PROGNOSIS OF SEA LEVEL DYNAMICS

This project harnesses machine learning to forecast essential climate variables such as global temperature anomalies, atmospheric CO2 concentrations, and sea level rise. By analyzing an extensive dataset covering multiple decades, the models developed offer detailed predictions of future climate outcomes under different emission scenarios. The findings highlight an accelerating trend in climate change, with projections indicating a potential temperature increase of up to 2.5°C by 2050 if current emission rates persist. These insights are vital for guiding policy decisions and shaping global strategies to mitigate the impacts of climate change.

Introduction

- Climate change is a critical global issue with widespread impacts.
- The project uses Python and machine learning to analyze and predict climate trends.
- Focused on creating models that can help understand future climate changes.

Data Processing

- Cleaning and normalizing data
- Handling missing values
- Feature engineering to identify relevant predictors

EDA

- EDA involves summarizing and visualizing data to uncover patterns and trends.
- In this project, it helped understand relationships between climate indicators and identify issues before modeling.

Analysis

- Temperature Predictions:
  - Possible rise of up to 2.5°C by 2050.
- CO2 Levels:
  - Predicted to exceed 500 ppm by 2040.
- Sea Level Rise:
  - Projected increase of around 30 cm by 2050.
- Model Performance:
  - High accuracy in predicting key climate indicators.

Methodology

- Data Sources:
  - Dataset from NASA and NOAA covering climate data from 1900 to 2023.
- Data Preprocessing:
  - Normalization, missing value handling, and outlier detection were performed.
  - Feature selection targeted key climate variables.
- Evaluation:
  - Linear regression model showed strong performance.
- Visualization:
  - Time series, scree and correlation plot are some of the dynamics used.
  - PCA reduces the dataset's dimensionality to reveal key patterns and relationships in sea level data, highlighting the most influential variables.
  - Clustering groups observations into clusters based on PCA components, identifying distinct patterns or trends in sea level rise and related factors.

Results

- This project demonstrates the utility of machine learning models in predicting climate change impacts.
- The models provide a detailed forecast of the potential future climate, underscoring the critical need for immediate policy interventions.prediction accuracy.

Challenges

- Data Quality and Gaps:The reliability of predictions depends on the historical climate data available. Issues like missing data and inconsistencies can affect the accuracy of the model's outcomes.
- Model Complexity:More advanced models, while often more accurate, can be harder to interpret. Explaining how these models make predictions can be challenging, especially for broader audiences.

Future Prospects

- Adding More Climate Variables:Future work could involve including additional climate factors, such as ocean currents or ice sheet changes, to improve the model's predictions and offer a more complete view of climate trends.
- Using Real-Time Data:Incorporating real-time data could help the model continuously update its predictions, making them more accurate and up-to-date as new information becomes available.

Related literature

- http://www.tiutic.org/pdf/vol-III/Vol3 _ Article%201.pdf
- https://www.nature.com/articles/s41598-021-87460-z
- https://www.sciencedirect.com/science/article/abs/pii/S027737 9104000526
- https://www.mdpi.com/2073-4441/13/24/3566

Accuracy

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Mean Absolute Error (MAE): 0.8029601
Mean Squared Error (MSE): 1.010391
Root Mean Squared Error (RMSE): 1.005182
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Dataset

Date	Location	Country	Temperature	CO2.Emissions	Sea.Level.Rise	Precipitation	Humidity
<date>	<chr>	<chr>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>
2000-01-01	New Williamtown	Latvia	10.688986	403.1189	0.7175060	13.835237	23.63126
2000-01-01	North Rachel	South Africa	13.814430	396.6635	1.2057146	40.974084	43.98295
2000-01-02	West Williamland	French Guiana	27.323718	451.5532	-0.1607830	42.697931	96.65260
2000-01-03	South David	Vietnam	12.309581	422.4050	-0.4759315	5.193341	47.46794
2000-01-04	New Scottburgh	Moldova	13.210885	410.4730	1.1357566	78.695280	61.78967
2000-01-05	South Nathan	Saint Helena	6.229326	392.4733	1.1222097	76.368331	48.97389

