NYS ClimAID

Dealing with Climate Change

… A Recipe for Lemonade

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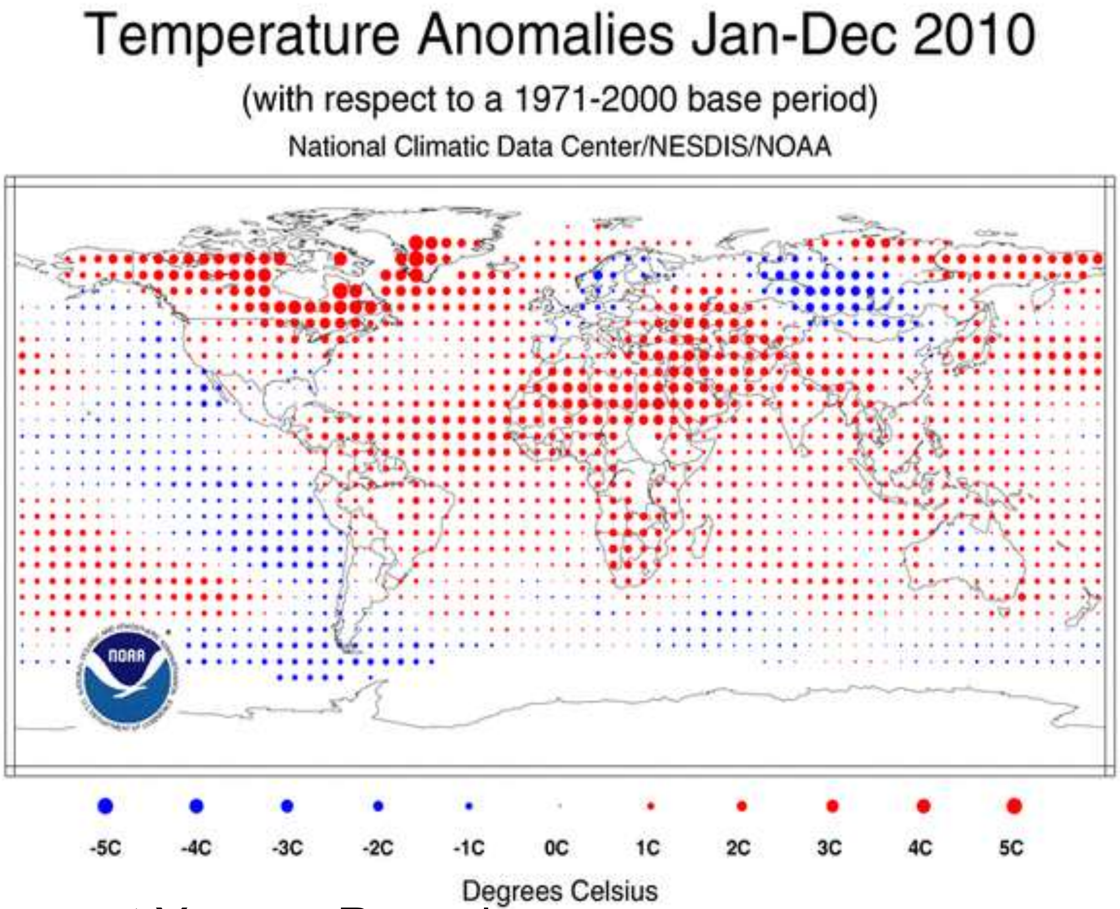
Talk Outline

Current status of world's climatic processes
Mitigation - Greenhouse gas emissions

NYS ClimAid
Vulnerabilities and adaptations by sector

Global Warming

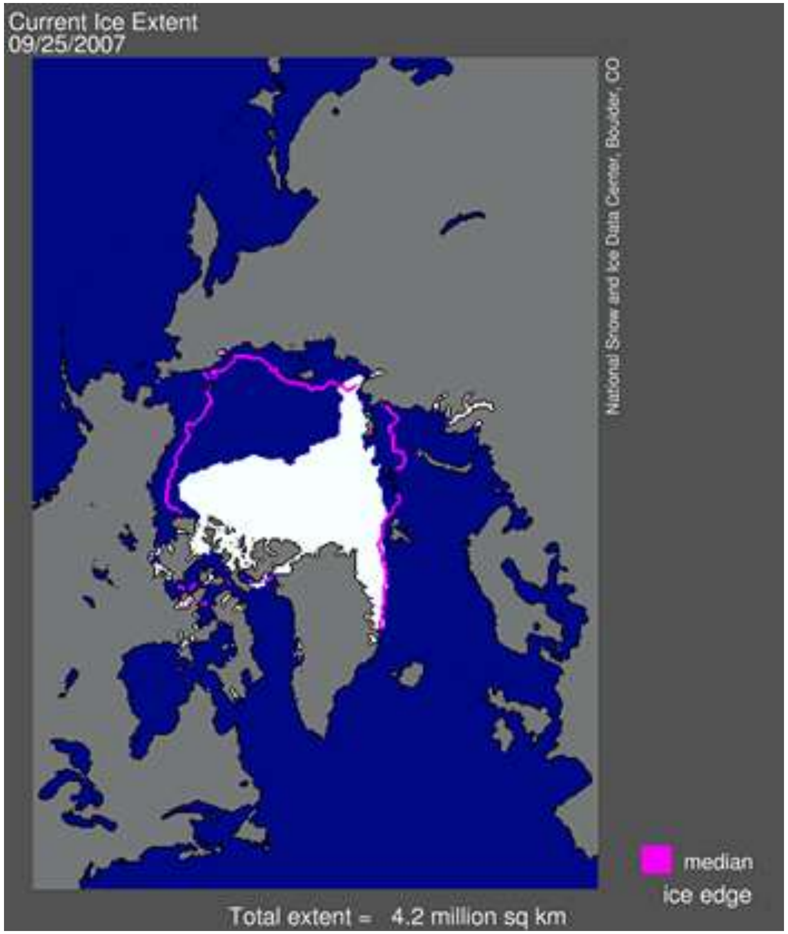


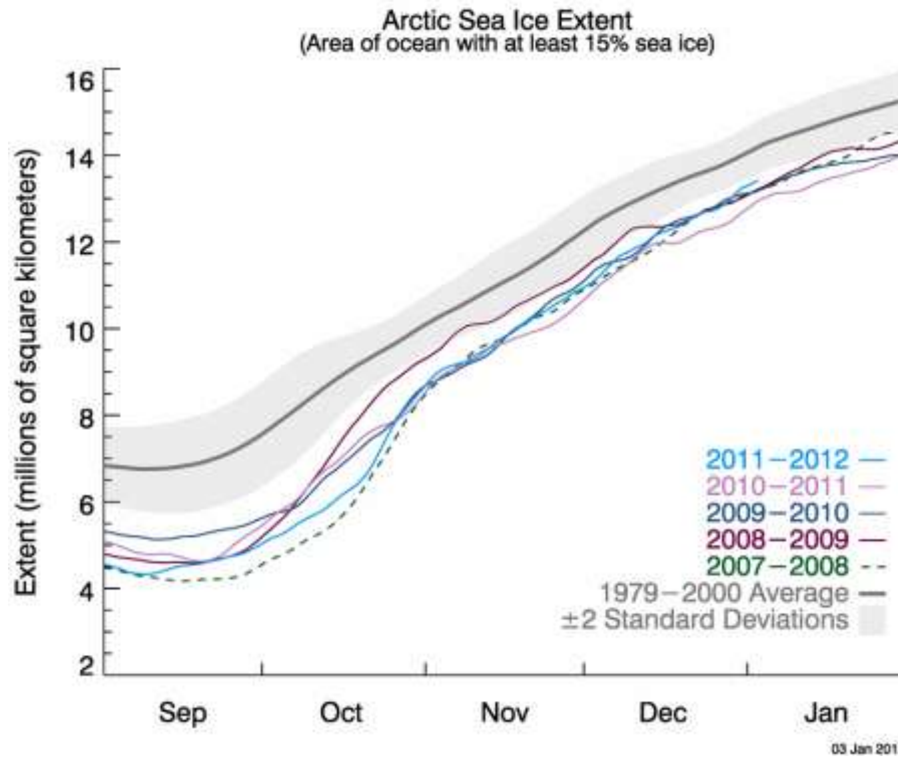
NASA Finds 2011 Ninth-Warmest Year on Record

January 19, 2012

The global average surface temperature in 2011 was the ninth warmest since 1880, according to NASA scientists. The finding continues a trend in which nine of the 10 warmest years in the modern meteorological record have occurred since the year 2000.

Arctic Ice Cap Melt

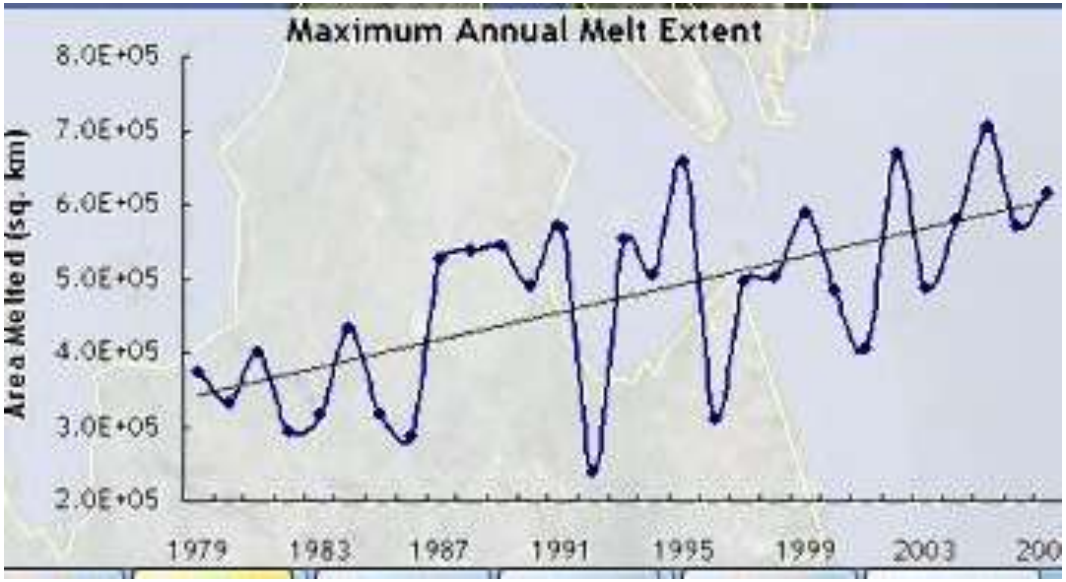


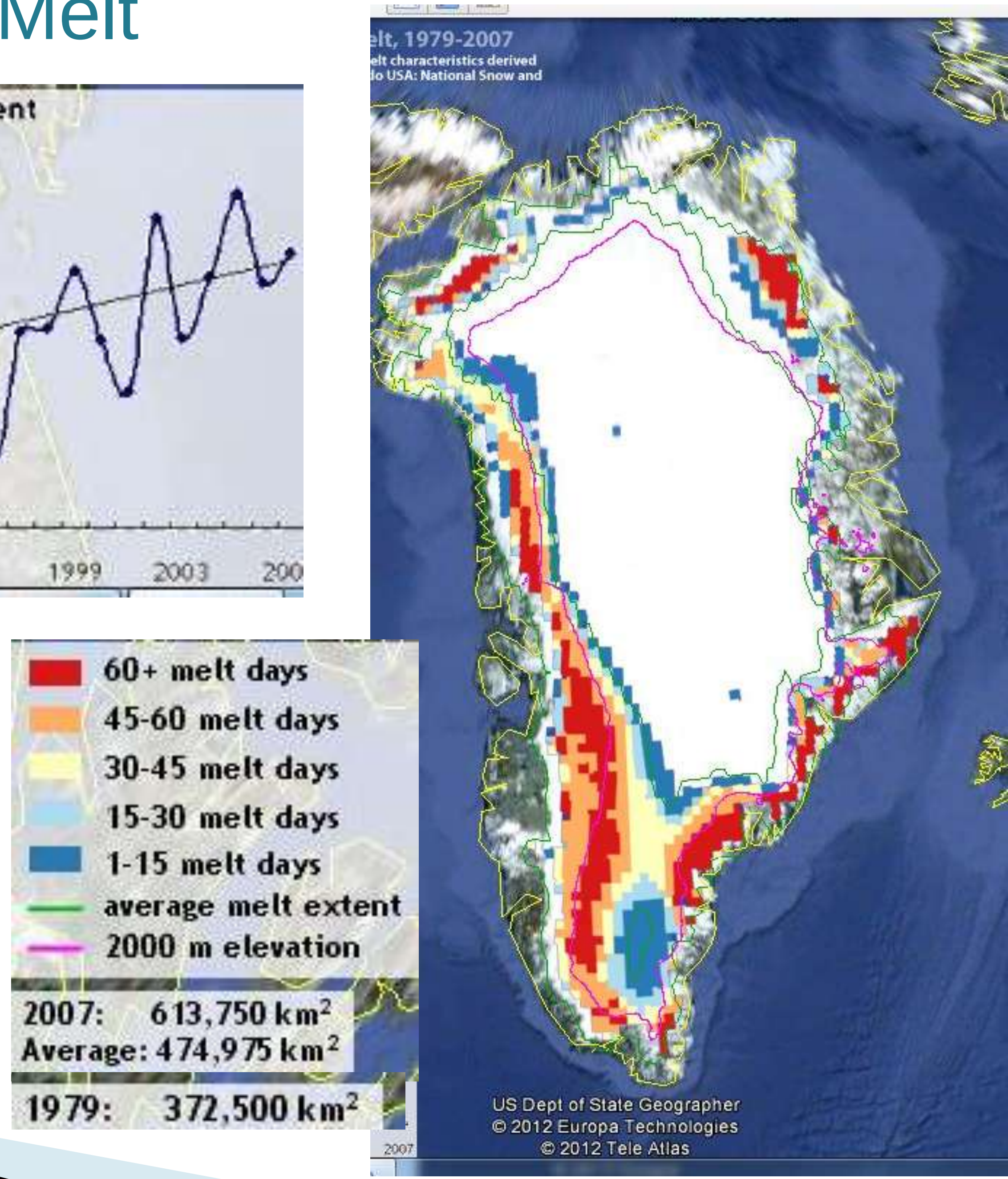


A new NASA study revealed that the oldest and thickest Arctic sea ice is disappearing at a faster rate than the younger and thinner ice at the edges of the Arctic Ocean's floating ice cap.

