

NCER Research Related to Climate Change

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Climate Change and Ecosystems:



What Does It Mean for ERAF?

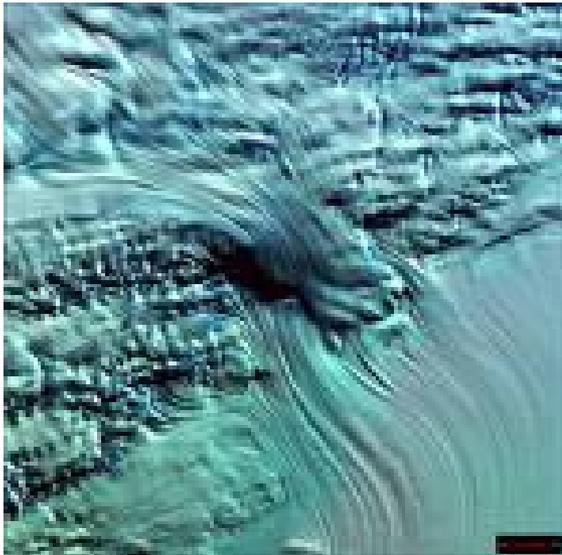
And What is NCER Doing?

Science.house.gov image

You've Already Heard About ...



- **Polar Bears**
(USGS image)



- **Permafrost**
(USGS image)



- **Glaciers**
(NASA image)

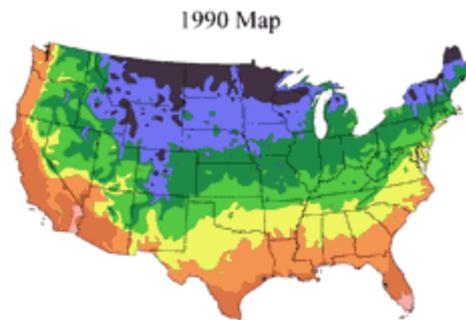
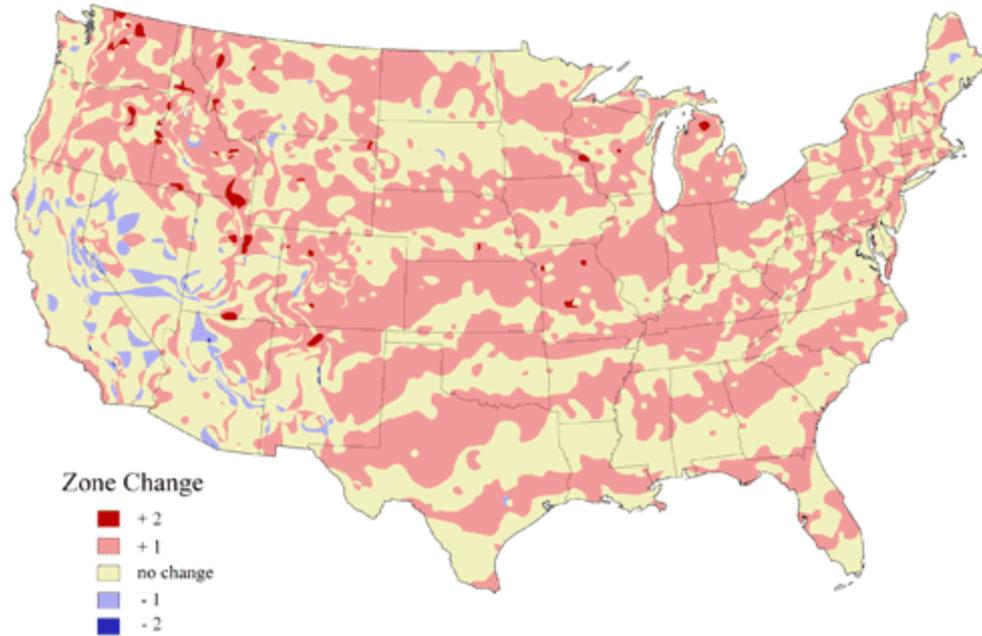
... but it's happening everywhere

- Increased temperature
- Altered precipitation patterns
- Sea-level rise (OK, not everywhere)

