Climate Change: Overview of the science and monitoring

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BE BOLD. Shape the Future.

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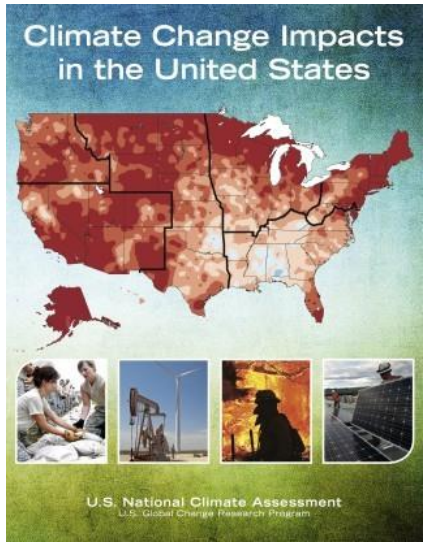
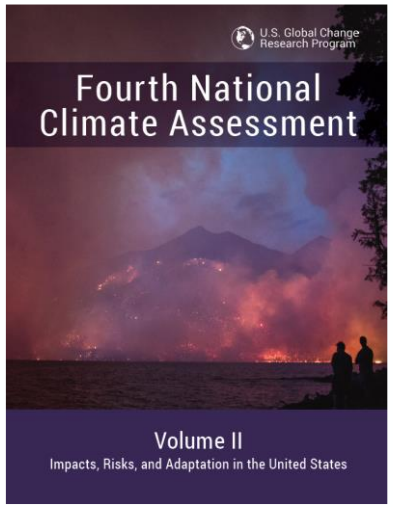
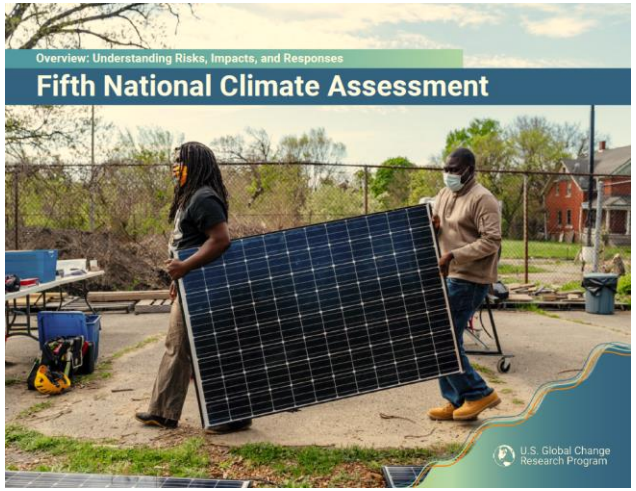
Past assessments at the global level

- IPCC Assessment Report 1-3
- IPCC Assessment Report 4 (2007-2008)
- IPCC Assessment Report 5 (2013-2014)
- IPCC Assessment Report 6 (2021-2023)
- Large body of peer reviewed work and numerous reports and data sets

IPCC = Intergovernmental Panel on Climate Change

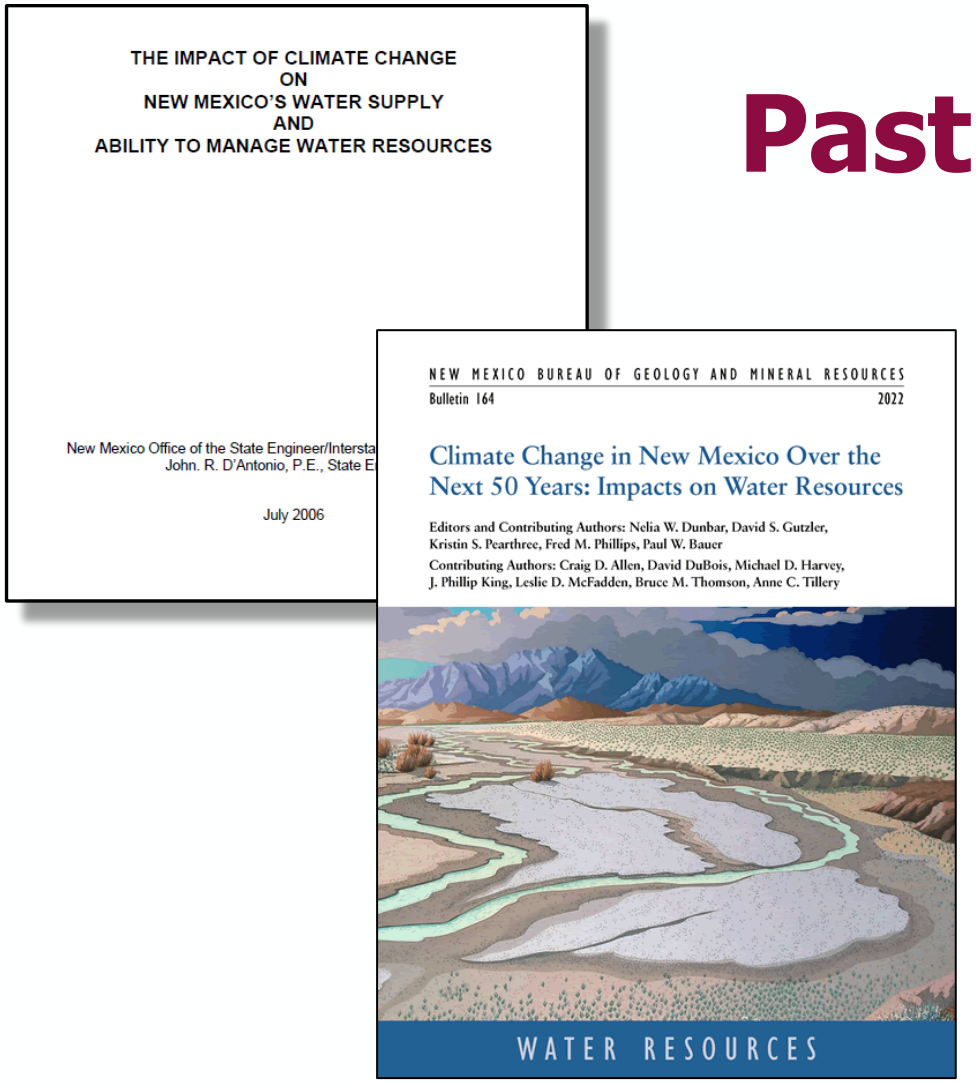






Past assessments at the national level

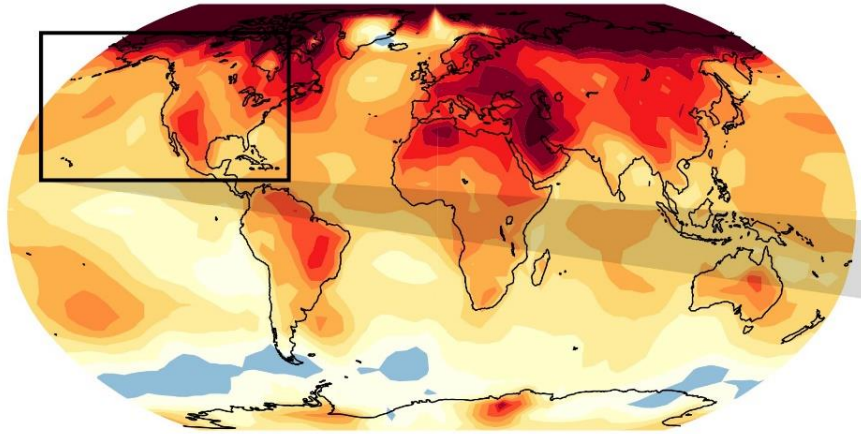
- 1st through 3rd National Climate Assessment
- 4th National Climate Assessment (2017-2018)
- 5th National Climate Assessment (2023)
- Large body of peer reviewed work and numerous reports and data sets



