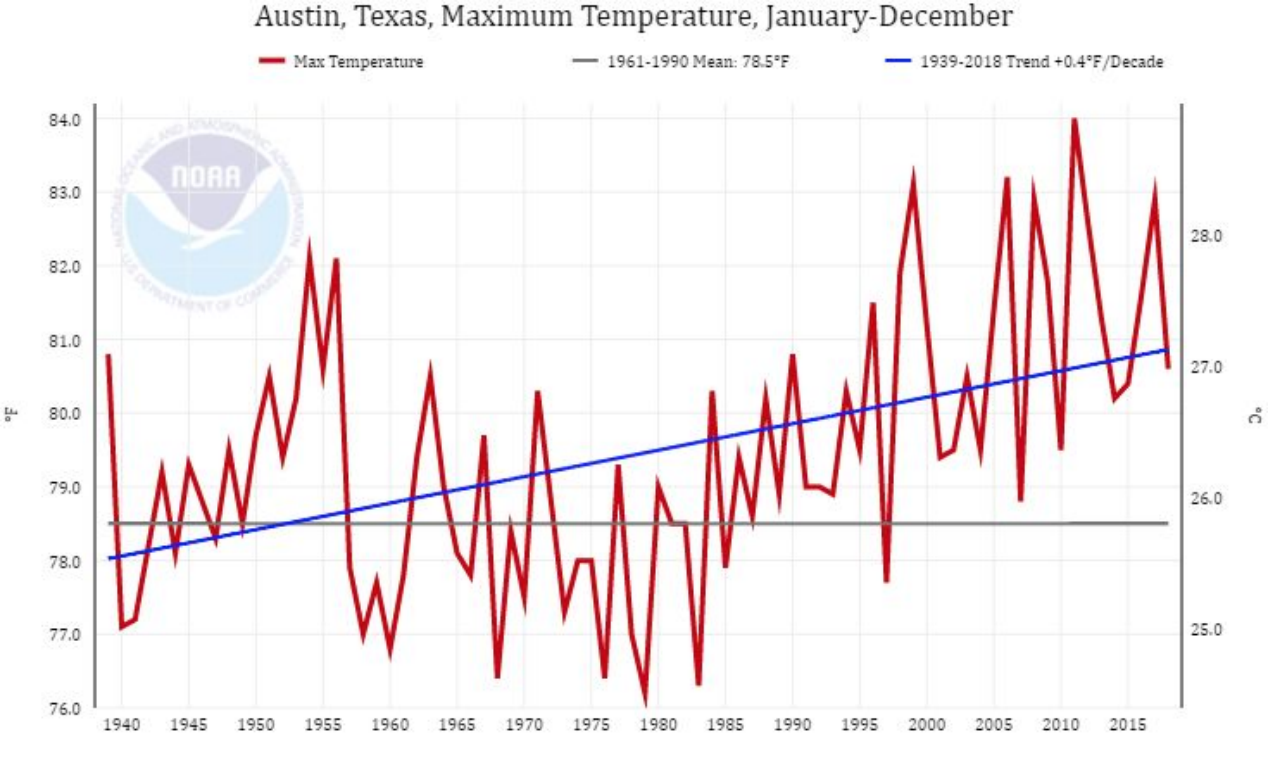
Changing Climate in the Austin Region

Cait Rottler
Southern Plains Climate Hub
November 6, 2019

Current Austin Climate: Temperature



