Science to Support Decision Making in New England

Presentation to

EPA New England Climate Change Forum

Joel D. Scheraga, Ph.D.

National Program Director

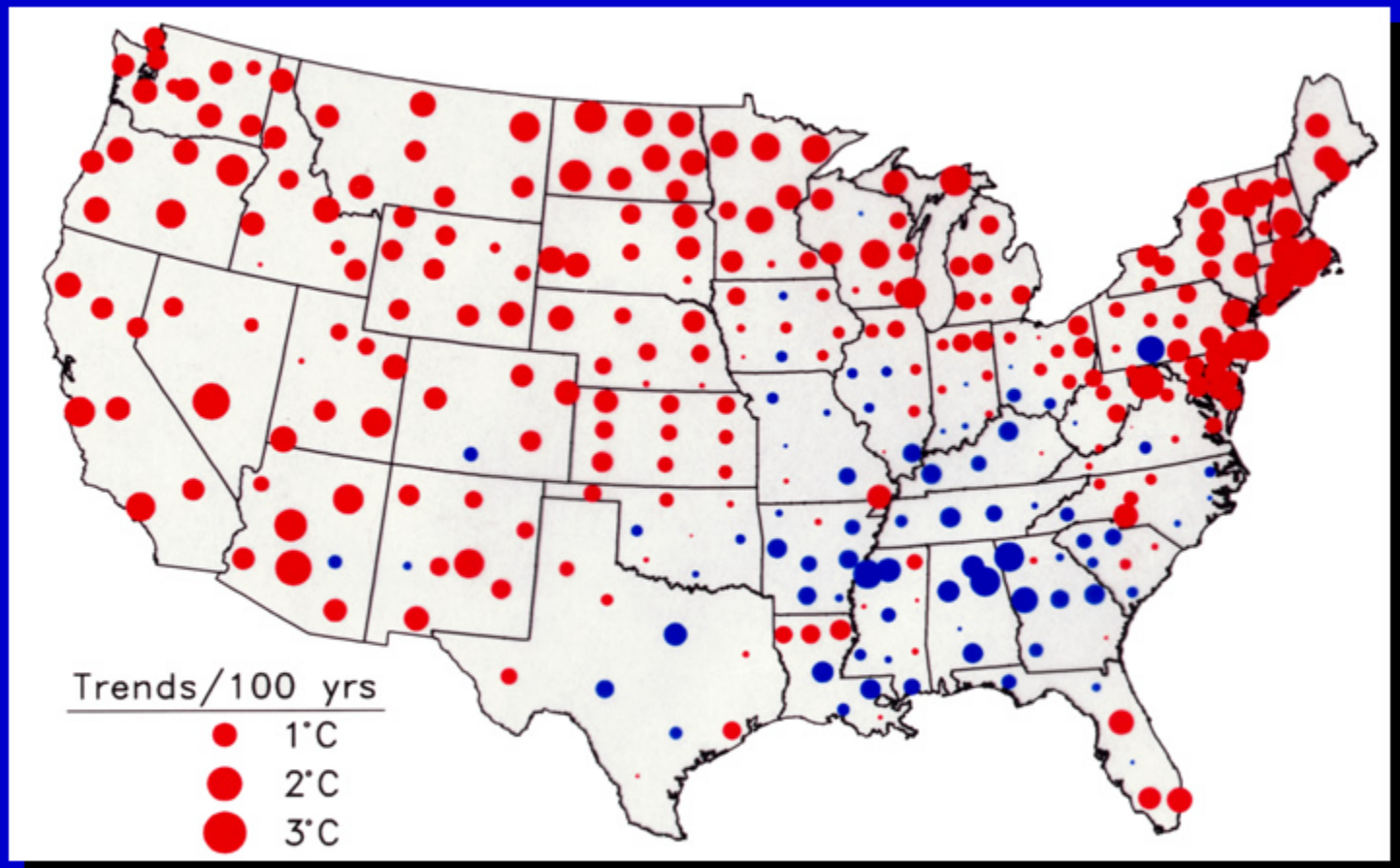
Office of Research and Development

U.S. Environmental Protection Agency