The thicker ice, known as multi-year ice, survives through the cyclical summer melt season, when young ice that has formed over winter just as quickly melts again. 29 Feb. 2012

Greenland Glacier Melt

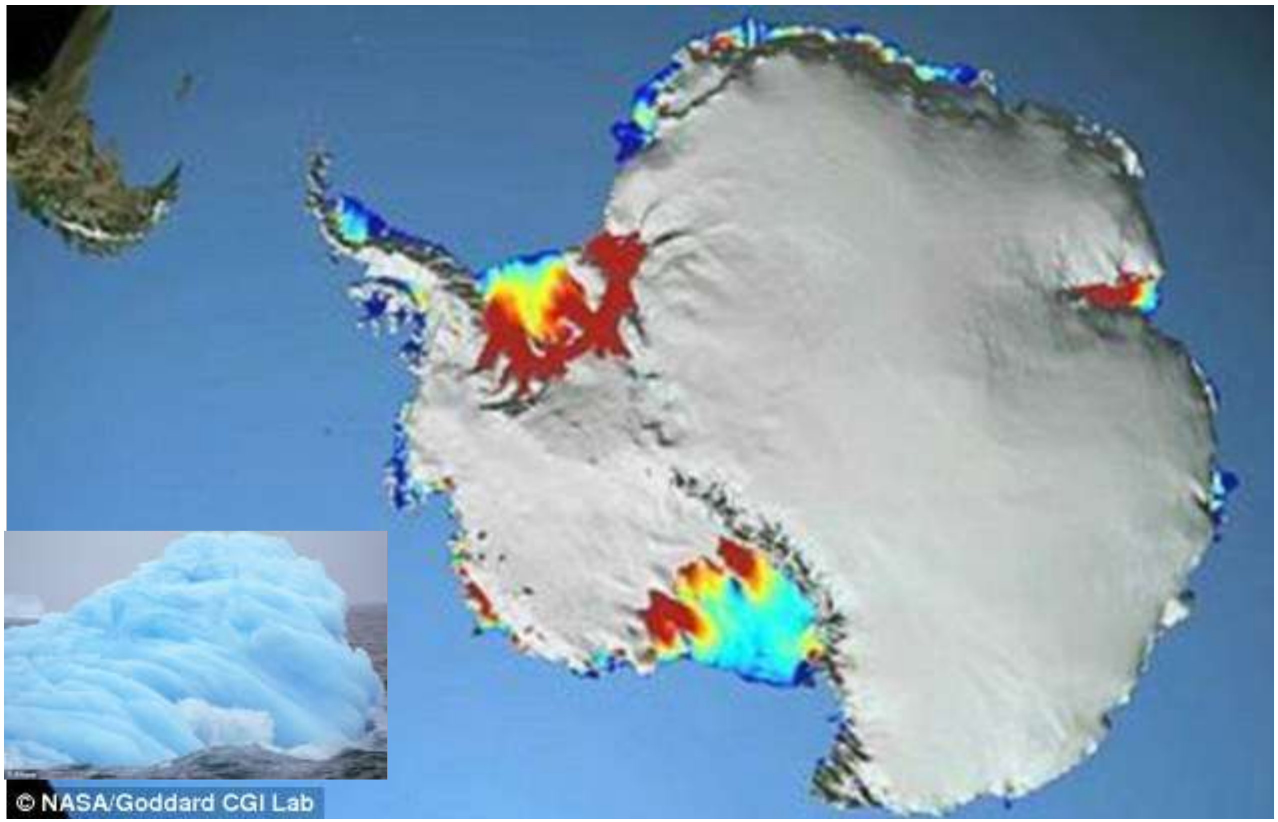




NSIDC

Antarctica Ice Shelves – Detach and Melt

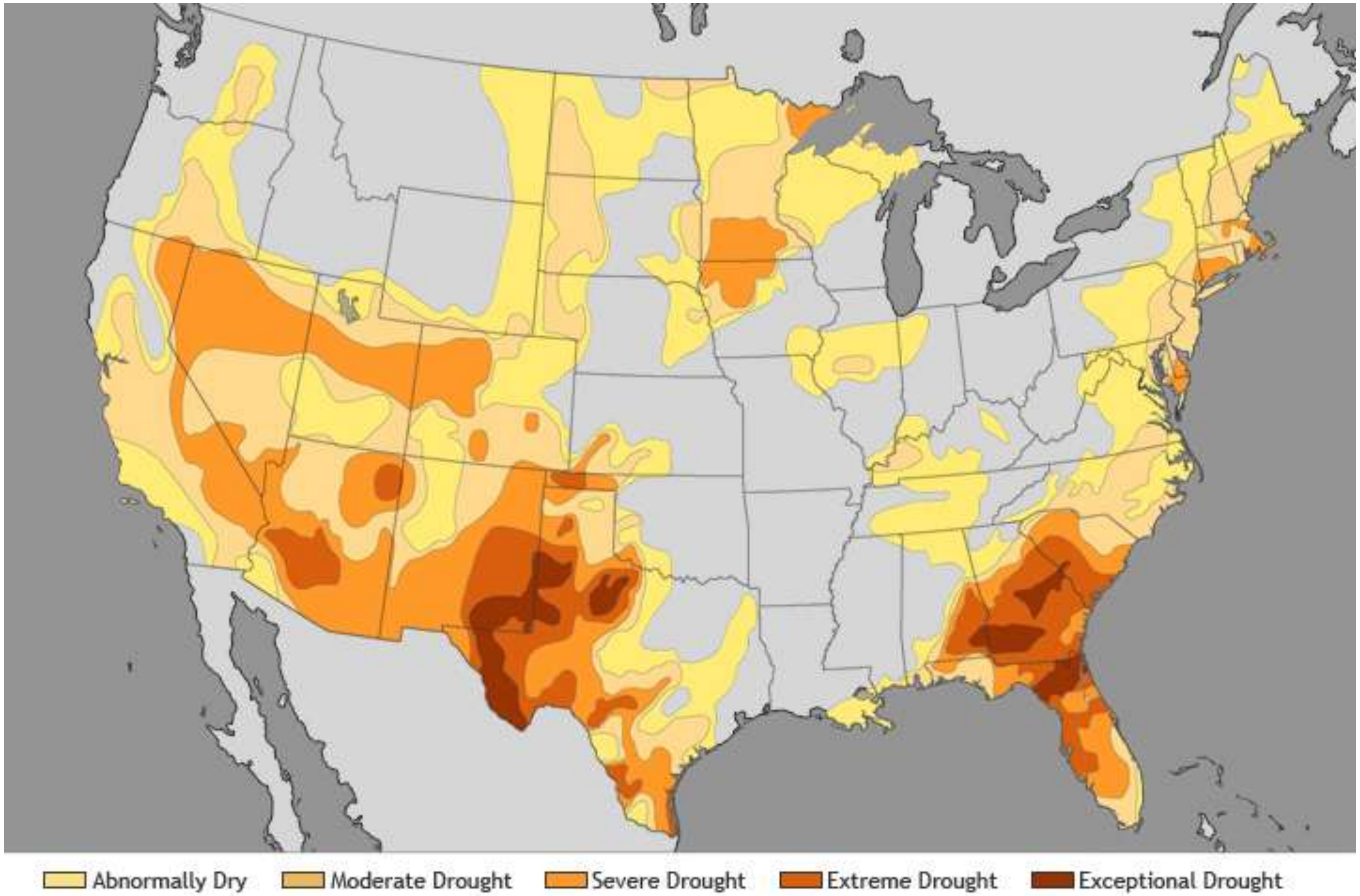
A total of 44 percent of the Antarctic coastline has ice shelves attached. Their aggregate area is 1,541,700 km^2 . A new study examining nearly 40 years of satellite imagery has revealed consistent decreases in ice shelf extent of West Antarctica through melt, calving, and complete disintegration of some shelves.



This map shows Antarctica's ice shelves on the continent's western coast thinning, with the red portion indicating ice thicker than 550 meters, while blue is thinner than 200 meters.

Shifts in Precipitation Patterns

Dry, Warm Spring No Help for Southern Drought Friday, April 27, 2012



NOAA CLIMATE SERVICES

Map by Hunter Allen and Richard Rivera, based on data from the [U.S. Drought Monitor] on April 24, 2012.

Increasing Wind Speeds

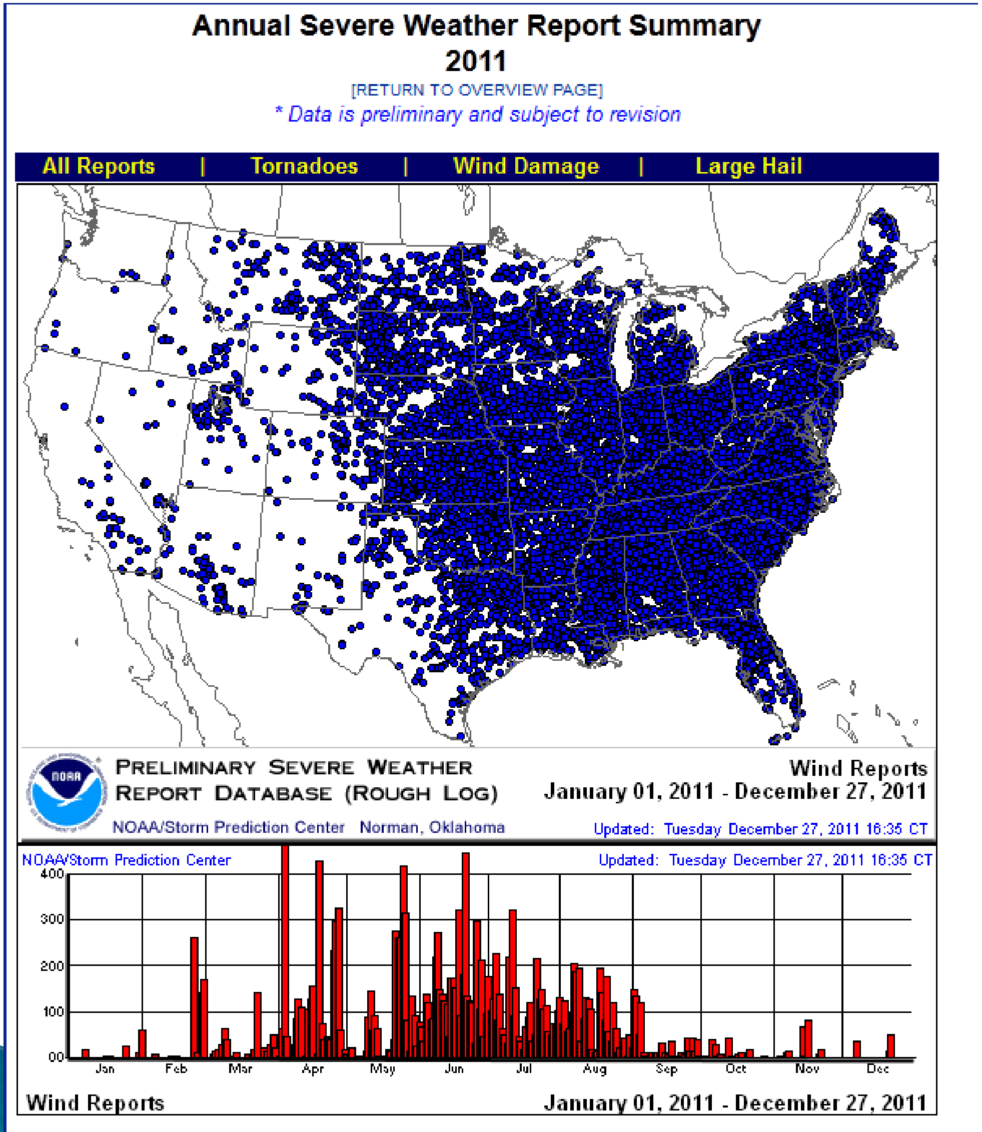
Earth Now a Windier World

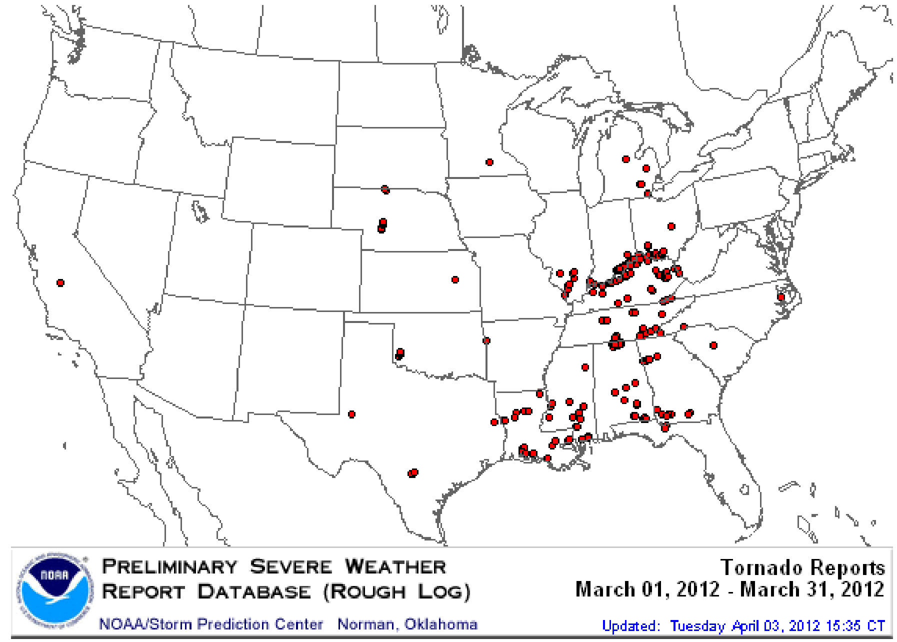
The world is getting breezier, according to a new study, which found a slow but steady increase in top wind speeds across the oceans over the last 23 years (1985 – 2008). Despite large seasonal variations, the mean wind speed over the oceans hasn't changed much in the last two decades, the researchers report today in the journal *Science*.

Speeds of the fastest winds, though, have risen by about half a percent each year, and heights of the biggest waves have risen by between a quarter and half a percent each year. Those trends have been strongest in the southern hemisphere.

