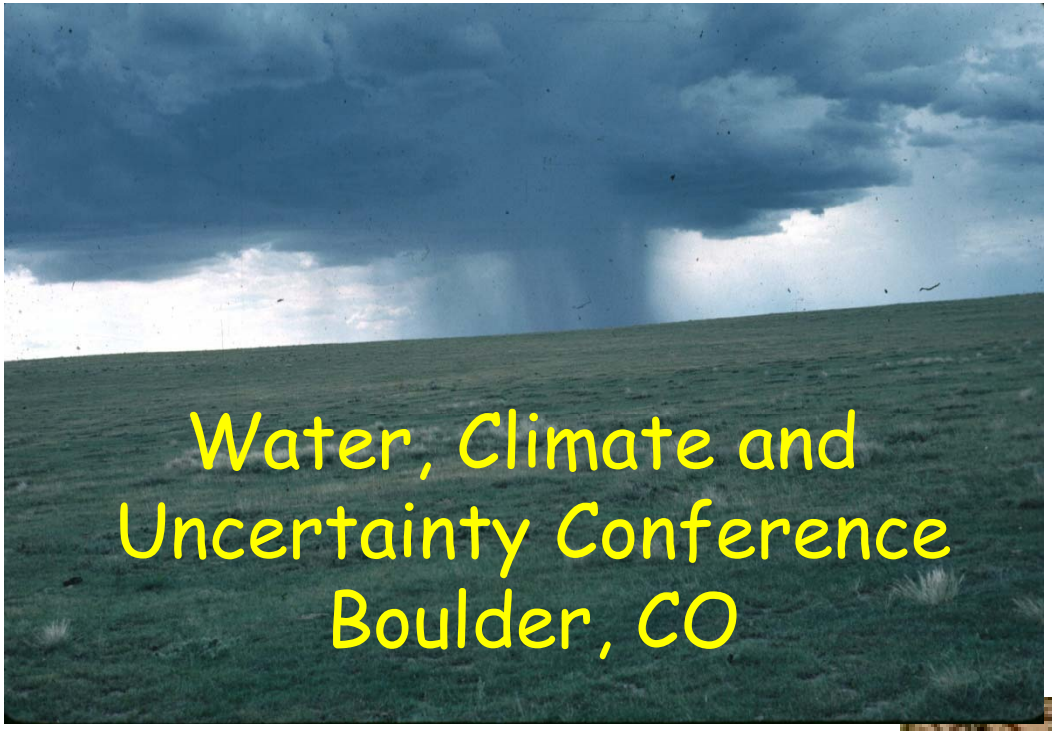
6-11-2013

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

Dennis Ojima



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

11 June 2003

Dennis Ojima

Colorado State University
Knowledge to Go Places

Natural Resource Ecology Laboratory

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

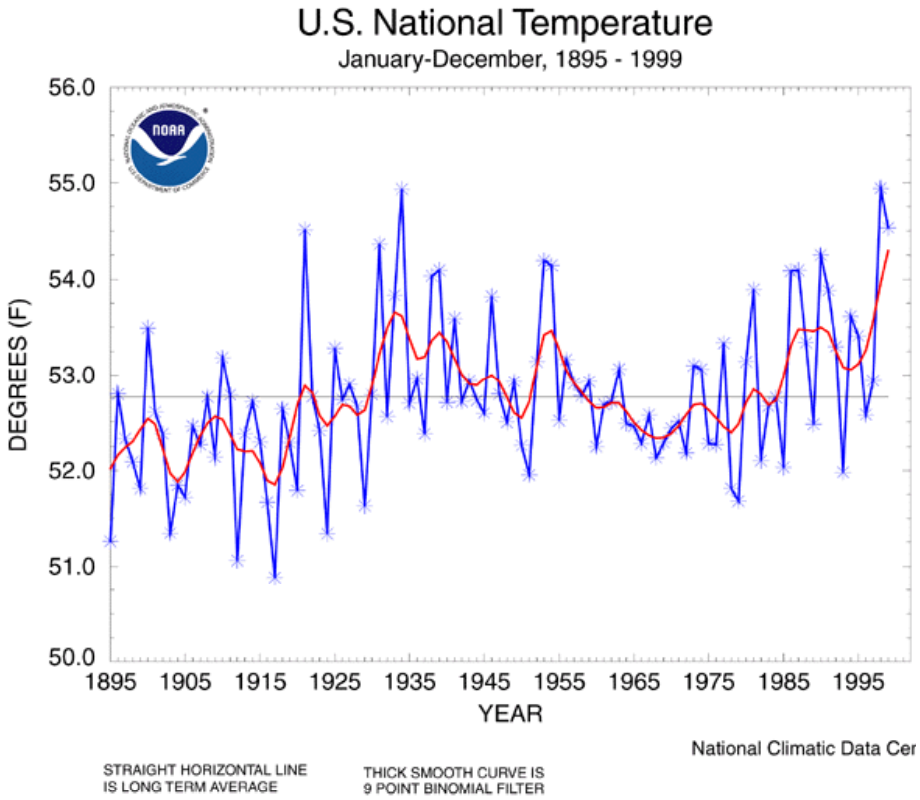
CENTRAL GREAT PLAINS CLIMATE CHANGE IMPACT ASSESSMENT

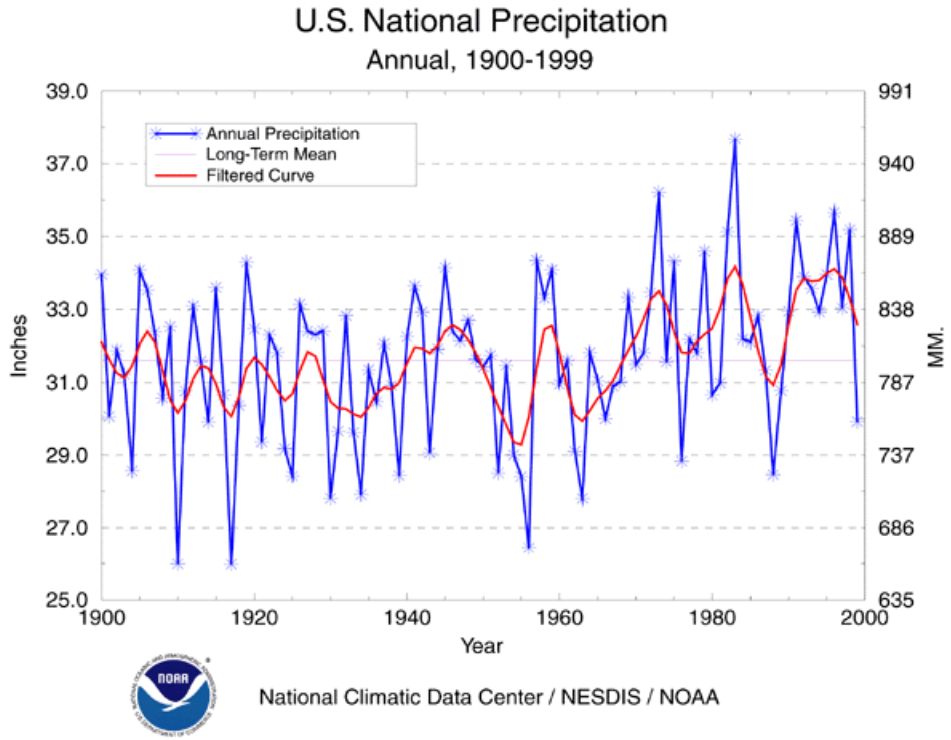
Key Questions

- 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)?

