

Weather Analysis

STA 141B, Fall 2021

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Introduction

For thousands of years, people have been studying the dry and rainy seasons for agricultural planning and urban and rural construction. However, the time period of the dry and rainy season is not fixed. We believe that certain weather terms determine the dry and rainy season. Therefore, we want to analyze the factors show the changes in the rainy and dry seasons. We list four factors related to the dry and rainy seasons as variables: humidity, air pressure, wind speed, and temperature.

According to the topic, we have two following questions from time and place as starting points:

- For different locations at a fixed time, what is the difference between the dry and rainy seasons in different areas? In order to avoid little difference between the dry and rainy seasons in the same climate region, we choose cities in five different climate regions in the United States from 2016 to 2020: Sacramento, Lake Tahoe, Las Vegas, Denver, and Indianapolis.



- For a fixed location at different times, is there any difference between the current and the past dry and rainy seasons? We choose Sacramento as the location for this question, and observe and compare the dry and rainy seasons of 1976-1980 and 2016-2020 Sacramento.

Data and Methods

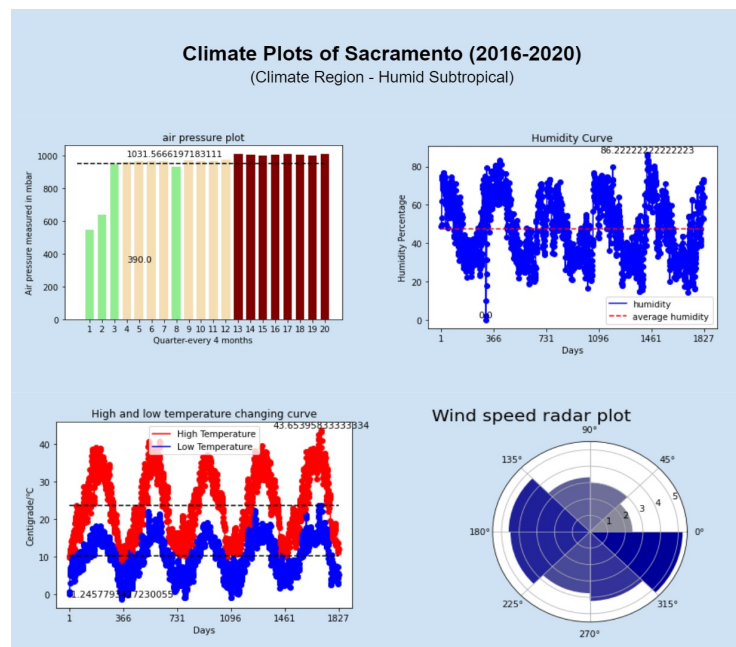
In our project, we chose the data for weather coming from Meta Weather. To determine our wet and dry seasons, we select the data on four variables (humidity, air pressure, wind speed, and temperature) from 2016 to

seasons, we select the data on four variables (humidity, air pressure, wind speed, and temperature) from 2016 to 2020 in five U.S. cities: Sacramento, Lake Tahoe, Las Vegas, Denver, and Indianapolis. The data of Meta Weather is only up to early 2013, so we decide to look for websites with earlier weather data. Unfortunately, other websites do not have earlier weather data. We find that only WeatherSpark displays the dry and rainy seasons in the early years with accurate graph analysis. Thus, for the data of 1976-1980 Sacramento, we directly use the graphs on WeatherSpark to compare with the conclusions we got on Meta Weather. The methods we use are API, json, web scraping, data visualization and graphs (histogram, line plot, and radar chart).

