Urban Adaptation to Climate Change: The Case of New York City

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CLIMATE SUMMIT FOR MAYORS COPENHAGEN 09

cities act

December 14th-17th

NASA

CENTER FOR CLIMATE SYSTEMS RESEARCH

THE EARTH INSTITUTE AT COLUMBIA UNIVERSITY

Copenhagen and Beyond

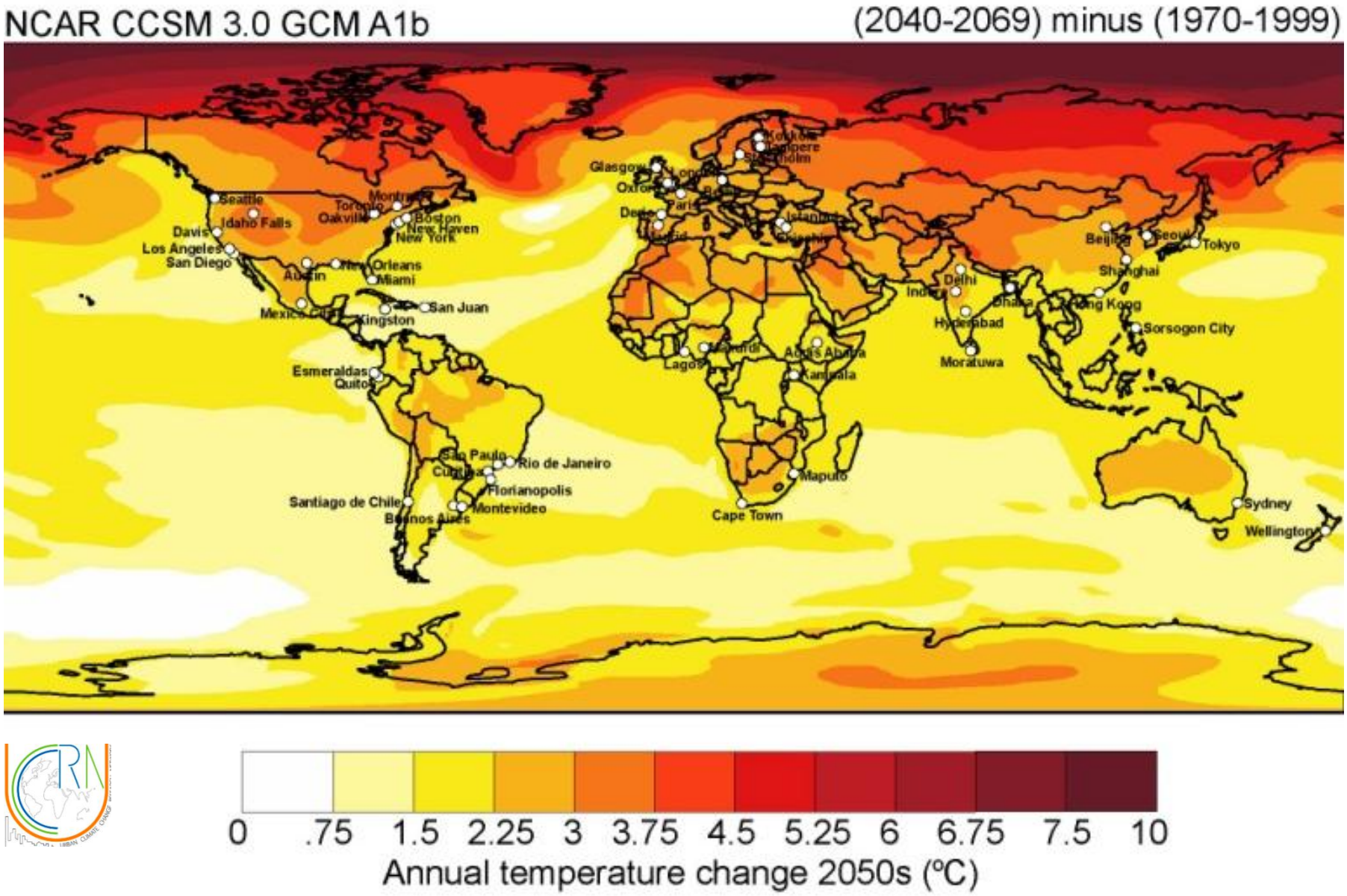
- **Critical numbers:**

  45,000, 15,000, 128, 5 . . .

- **Role of Sub-National Actors**
- **‘Just do it’**

Coordinate with Global Efforts

First UCCRN Assessment Report on Climate Change in Cities (ARC3)



BUILDING THE SCIENTIFIC BASIS FOR LOCAL ACTION

Cities generate no less than 40% of global GHG emissions and are extremely vulnerable to climate change impacts

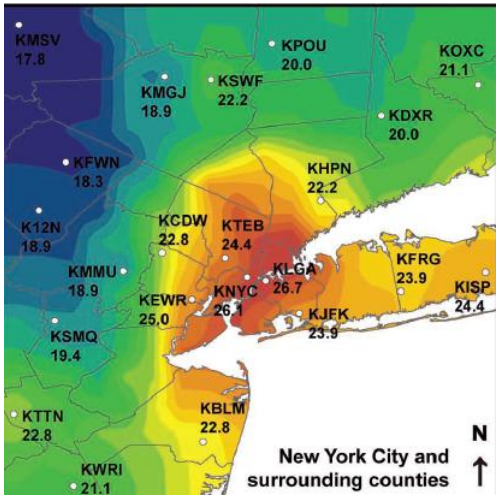
Past climate research has overlooked cities despite unique factors

1. Majority of global population is urban
2. Hubs of economic activity
3. Frequently located on coasts or major rivers
4. Urban heat island and air quality problems
5. On front lines dealing with climate impacts

ARC3 Goal

To establish on-going city-centered state-of-knowledge reports to urban decision-makers and help build capacity for action

Climate change and water stress in African slums, Kampala



Source: Rosenzweig et al., 2009

Urban Heat Island, New York City

CONTENTS

Vulnerability

Framework for vulnerability assessment applied to four diverse cities: Buenos Aires, Delhi, Lagos, New York City.

Climate Hazards

City-specific hazard assessment using observed and projected data on temperature, precipitation, and sea level rise.

Energy

How climate change affects urban energy systems, especially surge in peak load demand, and mechanisms to mitigate and adapt.

Water and Wastewater

Linking climate change with water systems in the cities across the globe with a focus on formal and informal water supply and sanitation services.

Transportation

How urban transportation systems are impacted by and impact climate change. Assessment of regulatory and market mechanisms for mitigation and instruments for adaptation.

Health

Impacts of climate change on human health in citiesand adaptation measures.

Land Use

Analysis of how land use zoning and population density interacts with urban planning and management to mitigate and adapt to climate change.

Governance

How city governments may strengthen science-based policy-making, effective leadership, efficient financing, jurisdictional coordination, planning, and citizen participation.

SECTION 1

DEFINING RISK FRAMEWORK

- Vulnerabilities and agency assessed
- Climate hazards assessed using City-specific existing data
- Science base for city decision-makers

SECTION 2

URBAN SECTORS

- Risks
- Adaptation
- Mitigation
- Policy alternatives

CASE STUDIES

- Range of examples to illustrate organizational strategies from range of socio-economic and physical city conditions

SECTION 3

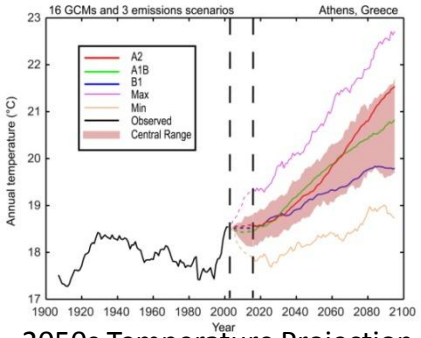
CROSS-CUTTING ISSUES

- Complex interactions among city sectors, systems, and land use
- Implication for city governance to combat climate change

CLIMATE HAZARDS

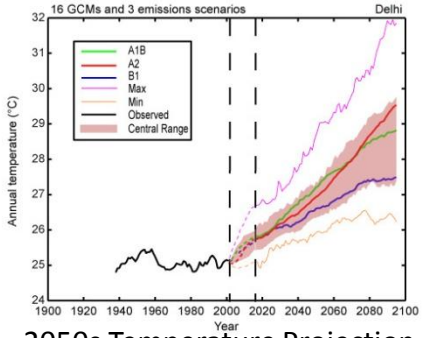
Copenhagen Climate Summit for Mayors

Athens



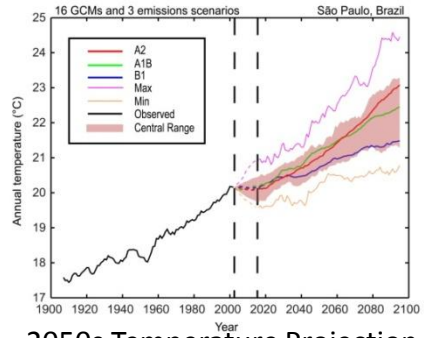
2050s Temperature Projection

Delhi



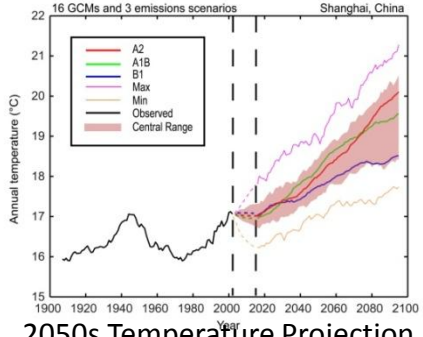
2050s Temperature Projection

Sao Paulo



2050s Temperature Projection

Shanghai



2050s Temperature Projection

12 Cities Analyzed

1. Athens
2. Dakar
3. Delhi
4. Harare
5. Kingston
6. London
7. Melbourne
8. New York
9. Sao Paulo
10. Shanghai
11. Tokyo
12. Toronto

2050s projected temperature increase between 1 C to 4 C

Source: Center for Climate Systems Research Columbia University 2009

Key takeaway

1. More frequent/longer/hotter heatwaves
2. More floods and droughts
3. Sea-level rise with enhanced coastal flooding

HEALTH

Risks

1. Large size and high density amplify health risks
2. Increase in poor and elderly populations compounds threats of heat and vector-related illness
3. Cities with limited existing water services at greater risk of drought and vector-related illnesses

Adaptation and Mitigation strategies

1. Passive approaches (tree planting, green roofs, permeable pavements) to reduce urban heat island
2. Improving and increasing water and energy services
3. Regulate settlement growth in flood plains
4. Expand health surveillance and early warning systems

Key takeaway

Climate change likely to exacerbate existing health risks in cities and create new ones

Source: Shagun Mehrotra, 2003

High Existing Health Risks, Kibera, Nairobi

Source:

Heatwave exacerbates existing health risks of poor & elderly in NYC, July 4-6, 1999

WATER

Risks

1. Variance in precipitation significantly affects quantity and quality of water supply
2. Impervious city surfaces and increased precipitation intensity overwhelm current city drainage systems
3. Over 1/2 the people in large developing country cities rely on informal water supply vendors

Adaptation and Mitigation strategies

1. Reduce water theft and leaks
2. Adjust water-intake locations
3. Rainwater harvesting and water reuse
4. Demand management—public education, industrial process changes to reduce water intensity

Source: Ademolo Omojola

Water Scarcity and Vendors, Lagos

Key takeaway

Water supply services highly vulnerable to drought, extreme precipitation, and sea level rise

TRANSPORT

Risks—contingent on local transport systems

1. Mass transit vs. individual vehicles
2. Underground vs. elevated roads and rail
3. Moving people vs. goods
4. Impacts on power and telecom systems create transport system risks

Adaptation and Mitigation strategies

1. Technical vs. ecosystem-based approaches
2. Levees, dams, pumps to limit flood damage
3. Improve drainage to protect transport assets
4. Elevate equipment to eliminate flood risk
5. Temporarily move rolling stock in advance of storms
6. Diversify transport modal choices

Compressed Natural Gas, Cabs, Delhi

Civil society organizations and courts have been instrumental in legislating conversion of public transport to be fuelled by CNG

Key takeaway

Incorporate climate considerations into transit plans, construction, and management systems while retrofitting existing assets

ENERGY

Risks – both supply and demand

1. Power plant flooding
2. Increased variance in water quantity and timing impact hydro-power
3. Increase in heat waves imply more frequent blackouts, damaging local economy
4. Demand may increase *or* decrease

Adaptation and Mitigation strategies

1. Demand management programs to cut peak load
2. "Harden" power plants and networks to increase resilience to flooding/storm/temperature risks
3. Diversify fuel-mix for city power to increase share of renewables

Coal Based Energy Supply, Baoshan

Key takeaway

Mitigation prioritized, but adaptation focus equally important

GOVERNANCE

Challenges

1. Climate is one of many issues on local government's agenda
2. Tradeoffs between current priorities and long-term risks
3. Uncertainties about timing and scale of local impacts affects prioritization of investments and action
4. Local authorities constrained by policy and fiscal space
5. Jurisdictional conflicts, multiple stakeholders

WAY FORWARD

1. Science-based policy-making
2. Effective leadership
3. Efficient financing
4. Jurisdictional coordination
5. Land-use planning,
6. Citizen participation

Key takeaway

Local authorities recognize the challenge and many are working together to take action

NEW YORK CITY TIMELINE

Credit for images (Central Park and subway): New York City Department of Records/ Municipal Archives

1800
1825
1850
1875
1900
1925
1950
1975
2000

Now is our moment
to make a difference in the future of our city

Throughout our history, there have been key moments when New Yorkers looked forward and took bold steps to prepare our city for its future.