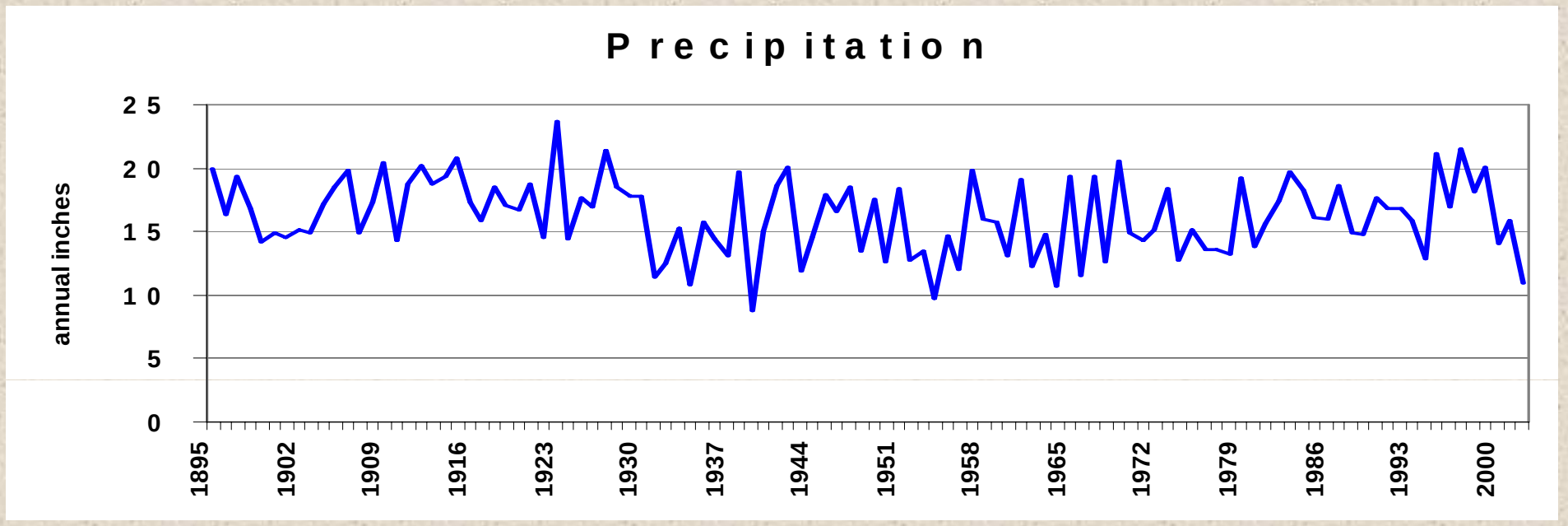
OUR APPROACH

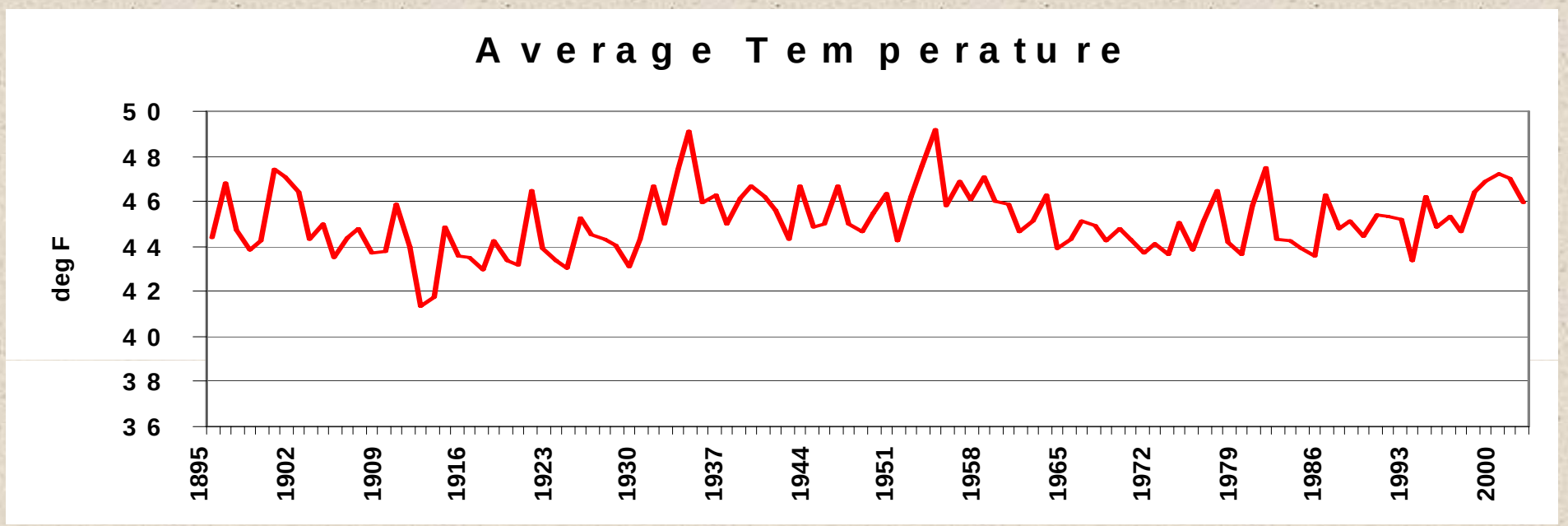
- What We Know
- Concerns
- Develop Scenarios
- Evaluate Suite of Responses
- Coping Strategies


U.S. National Temperature
January-December, 1895 - 1999
DEGREES (F)
56.0
55.0
54.0
53.0
52.0
51.0
50.0
1895 1905 1915 1925 1935 1945 1955 1965 1975 1985 1995
YEAR
National Climatic Data Cer
STRAIGHT HORIZONTAL LINE
IS LONG TERM AVERAGE
THICK SMOOTH CURVE IS
9 POINT BINOMIAL FILTER


U.S. National Precipitation
Annual, 1900-1999
Annual Precipitation
Long-Term Mean
Filtered Curve
Inches
39.0
37.0
35.0
33.0
31.0
29.0
27.0
25.0
MM.
991
940
889
838
787
737
686
635
1900 1920 1940 1960 1980 2000
Year
National Climatic Data Center / NESDIS / NOAA

