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

New Mexico Climate and Water Advisory Team

A collaboration between two state-funded agencies

50 Year Water Plan

Smart Water Management - Sustainability - Equity

The New Mexico Interstate Stream Commission (NMISC) is leading a collaborative effort to develop the 50-Year Water Plan. When Governor Michelle Lujan Grisham took office, she tasked the NMISC to produce a 50-Year Water Plan for the state. The Governor has long talked about the importance of water to the arid state. As outlined by the Governor, the pillars of the 50-Year Water Plan are stewardship, equity and sustainability.

It is critical that the state starts charting a course that will allow for more flexibility in managing water supplies and infrastructure in the face of weather extremes brought on by a changing climate.

"Planning ahead to secure New Mexico's water future" - Lucia Sanchez

Climate and Water Advisory Team

Water Planning Program Activities

In Case You Missed It!

https://www.ose.state.nm.us/Planning/50YWP/index.php

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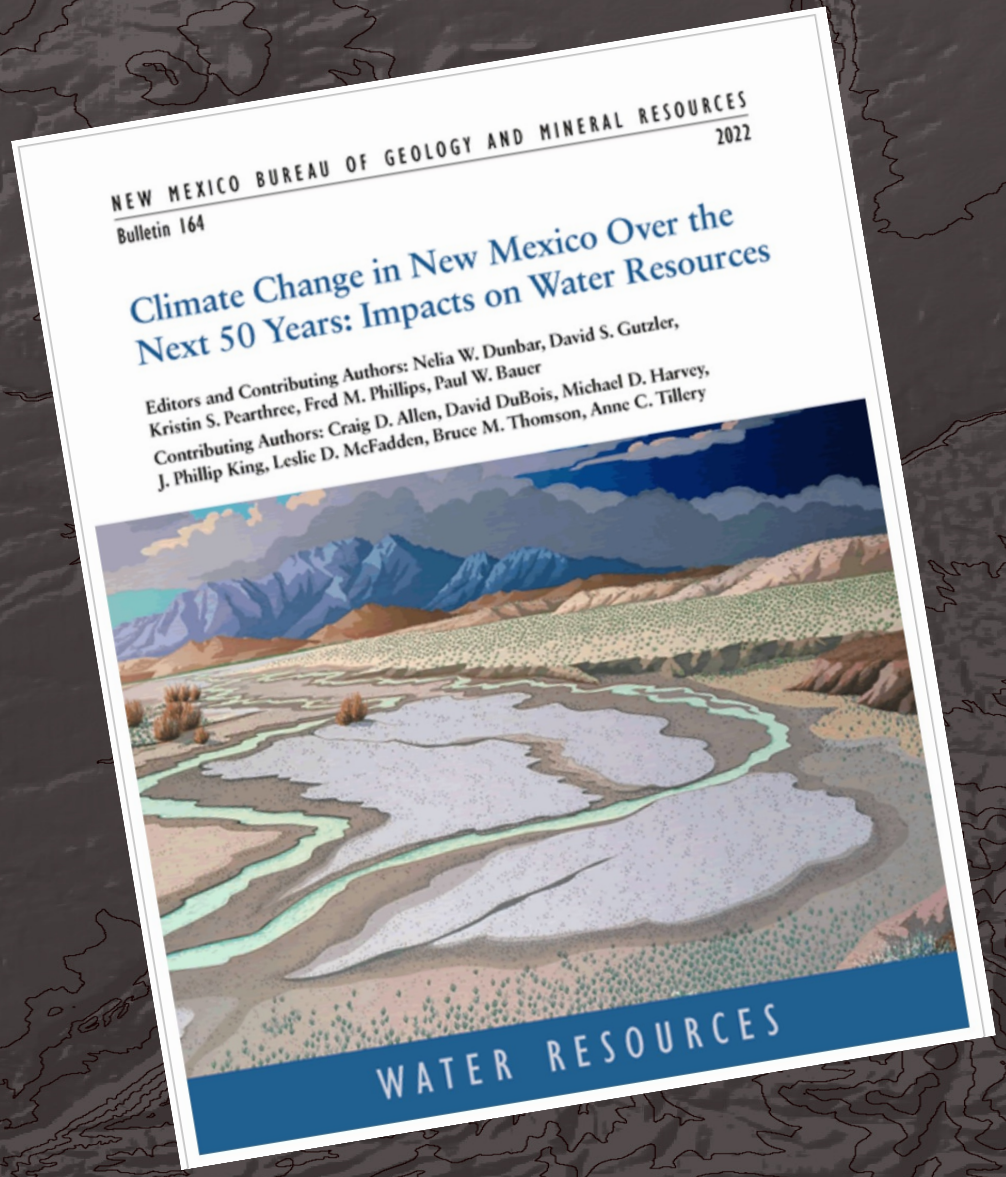
https://geoinfo.nmt.edu/publications/monographs/bulletins/164/home.cfm



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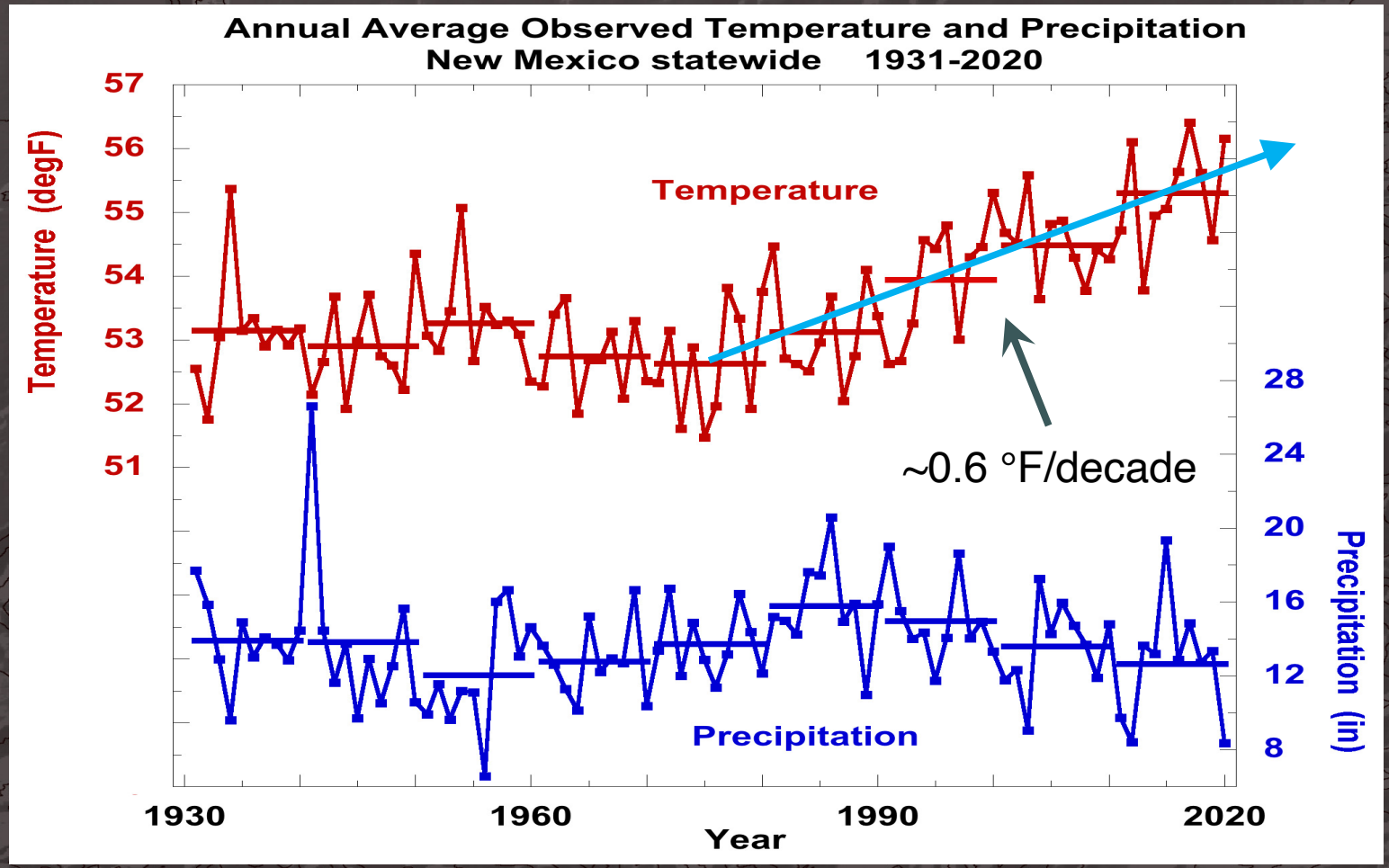
Why do we need this?

