U.S. Climatological Standard Normals: A Utilitarian Workhorse

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National Oceanic and Atmospheric Administration

October 28 2021, Session 6, 2:30 PM

Conventional Climate Normals: standard 30-year averages and statistics of weather observations

- A baseline for putting today's weather in proper context
  - NOAA NWS
  - Broadcast Meteorology

- Understanding today's climate for decision making:
  - Energy
  - Agriculture
  - Construction and Design
  - Retail
  - Travel
  - Business and Industry

Sources of the In Situ Climate Observations

- NOAA National Weather Service measures weather and climate and provides most of the station data for normals:
  - Automated Surface Observing Systems Network – automated
  - Cooperative Observer Network – volunteers
- New additions for the first time to precipitation normals:
  - U.S. Department of Agriculture Snow Telemetry Network - automated
  - Community Collaborative Rain, Hail and Snow Network - volunteers

  – ***Citizen Science is Key***

What do the New Normals Say?

- There are now almost 15,000 stations with precipitation normals and more than 7,300 stations with temperature normals
- Warming from 1981-2010 to 1991-2020 is widespread but not ubiquitous across the conterminous U.S., either in geographic space or time of year, with recent cooling in the north central U.S.
- Precipitation changes from 1981-2010 to 1991-2020 also vary considerably on a month-to-month basis, but are generally wetter in the southeast and central U.S.

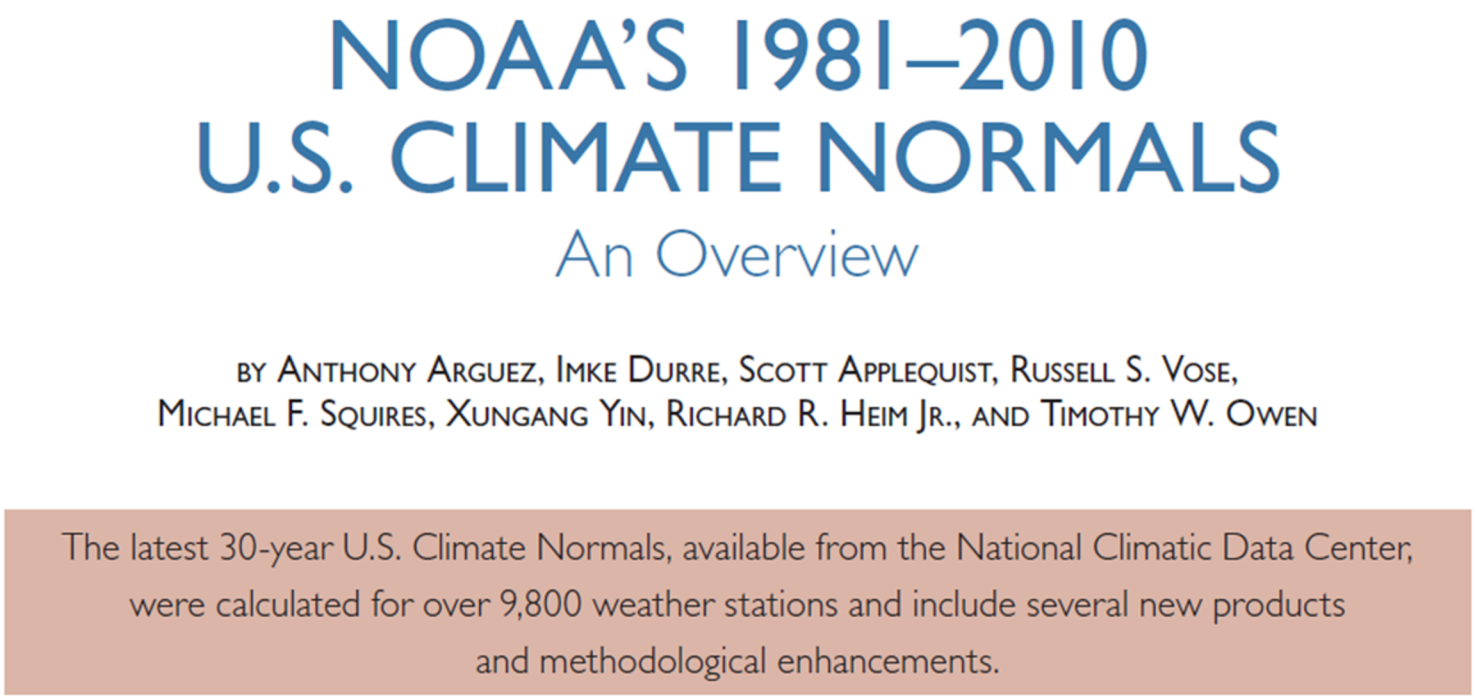
Conventional 30-Year Normals and New Supplemental 15-Year Normals

- The U.S. is replacing the current 1981-2010 normals with 1991-2020 normals
- Shorter-period normals are required by some sectors; a full set of all normals variables for 2006-2020 is now available for the first time
- NOAA NCEI is the source of official climate normals for station locations in the U.S.
- https://www.ncei.noaa.gov/products/us-climate-normals

Included in the Normals

- Overview:
  - Annual/seasonal/monthly/daily: temperature, precipitation, snow
  - Hourly: temperature, dew point, sea level pressure, clouds, wind
  - Averages, degree days, counts/frequencies, growing season, terciles, quartiles, quintiles

Theoretical Basis for U.S. Climate Normals Has Not Changed from Last Time


NOAA'S 1981–2010
U.S. CLIMATE NORMALS
An Overview

BY ANTHONY ARGUEZ, IMKE DURRE, SCOTT APPLEQUIST, RUSSELL S. VOSE, MICHAEL F. SQUIRES, XUNGANG YIN, RICHARD R. HEIM JR., AND TIMOTHY W. OWEN

The latest 30-year U.S. Climate Normals, available from the National Climatic Data Center, were calculated for over 9,800 weather stations and include several new products and methodological enhancements.

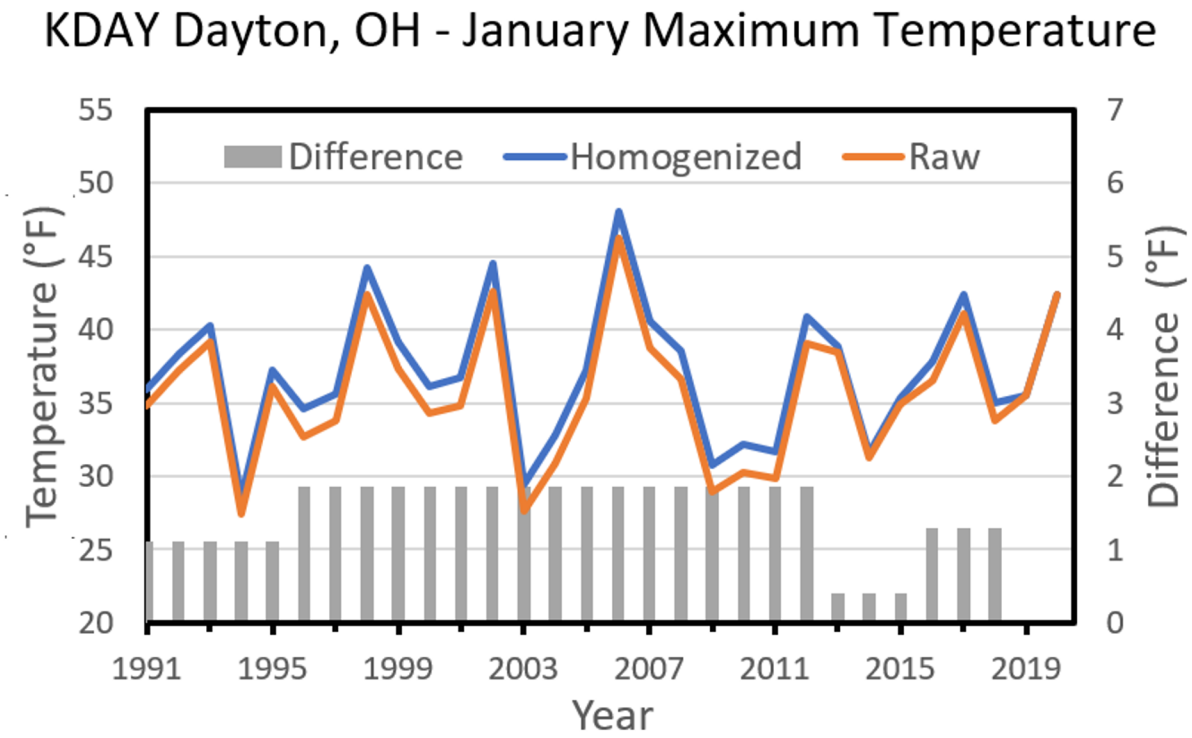
Arguez et al. 2012. Bulletin of the American Meteorological Society, 93, 1687-1697.*https://doi.org/10.1175/BAMS-D-11-00197.1* and more details are in the publications listed at the bottom of this web page.

