

# Planning for Changing Climate in New York City

AMS Policy Forum

What About Water?

A Reality Check for the 21<sup>st</sup> Century

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# NYC Climate Change Timeline


- Metro East Coast report, 2001 (part of National Assessment of Climate Variability and Change)
- New York City Department of Environmental Protection Climate Change Task Force, 2003-2007
- MTA August 8 2007 Storm Report
- New York City Infrastructure Task Force (PlaNYC, in process)
- LI shoreline study (non-governmental)

# New York City's Water Supply System

## Catskill/Delaware Watersheds

## Croton Watershed





- Catskill / Delaware Watershed Area
- Croton Watershed Area
- Rivers and Reservoirs
- Catskill Aqueduct and Tunnels
- Croton Aqueduct
- Delaware Aqueduct and Tunnels
- County Borders
- State Borders

[www.nyc.gov/dep](http://www.nyc.gov/dep)

# New York City Department of Environmental Protection Climate Change Task Force

- A collaborative effort with: agency personnel from each Bureau; Columbia and Hunter scientists; consulting firm personnel
- Monthly technical and policy meetings
- Climate change workshops for all NYCDEP staff
- NYCDEP report forthcoming

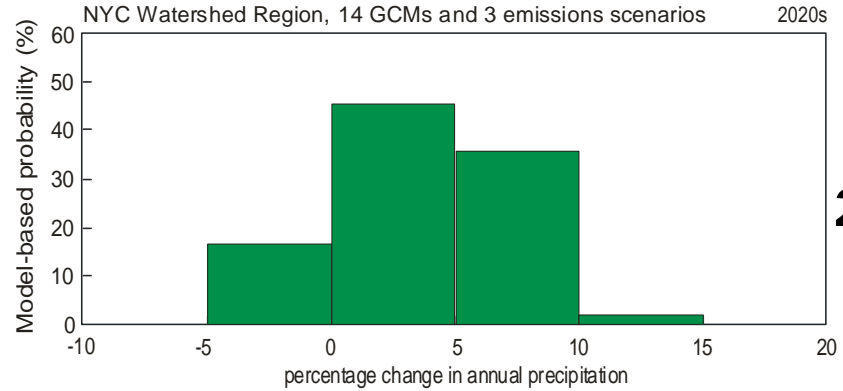
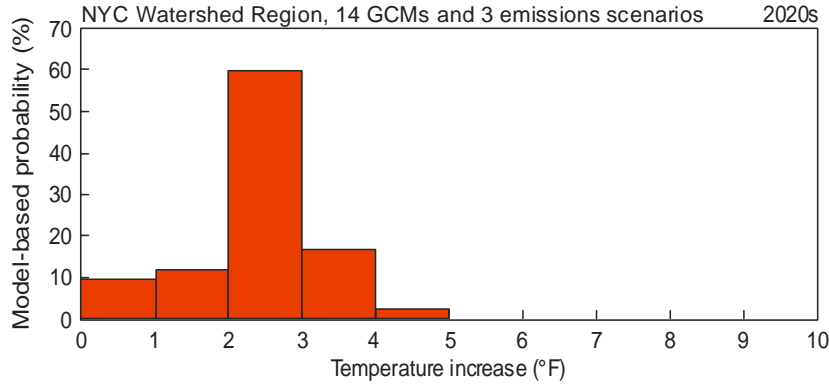
# IPCC Forecasts for 2090-2099

- Warming: 3.2 ° to 7 ° F (1.8 ° to 4.0 ° C)
- Sea Level Rise: 7- 23 inches (.18 to .59 meters)  
(excluding future rapid changes in ice flow)
- More droughts and intense precipitation events,  
more intense tropical storms

