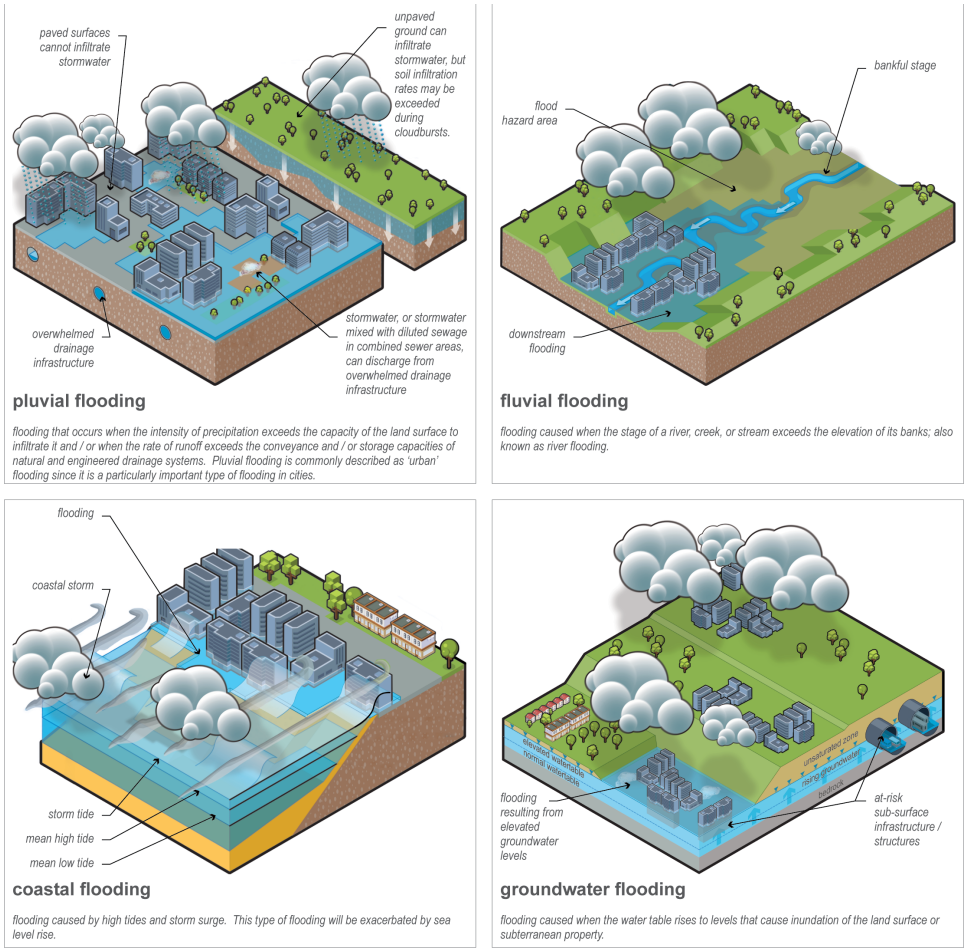
This is the first NPCC chapter focused only on New York City's different types of flood risk. It expands on earlier NPCC reports of climate change impacts on New York City flood risks by comprehensively assessing the city's five types of flood hazards: pluvial (rainfall), fluvial (rivers and streams), coastal (tidal and storm surge), groundwater, and compound flooding (when a storm causes coastal and rain flooding).

Highlights from this chapter include:

1. **Climate change increases pluvial (rainfall) flooding by causing more intense but brief rainstorms.** These extreme rainstorms, also called "*Cloudbursts*," produce more rain than existing city stormwater infrastructure can typically handle, leading to flooding. To better understand cloudburst flooding, more observations of rainfall rates and the depth, velocity, and chemistry of floodwaters during pluvial flood events is needed.

