

# Assessment of Impacts of Climate on New Mexico Water Resources over the Next 50 Years

## A Foundation for the New Mexico 50 Year Water Plan

A collaboration between  
two state-funded agencies



# The report is available!

NEW MEXICO BUREAU OF GEOLOGY AND MINERAL RESOURCES

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## Climate Change in New Mexico Over the Next 50 Years: Impacts on Water Resources

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WATER RESOURCES

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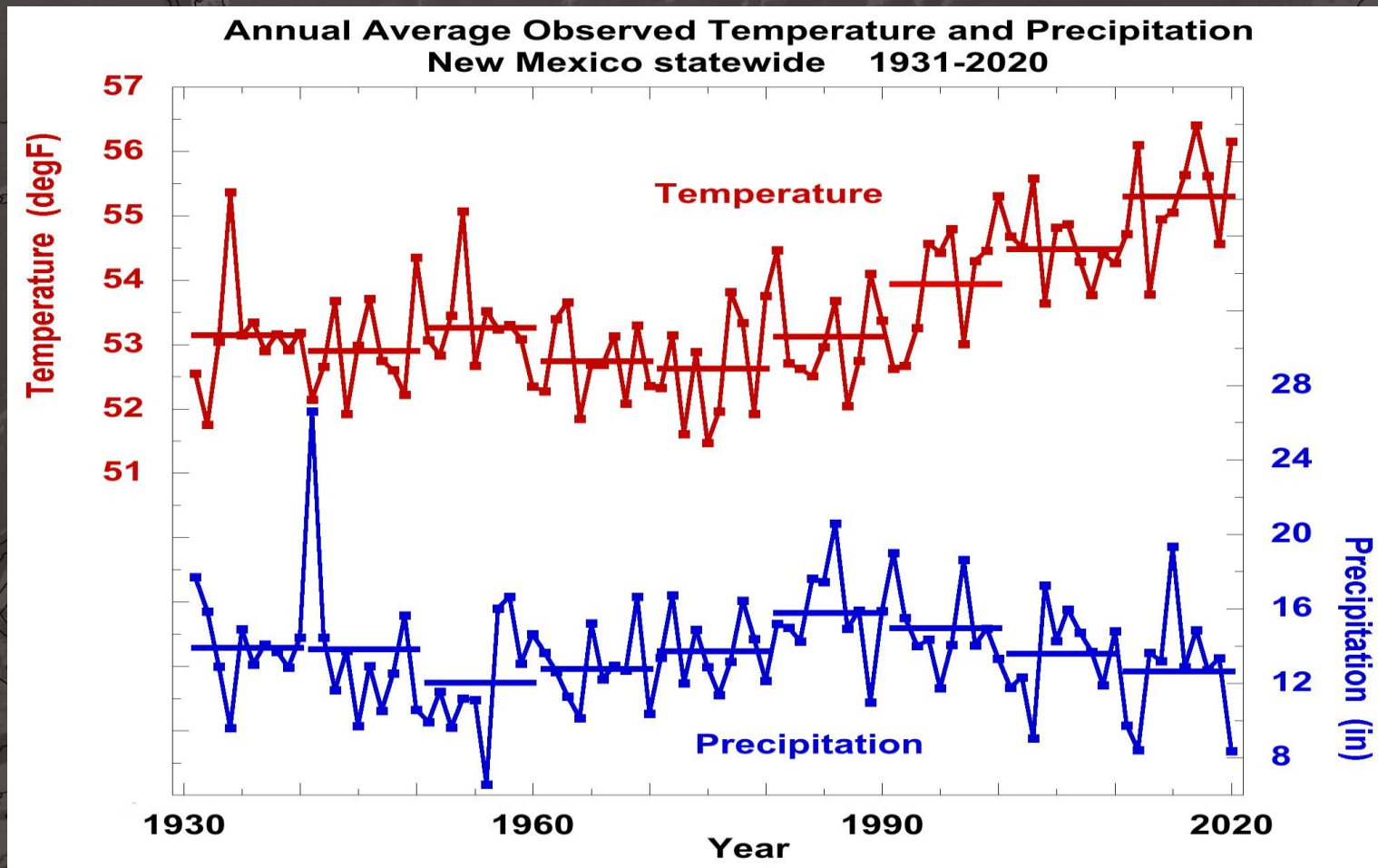
Or...

Search for: Bureau of Geology  
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# Why do we need this?

## New Mexico's climate is warming

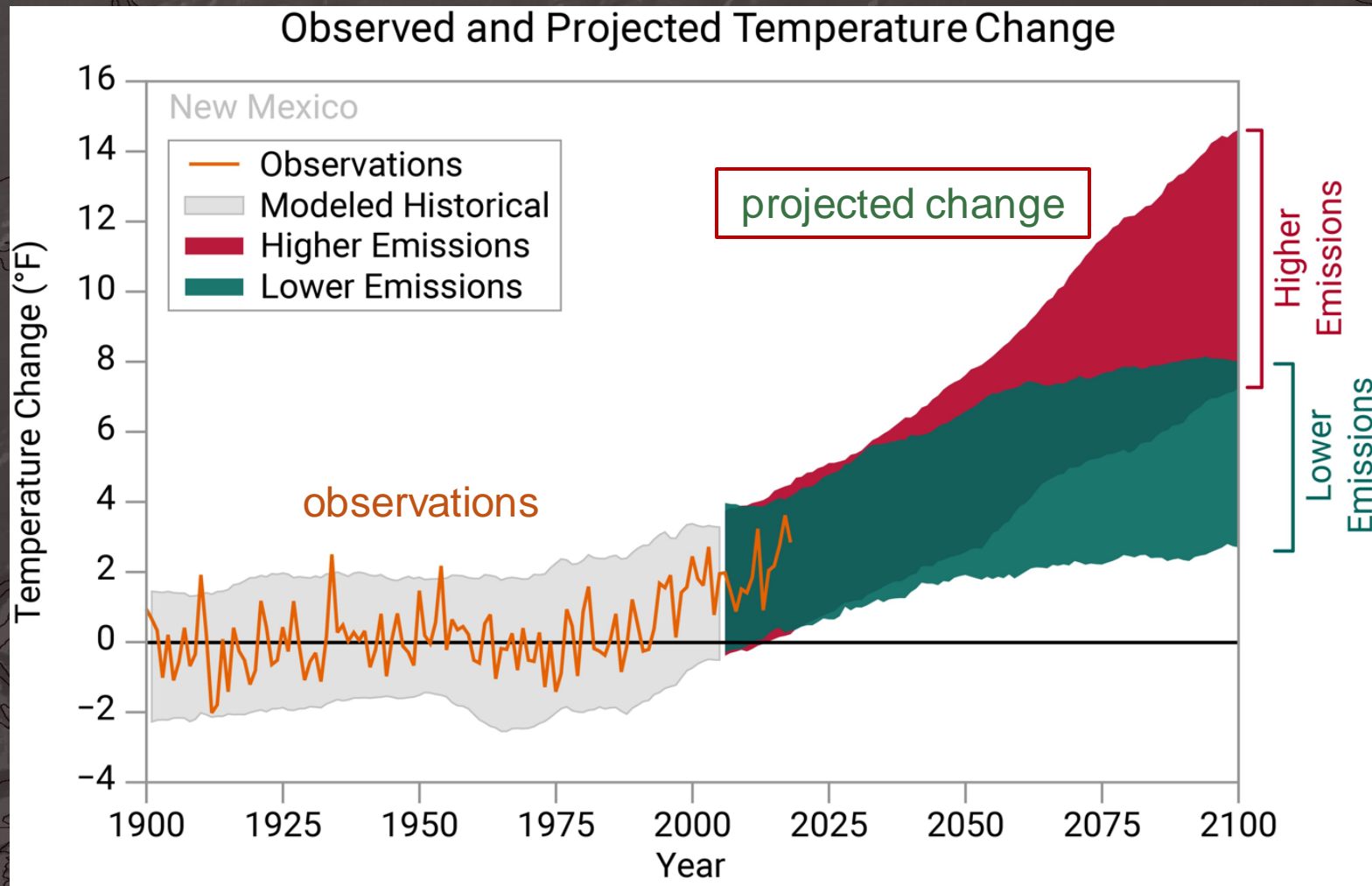
A new 50-year water plan for the state must account for ongoing and future changes to our climate and water resource reliability



