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

NYSERDA EMEP Meeting

Albany, New York

October 15th, 2009

NYSERDA
CENTER FOR CLIMATE SYSTEMS RESEARCH
THE EARTH INSTITUTE AT COLUMBIA UNIVERSITY
Cornell University
The INSTITUTE for SUSTAINABLE CITIES
CITY UNIVERSITY OF NEW YORK

Timeline

Introduction	5 minutes
Project Overview	5 minutes
Climate	5 minutes
Sector highlights Energy Water Resources	5 min each
Conclusions & Recommendations	5 minutes

ClimAID Goals

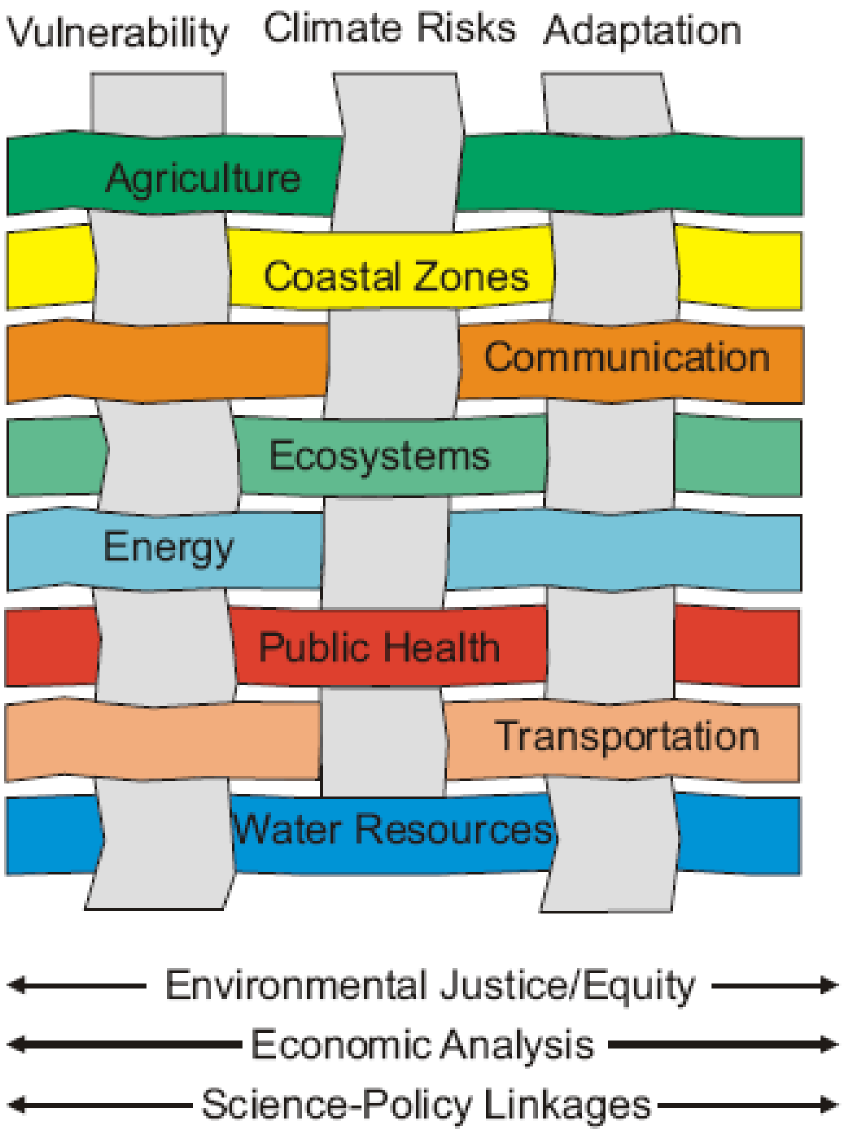
To provide New York State with cutting-edge information on its vulnerability to climate change and to facilitate the development of adaptation policies informed by both local experience and state-of-the-art scientific knowledge.

