

INCREASING VULNERABILITY TO DROUGHT AND CLIMATE CHANGE ON THE NAVAJO NATION: CURRENT CONDITIONS & ACCOUNTS OF CHANGES DURING THE LAST 100 YEARS



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CONDITIONS IN THE U.S. TODAY

- ✘ The first six months of 2012 now officially the hottest ever recorded.
- ✘ The past 12 months have also been the hottest in recorded history, beating out the record for the previous 12 months.
- ✘ In the last two weeks of June alone, more than 170 all-time heat records were either broken or tied.

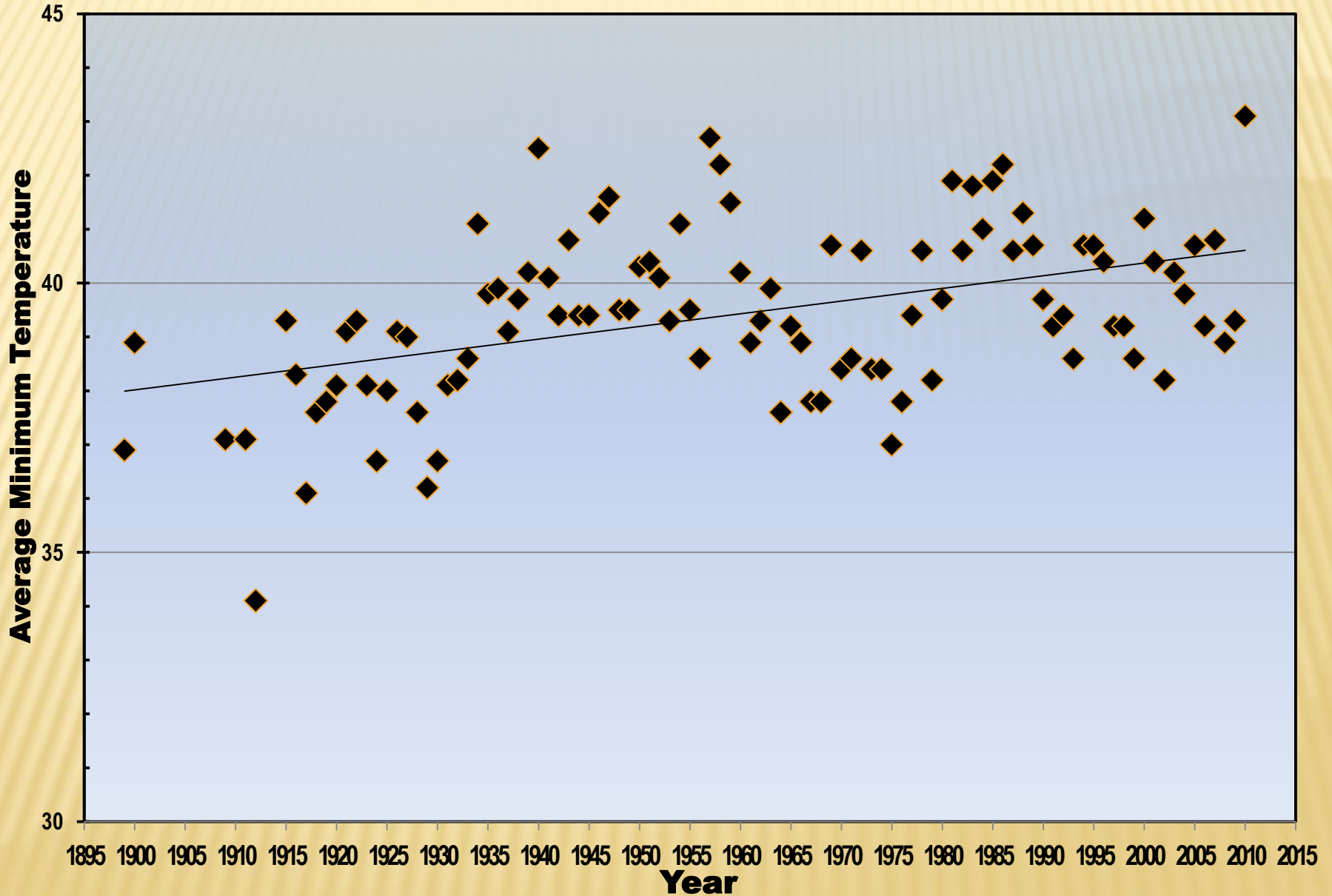
CONDITIONS IN THE U.S. TODAY

- ✘ Blistering heat and drought have fueled record wildfires, damaged the nation's corn crop and killed scores of people.
- ✘ Fires have consumed 1.3 million acres, the second-biggest area to burn during any June on record.
- ✘ While the Great Plains are facing the worst drought in a quarter century, drenching rains in Florida made last month the wettest June on record there.

