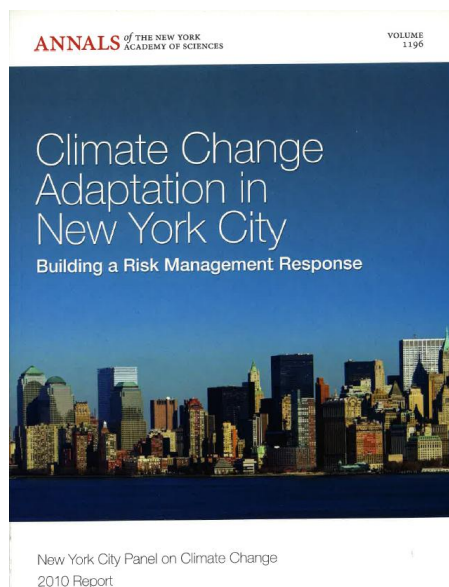




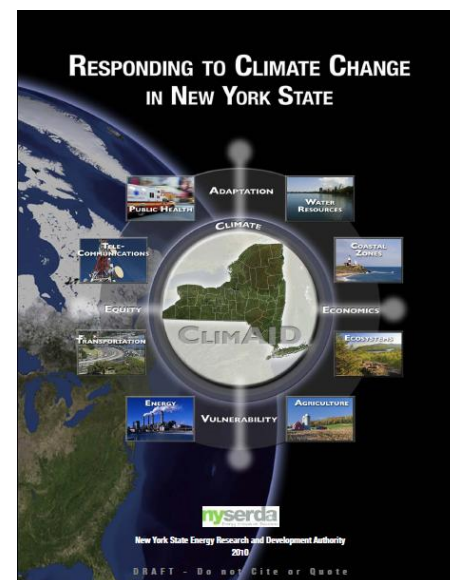
# Climate Risk, Sea Level Rise, and Adaptation Implications



*NPCC - Climate Change Adaptation in New York City: Building a Risk Management Response*

Cynthia Rosenzweig

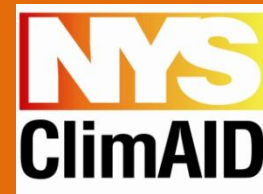
Urban Wetlands Protection and Restoration  
Workshop  
New York, New York  
December 1, 2010



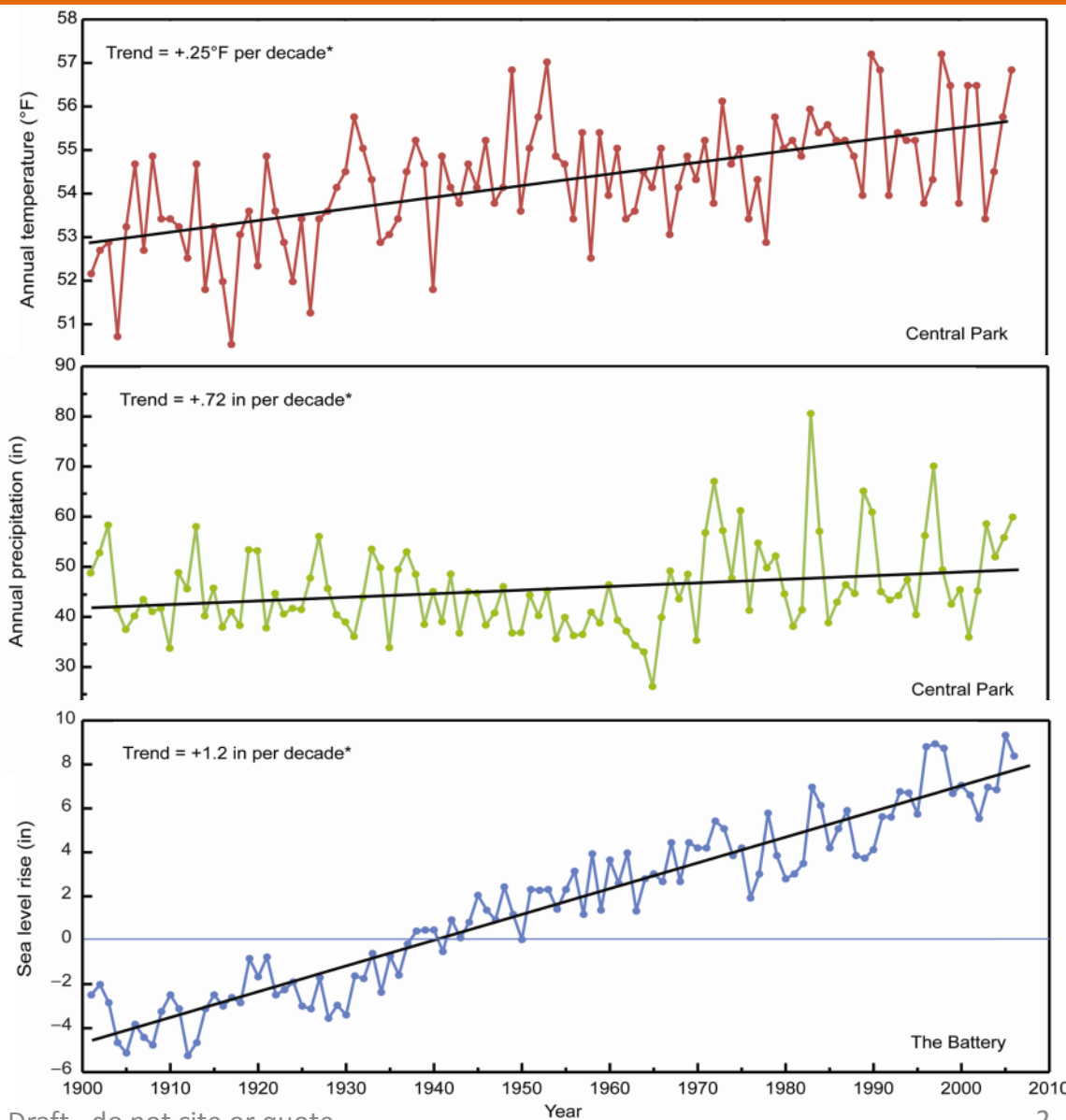
*ClimAID - Integrated Assessment for Effective Climate Change Adaptation Strategies in New York State*