Structure

Sectors
- Agriculture/Ecosystems
- Coastal Zones
- Energy
- Public Health
- Transportation/ Communication
- Water Resources

Key Themes
- Climate Risks
- Vulnerability
- Adaptation

Cross Cutting Elements
- Science/Policy Linkages
- Economic Policy Linkages
- Environmental Justice



Project Timeline

- **NOV 2008**: Kickoff
- **SPRING 2009**: Initial stakeholder meetings
- **MAR 2009**: Project Team Mtg
- **JULY 2009**: PAC feedback & Mtg
- **FALL 2009**: Follow-up stakeholder meetings
- **OCT 2009**: Project Team Mtg
- **NOV 2009**: PAC feedback & Mtg
- **SPRING 2010**: Project Team Mtg
- **SPRING 2010**: Expert Reviews of final drafts, Focus on developing outreach tools

Report Outline – Current Plan

Summary for Policymakers

I. Introduction

II. Vulnerability and Adaptation

III. Equity, Economics, and Science-Policy Linkages

IV. Climate Risks

V. Sector Chapters

  a. Water

  b. Coastal Zones

  b. Ecosystems

  c. Agriculture

  d. Energy

  e. Transportation

  f. Communication

  g. Public Health

- Sector Description*
- Stakeholder Engagement & Key Climate-related Decisions*
- Sector-specific Vulnerabilities* **
- Sector-specific Climate Risks* **
- Sector-specific Adaptation Strategies* **
- Highlighted Case Study with CCE Input
- Sector-specific Science-Policy Linkages* **
- Conclusions and Recommendations

**Includes CCE Contributions as appropriate*

***Includes Other Case Studies as appropriate*

VI. Conclusions and Recommendations

VII. Appendices; a. Glossary & Acronyms; b. Benchmark Adapt. Study Review

Case Studies

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Highlighted case studies for each sector

- **Agriculture** – Apple and grape production
- **Communications Infrastructure** – Ice storm
- **Ecosystems** – Winter recreation
- **Energy** – Heat waves
- **Ocean Coastal Zones** – Nor'easter
- **Public Health** – Air quality
- **Transportation Infrastructure** – 100-year storm in NYC metro region
- **Water Resources** – Susquehanna River flooding

Products

- Final report
- Project presentations
- Sector reports, brochures
- Newspaper articles
- Briefings/conferences
- Coordination with NYSERDA's Outreach Contractors
- Peer-reviewed publications
- Website

Stakeholder Interactions

- **Spring 2009** — Initial Stakeholder Meetings
- **Late Spring 2009** — Stakeholder Surveys
- **Throughout 2009** — Interaction with Stakeholder Focus Groups
- **Spring 2010** — Follow-up Stakeholder Meetings

CLIMATE SCIENCE

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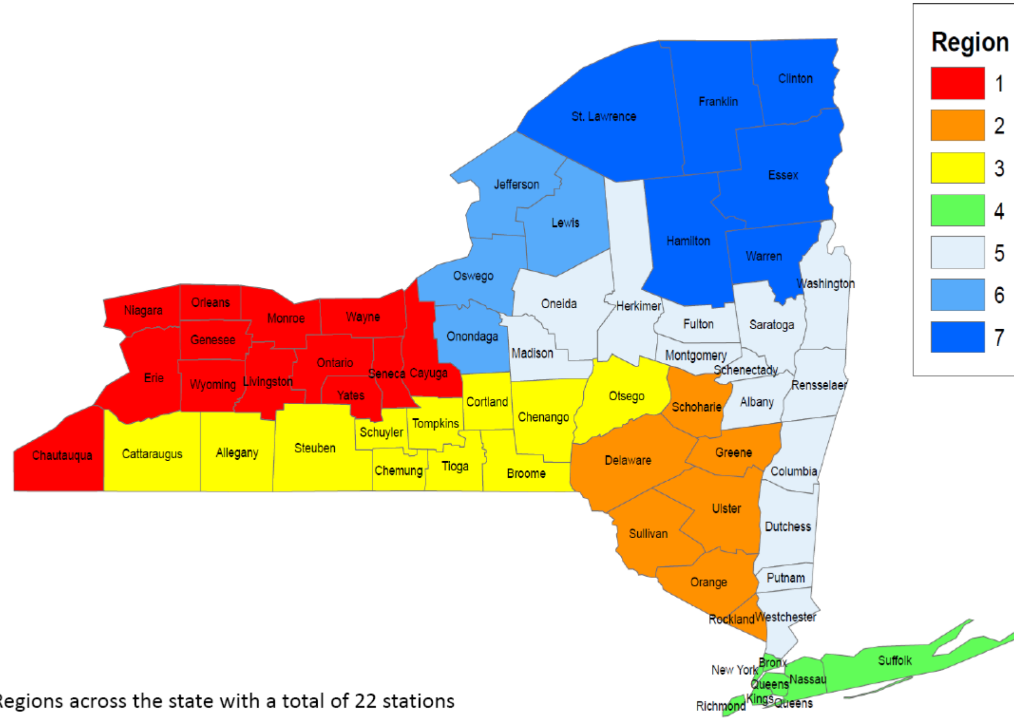
Key Products

