

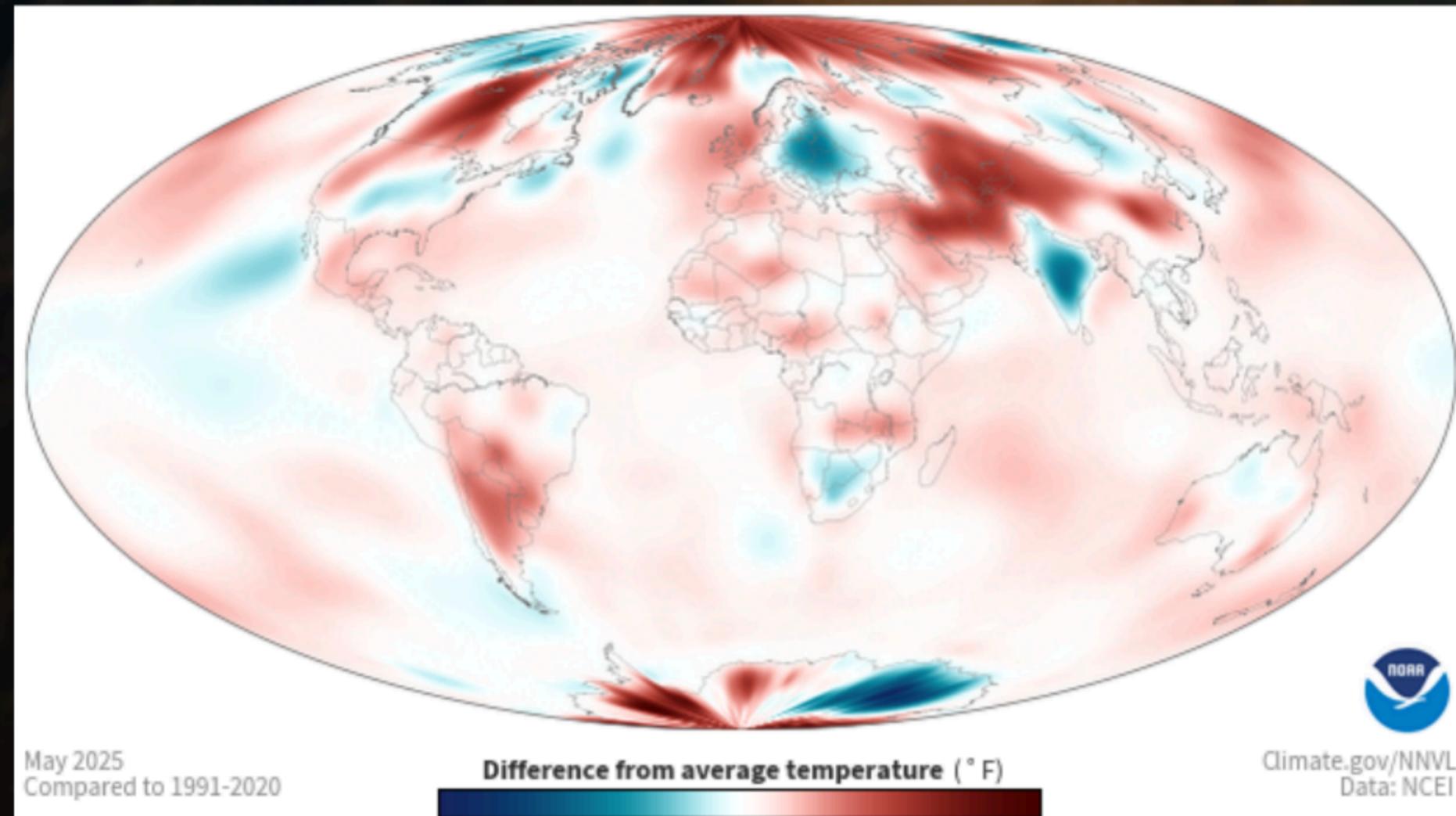
Analyzing Global Warming Using Machine Learning and Climate Data