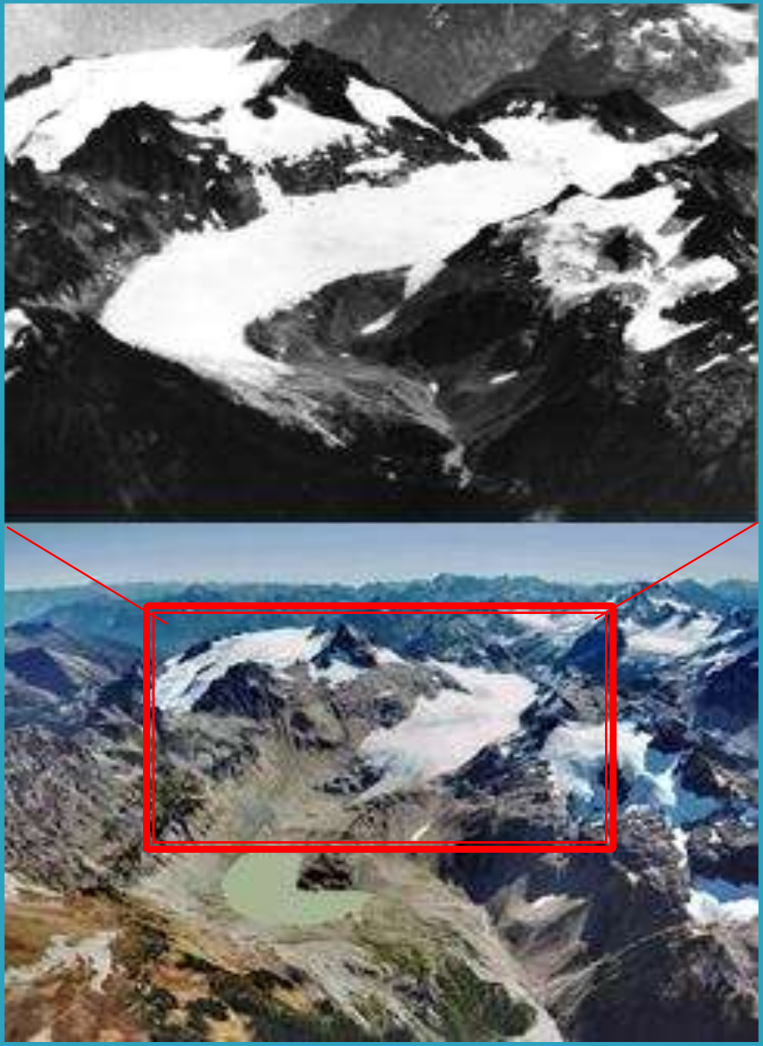
For example, Off the coast of Southern Australia, the tallest 1 percent of waves have risen from five to six meters (16 to 20 feet). The most extreme winds are now blowing 10 percent faster than they used to.

Increasing Wind Speeds





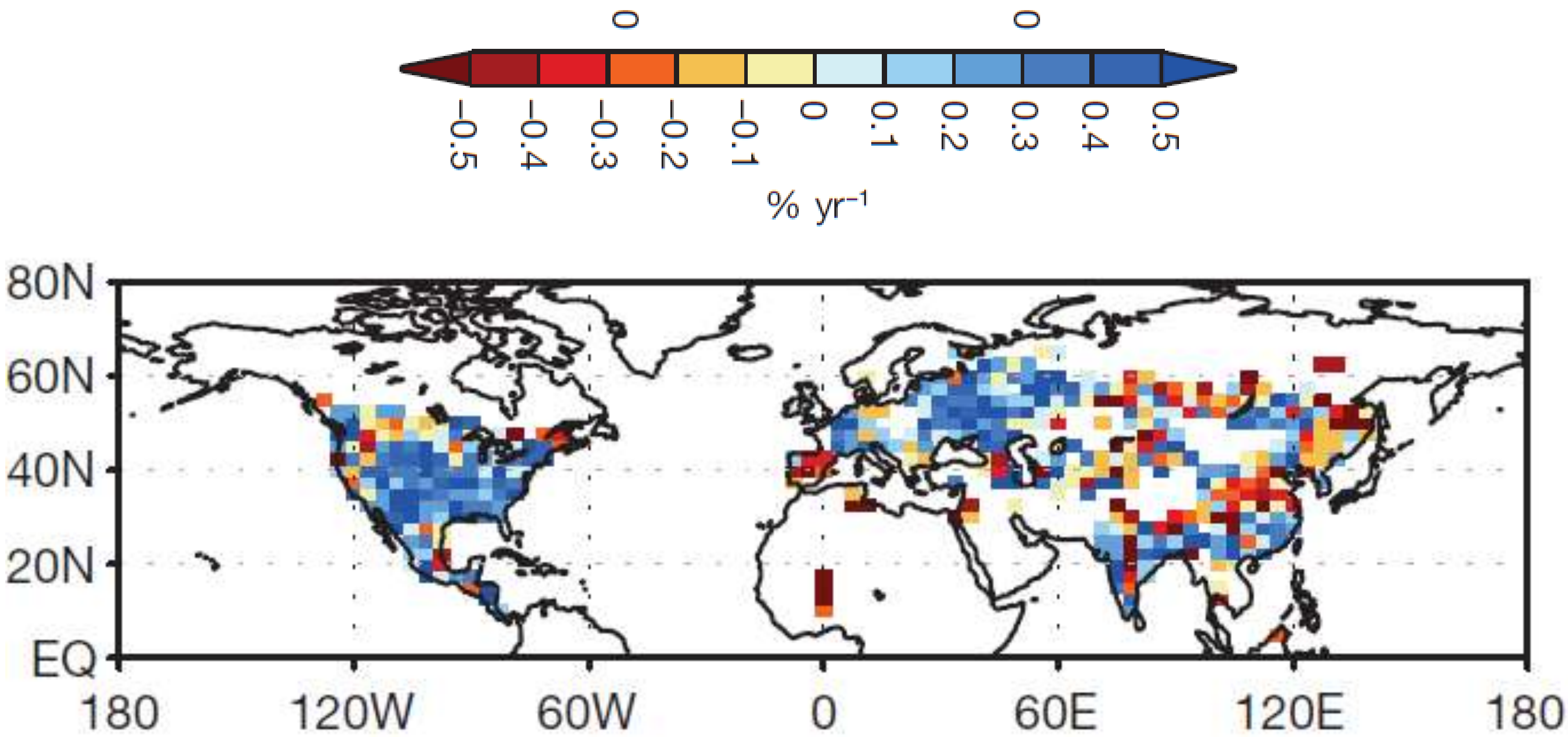
Disappearance of Montane Glaciers



The South Cascade Glacier, Washington in 1928 (top) and In July 2009 (bottom)

"Fifty years of U.S. Geological Survey (USGS) research on glacier change shows recent dramatic shrinkage of glaciers in three climatic regions of the United States. These long periods of record provide clues to the climate shifts that may be driving glacier change.“ U.S. Geological Survey *July 2009*
South Cascade Glacier in Washington state, the Gulkana Glacier on the coast of Alaska and Wolverine Glacier in Alaska's interior.

Extreme Precipitation Events



Annual maximum five day precipitation amount
Trend from 1951-1999 (percent observed change per yr)

Survey Shows More Americans Believe Climate Change is Happening

"The number of Americans who believe global warming is happening Is on the rise, according to a Brookings Institution Report on the latest National Survey of American Public Opinion on Climate Chaabnge Survey conducted in December, 2011. "

December 8, 2011 | 9:18 AM | By **Kimberly Ayers**

NOAA Chief Wants Nation "Weather-Ready" for More Extreme Events

FILED UNDER: **The Science**, **extreme weather**, **NOAA**

2 Comments Tweet 10 Share 180 Permalink

Fifty-two billion dollars and counting, one thousand deaths — double the yearly average — from 12 extreme weather events in 2011 alone.

NOAA

Those grim numbers are part of the reason why the country's top weather official is calling for better and smarter observation tools, new climate models and a new national readiness.National Oceanic and Atmospheric Administration (NOAA) Administrator Jane Lubchenco shared those stats with scientists here at the American Geophysicial Union's fall meeting in San Francisco (#AGU11), many of whom are giving presentations about how to better forecast these events and measure them."

I think that people have to appreciate how very bizarre the weather has been this year," Lubchenco told us in an interview following her keynote presentation. "And it's pretty clear that for some of those events like heat waves, droughts, really big intensive rainfall events – those we can connect the dots to climate change pretty convincingly."

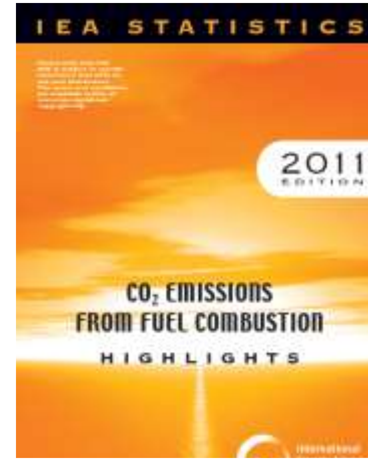
Addressing Climate Change

Mitigation: focus on reducing emissions of CO_2 and other greenhouse gases

VS

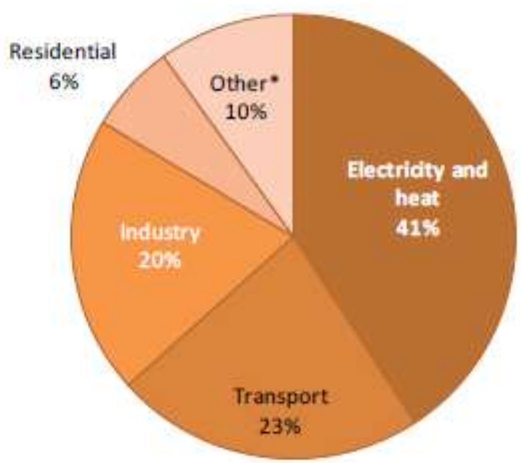
Adaptation: identify strategies that help communities to be more resilient to the impacts of climate change

Last year's greenhouse gas emissions topple worst-case scenario November 7, 2011



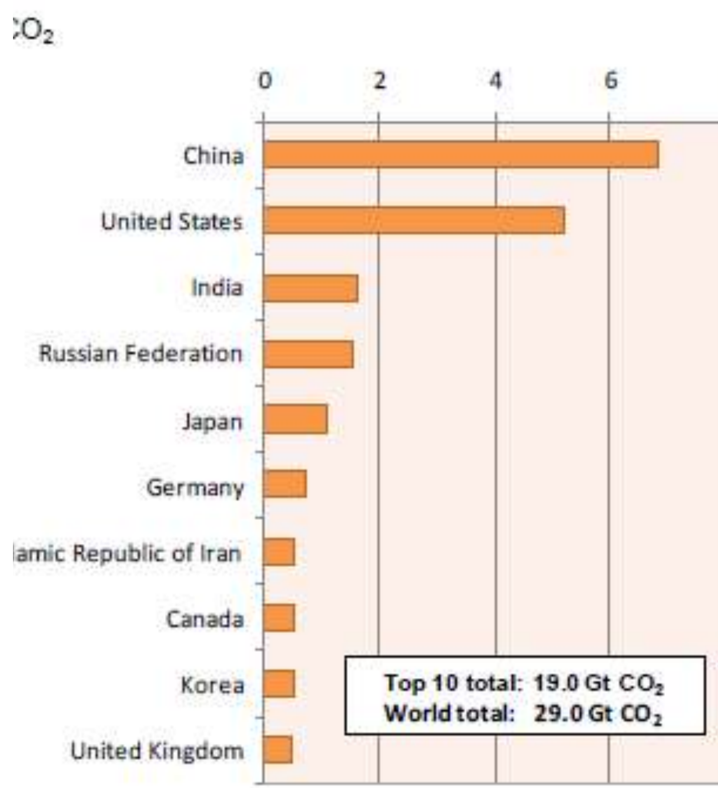
Global carbon emissions last year exceeded worst-case scenario predictions from just four years before, according to the US Department of Energy (DOE). A rise of 6 percent (564 million additional tons) over 2009 levels was largely driven by three nations:

Figure 5. World CO_2 emissions by sector in 2009



* Other includes commercial/public services, agriculture/forestry, fishing, energy industries other than electricity and heat generation, and other emissions not specified elsewhere.

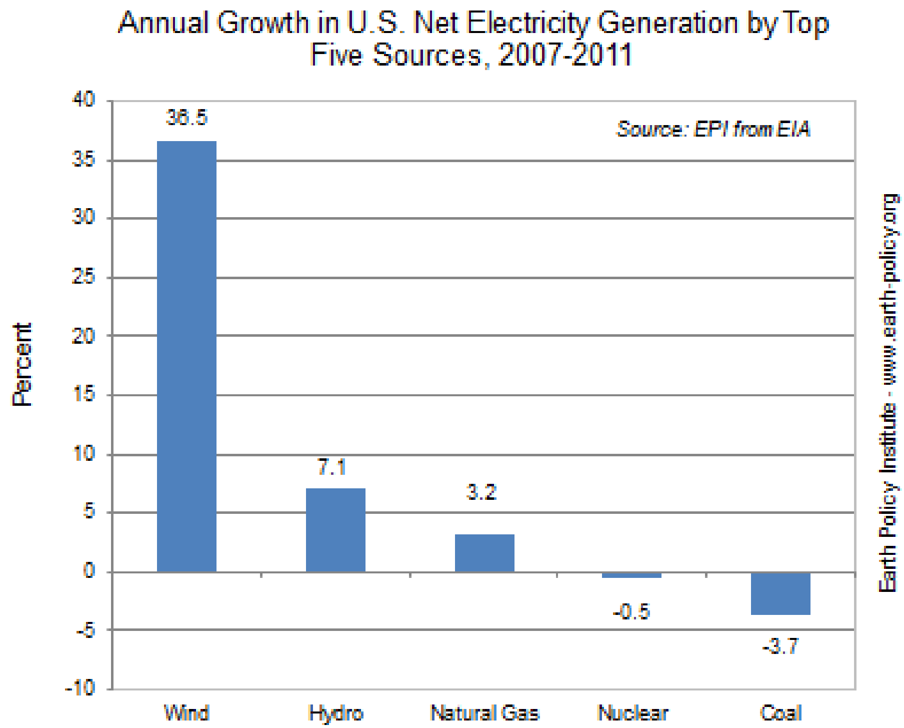
Figure 4. Top 10 emitting countries in 2009



Wind Tops 10% Share of Electricity
In Five US States April, 2012

It's Good News! Friday

A new picture is emerging in the U.S. power sector. In 2007, electricity generation from coal peaked, dropping by close to 4 percent annually between 2007 and 2011. Over the same time period, nuclear generation fell slightly, while natural gas-fired electricity grew by some 3 percent annually and hydropower by 7 percent. Meanwhile, wind-generated electricity grew by a whopping 36 percent each year. Multiple factors underlie this nascent shift in U.S. electricity production, including the global recession, increasing energy efficiency, and more economically recoverable domestic natural gas. But ultimately it is the increasing attractiveness of wind as an energy source that will drive it into prominence.



pond biofuels

Working Green

It's Good News! Friday

Canadian Cement Plant Becomes First to Capture CO2 in Algae

A Canadian company called Pond Biofuels is capturing CO_2 emissions from a cement plant in algae — algae the company ultimately plans on using to make biofuel. It's no secret that the process of manufacturing cement is both energy intensive and dirty. Global cement production alone emits ~ 5% of greenhouse gas emissions annually, both as a byproduct of limestone decarbonation (60%) and from the burning of fossil fuels in the cement kilns (40%). And as the demand for concrete-intensive infrastructure soars in developing countries like China and India, global emissions from cement plants—and other industrial sources—will continue to rise.

