Get Past the Past: Climate Change Adaptation In & Around NYC

Responding to Climate Change as a Risk-Management Issue

The New York City Approach

September 23, 2010

New York Academy of Sciences

Gary Yohe

Wesleyan University

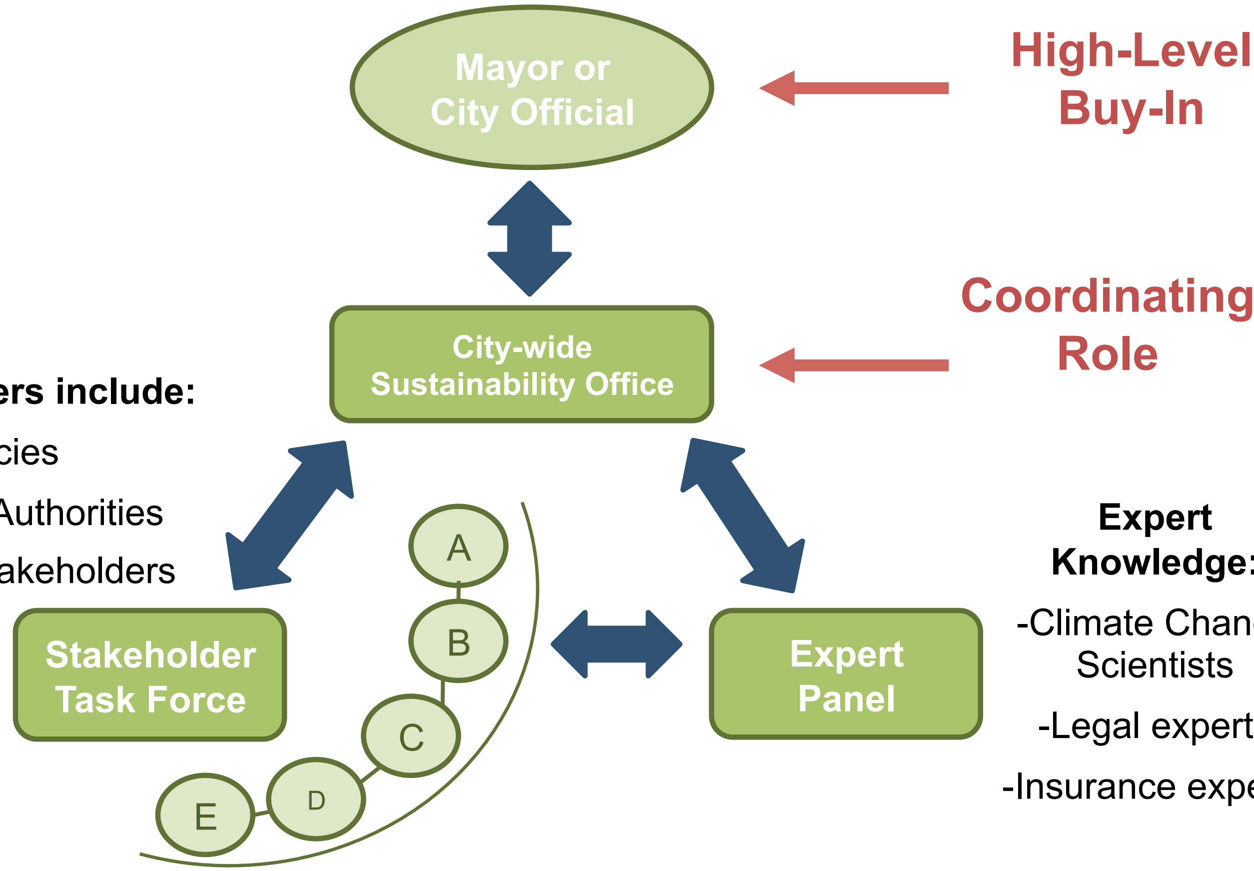
New York City Panel on Climate Change

- Modeled after the IPCC
- Independent advisory body for the New York City Climate Change Task Force
- Convened by Mayor Bloomberg in August 2009
- Composed of climate change and impacts scientists, legal, insurance and risk management experts

