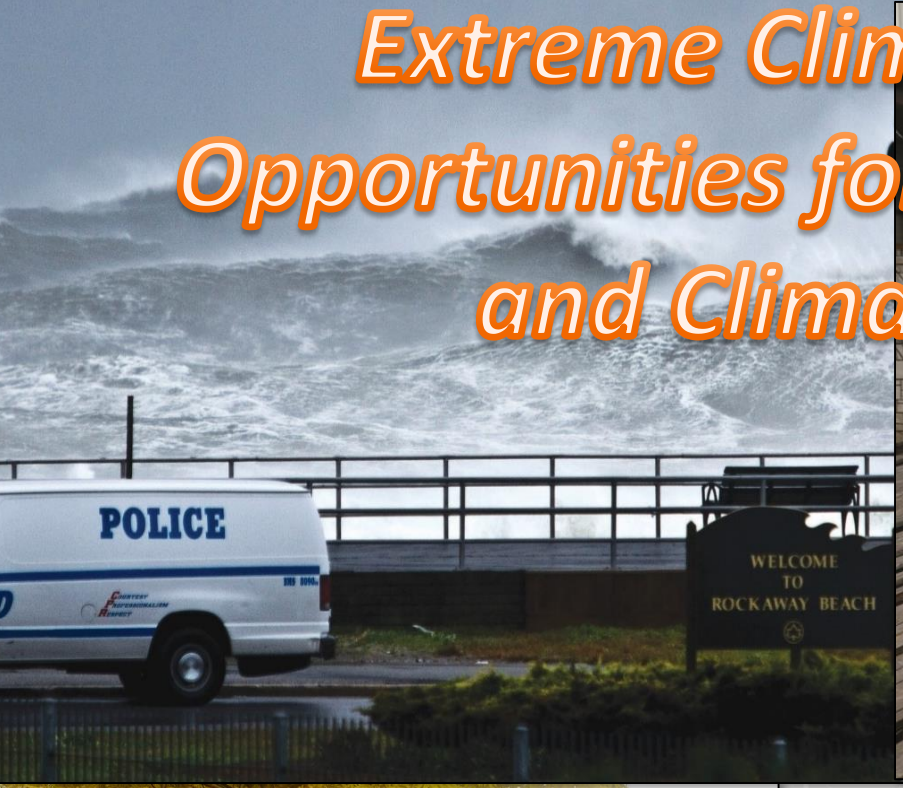
Extreme Climate Events and Opportunities for Risk Management and Climate Resiliency



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EXTREME CLIMATE EVENTS AND URBAN SYSTEMS

Extreme Events and Urban Systems and Residents

Climate Risk and Hazard	Potential Impacts
1. Increased frequency of extreme precipitation events	Threat to human health and welfare
	Inland and street level flooding
	Landslides
	Heavy snowfall
2. Increased frequency of extreme heat days and heat waves	Threat to human health and welfare
	Excessive heating of equipment and infrastructure; increased fatigue of materials
	Failed air conditioning systems
	Wildfires
	Droughts and water shortages
	Blackouts – e.g. from power failures during peak load demand
3. Sea level rise / coastal storm surge	Inundation and wide spread property damage and threats to human health and welfare
	Wave action and scour
	Salt water corrosion
	Salt water intrusion in aquifers
4. Increased frequency of extreme wind events	Threat to human health and welfare
	Obstructions and loss of equipment – e.g. localized loss of power and overhead wiring
	Blackout and large scale power loss

Main Message - U.S. urban residents and critical infrastructure systems are already experiencing climate change – and the impacts will accelerate in the coming decades

New York City Hazards 1960-2015

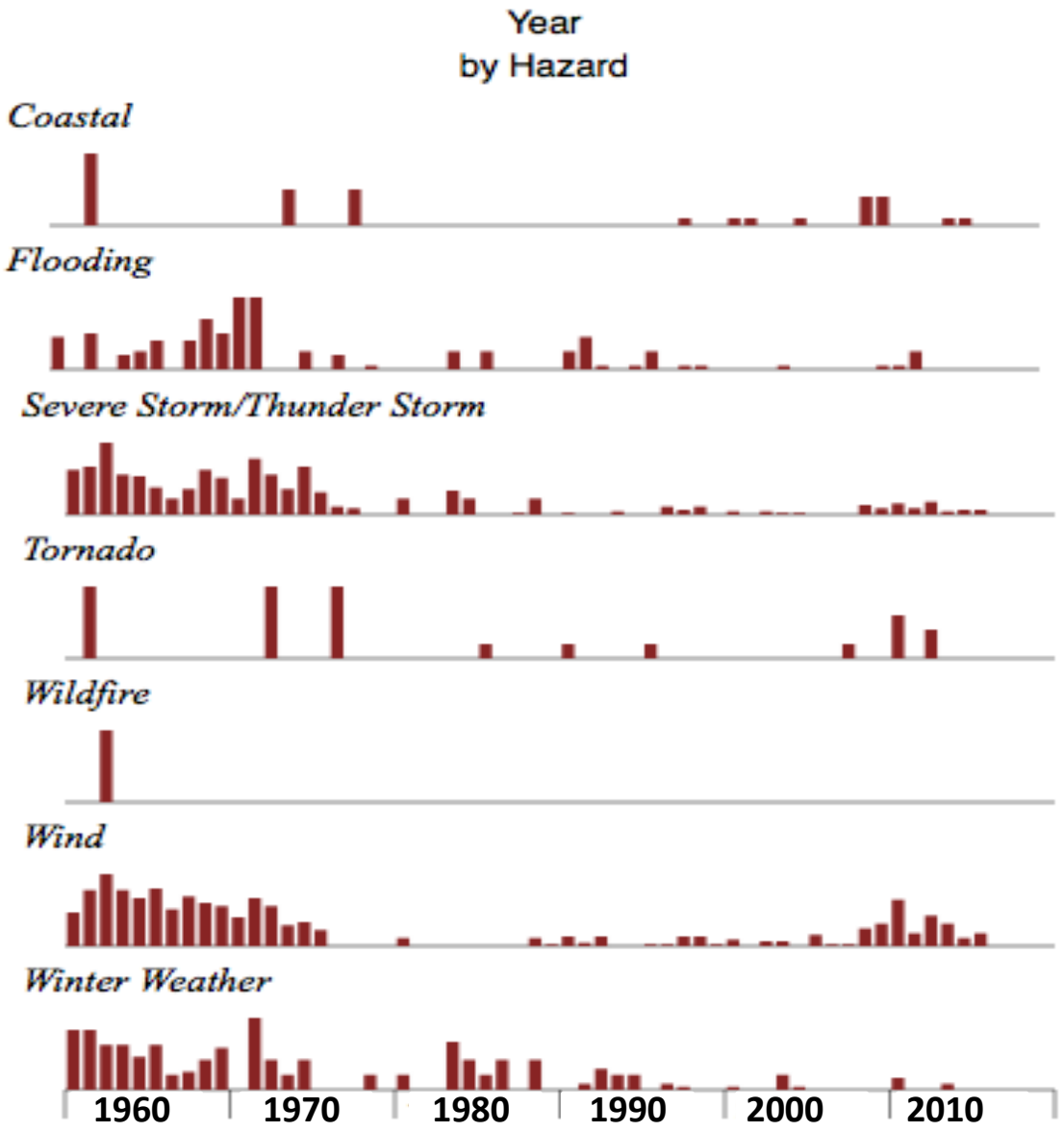
Event context for shift: weather event(s) such as flooding.

