°C SHIFT

TEMPERATURE SHIFT: A GROWING CONCERN FOR CROPS

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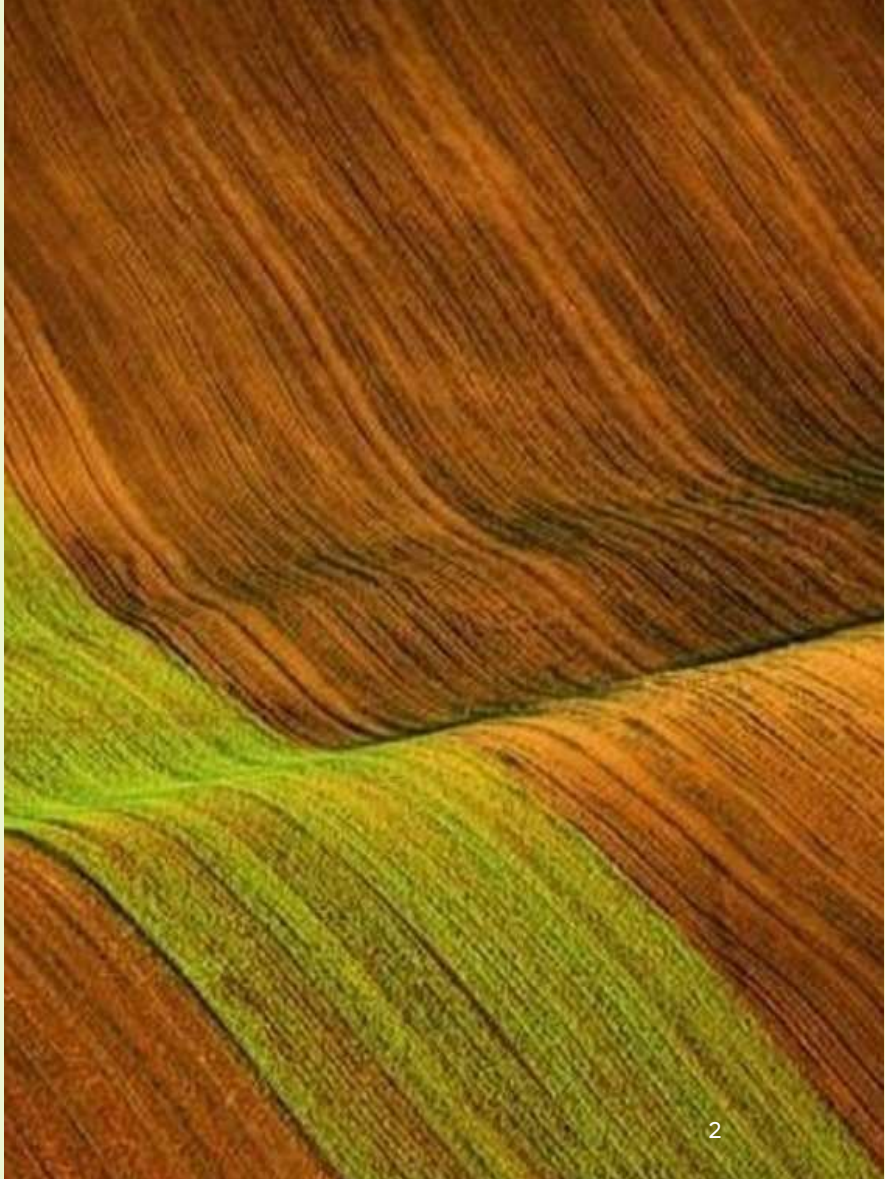
THE CLIMATE CRISIS: A GLOBAL CHALLENGE

THE PAST DECADE HAS BEEN THE HOTTEST IN RECORDED HISTORY. BY 2075, UNCHECKED EMISSIONS COULD LEAD TO CATASTROPHIC CONSEQUENCES. OUR MODEL PREDICTS TEMPERATURE RISE TRENDS TO HELP DRIVE MITIGATION EFFORTS.