But a Canadian company called Pond Biofuels sees some real opportunity in all those industrial greenhouse gas emissions. At the St. Marys Cement plant in southwestern Ontario, Pond Biofuels has become the first to successfully use carbon dioxide emitted from a major industrial source to produce high value biomass from microalgae.

Pond Biofuels is capturing carbon dioxide and other emissions from a cement plant and using it to create a nutrient-rich algae slime which can be dried and used as a fuel.

The algae will be grown at a facility adjacent to the stacks, harvested, dried using industrial waste heat, from the cement plant and then used along with the fossil fuels that are currently used in its cement kilns. The company says they hope to demonstrate the scalability of the … (April 2010)

What can you do re mitigation?

Get informed.

Move the conversation forward.

Inform your friends.

Be part of the solution.

Be active – write your legislators and insist that our state and federal governments make this a higher priority.

Go “green” in your daily activities:

- reduce electricity usage
- reduce auto emissions
- plant trees

NYS ClimAID

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

Final Report

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Full Report may be found at www.nyserda.ny.gov

NYSERDA

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THE EARTH INSTITUTE AT COLUMBIA UNIVERSITY

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CITY UNIVERSITY OF NEW YORK

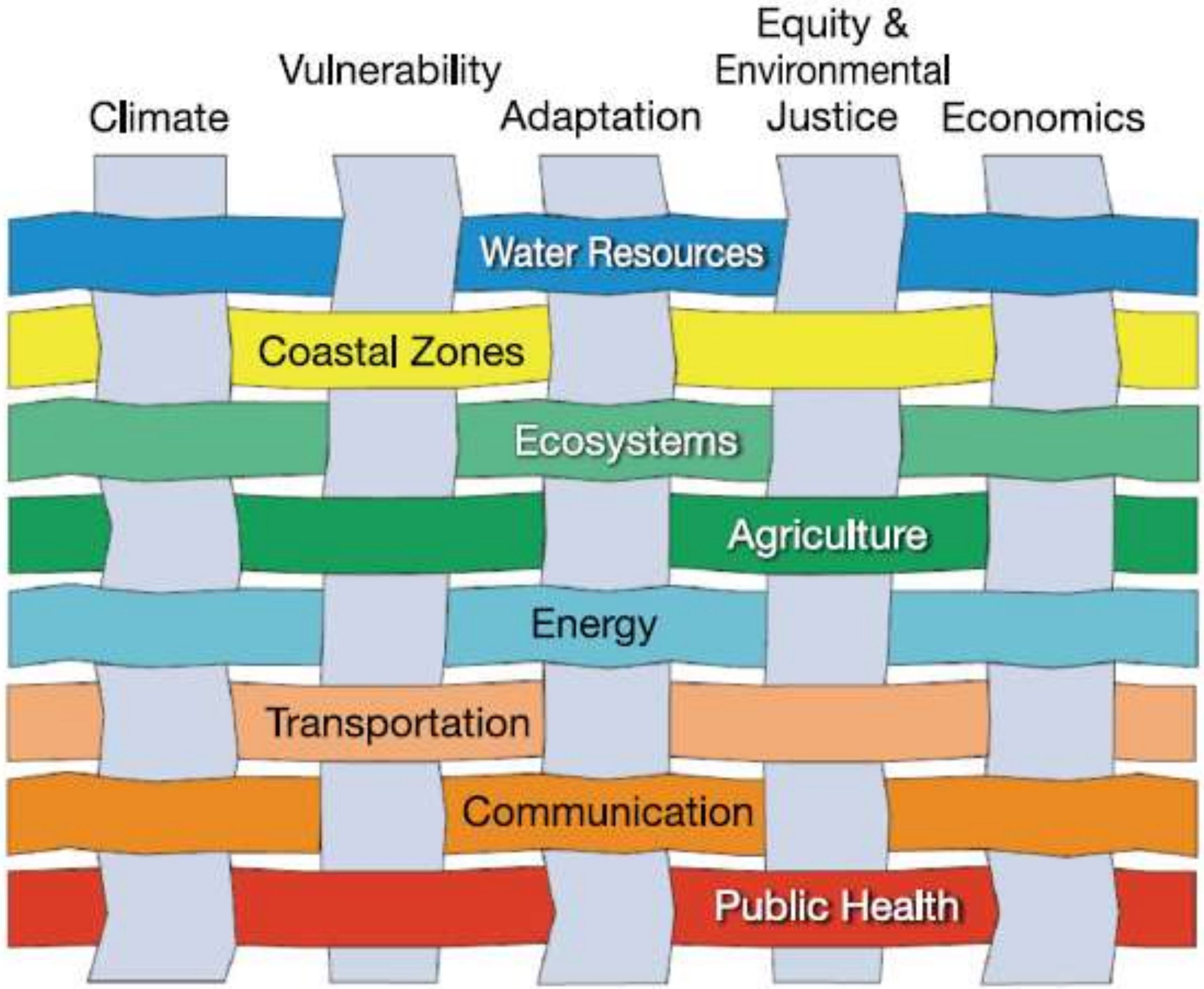
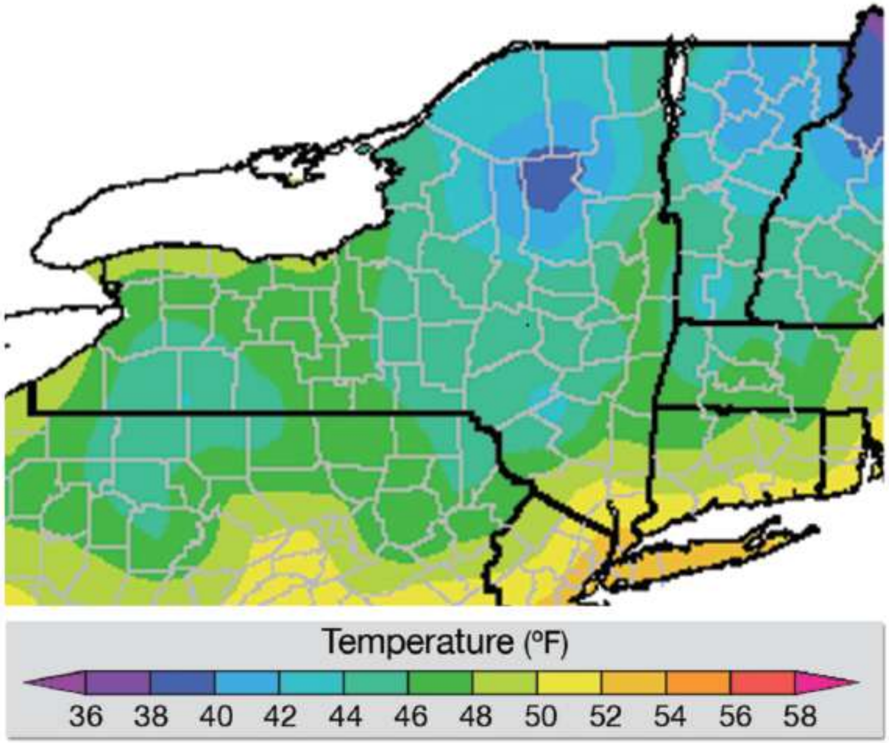


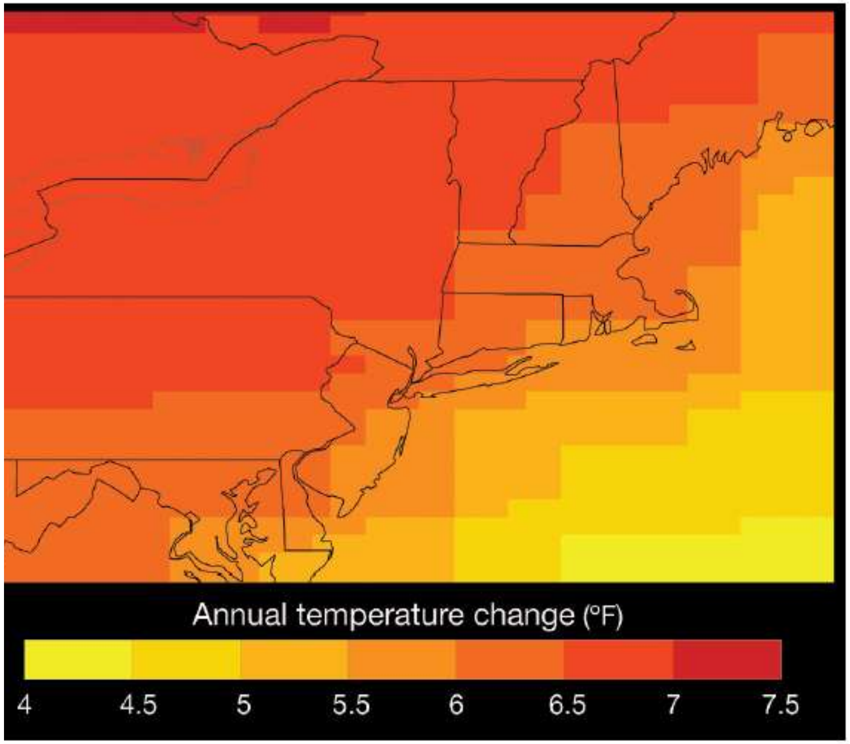
Figure 1 ClimAID integrating themes and sectors, illustrating the interwoven fabric of climate change assessment

NY Climate Predictions – Temperature



Source: Northeast Regional Climate Center

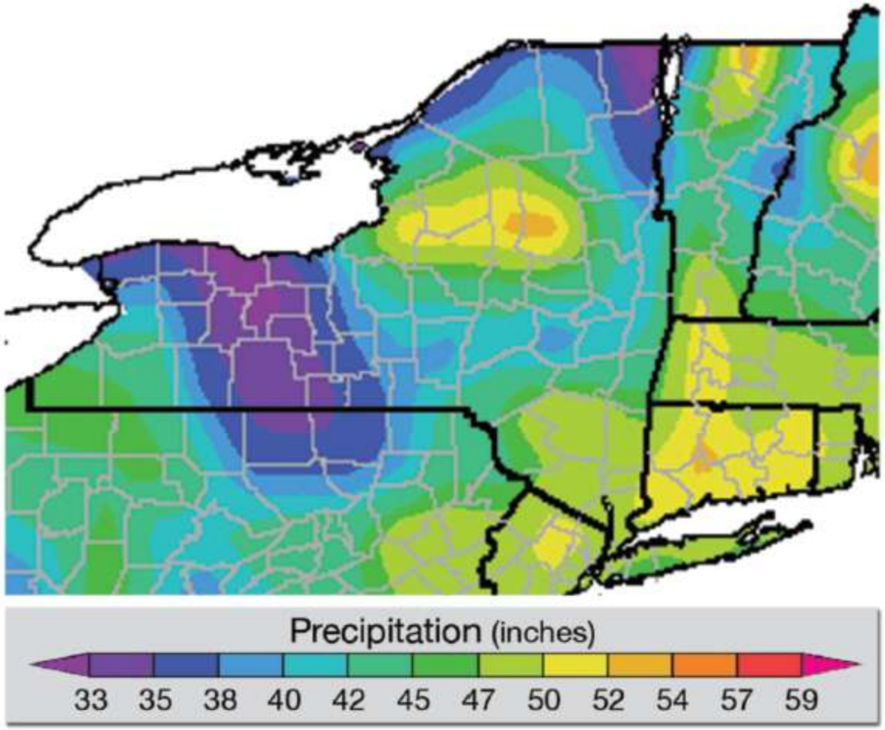
Figure 1.2 Normal average temperature in New York State



ource: Columbia University Center for Climate Systems Research. Data are rom WCRP and PCMDI

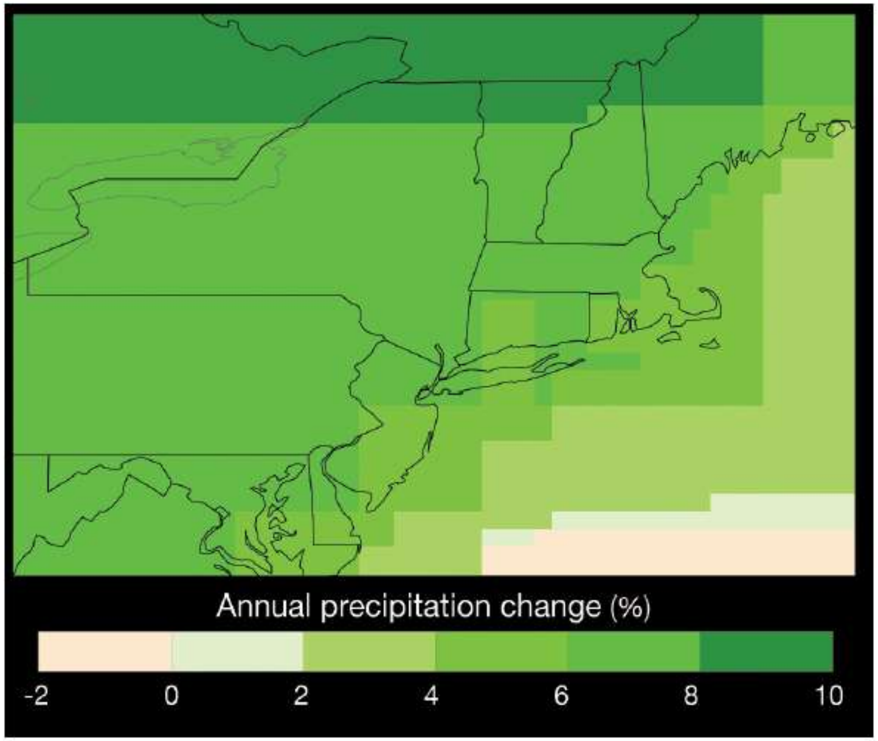
Figure 1.6a Projected change in annual temperature for the 2080s in the Northeast relative to the 1980s baseline period