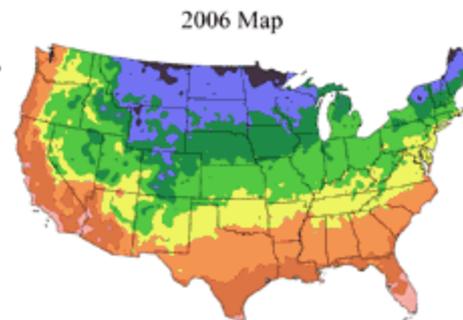
Increased Temperature

- Plant hardiness zones
- Habitat characteristics
- Habitat squeeze
- Migration times

Differences between 1990 USDA hardiness zones and 2006 arborday.org hardiness zones reflect warmer climate



After USDA Plant Hardiness Zone Map, USDA Miscellaneous Publication No. 1475, Issued January 1990



National Arbor Day Foundation Plant Hardiness Zone Map published in 2006.



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Increased Temperature

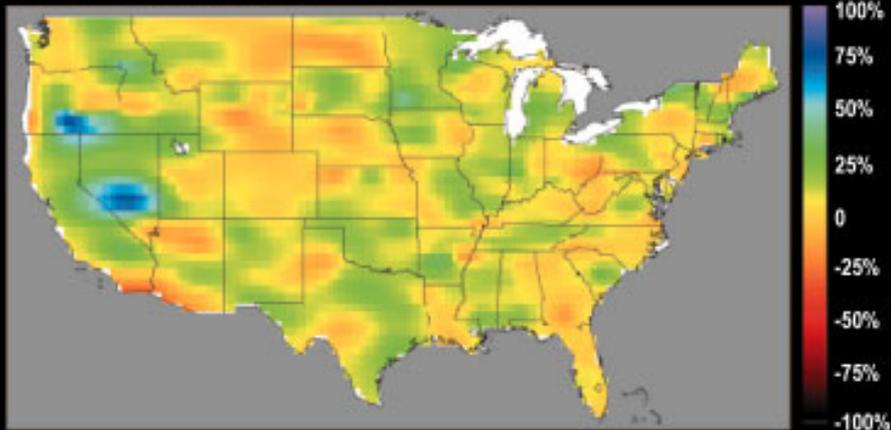
- Species ranges
- Disease incidence
- Invasive species

Altered Precipitation

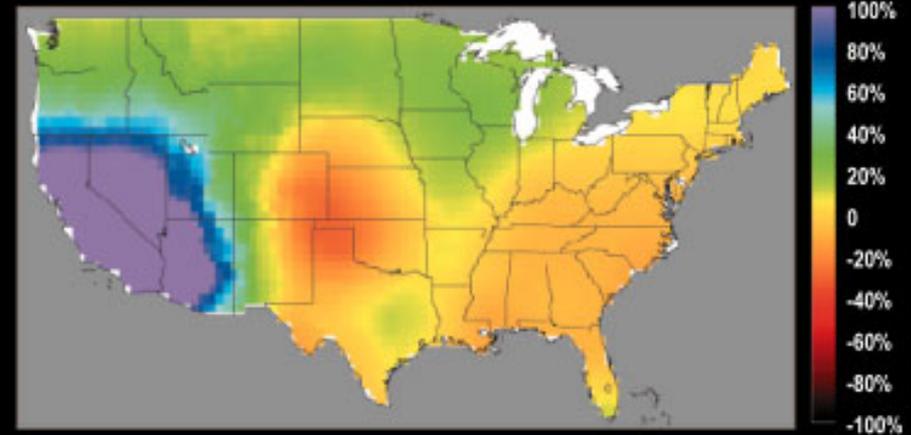
- More
 - Larger or more-frequent floods
 - Channel scouring
 - Erosion
- Less
 - Drought
 - Wetland shift or change
 - Smaller or less-frequent floods
 - Plant establishment