Policy responses can also happen after being impact directly and/or indirectly multiple instances over time

1960: Hurricane Donna

2011: Hurricane Irene

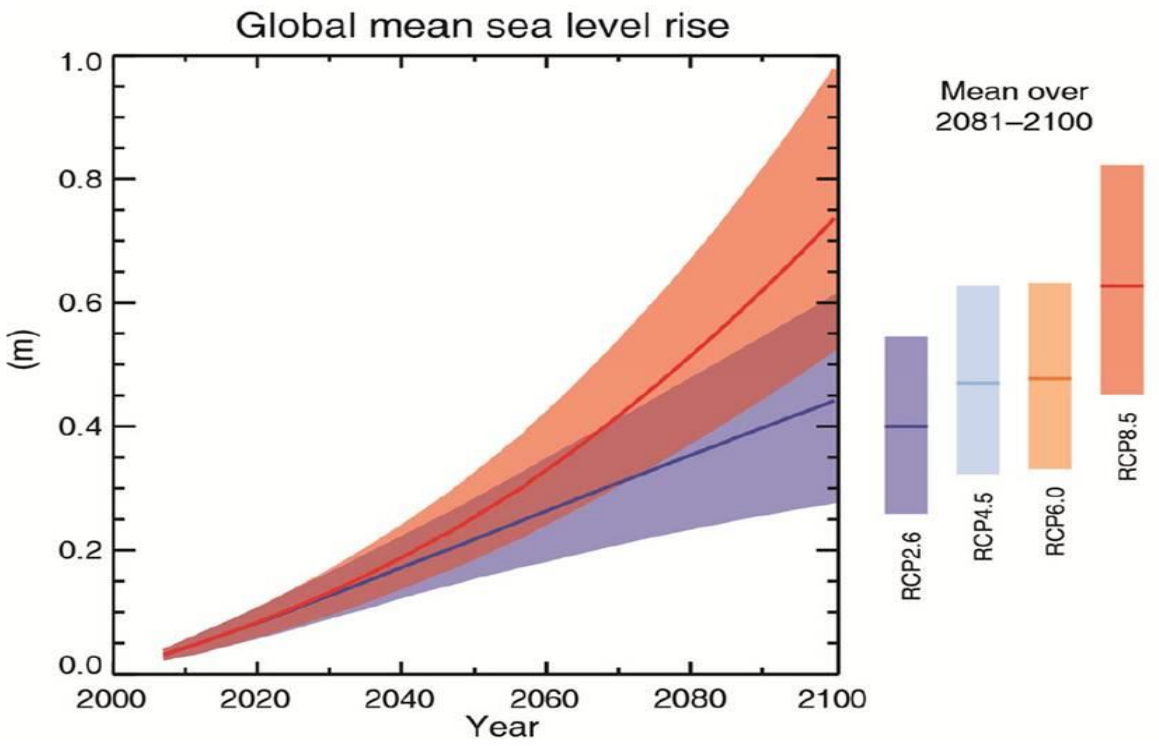
2012: Hurricane Sandy

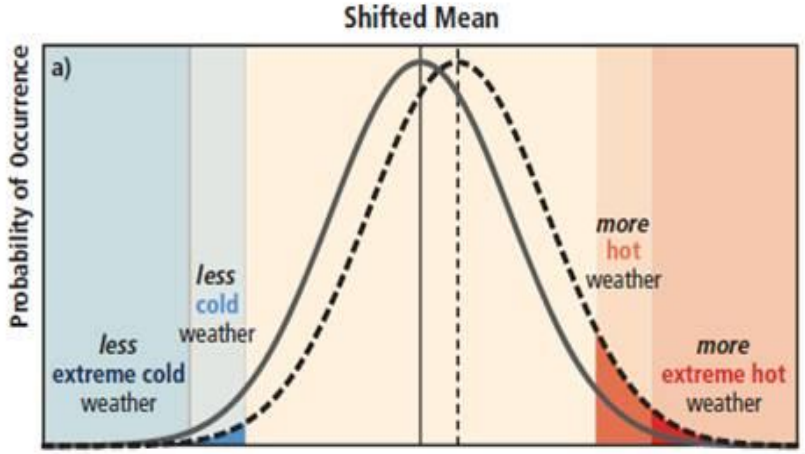


Extreme Events and Climate Change

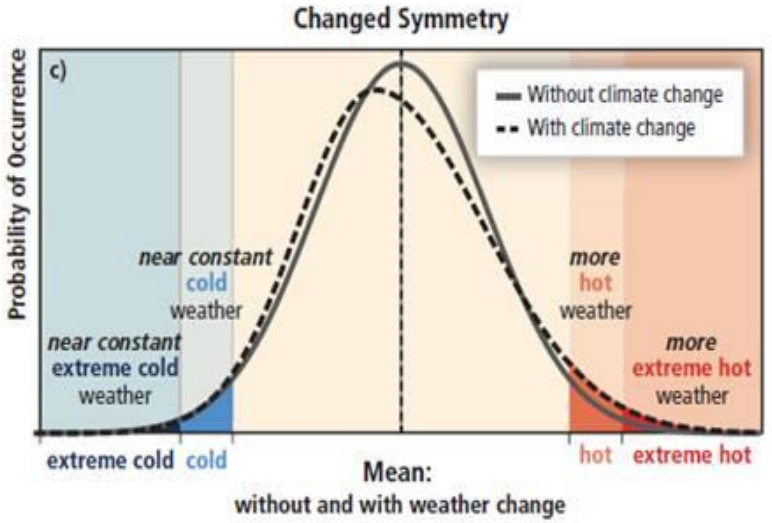
Observation and Projections

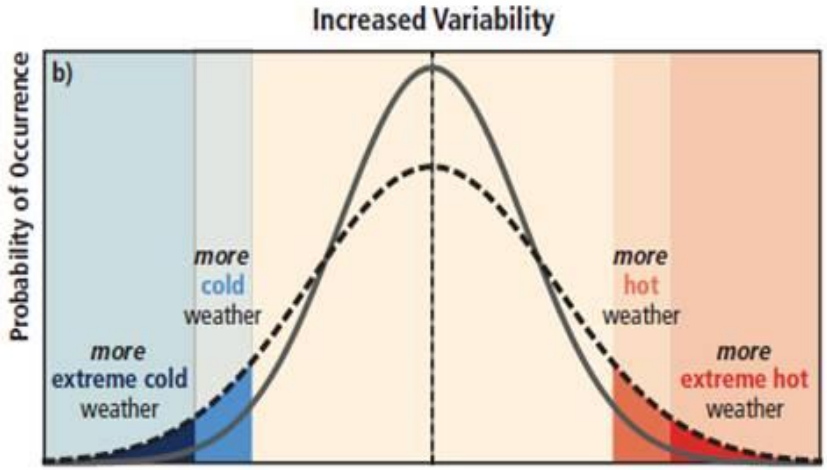
- Temperature and Precipitation Trend
- Sea Level Rise
- Other measures – snow cover, heat waves
- Extreme events