Design Integrative Process

Stakeholders include:

- City Agencies
- Regional Authorities
- Private Stakeholders



Integration across Sector-specific Working Groups

Expert Knowledge:

-Climate Change Scientists

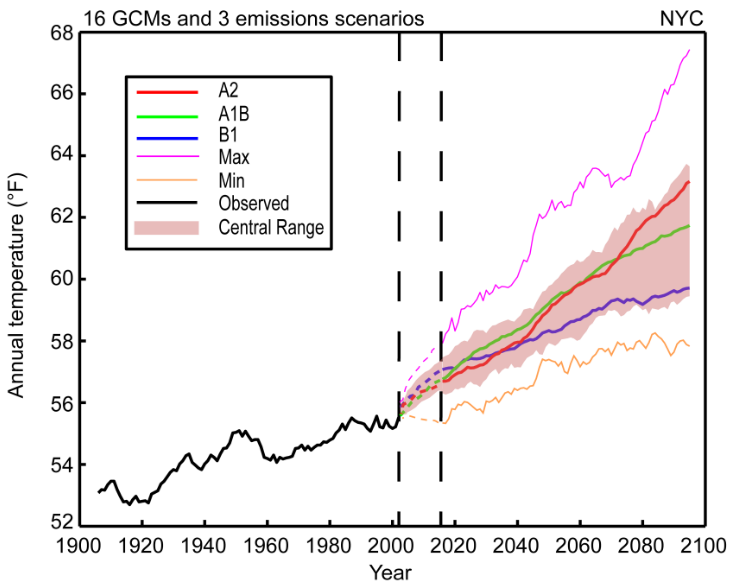
-Legal experts

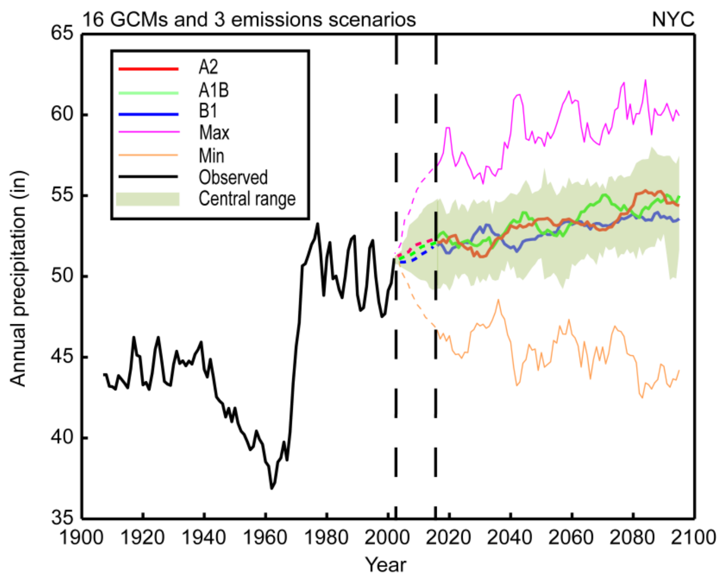
-Insurance experts

Foundation of Climate Change Action in New York City

YEAR	REPORT TITLE	ORGANIZATION/PUBLICATION
Underway - 2010	*New York State Adaptation Assessment*	*New York State Energy Research & Development Authority*
2009	*New York City Panel on Climate Change*	*Columbia University and CUNY*
Underway - 2009	*New York City Climate Change Adaptation Task Force*	*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	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: 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*

Future Climate Projections





Mean Annual Changes[1]

	Baseline 1971-2000	**2020s**	**2050s**	**2080s**
Air Temperature Central Range[2]	55˚F	+ 1.5 to 3.0˚F	+ 3.0 to 5.0˚F	+ 4.0 to 7.5˚F
Precipitation Central Range	46.5 in[3]	+ 0 to 5 %	+ 0 to 10 %	+ 5 to 10%
Sea level rise[3] Central Range	NA	+ 2 to 5 in	+ 7 to 12 in	+ 12 to 23 in
Rapid ice-melt scenario[4]	NA	~ 5 to 10 in	~ 19 to 29 in	~ 41 to 55 in