- Providing state-of-the-art climate information
- Quantitative and qualitative projections, statewide and by region
- Sector-specific climate products
- Regional climate modeling and statistical downscaling



7 Regions across the state with a total of 22 stations

Region 1 – Western New York (4)
Region 2 – Catskills (3)
Region 3 – Central New York (3)
Region 4 – New York City and Long Island (3)
Region 5 – Mohawk and Hudson Valley (4)
Region 6 – Tug Hill Plateau (2)
Region 7 – Adirondacks (3)

Climate Scenarios

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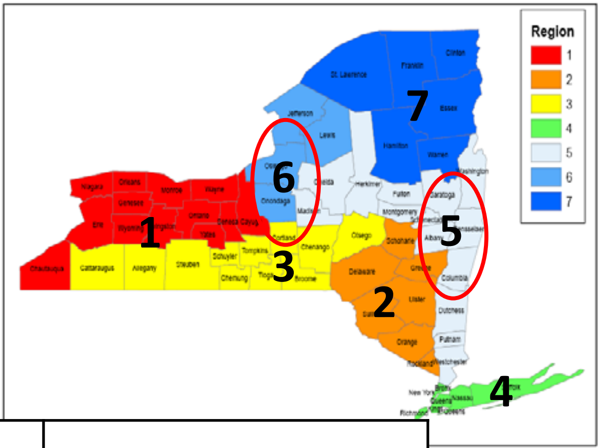
Quantitative Projections by Region: Mean Changes



Region 5	Baseline[1] 1971-2000	2020s	2050s	2080s
Air temperature Min (Central Range) Max[2]	50° F	0.5 (1.5 to 3.0) 3.5° F	2.5 (3.0 to 5.5) 7.5° F	3.0 (4.0 to 8.0) 10.0° F
Precipitation Min (Central Range) Max	51 in	- 5 (0 to + 5) 10 %	-5 (0 to + 10) 10 %	0 (5 to 10) 15%

Region 6	Baseline 1971-2000	2020s	2050s	2080s
Air temperature Min (Central Range) Max	44° F	+ 0.5 (1.5 to 3.0) 4.0° F	+ 2.5 (3.5 to 5.5) 7.5° F	+ 3.0 (4.5 to 9.0) 10.5° F
Precipitation Min (Central Range) Max	51 in	- 5 (0 to + 5) 15 %	-5 (0 to + 10) 15%	-5 (+ 5 to 15) 20%

Source: CCSR

[1] The baselines for each region are the average of the values across all the stations in the region.

[2] The minimum, central range (middle 67%), and maximum of values from model-based probabilities across the GCMs and greenhouse gas emissions scenarios is shown.

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Sea level rise

New York City	Baseline (1971-2000)	2020s	2050s	2080s
Sea level rise1 Central range2	NA	+ 2 to 5 in	+ 7 to 12 in	+ 12 to 23 in
Rapid Ice-Melt[3] Sea level rise	NA	~ 5 to 10 in	~ 19 to 29 in	~ 41 to 55 in

NYC

Troy	Baseline (1971-2000)	2020s	2050s	2080s
Sea level rise[1] Central range[2]	NA	+ 1 to 4 in	+ 5 to 9 in	+ 8 to 18 in
Rapid Ice-Melt[3] Sea level rise	NA	~ 4 to 9 in	~ 17 to 26 in	~ 37 to 50 in

Troy

The coastal zones sector is helping to support the development of a simple hydrodynamic model for the Hudson River. This modeling effort is being led by Jery Stedinger at Cornell. The coastal zones chapter will include the effort as a case study; this model may ultimately improve our understanding of key processes including tidal cycles and storm surge flooding.