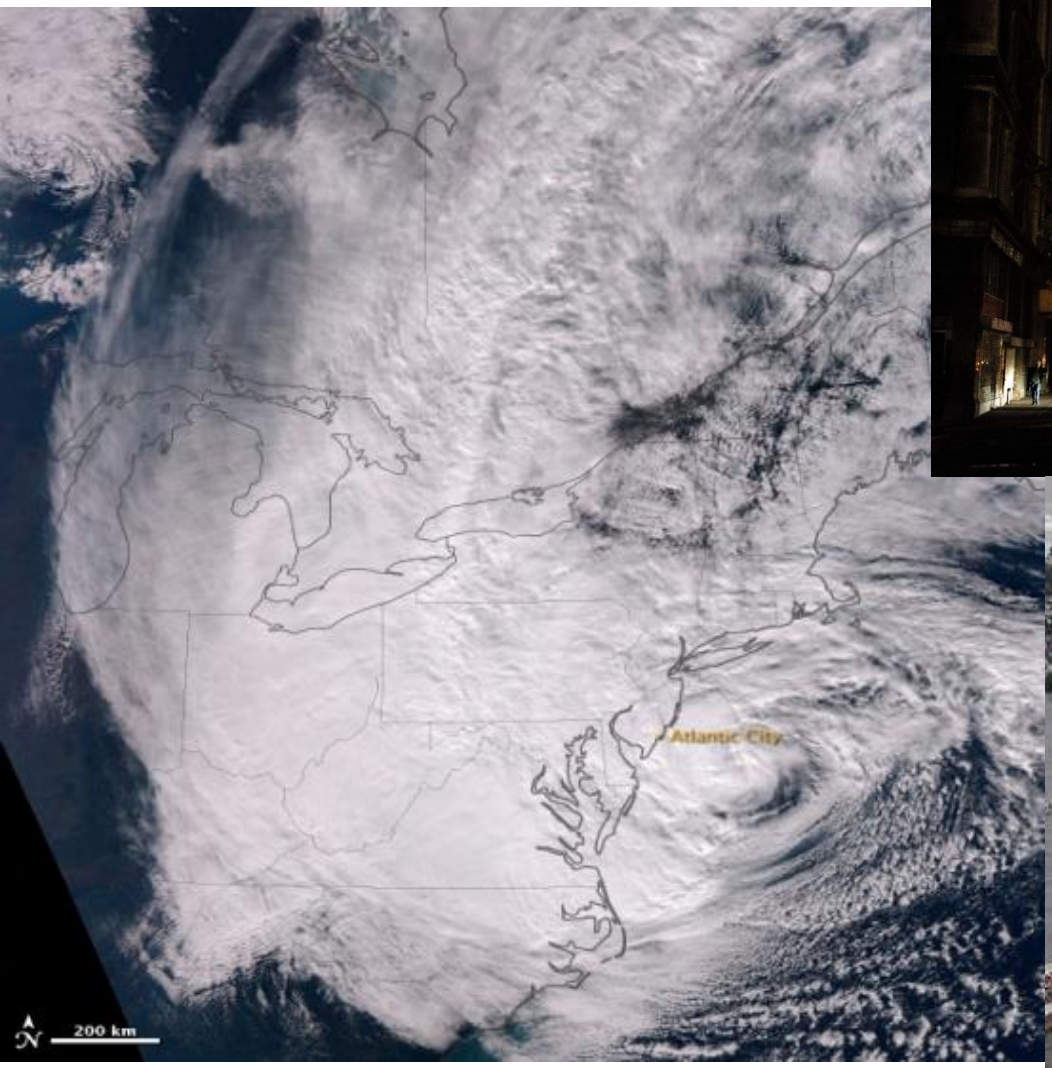


Source: SREX IPCC 2012





Hurricane Sandy, 28 October 2012

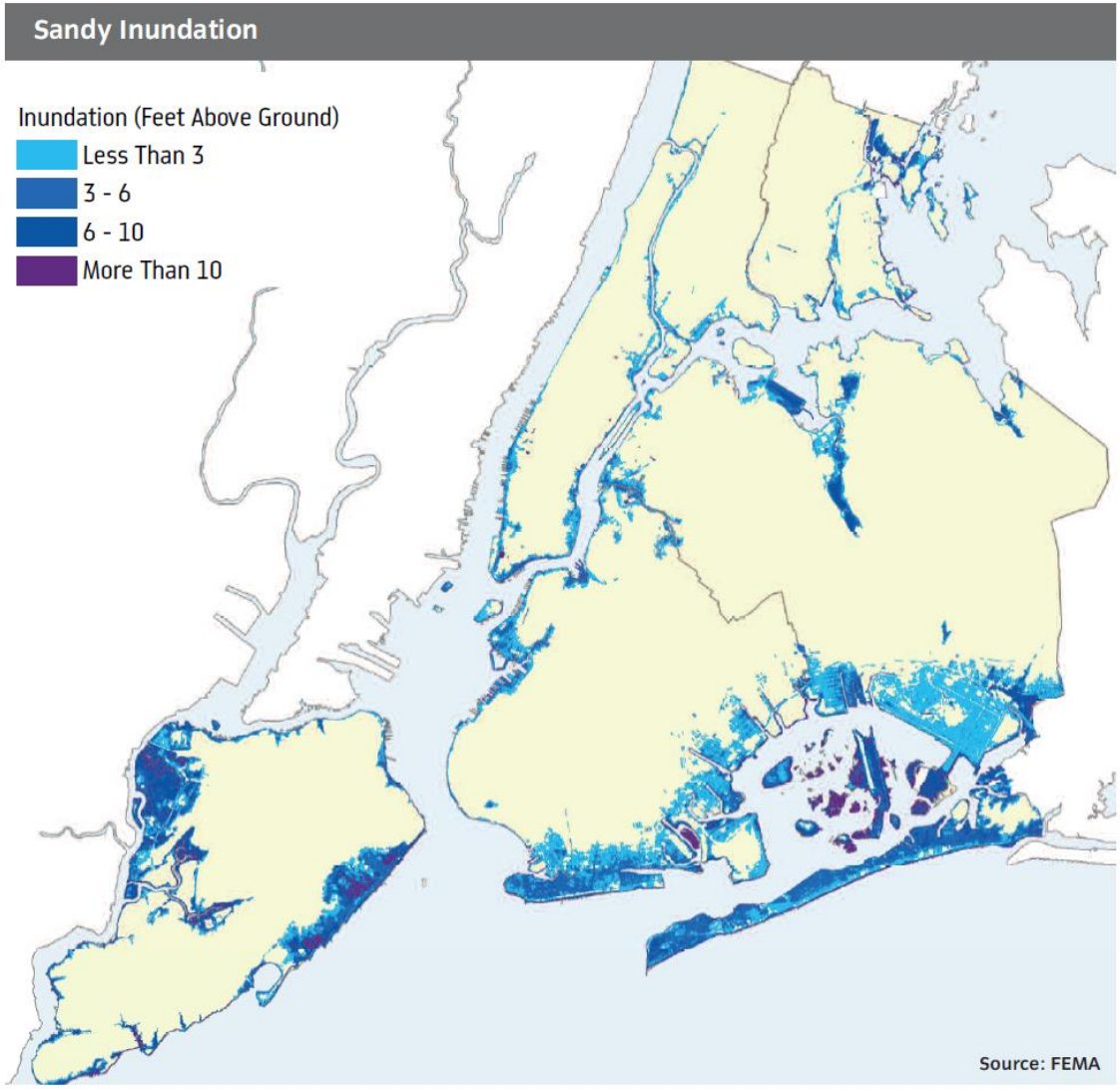


Movement from disaster recovery to disaster rebuilding and resilience

Change in conceptualization of extreme events

From discrete acute events to events as part of a chronic process. Looking into future dynamics as much as the present and past