June 19, 2008

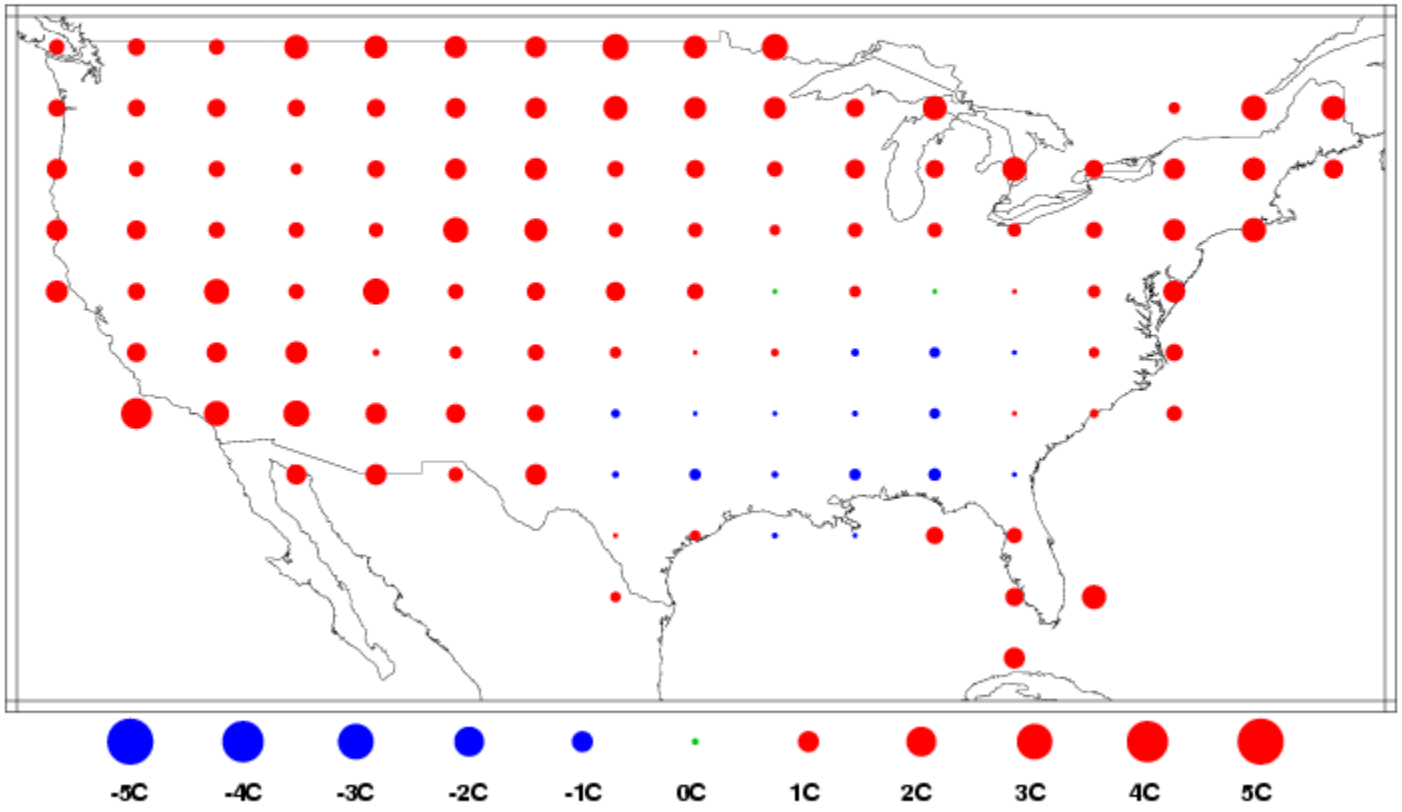
The Climate is Changing

Temperature Trends: 1901 to 1998



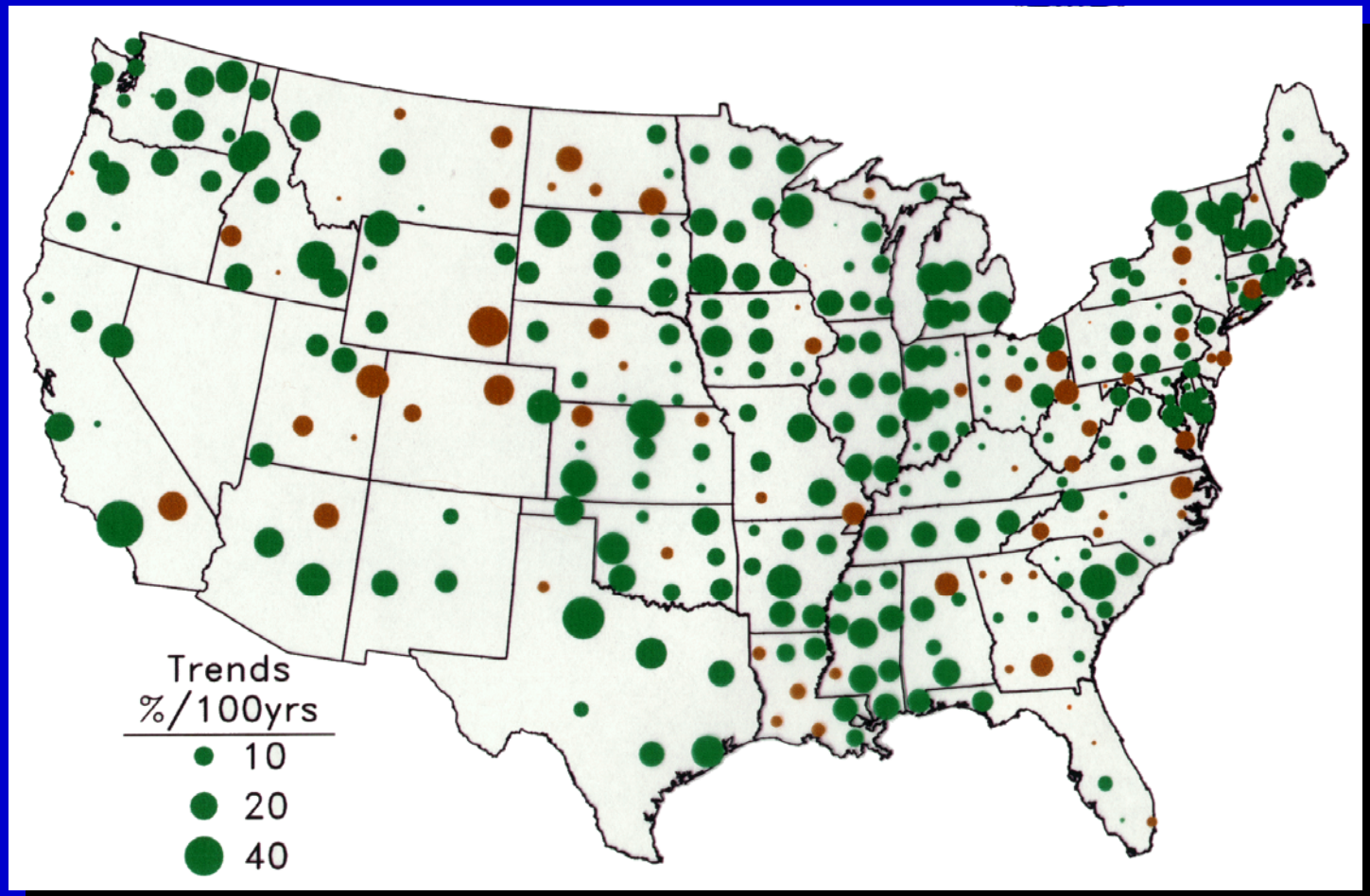
Red circles reflect warming
Blue circles reflect cooling
Source: National Climatic Data Center/NESDIS/NOAA

