Climate Change Impacts and Adaptation Efforts in New York City

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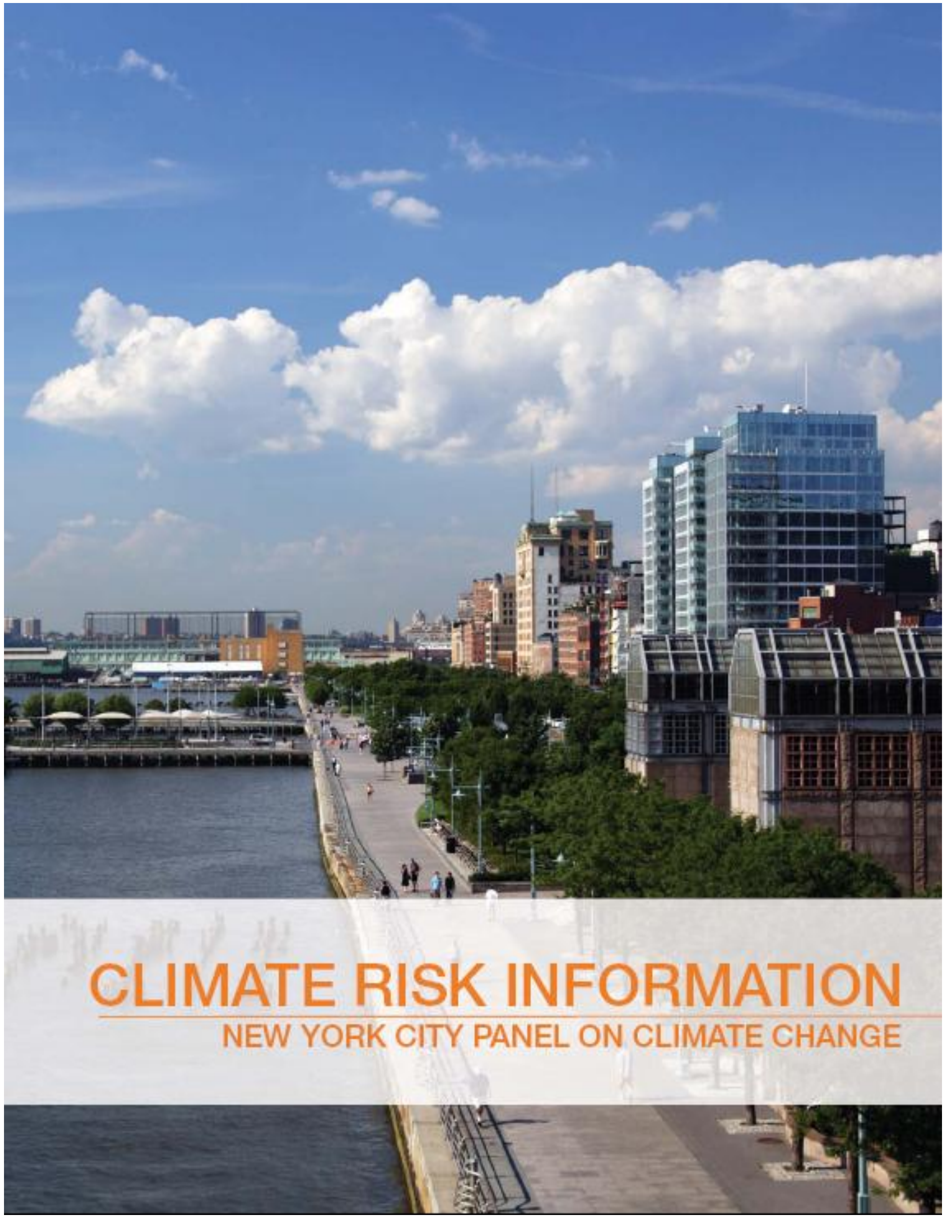
New York City Panel on Climate Change

NPCC Background

- Funded by donation from the Rockefeller Foundation
- 13 Members:
  - climate change and impacts scientists
  - legal
  - insurance
  - risk management experts
- Technical advisory body for the Task Force
- 3 Workbooks:
  - Climate Risk Information
  - Adaptation Assessment Checklist
  - Climate Protection Levels
- Final Foundation Report