Urban Lifelines and Infrastructure System Failures



Water Supply

Electricity

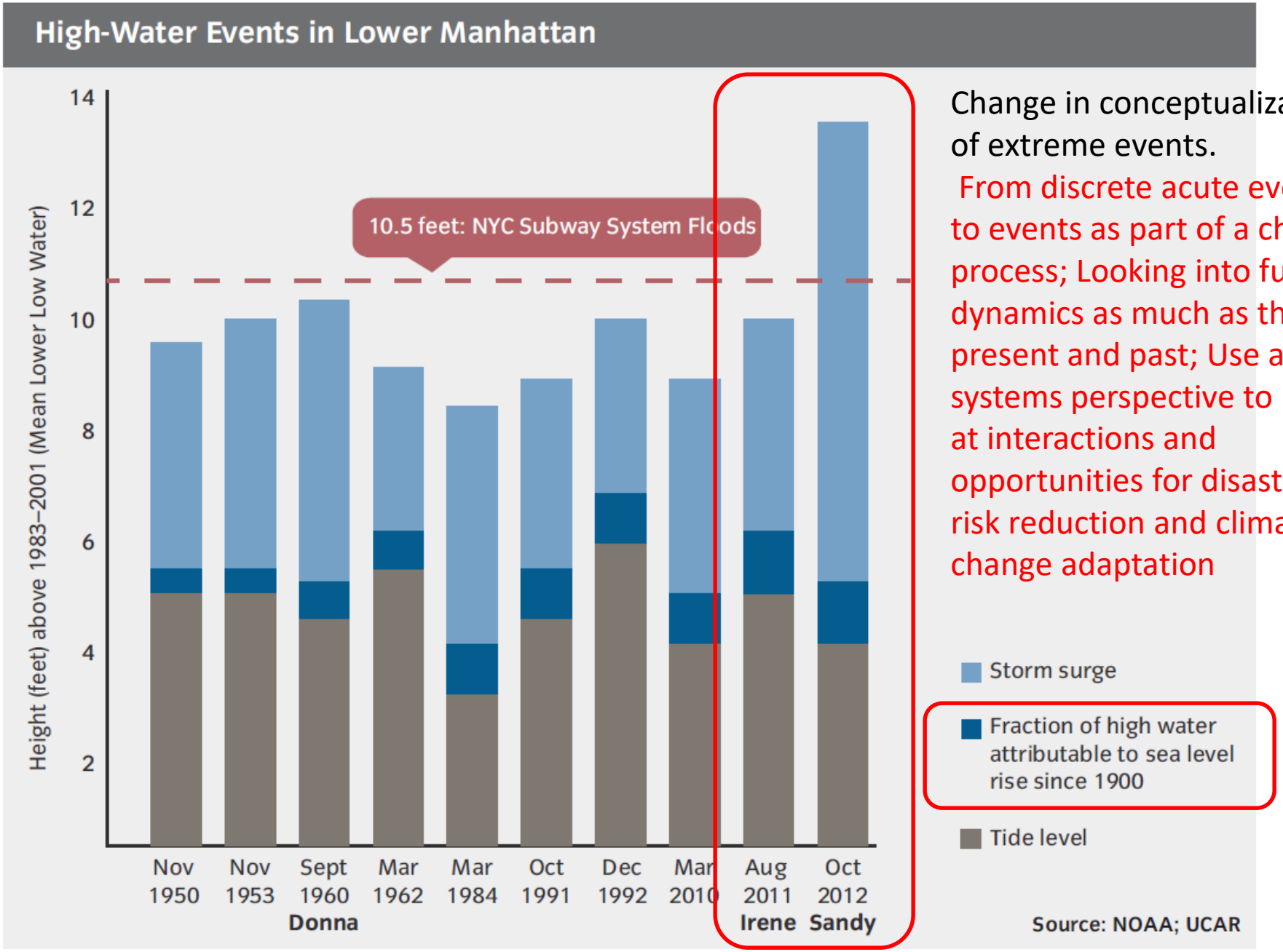
Transportation

Gasoline Supply

Pharmacy – Drug Supply

General Observations

- Cascading system impacts
- Uneven geography – not all on the coast, but most impactful on coast
- Highly complex systems require significant redundancy and context specific vulnerabilities – e.g. health care system
- Role of ecosystem protection opportunities – lost and found – e.g. wetlands
- Data rich assessment – smart city context yielding critical data – challenge is how to use it
- A lot more impact and vulnerability work to be done



Change in conceptualization of extreme events.

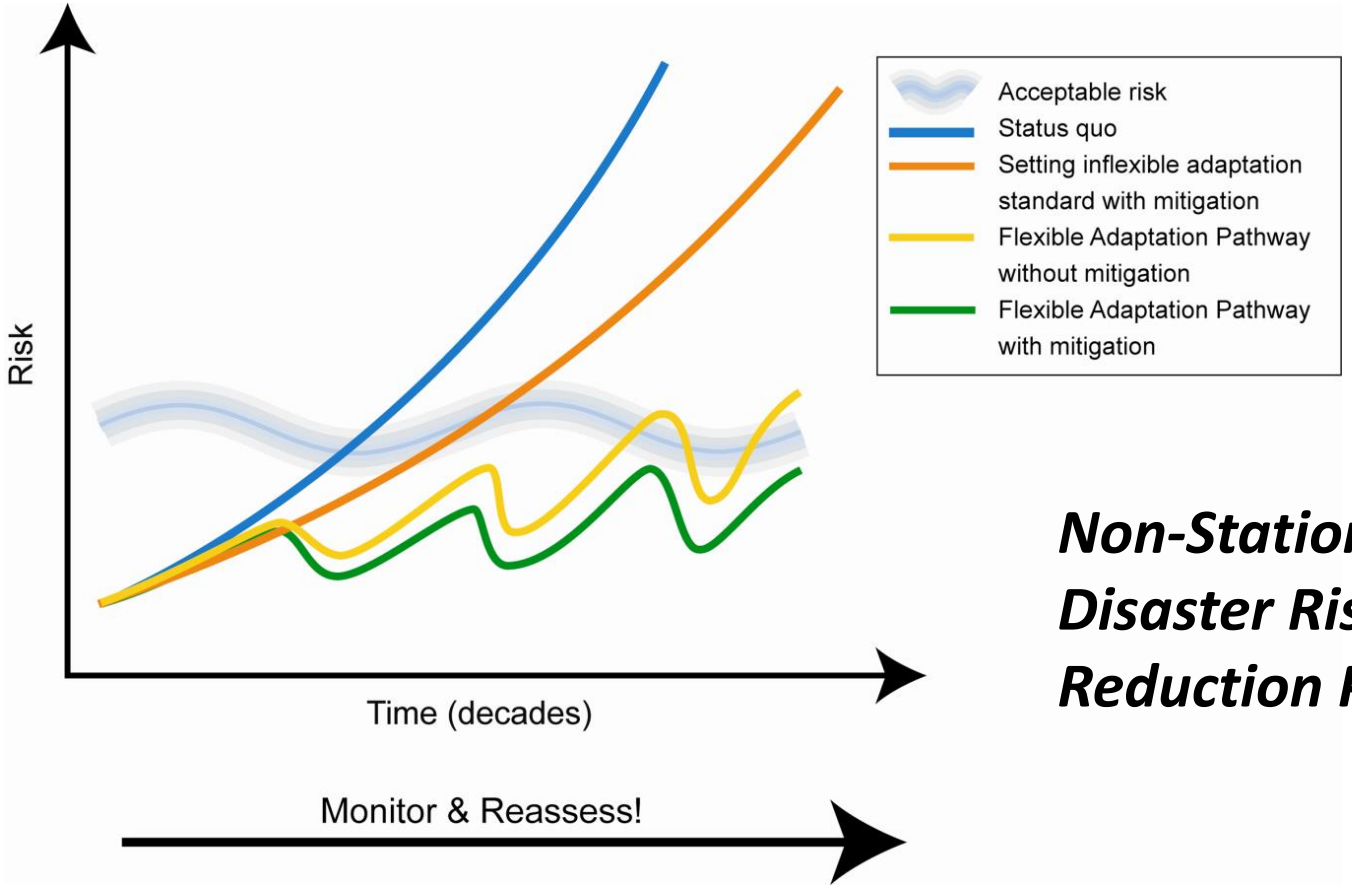
From discrete acute events to events as part of a chronic process; Looking into future dynamics as much as the present and past; Use a systems perspective to look at interactions and opportunities for disaster risk reduction and climate change adaptation

