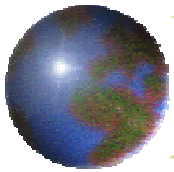
National and International Objectives in Environmental Sciences

KEY: ADVANCED KNOWLEDGE IS POWER

- Protect Life and Property
- Promote Economic Vitality
- Environmental Stewardship
- Promote Fundamental Understanding

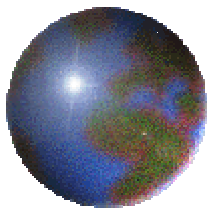
Examine a specific key question:

- How vulnerable or resilient are the nation's natural and human resources and systems to the changes in climate projected to occur over the decades ahead?



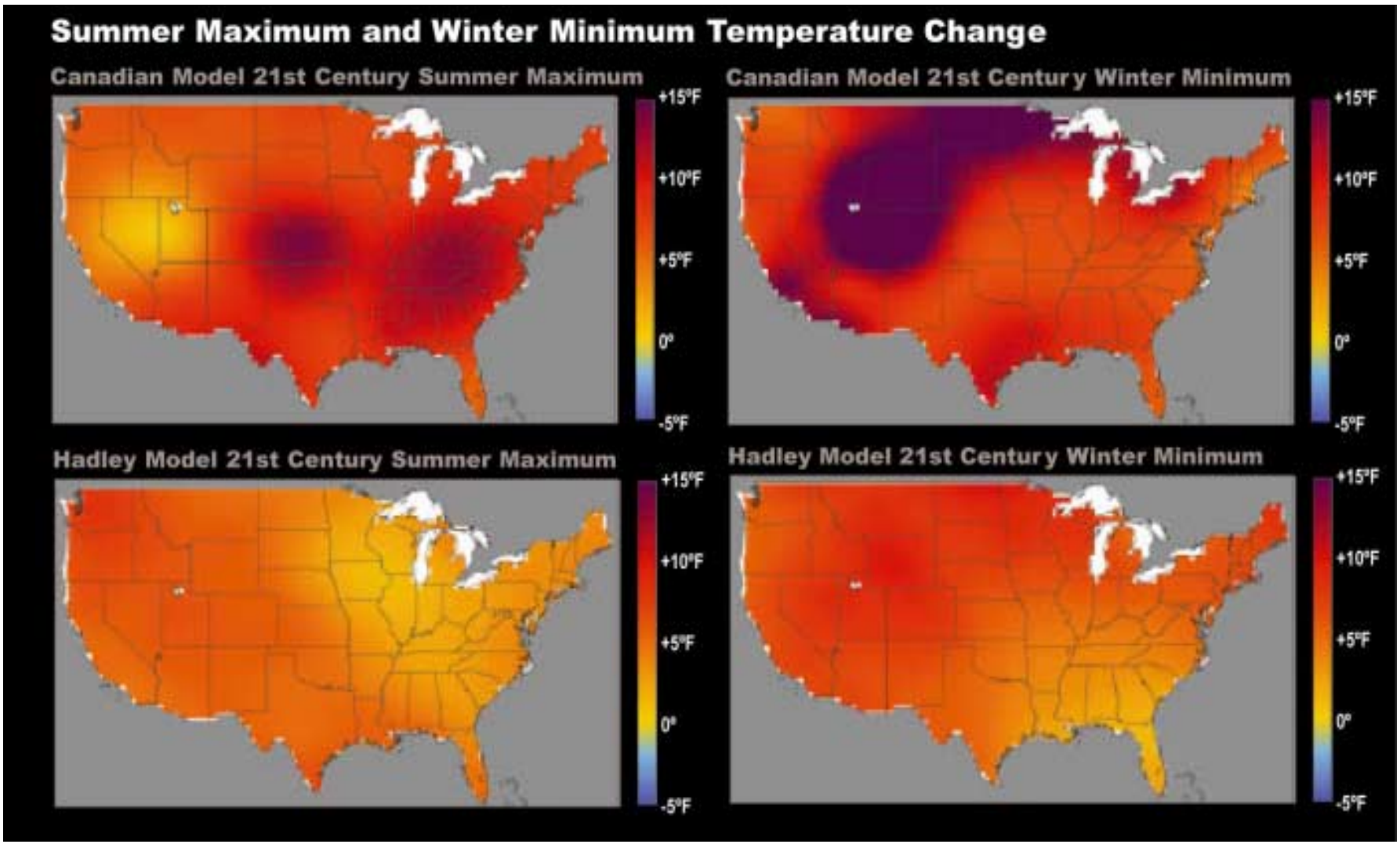
U.S. National Assessment of Climate Impacts

- Doesn't argue about whether climate change will occur
- Asks how significant climate change will be if climate model projections are correct
- Uses two models with a range of sensitivity
- Examines forestry, agriculture, water, human health, and coastal regions
- Sets the stage for research, including information technology and observing systems



How large are the potential climate changes?

Temperature and Precipitation

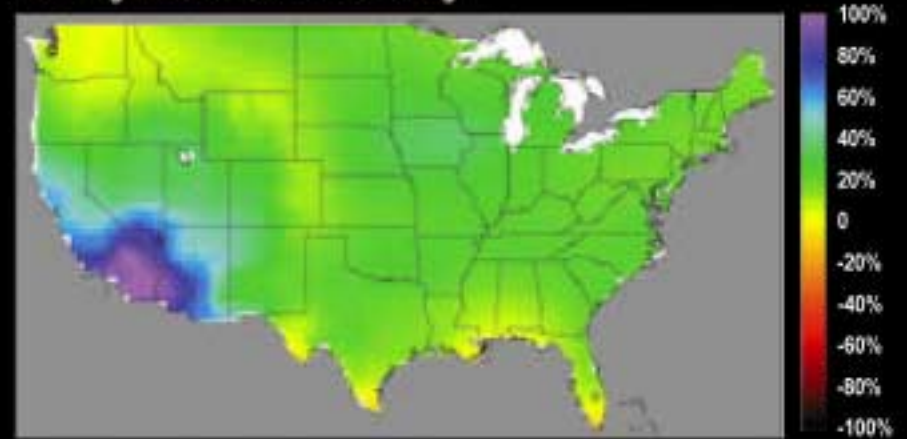

Summer Maximum and Winter Minimum Temperature Change
Canadian Model 21st Century Summer Maximum
+15°F
+10°F
+5°F
0°
-5°F
Canadian Model 21st Century Winter Minimum
+15°F
+10°F
+5°F
0°
-5°F
Hadley Model 21st Century Summer Maximum
+15°F
+10°F
+5°F
0°
-5°F
Hadley Model 21st Century Winter Minimum
+15°F
+10°F
+5°F
0°
-5°F

Precipitation Change

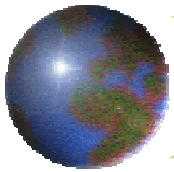
Observed 20th Century

Canadian Model 21st Century

Hadley Model 21st Century



Significant increases in precipitation have occurred across much of the US in the 20th century. Some localized areas have experienced decreased precipitation. The Hadley and Canadian model scenarios for the 21st century project substantial increases in precipitation in California and Nevada, accelerating the observed 20th century trend (some other models do not simulate these increases). For the eastern two-thirds of the nation, the Hadley model projects continued increases in precipitation in most areas. In contrast, the Canadian model projects decreases in precipitation in these areas, except for the Great Lakes and Northern Plains, with decreases exceeding 20% in a region centered on the Oklahoma panhandle. Trends are calculated relative to the 1961-90 average.

