



CLIMATE ACTION



Team Members

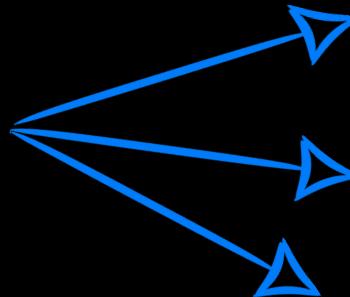
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Motivation

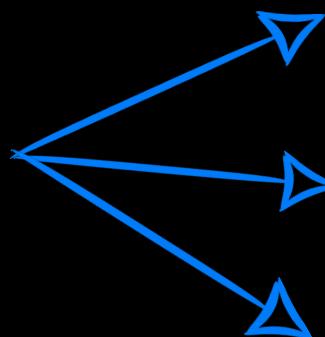


- Climatic changes like change in weather patterns, loss of ice cover, rise in temperature
- Understanding what human actions are leading to this change
- Need of assessing situations we would face in coming years if no actions are taken

Goals



Big Data



Analyzing correlation for factors that might affect climate change



Predicting what change we can see in coming years



Regional analysis of climate affecting attributes



Climate change is slow



Need data for hundreds of years



Speed and efficiency supported by big data frameworks for processing



Background research

- <https://climatedataguide.ucar.edu/climate-data-tools-and-analysis/trend-analysis>

This contributes to topic by studying the rate of change of temperature given a time-series and uses the Student's t-test to study the statistical significance
- https://economics.stanford.edu/sites/g/files/sbiybj9386/f/climate_20160208.pdf

This paper studies long-run effects of climate change using fixed effects regression
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5393220/>

This study analyses the question whether the climate change is of natural origin or not. They used Monte Carlo simulations with the Holm–Bonferroni method to verify statistical significance of the same

Data

- **Primary Data: Global Climate Summary of the Day**

<https://www.ncei.noaa.gov/data/global-summary-of-the-day/archive/>

Number of features: 28

Total Data Size: 30 GB

Data has attributes like latitude, longitude, date, temperature and precipitation for that day from 1929 to 2020

Approximately 2% of the values were missing for precipitation

- **Secondary Data:**

<https://data.worldbank.org/indicator/>

Number of features: 3

Total Data Size: 1 MB

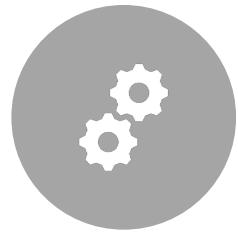
Data has country name, country code and CO₂, energy use, population recorded per year from 1960 to 2014

Approximately 8% of the data was missing for CO₂ emission, energy use and population