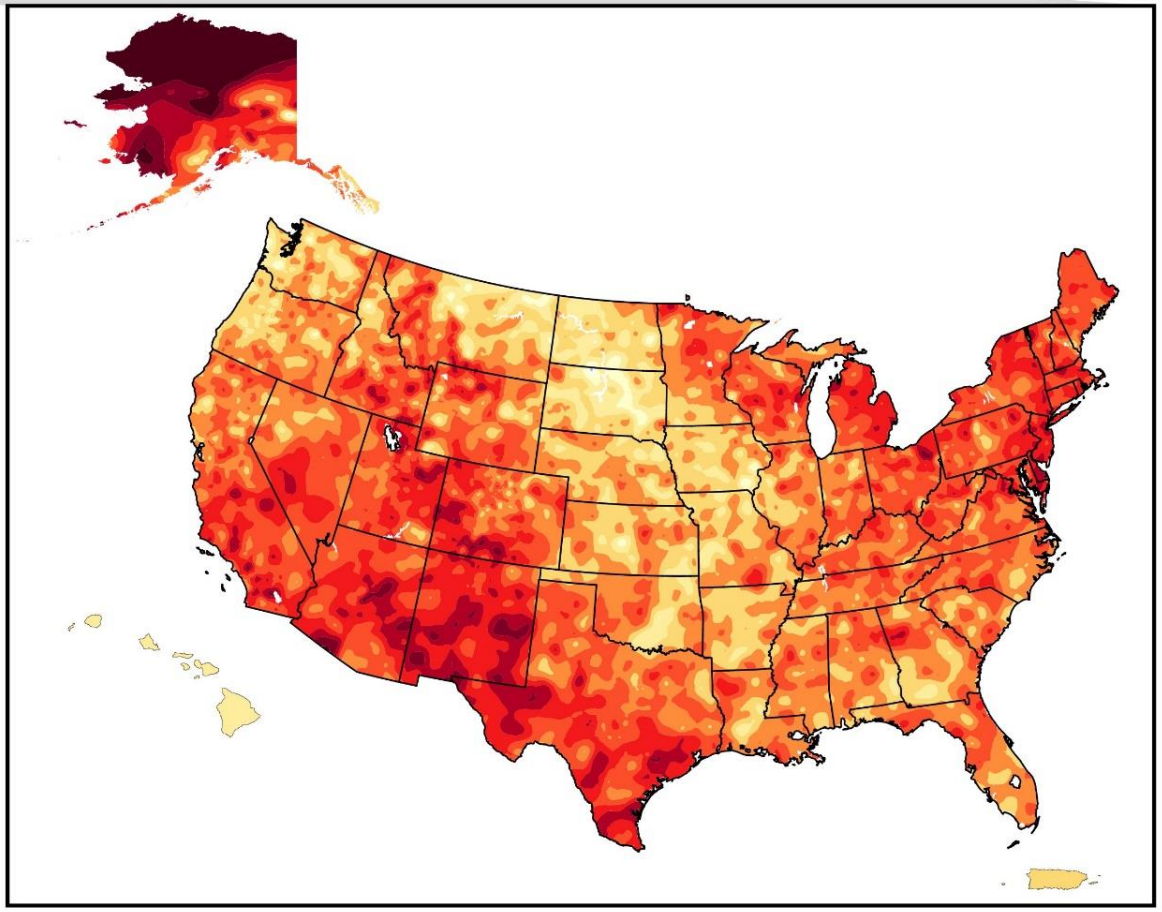
Past assessments for NM

- Watkins et al. 2006 for the Office of the State Engineer
- Climate report for the 50-year water plan for OSE/ISC in 2022
- Basin studies (Rio Grande, Pecos, etc)
- Climate Assessment of the Southwest CLIMAS

Regional Differences in Climate Response



While temperatures have been rising almost everywhere, warming has not occurred uniformly over the planet



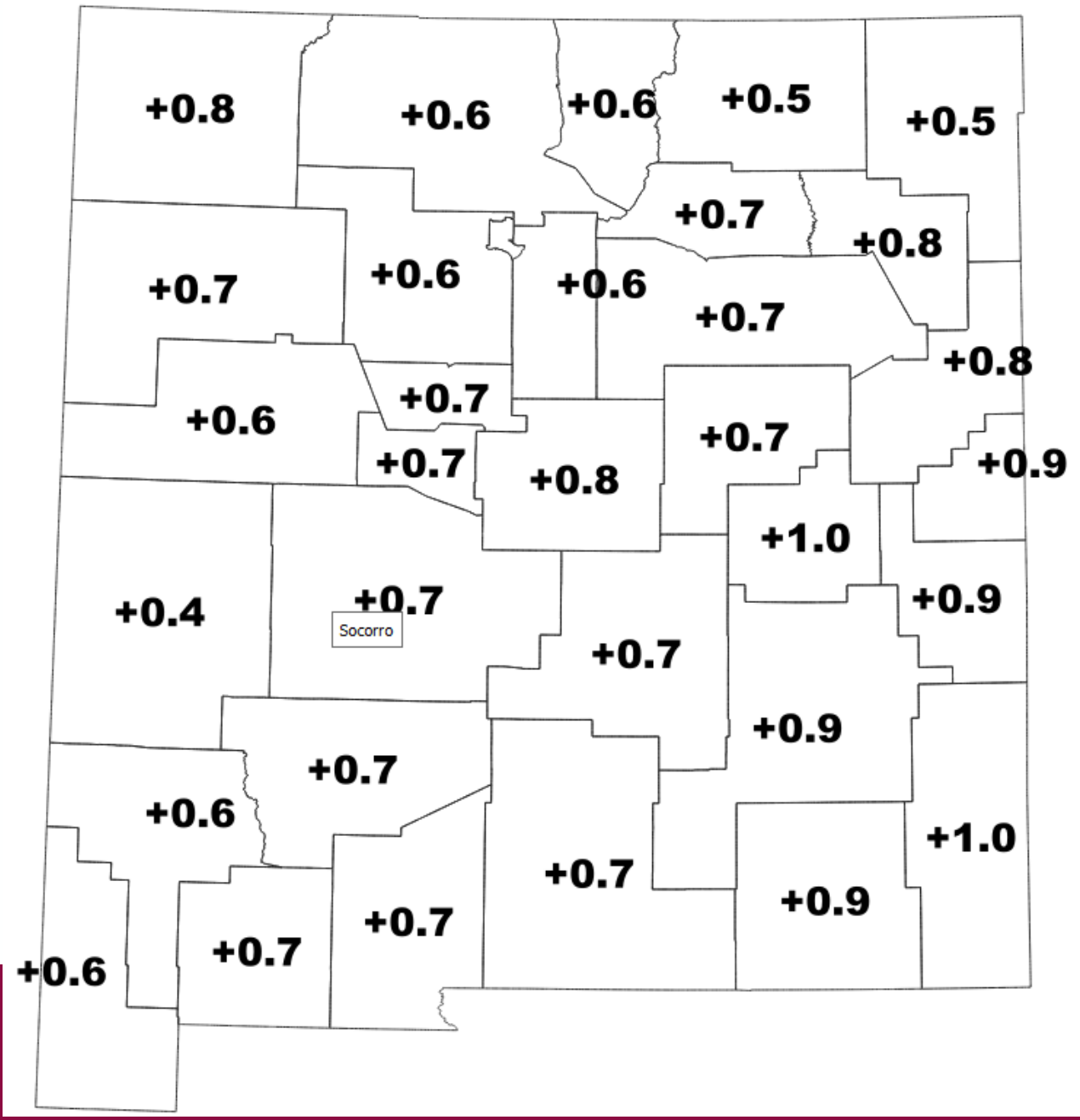
Temperature trend (°F per decade)
1972–2021

−0.1 0.1 0.3 0.5 0.7 0.9

Trends in summer high temperatures are increasing

These are the trends in June to August high temperatures in °F per decade from 1970 to 2023 by county.