Workbook #1

Climate Risk Information



Climate Risk Information

Document Guide

Global Climate Scenarios

- SRES greenhouse gas emissions pathways
- GCM simulations

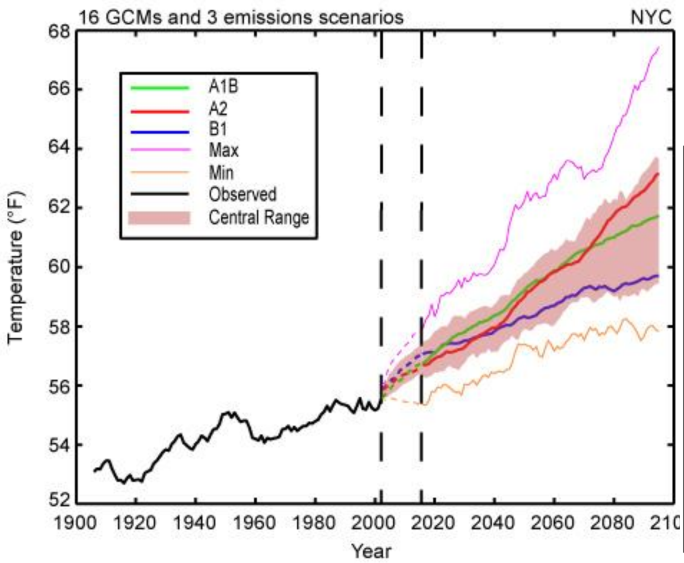
Local Climate Change Information

- Observed data
- Quantitative GCM-based projections
- Qualitative GCM-based projections

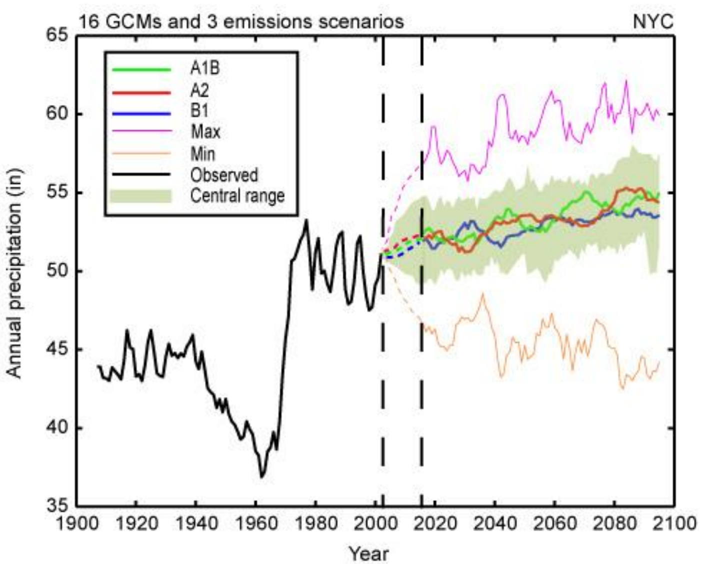
Climate Risk Factors

- Generalized climate hazards of most consequence to NYC infrastructure used to determine critical infrastructure at-risk

GCM-based Regional Projections--Mean 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



Combined observed and projected temperature and precipitation. The three thick lines (green, red, and blue) show the average for each emissions scenario across the 16 GCMs. Shading shows the central range. The bottom and top lines, respectively, show each year's minimum and maximum projections across the suite of simulations. A ten-year filter has been applied to the observed data and model output. The dotted area between 2002 and 2015 represents the period that is not covered due to the smoothing procedure.

