



# Climate Change

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# Problem: Climate Change

**Water** - increase in floods, water quality problems, heavy downpours, less snow accumulation in the mountains, droughts etc.

**Food** - weather extremes, water stress, diseases could be very challenging for the farmers to supply food.

**Human health:** poor air quality, waterborne diseases, diseases transmitted by insects and rodents

## Environment:

- Rising sea levels
- Thermal expansion
- Hotter, more acidic, expanding oceans
- Extreme weather events: heat waves, hurricanes, droughts, wildfires



# Datasets:

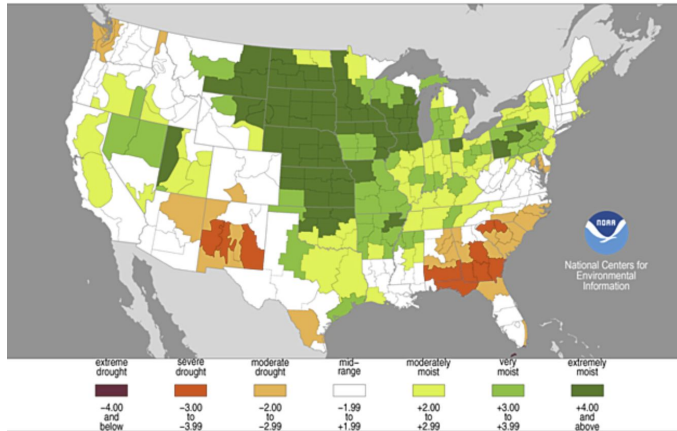
The purpose of this project is to establish the intensity and breadth of the effects of climate change. Specifically, we explored:

- Drought levels
- Global Temperatures
- Carbon Dioxide Emissions
- Glacier Size
- Sea Level

# Related Work -

- Tableau: [Climate Change is Real](#)
- Research Paper : [The Impact of Sea Level Rise on Developing Countries: A Comparative Analysis](#)

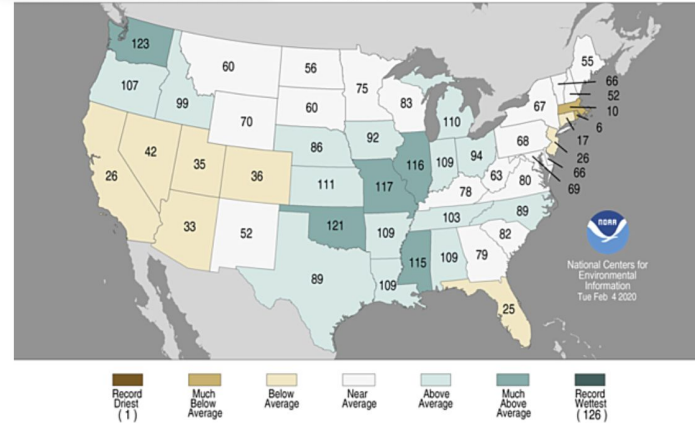
Palmer Drought Severity Index  
September, 2019



Statewide Precipitation Ranks

1-Month Statewide Precipitation Ranks

January 2020  
Period: 1895-2020



# Droughts

- prolonged shortages in the water supply, primarily caused by low rainfall
- Profound Impacts
  - a. increased food prices
  - b. agricultural losses
  - c. scarcity of drinking water
  - d. increases in wildfire



# Drought Datasets

- **US Drought Monitor:** produced through a partnership between
  - National Drought Mitigation Center (University of Nebraska-Lincoln)
  - US Department of Agriculture,
  - National Oceanic and Atmospheric Administration.

Category	Description	Possible Impacts
D0	Abnormally Dry	Going into drought: <ul style="list-style-type: none"><li>▪ short-term dryness slowing planting, growth of crops or pastures</li></ul> Coming out of drought: <ul style="list-style-type: none"><li>▪ some lingering water deficits</li><li>▪ pastures or crops not fully recovered</li></ul>
D1	Moderate Drought	<ul style="list-style-type: none"><li>▪ Some damage to crops, pastures</li><li>▪ Streams, reservoirs, or wells low, some water shortages developing or imminent</li><li>▪ Voluntary water-use restrictions requested</li></ul>
D2	Severe Drought	<ul style="list-style-type: none"><li>▪ Crop or pasture losses likely</li><li>▪ Water shortages common</li><li>▪ Water restrictions imposed</li></ul>
D3	Extreme Drought	<ul style="list-style-type: none"><li>▪ Major crop/pasture losses</li><li>▪ Widespread water shortages or restrictions</li></ul>
D4	Exceptional Drought	<ul style="list-style-type: none"><li>▪ Exceptional and widespread crop/pasture losses</li><li>▪ Shortages of water in reservoirs, streams, and wells creating water emergencies</li></ul>

			Ranges				
Category	Description	Possible Impacts	<u>Palmer Drought Severity Index (PDSI)</u>	<u>CPC Soil Moisture Model (Percentiles)</u>	<u>USGS Weekly Streamflow (Percentiles)</u>	<u>Standardized Precipitation Index (SPI)</u>	<u>Objective Drought Indicator Blends (Percentiles)</u>
D0	Abnormally Dry	Going into drought: <ul style="list-style-type: none"> <li>■ short-term dryness slowing planting, growth of crops or pastures</li> </ul> Coming out of drought: <ul style="list-style-type: none"> <li>■ some lingering water deficits</li> <li>■ pastures or crops not fully recovered</li> </ul>	-1.0 to -1.9	21 to 30	21 to 30	-0.5 to -0.7	21 to 30
D1	Moderate Drought	<ul style="list-style-type: none"> <li>■ Some damage to crops, pastures</li> <li>■ Streams, reservoirs, or wells low, some water shortages developing or imminent</li> <li>■ Voluntary water-use restrictions requested</li> </ul>	-2.0 to -2.9	11 to 20	11 to 20	-0.8 to -1.2	11 to 20
D2	Severe Drought	<ul style="list-style-type: none"> <li>■ Crop or pasture losses likely</li> <li>■ Water shortages common</li> <li>■ Water restrictions imposed</li> </ul>	-3.0 to -3.9	6 to 10	6 to 10	-1.3 to -1.5	6 to 10
D3	Extreme Drought	<ul style="list-style-type: none"> <li>■ Major crop/pasture losses</li> <li>■ Widespread water shortages or restrictions</li> </ul>	-4.0 to -4.9	3 to 5	3 to 5	-1.6 to -1.9	3 to 5
D4	Exceptional Drought	<ul style="list-style-type: none"> <li>■ Exceptional and widespread crop/pasture losses</li> <li>■ Shortages of water in reservoirs, streams, and wells creating water emergencies</li> </ul>	-5.0 or less	0 to 2	0 to 2	-2.0 or less	0 to 2

## Filters

Measure Names

## Marks

Area

Color

Size

Label

Detail

Tooltip

Measure Na..

## Measure Values

AVG(D0(Abnormally ..

