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(Summer Conference, June 11-13)

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SLIDES: Is There a Dust Bowl in Our Future?: Projections for the Eastern Rockies and Central Great Plains

Dennis Ojima

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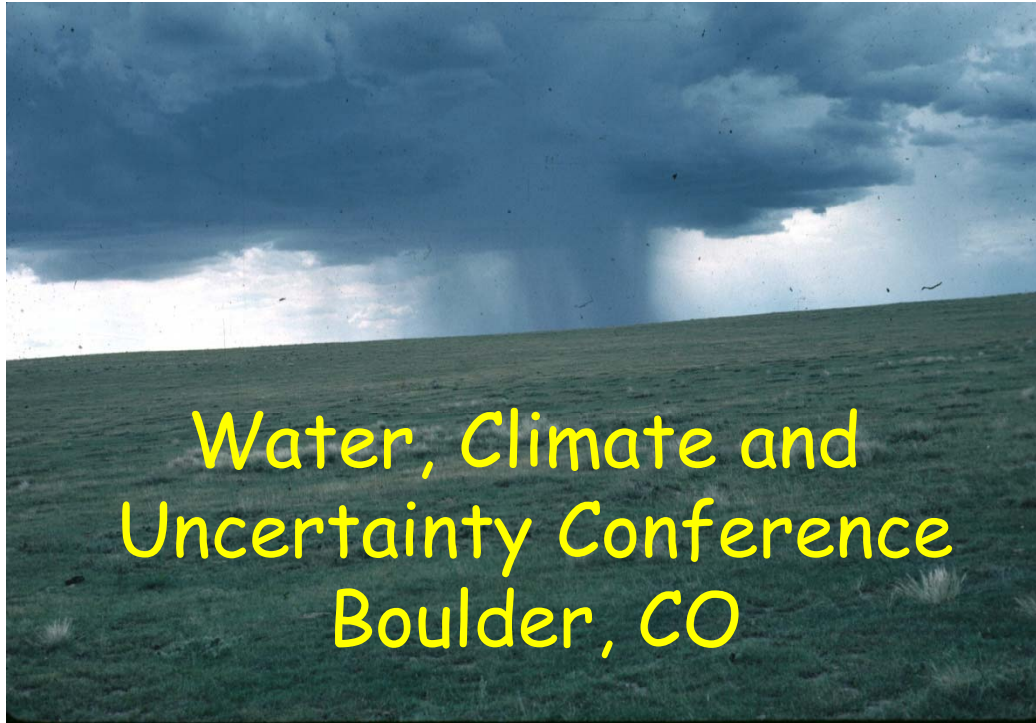
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Water, Climate and
Uncertainty Conference
Boulder, CO

*Is There a Dust Bowl
in Our Future?
Projections for the
Eastern Rockies and
Central Great Plains."*

11 June 2003

Dennis Ojima



SHORT ANSWER:

YES

LONG ANSWER:

WHEN?

HOW BIG?

OVER WHAT REGION?

GIVEN HUGE
UNCERTAINTIES

WHAT SHOULD
WE DO?

COPING STRATEGIES

- USE AVAILABLE SCIENCE INFORMATION
 - Theory
 - Techniques
 - Facts
- UNDERSTAND VULNERABILITIES
 - Inter-relationships
 - Current Constraints
 - Current Strategies
- MULTI-SECTORAL PERSPECTIVE

CASE IN POINT

CENTRAL GREAT PLAINS
CLIMATE CHANGE IMPACT
ASSESSMENT

Key Questions

- Do people worry about climate change?
- What are the current concerns about climate variability and change?
- What do people need to know that isn't already known about climate change (future research)?

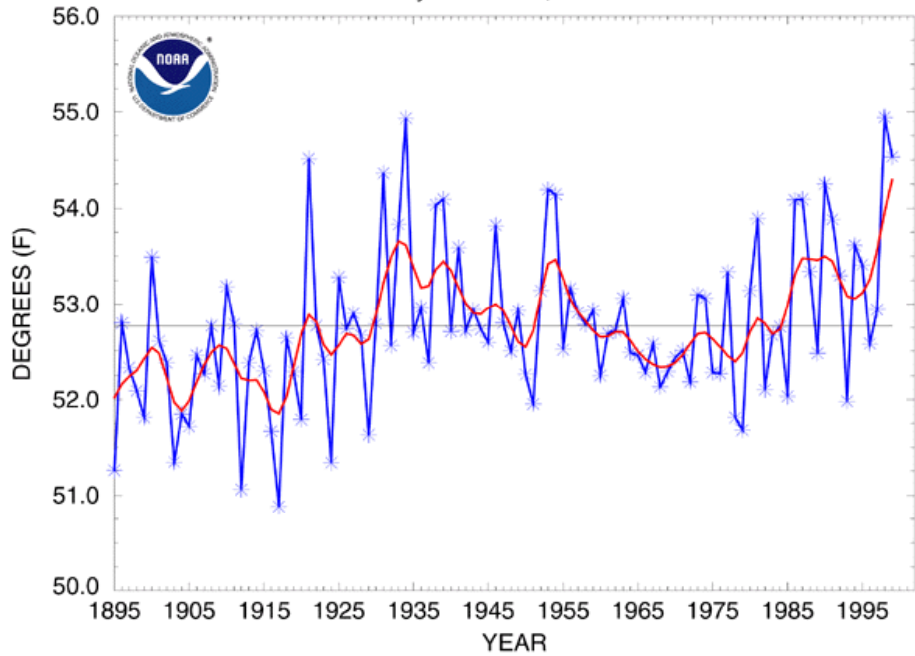


OUR APPROACH

- What We Know
- Concerns
- Develop Scenarios
- Evaluate Suite of Responses
- Coping Strategies

