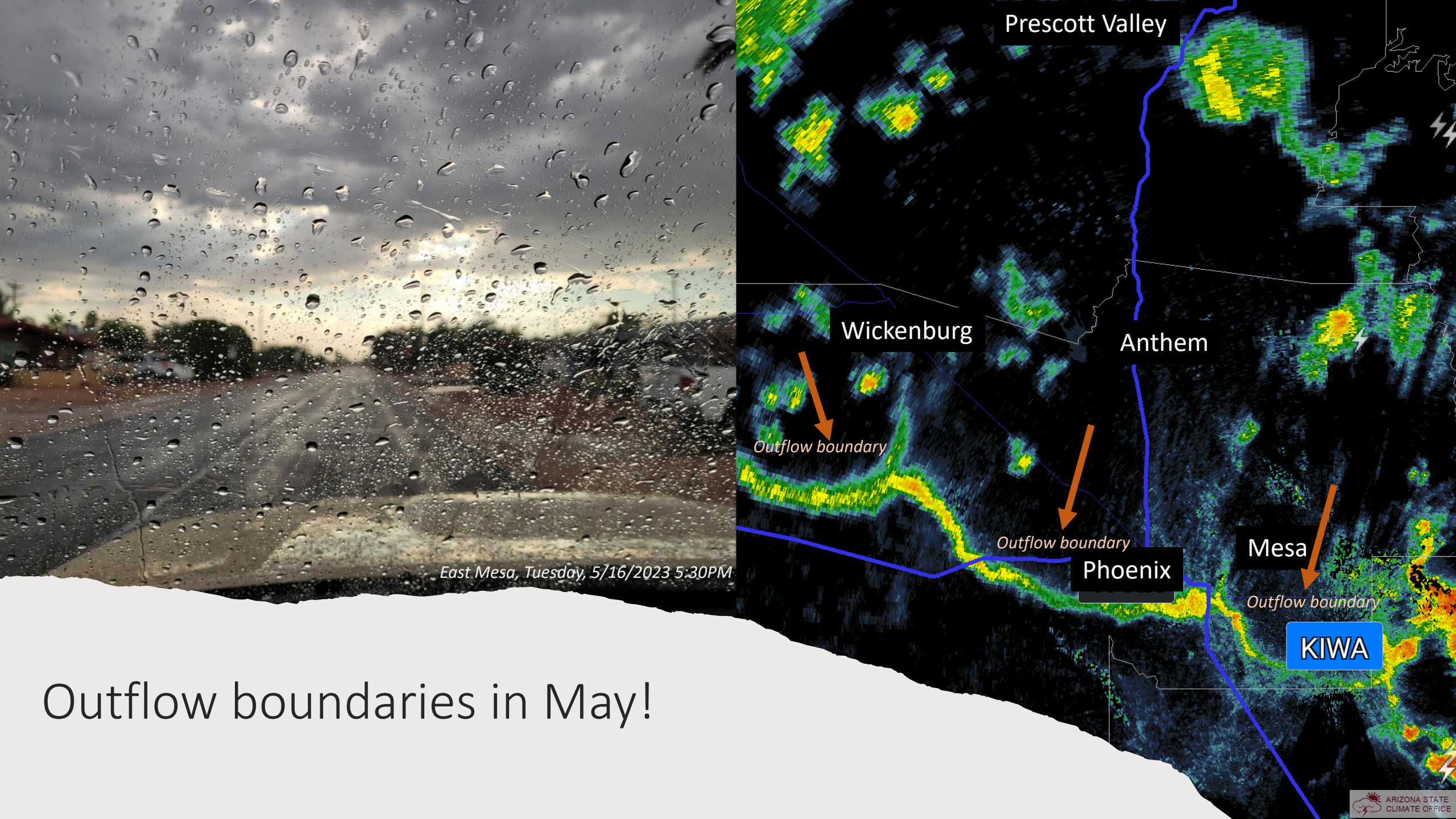
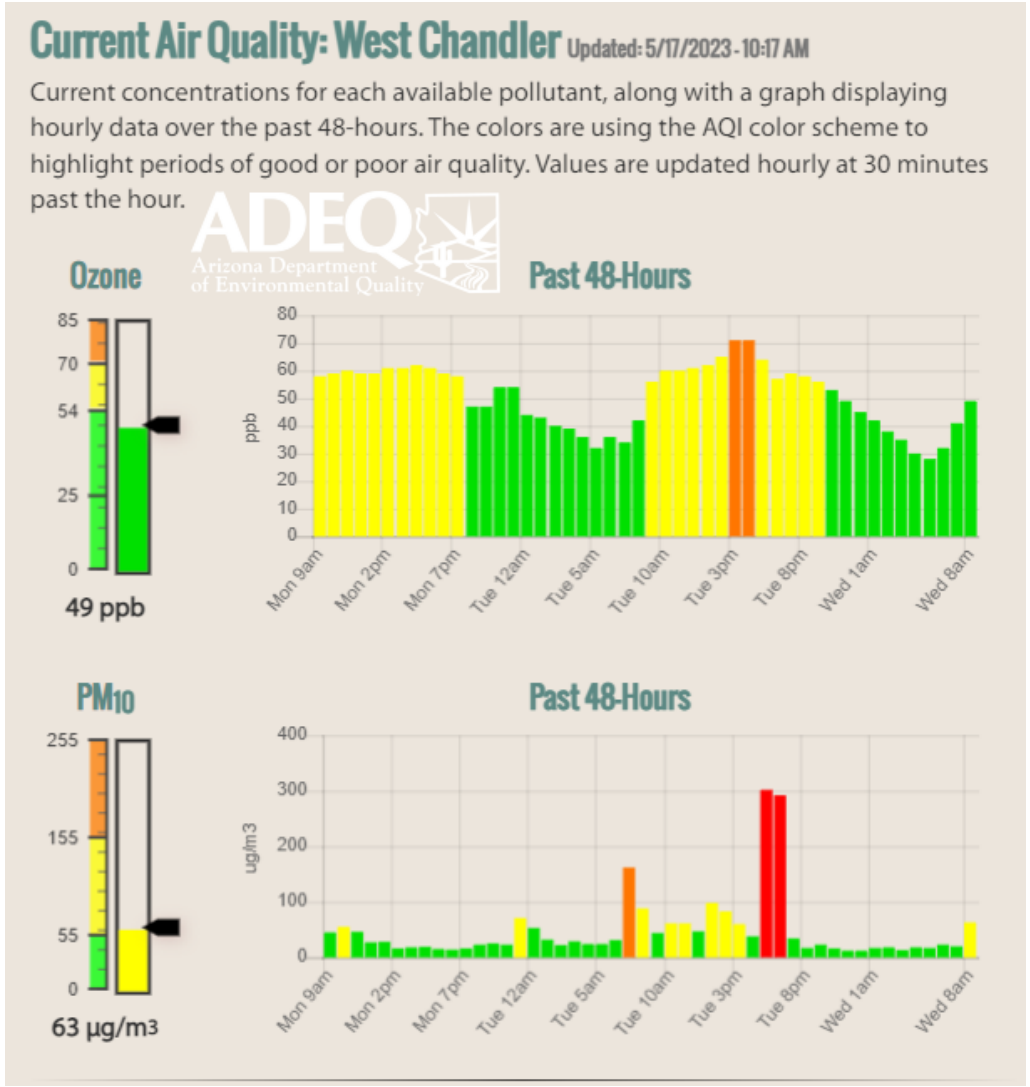
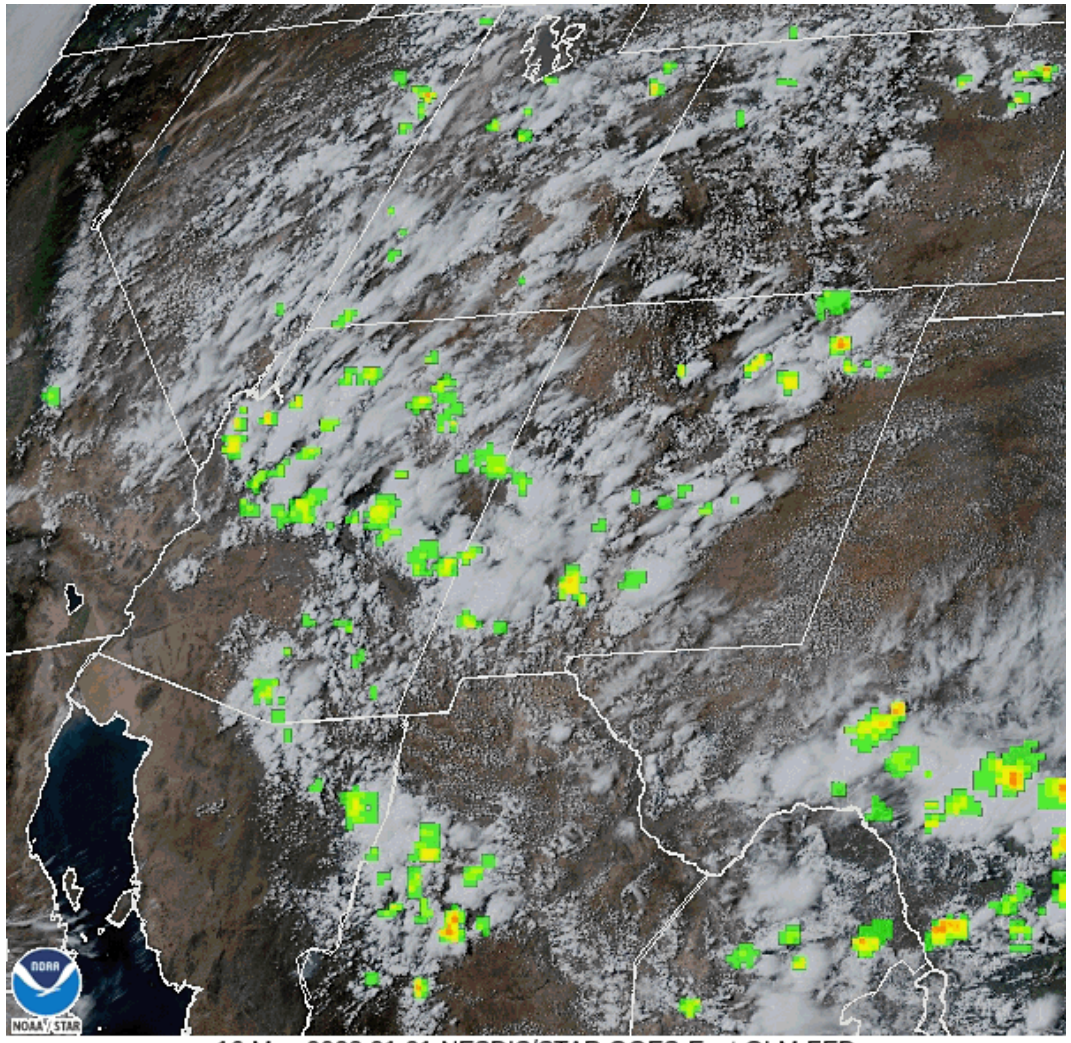


Outflow boundaries in May!