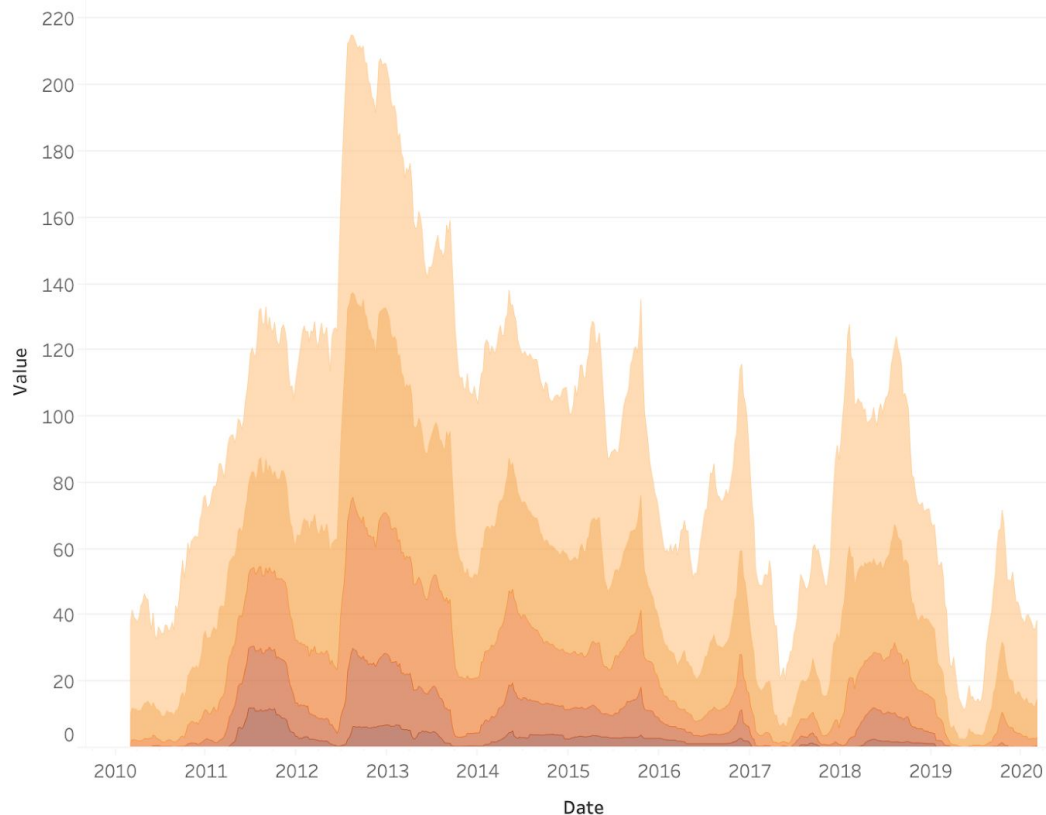
AVG(D1 (Moderate D..

AVG(D2 (Severe Dro..

AVG(D3 (Extreme Dr..

AVG(D4 (Exceptional ..

