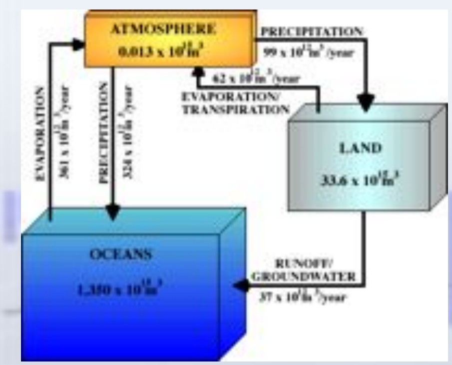
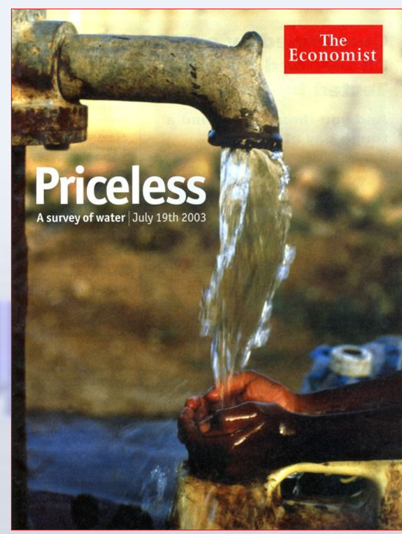
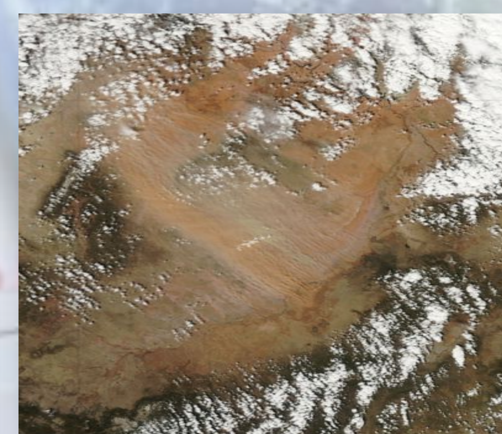
People, thresholds and knowledge