The street grid plan of 1811 plotted out room for a million people—more than 10 times Manhattan's population at the time. In 1858, we unveiled plans for a Central Park devoted to the people—even though most New Yorkers still lived a mile away. Starting in 1901, we began building one of the world's largest subway systems when our city was mostly still farmland and fields. And 50 years ago, we transformed a golf course into the international aviation hub of the United States through the construction of JFK International Airport.

Now is our moment—and we need your help.

There are many ways to get involved.

Visit our website www.nyc.gov/planyc. Here you can learn more about each goal and share your ideas on how to reach them.

If you can't log on, **send us a letter.**

Look for a town hall meeting in your borough.

And most importantly, **tell your family and friends** so we can hear from them, too.

All of New York has a stake in this discussion—because every New Yorker will experience its impact.

And over the next three months, these ideas—your ideas—will shape a plan to secure our city's sustainable future.

planNYC

Visit www.nyc.gov/planyc

Ten goals for creating a sustainable city over the next 25 years

openNYC

1. Create homes for almost a million more New Yorkers, while making housing more affordable and sustainable
2. Improve travel times by adding transit capacity for millions more residents, visitors, and workers
3. Ensure that all New Yorkers live within a 10-minute walk of a park

maintainNYC

4. Develop critical back-up systems for our aging water network to ensure long-term reliability
5. Reach a full "state of good repair" on New York City's roads, subways, and rails for the first time in history
6. Provide cleaner, more reliable power for every New Yorker by upgrading our energy infrastructure

greenNYC

7. Reduce global warming emissions by more than 30%
8. Achieve the cleanest air of any big city in America
9. Clean up all contaminated land in New York City
10. Open 90% of our waterways for recreation by reducing water pollution and preserving our natural areas

Together we can make the New York of 2030 cleaner, healthier, more reliable, and more sustainable than the city we love today.

Mitigation/Adaptation

Photo: S. Cornwell

Mainstreaming Adaptation in New York City

Steps

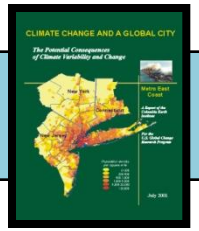
1. Lay the Foundation
2. Design Integrative Process
3. Articulate Overall Approach
4. Provide Planning Tools for Action Plans
5. Monitor and Reassess!

New York City

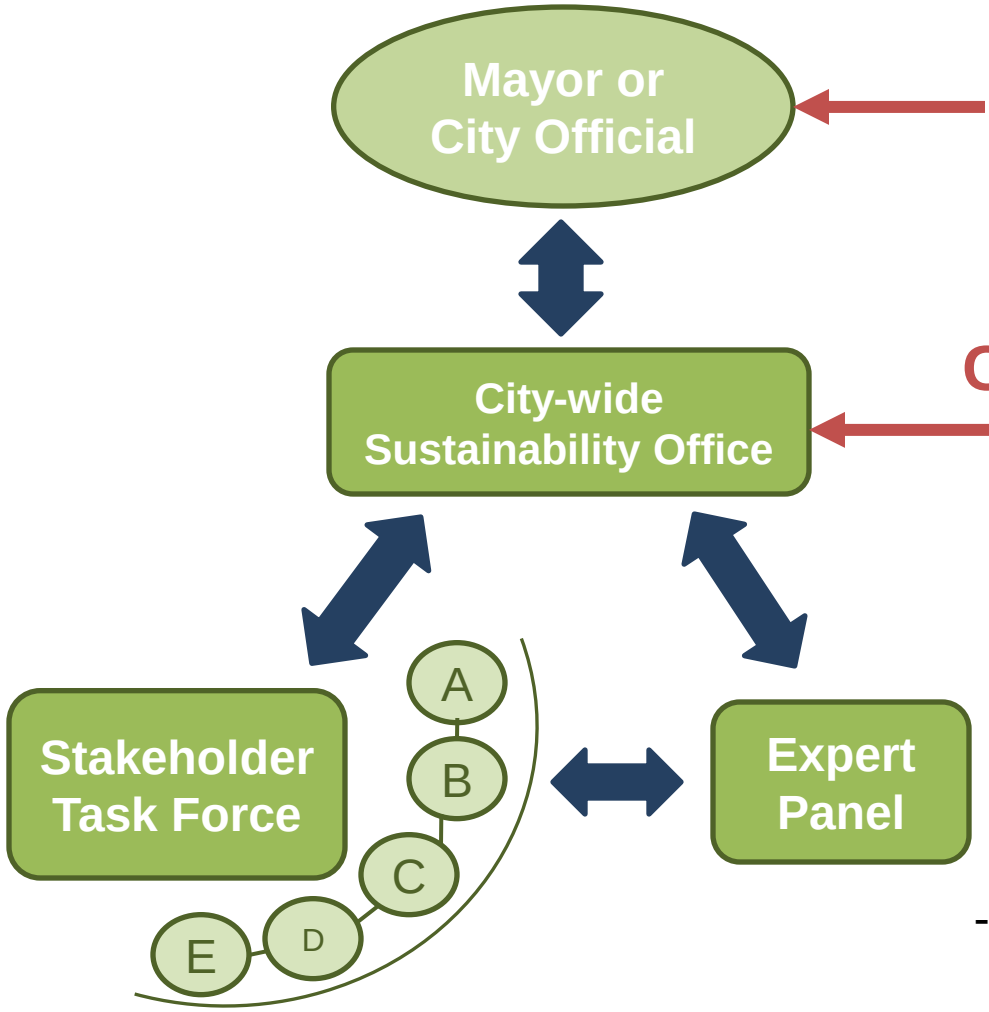
- Key Assessment Reports & Studies
- Public and Private Decision-makers and Experts, High-Level Initiation/Buy-In
- Flexible Adaptation Pathways
- Climate Risk Information, Adaptation Assessment Checklist, Climate Protection Levels
- Indicators and Foundation Report

Step 1. Laying the Foundation

YEAR	REPORT TITLE	ORGANIZATION/PUBLICATION
Underway - 2010	*New York State Adaptation Assessment*	*New York State Energy Research & Development Authority*
Underway - 2009	*New York City Climate Change Adaptation Task Force & New York City Panel on Climate Change*	*NYC Office of Long Term Planning & Sustainability*
Underway - 2009	*Long Island Shore Study*	*The Nature Conservancy*
2008	New York City's Vulnerability to Coastal Flooding: Storm Surge Modeling of Past Cyclones	*Bulletin of the American Meteorological Society*
2008	NYC DEP Climate Change Program Assessment and Action Plan	*New York City Department of Environmental Protection*
2007	Confronting Climate Change in the U.S. Northeast: Science, Impact and Solutions	*Union of Concerned Scientists*
2007	August 8, 2007 Storm Report	*Metropolitan Transit Authority*
2001	Climate Change and a Global City: The Potential Consequences of Climate Variability and Change	*U.S. National Assessment Columbia Earth Institute*
1999	Hot Nights in the City: Global Warming, Sea-Level Rise and the New York Metropolitan Region	*Environmental Defense Fund*
1996	The Baked Apple? Metropolitan New York in the Greenhouse	*New York Academy of Sciences*



Step 2. Design Integrative Process



Stakeholders include:

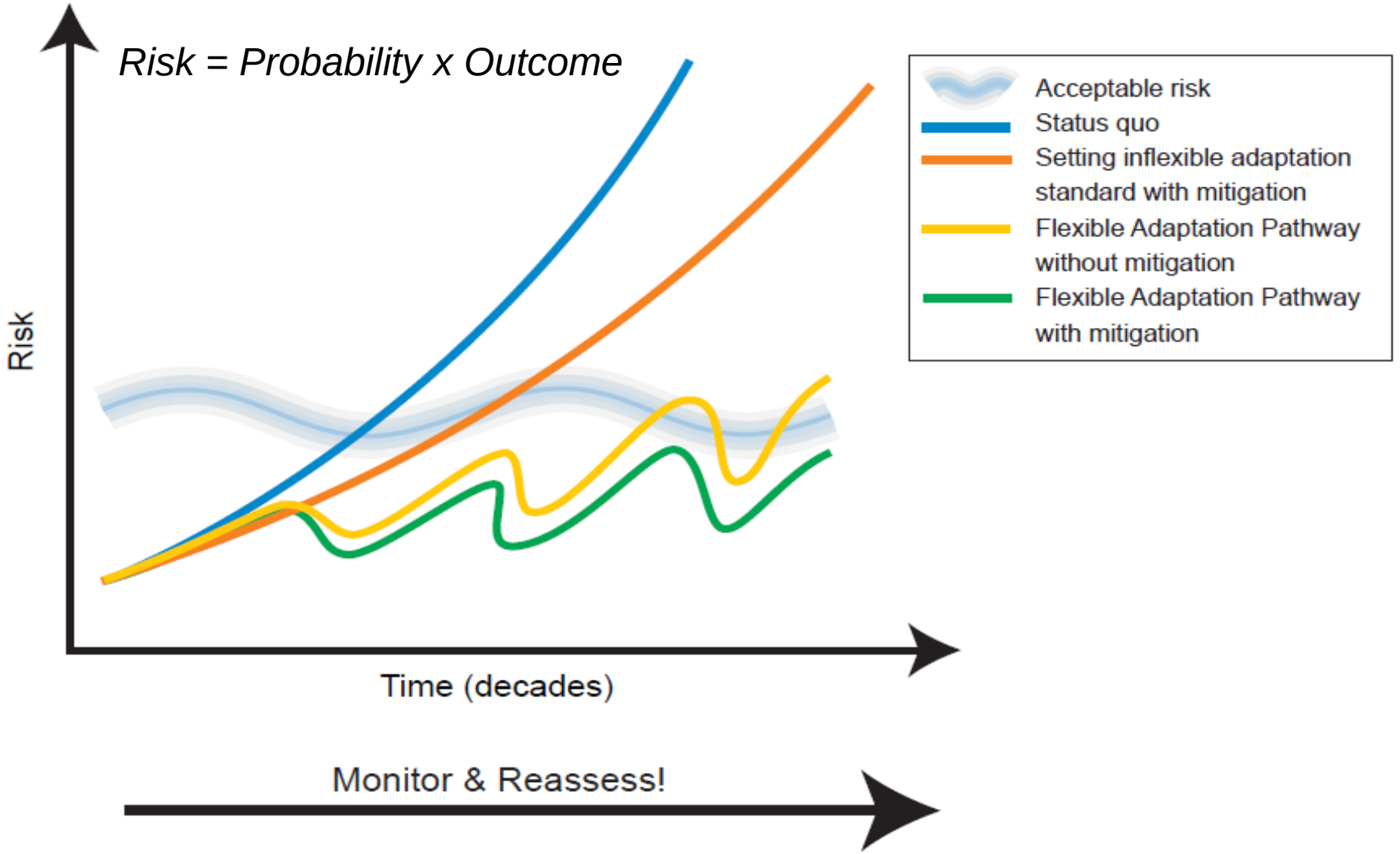
- City Agencies
- Regional Authorities
- Private Stakeholders