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 decadally. 4 of the 5 driest years since 1930 have occurred in the past two decades

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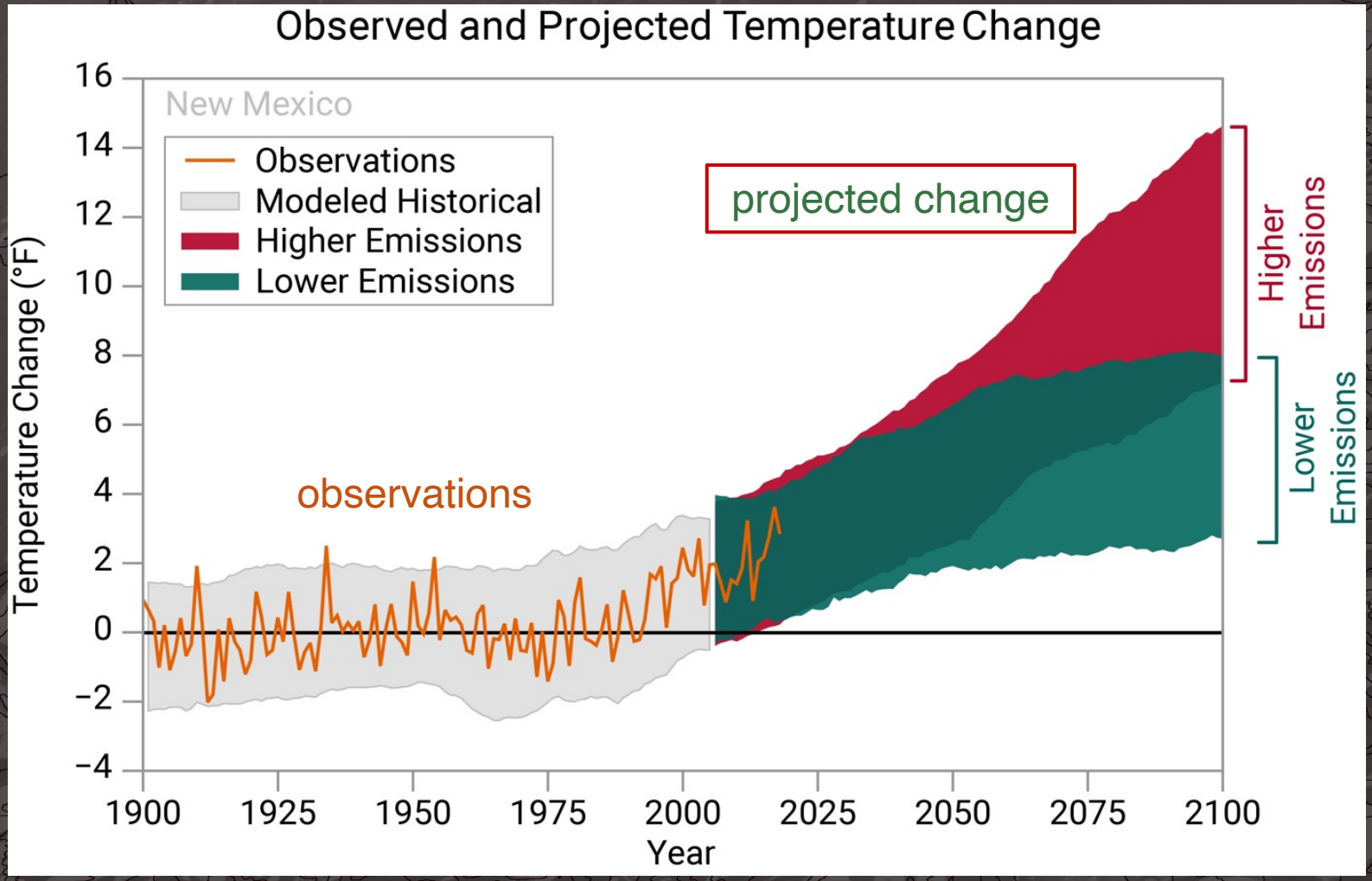
New Mexico's climate will continue to warm in response to increasing concentrations of atmospheric greenhouse gases



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

- Dave Gutzler (climatologist)
- Fred Phillips (hydrologist)
- Craig Allen (ecologist)
- Dave DuBois (climatologist)
- Phil King (civil engineer)
- Les McFadden (soil scientist)
- Bruce Thomson (environmental scientist/engineer)
- Anne Tillery (surface systems specialist)

Ground rules of the study

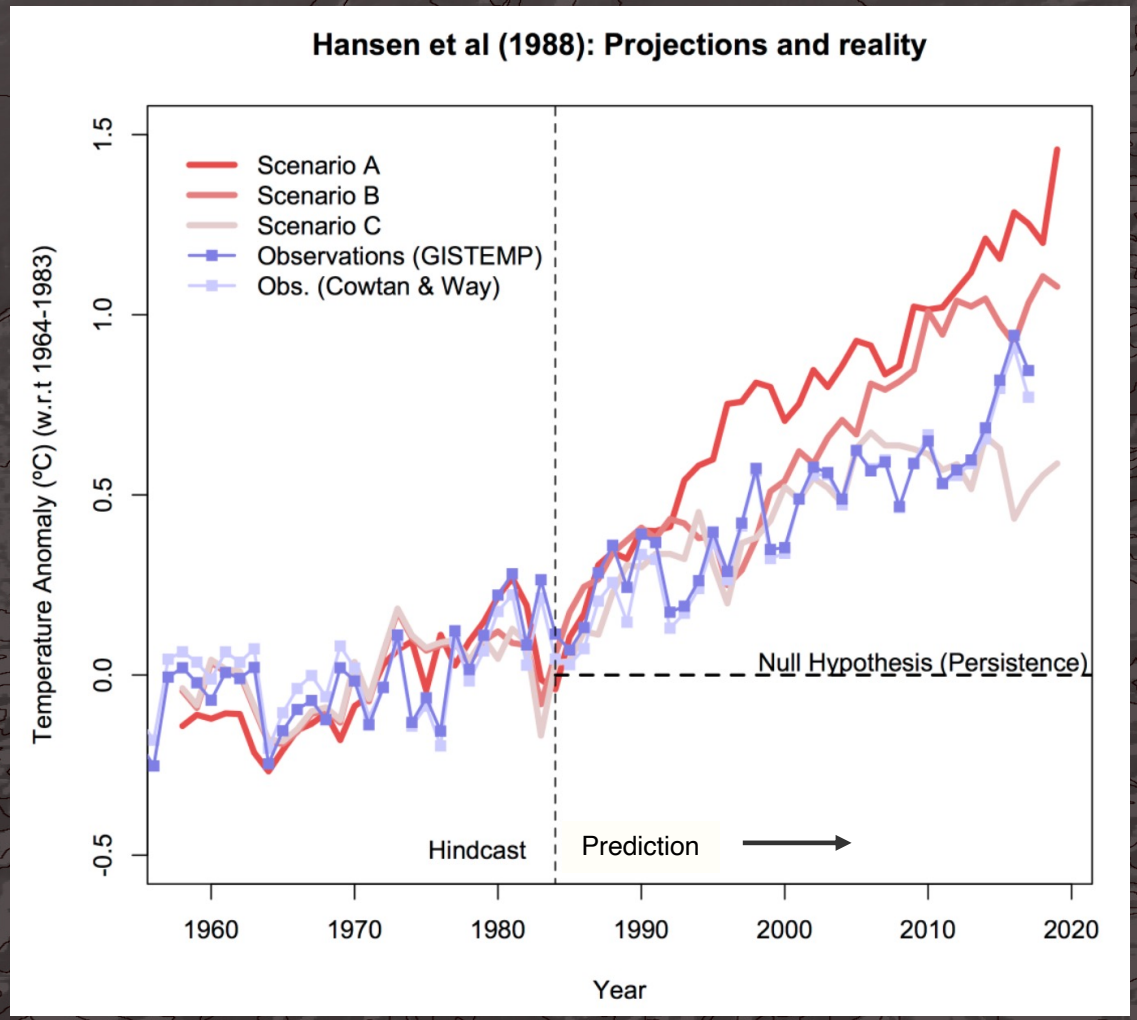
→ Assess and synthesize recent scientific literature on climate, hydrology, and impacts of these changes