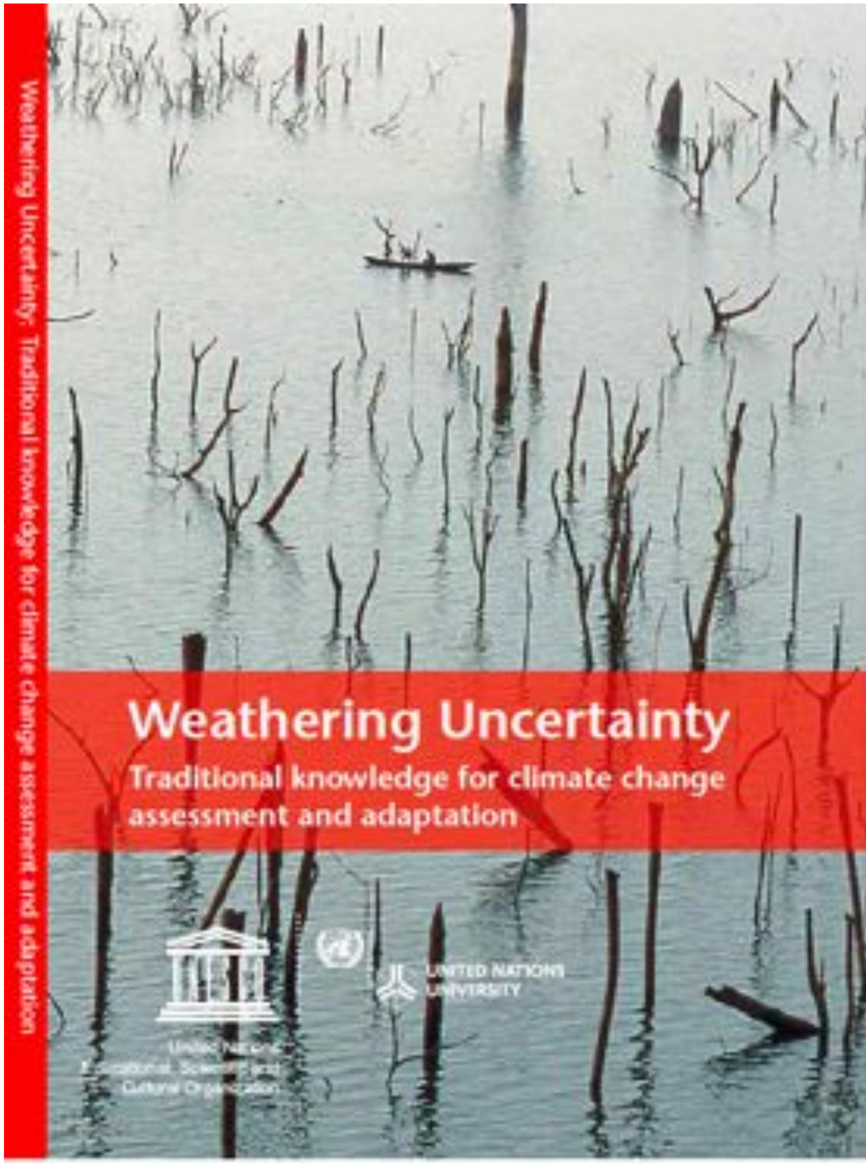
Margaret Hiza Redsteer USGS

Roger S. Pulwarty NOAA







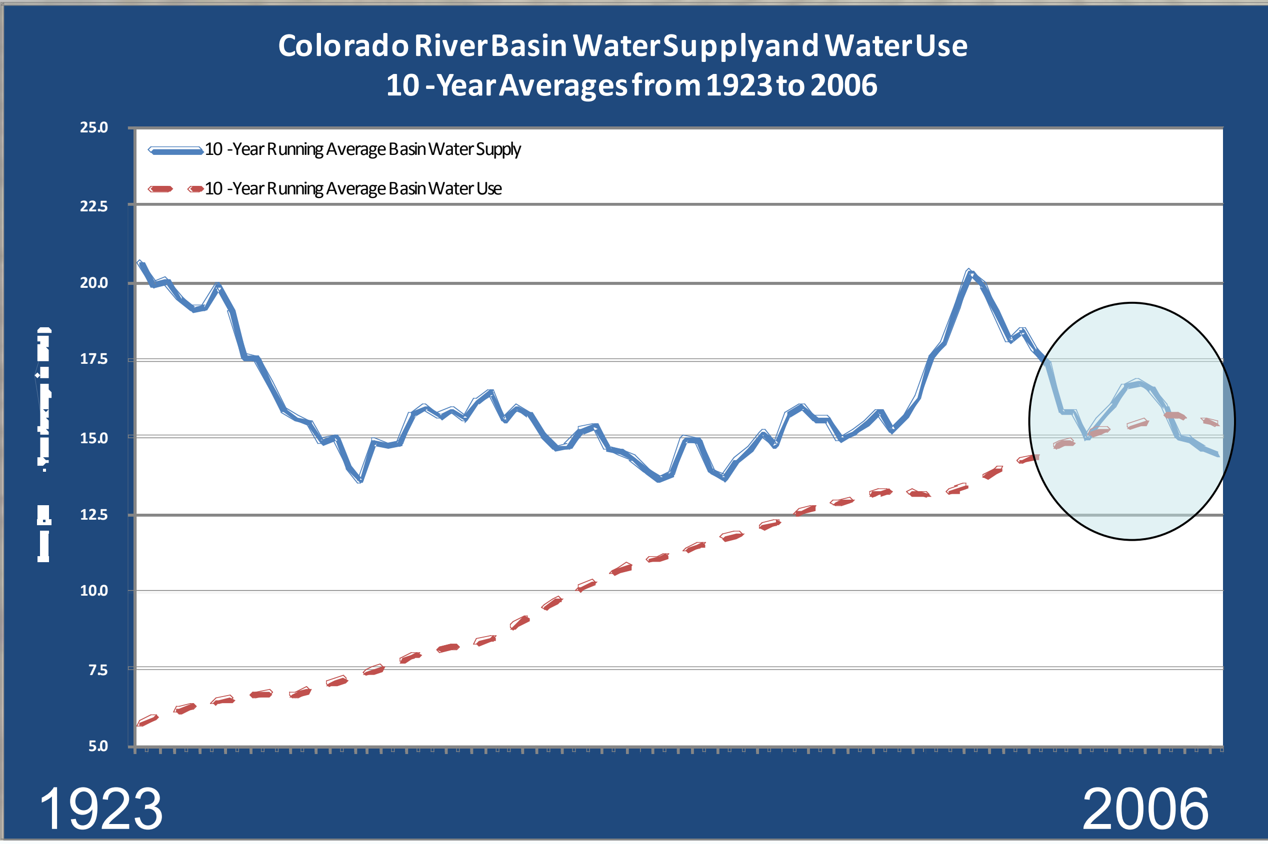


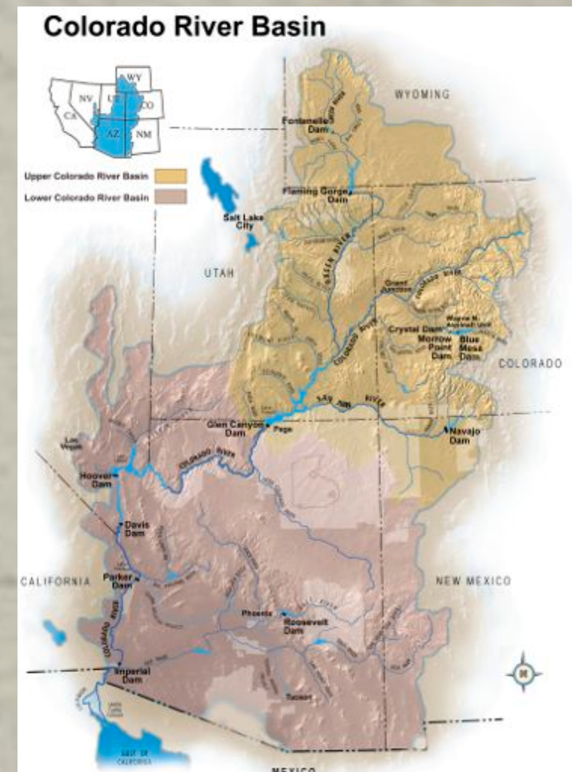
Weathering Uncertainty

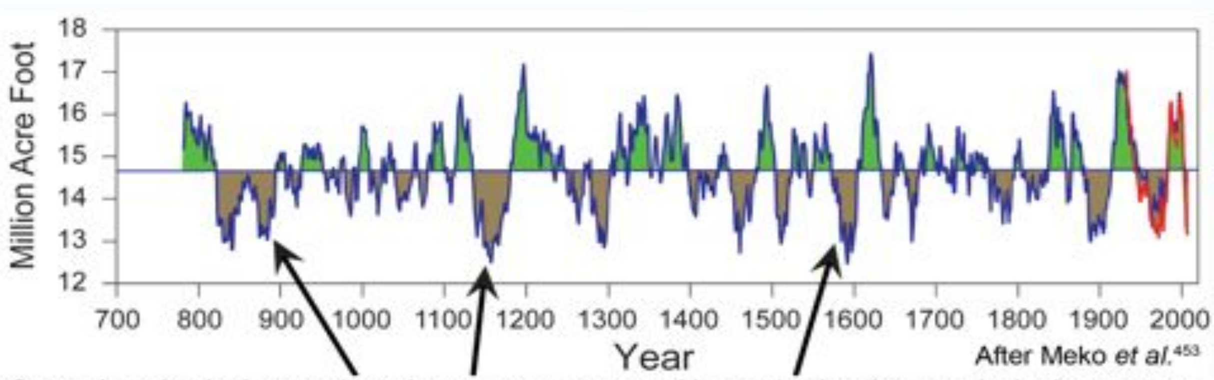
Traditional Knowledge for Climate Change Assessment and Adaptation

A growing number of movements and networks
Many Native peoples live in the harshest environments of the world

Colorado River Water Supply & Use



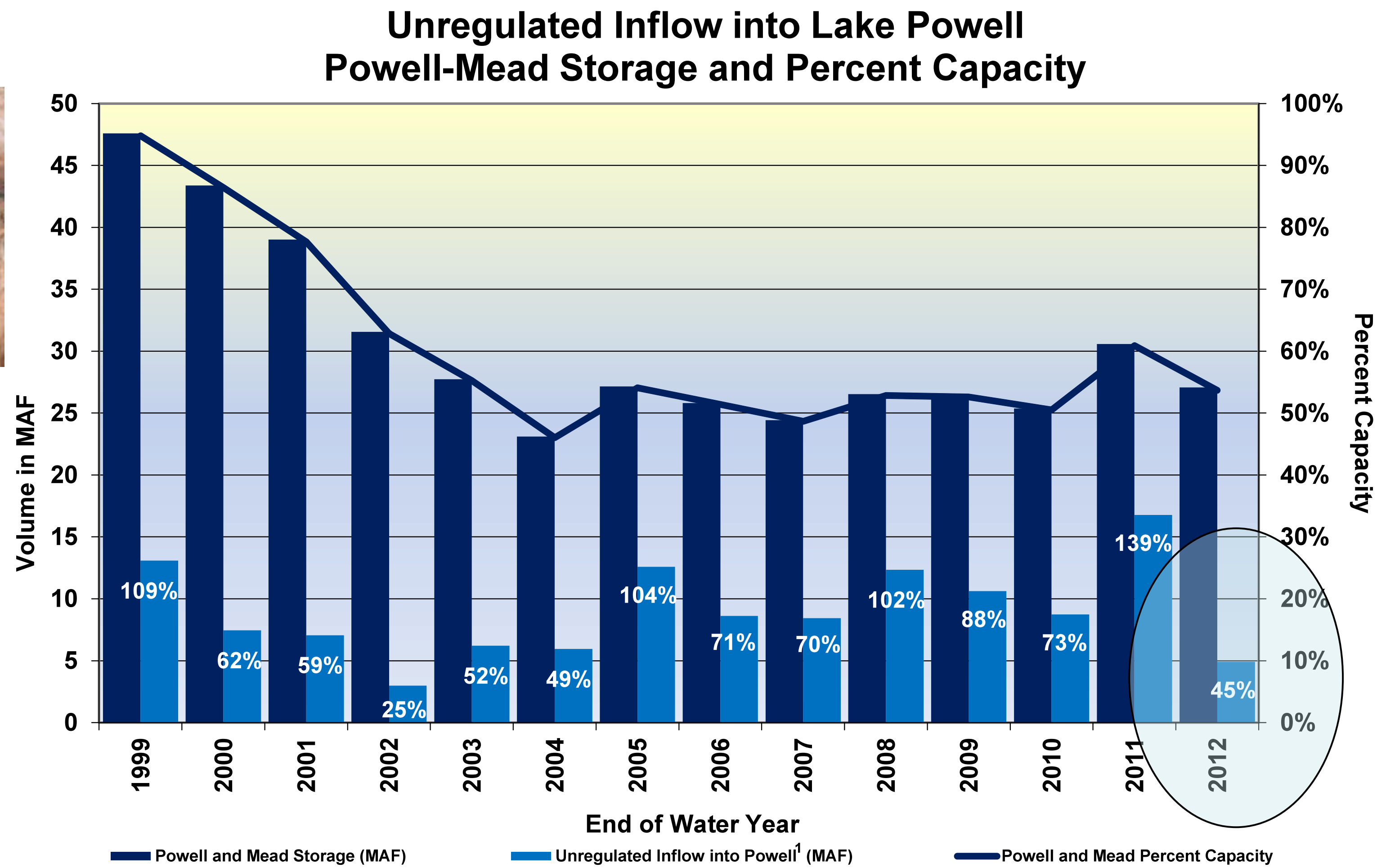




Some droughts in the past have been more severe and longer lasting than any in the last century.

Colorado River flow has been reconstructed back over 1200 years based primarily on tree-ring

State of the System (Water Years 1999-2012)[1]



[1] Percentages at the top of the light blue bars represent percent of average unregulated inflow into Lake Powell for a given water year. Water years 1999-2011 are based on the 30-year average from 1971 to 2000. Water year 2012 is based on the 30-year average from 1981-2010.