Source: Columbia Center for Climate Systems Research

Climate Risk Information

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

Climate Risk Information

Table 3: Qualitative Changes in Extreme Events

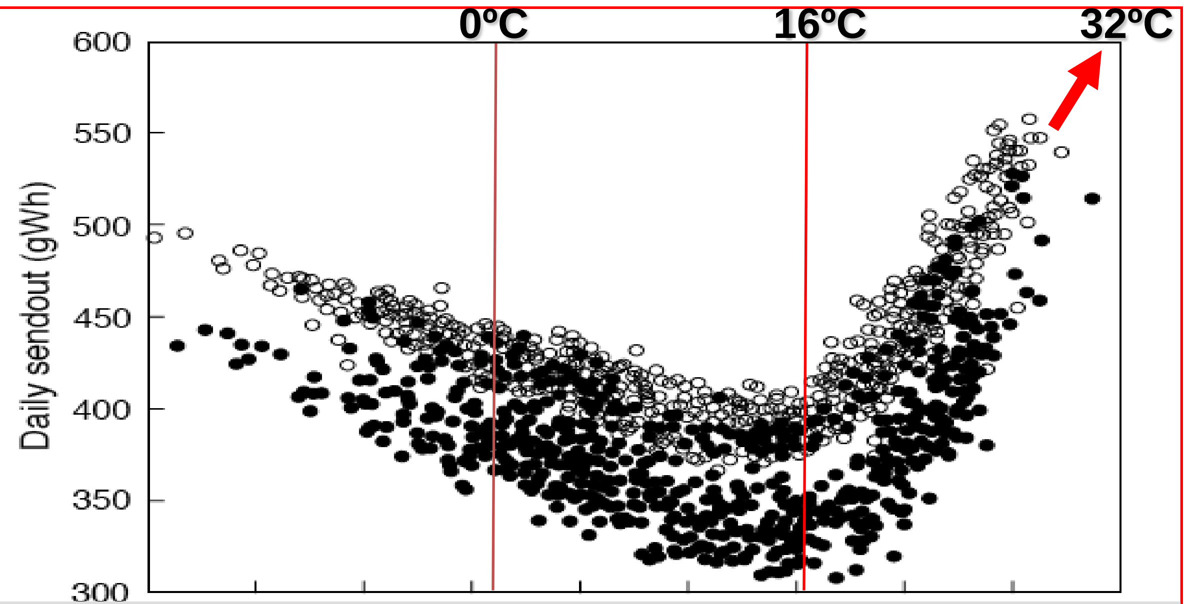
Extreme Event	Probable Direction Throughout 21st Century	Likelihood[1]
Heat Index[2]	Up	Very likely
Ice storms/ Freezing rain	Up	About as likely as not
Snowfall frequency & amount	Down	Likely
Intense Hurricanes	Up	More likely than not
Nor'easters	Unknown	
Lightning	Unknown	
Downpours (precipitation rate/hour)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

from pg. 21, CRI

Impacts: Heat Waves and the Energy and Health Sectors (1)

During heat waves, even a small increase in temperature can mean a large increase in energy load….

…Leading to an increased risk of power outages

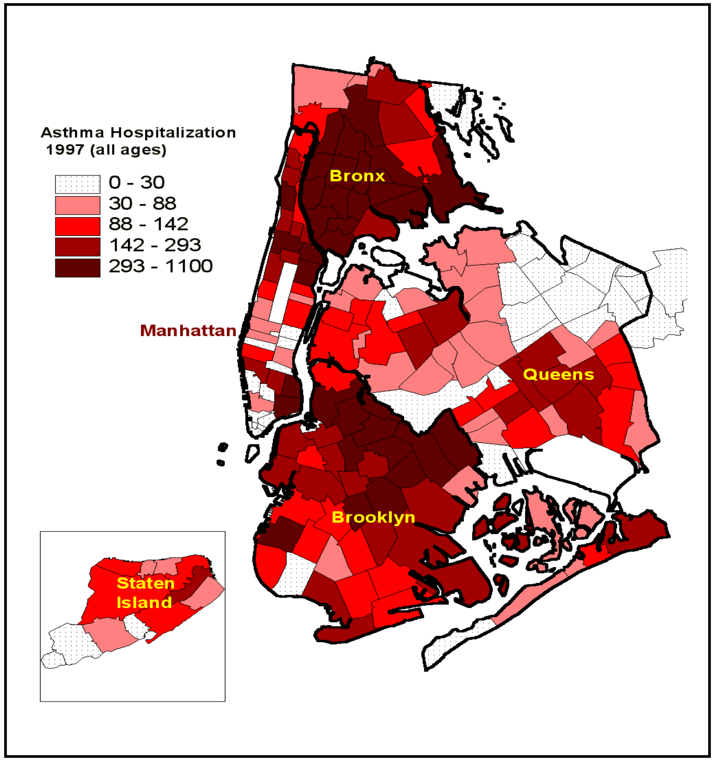


Daily Electric Energy Load (gigawatt-hours) in NY State, vs. Daily-Average Temperature. Solid Points=1966; Open Points=1997 => Peak Load Issues