NY Climate Predictions – Precipitation



Source: Northeast Regional Climate Center

Figure 1.3 Normal average precipitation in New York State

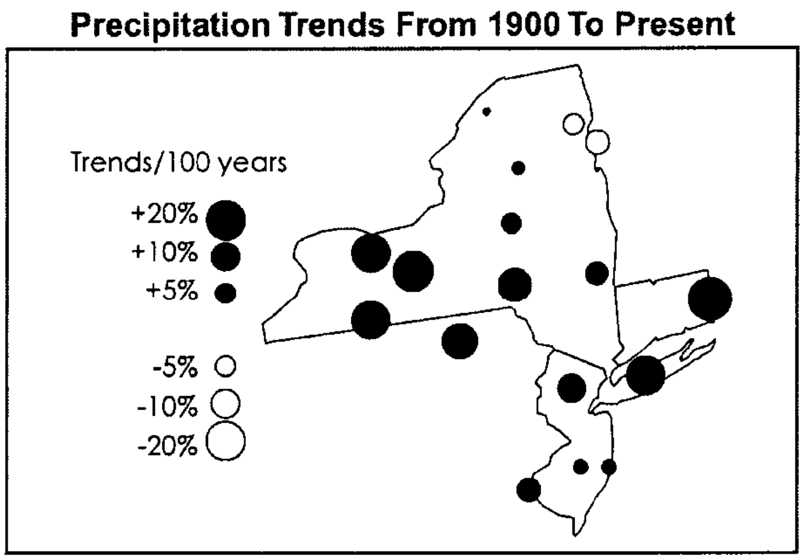


Source: Columbia University Center for Climate Systems Research. Data are from WCRP and PCMDI

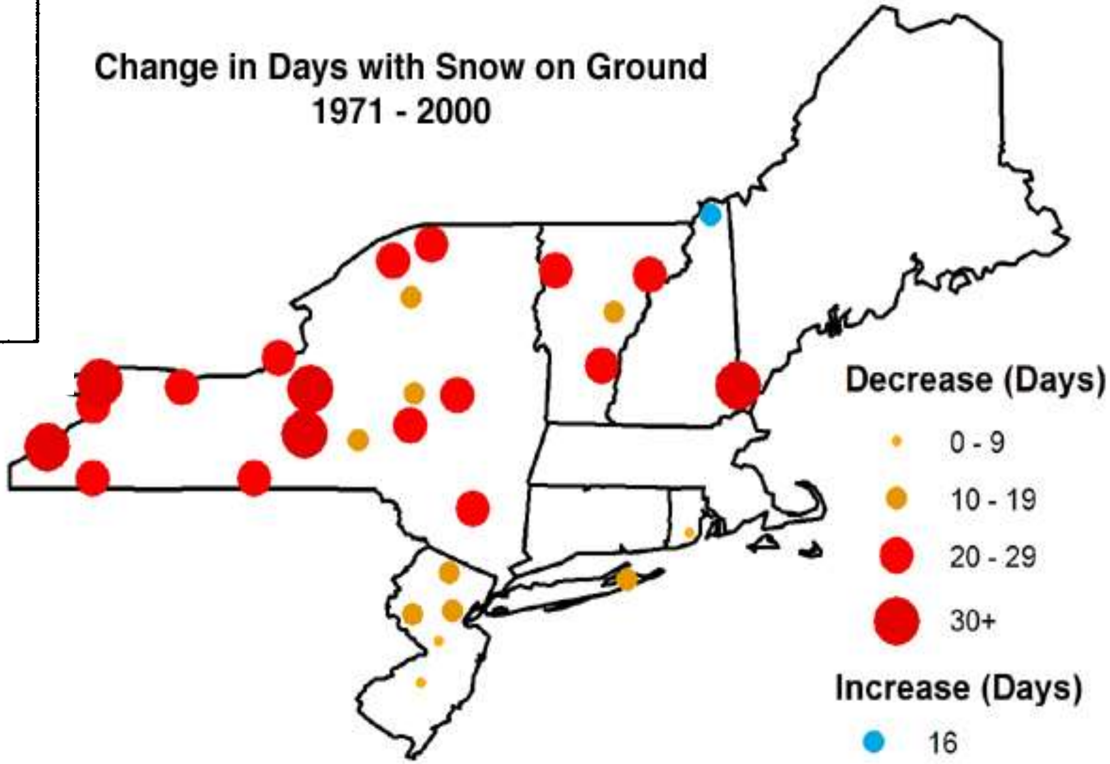
Figure 1.6b Projected change in annual precipitation for the 2080s in the Northeast relative to the 1980s baseline period

NY Climate Predictions – Precipitation

Reduced or loss of snowpack and early snowmelt



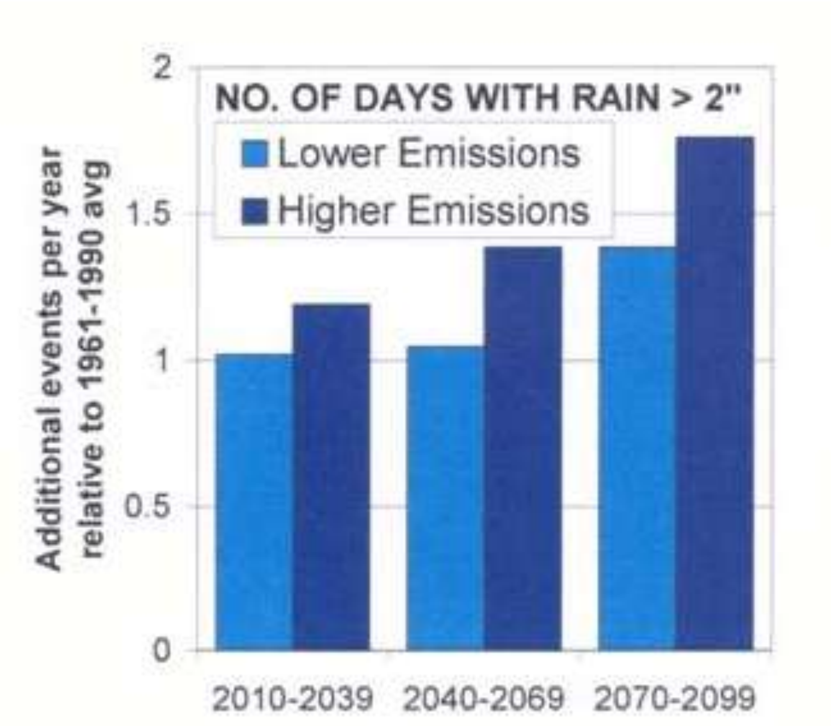
Source: Karl et al. (1996)

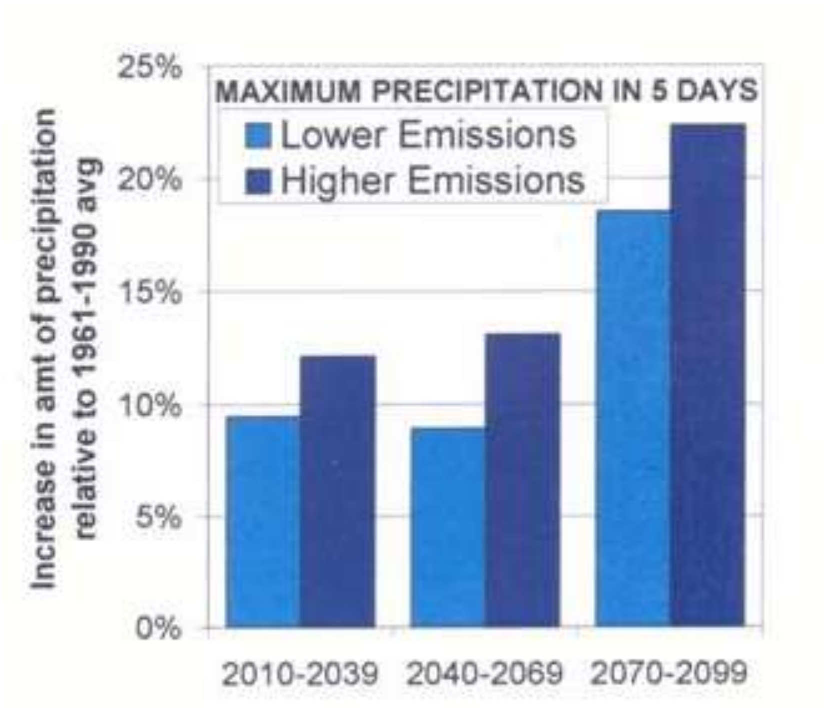


Source:
C. Wake, UNH

NY Climate– Precipitation

It's Good News! Friday

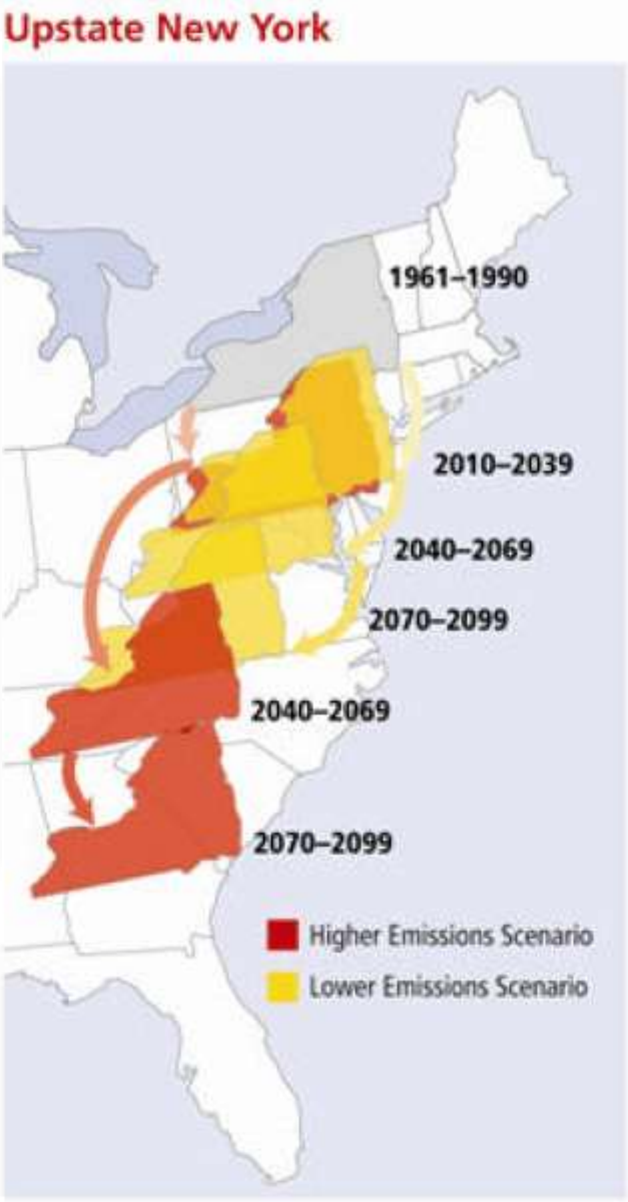




NY Climate Predictions

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
Downpours (precipitation rate/hour)	∧	Likely
Lightning	Unknown	
Intense hurricanes	∧	More likely than not
Nor'easters	Unknown	
Extreme winds	∧	More likely than not

Figure 10. Qualitative Changes in Extreme Events for New York City/Long Island (ClimAID Region 4)