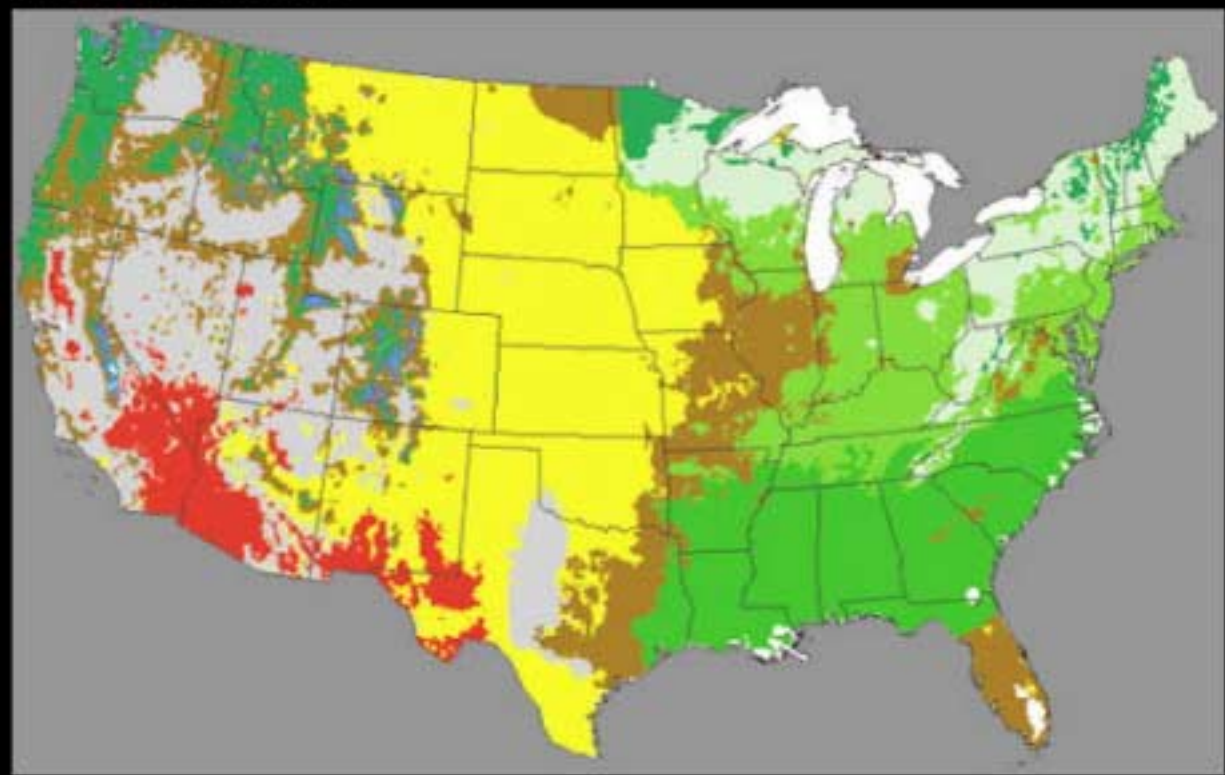


What are the impacts for forestry, agriculture, water, human health and the coastal region?

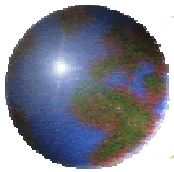
Ecosystem Models

Maps of current and projected potential vegetation distribution for the conterminous US. Potential vegetation means the vegetation that would be there in the absence of human activity. Changes in vegetation distribution by the end of the 21st century are in response to two climate scenarios, the Canadian and the Hadley. Output is from MAPSS (Mapped Atmosphere-Plant-Soil System).

Current Ecosystems

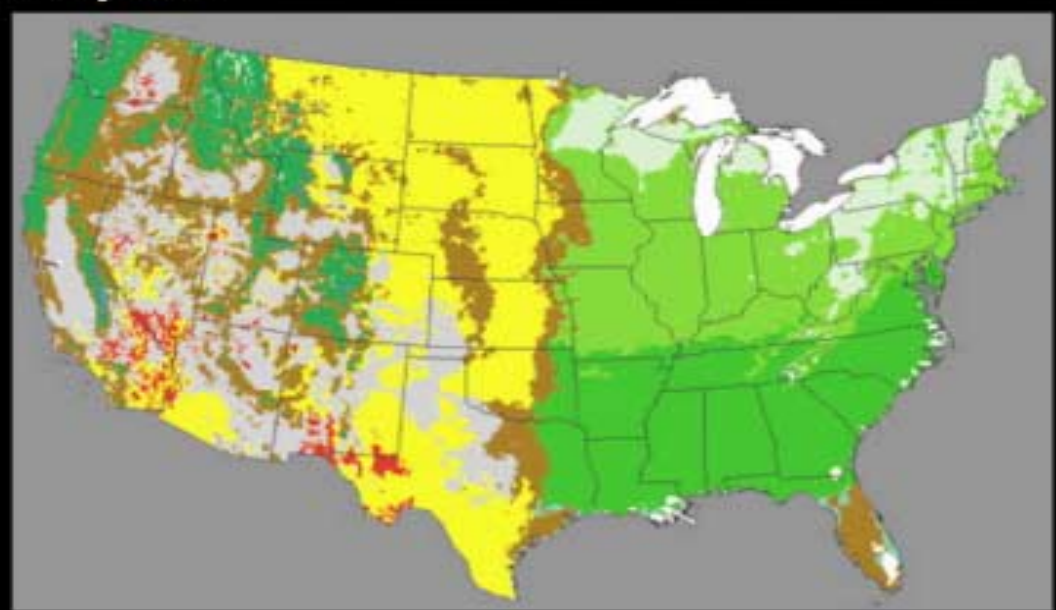


- Tundra
- Taiga / Tundra
- Conifer Forest
- Northeast Mixed Forest
- Temperate Deciduous Forest
- Southeast Mixed Forest
- Tropical Broadleaf Forest
- Savanna / Woodland
- Shrub / Woodland
- Grassland
- Arid Lands