## US Drought Monitor: Percentage of Area Affected 2010-2020

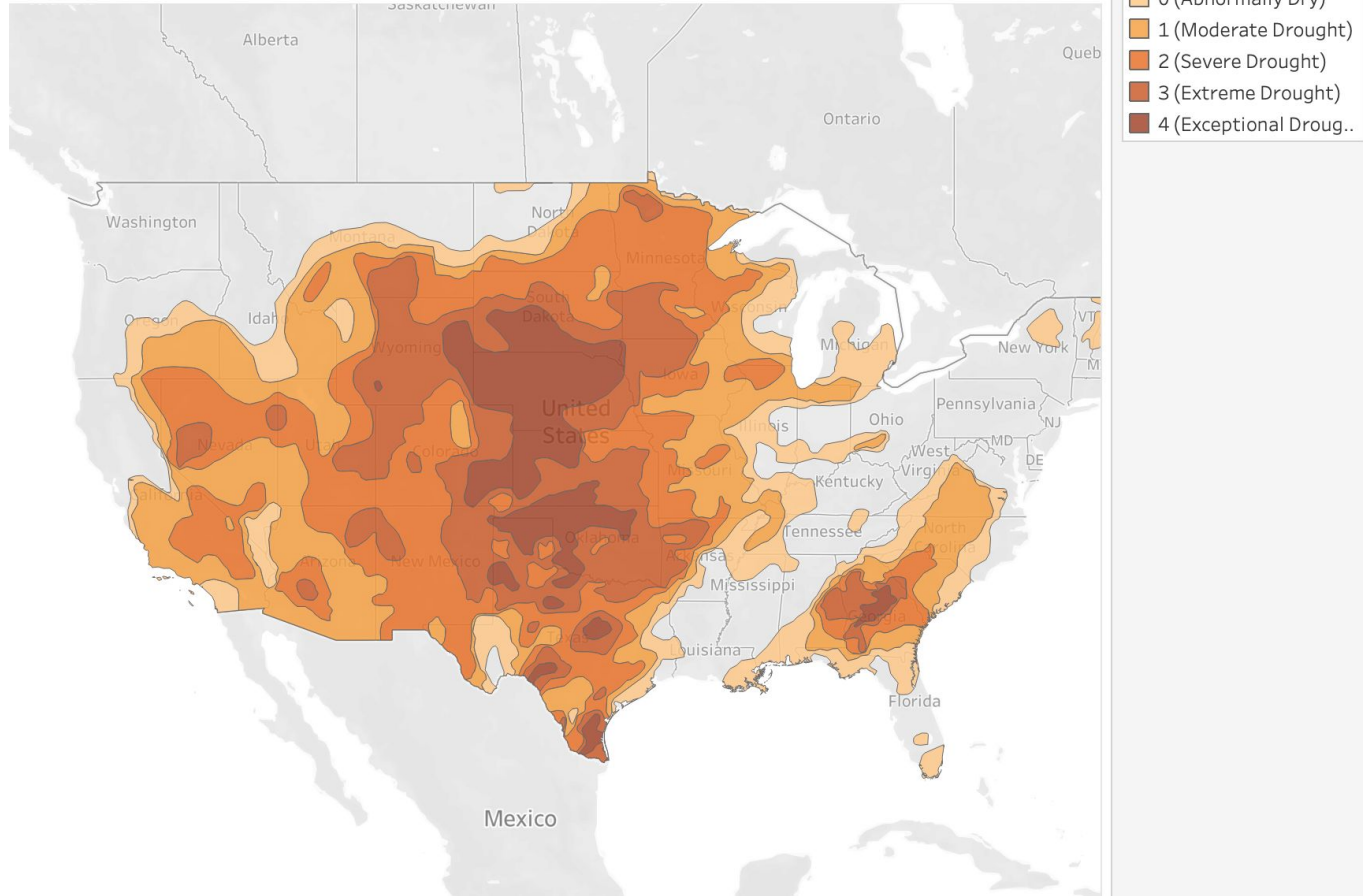


## Measure Names

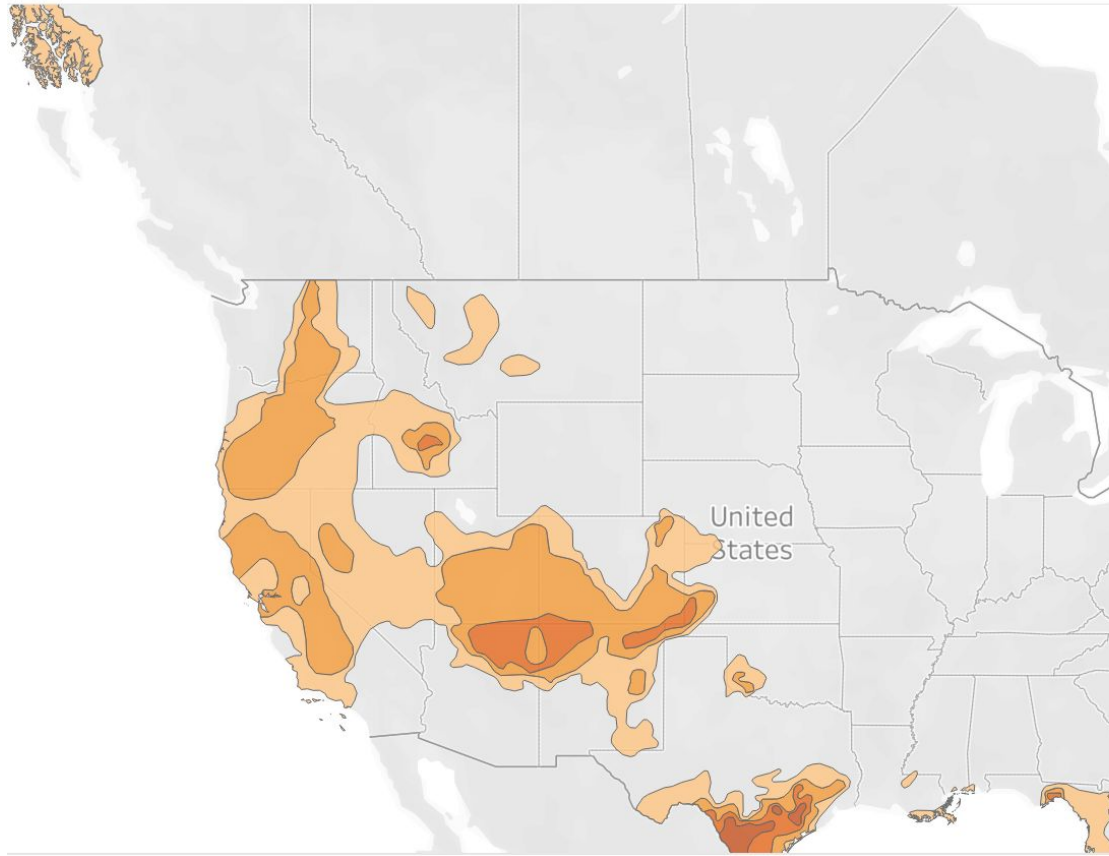
- Avg. D0(Abnormally ..
- Avg. D1 (Moderate D..
- Avg. D2 (Severe Dro..
- Avg. D3 (Extreme Dr..
- Avg. D4 (Exceptional..



## US Drought Monitor: Jan 8, 2013



## US Drought Monitor: March 2020



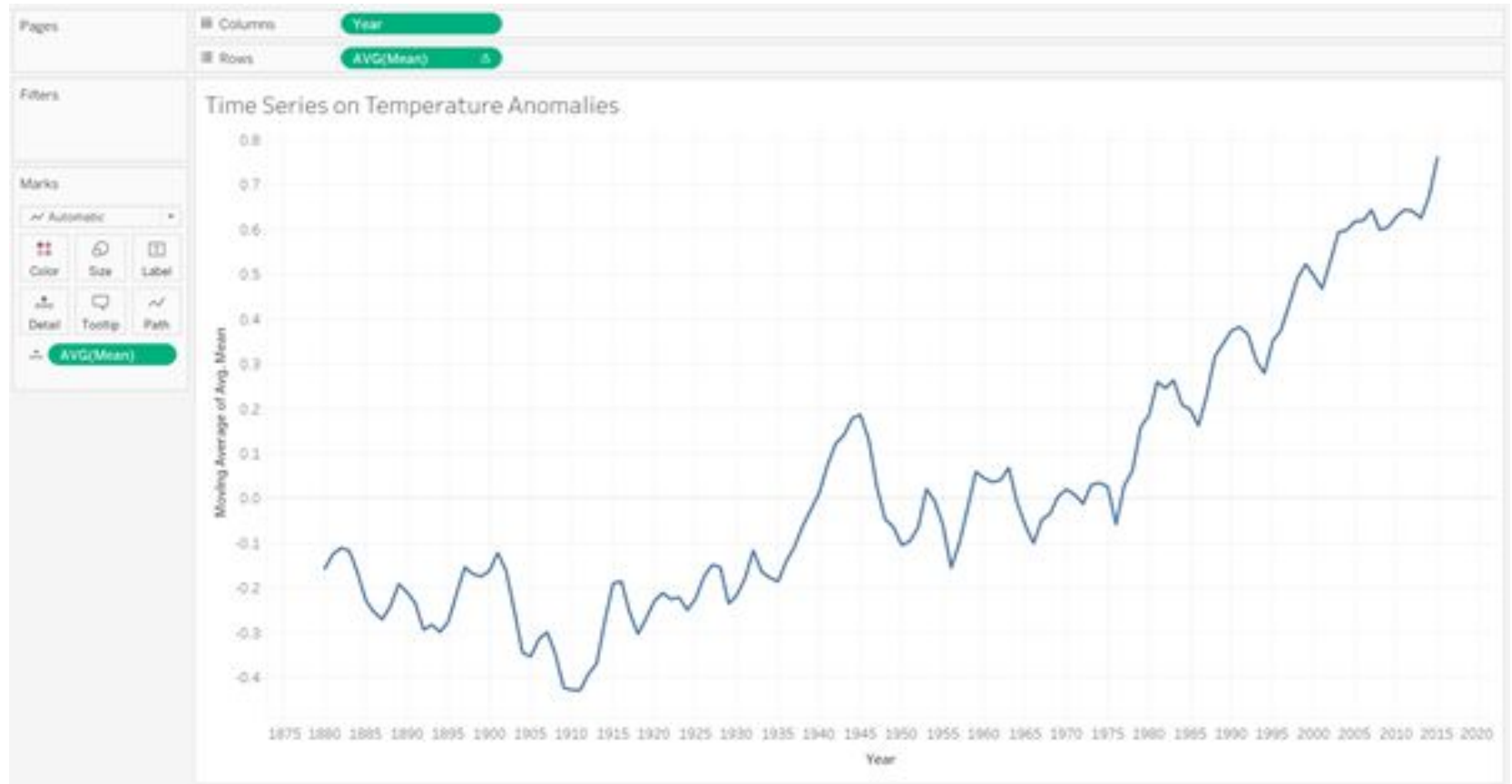
### Drought Level

- 0 (Abnormally Dry)
- 1 (Moderate Drought)
- 2 (Severe Drought)
- 3 (Extreme Drought)

# Global Temperatures

- Temperature is one such variable which gives a perspective about how adverse climate's becoming.
- Climate change can be recognized by understanding the rise in temperatures over a period of time and later drill down to understand the exact reasons
- The planet's average temperature has risen of about 0.9 degrees centigrade since 19<sup>th</sup> century