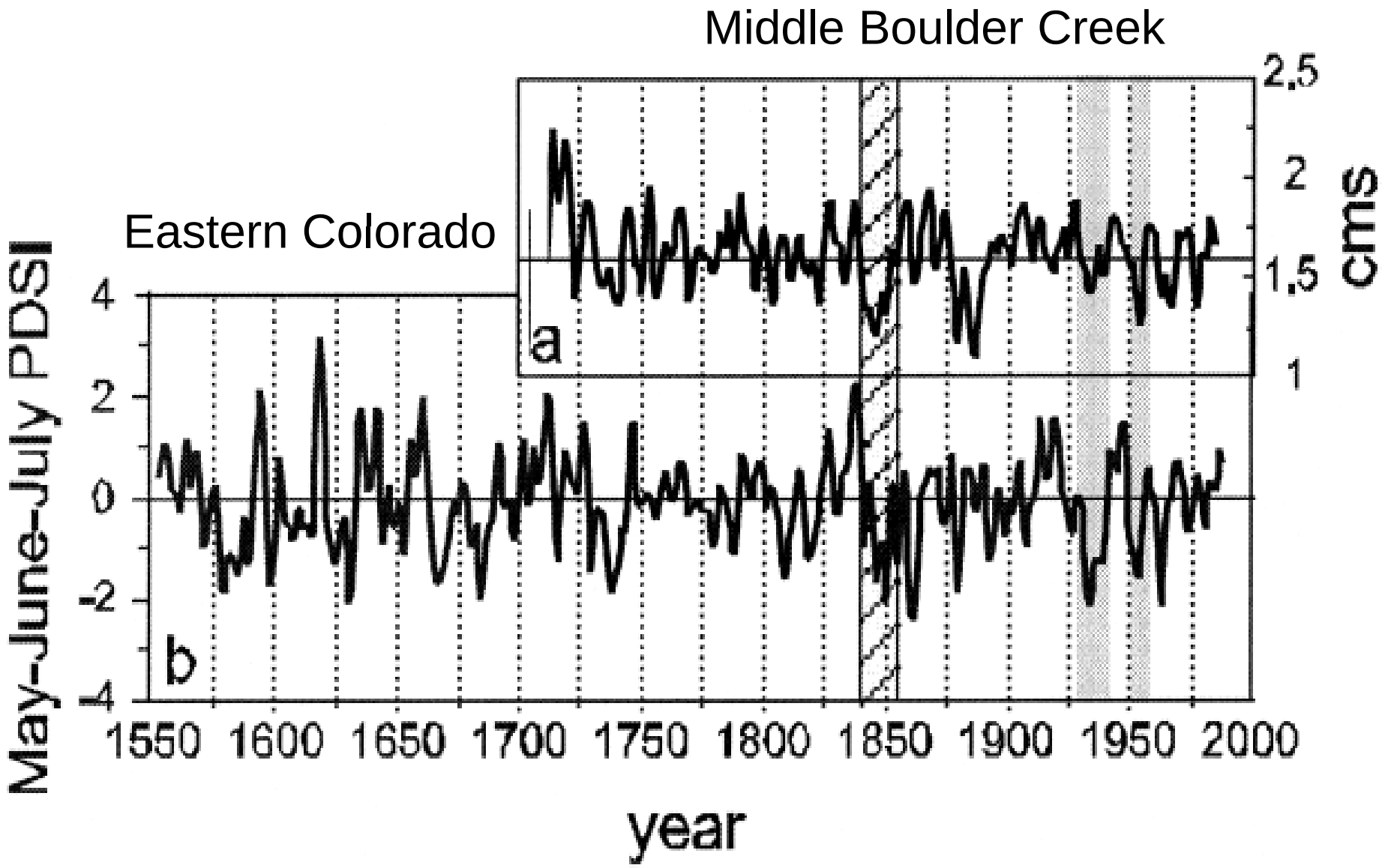
Platte River Basin, Colorado





CREATING SCENARIOS

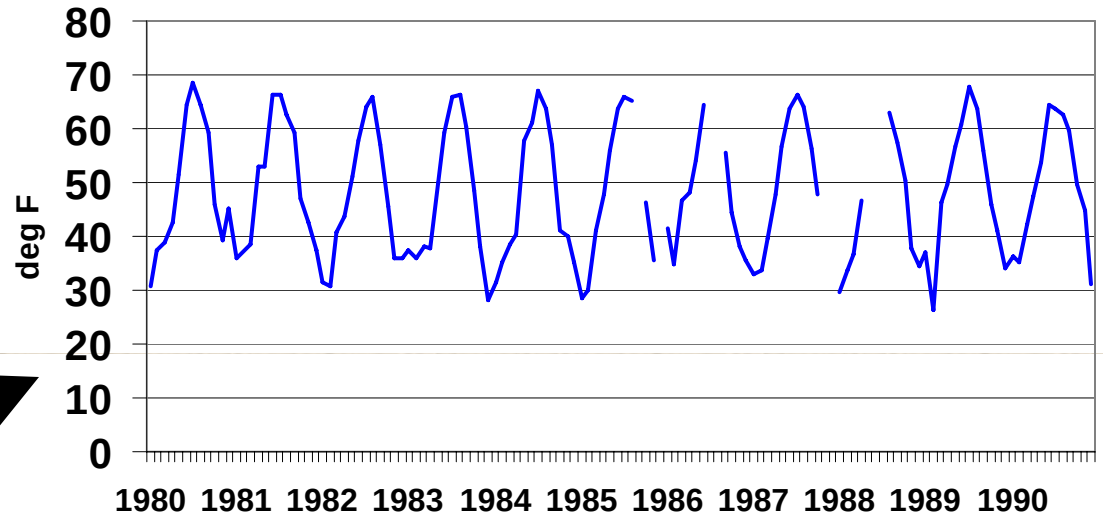
- LOOK TO THE PAST
- CRITICAL CHARACTERISTICS OF INTEREST
- APPLY "WHAT IF"
- USE HYPOTHESIZED TRAJECTORIES



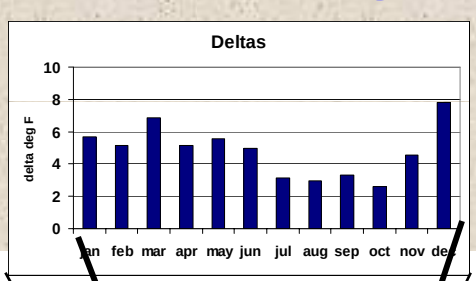
(Source: Woodhouse et al., 2002)

