An Introduction to Climate Change Adaptation

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The Climate is Changing

It’s changing at an increasingly rapid rate…

and at a rate beyond historic experience…

Why Does Climate Change Matter?

Climate Change and Sustainable Communities

- States and cities are operating in this rapidly changing world.
- Outcomes they are trying to attain (*e.g.,* clean air, safe drinking water, economic growth) are sensitive to changes in climate.
- Until now, state and local planners have been able to assume "stationarity" of climate
  → *i.e.*, climate is relatively stable and future climate will mirror past climate
- But the past if no longer a good predictor of the future.
- Climate change is posing new challenges.
  - **making it more difficult for cities and states to attain their goals**
  - making it more difficult to develop sustainable communities.
- **The nation must adapt. We must anticipate and plan for future changes in climate.**

Adaptation is Essential

Adaptation is critical if the nation is to attain its desired environmental, human health, and economic outcomes.

Adaptation: *Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.* (IPCC, 2001)

We can plan ahead…. or we can react

Wildlife can only react

But humans can anticipate

(Main CN Line Near Amherst, NS)

Climate Adaptation Must be "Mainstreamed" into Planning Decisions

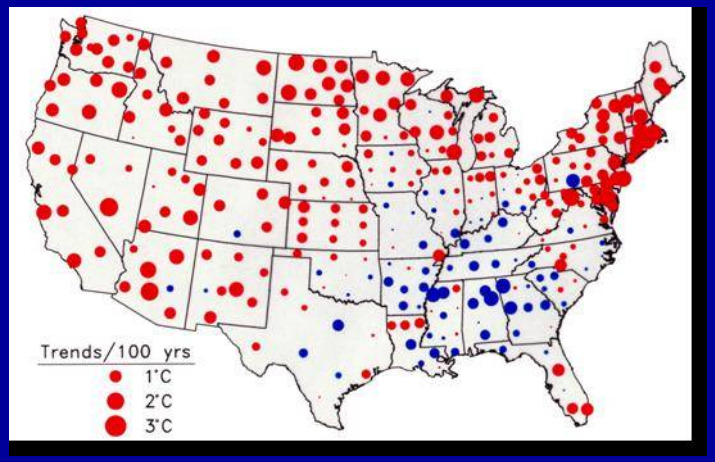
Any Smart Policy Portfolio
Must Consist of Both Mitigation and Adaptation Strategies

- 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

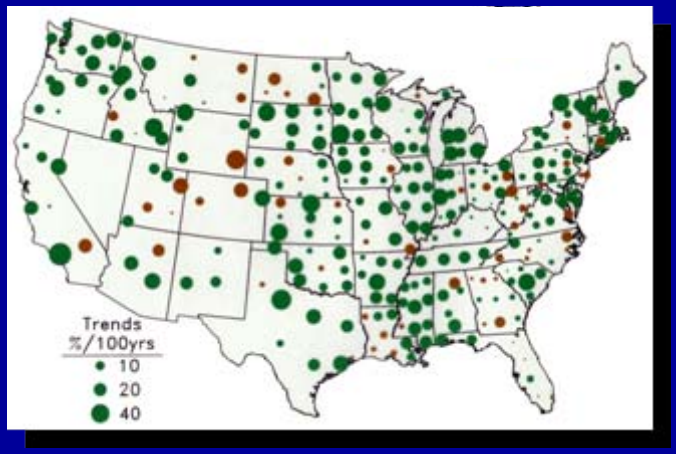
There are opportunities for co-benefits!