- Future climate projections
- Changes to the surface water budget
- Ecological dynamics
- Landscape change/fires/erosion
- Extreme precipitation and flooding
- Soils
- Water supply
- Water quality

But before we show current results, how have past efforts fared?

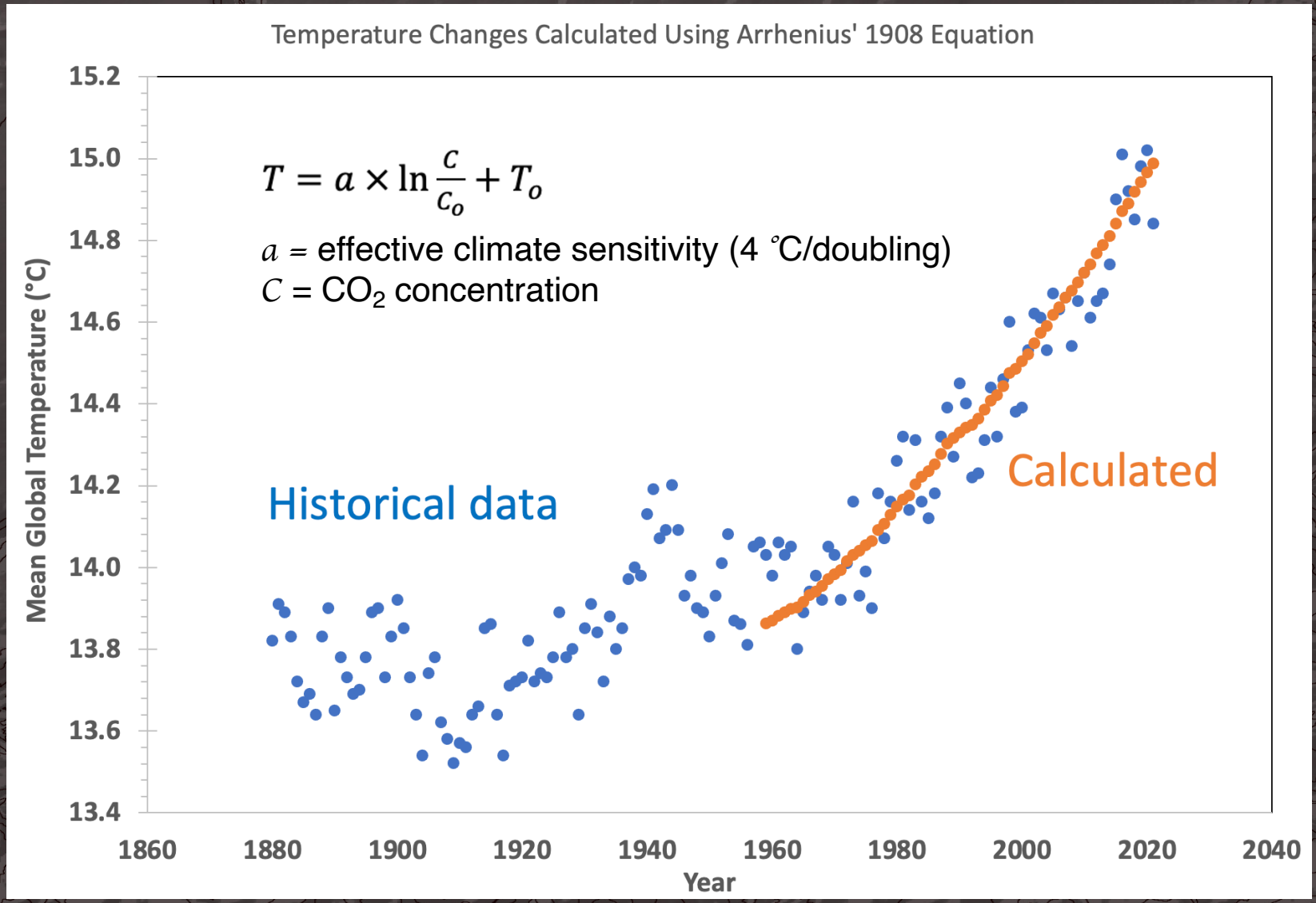
This shows the results of a modeling projection made in 1988. The model projections are the red-ish lines. Actual temperature data from subsequent years are shown in blue.

(A. Gavin, 2018)



Arrhenius could have predicted it in 1908!

Svante August Arrhenius (1859-1927) won Nobel Prize for Chemistry in 1903.In 1908 published "Worlds in the Making: Evolution of the Earth". He predicted that fossil-fuel CO_2 could increase the temperature of the earth.