U.S. National Temperature

January-December, 1895 - 1999



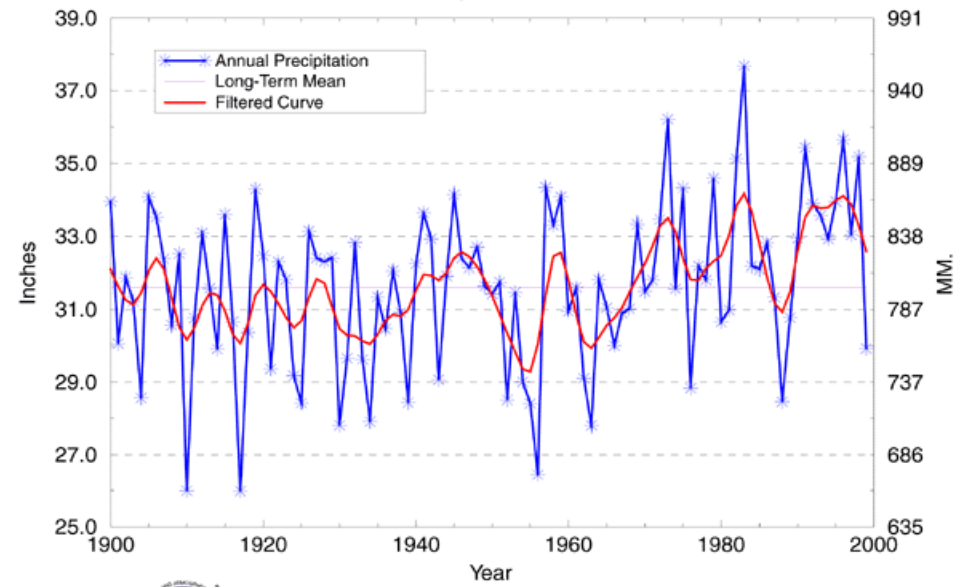
STRAIGHT HORIZONTAL LINE
IS LONG TERM AVERAGE

THICK SMOOTH CURVE IS
9 POINT BINOMIAL FILTER

National Climatic Data Center

U.S. National Precipitation

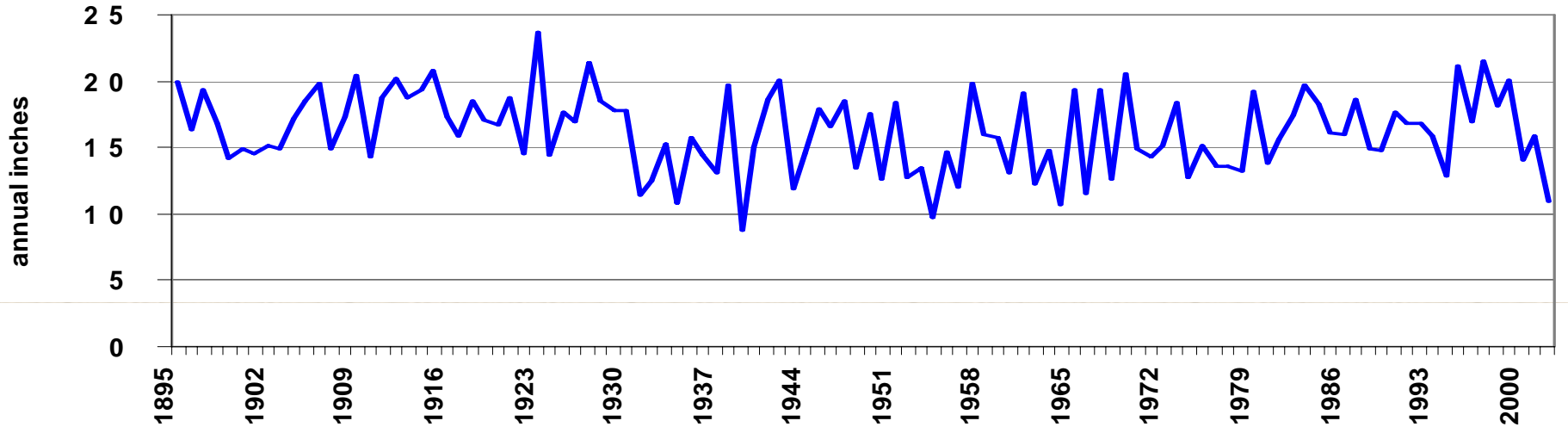
Annual, 1900-1999



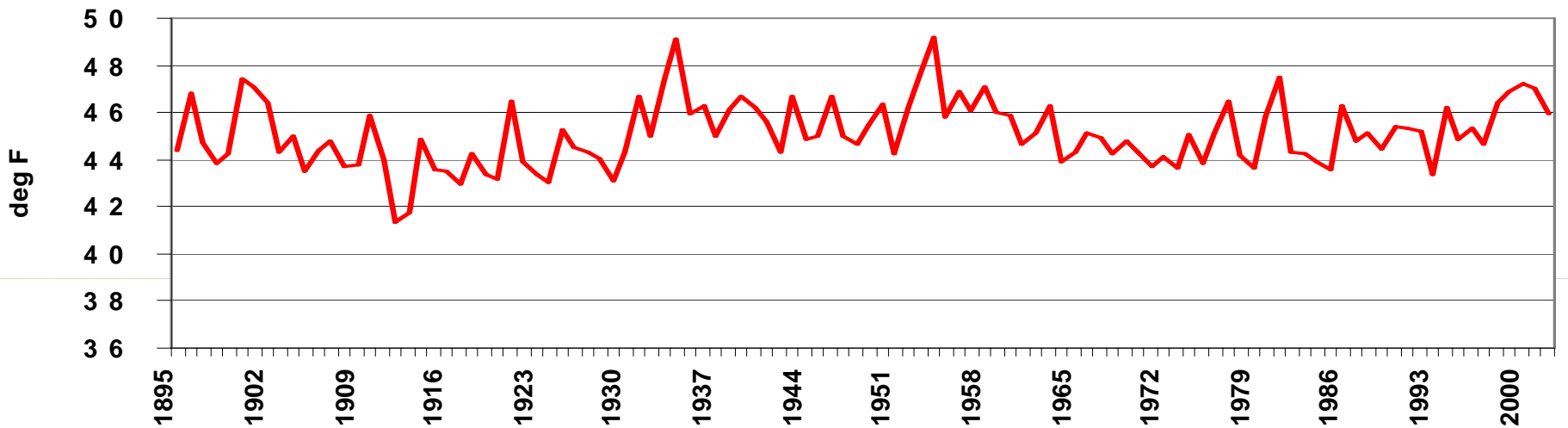
National Climatic Data Center / NESDIS / NOAA