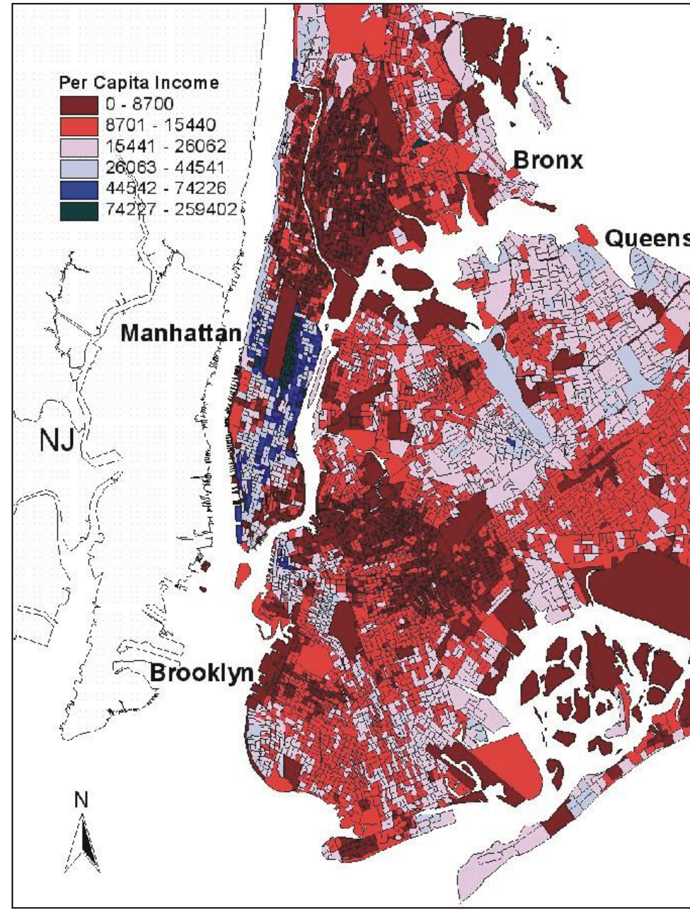
=More stress on systems

Impacts: Heat Waves and the Energy and Health Sectors (2)

Asthma Hospitalizations, 1997 –All Ages



Hospitalizations/100,000 persons/yr



Vulnerability
Non-linearity
Remote climate hazards
Combined effects of multiple climate hazards
=Cascading uncertainty

MetroEast Coast Assessment

Bureau of the Census, 1999; CDC, NHDS, 1997

Climate Risk Information

Section 4: Infrastructure Impacts

Climate Risk Factor → **Likelihood** → **Potential Implications for NYC Infrastructure**

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

- Increase of street, basement and sewer flooding
- Increase in delays on public transportation and low-lying highways
- Decrease in average reservoir storages

- Encroachment of saltwater on freshwater sources and ecosystems
- Increase in pollution released from brownfields & other waste sites
- Increase in structural damage to infrastructure from flooding and wave action

Climate Risk Information

Section 5: Indicators & Monitoring

Climate Indicators

- Mean annual temperatures
- Hot & cold degree days
- Temperature extremes

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- Temperature extremes

- Tropical storms
- Earth's carbon cycle

Climate-related Impact Indicators

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

Infrastructure-specific Impacts

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

MONITOR & REASSESS

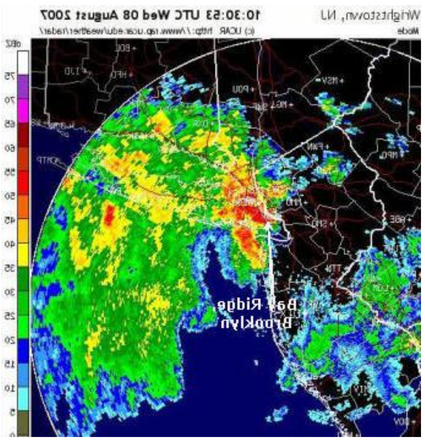
Adaptation Assessment Steps

1	Identify current and future climate hazards relevant to critical infrastructure & assets
2	Conduct inventory of infrastructure and assets
3	Characterize risk of climate change on infrastructure a. Identify at-risk infrastructure b. Rank magnitude of consequence & likelihood of impact c. Determine location on Risk Matrix
4	Develop initial adaptation strategies a. Categorize strategies b. Evaluate strategies
5	Link strategies to capital and rehabilitation cycles
6	Identify opportunities for coordination
7	Prepare and implement Adaptation Plans
8	Monitor and reassess

Drainage and Wastewater Management--Adaptations

Rainwater Drainage

- Improve collection (expand sewers and pumps, and retain stormwater above ground)
- Enhance natural landscape and drainage
- Plan for controlled flooding