Introduction

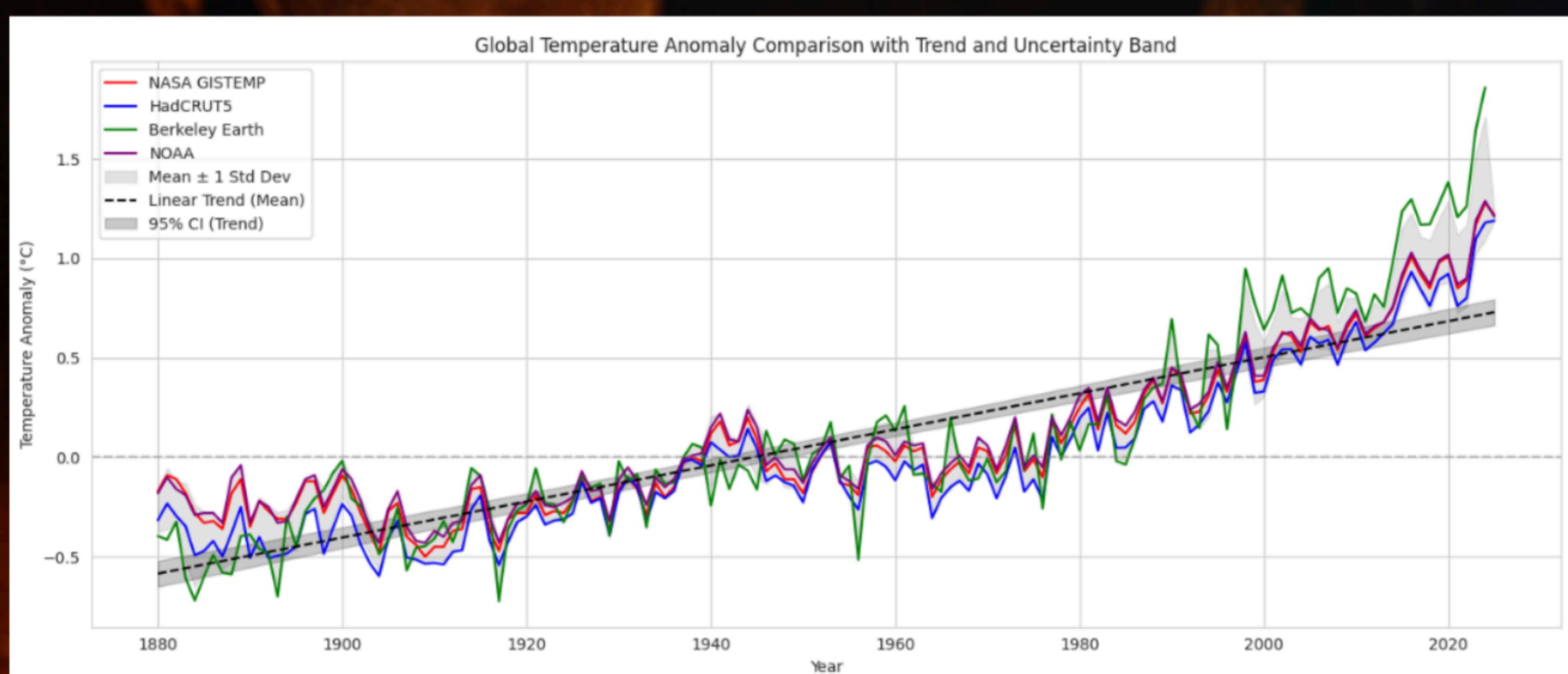
What is driving modern global warming - human activity or natural factors?
 Modern global warming is a critical challenge with global consequences.
 In this project, we analyze globally averaged temperature, CO₂, volcanic aerosol, and solar irradiance data using major international datasets including NASA GISTEMP, Berkeley Earth, HadCRUT, and NOAA.
 By applying advanced statistical and machine learning techniques, we rigorously test the true drivers behind recent climate change.

