



NORTH CENTRAL
**CLIMATE
SCIENCE**
CENTER

Implications of Climate Change for Wildlife and Ecosystems of the Great Plains: A
Perspective from the Department of Interior

Climate Change Roundtable
University of Nebraska, Lincoln
October 5, 2015

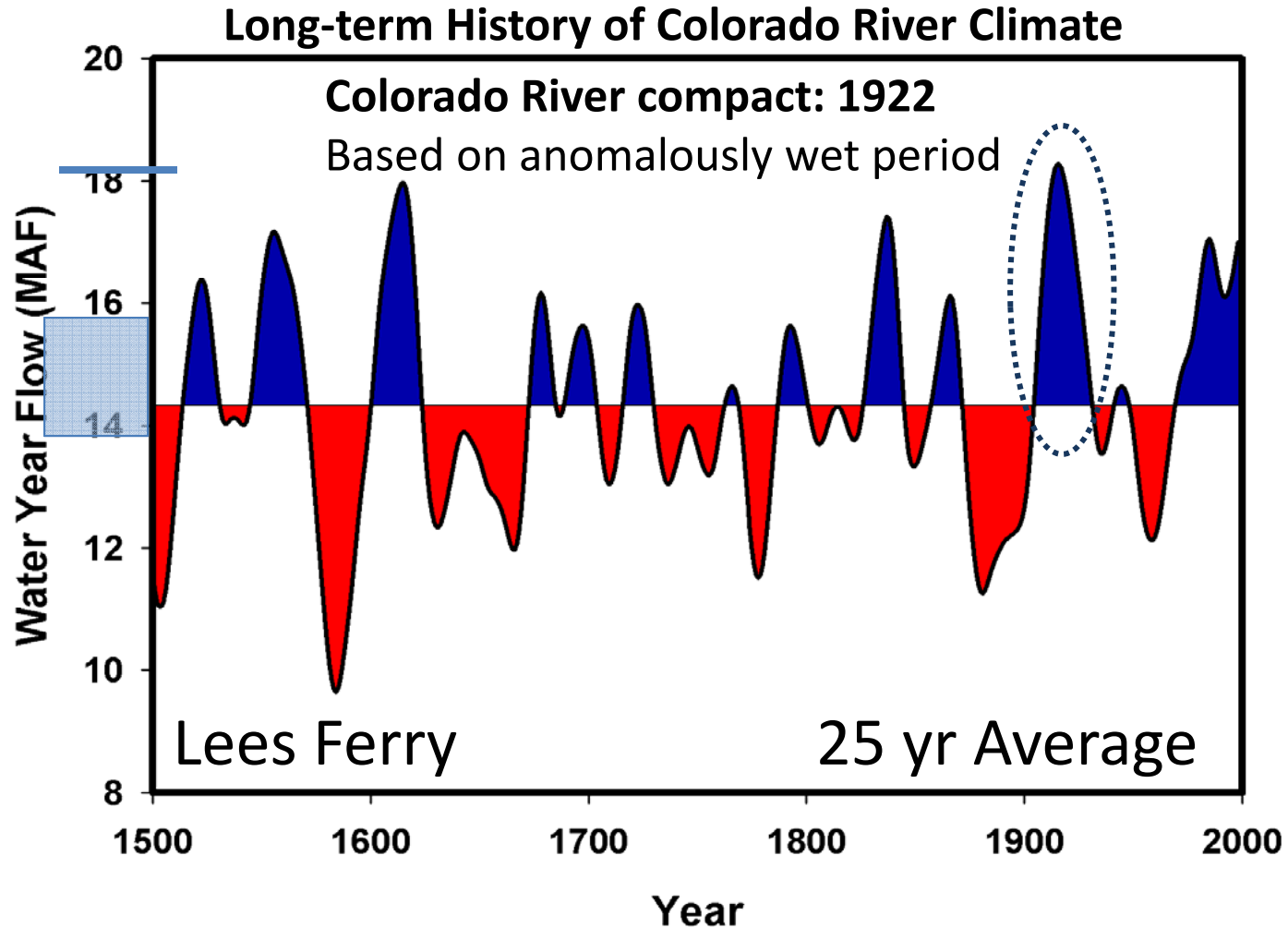
Jeff Morisette (and a host of other folks...)



**Resource for
Vulnerability assessment
Adaptation and
Mitigation
Projects**



“Stationarity is Dead” (Milly et al., Science 2008)



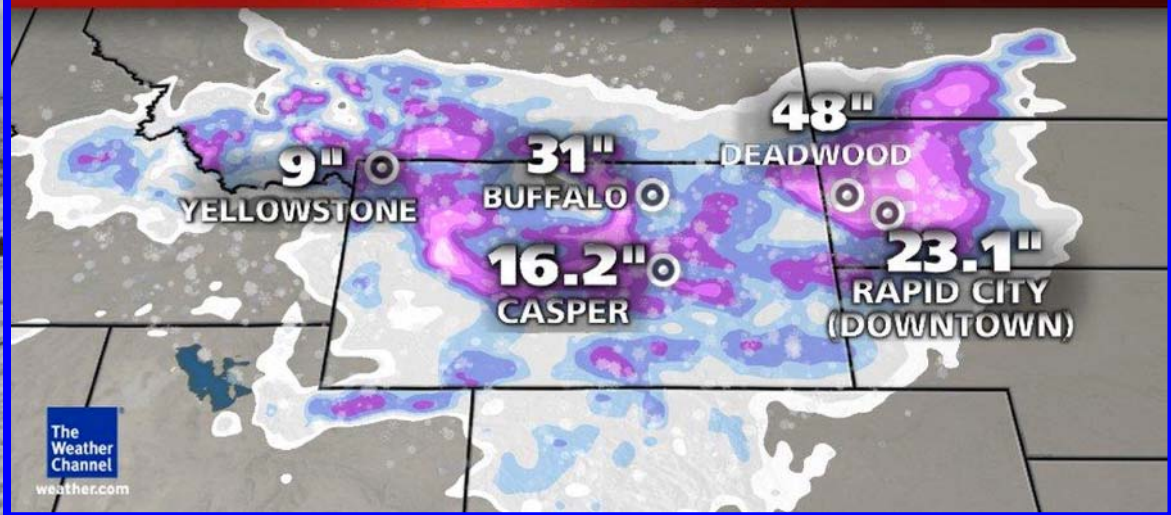
Slide courtesy of Dr. Steve Gray, DOI Alaska Climate Science Center, based on Woodhouse, Gray, and Meko (2006). *Water Resources Research* 42:W05415



“The mighty Colorado is reduced to a trickle in Mexico”

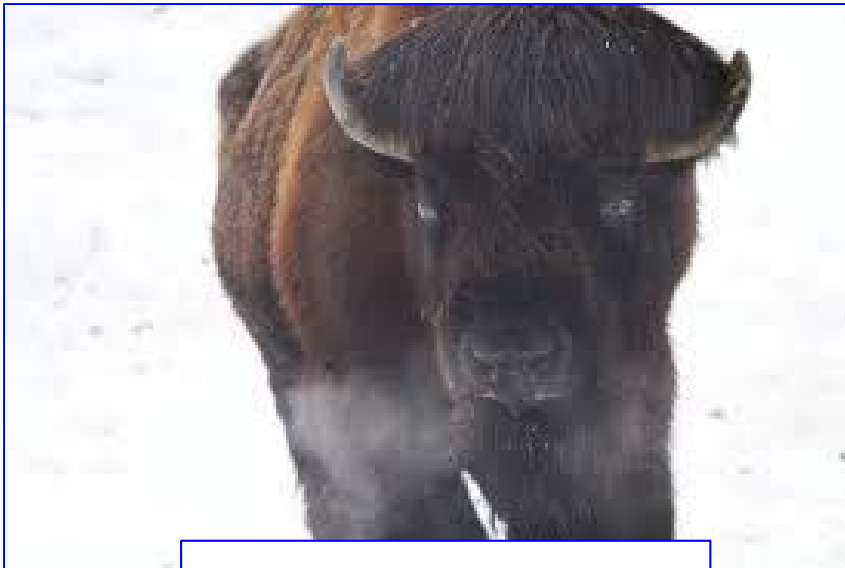
WINTER STORM ATLAS

SNOW REPORTS



October 2013

South Dakota Blizzard October, 2013



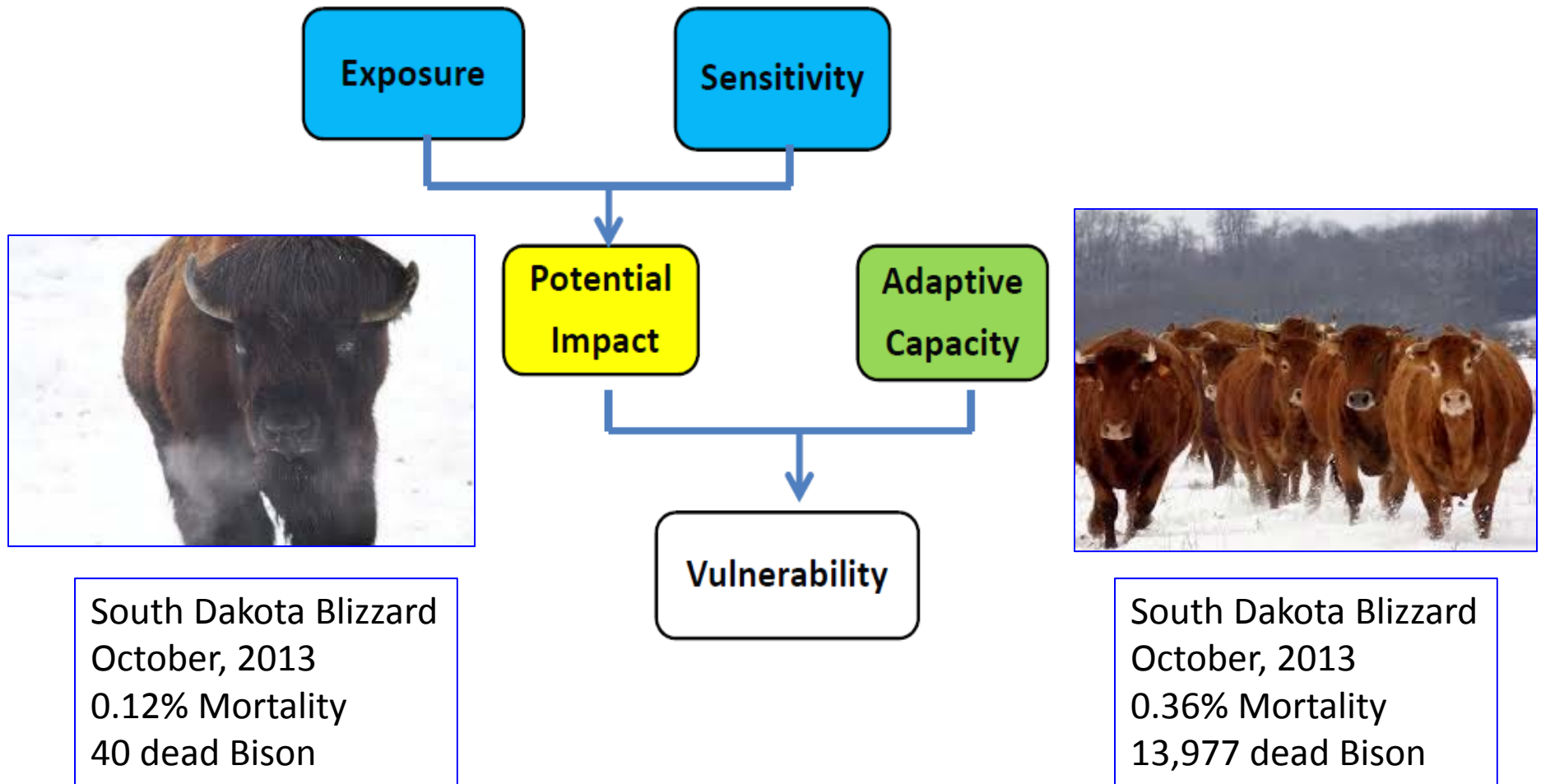
0.12% Mortality
40 dead Bison



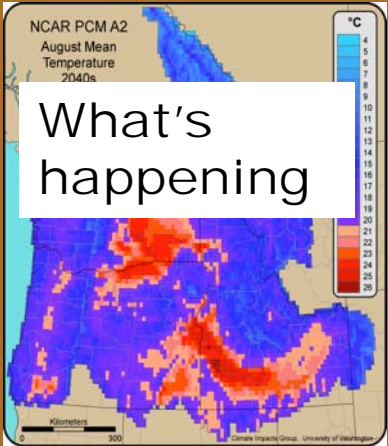
0.57% Mortality
13,977 dead Cattle

Components of Climate Change Vulnerability

Bison and Cattle example



Components of Climate Change Vulnerability



Exposure

Sensitivity



Potential
Impact

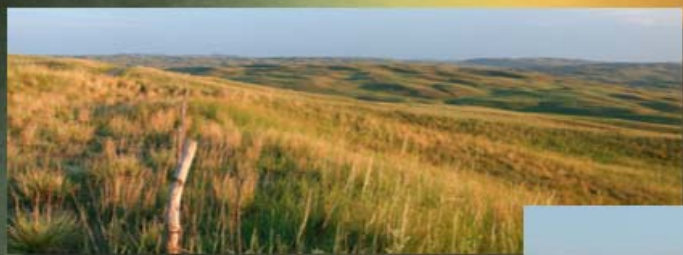
Adaptive
Capacity



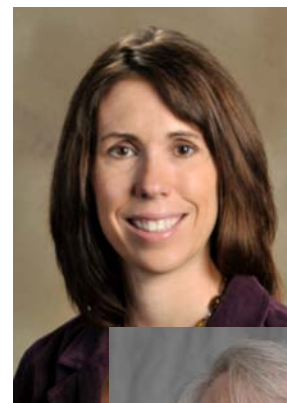
Vulnerability

SO WHAT'S HAPPENING...

