CMSC 6950 Final Project - pymagicc

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1 Introduction

Pymagicc[1] is an open-source Python wrapper for the Fortran-based MAGICC climate model. It makes it simpler to use and run the MAGICC model Windows application. Pymagicc comes with several built-in data structures to model the several emission pathways. MAGICCData is the core data structure used to model the Representative Concentration Pathways (RCP) and comes with Pandas DataFrame like functionality and also has the ability to make line plots.

MAGICC, which stands for Model for the Assessment of Greenhouse Gas Induced Climate Change, is a climate model widely used to assess future Greenhouse gas emissions in climate policy analyses. It is most prominently used by the Intergovernmental Panel on Climate Change (IPCC) for crucial scientific publications and by many Integrated Assessment Models, especially in the Fifth Assessment Report (AR5).

Climate change scenarios are the projections of future greenhouse gas emissions. The IPCC's Fifth Assessment Report (AR5) introduced new sets of climate change scenarios that are called Representative Concentration Pathway (RCP). RCP2.6, RCP4.5, RCP6, and RCP8.5 are the four pathways used to describe different climate futures which are considered to be possible based on the emissions of greenhouse gases in the years to come.

In this project, The first visualization plots Carbon Dioxide (CO2) and Methane (CH4) gas emissions in the RCP2.6 and RCP4.5 scenarios. The second visualization uses the projections made by the MAGICC model for each of the four scenarios to plot Radiative Forcing and Surface Temperature values.

2 Tasks

This project utilizes the Pymagicc module to achieve the below computational tasks and visualizations. While MAGICCData object provides built-in functionality to make line plots, this project uses the Matplotlib library to generate plots. The majority of the tasks involve wrangling the scenario's data to generate the desired line charts.

Note: All of the visualizations have been recreated from the examples in the original git repository. Also, the data available in this project is time-series

data. Hence there was little room for experimentation, and we were limited to just line charts.

2.1 Task 1 - Generate Greenhouse Gas Emissions

The computational task involves reading data from RCP2.6, RCP4.5, RCP6, RCP,8.5 scenario files and converting the data in MAGICData format to a pandas DataFrame. Using the data previously saved, we build visualizations to show Carbon Dioxide and Methane gas emission projections for RCP2.6 and RCP4.5 scenarios.