EXTREME EVENTS AS DRIVERS OF RISK MANAGEMENT CHANGE

Flexible Adaptation Pathways

Climate change adaptation as a risk management issue

Flexible Adaptation Pathways as the response



Non-Stationarity Disaster Risk Reduction Policy

Source: NPCC, 2010

Flexible Adaptation Pathways

Climate change adaptation as a risk management issue

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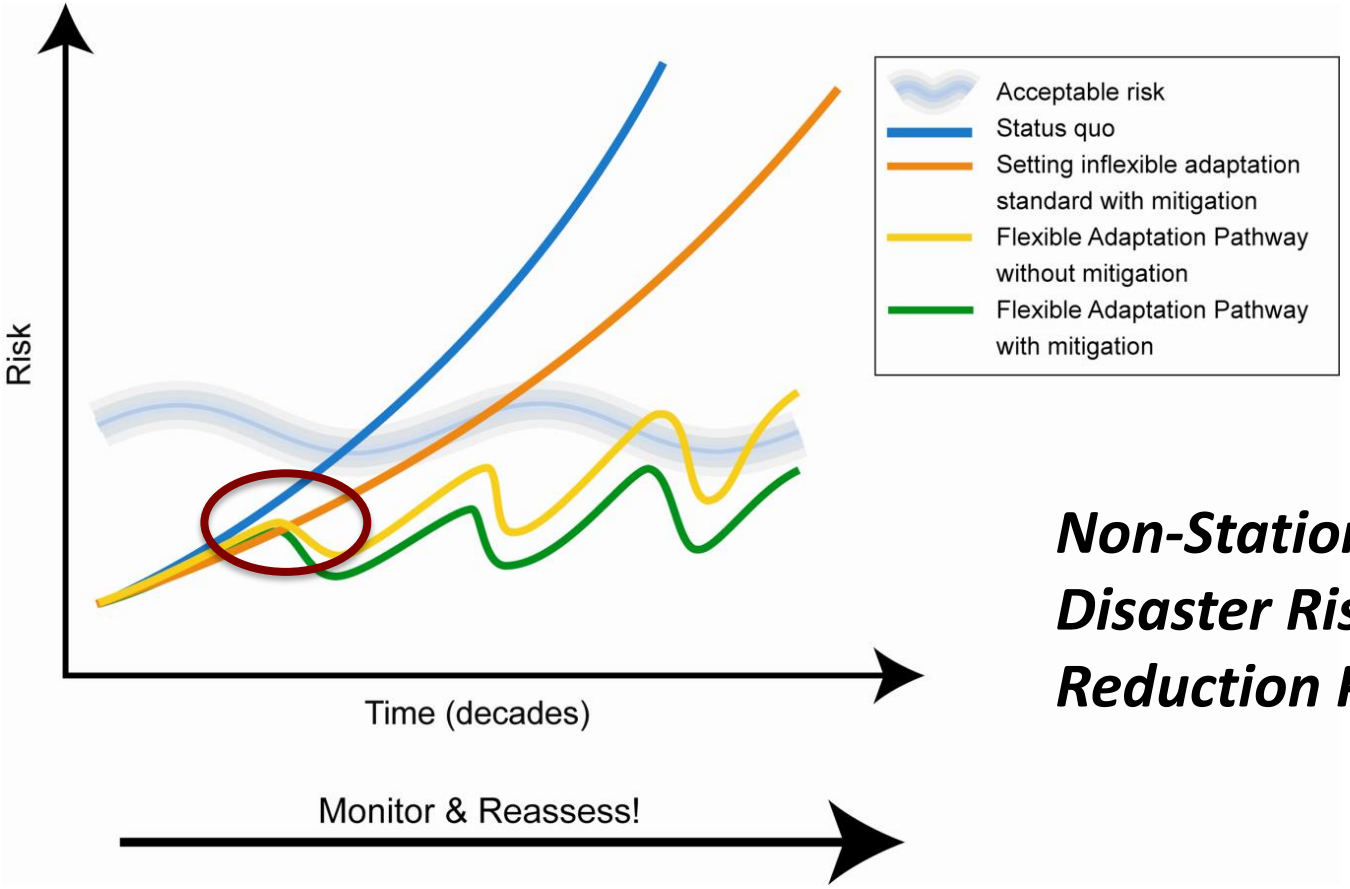


Non-Stationarity Disaster Risk Reduction Policy

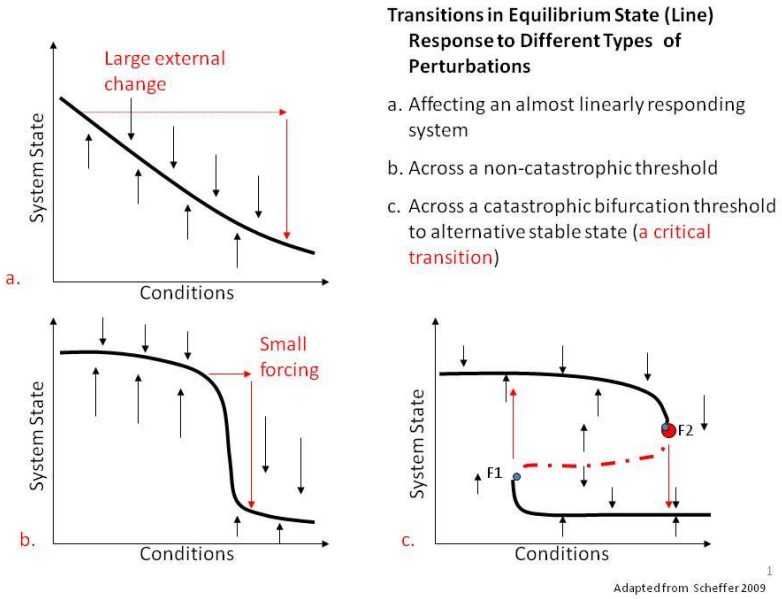
Source: NPCC, 2010

Key Concepts and Definitions – Drawn from resilience theory, and hazards literature

- **Resilience:** Capacity to withstand or absorb a shock or stress; recovery
- **Transformation**: A restructuring of a system and development of a new system with fundamentally different composition and structure.
- **Transition:** Change of a system from one state to another – early warning signals, tipping point and regime shift to a different state.

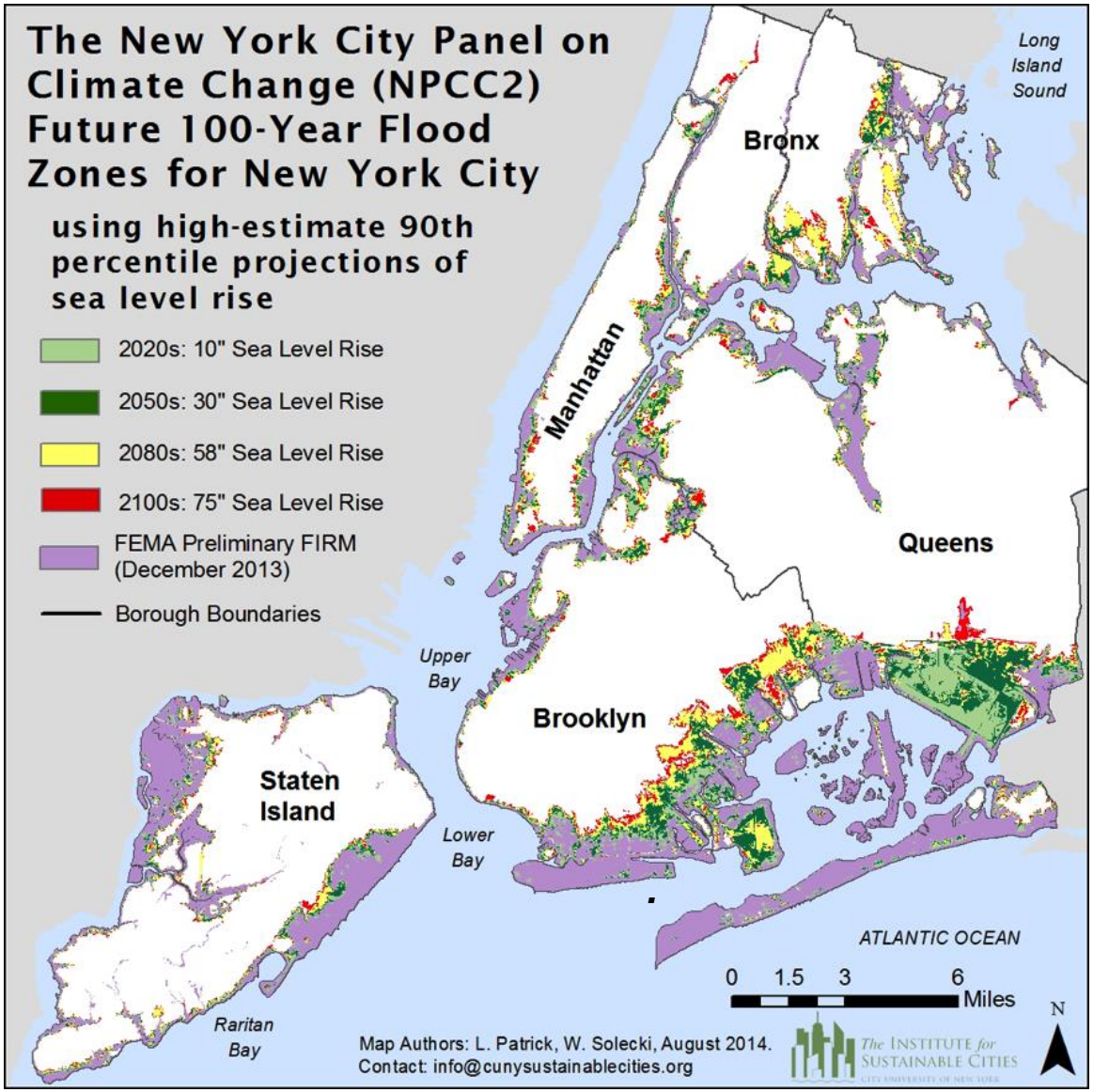
Extreme events such as Hurricane Sandy provide a significant shock to a system which could result in a transition of a system and a potential transformation