Decade-average temperatures have been climbing steadily for the past 50 years

Precipitation has no clear trend but is hugely variable, annually and decadal  
4 of the 5 driest years since 1930 have occurred in the past two decades

New Mexico's climate will continue to warm in response to increasing concentrations of atmospheric greenhouse gases



Red and green bands represent future temperature increases in NM projected by an ensemble of climate models, in response to higher or lower rates of future greenhouse gas emissions

**An experienced team of New Mexico research experts  
was assembled to work together, to assess the  
state of knowledge and develop a review report**

## Ground rules of the study

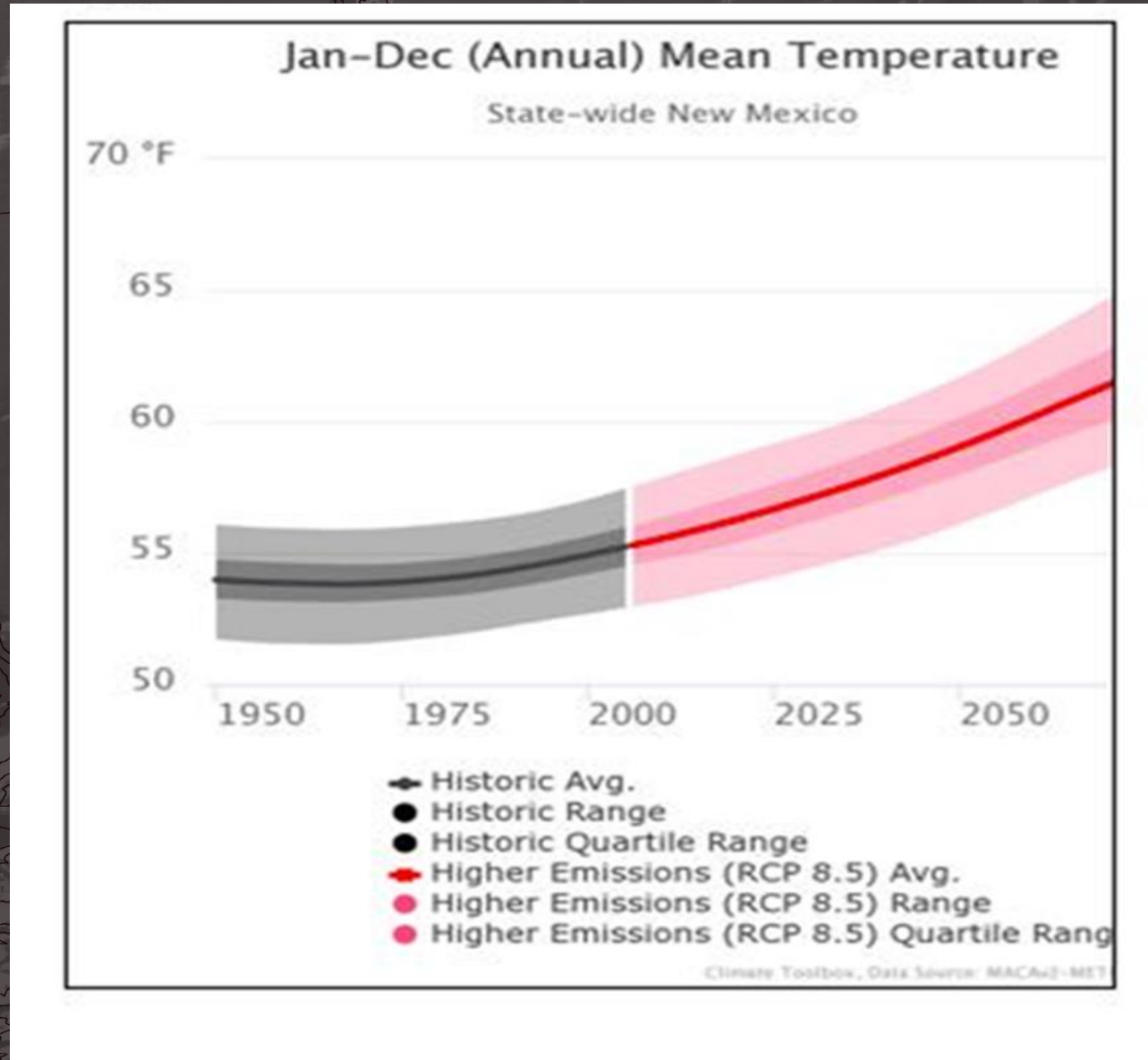
→ **Assess and synthesize recent scientific literature on climate, hydrology, and impacts of these changes**

- Future climate projections
- Changes to the surface water budget
- Ecological dynamics
- Impact on soils
- Landscape change/fires/erosion
- Surface water and groundwater
- Sedimentation in rivers
- Extreme precipitation and flooding
- Water quality