The Climate is Changing

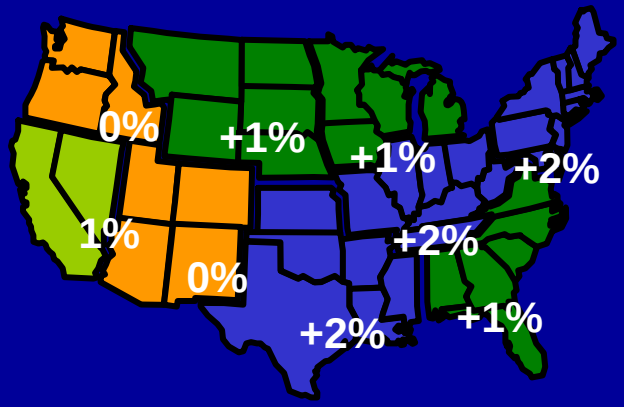
Temperature Trends: 1901 to 1998



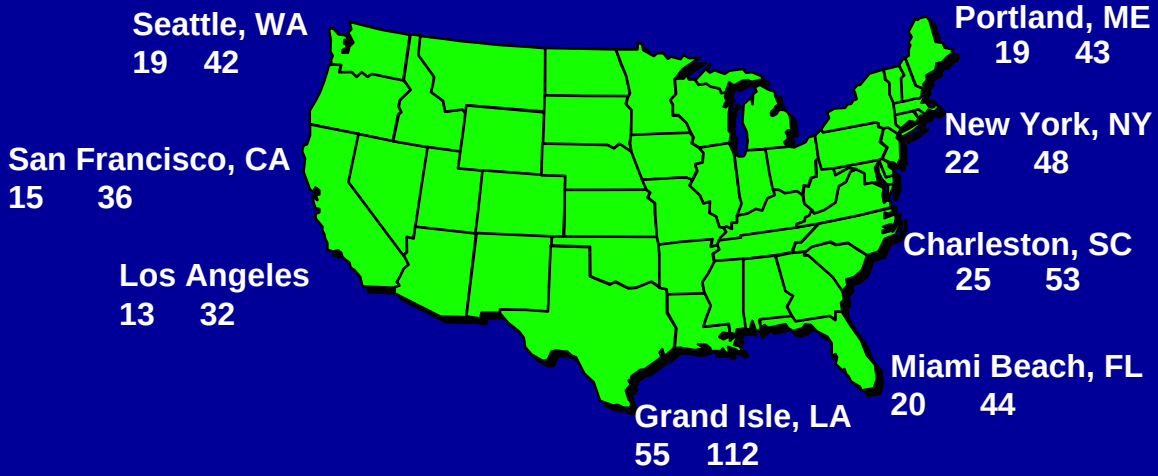
Precipitation Trends: 1901 to 1998



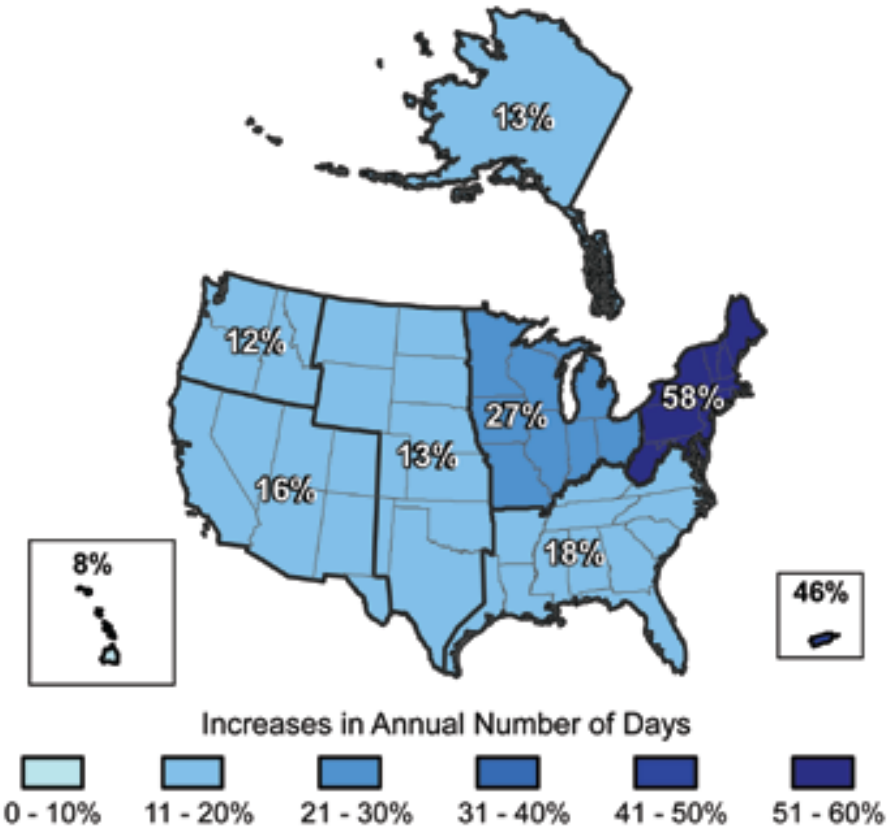
More Rainfall Occurring in Intense Downpours