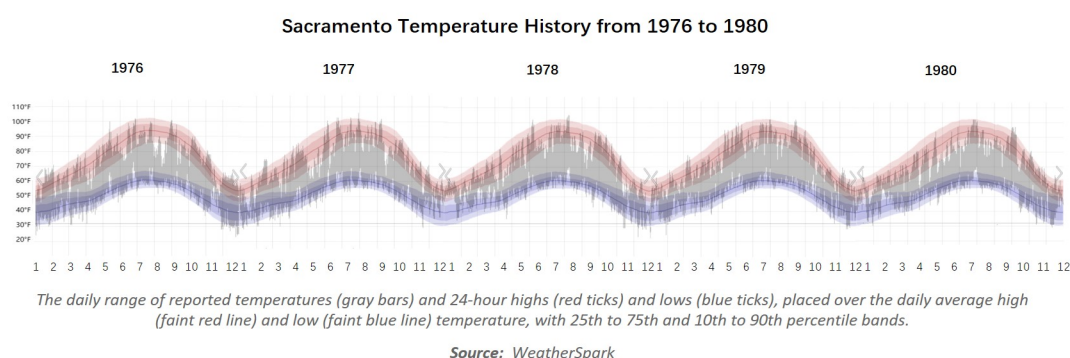
Analysis

Fixed Location Different Time - Sacramento

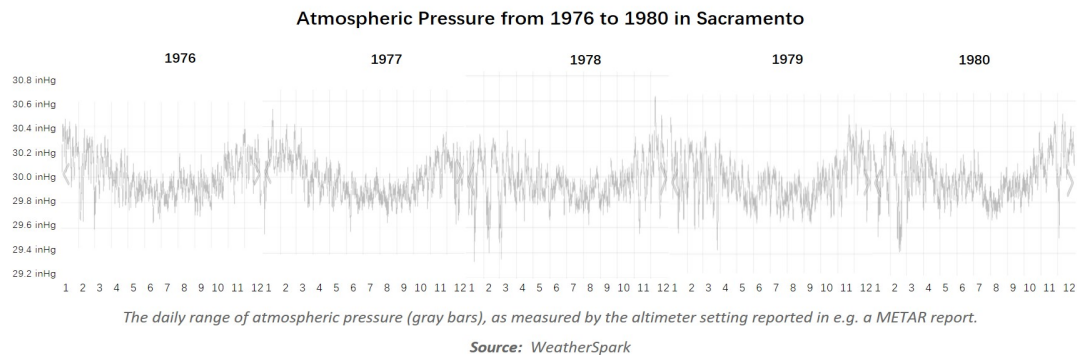
For understanding whether there exists variation over time in the climate parameters of Sacramento, especially the four major factors utilized in our project, we obtain the historical data provided by the professional weather website, WeatherSpark, which offers precise and interactive graphs that allow us to visualize the trend. The results generated from the contemporary climate condition of Sacramento during 2016-2020 based on the data from MetaWeather are compared with the historical data in this part.



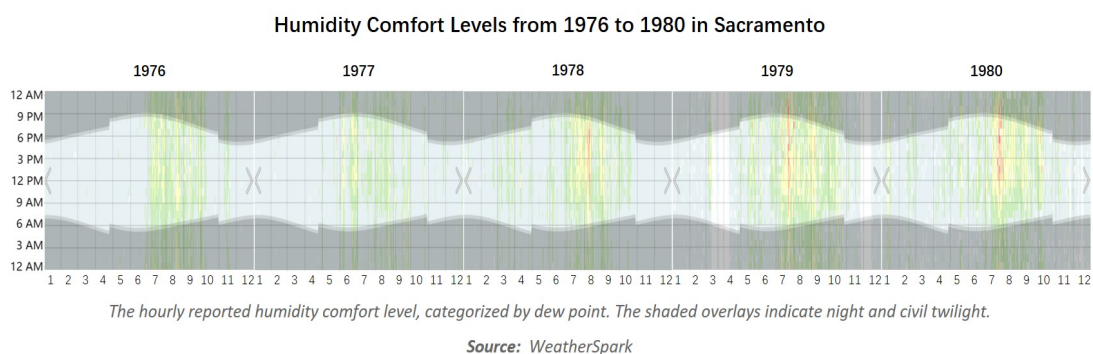
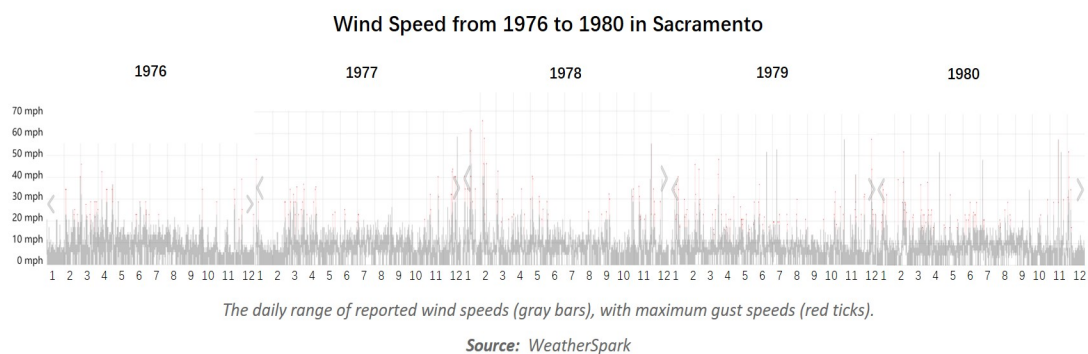
First of all, the temperature is a clear measure of the climate condition, and usually a symbol of climate change. According to the historical data in 1976-1980 in Sacramento, the range of maximum temperature is mainly between 50°F and 90°F (10 ~ 32.22°C), and the minimum temperature is mostly between 40°F and 60°F (4.45 ~ 15°C). However, the current data of 2016-2020 reveals a significant distinction: the rough range of maximum value is 10 ~ 40°C; the rough range of minimum value is 0 ~ 20°C. Therefore, this phenomenon means a general increase of temperature from the period 1976-1980 to 2016-2020, which should attract the attention of the public and further be investigated to figure out its cause and effect.