ESTES PARK AVERAGE TEMPERATURE

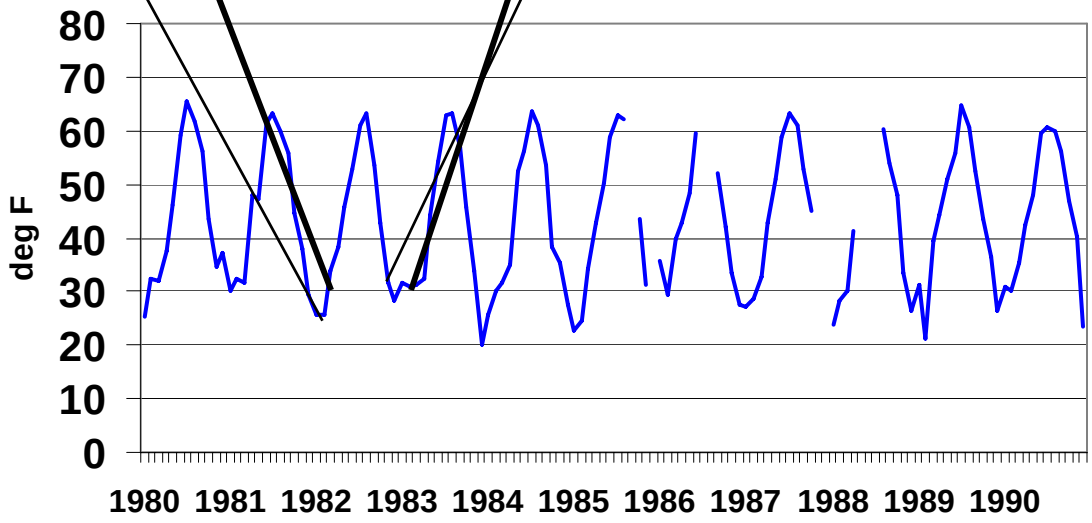
Scenario Data

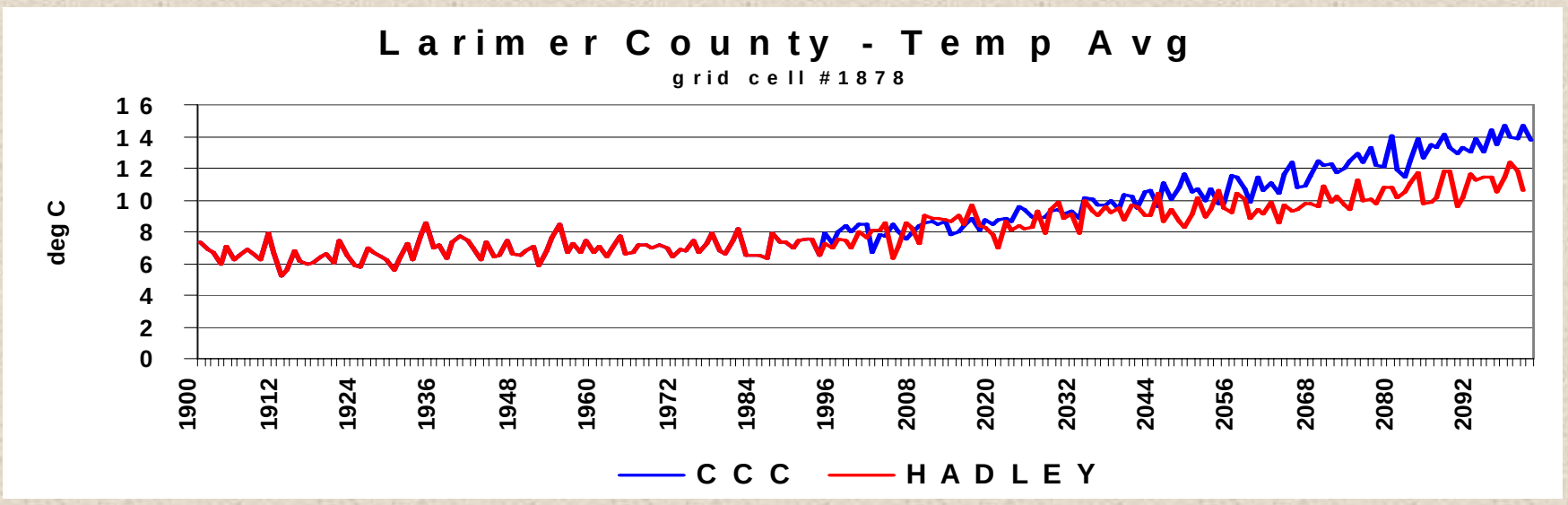


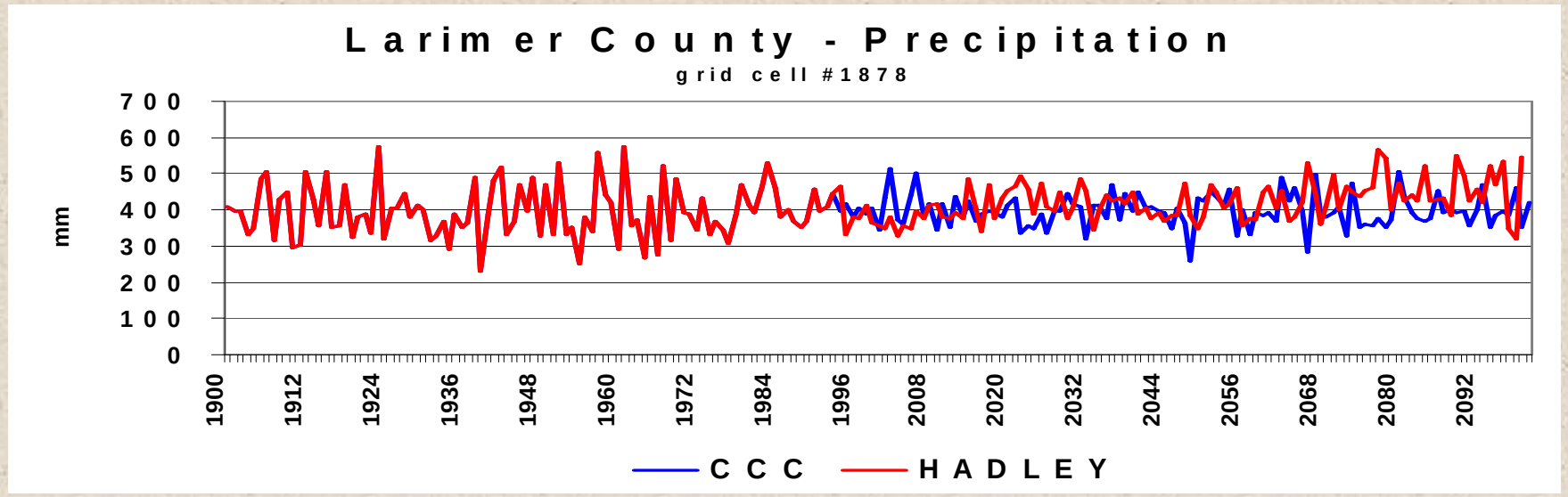
Climate changes



Observed Data




Larimer County - Temp Avg
grid cell #1878
deg C
16
14
12
10
8
6
4
2
0
1900
1912
1924
1936
1948
1960
1972
1984
1996
2008
2020
2032
2044
2056
2068
2080
2092
CCC
HADLEY


Larimer County - Precipitation
grid cell #1878
mm
700
600
500
400
300
200
100
0
1900
1912
1924
1936
1948
1960
1972
1984
1996
2008
2020
2032
2044
2056
2068
2080
2092
CCC
HADLEY

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

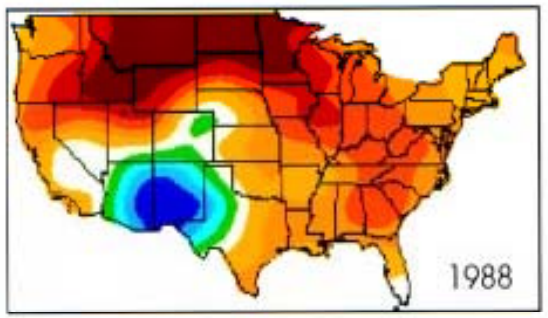
CURRENT STRESSES

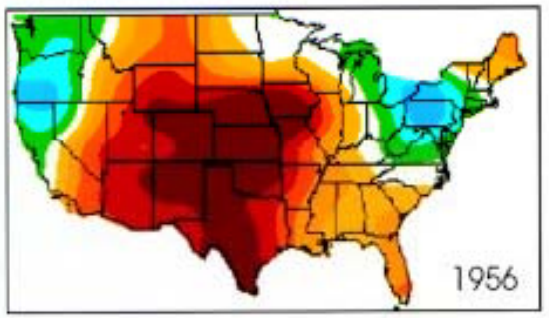
- Climate Variability
- Global Market Changes
- Decline In Rural Infrastructure
- Loss Of Biodiversity/Invasive Species
- Urban And Exurban Expansion
- Air And Water Pollution
- Water Competition
- N Deposition