Source: NCEI divisional data

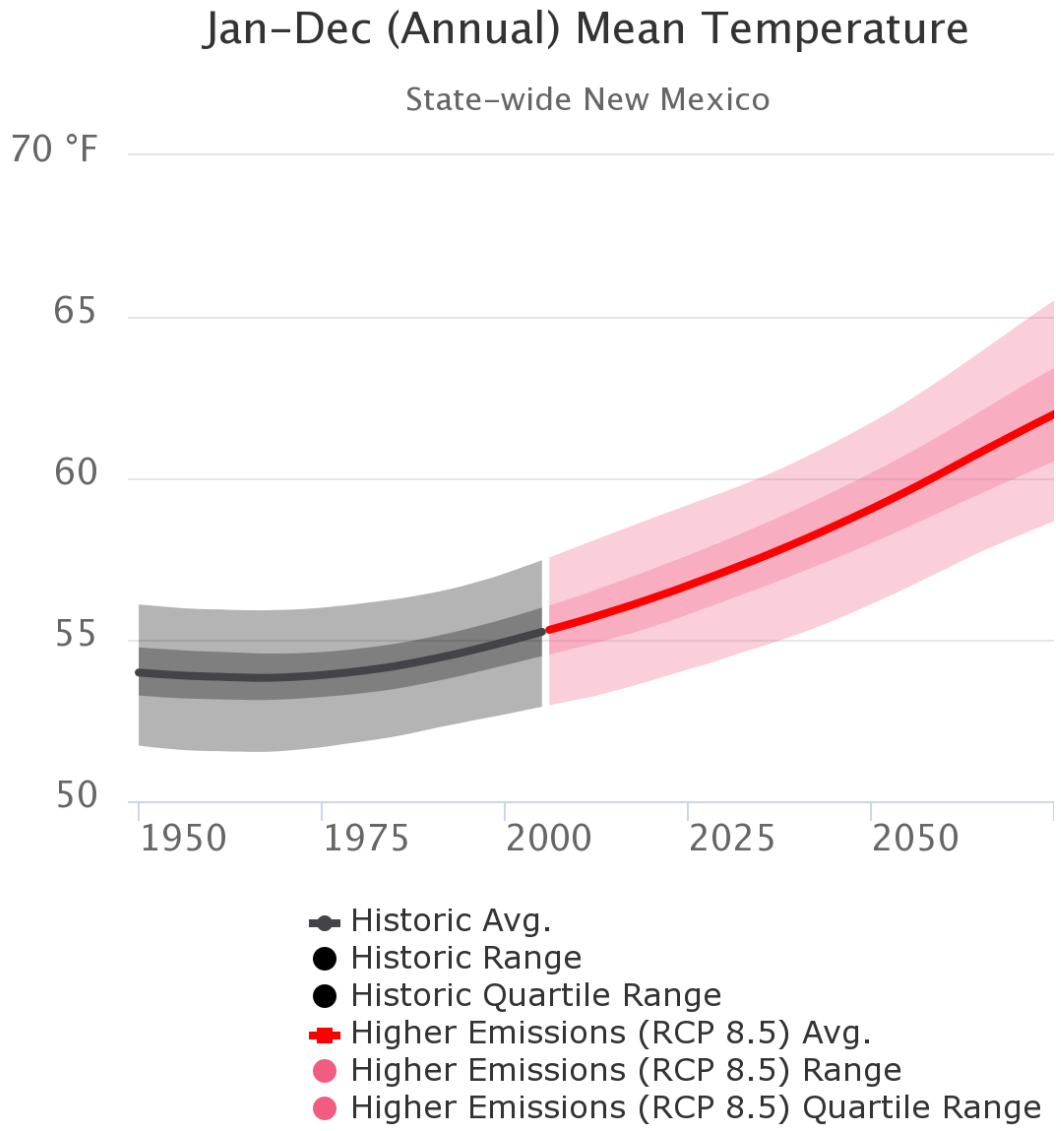


What does a possible future climate in NM look like?

NM Temperature Projection

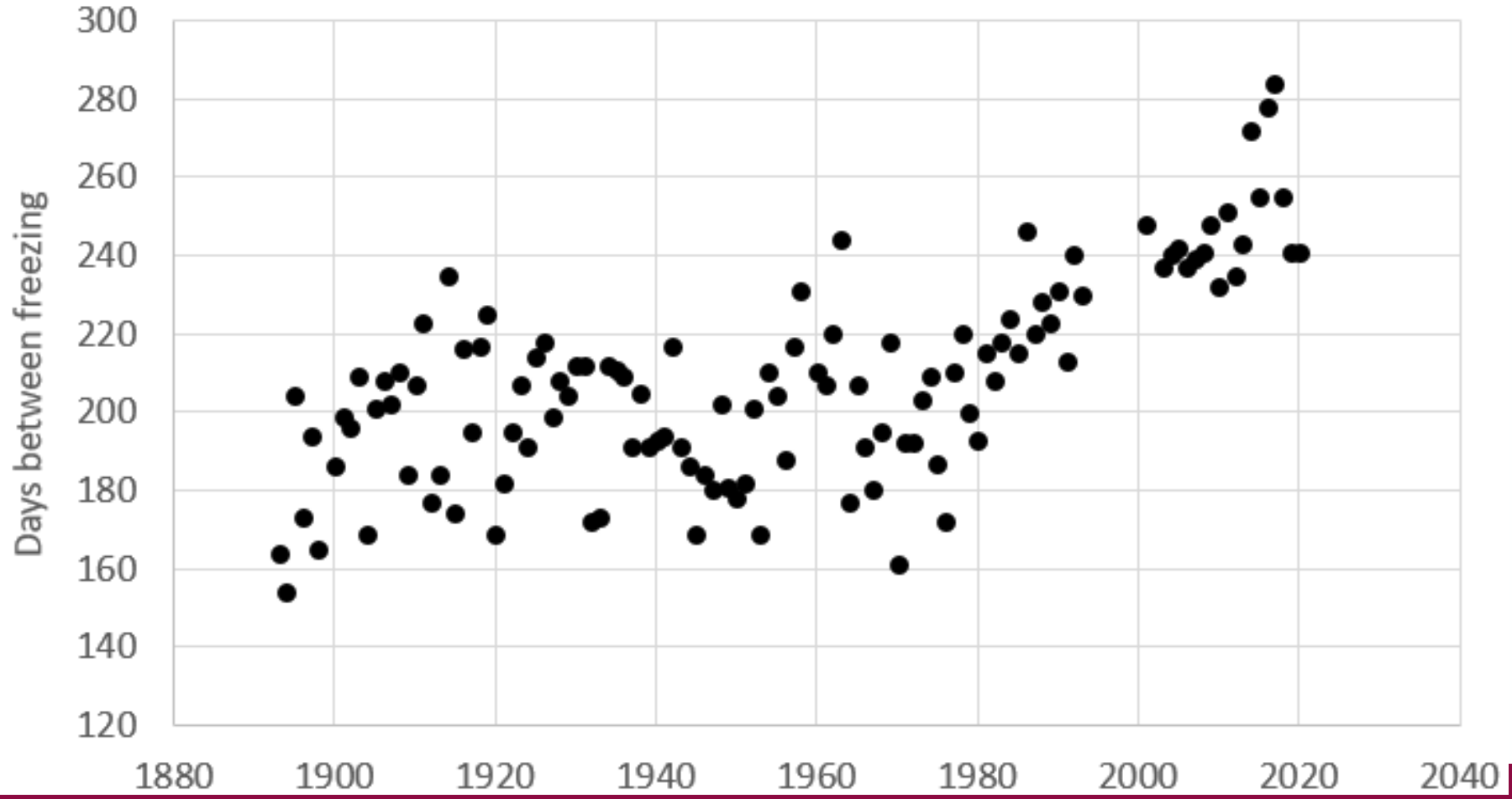
A strong scientific consensus indicates that New Mexico should plan for a hotter, more arid climate for at least the next half-century