Fundamental Normals – Not so Simple

- Monthly temperature data were homogenized before the normals were calculated, accounting for station discontinuities

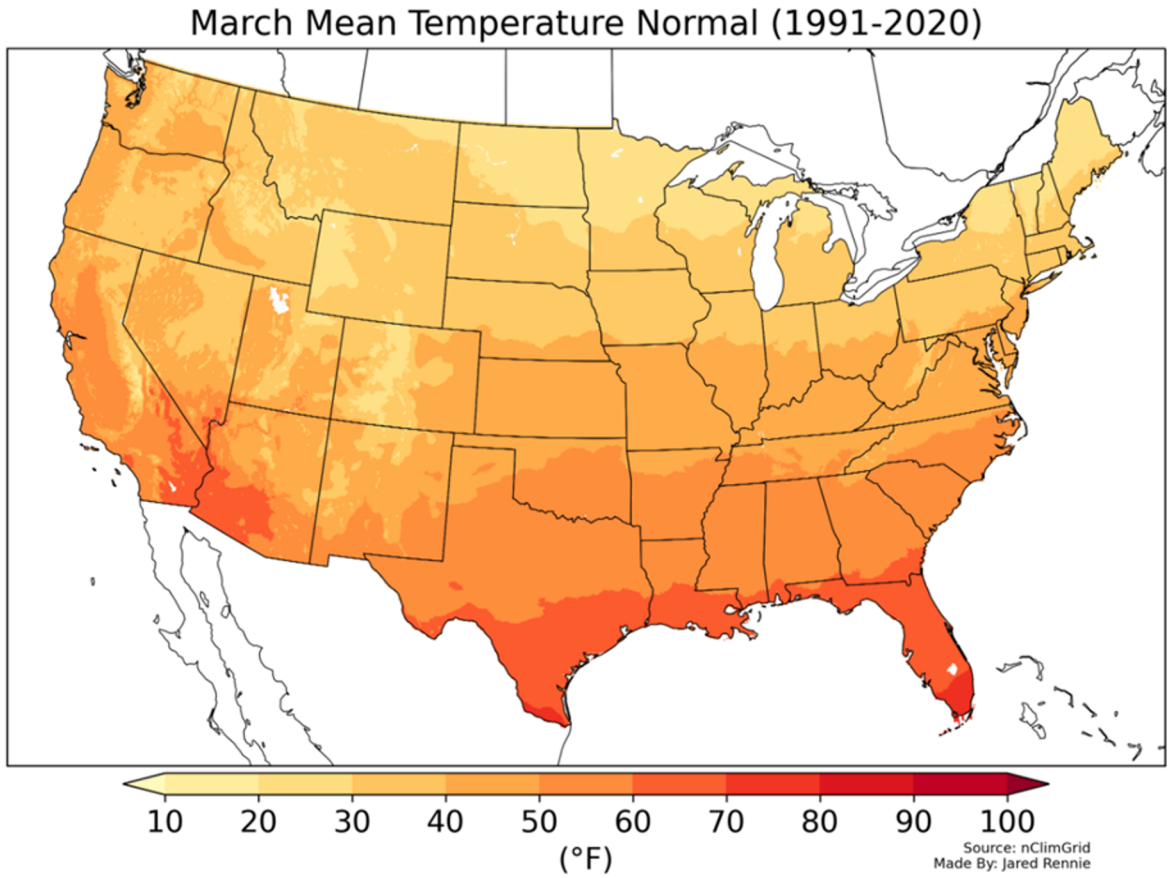
- Monthly precipitation data are not homogenized; they are required to be complete with all days available for monthly normals

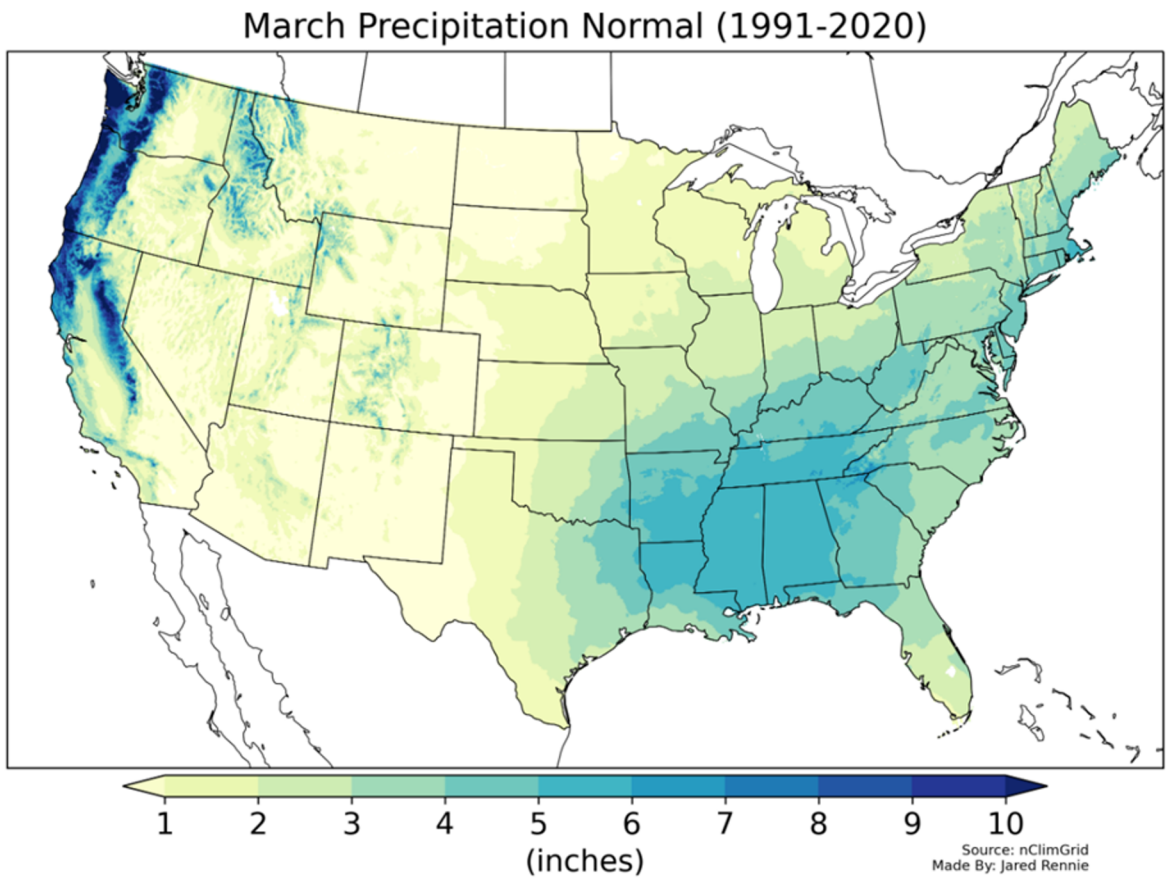
Example: Dayton, OH Homogenized Time Series of Maximum Temperature Versus Raw Temperature, January 1991-2020