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

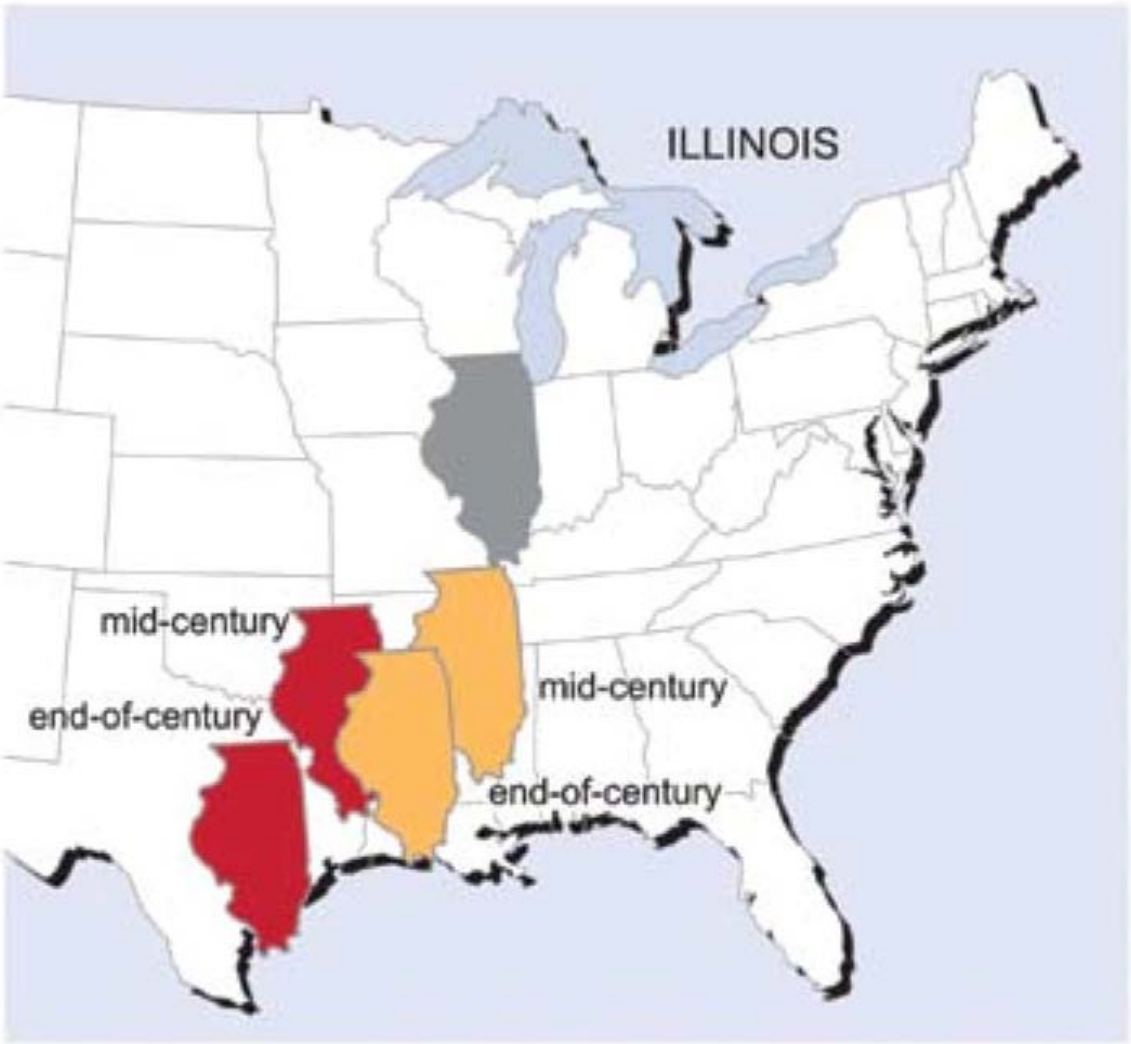


Increases in the Number of Days with Very Heavy Precipitation (1958 to 2007)



The map shows the percentage increases in the average number of days with very heavy precipitation (defined as the heaviest 1 percent of all events) from 1958 to 2007 for each region. There are clear trends toward more days with very heavy precipitation for the nation as a whole, and particularly in the Northeast and Midwest.