Platte River Basin, Colorado

P r e c i p i t a t i o n



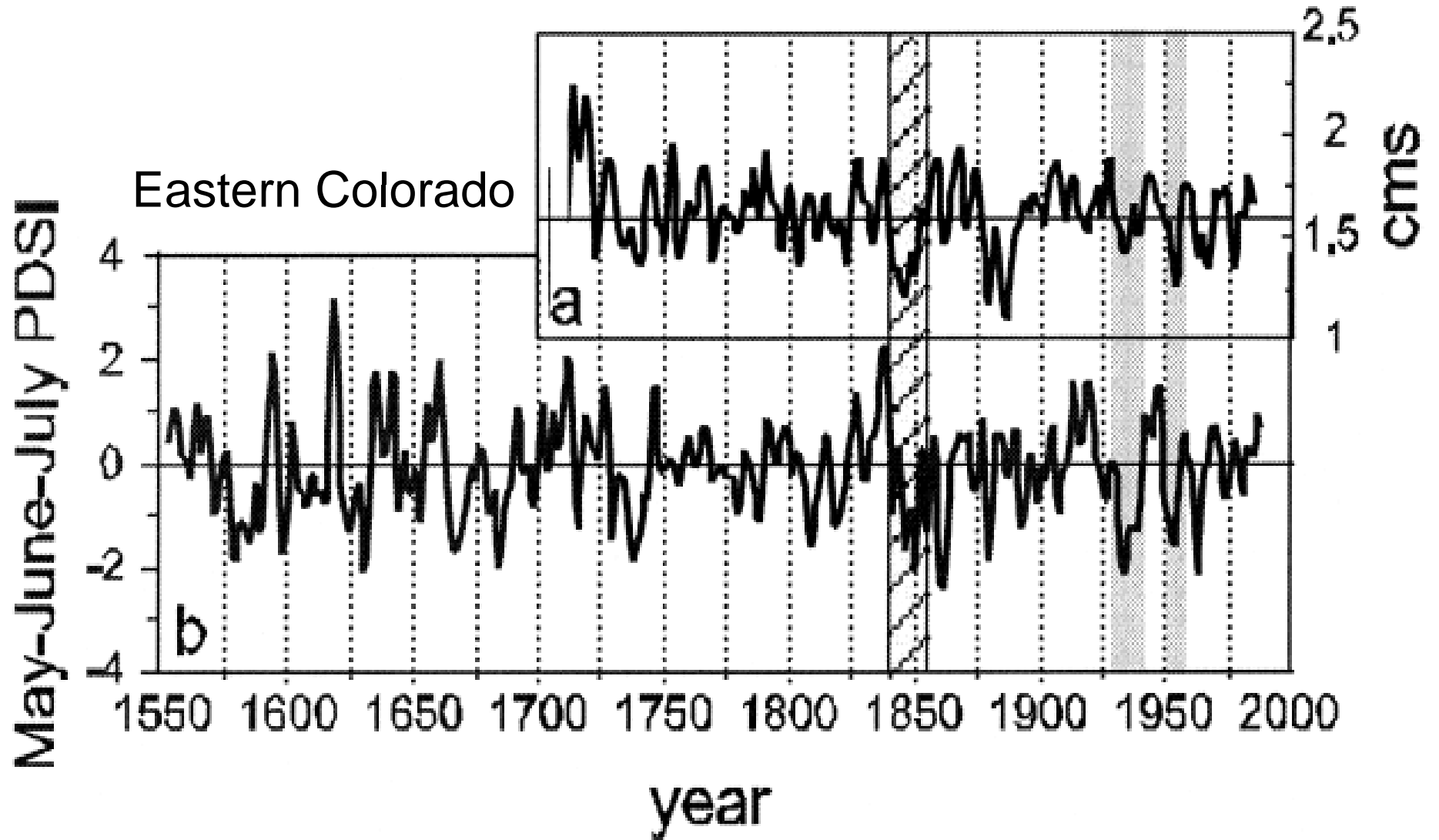
A v e r a g e T e m p e r a t u r e



CREATING SCENARIOS

- LOOK TO THE PAST
- CRITICAL CHARACTERISTICS OF INTEREST
- APPLY "WHAT IF"
- USE HYPOTHESIZED TRAJECTORIES

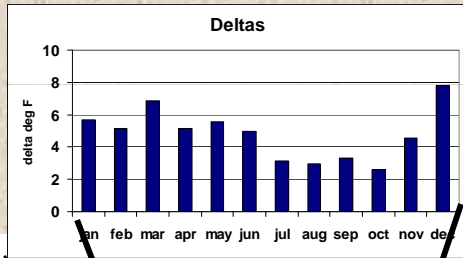
Middle Boulder Creek



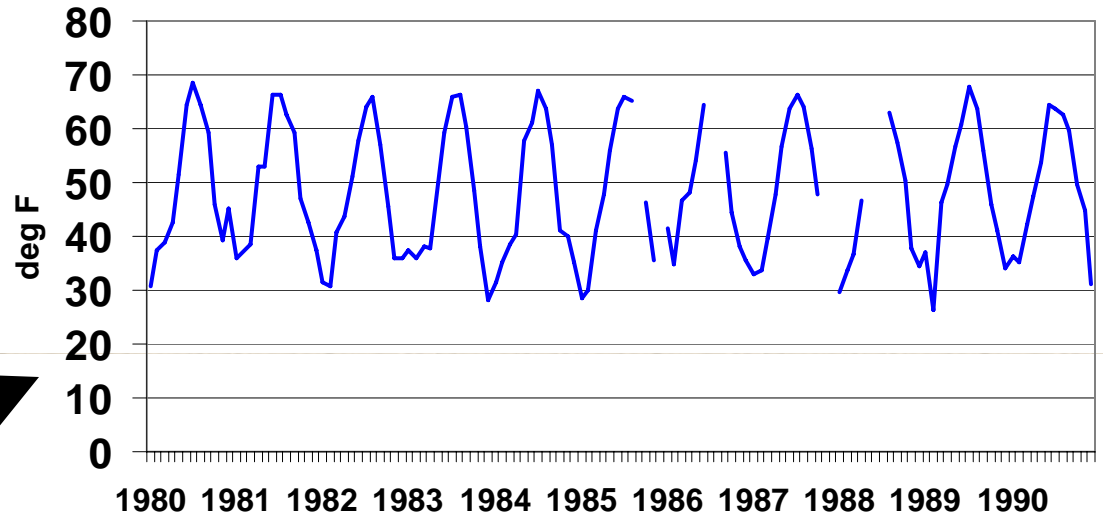
(Source: Woodhouse et al., 2002)