Understanding and Assessing Climate Change Implications for Nebraska



University of Nebraska–Lincoln

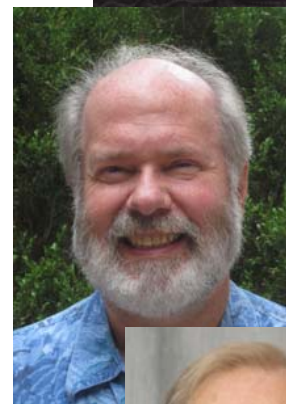


Lead Authors:

Deborah Bathke



Bob Oglesby



Clint Rowe



Donald Wilhite

**Addressing the Impacts of Climate Change on
Wildlife and Ecosystems in Nebraska**



OCT 5 - Public lecture
OCT 6 - Roundtable



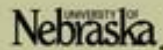
**Implications of Climate Change on
Human Health in Nebraska**

OCT 6 - Public lecture
OCT 7 - Roundtable



**Implications of Climate Change on
Nebraska's Forests and Fire**

OCT 13 - Public lecture
OCT 14 - Roundtable



**Implications of Climate Change on
Nebraska's Agriculture, Food and Water**

OCT 20 - Roundtable



Implications of Climate Change on Energy Availability, Use and Management in Nebraska

OCT 22 - Roundtable



Climate Change in Nebraska: What Does it Mean for our Faith Communities?

SEPT 17 - Public lecture

SEPT 18 - Roundtable



Implications of Climate Change on Nebraska's Urban & Rural Communities

SEPT 22 - Roundtable



Institutional Responses to Climate Change: Implications for College Campuses in Nebraska

OCT 1 - Roundtable



Understanding and Assessing Climate Change Implications for Nebraska



Change in the length of the growing season.

Greater variability in temperature and precipitation.



Highlights

Explore highlights of the National Climate Assessment including an Overview, the report's 12 overarching findings, and a summary of impacts by region.

→ EXPLORE HIGHLIGHTS



Full Report

Explore the entire report covering our changing climate, regions, cross sector topics, and response strategies in full detail.

→ EXPLORE THE REPORT





19 GREAT PLAINS

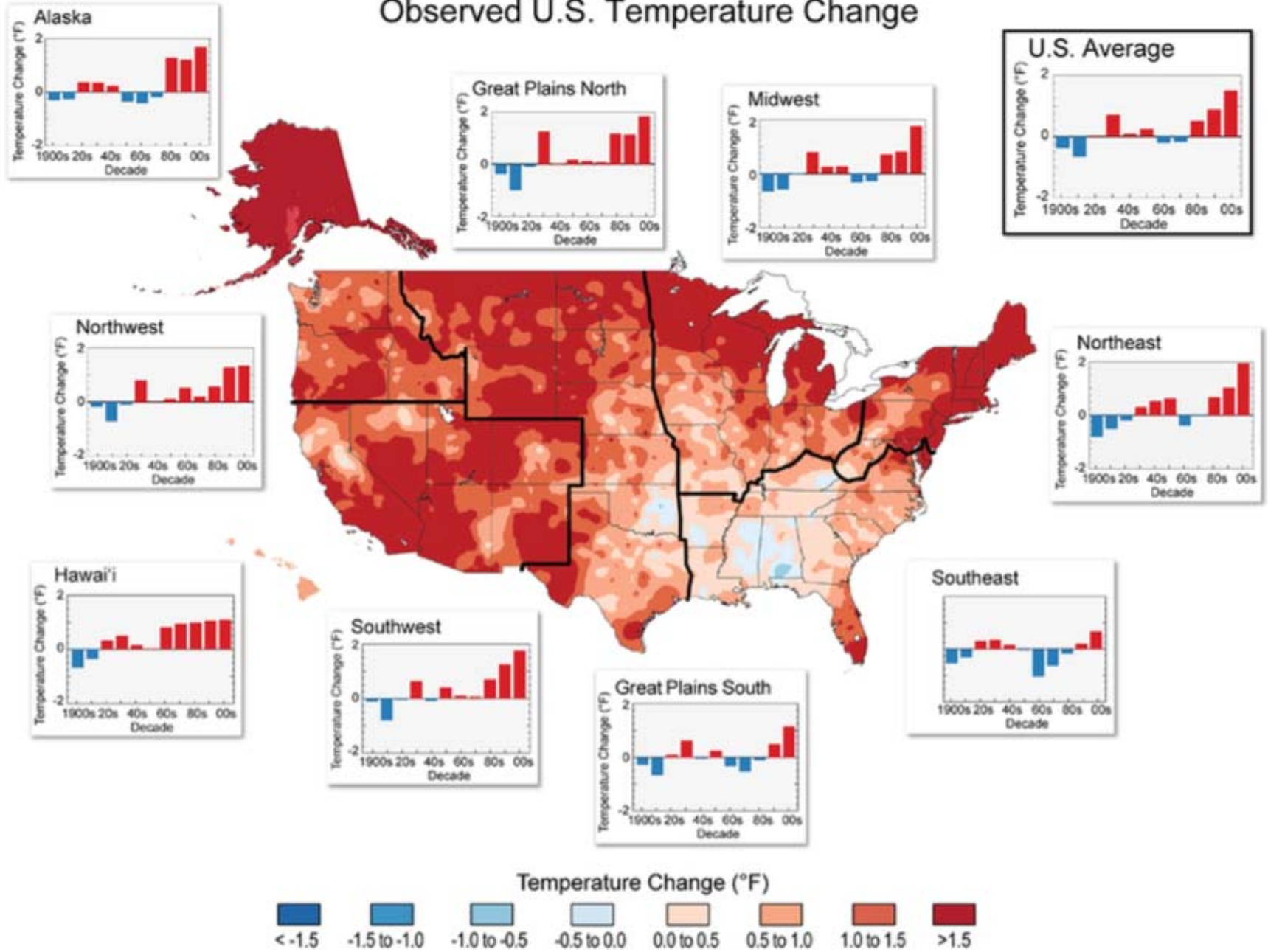
KEY MESSAGES

- 1. Rising temperatures are leading to increased demand for water and energy. In parts of the region, this will constrain development, stress natural resources, and increase competition for water among communities, agriculture, energy production, and ecological needs.**
- 2. Changes to crop growth cycles due to warming winters and alterations in the timing and magnitude of rainfall events have already been observed; as these trends continue, they will require new agriculture and livestock management practices.**
- 3. Landscape fragmentation is increasing, for example, in the context of energy development activities in the northern Great Plains. A highly fragmented landscape will hinder adaptation of species when climate change alters habitat composition and timing of plant development cycles.**
- 4. Communities that are already the most vulnerable to weather and climate extremes will be stressed even further by more frequent extreme events occurring within an already highly variable climate system.**
- 5. The magnitude of expected changes will exceed those experienced in the last century. Existing adaptation and planning efforts are inadequate to respond to these projected impacts.**

Weather vs Climate what's the difference?

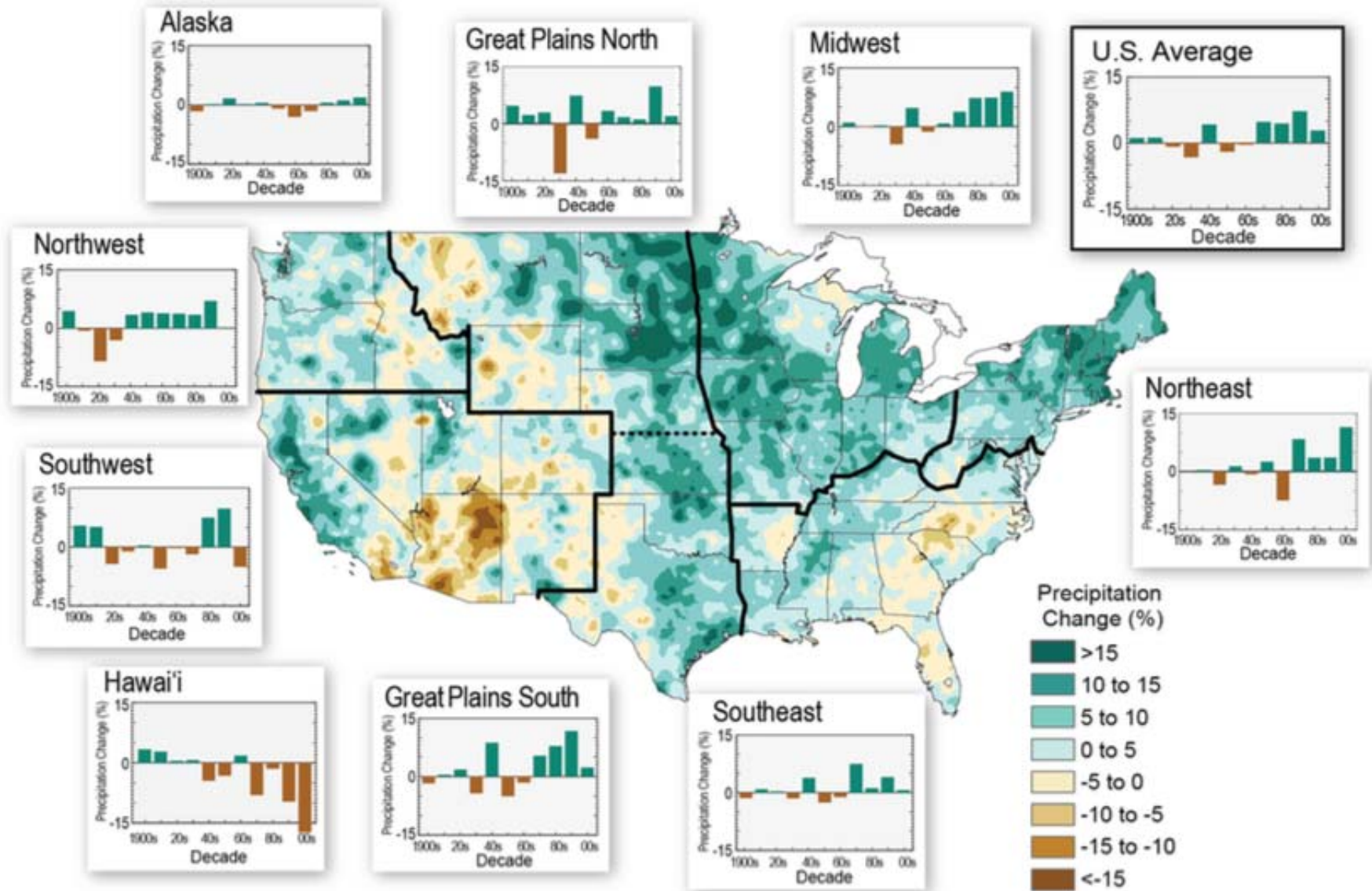
- If you don't like the **weather**:
 - *Wait a few minutes!*
- If you don't like the **climate**:
 - *Move!*

Observed U.S. Temperature Change



From: Understanding and Assessing Climate Change: Implications for Nebraska

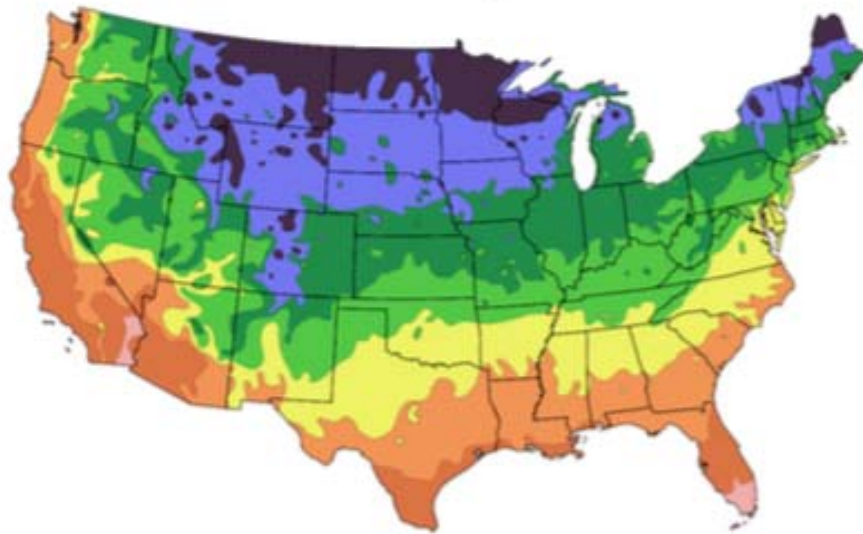
Observed U.S. Precipitation Change



From: Understanding and Assessing Climate Change: Implications for Nebraska

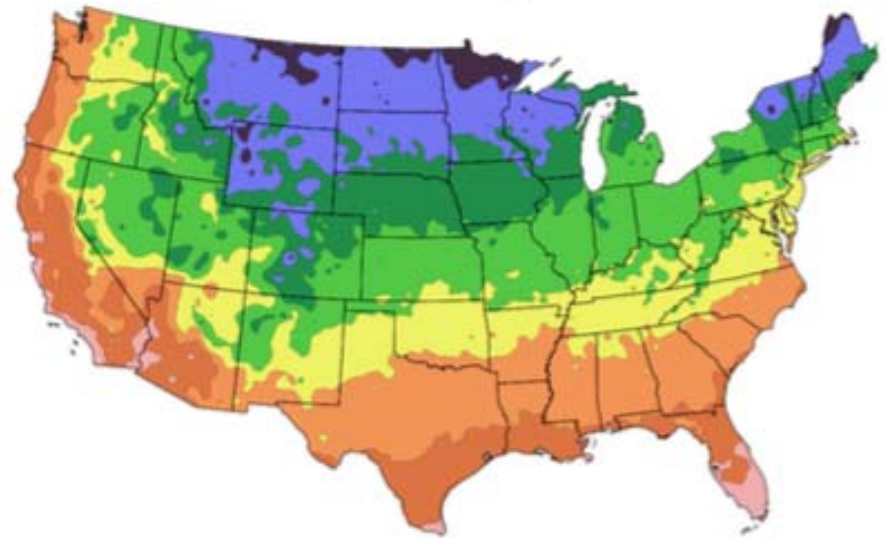
**DOES IT MATTER TO WILDLIFE AND
ECOSYSTEM...**