# NYS Climate is Changing



- Temperature
  - Significant warming since 1970
- Precipitation
  - Interannual variability dominates long-term trend
- Sea level
  - Significant increase over the 20<sup>th</sup> century at the Battery

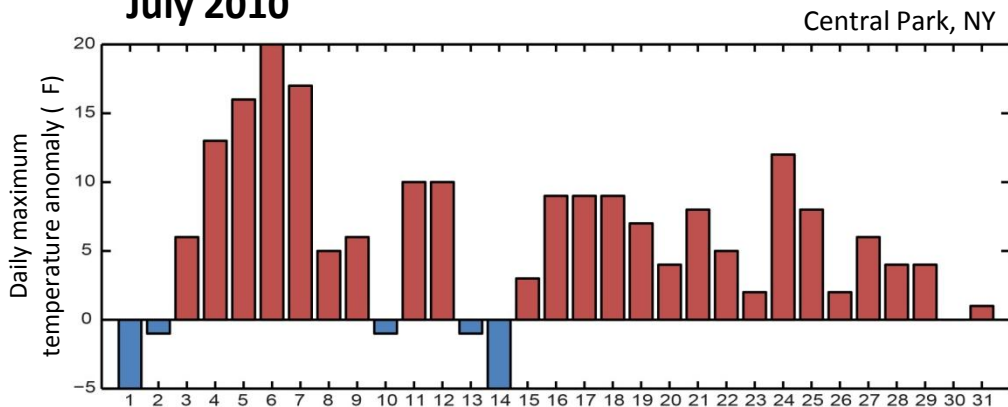




# The Hot Summer of 2010

## *Summer was hottest on record*

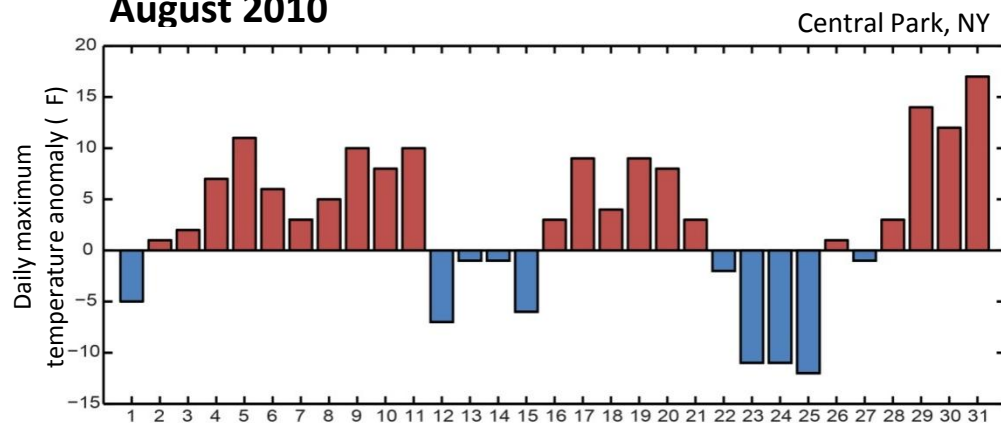
### July 2010



- **July** was the **2<sup>nd</sup> warmest month on record** at Central Park, with average temperature of 81.3 F (July '99 was the warmest 81.4 F)
- There were **16 days at or above 90 F**, the normal for July is 6.
- In July 2009, the highest maximum temperature for the month was 86 F

- Mean temperature in **August** was 2.3 F above normal monthly average of 75.1 F