Gridded Normals: Another New Product

- Example: March Temperature and Precipitation Normals



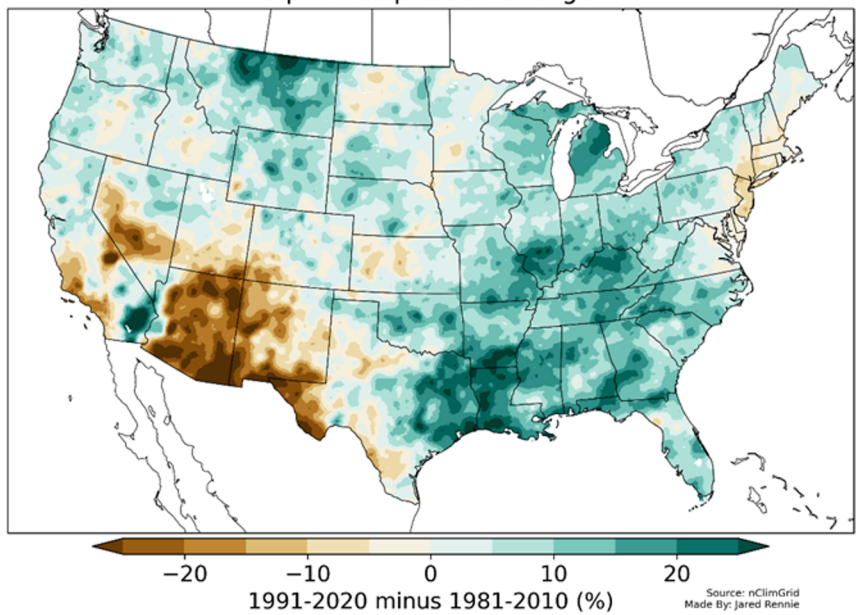


Annual Normals Changes At Some U.S. Cities

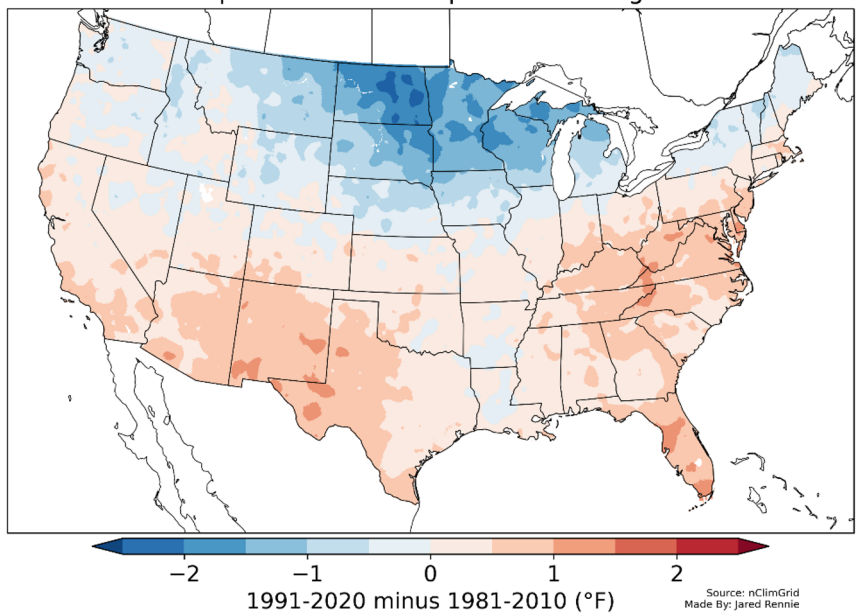
Location	ICAO	Precipitation	Change	Mean Temperature	Change
Asheville, NC	KAVL	49.59	4.02	57.4	1.5
Atlanta, GA	KFFC	49.30	-0.41	63.2	0.6
Boston, MA	KBOS	43.59	-0.18	52.0	0.5
Chicago, IL	KORD	37.86	0.97	51.4	1.5
Dallas-Fort Worth, TX	KDFW	37.01	0.87	66.6	0.3
Fargo, ND	KFAR	23.95	1.37	42.3	-0.1
Laramie, WY	KLAR	10.52	-0.40	41.5	0.5
Phoenix, AZ	KPHX	7.22	-0.81	75.6	0.5
Los Angeles, CA	KLAX	12.23	-0.59	63.6	1.0
Seattle, WA	KSEA	39.34	1.85	53.7	1.1
Fairbanks, AK	PFAI	11.67	0.86	28.4	0.7
Anchorage, AK	PANC	16.42	-0.16	37.7	0.6
Hilo, HI	PITO	120.39	-6.33	74.0	0.1
Honolulu, HI	PHNL	16.41	-0.69	78.1	0.4