OUR APPROACH

Key Climate Trends & Insights

- Global Temperature Anomalies
- CO_2 Emissions & Concentration Over Time

Regression Analysis & Modeling

- Polynomial Regression for Temperature Anomalies
- Model Performance & Limitations

Temperature Forecasting

- ARIMA for Time Series Prediction
- Future Temperature Trends & Projections

Future-Proofing for Climate Change

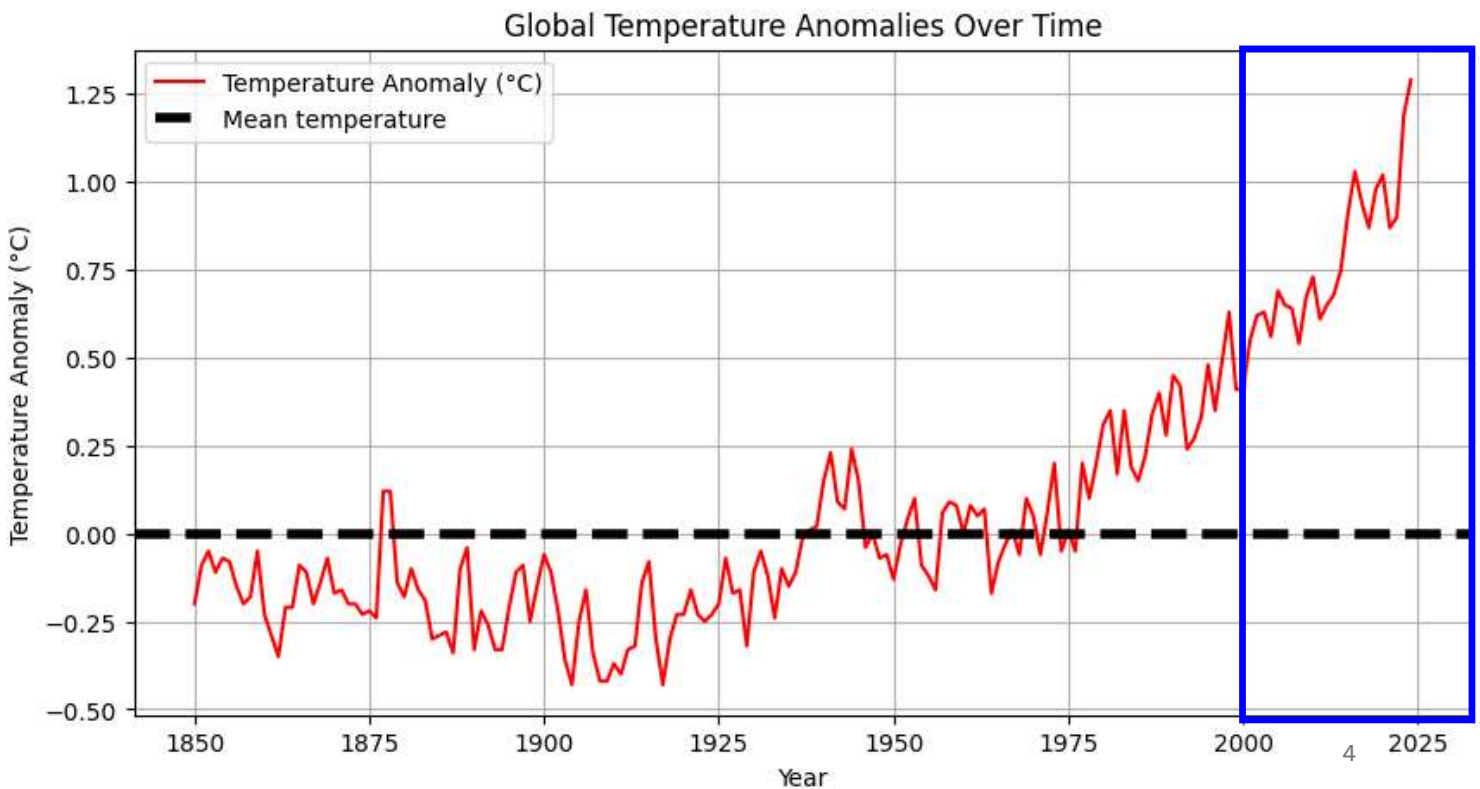
- Climate-Resilient Crops & Mitigation Strategies