- Summer was hottest on record by 0.5 F
- At Central Park, there were **37 days at or above 90 F**, tied for the 2<sup>nd</sup> most on record

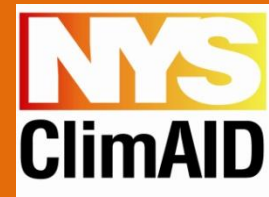
### August 2010



*Mean number of days at or above 90 F per year for the 2050s  
is projected to be 38 days*



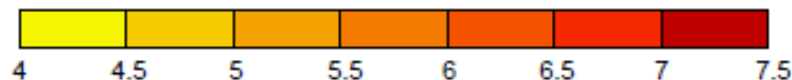
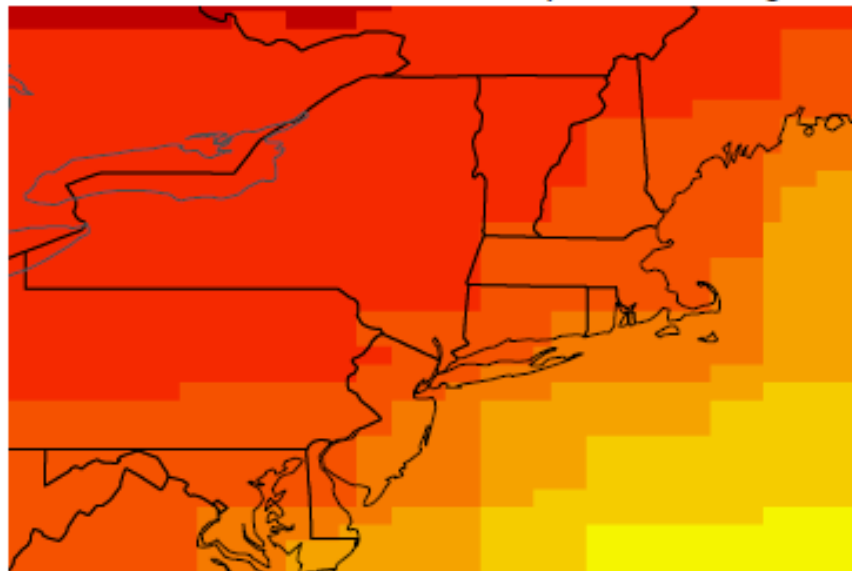
# NYS Climate will Continue to Change



The climate of New York State is projected to change

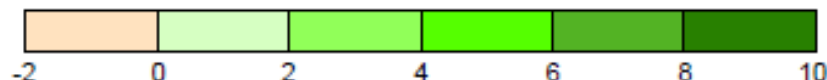
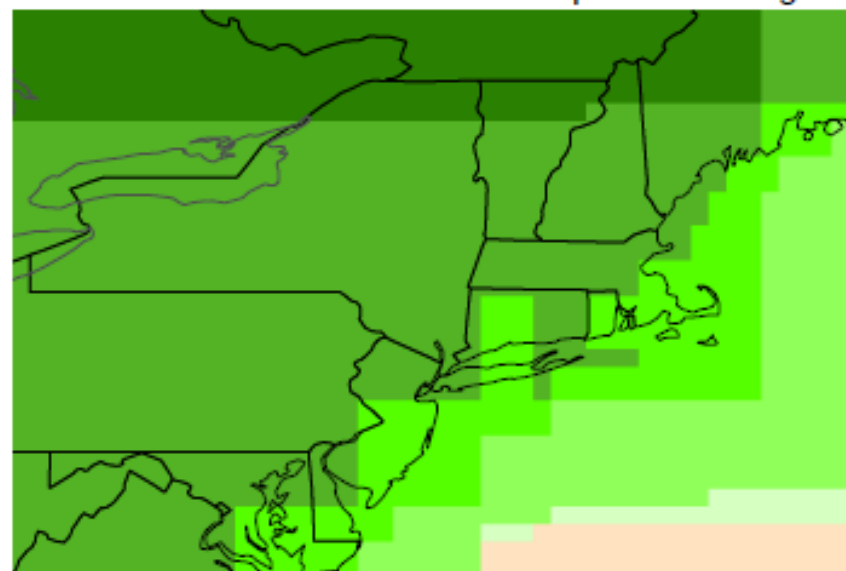
- Warmer temperatures with more heat waves
- More frequent and intense precipitation events
- Increased sea level rise and coastal flooding