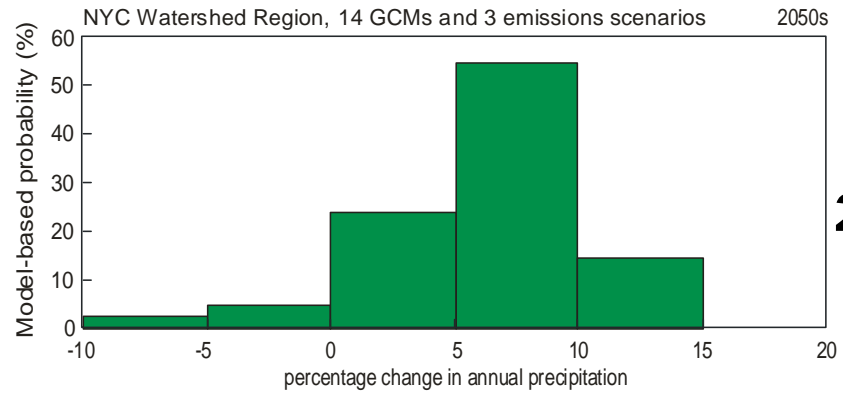
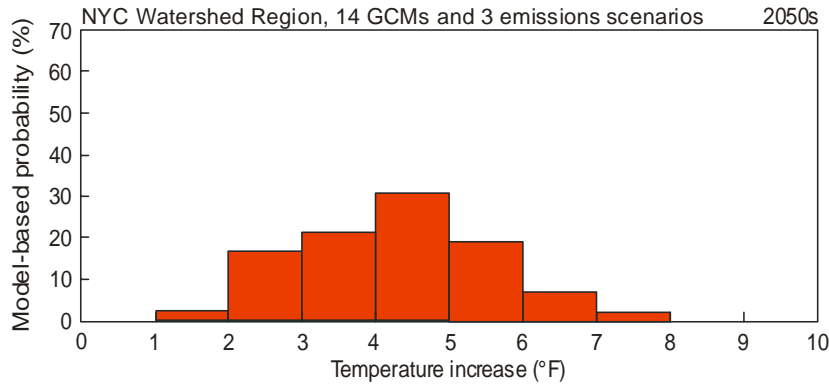
# Downscaling for NYC Scenarios

- GCM models: originally 5, now 14
- 3 emissions scenarios: low, medium, moderately high (B1, A1B, A2)
- Downscaled to NYC region from appropriate model grid boxes, weighting nearest boxes more heavily
- Validation: hindcasting

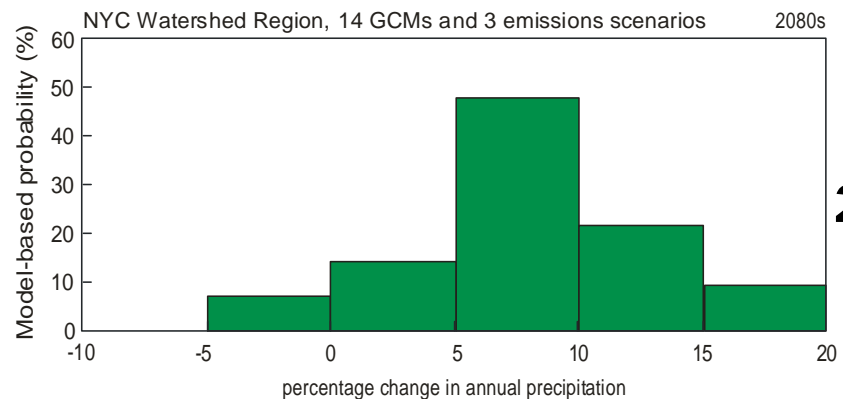
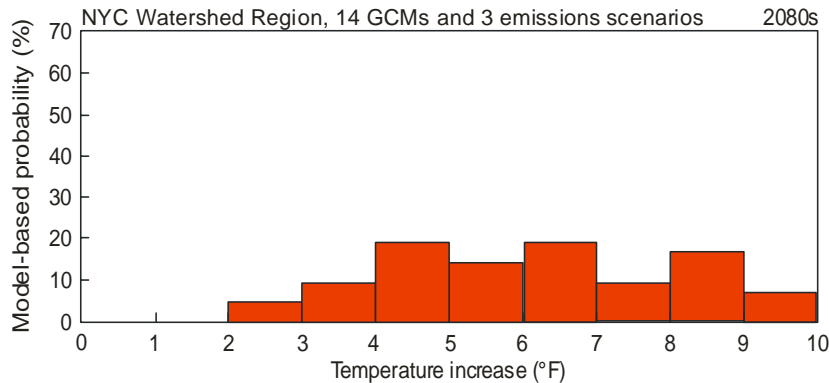
# Model-Based Climate Probabilities