Canadian Model

Hadley Model

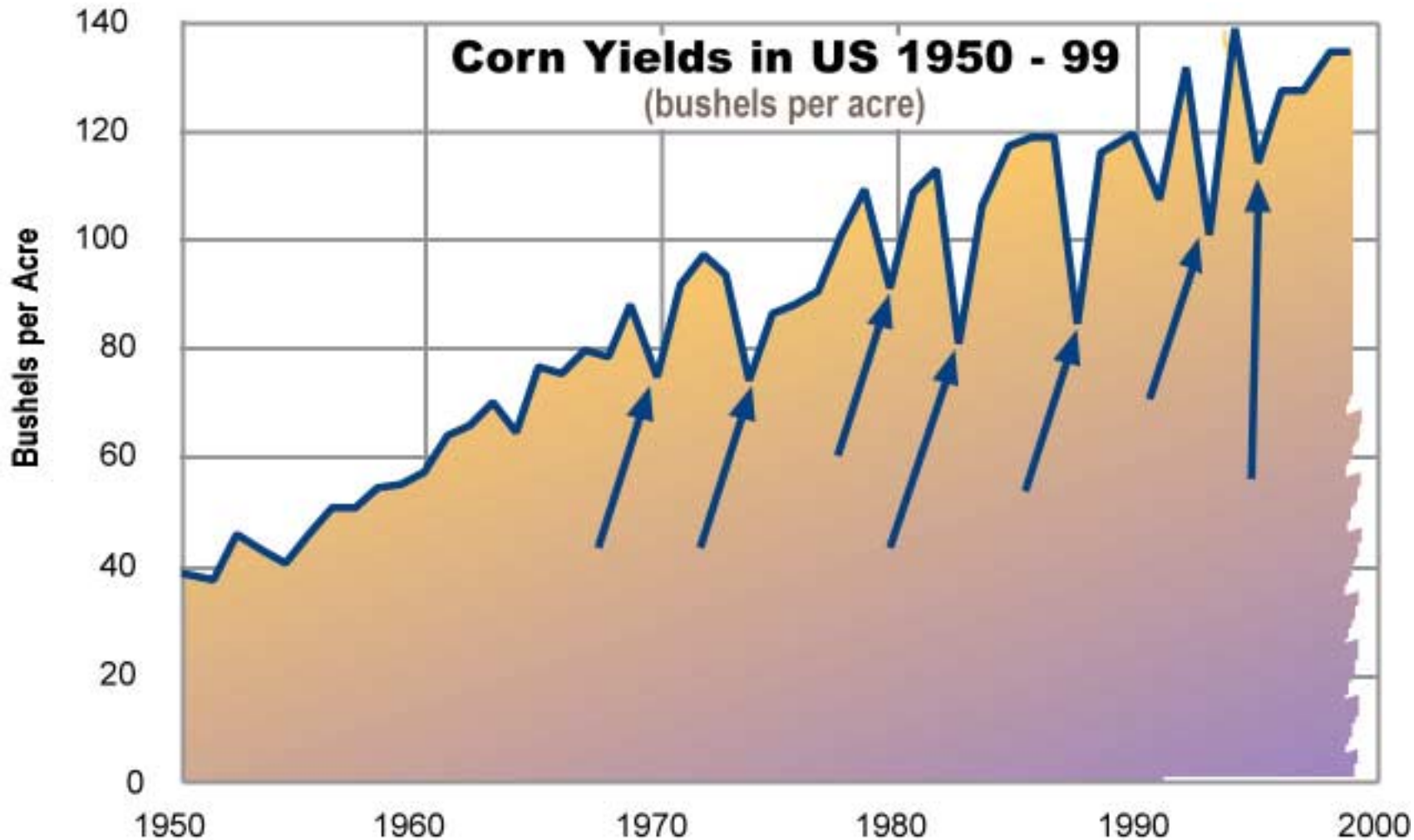


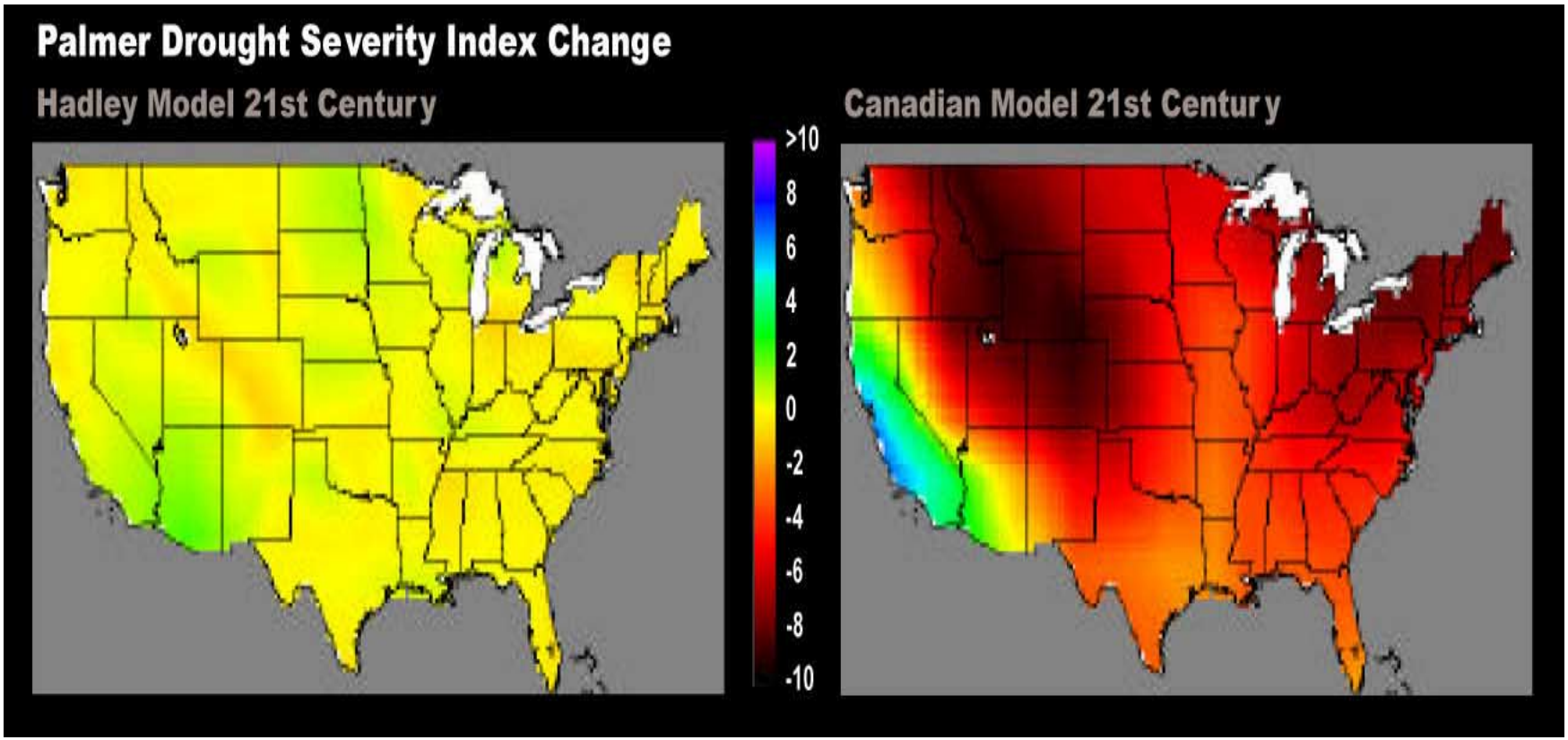
A substantial portion of the Southeast's mixed forest is replaced by a combination of savanna and grassland in response to fire caused by warming and drying of the region as projected by the Canadian model. The Hadley climate projection leads to a simulated northward expansion of the mixed forest.