ESTES PARK AVERAGE TEMPERATURE

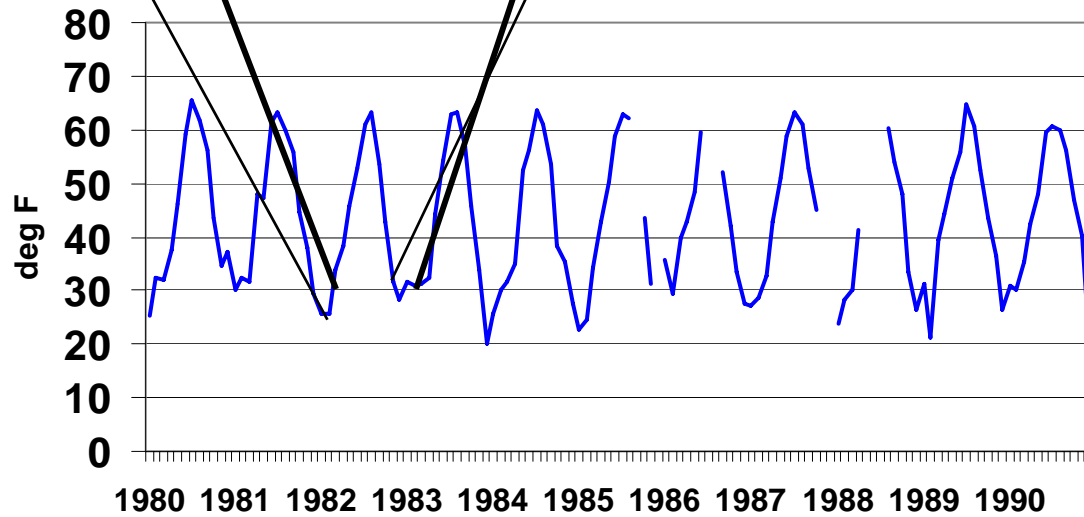
Climate changes



Scenario Data

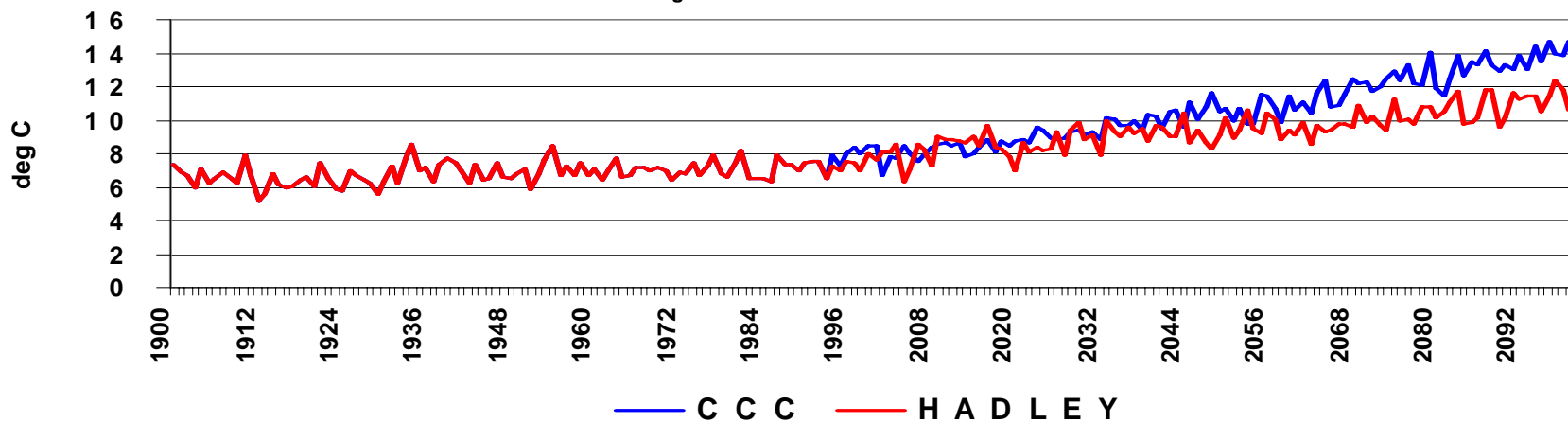


Observed Data



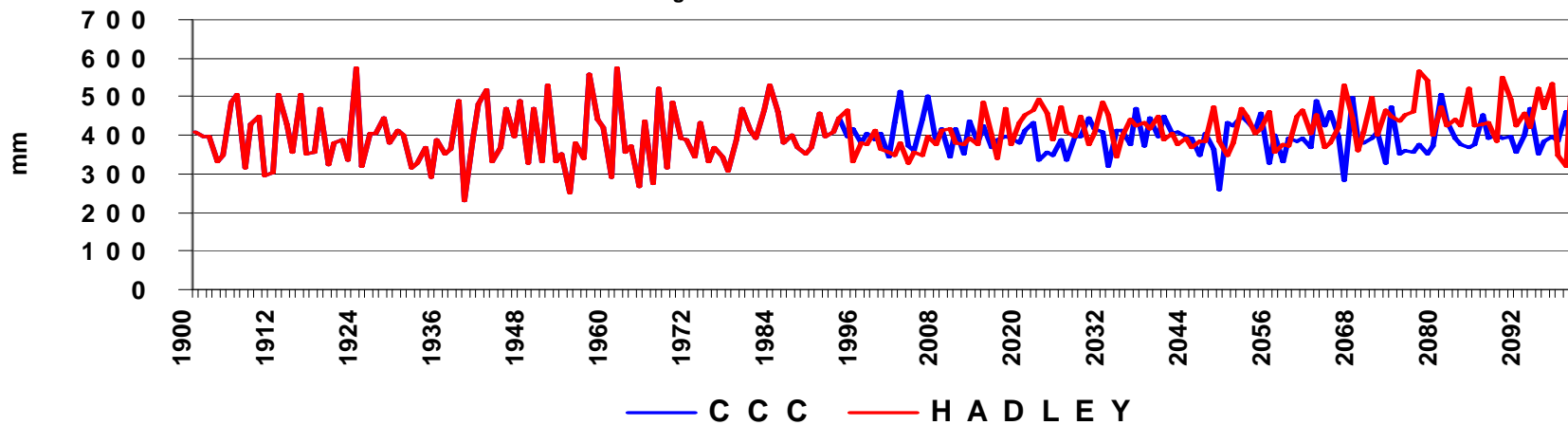
Larimer County - Temp Avg

grid cell #1878



Larimer County - Precipitation

grid cell #1878



Assessment Process

- Identify vulnerabilities and opportunities related to climate change
- Gather information from and provide information to stakeholders
- Run stakeholder-defined analyses
- Assess future coping strategies



Land Use

- Agriculture and livestock major land uses



- Major human transformation of land



- Fewer, larger operations - increase in high-tech operations

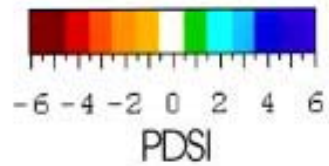
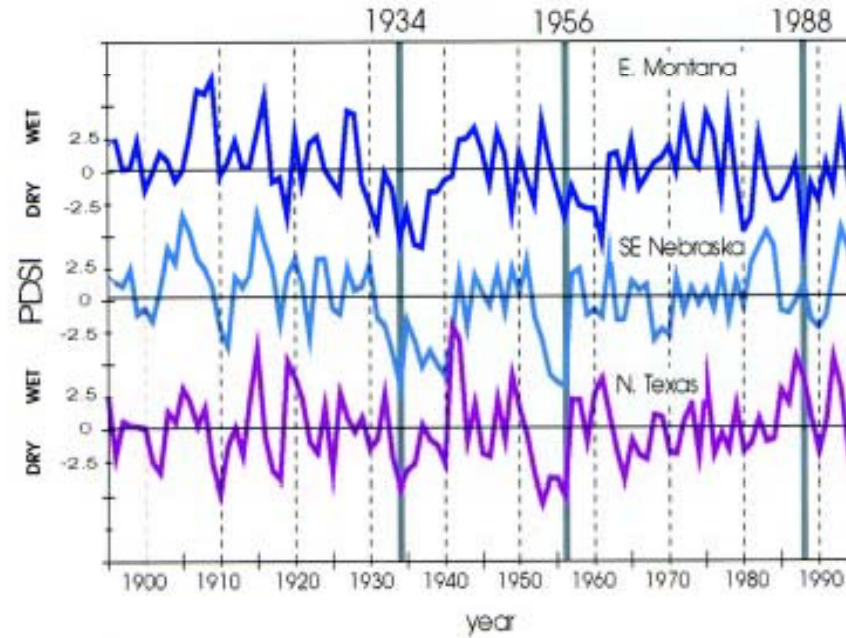
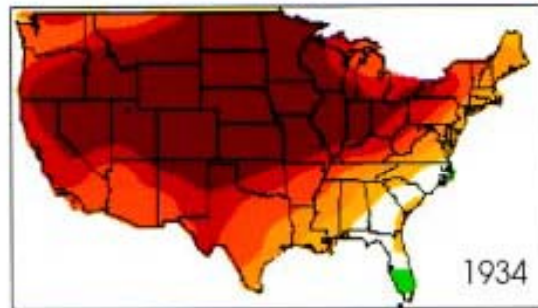
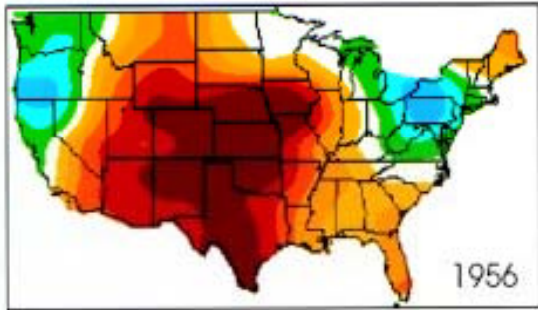
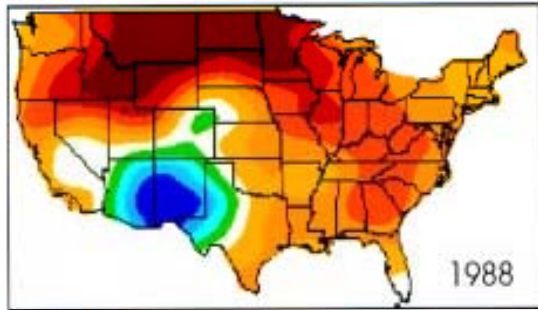
CURRENT STRESSES