A1B 2080s 16 GCM Annual Temperature Change



Annual temperature change (°F)

A1B 2080s 16 GCM Annual Precipitation Change

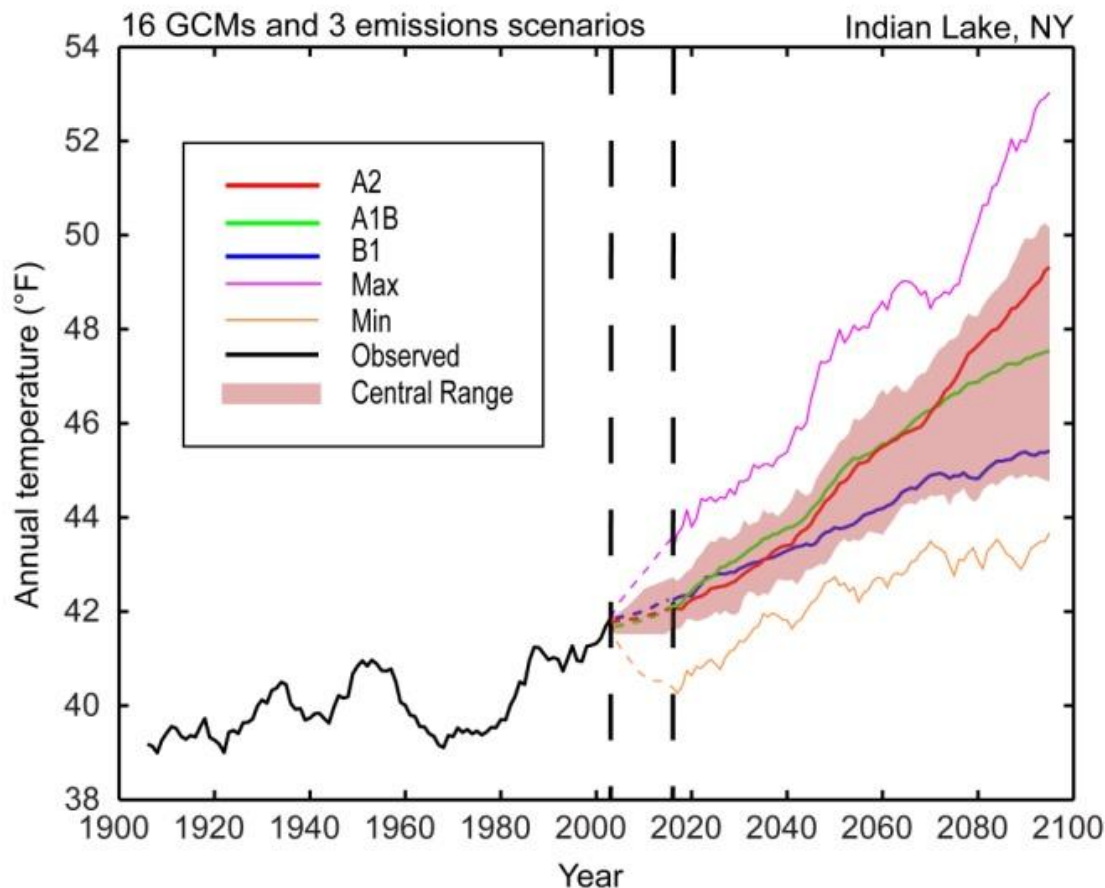


Annual precipitation change (%)