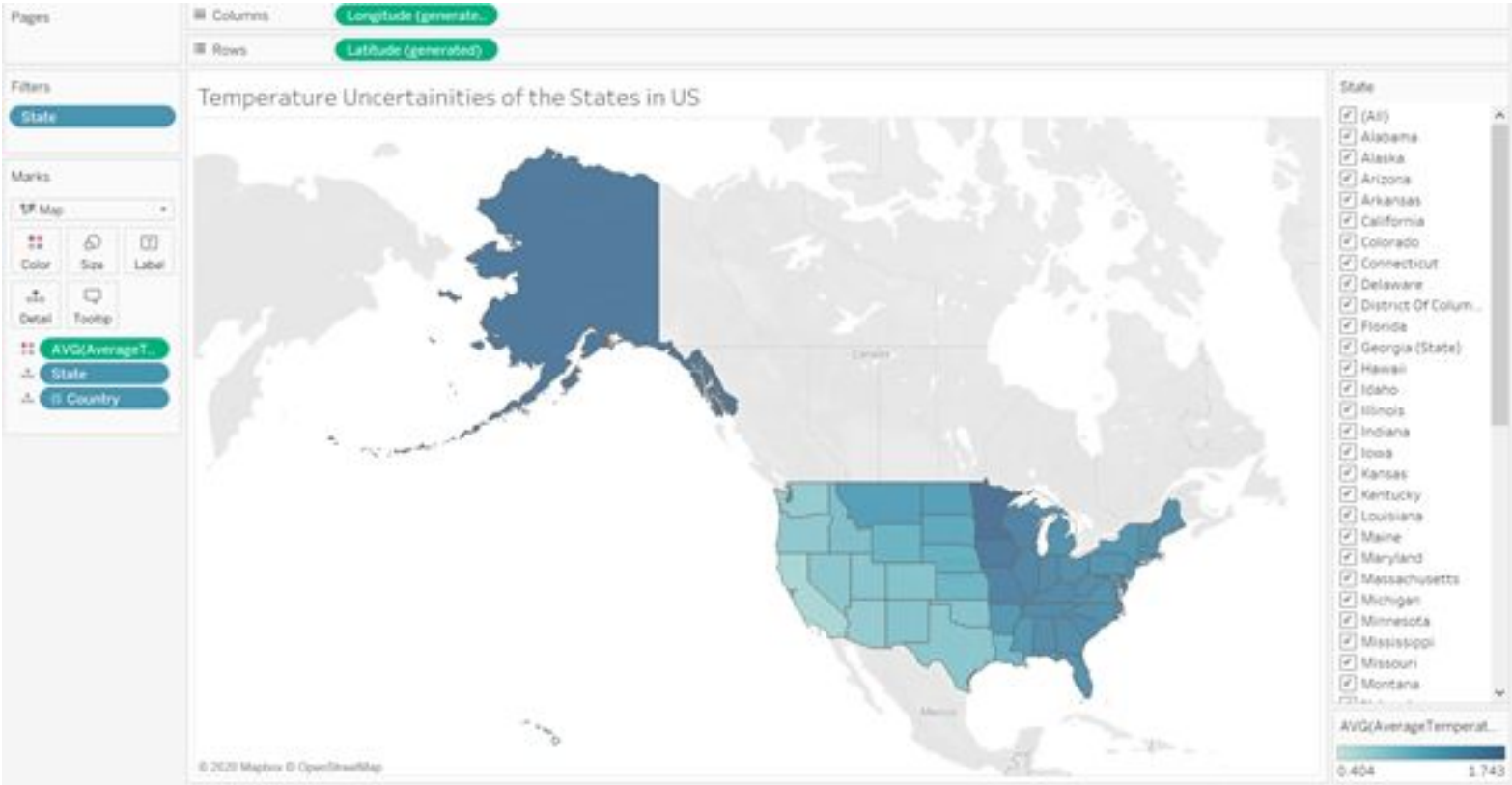
# Time Series Analysis on Temperature Anomalies



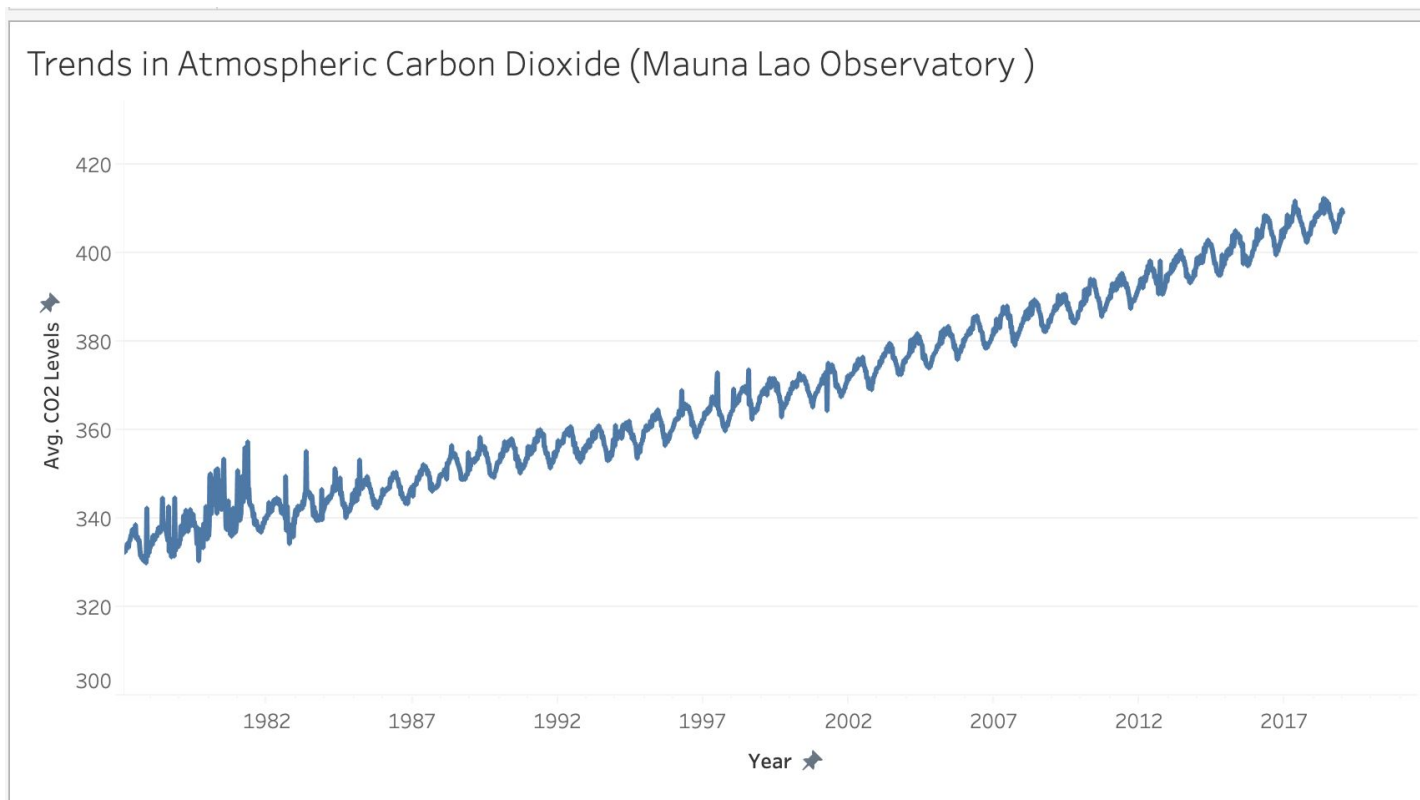
# Comparing Average Global Temperatures - Decade wise