In the Colorado River's 100-year recorded history, 1999 through 2010 ranks as the second-driest 12-year period

Drought and Climate Change Part II
Diné/Navajo and the Four Corners Region

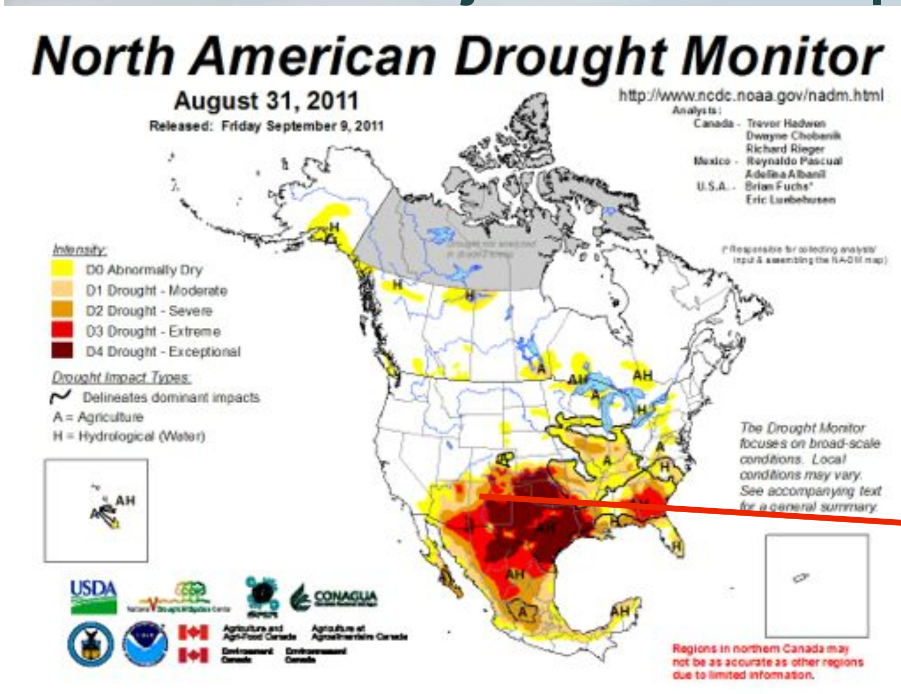
Native Nations in Southwest US are major land managers

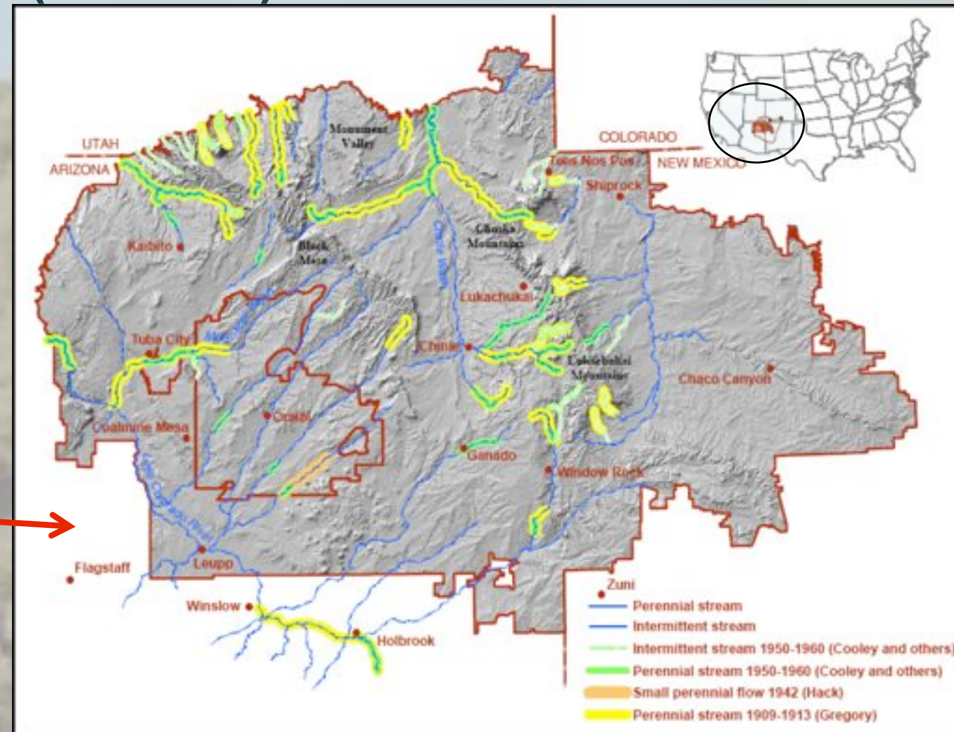
Regional Characteristics

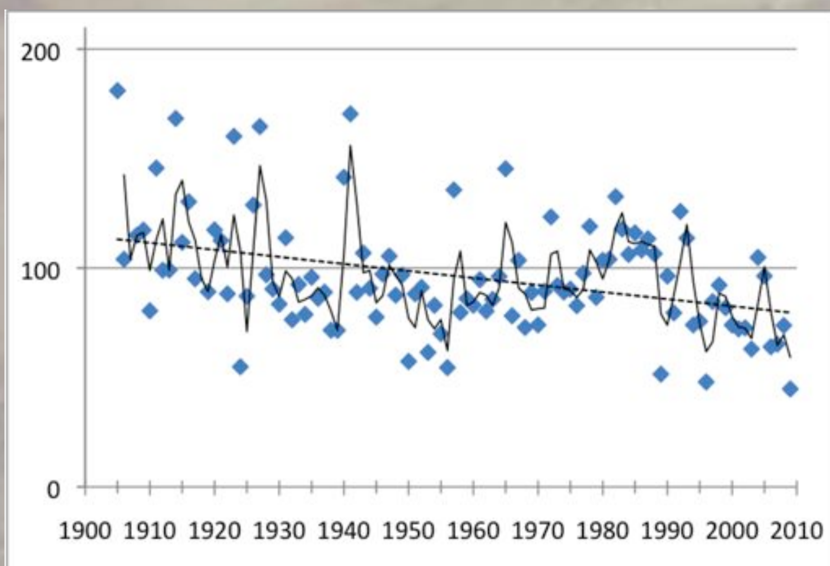
Reservation history and local land tenure