Trend is +0.4F per decade from 1939-2018

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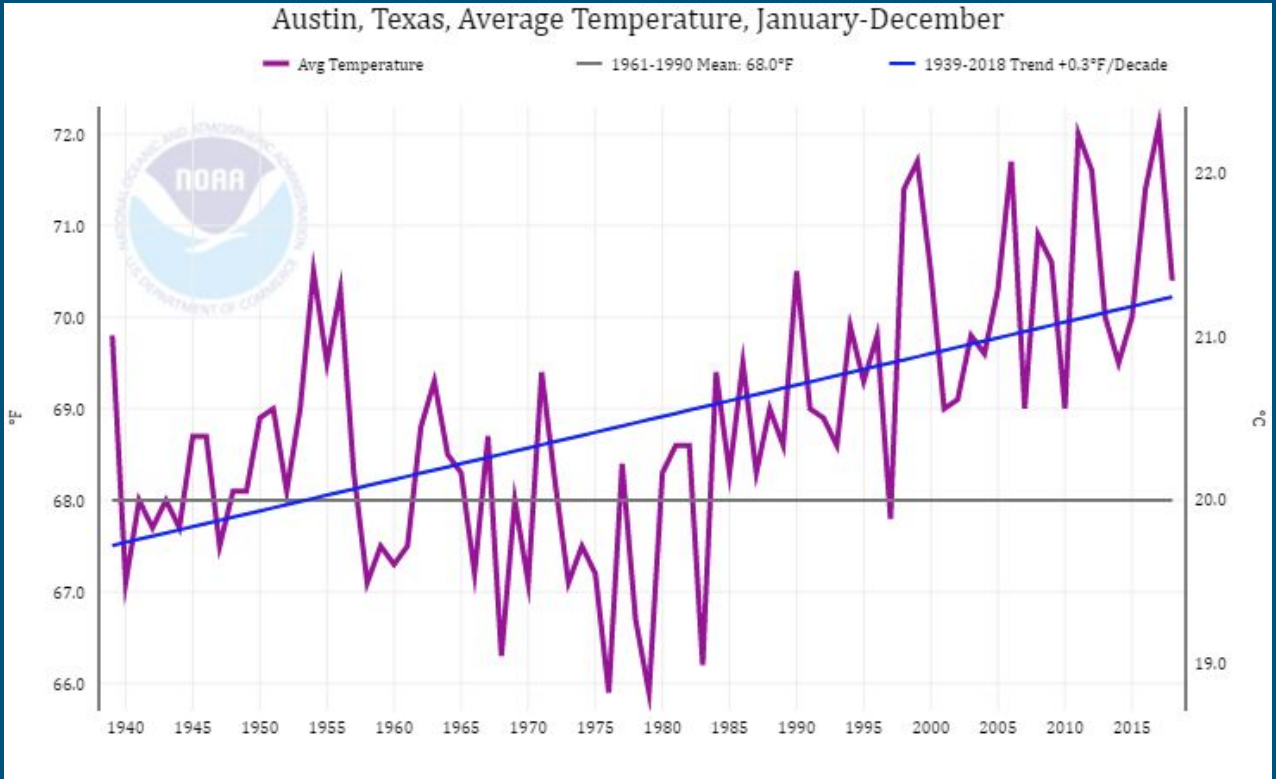
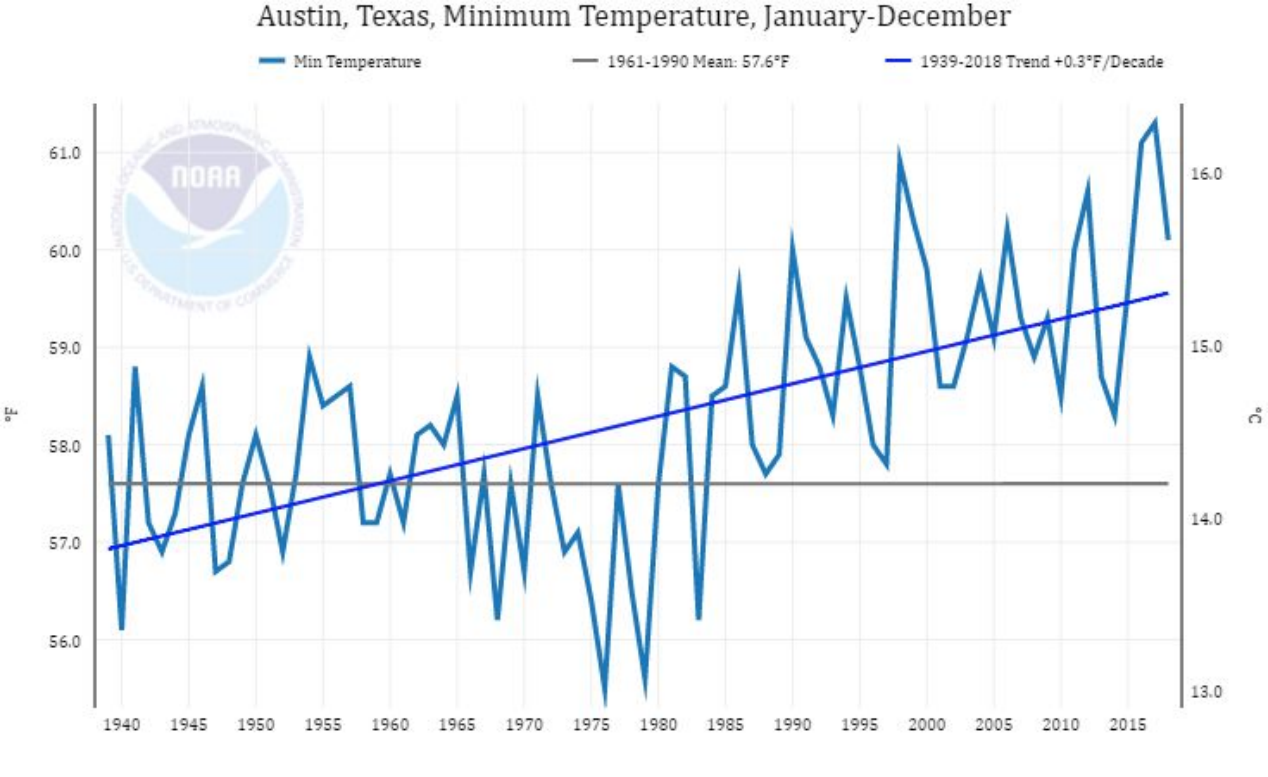