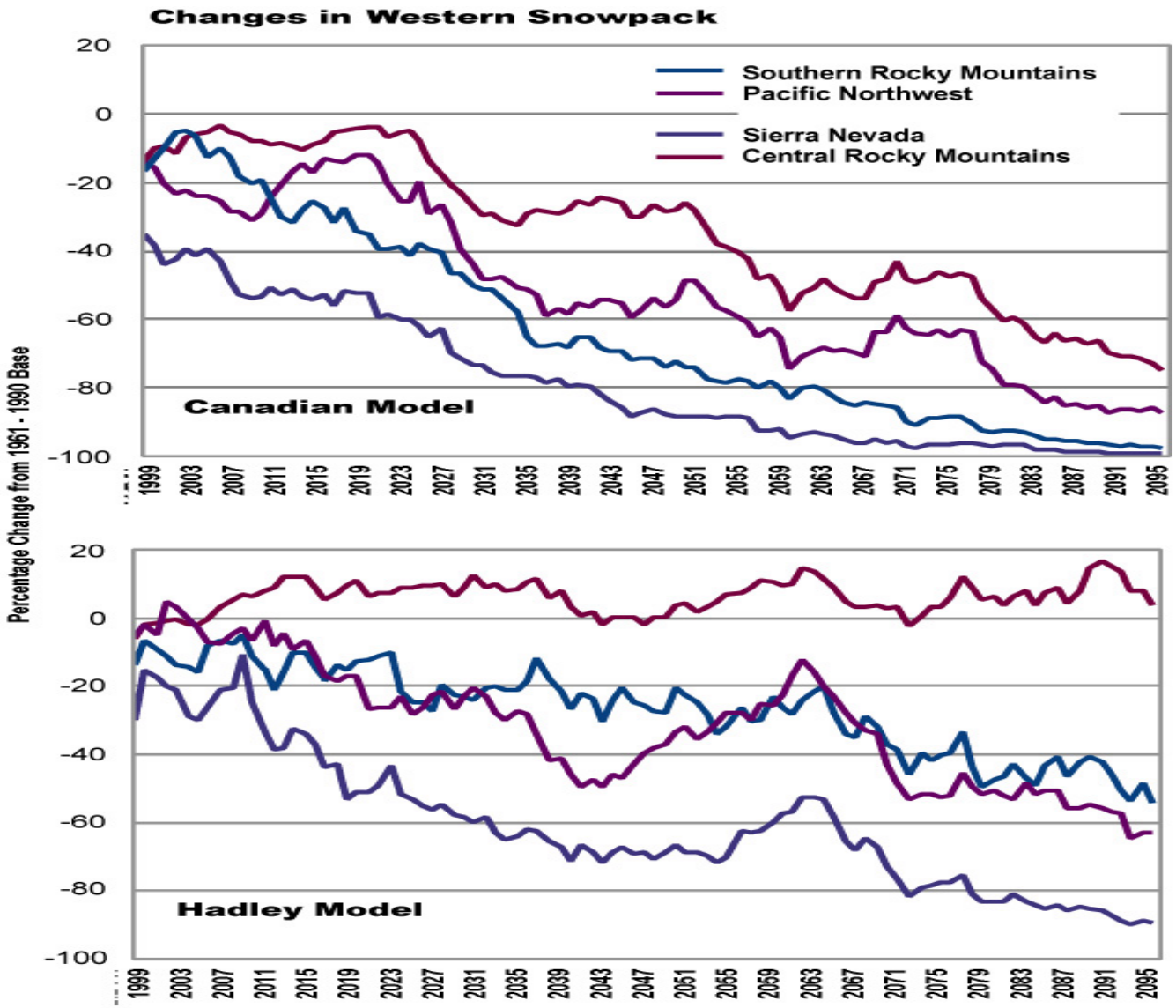
These particular model runs show the response of vegetation to atmospheric concentrations of CO_2 that have stabilized at about 700 parts per million, approximately twice the present level.

In the Southwest, large areas of arid lands are replaced with grassland or shrub/woodland in response to increases in precipitation projected by both models.

- Tundra
- Taiga / Tundra
- Conifer Forest
- Northeast Mixed Forest
- Temperate Deciduous Forest
- Southeast Mixed Forest
- Tropical Broadleaf Forest
- Savanna / Woodland
- Shrub / Woodland
- Grassland
- Arid Lands


Corn Yields in US 1950 - 99
(bushels per acre)
Bushels per Acre
140
120
100
80
60
40
20
0
1950
1960
1970
1980
1990
2000

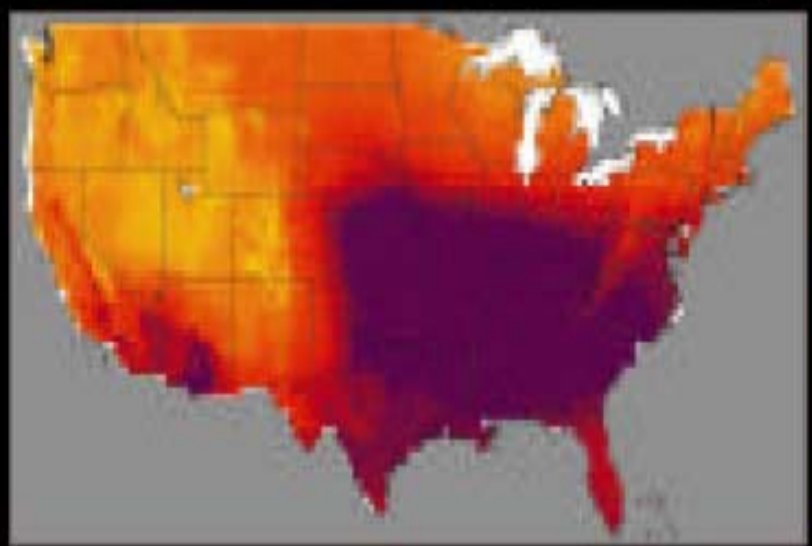

Palmer Drought Severity Index Change
Hadley Model 21st Century
Canadian Model 21st Century
>10
8
6
4
2
0
-2
-4
-6
-8
-10


Changes in Western Snowpack
Southern Rocky Mountains
Pacific Northwest
Sierra Nevada
Central Rocky Mountains
Canadian Model
Hadley Model
Percentage Change from 1961 - 1990 Base
20
0
-20
-40
-60
-80
-100
1999
2003
2007
2011
2015
2019
2023
2027
2031
2035
2039
2043
2047
2051
2055
2059
2063
2067
2071
2075
2079
2083
2087
2091
2095

July Heat Index Change

The projected changes in the heat index for the Southeast are the most dramatic in the nation with the Hadley model suggesting increases of 8 to 15°F for the southernmost states, while the Canadian model projects increases above 25°F for much of the region.

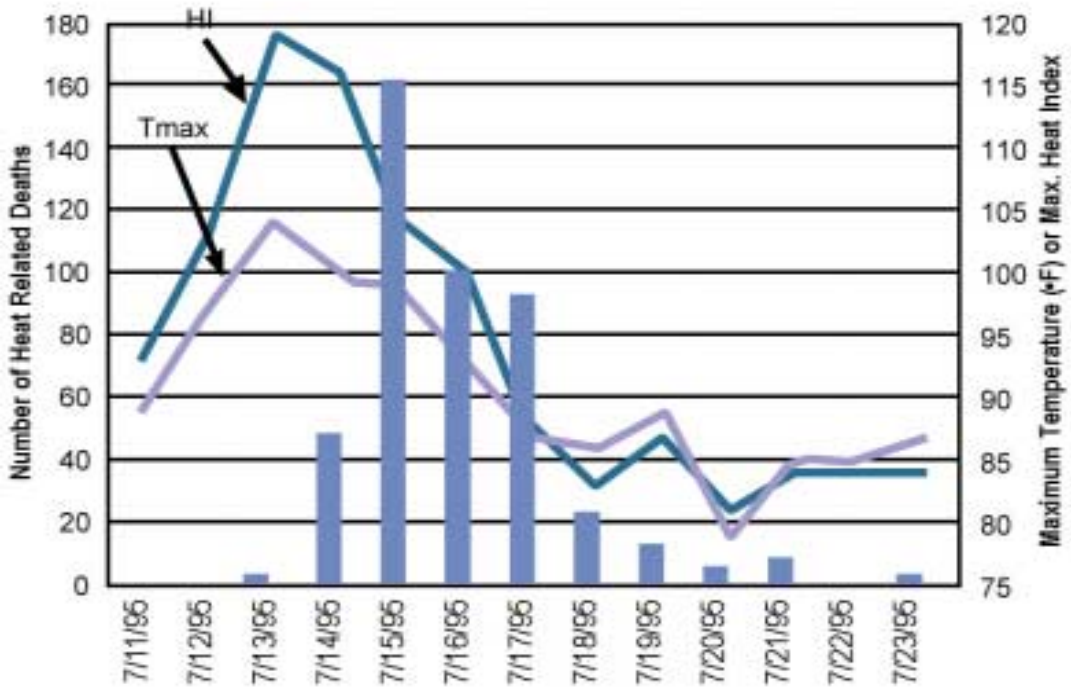
Canadian Model 21st Century



Hadley Model 21st Century

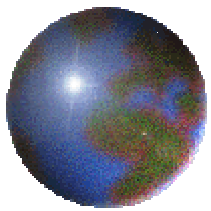
Heat Related Deaths - Chicago, July 1995