Climate on the Move:
Changing Summers in the Midwest



Climate Change is Affecting Human Health and the Environment

Infrastructure
Water
Transportation
Energy Supply & Use

Climate Changes

Temperature

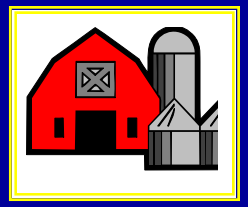
Precipitation

Sea Level Rise

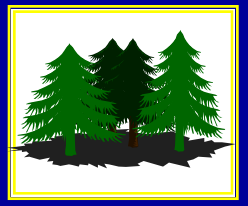
Cultural Resources

Economic Disruption

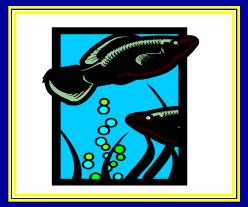
Health
Weather-related Mortality
Infectious Diseases
Air Quality -Respiratory Illnesses



Agriculture
Crop yields
Irrigation demands

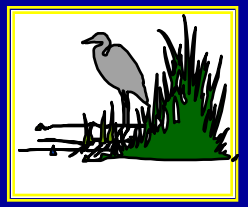


Forest
Change in forest composition
Shift geographic range of forests
Forest Health and Productivity



Water Resources
Changes in water supply
Water quality
Increased competition for water

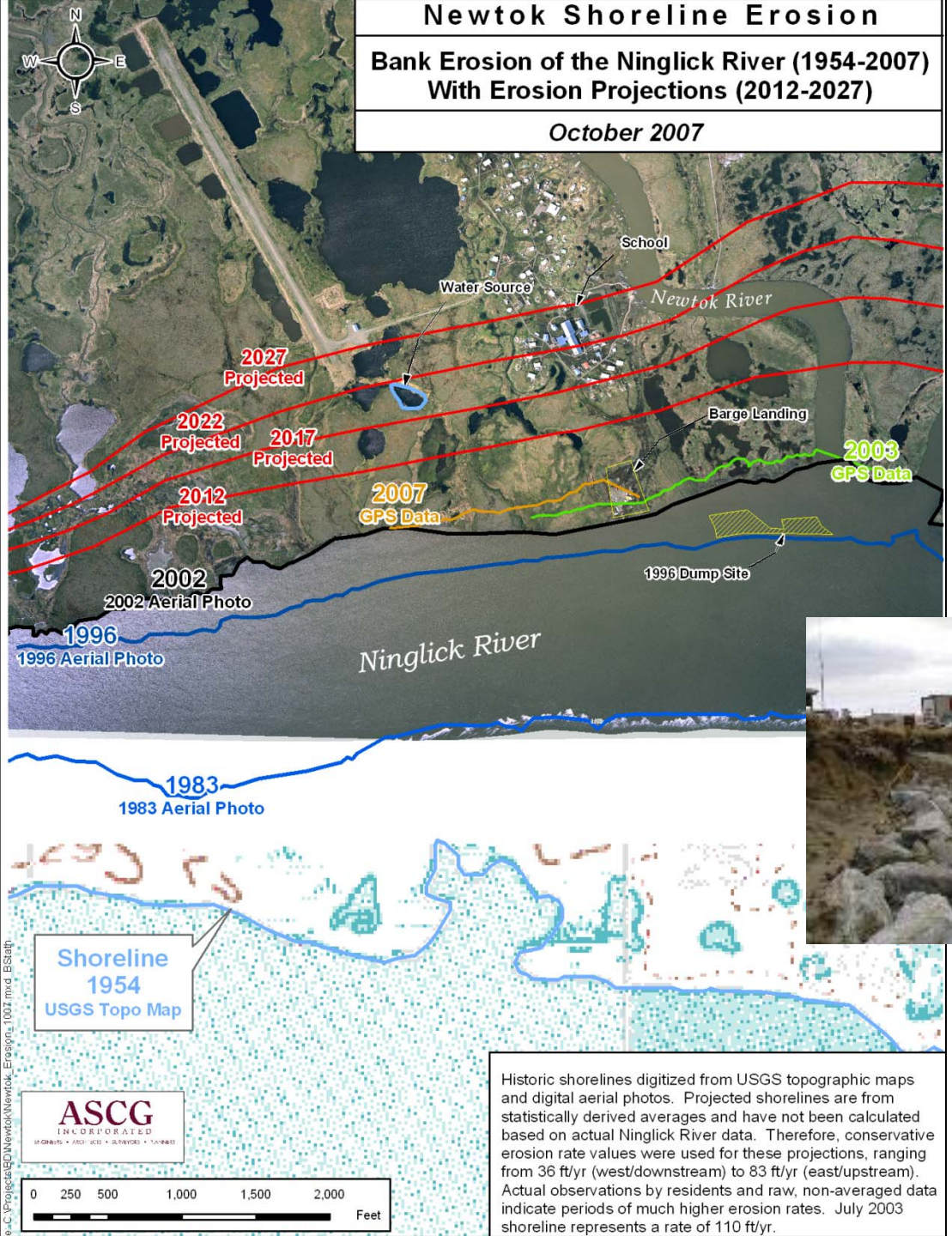
Coastal Areas
Erosion of beaches
Inundate coastal lands
Costs to defend coastal communities