2020s



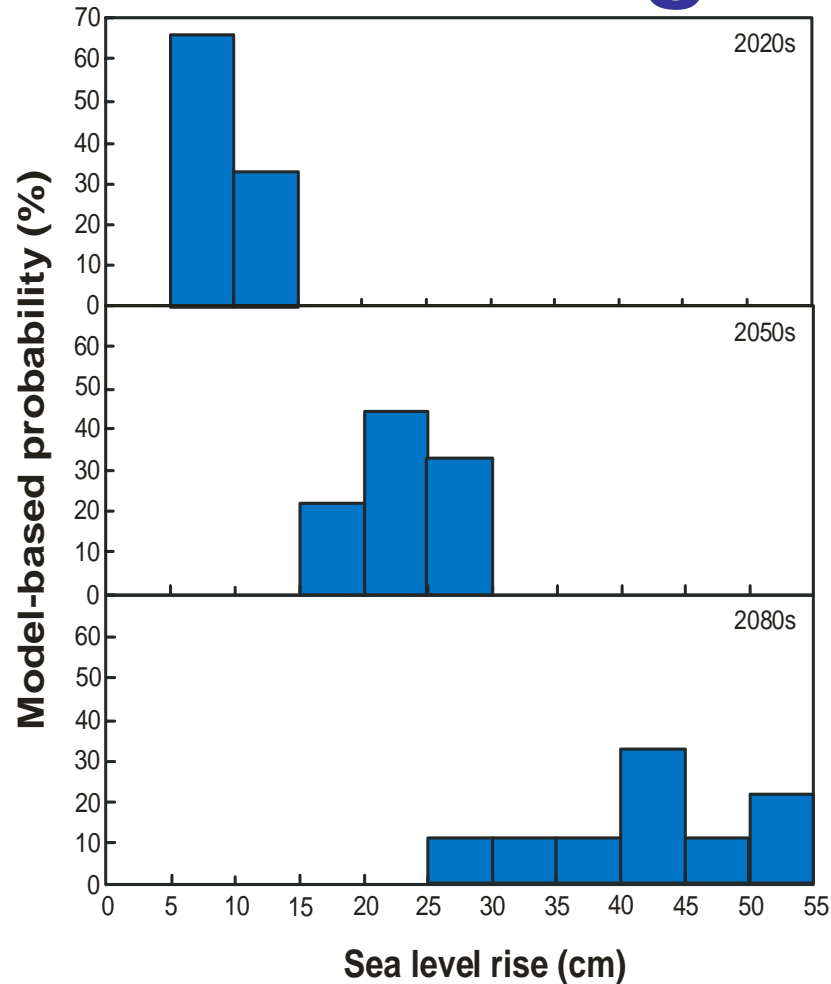
2050s



2080s

**Frequency distribution of temperature (°F), and precipitation (%) changes, relative to 1970-1999, 14 GCMs/3 GHG scenarios (B1, A1B, A2)**

# Future Sea Level Scenarios in NY Metro Region



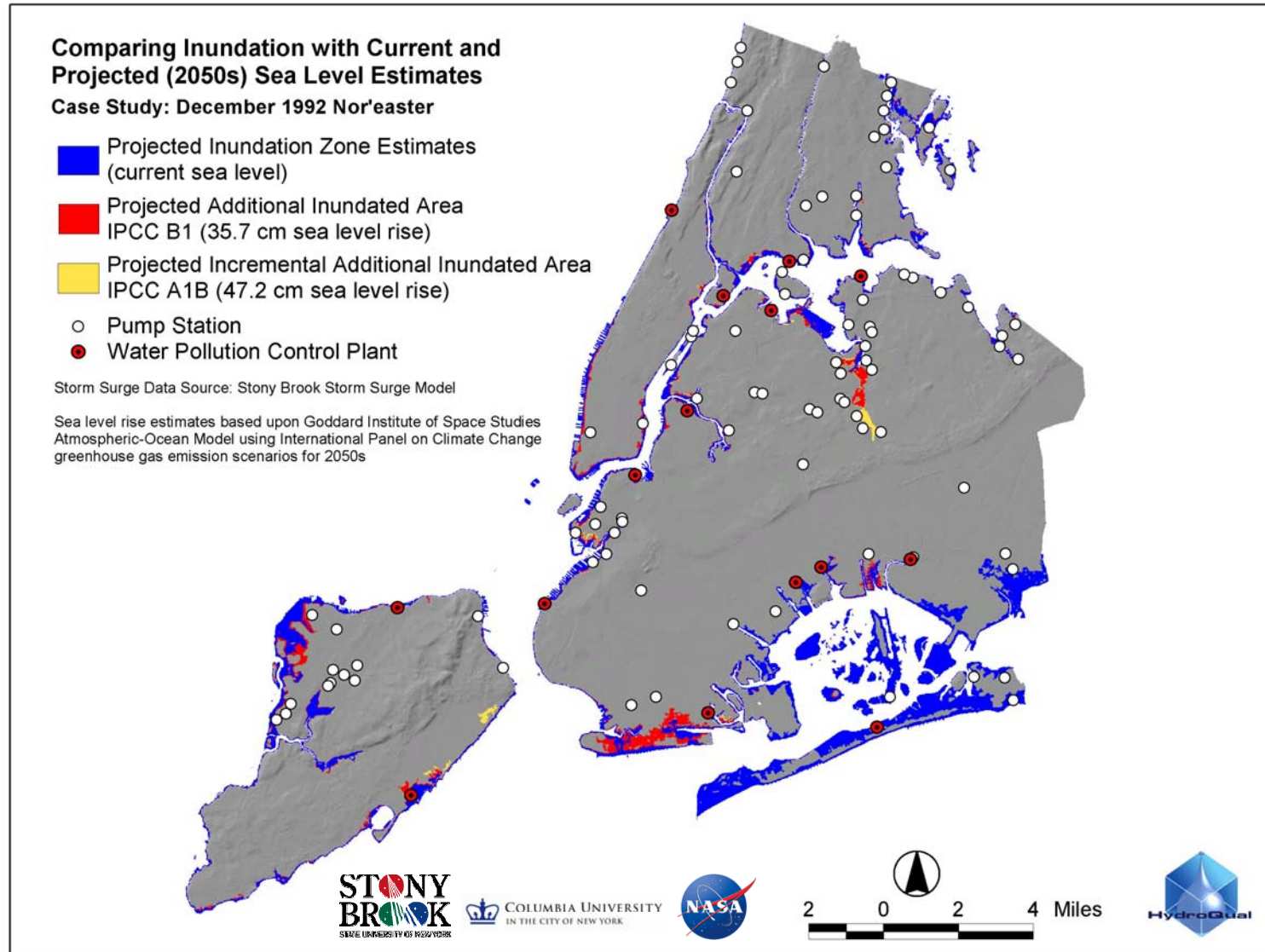
**Forecast changes in Battery Park Sea Level (cm), relative to 2000-2009 (3 models and 3 emissions scenarios, incorporating local effects)**

