

Group meeting

2024-06-05

Yunlong Pan

Outline

- Paper Draft
 - Introduction
 - Background
 - Method (last week)
 - Experiment level1
 - Experiment level2(last week)
 - Discussion
 - Conclusion
- Idea review(future)

Introduction

Motivation

1. Large language models
2. Climate change
3. The use of scenarios and modelling methods are **pillars** in IPCC Working Group III (WGIII) Assessment Reports
4. The need to improve the **transparency** of model assumptions and enhance the **communication** of scenario results was also recognised

https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_Annex-III.pdf

Contribution

1. Introduce a framework by combining the LLM (ChatGPT) with Climate models(IAMs)
2. Evaluate the performance by in two level tasks.

Findings

1. The potential of incorporating advanced models to improve LLM performance in specific task, such as Q&A, fact-checking.
2. Our approach can supply decision-makers and the public with trustworthy information on climate change, finally facilitating better-informed decision-making.

Experiment: level1 Q&A task

Example: “What is the World Surface Air Temperature Change under ssp585 in 2089?”



Searched 4 sites

- Q “World Surface Air Temperature Change under ssp585 in 2089”
bing.com
- GISS NASA Publications — Pubs.GISS: Nazarenko et al. 2022: Future climate change under SSP emissi...
pubs.giss.nasa.gov
- Science On a Sphere — Climate Model - Surface Temperature Change: SSP5 (Fossil-fueled...
sos.noaa.gov
- NTRS NASA — Future Climate Change Under SSP Emission Scenarios with GISS-E2.1 - NASA Technical...
ntrs.nasa.gov

Under the SSP5-8.5 scenario, which represents a high greenhouse gas emissions pathway, the global mean surface air temperature is projected to increase significantly by 2089. This scenario, often referred to as "business as usual," assumes continued heavy reliance on fossil fuels and minimal efforts to mitigate emissions. The projected increase in global surface air temperature under this scenario is expected to be around 4.6°C to 5.2°C by the year 2100 ([GISS NASA Publications](#)) ([Science On a Sphere](#)) ([NTRS NASA](#)).

This level of warming would have profound impacts on global climate systems, leading to more extreme weather events, sea level rise, and disruptions to ecosystems and human societies. The SSP5-8.5 scenario highlights the critical importance of global efforts to reduce emissions and transition to more sustainable energy sources to mitigate these severe impacts.

Experiment: level1 Q&A task

Example: “What is the World Surface Air Temperature Change under ssp585 in 2089?”

The World Surface Air Temperature Change under ssp585 in 2089 is projected to range from 3.778696598K to 4.932482159K, with the median or most probable prediction being 4.3954706K.

In finer detail:

- The model used for this prediction is REMIND-MAGPIE
- The results provide a range of predicted values according to different quantiles.
- The 0.005 (or 0.5%) quantile prediction is 3.778696598K, meaning there's a 0.5% chance that the temperature change will be at or below this number.
- The 0.025 (or 2.5%) quantile prediction is 3.816266588K.
- The 0.5 (or 50%, also known as the median) quantile prediction is 4.3954706K. This is the number most probable value.
- The 0.975 (or 97.5%) quantile prediction is 4.899770795K, which means there's a 97.5% chance that temperature change will be at or below this number.
- The 0.995 (or 99.5%) quantile prediction is 4.932482159K, meaning that there's a 99.5% chance that temperature change will be at or below this value.

The prediction suggests a significant increase in the World Surface Air Temperature by 2089 under the ssp585 scenario. These rising temperatures highlight a severe climate situation, implicating that the globe will significantly warm up. This increase could lead to extreme weather conditions, increased ice melt, sea-level rise, and other profound impacts on ecosystems and biodiversity. It underscores the urgency of mitigating greenhouse gas emissions right now, to prevent or at least mitigate those adverse effects of climate change.