USHCN V2 Ann MeanTemp Trends 1900-2006



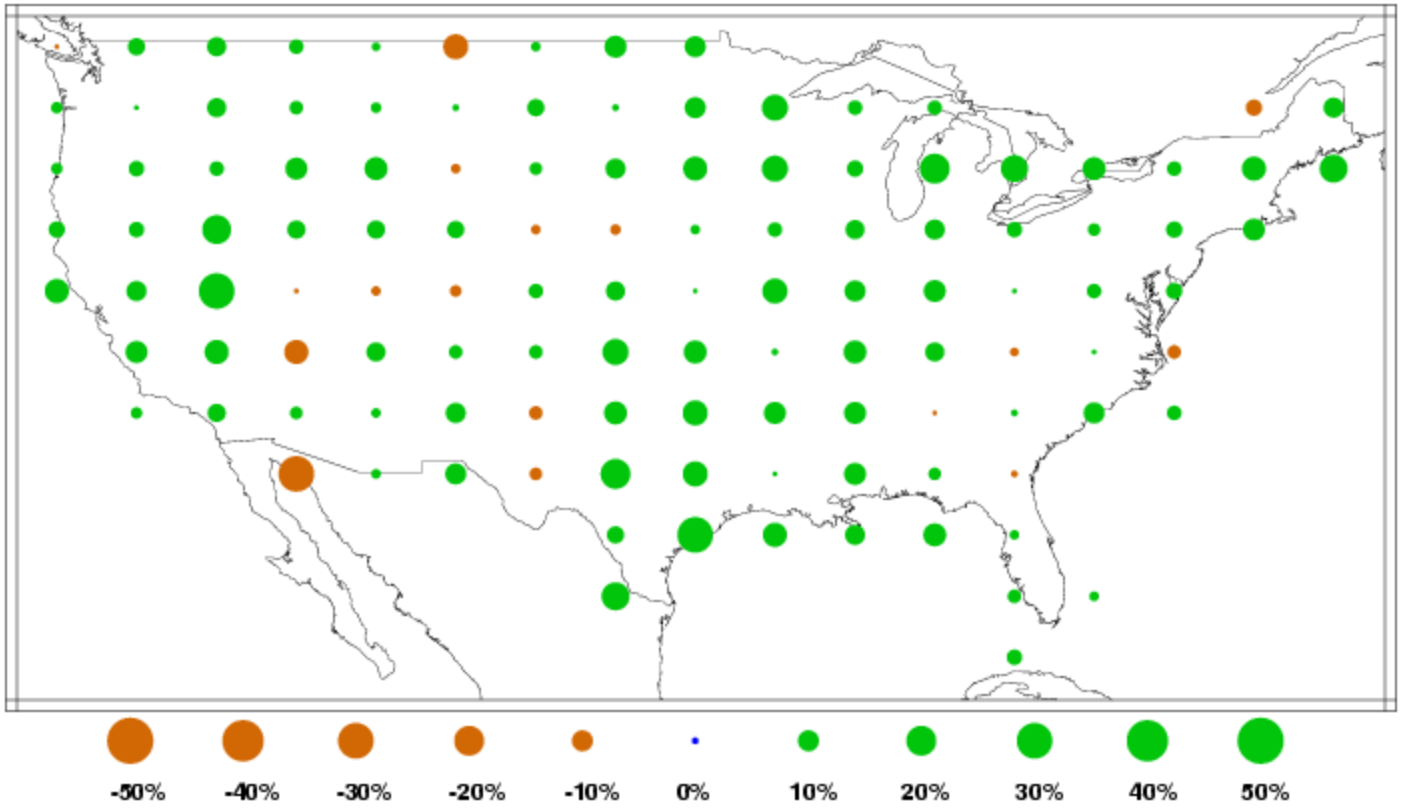
Source: National Climatic Data Center/NESDIS/NOAA

Precipitation Trends: 1901 to 1998



Green circles reflect increasing precipitation
Brown circles reflect decreasing precipitation
Source: National Climatic Data Center/NESDIS/NOAA