Expert Knowledge:

- Climate Change Scientists
- Legal experts
- Insurance experts

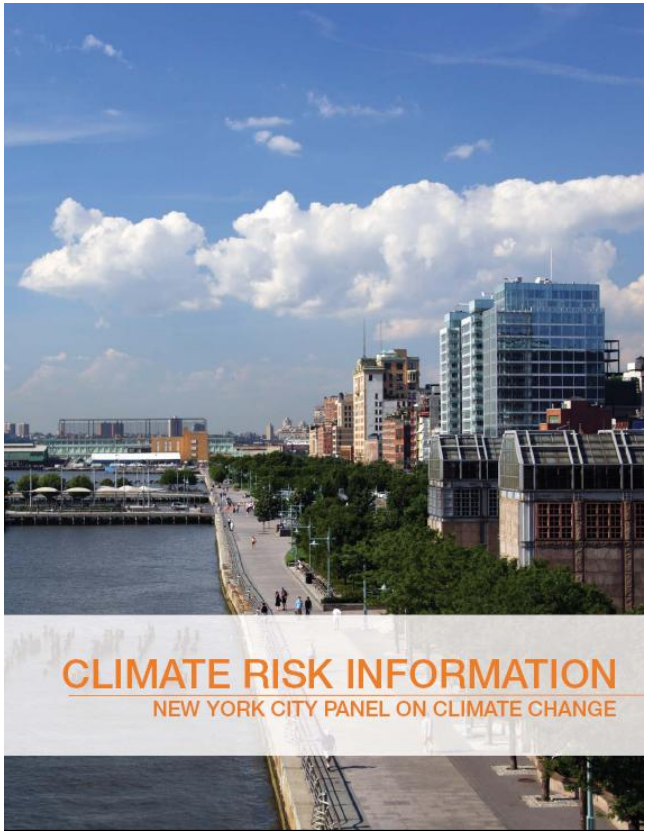
Step 3. Articulate Overall Approach

Climate change adaptation as a risk management issue → Flexible Adaptation Pathways as the response



Step 4. Provide Planning Tools for Action Plans

1. Assessment Report
   - background expert knowledge
   - best practices
   - resource guide
   - case for adaptation
2. Workbooks for stakeholders
   - Climate Risk Information
   - Adaptation Assessment Guidebook
   - Climate Protection Levels



Step 5: Indicators & Monitoring

Direct Climate Indicators

- Mean annual changes
- Extreme events
- Tropical storms
- ENSO & NAO
- Earth's carbon cycle

Indirect Climate Indicators

- Shoreline erosion
- Localized inland flooding
- Biological & chemical composition of waters
- Changes in vegetation

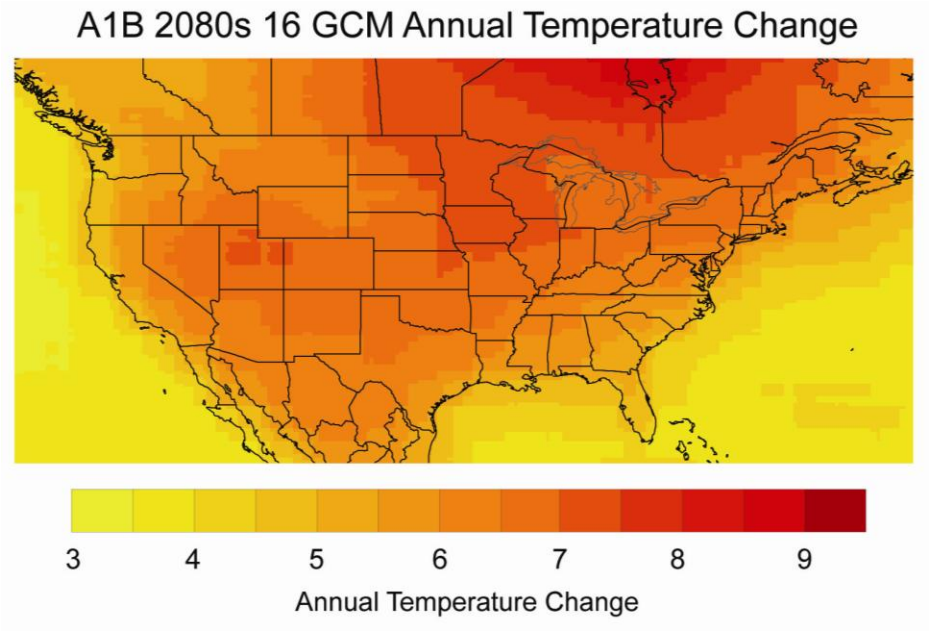
Infrastructure Impacts

- Infrastructure damage from climate-related factors
- Impacts on operations, including transportation delays
- Combined sewer overflow events (CSOs)
- Climate-related power outages

MONITOR & REASSESS

Source: Columbia University Center for Climate Systems Research & NPCC CRI

Maps: Annual Temperature



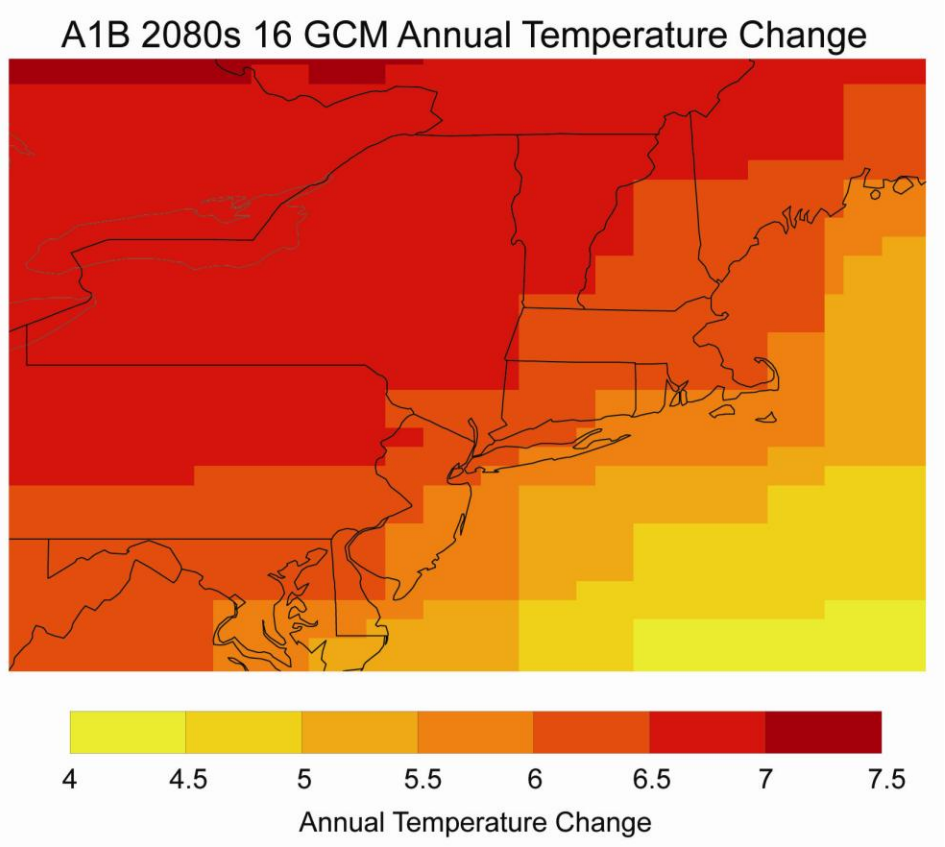
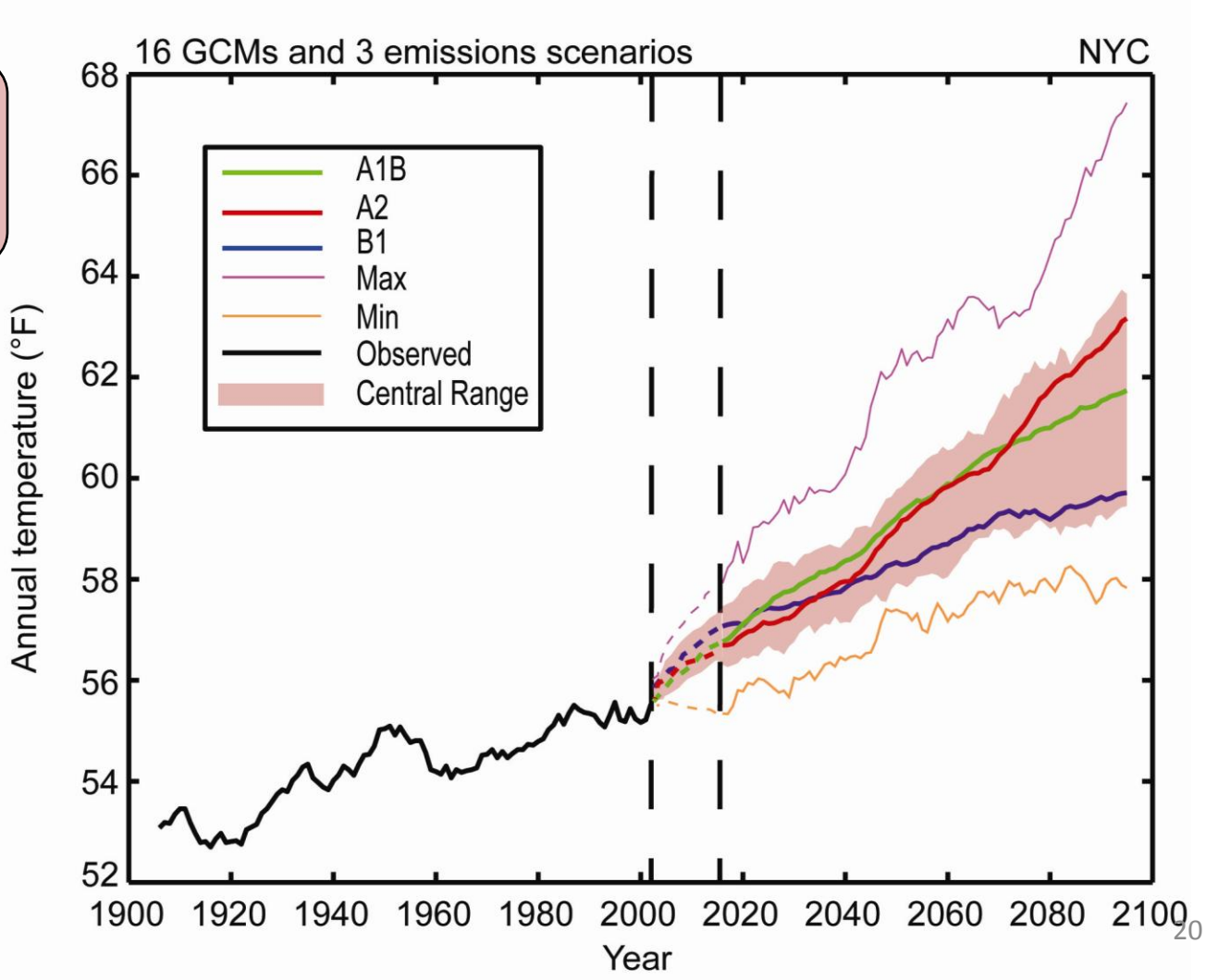