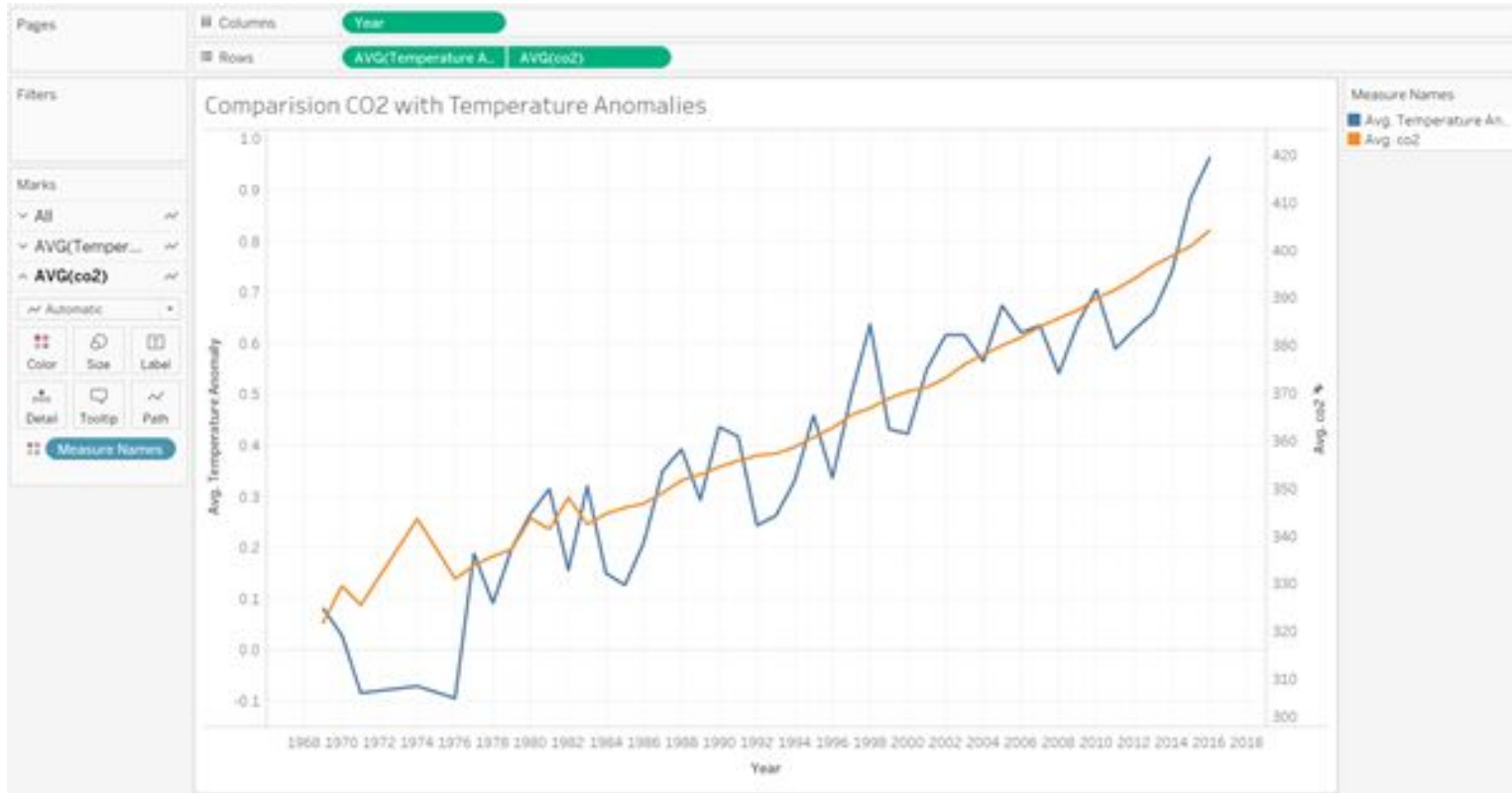
# Average Temperature Uncertainties in United States