Limitations & Considerations

Conclusion & References

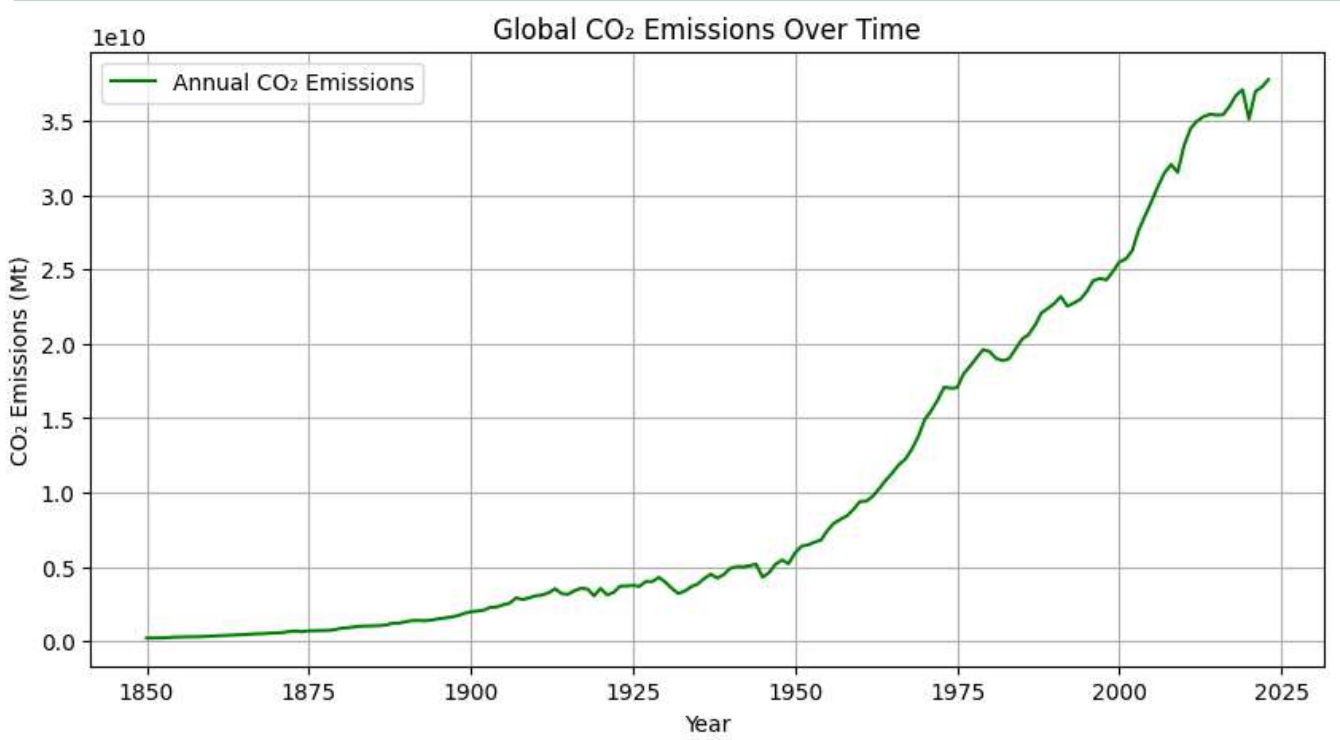
GLOBAL TEMPERATURE ANOMALIES

- ✓ The temperature anomaly trend shows significant increase after 1950.
- ✓ The sharpest rise has occurred in the past 50 years, aligning with industrial expansion.
- ✓ Record highest temperature anomalies since 2000