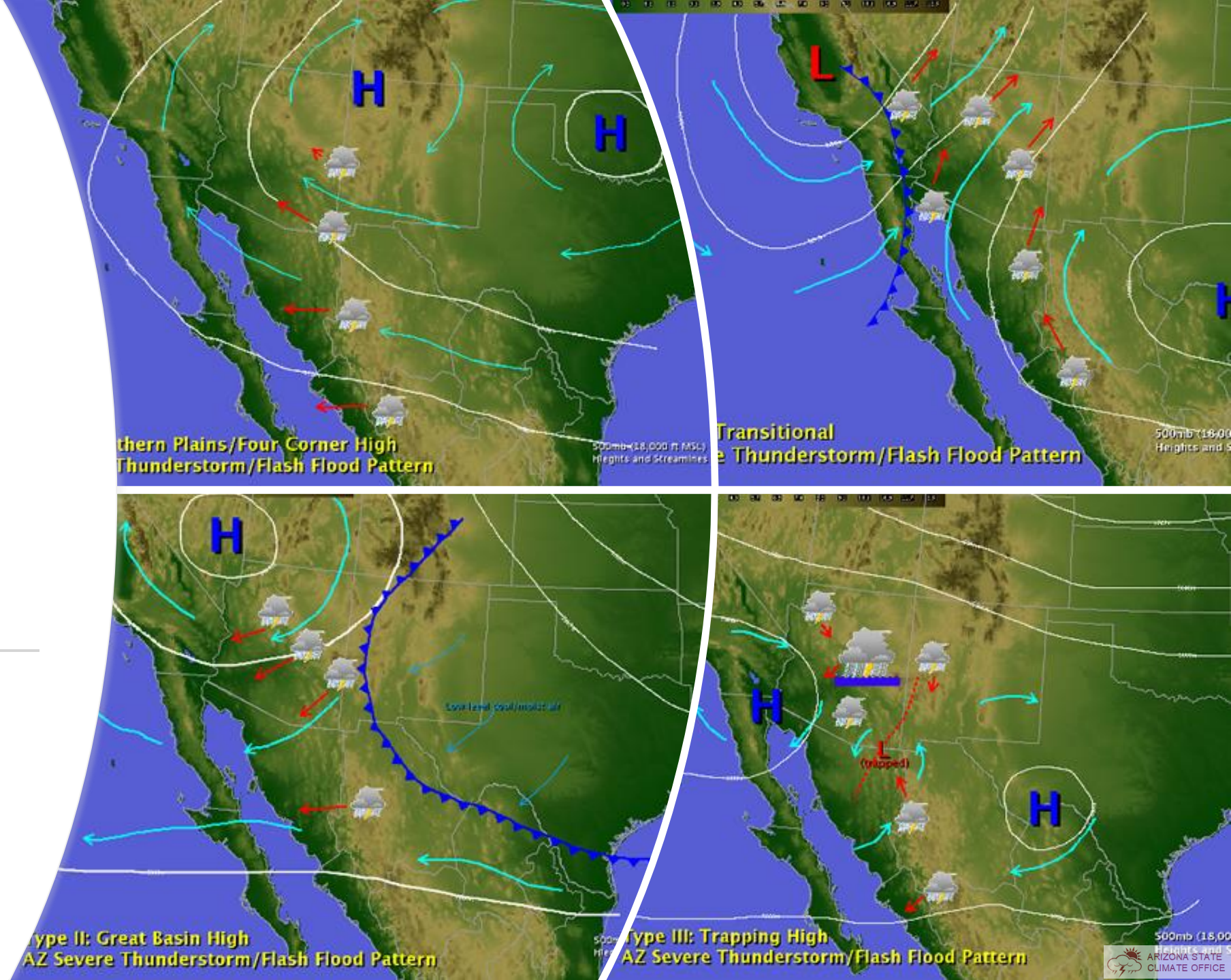
“Dry” lightning is real but “Heat” lightning isn’t



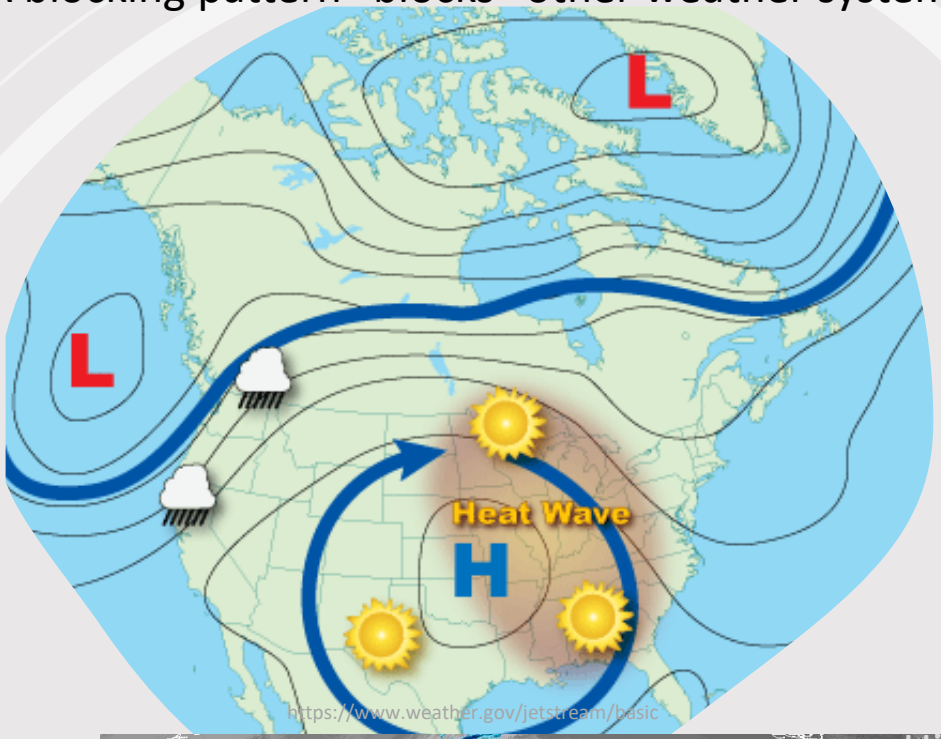


16 May 2023 21:21 NESDIS/STAR GOES-East GLM FED

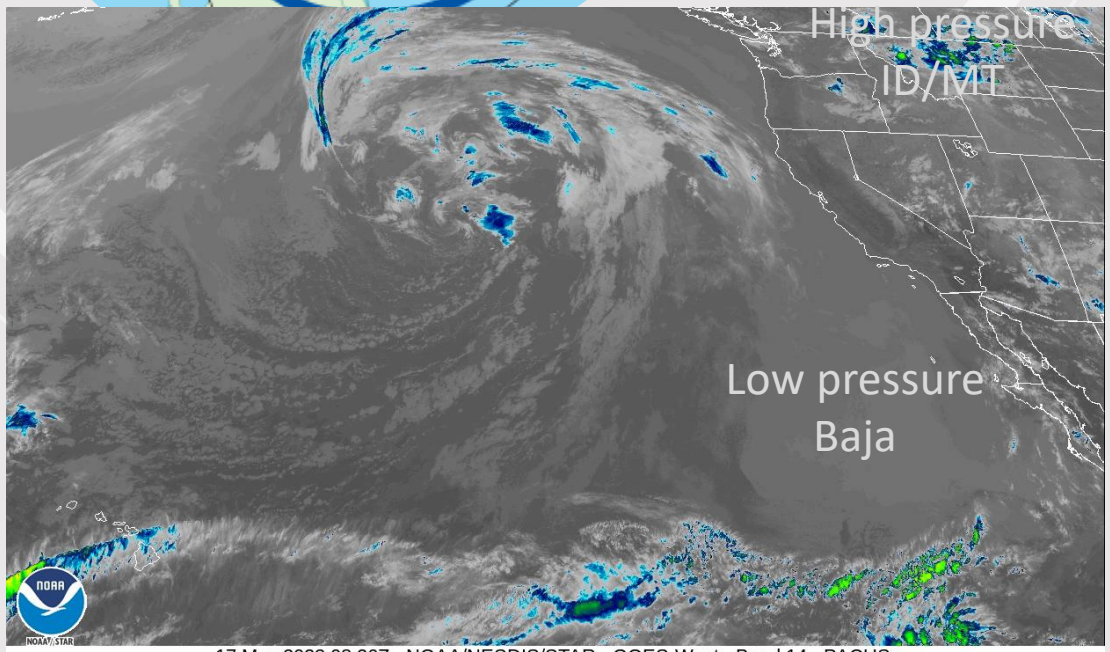
Monsoon2023 …..not yet!