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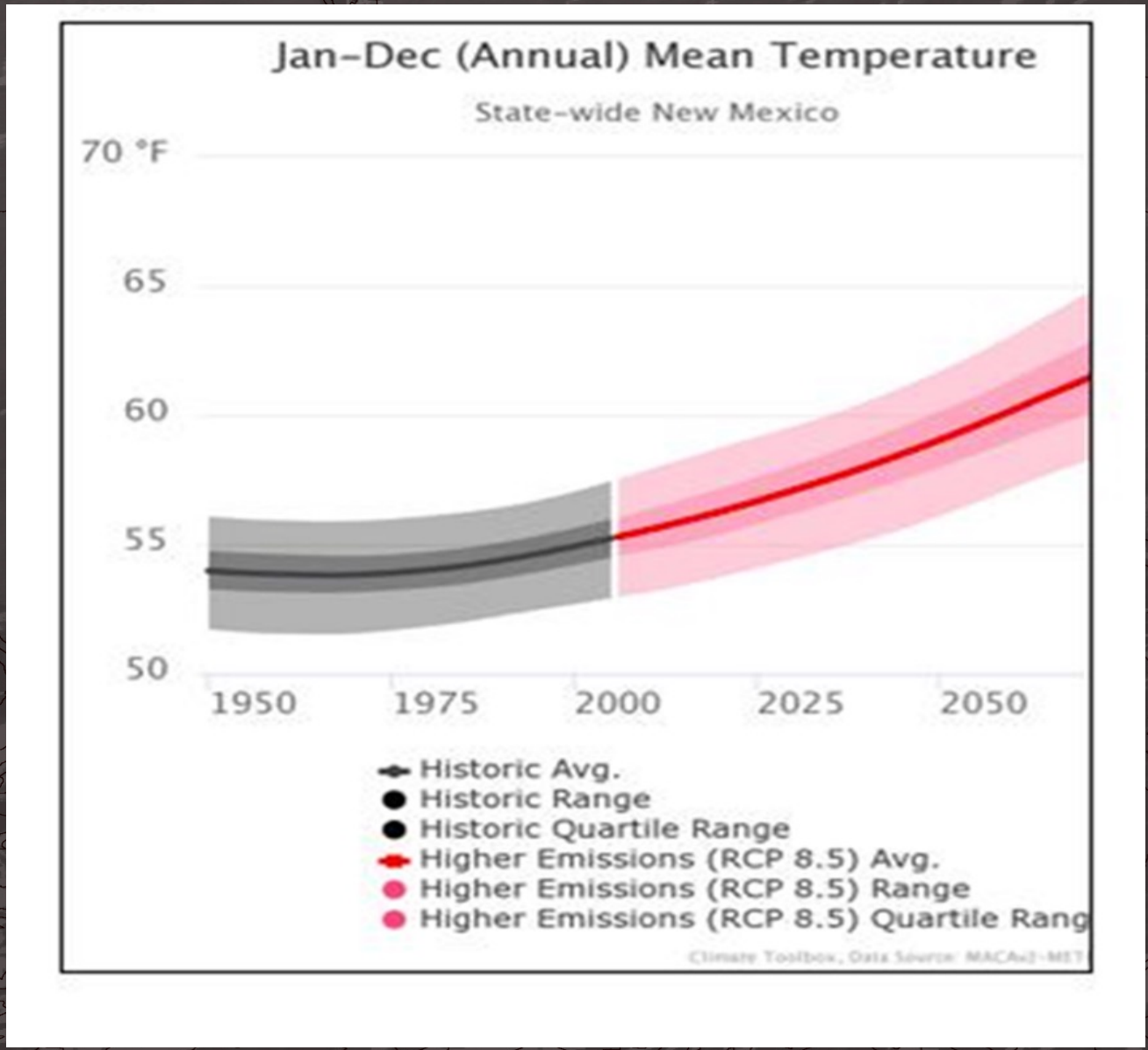
Future Climate Projections



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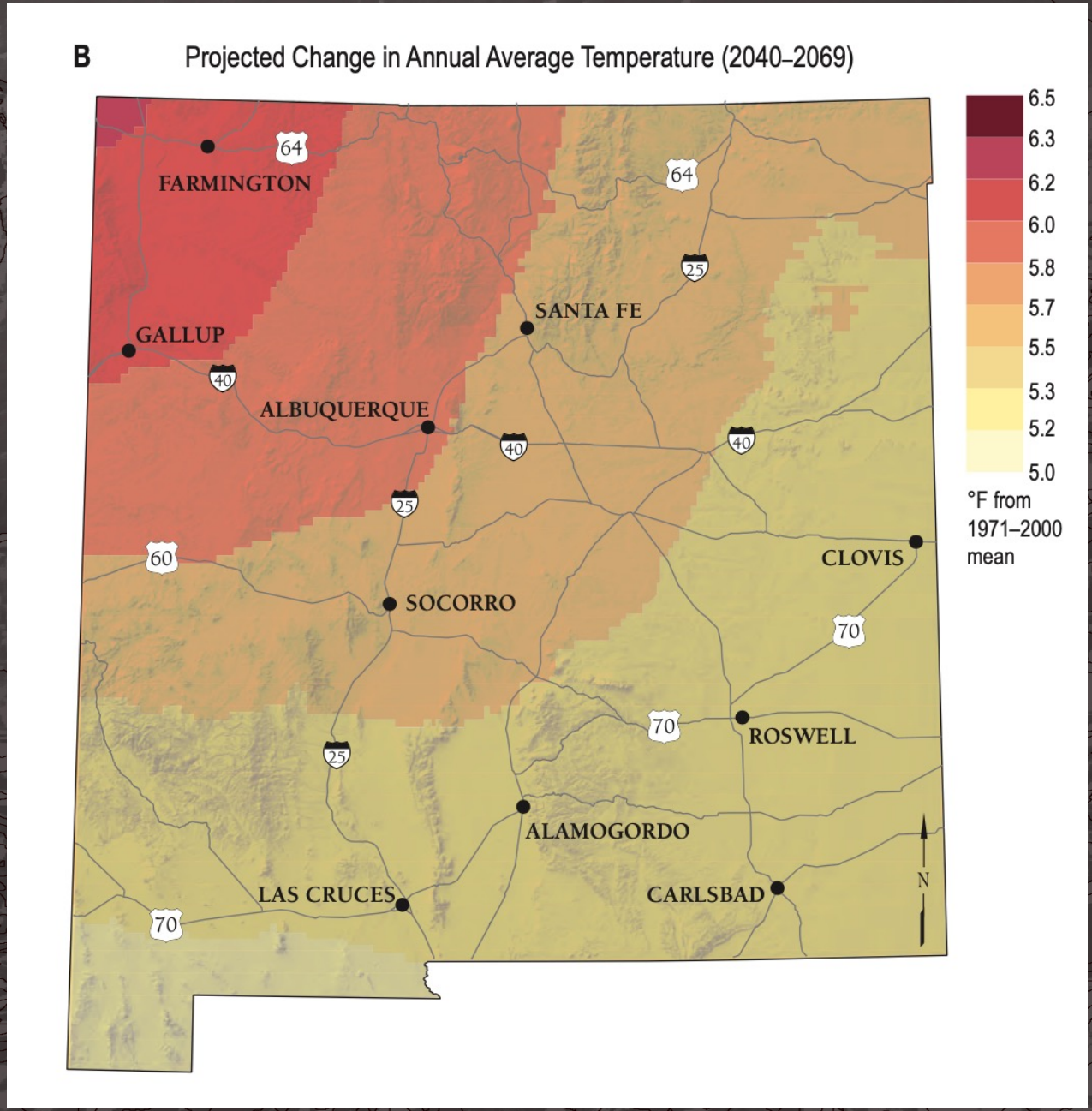
Warming everywhere. Temperature rise non-uniform across the state of New Mexico