Increase in annual state-wide temperature is about 5 ^{o}F by mid-century



'Range' between the minimum and maximum value from the 20 models. 'Quartile Range', or the 25th to 75th percentile of the values from the 20 models.

Las Cruces growing season (NMSU)

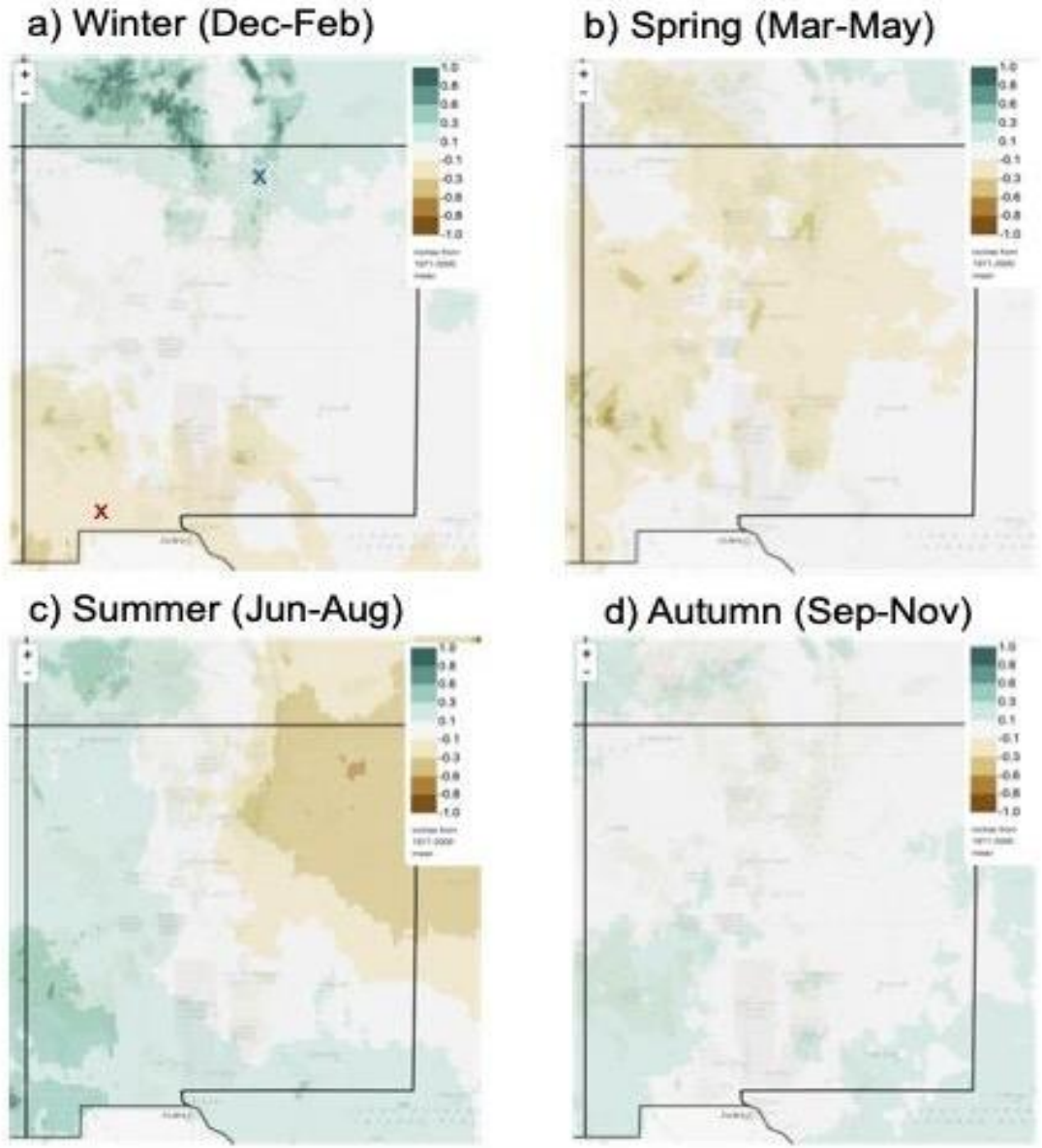


Seasonal Precipitation

Spring exhibits a general state-wide drying trend combined with hotter temperatures represents a clear trend toward aridity.

Summer includes a modest trend toward stronger monsoon precipitation in the southwestern corner of the state, combined with a trend toward less precipitation in the northeast.