Precipitation Change

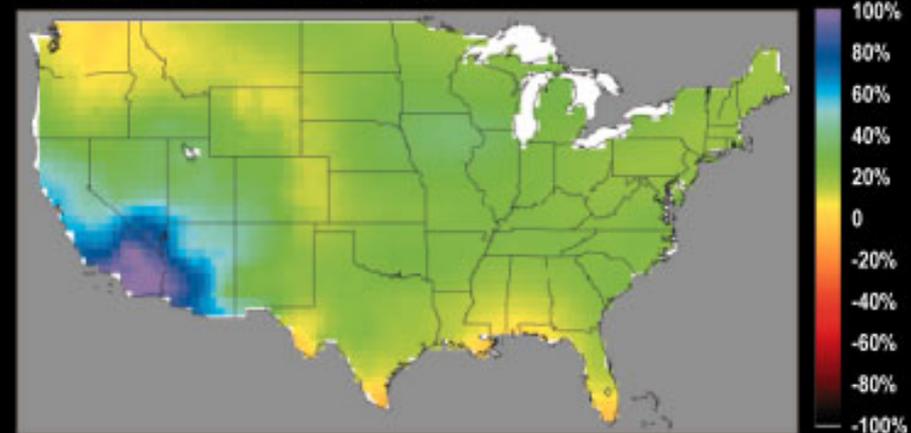
Observed 20th Century



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.

Altered Precipitation

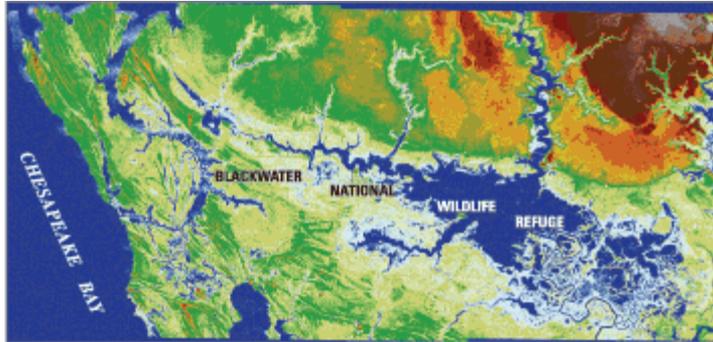
- Different pattern
 - Stronger storms
 - More erosion
 - More contaminant, nutrient, sediment transport into receiving waters
 - Extreme salinity fluctuations

Altered Precipitation

- Different pattern
 - Weaker storms
 - Less flushing / transport
 - Sediment buildup
 - Smaller salinity fluctuations

Sea-Level Rise

- Coastal wetland loss
- Shift from freshwater to brackish wetlands
- Increased erosion and flooding (buffer zone loss)

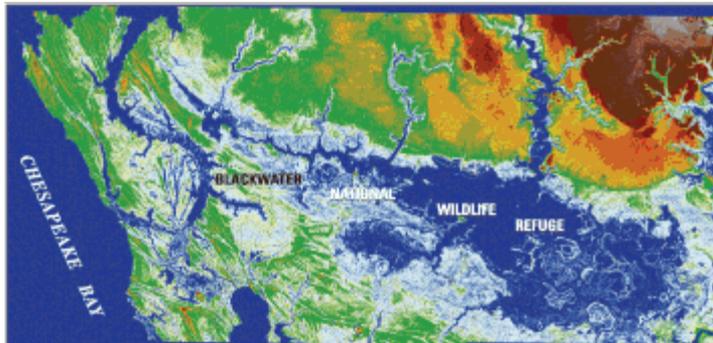


(A)

Year 2002

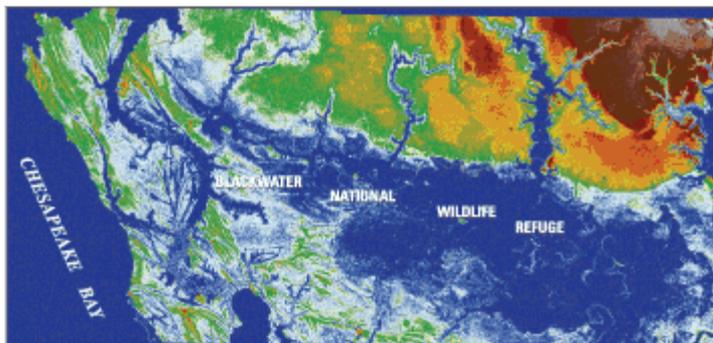


Healthy marshes (green) and stressed marshes (brown) in Blackwater National Wildlife Refuge, June 2006. Photograph by Jane Thomas, *IAN Image Library* (www.ian.umces.edu/imageLibrary/) (Marsh colors refer to this photo only.)