1990 Map



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

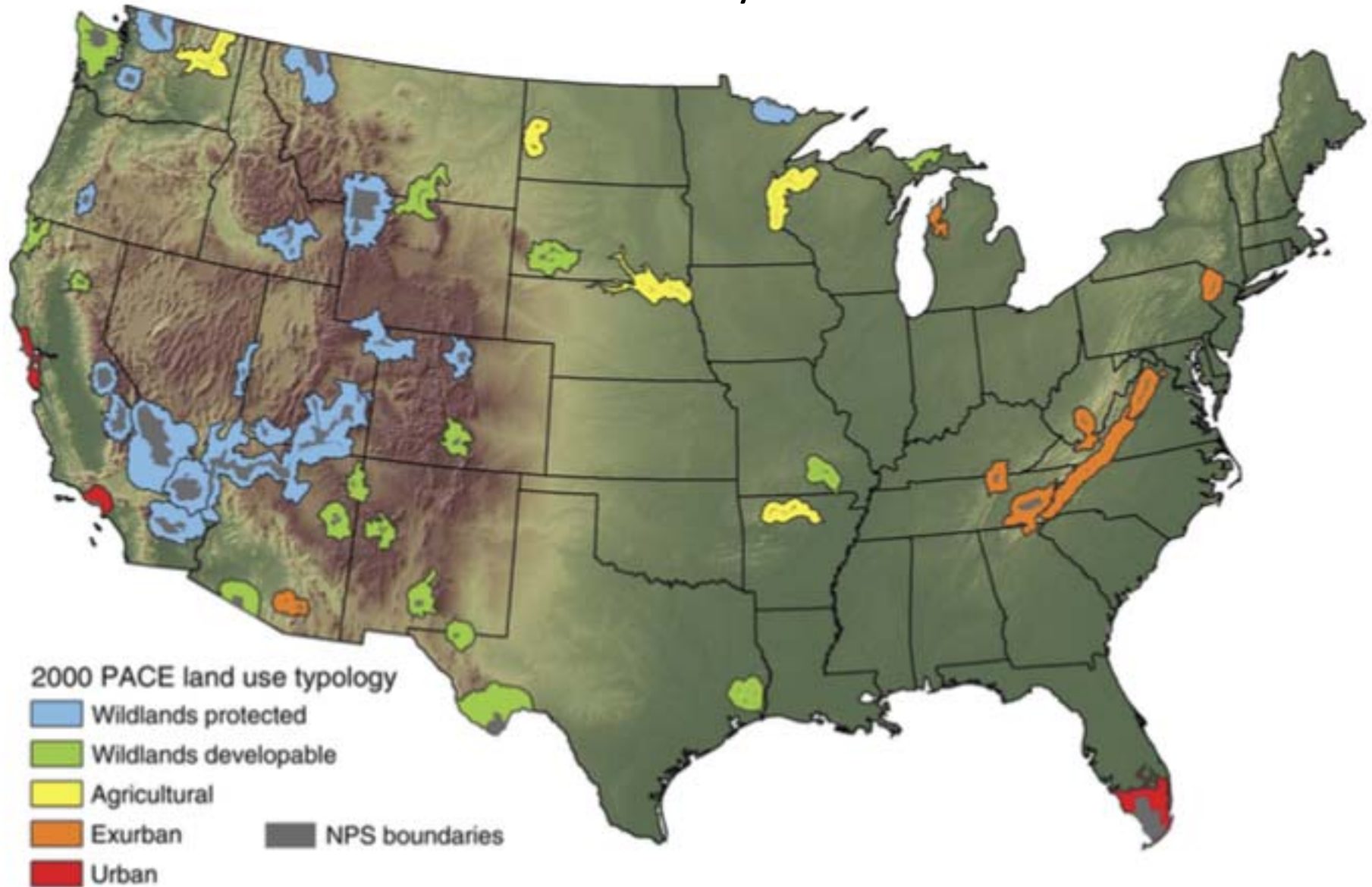
2006 Map



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

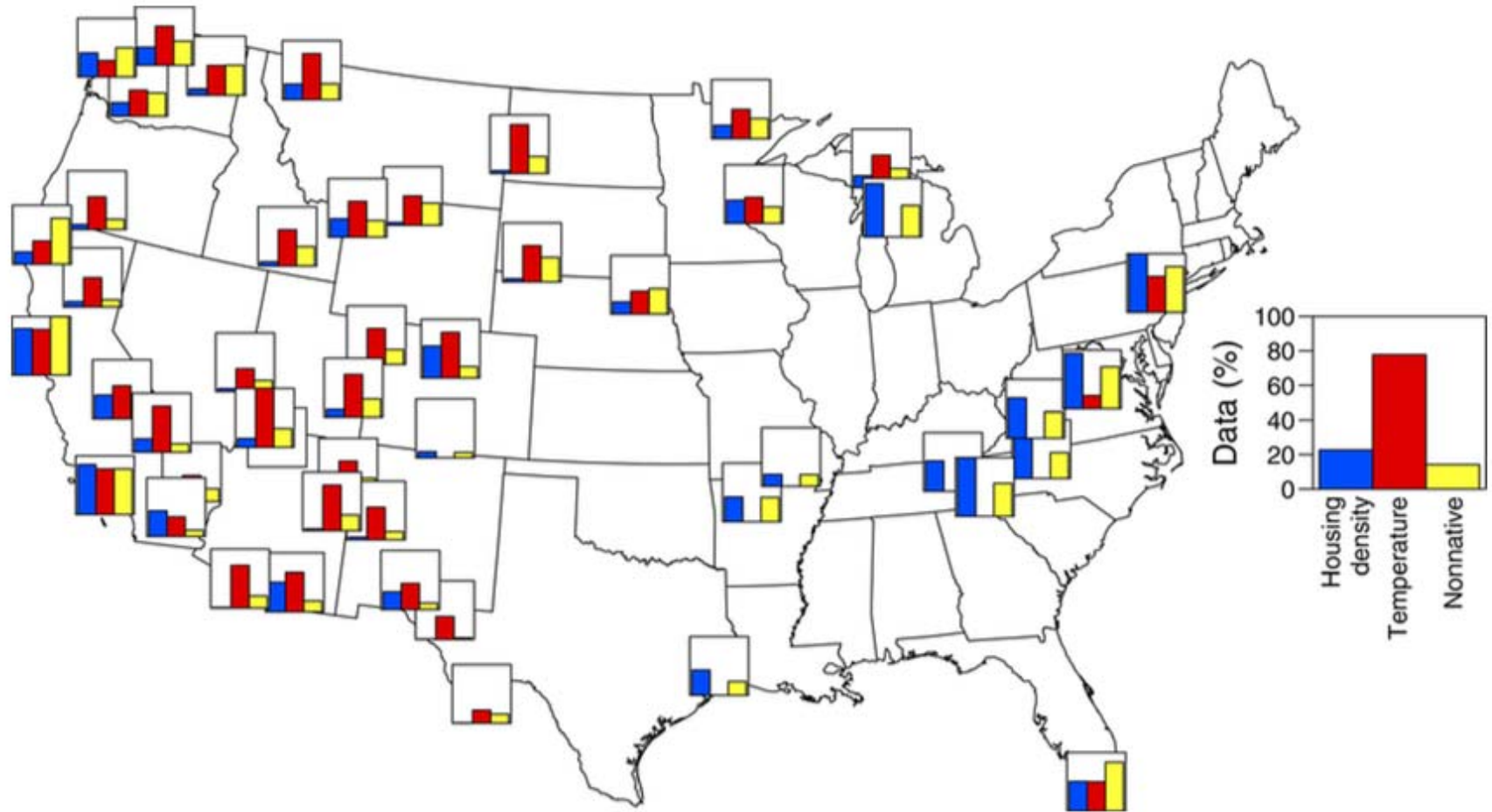


Protected Area Ecosystems and associated land use



Hansen, Andrew J., et al. "Exposure of US National Parks to land use and climate change 1900-2100." *Ecological Applications* 24.3 (2014): 484-502.

Housing, temperature, and non-natives across U.S. National Parks



Hansen, Andrew J., et al. "Exposure of US National Parks to land use and climate change 1900-2100." *Ecological Applications* 24.3 (2014): 484-502.

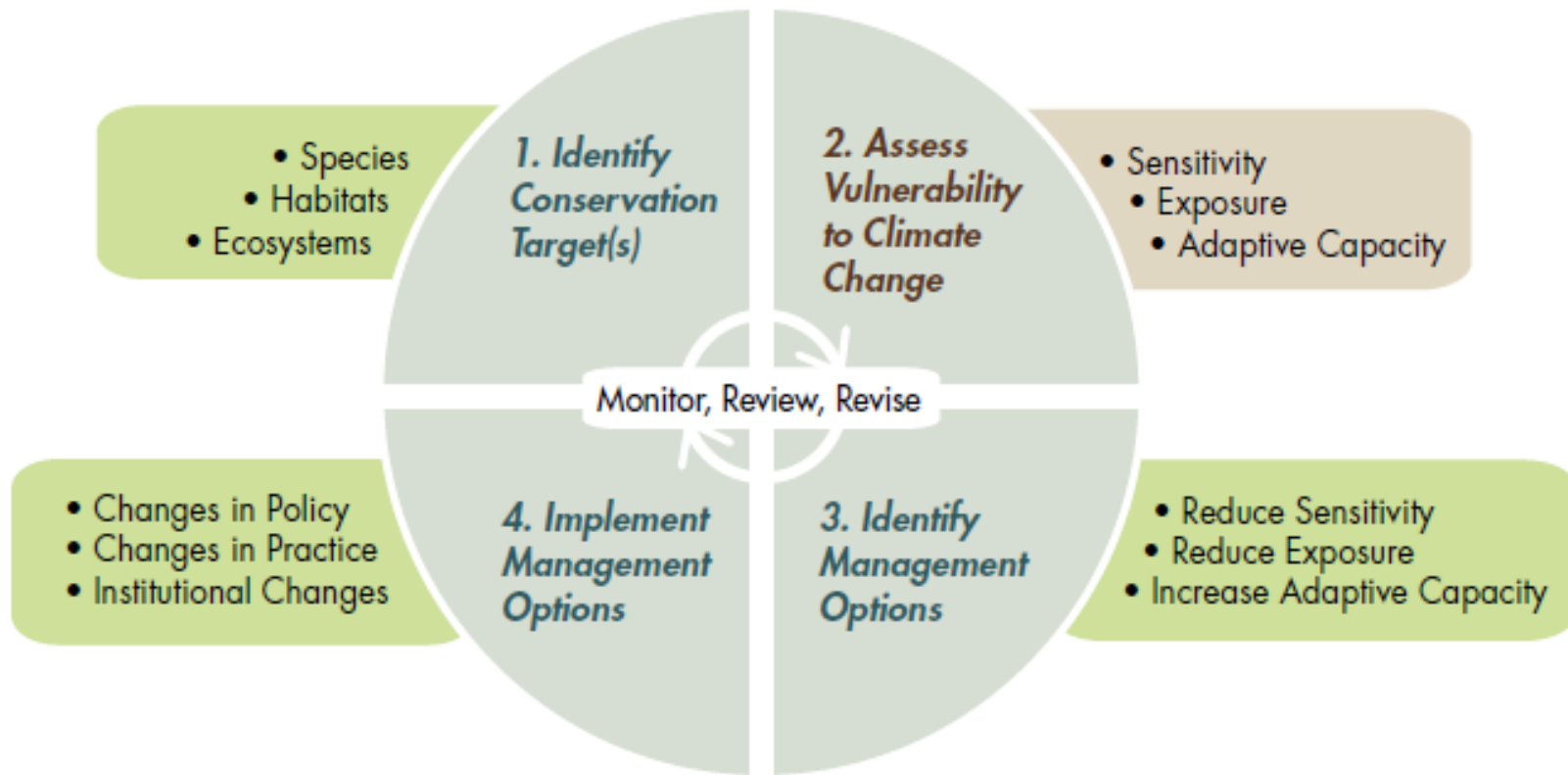
Scanning the Conservation Horizon

*A Guide to Climate Change
Vulnerability Assessment*



Glick, P., Stein, B.A., and Edelson, N.A., eds., 2011, Scanning the conservation horizon: A guide to climate change vulnerability assessment: Washington, D.C., National Wildlife Federation, 176 p.