Example: April Changes New-Old Normals

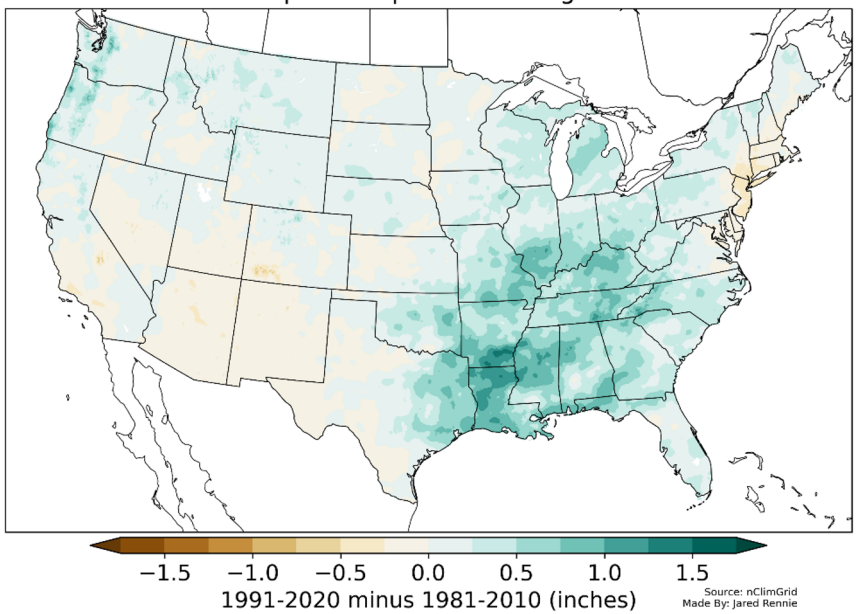
April Precipitation Change



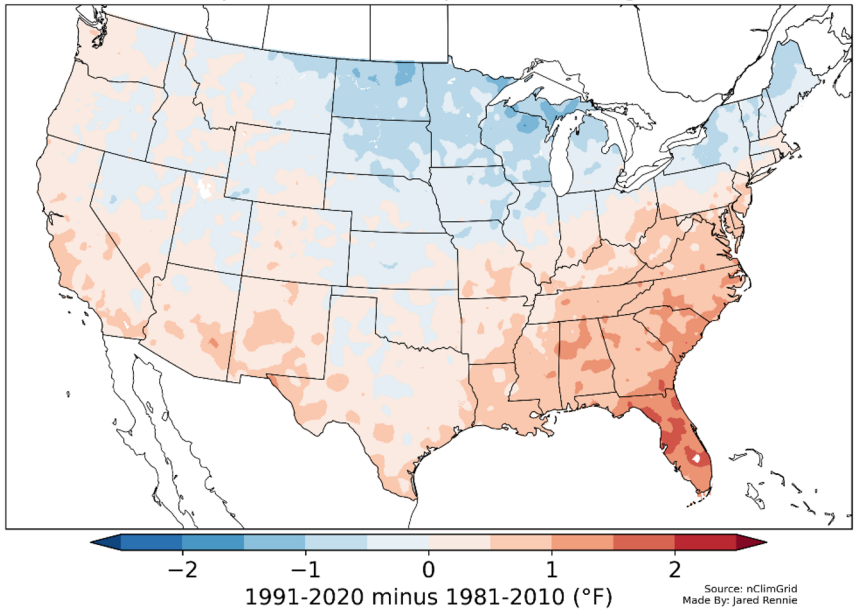
April Maximum Temperature Change



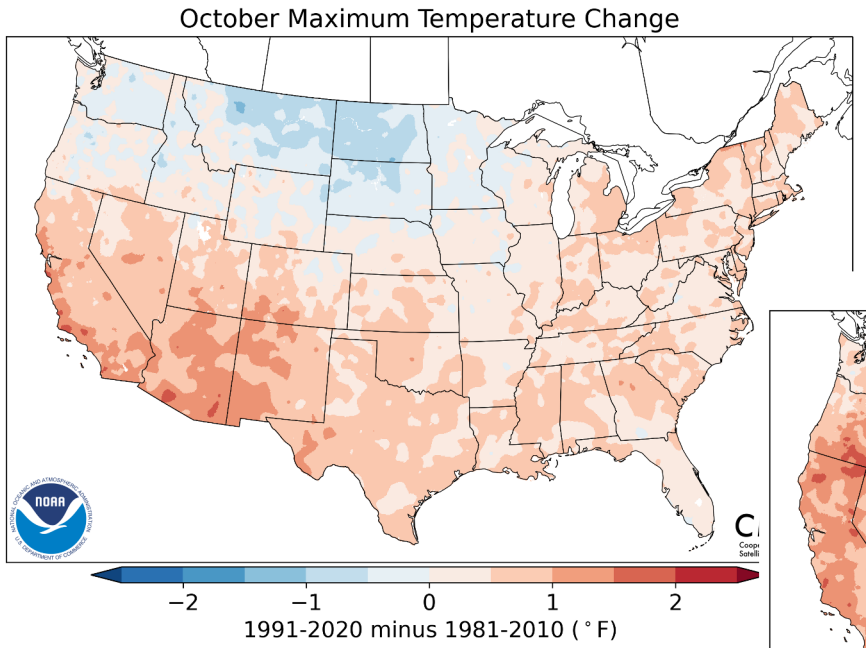
April Precipitation Change

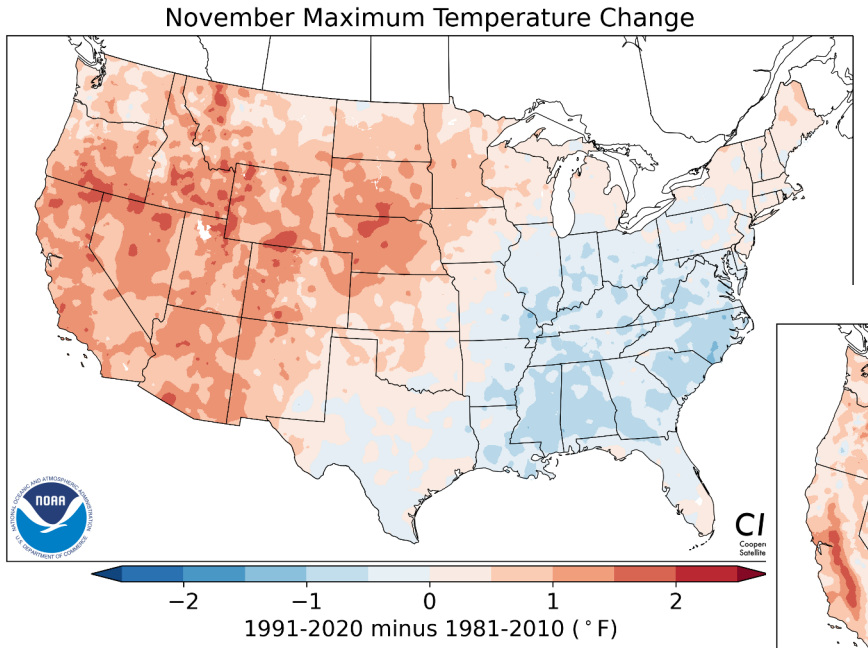


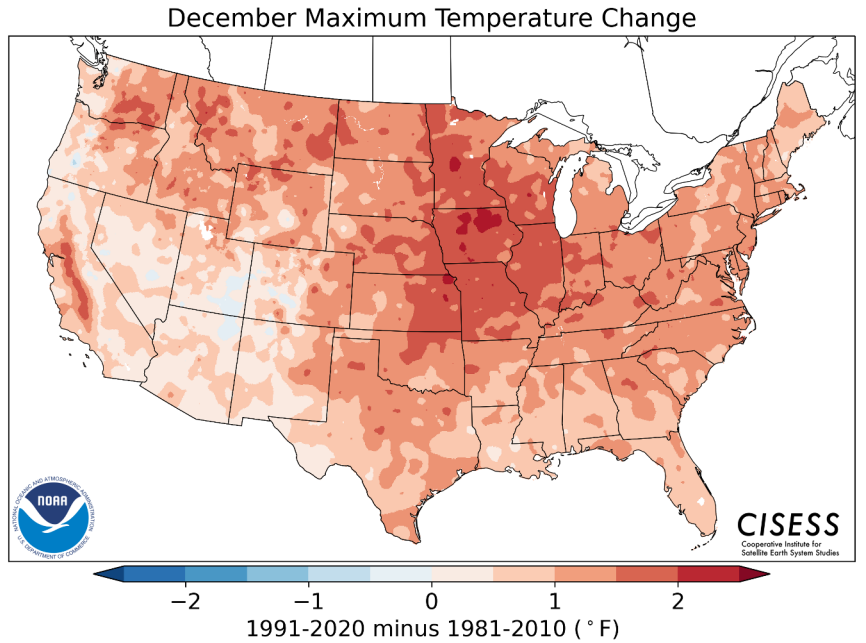
April Minimum Temperature Change



Difference in Normals Vary By Month

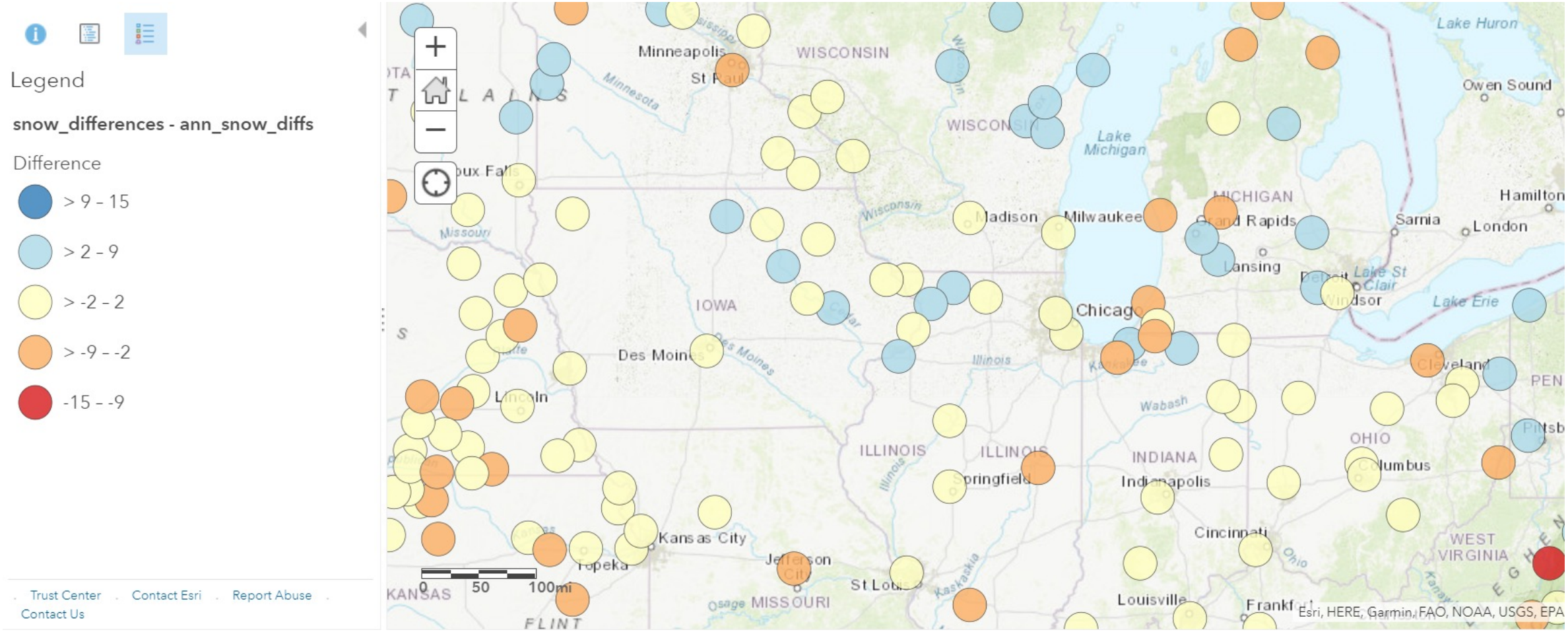






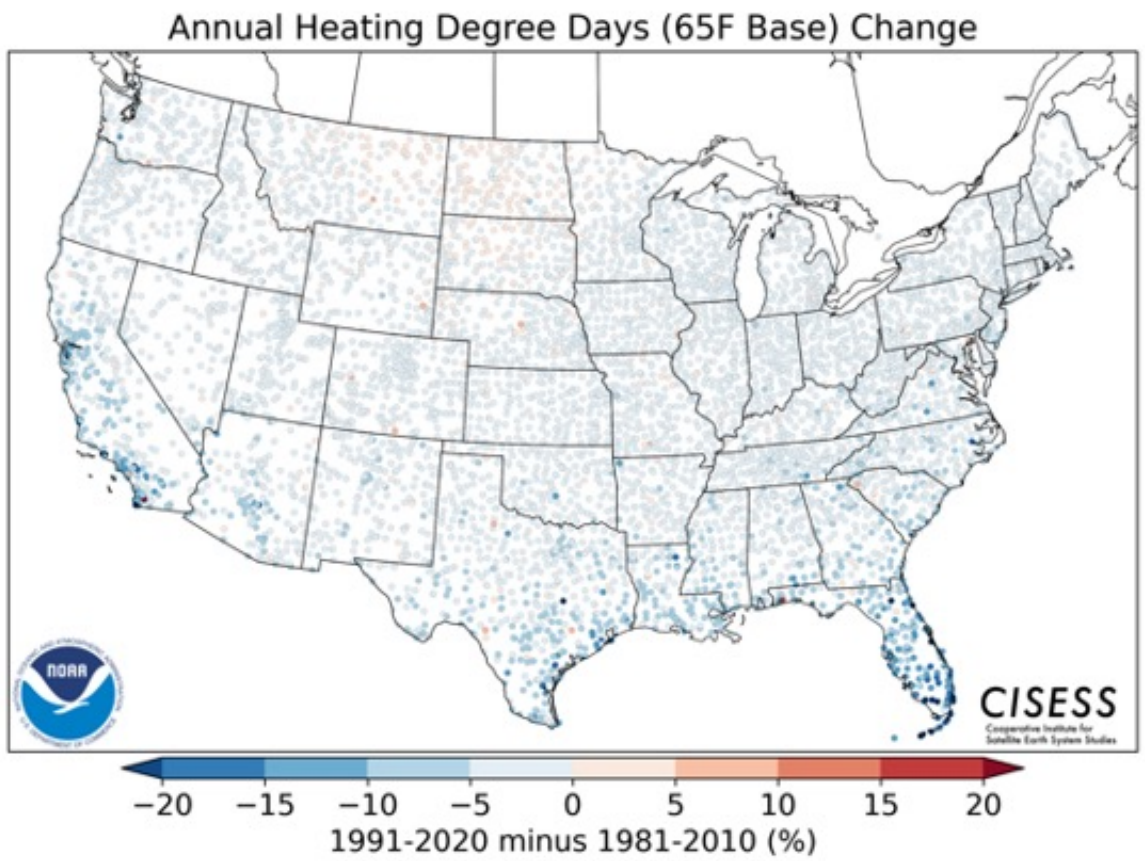
Big shifts in the Southeast normals from October to December