A blocking pattern “blocks” other weather systems



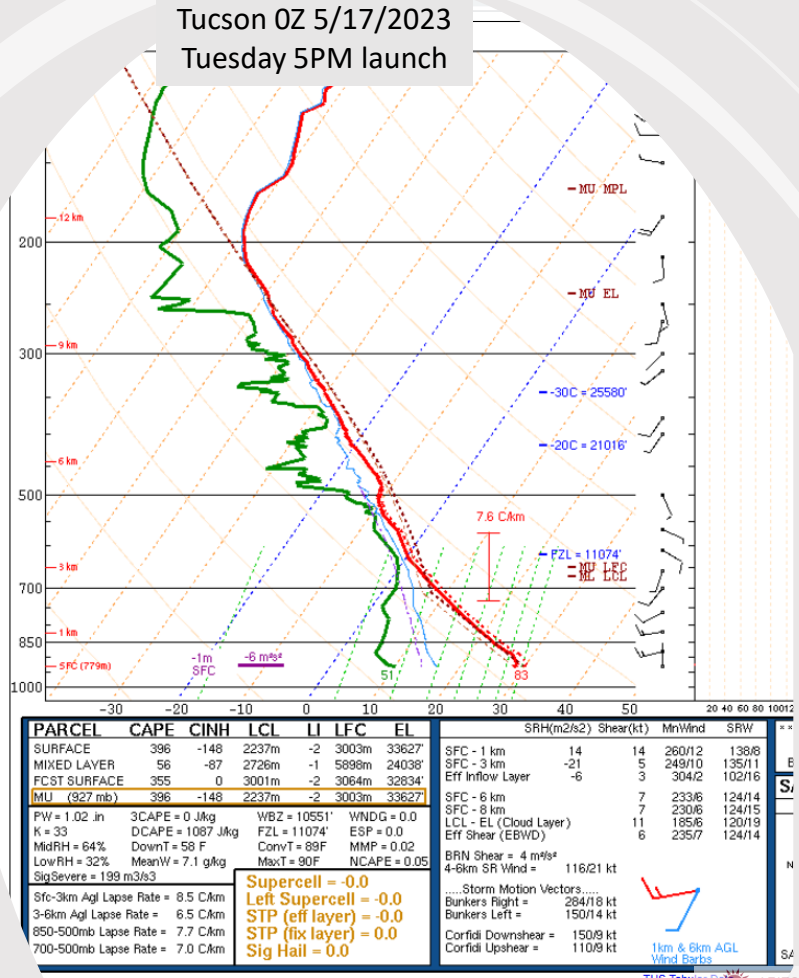
https://www.weather.gov/jetstream/basic



17 May 2023 08:26Z - NOAA/NESDIS/STAR - GOES-West - Band 14 - PACUS

PW over 1” at 90th percentile

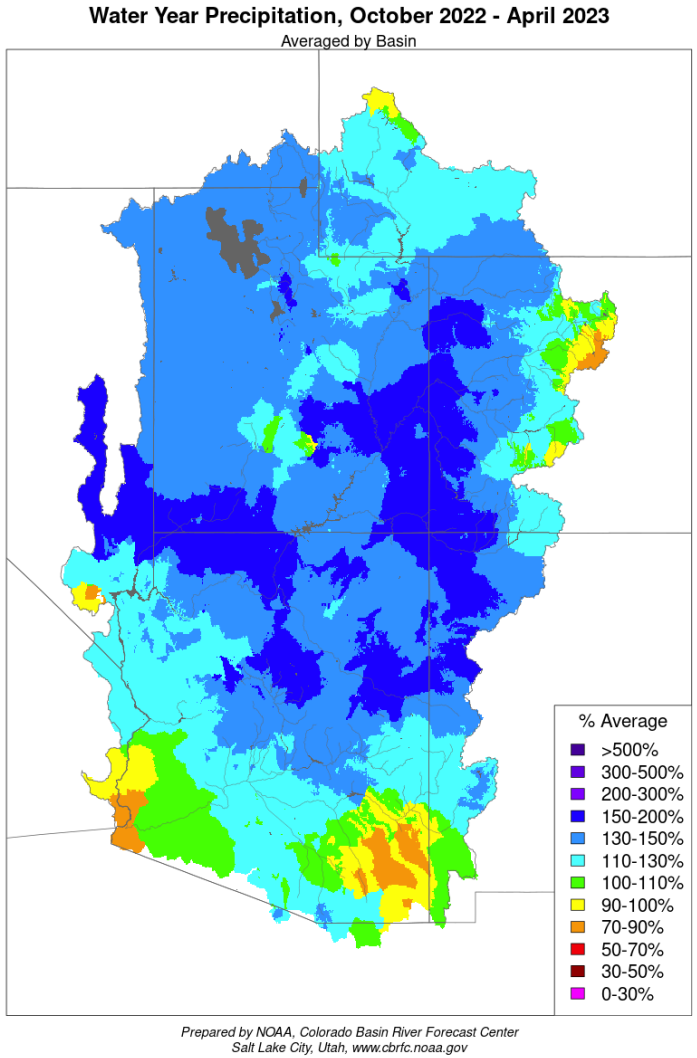
Tucson 0Z 5/17/2023
Tuesday 5PM launch

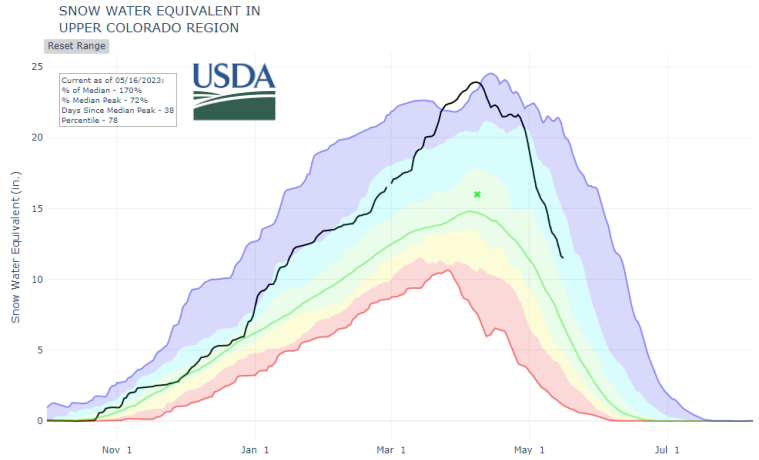


https://www.spc.noaa.gov/

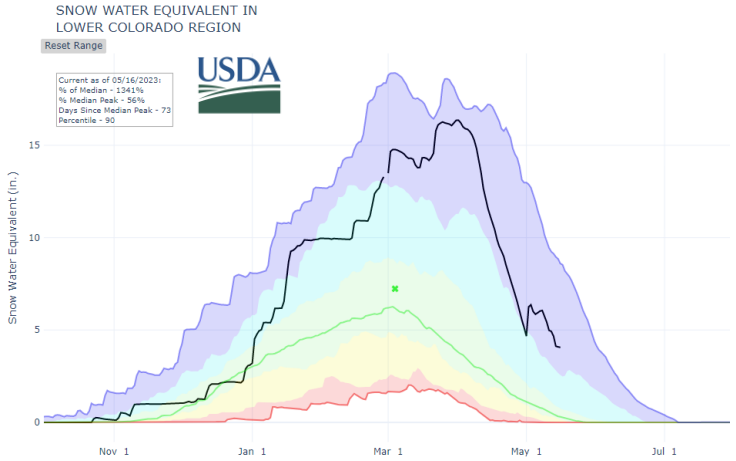
ARIZONA STATE CLIMATE OFFICE

Snowmelt still happening in Colorado





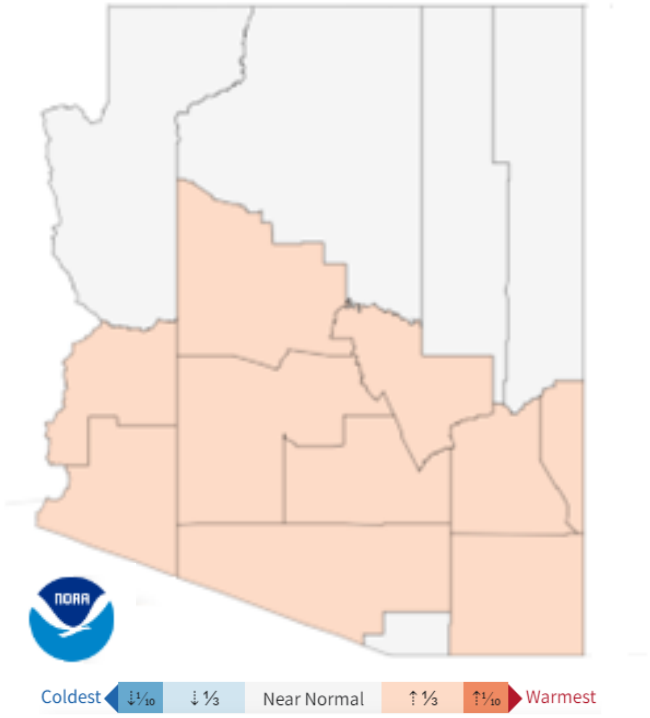
Upper Basin still expecting inflow



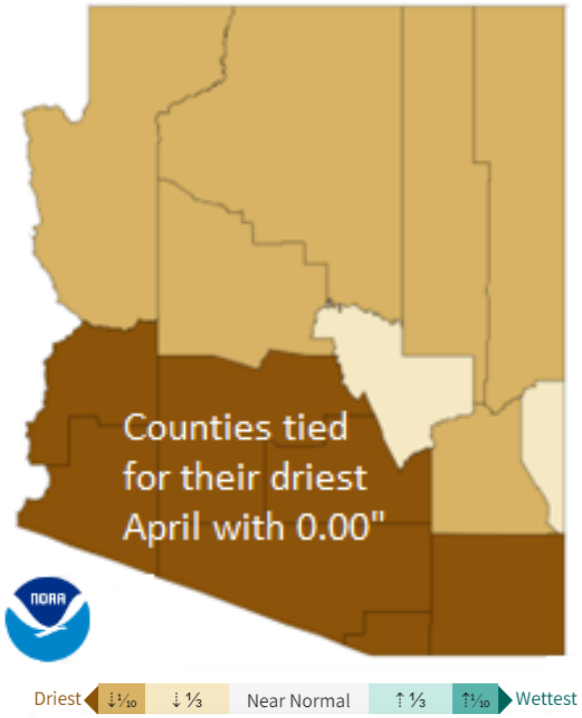
Lower Basin almost complete

April 2023 was very dry

April 2023: 38th warmest April



April 2023: 3rd driest April

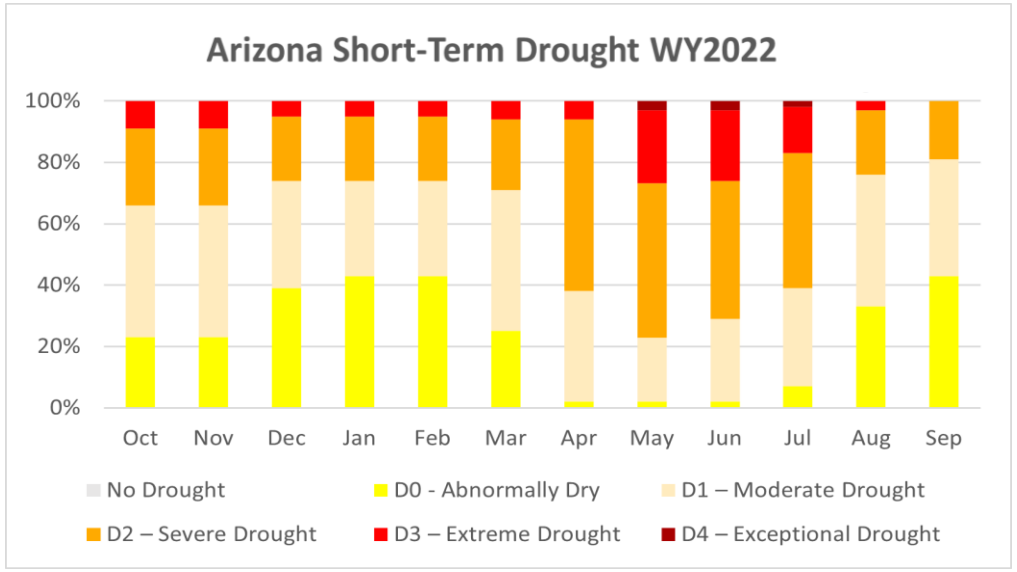


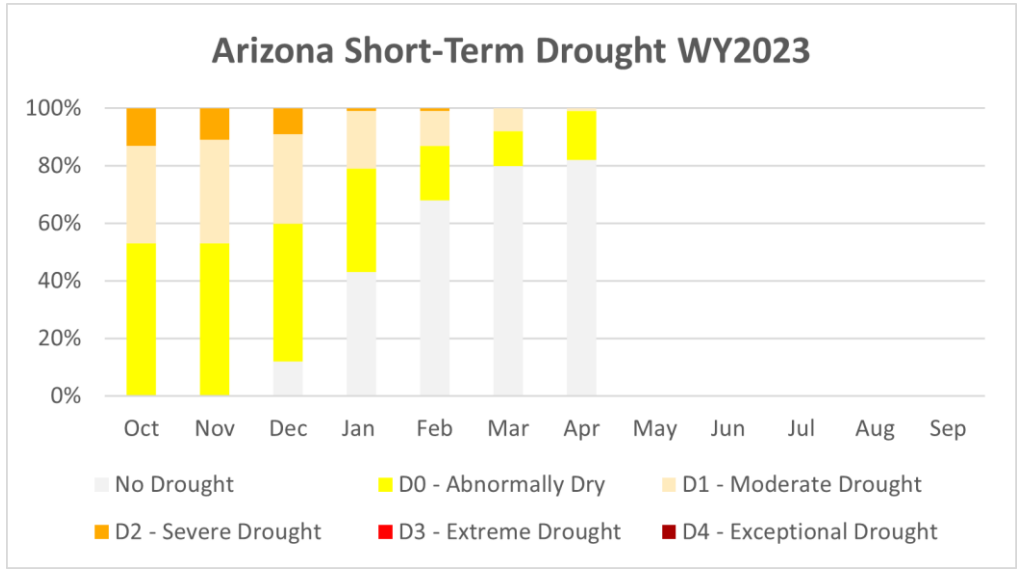
Oct-Apr: 27th wettest
= 8.56”