# Climate change is impacting New Mexico's water resources in multiple ways

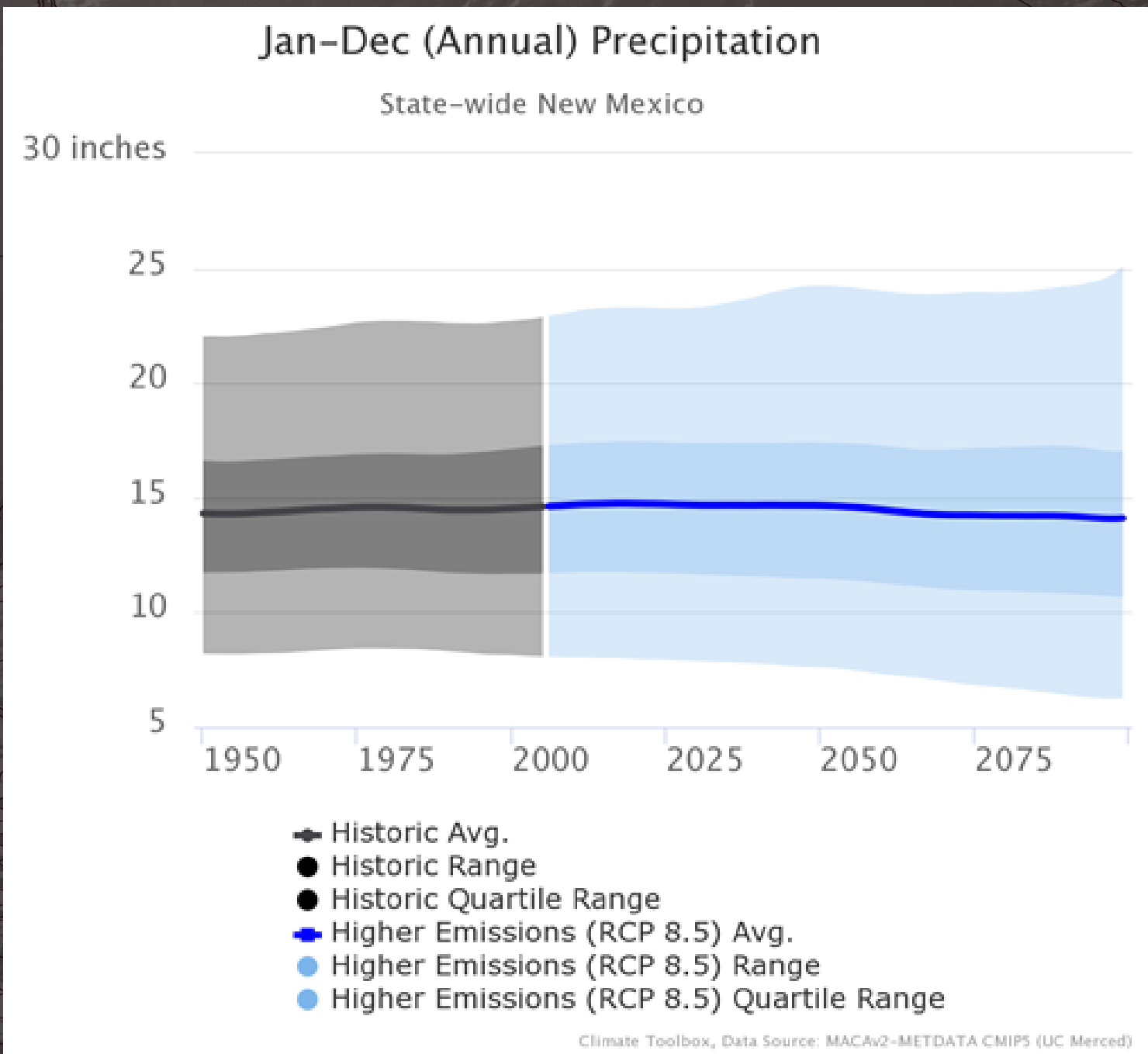
- Lower streamflow and recharge because of increased aridity
- Greater interannual variability in precipitation
- Hotter, more severe droughts
- Decreasing snowpack → earlier and diminishing snowmelt runoff
- Greater demands on groundwater
- Vegetation stress
- Increasing catastrophic forest fires
- Increasing flooding and sedimentation in rivers
- Irreversible damage to soils through loss of vegetation and erosion
- Degraded quality of surface waters

# Future Climate Projections



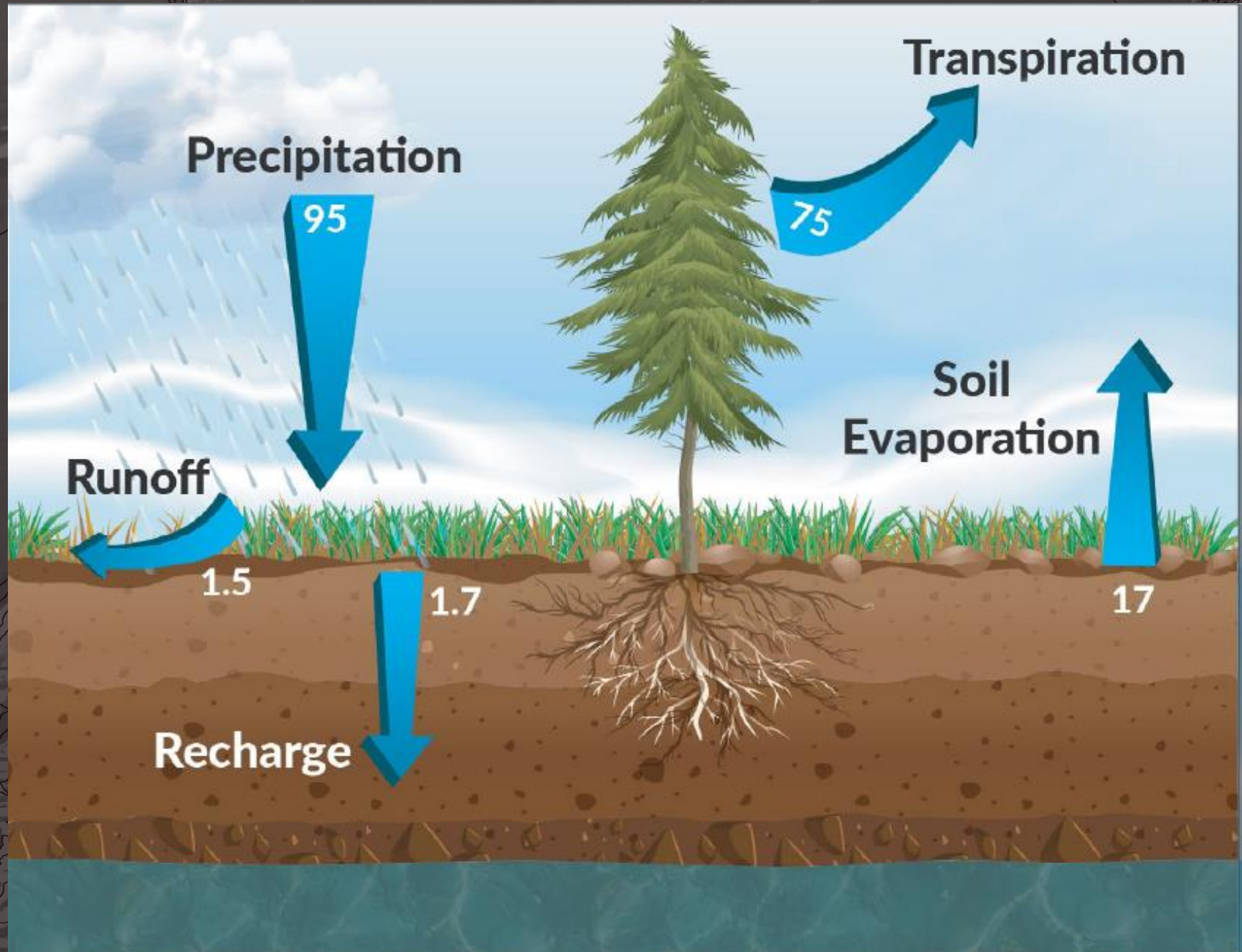


# Average Precipitation



# Land-surface water budget in New Mexico's arid climate

Numbers represent millions of acre-feet per year



# Even with no trend in precipitation, New Mexico will become more arid because of increasing air temperature

- The amount of water that air can “hold” goes up as the air temperature rises (a ~2°F increase in temperature allows air to hold 7% more water vapor).
- Liquid water will be lost more rapidly from leaves and soil.
- Dry soil “sucks in” precipitation faster than wet soil, causing less runoff and recharge.