Complex Systems Theory and Extreme Events



Coastal Flooding

- NYC Stakeholder Comment:
- "I think the fundamental issue is a lack of acknowledgement of what we are heading towards. Beautiful maps show sea level rise and describe impacts, but at our core we can't acknowledge that we have to fundamentally change how we live in NYC."



100-year flood map developed using the static approach

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Guiding Research Questions

1. What is the connection between stress and crisis and urban resilience*?*

What do extreme weather and climate events (hazards, disasters) reveal about resilience of urban social-ecological-technological systems?

1. How does change in resilience result in transitions of risk management policy and programming?

When and how do disaster risk reduction and climate change adaptation policies shifts occur?

3. What is the connection between risk management policy and programming change and transformative adaptation?

Under what conditions can transformative adaptation occur? What is the role of extreme events?

What is the Knowledge Base to Answer these Questions?

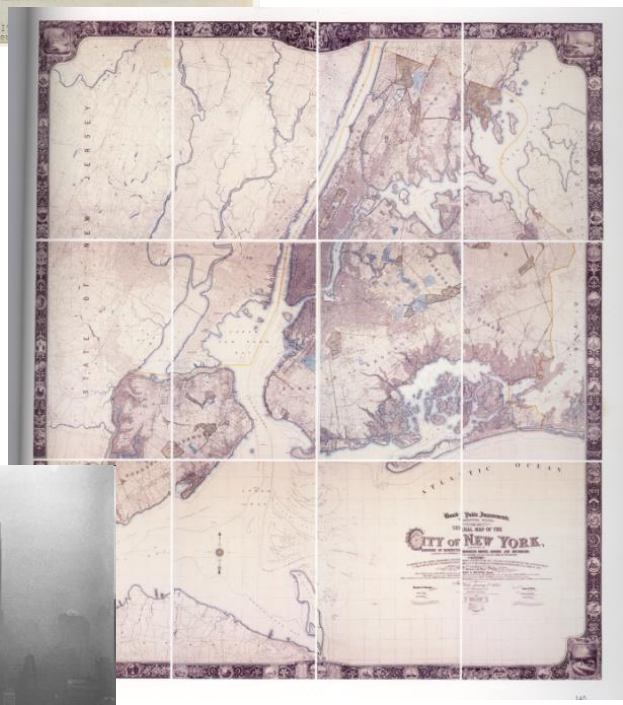
Drivers of Policy Change in the Post Extreme Event Settings

- Size and extent of disaster – loss and damage experienced
- Expectation of future risks and hazards
- Community of action – what are my neighbors, colleagues, cohorts doing
- Institutional and legal framework for adaptation – varied storylines
- Role of emerging science – e.g., New York City Panel on Climate Change
- Root (cultural, historical), contextual (sectoral, system), and proximate factors (conditions of the extreme events)

Environment Crises and Urban Transitions in New York City

- Water quality and supply - 1830s
- Open Space and Recreation -1850s
- Public Health and Sanitation – 1870s
- Mobility and Congestion – 1910s
- ‘Urban Renewal’/Loss of Community –1950s
- Air Pollution – 1960s
- Climate Change - 2010s?

Looking south over Central Park in 1861



New York City Environs - 1900

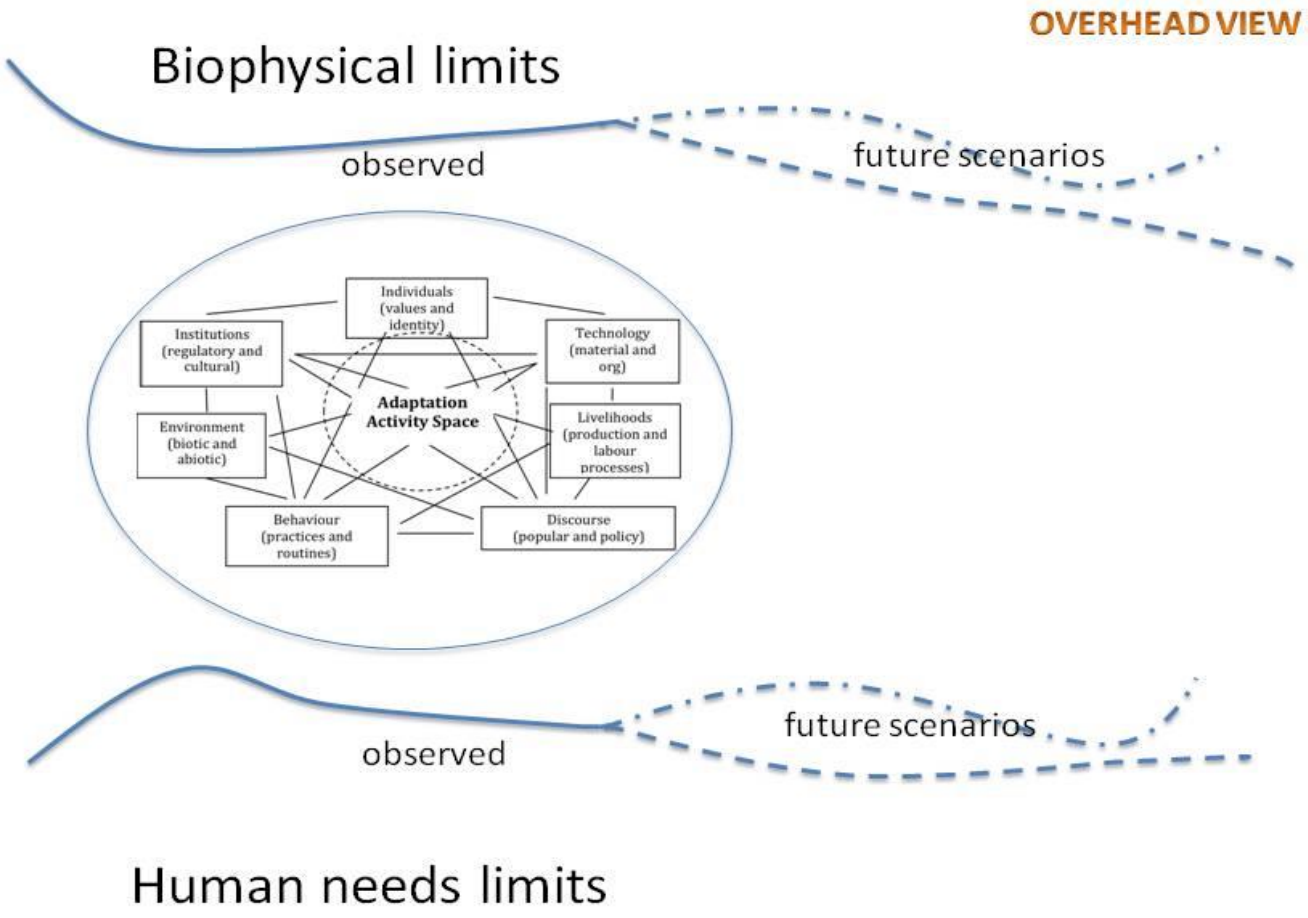
What evidence of a transition can be found and warning signals