To be specific, by checking the line chart Atmospheric Pressure from 1976 to 1980 in Sacramento, we can roughly estimate the range which is mainly between 29.8 inHg and 30.2 inHg (1009.144 ~ 1029.469 mbar). On the contrary, the air pressure in contemporary Sacramento shows a significant difference. As we can see from the Air Pressure Plot in Sacramento from 2016 to 2020, the expected air pressure is 1031.567 mbar, and actually, as time goes on, the data in most of time since the 4th quarter of 2016 has been larger than 1031.567 mbar. Such a result obviously reveals the increase of air pressure from the period 1976-1980 to 2016-2020. From the perspective of climatology, the increase of air pressure relates to the increase of temperature, thus this variation can be considered as a joint reaction of climate change.



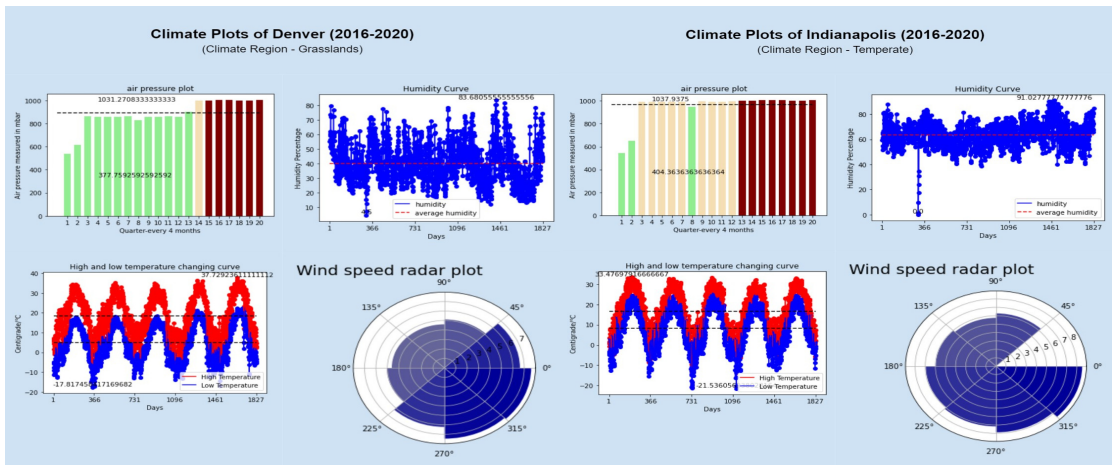
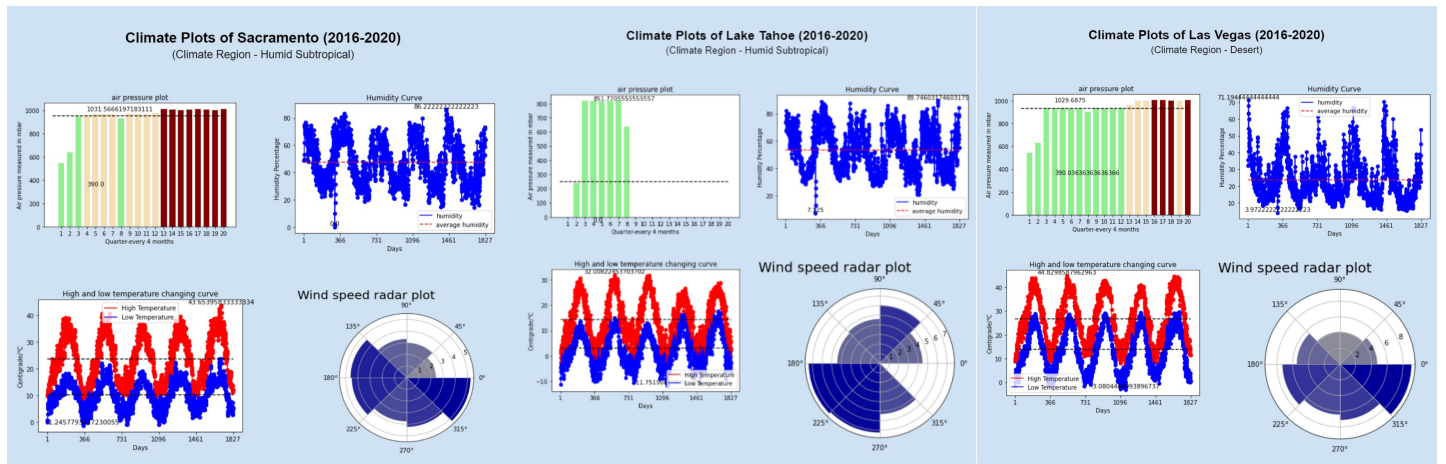
Apart from temperature and air pressure, the differences of the other two graphs about humidity and wind speed tend to be less obvious. According to the Environmental Protection Agency (EPA), the ideal humidity level between 30% to 50% can be considered to be comfortable, and a humidity lower than 30% can be considered as a dry level. The graph of Humidity Comfort Level from 1976 to 1980 in Sacramento reveals that the comfort level most of the time is dry or comfortable, which is similar to the circumstance during the period 2016-2020. Moreover, the wind speed during the two periods tends to be stable. As the data of the period 1976-1980 reveals, the main range of wind speed is less than 20 mph (about 2 ~ 4 Beaufort Number). For the Wind Speed Radar Plot recording the data from 2016 to 2020, most of the wind speed data reveals an index between 2 to 4, which is similar to what we obtain from the radar plot.



To summarize, over the four decades, there exists significant changes of temperature and air pressure in Sacramento, but the other two parameters, humidity and wind speed, tend to remain similar. The obvious increases in temperature and air pressure are worth paying attention to by the public. As the climate closely relates to almost all aspects of human beings' life such as agricultural activities and habitable zones, climate change will widely influence our future. Therefore, further research on the cause and response of this phenomenon and feasible solution to mitigate the negative effects of climate change is in urgent need. The

specific solution about how we can adjust agricultural and industrial activities to adapt to this climate change also needs to be studied.

Different Locations at Fixed Time



Lake Tahoe (2016-2020)

From the plot, the atmospheric pressure in Lake Tahoe is missing from 2017 to 2020. This is due to the missing data. The general trend for humidity is high in the beginning and end of the year, while low in the middle of the year. The range of temperature is between -11°C and 32°C . In one year the temperature is generally high in the middle and low in the beginning and end of year, with a large difference between daily high and daily low in summer. From the wind radar chart, the five-year average wind speed in the southwest direction is 7 wind strength (over 32-38mph), which is higher than the average wind speed in other directions.