Global Warming Map



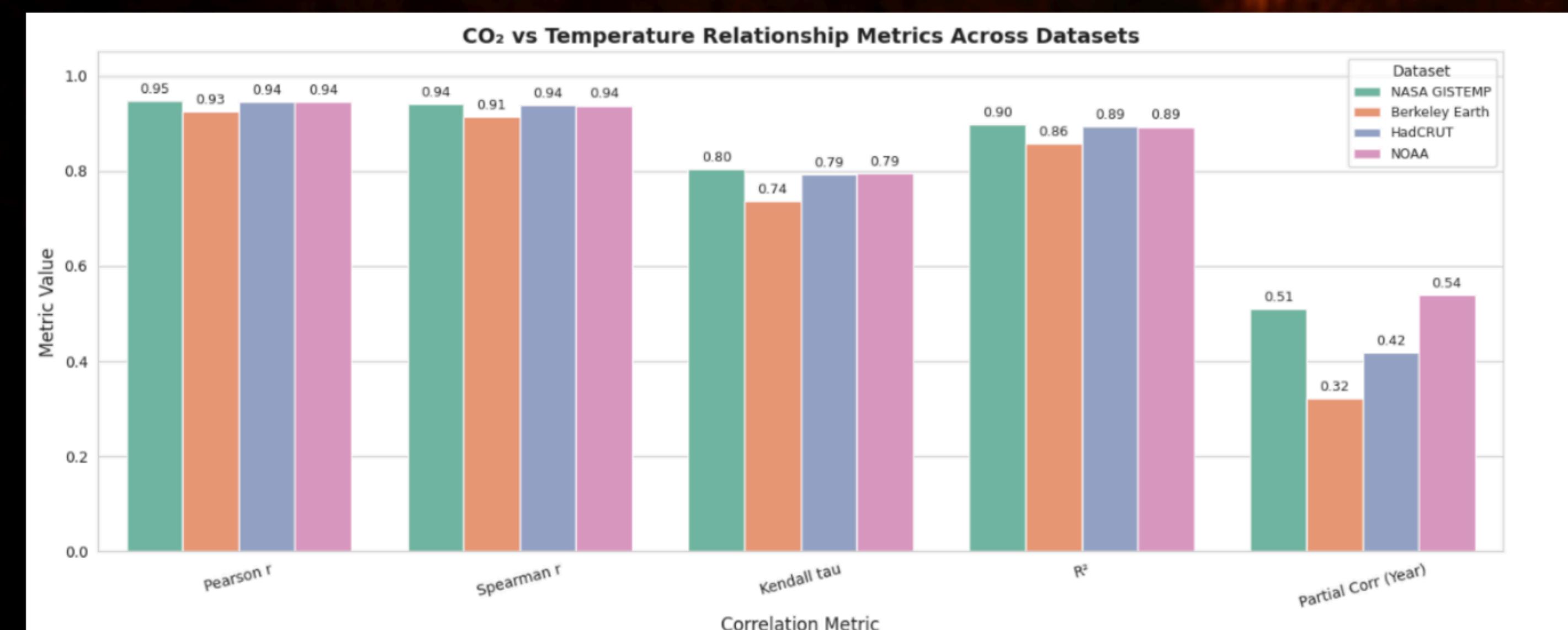
*May 2025 temperature anomalies vs. 1991–2020 average (NOAA/NCEI).