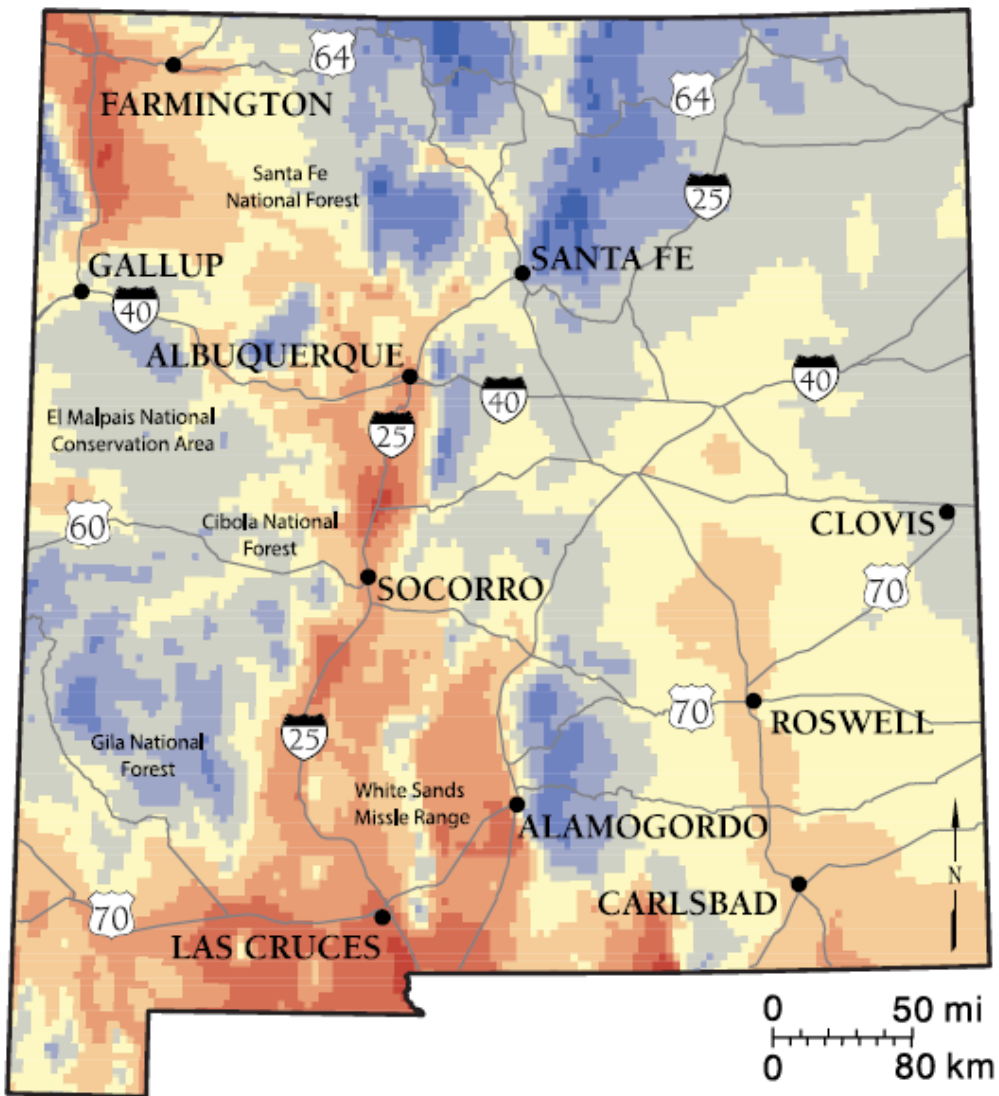
Aridity Increases



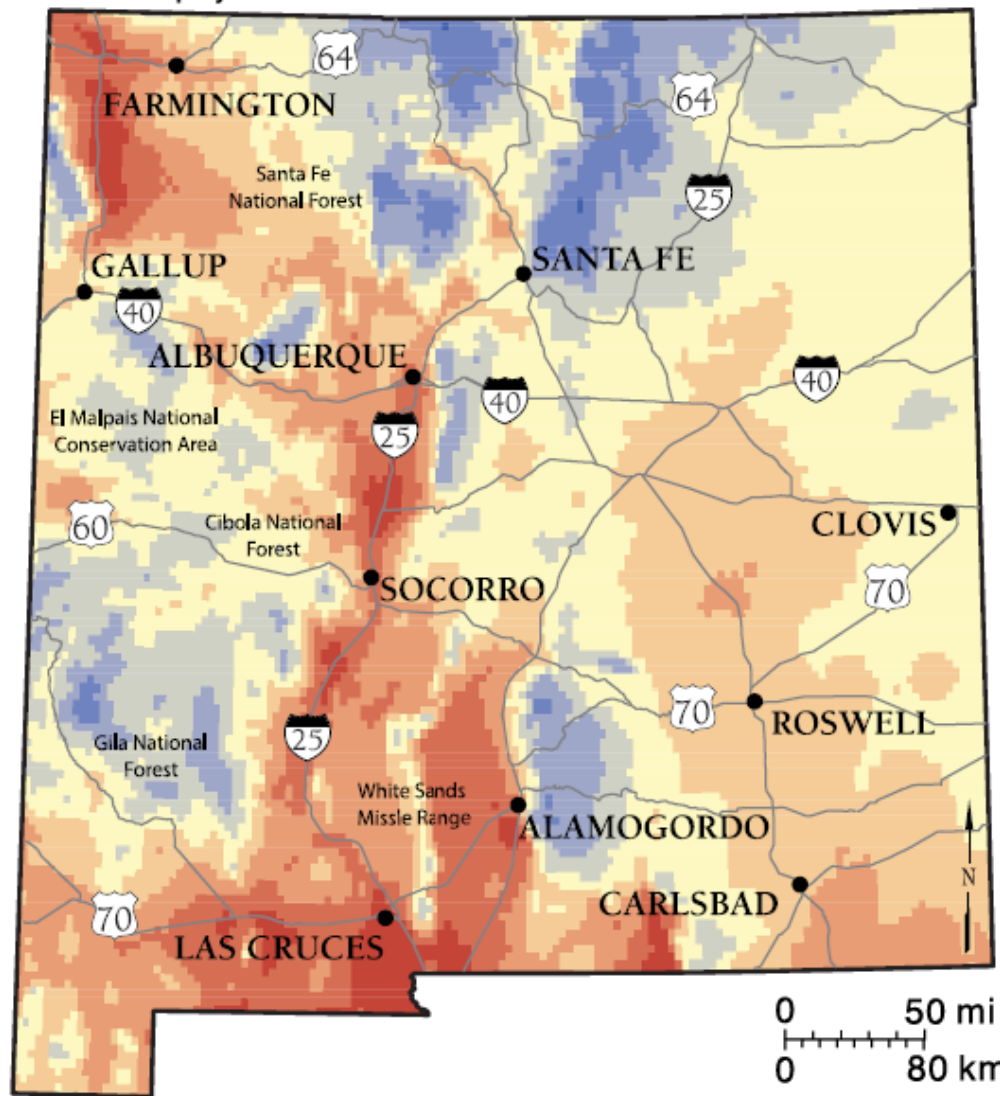
More Severe Droughts

$$\text{Aridity Index} = \text{Average Potential Evapotranspiration} / \text{Average Precipitation}$$