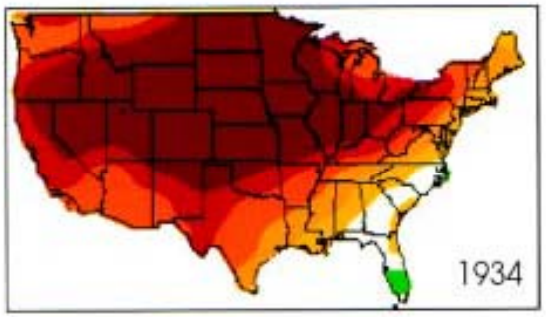
Factors in Land Use Decision Making

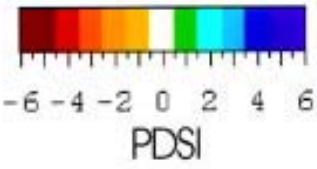
- Land - Soil, moisture, and knowledge of the land
- Family - Family priorities
- Economy - Input costs, commodity prices, and credit
- Environment - Personal environmental concerns and conservation/rotation practices
- Risk - Reducing risk
- Operation - Equipment and labor availability
- Policies -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

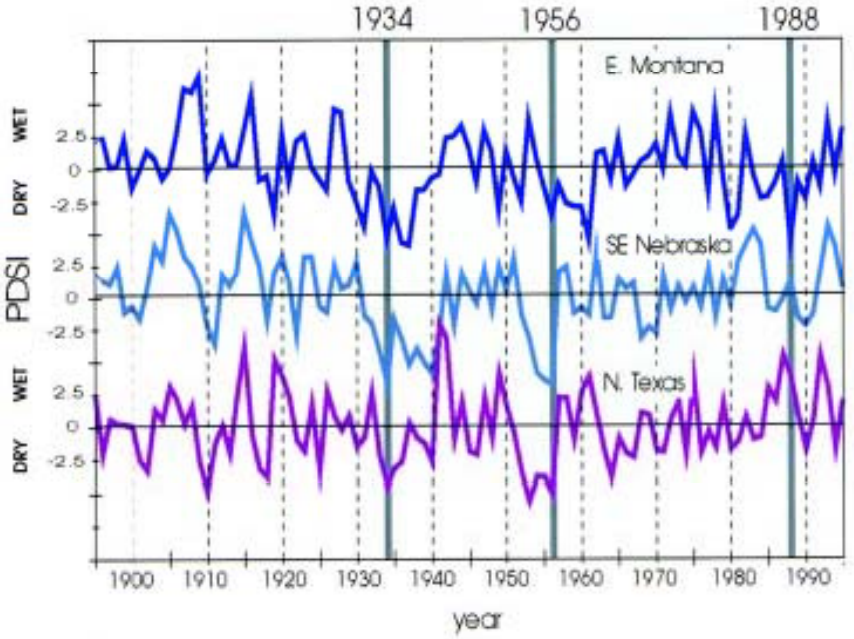
(Bohren and Knop)