Global Temperature Anomaly



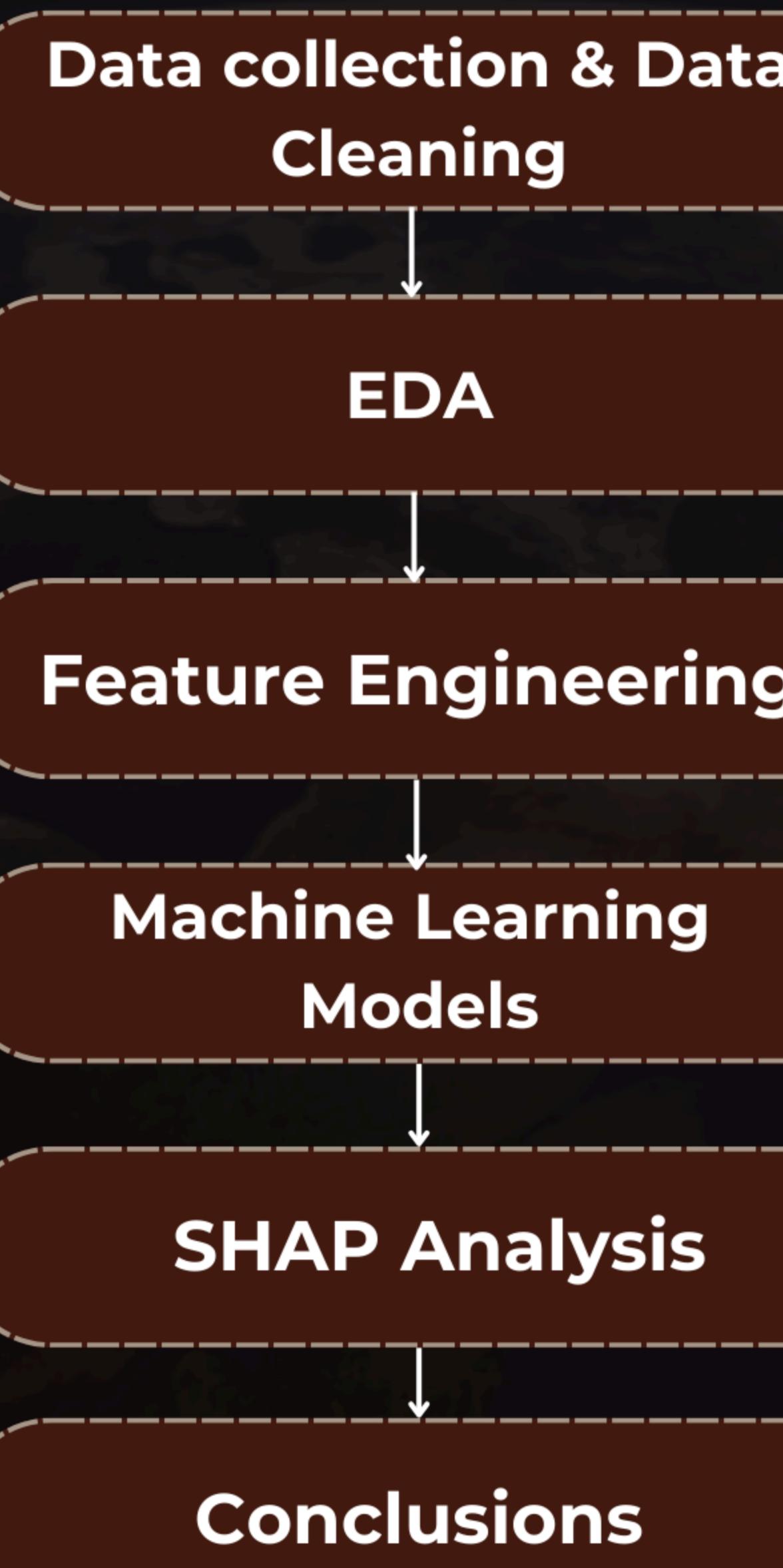
Global temperature anomalies from NASA GISTEMP, HadCRUT, Berkeley Earth, and NOAA all show a strong, consistent warming trend since 1880. The agreement across independent datasets highlights the robustness of observed global warming.