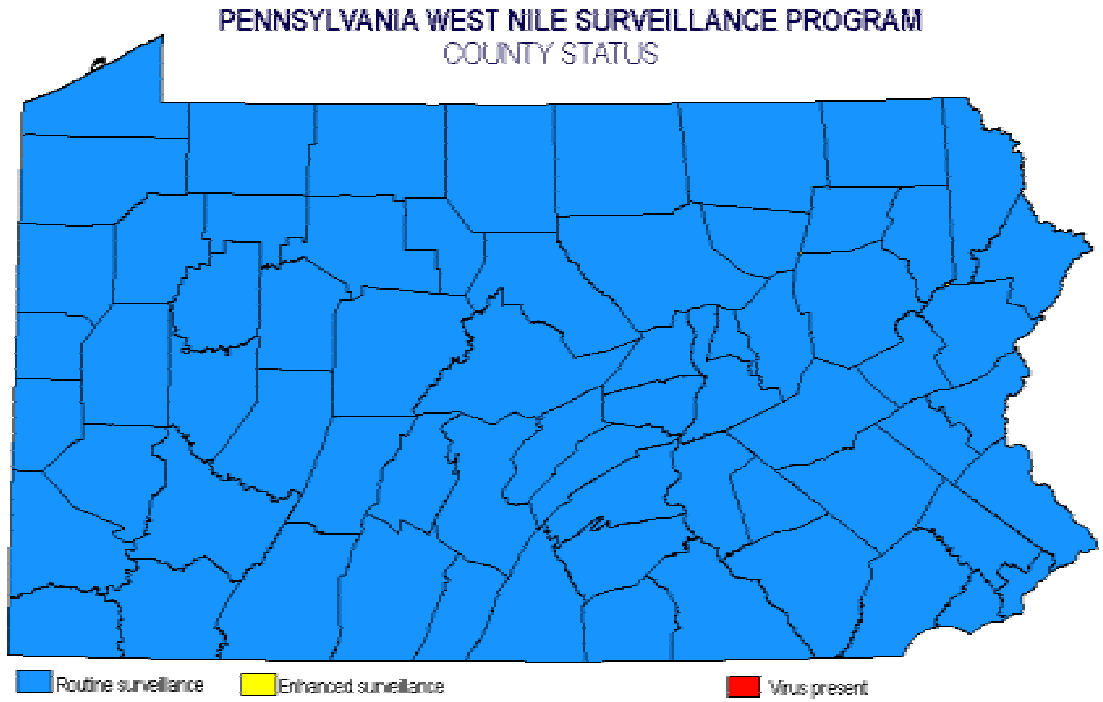
Maximum Temperature and Heat Index



This graph tracks maximum temperature (Tmax), heat index (HI), and heat-related deaths in Chicago each day from July 11 to 23, 1995. The gray line shows maximum daily temperature, the blue line shows the heat index, and the bars indicate number of deaths for the day.

Pennsylvania's West Nile Virus GIS Based Surveillance Program



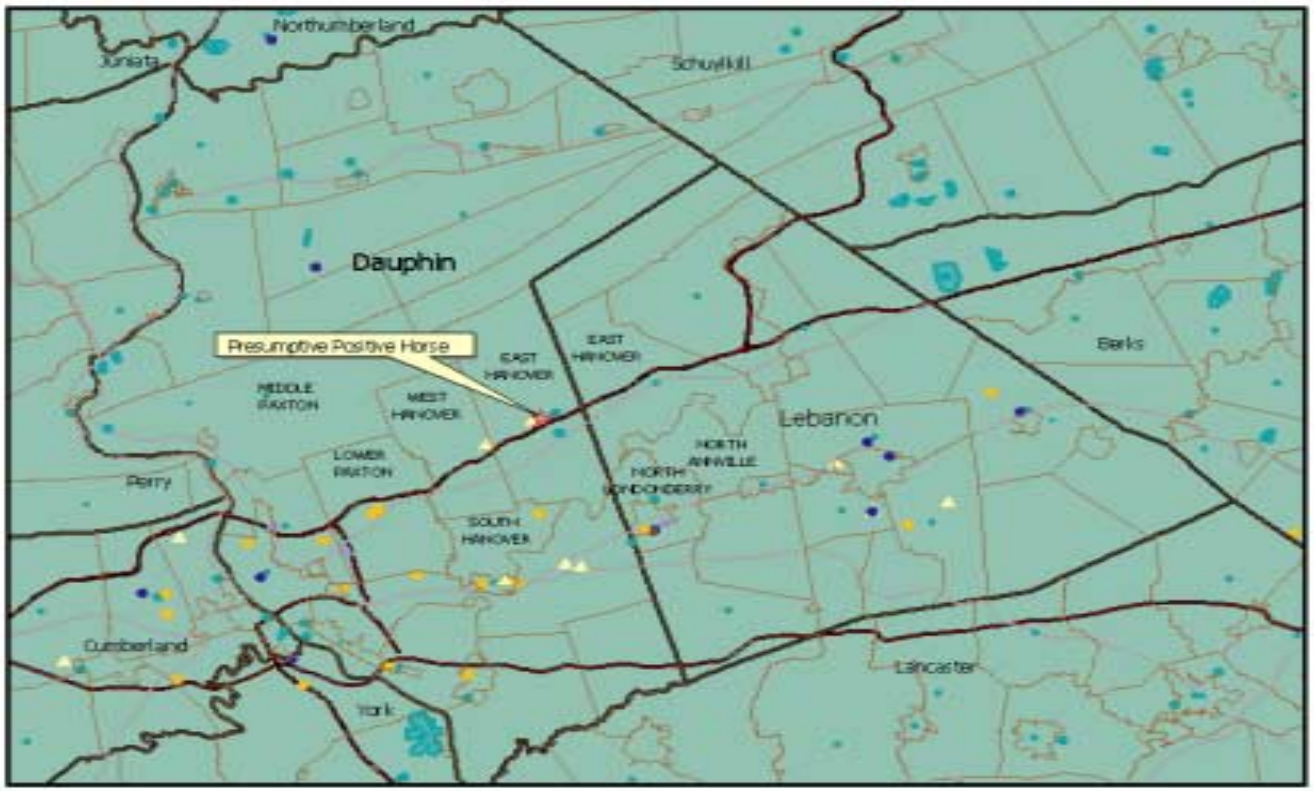


Eric R. Conrad
Pennsylvania DEP
WNV Program

www.westnile.state.pa.us

Pennsylvania West Nile Virus Surveillance Program

Mosquito and Dead Bird Surveillance Through September 22, 2000



Legend

Dead Birds Submitted for Testing

- Bird Positive for WNV
- Crow
- Birds other than crows

Sighted but NOT Submitted Dead Birds

- Crow
- Birds other than crows
- Mosquito Surveillance Sites
- Presumptive Positive Horse