[1] Shown is the central range (middle 67%) of values from model-based probabilities. Rounded to the nearest inch.
[2] The model-based sea level rise projections may represent the range of possible outcomes less completely than the temperature and precipitation projections.
[3]"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.

Source: CCSR

Sector-Specific Climate Products Provided

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Select Examples

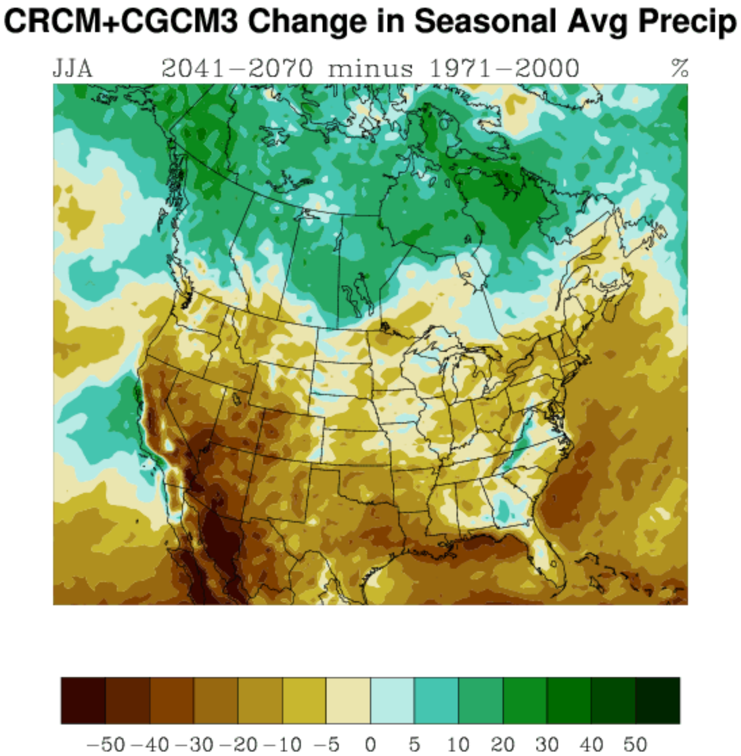
- **Coastal**: Sea surface temperatures
- **Energy**: Hourly temperature data
- **Public Health**: Daily temperature projections
- **Water Resources**: Palmer Drought Severity Index (a measure of longer-term dryness/wetness)