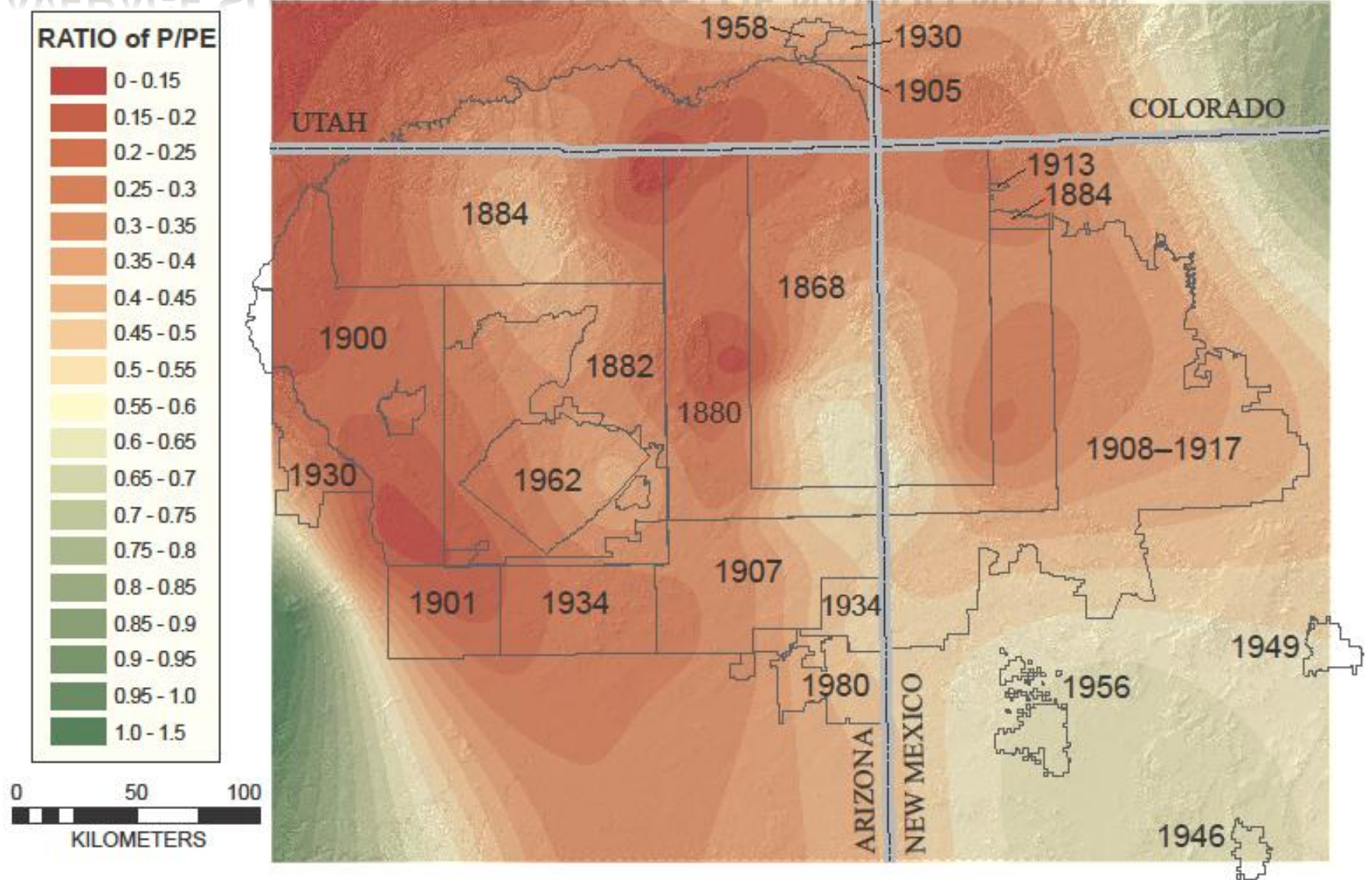
BASED ON LOCAL KNOWLEDGE: PROJECTED CHANGES IN THE SW UNITED STATES MAY HAVE ALREADY BEGUN

- ❖ **On the Navajo Nation, drought conditions have persisted since 1994**
- ❖ **Climate change is influencing drought impacts of the Southwestern United States**
- ❖ **Long term trends of increasing temperature and decreasing snowfall are superimposed on the current drought**
- ❖ **Observations of Navajo tribal elders suggest that these long term trends have had a significant impact on plant and animal populations, as well as living conditions**


Changing temperatures in Winslow AZ



AVERAGE SOIL MOISTURE (P/PE) OF NAVAJO NATION



These are conditions upon which climate change effects are superimposed



From tract after tract of [ancestral] lands they have been driven out year by year by the white settlers of the country until they can retreat no further, some of their villages being literally on the last tillable spot on the deserts edge or in mountains far recesses... many fertile valleys were thirty years ago the garden spots of these same Indians.

-Helen Hunt Jackson

A Century of Dishonor, 1883

What are the impacts of climate change &/or drought??

How do we document them?

Accounts of Traditional Elders & Physical Science Information:

- Accurate accounts of changes verified in scientific data
- 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
- Because the area is poorly monitored, accounts provide additional lines of evidence, and more complete characterization of changes over the long-term