# Atmospheric Carbon Dioxide



# Correlation between Atmospheric Carbon Dioxide & Global Temperatures



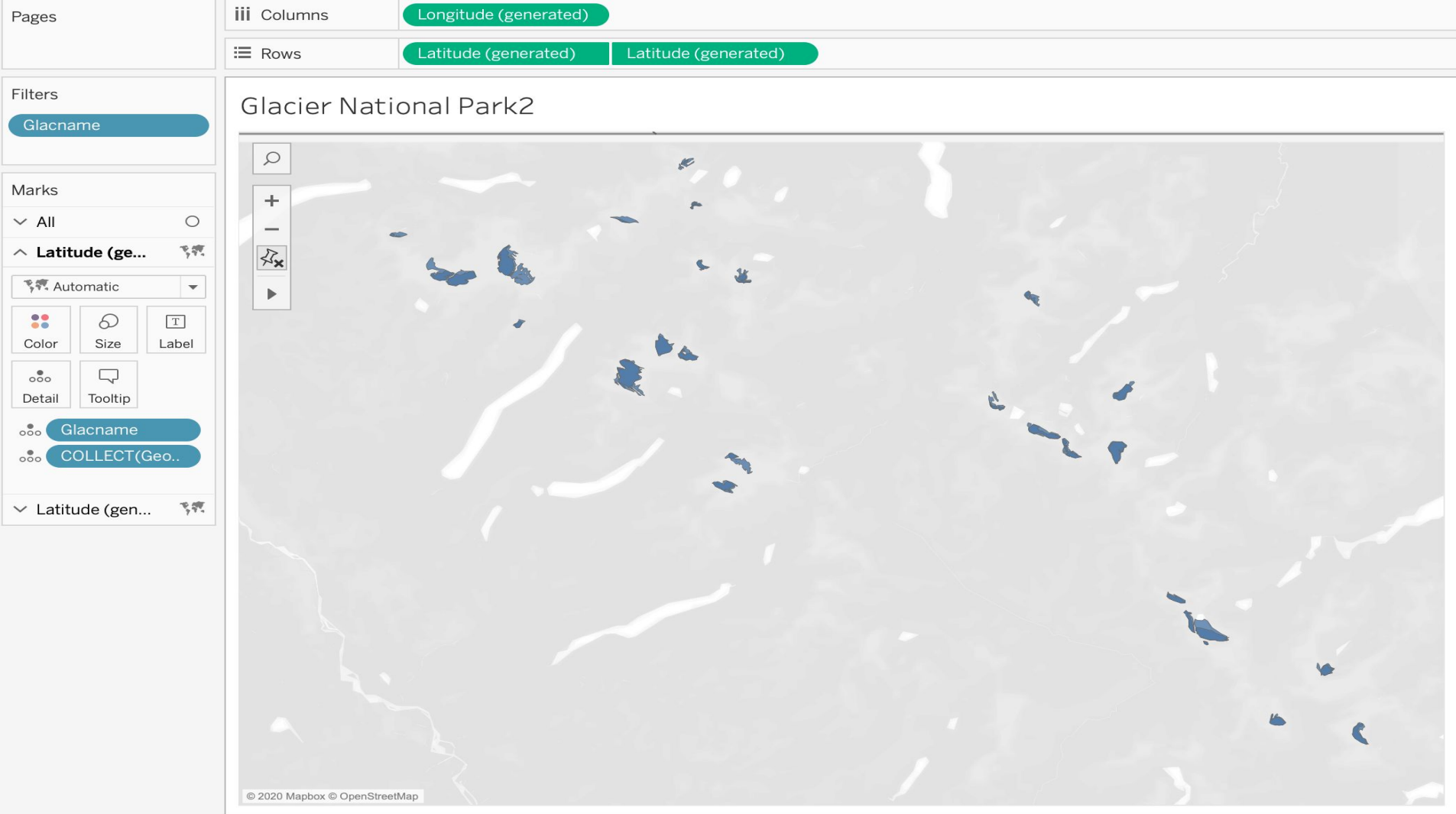


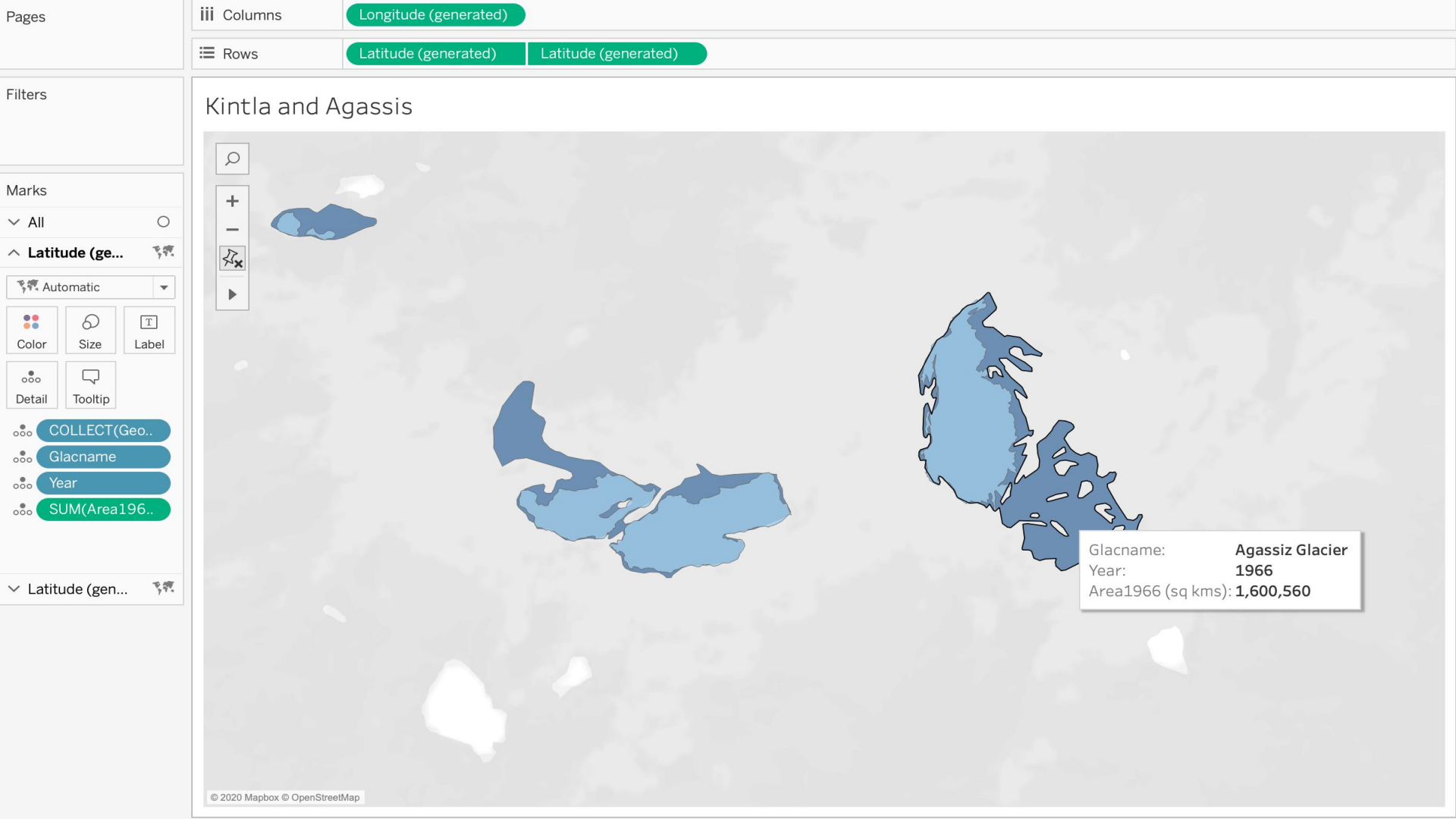
# Glacier Size

- Glacier is a body of snow and ice of sufficient size and mass to move under its own weight.
- A Glacier is formed when winter snowfall exceeds summer melting
- Dynamic

Why are they important?

- Play an important role in ecology of the region
- Frozen reservoirs of water
- Survival of aquatic life
- Drinking water to some communities, agriculture and recreation.
- Glacier retreat is indicative of long term climate change and has hydrologic & ecological importance to many resources.





# Sea Levels

Sea Level rise due to climate change is a serious threat.

Reasons:

- Melting ice sheets are the cause for the rise in the sea level.
- Oceans getting warm and warm water take up more space
- Rise in atmospheric temperatures

- co2
- co2 (1).txt+ (Multiple Conn...
- co2 (2)
- co2.txt (Multiple Connectio...
- co2.txt+ (Multiple Conne...
- co2\_mlo\_surface-flask\_1\_...
- csiro\_alt\_gmsl\_yr\_2015\_csv
- DM
- DM (2)
- dm\_export\_20100308\_20...
- epa-sea-level
- epa-sea-level (2)
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- GNPglaciers\_1966+ (Multi...
- Sheet1 (decade\_split)
- Sheet1 (decade\_split) (2)
- Sheet1 (decade\_split) (2) (...)
- Sheet1 (decade\_split) (3)
- USDM\_20200303

## Dimensions

- Year
- Measure Names

## Measures

- CSIRO Adjusted Sea Level
- Lower Error Bound
- NOAA Adjusted Sea Level
- Upper Error Bound
- Number of Records

## Filters

- SUM(NOAA Adjusted...
- SUM(CSIRO Adjuste...

## Marks

- All
- SUM(CSIRO ...

Automatic

- Color
- Size
- Label
- Detail
- Tooltip
- Path

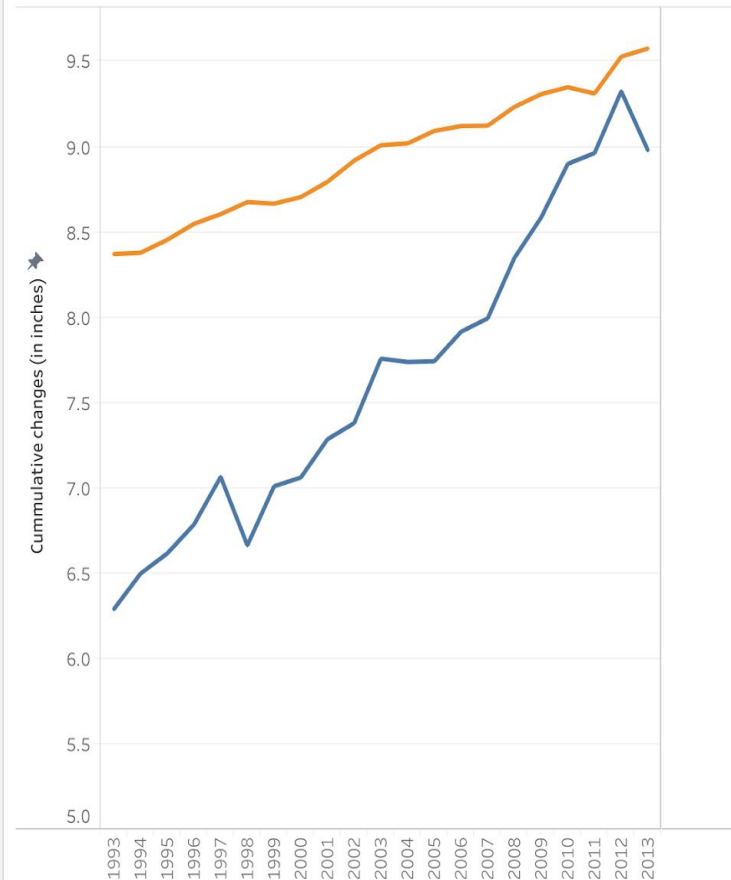
Measure Names

SUM(NOAA ...

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## Global Average Absolute Sea Level Change (1880-2014)



## Measure Names

- CSIRO Adjusted Sea ..
- NOAA Adjusted Sea L..