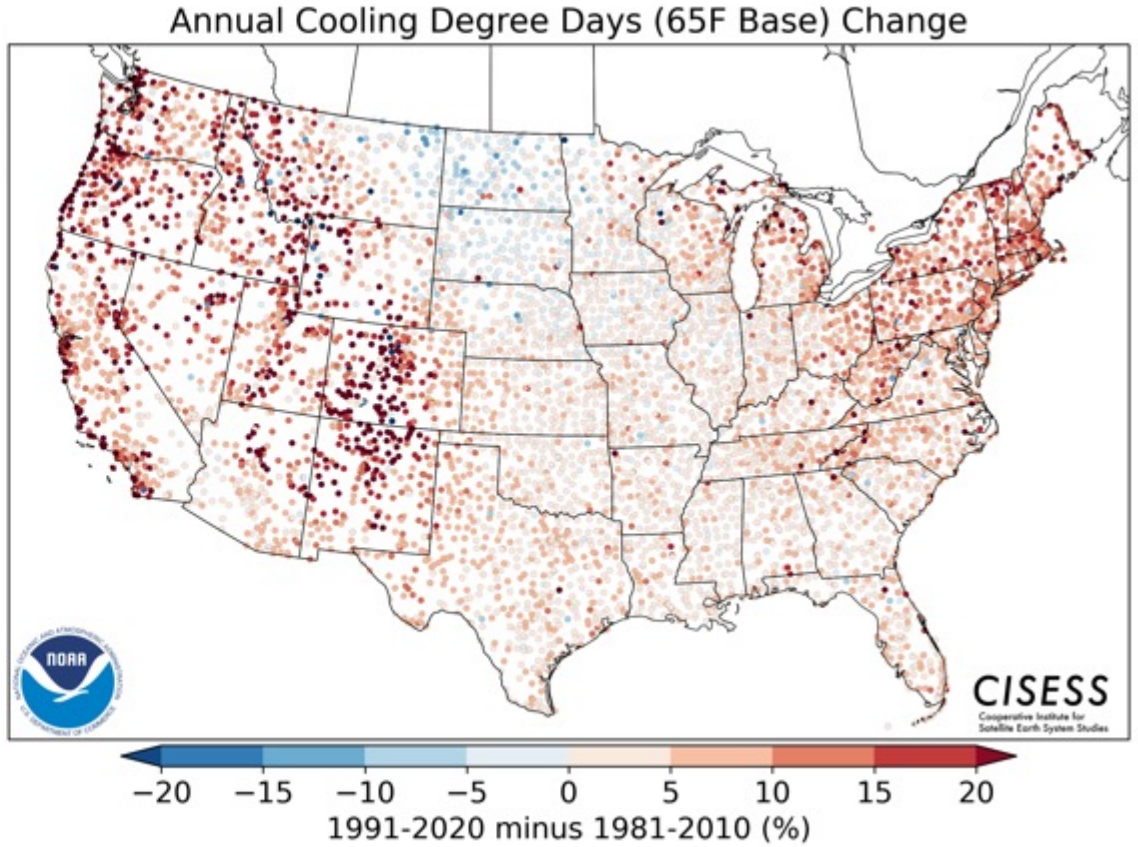
Difference in Annual Snow Normals



Snowfall increased slightly to the north in the Midwest, and decreased to the south.

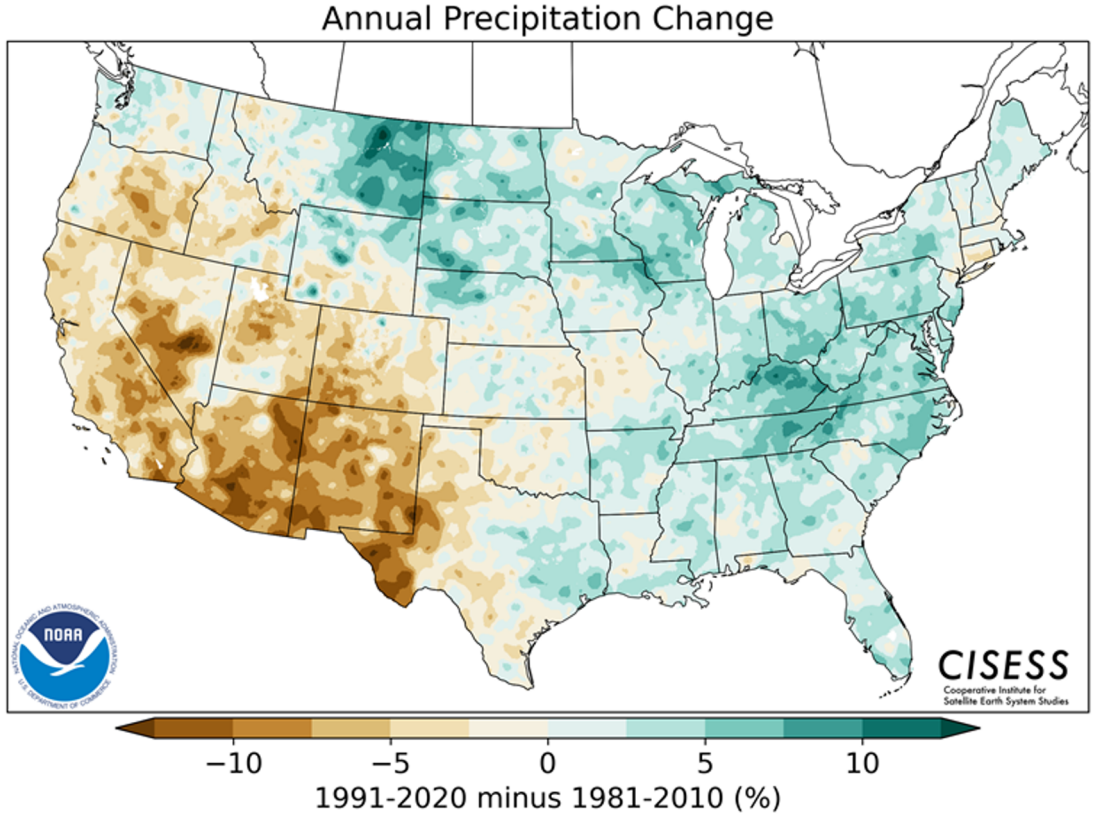
Degree Day Normals Change – HDD and CDD

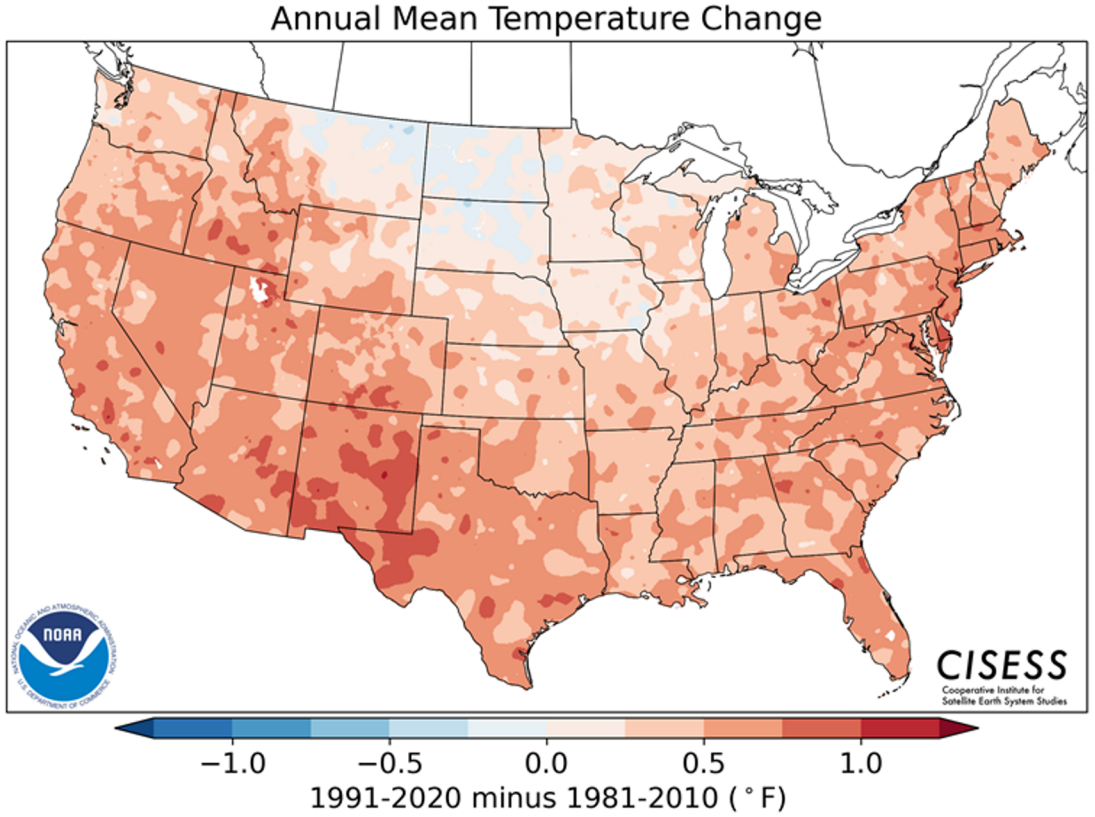




- HDDs are reduced in most of the U.S., generally less than 5%
- CDDs are increased in most of the U.S., with changes greater than 10% in most of the West and Northeast