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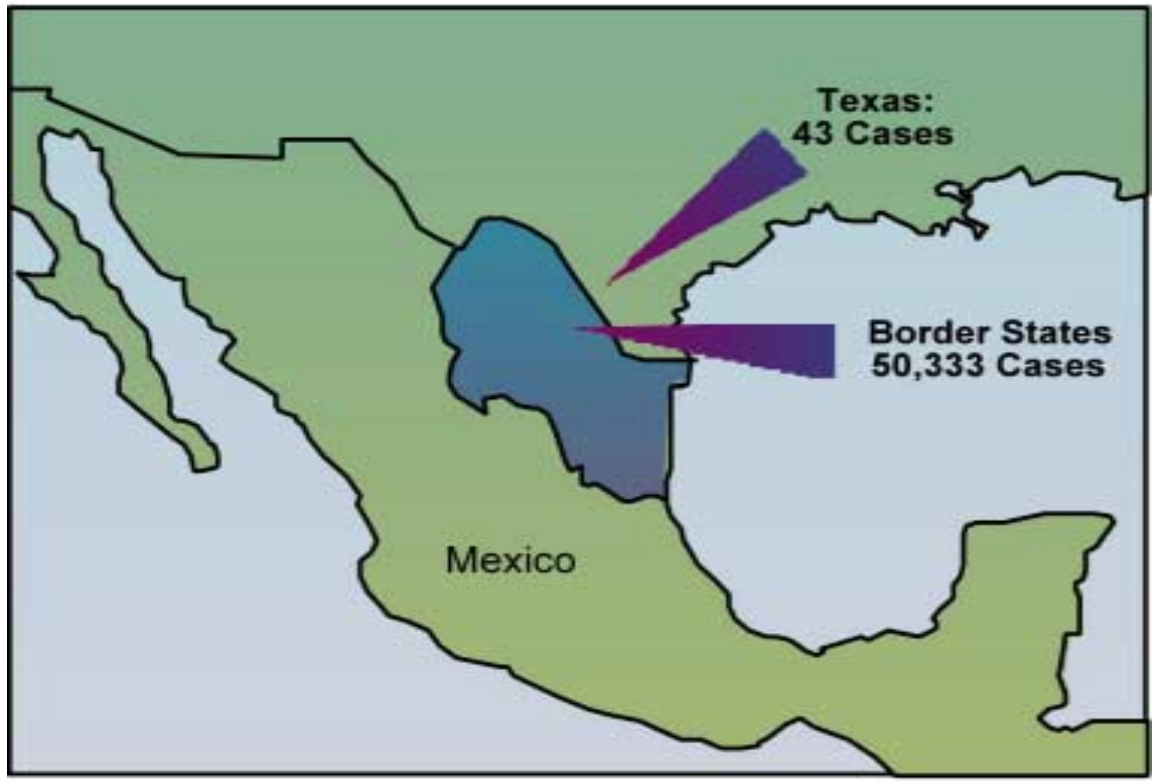
Printed: October 2, 2000

http://www.westnile.state.pa.us

Reported Cases of Dengue 1980-1996

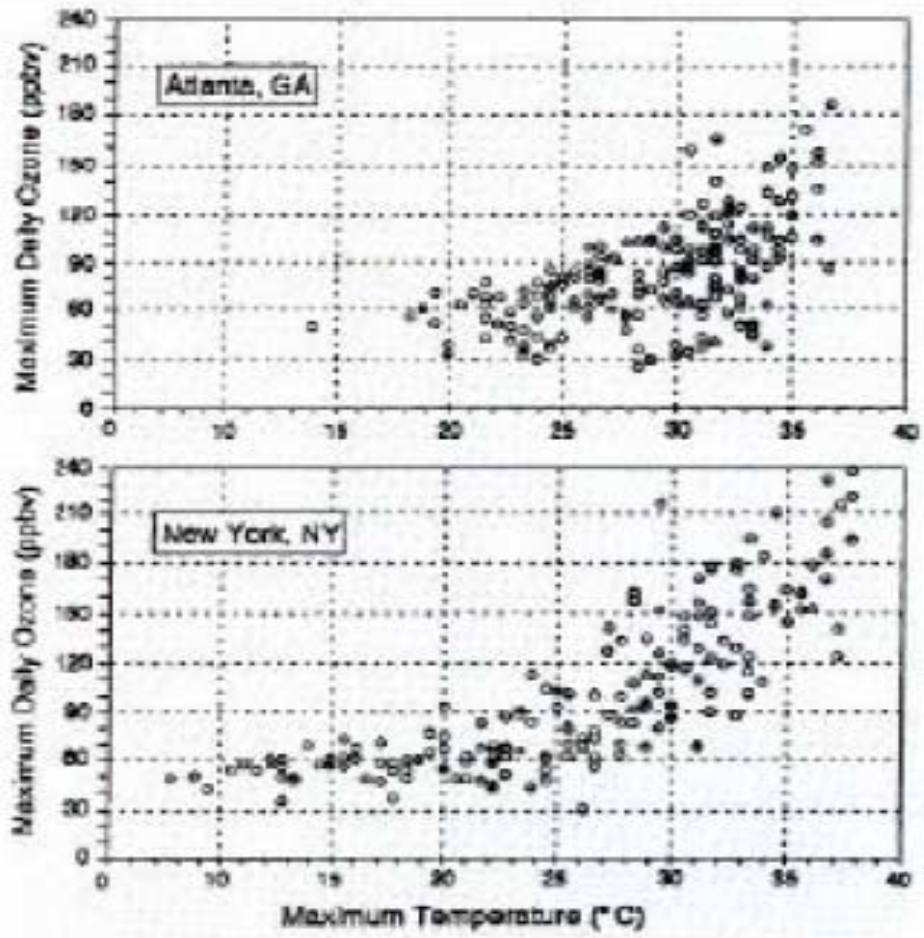


Dengue along the US-Mexico border. Dengue, a mosquito-borne viral disease, was once common in Texas (where there were an estimated 500,000 cases in 1922), and the mosquito that transmits it remains abundant. The striking contrast in the incidence of dengue in Texas versus three Mexican states that border Texas (43 cases vs. 50,333) in the period from 1980-1996 provides a graphic illustration of the importance of factors other than temperature, such as public health infrastructure, use of air conditioning and window screens, in the transmission of vector-borne diseases.

Maximum Daily Ozone Concentrations

and Maximum Daily Temperature - Atlanta & New York

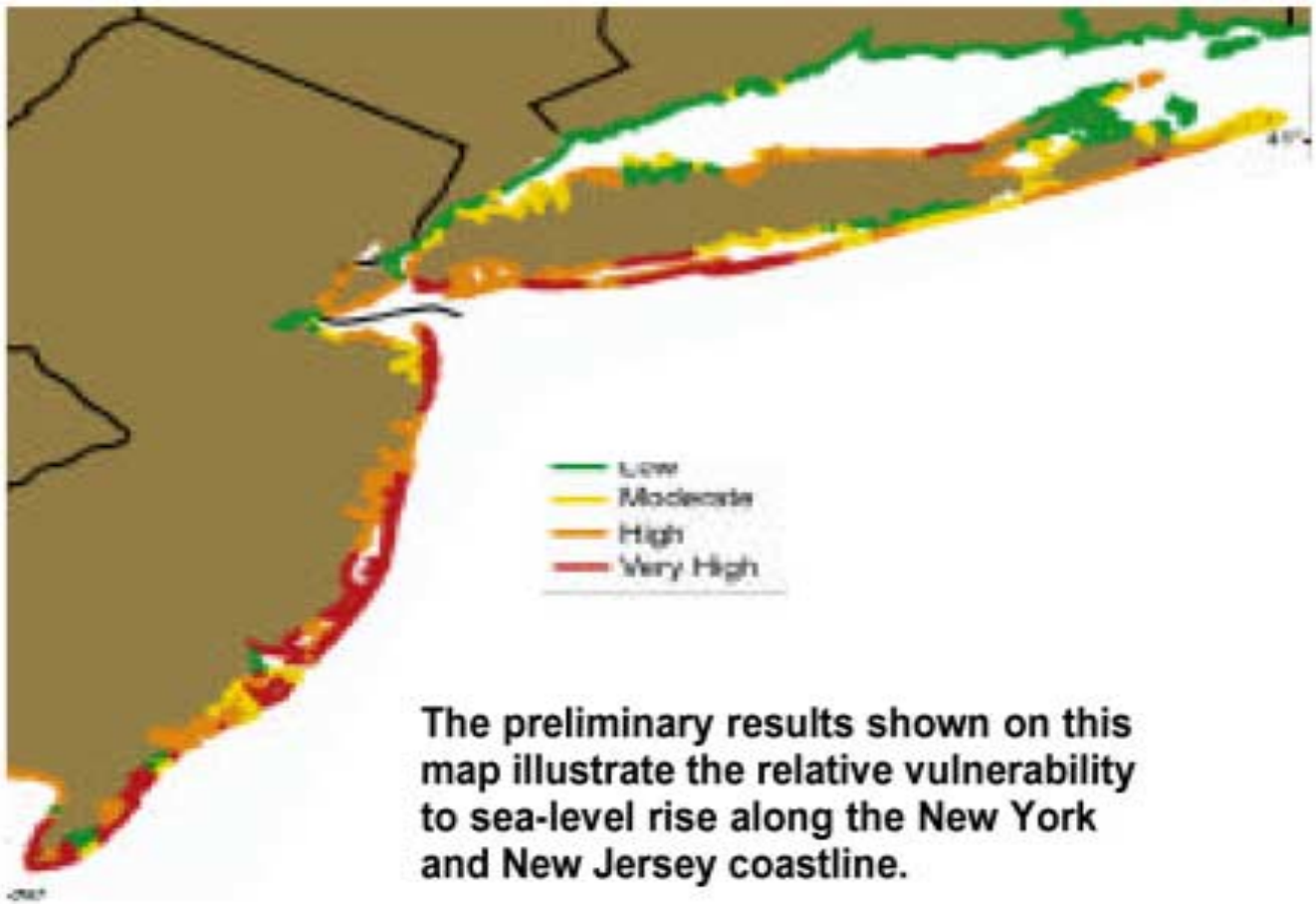
These graphs illustrate the observed association between ground-level ozone concentrations and temperature in Atlanta and New York City (May to October 1988-1990). The projected higher temperatures across the US in the 21st century are likely to increase the occurence of high ozone concentrations, especially since extremely hot days frequently have stagnant air circulation patterns, although this will also depend on emissions of ozone precursors and meteorological factors. Ground-level ozone can exacerbate respiratory diseases and cause short-term reductions in lung function.