Wildlife and Ecosystems
Shift in ecological zones
Loss of habitat and species
Damage to Coral Reefs

We are already seeing the impacts of climate change

Newtok, Alaska



Shishmaref, AK)

The Importance of Mainstreaming

Examples

Potential Impacts of Climate Change on U.S. Regional Air Quality

(EPA report released April 17, 2009)

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

Answer: Yes

Climate change should be considered by air quality managers as they develop air pollution control strategies (e.g., *in SIPs). Climate change has the potential to produce significant increases in ground-level ozone in many regions.*

http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=203459

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

Combined Sewer Overflow in the Great Lakes Region

(EPA report released February 2008)

- Issue: There are 182 combined sewer systems in the Great Lakes Region. Billions of dollars are being spent redesigning and rebuilding these systems.
- Key Questions:
  - ✓ Does climate change matter to the redesign of combined sewer systems in the Great Lakes Region?
  - ✓ When the climate changes, how might CSO event frequency change, and in how many cases will the four CSO events per year threshold be exceeded?
- If combined sewer systems are designed to meet the EPA's CSO Control Policy design standard of 4 events per year, but fail to plan for climate change:
  - ✓ climate change may result in failure to meet the standard
  - ✓ **there could be an average of 237 events per year above the control policy's objectives across 182 communities**

Opportunity for EPA to Partner with City Planners to Manage the Risks

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***

http://cfpub.epa.gov/ncea/global/recordisplay.cfm?deid=188306

Climate Change and TMDLs

- Climate change is already leading to more frequent and intense precipitation events
- May be increasing delivery of sediments, sediment-enriched pollutants *(e.g.*, phosphorous, pesticides) and soluble pollutants (*e.g.,* nitrates) to rivers and streams
- Particular concern: Streams, rivers and lakes that do not meet water quality standards -- even though most large point sources are complying with discharge limits
- More stringent TMDL limits might have to be developed for all pollutant sources

Analyses of the Effects of Global Change on Human Health and Welfare and Human Systems (July 2008)

Report conclusion: Climate change poses real risks to human health and the human systems that support our way of life in the United States.

Heat-related mortality & morbidity

Changes in air quality

Infectious Diseases (*e.g.*, dengue fever)

Airborne Allergens (*e.g.*, asthma)

http://www.climatescience.gov/Library/sap/sap4-6/final-report/default.htm

The Good News

Opportunities exist *today* to anticipate
and adapt to a changing climate

-- and to protect water quality, ecosystems, human health, and the economy

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

Investments in Adaptation

It's not a question of *if* you'll pay to adapt…

It's a question of *when* you'll pay.

We can plan ahead and get to where we want to go (Anticipatory Adaptation)

GREEN ROOFS Programs in Urban Areas

Help address:

- **stormwater runoff**
- **urban heat island effect**
- **regional warming due to global climate change**

or…

We can incur damages later, clean up the mess, and live with the consequences (Reactive Adaptation)

(Scheraga, 2010)

It Pays to Plan Ahead:
Reactive Adaptation During a 1957 Kentucky Flood

(KY Power office in Lothair, 1957)

The pig knew how to get to higher ground…

Getting back down was a problem.

(Scheraga, 2004)

Sometimes it pays to plan ahead…

Lest we be cavalier about how easy it is to adapt…

New Orleans, 2005

(Scheraga, 2005)

Sometimes it pays to plan ahead…

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