# Additional Scenario Elements

- Inland and coastal flooding
- Droughts
- Low-probability, high-impact events
- Regional climate model runs (in process)

# Collaborative Project: Comparing Inundation with Current and Projected (2050s) Sea Level Estimates

## Case Study: December 1992 Nor'easter



# Extreme Events

## Estimated future recurrence intervals for coastal flood events with sea level rise

### Battery Park, NYC

<i>Sea Level Rise</i>	<b>Low (B1)</b>	<b>Medium (A1B)</b>	<b>High (A2)</b>
Recurrence Interval 1 in 5 years			
2020s	2x / 3 years	1x / 3 years	2x / 3 years
<b>2050s</b>	<b>1x / year</b>	<b>1x / year</b>	<b>1.5x / year</b>
2080s	~1x / 3 months	>1x / 3 months	1x / month
Recurrence Interval 1 in 10 years			
2020s	1x / 3 years	1x / 3 years	1x / 3 years
<b>2050s</b>	<b>2x / 3 years</b>	<b>2x / 3 years</b>	<b>2x / 3 years</b>
2080s	1x / year	1x / 6 months	~1x / 3 months

***Sea level rise values are averages of the GISS E, Hadley, and MPI GCM-based projections (after Rosenzweig et al., 2007). Current recurrence intervals are based on daily tide data from 1960 to 2006 (<http://tidesandcurrents.noaa.gov>). This 46-year period may not fully represent the flood risk. Draft: not for citation.***

# Guidelines for Incorporating Climate Change in Infrastructure Design

- Conduct audit of existing infrastructure, lifetimes, rehabilitation cycles
- Compare with climate change forecasts for the region/locality
- Design for thresholds and ranges of forecast temperature, sea level, hydrology
- Evaluate potential adaptations (cost/benefit, environmental impacts)
- Schedule (over decades)
- Review climate parameters (every 3-5 years)

