

Climate Models: Knowledge Graph to Support Evaluation and Development of Climate Models

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Use case description and societal challenge being addressed

Model Evaluation and Selection: Climate scientists and researchers can evaluate the performance of different climate models and select the most suitable ones for specific research questions or applications. This includes assessing model biases, strengths, and weaknesses across different variables and geographic regions. **Scenario Analysis:** Policymakers and planners can analyze various climate change scenarios and their potential impacts on different sectors such as agriculture, water resources, energy, and infrastructure. This helps in developing adaptive strategies and resilience plans. **Climate Impact Studies:** Environmental scientists and conservationists can study the impacts of climate change on ecosystems, species distribution, biodiversity, and ecosystem services. This information is crucial for conservation efforts and ecosystem management. **Risk Assessment and Management:** Businesses, insurance companies, and risk analysts can assess climate-related risks such as extreme weather events, sea level rise, droughts, and floods. This enables better risk management strategies and financial planning. **Educational Tools:** Educators and students can learn about climate science, climate modeling, and the complexities of global climate change. Interactive visualizations and data explorations can enhance the learning experience.

Knowledge graph source datasets

We use scientific papers on climate modeling, including CMIP models, to construct the knowledge graph.

User queries / competency queries for the use case

- **Model Evaluation and Selection:** Simulate historical temperature data with an accuracy of $\pm 0.5\text{C}$ compared to observations, Compare projected sea level rise for the year 2100 under RCP8.5 scenario, Identify models that show consistent performance across multiple variables (e.g. temperature, precipitation, sea ice extent) for the historical period, Compare performance metrics (eg. RSME, correlation) for simulating global temperature trends over the past century.
- **Scenario Analysis:** Assess climate change impact on crop yields in South America by 2050, Analyze projected impacts of climate change on water availability in a region under different emission scenarios, Evaluate risk of infrastructure damage (e.g. from storm surges, landslides) in coastal and mountainous regions using data on extreme weather events, Evaluate the impact of climate change on hydropower production by analyzing changes in precipitation patterns and water availability.
- **Climate Impact Studies:** Assess vulnerability of coral reefs to ocean acidification and warming based on sea surface temperature and pH level projections, Investigate risk of biodiversity loss in tropical rainforests due to climate-induced habitat changes, Understand the impact of climate change on ecosystem services such as pollination, water purification, and carbon sequestration, Study shifts in vegetation types and land cover (e.g. forest cover, agricultural land) due to climate-induced changes in temperature and precipitation.
- **Risk Assessment and Management:** Investigate projected changes in extreme weather events (e.g. hurricanes, heatwaves) under different emission scenarios, Evaluate potential effects of sea level rise on coastal communities by 2050 based on model projections under SSP1 and SSP5 scenarios, Identify models that project an increase in frequency and intensity of heatwaves in a region over the next 50 years, Evaluate potential impact of climate change on frequency and severity of hurricanes using data in the Atlantic region.
- **Educational Tools:** Provide overview of the CMIP project and its importance, Explain climate models and how they simulate past, present, and future climate conditions, Showcase examples of studies using CMIP outputs to project future scenarios of sea level rise, heatwaves, droughts, and other climate-related hazards, Describe how different levels of greenhouse gas emissions lead to varying degrees of global warming and associated climate impacts.
- **Some other examples of queries:** Compare simulated sea surface temperature trends from CMIP5 and CMIP6 models over the past 50 years, Evaluate performance of CMIP models in reproducing historical precipitation patterns for the Amazon rainforest region, Assess contributions of greenhouse gas emissions and natural variability to observed changes in Arctic sea ice extent using CMIP data, Explore projected changes in extreme heat events for South Asia based on CMIP6 model simulations under different emissions scenarios, Investigate uncertainties in future projections of global mean temperature from CMIP models and their implications for climate policy, Identify CMIP models that best capture observed changes in ocean heat content over the past three decades, Examine differences in projected precipitation changes between CMIP5 and CMIP6 models for the Mediterranean region.