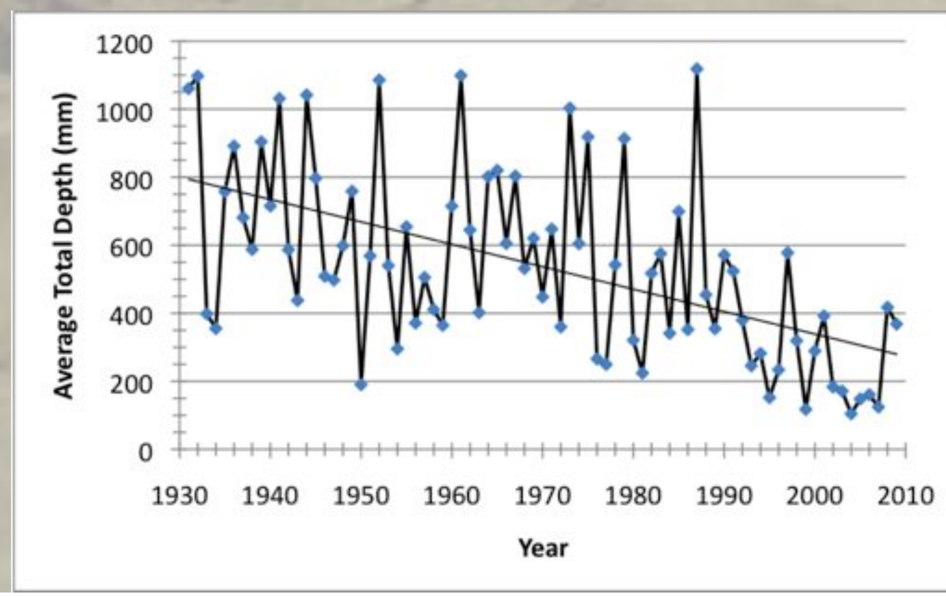
Drought and climate change: Thresholds

Navajo/Dine and Hopi (rain-fed) Homelands

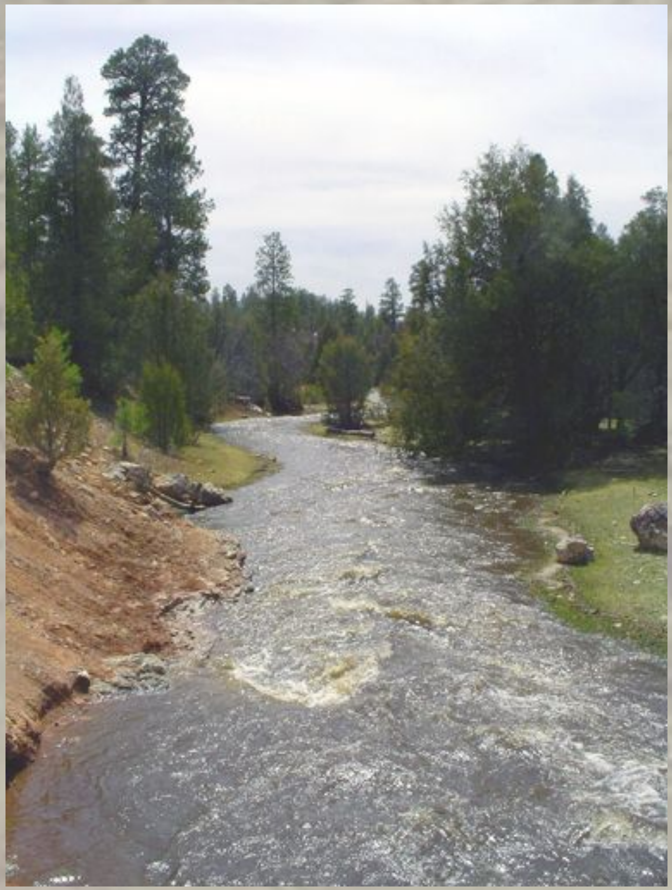








Changing Streamflow

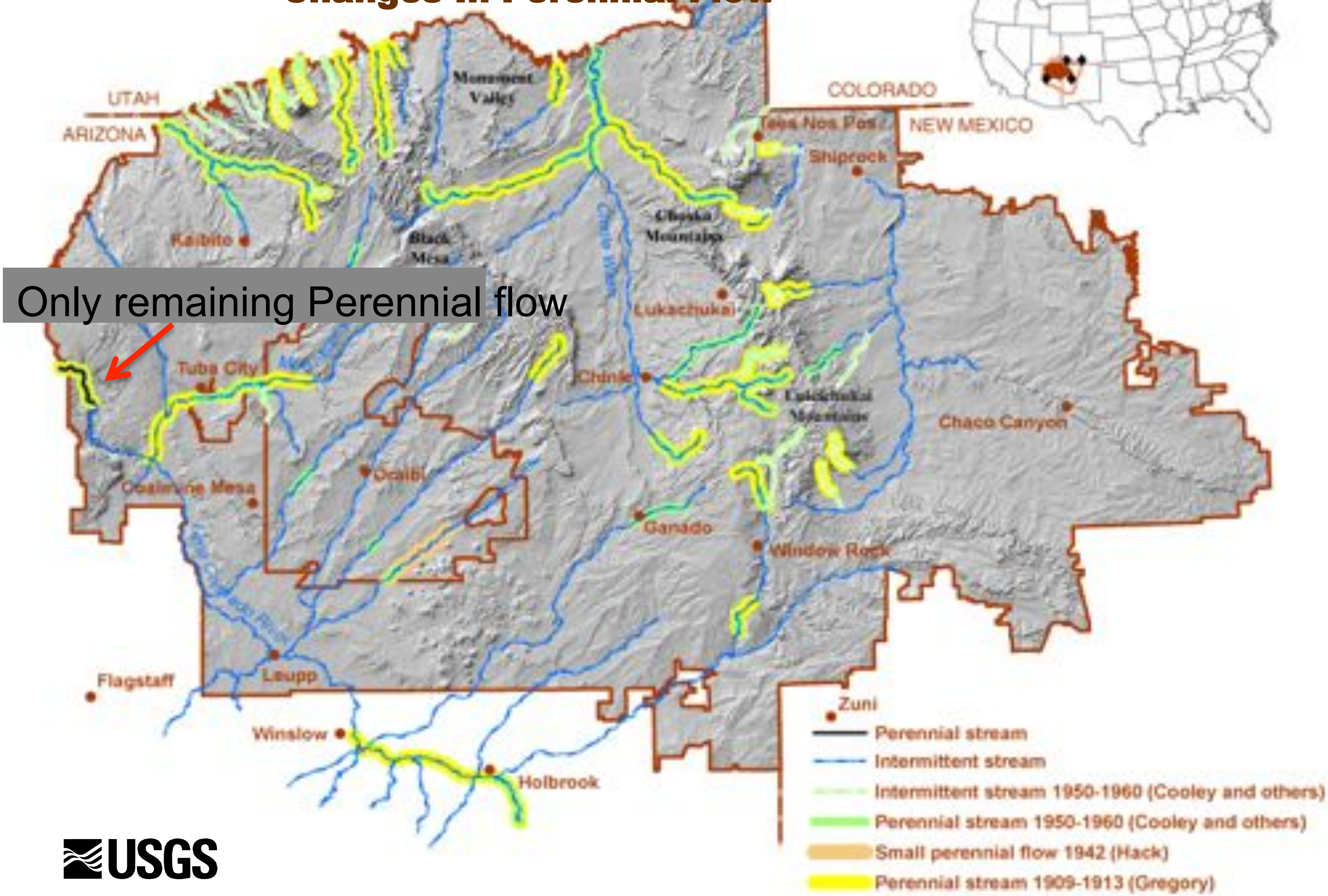


Photographs of the stream flow in Wheatfields Creek upstream of Wheatfields Lake in April 2005 (left) and April 2006 (right).

Slide courtesy of Jolene Tallsalt Robertson, Navajo Nation Dept of Water Resources

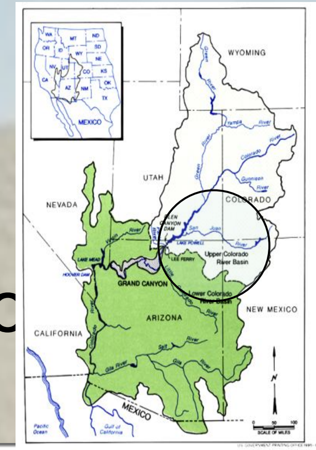
Rivers Flowing Less Often:

Changes In Perennial Flow

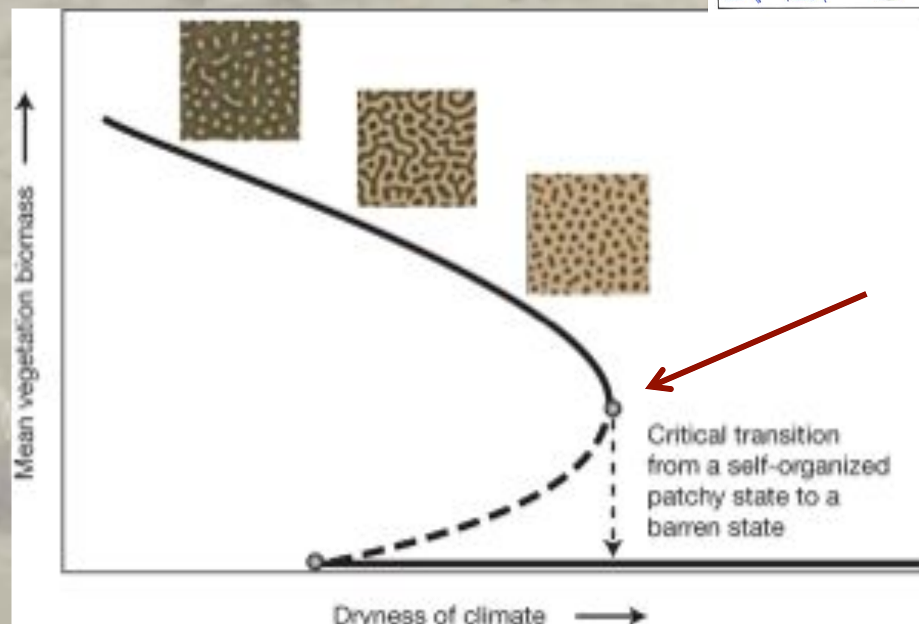


USGS

Landscape changes- Native American Lands in the Four-Corners Region-Early-warning signals for critical transitions



Mean vegetation biomass



Dryness of climate →

(Nature, 2009, Redsteer, 2011; UNISDR, NIDIS 2012)


LOCAL NEWS

Multiple crashes due to wind and dust along I-40

More Phoenix Local News

09:21 PM Mountain Standard Time on Thursday, March 26, 2009

azfamily.com

WINSLOW – A dust storm shut down Interstate 40 in the High Country for several hours.