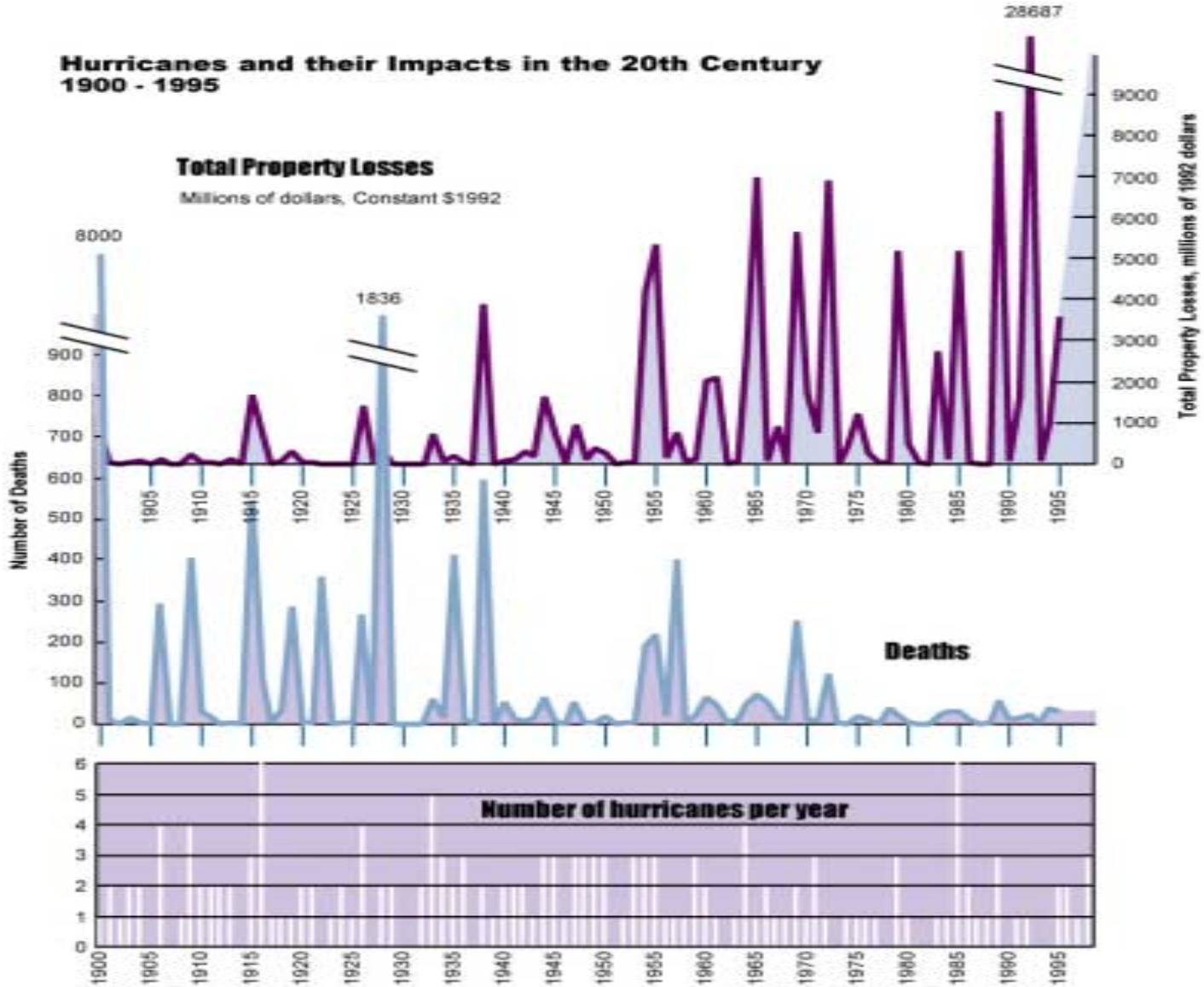
Wastewater systems that combine storm drains, sewage and industrial waste are still used in about 950 communities, mostly in the Northeast and Great Lakes regions. During rainstorms or spring snowmelt, when the volume of water being discharged can exceed the capacity of the sewage treatment system, these systems are designed to overflow and discharge untreated sewage into surface waters. In 1994, EPA developed a framework to control such combined-sewer overflows under the federal Clean Water Act's water discharge permit program. If combined sewer systems remain in place and continue to discharge untreated wastewater during storms, they will very likely pose an increased health risk under projected increases in intense precipitation events.