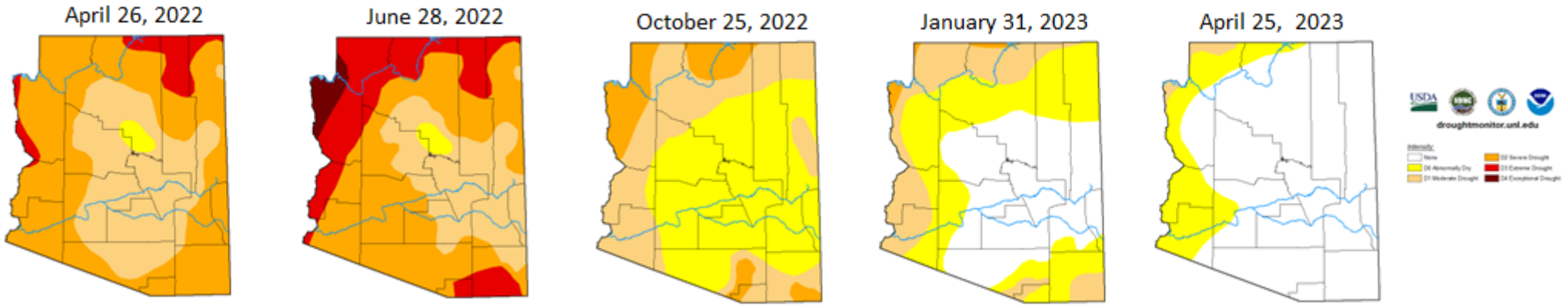
Long-term WY avg: 12.26”
= -3.7”

April 2023 was warmer

Short-term drought has improved

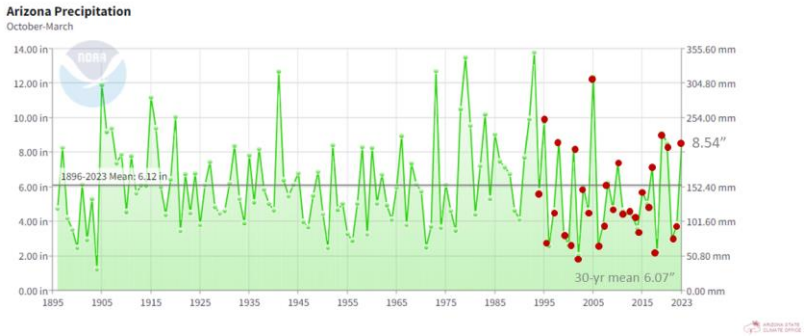




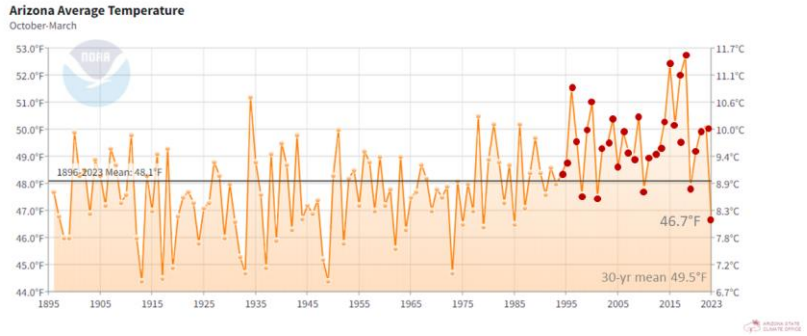


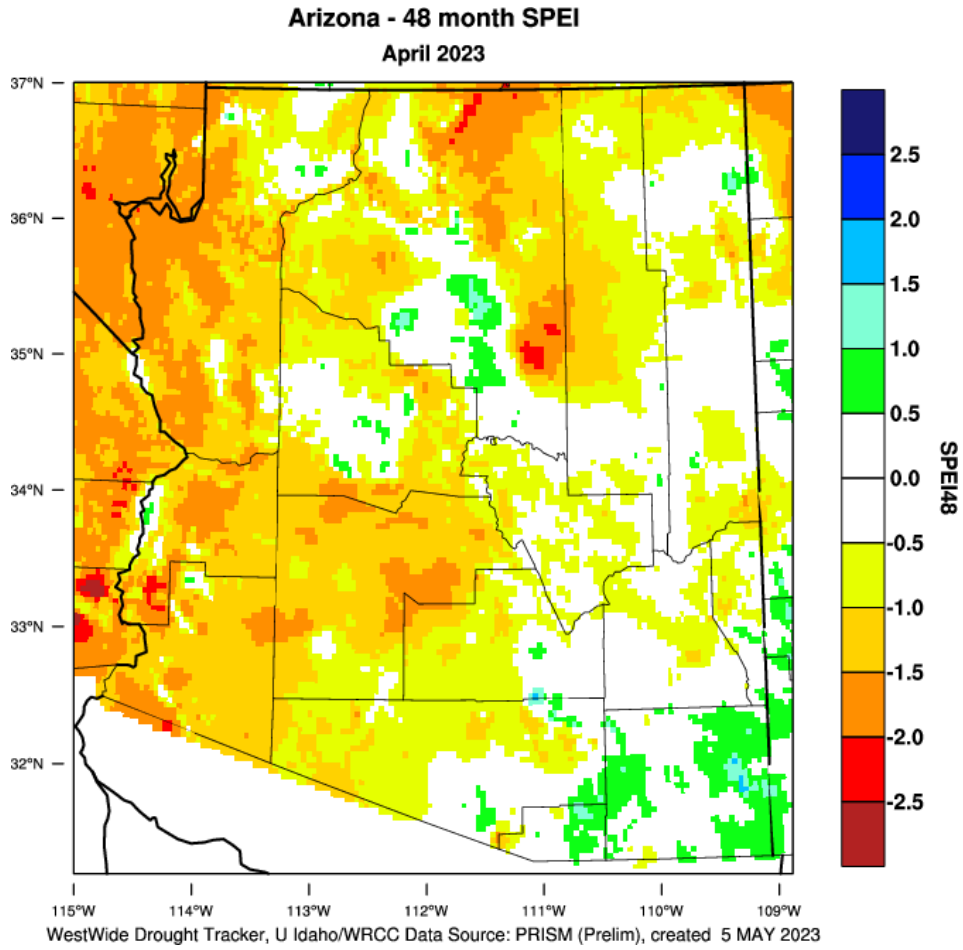
Long-term drought continues

Statewide precipitation above average
(Oct to Mar)