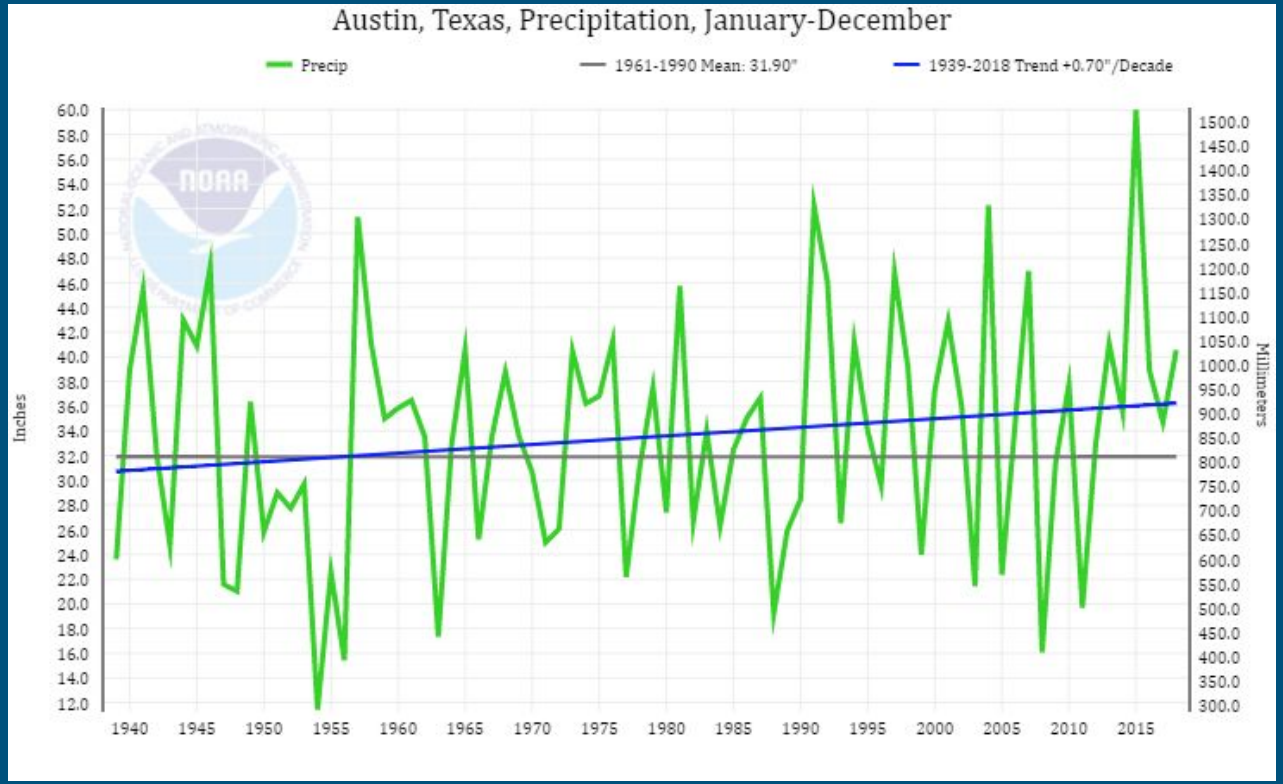
Trend is +0.3F per decade from 1939-2018