Data Frameworks and Pipelines used



DATA PIPELINES



SPARK

FOR EFFICIENT AND PARALLEL COMPUTATIONS, DATA CLEANING AND MANIPULATIONS



TENSORFLOW

FOR PERFORMING FIXED EFFECTS LINEAR REGRESSION



ALGORITHMS



HYPOTHESIS TESTING

VALIDATE THE CORRELATION BETWEEN DIFFERENT PARAMETERS PERTAINING TO CLIMATE AND HUMAN ACTIONS

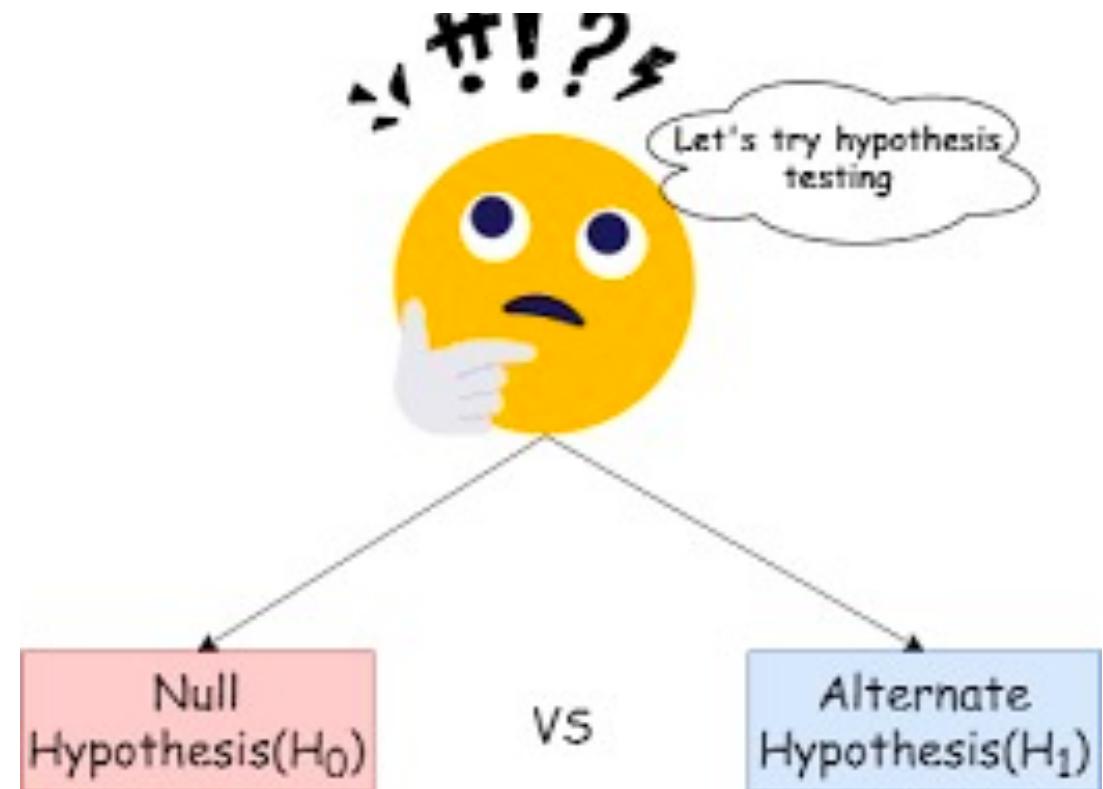


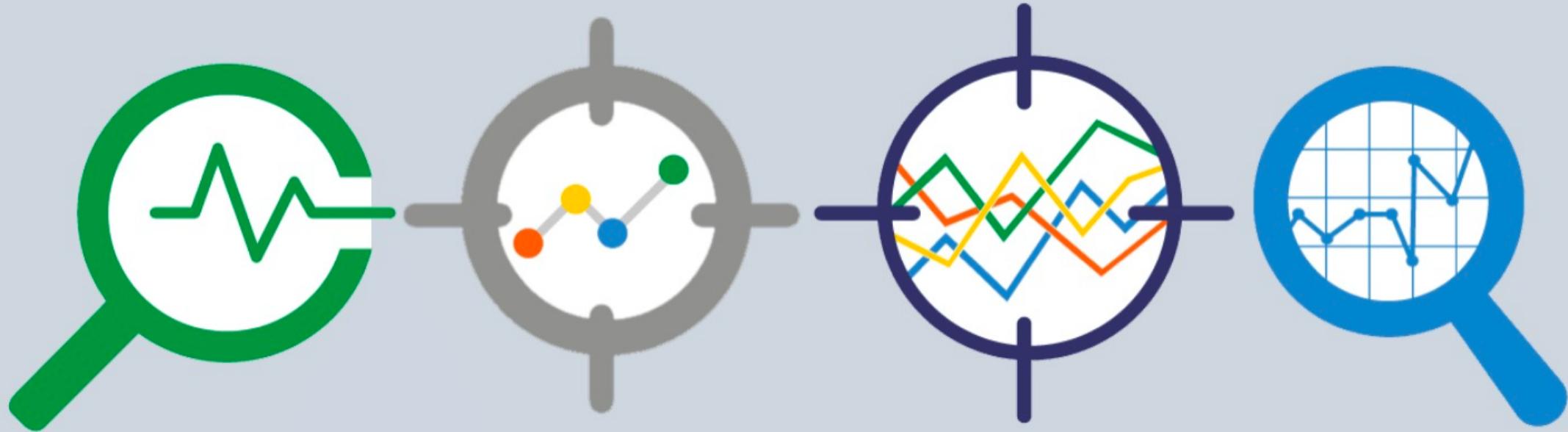
TIME SERIES

FOR PREDICTING TEMPERATURE AND PRECIPITATION IN COMING YEARS USING SARIMA MODEL

Hypothesis Testing

- Impact of CO₂ emission, energy use and population on temperature and precipitation
- Null hypothesis (H_0) : The above human caused factors have no significant correlation on climate attributes
- Fixed Effects Linear Regression to handle geographical and time dependent attributes
- Performed student's t-test to get the p-value to decide whether to Accept/Reject null hypothesis