# Climate Projections – Temperature

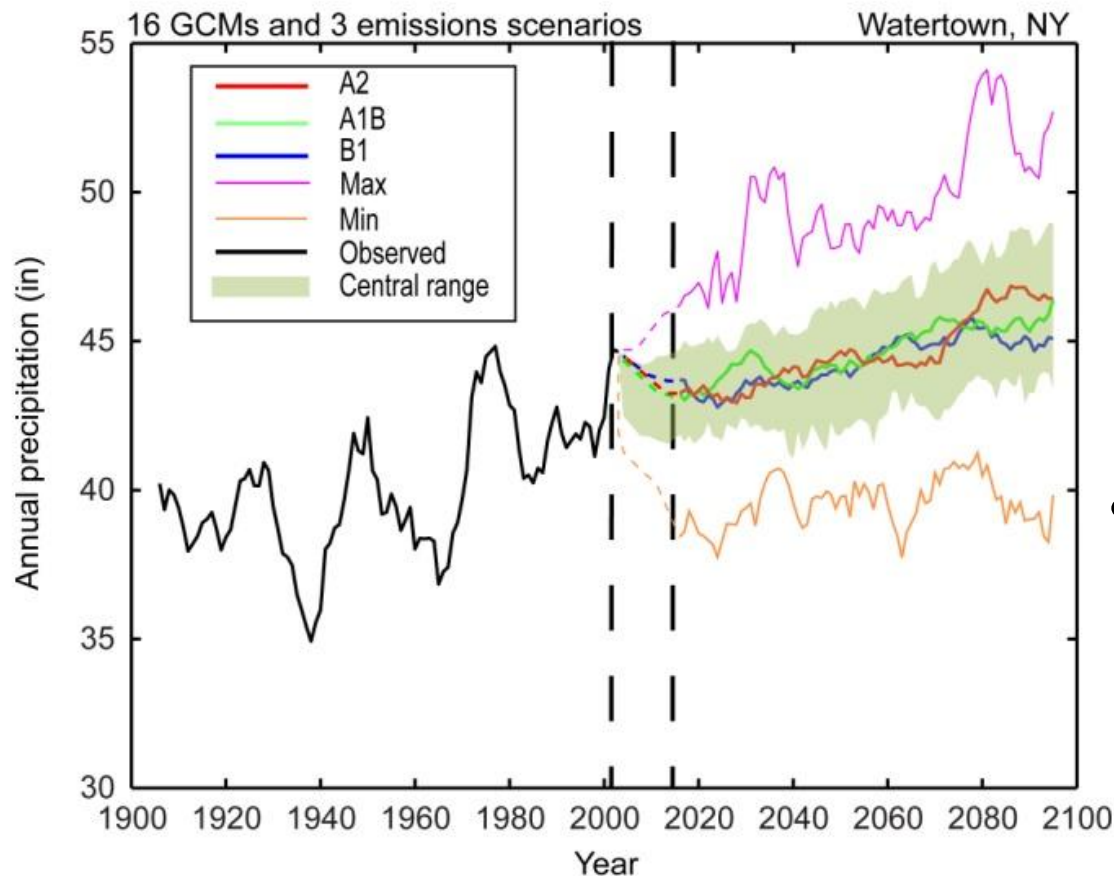
- Annual average **temperatures** are expected to rise by:
  - 1.5 to 3°F by the 2020s
  - 3 to 5.5°F by the 2050s
  - 4 to 9°F by the 2080s
- **Heat waves** will be more frequent and intense







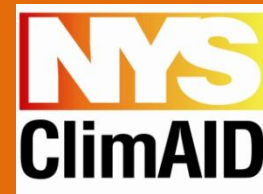
# Climate Projections – Precipitation



- Annual average **precipitation** is projected to increase by:
  - up to 5% by the 2020s
  - up to 10% by the 2050s
  - up to 15% by the 2080s
- **Downpours** will become more frequent and intense



# Climate Projections – Sea Level Rise






- **Sea level** is projected to rise by ~2 ft this century using GCM-based methods
- A **rapid ice melt** scenario would lead to more than 4 feet of rise this century
- Due to sea level rise alone, the frequency and intensity of **coastal flooding** will increase

Scenario	2020s	2050s	2080s
GCM-based	+ 1 to 5 in.	+ 5 to 12 in.	+ 8 to 23 in.
Rapid ice melt	+ 4 to 10 in.	+ 17 to 29 in.	+ 37 to 55 in.