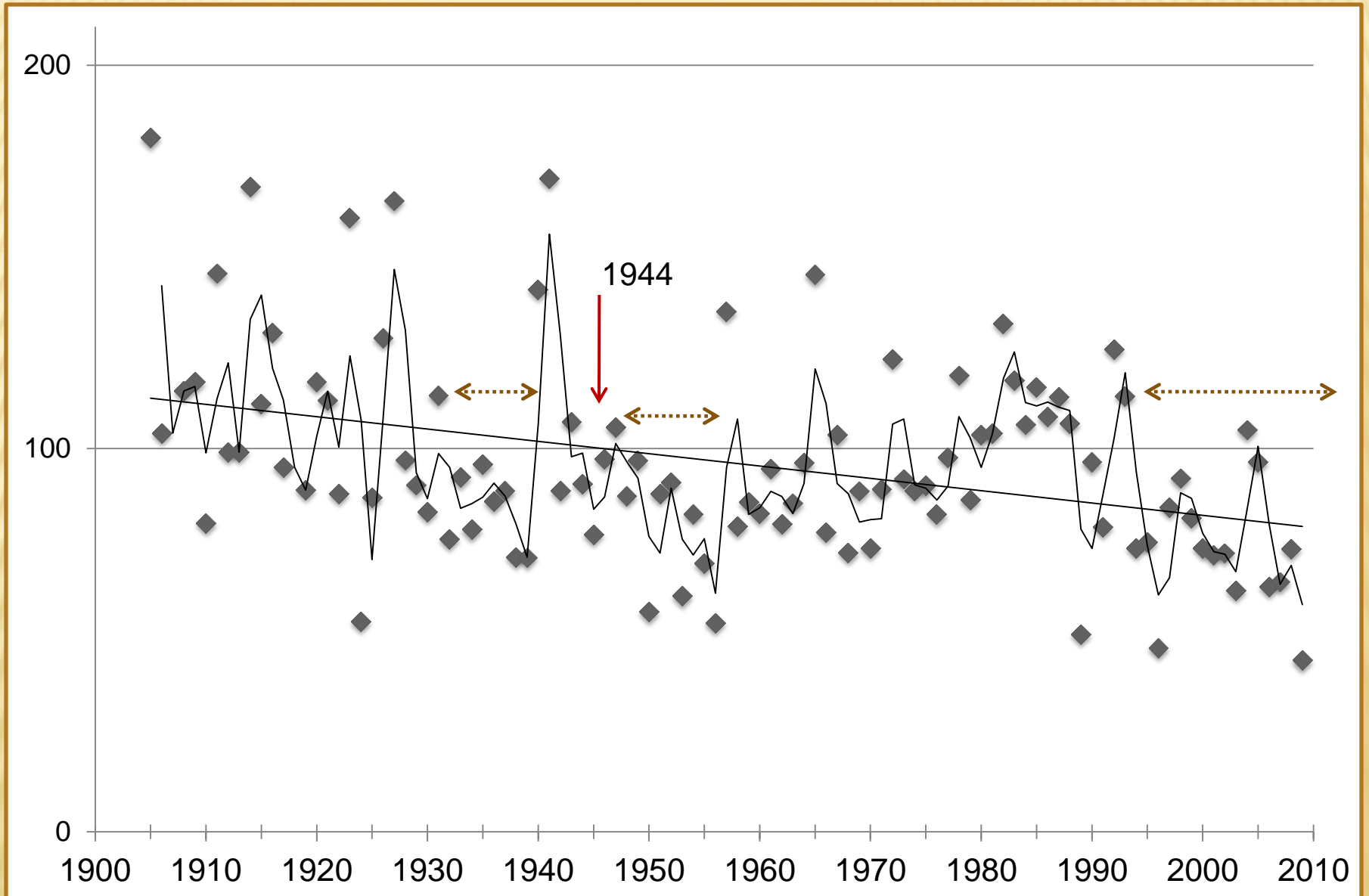


OBSERVATIONS FROM 73 ELDERS:

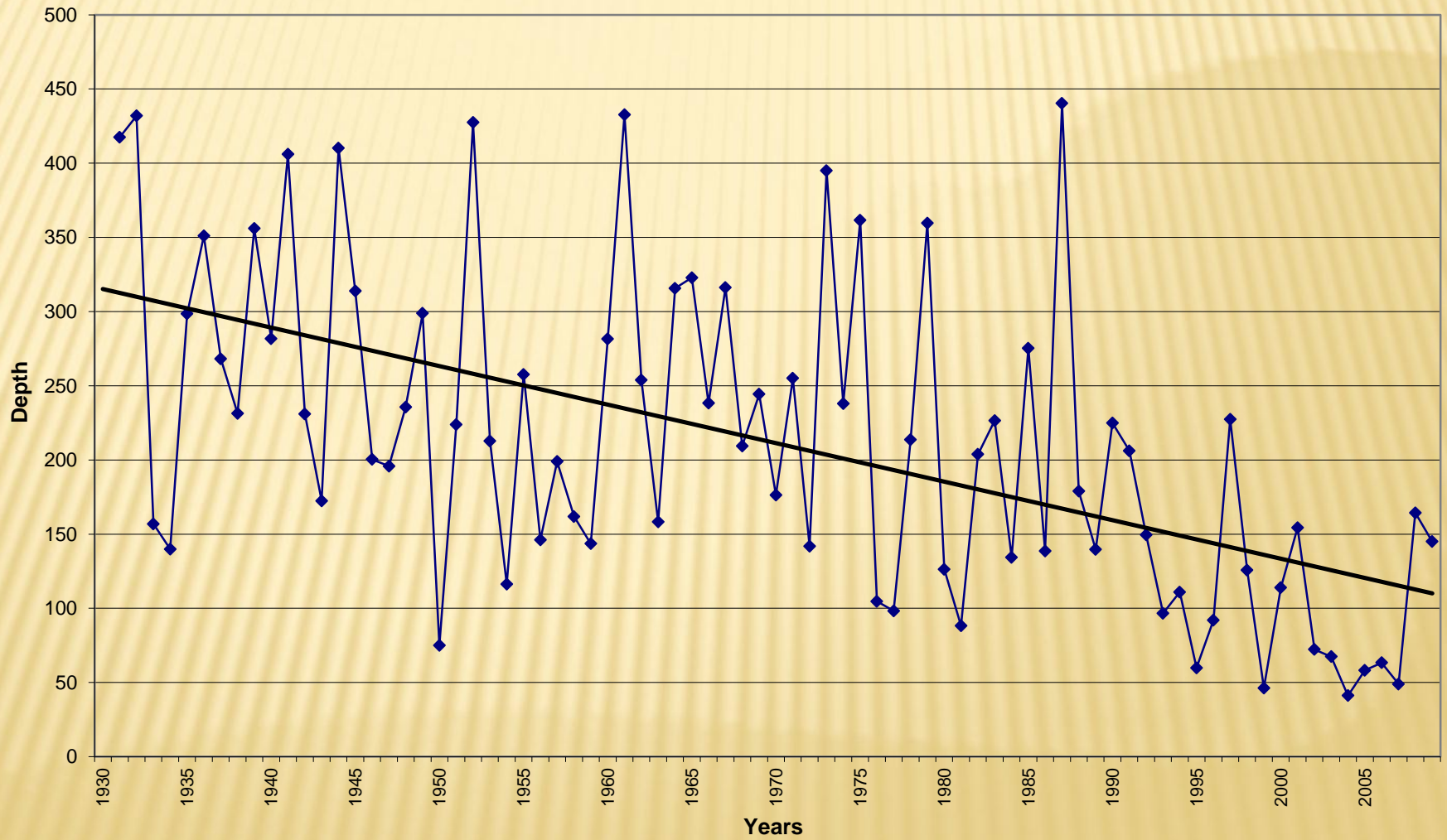
Changes in Weather

- 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

Percent Normal Precipitation on the Navajo Nation



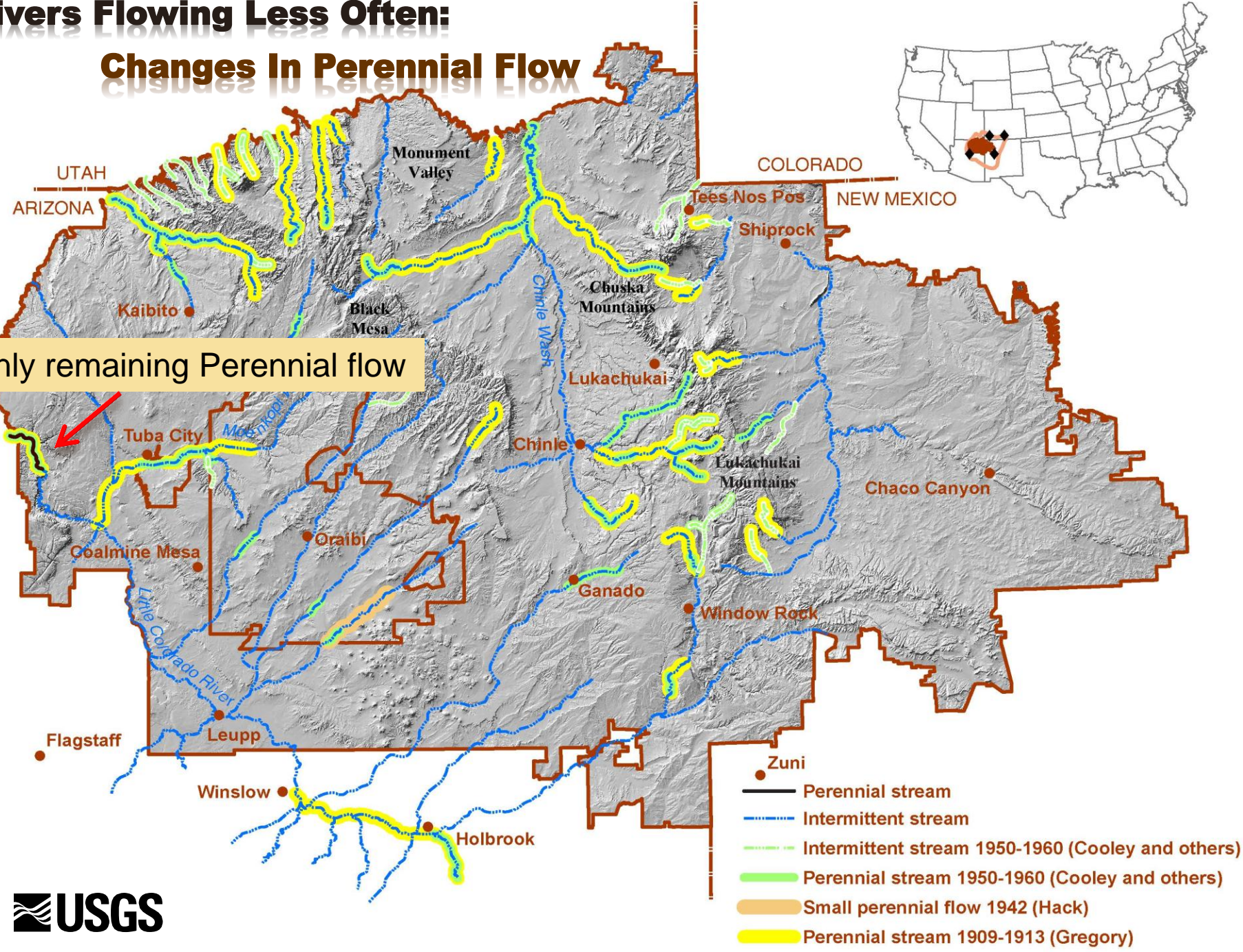
1931 - 2009 Trends in Snowfall for Navajo Nation



Rivers Flowing Less Often: Changes In Perennial Flow



Only remaining Perennial flow



- Zuni
- Perennial stream
- Intermittent stream
- Intermittent stream 1950-1960 (Cooley and others)
- Perennial stream 1950-1960 (Cooley and others)
- Small perennial flow 1942 (Hack)
- Perennial stream 1909-1913 (Gregory)



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

Vegetation that grew when adequate rainfall occurred (2010) died off rapidly during the subsequent dry year (2011). Short-term (single-season) increases in rainfall will not improve landscape stability in the long term because perennials, which are more effective than annual plants at stabilizing sand against wind erosion, require multiple consecutive seasons of adequate rain.