Integrating Mechanisms: Climate

- Validation of global climate model output

  - Mean values, climatology, trends, and variance

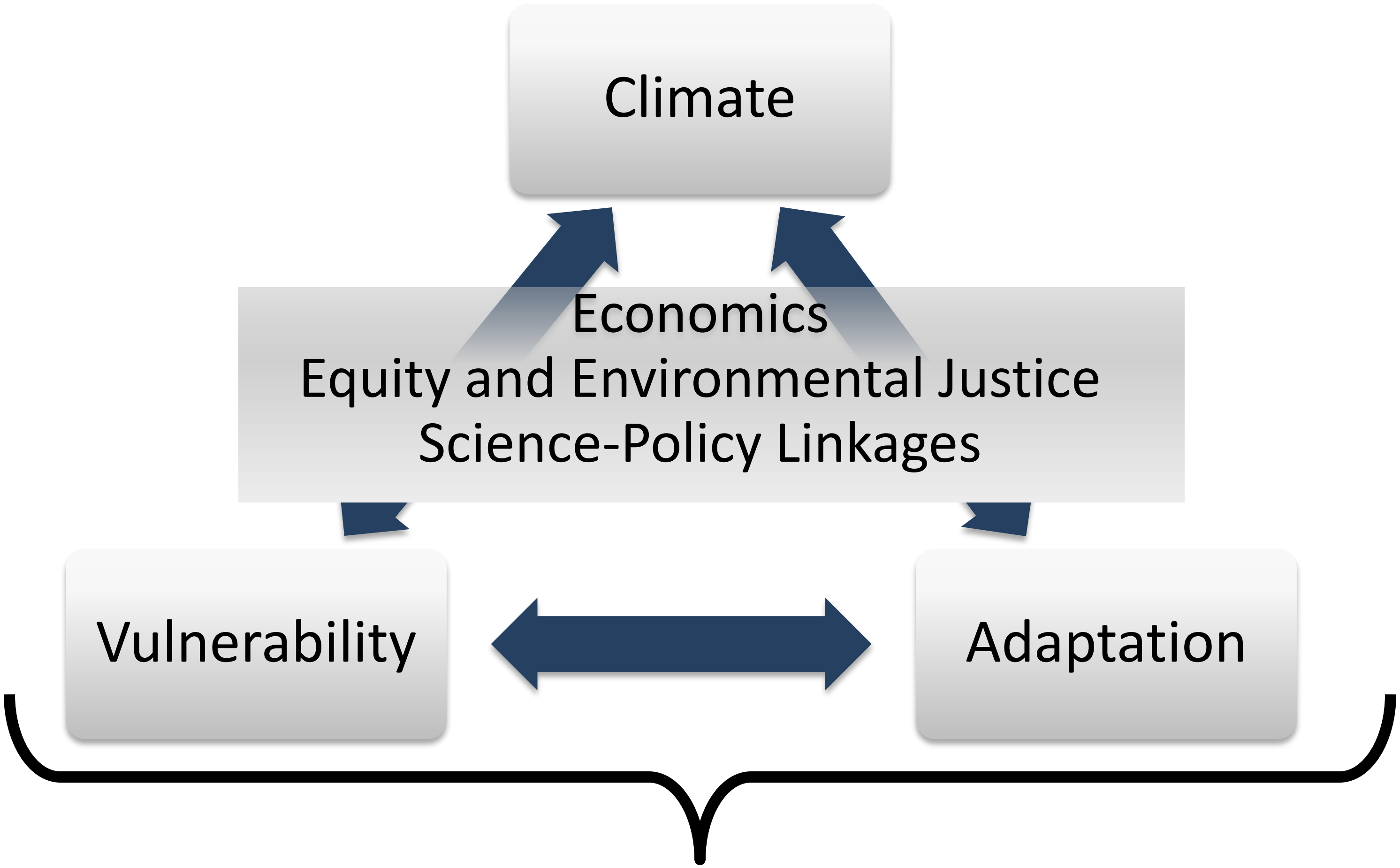
- Evaluation of NARCCAP
- Analysis of uncertainty
- Climate change (and climate change impact and adaptation) indicators



Source: NARCCAP

HIGHLIGHTS OF TWO SECTORS

Focus on Two Sectors



CLIMATE-PROTECTED NYS

Reduced Vulnerability and Enhanced Adaptive Capacity

ENERGY: Team

Steve Hammer, Columbia University

Lily Parshall, Columbia University

Michael Bobker, CUNY Institute for Urban Systems

ENERGY: Stakeholder Process

Two tracks

1. Detailed interviews to discuss climate planning, anticipated impacts, changes in operating practices
   - Generators & Distribution Utilities: NYPA, NRG, TransCanada, Con Edison, RGE, NYSEG, National Grid, Central Hudson
   - Some utilities are already taking changes on board; for others climate change is a brand new issue
2. Demand forecasting

   Efforts to improve how climate change is characterized in the NYISO demand forecast modeling

ENERGY: Stakeholder Engagement

Team is working with stakeholders to identify:

- vulnerabilities & impacts
- timing
- decisions
- potential adaptation strategies

NYSERDA Climate Change Adaptation Assessment for New York State

ENERGY

DRAFT

Climate Variable	Probability	Vulnerability & Impacts	Timing	Decisions	Adaptation Strategy
Warmer temperatures	Extremely likely	Increased energy demand --> equipment failure		Regulate and enforce building and landscape design codes to reduce energy demand; Reduce/eliminate energy subsidies so prices reflect true cost	Increase peak or overall system capacity; Install solar PV technology to reduce effects of peak demand
Decline in stream flow	TBD-Region Dependent	Decreased summer stream flow --> decreased hydropower availability		Alter water management rules to protect hydro supply availability	Use increased winter stream flow to refill hydropower dam reservoirs; develop non-hydropower generation resources
Increase storm-related coastal flooding due to sea level rise	Very Likely	Energy plants vulnerbale to flooding; alteration of water intake and outflow pipes; loss of cooling water capacity		Establish new coastal power plant siting rules to minimize flood risk	Adopt flood prevention or abatement plans; protect infrastructure with dykes/ berms;