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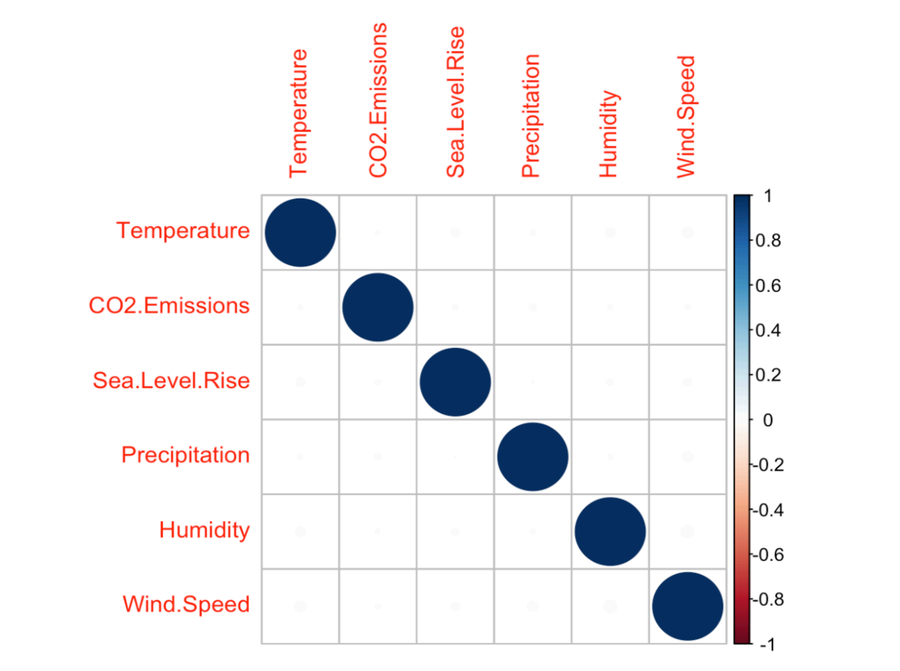
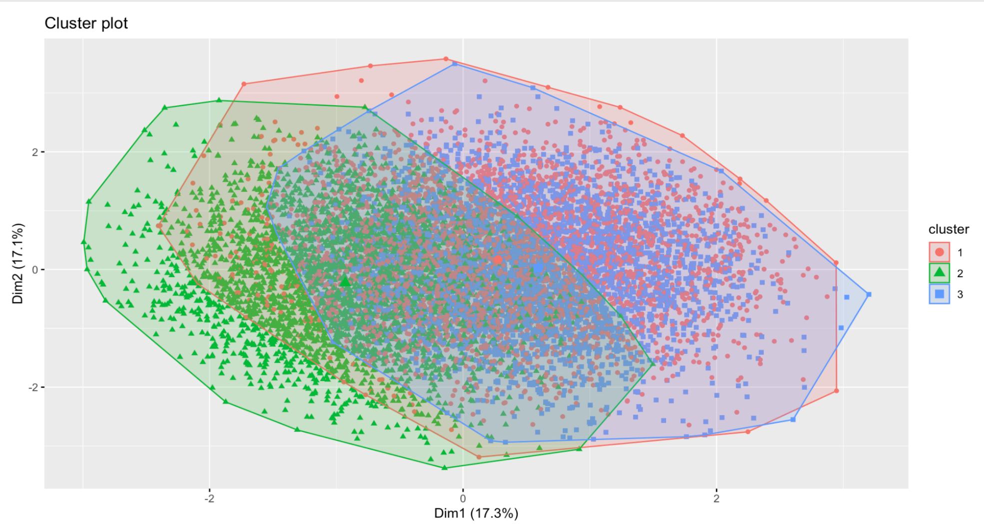
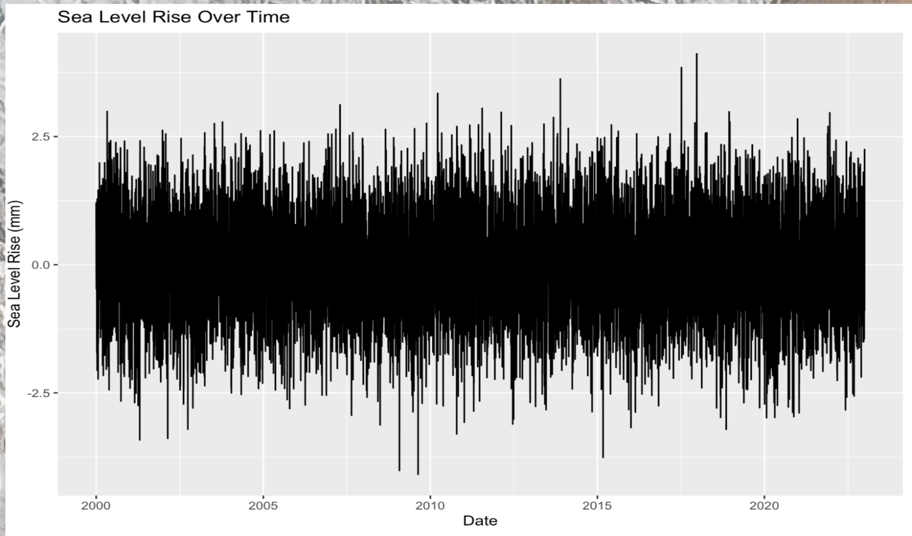
Correlation Plot