Source: Columbia University Center for Climate Systems Research

[1] Based on 16 GCMs (7 GCMs for sea level rise) and 3 emissions scenarios. Baseline is 1971-2000 for temperature and precipitation and 2000-2004 for sea level rise. Data from National Weather Service (NWS) and National Oceanic and Atmospheric Administration (NOAA). Temperature data are from Central Park; precipitation data are the mean of the Central Park and La Guardia Airport values; and sea level data are from the Battery at the southern tip of Manhattan (the only location in NYC for which comprehensive historic sea level rise data are available).
[2] Central range = middle 67% of values from model-based probabilities; temperatures ranges are rounded to the nearest half-degree, precipitation to the nearest 5%, and sea level rise to the nearest inch.
[3] The model-based sea level rise projections may represent the range of possible outcomes less completely than the temperature and precipitation projections. For more information, see the “sea level rise” paragraph in the “mean annual changes” section.
[4] “Rapid ice-melt scenario” is based on acceleration of recent rates of ice melt in the Greenland and West Antarctic Ice sheets and paleoclimate studies.

Extreme Events
The Sources of Risk

	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	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
	4 inches	*0.3*	0.2 to 0.4	0.3 to 0.4	0.3 to 0.5
	Drought to occur, on average[3]	*~once every 100 yrs*	~once every 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 (in ft) associated with 1-in-10 yr flood	*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 (in ft) associated with 1-in-100 yr flood	*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 (in ft) associated with 1-in-500 yr flood	*10.7*	10.9 to 11.2	11.4 to 11.7	11.8 to 12.6

1 Decimal places shown for values less than 1 (and for all flood heights), although this does not indicate higher accuracy/certainty. More generally, the high precision and narrow range shown here are due to the fact that these results are model-based. Due to multiple uncertainties, actual values and range are not known to the level of precision shown in this table.
2 Defined as 3 or more consecutive days with maximum temperature exceeding 90°F.
3 Based on minima of the Palmer Drought Severity Index (PDSI) over any 12 consecutive months. More information on the PDSI and the drought methods can be found in Appendix B.
4 Does not include the rapid ice-melt scenario.

Source: Columbia University Center for Climate Systems Research

NPCC: Ch 3 - Climate Observations and Projections

Chapter 2

Adopting a Risk-based Approach

Gary Yohe[1] and Robin Leichenko[2]

[1] Wesleyan University

[2] Rutgers University

Objective & Rationale

- "Responding to climate change involves an ***iterative risk management process that includes both adaptation and mitigation***, and takes into account climate change damages, co-benefits,sustainability, equity and attitudes to risk (IPCC, 2007; our emphasis)."
- This is a perspective that has since been adopted by the National Research Council in the America's Climate Choices panel Reports.

Key Findings & Relevance

Risk is the product of probability and consequence It follows that attention should be paid to:

- near and medium-term impacts caused by incremental changes in, for example, temperature and precipitation;
- ***and*** the possibility that low-probability but high consequence events may occur (or become more likely).

Key Findings & Relevance

– ***and*** the possibility that low-probability but high consequence events may occur (or become more likely). It is in here that it is necessary
  - (1) to identify, characterize, and understand nonlinear tipping points and impact triggers, and
  - (2) to devise decision pathways that suggest when and how to adopt different types of adaptation measures.

Mean Annual Changes[1]

	Baseline 1971-2000	**2020s**	**2050s**	**2080s**
Air Temperature Central Range[2]	55˚F	+ 1.5 to 3.0˚F	+ 3.0 to 5.0˚F	+ 4.0 to 7.5˚F
Precipitation Central Range	46.5 in[3]	+ 0 to 5 %	+ 0 to 10 %	+ 5 to 10%
Sea level rise[3] Central Range	NA	+ 2 to 5 in	+ 7 to 12 in	+ 12 to 23 in
Rapid ice-melt scenario[4]	NA	~ 5 to 10 in	~ 19 to 29 in	~ 41 to 55 in