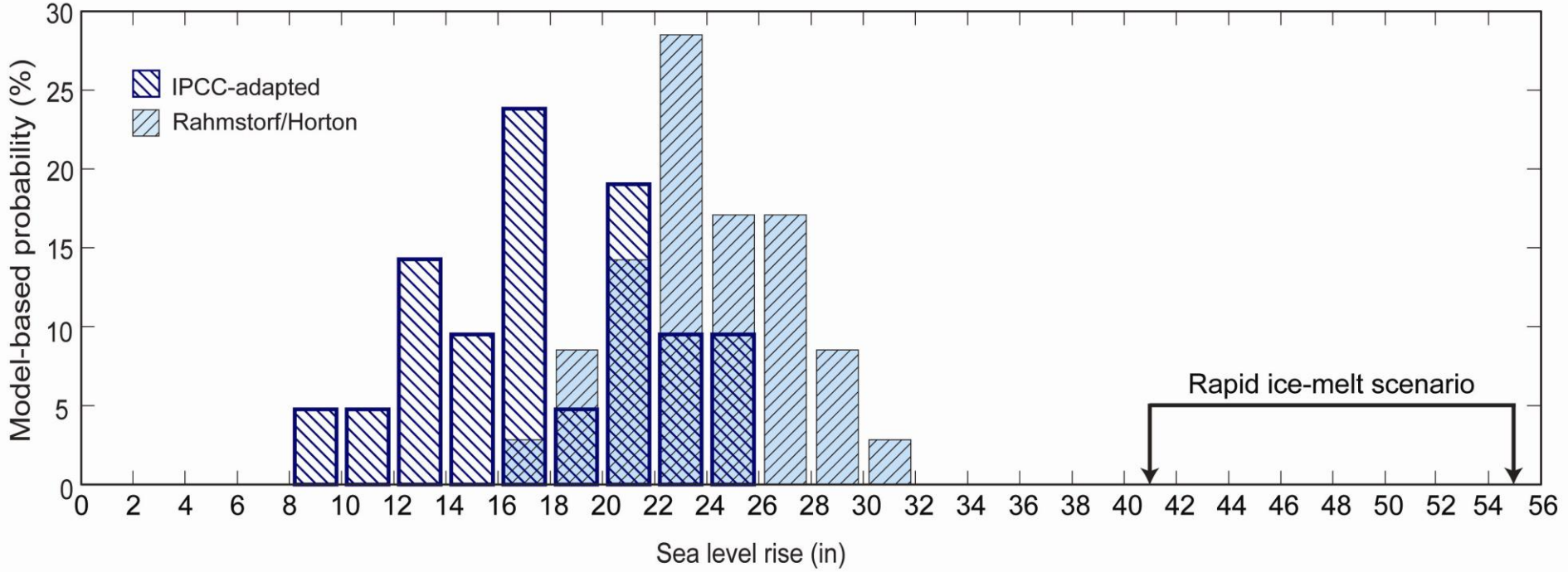
Figure 1a: Observed Climate & Future Projections

Annual Temperature



from pg. 18, CRI

Figure 18: Comprehensive set of sea level rise projections for NYC and the surrounding region



from pg. 54, CRI

Table 2: Quantitative Changes in Extreme Events

	Extreme Event	Baseline (1971-2000)	2020s	2050s	2080s
Heatwaves & Cold Events	# of days/year with maximum temperature exceeding:				
	90° F	14	23 to 29	29 to 45	37 to 64
	100° F	0.4[1]	0.6 to 1	1 to 4	2 to 9
	# of heat waves/year[2]	2	3 to 4	4 to 6	5 to 8
	Average duration (in days)	4	4 to 5	5 to 5	5 to 7
	# of days/year with minimum temperature below 32° F:	72	53 to 61	45 to 54	36 to 49
Intense Precipitation & Droughts	# of days per year with rainfall exceeding:				
	1 inch	13	13 to 14	13 to 15	14 to 16
	2 inches	3	3 to 4	3 to 4	4 to 4
	4 inches	0.3	0.2 to 0.4	0.3 to 0.4	0.3 to 0.5
	Drought occurs, on average[3]	~once every 100 yrs	~once every 100 to 100 yrs	~once every 50 to 100 yrs	~once every 8 to 100 yrs
Coastal Floods & Storms[4]	1-in-10 yr flood to reoccur, on average	~once every 10 yrs	~once every 8 to 10 yrs	~once every 3 to 6 yrs	~once every 1 to 3 yrs
	Flood heights associated with 1-in-10 yr flood (in feet)	6.3	6.5 to 6.8	7.0 to 7.3	7.4 to 8.2
	1-in-100 yr flood to reoccur, on average	~once every 100 yrs	~once every 65 to 80 yrs	~once every 35 to 55 yrs	~once every 15 to 35 yrs
	Flood heights associated with 1-in-100 yr flood (in feet)	8.6	8.8 to 9.0	9.2 to 9.6	9.6 to 10.5
	1 in 500-yr flood to reoccur, on average	~once every 500 yrs	~once every 380 to 450 yrs	~once every 250 to 330 yrs	~once every 120 to 250 yrs
	Flood heights associated with 1-in-500 yr flood (in feet)	10.7	10.9 to 11.2	11.4 to 11.7	11.8 to 12.6

from pg. 20, CRI

Table 3: Qualitative Changes in Extreme Events

Extreme Event	Probable Direction Throughout 21st Century	Likelihood[1]
Heat Index[2]	↑	Very likely
Ice storms/ Freezing rain	↑	About as likely as not
Snowfall frequency & amount	↓	Likely
Intense Hurricanes	↑	More likely than not
Nor'easters	Unknown	
Lightning	Unknown	
Downpours (precipitation rate/hour)	↑	Likely
Extreme winds	↑	More likely than not

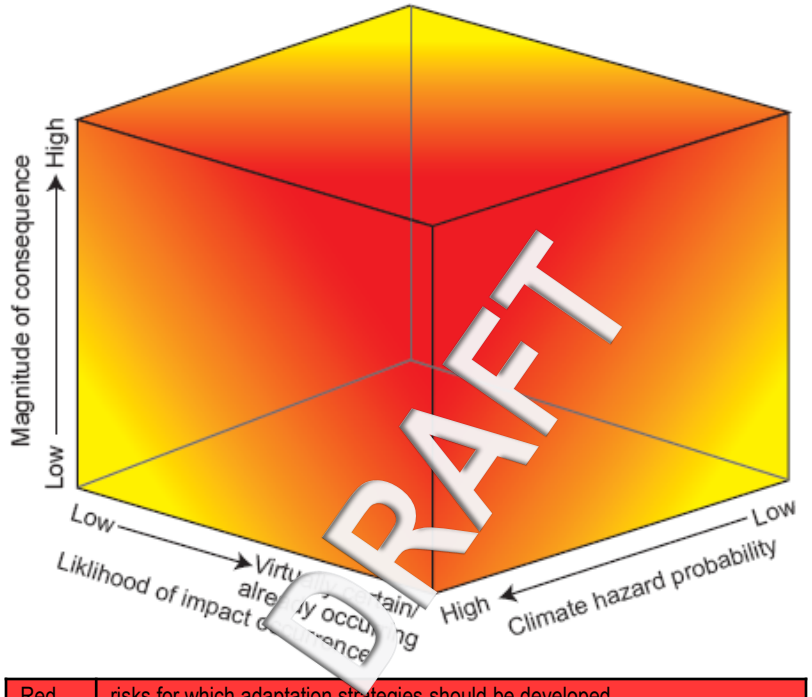
from pg. 21, CRI

Virtually certain	>99% probability of occurrence	Likely	>66% probability of occurrence
Extremely likely	>95% probability of occurrence	More likely than not	>50% probability of occurrence
Very likely	>90% probability of occurrence	About as likely as not	33-66% probability of occurrence

Adaptation Assessment Checklist

Guides stakeholders through completing:

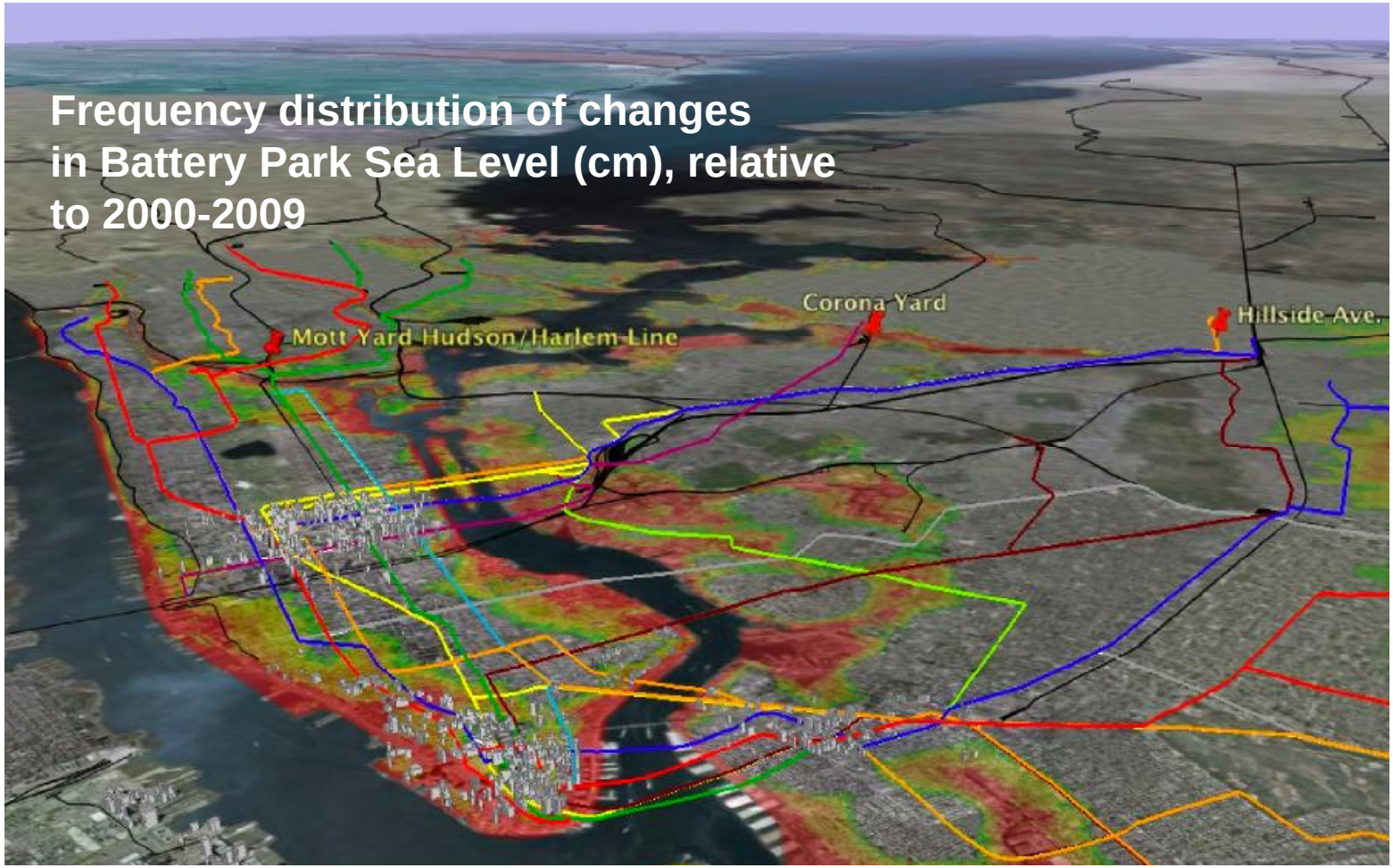
- Inventory of at-risk Infrastructure
- Risk Assessment Template
- Risk Prioritization Matrix



Red	risks for which adaptation strategies should be developed
Orange	risks for which adaptation strategies may need to be developed or for which further information is needed is intermediate
Yellow	risks for which impacts should be monitored but which may not need actions at this time

Leading to Adaptation Plans

Hurricane Flood Risk



Shaded areas depict worst-track storm surge flood zones for Saffir-Simpson Category-1 in red, SS2 in brown, SS3 in yellow, and SS4 in green. Shaded lines are subways, black lines are rail sytems.