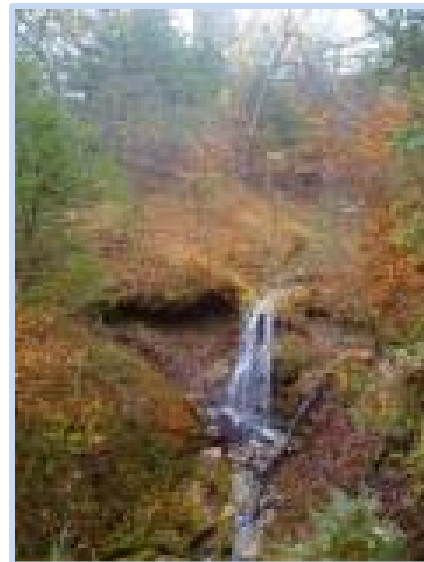
Overarching Conservation Goal(s)



In an analysis by the Nebraska Game and Parks Commission, mollusks, amphibians, and small stream fishes were found to be the most vulnerable to climate change of all groups of plants and animals considered.



<http://snr.unl.edu/herpneb/>



https://en.wikipedia.org/wiki/Missouri_River

Schneider, 2014. Conserving Biodiversity in a Changing Climate, Prairie Fire.



National Climate Assessment

Climate Change Impacts in the United States

CHAPTER 28 ADAPTATION

Convening Lead Authors

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Recommended Citation for Chapter

Bierbaum, R., A. Lee, J. Smith, M. Blair, L. M. Carter, F. S. Chapin, III, P. Fleming, S. Ruffo, S. McNeeley, M. Stults, L. Verduzco, and E. Seyller, 2014: Ch. 28: Adaptation. *Climate Change Impacts in the United States: The Third National Climate Assessment*, J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 670-706. doi:10.7930/J07H1GGT.

On the Web <http://nca2014.globalchange.gov/report/response-strategies/adaptation>

28 ADAPTATION

KEY MESSAGES

1. Substantial adaptation planning is occurring in the public and private sectors and at all levels of government; however, few measures have been implemented and those that have appear to be incremental changes.
2. Barriers to implementation of adaptation include limited funding, policy and legal impediments, and difficulty in anticipating climate-related changes at local scales.
3. There is no “one-size fits all” adaptation, but there are similarities in approaches across regions and sectors. Sharing best practices, learning by doing, and iterative and collaborative processes including stakeholder involvement, can help support progress.
4. Climate change adaptation actions often fulfill other societal goals, such as sustainable development, disaster risk reduction, or improvements in quality of life, and can therefore be incorporated into existing decision-making processes.
5. Vulnerability to climate change is exacerbated by other stresses such as pollution, habitat fragmentation, and poverty. Adaptation to multiple stresses requires assessment of the composite threats as well as tradeoffs among costs, benefits, and risks of available options.
6. The effectiveness of climate change adaptation has seldom been evaluated, because actions have only recently been initiated and comprehensive evaluation metrics do not yet exist.

WHAT CAN BE DONE...

What can be done...

- Take advantage of available resources.
- Increase our understanding and address uncertainty.
- Focus that understanding on “decision space”.
- Consider both Adaptation *and* Mitigation.

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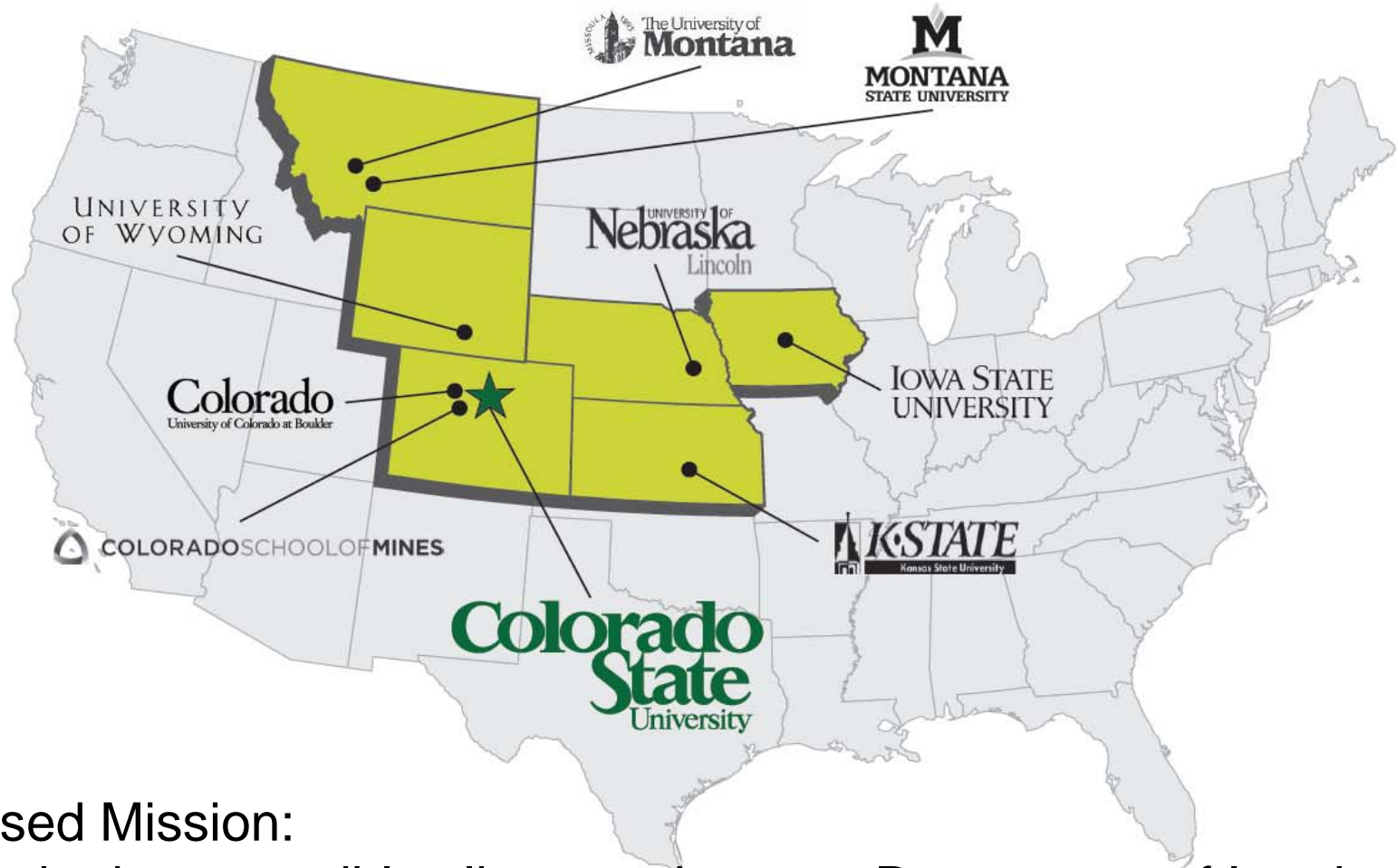
DOI Climate Science Centers



Mission:
To provide the best possible
climate science to Department of
Interior land managers



Northcentral Climate Science Center



Draft Revised Mission:

To provide the best possible climate science to Department of Interior land managers & provide university and USGS researchers an opportunity to work with an engaged and proactive applied management community.



[Home](#) » Northern Plains Hub

Northern Plains Hub Welcome Note

Welcome to the Northern Plains Hub, where our purpose is to deliver science-based knowledge, practical information, management/conservation strategies, and decision tools to farmers, ranchers, forest landowners that will help them to adapt to weather variability and changing climatic conditions.



No-till management and cover crops provide farmers with increased soil health, resulting in greater organic matter and water...



Northern Plains Hub



Popular Topics:

- > [Northern Plains Regional Vulnerability Assessment](#)
- > [Effects on Rangeland and Pasture](#)
- > [Resources for land managers](#)
- > [Climate research and data](#)
- > [Western Water Assessment Climate Dashboard](#)



CLIMATE PROGRAM OFFICE

Advancing scientific understanding of climate, improving society's ability to plan and respond



Western Water Assessment

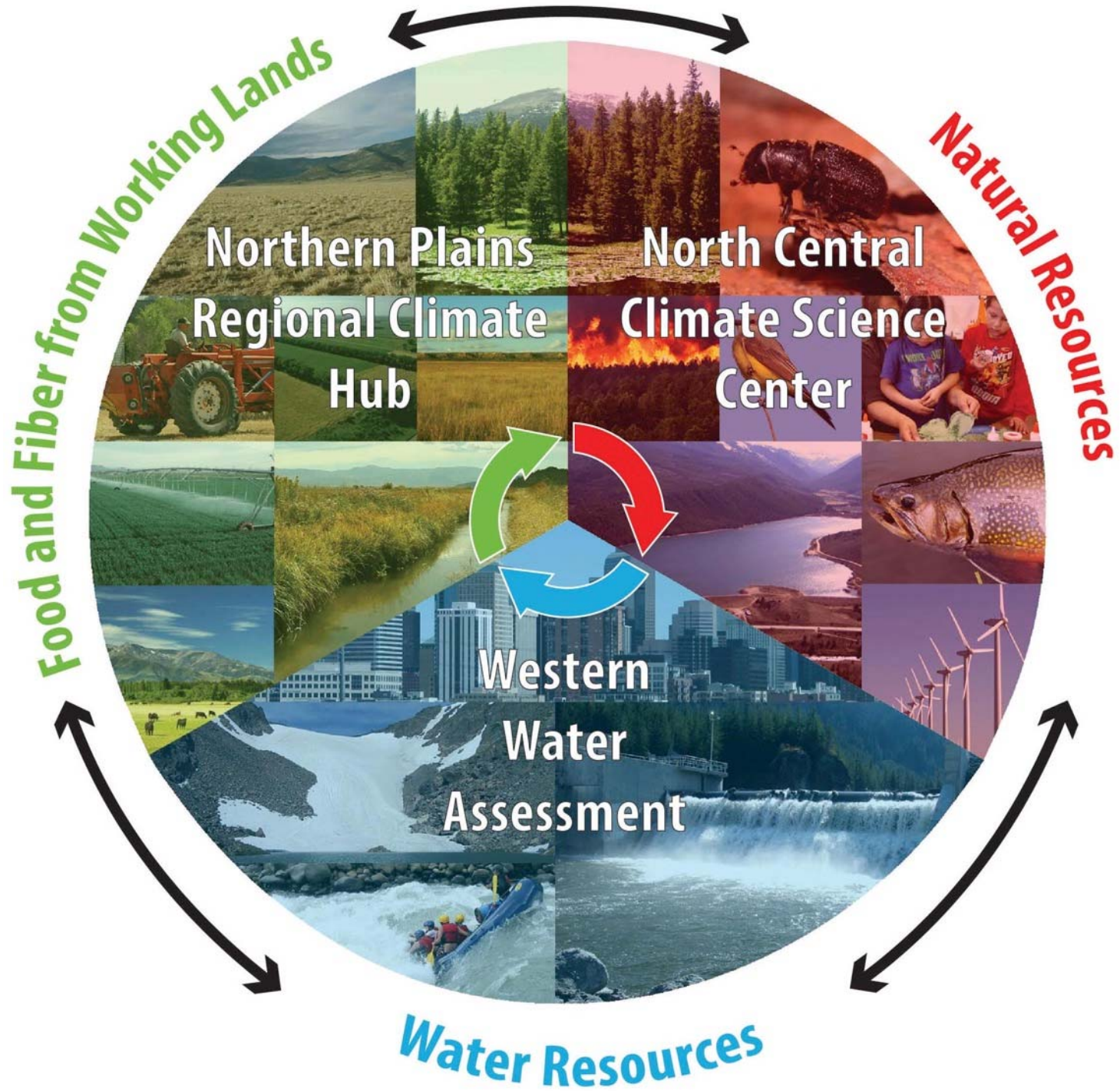


**National Integrated
Drought Information System**



High Plain
Regional Climate Center






www.colorado.edu/climate/dashboard2.html

CU Home | CIRES Home | People | Maps

SEARCH WWA

Home About Us Projects Publications Tools & Resources Workshops & Events Climate




WWA Home » Intermountain West Climate » Intermountain West: Climate Dashboard

Rocky Mountains–High Plains Climate Dashboard (beta)

A collaboration between Western Water Assessment, the North Central Climate Science Center, and the USDA Northern Plains Regional Climate Hub

The Rocky Mountain–High Plains Climate Dashboard provides an array of images for climate, drought, and water-supply monitoring that are automatically updated when the original providers update them on their respective websites. The RM-HP Dashboard is focused on these eight states: **Montana, Wyoming, Utah, Colorado, North Dakota, South Dakota, Nebraska, and Kansas**. The RM-HP Dashboard is based on the WWA [Intermountain West Climate Dashboard](#).

Click on any image to view a full-sized version, and click again to reduce it. You can enlarge multiple images at the same time, and click-drag to move them around your desktop. Each image's name is linked to the corresponding page at the provider's website.

See [this page](#) for detailed descriptions of *most* of the Dashboard graphics, or click the  above each graphic to see the description of that graphic.

This beta product is still in development. Please share with us [your feedback](#) on these questions:

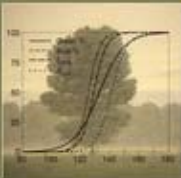
- Which images on the Dashboard are the most useful for your area, interests, and applications? Which are the least useful to you?
- What other climate-monitoring images, that you currently access online, would you like to see added to the Dashboard?
- Do you have other suggestions to make the Dashboard more effective?

LCC Science Plan 2015.html SC outcomes draft 1....docx Data Management Pl... docx USGS Stories revam....docx NC CSC tribal work e....xlsx Show All

<http://wwa.colorado.edu/climate/dashboard2.html>

What can be done...