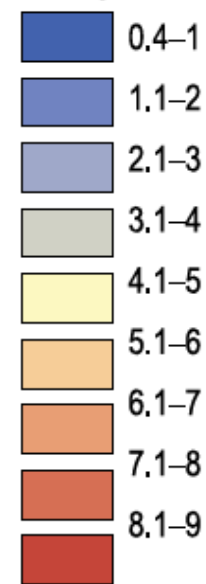
**A** Historical 1970–2020



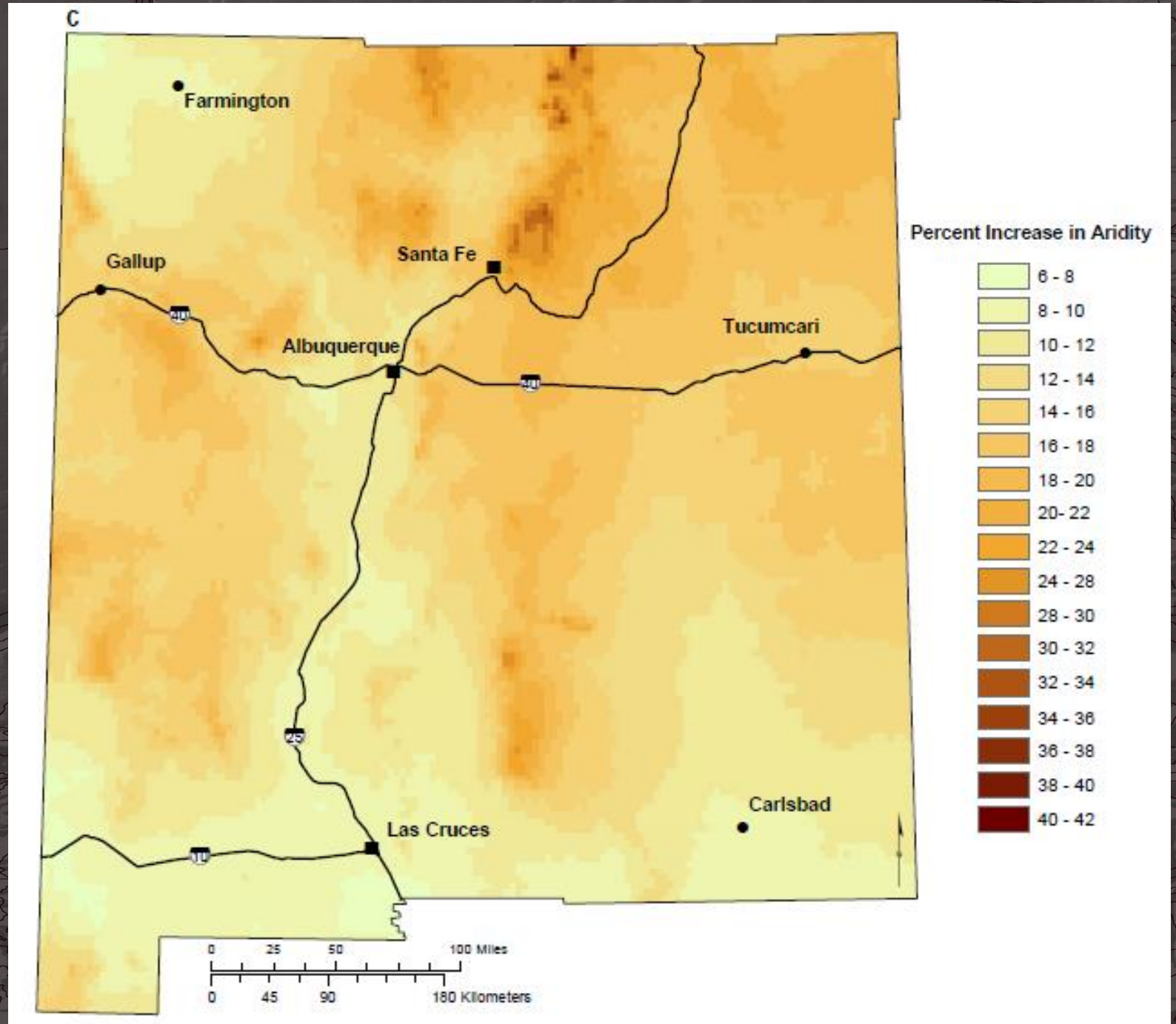
**B** Future projection 2040–2069



**Aridity index**

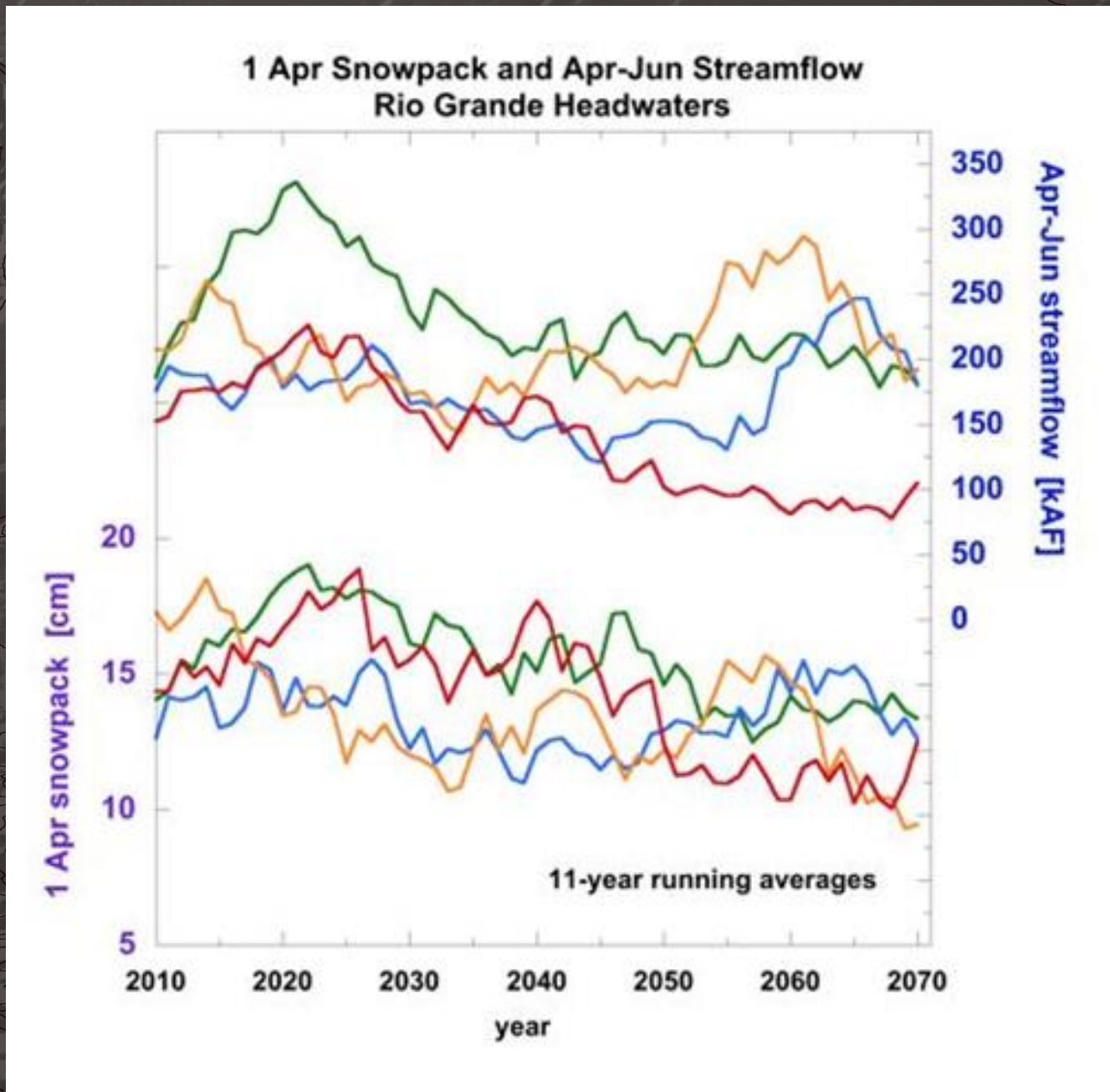


# Percent increase in aridity index between 2040-2069 and 1970-2000



# Snowpack and spring streamflow will decline

Different colored lines represent 4 individual simulations that show range of future projections



# Impacts of drought on forest health



# Post-fire erosion





# Extreme post-fire sedimentation



# Extreme Precipitation

- Based on increased