Experiment: level1 Q&A task

- https://github.com/yl1127/Academic-projects/blob/main/yl_Climate_LLM/ChatIAMs/Prediction_level1_result.csv

question	output_variables	year	scenario
What is the World Effective Radiative Forcing under ssp119 in 2039?	Effective Radiative Forcing	2039	ssp119
What is the World Effective Radiative Forcing Aerosols Direct Effect under ssp245 in 2056?	Effective Radiative Forcing Aerosols Direct Effect	2056	ssp245
What is the World Effective Radiative Forcing Aerosols Direct Effect BC under ssp585 in 2083?	Effective Radiative Forcing Aerosols Direct Effect BC	2083	ssp585
What is the World Sea Level Change under ssp585 in 2100?	Sea Level Change	2100	ssp585
What is the World Sea Level Change under ssp245 in 2033?	Sea Level Change	2033	ssp245
What is the World Effective Radiative Forcing CO2 under ssp119 in 2097?	Effective Radiative Forcing CO2	2097	ssp119
What is the World Effective Radiative Forcing Aerosols Direct Effect BC under ssp370 in 2030?	Effective Radiative Forcing Aerosols Direct Effect BC	2030	ssp370
What is the World Effective Radiative Forcing Aerosols Direct Effect under ssp585 in 2035?	Effective Radiative Forcing Aerosols Direct Effect	2035	ssp585
What is the World Effective Radiative Forcing Aerosols under ssp245 in 2045?	Effective Radiative Forcing Aerosols	2045	ssp245
What is the World Effective Radiative Forcing Aerosols Indirect Effect under ssp245 in 2053?	Effective Radiative Forcing Aerosols Indirect Effect	2053	ssp245
What is the World Effective Radiative Forcing Aerosols Indirect Effect under ssp585 in 2064?	Effective Radiative Forcing Aerosols Indirect Effect	2064	ssp585
What is the World Effective Radiative Forcing CO2 under ssp370 in 2088?	Effective Radiative Forcing CO2	2088	ssp370
What is the World Effective Radiative Forcing CO2 under ssp119 in 2081?	Effective Radiative Forcing CO2	2081	ssp119
What is the World Surface Air Temperature Change under ssp585 in 2089?	Surface Air Temperature Change	2089	ssp585
What is the World Surface Air Temperature Change under ssp119 in 2049?	Surface Air Temperature Change	2049	ssp119
What is the World Effective Radiative Forcing Aerosols under ssp460 in 2025?	Effective Radiative Forcing Aerosols	2025	ssp460
What is the World Effective Radiative Forcing CO2 under ssp585 in 2097?	Effective Radiative Forcing CO2	2097	ssp585
What is the World Effective Radiative Forcing Aerosols Indirect Effect under ssp460 in 2094?	Effective Radiative Forcing Aerosols Indirect Effect	2094	ssp460
What is the World Sea Level Change under ssp585 in 2082?	Sea Level Change	2082	ssp585
What is the World Effective Radiative Forcing Aerosols Direct Effect OC under ssp585 in 2038?	Effective Radiative Forcing Aerosols Direct Effect OC	2038	ssp585
What is the World Effective Radiative Forcing under ssp119 in 2061?	Effective Radiative Forcing	2061	ssp119
What is the World Surface Air Temperature Change under ssp119 in 2041?	Surface Air Temperature Change	2041	ssp119

Discussion: Limitations & Future works

1. Climate models

- Variables "Surface Air Temperature Change", "Atmospheric Concentrations|CO2", "Effective Radiative Forcing", "CO2", "Aerosols", "Direct Effect|BC", "Direct Effect|OC", "Direct Effect|SOx", "Direct Effect", "Indirect Effect" and "Sea Level Change"
- Year between 2024 and 2100,
- Scenarios from ssp119, ssp126, ssp245, ssp370, ssp460 and ssp585

Discussion: Limitations & Future works

2. Technical infrastructure.

- ChatGPT
- Open source

3. Multi-modal system

- various forms of data inputOpen source, such as images, graphs, and videos
- interactive platform

Ideas review(future)

- Digital twin earth
- Representation/Parameterization
- CMIP