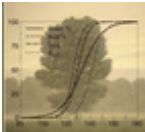
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PhenoCam - Site Map

[About](#)[Gallery](#)[Map](#)[FAQ](#)[Tools](#)[Data](#)[Site Table](#)[Admin](#)Welcome, Guest ([login](#))

Site types:  Core  Affiliated (show inactive sites)



PHENOCAM - Camera Information

- [About](#)
- [Gallery](#)
- [Map](#)
- [FAQ](#)
- [Tools](#)
- [Data](#)
- [Site Table](#)
- [Admin](#)

Welcome, Guest ([login](#))

Site Name: ninemileprairie ([show IR view](#))

Location: Nine Mile Prairie, Univ. of Nebraska - Lancaster

County,Nebraska, USA

Lat: 40.8680 Lon: -96.8221 Elev(m): 381

Image Count: 6456 Start Date: 2015-04-16 Last Date: 2015-10-03

ninemileprairie - NetCam SC IR - Sun Oct 04 2015 18:00:06 CST - CST6
 Camera Temperature: 40.5
 Exposure: 2466



- Base Layer
- Google Hybrid
 - Google Satellite
 - Google Physical
- Overlays
- MODIS LC 2007

[Browse Images](#)



09/29
(272)

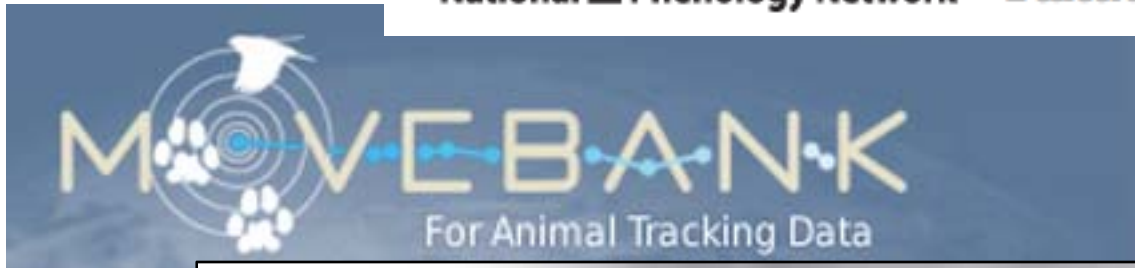
09/30
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10/01
(274)

10/02
(275)

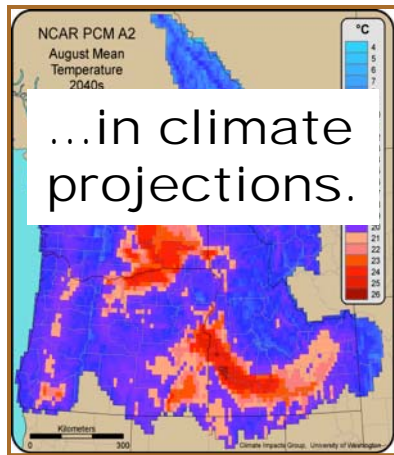
10/03
(276)

latest image



Snapshot Wisconsin

Uncertainty...



Exposure

Sensitivity



Potential
Impact

Adaptive
Capacity

Vulnerability





Loading Dock Model



Megaphone Model



Trust me...
I'm a scientist.

Authority Model

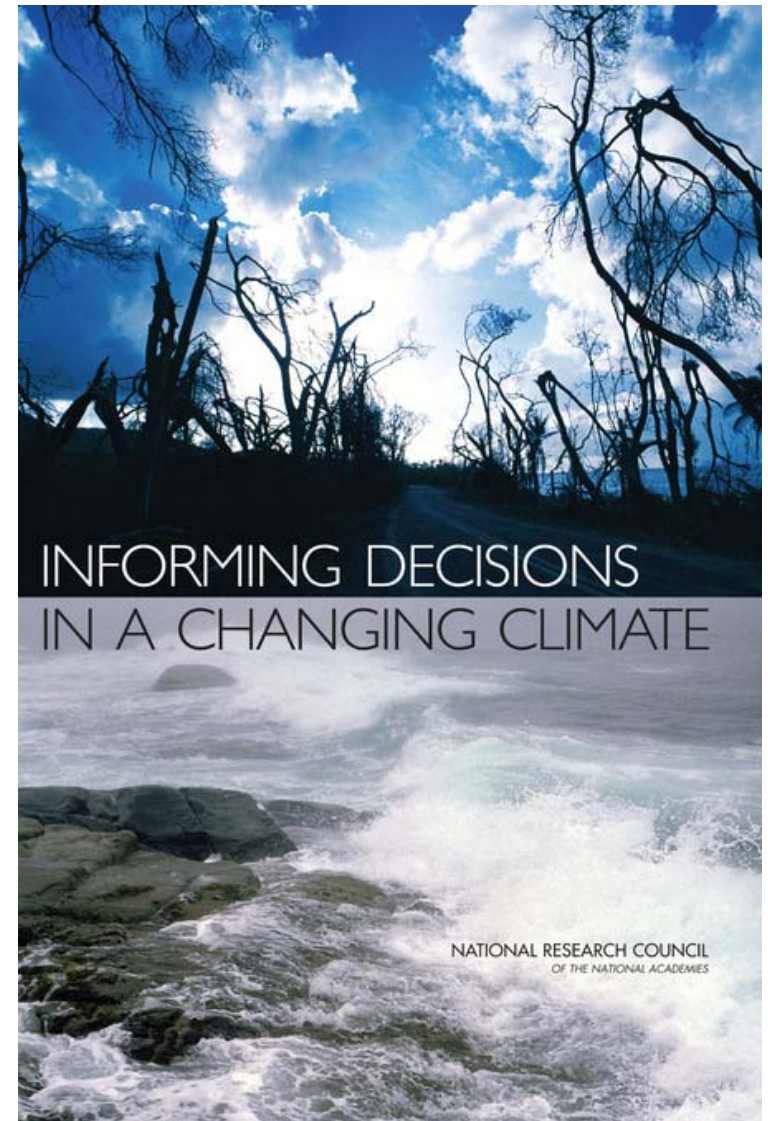


Packaging Model

Slide courtesy of Dr. Steve Jackson, SW CSC.

The National Research Council (2009) suggests that government agencies organize their climate-related decision support efforts around six principles:

1. begin with user's need in mind
2. give priority to process over products
3. link information producers and users
4. build connections across disciplines and organizations
5. seek institutional stability and
6. design process for learning



National Research Council, 2009. Informing Decisions in a Changing Climate. Panel on Strategies and Methods for Climate-Related Decision Support, Committee on the Human Dimensions of Global Change. Division of Behavioral and Social Sciences and Education. Washington, DC: the National Academies Press. 188 p.

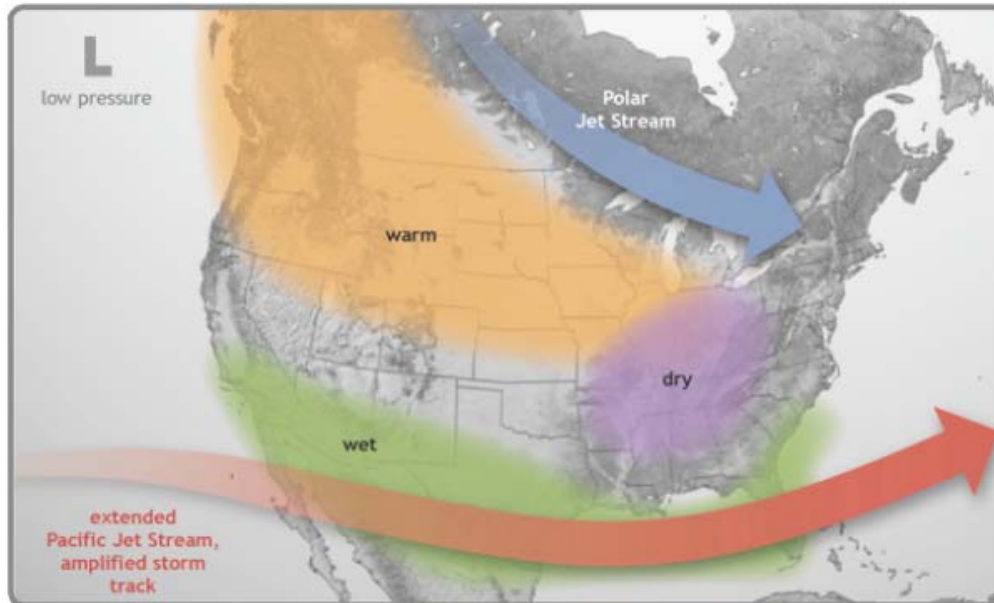
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Typical El Niño Winter Pattern



The image above shows the typical pattern in the winter during El Niño events. The polar jet stream tends to stay to the north of the Missouri Basin region, while the Pacific jet stream remains across the southern U.S. With the Missouri Basin isolated between the storm tracks, warmer and possibly drier conditions can develop during El Niño events.

Image courtesy of the National Oceanic and Atmospheric Administration.
For more information please visit: <https://www.climate.gov/news-features/department/enso-blog>

El Niño Outlook

El Niño in Winter

An El Niño develops when sea surface temperatures are warmer than average in the equatorial Pacific for an extended period of time. This is important to North America because El Niño has an impact on our weather patterns, most predominantly in the winter.

Although each El Niño is different, there are some general patterns that are predictable. For instance, the polar jet stream is typically farther north than usual, while the Pacific jet stream remains across the southern United States (see figure to left).

This pattern brings above-normal temperatures to much of the Missouri River Basin region, particularly across the northern tier of the basin. Keep in mind that this does not mean that cold weather will not happen; however, cold weather may be milder.

Snowpack can also be impacted by the El Niño winter pattern as northern Rockies and Plains heavy snow events may be reduced.



Potential Winter and Spring Impacts

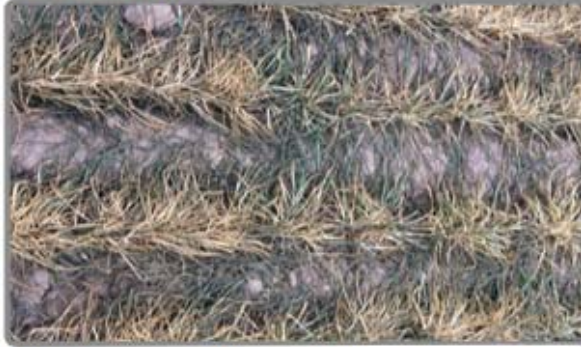
Missouri River



The Missouri River at Gavins Point, South Dakota. Image courtesy of Natalie Umphlett.

The wet spring resulted in higher than normal river levels in the lower Basin, but with weather conditions in the upper Basin switching from wet to dry to wet again, 2015 runoff above Sioux City, Iowa is expected to be near average at about 25 million acre feet. The Missouri River Mainstem Reservoir System will begin the 2016 runoff season at the base of the Annual Flood Control and Multiple Use Zone, which means that all flood control storage will be available. Some indicators suggest a tilt toward lower than normal mountain snowpack in the upper Basin during a moderate to strong El Niño. Mountain and Plains snowpack will be closely monitored.

Agriculture



Wheat damaged by cold weather in Kansas - 2014. Image courtesy of Mary Knapp.

El Niño has worldwide impacts to the agricultural sector, and in the Missouri Basin region, there could be mixed impacts. Because El Niño winters typically result in a reduced snowpack in the northern Plains, this could expose winter wheat to harsh temperatures and wind, and also lead to soil moisture concerns. In southern areas, however, good soil moisture conditions could be expected where above-normal precipitation may occur. Additionally, warmer conditions in the northern tier of the basin could be beneficial for livestock producers both in terms of greater gains due to less severe cold weather and for calving in the later winter and spring.

Ecosystems



An iconic animal of the Great Plains - the bison. Image courtesy of Natalie Umphlett.

For northern areas of the Missouri Basin region, higher temperatures combined with a lower snowpack could be a recipe for increased fire danger this winter and spring. These conditions could also result in earlier peak stream flow, reduced wetlands, and potential impacts on spring stream runoff or negative impacts on spring or springtime



HPRCC



Volume 27 Number 13 • August 1, 2015

WYOMING LIVESTOCK ROUNDUP

The Weekly News Source for Wyoming's Ranchers, Farmers and AgriBusiness Community • www.wylnr.net

El Niño impacts predicted to influence warm, dry winter in West

As farmers and ranchers are looking toward winter and the promise for moisture to alleviate drought in the coming year, meteorologists and other experts predict a strong to very strong El Niño will hold until at least spring 2016, meaning a

warm, dry winter is likely.

“El Niño-Southern Oscillation (ENSO) is a global phenomenon that happens in the tropical Pacific, but it has the potential to affect atmospheric circulation,” said Imtiaz Rangwala, researcher

with Western Water Assessment, during an update with the North Central Climate Science Center. “Really, a strong El Niño increases the potential for more enhanced extreme weather across the globe, although the impact varies from place to place.”