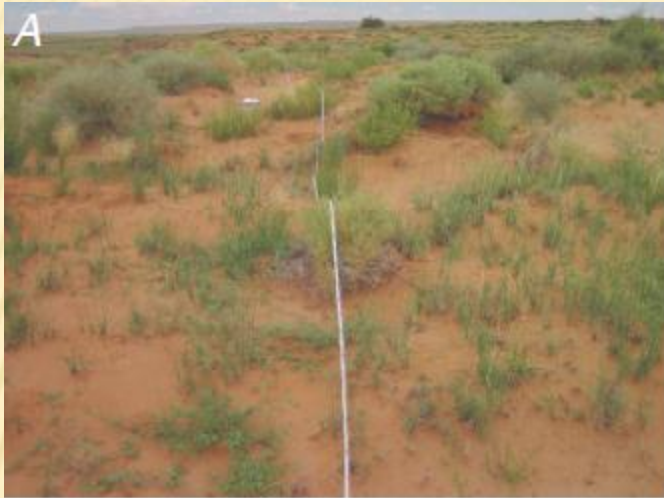
2010

2011



Spring Vegetation Surveys

2010 **2011**



Today there is more blowing sand and dust



DUST FROM NE ARIZONA

UT

CO

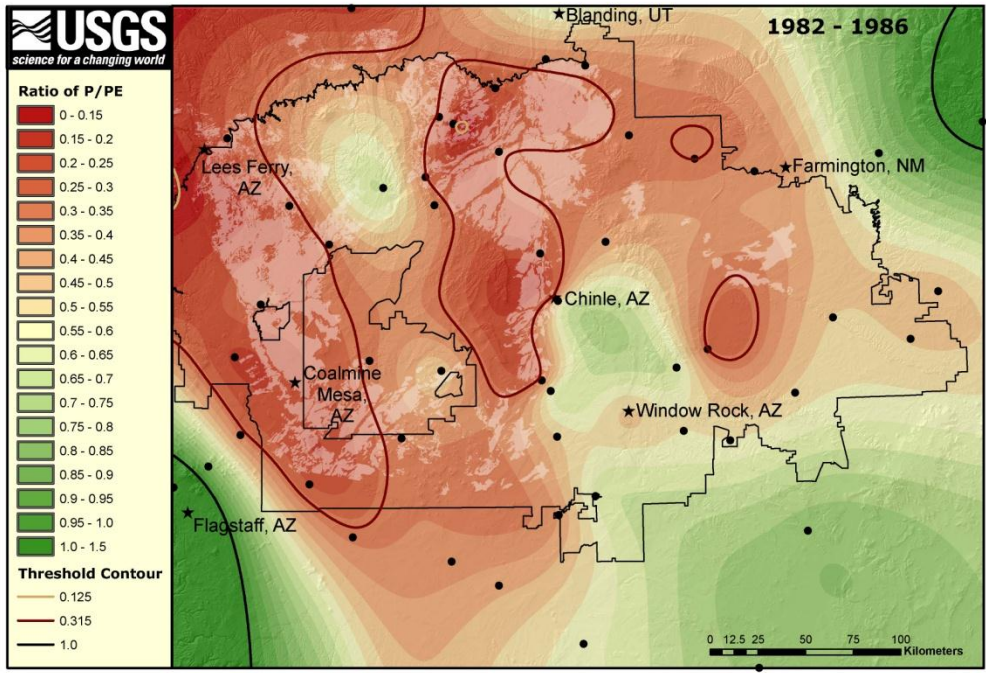
AZ

NM



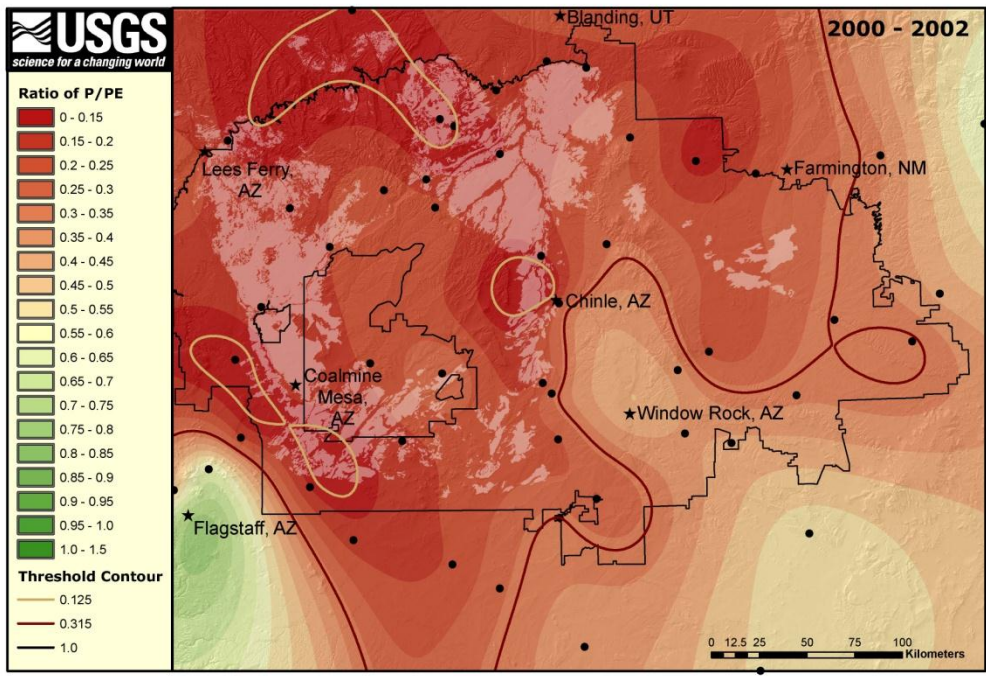
Flagstaff, AZ





DUNE MOBILITY MAPS

- ✘ Maps layers of climate information (P/PE) and distribution of sand dunes
- ✘ Where dunes coincide with low P/PE (Red) likely to have blowing sand and dust