atmospheric moisture and temperature, more extreme precipitation events would be expected.
- Record over past 20 years is notably variable, so difficult to use past data to predict future behavior



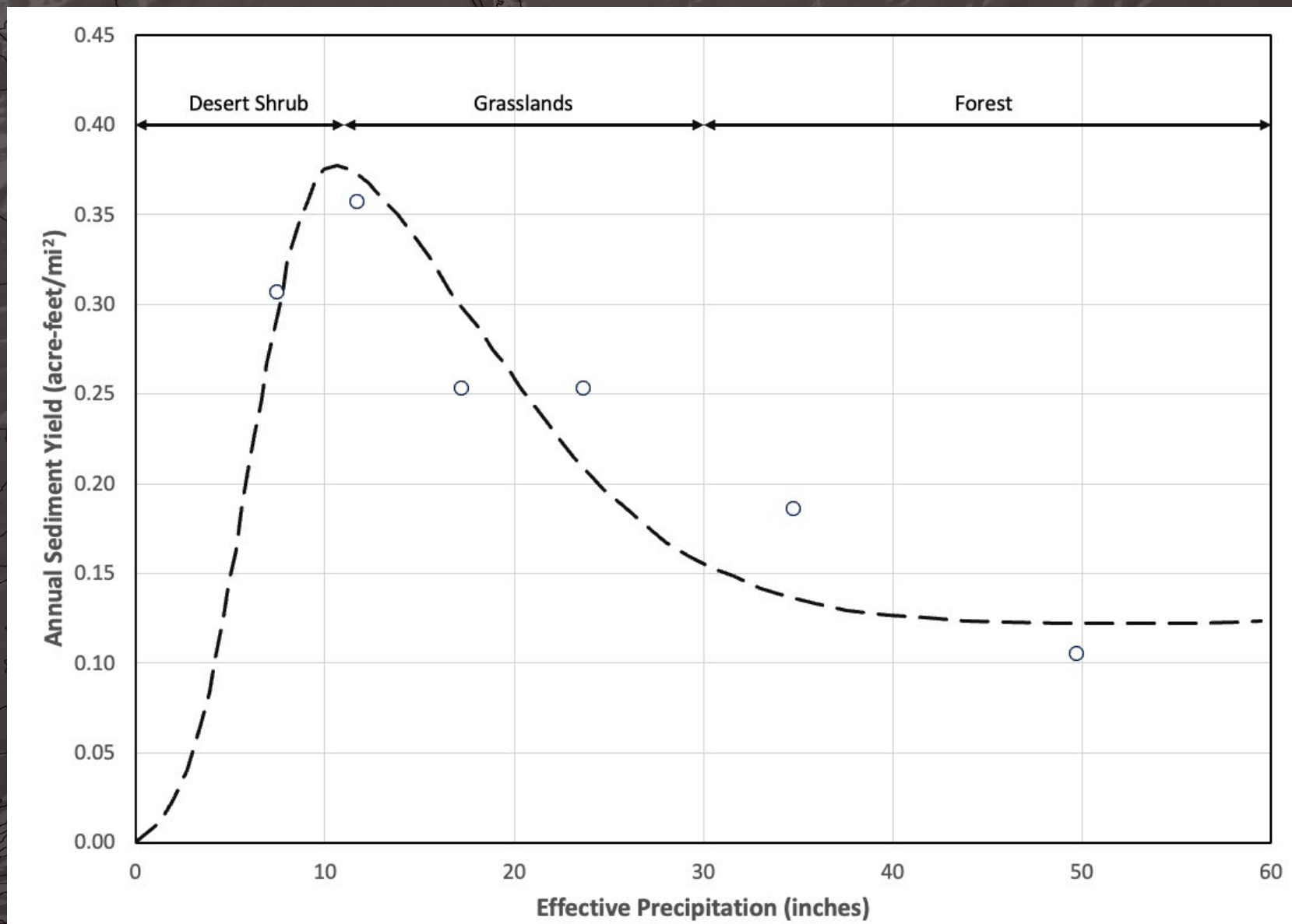
Photo by Dana Ulmer-Scholle

# Impact on New Mexico Rivers

- Over next 50 years, flow will decline by 16-28%
- Due to extreme precipitation and fire-drive disruption of watersheds, the amount of sediment delivered to rivers will double
- Beds of undammed rivers will be built up
- Reservoir capacity will be reduced
- Channels will narrow