Difference between 2040-2069 with past 1971-2000



Future Droughts - Aridification

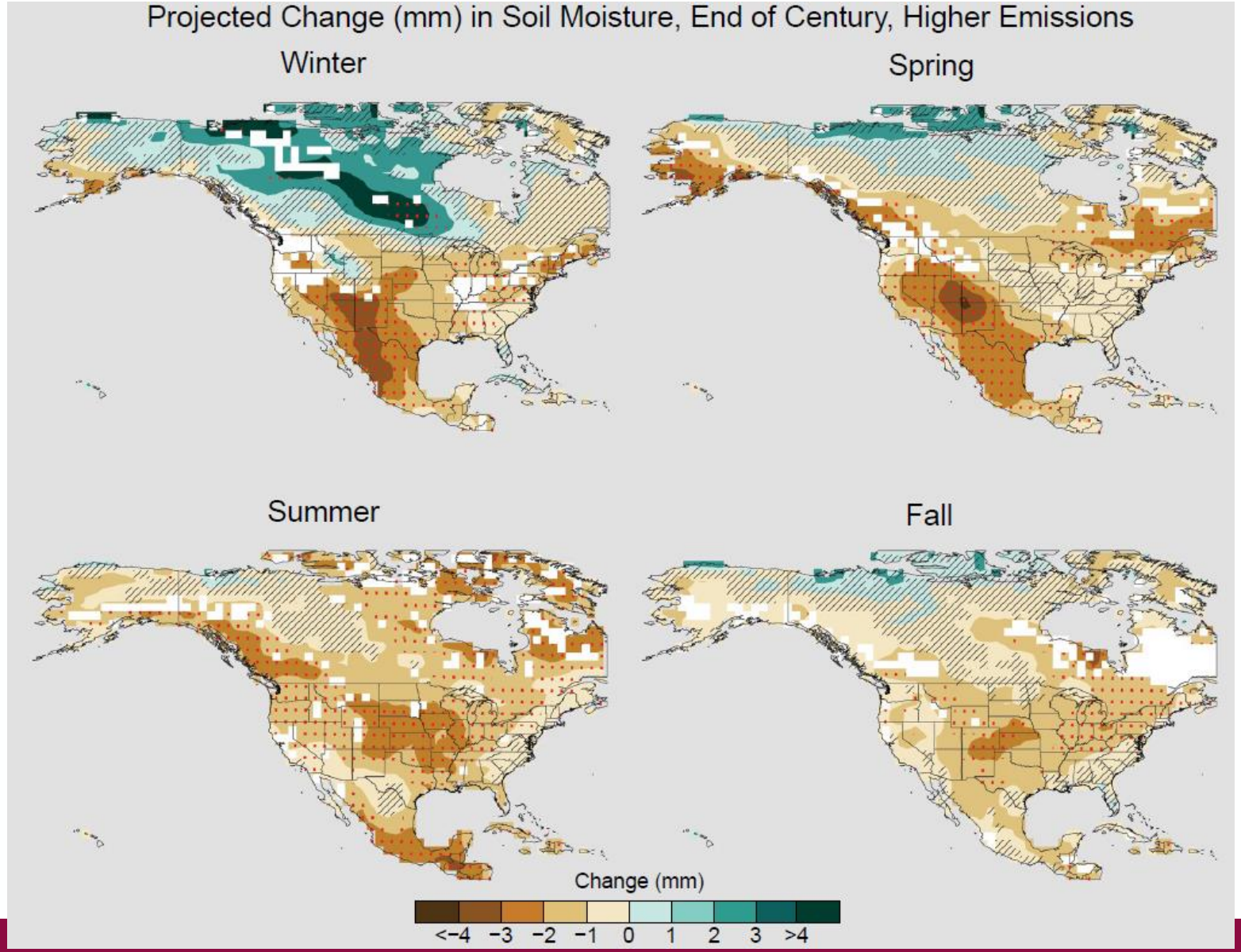
- Increasing temperatures, forcing future droughts to be more severe than the past
- Increased evaporative losses on reservoirs
- Snowpack projected to decline substantially by 2070
- Dust on snow leads to early snowmelt
- Surface water supplies projected to decrease over next half of century