STABLE SAND DUNES = $P/PE > 0.31$



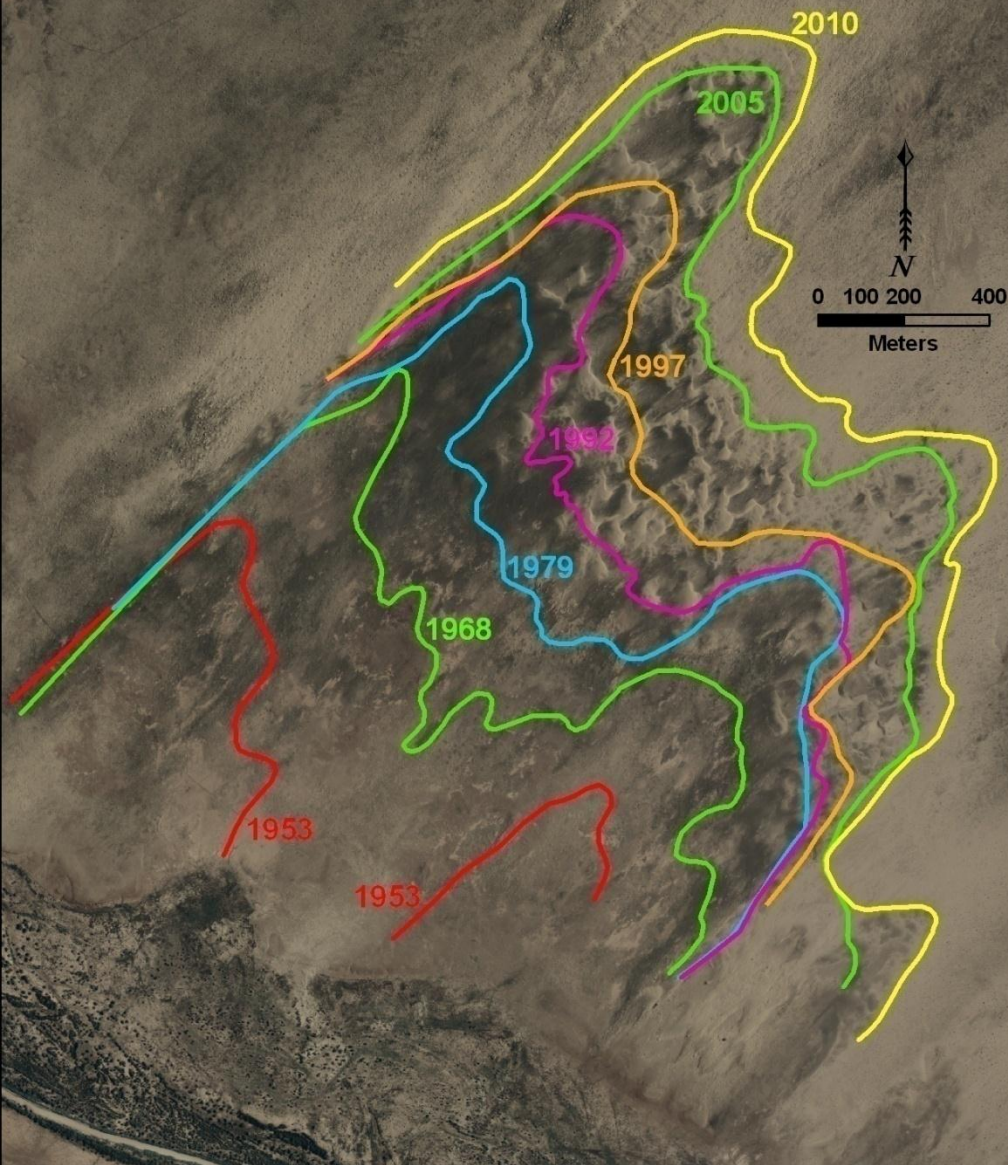
PARTLY ACTIVE DUNES



FULLY ACTIVE DUNES = $P/PE < 0.125$

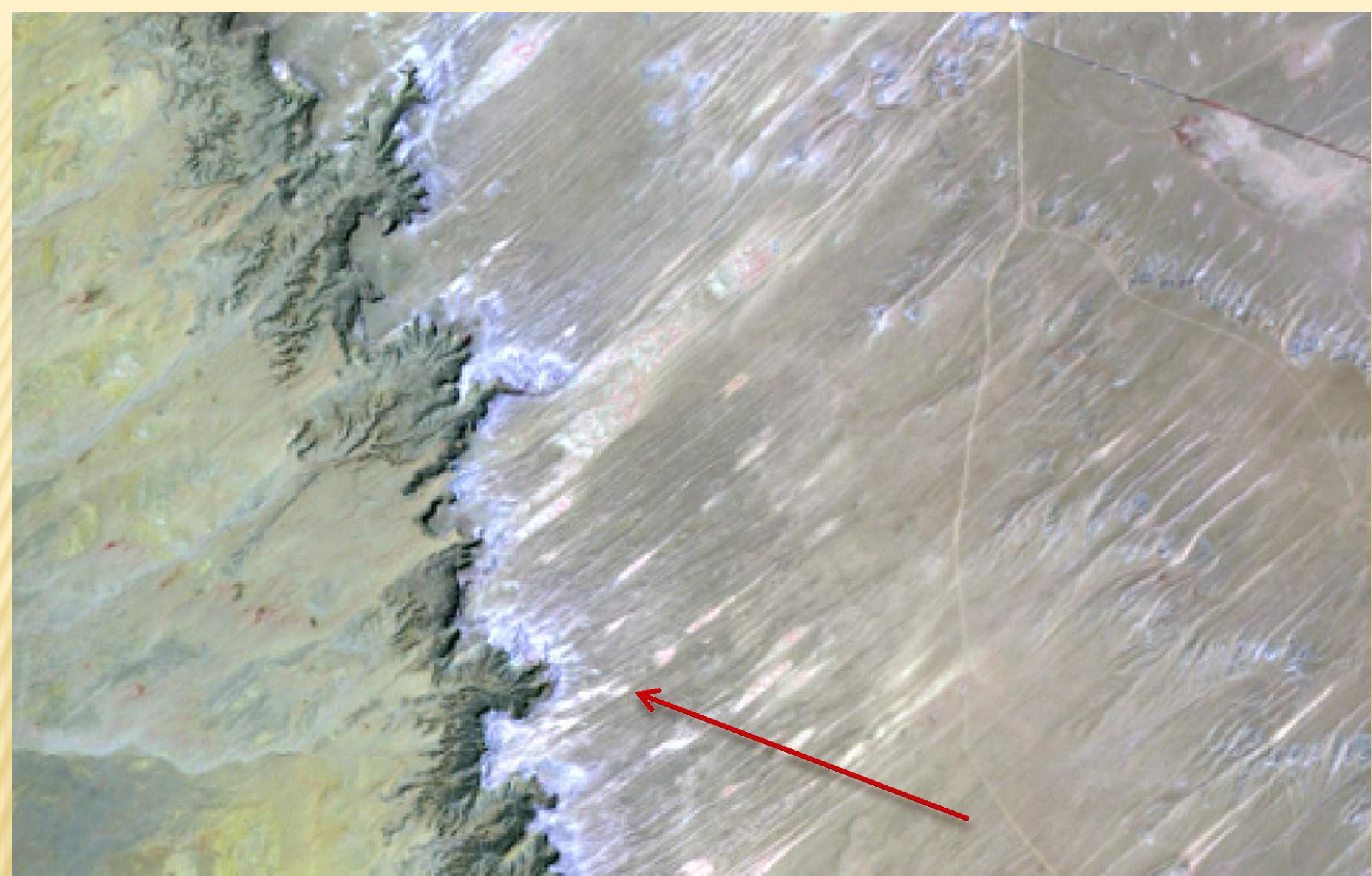


Grand Falls Dune Field Migration 1953 - 2010

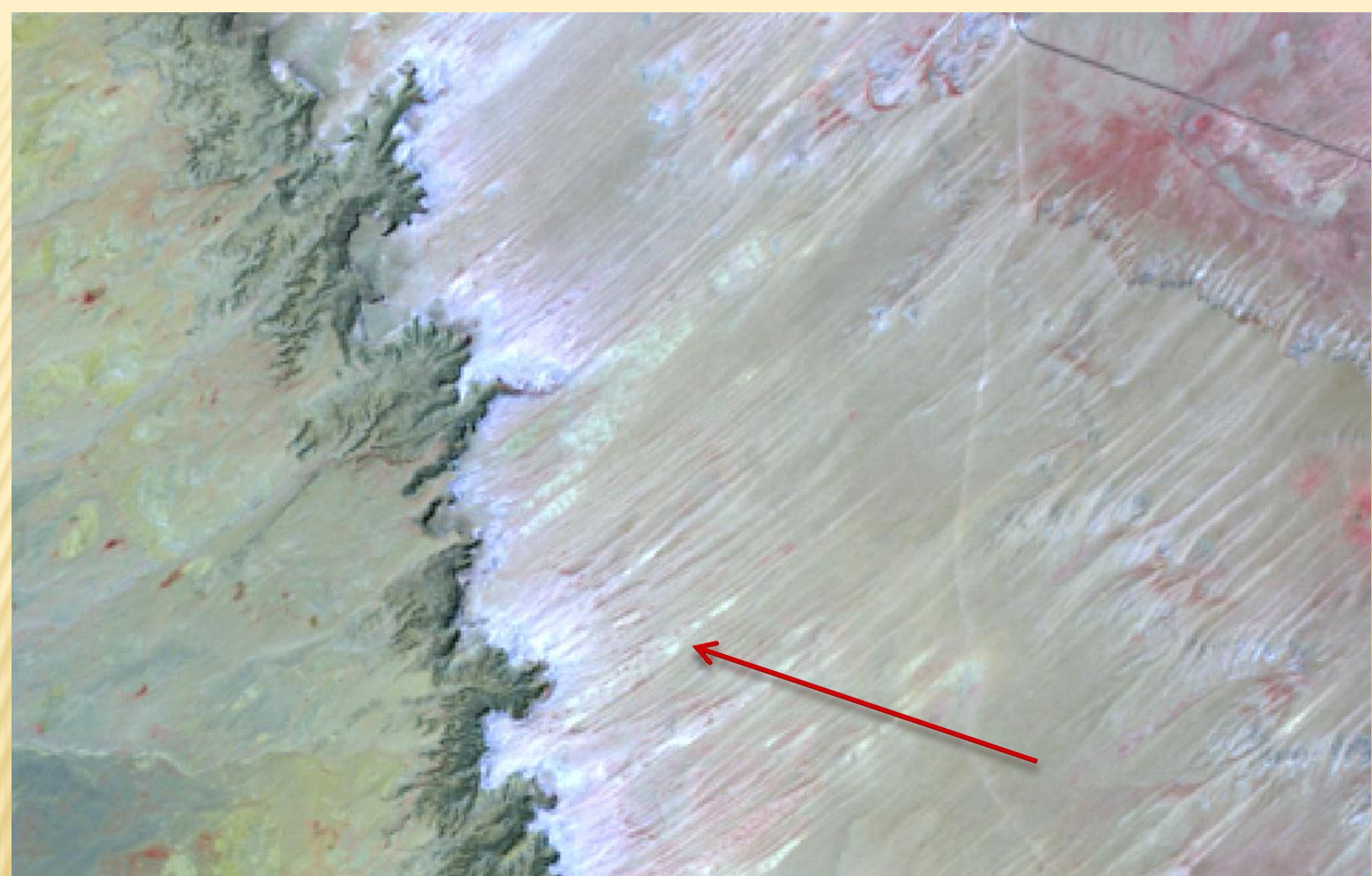


Dune source sediments –
Flood deposits from 1940's

Dune movement beginning
During early 1950's drought



1985 close-up of linear dune field on the Navajo Nation (Landsat band 4,3,2)



2010 close-up of linear dune field on the Navajo Nation (Landsat band 4,3,2)



Direction of sand transport

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



TRADITIONAL KNOWLEDGE AND THE NATIVE PERSPECTIVE:

- Increases our ability to understand changing environmental conditions
- Can provide the close-knit kinship ties that help communities survive adversity