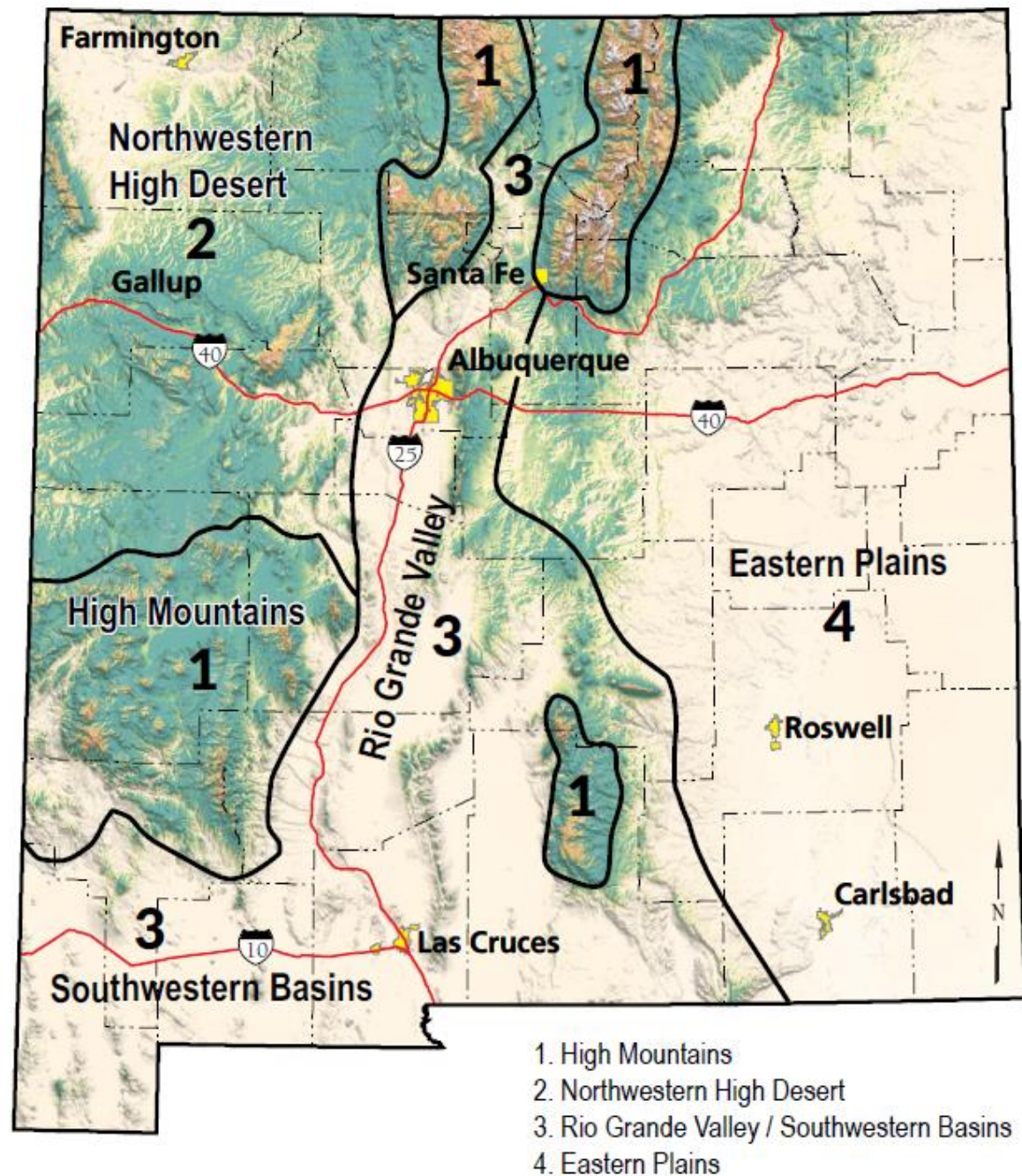
# Sediment yield as a function of precipitation and vegetation type