Trends in Soil Moisture

Map based on RCP8.5 scenario in 4th National Climate Assessment

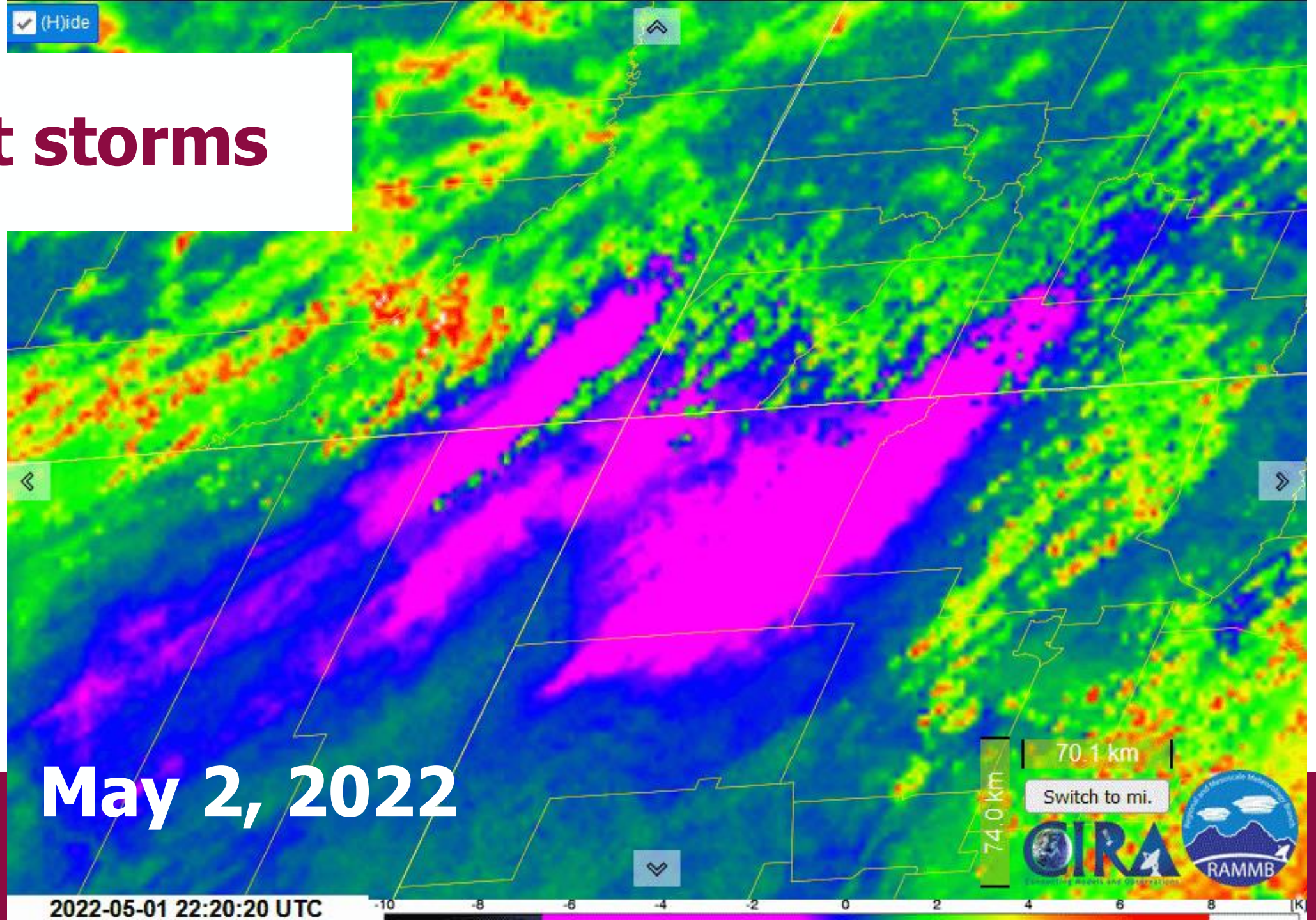
Top 10 cm of the soil

Most pronounced declines in soil moisture are expected in winter and spring



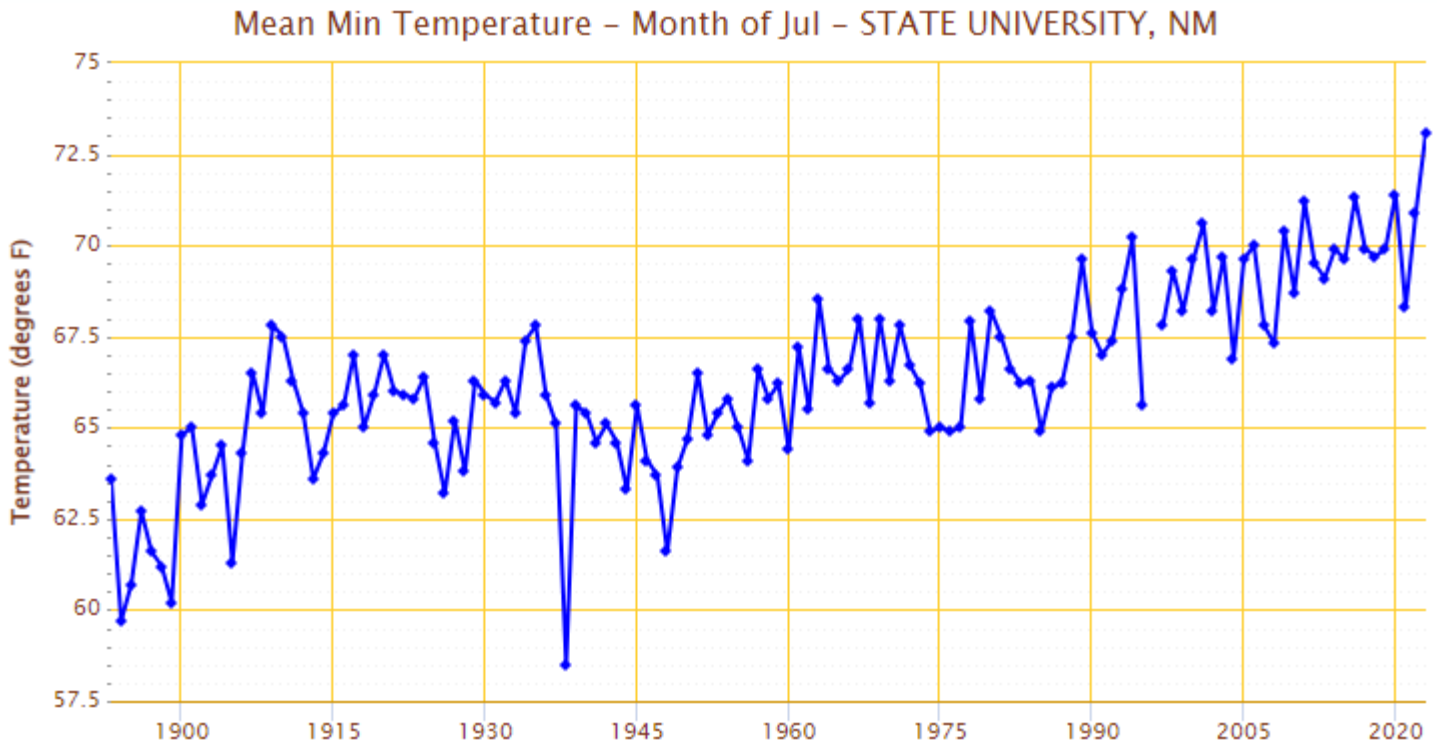
USGCRP, 4th NCA, volume I (2017)

Dust storms

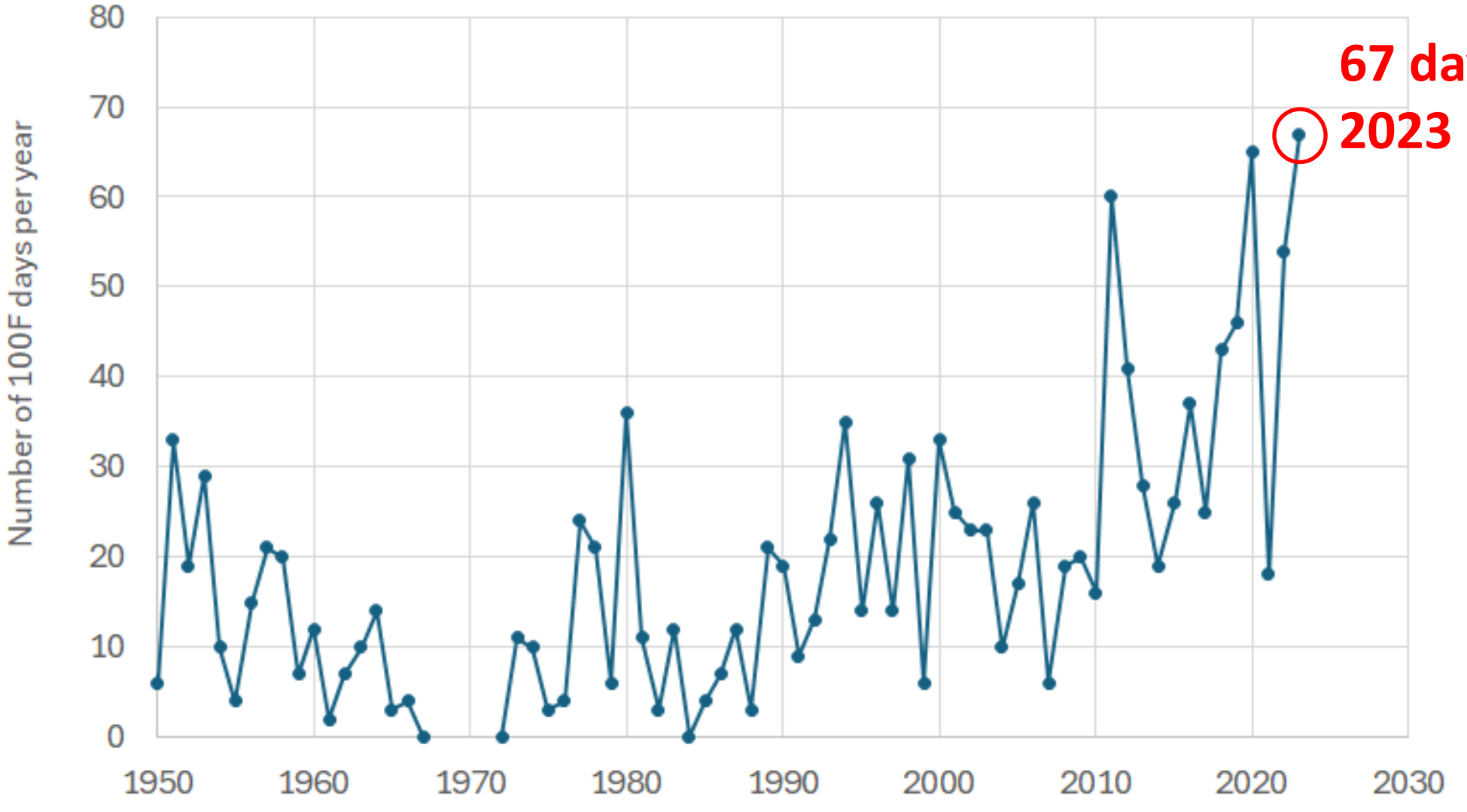

(H)ide
May 2, 2022
70.1 km
74.0 km
Switch to mi.
CIRA
RAMMB
2022-05-01 22:20:20 UTC
-10 -8 -6 -4 -2 0 2 4 6 8 [K]

Heat Waves

- Increased probabilities of heat waves with higher overnight temperatures
- Most frequent weather-related cause of injury and death in the United States