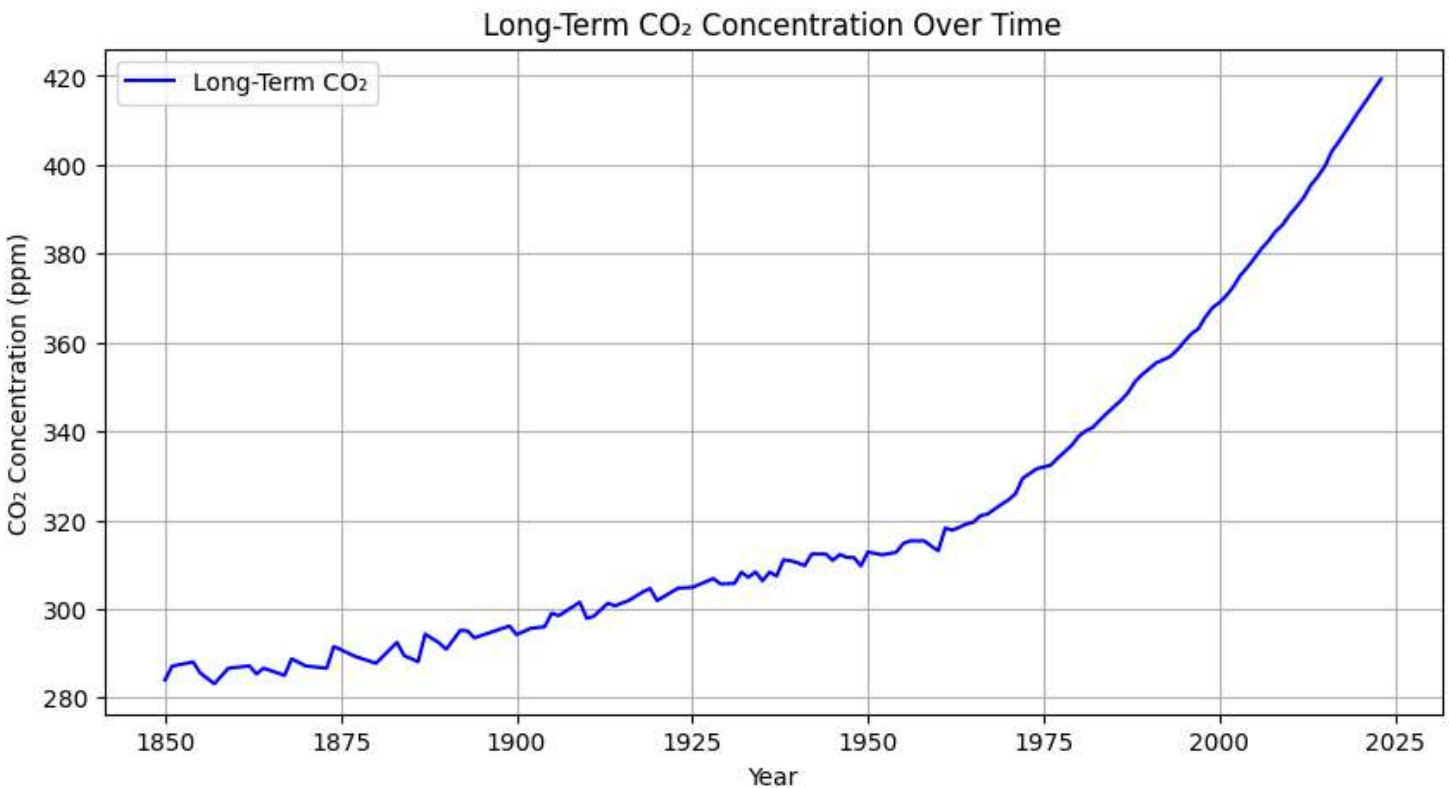
GLOBAL CO2 EMISSIONS OVER TIME

- ✓ CO2 emissions were nearly zero before 1850 confirming human induced emissions.
- ✓ There is rapid increase post 1950 aligning with fossil fuel combustion and industrial growth.