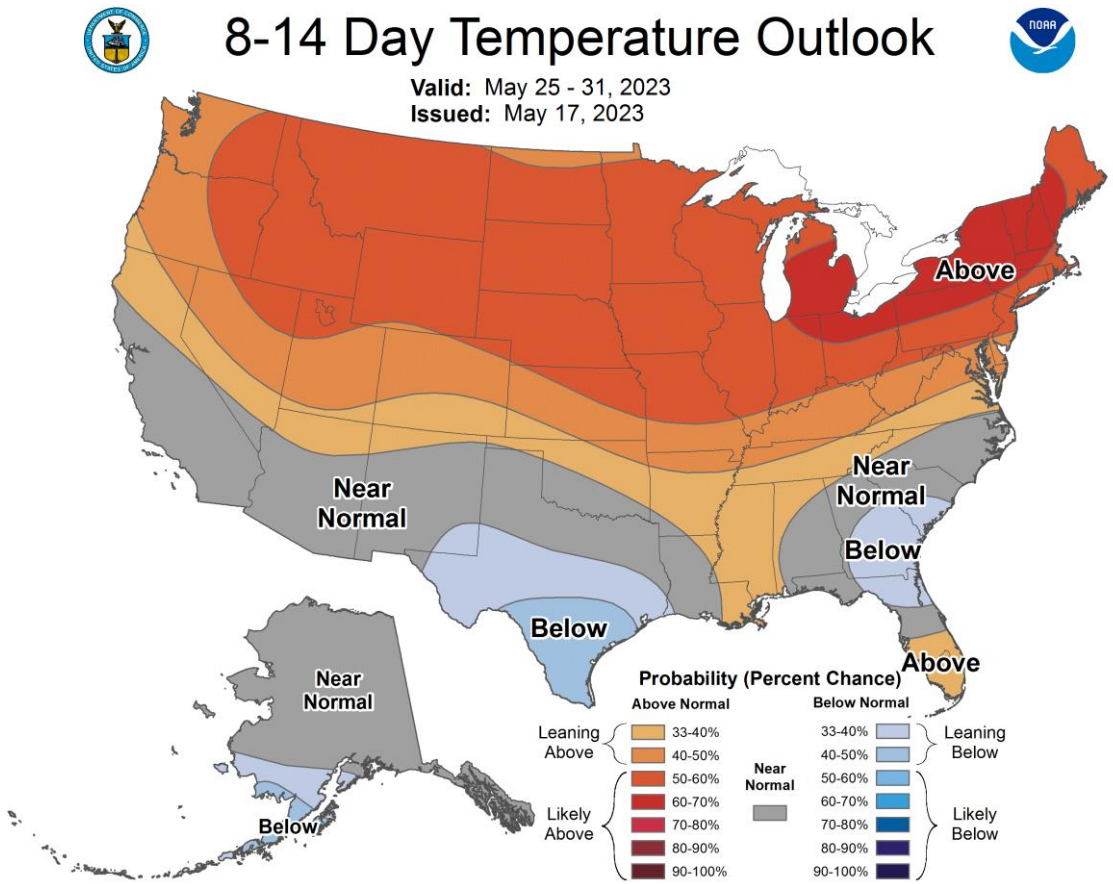


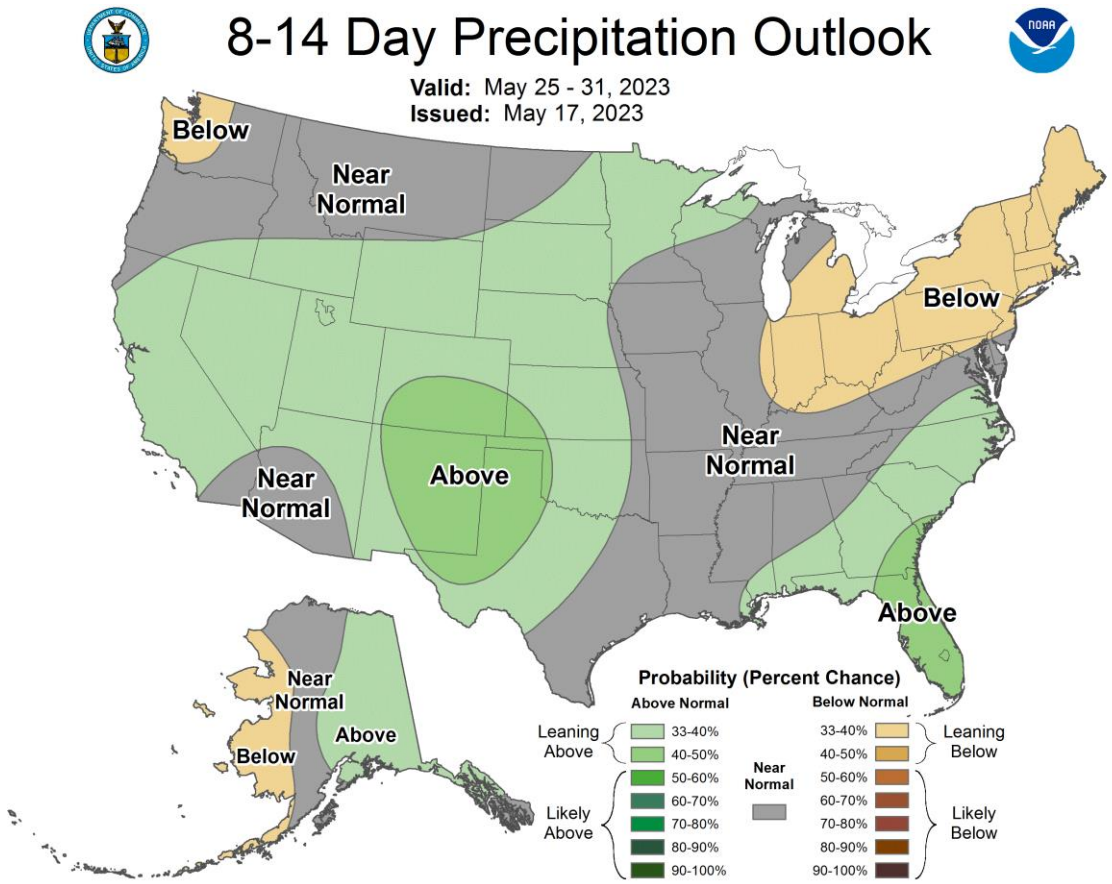
Statewide temperature below average
(Oct to Mar)