Lamont-Doherty Earth Observatory, Google Earth, and
NYSEMO (for colored flood zones and NYCT subway lines)

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 Wastewater Pollution Control Plants, tide gates, and other structures, and to develop and evaluate adaptations. Issuance within a few months.

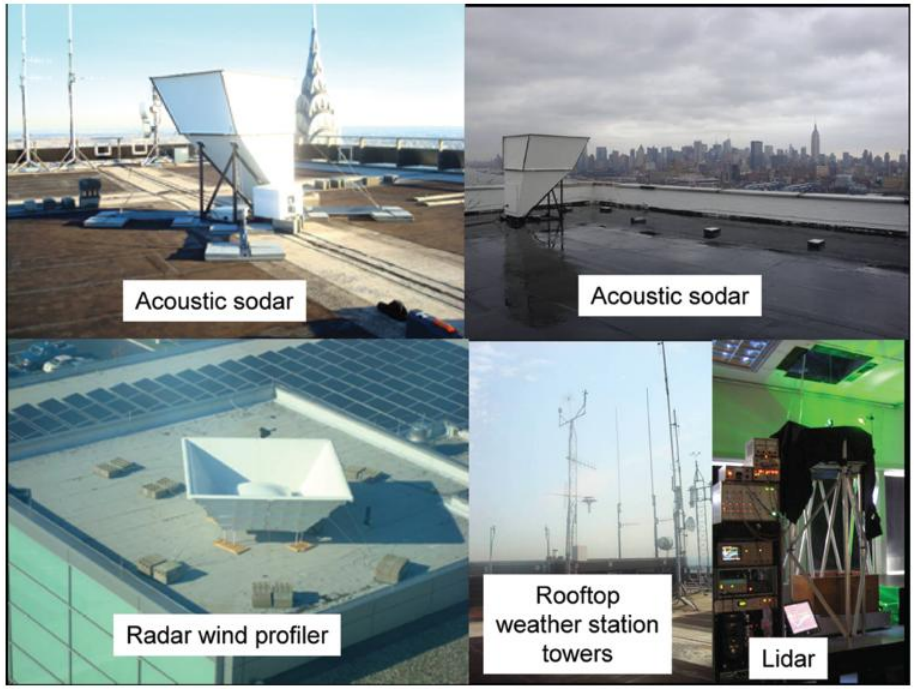
Treatment tanks overflowed at the Hunts Point (Bronx) WPCP during a March 2001 storm; unusually high tide elevations prevented discharge of treated sewage into the East River and caused back-up

Developing New Climate Protection Levels

- Changes in policies, rules & regulations
- Based on:
  - climate science,
  - engineering, legal & insurance practices, &
  - discussions with stakeholders
- Examples:
  - ✓ Protect long-lived infrastructure against future 1-in-100 year storms
  - ✓ Prepare for a specified number of heatwaves
  - ✓ Withstand a specified number of droughts & floods

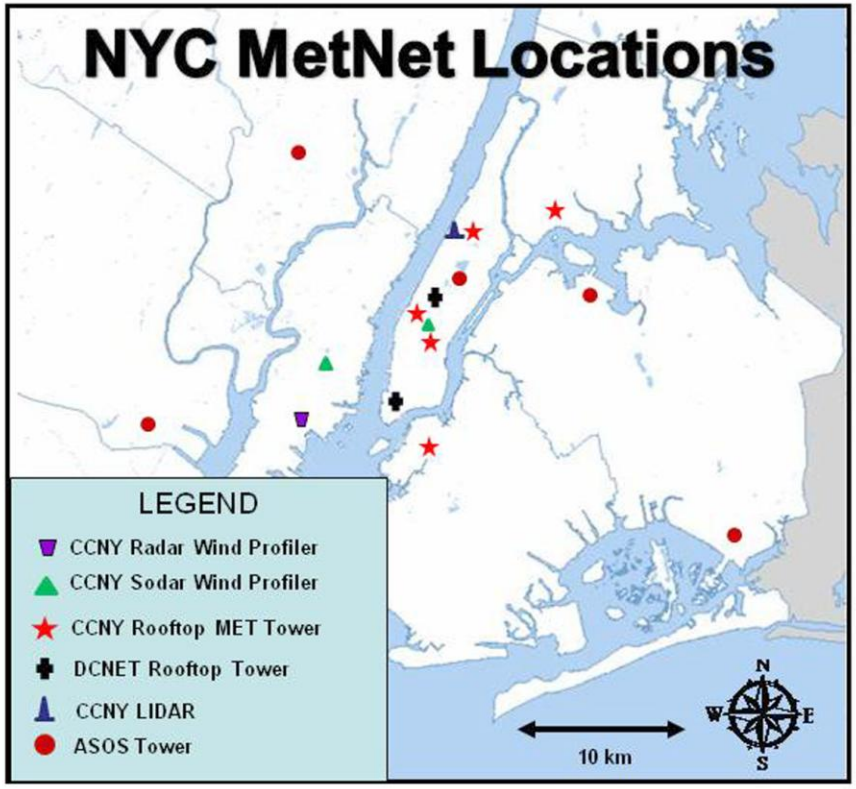
All considerations based on review of timing, location, and preexisting regulations & controls

Indicators and Monitoring



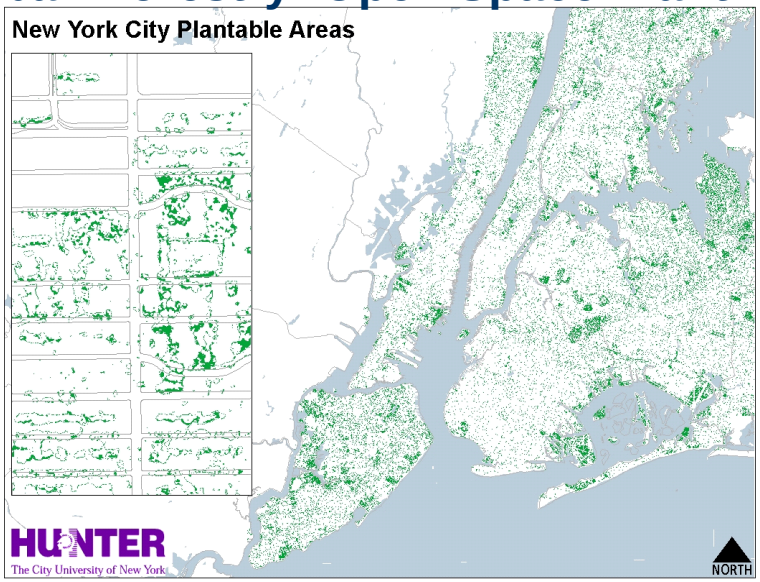
- Weather stations, acoustic sodar, and radar wind profiler
- Deployed in a dense grid within NYC and its immediate environs

NYC MetNet Instruments



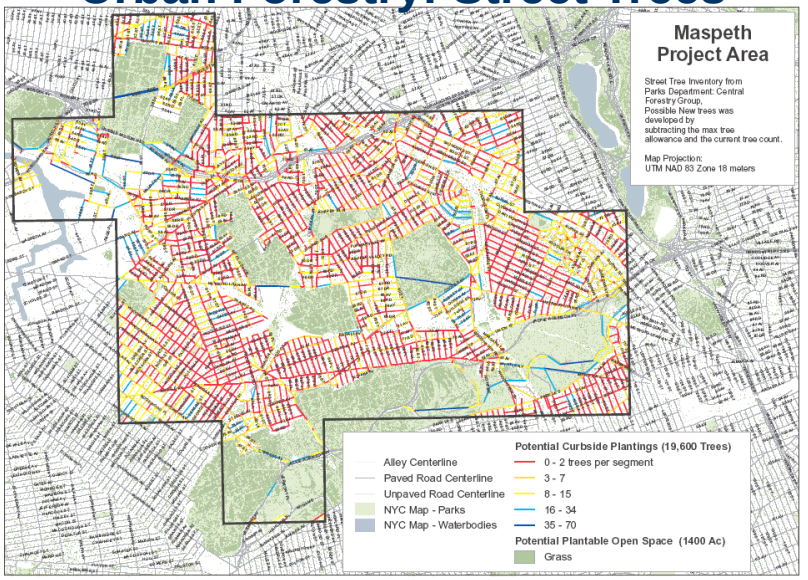
Encourage Mitigation and Adaptation Synergies

Urban Forestry: Open Space Planting



Grass areas; 3 m resolution

Urban Forestry: Street Trees



Street tree inventory from NYC Dept. of Parks; assumes avg canopy width of 37.7 ft.

Green Buildings

Solaire Building Battery Park City

Living Roofs

Chicago City Hall
Source: Dunnett and Kingsbury, *Planting Green Roofs and Living Walls*, 2004

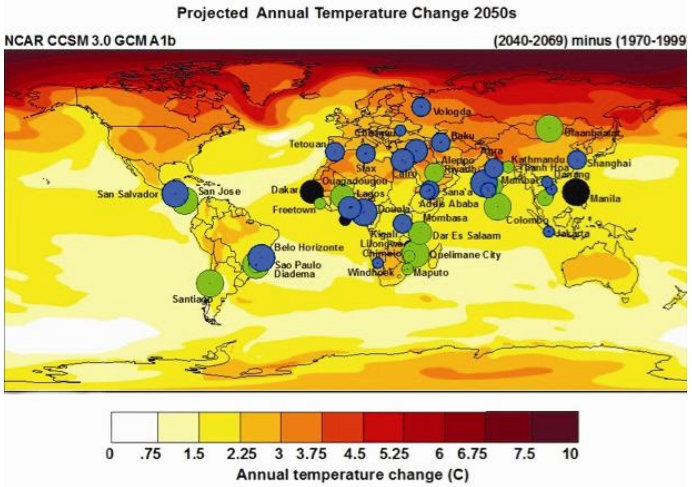
Key NPCC Findings

New York City has many tools in place that can be used to facilitate climate change adaptation

- Risk and hazard management strategies
- Design standards
- Legal framework
- Insurance industry
- Adjustments in operations, and management, capital investments in infrastructure, and development of policies that promote flexibility

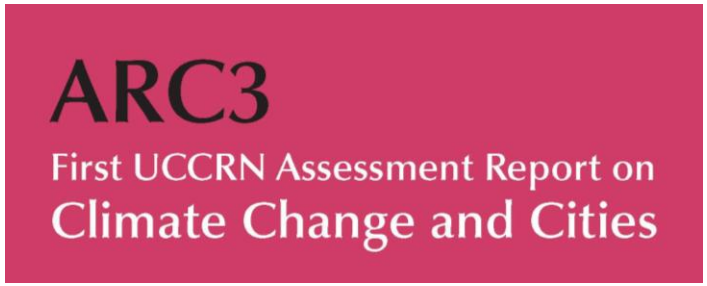
Back to Copenhagen… CITIES ACT

1. Cities are highly vulnerable to climate change, but have great potential to lead on both adaptation and mitigation efforts
2. Cities are serving as laboratories for climate change action, despite constraints
3. Ample climate risk and response information available for effective action, yet in limited use
4. Cities must mainstream climate science, adaptation strategies, and mitigation actions into daily decision-making and long-term plans and investments
5. Research community able and willing to help



Cities are developing long-term action plans—but many need to mainstream climate risks into existing planning efforts

Climate Change Adaptation in New York City: Building a Risk Management Approach
NPCC Report 2010
New York Academy of Sciences Annals/Wiley 2010



Cambridge University Press 2010

For pre-order and updates please visit www.uccrn.org

Going Beyond Conventional Wisdom

Climate Change Adaptation

Conventional Wisdom:

Adaptation is Local . . .

Mitigation is Global and National . . .