100-degree days in Roswell on the increase

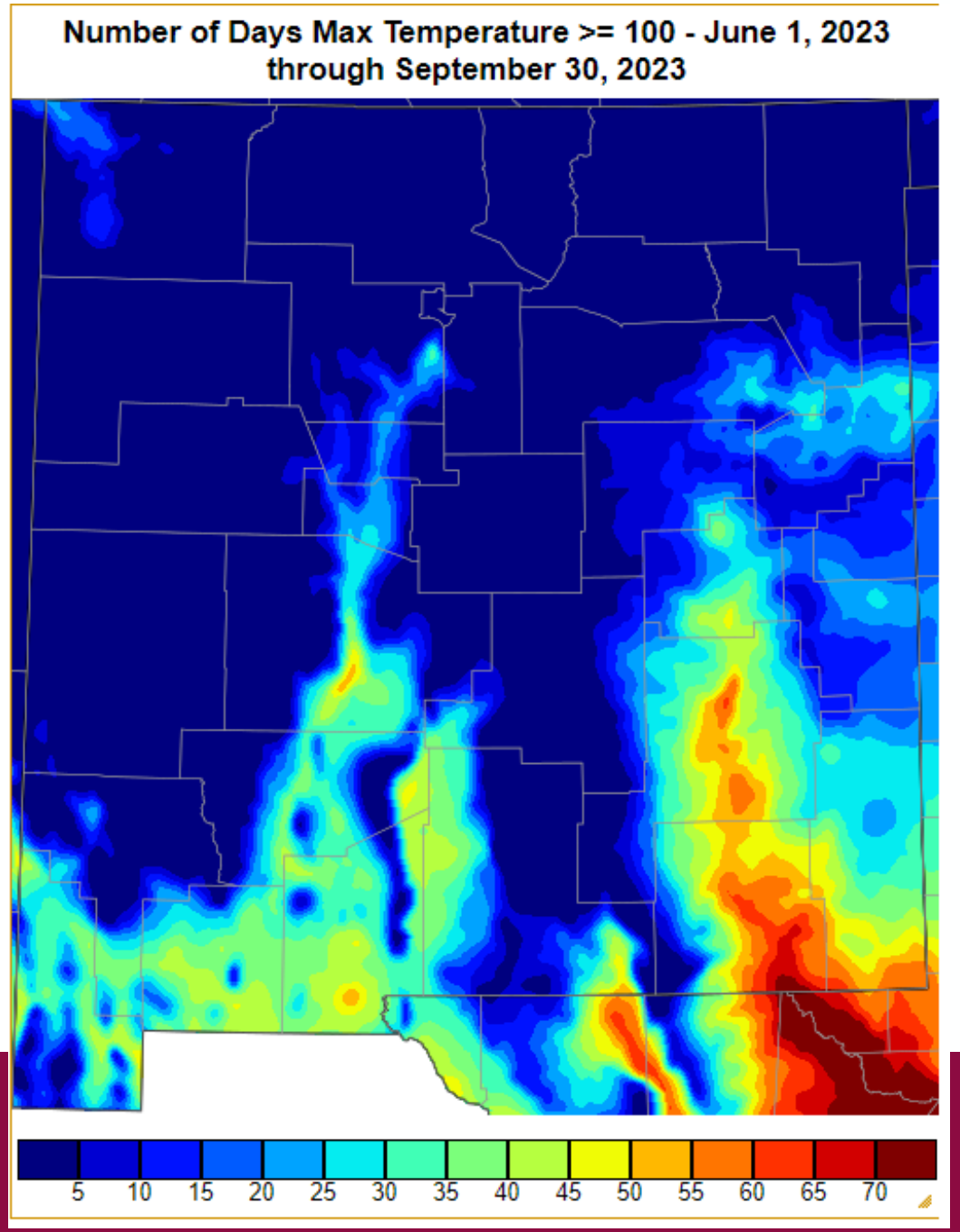


100º days in 2023

Counting the number of days at or above 100ºF in 2023

67 Roswell
64 in Carlsbad
52 Las Cruces
24 Silver City
19 Aztec
17 Albuquerque

89 in Tucson, 133 in Phoenix



Wildfire impacts

- Water quality (debris flow)
- Air quality (smoke, ozone) frequency and size to increase; PM2.5 impacts large areas & can be transported long distances
- Ecosystem impacts (fisheries)
- Agricultural losses
- Infrastructure damage/loss
- Loss of tourism

Courtesy Kerry Jones, USFS

Impacts to Agriculture

- Higher evapotranspiration, stress on plants, higher water needs
- Costs of hauling water and supplemental feed
- Higher water requirements for animals during heat waves
- Reliability of existing water sources threatened

What is a Mesonet?

Network of automated weather observing stations that:

- Monitor environment between 10 m above to 1-m below ground surface such as air temperature, relative humidity, rainfall, winds, solar radiation, soil temperature, and soil moisture
- Report data at a sub-hourly temporal resolution
- Have a spatial density of approximately one station per 1,000 km^2 or greater (average spacing of approximately 30 kilometers)
- Emphasis on data quality, reliability, and completeness to deliver data in near real-time

Why do we need a mesonet?

- Location specific weather and environmental data
- Need for near real-time data
- Need for higher density with consistent sensors and high quality
- Need for weather data at high temporal rate (1-5 minutes)
- No other measurements are available
- Build climatology to cover more geographies, landuse and landcovers
- Input to numerical weather and environmental models
- Calibrate and validate satellite-based products

Managing through drought with mesonet data

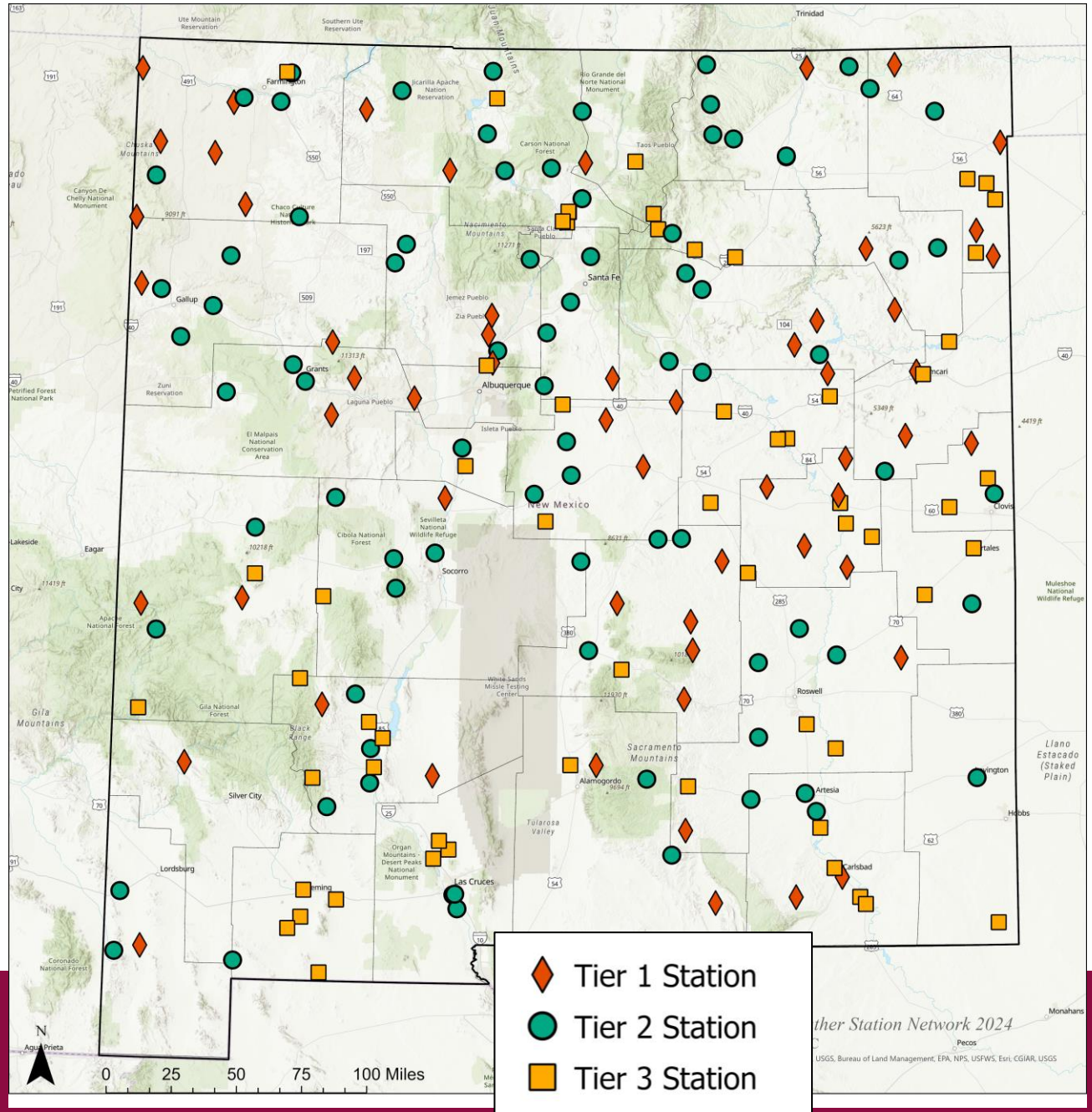
- Better depiction on drought maps (e.g. US Drought Monitor)
- Planting time based on soil temperature
  - For example, 5-day average temperature $\geq$ 18.3°C
- Irrigation scheduling based on evapotranspiration
  - We are working on an online scheduling tool for trees
- Tracking soil moisture prior to planting and through the growing season
  - ZiaMet collects 10-cm soil temperatures and moisture %
- Using heat units crop development and pest management