- **Climate Variability**
- **Global Market Changes**
- **Decline In Rural Infrastructure**
- **Loss Of Biodiversity/Invasive**
- **Urban And Exurban Expansion**
- **Air And Water Pollution**
- **Water Competition**
- **N Deposition**

Species

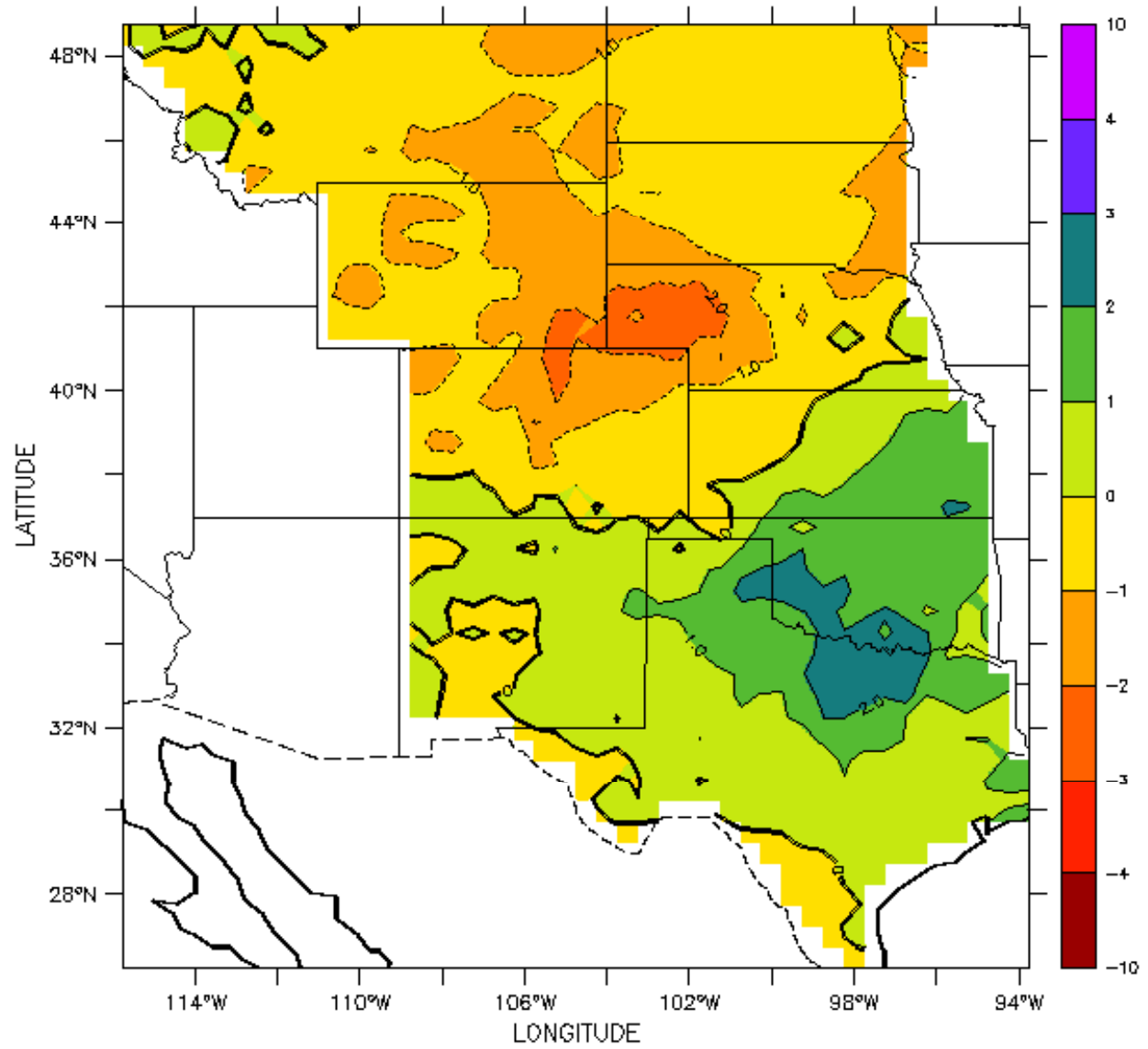
Factors in Land Use Decision Making

- **Land** - Soil, moisture, and knowledge of the land
- **Family** - Family priorities
- **Economy** - Input costs, commodity prices, and credit
- **Environment** - Personal environmental concerns and conservation/rotation practices
- **Risk** - Reducing risk
- **Operation** - Equipment and labor availability
- **Policies** - Government support policies
- **Community** - Community pressures



. Source: Woodhouse and Overpeck, 1998

DATA SET: clim104233C1xx_pdsi.asc

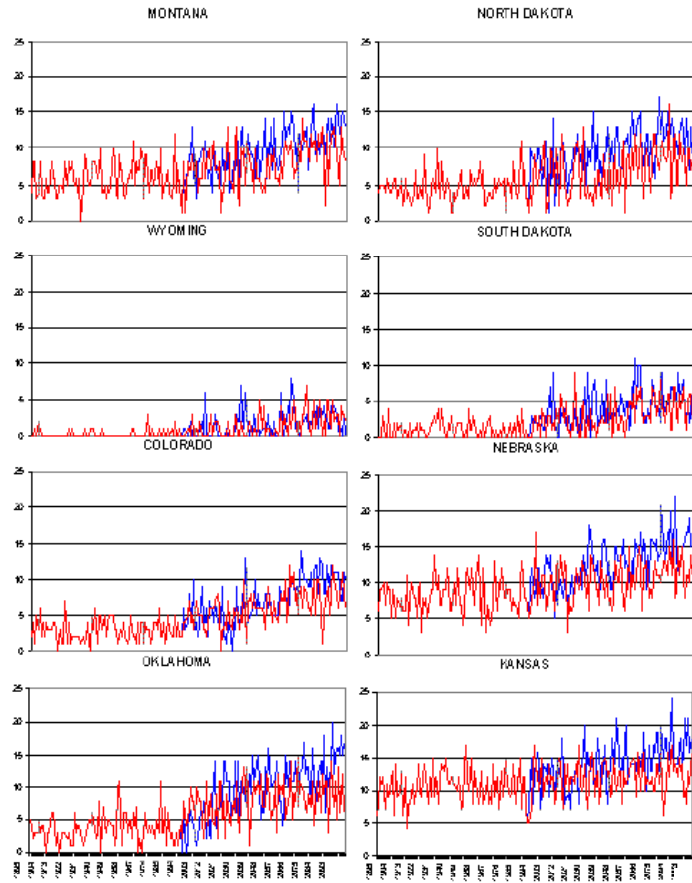


clim CCC pdsi GP (relative) 1994

GCM SCENARIO FOR THE GREAT PLAINS

	2030	2090	2030	2090	2030	2090
GCM	T °C	T °C	T °C	T °C	ppt	ppt
	(max)	(max)	(min)	(min)	(ratio)	(ratio)
CCC	2.6	6.1	2.5	6.5	1.0	1.2
HAD	1.4	3.1	1.8	4.2	1.1	1.2