More Useful Approach:

Local, National, and Global Initiatives are needed to ‘mainstream’ both Adaptation and Mitigation (and their interactions)

Challenges

- Responding to Need for Rapid, Recurring Assessments
- Political terms come and go
- Climate system is changing
- Enhancing Coordination
- Stakeholders
- Jurisdictions
- Scenarios
- Handling Uncertainty of Climate Information
- Downscaling
- High-end Scenarios, e.g., Rapid Icemelt
- Revising Standards and Regulations
- Defining and Implementing Role of Different Levels of Government

Common Definitions

Including:

- Adaptation* – Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.
- Adaptation Assessment* – The practice of identifying options to adapt to climate change and evaluating them in terms of criteria such as availability, benefits, costs, effectiveness, efficiency and feasibility.
- Risk – Product of the likelihood of an event occurring times the magnitude of consequence should that event occur.
- Climate hazard – Climate variables which could have particular consequence to a given region or sector (i.e., temperature, precipitation, sea level rise).
- Uncertainty & Likelihoods* – An expression of the degree to which a value is unknown. Uncertainty can result from lack of information or from disagreement about what is known or even knowable.

** IPCC AR4 WGII, all others from NPCC CRI*

NYC Task Force Members

City Agencies

- Dept. of Buildings
- Dept. of City Planning
- Dept. of Design & Construction
- Dept. of Environmental Protection
- Dept. of Health
- Dept. of Law
- Dept. of Parks & Recreation
- Dept. of Sanitation
- Dept. of Transportation
- Economic Development Corp.
- Office of Emergency Management
- Office of Management & Budget

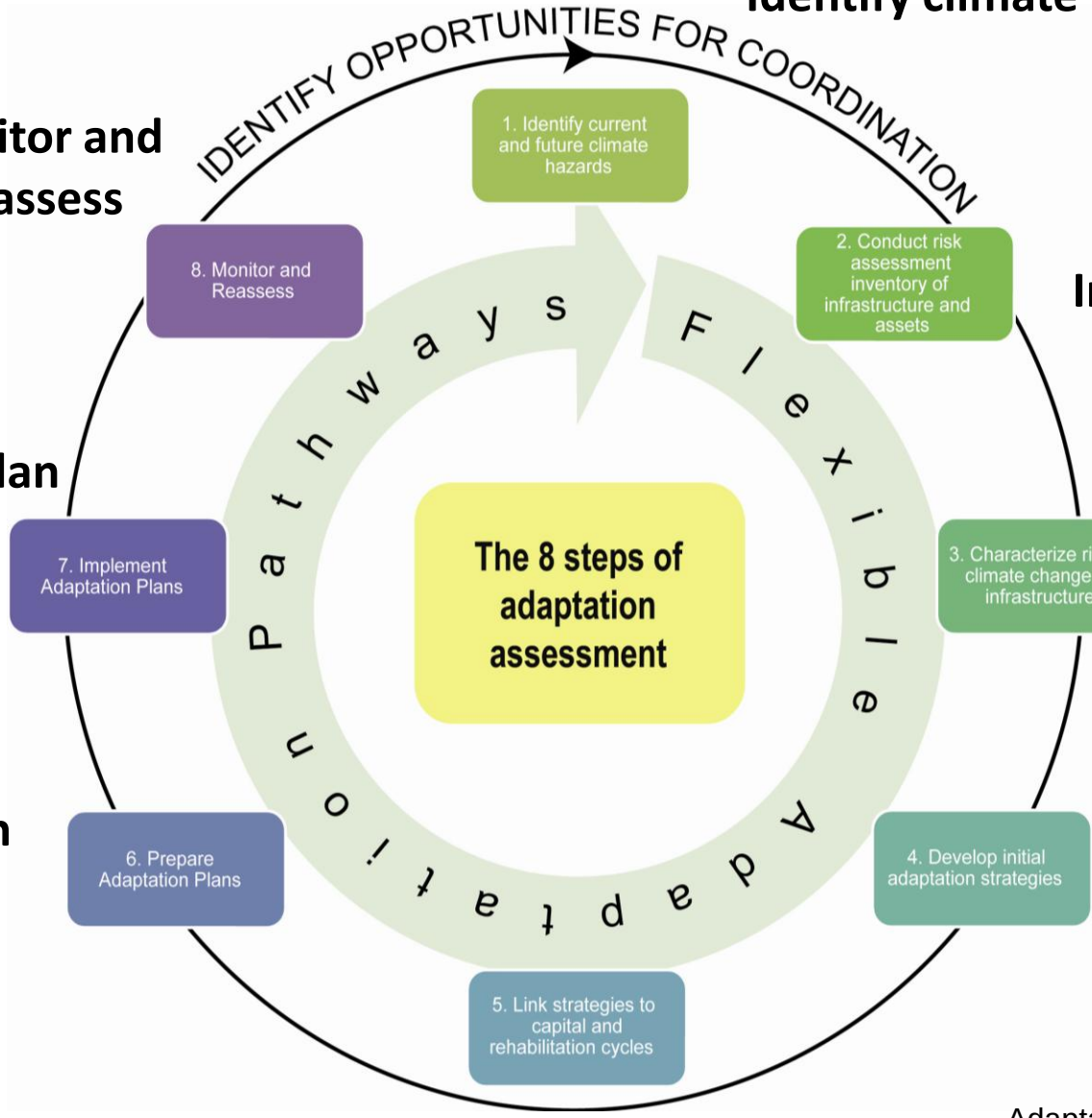
Federal & State Agencies/Authorities

- Dept. of Environmental Conservation
- Dept. of State
- Dept. of Transportation
- Metropolitan Transportation Authority
- NY Power Authority
- NYS Public Service Commission
- NJ Transit
- Port Authority of NY/NJ
- State Emergency Management Office
- U.S. National Park Service (Gateway Natl Recreation Area)

Other Stakeholders

- Amtrak
- Astoria Energy LLC
- AT&T
- Cablevision
- Con Edison
- CSX
- National Grid
- NRG Energy
- NY Independent System Operator
- Sprint Nextel
- Suez Energy, NA
- Time Warner Cable
- T-Mobile
- TransCanada
- USPowerGen
- Verizon

Adaptation is a Process



Identify climate hazards

Inventory risks

Categorize risks

Develop strategies

Link to capital cycles

Prepare Plan

Implement Plan

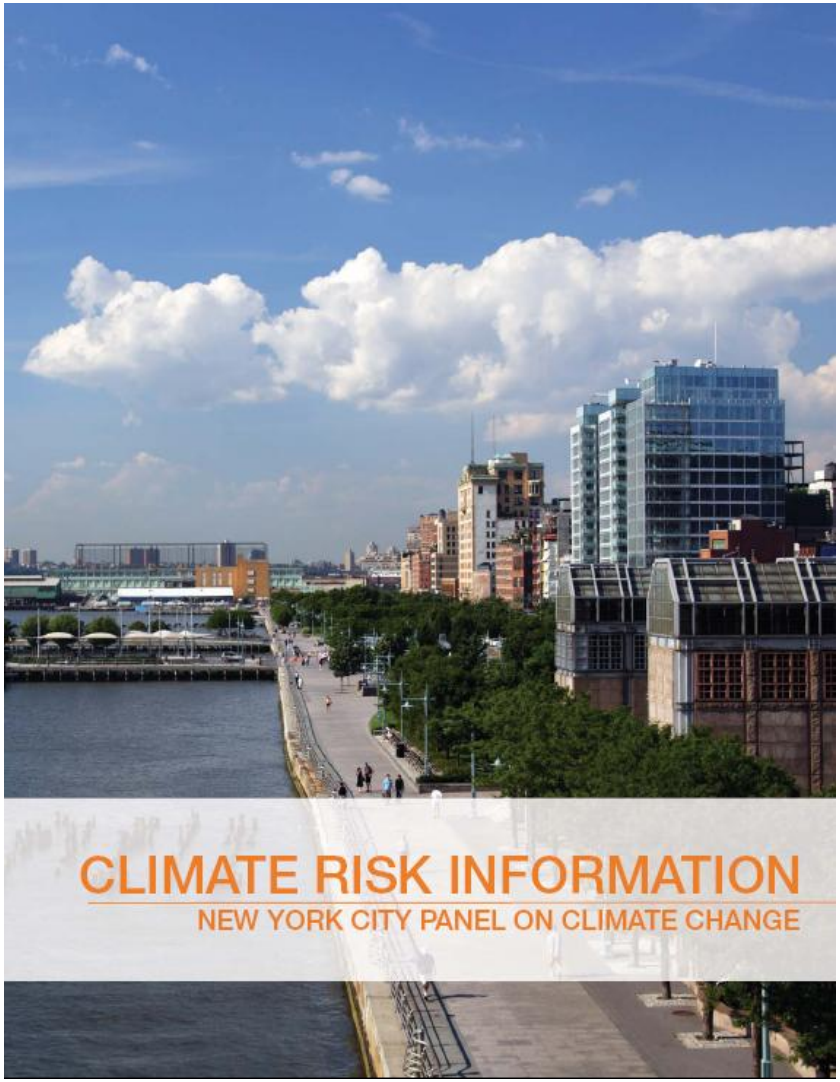
Monitor and Reassess

Adaptation Assessment Guidebook
New York City Panel on Climate Change

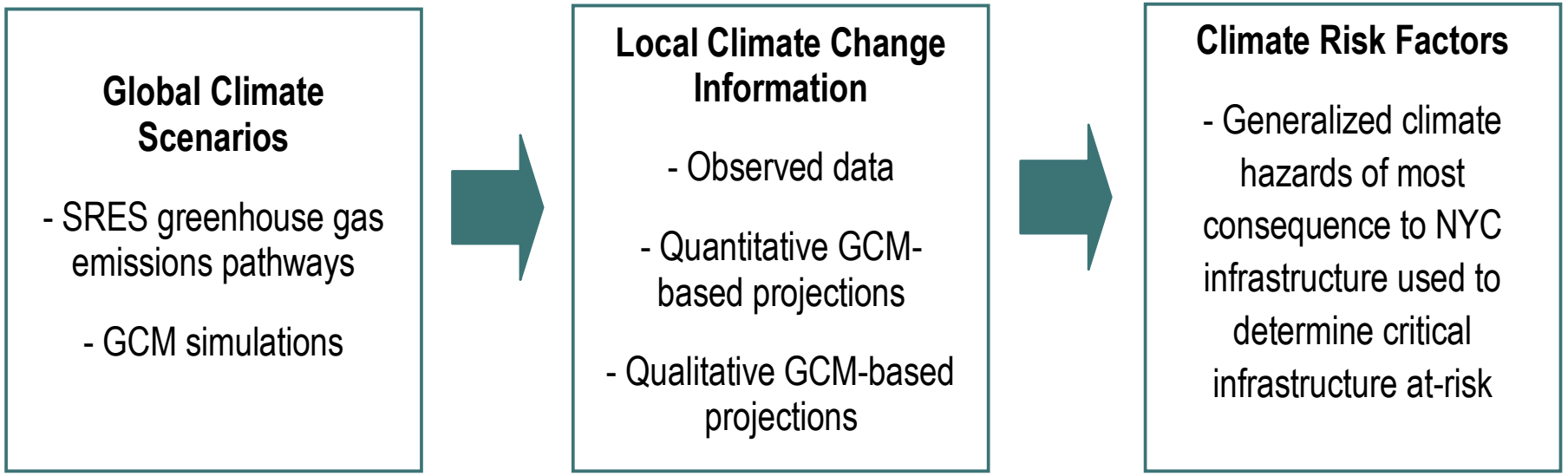
Climate Risk Information

Executive Summary

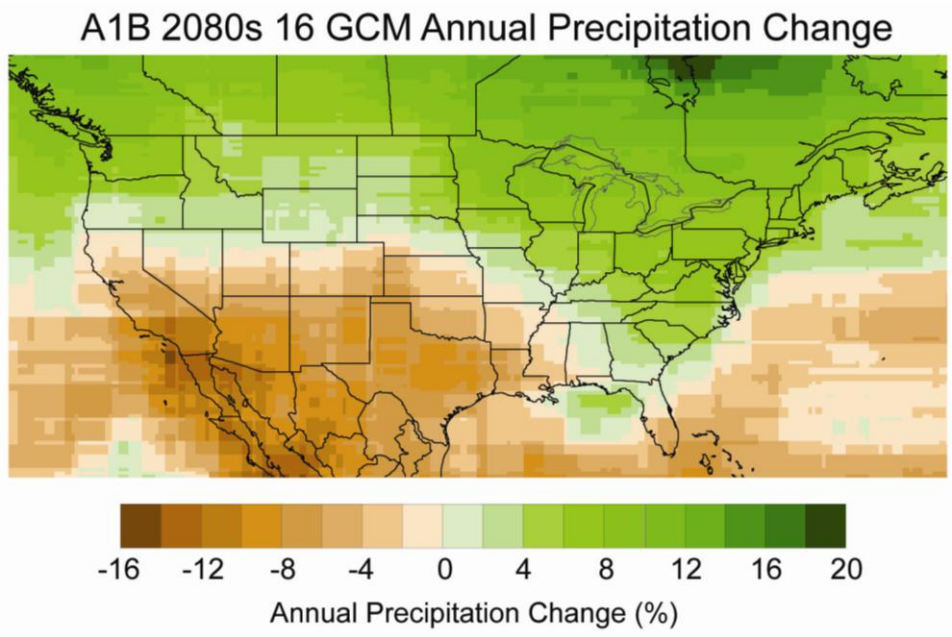
1. Climate Change Scenarios & New York City
2. Observed Climate
3. Future Projections
4. Infrastructure Impacts
5. Indicators & Monitoring
6. Appendices
7. Glossary
8. References