Smog - November 1953

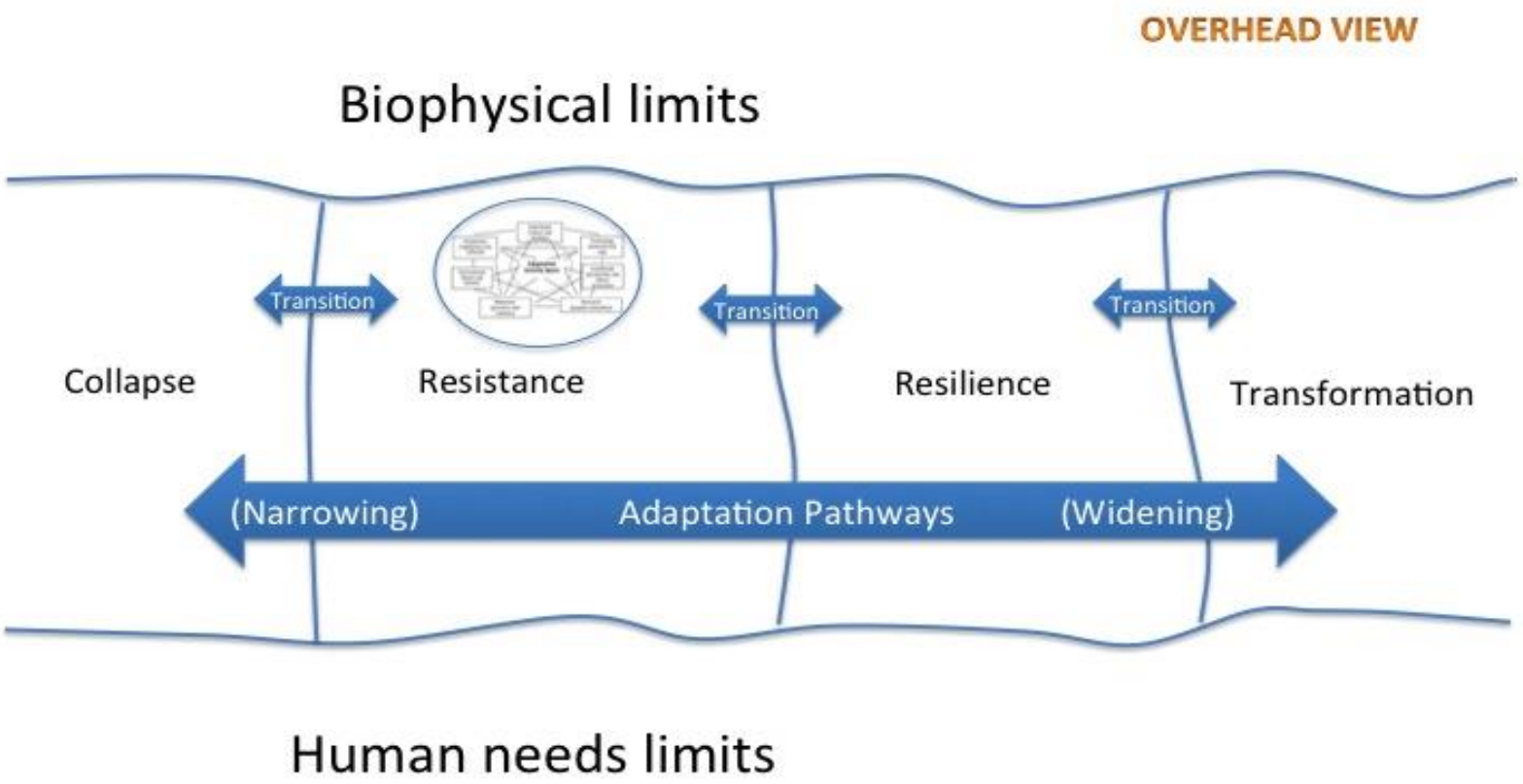
"Transitions between Risk Management Regimes in Cities" – W. Solecki, M. Pelling, and M. Garschagen. Ecology & Society. 2017

CONCEPTUAL FRAMEWORK OF ADAPTATION TRANSITION AND BUILDING A DECISION SUPPORT TOOL

Conceptual Framework: Adaptation Activity Sphere within Observed and Future Scenario Limits



Adaptation Activity Sphere, Transitions, and Adaptation Pathway(s)

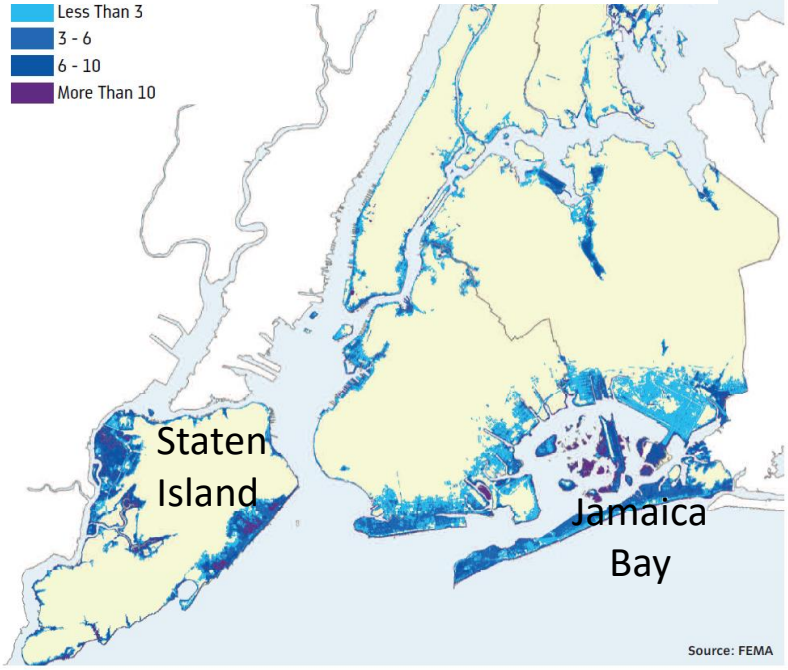


Note – Time in this diagram is not left to right. Adaptation pathways can move from a lower state to higher state (i.e. left to right) or from a higher state to lower state (i.e., right to left); Time is referenced from the current to moments or eras in a future time.