(B)

Year 2100,
assuming a 3-millimeter-
per-year rise in sea level



(C)

Year 2100,
assuming a 6.2-millimeter-
per-year rise in sea level



Location of Blackwater National Wildlife Refuge, Dorchester County, Maryland.

What's a Site Manager To Do?

- Think long-term
- Engage partners
- Use native species
- Think south to north
- Anticipate shifts
- Draw from subsidence literature
- Minimize emissions and materials use

How Is NCER Helping?

- Solicitation: “Ecological Impacts from the Interactions of Climate Change, Land Use Change and Invasive Species”
- Jointly funded w/USDA
- Six grants funded

Currently Funded Grants

R833833 - [Predicting Relative Risk of Invasion by the Eurasian Saltcedar and New Zealand Mud Snail in River Networks Under Different Scenarios of Climate Change and Dam Operations in the Western United States](#) – 7/08 – 6/11

R833834 - [Integrating Future Climate Change and Riparian Land-Use to Forecast the Effects of Stream Warming on Species Invasions and Their Impacts on Native Salmonids](#) – 7/08 – 6/11

R833835 - [Understanding the Role of Climate Change and Land Use Modifications in Facilitating Pathogen Invasions and Declines Of Ectotherms](#) – 4/08 – 3/11

R833836 - [Beach Grass Invasions and Coastal Flood Protection: Forecasting the Effects of Climate Change on Coastal Vulnerability](#) – 5/08 – 6/11

R833837 - [Elevated Temperature and Land Use Flood Frequency Alteration Effects on Rates of Invasive and Native Species Interactions in Freshwater Floodplain Wetlands](#) – 5/08 – 5/11

R833838 - [Ecological Impacts from the Interactions of Climate Change, Land Use Change and Invasive Species](#) – 5/08 – 3/11

Other NCER-Funded Grant Suites

- Wildlife Risk Assessment
- Multiple Stressors
- Coral Reefs & Tidal Marshes
- Regional-Scale Stressor-Response Models
- Watershed Classification
- Ecological Thresholds
- Ecological Effects of Harmful Algal Blooms

Wildlife Risk Assessment Suite

- [Evaluating the Impact of Multiple Stressors on Common Loon Population Demographics - An Integrated Laboratory and Field Approach](#) - Meyer, WI DNR
- [Models and Mechanisms: Understanding Multiple Stressor Effects on an Amphibian Population](#) - Palmer, U of KY
- [Modeling the Individual and Interactive Risks to an Amphibian Population Resulting from Breeding Site Contamination and Terrestrial Habitat Loss](#) - Rowe, U of MD

Wildlife Risk Assessment Suite

- **Individual Variability, Environmental Stressors, and Sampling Uncertainty in Wildlife Risk Assessment** - Kendall, UC Santa Barbara
- **Spatial Demographic Models for the Study of Stress Effects on Wildlife Populations** - Caswell, Woods Hole Oceanographic Institution
- **Assessment of Extinction Risk in Dynamic Landscapes** - With, Kansas State

Wildlife Risk Assessment Suite

- **Habitat Alteration and Disease Rffects on Black-Tailed Prairie Dogs** - Collinger, U of CO Boulder
- **Habitat Degradation and Introduced Diseases Stress the Endangered Hawaii Akepa** - Freed, U of HI at Honolulu
- **Evaluating Multiple Stressors in Loggerhead Sea Turtles: Developing A Two-Sex Spatially Explicit Model** - Wyneken, FL Atlantic U

How Eco Research Works Now

- Ecosystem Services Research Program
 - It's all about *services*:
 - Food, fiber, fuel, etc.
- Unlike other research programs
- Lisa Jackson (23 Jan 09): “Science must be the backbone for EPA programs”

What Do You Think?

- Should one of NCER's research questions be:
 - What tools and information do state/tribal waste-management or land-management agencies need to effectively manage waste and restore contaminated land in the face of climate change (e.g., increased T, altered PPT, and SL rise)?
 - Can we place this in the current “ecosystem services” format?
 - Should we?