Document Guide



Maps: Annual Precipitation



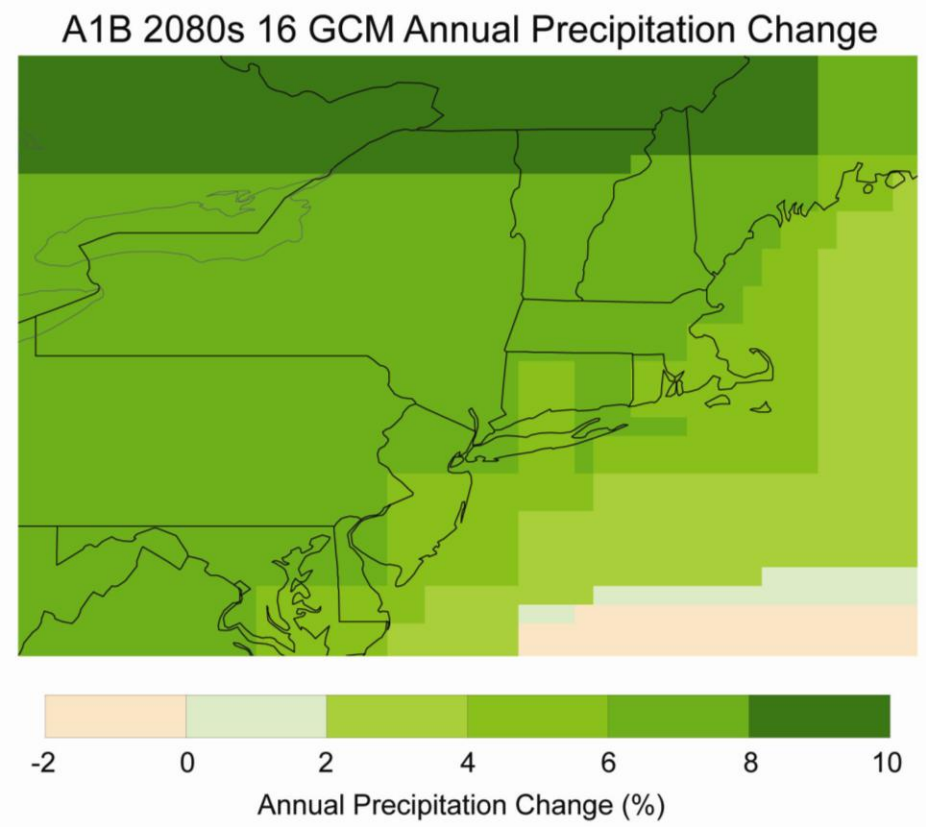
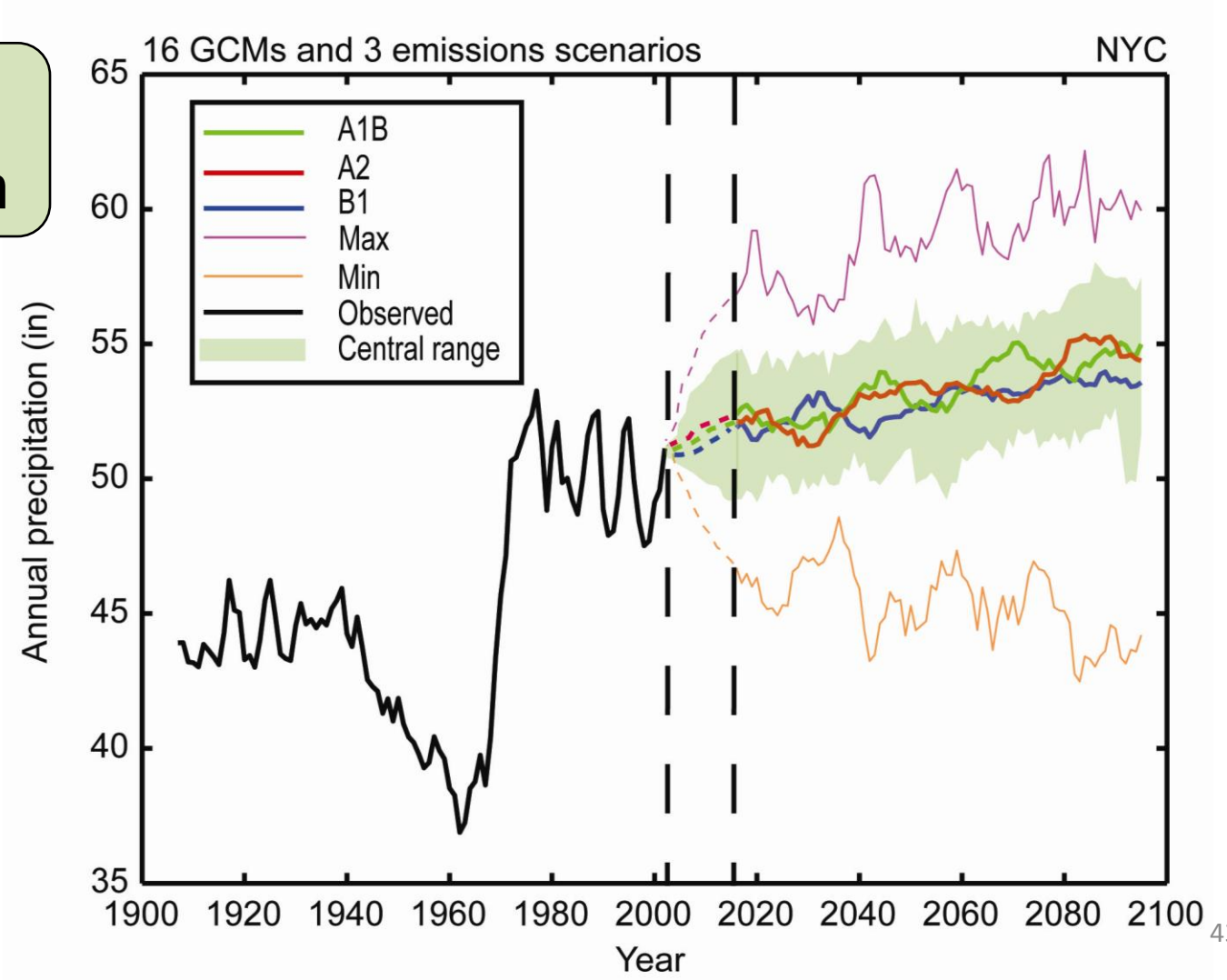


Table 1:
Baseline Climate and Mean Annual Changes

	Baseline 1971-2000	2020s	2050s	2080s
Air temperature Central range[2]	55°F	+ 1.5 to 3°F	+ 3 to 5°F	+ 4 to 7.5°F
Precipitation Central range[2]	46.5 in	+ 0 to 5 %	+ 0 to 10 %	+ 5 to 10 %
Sea level rise[3] Central range[2]	NA	+ 2 to 5 in	+ 7 to 12 in	+ 12 to 23 in
Rapid Ice-Melt Sea Level Rise[4]	NA	~ 5 to 10 in	~ 19 to 29 in	~ 41 to 55 in