DUNE STABILITY WORK 2011

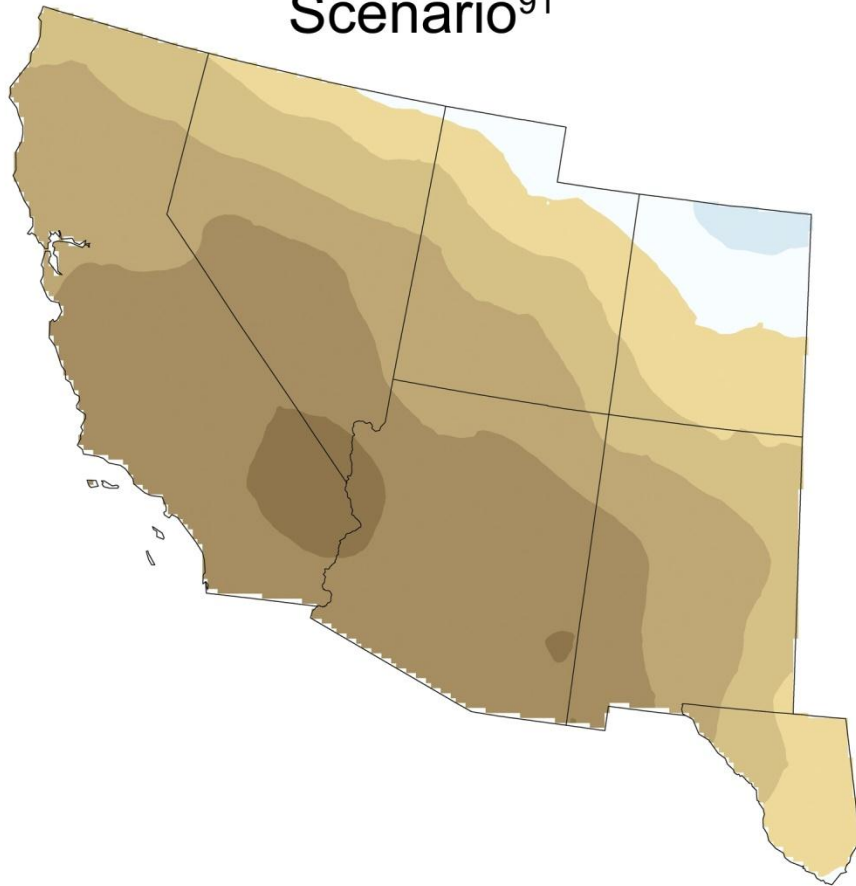




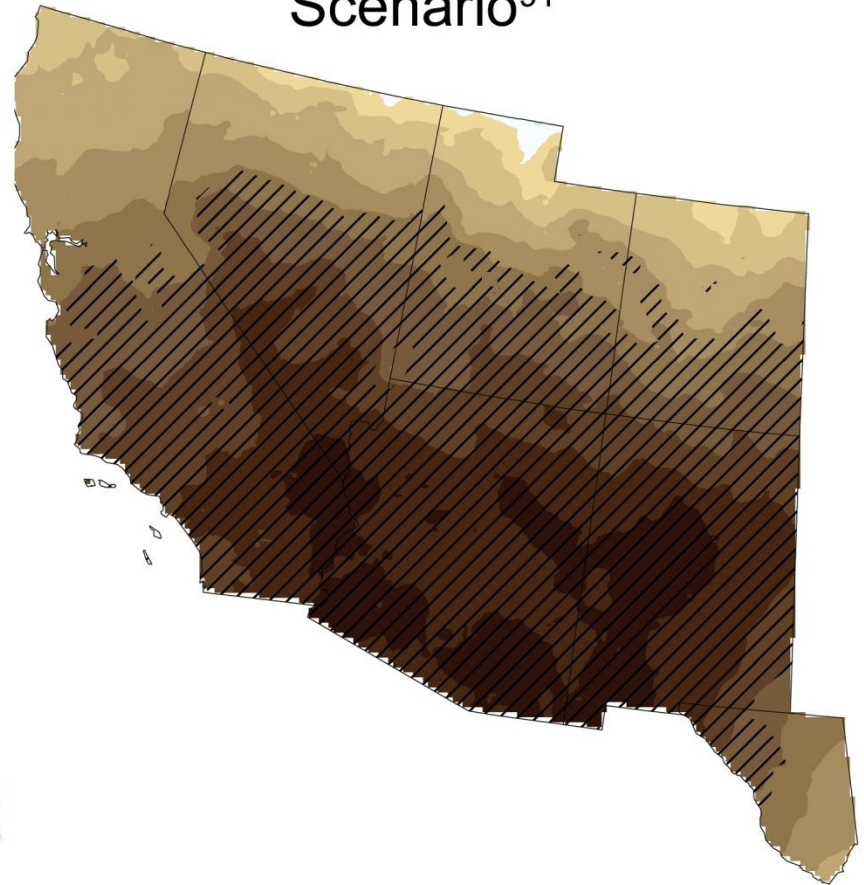
**Rice grass
planting has
been
successful**

But more challenges lie ahead

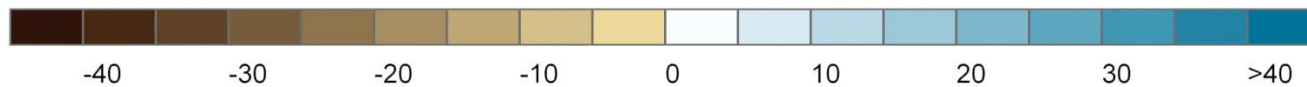
Lower Emissions Scenario⁹¹



Higher Emissions Scenario⁹¹




Precipitation Change in Percent



CMIP3-B¹¹⁷

Percentage change in March-April-May precipitation for 2080-2099 compared to 1961-1979 for a lower emissions scenario⁹¹ (left) and a higher emissions scenario⁹¹ (right). Confidence in the projected changes is highest in the hatched areas.



**Native People have adapted to many changes...
Today the challenges are different,
but the adaptability of Native people is still here,
so is our ability to recognize changes around us**

**When looking at people who have weathered catastrophes,
Being able to recognize the problem at hand,
and address vulnerabilities is the key to survival**

So too, is the need for people to work together and help each other

These are the characteristics most needed for communities to survive