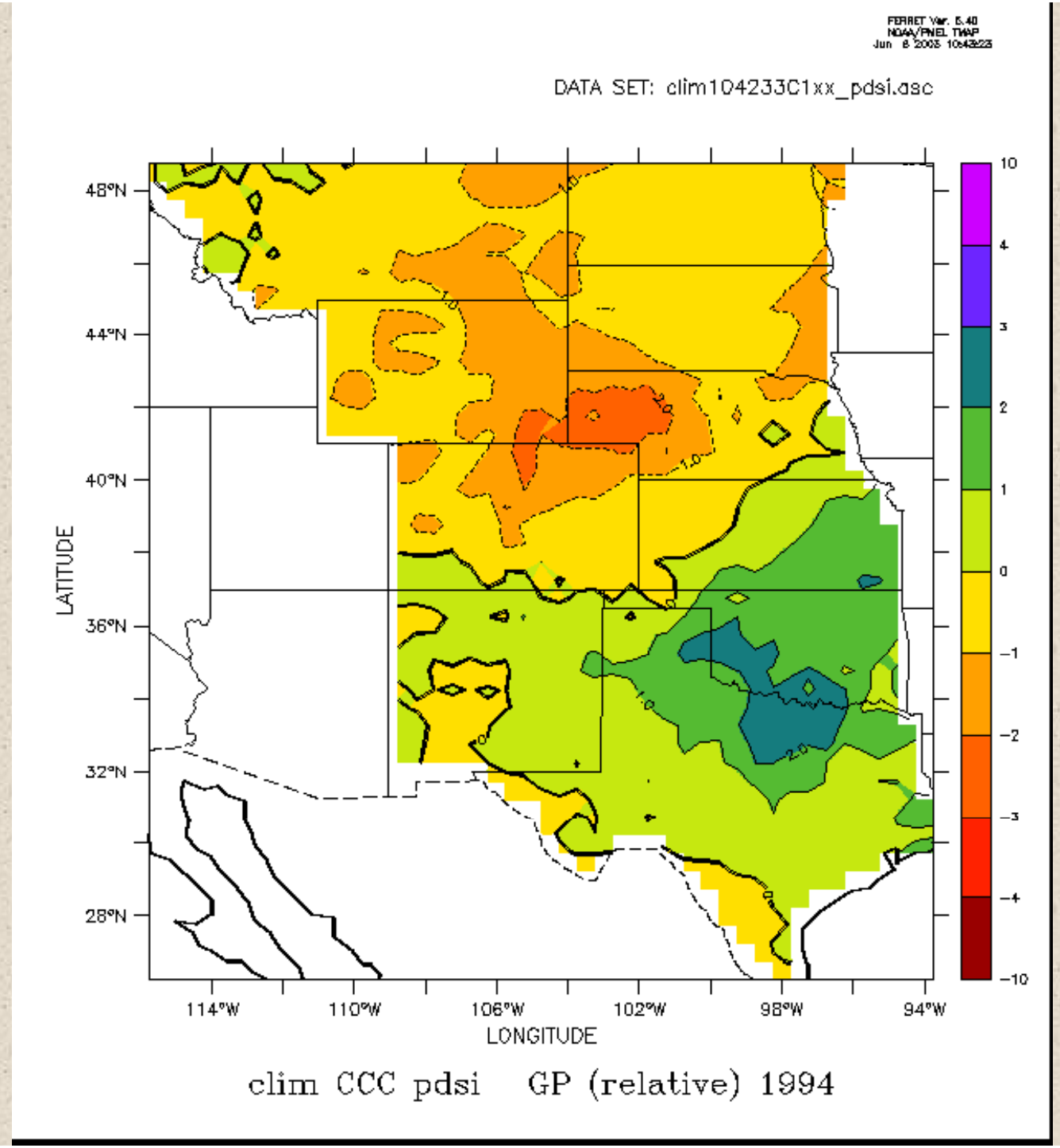








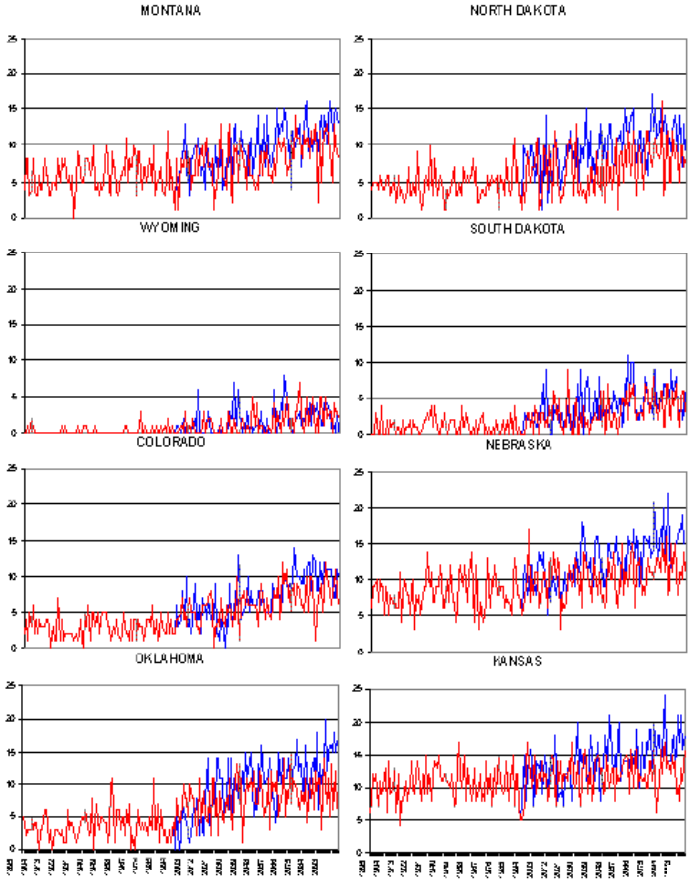
. **Source: Woodhouse and Overpeck, 1998**


FERRET Ver. 5.40
NOAA/PMEL TMAP
Jun 6 2003 10:43:23
DATA SET: clim104233C1xx_pdsi.dsc
48°N
44°N
40°N
36°N
32°N
28°N
LATITUDE
114°W
110°W
106°W
102°W
98°W
94°W
LONGITUDE
10
4
3
2
1
0
−1
−2
−3
−4
−10
clim CCC pdsi GP (relative) 1994

GCM SCENARIO FOR THE GREAT PLAINS

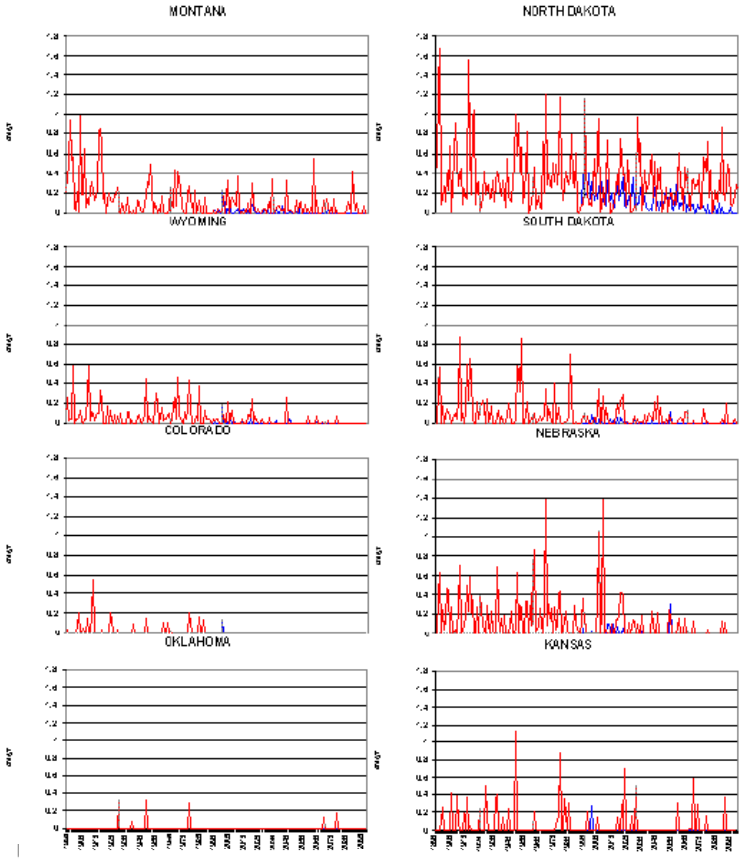
	2030	2090	2030	2090	2030	2090
GCM	T °C (max)	T °C (max)	T °C (min)	T °C (min)	ppt (ratio)	ppt (ratio)
CCC	2.6	6.1	2.5	6.5	1.0	1.2
HAD	1.4	3.1	1.8	4.2	1.1	1.2

3+ Consecutive Days exceeding 32°C



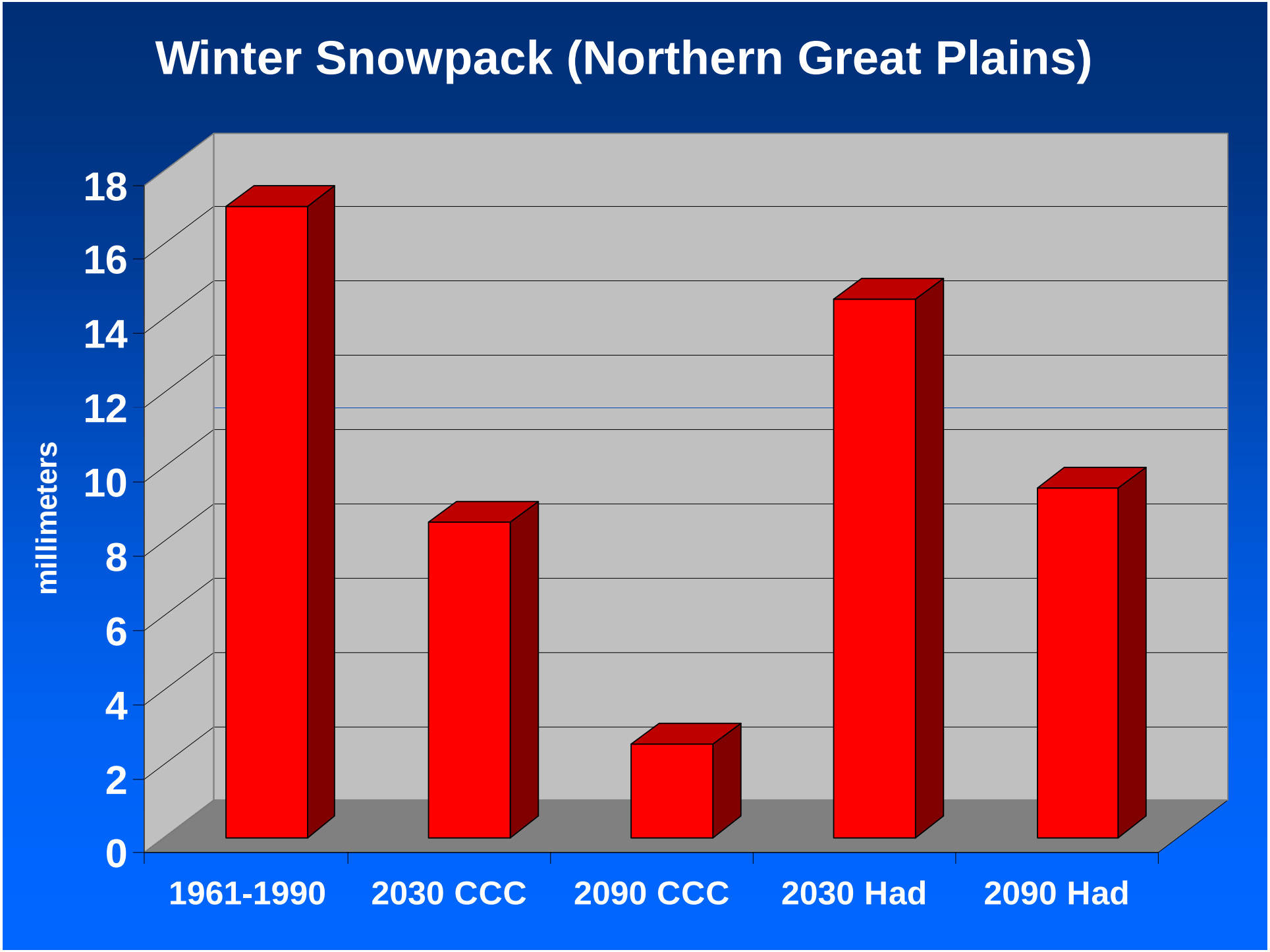
Transient/CCC — Transient/Hadley

Annual Accumulation of Snow
(water equivalent cm/yr)