Current Austin Climate: Temperature



Trend is +0.3F per decade from 1939-2018

Current Austin Climate: Precipitation



Trend is +0.7” per decade from 1939-2018

Future Austin Climate: Temperature

	30-Year Normal	RCP 4.5 w/ CNRM-CM5 (low emissions)			RCP 8.5 w/HadGEM2-ES365 (high emissions)		
	1981-2010	2010-2039	2040-2069	2070-2099	2010-2039	2040-2069	2070-2099
Mean Temperature (℉)							
Winter	52	54 (+2)	56 (+4)	57 (+5)	55 (+3)	58 (+6)	61 (+9)
Spring	68	70 (+2)	71 (+3)	73 (+5)	71 (+3)	75 (+7)	78 (+10)
Summer	84	85 (+1)	86 (+2)	87 (+3)	88 (+4)	91 (+7)	94 (+10)
Fall	70	72 (+2)	73 (+3)	73 (+3)	74 (+4)	77 (+7)	81 (+11)
Annual	68	70 (+2)	72 (+2)	73 (+3)	72 (+4)	75 (+7)	78 (+10)
Mean Maximum Temperature (℉)							
Winter	63	65 (+2)	67 (+4)	68 (+5)	66 (+3)	69 (+6)	72 (+9)
Spring	79	81 (+2)	82 (+3)	84 (+5)	82 (+3)	87 (+8)	89 (+10)
Summer	95	96 (+1)	97 (+2)	98 (+3)	99 (+5)	103 (+8)	105 (+10)
Fall	81	83 (+2)	84 (+3)	85 (+4)	86 (+5)	88 (+6)	92 (+11)
Annual	80	82 (+2)	83 (+3)	84 (+4)	82 (+2)	85 (+5)	88 (+8)
Mean Minimum Temperature (℉)							
Winter	40	43 (+3)	45 (+5)	45 (+5)	44 (+4)	47 (+7)	50 (+10)
Spring	57	59 (+2)	61 (+4)	62 (+5)	60 (+3)	63 (+6)	66 (+9)
Summer	73	74 (+1)	76 (+3)	76 (+3)	76 (+3)	79 (+6)	82 (+9)
Fall	58	60 (+2)	62 (+4)	62 (+4)	63 (+5)	65 (+7)	69 (+11)
Annual	57	59 (+2)	61 (+4)	62 (+5)	60 (+3)	63 (+6)	66 (+9)
Days w/ Heat Index >105℉							
Annual	10	20 (+10)	33 (+23)	43 (+33)	38 (+28)	86 (+76)	122 (+112)

Future Austin Climate: Precipitation

	30-Year Normal	RCP4.5 w/ CNRM-CM5 (low emissions)			RCP8.5 w/HadGEM2-ES365 (high emissions)		
	1981-2010	2010-2039	2040-2069	2070-2099	2010-2039	2040-2069	2070-2099
Mean Precipitation (inches)							
Winter	6.7	6.7	7.1	6.6	7.6	7.1	8.3
Spring	9.4	9.7	9.5	10.2	9.9	8.1	9.5
Summer	7.9	7.8	8.7	7.5	6.2	4.9	5.6
Fall	9.1	8.2	8.8	8.6	9.2	9	9.7
Annual	33.5	33	34	33	33	29	33
% Change in Precipitation							
Winter		-4.4	0.7	-5.6	4.6	-0.9	14.2
Spring		1.2	-0.8	6.1	14.1	-7.1	9.3
Summer		1	13.9	-3.5	-28	-42.6	-35.2
Fall		-9.9	-2.6	-6.4	0.1	-2.4	5
Annual		-3.1	2.4	-2	-2.5	-13.5	-2.1
	Averages	**Soil Moisture Content (inches)**					
Winter	19	18	18	19	19	18	18
Spring	19	18	19	19	19	19	18
Summer	18	18	18	18	18	17	17
Fall	17	17	17	18	17	17	17
Annual	18	18	18	18	18	18	17
	Averages	**Total Runoff (inches)**					
Winter		13	17	15	20	14	15
Spring		20	20	17	19	13	18
Summer		17	18	17	12	8	10
Fall		12	20	21	13	14	15
Annual		16	19	18	16	12	14