Bootheel is around a decade behind the NW corner



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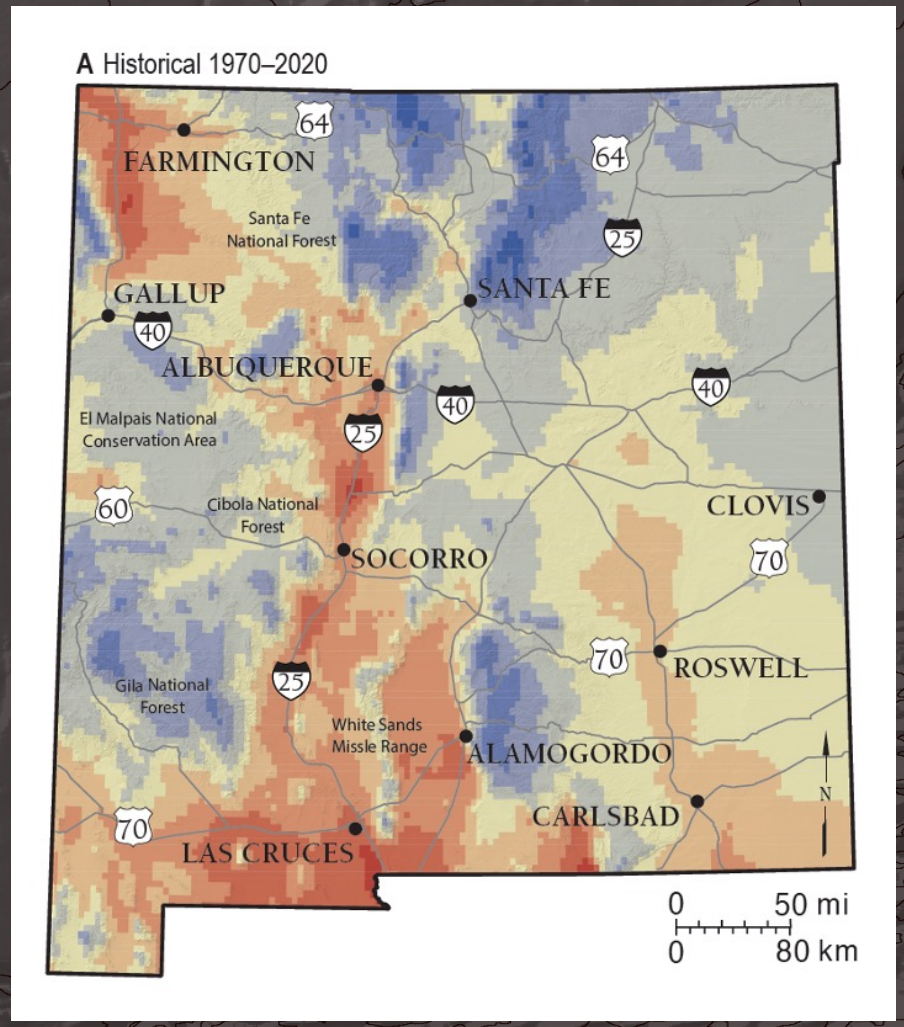
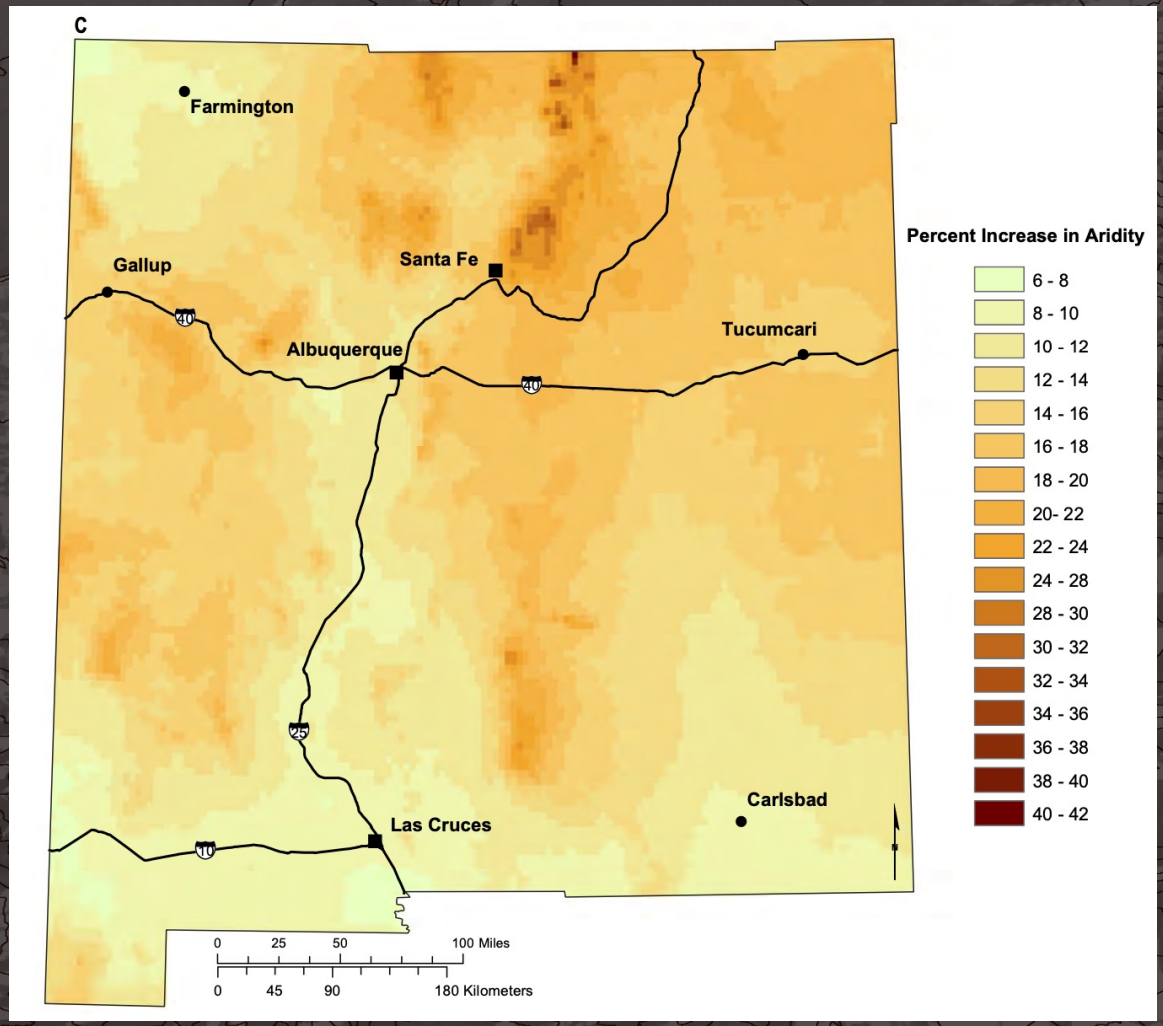
New Mexico will become more arid

Historical Aridity Index



Aridity Index increase to 2055 (percent)