LONG TERM CO_2 CONCENTRATION OVER TIME

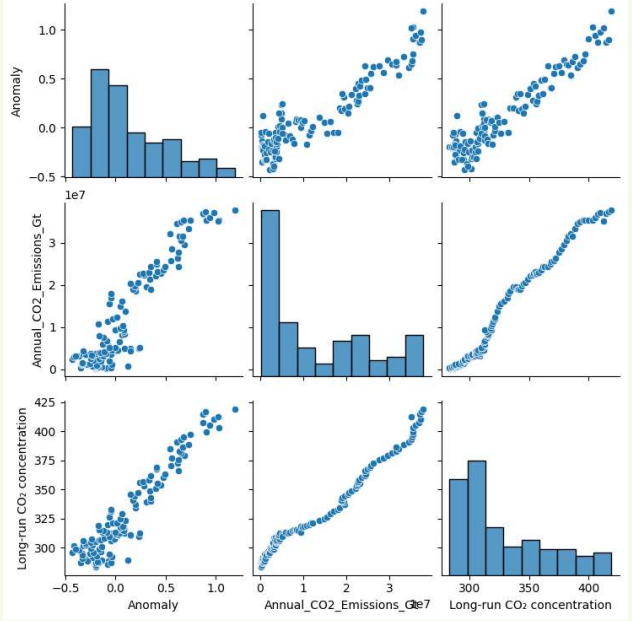
- ✓ CO_2 concentration remained stable for thousands of years until industrial revolution.
- ✓ The steepest CO_2 rise has occurred in past century
- ✓ CO_2 level now exceeds 400 ppm



INSIGHTS FROM EXPLORATORY DATA ANALYSIS

- ✓ There is clear correlation between CO_2 increase and temperature rise.
- ✓ Temperature anomalies shows an accelerated rise post 1950, matching CO_2 trends.
- ✓ Human activities are strong linked to increasing CO_2 levels.
- ✓ There is strong correlation between CO_2 emissions and long term CO_2 concentration level indicating that they are not independent of each other.

- Note : Since CO_2 concentration level is the biggest contributor to the overall atmospheric CO_2 level, hence no other feature such GHG, methane levels has been included in this EDA.



POLYNOMIAL REGRESSION FOR TEMPERATURE ANOMALY ANALYSIS

What is Polynomial Regression?

1. Polynomial Regression is an extension of linear regression that captures **non-linear relationships** by fitting a polynomial equation to the data.
2. Instead of fitting a straight line, it models **curved trends**, making it useful for **complex climate trends**.

Why Polynomial Regression?

1. **Better Fit for Climate Data**: Climate trends are not strictly linear; they show **accelerated warming at higher CO_2 levels**.
2. **Higher Accuracy**: Our analysis showed that **Polynomial Regression outperforms Linear Regression** in capturing temperature anomalies.