2. **Climate change increases the frequency and magnitude of fluvial flooding from rivers and streams.** Fluvial flooding occurs when rainfall causes water levels to rise onto dry land. Rising sea levels can also block the ability of rivers and streams to drain into the harbor forcing water back-up onto dry land. Areas with many rivers and streams, like in the Bronx and Staten Island, are more exposed to fluvial flooding. More real time observations of streamflow are needed to understand fluvial flooding.

3. **Climate change is increasing the intensity, frequency, and magnitude of coastal flooding from coastal storm surge (when coastal water is pushed on land during a storm) and chronic tidal flooding (flooding that occurs during regular high-tides – also known as "sunny day" flooding).** Low-lying, coastal neighborhoods like those around Jamaica Bay are already experiencing high-tide flooding. More research on coastal storms and storm surges is needed to assess coastal flood risks and to improve forecasting and emergency management.



Four types of floods that impact New York City (pluvial, fluvial, coastal, and groundwater). The impacts of these four flood types can be compounded when they occur in combination resulting in Compound Flooding. Figures adapted from UK Research and Innovation (UKRI) and the Natural Environment Research Council (NERC) / Ben Gilliland under Creative Commons License CC BY-NC 4.0

4. **Climate change may worsen groundwater flooding due to rising sea levels and increased precipitation.** Water that accumulates underground is called groundwater. Groundwater flooding occurs when that water rises above normal levels, flooding basements, tunnels, and normally dry areas above ground. In parts of eastern Brooklyn and southern Queens, the depth to groundwater is shallow. These areas are particularly exposed to potential groundwater flooding if levels continue to rise. Additional research is needed to improve understanding of how sea level rise could increase groundwater flood hazards and associated impacts on the city's infrastructure.

5. **Climate change is increasing the frequency and intensity of compound flooding, which is caused when rainfall and coastal flooding occur at the same time.** Compound flooding commonly occurs during coastal storms such as hurricanes and nor'easters. More research is needed to provide a deeper understanding of compound flooding in our current climate and with climate change. Research that assesses real-time data along with statistical assessment is also needed for a better understanding of actual, on-the-ground impacts.

6. **Flood risk management includes structural (physical interventions) and non-structural (knowledge, practice, agreements, laws, policies) measures.** Natural and nature-based systems are a form of structural flood risk management and can provide ecological and environmental benefits while also contributing to short- and long-term flood risk management. However, the efficacy of flood protection of natural and nature-based systems is dependent on local conditions and design. Flood risk management should comprehensively and pro-actively address the full range of flood hazards emphasizing long-term flood resilience, sustainability, equity, and highlight the role of nature-based systems.

Summary

Climate Change and New York City's Flood Risk describes how climate change worsens flooding in New York City through a rise in precipitation and sea levels. This chapter provides a more comprehensive picture of New York City flood risks by expanding the examination of those risks beyond the mapped Special Flood Hazard Areas ('100-year floodplains') that have conventionally been used, and by accounting for a wider range of flood hazards beyond coastal flooding. Addressing each type of flood hazard, the chapter provides historical examples of such flooding, characterizes exposure, vulnerability, and ways that climate change can further exacerbate the risk associated with each type of flooding, and identifies persistent knowledge gaps.

The chapter emphasizes structural (e.g., elevating buildings and utilities or adding barriers) and non-structural (e.g., early warning, buyouts, flood insurance) approaches to flood risk management. Importantly, it presents flood risk management as a proactive set of strategies to reduce vulnerability and increase the livability of flood prone communities before, during, and after flooding. Finally, it summarizes areas for future research including continued growth of flood monitoring (e.g. the FloodNet program), furthering work on the *Flood Susceptibility to Harm and Recovery Index (FSHRI)*, improving community-driven, neighborhood-scale flood risk management planning, enabling social and ecological restoration, and developing hazard maps that represent a broader range of hazards and their increase in size in response to climate change.

Chapter Authors:
Bernice Rosenzweig, Franco Montalto, Philip Orton, Joel Kaatz, Nicole Maher, Jerry Kleyman, Ziyu Chen, Eric Sanderson, Nirajan Adhikari, Timon McPhearson, Pablo Herreros-Cantis

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