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ENERGY: Vulnerability

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Climate-related vulnerabilities and impacts

Supply

- **Flooding of water-side facilities** (sea level rise, storm surge, extreme rainfall events)
- **Water-cooling related impacts** (drought, turbidity from storm events, water temperature)
- **Air temperature** (equipment breakdown during extreme heat events, decreased power plant output or transmission/distribution line throughput capacity, snow vs. rain = timing of hydro availability)
- **Drought** (hydro availability)
- **Resource availability** (hydro, solar, wind availability)

Demand

- Changes in seasonal and diurnal load patters (winter peaking = reduced demand due to warming; summer peaking = length of extreme heat waves + changing air conditioning saturation rates)

ENERGY: Climate Variables

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Region 5 – Yorktown Heights

Extreme events

	Extreme Event	Baseline (1971 – 2000)	2020s	2050s	2080s
Heat waves & cold e	# of days/yr with max temp exceeding: 90 °F 95 °F	 7 0.7[1]	 9 to 14 1 to 2	 15 to 28 2 to 7	 20 to 51 4 to 18
	# of heat waves/yr[2] average duration	0.8 4	1 to 2 4 to 4	0.6 to 2 4 to 5	3 to 7 5 to 6
	# of days/yr with min temp below: 32°F 0 °F	 124 3	 95 to 107 1 to 2	 79 to 95 0.7 to 1	 63 to 87 0.3 to 0.9
	Cooling degree days[3] Heating degree days	649 6093	785 to 940 5297 to 5666	957 to 1252 4749 to 5276	1089 to 1688 4071 to 5022
Intense precip & droughts	# of days/yr with rainfall exceeding: 1 inch 2 inches	 15 3	 14 to 16 3 to 3	 15 to 17 3 to 3	 14 to 16 3 to 4
	Drought occurs, on average[4]	~ once every 100 yrs	~ once every 30 to 55 yrs	~ once every 10 to 50 yrs	~ once every 5 to 30 yrs

[1]Decimal places shown for values <1, although this does not indicate higher accuracy/certainty. More generally, the high precision and narrow range shown here are due to the fact 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+ consecutive days with maximum temperature exceeding 90 °F
[3] A degree day is the difference between a day's average temperature and 65°F. Cooling degree days are those where the mean temperature exceeds 65 °F and heating degree days are those where the mean temperature falls below 65 °F.
[4] Based on the minima of the Palmer Drought Severity Index (PSDI) over any 12 consecutive months.

Source: CCSR

ENERGY: Adaptation

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Adaptation Strategy Development in Practice

(examples – lit review only, additional examples to be included based on stakeholder surveys)

	Energy Supply	Energy Demand
Anticipatory strategies	• Dikes/berms (power plant flooding) • Power plant siting • Solar PV reduces peak demand • Additional generation supply to offset anticipated hydro reductions or decreased throughput/output	• New building designs/ codes to reduce cooling demand • Public education • Air cooling • Tree planting & cool roofs • Establish more robust demand response
Reactive strategies	• Automate/improve system restoration to speed return to full power • De-rate cables or generators • Change water management rules for other users • Upgrade T&D network to handle increased load	• Fans vs. air-conditioning • Tree planting & cool roofs • Weatherization programs (significant overlap with adaptive strategies, partly a function of timing)

ENERGY: Case Study

Climate Change Impacts on Hydro Output on NYPA facilities

- Great Lakes expected to experience lake level decline due to decreased precipitation, evaporation, etc.
- Declines may have varying impacts at Niagara vs. Massena due to difference in facility design (gravity + pumped storage vs. run of river)
- Additional analysis needed to discern past impacts of drought on NYPA power output
- Challenges arise due to international treaties re: water availability for Niagara Falls during tourist season

WATER RESOURCES: Team

Art DeGaetano
Andrew McDonald
Susan Riha
Rebecca Schneider
Stephen Shaw
Lee Tryhorn

Orange Co. Water Supply case study:
Allan Frei (Hunter College, CUNY)