Las Vegas (2016-2020)

Over time, the atmospheric pressure in Las Vegas is also increasing. The expected air pressure is 1029.6875 mbar and the atmospheric pressure in 2019 and 2020 is greater than expected air pressure. From the humidity graph, the lowest humidity in Las Vegas is 3.9723% and the highest humidity is 71.1945%. The humidity range is between 8 and 68%. The temperature plot is a time series plot because it repeats the cycle. The range of maximum temperature is between 10°C and 45°C , and the minimum temperature is between 0°C and 30°C . From the wind radar chart, the five-year average wind speed in the southeast direction is 7.7 wind strength, which is higher than the average wind speed in other directions.

Denver (2016-2020)

From the air pressure plot, the expected air pressure is 1031.2708 mbar. The air pressure in 2016 is relatively low compared to other years, and the atmospheric pressure in 2019 and 2020 is larger than expected air pressure. The humidity range is between 15 and 80%. The lowest humidity in Las Vegas is 4.5% and the highest humidity

is 83.6805%. Since the temperature plot repeats the cycle, it is a time series plot. The range of maximum temperature is between -2°C and 35°C, and the minimum temperature is between -15°C and 20°C. From the wind radar chart, the five-year average wind speed in the southeast direction is 7.5 wind strength, which is higher than the average wind speed in other directions.

Indianapolis (2016-2020)

According to the plot, the atmospheric pressure in Indianapolis is also increasing. The expected air pressure is 1037.9375 mbar and the atmospheric pressure from the end of 2016 to 2020 is greater than expected air pressure. From the humidity graph, it is nearly constant over the 5 year period except for the end of 2016 with extreme values because of the mountain fire. The humidity range is mostly between 40 to 80%. The temperature plot is a time series plot because it repeats the cycle. The range of temperature is between -21°C and 33°C. In one year the temperature is generally high in the middle and low in the beginning and end of year. From the wind radar chart, the five-year average wind speed in the southeast direction is 8.5 wind strength (over 39-46mph), which is higher than the average wind speed in other directions.

Comparison of five locations

In contrast, excluding Lake Tahoe, the highest five-year average wind speeds in the other four cities are all southeast winds. The humidity in Indianapolis is relatively higher than the humidity in the other four cities, which means that the rainfall in Indianapolis is higher than that in the other cities. We believe that the higher the humidity, the greater the possibility of rain. Humidity is generally high in months in the spring season, so this means that spring season is usually the rainy season. In the rainy season, the temperature is generally between 20 °C and 30 °C. Although the air pressure increases with the growth of the year, the contrast is not obvious due to the changes in the air pressure in each year. Therefore, we have no way to judge the dry and rainy seasons of five cities from the atmospheric pressure.

Conclusion

As our project aims to figure out the factors influencing the dry and rainy seasons from the perspectives of different locations and different time periods, we analyzed the change in climate parameters particularly in Sacramento and the similarities and differences in five representative places, Sacramento, Lake Tahoe, Las Vegas, Denver, and Indianapolis, which are located in five different major climate regions in United States. The results generated from the analysis not only lends support to some of our hypotheses, but also inspires us to consider our coming future. Based on our research, different climate regions have distinct characteristics shown in specific climate parameters. The differences in the temperatures of these five locations are the most obvious symbol to distinguish them. In general, there exists a common trend for all these five locations that the air pressure has been gradually increasing in recent years but is almost irrelevant to the time of dry or rainy seasons, and a relatively high humidity serves as a main factor to determine the rainy season, especially in Spring season. Other factors like the wind speed show obvious main direction from southeast, but the condition in Lake Tahoe is an exception. Moreover, the variation over time is worth paying attention to. The significant increases of temperature and air pressure tend to reveal the phenomenon of climate change, indicating potential risk to activities of human beings in variou fields. As a result, for the brilliant future of human beings, further research and effective actions to promote sustainable development is of great importance.

Grading Criteria

We would like to choose the 1 , 2 , 4 , 5 , 6 criterias in the rubric, which are project organization, writeup readability, and overall conclusions; code quality, readability, and efficiency; data munging; data visualization; and data extraction.