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Physical Impacts

Heat and Cold Tolerance and Growing Season

	Average	RCP4.5			RCP8.5		
	1971-2000	2010-2039	2040-2069	2070-2099	2010-2039	2040-2069	2070-2099
Plant Heat-Tolerance Zone	9	10	11	11	10	11	12
Cold Hardiness Zone	8b	8b	9a	9a	8b	9a	9b
Growing Season Length (Days)	278	276	286	300	299	319	359

Heat Stress

- Austin's **current** average is 13 days/year over 100F
- **Business as usual** predictions add an additional 30-60 days over 100F by the year 2100
- Urban areas warm faster and worse than rural areas (urban heat island effect)

Heat Stress

Heat stress in a *Prunus mexicana*

Drought Stress

- Austin is in the belt separating the arid southwest from the humid midwest
- This belt, called the “100th meridian”, has shifted approximately 140 miles east
- Austin may become part of the arid southwest if the belt keeps migrating east
- Past severe droughts have drastically affected Austin trees; ~10% of them died in the 2010-2011 drought

Drought Stress

Severe Weather

- Hurricanes, which can encroach inland and drop large amounts of rain, are expected to become more intense as the ocean continues to warm
- It is unclear how climate change will affect windstorms and the likelihood of wind damage to the urban forest
- Heavy rain events are expected to increase with climate change, leading to more frequent occurrences of so-called 100-year flood events

Severe Weather

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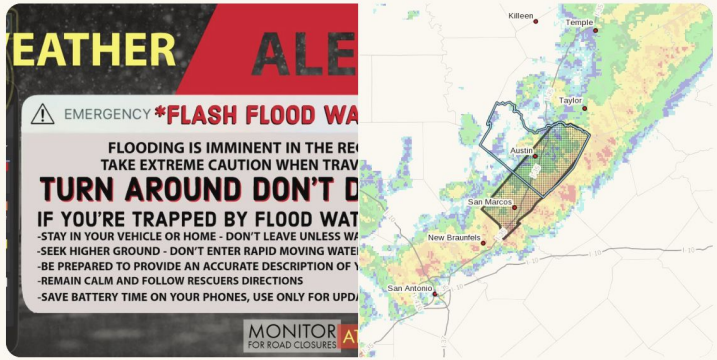
Follow

#ATXWX Alert!! @NWSSanAntonio issued a Flash Flood Warning for Travis County, until 10:45pm. Life Threatening Flash Flooding is already occurring. Remain #WeatherAware & stay tuned to local forecasts. Your #ATCEMSMedics remind you to stay safe, and #TurnAroundDontDrown.



6:52 PM - 24 Oct 2019

LOCAL

Central Texas has seen three 100-year floods in 5 years. Now thousands are destined to flood

Once every 100 years. That's the mark of a major flood. That means homes have a one percent chance of experiencing a flood in any given year. We've had three 100-year flood events in five years. Scientists say it's a sign of the times. Thousands more families in Central Texas are destined to flood.

Author: Terri Gruca
Published: 12:41 PM CST November 19, 2018
Updated: 10:22 PM CST November 20, 2018