Susquehanna River Flooding Case study:
Robin Leichenko (Rutgers)
Yehuda Klein (CUNY)
Peter Vancura (Rutgers)
Burrell Montz (SUNY Binghamton)

WATER RESOURCES:
Stakeholder Engagement

Stakeholders work with team to identify:

- vulnerabilities & impacts
- timing
- decisions
- potential adaptation strategies

Representatives from:

- NYS Federation of Lake Associations
- NYS Chapter, American Public Works Association
- Cornell Cooperative Extension Educators
- Private Landowners
- NYS Dept. Environmental Conservation
- NYS Wetland and Floodplain Managers

WATER RESOURCES: Vulnerabilities

Water Supply Across New York

	Category	Sensitivity to Climate Change	Population Served
1	Draw from Large Waterbodies	Low	2,000,000
2	NYC System	Moderate	8,300,000
3	Other Reservoir Systems	Moderate	1,300,000
4	Run-of-the-river on small drainage	High	62,000
5	Long Island GW	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 (GW or SW)	Moderate to High	1,600,000
		Total =	**19,000,000**

WATER RESOURCES: Climate

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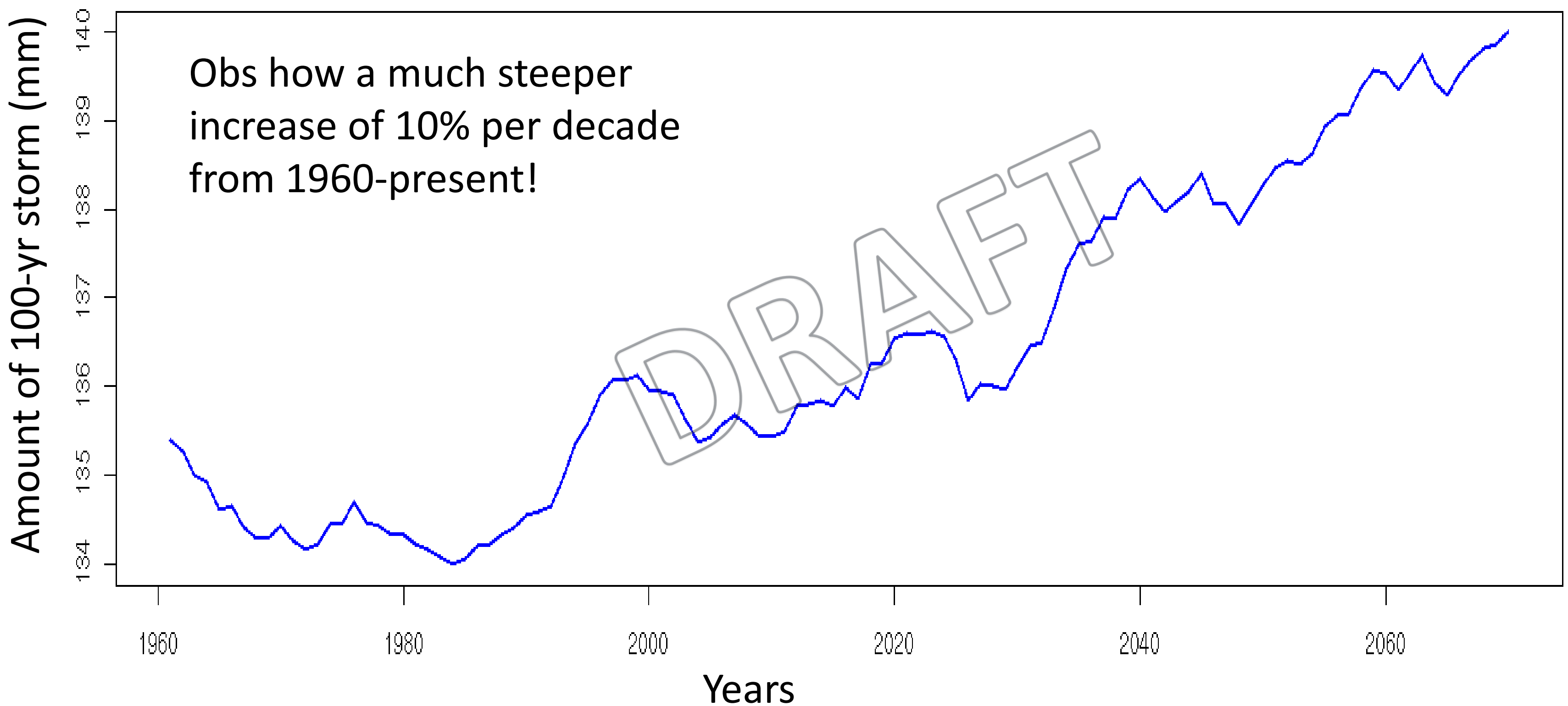
Flooding -- relative contribution of rain vs pet will lead to floods or droughts, and uncertainty