Sand Dune Mobility = W/(P/PE)

Stable Sand Dunes
= P/PE > 0.31

Partly Active Dunes
P/PE = 0.31-0.13

Fully Active Dunes
P/PE< 0.13


Direction of sand transport
USGS

OBSERVATIONS FROM 73 ELDERS:

Changes in Weather

- Today less rain & snow (all)
- In late 1930s - 1940s climate began to shift from wet to dry (oldest)
- In the 1920s and 1930s it rained a lot, rains could last for a week.
- In the 1930s it snowed deeper
- In the 1940s the snow was big, chest high on the horses (15)
- The climate has gotten drier since 1944 (8)
- More moving sand &dust starting in 1950's
- In 1954, 1962 and 1999 there were strong wind storms
- Until 1971 enough water in streams to grow crops
- Since the 1990s there is drought & heat
- Now it's hotter with more wind

OBSERVATIONS FROM 73 ELDERS:

Environmental Changes

- Springs and Lakes drying up
- Rivers flowing less often
- Disappearance of Beavers, Cranes, Herons, Egrets, Eagles, Lizards
- Very few bees & locusts
- Until 1944, the ground stayed moist until July (Monsoon season)
- Until late 1970s there was enough water and people planted crops
- Disappearance of cottonwood trees, willows, ceremonial and medicinal plants
- Ceremonialists traveling farther to cooler, wetter high elevations for medicines
- New plants with no Navajo names

Current Challenges from Drought 1994-2012 drought mitigation- extra hay, water trucks

- **SPI Information from climate divisions rather than local data used to declare drought**
- **Drought means no water to drink**
- **Visible rangeland changes: no forage for livestock**
- **Poor Socioeconomic Conditions leave few alternatives**

Past Adaptation Strategies

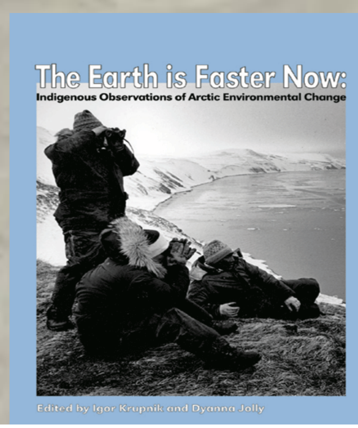
- **Movement of livestock within a broader region shared by extended families**
- **Kin-based sharing of resources,**
  - **movement away from drought affected areas**

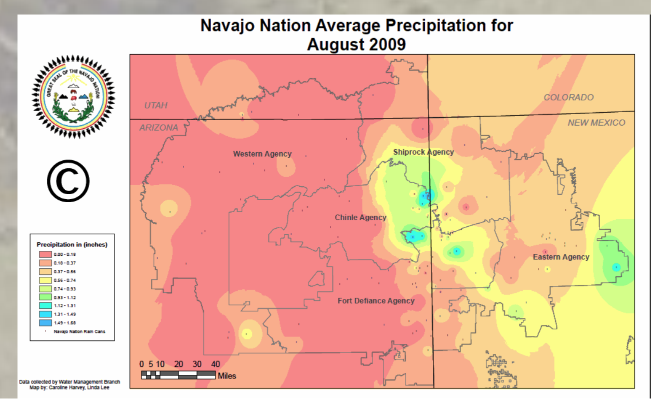
These ways are discouraged by the current grazing and land use policies,

Now land and water disputes are common

What does/will drought+warming mean for tribes in the SW?

- Threatens livelihoods (e.g. ranching) and vital cultural practices (e.g. dryland farming)
- Landscape changes (e.g. sand dune migrations) threaten habitation and infrastructure
- Ecosystem changes mean access to traditional plants and animals may be limited
- **Throughout much of Indian Country, there is a lack of quality climate data to support adequate monitoring of climate conditions**

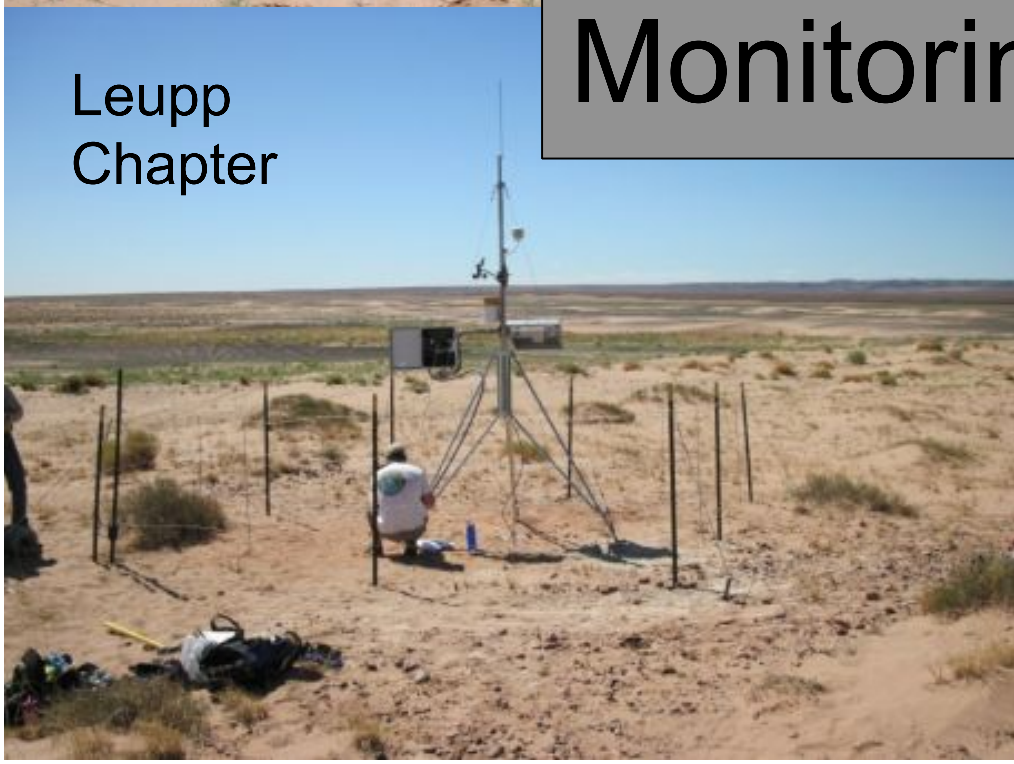


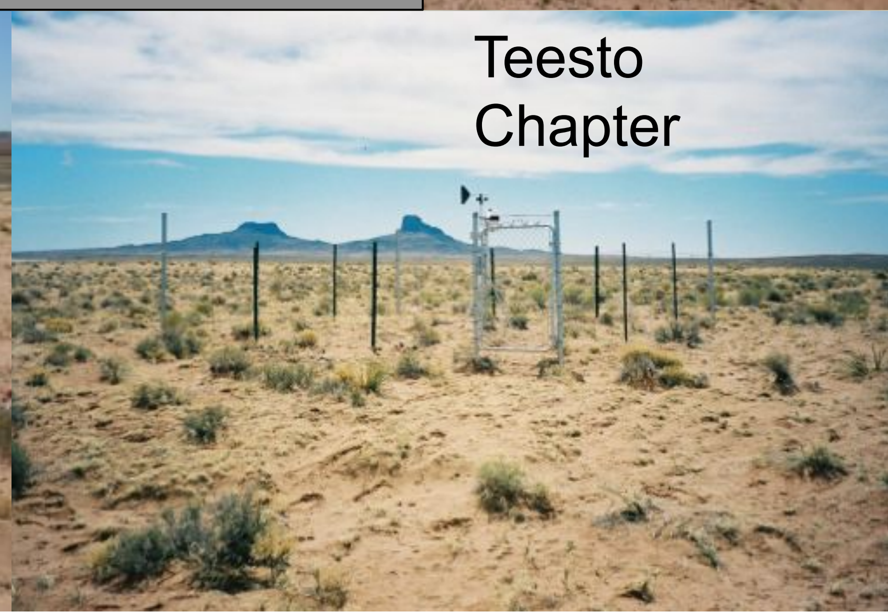


Traditional Knowledge and Perspectives:

- Increases our ability to understand changing environmental conditions
- Refines timing of events
- Fills monitoring gaps

Monitoring Sites





Dune stability work 2011


Rice grass planting has been successful
But more challenges lie ahead

Scenarios: Diné/Navajo Lands

Through conversations before and during workshops, the team identified the most important and most uncertain climate drivers that will affect conditions over the next 40 years. These were combined in the following matrix. (Also note that temperature increase was a 'given' so it applies in all scenarios

Patterns shift – more winter precipitation relative to summer

Shrubland

Ecosystem becomes more susceptible to annual grass invaders. Fate of pines and other trees uncertain. Soil erosion increases. Faunal composition changes.