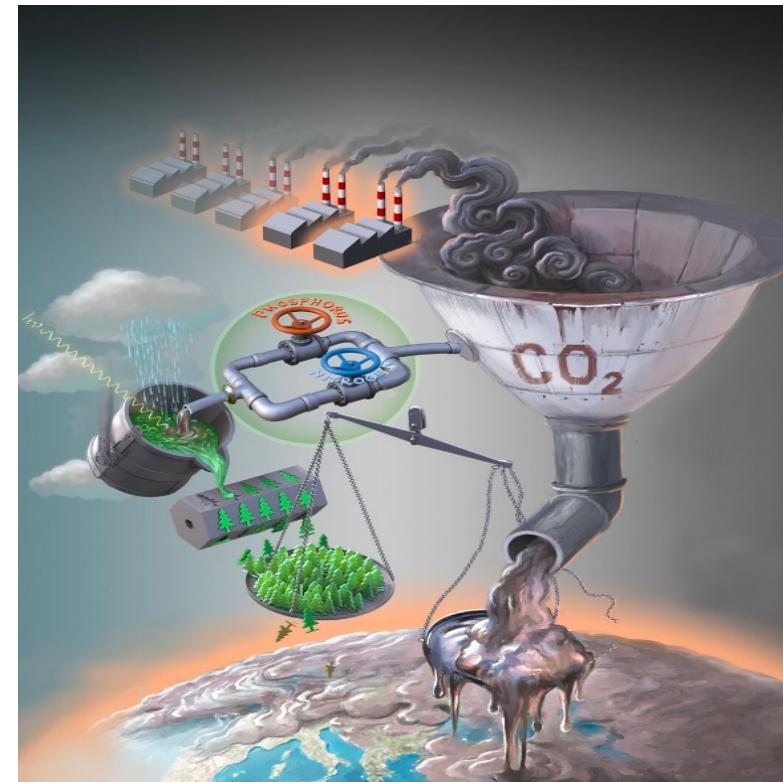
Time Series



- Predicted temperature and precipitation till year 2050
- SARIMA Model to handle seasonal nature of the data
- Hyperparameters tuning for optimal model parameters
- Trained on 'train' data and tested on 'test' data
- RMSE as cost function to evaluate the accuracy of the model

Country wise Data Analysis

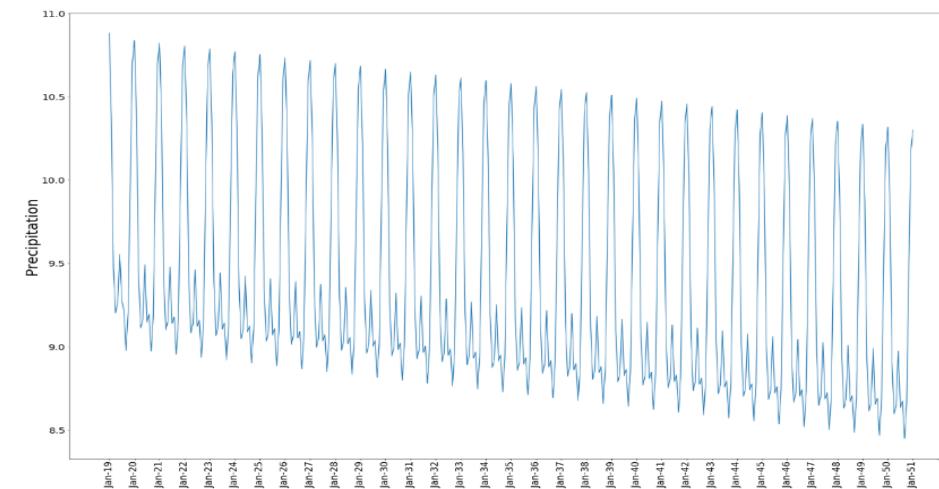
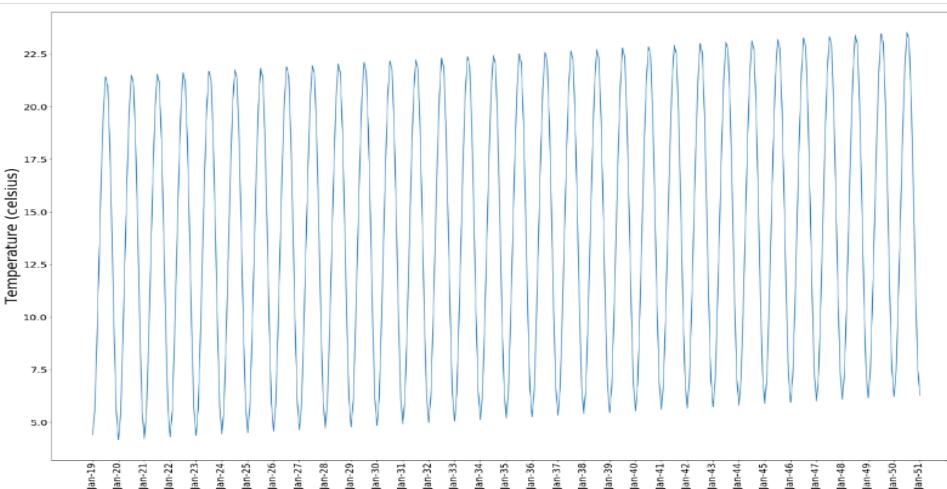
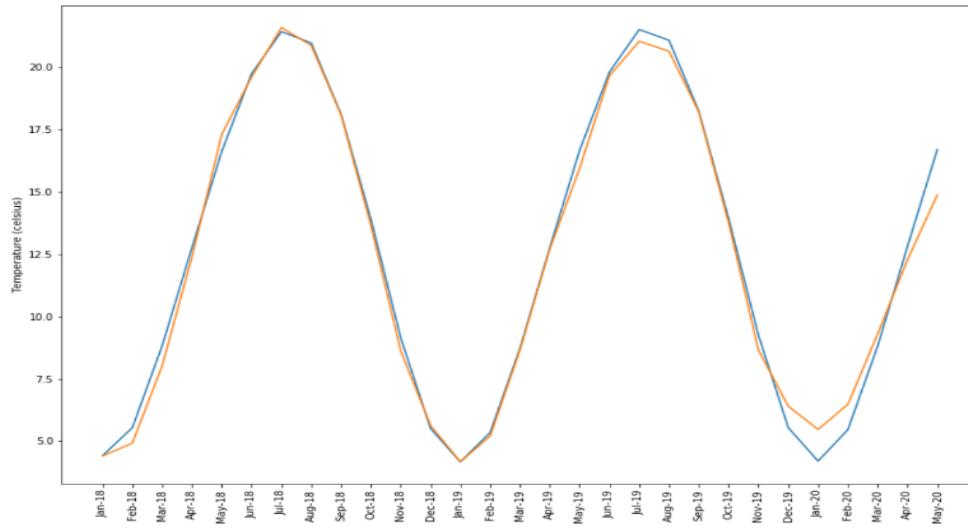
- Effects of CO₂ emission on temperature controlling for population and energy per country
- Betas calculated for Top 10 and Bottom 10 CO₂ emitting countries
- Analyzed beta values for the above components to study the impact on temperature.