3+ Consecutive Days exceeding 32°C

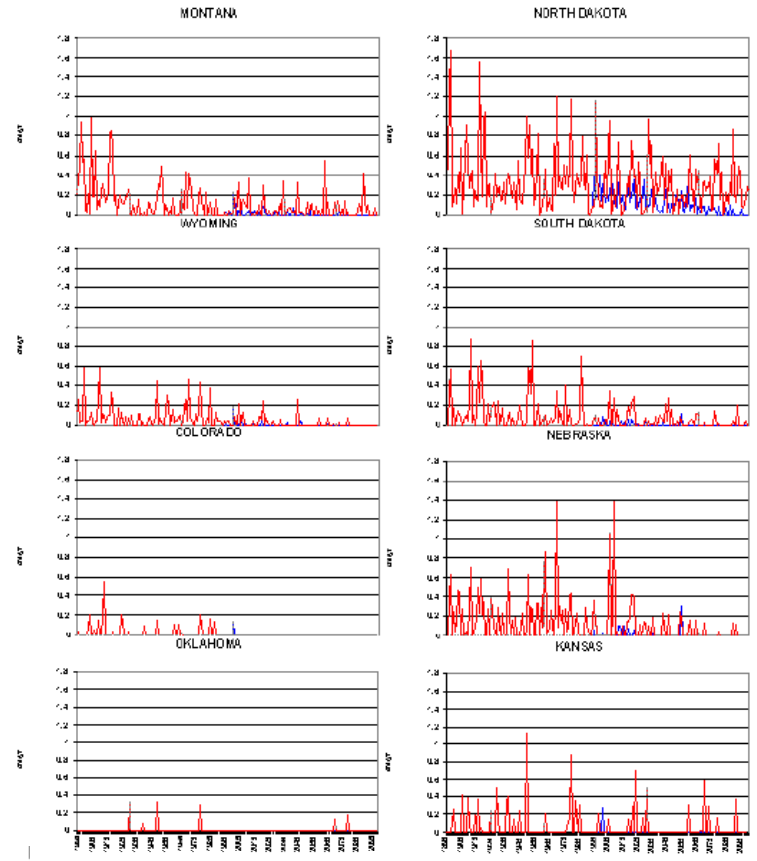


— Transient/CCC — Transient/Hadley

Bioclimatic Regions

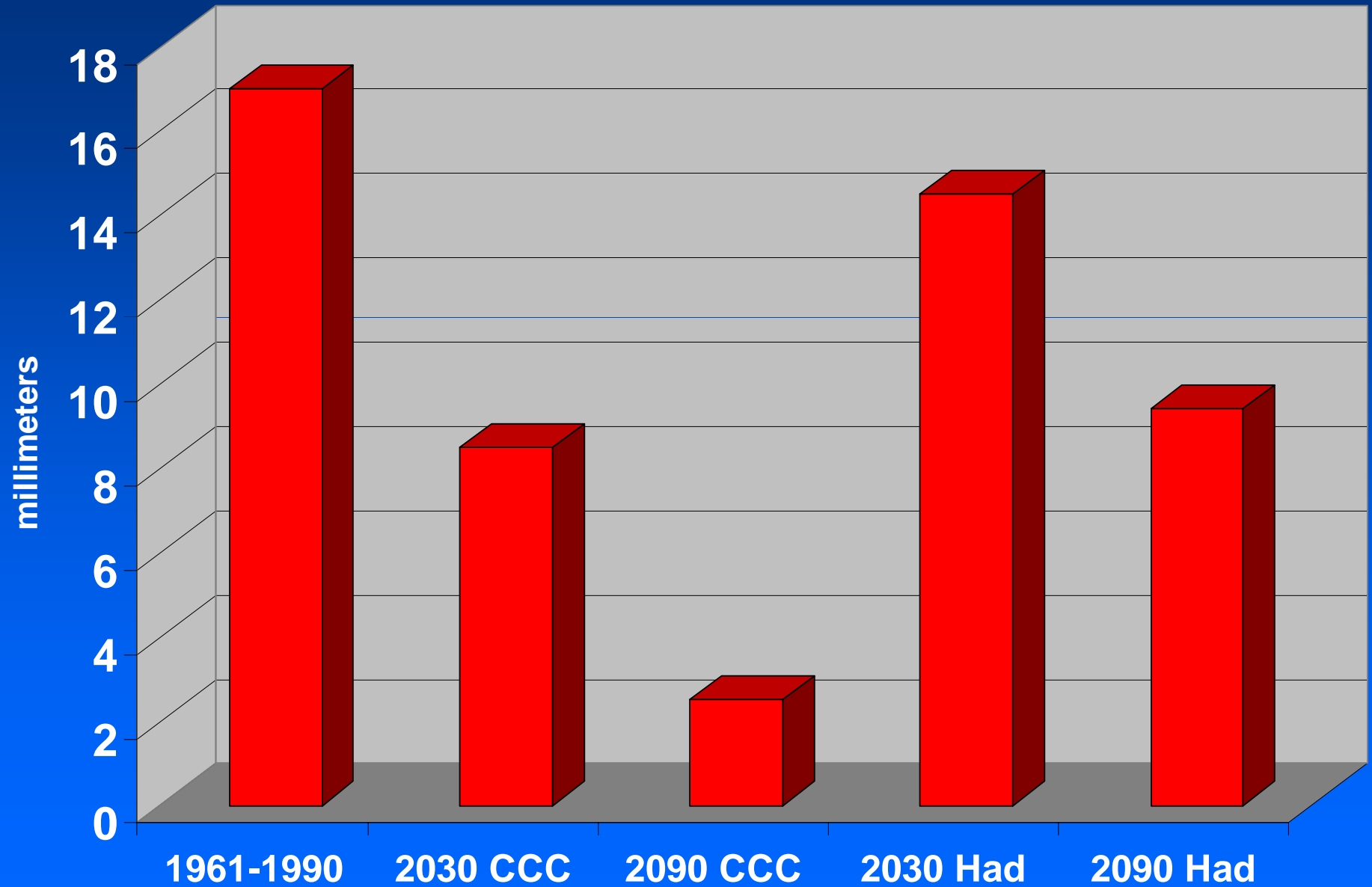


Annual Accumulation of Snow (water equivalent cm/yr)