How We Used It

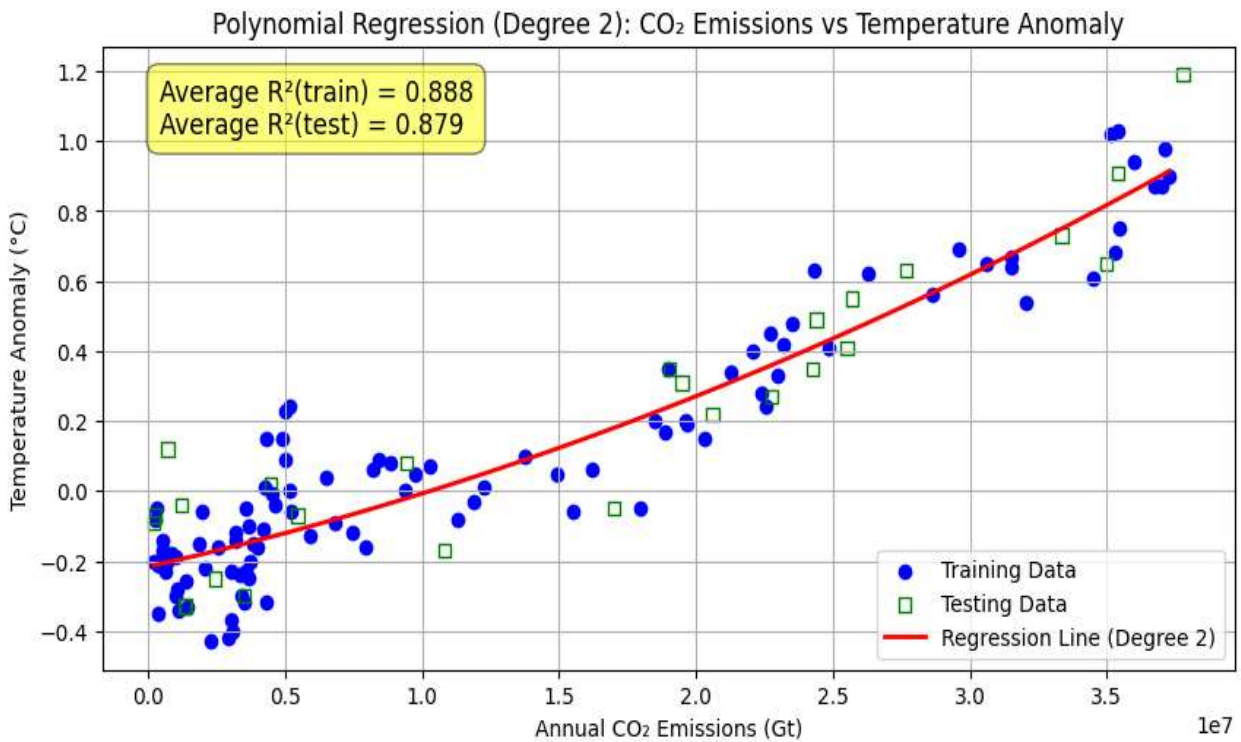
1. **Feature Selection**: CO_2 emissions were used as the predictor variable.
2. **Degree Selection**: We tested different polynomial degrees and selected the best fit based on validation performance.
3. **Model Validation**: The model was evaluated using **training and test datasets** to ensure accuracy.

REGRESSION ANALYSIS

- ✓ 88.8% of the variation in temperature anomaly of can be explained by CO2 emission in the training data. **Good fit model.**
- ✓ Slight acceleration in temperature changes at higher CO2 levels, hence Polynomial regression fits better Vs Linear regression.

Limitations:

1. Ignores other climate factors
2. May not work for extreme future CO2 levels such as sudden volcanic activity / massive deforestation etc.



TIME SERIES FORECASTING WITH ARIMA

What is ARIMA?

1. ARIMA (**AutoRegressive Integrated Moving Average**) is a **statistical time series model** used for forecasting.
2. It considers **past temperature anomalies** and trends to make future predictions.

Why ARIMA for Temperature Forecasting?

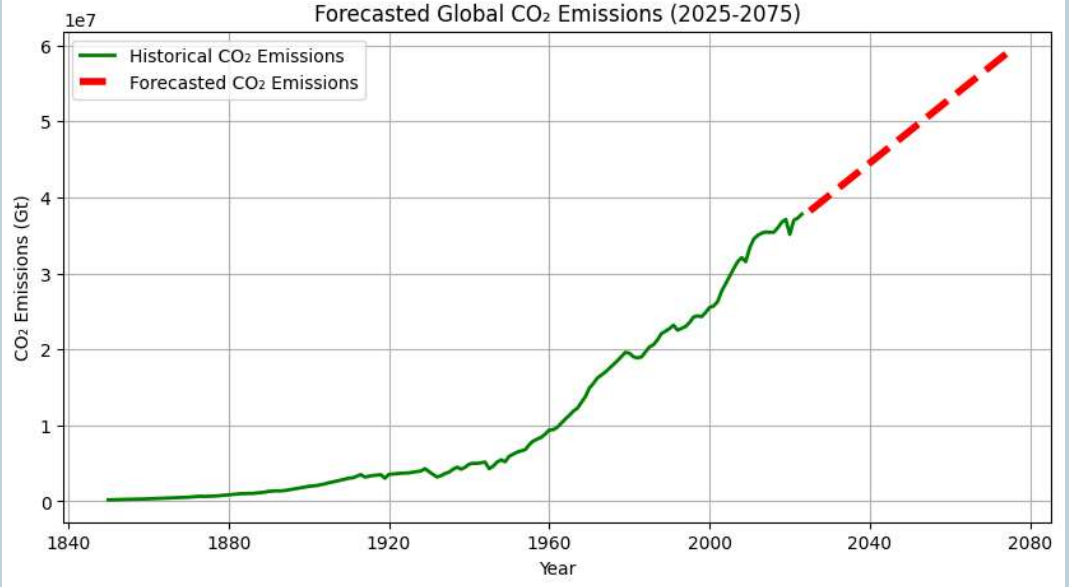
1. **Captures Temporal Dependencies**: Unlike regression, ARIMA models the **sequential nature** of temperature data.
2. **Handles Trends and Seasonality**: Our model **differentiates between long-term trends and short-term fluctuations**.
3. **Reliable Forecasting**: ARIMA provides a **data-driven approach** to predict future temperature changes based on historical data.