*The central range (middle 67% of values from model-base probabilities) across the GCMs and GHG emissions scenarios is shown; sea level rise rounded to the nearest inch. “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.*



# Key Impacts

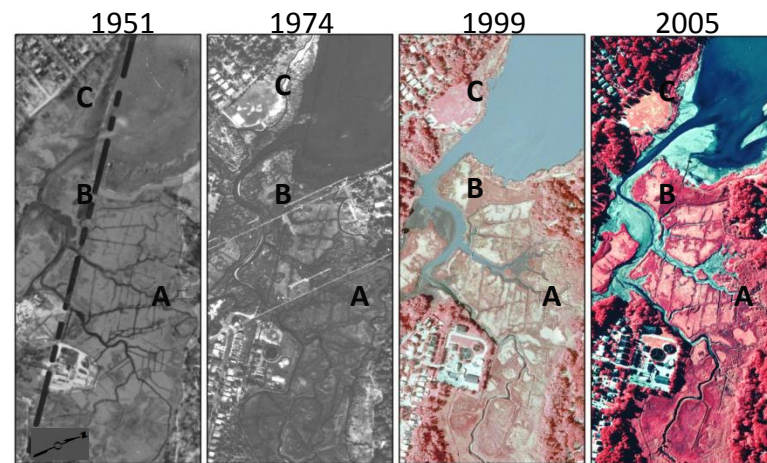
	<b>Water</b>	Increased risk of river flooding, potential changes of <b>drinking supply</b>
		Increased <b>pollutants</b> in the water supply due to flooding
		Possibility of longer summer <b>dry periods</b> , impacting the ability of water supply systems to meet demands and increasing the competition for the resource
	<b>Coastal</b>	Greatly amplified risks of <b>storm surge-related flooding</b> , potential <b>permanent inundation</b> of coastal lands, increased beach erosion and alteration of barriers islands
		Loss of <b>key coastal habitat</b> , especially wetlands
		Reduction of <b>species diversity</b> , including fish and shellfish populations
	<b>Ecosystems</b>	Widespread shifts in species composition in the state's forests and other natural landscapes, with the loss of <b>spruce-fir forests, alpine tundra and boreal plant</b> communities
		Expansion of some <b>invasive species</b> into New York, such as the aggressive weed, kudzu, and the insect pest, hemlock woolly adelgid
		Increased water temperatures will negatively affect brook trout and other <b>native coldwater fish</b> .





# Coastal Zones and Wetlands

- Coastal marshes and wetlands are affected by rapid **sea level rise** and wave erosion from **coastal storms**
- **Sea level rise** may become the dominant stressor acting on vulnerable salt marshes
- Bio-engineered strategies including restoring or creating wetlands are **adaptation options**



Marsh Loss Comparisons at Udalls Cove Park, Queens, NY



# Framing Adaptation

- *Reduce the level of physical, social, or economic impact of climate change and variability*
- *Take advantage of new opportunities emerging from climate change*



## **Type**

- Management/operations
- Infrastructure – physical components of each sector
- Policy

## **Administrative Group**

- Private vs. public organizations
- Local/municipal, county, state, national

## **Level of Effort**

- Incremental action
- Large-scale shifts

## **Timing**

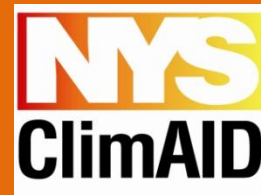
- Short term <5 yrs; medium term 5-15 yrs; long term >15 years
- Abrupt Changes - tipping points/policy triggers

## **Scale**

- Wide-spread, clustered, isolated/unique



# New York State Climate Action Plan



- The Climate Action Plan will help New York State reduce greenhouse gas emissions and adapt to climate change
  - Interim report released in early November (available online at <http://nyclimatechange.us>)
- Identifies conservation of open space, agricultural lands, and wetlands as a potential mitigation and adaptation option
  - Protect and restore freshwater and tidal wetlands through acquisition of fee or easement and regulation to reduce GHG emissions
  - Ensure that existing freshwater and tidal wetlands continue to sequester carbon and mitigate the effects of more intense storm events caused by climate change



## • Coastal Zones Adaptation Policy Options

- New York State should endorse a coordinated set of projections for sea level rise and associated changes in flood recurrence intervals in all coastal areas
- Integrate sea level rise and flood recurrence interval projections into all relevant agency programs and decisions
- Identify and map areas of greatest current risk from coastal storms and sea level rise to support risk reduction actions in those areas
- Reduce vulnerabilities in coastal areas at risk from sea level rise and storms (coastal risk management zone) and support increased reliance on non-structural measures and natural protective features to reduce impacts from coastal hazards
- Develop a long-term interagency mechanism to regularly evaluate climate change science; set research priorities to foster adaptation; coordinate actions; and assess progress