CO₂ vs Temperature

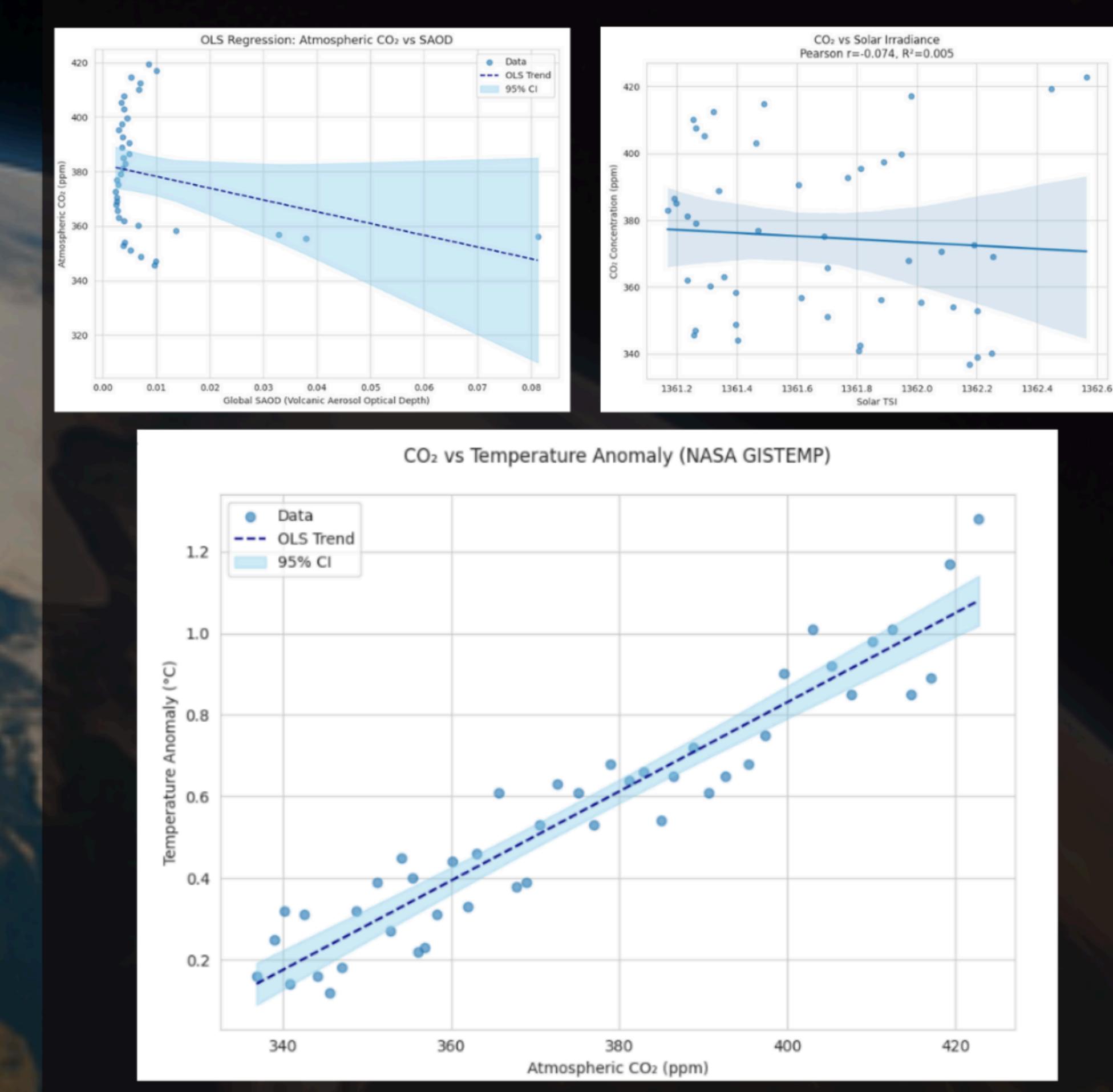


Multiple correlation metrics confirm a strong, consistent relationship between atmospheric CO₂ and global temperature anomaly across NASA GISTEMP, Berkeley Earth, HadCRUT, and NOAA datasets.