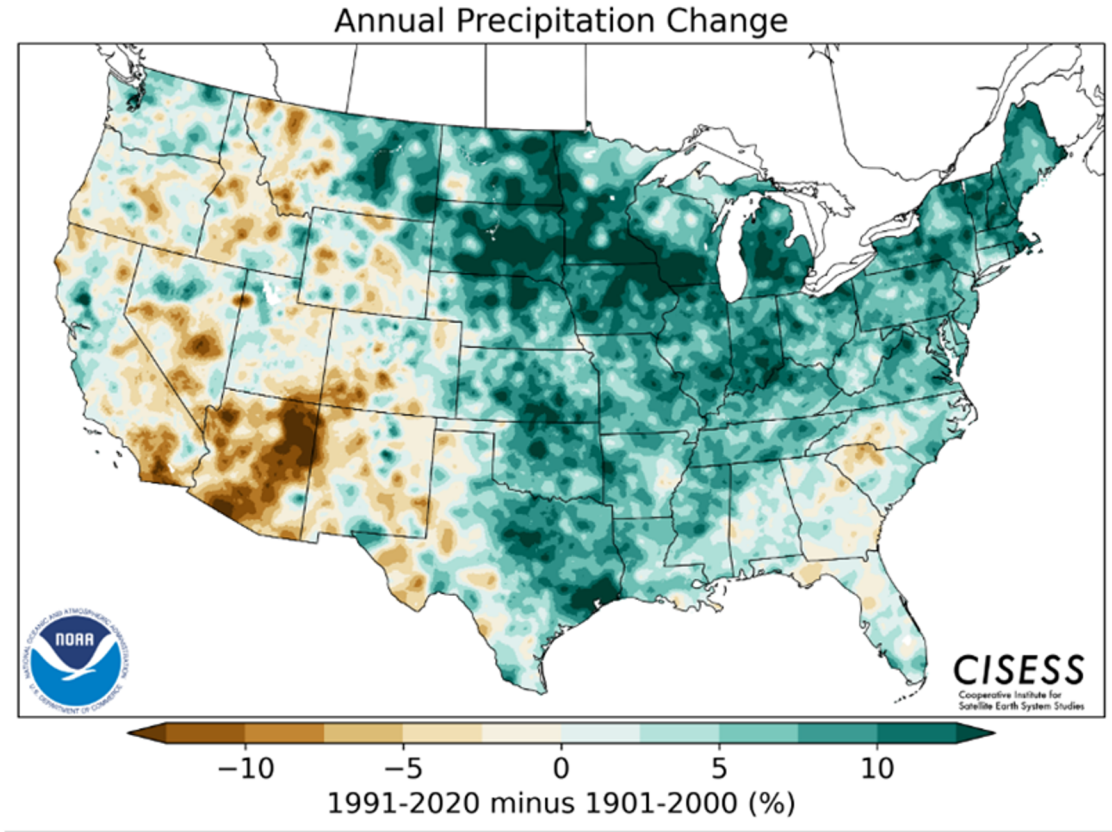
Annual Normals Changes: 1991-2020 minus 1981-2010

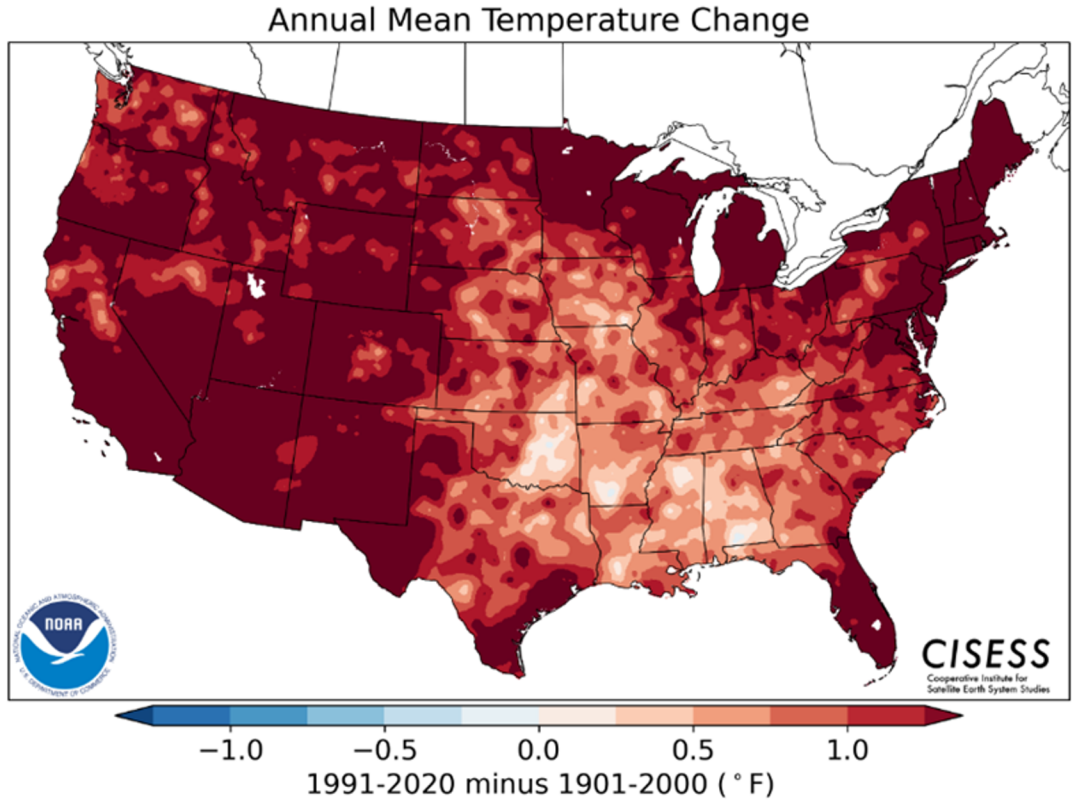




- Wetter in the central and eastern U.S., drier in the Southwest
- Warmer everywhere except the north central U.S.