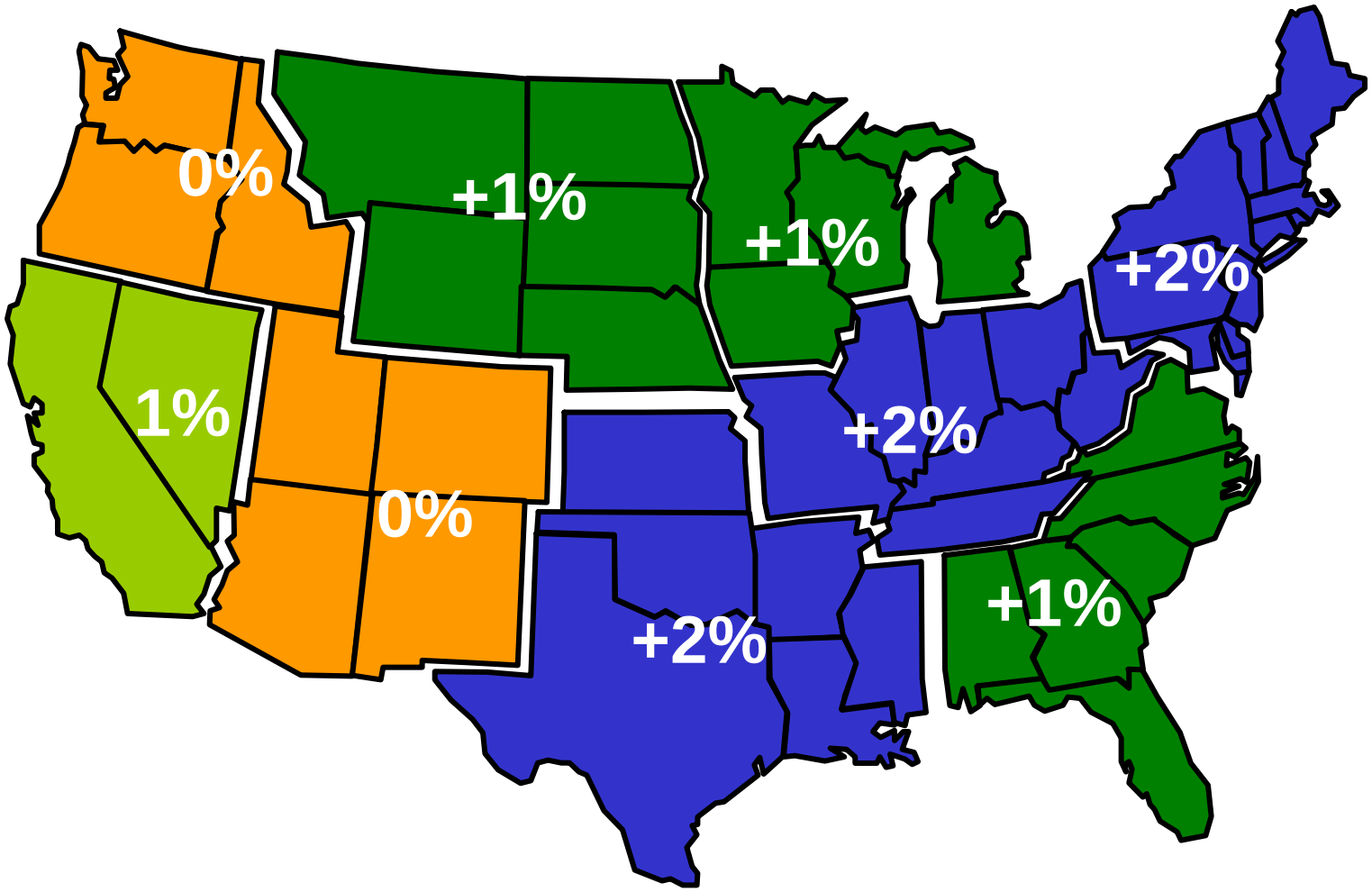
USHCN V1 Ann Prcp Trends 1900-2006



Source: National Climatic Data Center/NESDIS/NOAA

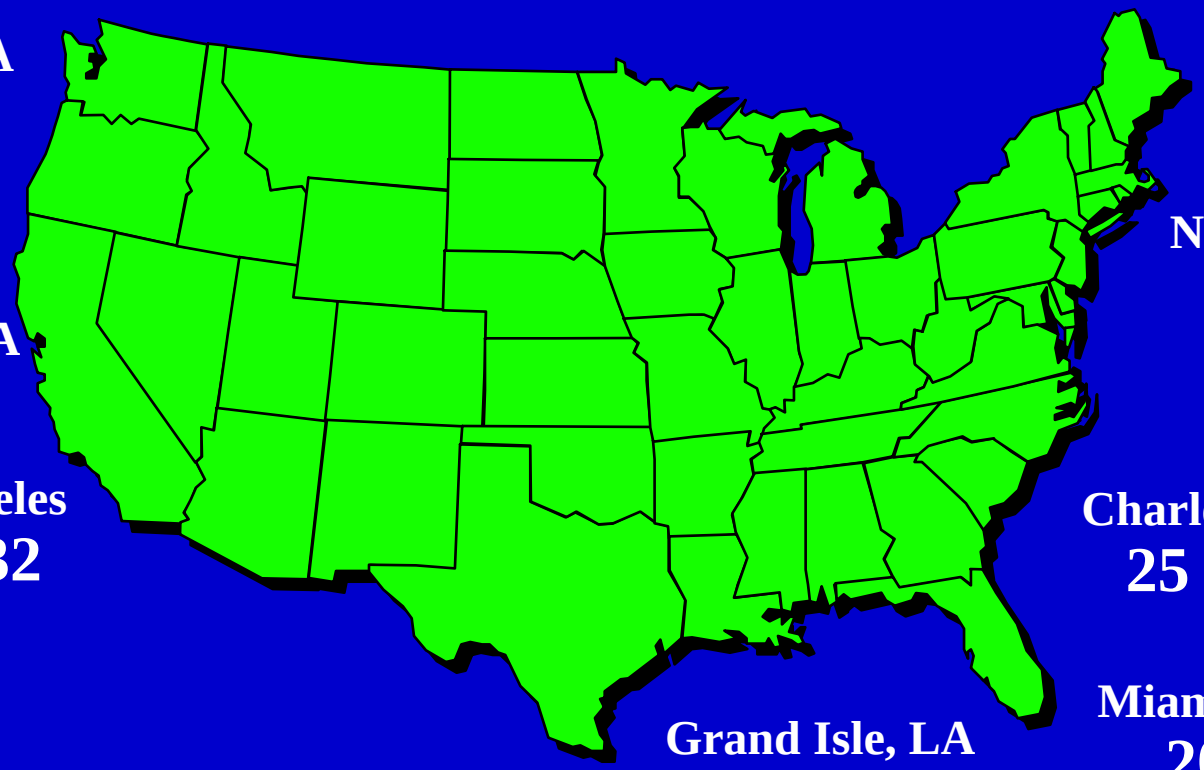
More Rainfall Occurring in Intense Downpours