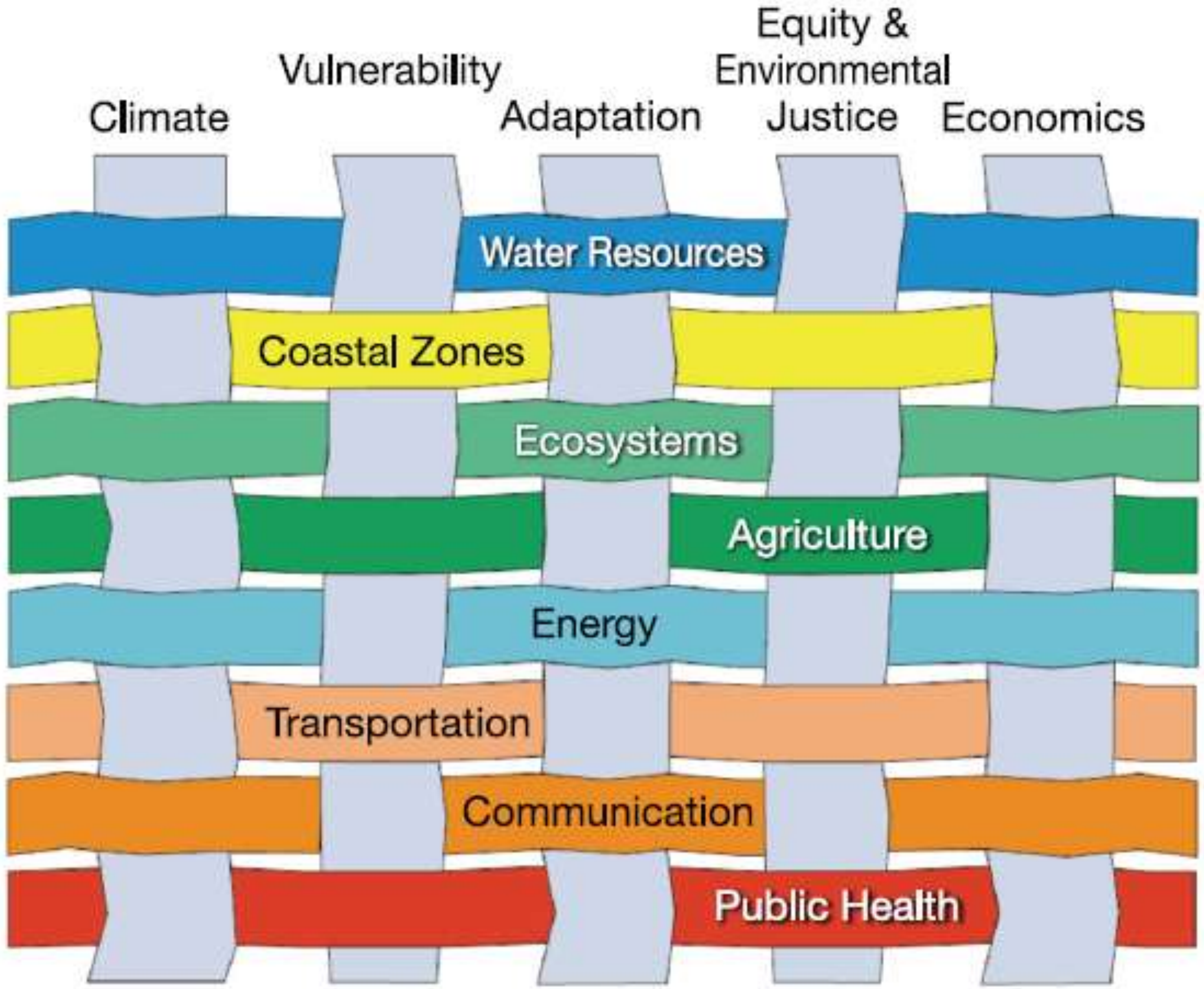


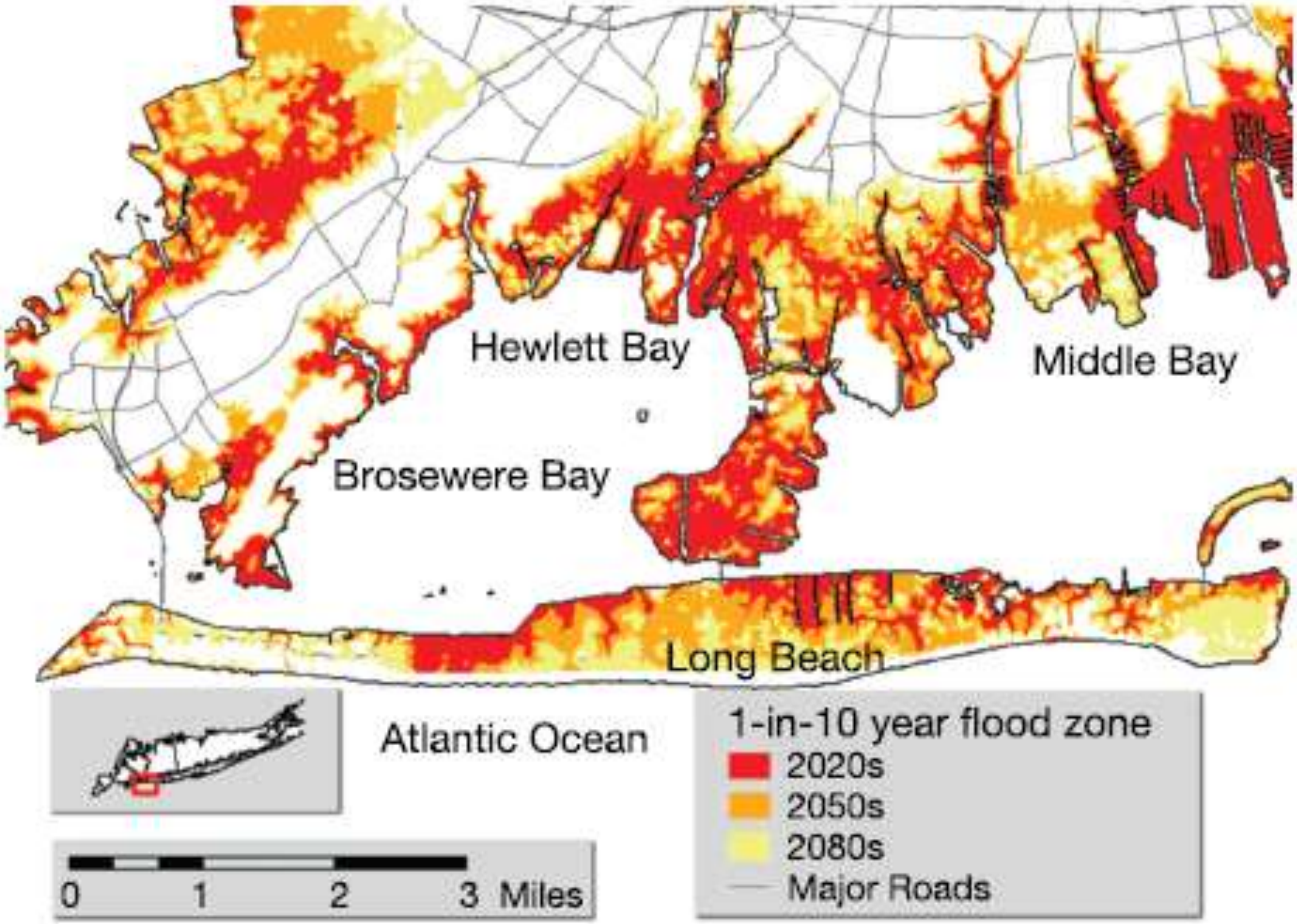
Figure 1 ClimAID integrating themes and sectors, illustrating the interwoven fabric of climate change assessment

NY Coastal Areas - *Vulnerabilities*

- Sea level rise: How much? How fast?
  7- 23 inches by 2100
  Due to ocean warming and expansion, and
  melting of ice caps, glaciers
- Warming waters and impacts on shellfisheries
- Salt water intrusion into freshwater groundwater aquifers
- Loss of salt marshes

Documented ~25% decline in extent of 12 L.I. salt marshes from 1974 to 2000

NY Coastal Areas



NY Coastal Areas - *Adaptations*

Example adaptation strategy framework for flood-damage reduction

Adaptation Strategy	Level of Development	Level of Protection	Time Imp/Life*	Potential Consequences	SLR** GCM	RIM
Beach Nourishment	All	Up to 1-in-100 yr flood	< 1–yr/ 3–7 yrs	Steepen profile, reduce overwash sediments to bay, habitat disruption	X	X
Moderate Engineering Solutions#	Urban to suburban	Up to 1-in-100 yr flood	2–5 yrs/ 20–50 yrs	Reduced littoral sediments creates downdrift erosion	X	
Macro Engineering Solutions##	Urban	> 1-in-100 yr flood level	10–15 yrs/ 75–150 yrs	Alter regional hydrodynamics, habitat disruption		X
Slow Retreat	Suburban to rural	NA	NA	Depends on strategies used	X	
Rapid Retreat	Suburban to rural	NA	NA	Loss of equity, decreased property values		X
Do Nothing	All	NA	NA	Catastrophic loss of property and natural resources	X	X

* Time necessary for implementation of adaptation measure and life expectancy of project. necessary for design and implementation.

** Sea level rise scenarios, GCM for central range and RIM for rapid ice-melt.

\# Moderate engineering structures such as seawalls, revetments, groins, and bulkheads.

\## Macro engineering structures such as storm surge barriers and dikes.

NY Agriculture - *Vulnerabilities*

2.9 million acres of agricultural land in NY

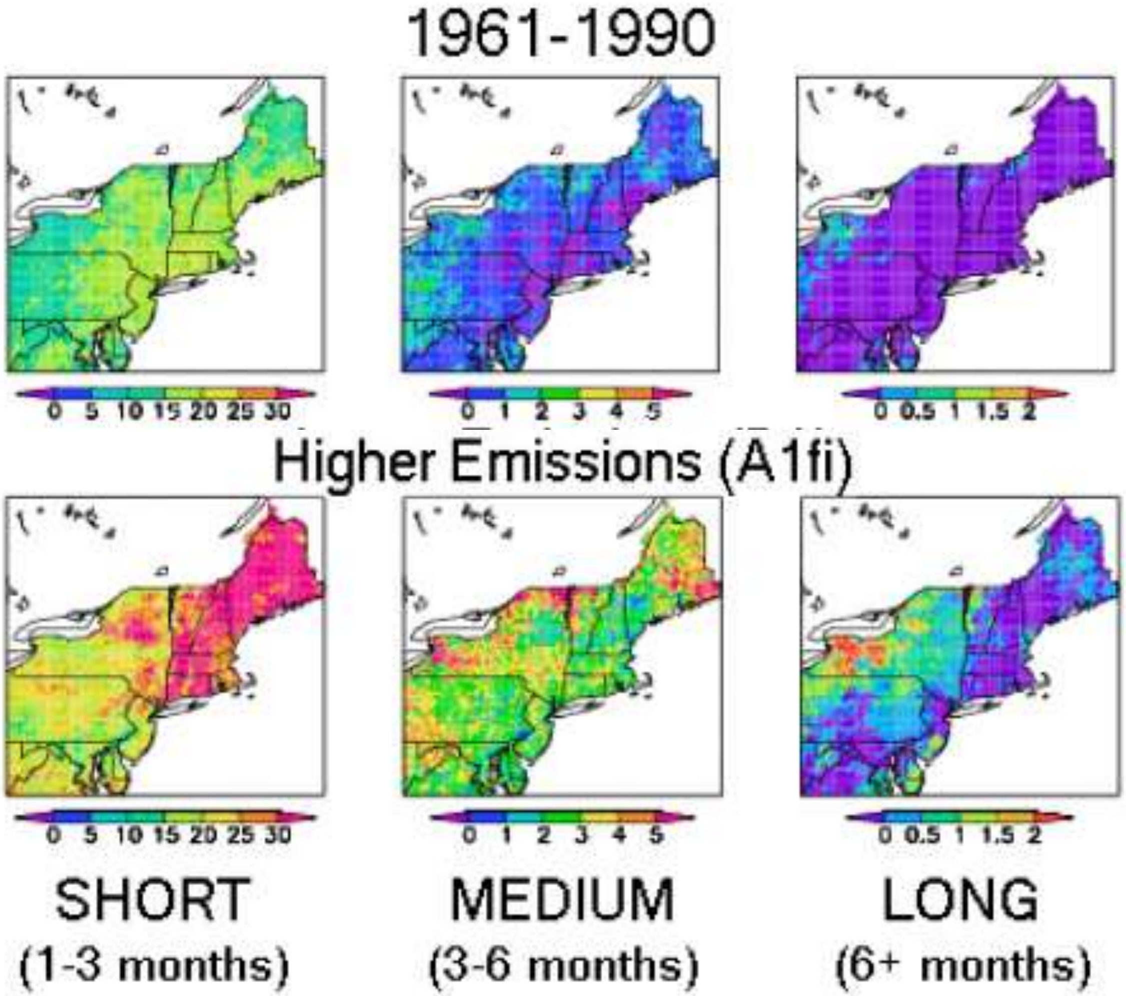
$ 4.5 billion value of agricultural products NASS, 2006)

Commodity	2007 Value (1,000 dollars)	2007 Harvested Acres (1,000's)	National Rank
Dairy Products	$2,377,987	N/A	1 (cottage cheese) 3 (milk)
Poultry, eggs	122,643	N/A	26 (poultry) 22 (eggs)
Cattle, hogs, sheep	118,742	N/A	2 (calves) 6 (lambs sheep)
Other	107,927		
Total Livestock	2,727,299		
Apples (fresh)	198,467		
Apples (processed)	50,432		
Apples (Total)	286,000	42	2
Grapes (fresh)	3,600		
Grapes (juice)	25,200*		
Grapes (wine)	14,842		
Grapes (Total)	49,222	34	3
Tart cherries	4,369	1.7	4
Sweet cherries	3,518	0.7	8
Peaches	3,995	1.7	10
Pears	5,120	1.2	4
Strawberries	7,590	1.5	7
Blueberries	3,373	0.7	10
Red raspberries	5,723	0.45	N/A
Other fruits and nuts	4,440		
Total Fruit Crops	373,350	84.25	
Cabbage (fresh)	101,190	12.6	2
Cabbage (kraut)	4,460	2.6	N/A
Sweet corn (fresh)	72,600	27.5	4
Sweet corn (processed)	15,286	17.2*	N/A
Snap bean (fresh)	49,749	9.9	4
Snap bean (processed)	14,990	19.9*	N/A
Pumpkins (fresh)	22,694	6.4	4
Onions (fresh)	94,182	12.3	5
Peas (processed)	9,033	17.4*	N/A
Beets (processed)	1,824	2.4	N/A
Other	189,815		
Total Vegetable Crops	575,823	109.1	
Grain corn	300,355	550	22
Silage corn	262,548	495	3
Potatoes (Total)	64,372	18.3	11
Soybeans	75,212	203	24
Dry beans	8,557	16.5	12
Wheat	29,835	85	31 (winter wheat)
Oats	7,866	60	8
Hay (Total)	322,128	1,360	22
Total Field Crops	1,070,873**	27695	
Floriculture	199,028	N/A	6
Nursery	63,343*	N/A	N/A
Other greenhouse	125,000	N/A	N/A
Total Other	357,661		
Total Livestock & Crops	$4,454,294	(actual cash receipts)	

2007 NY Agriculture, Harvested Acres and Ranks

NY Agriculture

Approximately 2.5% of NY agricultural land is irrigated (NASS, 2002). Drought is already a significant production constraint in many years.



NY Agriculture - *Adaptations*

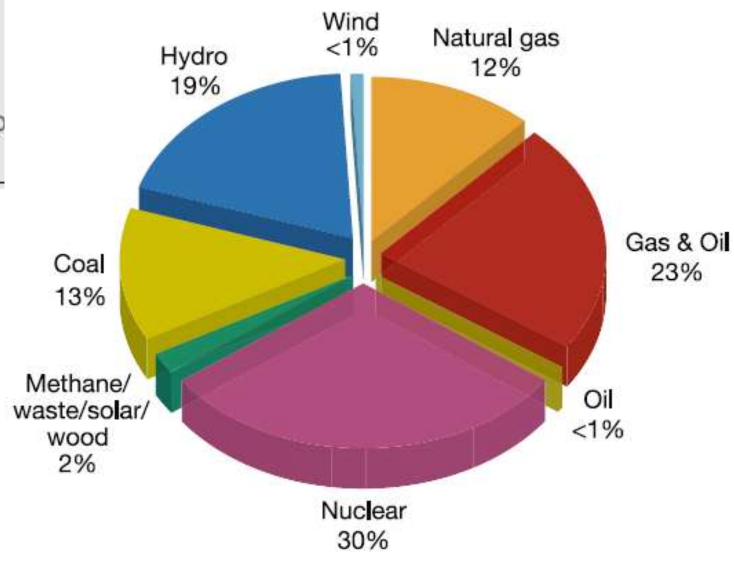
Climate factors, vulnerabilities and opportunities, and adaptation strategies

Climate Factor	Climate Certainty	Associated Vulnerabilities/Opportunities	Certainty*	Timing	Adaptation Strategies	Adaptation Capacity
Warmer summers; longer growing seasons	High	*Crops and weeds* Opportunities to obtain higher yields with current crops and grow higher-yielding varieties and new crops. Eventual double-cropping opportunities. Weeds will grow faster and will have to be controlled for longer periods. Increased seasonal water and nutrient requirements.	Moderate to high	Now, with some effects occurring later this century	Cautiously explore new varieties, new crops; develop markets for new crops. Increased weed control and new approaches to minimize chemical inputs. Increased water and fertilizer applications.	High
		Insects More generations per season; shifts in species range.	Moderate to high	Now	Better regionally coordinated monitoring through integrated pest management. Increased pest control. Proactively develop new approaches to minimize chemical inputs.	Moderate
Increased frequency of summer heat stress	High	*Livestock (dairy)* Reduced milk production; reduced calving rates.	High	Serious by mid-century	Increase cooling capacity of existing dairy barns. Increase use of fans and sprinklers. Change feed rations. Provide plenty of water. Design new barns based on projected future heat loads.	Moderate to High
		Crops Could negatively affect yield or quality of many cool-season crops that currently dominate the agricultural economy, such as apple, potato, cabbage, and other cole crops.	High	Serious by mid-century	New heat-tolerant varieties when available. Change plant dates to avoid stress periods. Explore alternative crops.	Moderate to high