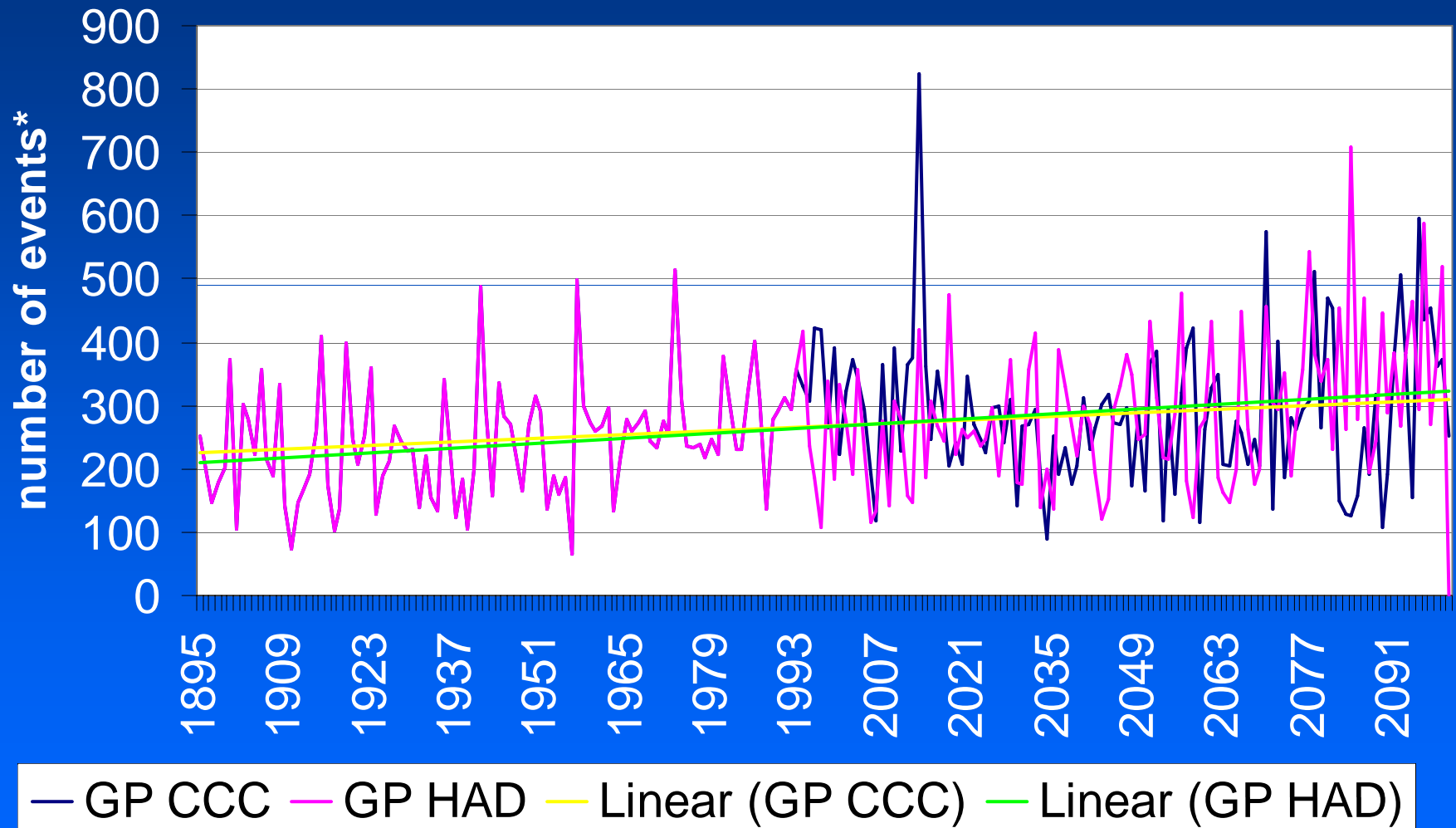


— Transient/CCC — Transient/Hadley

Winter Snowpack (Northern Great Plains)

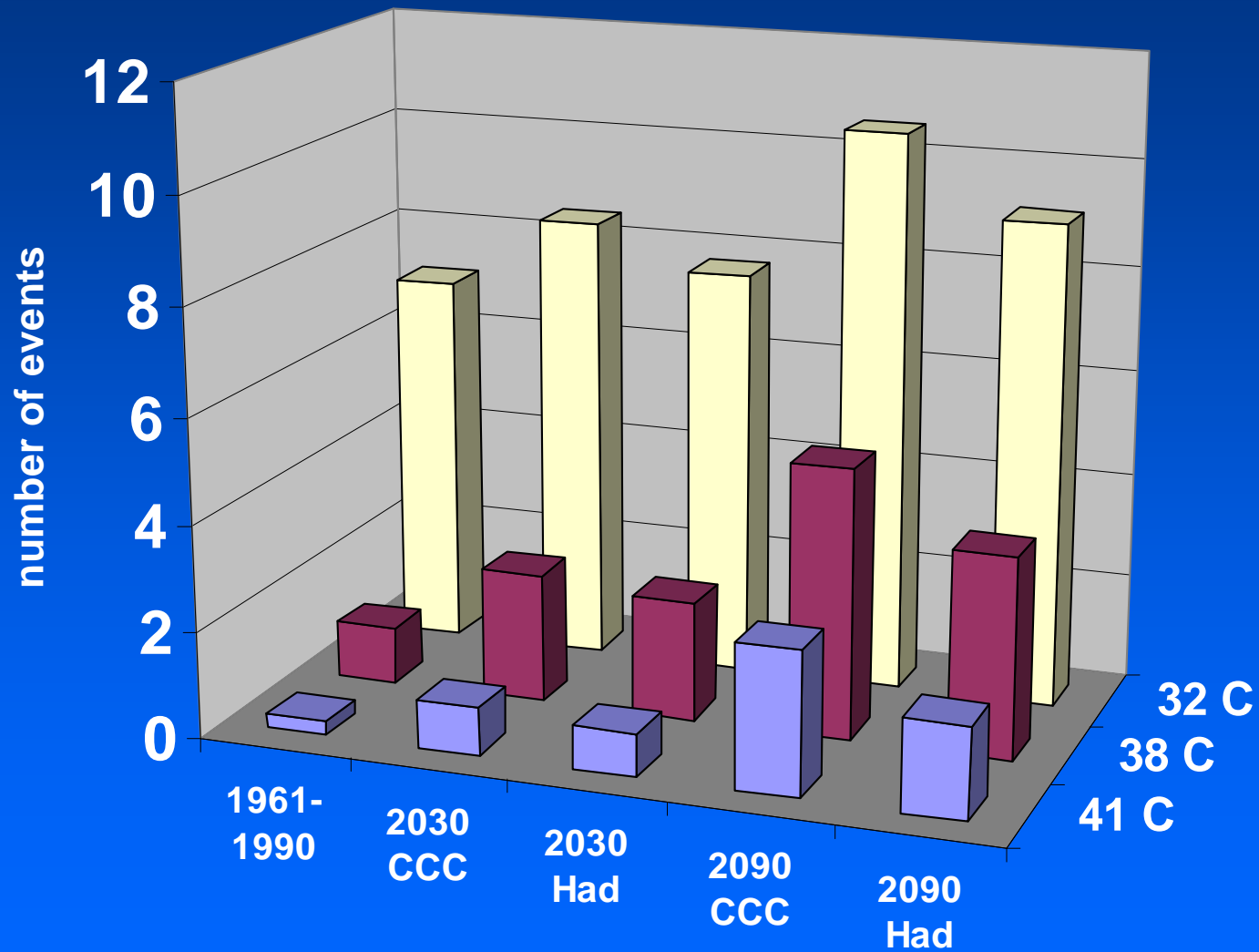


Extreme Rainfall (>50mm) in 24 hrs.