Trends in Proportion of Annual Precipitation of Extreme Intensity (*i.e.*, more than 2 in. per day): 1910-1995



Source: Karl and Knight, 1998. BAMS, Vol 79(2), pg 231-41

Regional 50% Probability Estimates of Sea Level Rise in 2100 and 2200



Seattle, WA
19 42

Portland, ME
19 43

New York, NY
22 48

San Fransisco, CA
15 36

Los Angeles
13 32

Charleston, SC
25 53

Miami Beach, FL
20 44

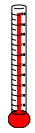
Grand Isle, LA
55 112

Estimates are in inches.

Source: U.S. EPA (1995).

The Potential Impacts of Climate Change

Climate Changes



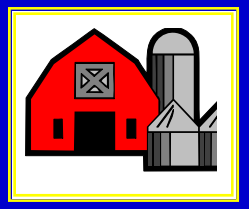
Temperature

Precipitation

Sea Level Rise

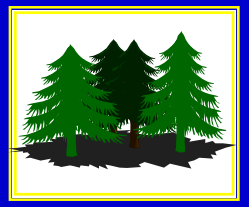
Health Impacts

Weather-related Mortality
Infectious Diseases
Air Quality-Respiratory Illnesses



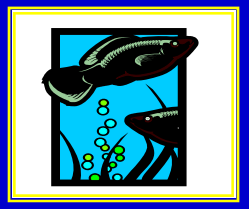
Agriculture Impacts

Crop yields
Irrigation demands



Forest Impacts

Change in forest composition
Shift geographic range of forests
Forest Health and Productivity



Water Resource Impacts

Changes in water supply
Water quality
Increased competition for water

Impacts on Coastal Areas

Erosion of beaches
Inundate coastal lands
Costs to defend coastal communities

Wildlife and Ecosystems

Shift in ecological zones
Loss of habitat and species

Cultural Resources

EPA

A Smart Approach to Shaping the Future Requires a Mix of Strategies

- Consists of a mix of strategies to ***mitigate*** GHG emissions and to ***adapt*** to a changing climate

- **Mitigation:** essential to slow the rate of change

- **Adaptation**: essential because climate will continue to change
  - ➢ regardless of actions taken to mitigate
  - ➢ due to **natural variability** in climate
  - ➢ as well as **human-induced** climate change

- Adaptation increases resilience to change
  - ➢ reduces **risks** and takes advantage of **opportunities**
  - ✓ potential payoffs *today*

Many opportunities exist to anticipate and adapt to a changing climate

We can plan ahead…. or we can react

Wildlife can only react

But humans can anticipate

(Main CN Line Near Amherst, NS)

Many Opportunities to Adapt Exist
(examples)

- Modify long-term planning, engineering standards, and infrastructure design
- Land use planning (*e.g.,* limit development in flood-prone areas!)
- Development of riparian buffer zones
- Shipping: shallower draft ships; dredging ports; length of shipping season; shift to land transport
- Restore and maintain watersheds as an integrated strategy for managing water quality and quantity
- Changes in management and political institutions
- Develop response management plans for invasive species
- Establish heat stress warning systems
- Reduce urban heat island effect
- Enhance water use efficiencies

- **"The severity and duration of summertime regional air pollution episodes are projected to increase in the Northeast and Midwest US by 2045-2052 due to climate-change-induced decreases in the frequency of surface cyclones."** (IPCC, 2007)

- **By 2050, warming alone may increase by 68% the number of Red Ozone Alert days across the Eastern US.** (IPCC, 2007 -Bell et al, 2006)

For Madison, *if 20% of car trips were replaced by bike trips:*

1. **10 lbs (4.5 kg) lost /person/yr** (for 6.8 mi. roundtrip commute)

2. **12% fall each in Ozone and NOx : 2% drop in $PM_{2.5}$**

- **17,990 fewer lost-work days/yr**
- **1,906 fewer Asthma admisisons/yr**
- **14,586 fewer acute respiratory cases/yr**
- **$40 million saved in health costs/yr**

3. **16,687 tons of CO_2 not emitted**

The Triple Win

(Source: Grabow et al, in preparation)