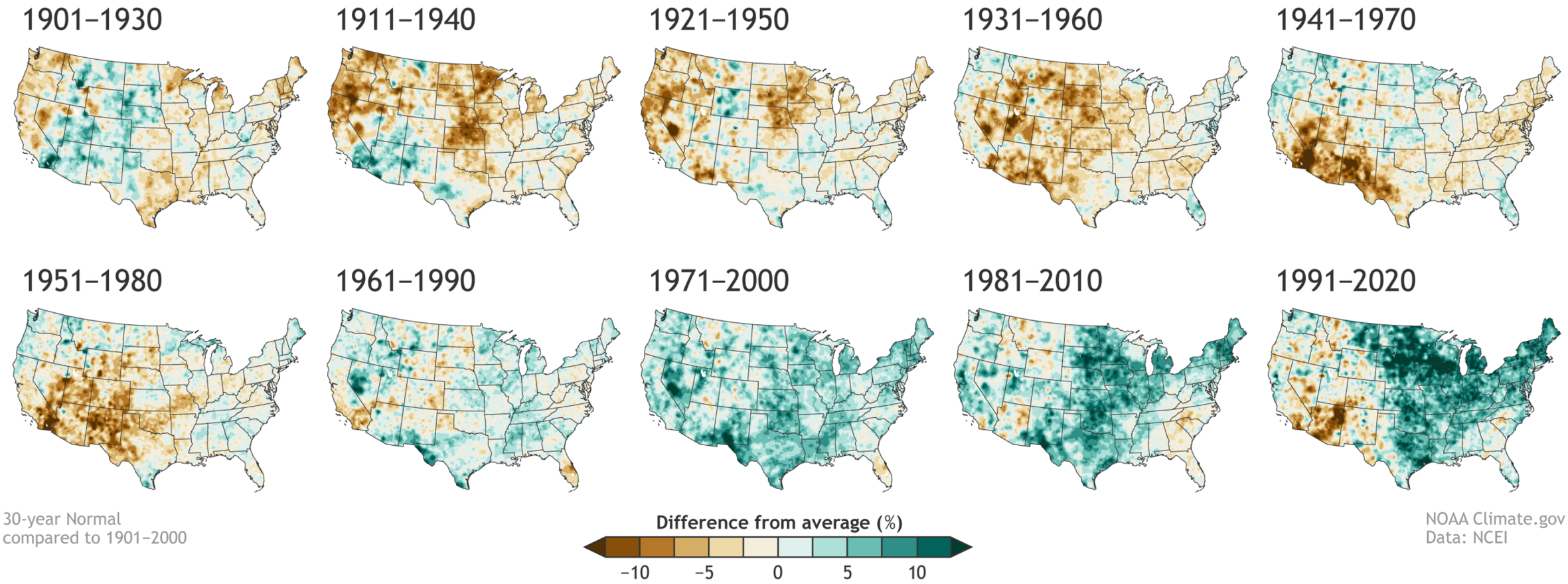
Comparing 1991-2020 to 1901-2000





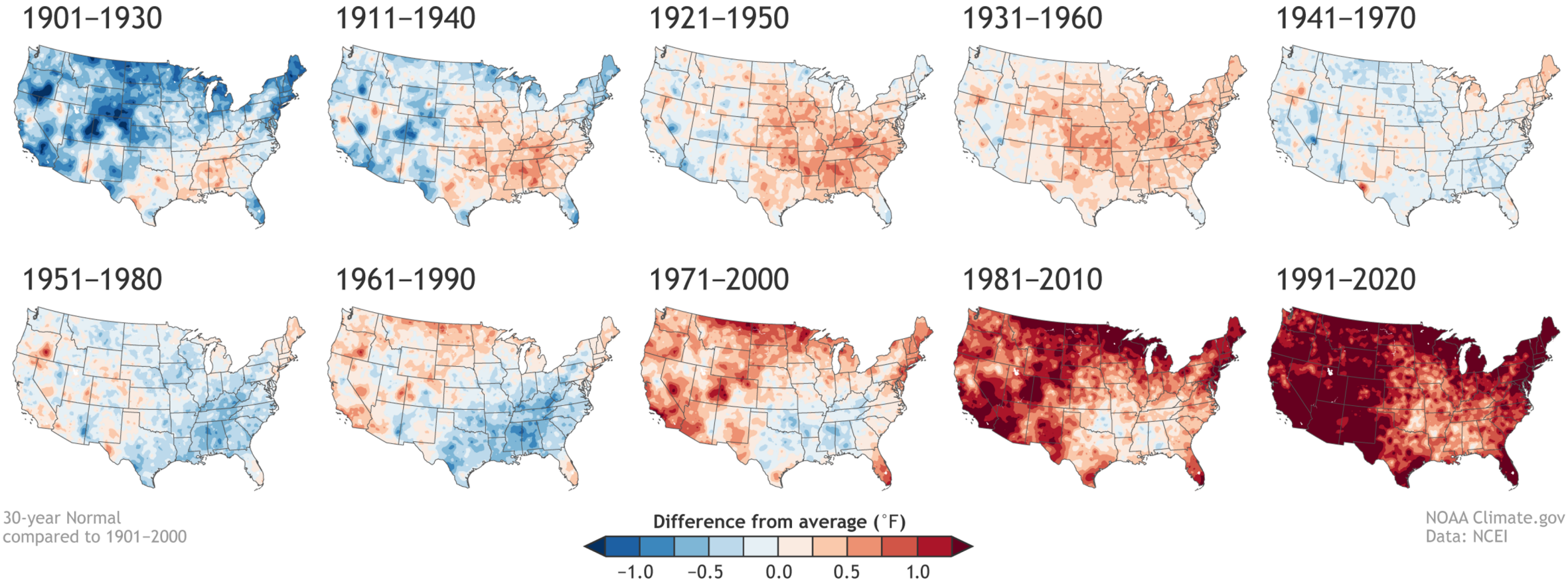
- Climate change is clearly seen in comparing the new normals to the Twentieth Century averages

Annual Precipitation Normals since 1901 compared to the 20th Century Average

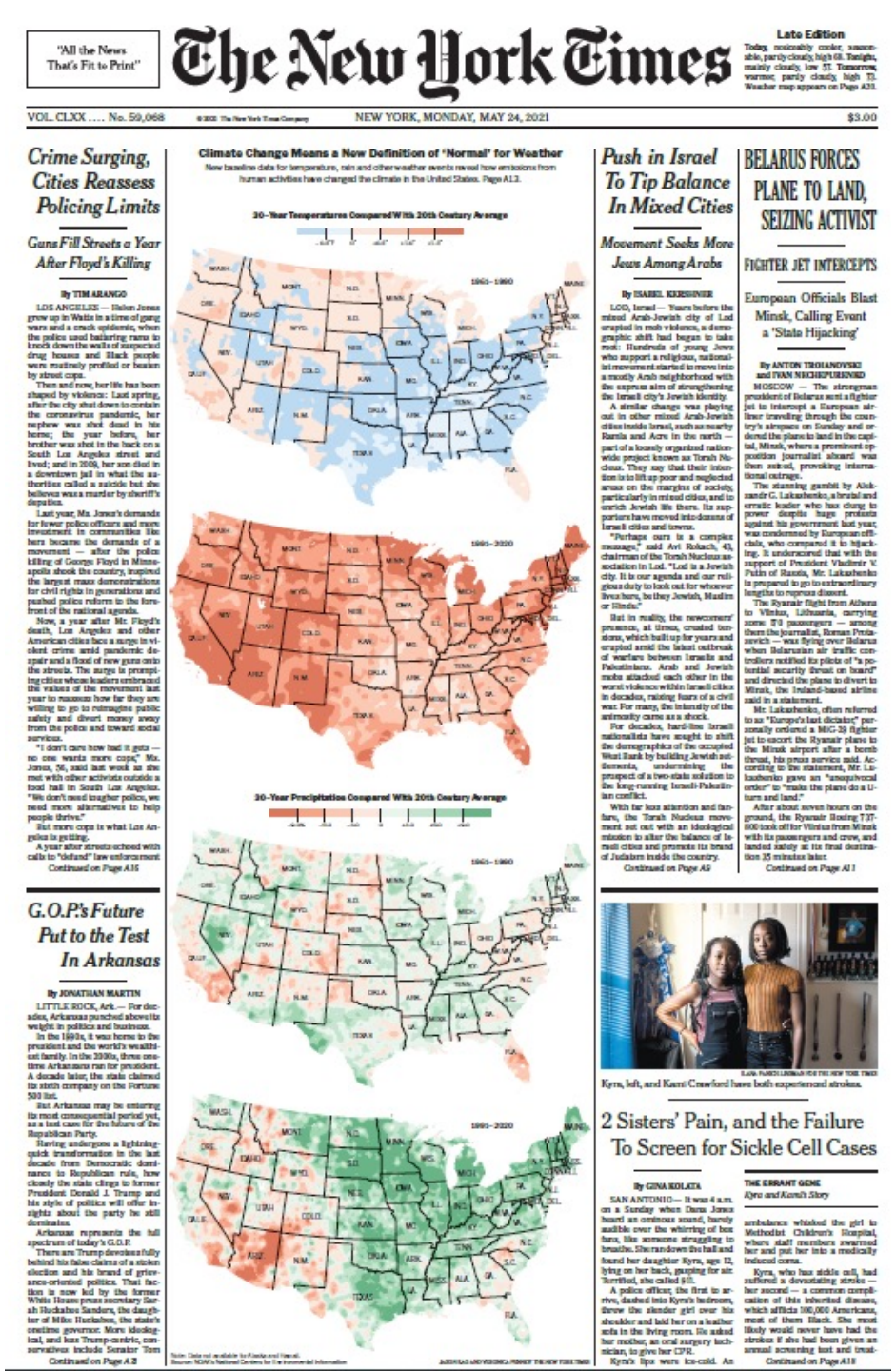


- Climate change is coming into focus in recent normals.

Annual Temperature Normals since 1901 Compared to the 20th Century Average



https://www.climate.gov/news-features/understanding-climate/climate-change-and-1991-2020-us-climate-normals



"All the News That's Fit to Print"

The New York Times

Late Edition

Today, noticeably cooler, seasonable, partly cloudy, high 68. Tonight, mainly cloudy, low 57. Tomorrow, warmer, partly cloudy, high 75. Weather map appears on Page A20.

