CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Philip M. Felizarta

Project Number
S1107

Project Title
A Climate Model for Predicting Global Mean Temperature Anomalies

Abstract

Objectives/Goals
The objective of this study is to confirm the correlation between CO2 concentration and average global temperature and to create a simple climate model that can accurately predict annual global mean temperature anomalies.

Methods/Materials
Berkeley Earth was the source of data for actual annual global mean temperature anomalies from 1955 to 1999. The climate model was designed by incorporating CO2, volcano and solar forcing with the ENSO cycle. Mean annual atmospheric CO2 concentrations were obtained from the 5th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). Yearly mean sunspot numbers were accessed from the National Geophysical Data Center. The list of the largest volcanic eruptions and historical ENSO Index values were obtained from the National Weather Service/NOAA. The computed values were compared to the actual temperature anomalies to determine accuracy. The 1955-1999 model was used to predict the temperature anomalies from 2000 to 2015 and from 2016 to 2100 with different climate change mitigation scenarios.

Results
The CO2 forcing is the only factor to closely parallel the overall increasing trend of the actual temperature anomalies. However, the combined effects of the natural forcings nearly match the fluctuations of the temperature anomalies.

The forecast for 2000-2015 in terms of the sunspot number, ONI and CO2 emission were accurate when compared to the actual data. It also predicted an apparent slowdown in the warming trend from 2000 to 2014.

According to the model, the mean global temperature will increase by 5°C (9°F) in 2100 with absence of climate change mitigation; it will increase by 4°C (7°F) with existing mitigation and 2°C (3.6°F) with substantial mitigation.

Conclusions/Discussion
Natural forces including sun, volcanoes and the El Nino Southern Oscillation (ENSO) have strong short term effects on global temperature. However, the long warming trend is driven predominantly by atmospheric CO2 concentration. The apparent slowdown in global warming from 2000 to 2014 can be explained by the cyclical pattern of the ENSO.

Summary Statement
A climate model incorporating carbon dioxide and natural forces can accurately predict annual global mean temperature anomalies.

Help Received
none