- co2
- co2 (1).txt+ (Multiple Conn...
- co2 (2)
- co2.txt (Multiple Connectio...
- co2.txt+ (Multiple Conne...
- co2\_mlo\_surface-flask\_1\_...
- csiro\_alt\_gmsl\_yr\_2015\_csv
- DM
- DM (2)
- dm\_export\_20100308\_20...
- epa-sea-level
- epa-sea-level (2)
- epa-sea-level\_csv
- GlobalTemperatures (Globa...
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- GlobalTemperatures (Globa...
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- GNPglaciers\_1966+ (Multi...
- Sheet1 (decade\_split)
- Sheet1 (decade\_split) (2)
- Sheet1 (decade\_split) (2) (...)
- Sheet1 (decade\_split) (3)
- USDM\_20200303

## Dimensions

- Time
- Measure Names

## Measures

- Gmsl
- Number of Records
- Measure Values

## Filters

## Marks

Automatic

Color Size Label

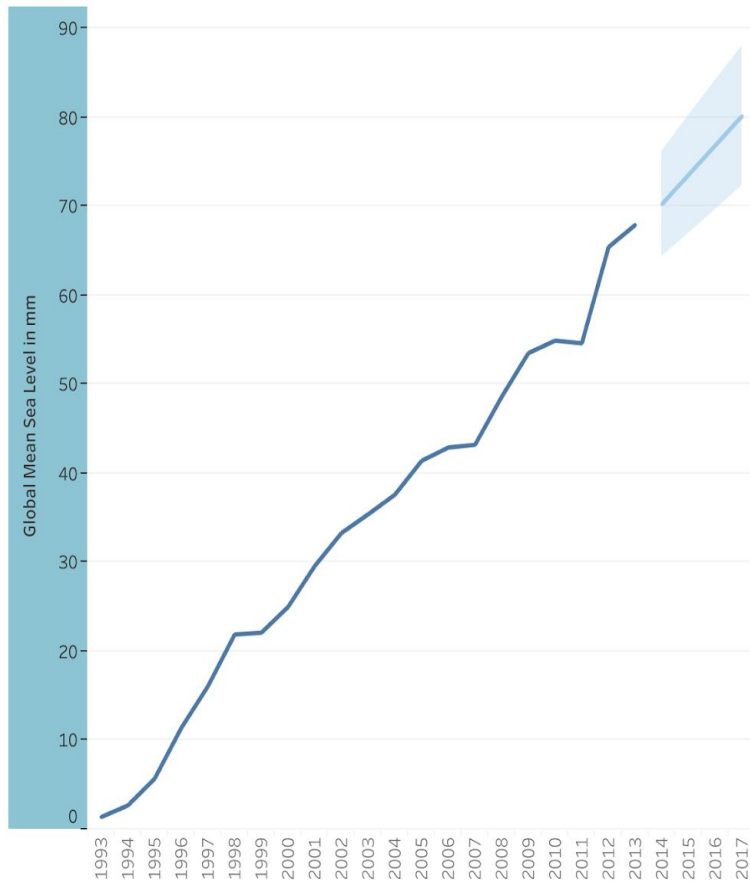
Detail Tooltip Path

Forecast ind..

YEAR(Time)

SUM(Gmsl)

## Global Mean Sea Level (1993 - 2015)

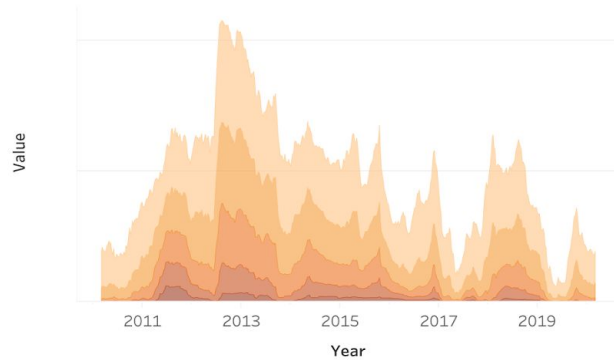


## Forecast indicator

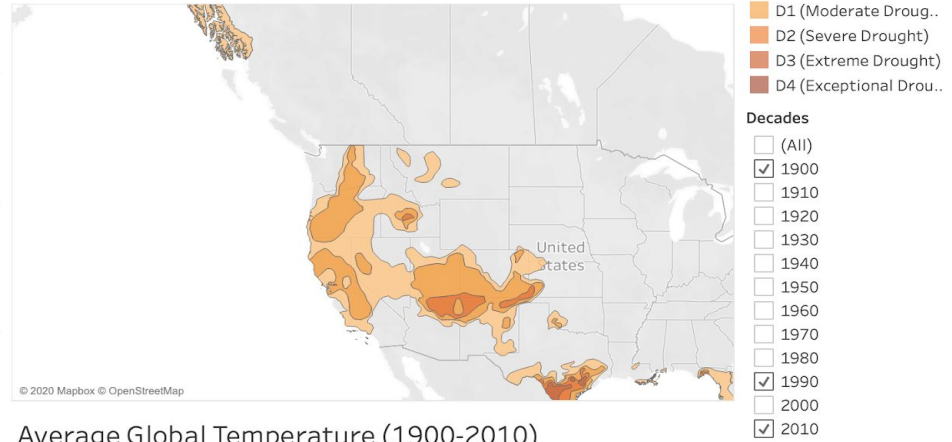
- Actual
- Estimate

## Climate Change - Drought and Land Temperatures

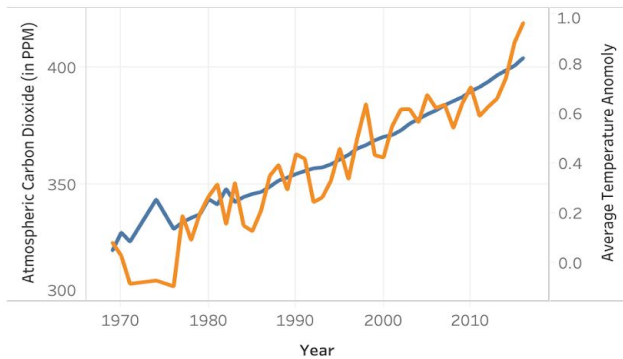
US Drought Monitor:  
Percentage of Area Affected 2010-2020



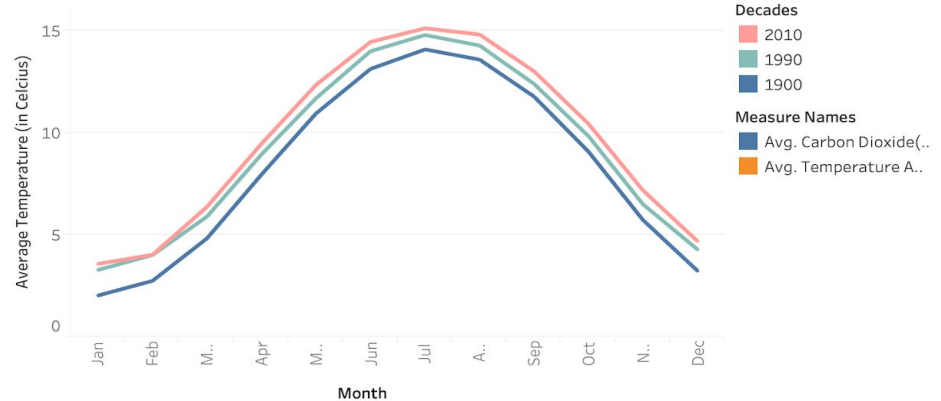
US Drought Monitor: March 2020



Atmospheric Carbon Dioxide & Global  
Temperatures



Average Global Temperature (1900-2010)



# Climate Change - Sea and Glaciers

Measure Na..

- CSIRO A..
- NOAA A..

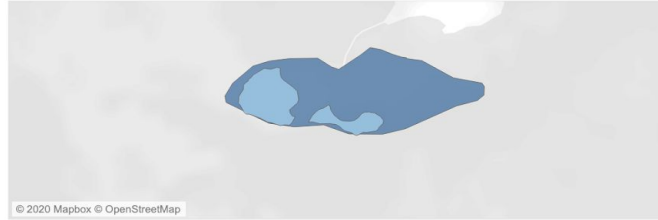
Forecast indi..