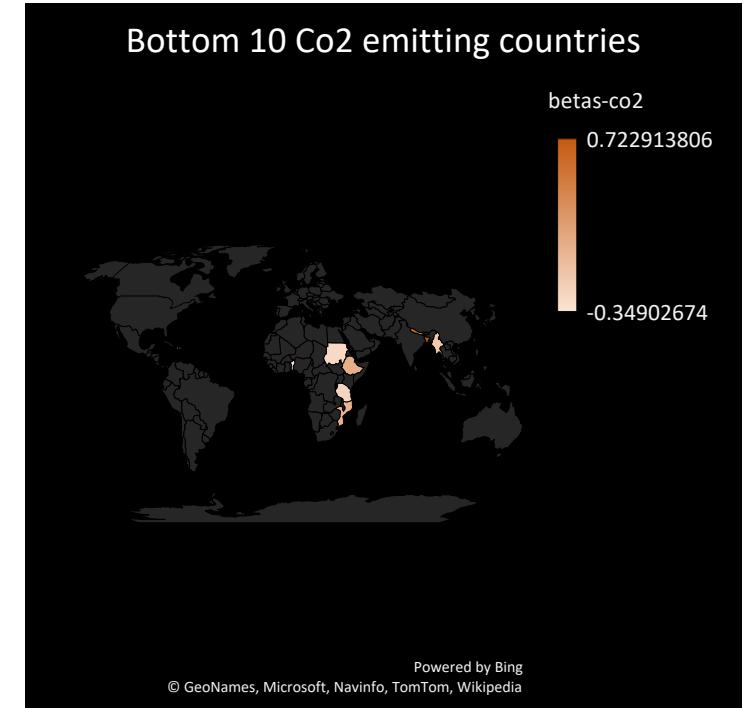
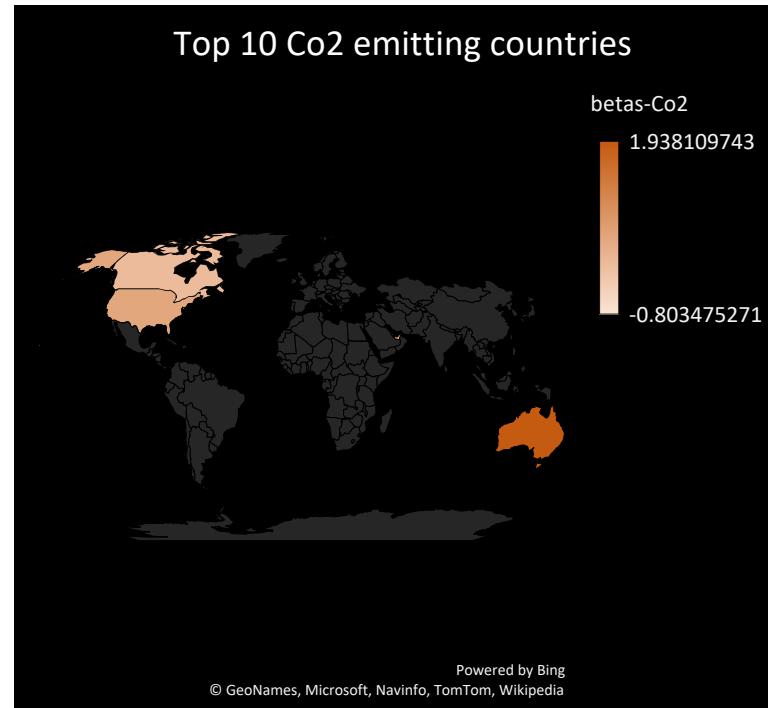
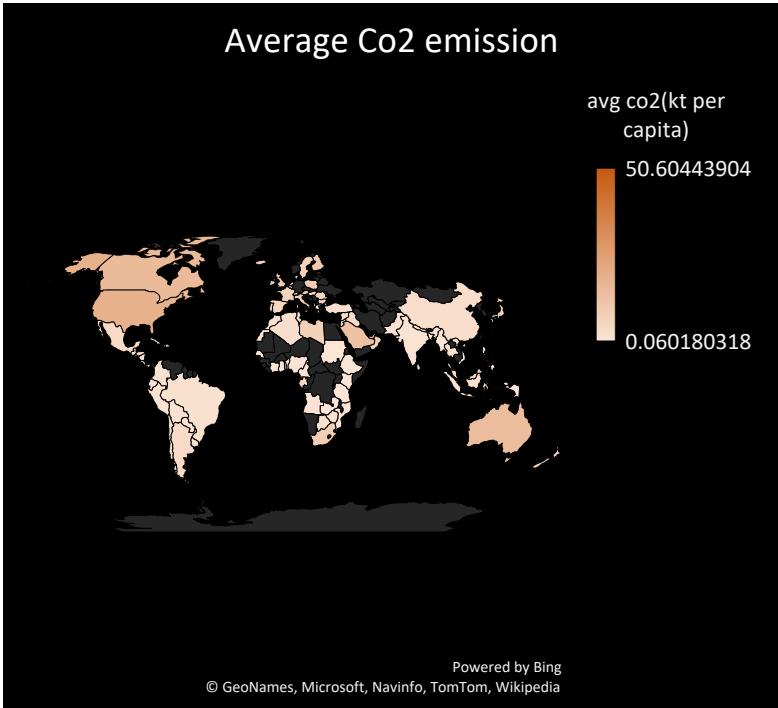
Results