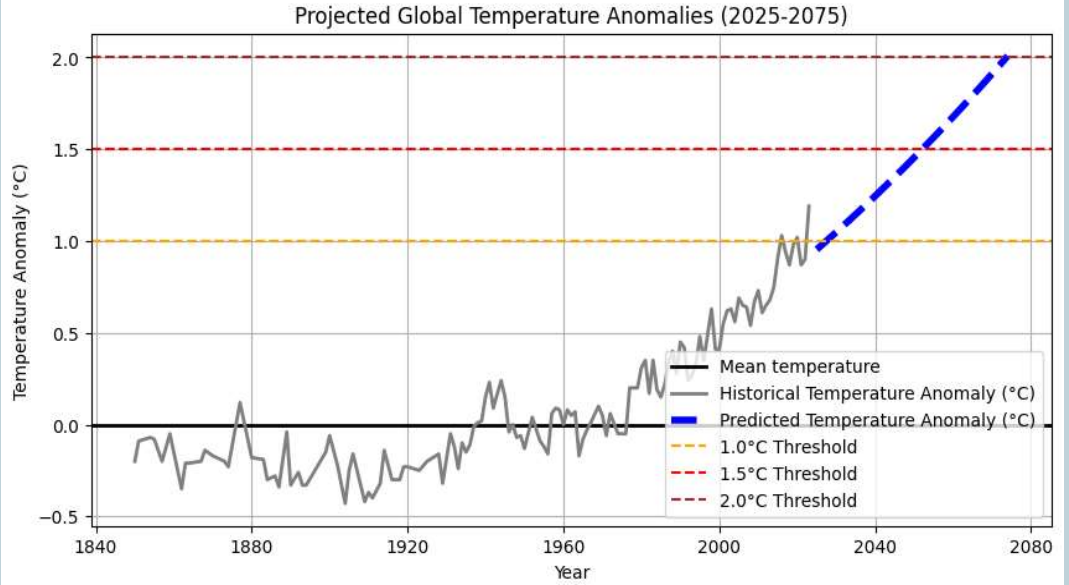
How We Used It

1. **Data Preparation**: We ensured stationarity by differencing the time series data.
2. **Forecasting**: The trained ARIMA model projected **temperature rise trends**, showing a **steady increase in anomalies** over the next few decades.

TEMPERATURE FORECASTING

- ✓ Projected steady increase in global CO2 emissions from around 3.5GT to 6.0GT in next 50 years
- ✓ Indicates a continued reliance on fossil fuels and insufficient mitigation efforts to curb emissions.
- ✓ Temperature anomalies are expected to rise steadily, with **1.0°C** rise by the year **2027**.
- ✓ The **1.5°C** warming threshold (Paris Agreement) will likely exceed by the year **2052.**
- ✓ The **2.0°C** threshold linked to severe climate consequence maybe reached by the year **2073.**