- Actual
- Estimate

Boulder



Harris



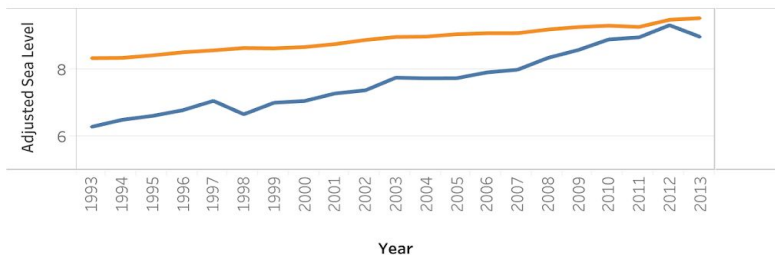
Kintla and Agassiz



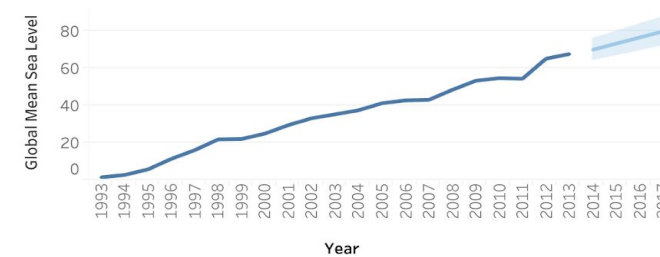
Herbst



Global Average Absolute Sea Level (1880-2014)



Global Mean Sea Level (1993 - 2015)





# What We Learned

- Geomaps: plotting geographic polygons
- Data cleaning
- Area graphs
- Filtering values
- Dual axis
- Dual Trend lines
- Forecasting
- Moving Averaging

# Future Work

## Global Warming

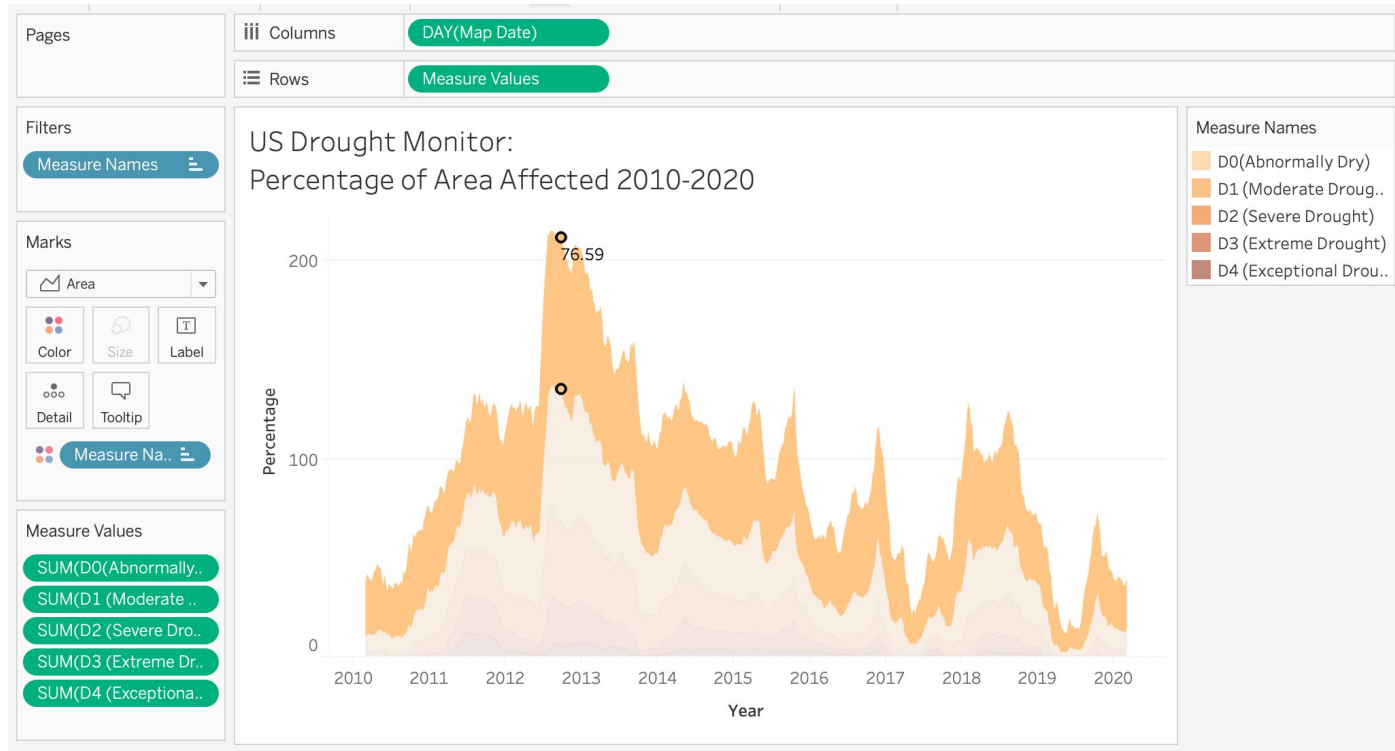
- Deforestation
- Air circulation and weather patterns: weather patterns move water
- Analyze rapidly growing geographic areas
- Rise in ocean temperatures- cause glaciers to melt
- Oil and Gas Drilling

Explore relationship between both human and natural causes to climate

- Other Greenhouse gases - Methane and Nitrous oxide
- Volcanoes and contribution to Global Warming

Thank you!

# Reference Slides



# Drought Dataset 1

Sort fields

Data source order

Show aliases

Show hidden fields

523

rows

<div><div></div><div>dm_export_2010030...</div></div> <div>Map Date</div>	<div>Abc</div> <div>dm_export_20100308_2020...</div> <div>Area Of Interest</div>	<div>#</div> <div>dm_export_...</div> <div>None</div>	<div>#</div> <div>dm_export_20100308_2020...</div> <div>DO(Abnormally Dry)</div>	<div>#</div> <div>dm_export_20100308_2020...</div> <div>D1 (Moderate Dro...</div>	<div>#</div> <div>dm_export_20100308_2020...</div> <div>D2 (Severe Droug...</div>	<div>#</div> <div>dm_export_20100308_2020...</div> <div>D3 (Extreme Drou...</div>	<div>#</div> <div>dm_export_20100308_2020...</div> <div>D4 (Excep</div>
3/3/2020	CONUS	76.2100	23.7900	11.5200	2.5100	0.5200	
2/25/2020	CONUS	76.9800	23.0200	10.1600	2.2500	0.2300	
2/18/2020	CONUS	76.4900	23.5100	9.5600	2.4900	0.2300	
2/11/2020	CONUS	75.8500	24.1500	10.6000	2.5700	0.1700	
2/4/2020	CONUS	74.3000	25.7000	10.6100	2.4600	0.0700	
1/28/2020	CONUS	73.3200	26.6800	11.0000	2.3900	0.0500	
1/21/2020	CONUS	75.1300	24.8700	11.4700	3.3800	0.0700	
1/14/2020	CONUS	76.7000	23.3000	10.7300	3.1200	0.1100	
1/7/2020	CONUS	75.9400	24.0600	11.1900	3.2200	0.1200	
12/31/2019	CONUS	75.8000	24.2000	11.2000	3.8200	0.0600	
12/24/2019	CONUS	74.3700	25.6300	12.3000	4.1800	0.1000	