Figure 1b: Observed Climate & Future Projections

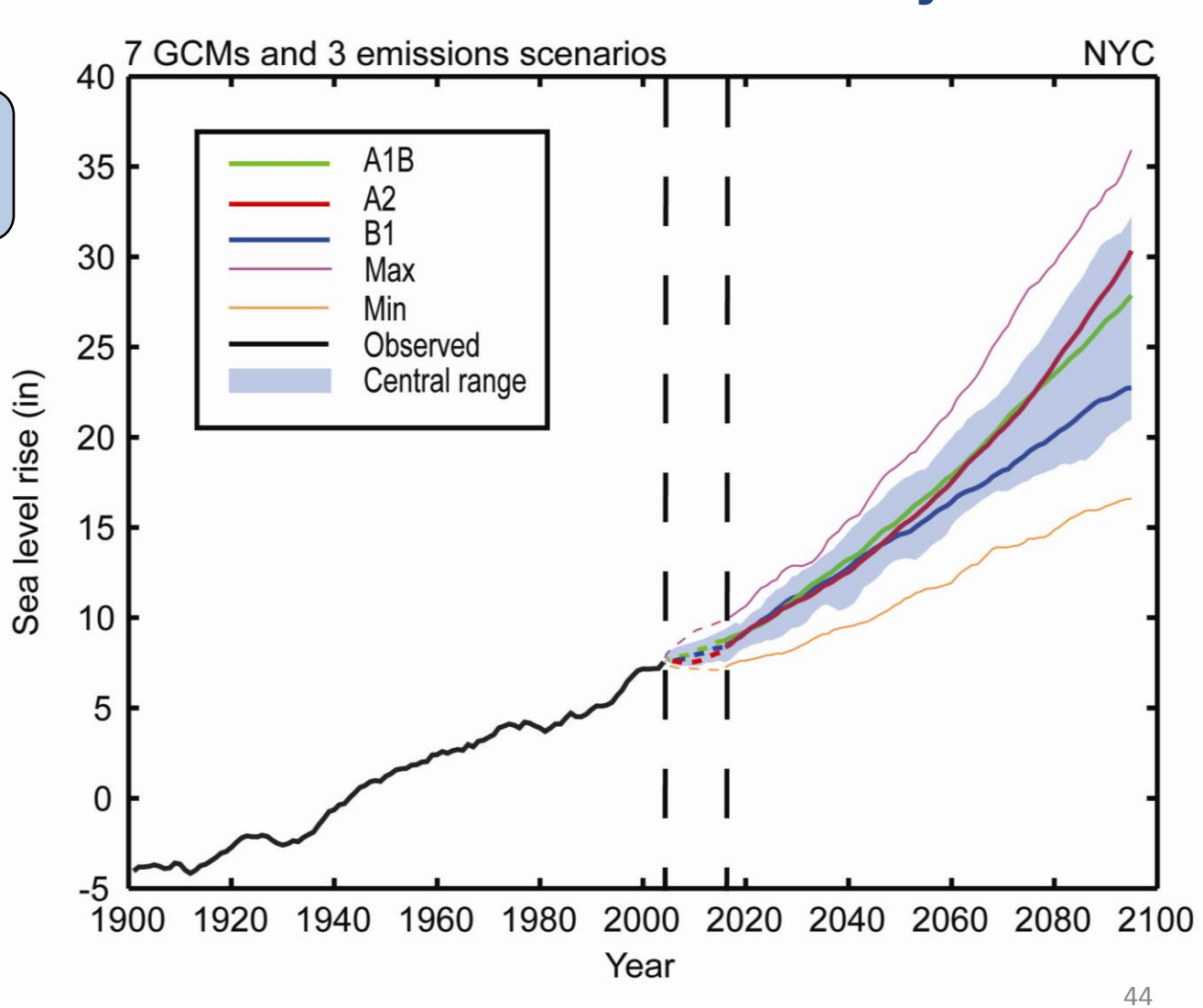
Annual Precipitation



from pg. 19, CRI

Figure 1c: Observed Climate & Future Projections

Sea Level Rise



from pg. 19, CRI

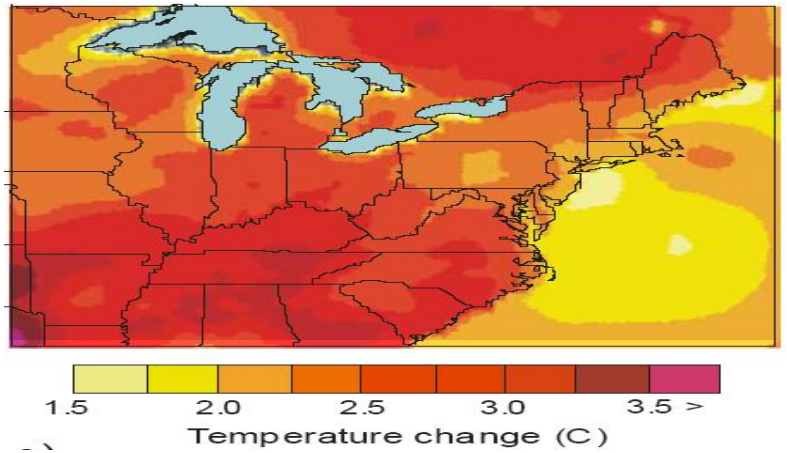
Section 4: Infrastructure Impacts

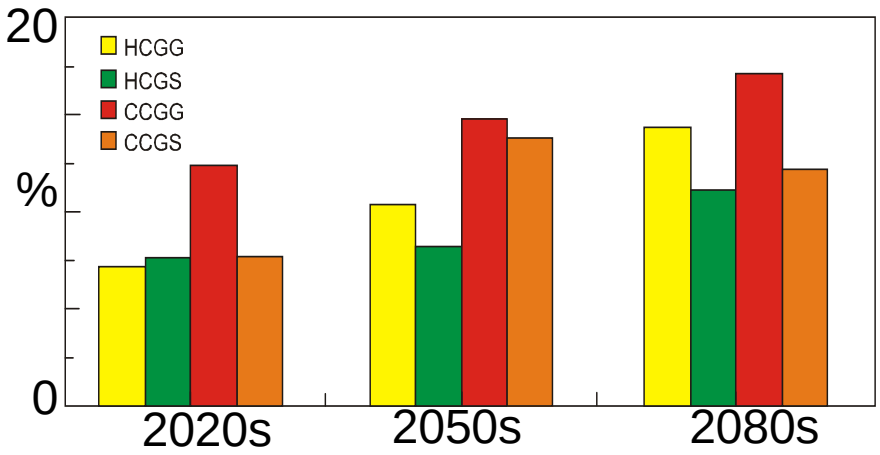
Temperature Risk Factors & Likelihood → **Potential Implications for NYC Infrastructure**

• More hot days	Very likely
• Hotter summers	Very likely
• More frequent & intense heat waves	Very likely
• Warmer winters	Very likely
• Fewer & less extreme cold air outbreaks	Very likely
• Warmer water temperatures	Very likely

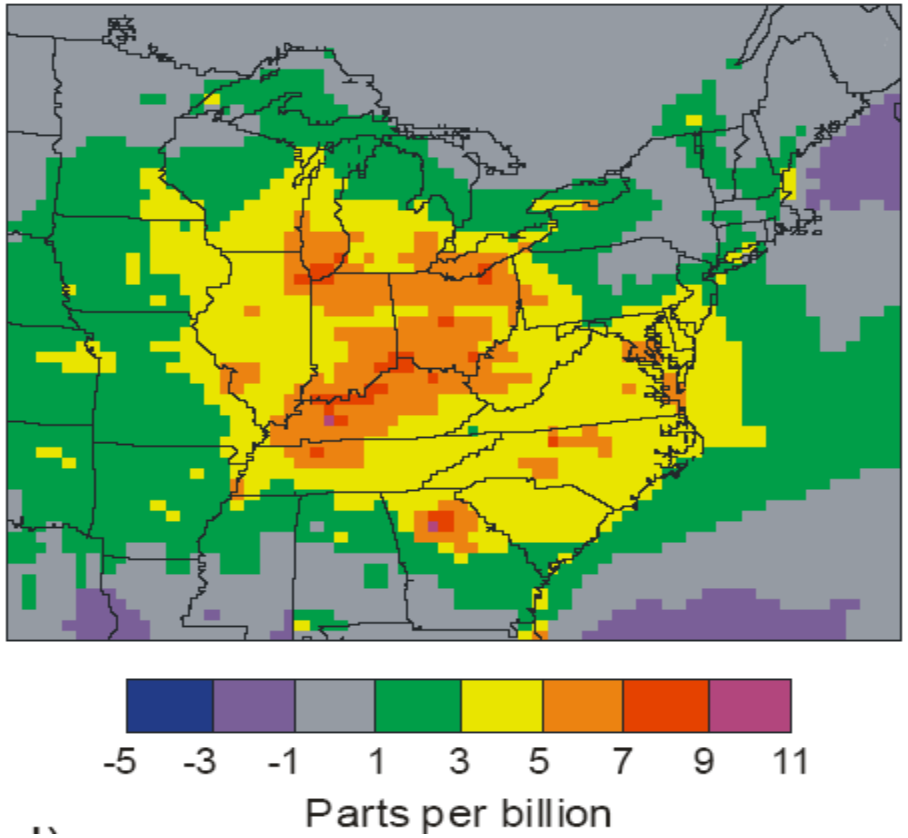
- Degradation of and increased strain on materials
- Increase in peak electricity load, resulting in more frequent power outages
- Increase of demand on HVAC systems

Key Risks and Integrated Impacts
Energy, Air Quality and Health





Increase in peak load



Change in ozone

Increased incidence of black outs, heat stress, asthma

MEC, 2001; Kinney et al., 2004

Section 4: Infrastructure Impacts

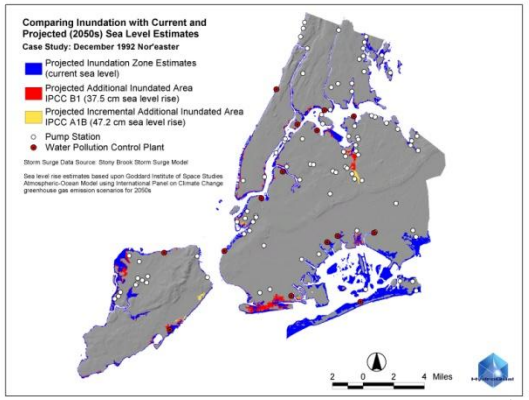
Precipitation Risk Factors & Likelihood		Potential Implications for NYC Infrastructure
• Reduced snowfall	Likely	• Increase of street, basement and sewer flooding • Increase in delays on public transportation and low-lying highways
• More frequent & intense rainfall	Likely	
• Increased average annual precipitation	More likely than not	• Decrease in average reservoir storages • Degradation of and increased strain on materials
• More frequent and intense droughts	More likely than not	

Section 4: Infrastructure Impacts

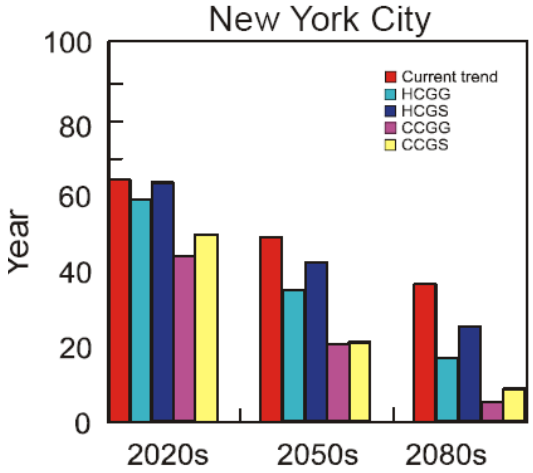
Precipitation Risk Factors & Likelihood → **Potential Implications for NYC Infrastructure**

Precipitation Risk Factors & Likelihood		Potential Implications for NYC Infrastructure
• Higher average sea levels	Extremely likely	• Encroachment of saltwater on freshwater sources and ecosystems • Increase in pollution released from brownfields & other unprotected waste sites
• More frequent and intense coastal flooding	Very likely	• Increase in structural damage to infrastructure due to flooding and wave action
• Shortened 100-year flood recurrence period	Very likely	

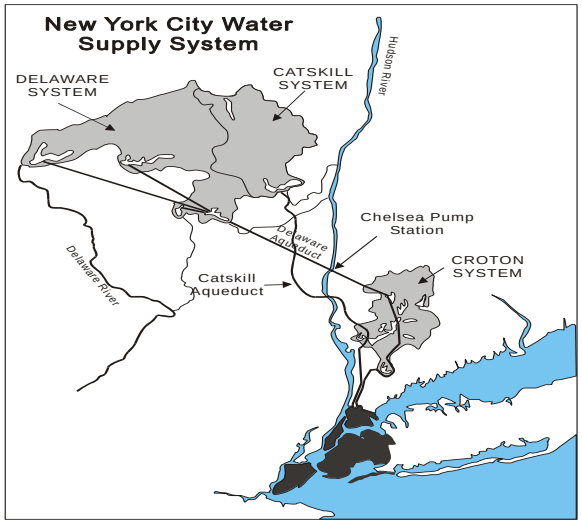
Key Risks and Integrated Impacts
Sea Level Rise, Transportation, and Water



Wastewater Treatment Plants

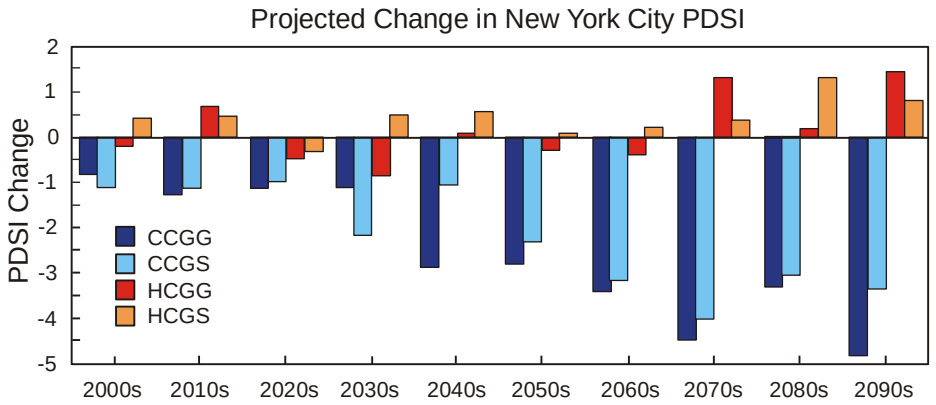


Change in 100-yr coastal floods



Water system

Transportation



Change in droughts and inland floods

MEC, 2001

Federal Government Can Foster Adaptation

- Set up ‘umbrella’ organization

  ~UK Climate Impacts Program
- Conduct broad-scale, ongoing assessments of climate change and responses

  ~US National Assessment
- Foster process for stakeholder – policymaker – scientist interaction

  ~ Agency Guidelines; National Adaptation Network
- Provide guidance and data for climate change scenarios

  ~ National Climate Service
- Coordinate between different levels of jurisdictions: city, state, federal

  ~ National Standards and Regulations
- **Funding**, including adaptation in stimulus funding