NY Energy - *Vulnerabilities*

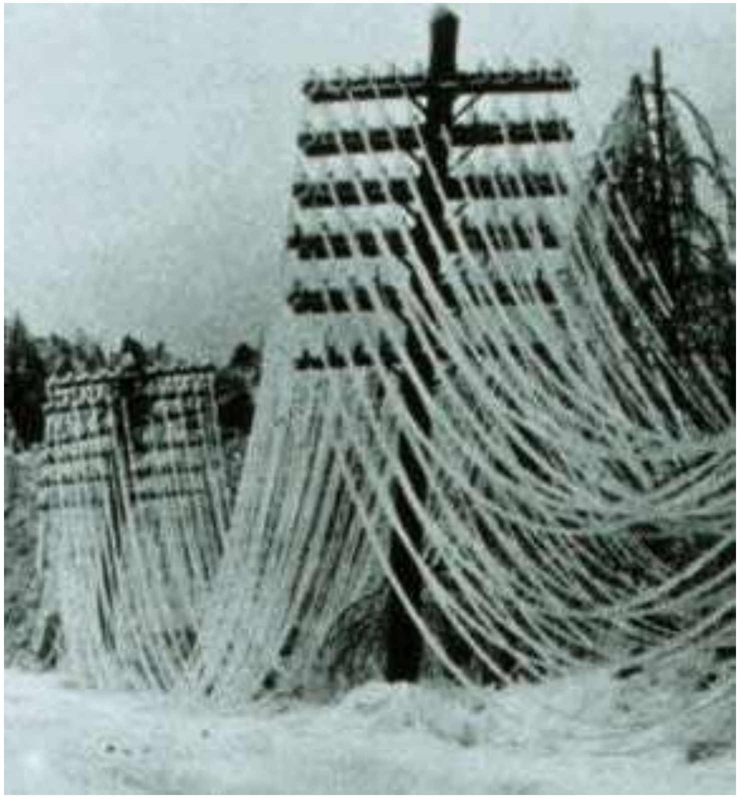
	Vulnerability	Principal Climate Variable(s)	Specific Climate-related Risks
Energy Supply and Distribution			
Power Supply	Thermoelectric power plants	Temperature	The thermal efficiency of power generation is affected by air temperature.
	Coastal power plants (including cogeneration at wastewater treatment facilities)	Extreme weather events & sea level rise	Flood risk at individual facilities depends on the likelihood and intensity of storm surges associated with extreme weather events and their interaction with sea level rise. Operational impacts may be different than impacts on fuel storage or fuel unloading operations.
	Water-cooled power plants	Temperature	Water-cooled nuclear plants are affected by changes in the temperature of intake and discharge water, which is affected by changes in temperature.
	Hydropower systems	Precipitation & temperature	Hydropower availability at individual plants is affected by the timing and quantity of precipitation, as well as snowmelt; snowmelt is also affected by seasonal temperature.
	Wind power systems	Wind speed and direction	Availability and predictably of wind power
	Solar power systems		Availability and predictably of solar power
	Biomass-fueled energy systems	Temperature & precipitation	Biomass availability depends on weather co season.

Sources of <u>electricity generation</u> by fuel type



NY Energy

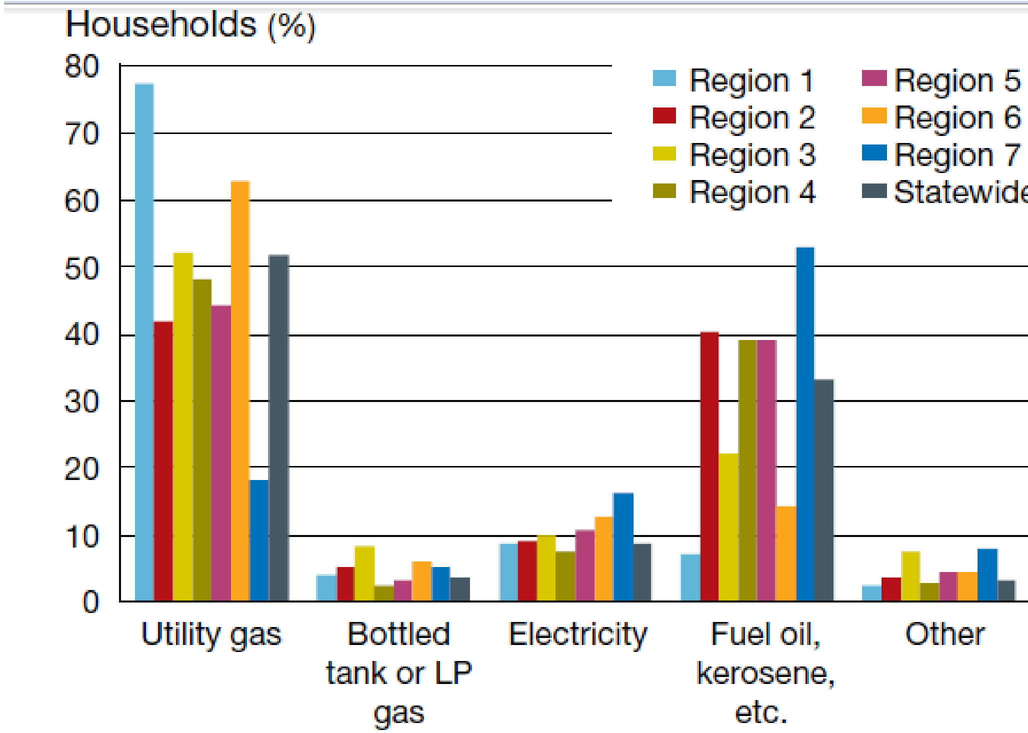
A multi-day ice storm in 1998 resulted in >1billion$ of damage across northeastern US and eastern Canada.
12,500 distribution poles, 3000 pole-top transformers, and 500 miles of wire conductor required replacing and 100,000 customers were impacted.



NY Energy

Energy Transmission and Distribution Assets	Transmission lines (winter)	Extreme weather events	Frequency, duration, and spatial extent of outages are affected by winter storms, particularly ice storms and high winds.	Western, Central, and Northern NYS	Communications
	Transmission lines (summer)	Temperature	Sagging lines can result from increased load associated with higher temperatures.	Statewide	Communications, Public Health
	Transformers	Temperature	Transformers rated for particular temperatures may fail during prolonged periods of increased temperature.	Statewide	Communications, Public Health
	Natural gas distribution lines	Temperature, extreme weather events, & flooding	Changing temperatures may affect vulnerability to frost heave risks, which can threaten structural stability of the pipeline. Flooding risks can also jeopardize pipeline stability/operations. Extreme weather events may threaten underwater pipelines in the Gulf Coast region, a large source of natural gas supply for New York.	Statewide	

Sources of fuel used for residential space heating



Source: Adapted from NYSERDA, 2009

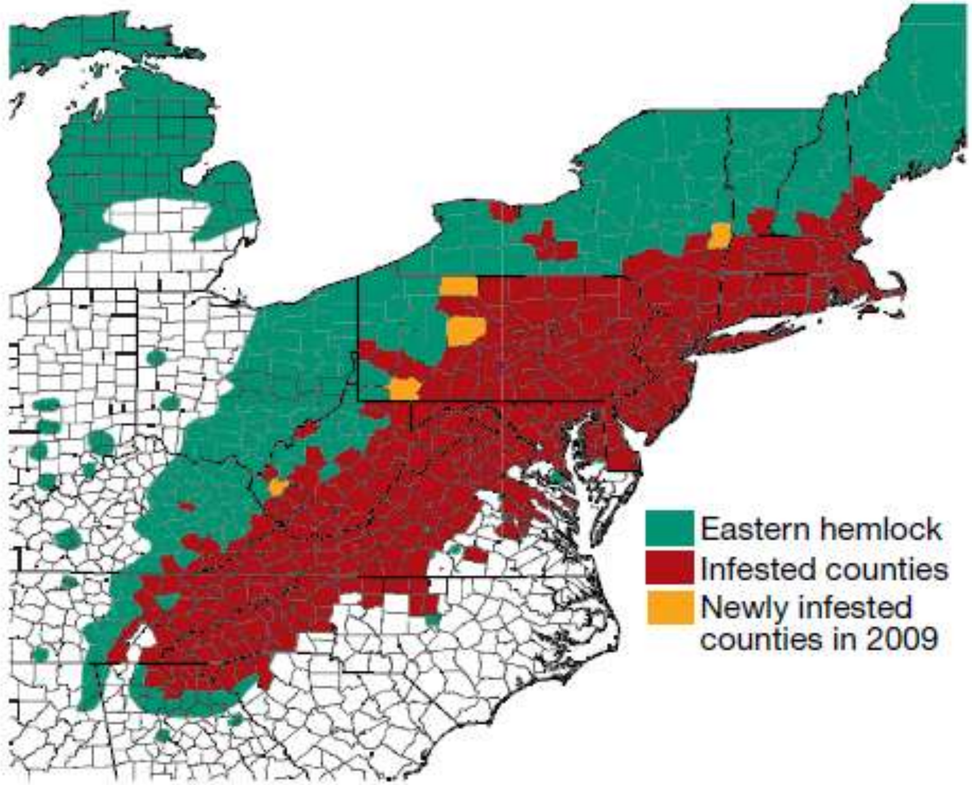
NY Energy -- *Adaptations*

Adaptation strategies to buffer energy sources.

Protect power plants from flooding with dykes/berms.
Bury or re-rate cable to reduce failures.
Establish new coastal power plant siting rules to minimize flood risk.
Change water management rules to protect hydropower supply availability.
Install solar PV technology to reduce effects of peak demand.
Use increased winter stream flow to refill hydropower dam reservoirs.
Develop non-hydropower generation resources to reduce need for hydropower generation during winter.
Construct additional transmission line capacity to bring more power to New York City to address peak demand periods.
Upgrade existing local transmission and distribution network to handle increased load.
Retrofit/reinforce existing energy infrastructure with more robust control systems that can better respond to extreme weather and load patterns.
Automate restoration procedures to bring energy systems back on line faster after weather-related service interruptions.

NY Ecosystems -- *Vulnerabilities*

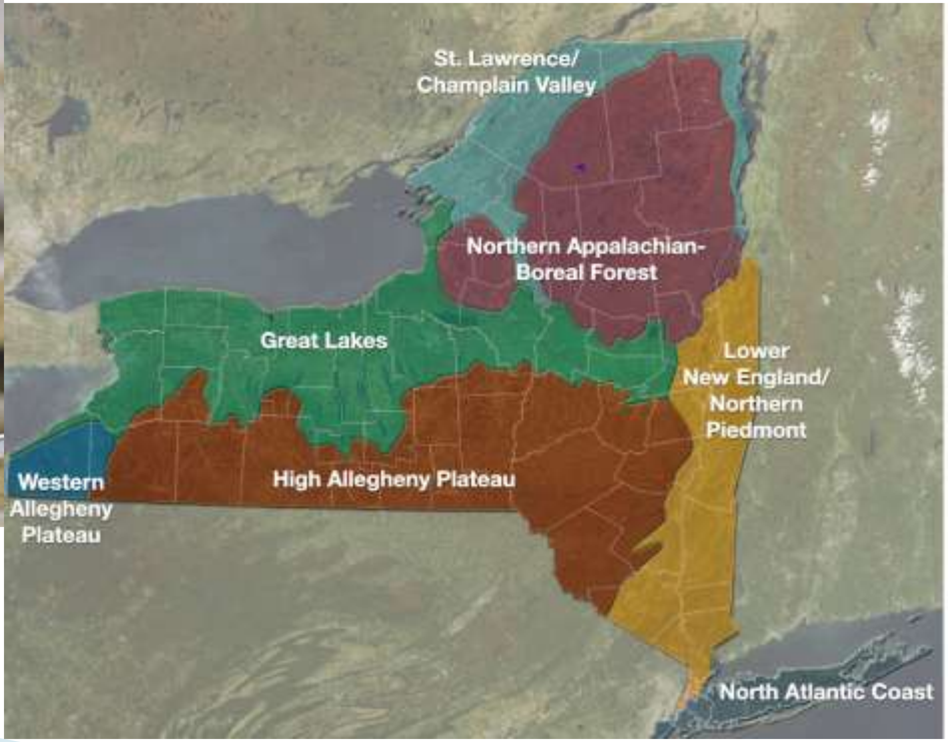
Increased invasion of pest species



Counties with existing and new infestations of Hemlock woolly adelgid as of 2009.

NY Ecosystems

Loss of high elevation, cold-dependent ecosystems – Adirondacks.



NY Ecosystems -- *Adaptations*

Good News – NY is ~75 % forested – not starting from Scratch.