Workflow

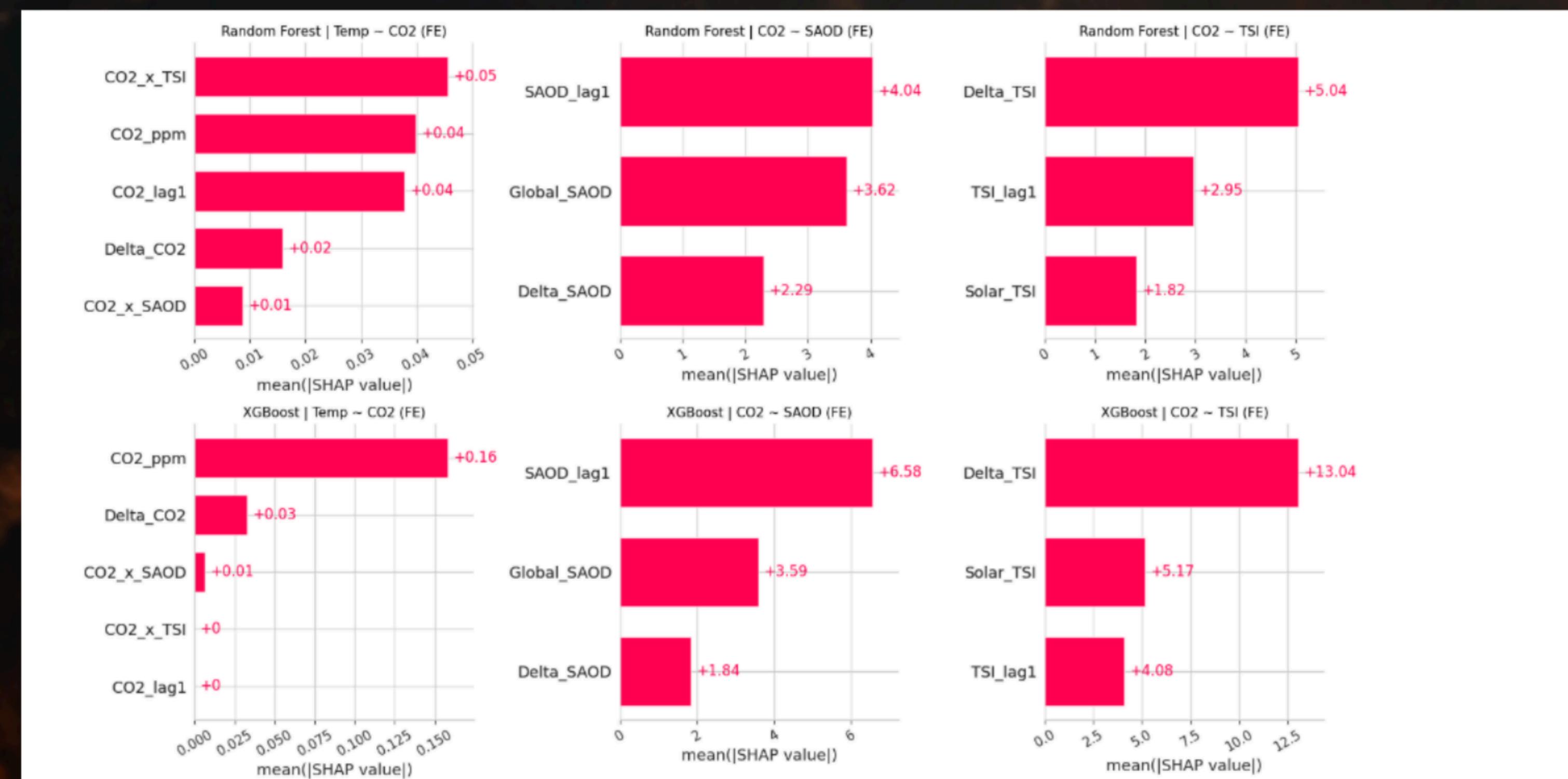


CO₂ vs Key Climate Drivers



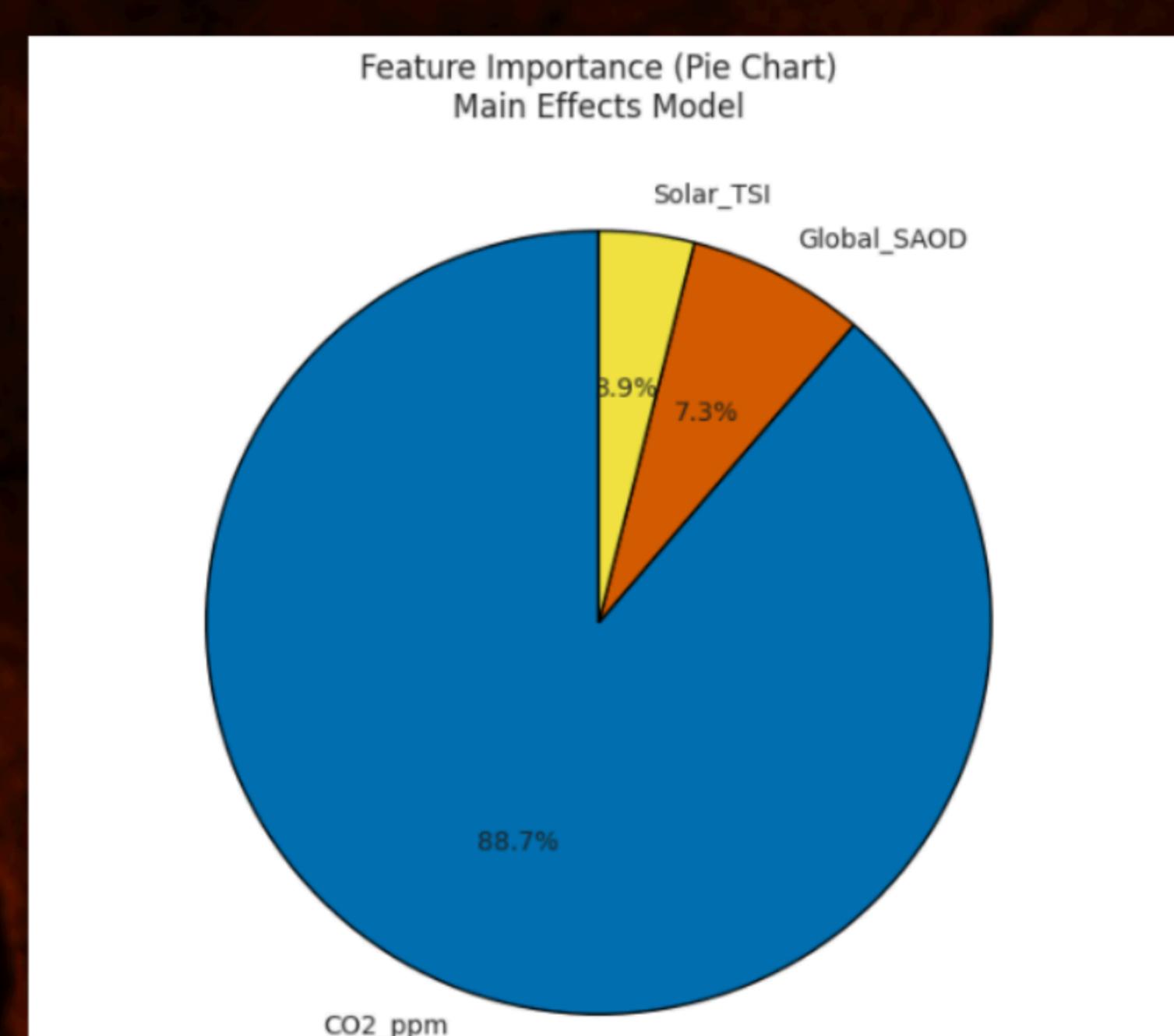
Atmospheric CO₂ is highly correlated with global temperature anomaly but shows no significant long-term relationship with volcanic aerosols (SAOD) or solar irradiance (TSI). This confirms that recent warming is not driven by natural factors, but closely tracks rising CO₂ levels.

Feature Importance by Model



SHAP values show that atmospheric CO₂ is the most important predictor of temperature anomaly in our feature engineered machine learning models, while volcanic and solar features have much less influence. This confirms that rising CO₂, not natural variability, is the main driver of recent warming.

Key Drivers



Conclusion

Our analysis of global temperature and CO₂ datasets shows a strong, consistent rise in both variables, with rigorous statistics confirming that increasing CO₂ is closely linked to recent warming. Investigations of volcanic and solar activity reveal no long-term correlation with CO₂ or temperature trends, ruling out natural causes. These results support the conclusion that human-made CO₂ emissions are the main driver of modern global warming.