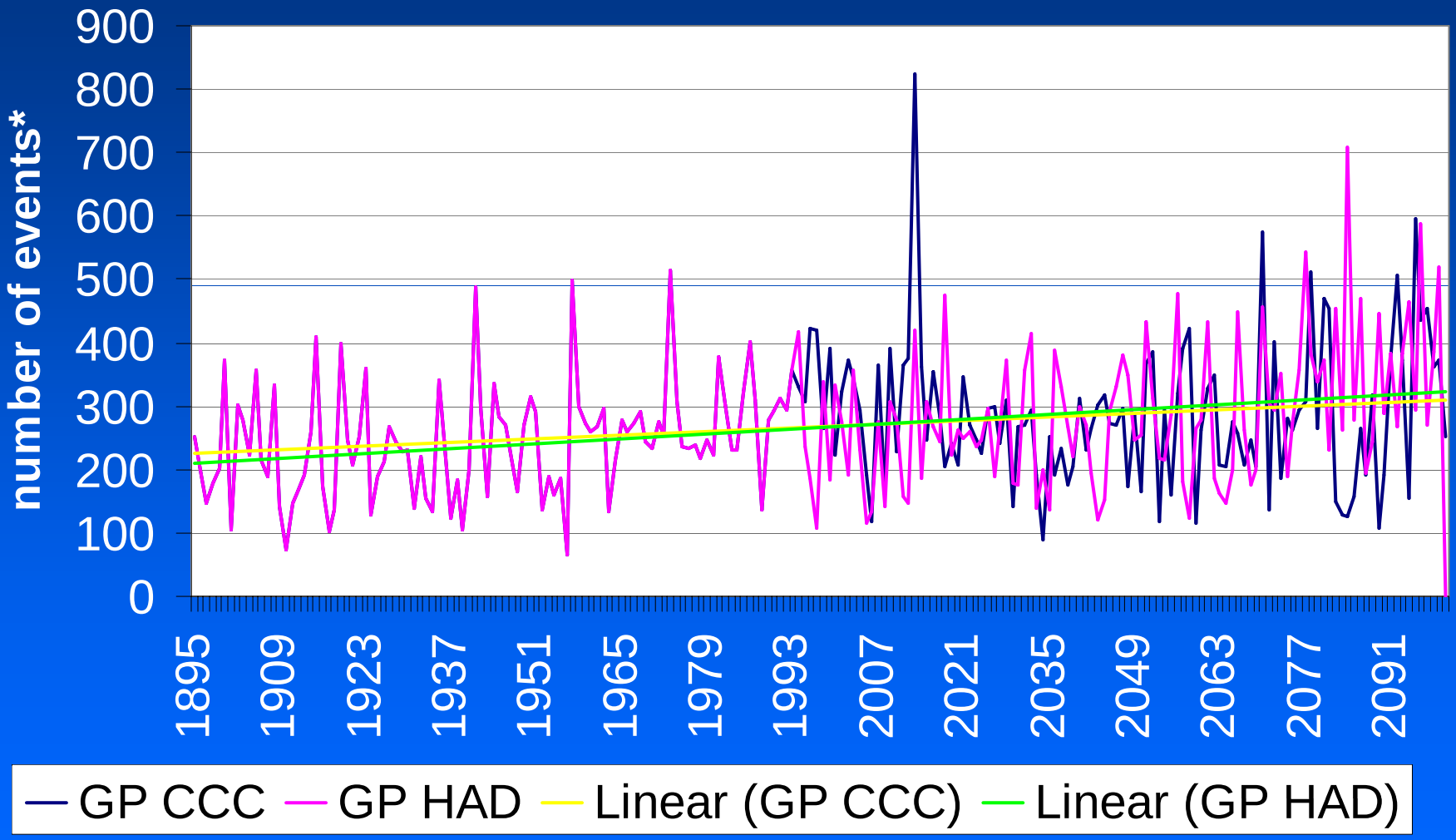


Transient/CCC — Transient/Hadley

Bioclimatic Regions

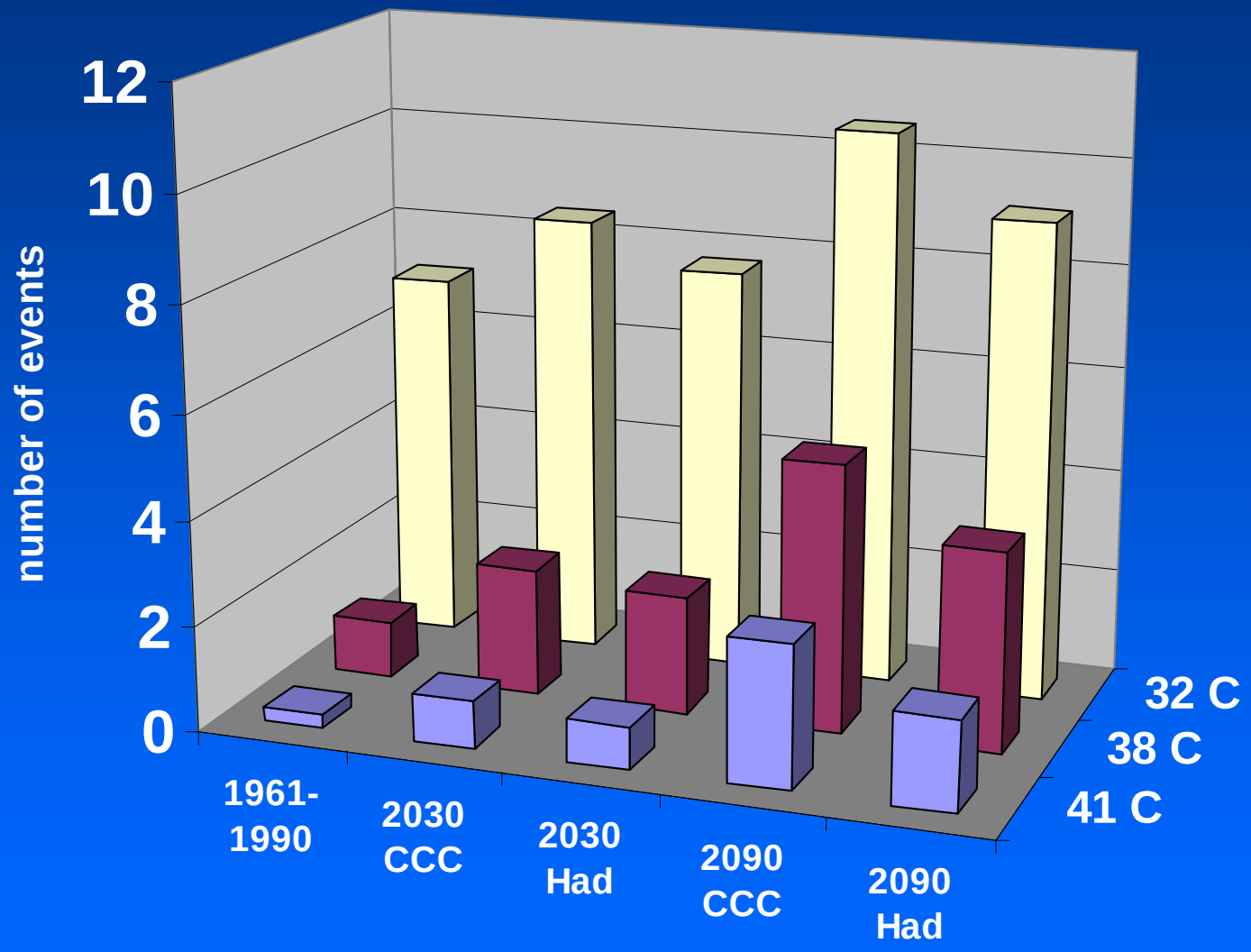

Winter Snowpack (Northern Great Plains)
millimeters
18
16
14
12
10
8
6
4
2
0
1961-1990
2030 CCC
2090 CCC
2030 Had
2090 Had

Extreme Rainfall (>50mm) in 24 hrs.