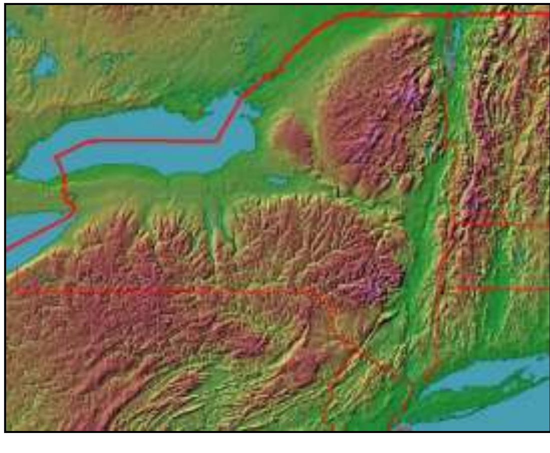
Adaptations:

- establish corridors to facilitate movement of organisms
- Protect large, intact healthy forests as “seed source and refuge.
- develop monitoring system for pests with rapid response
  engage volunteers, schools,
  expand on-line mapping programs
- reduce other stressors (pollution, habitat fragmentation) to build ecosystem resilience

NY Water Resources

It's Good News! Friday

- 40 in average annual precipitation
- 1,236 sq. miles of lakes, ponds,
  & reservoirs (including 8,300 lakes)
- 577 miles of Great Lakes shoreline
- 52,337 miles of rivers and streams, including headwaters of
  Chesapeake & Delaware Bays, Hudson, Mississippi, and
  St. Lawrence Rivers
- 1,530 sq. miles of estuaries, bays, & harbors
  (117.5 miles of Atlantic Ocean shoreline)
- 3,750 sq. miles of freshwater wetlands
- Extensive groundwater resources



NY Water Resources

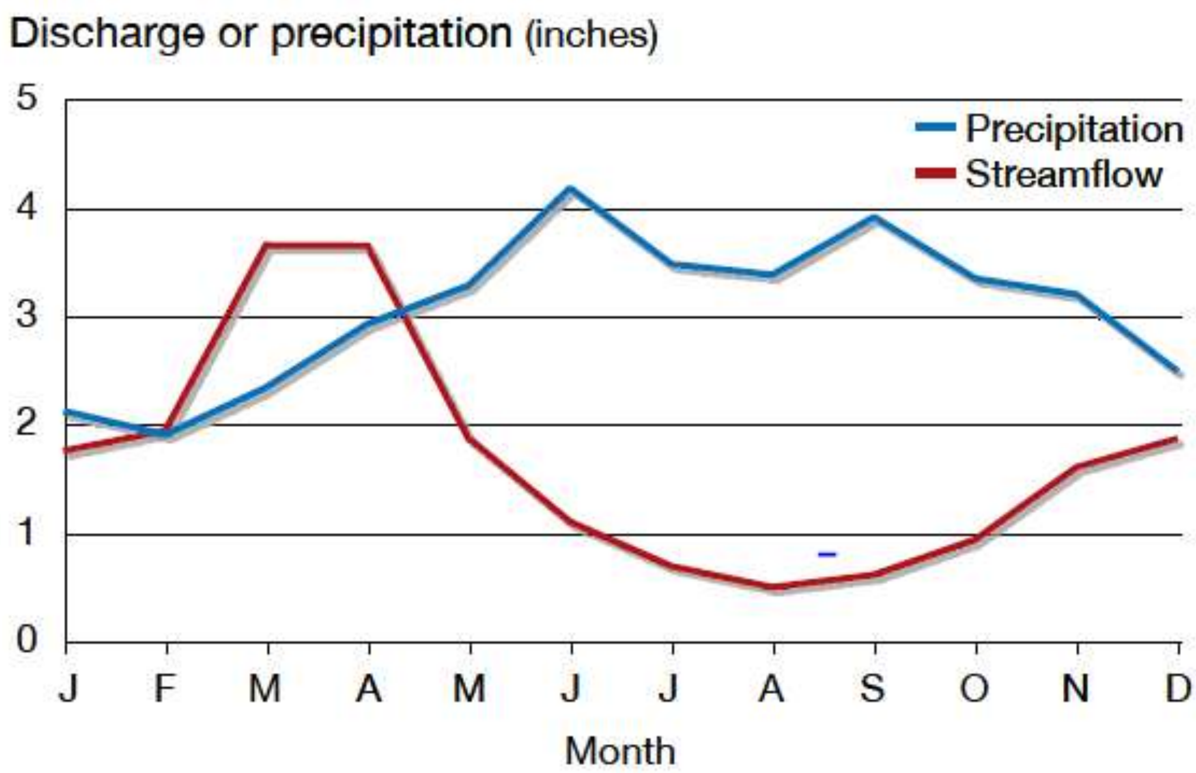


Figure 4.3 Average monthly streamflow discharge and precipitation for the Fall Creek watershed in Central New York

NY Water Resources – Vulnerability

Water supply

Avg daily demand, total storage, and approximate days of supply for a Sample of reservoir systems in NYS

Municipality	Demand (million gallons/day)	Storage (million gallons)	Secondary Source	Days of Supply w/ No Inflow
Ithaca	3.3	261	Yes	99
Oneonta	1.5	140	Yes	117
Beacon	2.3	218	Yes	118
Ilion	1.97	225	Yes	143
Rome	9.5	1,419	No	187
Colonie	10.4	1,797	Yes	216
Plattsburg	2.3	457	Yes	248
Guilderland/Watervliet	7.3	1,700	Yes	291
Fredonia	1.4	335	No	299
Albany	18.5	13,500	No	912
Troy	14.4	12,912	No	1121

Note: Storage volume information was taken from a USGS inventory of large dams in New York and from a New York State Department of Health (1974) report

NY Water Resources

Vulnerability of water supplies to drought

	Category	Sensitivity to Climate Change	Population Served
1	Withdrawal from large water bodies	Low	2,000,000
2	New York City system	Moderate	9,300,000
3	Other reservoir systems	Moderate	1,300,000
4	Run-of-the-river on small drainage	High	62,000
5	Long Island groundwater	Moderate	3,200,000
6	Other primary aquifers	Moderate	650,000
7	Homeowner well water	Moderate to high	1,900,000
8	Other small water supply systems (groundwater/surface water)	Moderate to High	600,000
	Total		19,012,000

Note: Water supply sensitivity is related to the length of drought that a water system could endure without being severely stressed, as estimated from system storage and demands. This analysis is only intended to provide a general assessment of vulnerability within broad categories. Ultimately, individual water supply systems would require system-specific analysis.

NY Water Resources -- Vulnerability

Flooding of floodplain communities

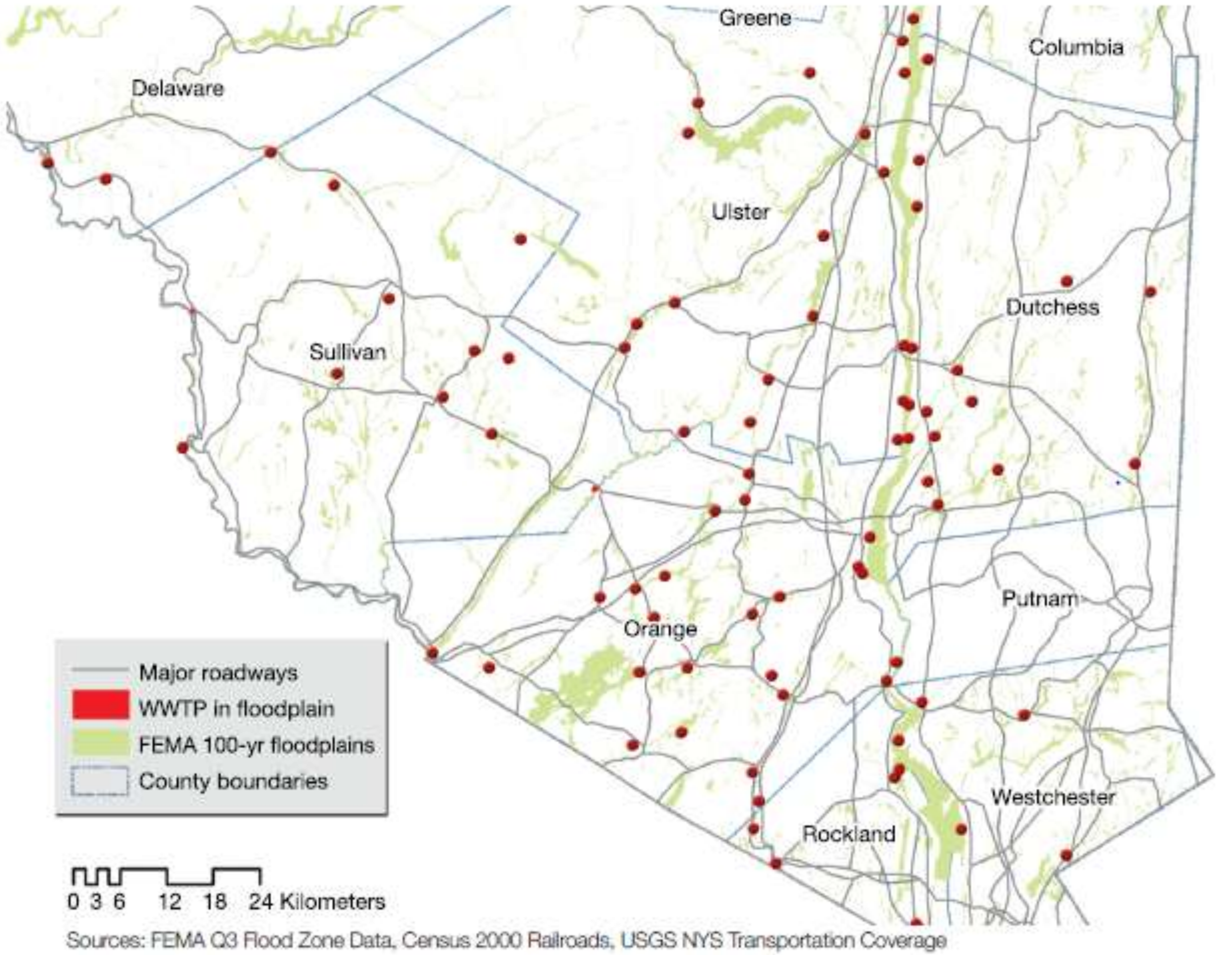


Figure 4.5 Wastewater treatment plants (WWTP) in proximity to floodplains in the Hudson Valley and Catskill Region

NY Water Resources

Source: E. Aswald, used with permission.

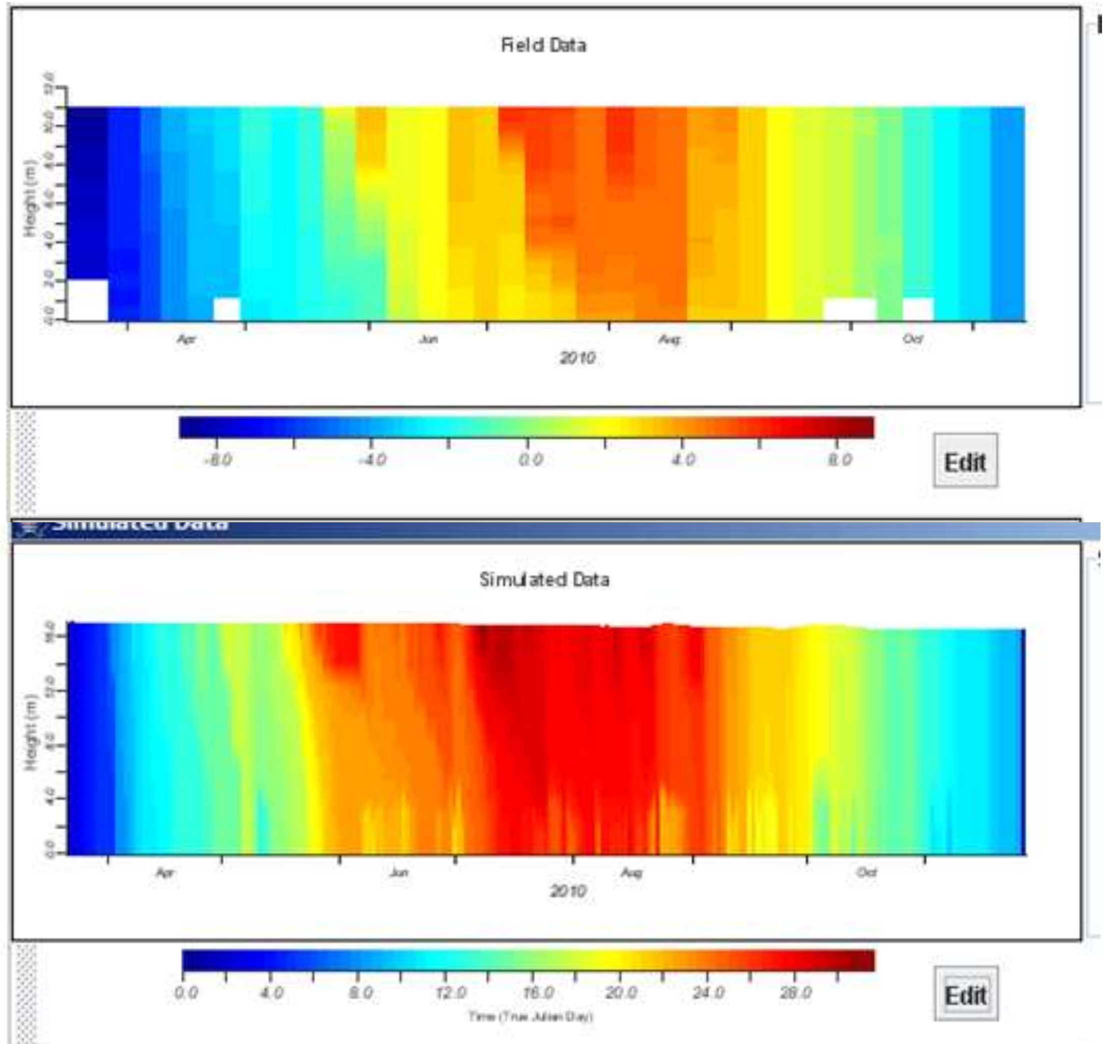
Endicott sewage treatment plant

June, 2006
Sept., 2011

NY Water Resources --Vulnerability

Increased water temperature and degraded water quality

Oneida Lake, NY
Observed 2010 temperature profiles summertime
VS
Predicted 2050 temperature Profiles – DYRESM model
Amy Hetherington
Draft MS thesis



NY Water Resources

Adaptations

Use buy-outs or land trading to move infrastructure and homes out of high risk floodplains.

Increase monitoring of reservoirs with “rule curves” triggering conservation for different drought thresholds.

Develop a state-wide policy concerning inventory, water monitoring and withdrawals.

Implement robust or “win-win” strategies, such as improving wastewater systems.

NY Water Resources -- Adaptations

Improve watershed mgmt and "save the rain for a sunny day"

NY Survey

Organizational Actions to Adapt to Anticipated Climate Change

"Has your organization already taken specific actions to address climate change?" (Yes=58.2%)

Questionnaire Items	(n)
1. Conduct outreach and education about climate change	144
2. Work through new or existing partnerships with local groups, organizations, or agencies to address climate change issues	104
3. Collect data to monitor climate change	78
4. Develop a climate action plan	66
5. Practice adaptive management	57
6. Plan on long-term horizons (10 years or more)	61
7. Provide funding for climate change research	42
8. Plan for specific climate change adaptations at the local level	41
9. Conduct a climate change vulnerability or risk assessment	30
10. Implement a climate action plan	27
11. Monitor and evaluate a climate action plan	22
12. Develop a comprehensive flood mitigation plan or program	17

Questions?

- **Cost** – What are the general costs of the proposed strategy, including human and other resources? yield a rough measure of benefits and costs to the extent that the consequences are measured in ec will also be important non-economic consequences in most decision problems.
- **Timing** – Timing of implementation should be considered relative to the timing of impact. Specifi will occur in a time frame comparable to the time required for implementation, there is need for in ation.
- **Feasibility** – How feasible is the strategy for implementation both within an organization and from engineering, policy, legal, and insurance? Are there expected technological changes that would im ity?
- **Efficacy** – To what extent will the strategy, if successfully implemented, reduce the risk?
- **Robustness** – Is there the potential to install equipment or upgrade infrastructure that is designed of climate hazards? Are there opportunities for flexible adaptation pathways?
- **Co-benefits** – Will strategies have a negative or positive impact on other stakeholders or sectors? Is cost sharing? Are there impacts on mitigation of greenhouse gases? Are there impacts on the envir able population?