FUTURE PROOFING – CLIMATE RESILIENT CROPS DEVELOPMENTS

Short Term (2025-2035)	Mid Term (2035-2050)	Long Term (2050-2075)
Increased use of gene editing to improve heat and drought resistance in staple crops. Field trials in Africa and Asia for heat resistance & salt tolerant crops. Applications of AI & big data- 1) Phenotyping, 2) Genomic Selection, 3) Climate Modelling, 4) Precision Agriculture and 5) Early Stress Detection	Multi trait crops that withstand heat, pests and inconsistent rainfall Invest heavily in biotech driven food security. Vertical farming and lab-grown food production. Resilient crops account for 50% of staple food production world wide	Full adoption of genetically enhanced client proof crops. Agricultural shift towards low-water, high nutrient, and CO2 absorbing plants for sustainability. Synthetic or bioengineered food alternatives, reducing reliance on traditional crops

LIMITATION

- The model only considers CO_2 concentration and emissions while ignoring other greenhouse gases (e.g., methane, nitrous oxide) and natural climate drivers (e.g., solar radiation, ocean currents)
- The prediction assumes a steady increase in CO_2 emissions, but real-world scenarios depend on mitigation efforts, policies, and technological innovations.
- ARIMA assumes stationarity, which may not hold for long-term climate trends where external forces (e.g., policy changes, technological advancements) influence emissions.
- The model provides temperature rise estimates but does not quantify prediction uncertainty, which is crucial in climate projections. Localized variations (e.g. Tropical vs Temperate, arid vs non-arid) add further complexities

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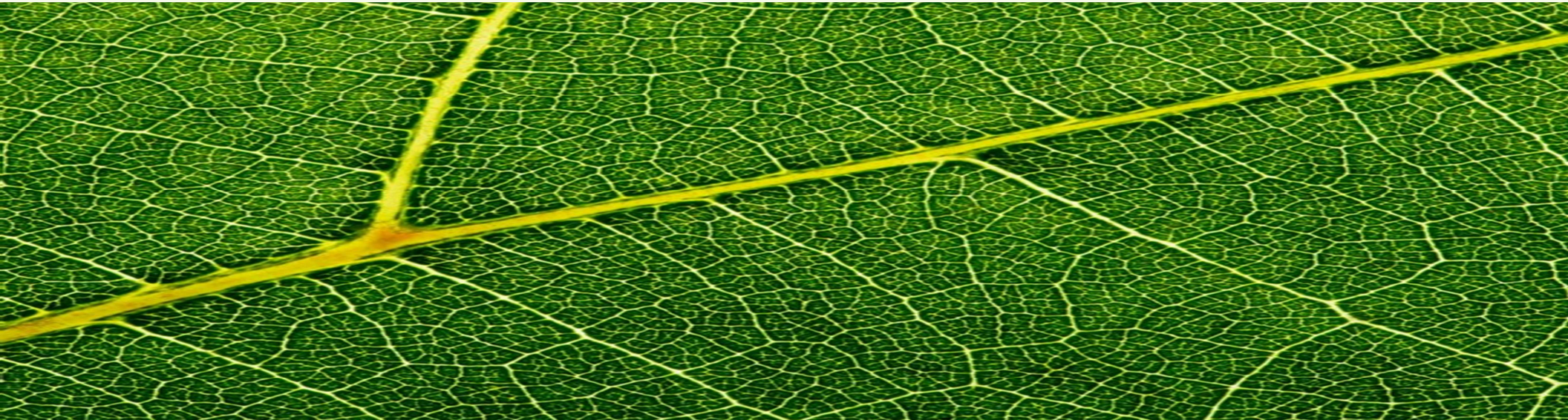
- NASA Goddard Institute for Space Studies (GISS). (n.d.). *GISTEMP: NASA Goddard Institute for Space Studies Surface Temperature Analysis*. Retrieved from https://data.giss.nasa.gov/gistemp/
- Chen, R., Huang, Z., & Zhou, Z. (2023). Application of the ARIMA-LSTM model in temperature prediction. In Proceedings of the 3rd International Conference on Applied Mathematics, Modelling, and Intelligent Computing (CAMMIC 2023) (Vol. 12756, p. 127563V). SPIE. https://doi.org/10.1117/12.2685944



THANK YOU