Source: Columbia University Center for Climate Systems Research

[1] Based on 16 GCMs (7 GCMs for sea level rise) and 3 emissions scenarios. Baseline is 1971-2000 for temperature and precipitation and 2000-2004 for sea level rise. Data from National Weather Service (NWS) and National Oceanic and Atmospheric Administration (NOAA). Temperature data are from Central Park; precipitation data are the mean of the Central Park and La Guardia Airport values; and sea level data are from the Battery at the southern tip of Manhattan (the only location in NYC for which comprehensive historic sea level rise data are available).
[2] Central range = middle 67% of values from model-based probabilities; temperatures ranges are rounded to the nearest half-degree, precipitation to the nearest 5%, and sea level rise to the nearest inch.
[3] The model-based sea level rise projections may represent the range of possible outcomes less completely than the temperature and precipitation projections. For more information, see the "sea level rise" paragraph in the "mean annual changes" section.
[4] "Rapid ice-melt scenario" is based on acceleration of recent rates of ice melt in the Greenland and West Antarctic Ice sheets and paleoclimate studies.

Extreme Events
The Sources of Risk

	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	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
	4 inches	*0.3*	0.2 to 0.4	0.3 to 0.4	0.3 to 0.5
	Drought to occur, on average[3]	*~once every 100 yrs*	~once every 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 (in ft) associated with 1-in-10 yr flood	*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 (in ft) associated with 1-in-100 yr flood	*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 (in ft) associated with 1-in-500 yr flood	*10.7*	10.9 to 11.2	11.4 to 11.7	11.8 to 12.6

1 Decimal places shown for values less than 1 (and for all flood heights), although this does not indicate higher accuracy/certainty. More generally, the high precision and narrow range shown here are due to the fact that these results are model-based. Due to multiple uncertainties, actual values and range are not known to the level of precision shown in this table.
2 Defined as 3 or more consecutive days with maximum temperature exceeding 90°F.
3 Based on minima of the Palmer Drought Severity Index (PDSI) over any 12 consecutive months. More information on the PDSI and the drought methods can be found in Appendix B.
4 Does not include the rapid ice-melt scenario.