Flash floods entering caves more often

Native grassland replaced by shrubland and exotic annuals

Ponderosa pine communities more susceptible to catastrophic fires due to decreasing summer precipitation

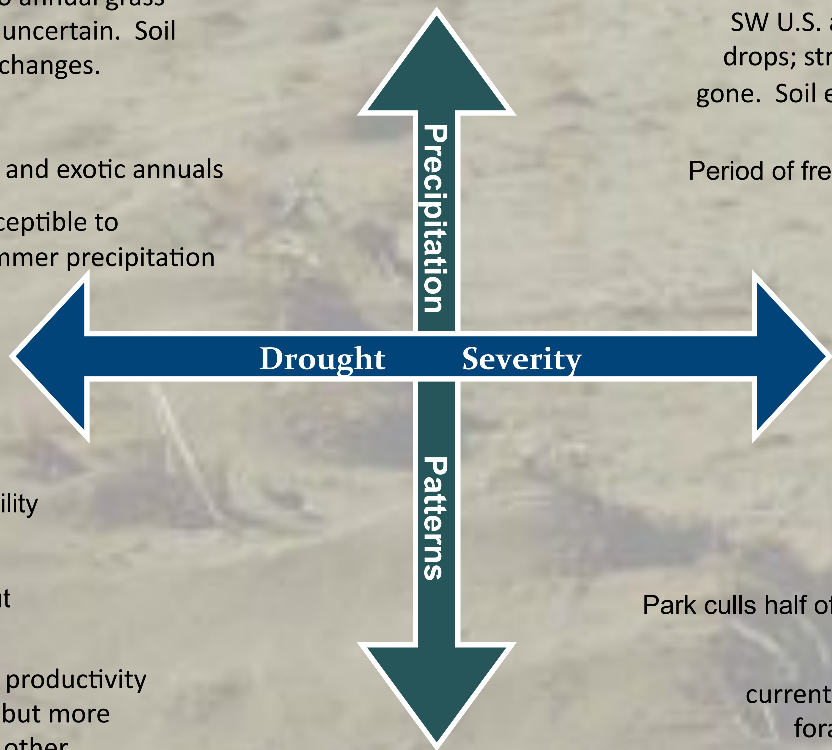
Novel Ecosystem

Climate changes quickly to something like southern SW U.S. and species migration limited. Water table drops; streams go from perennial to intermittent or gone. Soil erosion increases. Many fauna may not be sustainable.

Period of frequent, intense fire followed by decrease in fire because of lack of fuel

Tough decisions regarding above-ground mission

Duration and Frequency change little



Extreme Droughts become far more common

Changes seen as part of normal variability

Other management issues dominate

Streams more intermittent, trees dry out

Increased evaporation decreases plant productivity somewhat; ecosystem change occurs, but more slowly and/or to lesser degree than in other scenarios.

Extreme heat events – camp fire bans

Decreased water availability

Park culls half of the bison herd – limits on carrying capacity

Forest is more restricted by moisture than currently. Megafauna capacity decreases because forage production is lower. Water table drops; spring and stream flow decreases or ceases, depending on location.

Patterns change little

Mixed-grass Prairie

Shortgrass Prairie

SWINOMISH CLIMATE CHANGE INITIATIVE

Tribal Principles for Climate Legislation

PRESS RELEASE
March 12, 2009

TRIBAL PRINCIPLES FOR CLIMATE LEGISLATION

Federally-recognized tribes -- sovereign nations with certain rights ensured by the U.S. Con-stitution, treaties and legal precedence -- are facing the immediate, adverse impacts of climate change. Congress is also moving swiftly to draft and enact comprehensive legislation that would take measurable steps to address this adverse change and move the country away from uncontrolled greenhouse gas emissions. To best insure that tribal needs and con-cerns are adequately addressed in such legislation, the National Tribal Environmental Coun-cil has developed the following tribal principles for climate legislation in partnership with the National Congress of American Indians, Native American Rights Fund and National Wildlife Federation. It is our sincere hope that Congress and the President will take notice of these principles so as to properly incorporate Indian tribes into future legislative and non-legislative efforts to address climate change.

• Indian tribes, as defined in the Indian Self-Determination and Education Assistance Act, must be sovereign partners in assessing and addressing the problem of climate change at the national and international levels. Legislation must accord tribes, and other indigenous peoples worldwide, at least the status and rights recognized in the U.N. Declaration on the Rights of Indigenous Peoples and other international law.

• Indian tribes shall be provided equitable access to the same financial and technical resources provided to states and local governments, without having to obtain treatmentas- a-state (TAS) status or meet a similar burden, to access such resources.

Eric Blinman

2000 Years of Cultural Adaptation to Climate Change in the Southwestern United States

Photo: His Majesty King Carl XVI Gustaf of Sweden.

Modern concerns with climate change often overlook the extensive history of both climate change and human adaptation over the millennia. While questions of human–climate system causation are important, especially to the extent that our current behavior is driving environmental change, human societies have experienced multiple climate changes in the past, independent of causation. The histories of cultural adaptation to those changes can help us understand the dynamic interaction between climate and society, expanding the possibilities for "proactive adaptation" that may be available to us today. The underlying principles of cultural adaptation are generally independent of the source of the climate change, and the lessons of the past can suggest social and economic paths that can lead toward sustainability and away from collapse.

INTRODUCTION

The high desert of the Southwestern United States is a dramatic landscape of mesas and canyons interspersed with mountains and river valleys. For more than 2000 years, it has been the setting for the cultural development of Pueblo Indian peoples. For more than a century (1), this cultural development has been studied by archaeologists and anthropologists in remarkable detail (2). Tree-ring sequences sensitive to both moisture and cold provide a high-frequency record of climate variability as well as an extremely precise tool for dating archaeological sites (3, 4). Pollen and geomorphology studies, as well as the settlement patterns of the ancestral Pueblo people themselves, provide evidence for longer cycles of climate change (5). This integrated history of people and climate provides an opportunity to examine the dynamic nature of human responses to climate change (6, 7).

The focus of this summary is a roughly 250 000 km^2 area in Utah, Colorado, Arizona, and New Mexico of the Southwest-

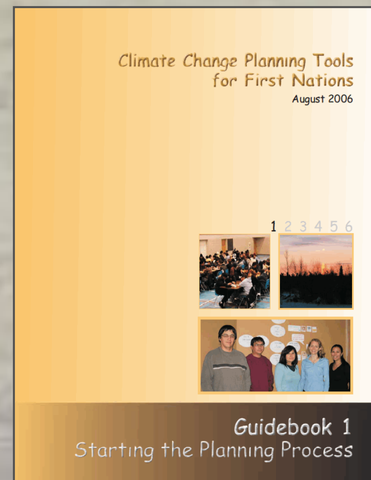
Ambio Special Report 14, November 2008 © Royal Swedish Academy of Sciences 2008 http://www.ambio.kva.se 489

Tribes, Climate Change and Solutions

Tribal Energy Solutions to Climate Change Workshop

(Billings, MT - April, 2008)

Henry Red Cloud from Lakota Solar Enterprises demonstrates low-cost and energy efficient solar heating panels to participants. © Alexis Bonogofsky, 2008



HUALAPAI TRIBAL NATION

The Earth is Faster Now:
Indigenous Observations of Arctic Environmental Change

Edited by Igor Krupnik and Dyanna Jolly

What are the impacts of climate change &/or drought??
How should they be documented?
How is control to be exercised?

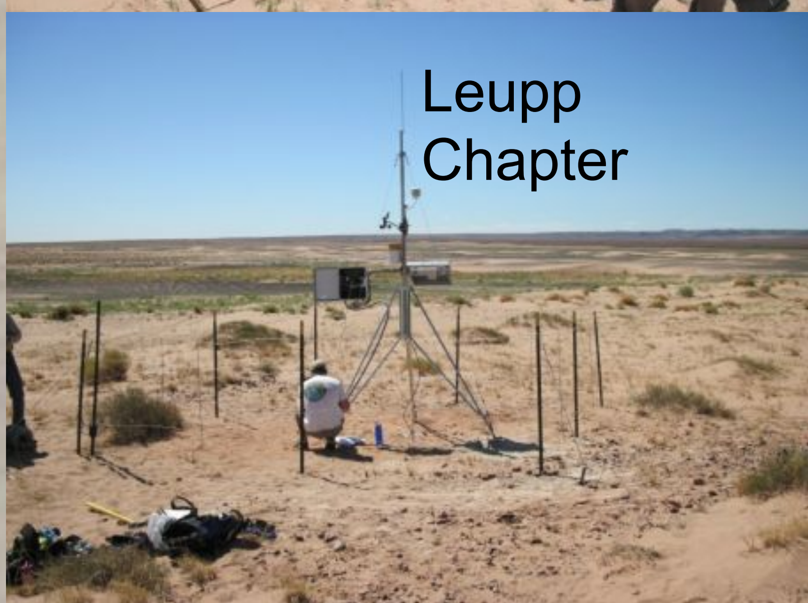
Accounts of Traditional Elders &

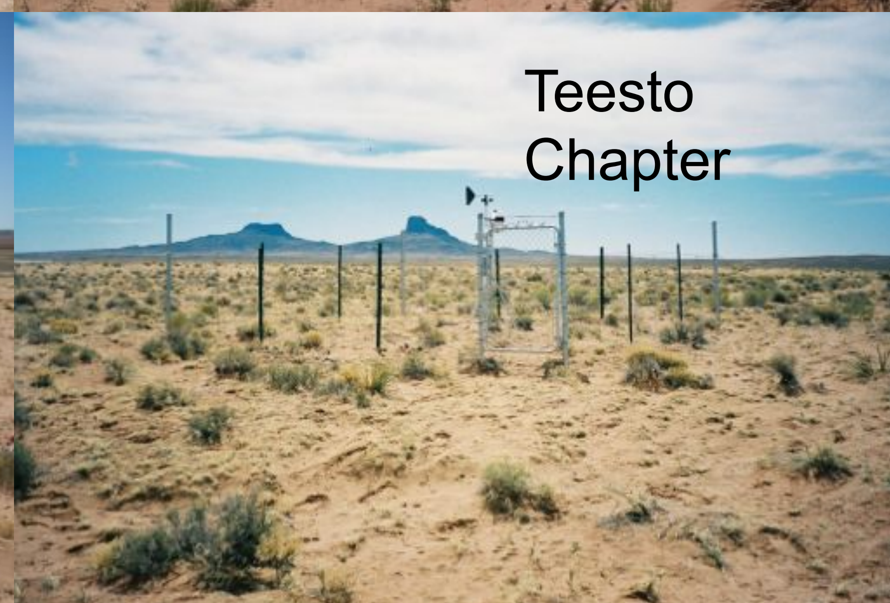
-Extension of data records to include physical dimensions in the environment otherwise unobtainable