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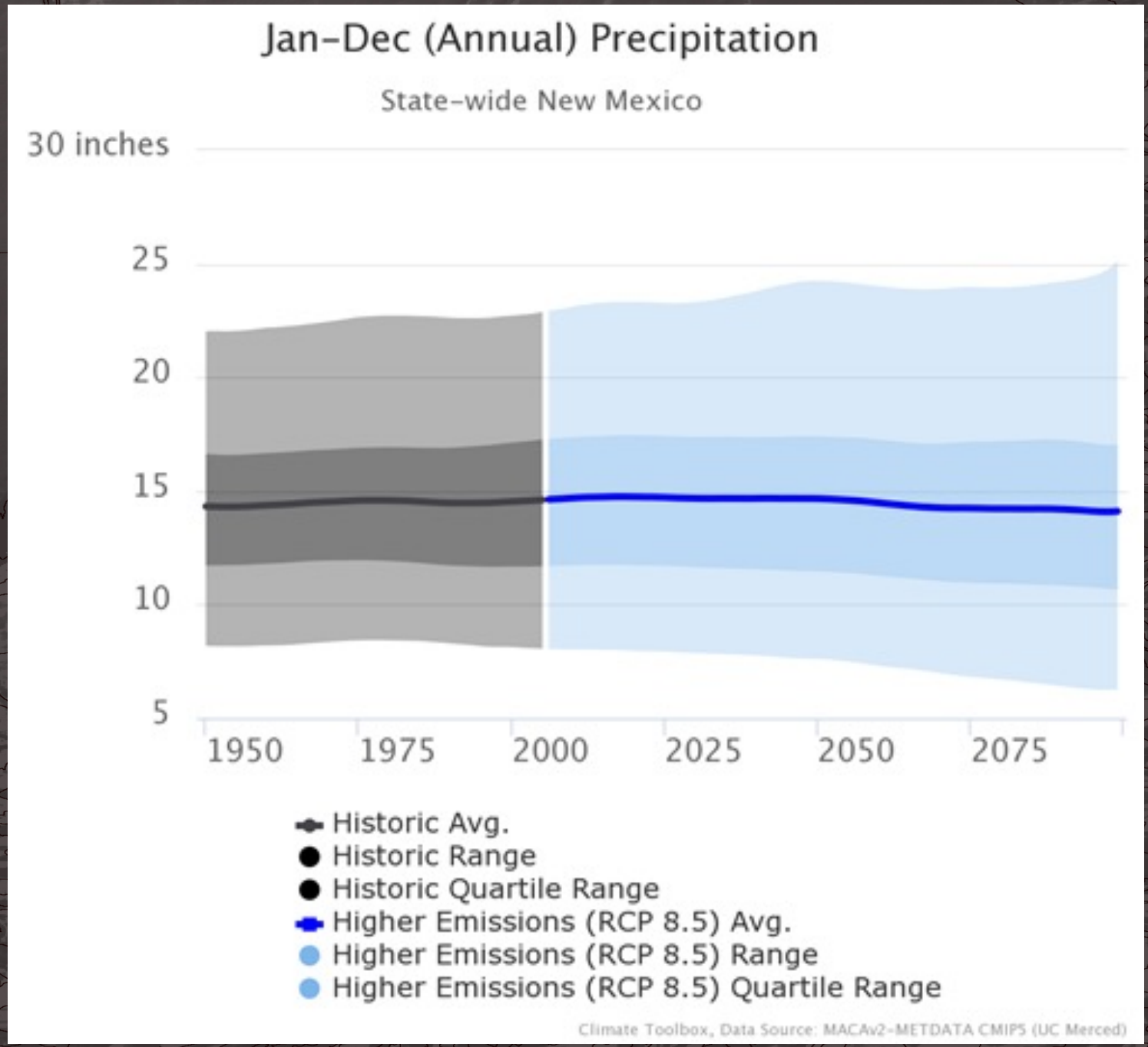
Average Precipitation



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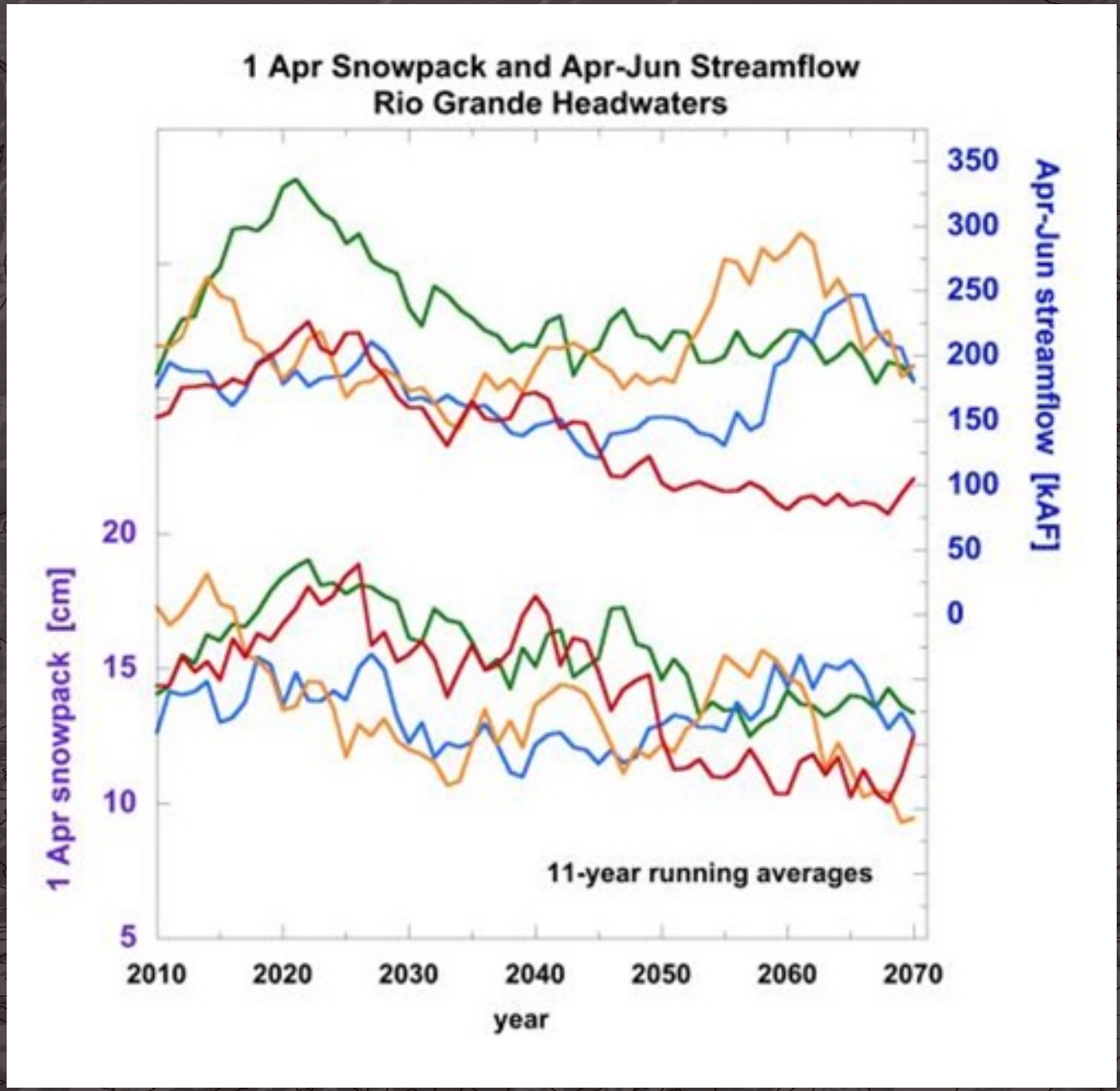
Snowpack and spring streamflow will decline