Attribute Y	Attribute X	Correlation	T-stats	P value	Hypothesis
Temperature	CO ₂	-2.45e-04	-0.877	0.38	Accept
Temperature	Energy	9.76e-03	4.83	1.4e-6	Reject
Temperature	Population	1.90e-02	13.92	0.0	Reject
Precipitation	CO ₂	5.58e-02	3.6	3.2e-4	Reject
Precipitation	Energy	-4.98e-02	-4.2	2.7e-5	Reject
Precipitation	Population	1.34e-02	8.78	2.22e-18	Reject

Results



Results



This aligns with the previous research findings that high CO₂ emitting countries have high oil/gas production/consumption

- Top 10 and Bottom 10 CO₂ emitting countries appear in cluster on the map suggesting that CO₂ emission may have far wider reach than the local country
- We cannot conclude relationship between CO₂ emission and temperature as beta values lie from positive to negative in both cases



Future Work . . .

- Formation of the clusters pushes for further research on socio-economic and demographic factors in these countries
- Other greenhouse gases and human activities like deforestation can be included to find the correlation with climate attributes
- More data can be included which dates back at least 100 years for better and accurate analysis

Conclusion

1.

CO₂ emission and temperature do not have significant correlation

2.

Further study needs to be done to conclude if change in energy use and population affects temperature and precipitation level

3.

A rise in temperature and fall in precipitation level can disturb the balance of ecosystem. Hence requires immediate attention

4.

There was a variation in the impact of CO₂ per country and hence it becomes important to study climate changes at both regional and global level

Image References

- <https://www.clipart.email/clipart/research-clipart-transparent-background-295016.html>
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