-Additional information that provides insights into the physical processes at work that are effecting the local ecology

-Tthe area is poorly monitored, accounts provide additional lines of evidence, and more complete characterization of changes over the long-term

Monitoring Site





Four dimensions:

- substantive-there are differences in the subject matter and characteristics of indigenous vs. western scientific traditions;

- methodological and epistemological - the two forms of knowledge employ different methods to investigate reality, and possess different world-views; and

- contextual - traditional and western knowledge differ because traditional knowledge is more deeply rooted in its context

- Multiple domains and types of knowledge- Objectivity: bringing all relevant information to bear on a problem

The likelihood of failure without using indigenous knowledge

- new frames for integration,
- greater cognizance of the social contexts of integration,
- expanded modes of knowledge evaluation, and
- involvement of inter-cultural "knowledge bridges"

Work cooperatively with other federal agencies on matters that affect Indian country or a Tribe's interests.

So what is needed now?

Dr. Margaret Hiza
US Geological Survey

Rachael Novak
US Environmental Protection Agency

Jolene Tallsalt Robertson
Hydrologist, Navajo Nation Department of Water Resources

Casey Kahn-Thornbrugh
Adjunct instructor of Geography
Tohono O'odham Community College

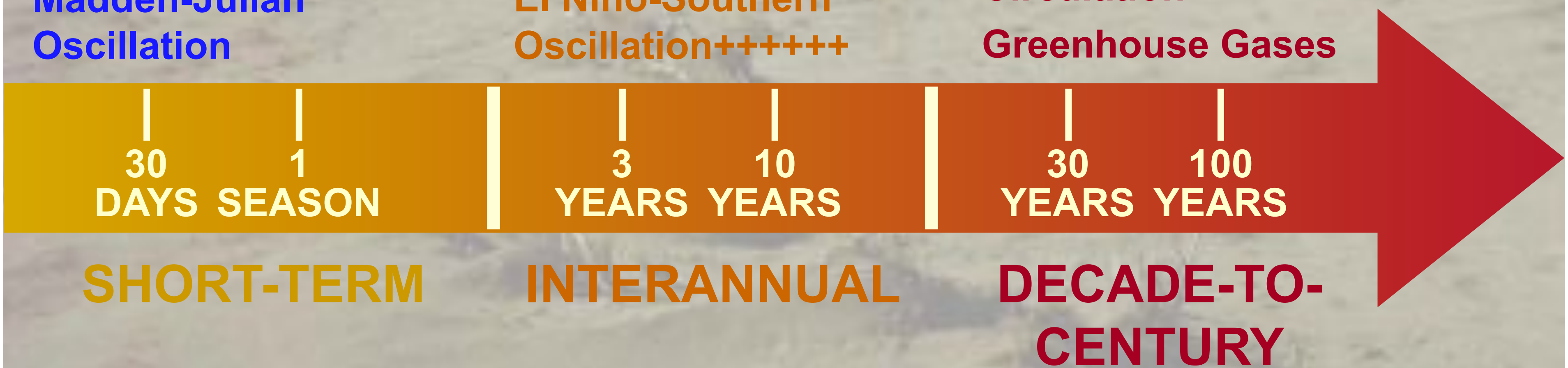
More Native researchers (cultural, social, physical, natural) to work for their communities

Climatic drivers of drought- a continuum

Heat Waves
Floods
Storm Track Variations
Madden-Julian Oscillation

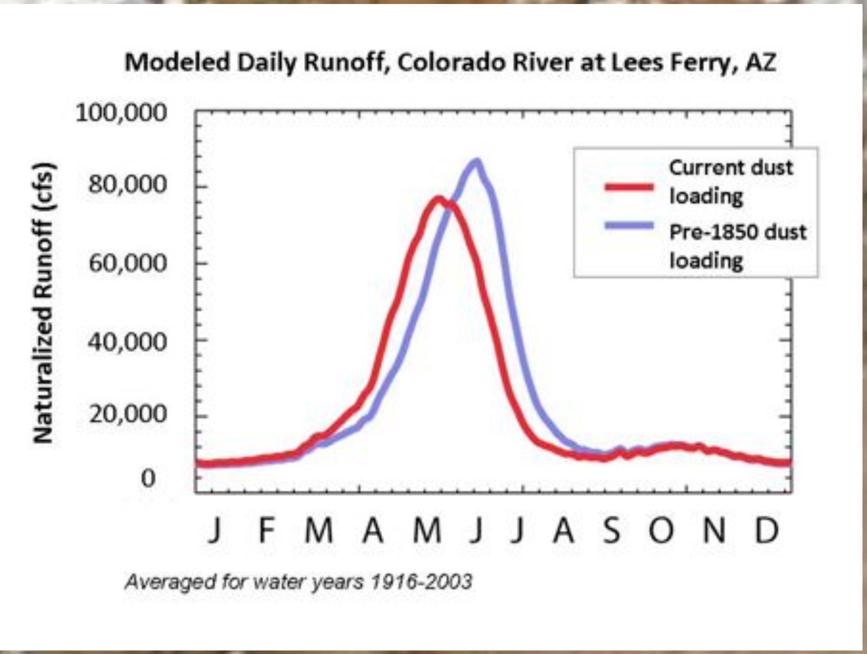
El Niño-Southern Oscillation++++++

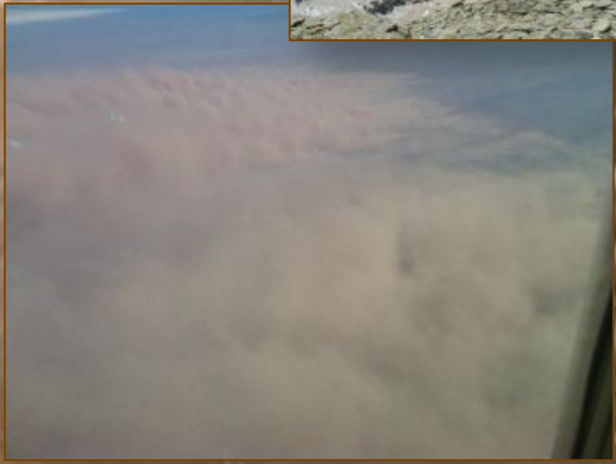
Decadal Variability
Solar Variability
Deep Ocean Circulation
Greenhouse Gases



- Droughts span an enormous range of time scales
- Droughts are caused by a number of complex variables-land surface feedbacks

Dust from NE Arizona



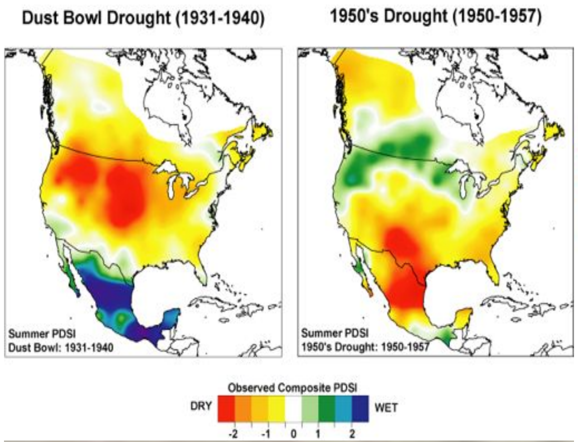


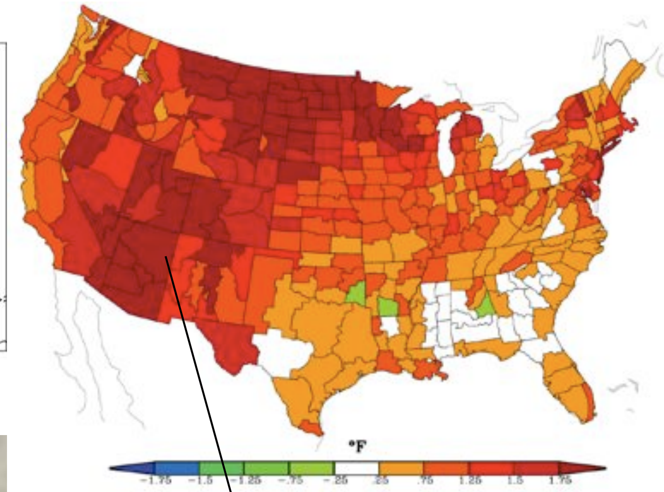
Ecosystem-based drought assessment and mitigation leads to better evaluation