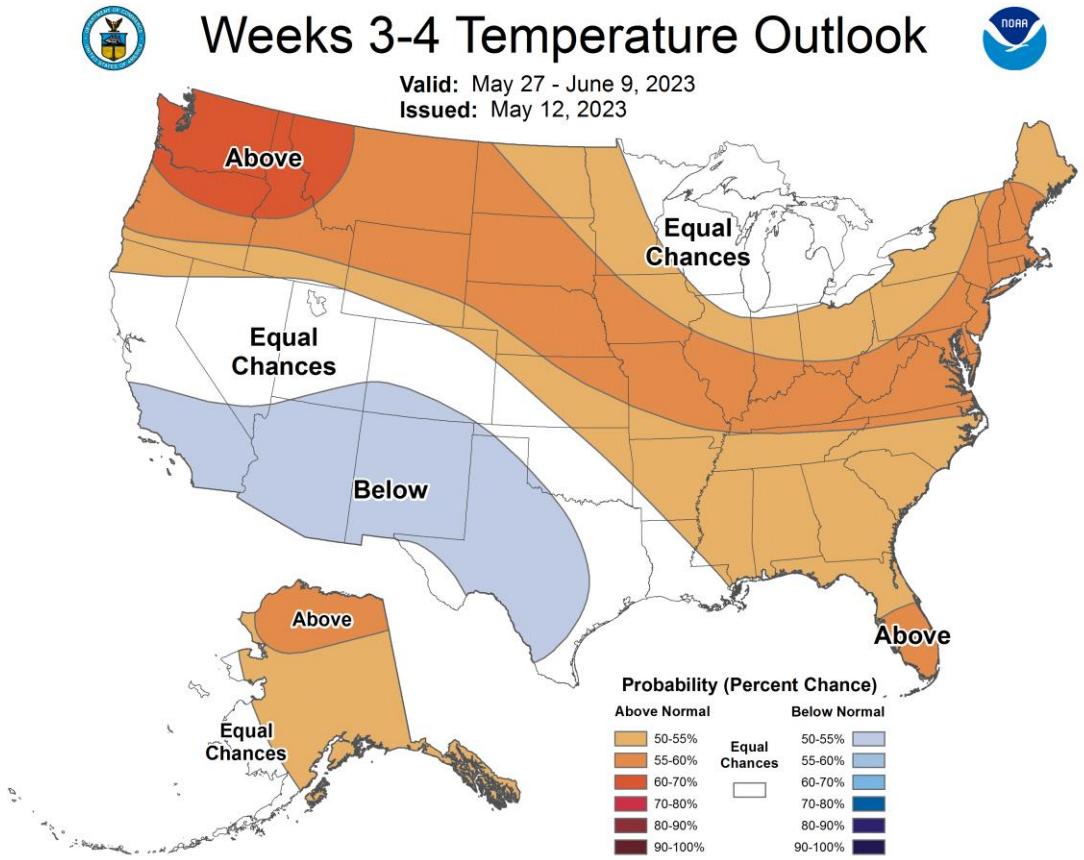


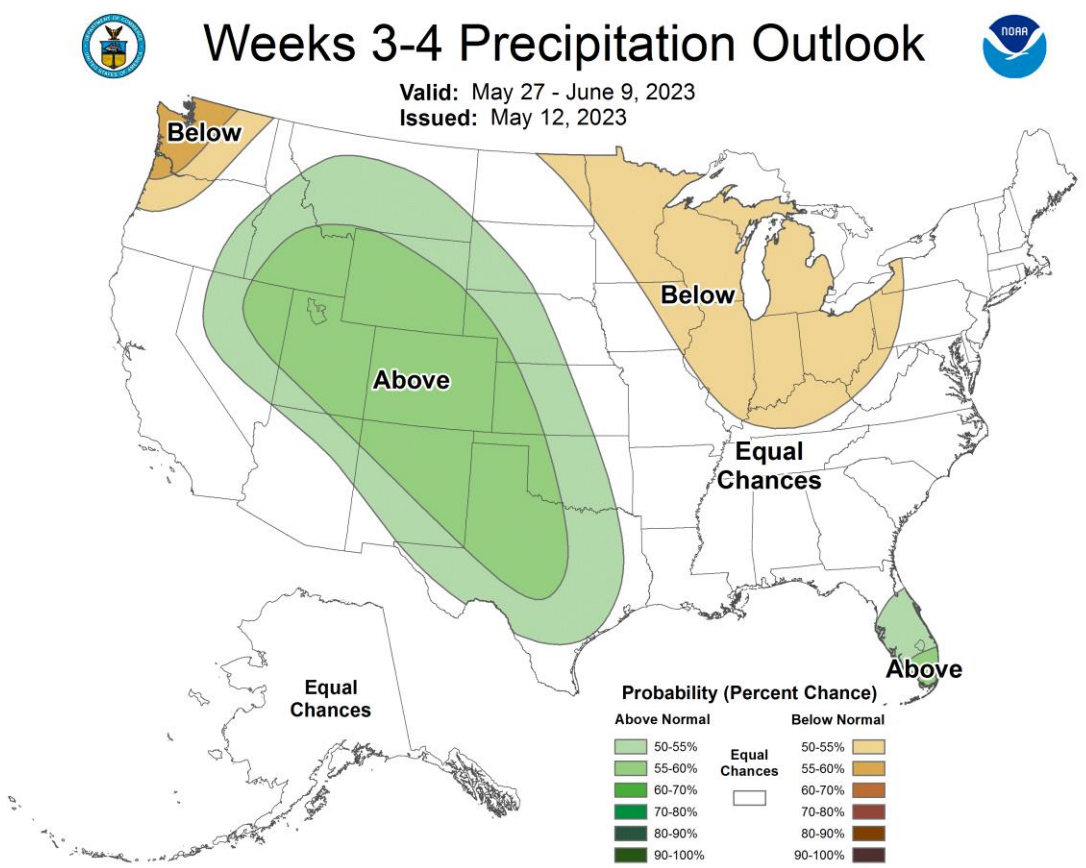
Short-term outlook



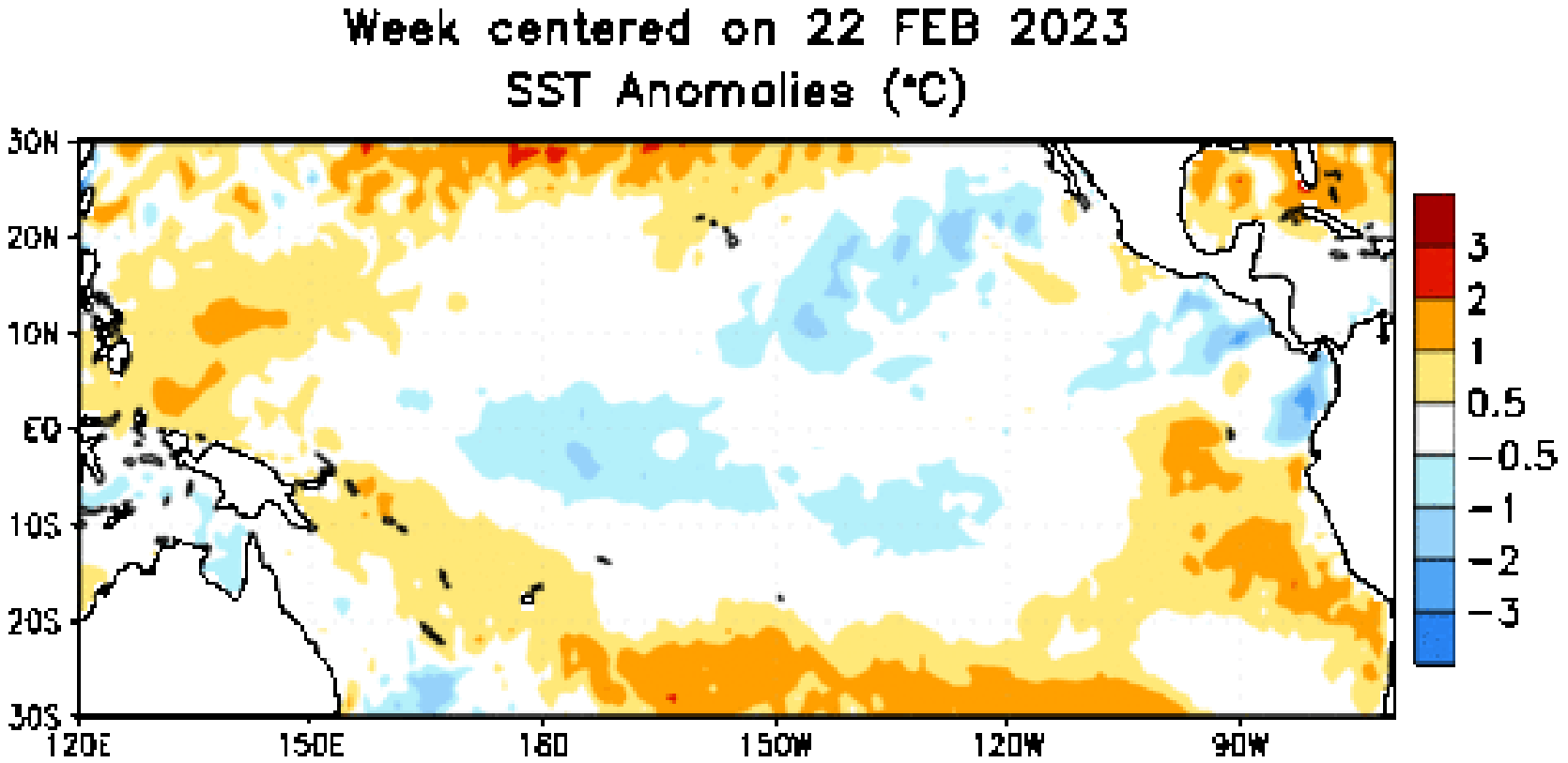


Outlook first week of June





90% chance El Nino winter



Wet versus Dry

Year	Winter (prev Dec to Mar)	Summer (Jun to Sep)
2018	Dry *(La Nina)*	Wet
2019	Wet *(El Nino)*	Dry
2020	Wet *(Neutral)*	Dry
2021	Dry *(La Nina)*	Wet
2022	Dry *(La Nina)*	Wet
2023	Wet *(La Nina)*	???

Wet or Dry based on above or below average

Summary

- April warm and dry but May has already had rain and even snow
- Short-term outlook shows might stay cooler
- Delayed monsoon??
- El Nino expected in winter

New puppy Andes!
3 months
Husky/Cattle Dog
Looks like an Andean bear

Flashes of Brilliance
The Science and Wonder of Arizona Lightning

Ronald Holle

Holle Meteorology & Photography

Oro Valley, Arizona

rholle@earthlink.net

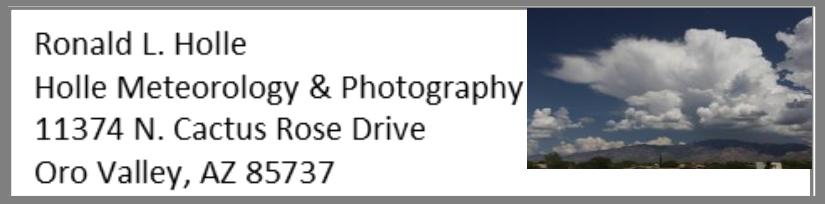
Daile Zhang

Earth System Science Interdisciplinary Center

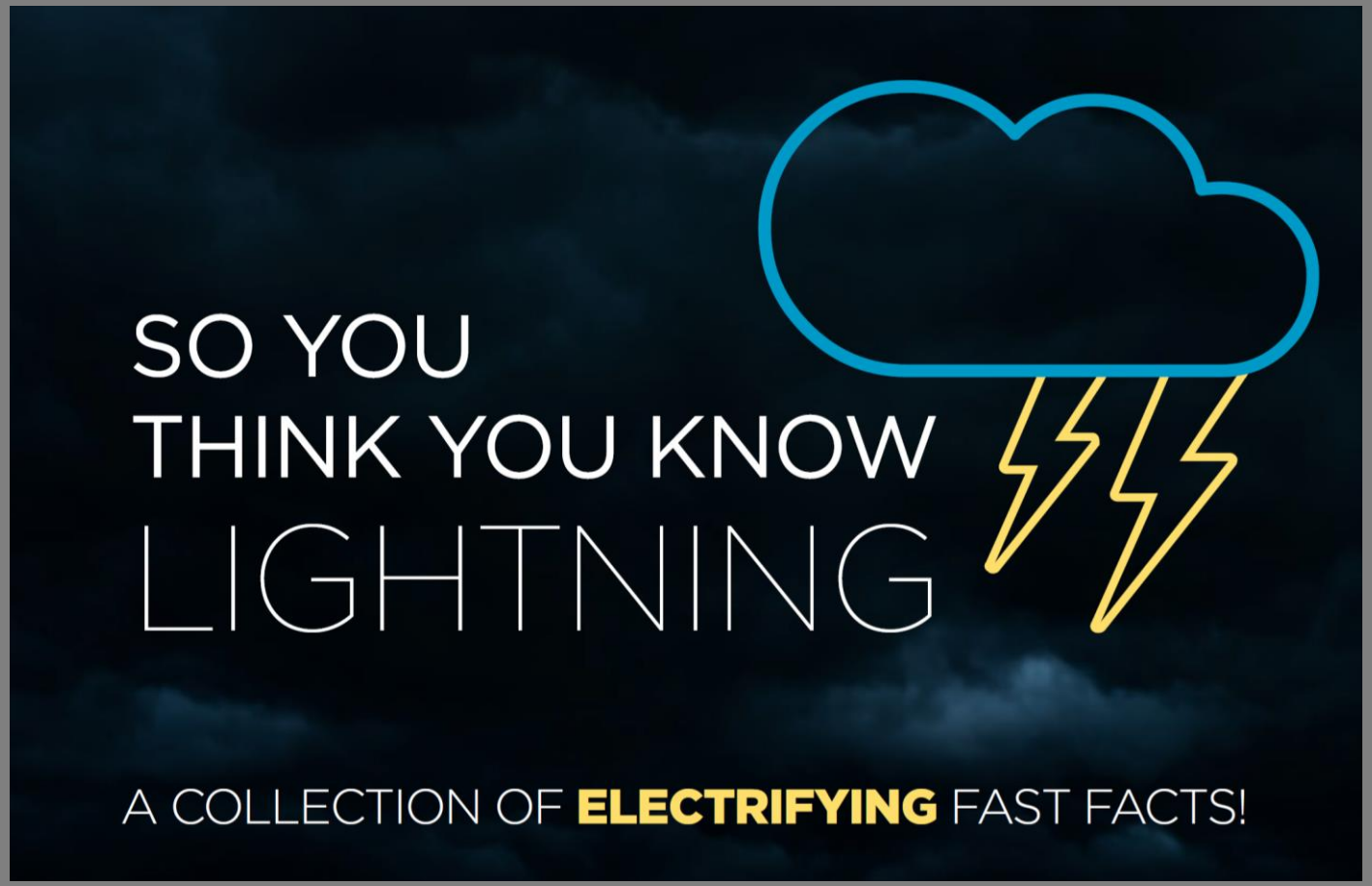
University of Maryland

College Park, Maryland

dlzhang@umd.edu



Predecessor publication in 2017



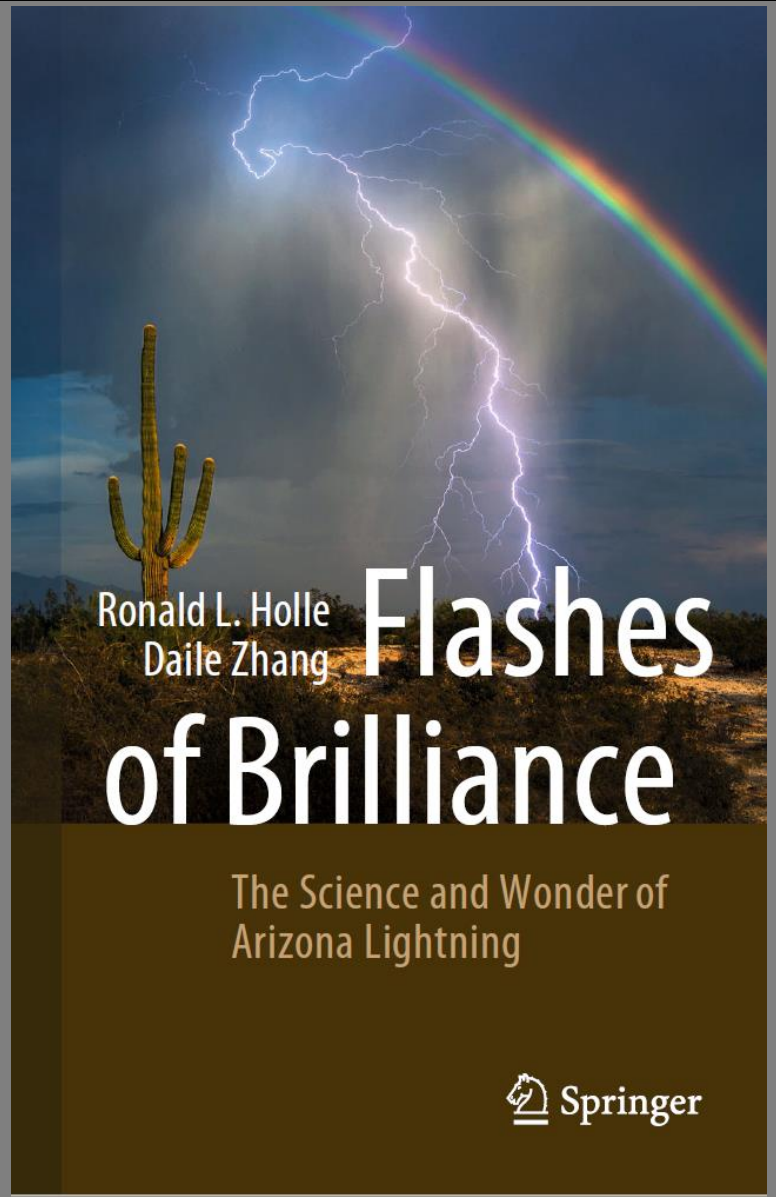
www.vaisala.com/en/system/files/documents/Lightning-Booklet.pdf