Source: Columbia University Center for Climate Systems Research

NPCC: Ch 3 - Climate Observations and Projections

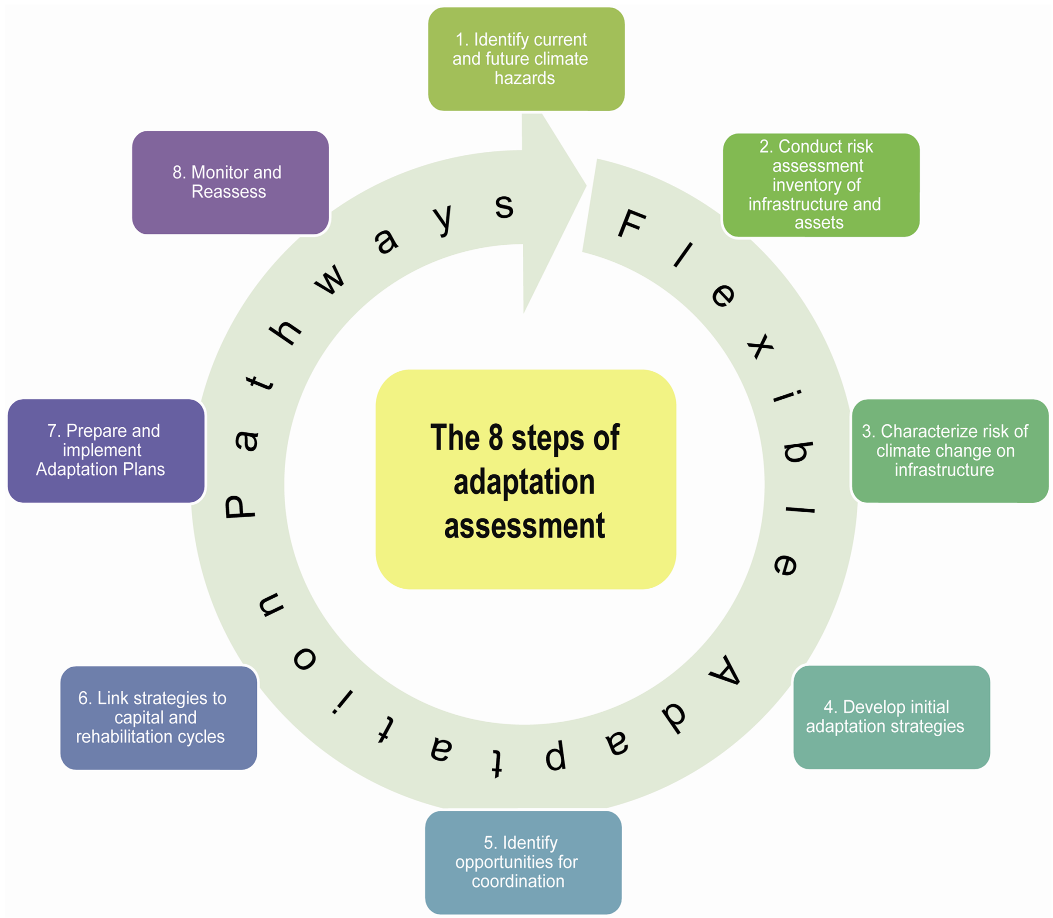
Key Findings & Relevance

- As a result, any iterative, or Flexible Adaptation Pathway, process must recognize with equal care the multiple dimensions of climate hazards, impacts, adaptations, economic development, and other social factors.
- A risk-based approach changes the underlying decision calculus because, at the very least, it leads immediately to consideration of adaptations that complement existing risk and hazard management strategies.