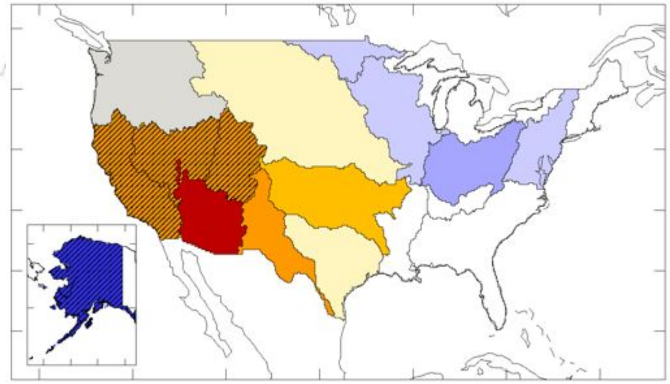
- Rangeland health is ecosystem-based
- Resilience (ability to handle or ride-out impacts) – ecosystems
- Large scale disasters, such as the Dust Bowl

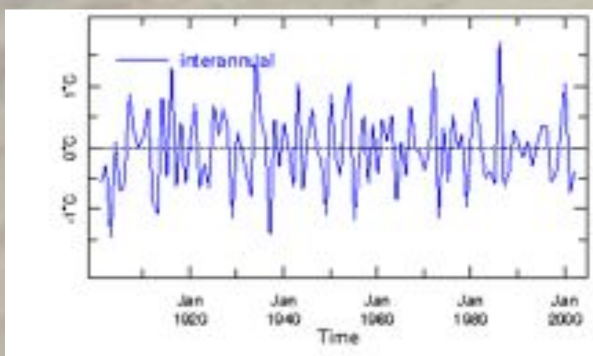
<u>Mitigation approaches can be ecosystem- based</u>

Looking at drought in relationship to ecosystems allows for a wholistic view of the influences of land use and societal issues that can lead to better resilience or more vulnerability









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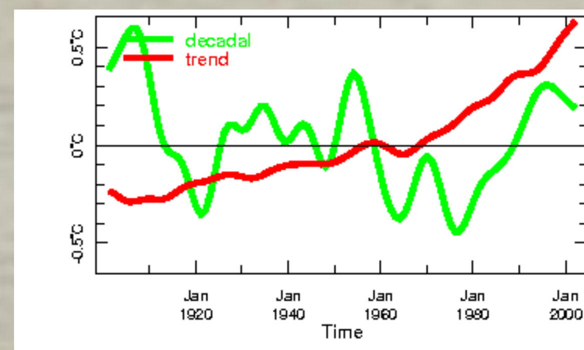

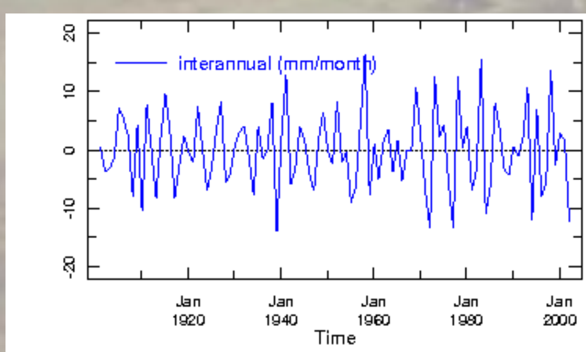

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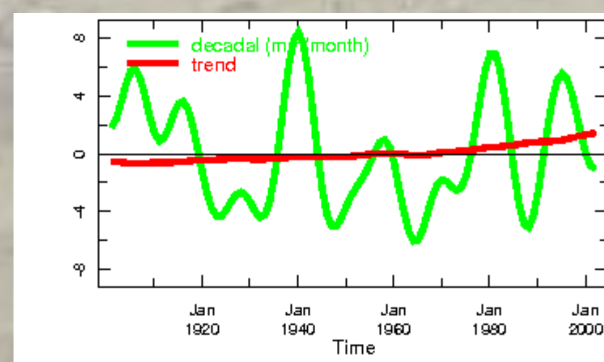
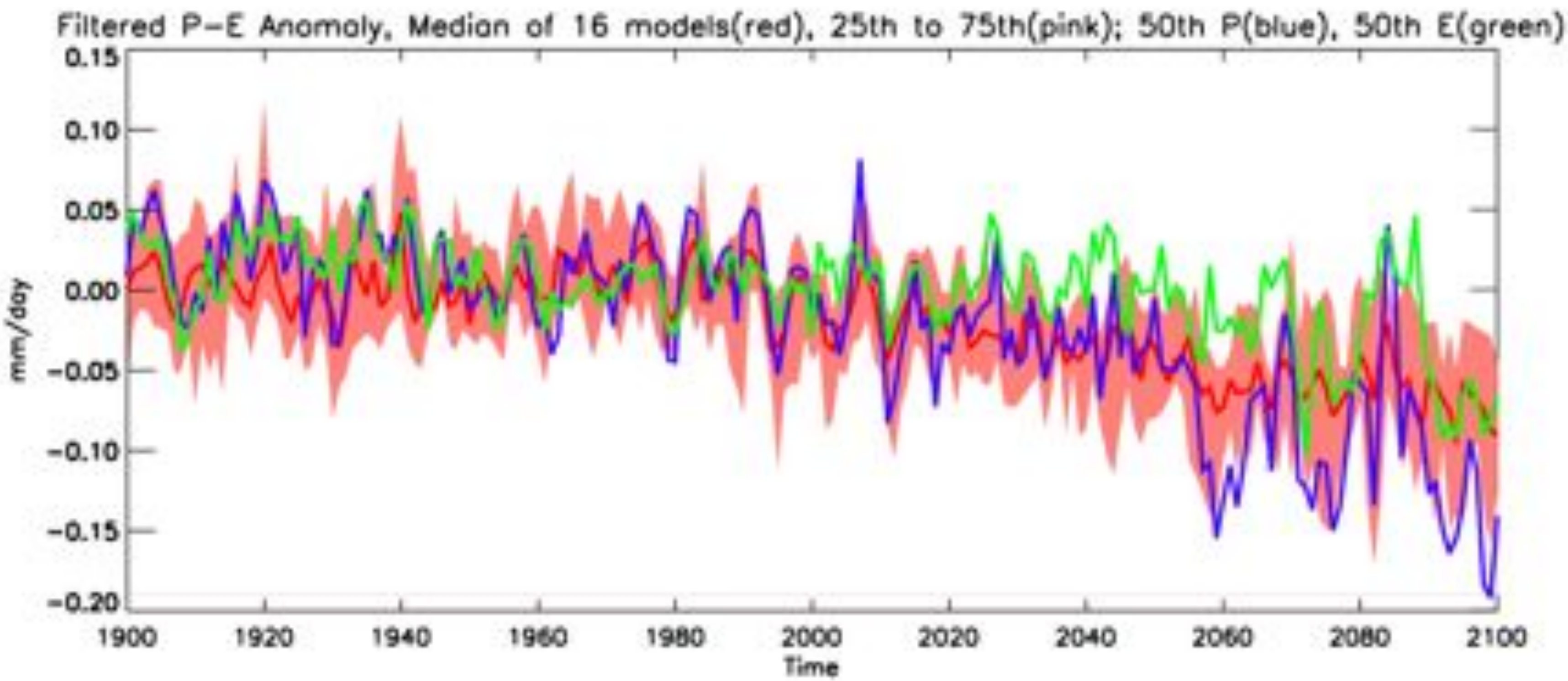


Changes in Average Annual Temperature

1° C increase =>50mm precipitation lost to ET

P, *E* and *P-E* averaged across all of SW North America in the IPCC AR5 global climate model simulations and projections for 1900 to 2100



Ongoing transition to a drier climate driven by decreasing precipitation

Seager, 2012)

ADAPTHOME-

Alliance For **D**rought **A**wareness And **P**articipation **T**owards **H**elping **O**ur **M**other **E**arth