* sum of grid cells over each year where an extreme rainfall event occurs

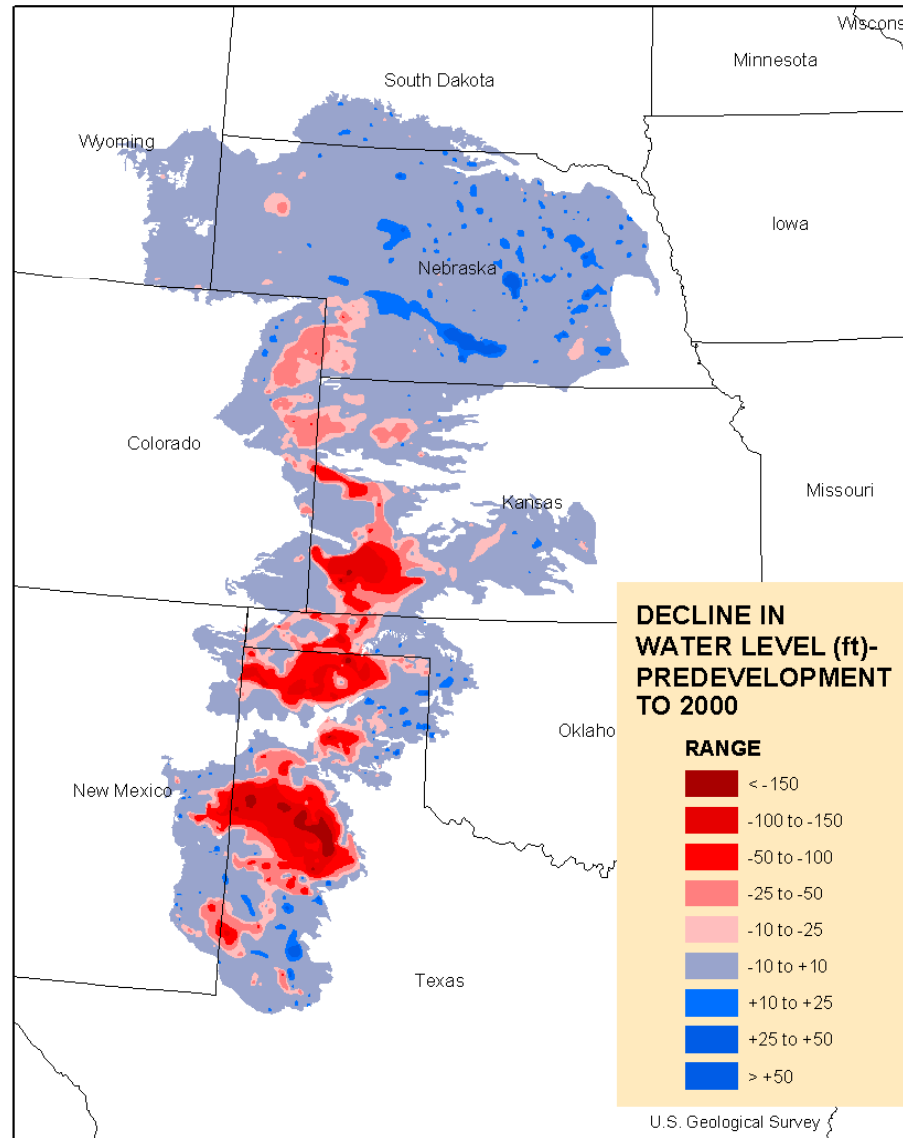
Number of Hot Day Events (Great Plains)



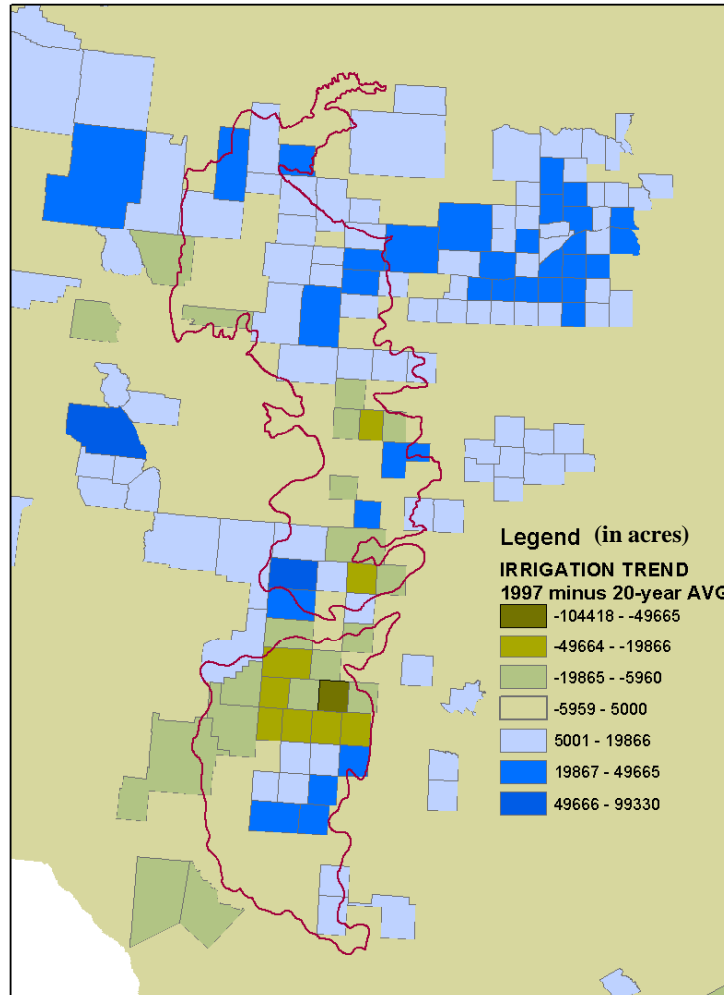
Potential Impacts

- Modified vulnerability of farm/ranch families to climate and market stresses
- Crop and livestock production modified
- Water use competition impacted
- Water quality changed
- Expansion of weeds, pests, and diseases
- Change plant-animal communities
- Fire and storm patterns altered

High Plains (Ogallala) Aquifer Decline



Drummond
USGS



1997 Irrigation
vs. Historical
Average
(1974-97)

Coping Strategies

- Better preparation for extreme events
- Flexible Management Strategies
- Diversification of practices to take advantage of opportunities/reduce vulnerabilities
- Increased Efficiency of Water Storage Areas
- Increasing soil organic matter to increase water holding capacity
- Participation in policy discussions
- Develop better communication at all levels

What Have We Learned

- *Seasonal changes* to snowmelt will impact water storage and delivery systems
- *Soil carbon management* is critical to coping with climate change - seen as "win-win" situation
- *Technological and information transfers* do not always reach the stakeholders

Conclusions

- impacts on natural systems cannot be looked at without also looking at impacts on social systems
- “WIN-WIN” solutions are feasible
- vulnerability of currently stressed sectors in the great plains will be exacerbated
- change in extreme events and variability in climate will affect livelihood more than monotonic change in climate
- extra-regional forces exacerbate vulnerability to climate change