https://lightningdev.umd.edu/aert/Safety.html

Frequently asked questions in booklet

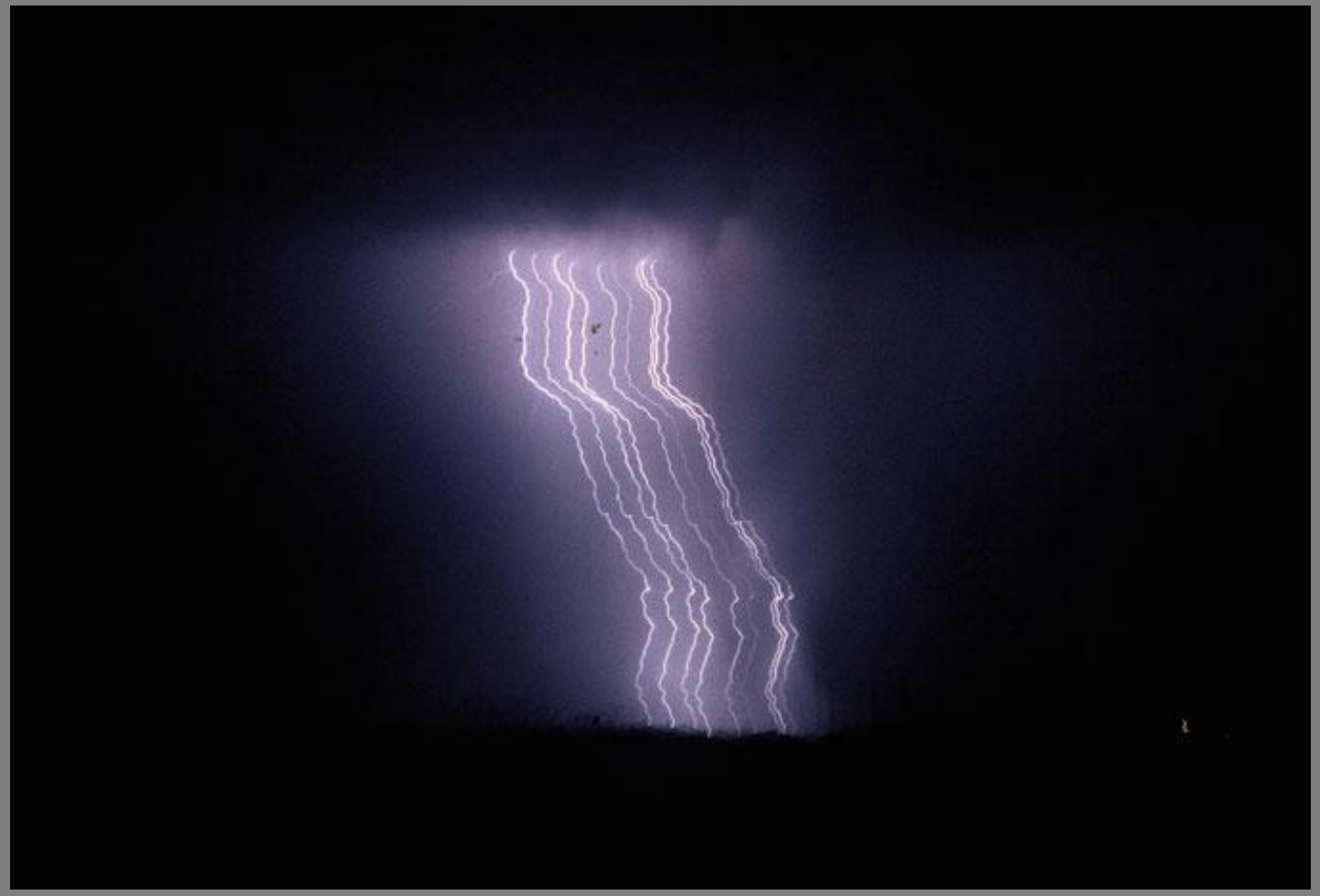
- Is it safe to use a mobile phone during a thunderstorm?
- Can rubber tires save you from a direct strike to your car?
- Are tents and small shelters safe during a thunderstorm?
- Is it safe to stand under a tree during a thunderstorm?
- Can rubber-soled shoes save you from lightning?
- Are passengers safe if lightning strikes a plane?

New Springer book



Cover photo by Greg McGown, Tucson

Chapter 1
The Scientific Basics of Lightning



Multiple strokes in a negative cloud-to-ground flash

Oro Valley, Arizona

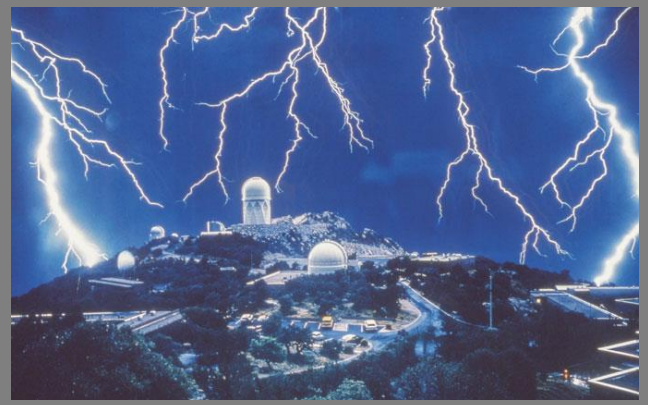
Chapter 2
Arizonans' Fascination and Perspectives About Lightning