There's a wealth of science
To support decision making in New England

EPA/ORD's Global Change Research Program: Well-Defined Mission

Assess the potential consequences of *global change* – particularly climate variability and change -- in the U.S.
Areas of focus: air quality; water quality/aquatic ecosystems
Provide timely and useful scientific information to **support decision making**
Focus on **adaptation** – to reduce risks and take advantage of opportunities presented by global change

http://www.epa.gov/ord/npd/globalresearch-intro.htm

FY2008: New Directions

- Additional Congressional Appropriations
- Funds being used “to support future rule making on greenhouse gases,” *e.g.,*
  - Environmental implications of alternative fuels (with a focus on biofuels)
  - Co-Benefits: Evaluation of relationship between GHG mitigation strategies and strategies for adapting to a changing climate
  - Evaluation of emissions reduction potential of technological and non-technological options for reducing GHG emissions and improving air quality

EPA’s Global Change Research Program: How we do our work

How We Conduct Our Assessments: Integration of Intramural and Extramural Expertise

- Research, assessments, and development of decision support tools conducted in 4 ORD Labs/Centers
- Extramural research augments areas in which the program has expertise
- Extramural expertise engaged through competition (STAR grants) – **33% of program**
- "Science to Achieve Results" (STAR) grants awarded through competitive process
- STAR grants provide ongoing, long-term support for selected topic areas
  - Air quality
  - Aquatic ecosystems
  - Human health

Major Commitment to Support Policy-Relevant Research in EPA Regions

1995 – 2007:

83 grants totaling $68,278,816

Region	Total Funding	Number of Projects
1	**$6,988,977**	**8**
2	$2,921,062	3
3	$12,012,401	14
4	$7,789,412	11
5	$12,130,400	16
6	$3,049,457	4
8	$7,503,865	7
9	$9,153,483	11
10	$6,729,759	9

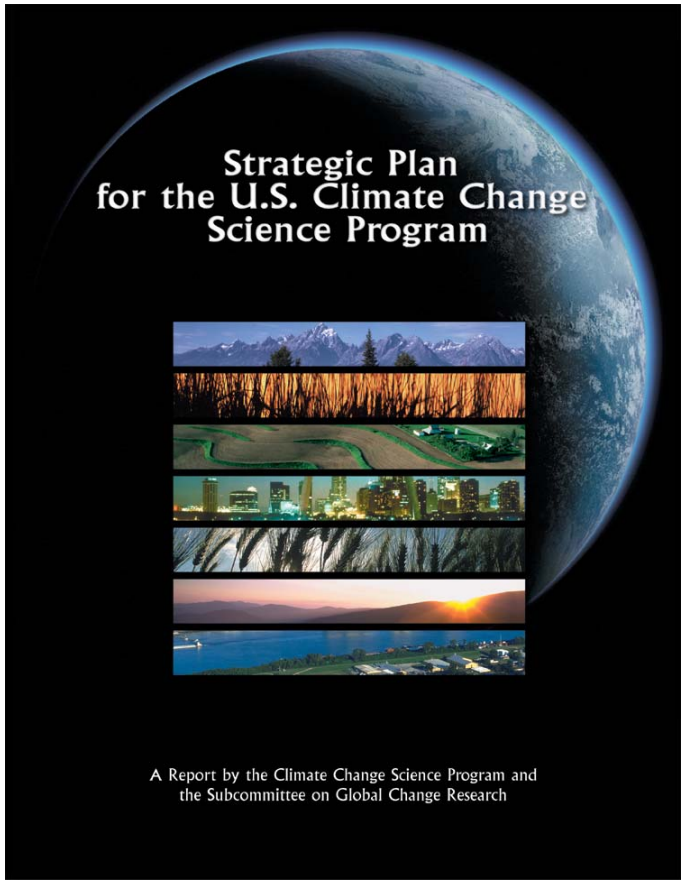
The Critical Role of Stakeholders in ORD's Global Change Research Program

- The development of science to support decision making hinges on the inclusion of stakeholders *throughout* the assessment process.
- Stakeholders help ensure that decision support is *informative* and *timely* by:
  - ✓ identifying specific information needs (**what** is needed, by **when** it is needed, and **how** it will be used)
  - ✓ providing expertise
  - ✓ providing data and information on a variety of topics including public values, equity considerations, relevant decision processes, and willingness to accept risk
- The uncertainties and information needs that stakeholders help to identify become the basis for prioritized research agendas.

EPA's Well-Defined Role within the U.S. Climate Change Science Program

- EPA is part of a larger family of 13 federal agencies
- CCSP is an interagency program responsible for coordinating and integrating scientific research on global change and climate change
- *All* program activities consistent with, and coordinated by, the CCSP (consistency with 2003 CCSP *Strategic Plan)*
- EPA's well-defined role: assessment of consequences for decision makers, evaluating adaptation options, and developing decision-support tools
- Close coordination and leveraging of activities through CCSP Work Groups

2003 CCSP *Strategic Plan*



"The* Strategic Plan for the U.S. Climate Change Science Program *articulates a guiding vision, is appropriately ambitious, and is broad in scope….Advancing science on all fronts identified by the program will be of vital importance to the nation." (NRC, February 2004)