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

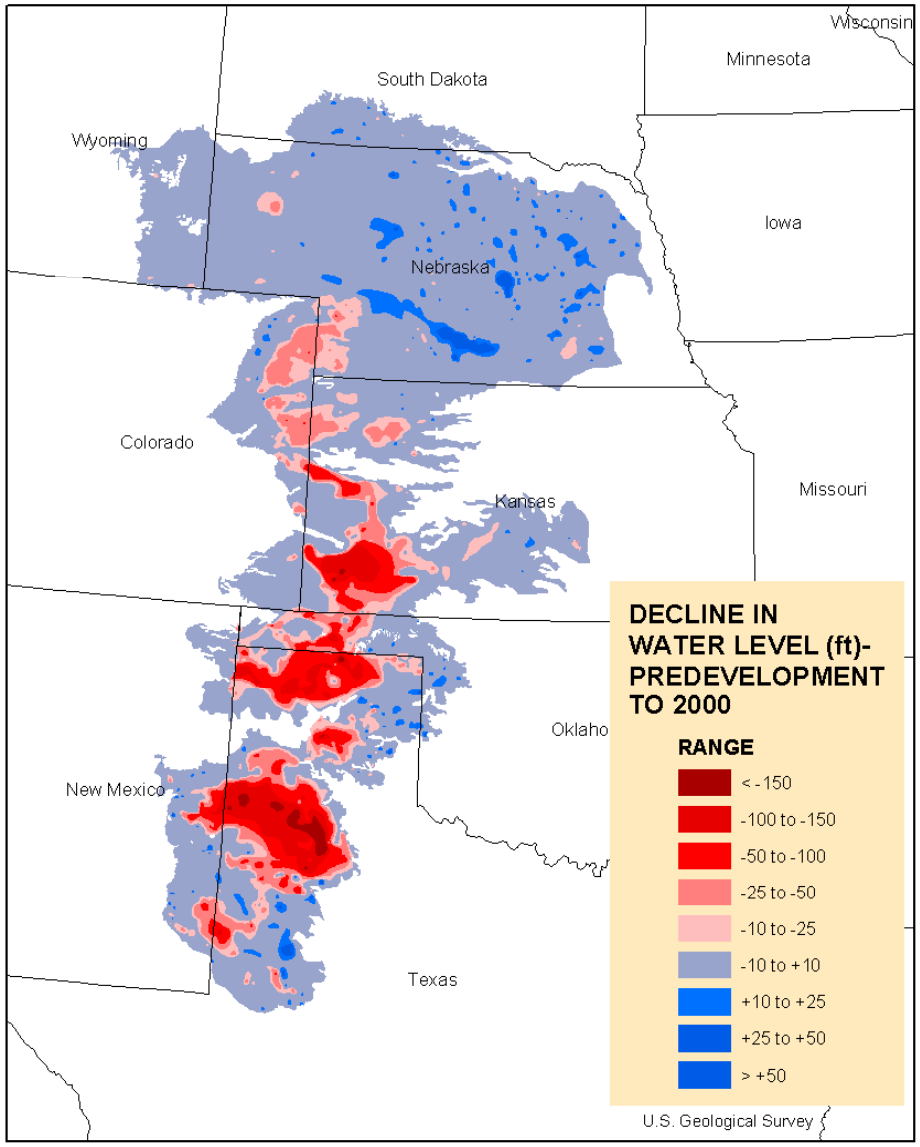
Number of Hot Day Events (Great Plains)



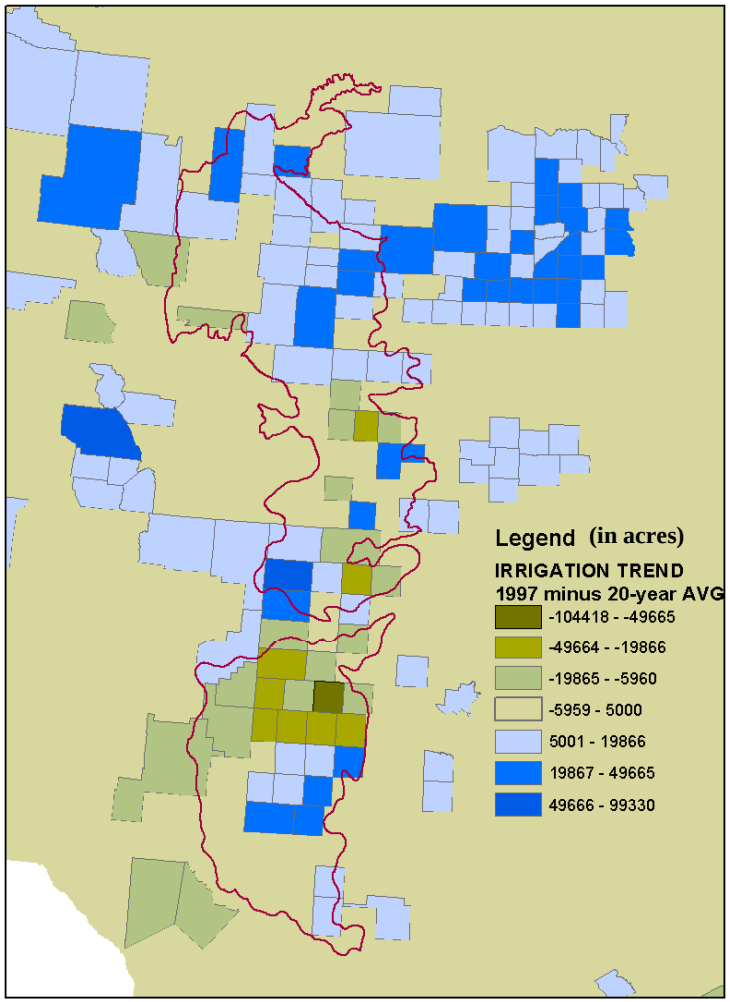
Potential Impacts

- 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 that monotonic change in climate
- extra-regional forces exacerbate vulnerability to climate change