Inside El Niño

The ENSO phenomenon occurs when tropical Pacific waters see increasing temperatures. Connected with the atmosphere, the warming oceans weaken easterly trade winds, even to

Please see ENSO on page 6



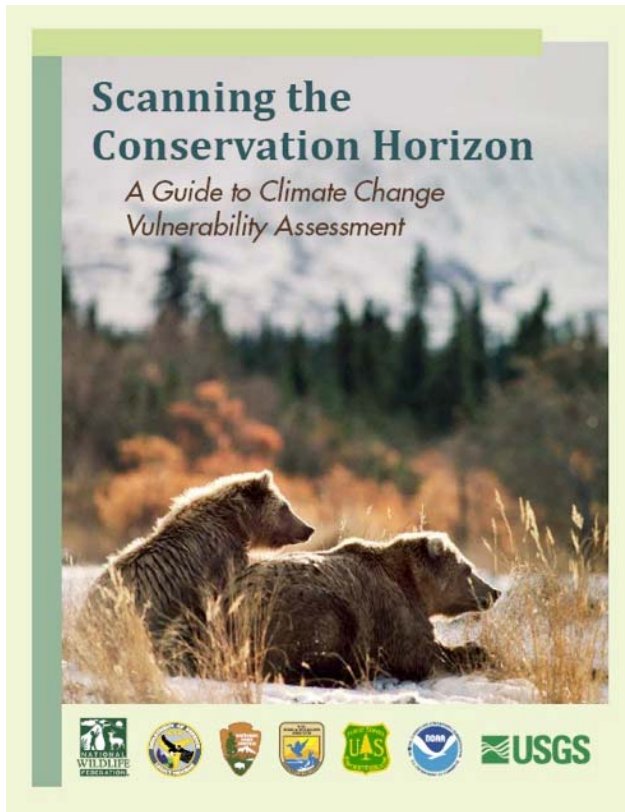
Pollinators
Producers support bee populations

Reclamation efforts

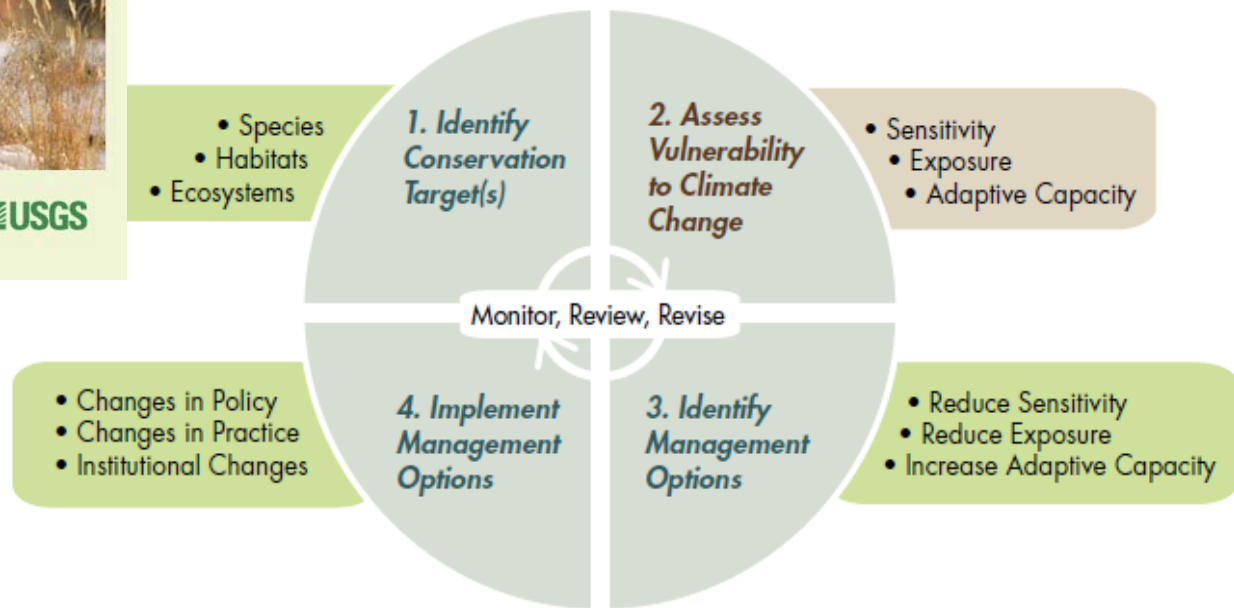
BLM strives to leave no trace after mineral extraction in Wyo

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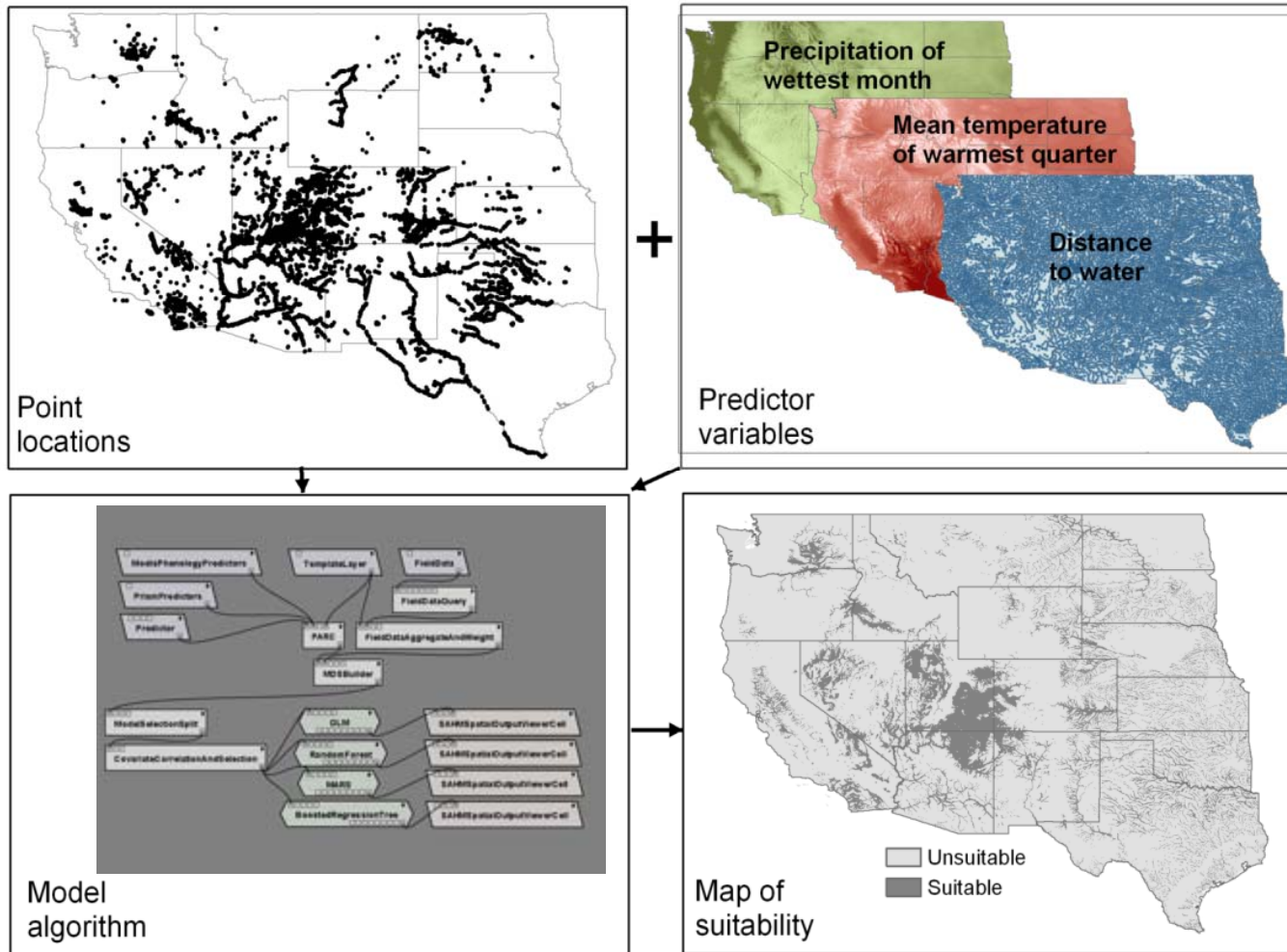


Overarching Conservation Goal(s)

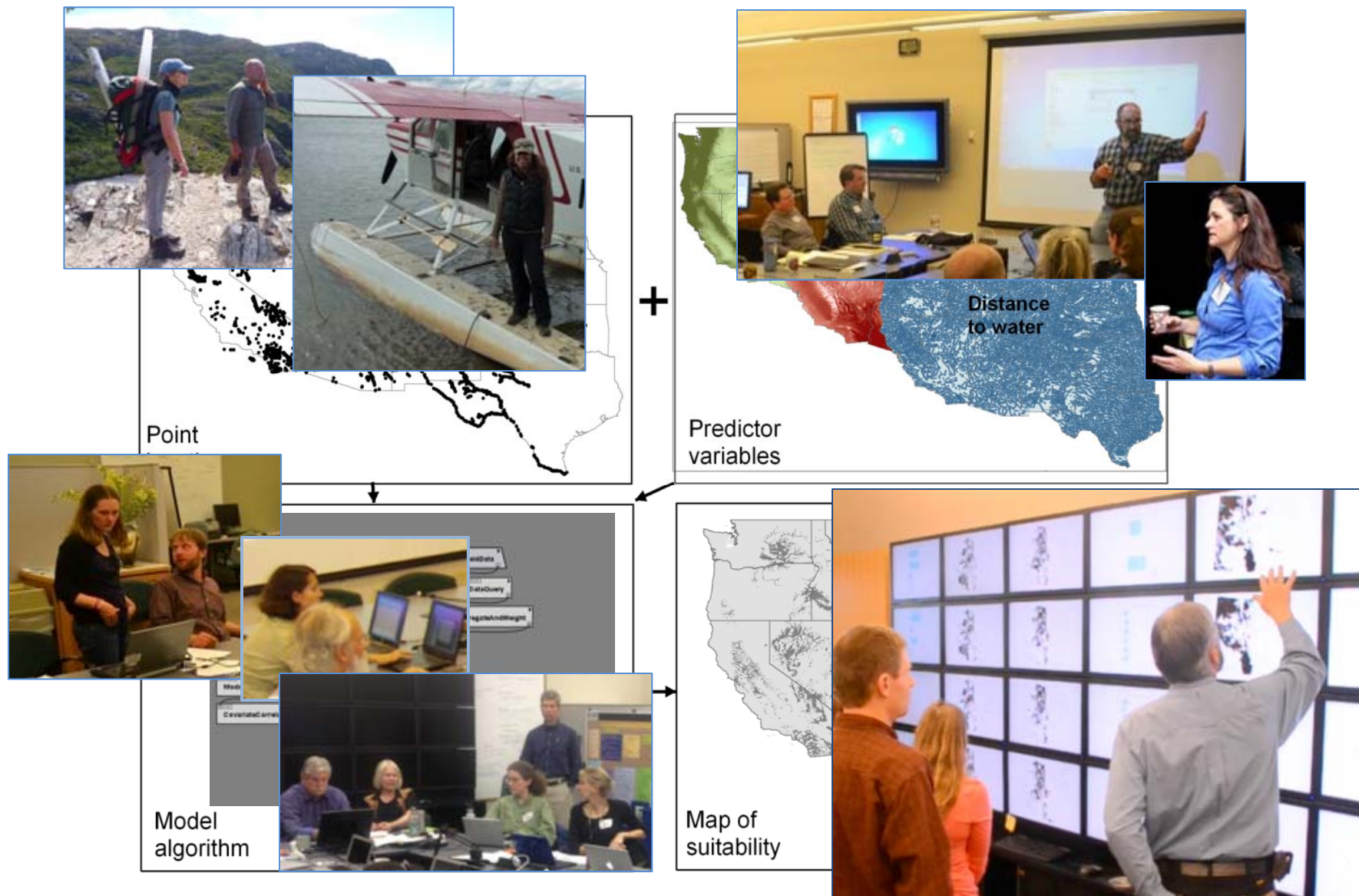


Glick, P., B.A. Stein, and N.A. Edelson, editors. 2011. Scanning the Conservation Horizon: A Guide to Climate Change Vulnerability Assessment. National Wildlife Federation, Washington, D.C.

Connecting Climate to Plants and Animals through ecological response models



Connecting Climate to Plants and Animals through Habitat Suitability Modeling



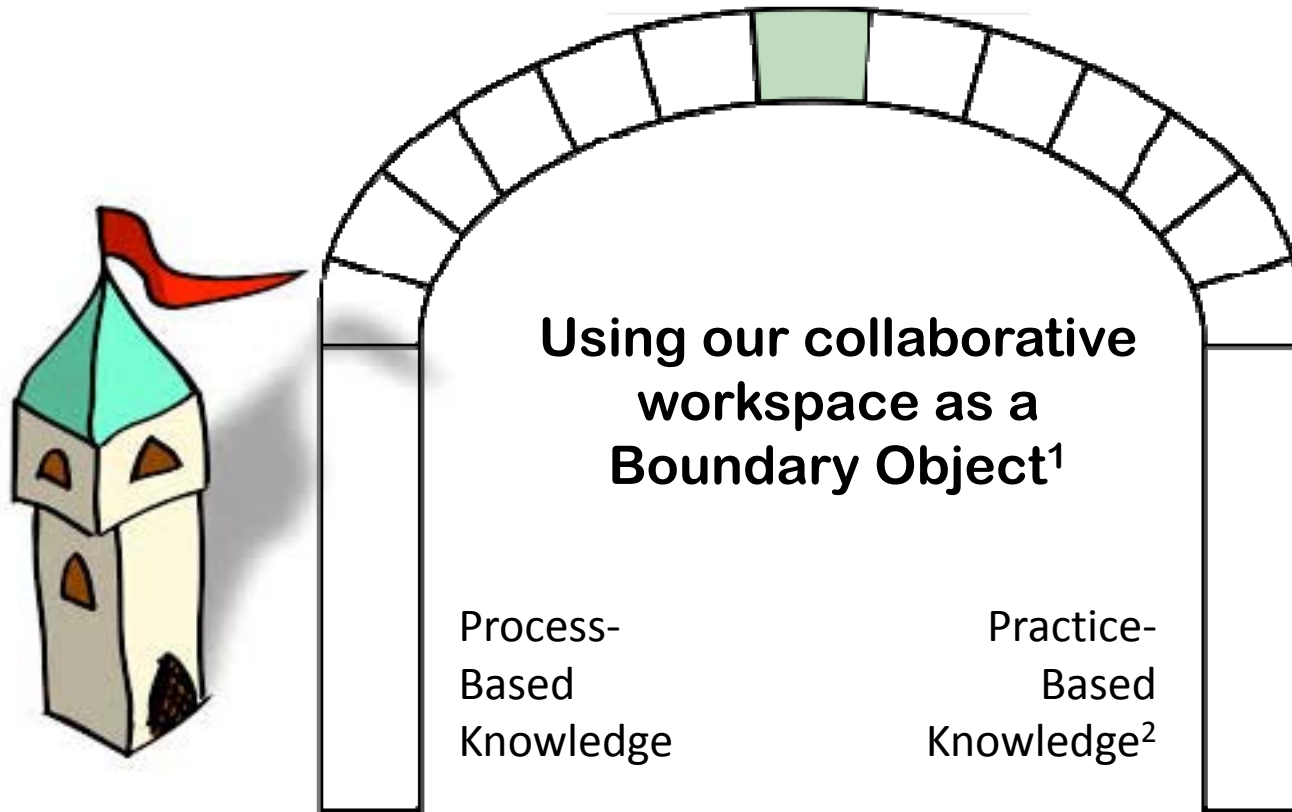


Stationarity is dead.
Milly et al. Science. 2008

BVA L
4103

Handwritten notes on the whiteboard, including the words "Stationarity" and "Science".