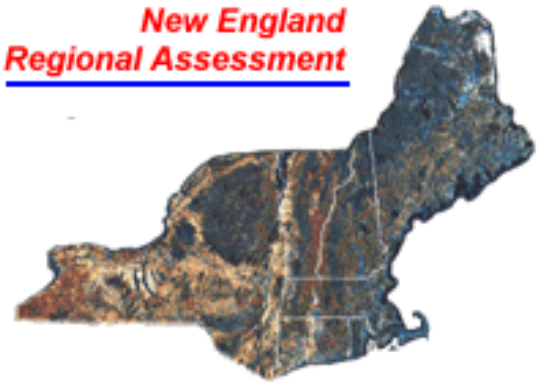
2008 Revised Research Plan

www.climatescience.gov

The U.S. Climate Change Science Program

- Mandated by the **Global Change Research Act of 1990**
- Section 104: Requires development of a long-term national global change research plan
- Section 106: Requires periodic assessments of potential impacts of *global change* on the United States (at least every 4 years)
  - 2000: First U.S. National Assessment delivered to Congress
  - 2007-2008: 21 Synthesis & Assessment Products (SAPs)
- **Production of "periodic assessments" will continue to be the CCSP's (and the ORD Global Program's) #1 priority in the future**

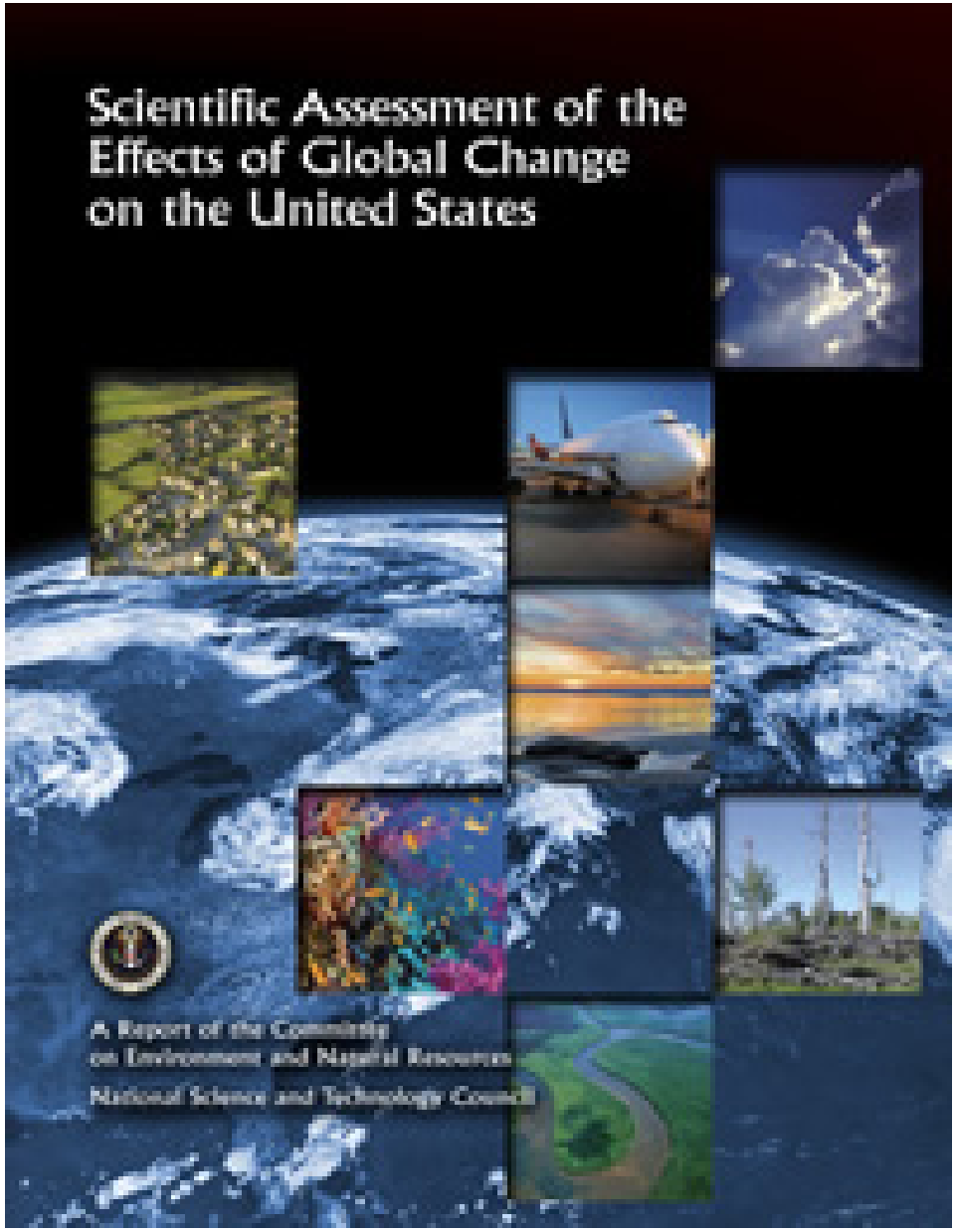
2000 U.S. National Assessment and New England Regional Assessment



21 Synthesis & Assessment Products (2007-2008)

- Reports on highest-priority science to support decision making
- EPA/ORD Contributions:
  - SAP #4.4: “Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources” (Completed)
  - SAP #4.6: “Analyses of the Effects of Global Change on Human Health and Welfare and Human Systems” (Completed)

2008 Scientific Assessment



Global Change & Air Quality

- What we promised:
  - Interim Assessment (FY 2007): Effects of **climate change** on air quality
  - Final Assessment (FY 2012): Effects of **global change** on air quality

2007 "Interim Assessment"

Completed in September 2007
Planned release for public review: July 2008

2007 “Interim” Assessment

- What is effect of projected changes in climate, climate variability and land-use patterns on regional U.S. AQ (O_3, PM, also Hg)?
- Which areas will experience AQ improvements and which deterioration due to climate change alone?
- How many areas are at risk of failing to attain standards?
- What is impact of climate change relative to emissions changes (due to controls, land use change, and socioeconomic changes)?
- How is the effectiveness of AQ management affected by climate change?