New York City Case Examples and Adaptation Pathways Observed and Potential* Analysis Space

*Observed empirical adaptation pathways can be derived from the case study data; understanding of potential adaptation pathways will be derived from the modeling, scenario work, and face-to-face discussions with local stakeholders

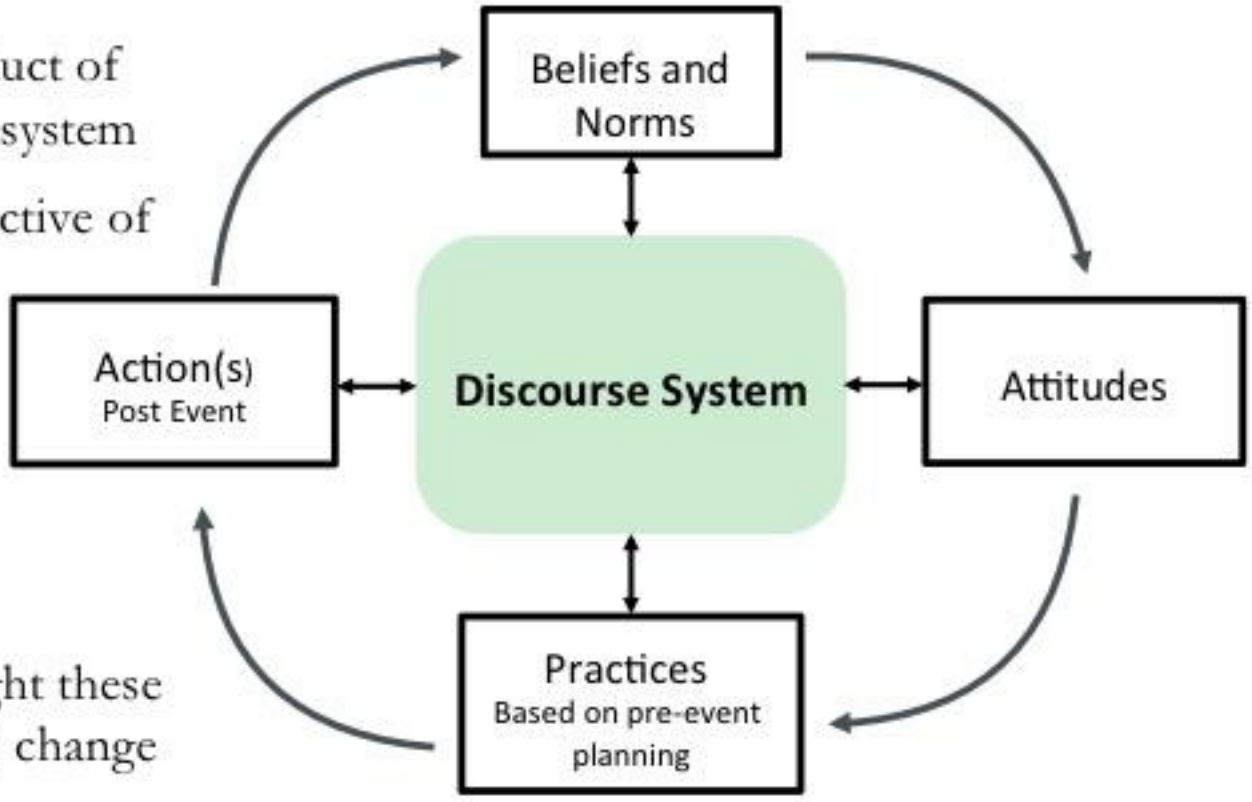
Detail Examples of Adaptation Pathways in the New York City



Discourse System: Understanding policy changes and context

Assuming:

- There is a new and revised discourse associated with each event
- Policy transitions are a product of interactions from discourse system
- "Size" of policy shift is reflective of change in discourse system



Observe and identify:

- Under what conditions might these discourse systems (policies) change
- Understand how policy shifts have occurred in the past
- Relative role of extreme weather events

Does it always have to be an extreme event and does it have to be local? Example of Nuisance Coastal Flooding

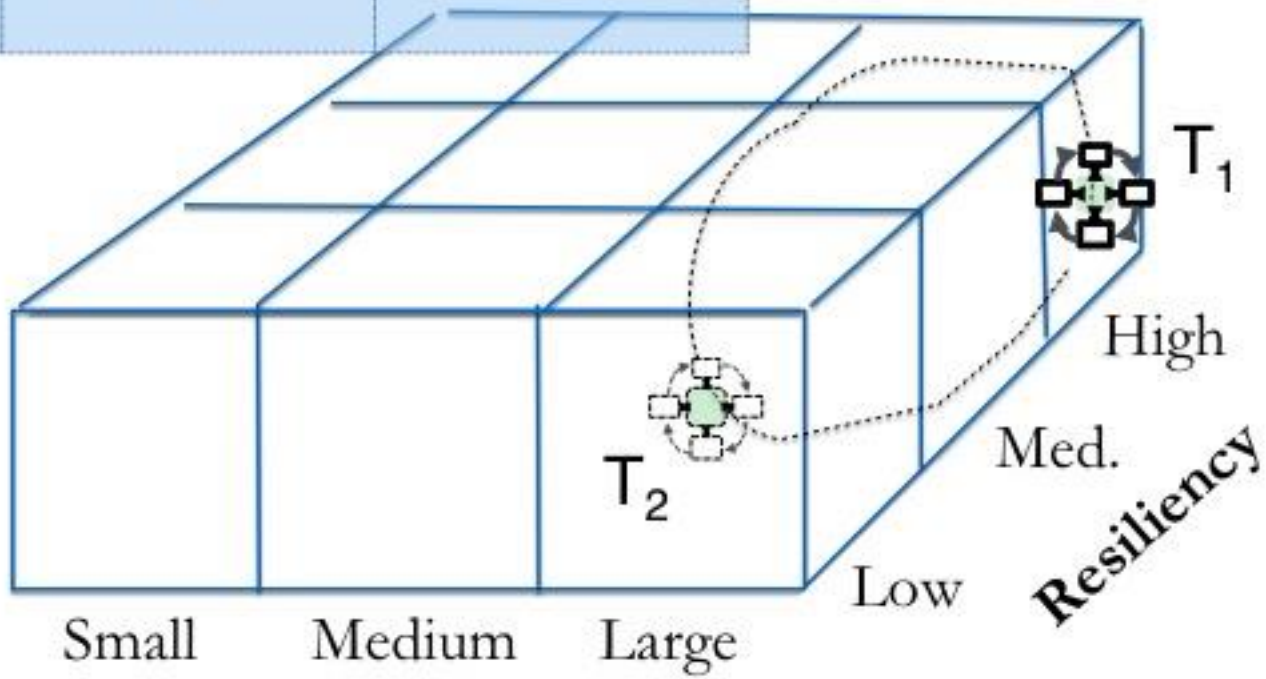
Broad Channel, Jamaica Bay, NY during a Super Moon high tide

Flooding in downtown historic Annapolis, Maryland

	Small	Medium	Large
High	○	○	○
Medium	○	○	⊗
Low	X	X	X

Size of the Extreme Event and Resilience of the Discourse System

Illustrating Shift in "Location" of Discourse System from T_1 to T_2



Building Decision Support Tools for Climate Change Action

- *PELT – Post Extreme Event Learning Tool*
- Post Extreme Event Policy Windows and how best to take advantage of them.
- How to go from post event disaster risk reduction to resiliency planning
- Beta test - ongoing

- *MART – Marco Adaptation Resiliency Tool*
- How to go from climate resiliency planning to larger-scale transformational planning
- From Micro-Adaptation to Macro-Adaptation

Summary of PELT

- PELT (post-event learning tool) allows users to take advantage of the limited policy "window" after extreme events to transform short term momentum into long term learning as well as potential new trajectories to address future extreme events and related policy issues
- Promotes three types of learning
- Consists of four sessions which can be done individually or in succession
- "Choose your own adventure" design and flexibility = applied in a wide variety of contexts, including in diverse stakeholder as well as intra-agency/ group settings
- Interactive, innovative, and even fun!

Three Types of Learning from PELT

- Individual ("Reflexive") learning allows for...
  - Self-inventory of what participants' "knowns" and "known unknown"
  - Self-assessment of what their goals are for participating
- Collaborative knowledge production allows for...
  - Identifying strengths and weaknesses from different knowledge sources
  - Filling in knowledge gaps associated with narrow perspectives
  - Finding commonality, intersection of ideas and priorities
- Collaborative *action* learning allows for…
  - Development of framework for addressing wide variety of perspectives, meeting common goals
  - Product development
  - Planning for sustained learning process

NOAA RISA CCRUN Project- Post Hurricane Sandy Online Survey

Focused assessing the longer term effects of Hurricane Sandy impacts across time, space, and sectorial response

- Survey Monkey link
- https://www.surveymonkey.com/r/75LTLCD
- You are welcome to take our survey

Thank you.

Contact: wsolecki@hunter.cuny.edu