Indian Watchtower
Grand Canyon National Park

David Fitzsimmons
Arizona Daily Star

Chapter 3
Arizona is the Lightning Photography Capital of the U.S

Kolb brothers
Grand Canyon National Park
Glass plate
Early 1910s



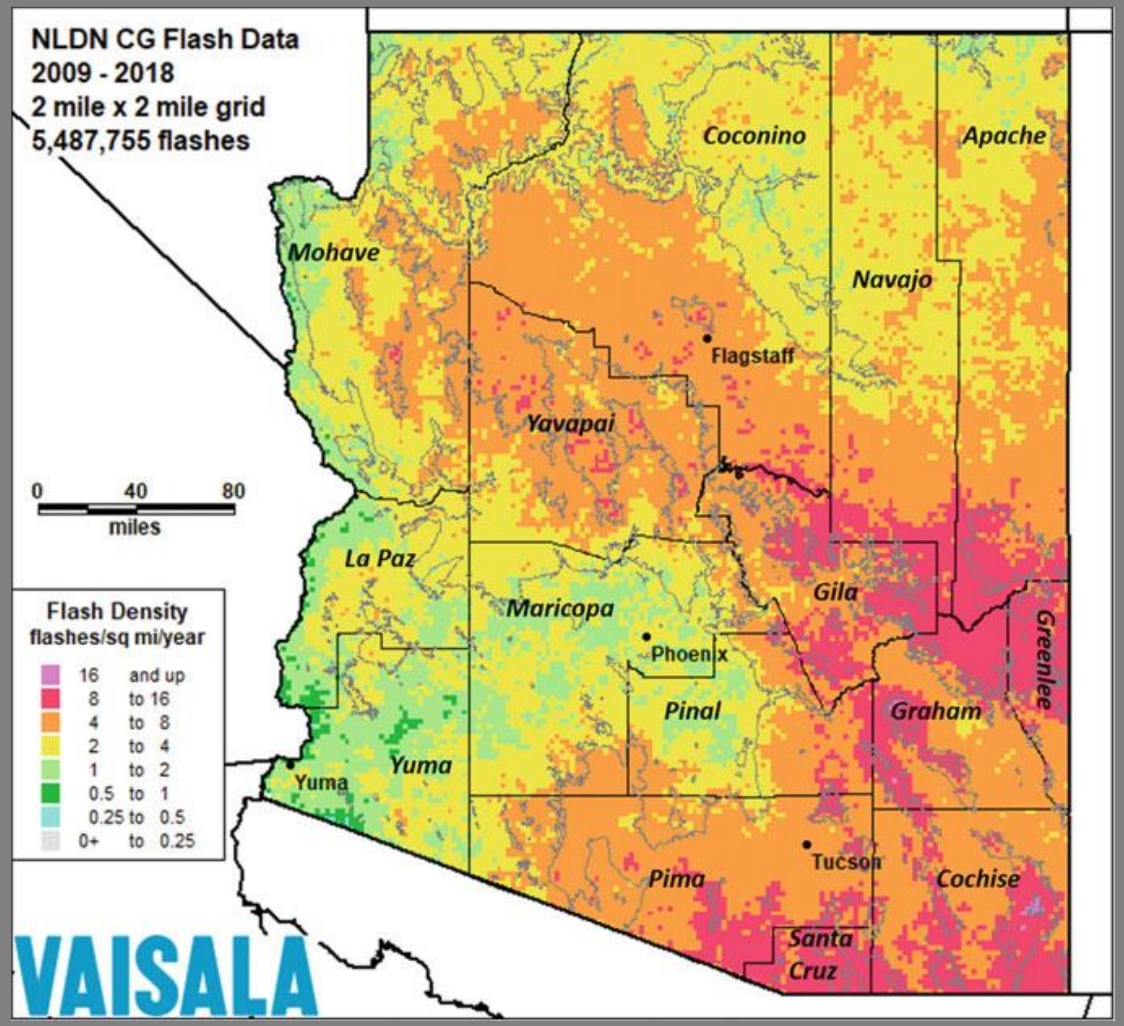
Gary Ladd, Kitt Peak, 1972

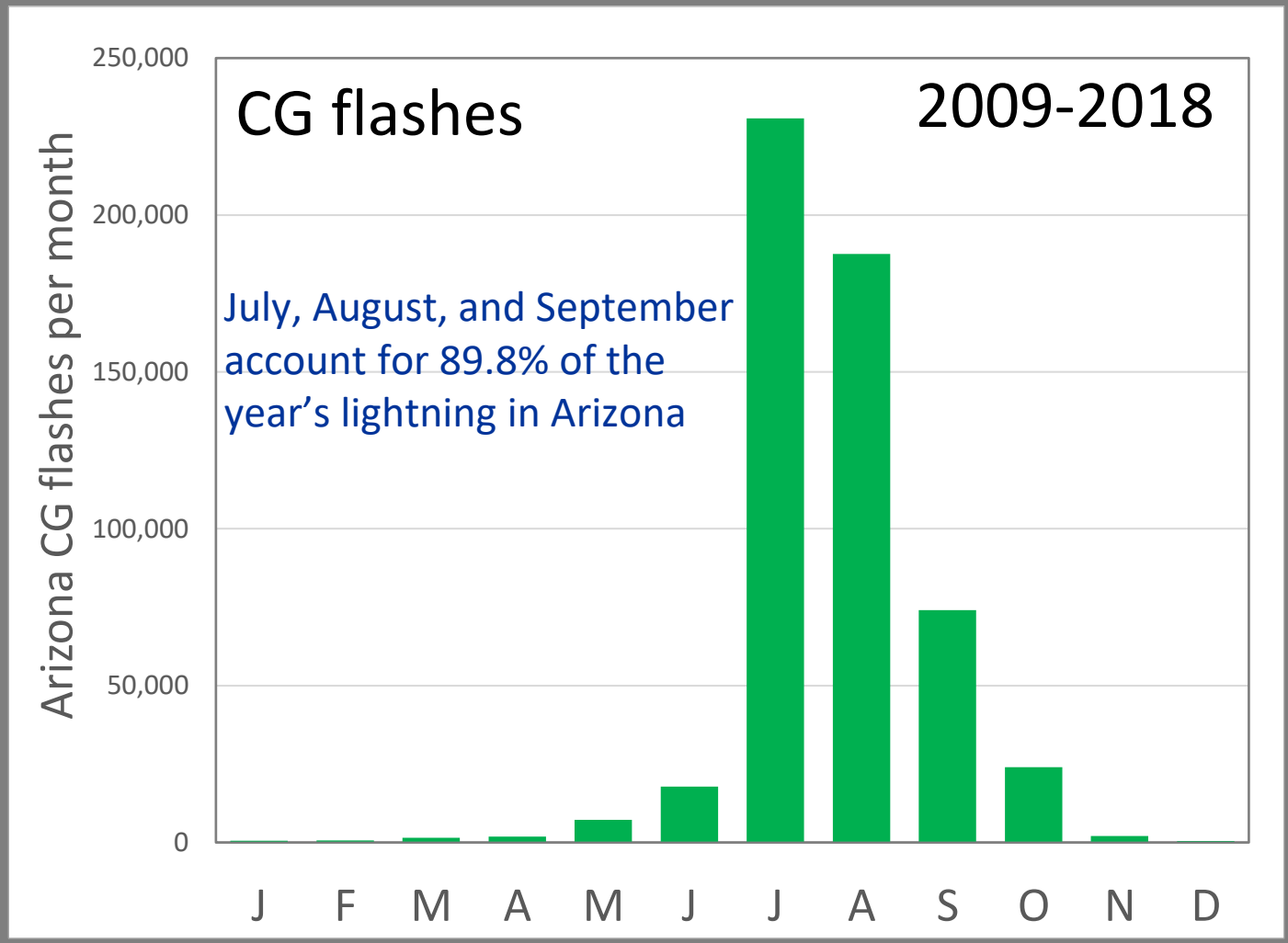
Mike Olbinski, Grand Canyon, 2017

Lori Bailey, Rio Rico, 2019

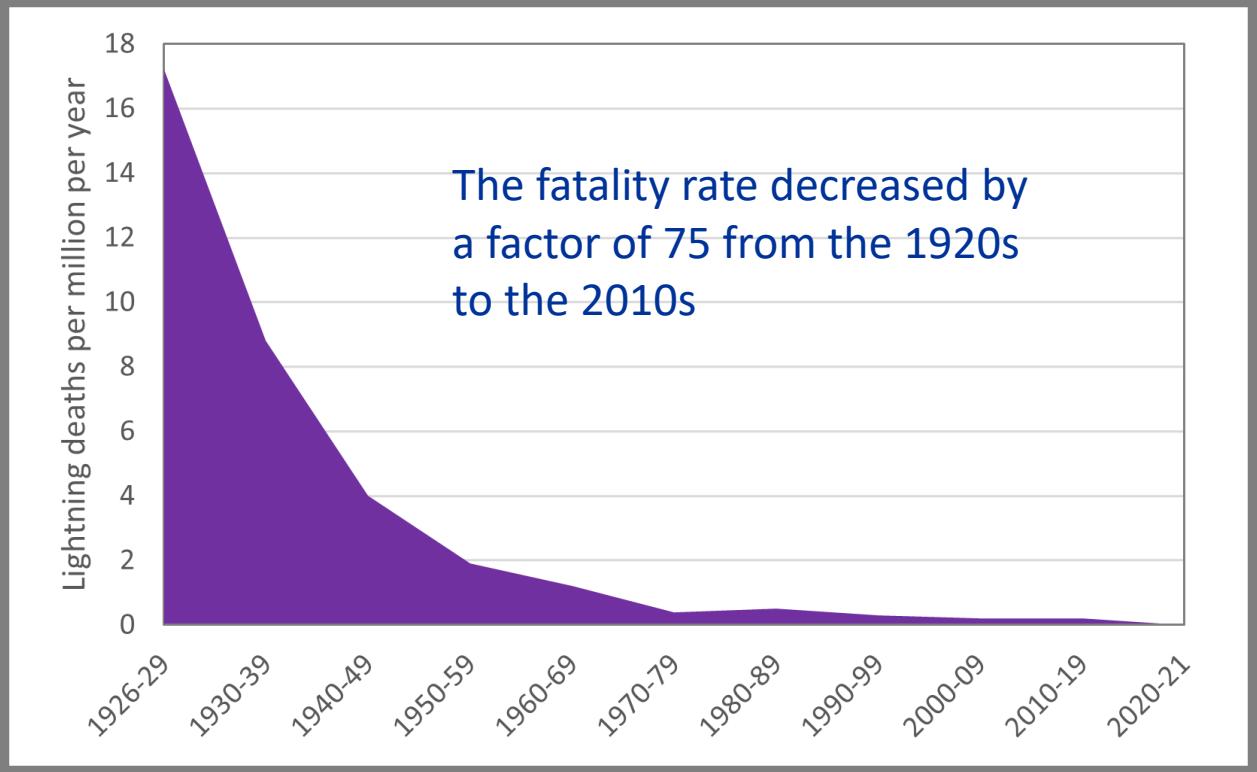
David Rankin, Lake Powell

Chapter 4
When, Where, and How Much Lightning Occurs in Arizona





Chapter 5
Human Impacts, Damages, and Benefits from Lightning in Arizona



95-year history of lightning fatality rate in Arizona

Lightning safety Wei Xu.

Chapter 6
How Lightning Detection Networks Were Developed in Arizona

Early antenna
Alaska, 1976

NLDN sensor
Yuma, 2021

Network Control Center
Tucson, 2019

Chapter 7
Lightning Research in Arizona

Table 7.1 University of Arizona lightning students arranged by year of key related publications

Student	Degree	Topic	Key early publication
Elizabeth Jacobson	M.S	KSC field mills	Jacobson and Krider (1976)
Charles Weidman	Ph.D.	Detailed lightning structure	Weidman (1982)
Michelle Piepgrass	M.S	KSC field mills/rain	Piepgrass and Krider (1982)
Launa Maier	Ph.D.	KSC LDAR	Maier et al. (1984, 1995)
Richard Blakeslee	Ph.D.	Maxwell currents	Krider and Blakeslee (1985)
Mark Williams	Ph.D.	Jupiter lightning	Williams (1986)
Thomas Adang	Ph.D.	Monsoon lightning	Adang (1989)
William Koshak	Ph.D.	KSC field mills	Koshak and Krider (1989)
Martin Murphy	Ph.D.	KSC field mills	Murphy (1996)
William Valine	M.S	Camera studies	Valine and Krider (2002)
Nicole Kempf	M.S	Rainfall versus lightning	Kempf and Krider (2003)
Natalie Murray	M.S	Stroke phenomena	Murray et al. (2005)
Bruce Gungle	M.S	Rainfall versus lightning	Gungle and Krider (2006)
Chris Biagi	M.S	NLDN validation	Biagi et al. (2007)
Kenneth Kehoe	M.S	NLDN validation	Biagi et al. (2007)
William Scheftic	M.S	Soil moisture and lightning	Scheftic et al. (2008)
Stacy Fleenor	M.S	Camera studies	Fleenor et al. (2009)
Lesley Leary Mozzarella	Ph.D.	Tropical cyclones	Leary and Ritchie (2009)
Christina Stall	M.S	Camera studies	Stall et al. (2009)
Mason Quick	Ph.D.	Optical studies	Quick and Krider (2013)
Gina Medici	M.S	Cloud lightning detection	Medici et al. (2017)
Carlos Minjarez-Sosa	Ph.D.	Rainfall versus lightning	Minjarez-Sosa et al. (2017)
Tyler Kranz	M.S	Grand Canyon	Presentations only
Daile Zhang	Ph.D.	Satellite lightning	Zhang et al. (2019, 2020)

U of A lightning graduate students

Pioneers of the NLDN

Interview with Krider

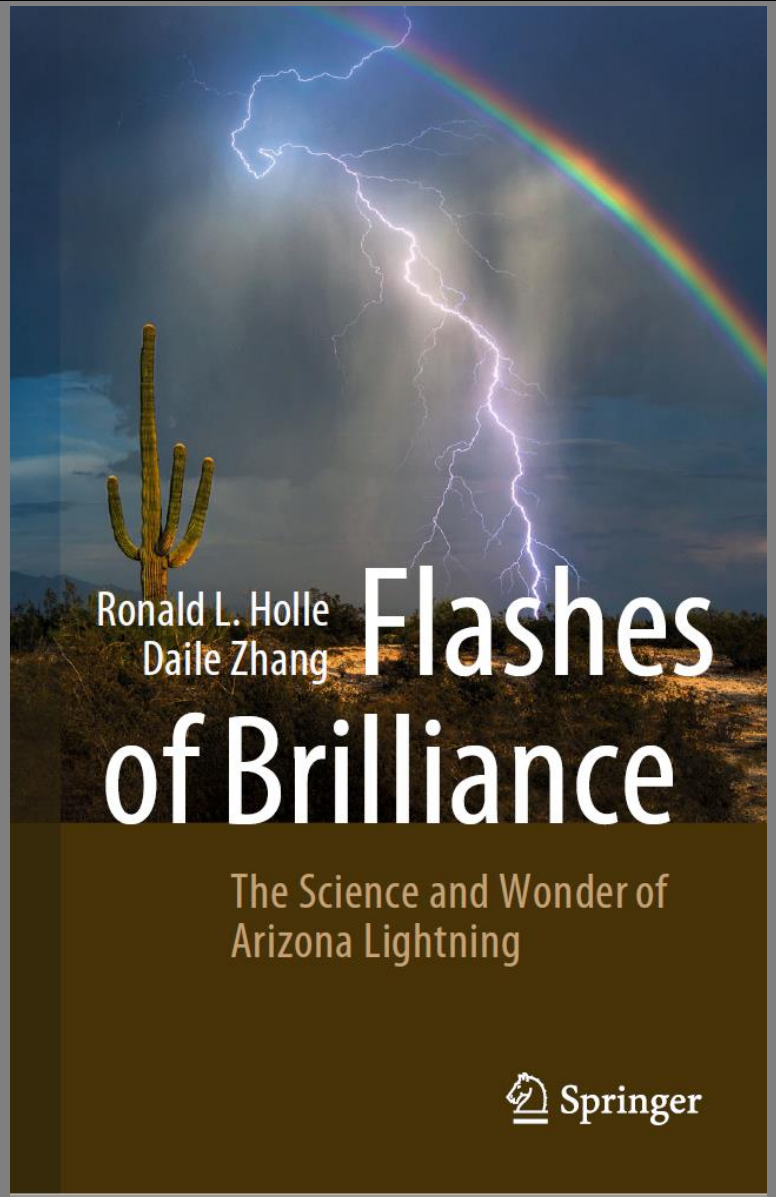
And so, we can see what kind of pulses made the return strokes and
what kind of pulses made other things, and the other things you didn't want
obviously depending on a lot of what the source was—if it was a Xerox
machine, which was a frequent problem.

"Xerox machines make pulses that look exactly like return strokes."

Conclusion

- This is the only known book summarizing diverse aspects of lightning and its research for one state or country

New Springer book



Ron Holle
rholle@earthlink.net

Daile Zhang
dlzhang@umd.edu

Thank you for attending the monthly Arizona weather and climate report!

Next report: June 15 at 10AM

Guest speaker: Mike Crimmons, UA, and the monsoon!

AASC AMERICAN ASSOCIATION OF STATE CLIMATOLOGISTS

ASU Julie Ann Wrigley Global Futures Laboratory Arizona State University

ASU School of Geographical Sciences and Urban Planning Arizona State University

ARIZONA STATE CLIMATE OFFICE

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