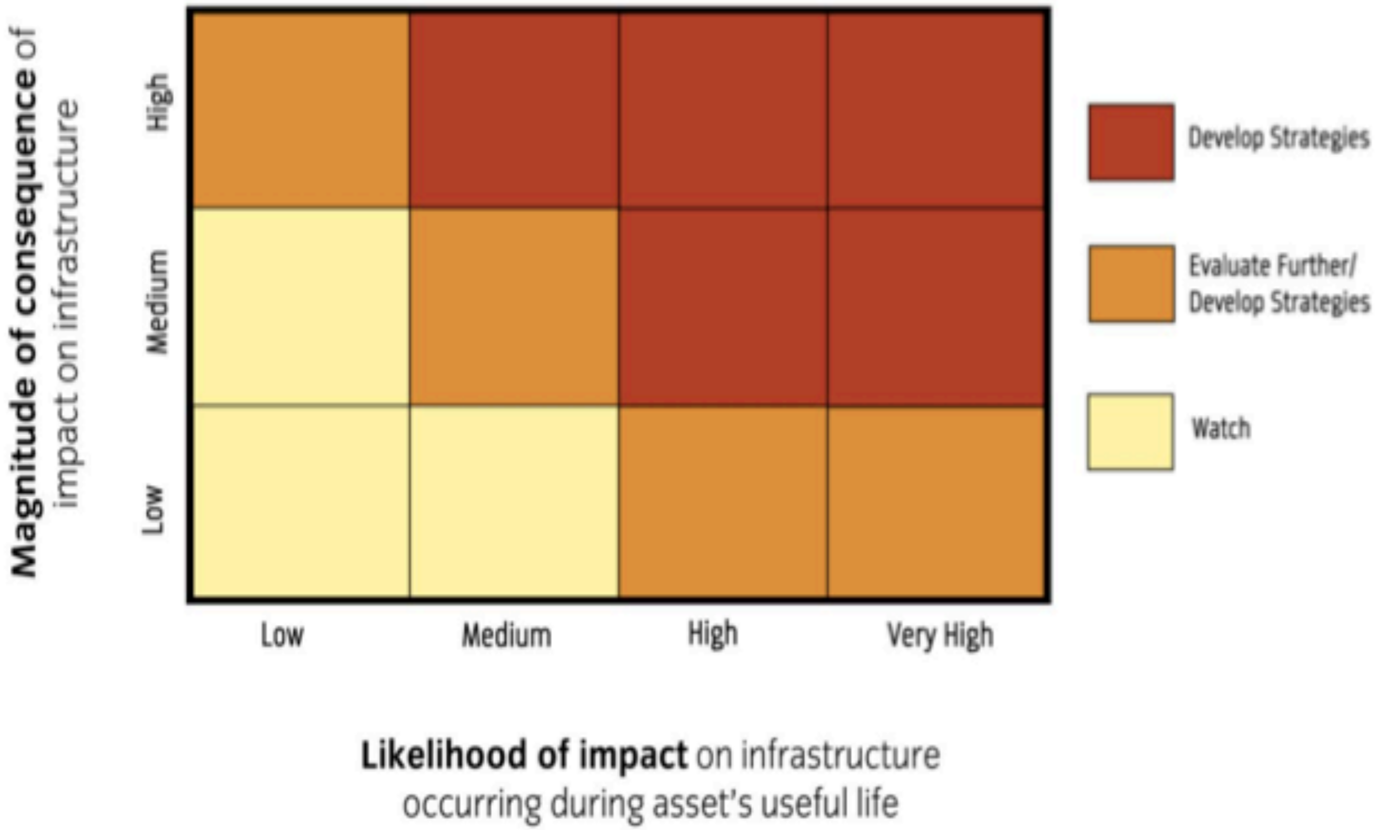
Key Findings & Relevance

- New York City has embraced this conclusion and, perhaps more importantly, has recognized that Flexible Adaptation Pathways will be feasible only if climate change monitoring programs are established.
- It will be responsible for New York City stakeholders to evaluate the ongoing change and the effectiveness of their risk management-based responses in order to seize opportunities and make the appropriate “mid-course” corrections