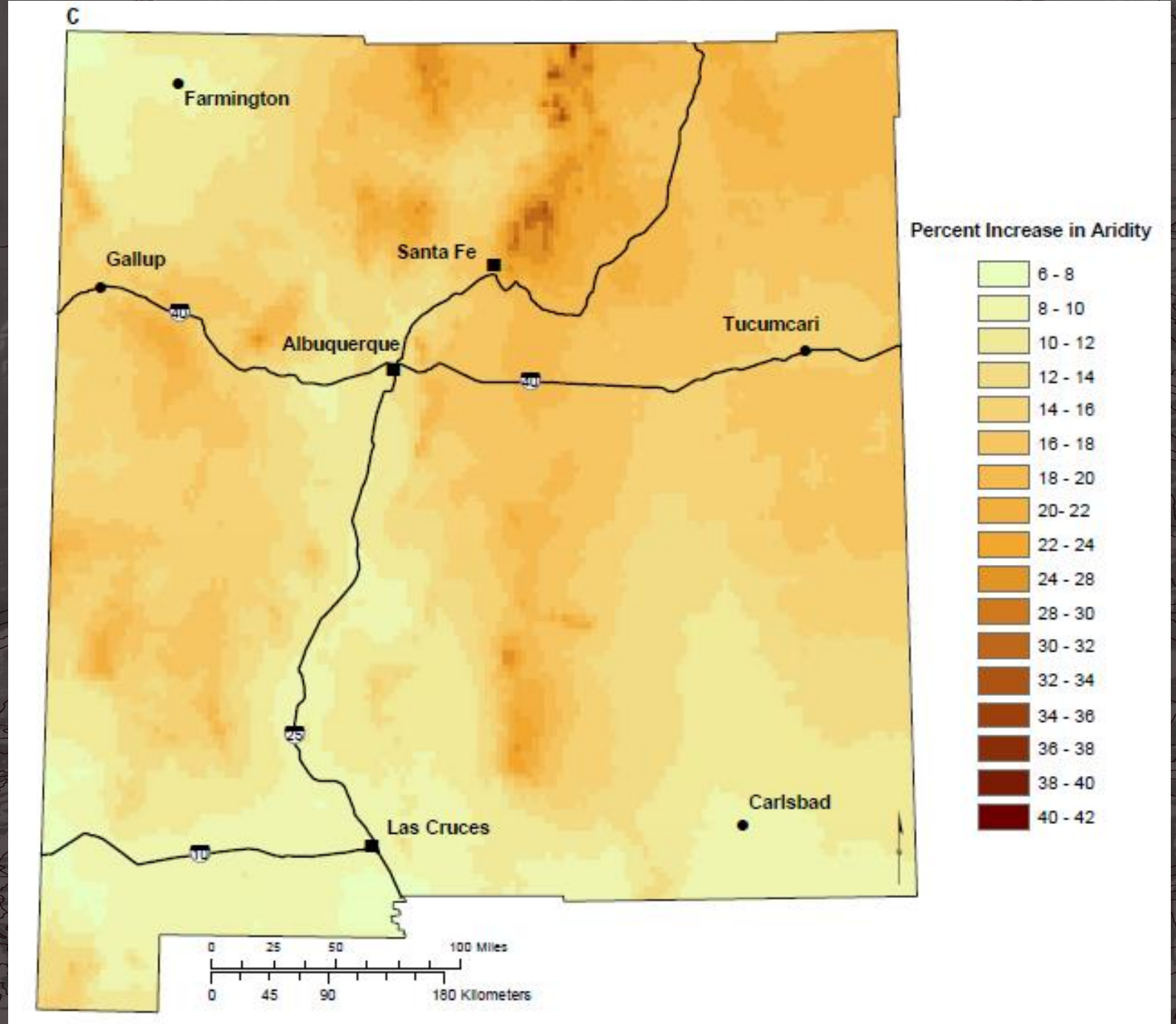
# Statewide and Regional Impacts

New Mexico is a state characterized by varied landscape. Increasing temperature will have different impacts on different parts of the state. We identified 4 regions which may experience similar impacts.

1. High Mountains
2. Northwestern High Desert
3. Rio Grande Valley/SE Basins
4. Eastern Plains



# Percent increase in aridity index between 2040-2069 and 1970-2000



# Dominant Impacts by Region

- **High Mountains**
  - Will be most impacted by climate change, and impacts will be felt throughout the state. Less snowmelt and higher evapotranspiration
  - Changes to plant communities and increased wildfire will be felt not only in the mountains, but also in “downstream” areas
- **Northwestern High Desert**
  - Loss of soil
  - Increased dustiness
  - Increased arroyo incision
  - Possible transition from grasses to shrubs

## Dominant Impacts by Region

- **Rio Grande Valley/Basin and Range**
  - Lower river flows (25% lower flow in Rio Grande in 50 years), changes in timing of runoff, trending earlier
  - Greater loss of water from reservoirs (with a 5 degree temperature increase, Elephant Butte will lose 2 additional feet of water per year)
- **Eastern Plains**
  - Extreme precipitation events
  - Loss of soil, increased desertification
  - Increased dustiness



## Chapter XII. Data Gaps and Research Directions

### PRECIPITATION

- Further assessment of extreme precipitation and seasonality of precipitation
- Better understanding of snowmelt runoff

### MODELS

- Fine-tuning local climate models, allowing determination of the most probable climate outcomes, as well as better understanding of clouds in GCMs
- Calibrated hydrological model for recharge and runoff specifically for NM
- Simpler vegetation dynamics models that incorporate disturbance processes

## OBSERVATIONAL DATA GAPS

- Quantitative and geographically distributed measurements of NM aquifer water levels and public accessibility of such data
- Soil moisture
- Impact of climate change on water quality
- Hydrological response to watershed vegetation changes
- Timing of landscape readjustment to climate disturbance
- Studies of soil, plant communities, and landscape characteristics in high elevation mountain ranges where recharge and runoff occur
- Long-term ecological monitoring and research to understand response of NM ecosystems to climate change, and associated ecohydrological responses

# Questions?

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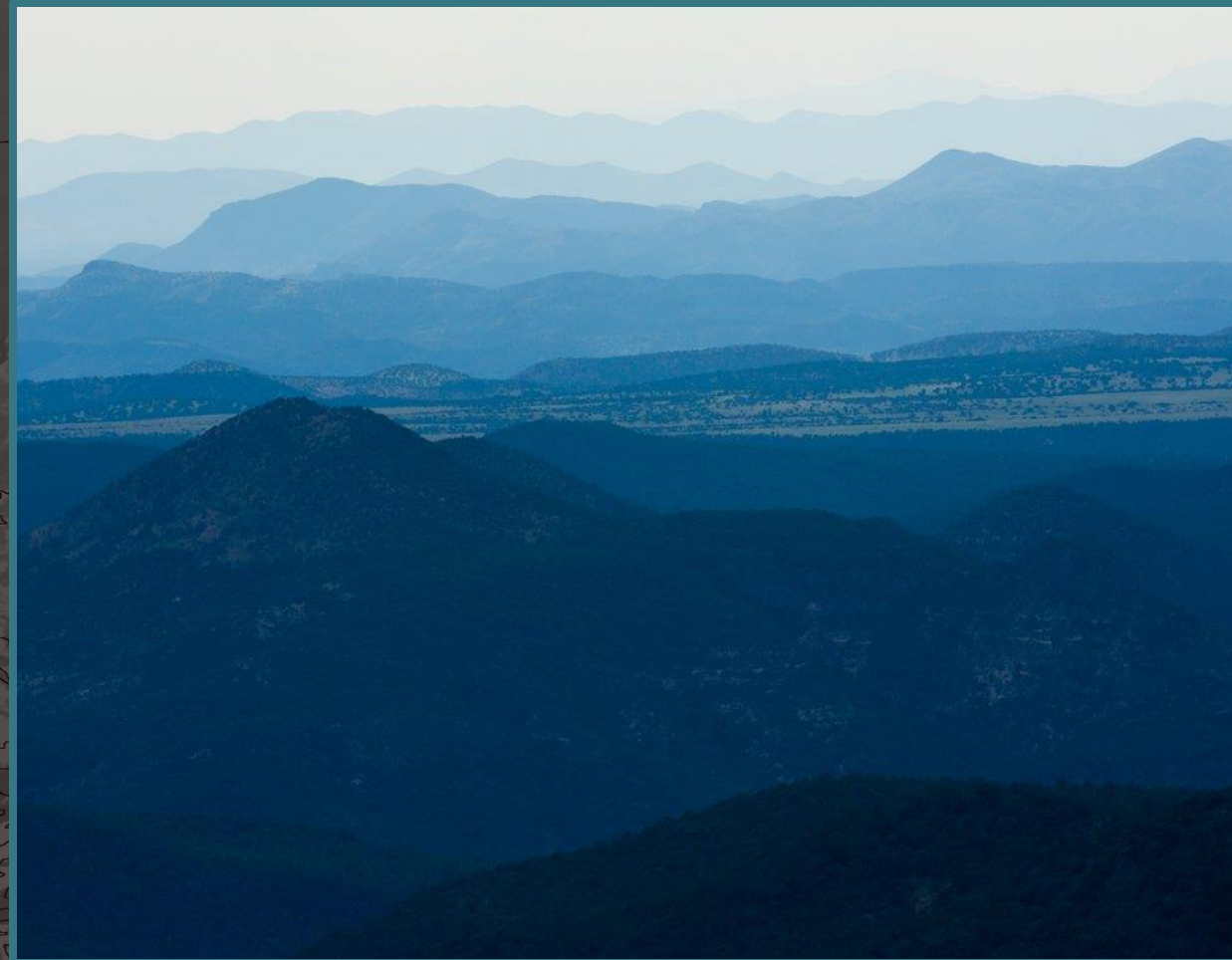


Photo by Matthew Zimmerer