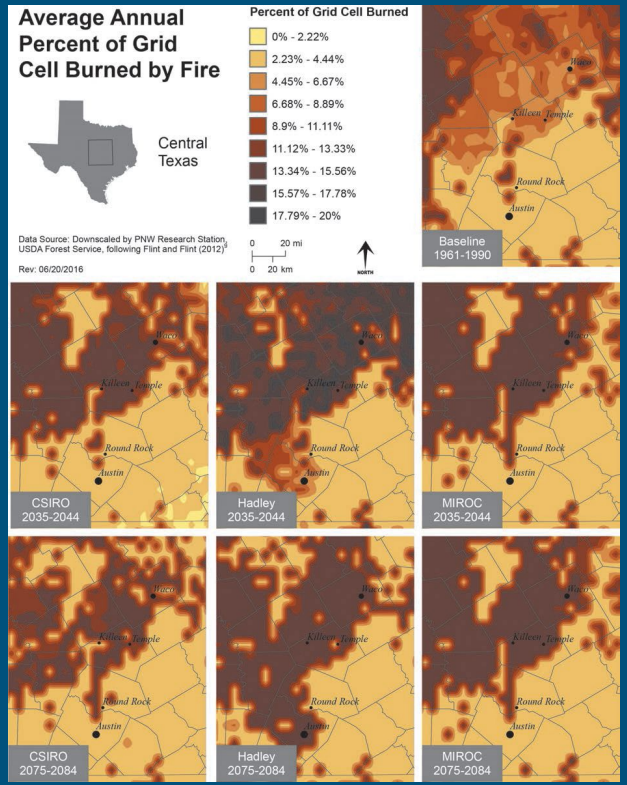
Carbon Cycling

- Austin's trees currently sequester about 92,000 tons of CO2 a year, making them a carbon sink
- Climate change and related aridification may cause them to become carbon sources
- The structure of tree communities that are not intensively managed may change with increasing CO2, as some trees are better able to capitalize on excess CO2 than others

Fire

- Drought, dry days, and days over 100F will make more ideal conditions for large, catastrophic fires
- Both the severity and frequency of fires in the Austin area are expected to increase
- Fires in the Austin area can be either fuel or temperature limited, so their response to climate change is less certain the further into the future a projection is attempted

Fire


Average Annual Percent of Grid Cell Burned by Fire
Central Texas
Percent of Grid Cell Burned
0% - 2.22%
2.23% - 4.44%
4.45% - 6.67%
6.68% - 8.89%
8.9% - 11.11%
11.12% - 13.33%
13.34% - 15.56%
15.57% - 17.78%
17.79% - 20%
Data Source: Downscaled by PNW Research Station, USDA Forest Service, following Flint and Flint (2012)
Rev: 06/20/2016
0 20 mi
0 20 km
NORTH
Waco
Killeen
Temple
Round Rock
Austin
Baseline 1961-1990
CSIRO 2035-2044
Hadley 2035-2044
MIROC 2035-2044
CSIRO 2075-2084
Hadley 2075-2084
MIROC 2075-2084

Biological Impacts

Phenological Shifts

- Timing of leafout, flowering, fruiting, and senescence will shift as temperatures increase
- The effect of increased temperature on tropical vs. temperate trees will vary depending on the factors influencing phenological cues
- The dividing line between temperature-influenced cues and other cues is typically an average temperature of 45F in Jan; projections for Austin predict average January temperatures in excess of this

Invasive Plants

- Invasive plants typically have high adaptive capacity, while many native plants do not
- Ranges of current invasive plants may increase or shift northward
- However, some recent models suggest that increasing temperatures may actually *decrease* the number of invasive species in Texas

Insect Pests and Pathogens

- Increased temperatures and drought are expected to stress trees and make them more susceptible to infection
- Oak wilt, hypoxolon, wood-boring beetles, and bacterial leaf scorch can more easily infect stressed trees
- Oak wilt and bacterial leaf scorch may benefit directly from warmer, drier conditions, in addition to more easily attacking stressed trees

Tree and Forest-Dependent Wildlife

- Some wildlife, such as the federally endangered golden-cheeked warbler, will likely experience a reduction in suitable habitat with climate change (nearly all of golden-cheeked warbler habitat is expected to disappear in the coming decades)
- Populations of white-tailed deer may experience shifts in breeding season
- The suitable range for invasive feral hogs is expected to increase

Nutrient Cycling

- Rates of nutrient cycling are likely to change in response to climate change
- Rates tend to increase with temperature, but decrease with aridity, both of which are expected in the Austin area
- Nutrient cycling depends on numerous factors, some of which are more affected by climate change than others
- The overall effect on nutrient cycling is unclear, and different nutrients may respond in different ways to climate change in the Austin area