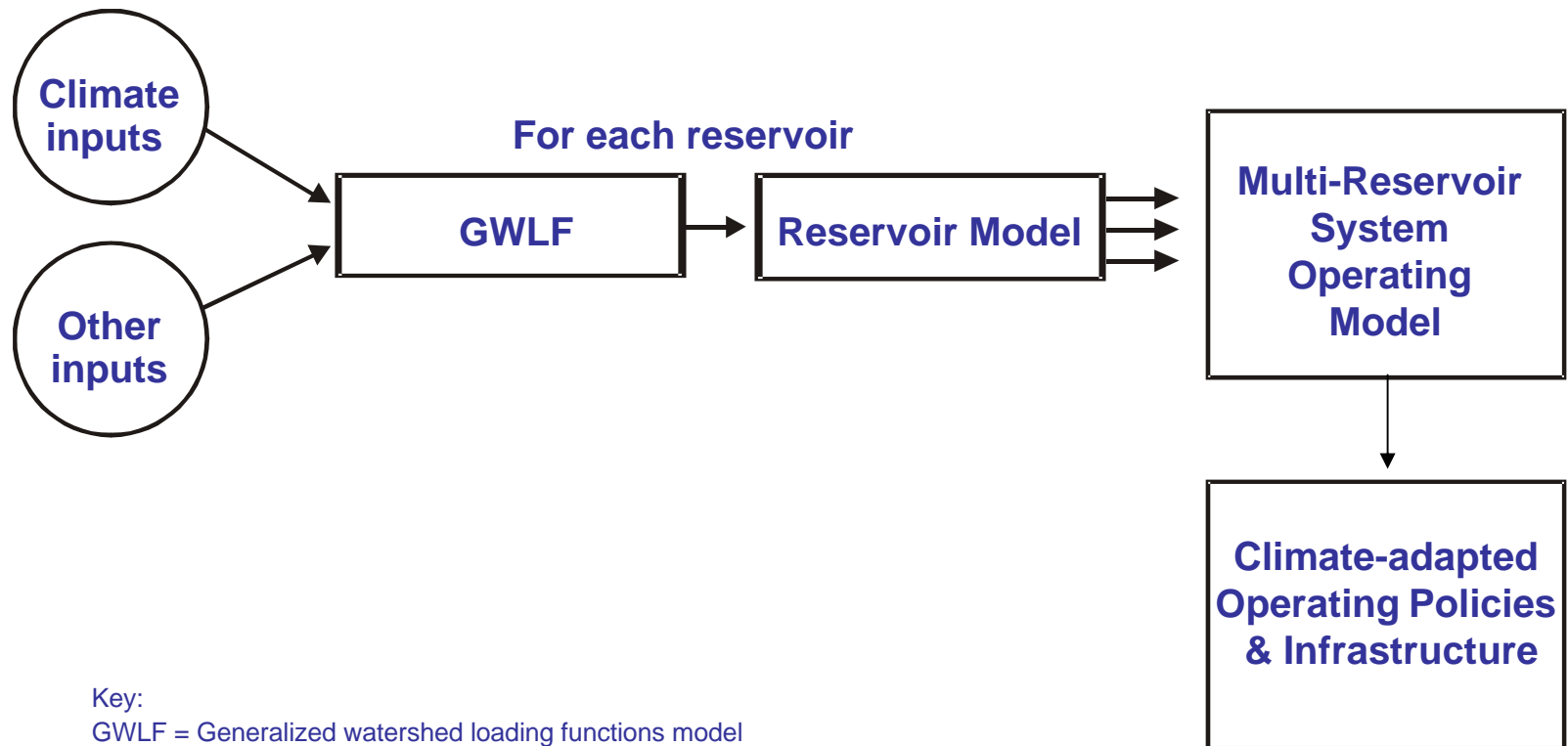
# Infrastructure Adaptation: Flood Walls

As part of its Climate Change Program, the New York City Department of Environmental Protection is preparing an RFP to study the impacts of rising sea level on WPCPs, tide gates, and other structures, and to develop and evaluate adaptations.



Treatment tanks overflowed at the Hunts Point (Bronx) WPCP during a March 2001 storm; unusually high tide elevations prevented discharge of treated sewage into the East River and caused back-up

# Infrastructure Adaptation: System Operation Studies



# Observations on NYC Climate Adaptation Studies

- Excellent local leadership
- Collaboration between NYC agencies and university centers and Federal agencies with strength in climate change
- Peer-reviewed science

# Current challenge: engineering design

- Choose climate protection levels (non-stationary processes)
- Incorporate normal implementation delays in design
- Consider the adaptation requirements for whatever may replace a newly-implemented structure

# Thanks!

Reference (NYCDEP work through 2007):

Cynthia Rosenzweig, David C. Major, Kate Demong, Christina Stanton, Radley Horton and Melissa Stults, “Managing climate change risks in New York City’s water system: assessment and adaptation planning,” *Mitigation and Adaptation*, 2007, DOI 10.1007/s11027-006-9070-5

### Annual Temperature (°C), NYC Watershed Region

1970-1999