Fundamentally: Is this something we have to pay attention to going forward?

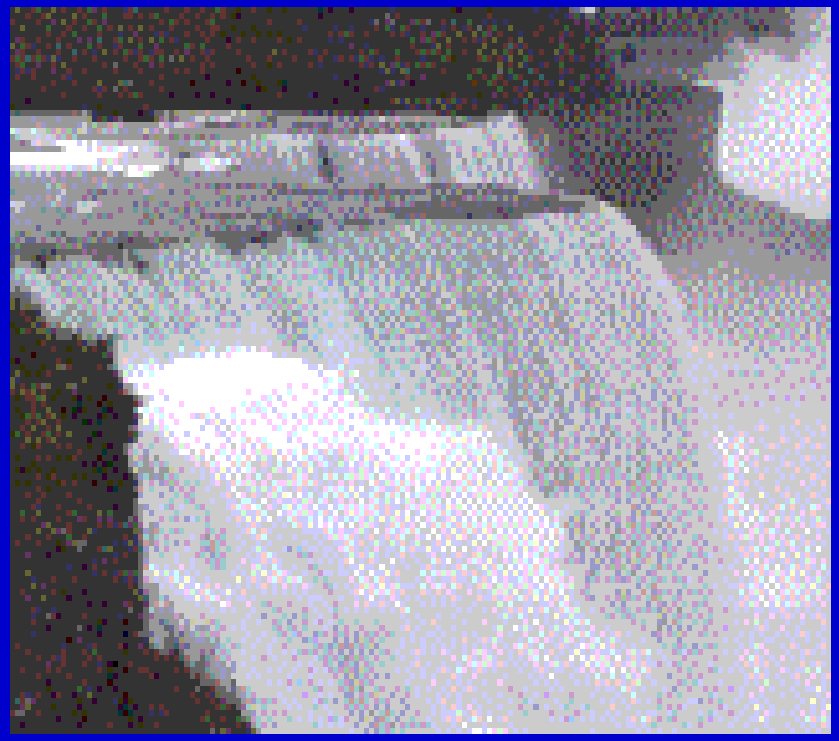
Global Change
and Water Quality / Aquatic Ecosystems

- **Goal:** To assess the potential impacts of global change on water quality and aquatic ecosystems in the United States

- **What we've produced:**
  - Evaluation of consequences of global change for water quality related to pollutants and microbial pathogens (2005-2006)
    - ✓ drinking water infrastructure
    - ✓ waste water treatment
    - ✓ pollutants and pathogens in surface waters (TMDLs)
  - Development of BASINS decision support tool for incorporating climate variability and change into water management decisions (2007)
  - Evaluation of consequences of global change for stream and river biological indicators (2007)
  - Evaluation of effects of climate change on aquatic invasive species and implications for management and research (2007)
  - Ongoing development of information and tools on global change impacts and adaptation options in key watersheds

USA: Combined sewer overflows

Courtesy: Kellogg Schwab



1.2 trillion gal of sewage & stormwater a year discharged during combined sewer overflows – would keep Niagara Falls roaring for 18 days

Center for Water & Health, JHU Bloomberg School of Public Health

Valuable Insights for City Planners

1. Climate change will affect future performance of many CSSs in the Great Lakes Region.
2. Calculations of system size should not be based on current hydrology and historic precipitation data.
3. A *policy* decision must be made about additional investments to build in a margin of safety.
4. **The risks posed by climate change to CSSs are manageable*.**

**** Opportunities to link adaptation to Smart Growth policies***

Water Quality Assessment: Partnership with the Office of Water (OW)

Motivation:

Climate can affect water quality and aquatic ecosystems through a number of pathways, potentially affecting OW's ability to fulfill its statutory/regulatory responsibilities.

Planned study:

The Global Program will work with OW to conduct a study of the sensitivity to climate change of goals articulated in the Clean Water Act and the Safe Drinking Water Act, and the opportunities available within the provisions of these Acts to address the anticipated impacts.

Approach:

Consistent with OW's watershed approach and the concept of designated uses: (a) watersheds; (b) human uses; (c) aquatic life uses

Planned Water Quality Assessment incorporated into new (draft) OW Climate Change Strategy

Tools* are being developed to support adaptive management decisions by EPA and its stakeholders

* non-prescriptive

"Enhanced" BASINS: An EPA Decision Support Tool for Water Resource Managers

- BASINS is a widely distributed tool designed for use by regional, state, and local agencies in performing watershed and water quality-based studies
  - EPA's Office of Water encouraging use of BASINS to support regulatory compliance (*e.g.* TMDLs)
  - New version (ver. 4) released in May 2007
- Enhanced BASINS with a **Climate Assessment Tool** (CAT)
- CAT provides a capability for understanding
  - how water resources could be affected by a range of potential changes in climate
  - the effectiveness of management practices for increasing the resilience of water resources to changes in climate

http://www.epa.gov/waterscience/BASINS/

This pale blue dot is planet Earth taken from Saturn by NASA's Cassini spacecraft looking back toward the Earth on Sept. 27, 2006. Saturn is about 800 million miles from the Earth.

Climate change and global warming are no long simply an environmental issue, it is a economic and human well-being issue!

So we need to mitigate and adapt to a changing climate

Thank You