August 8, 2007

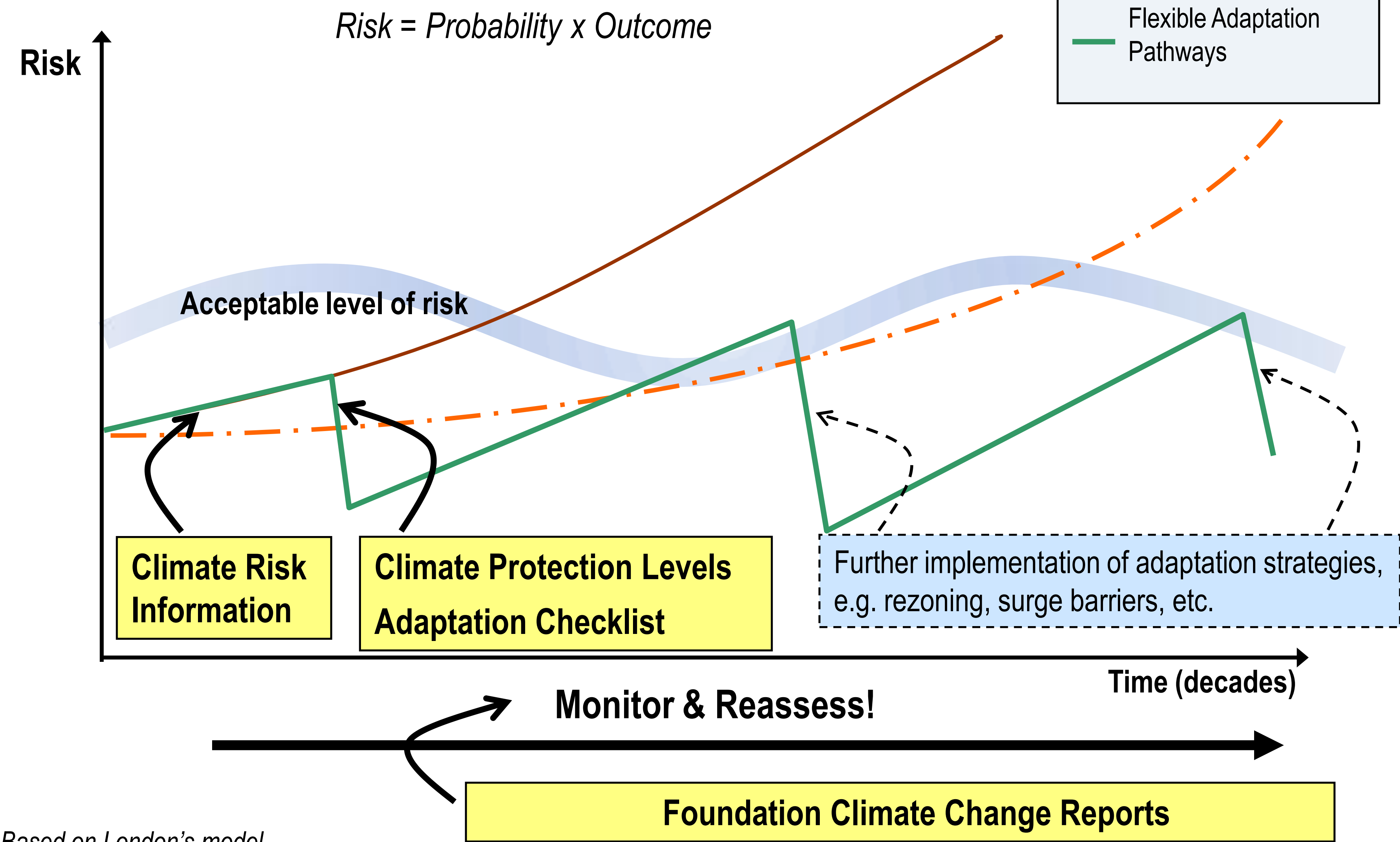
Storm Surge & Water Treatment

- Raise elevation of key infrastructure
- Use watertight containment of key equipment
- Have reserves of key equipment
- Install local protective barriers
- Allow some inundation in defined areas

Regional Strategy

Flexible Adaptation Pathways

Flexible Adaptation Pathways to managing flood risks



Based on London's model

Conclusions

- **New York City faces a range of current and future climate hazards**
- **The most cost-effective and efficient adaptation strategies are often relatively low-tech; these strategies are often focused on the most vulnerable populations and climate change concerns may be secondary**
- **Our understanding of climate, climate impacts, and climate change solutions remains limited**
- **Uncertainty is widespread in all systems, and does not argue for inaction (although it does present a host of challenges)**
  -Flexible adaptation pathways
- **Long-term planning can lessen negative outcomes of climate change, and increase positive outcomes**
- **Responding to today's weather risks helps to prepare for climate change risk in the future, and increases resiliency generally**