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



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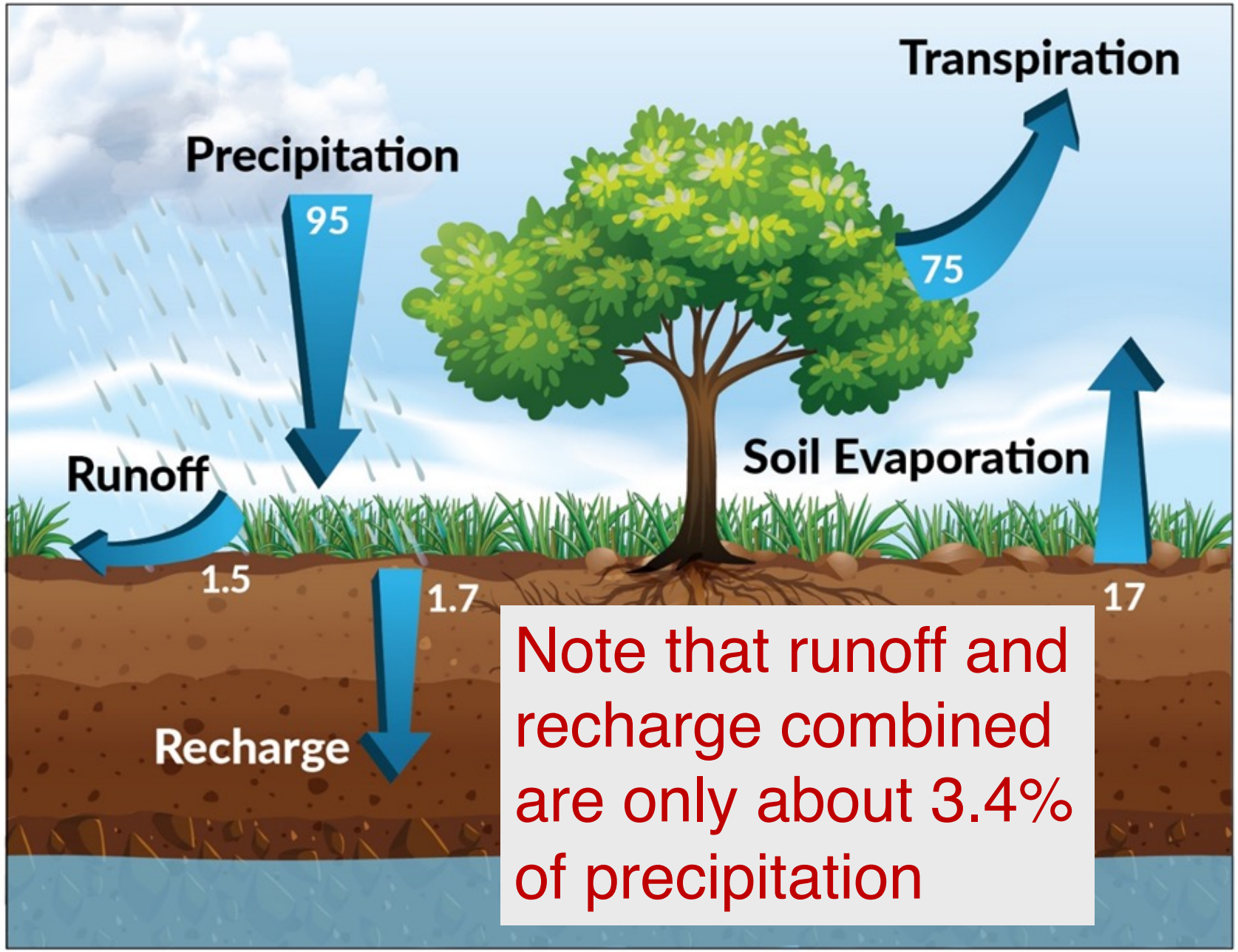
Land-surface water budget in New Mexico's arid climate

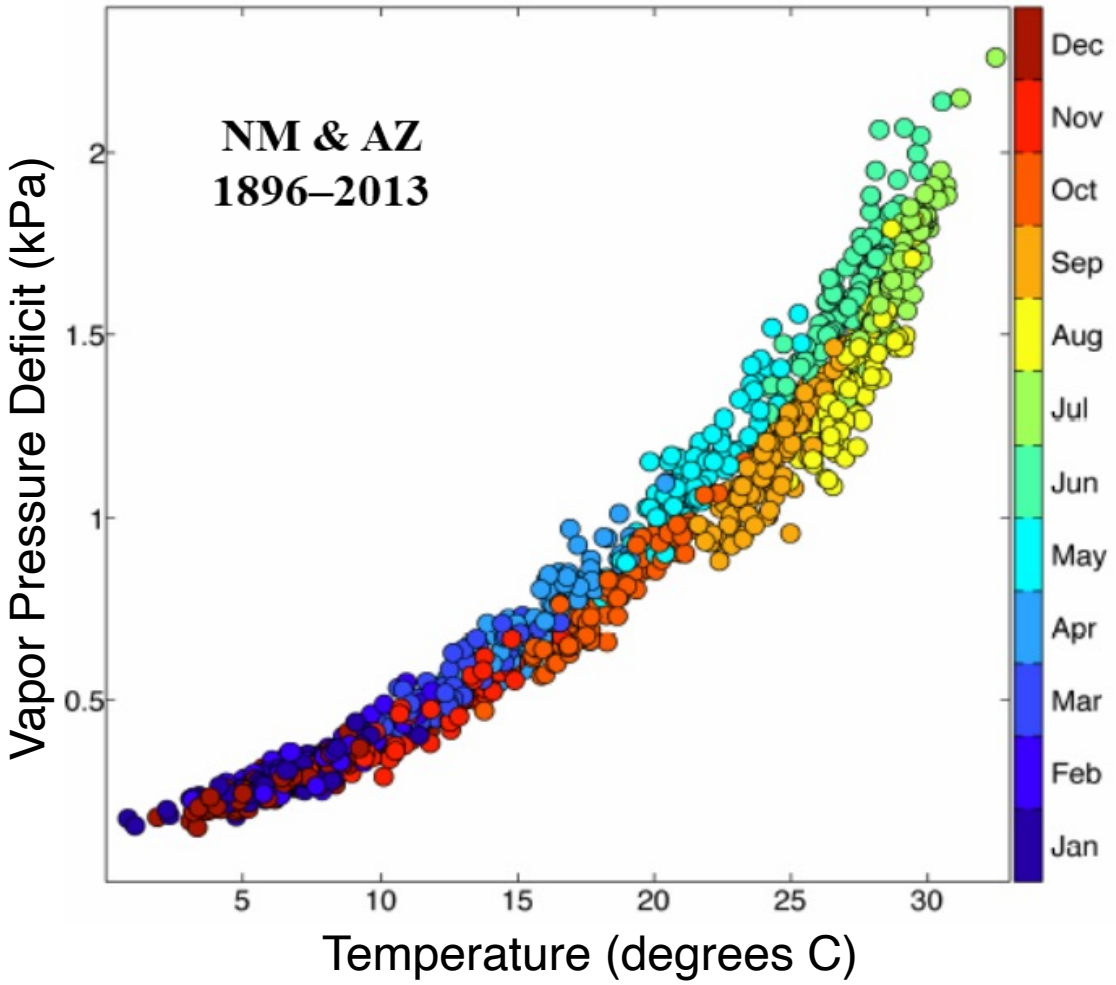
Numbers represent millions of acre-feet per year over New Mexico



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).
- Graph on right shows how moisture demand of the atmosphere increases strongly as temperature increases
- 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