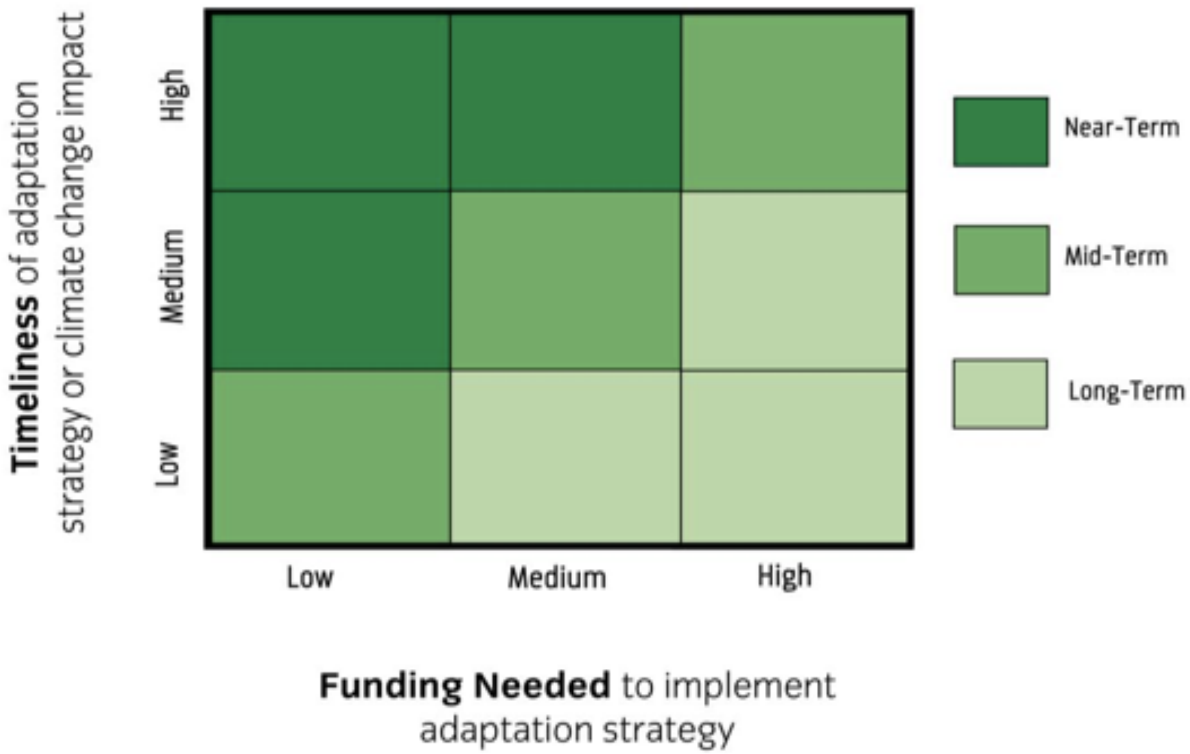
8 Adaptation Assessment Steps



Adaptation Assessment Risk Matrix



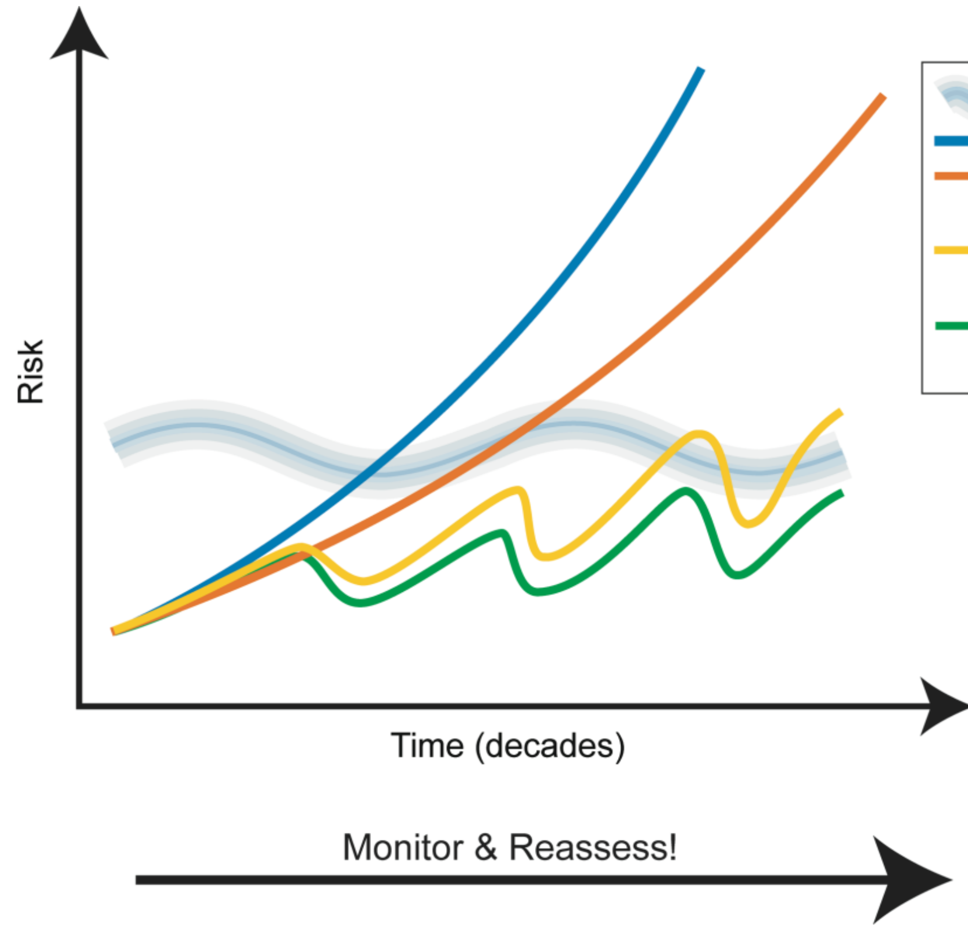
Adaptation Assessment Prioritizing Matrix



Key Findings & Relevance

- During the 21st Century:
  - Heat waves are very likely to become more frequent, intense, and of longer duration
  - Intense rain events are likely to become more common
  - Rising sea levels are extremely likely, and are very likely to lead to more frequent and damaging coastal flooding
- Climate projections should be updated regularly by leveraging NYC's science institutions, as well as improvements in modeling and observational data.

Key Findings & Relevance



Graphic adapted from: Lowe, J., T. Reeder, K. Horsburgh, and V. Bell. "Using the new TE2100 science scenarios." UK Environment Agency.

Thank you for your attention.