Boundary Organizations *Credible, Salient, and Legitimate*



¹See articles by David W. Cash et al on Boundary Organizations and boundary objects.

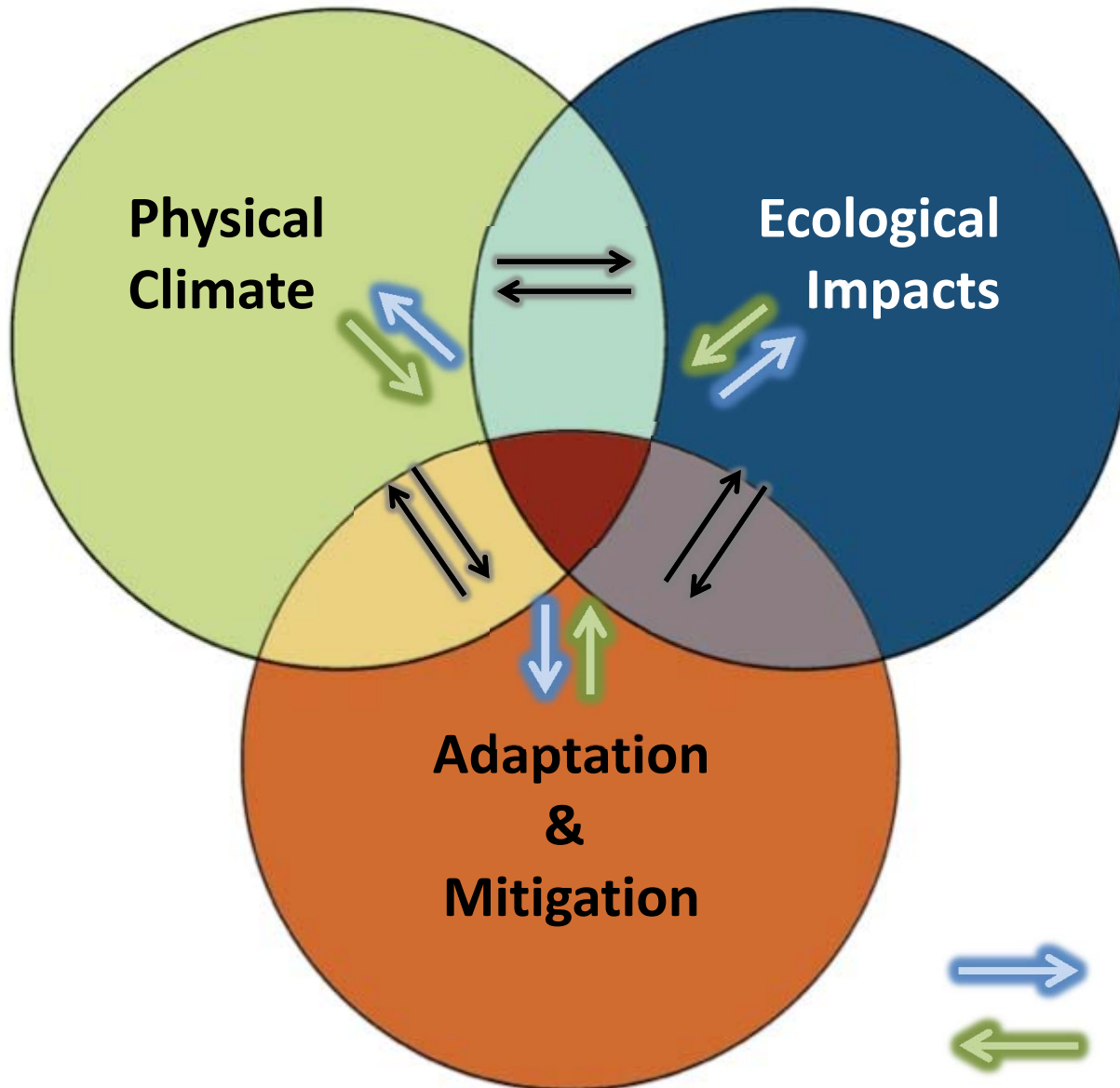
²Weber, Belsky, Lach & Cheng (2014): The Value of Practice-Based Knowledge, Society & Natural Resources: An International Journal

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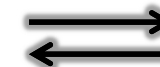
NORTH CENTRAL
**CLIMATE
SCIENCE**
CENTER



Management-driven science



Science-informed management



Synergies and leverage

Drought Risk and Adaptation in the Interior (DRAI)

- How do managers define or think about drought in the context of their landscape? (Issue Framing)
- Do managers view drought as a significant risk to their Management activities? (Risk Perceptions)
- What, if any, are some of the triggers that managers use to know if, when, and/or how drought is going to have a negative impact on their landscape? (Triggers/Indicators)
- What Management Decisions do land and resource managers have to make that are impacted by drought? (Management Decisions)
- What are the Adaptive Capacity/Barriers to respond/prepare for drought?

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- Focus that understanding on “decision space”.
- Consider both Adaptation ***and*** Mitigation.

What can be done...

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csurams.maps.arcgis.com/apps/Viewer/index.html?appid=b1f8ed733354917896911721bb1f1f2

NCCSC Region Map

Legend

FY 2013 Project Areas

- A - GYCC White Pine Bark Strategy
- B - Surrogate Species in Prairie Pothole Region
- C - Social-Ecological Resilience in Southwestern Colorado

NCCSC Region

Tribal Lands

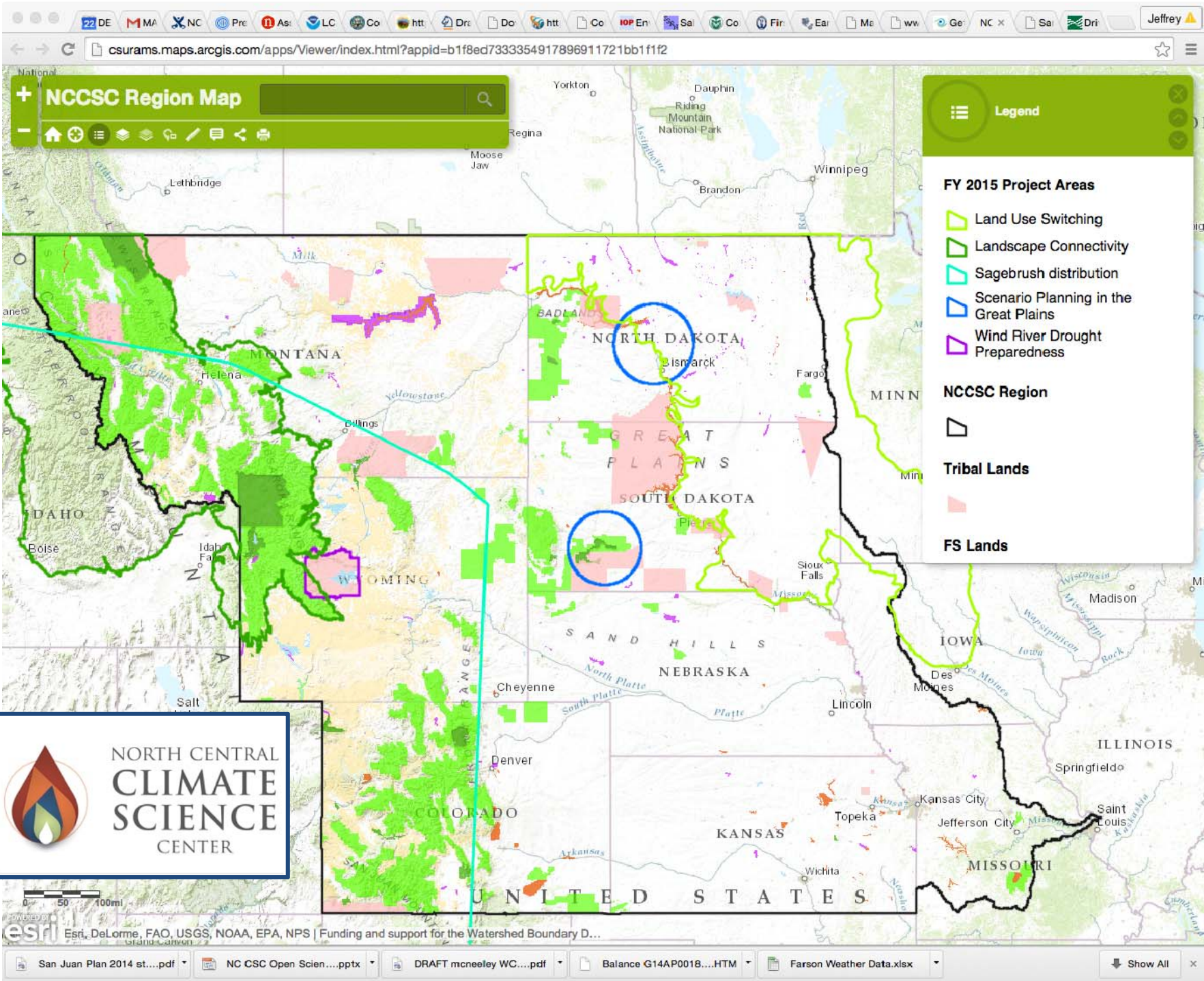
FS Lands

The map displays the NCCSC region, which includes parts of Montana, Wyoming, North Dakota, South Dakota, Nebraska, Kansas, and Missouri. The map is overlaid with various colored polygons representing project areas and land types. A legend on the right side of the map provides a key for these symbols. The legend includes: 'FY 2013 Project Areas' with three categories: 'A - GYCC White Pine Bark Strategy' (yellow), 'B - Surrogate Species in Prairie Pothole Region' (orange), and 'C - Social-Ecological Resilience in Southwestern Colorado' (red); 'NCCSC Region' (black outline); 'Tribal Lands' (pink); and 'FS Lands' (green). The map also shows state boundaries, major cities, and geographical features like the Great Plains and Sand Hills. A scale bar at the bottom left indicates 0, 50, and 100 miles. The Esri logo and a list of data providers (Esri, DeLorme, FAO, USGS, NOAA, EPA, NPS) are visible at the bottom of the map area.

NORTH CENTRAL CLIMATE SCIENCE CENTER

Esri, DeLorme, FAO, USGS, NOAA, EPA, NPS | Funding and support for the Watershed Boundary D...

San Juan Plan 2014 st....pdf | NC CSC Open Scien....pptx | DRAFT moneeley WC....pdf | Balance G14AP0018....HTM | Farson Weather Data.xlsx | Show All



NCCSC Region Map

Search bar and navigation icons (home, zoom in, zoom out, pan, etc.)