Clustering Analysis

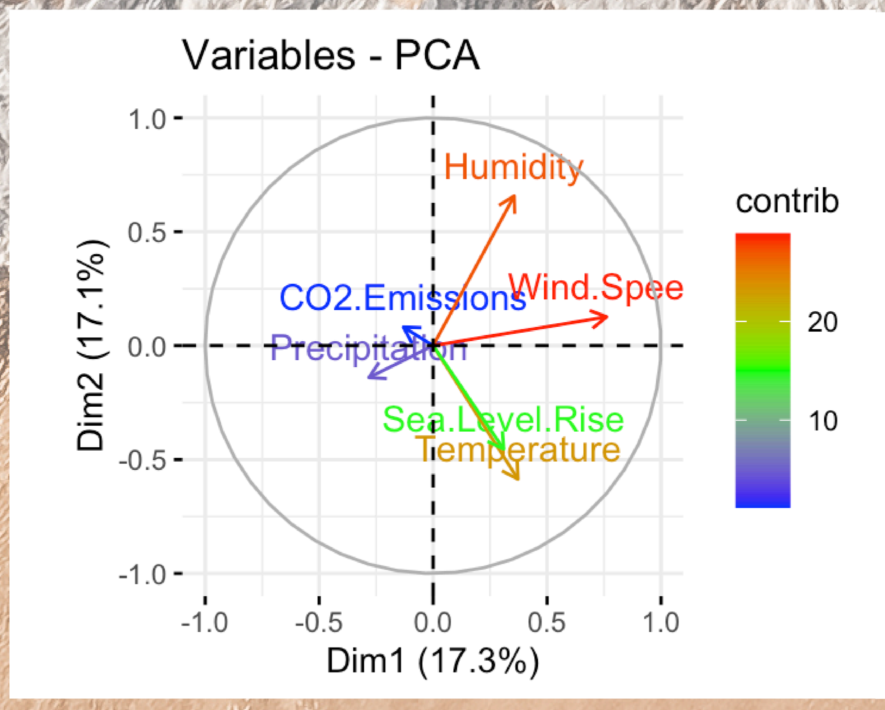


Sea Level Rise over Time

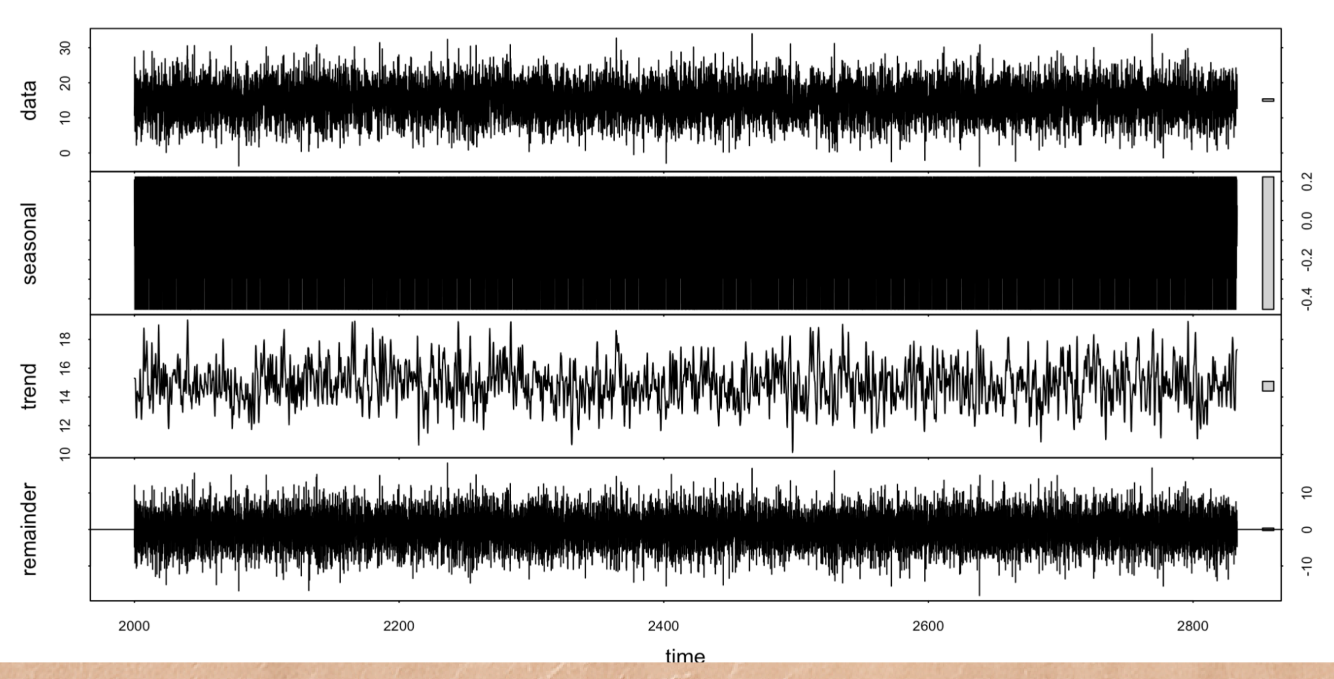


Linear Regression models the relationship between variables with a straight line. In this project, it was used to predict climate indicators from historical data. To understand how climate indicators like CO2 levels affect temperature anomalies and sea level rise.Historical data was used to train the model, predicting future values based on observed relationships.It showed simple, interpretable relationships but struggled with complex, non-linear data. Thus, more advanced models like Random Forest were used for better accuracy.

PCA: Dimesions and Contributions



Time Series Plot



ScreePlot: Variables vs Dimensions