Williams et al., 2013. Nature Climate Change



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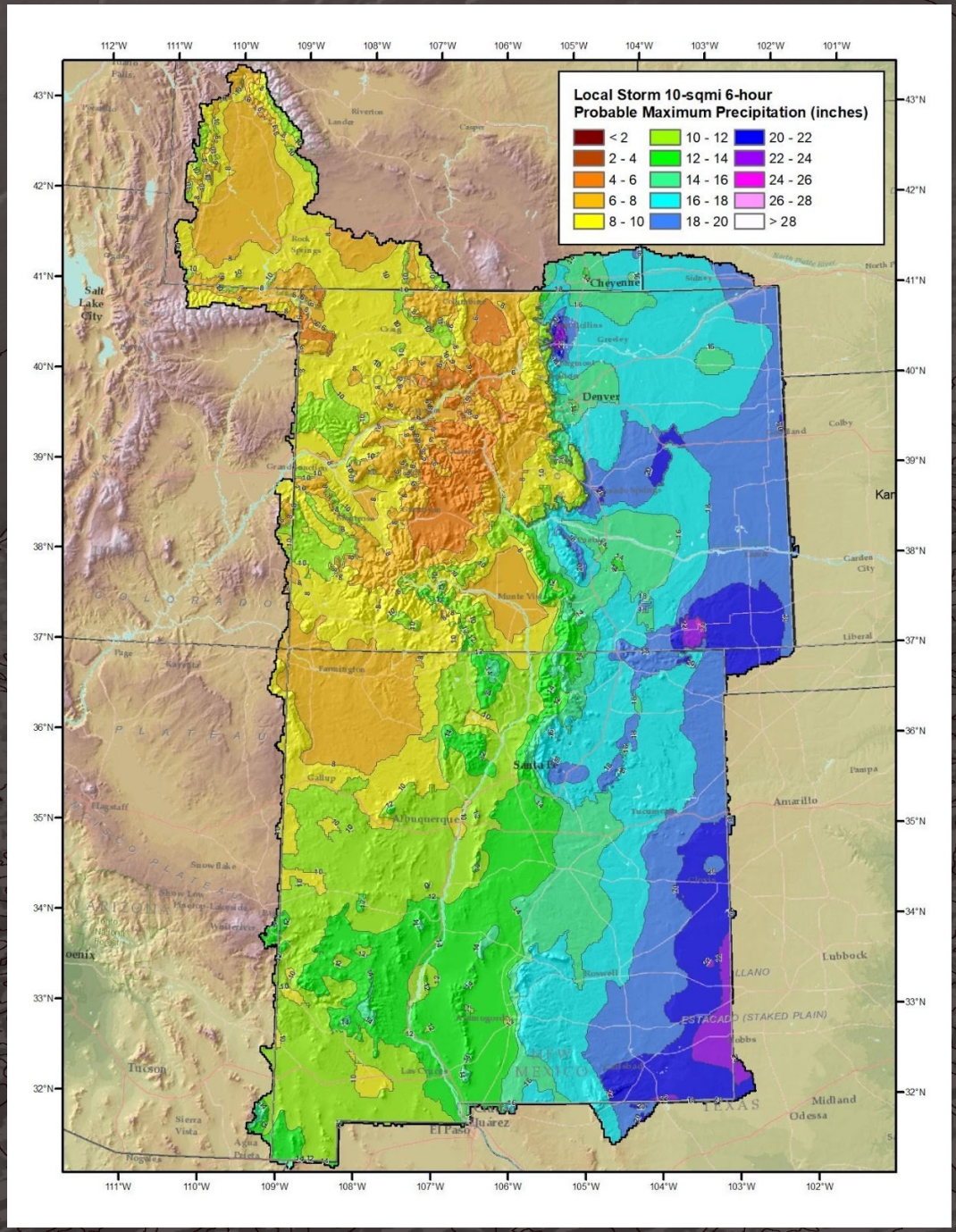
Extreme Precipitation

- 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



Groundwater Recharge

- Difficult to model in our arid environment
- Models estimate declines, but high degrees of uncertainty
- Declines observed in water level in many New Mexico aquifers, but difficult to separate declining recharge from pumping effects
- Despite uncertainties in future projections of both recharge and runoff, indications are strongly toward less of both, largely due to increased evapotranspiration due to warmer air temperature. Decreases of 20% to 30% over the next fifty years are plausible, if not demonstrable.

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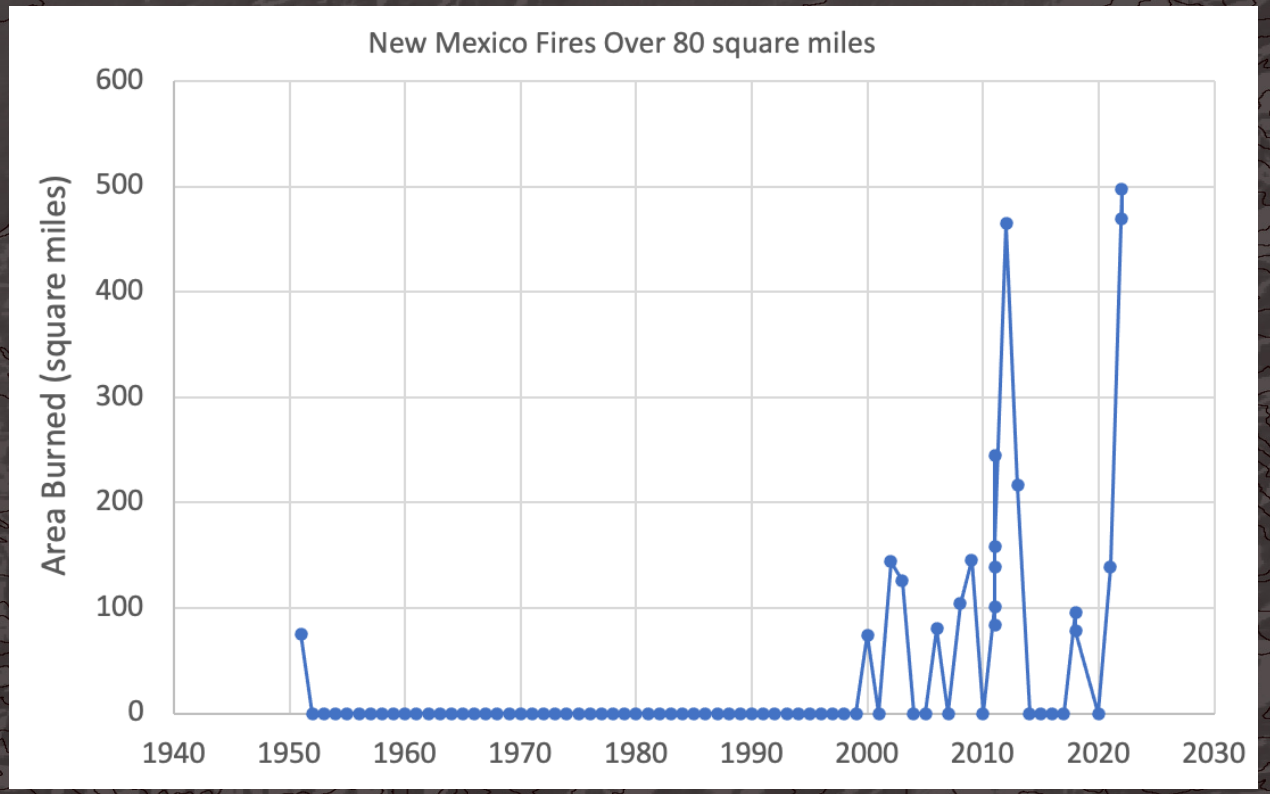
Ecological Dynamics, Landscape Change and Soils

Jemez Mountains after Las Conchas fire, 2011



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Ecological Dynamics, Landscape Change and Soils

Effect of Heat Stress on Rangeland Combustibility

Black Fire, 2022

Ruidoso fires 2024

Summary of Climate Impacts on Water Resources in New Mexico over the next 50 years

- Impact of climate change on New Mexico's water resources is, unfortunately, overwhelmingly negative
- Temperature will rise between 5 and 7°F, and precipitation is likely to remain constant or decrease, with likely higher incidences of extreme precipitation.
- Aridity will increase due to higher air temperatures, leading to lower runoff and recharge
- Snowmelt will be earlier and less
- Decreased surface water will lead to greater use of groundwater

Take-home summary

In 50 years:

- New Mexico will certainly get much warmer (at 7°F warmer, Albuquerque will be like Las Cruces and Las Cruces like Phoenix)
- Water demand for agriculture and landscaping will increase greatly (30 to 50%)
- Surface-water supply will decline by 25 to 50%