Combined Wastewater Systems

Coastal Vulnerabilty

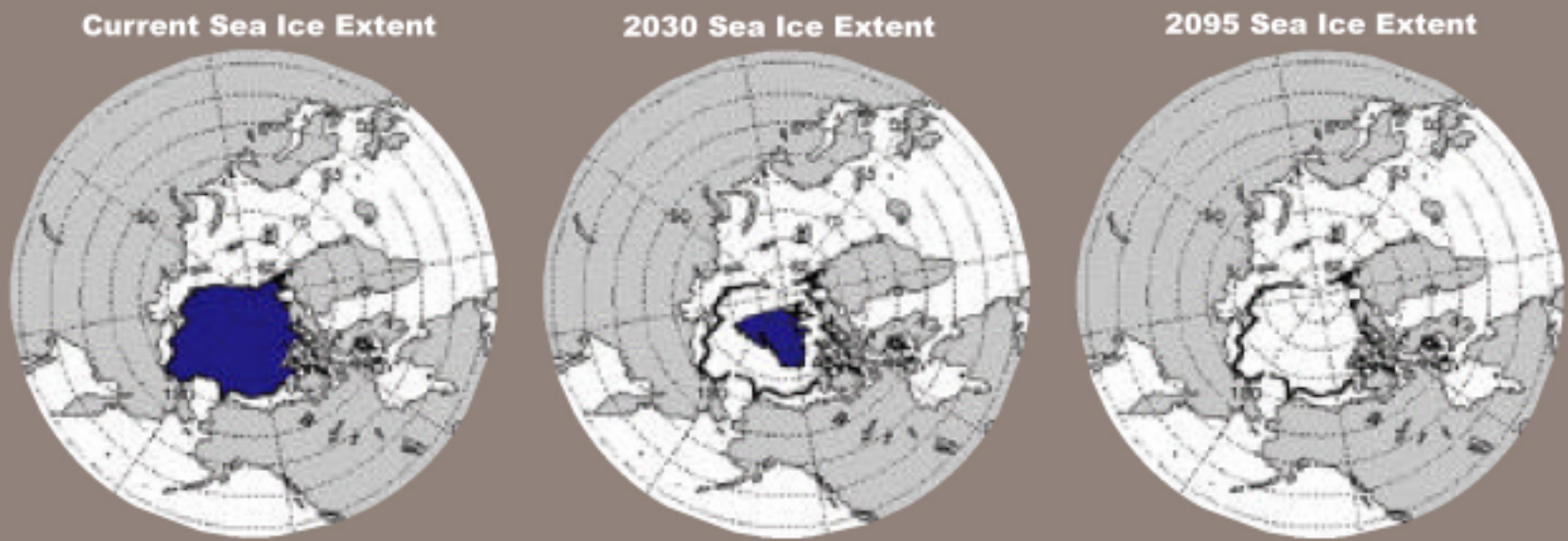


The preliminary results shown on this map illustrate the relative vulnerability to sea-level rise along the New York and New Jersey coastline.

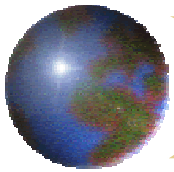

Hurricanes and their Impacts in the 20th Century
1900 - 1995
Total Property Losses
Millions of dollars, Constant $1992
28687
8000
1836
Total Property Losses, millions of 1992 dollars
Number of Deaths
Deaths
Number of hurricanes per year

Projected Summer Sea Ice Change

Canadian Model: an ice-free Arctic summer

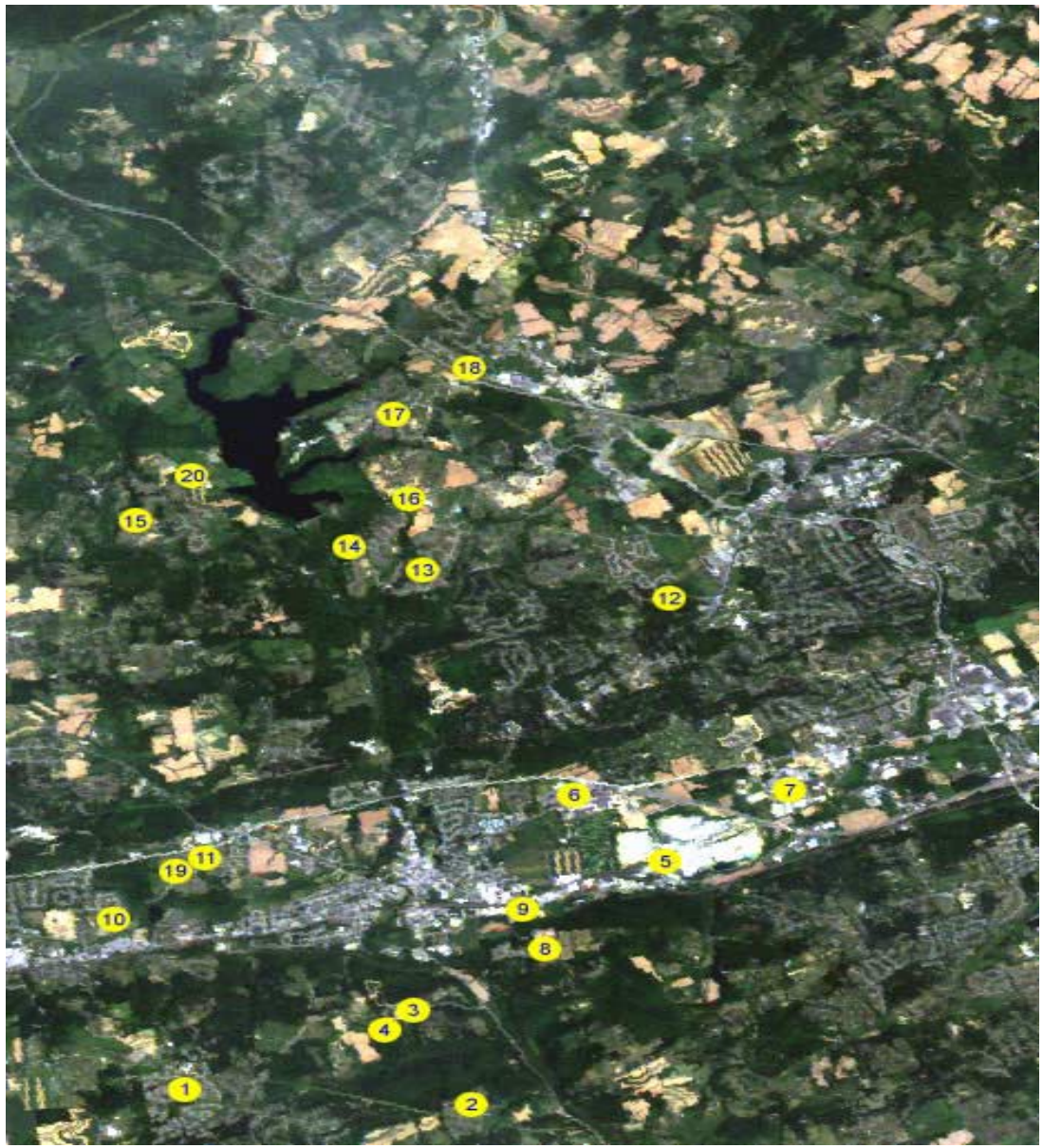


Both models project substantial further retreat of sea ice through the 21st century, with complete loss of summer Arctic sea ice in the Canadian model by 2095. Sea ice outputs were not available for the Hadley scenario, but a reconstruction based on sea-surface temperature shows a 40 to 50% loss of summer sea ice by the 2090s.



The Nature of Environmental Problems

- Many drivers of change are global – the impacts and decisions are “place-based”
- Every place is influenced by multiple stresses (climate, land use, pollution, etc)
- Cause and effect analyses are inadequate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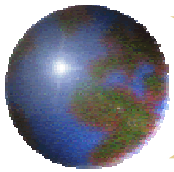
National Assessment - Recommendations

- **Recommendation 1: Develop a More Integrated Approach to Examining Impacts and Vulnerabilities to Multiple Stresses**

What is Standing in Our Way?

- Integration of Observing Systems
- Common modeling framework that enables integrated, full system prediction
- Foundation for process studies that is geared toward prediction
- Integrated Data and Information System
- Vigorous connection to users/decision-makers



The Challenge is one of Scale not Capability

- Mismatch of scales - problems are often regional or local while our efforts at developing a systems approach tend to be global
- Currently incapable of putting a global integrated picture together at a scale suitable to address many of the problems

A More Realistic Approach

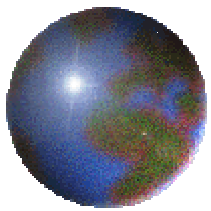
- Create an integrated approach at a tractable scale – a region or a state(s) defined by a set of problems
- Build toward a national and global framework based on advances at a regional scale
- Success creates a data and model “pull”

Create a Flexible Framework for Multiple Issues

- Water availability
- Air quality
- Water quality
- Ecosystem health
- Human health
- Agriculture
- Forestry

Addressing Societal Needs

- Integrated Observation Systems
- Data management and access
- High Resolution coupled models
- Human Dimensions



The Equivalent of an "Environmental Situation Room" or "Intel Center"