Legend

FY 2015 Project Areas

- Land Use Switching (light green outline)
- Landscape Connectivity (dark green outline)
- Sagebrush distribution (cyan outline)
- Scenario Planning in the Great Plains (blue outline)
- Wind River Drought Preparedness (purple outline)

NCCSC Region

- NCCSC Region (black outline)

Tribal Lands

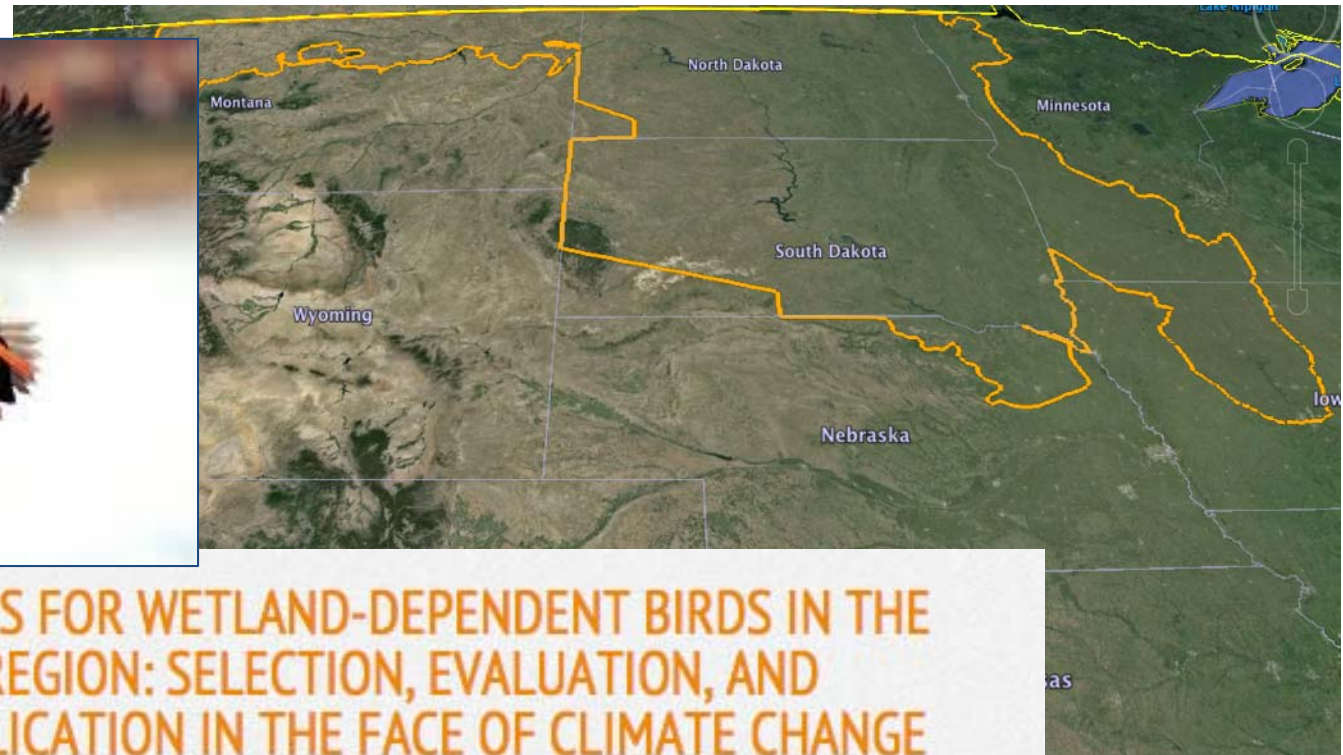
- Tribal Lands (pink fill)

FS Lands

- FS Lands (orange fill)



Esri, DeLorme, FAO, USGS, NOAA, EPA, NPS | Funding and support for the Watershed Boundary D...



SURROGATE SPECIES FOR WETLAND-DEPENDENT BIRDS IN THE PRAIRIE POT HOLE REGION: SELECTION, EVALUATION, AND MANAGEMENT APPLICATION IN THE FACE OF CLIMATE CHANGE

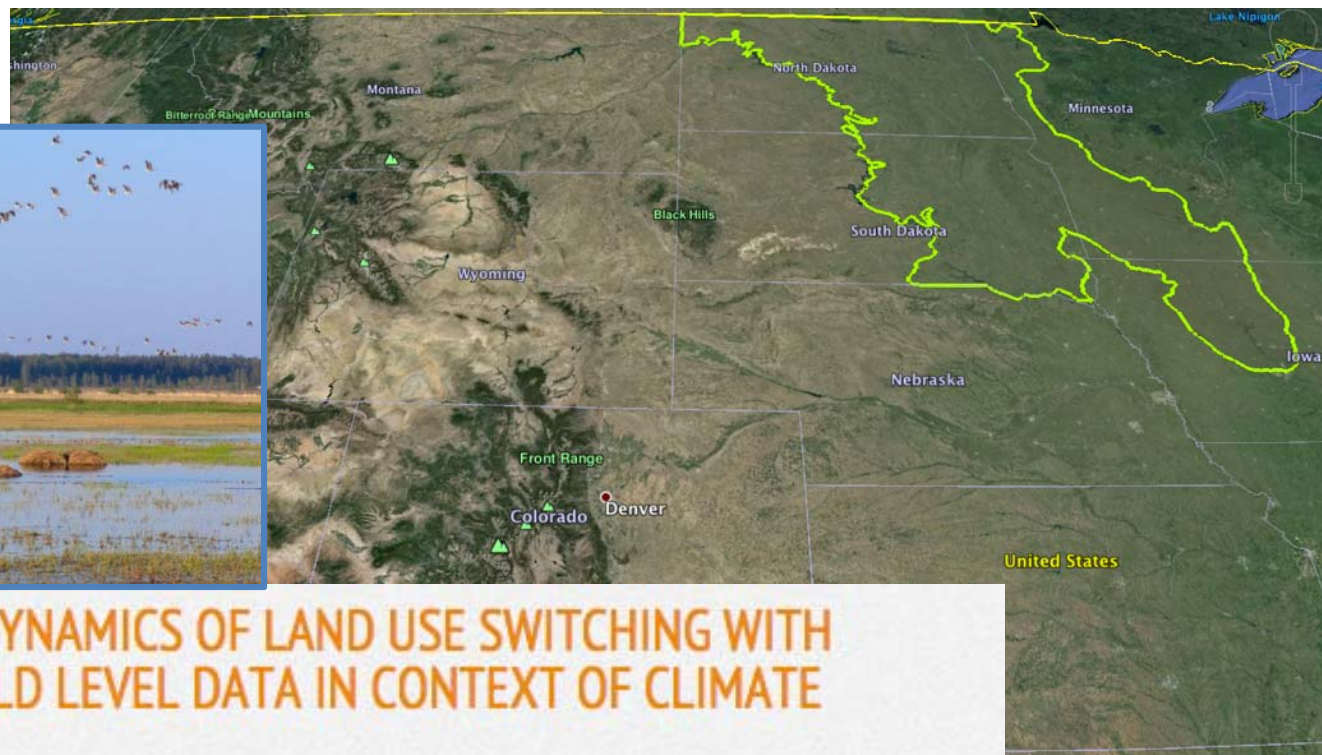
Principal Investigator(s):

Susan Skagen (U.S. Geological Survey, Fort Collins Science Center) and Barry Noon (Dept Fish, Wildlife and Conservation Biology, Colorado State University)

Co-Investigator(s):

Helen Sofaer (Colorado State University); Valerie Steen (USGS Fort Collins Science Center); Ben Rashford (University of Wyoming); John Stamm (USGS South Dakota Water Science Center); Kevin Doherty (USFWS, Prairie Pothole Joint Venture); Neil Niemuth, (USFWS, Habitat and Population Evaluation Team); Cami Dixon (Zone Biologist, USFWS Region 6, National Wildlife Refuge System); Mark Chase (Director, USFWS Natural Resource Program Center); Natalie Sexton (Chief, Human Dimensions Branch, USFWS Natural Resource Program Center); Lee O'Brien (Ecologist, USFWS National Wildlife Refuge System), Socheata Lor (USFWS, Regional Inventory and Monitoring Coordinator), Rick Nelson and Mike Olson (Plains and Prairie Pothole Landscape Conservation Cooperative (PPPLCC))

2013-2015



UNDERSTANDING DYNAMICS OF LAND USE SWITCHING WITH SATELLITE AND FIELD LEVEL DATA IN CONTEXT OF CLIMATE VARIABILITY

Principal Investigator(s):

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2015-2017



SCALING CLIMATE CHANGE ADAPTATION IN THE NORTHERN GREAT PLAINS THROUGH REGIONAL CLIMATE SUMMARIES AND LOCAL QUALITATIVE-QUANTITATIVE SCENARIO PLANNING WORKSHOPS

Principal Investigator(s):

Amy Symstad, Northern Prairie Wildlife Research Center; asymstad@usgs.gov. (Project Contact: Stephanie Manz, Administrative Officer, smanz@usgs.gov)

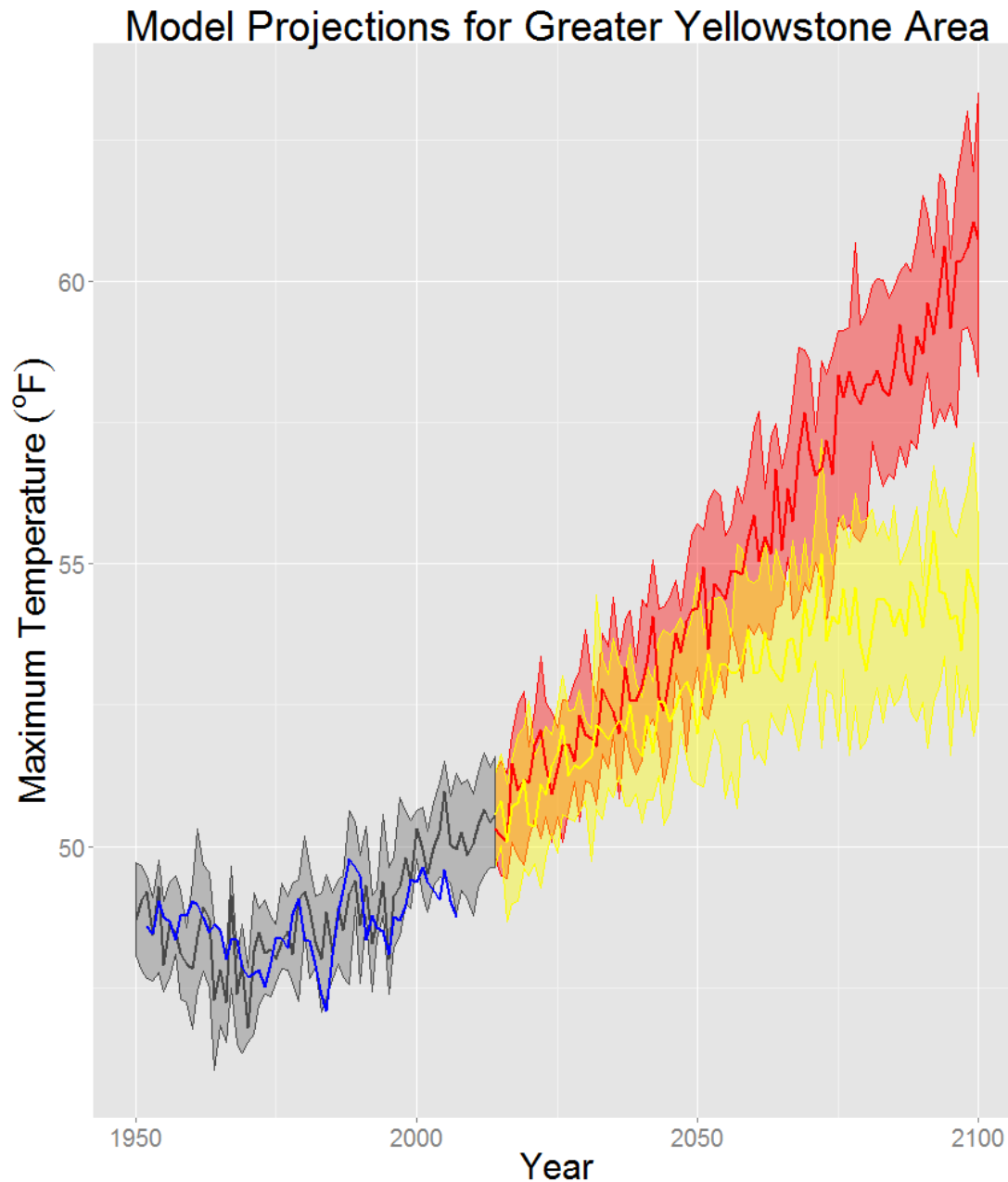
Co-Investigator(s):

Brian Miller [Colorado State University North Central Climate Science Center (NC CSC)], Nicholas Fisichelli [National Park Service (NPS)], Gregor Schuurman (NPS), Melinda Koslow (NPS), Andrea Ray [National Oceanic and Atmospheric Administration], Jonathan Friedman (USGS), Erika Rowland [Wildlife Conservation Society].
Cooperator: Marian Talbert (USGS, NC CSC), Partners: Milton Haar (NPS), Mike McNeill [U.S. Forest Service (USFS)], Wendy Ross (NPS), Cami Dixon [U.S. Fish & Wildlife Service (FWS)], Neil Shook (FWS).

2015-2017

What can be done...

- Take advantage of available resources.
- Increase our understanding and address uncertainty.
- Focus that understanding on “decision space”.
- Consider both Adaptation *and* Mitigation.



Shaded areas represent the variability in climate models.

The difference between the red and yellow projections is a function of **society's choices...**

..a function of how we choose to mitigate climate change.



National Park Service



CLIMATE *Friendly* PARKS

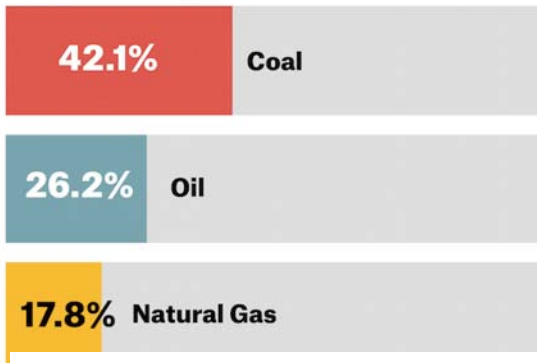
- Measure park-based greenhouse gas (GHG) emissions
- Educate staff, partners, stakeholders, and the public about climate change and demonstrate ways individuals and groups can take action to address the issue
- Assist parks in developing strategies and specific actions to address sustainability challenges, reduce GHG emissions, and anticipate the impacts of climate change on park resources

BLM Renewable Energy Program



Fossil Fuel Production on Federal Land

Percent of U.S energy production on federal land



23% of U.S. greenhouse gas emissions are attributable to fuel produced on federal land.

Source: U.S. Energy Information Administration as presented at <http://www.newrepublic.com/>