Amount of 100 yr storm in NYS (mm)

Model: HADCM3 Scenario: A2



less snow / more rain **+** larger storm rainfall amounts **+** longer growing season **+** more ET/ drier soils **=** **?**

WATER RESOURCES: Adaptation

Adaptation Strategy Development in Practice

1. "Do nothing/Business as usual"

2. Incremental

3. Identify "no regrets/ win-win" options:
   - Scaleable CSO mitigation strategies
   - Green stormwater infrastructure in urbanized areas
   - Water use conservation

WATER RESOURCES: Adaptation

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Adaptation Strategy Development in Practice

1. Strategic expenditures on **"no regret" options** that result in a net public benefit whether or not climate change projections are realized

2. **Organizational and operational changes** that provide more flexible and targeted responses to observed and projected climate changes.

3. Robust **monitoring efforts** that expand the collection of environmental data important to making management decisions but that also advances our fundamental understanding of the impacts of climate on New York's water resources

4. **Policy options** which will provide incentives for structural options

WATER RESOURCES: Case Study

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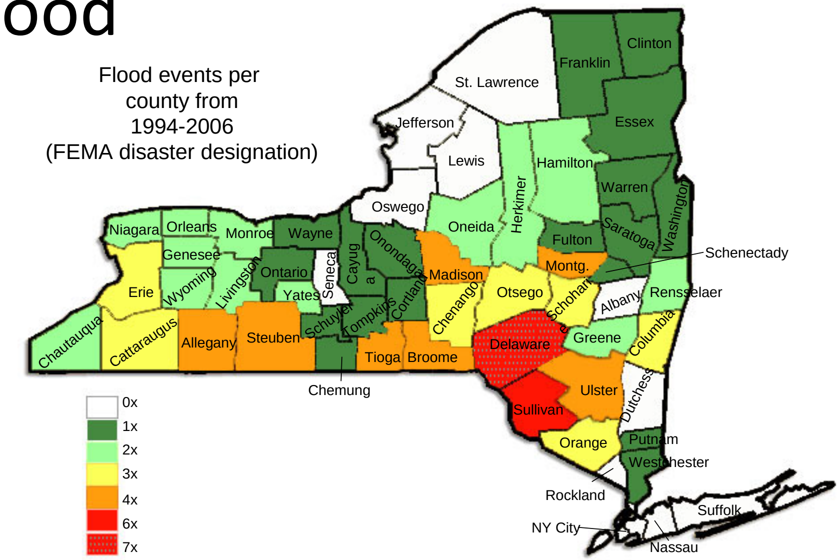
Susquehanna River June 2006 Flood

The flood of 2006 overwhelmed the Endicott Sewage Treatment Plant.



Evaluation of Cross Cutting Elements:

Equity: Relative vulnerability to flooding for communities based on age, income, race

Economics: Costs, benefits associated with different flood response options: (a) no response, (b) increasing barriers, levees, (c) phased withdrawal from high-risk areas, (d) watershed management to reduce flood-contributing runoff

Science-policy linkages: Interactions among science-based BMPs, existing legislation, insurance industry changes, and potential policy implications.

Conclusions & Next Steps

SPRING 2010:
- Ongoing **stakeholder** interaction
- Continued collaboration with **state-wide climate change initiatives** (SLR TF, Climate Action Council, Cost curves study)
- **Expert Reviews** of final drafts
- **Conclusions & recommendations**
- Focus on developing **outreach tools**

NOV 2009:
PAC feedback & Mtg

SPRING 2010:
Project Team Mtg
ClimAID Report