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Crime Surging, Cities Reassess Policing Limits

Guns Fill Streets a Year After Floyd's Killing

By TIM ARANGO

LOS ANGELES — Helen Jones grew up in Watts in a time of gang wars and a crack epidemic, when the police used battering rams to knock down the walls of suspected drug houses and Black people were routinely profiled or beaten by street cops.

Then and now, her life has been shaped by violence: Last spring, after the city shut down to contain the coronavirus pandemic, her nephew was shot dead in his home; the year before, her brother was shot in the back on a South Los Angeles street and lived; and in 2016, her son died in a downtown jail in what the authorities called a suicide but she believes was a murder by sheriff's deputies.

Last year, Ms. Jones's demands for fewer police officers and more investment in communities like hers became the demands of a movement — after the police killing of George Floyd in Minneapolis shook the country, inspired the largest mass demonstrations for civil rights in generations and pushed police reform to the forefront of the national agenda.

Now, a year after Mr. Floyd's death, Los Angeles and other American cities face a surge in violent crime amid pandemic despair and a flood of new guns onto the streets. The surge is prompting cities whose leaders embraced the values of the movement last year to reassess how far they are willing to go to reimagine public safety and divert money away from the police and toward social services.

"I don't care how bad it gets — no one wants more cops," Ms. Jones, 58, said last week as she met with other activists outside a food hall in South Los Angeles. "We don't need tougher police, we need more alternatives to help people thrive."

But more cops is what Los Angeles is getting.

A year after streets echoed with calls to "defund" law enforcement

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G.O.P.'s Future Put to the Test In Arkansas

By JONATHAN MARTIN

LITTLE ROCK, Ark. — For decades, Arkansas punched above its weight in politics and business.

In the 1990s, it was home to the president and the world's wealthiest family. In the 2000s, three one-time Arkansans ran for president. A decade later, the state claimed its sixth company on the Fortune 500 list.

But Arkansas may be entering its most consequential period yet, as a last case for the future of the Republican Party.

Having undergone a lightning-quick transformation in the last decade from Democratic dominance to Republican rule, how closely the state clings to former President Donald J. Trump and his style of politics will offer insights about the party he still dominates.

Arkansas represents the full spectrum of today's G.O.P.

There are Trump devotees fully behind his false claims of a stolen election and his brand of grievance-oriented politics. That faction is now led by the former White House press secretary Sarah Huckabee Sanders, the daughter of Mike Huckabee, the state's outgoing governor. More shocking-ical, and less Trump-centric, conservatives include Senator Tom

Continued on Page A 2

Climate Change Means a New Definition of 'Normal' for Weather

New baseline data for temperature, rain and other weather events reveal how emissions from human activities have changed the climate in the United States. Page A13.

Push in Israel To Tip Balance In Mixed Cities

Movement Seeks More Jews Among Arabs

By ISABEL KERSHNER

LOD, Israel — Years before the mixed Arab-Jewish city of Lod erupted in rash violence, a demographic shift had begun to take root: Hundreds of young Jews who support a religious, nationalist movement started to move into a mostly Arab neighborhood with the express aim of strengthening the Israeli city's Jewish identity.

A similar change was playing out in other mixed Arab-Jewish cities inside Israel, such as nearby Ramla and Acre in the north — part of a loosely organized nationwide project known as Torah Nucleus. They say that their intention is to lift up poor and neglected areas on the margins of society, particularly in mixed cities, and to enrich Jewish life there. Its supporters have moved into dozens of Israeli cities and towns.

"Perhaps ours is a complex message," said Avi Rokach, 43, chairman of the Torah Nucleus association in Lod. "Lod is a Jewish city. It is our agenda and our religious duty to look out for whoever lives here, be they Jewish, Muslim or Hindu."

But in reality, the newcomers' presence, at times, created tensions, which built up for years and erupted amid the latest outbreak of warfare between Israelis and Palestinians. Arab and Jewish mobs attacked each other in the worst violence within Israeli cities in decades, raising fears of a civil war. For many, the intensity of the animosity came as a shock.

For decades, hard-line Israeli nationalists have sought to shift the demographics of the occupied West Bank by building Jewish settlements, undermining the prospect of a two-state solution to the long-running Israeli-Palestinian conflict.

With far less attention and fanfare, the Torah Nucleus movement set out with an ideological mission to alter the balance of Israeli cities and promote its brand of Judaism inside the country.

Continued on Page A8

BELARUS FORCES PLANE TO LAND, SEIZING ACTIVIST

FIGHTER JET INTERCEPTS

European Officials Blast Minsk, Calling Event a 'State Hijacking'

By ANTON TROIANOVSKI and IVAN NECHEPURENKO

MOSCOW — The strongman president of Belarus sent a fighter jet to intercept a European airliner traveling through the country's airspace on Sunday and ordered the plane to land in the capital, Minsk, where a prominent opposition journalist aboard was then seized, provoking international outrage.

The stunning gambit by Aleksandr G. Lukashenko, a brutal and erratic leader who has clung to power despite huge protests against his government last year, was condemned by European officials, who compared it to hijacking. It underscored that with the support of President Vladimir V. Putin of Russia, Mr. Lukashenko is prepared to go to extraordinary lengths to repress dissent.

The Ryanair flight from Athens to Vilnius, Lithuania, carrying some 171 passengers — among them the journalist, Roman Protasevich — was flying over Belarus when Belarusian air traffic controllers notified its pilots of "a potential security threat on board" and directed the plane to divert to Minsk, the Ireland-based airline said in a statement.

Mr. Lukashenko, often referred to as "Europe's last dictator," personally ordered a MiG-29 fighter jet to escort the Ryanair plane to the Minsk airport after a bomb threat, his press service said. According to the statement, Mr. Lukashenko gave an "unequivocal order" to "make the plane do a U-turn and land."

After about seven hours on the ground, the Ryanair Boeing 737-800 took off for Vilnius from Minsk with its passengers and crew, and landed safely at its final destination 35 minutes later.

Continued on Page A11

Kyra, left, and Kamri Crawford have both experienced strokes.

2 Sisters' Pain, and the Failure To Screen for Sickle Cell Cases

By GINA KOLATA

SAN ANTONIO — It was 4 a.m. on a Sunday when Dana Jones heard an ominous sound, barely audible over the whirring of box fans, like someone struggling to breathe. She ran down the hall and found her daughter Kyra, age 12, lying on her back, gasping for air. Terrified, she called 911.

A police officer, the first to arrive, dashed into Kyra's bedroom, threw the slender girl over his shoulder and laid her on a leather sofa in the living room. He asked her mother, an oral surgery technician, to give her CPR.

Kyra's lips were ice-cold. An

THE ERRANT GENE
Kyra and Kamri's Story

ambulance whisked the girl to Methodist Children's Hospital, where staff members swarmed her and put her into a medically induced coma.

Kyra, who has sickle cell, had suffered a devastating stroke — her second — a common complication of this inherited disease, which afflicts 100,000 Americans, most of them Black. She most likely would never have had the strokes if she had been given an annual screening test and treat-

Continued on Page A18

- New York Times May 24, 2021

Normals As a Concept for Broader Use

- Long-Term Climate Change Stationary Baselines:
  - WMO 1961-1990
  - NCEI Monitoring Section 1901-2000
  - Optimal Hurricane Climatology 1971-2020
  - Robinson Recommendation 1951-1980
  - Period-of-Record
- Modern Moving Baselines:
  - NOAA NWS Climate Baseline (30-yrs every ten years)
  - NOAA NCEP ENSO Baseline (30-yrs every five years)
  - Optimal Climate Normals
- Remote Sensing / Gridded Observations / Model Output Baselines
  - IPCC 4th Assessment 1881-1910
  - IPCC 6th Assessment 1850-1900
  - Period-of-Record
  - Project Dependent

Normals As a Concept for Broader Use

- Considerations for baselines for anomalies:
  - Characterize current average state: use a stationary period that works for all variables in an analysis, 15-years or 30-years
  - It is not advisable to mix-and-match baseline periods when comparing climatologies or anomalies

- Considerations for baselines of climate statistics such as percentiles:
  - Characterize current distribution: most recent 30-years to describe 10^{th} to 90^{th} percentile (improve with sampling approaches)
  - Characterize extremes in distribution: most recent 50-years to describe 2^{nd} to 98^{th} percentile (improve with sampling approaches)
  - It is important to understand that the extremes of distributions based on brief time series are unstable

Conclusion

- Observational datasets of any type (in situ, remotely sensed) should be baselined by modern normals suitable for cross-comparison of variables relevant to an analysis
- Modeled datasets can set an arbitrary baseline as long as it is applied to all sources being compared
- Baseline periods should be updated regularly but not so often as to be confusing to the user community

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Thank you!

michael.palecki@noaa.gov
https://www.ncei.noaa.gov/products/us-climate-normals