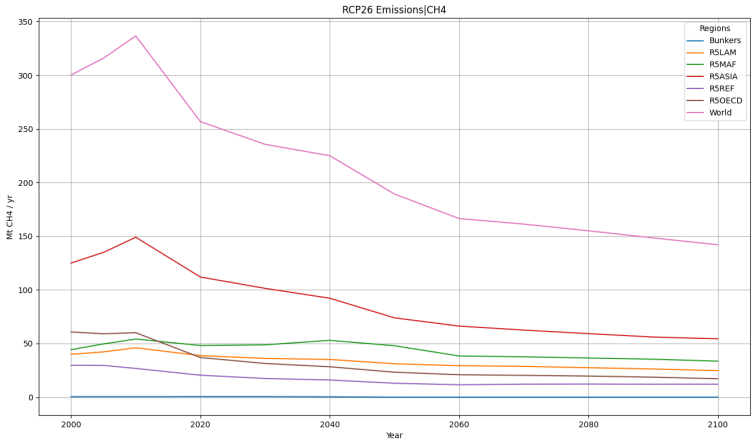

Figure 1: RCP26 CH4 Emissions Projections

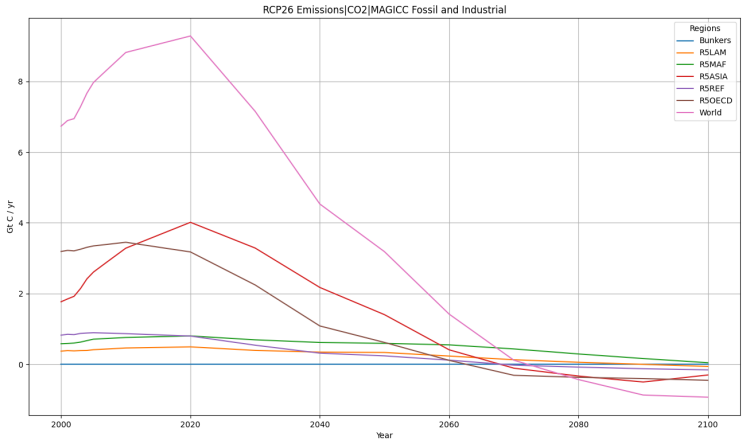

Figure 2: RCP26 CO2 Emissions Projections

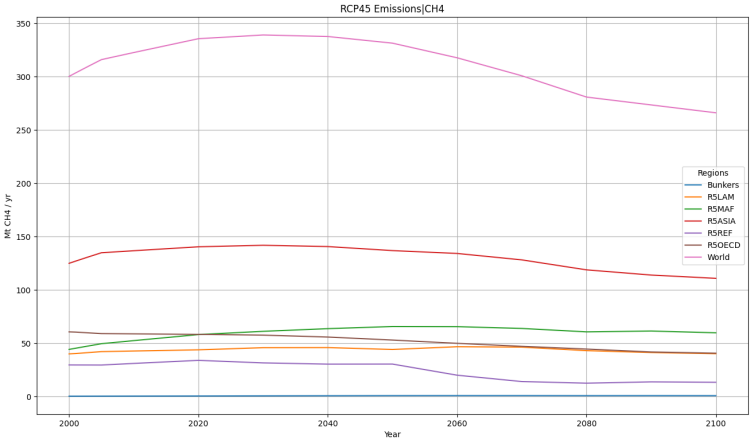

Figure 3: RCP45 CH4 Emissions Projections

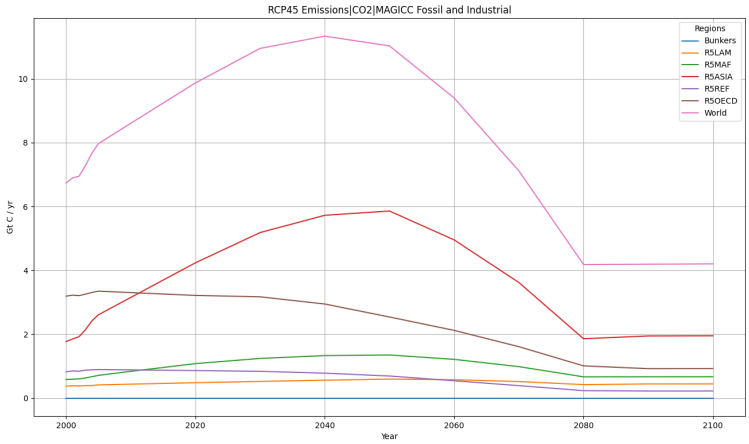

Figure 4: RCP45 CO2 Emissions Projections

2.2 Task 2 - Run MAGICC model

Here, the computational task involves running the MAGICC model on the RCP2.6, RCP4.5, RCP6, RCP,8.5 scenarios. Running the model will build projections like Concentration of gases, Radiative Forcing, Surface Temperatures, etc., for each the given climate scenario. Then, we make visualizations to plot Radiative Forcing and Surface Temperature projections for each of the four general scenarios from 1765 to 2100.

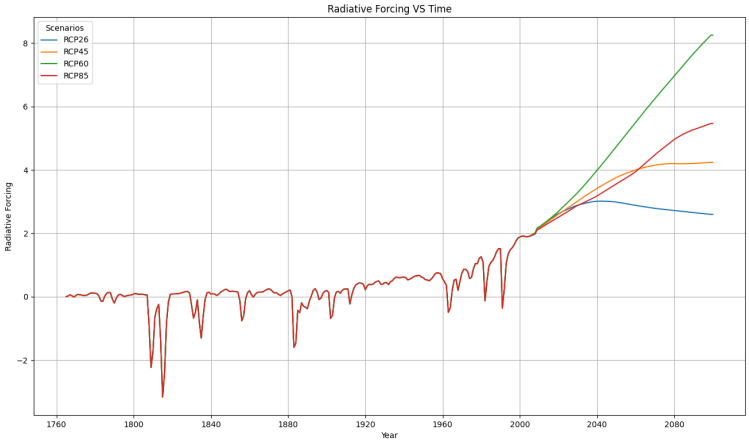

Figure 5: Radiative Forcing Projections

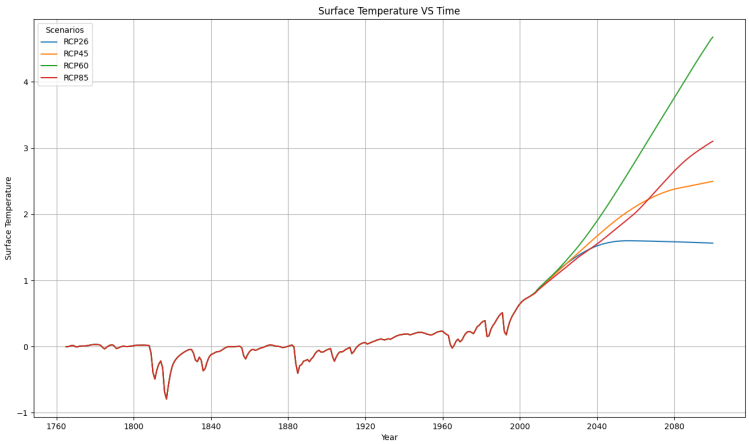

Figure 6: Surface Temperature Projections

References

[1] Robert Gieseke, Sven N. Willner, and Matthias Mengel. Pymagicc: A python wrapper for the simple climate model magicc. *Journal of Open Source Software*, 3(22):516, 2018.