The New Mexico Mesonet: ZiaMet

More than 200 stations in network, a mixture of 10-meter mesonet standard and 3-meter versions

Located primarily on private land

Used no-cost agreements and MOU

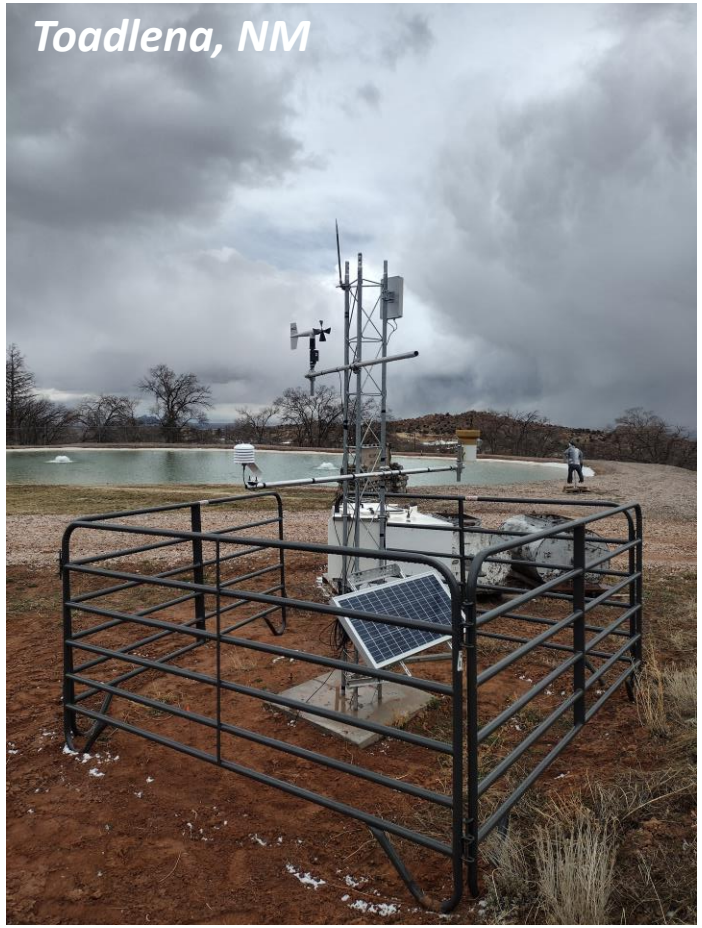


Weather Sensors

Measured Variable(s)	Sensor Model(s)
Air Temperature, Relative Humidity	Vaisala HMP60
Soil Moisture	Stevens HydraProbe
Wind Direction/Speed	R.M. Young 05103 MetOne 014A
Solar Radiation	CS320
Precipitation	TE525 OTT Pluvio^2
Atmospheric Pressure	BaroVue

Station Tiers

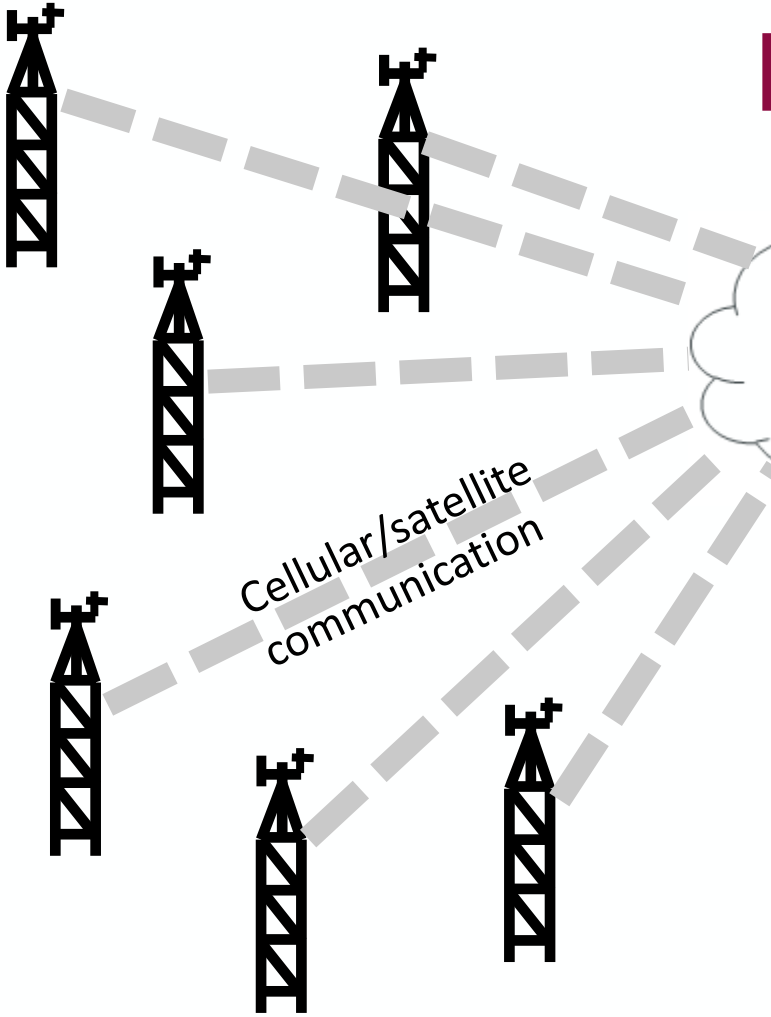
Tier 3



Tier 2

Tier 1

Data Pipeline



Cloud server

NMSU

National Mesonet Program

Public

Data products: ET, GDD, soil temp/moisture, more to come

NWS operations

Synoptic Data

Mesowest

ZiaMet Data Availability

- For New Mexico
  - NMSU website, weather.nmsu.edu, graphs, CSV, tables
  - ZiaMet API, version 1.0
- Nation-wide
  - Mesowest, https://mesowest.utah.edu/
  - National Weather Service, https://www.wrh.noaa.gov/map/
  - Synoptic Data API, https://synopticdata.com/weatherapi/

Contact Information

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