

Using Advanced Climate Models to Study Climate Change

State of the Climate

The State of the Climate is a collection of monthly summaries recapping climate-related occurrences on both a global and national scale.

Go to the NCDC State of the Climate page at: <http://www.ncdc.noaa.gov/sotc/>.

1. Click on Global Summary Information. Do the climate-related events that occurred in September suggest to you that the climate is changing?

2. Now look at the “Land and Ocean Temperature Percentiles: September 2020” What does the NCDC conclude about these temperature percentiles?

3. Do these conclusions suggest to you that the climate is changing?

Now click on Climate at a Glance in the navigation bar. A graph of global land and ocean temperature anomalies will appear. A red bar means the global temperatures were above the global average; a blue bar means that the global temperatures were below the global average.

Plot maps (and save them) for March, June, September and December and answer the questions below.

4. What is the trend in anomalies from 1880 to present? Explain this trend using your own understanding of history.

5. Does this trend vary by month? Why do you think this is?

Future Climate Change Scenarios

Introduction

A large number of climate change experiments using General Circulation Models (GCMs) have been completed in recent years, both equilibrium and transient experiments, and both experiments forced with changes in greenhouse gas concentrations alone and those forced with greenhouse gas and sulfate aerosol changes. The IPCC Task Group on Scenarios for Climate Impact Assessment (TG CIA) defined a set of criteria to identify GCM experiments whose results could be used for further evaluation and policy making (http://www.ipcc-data.org/sres/gcm_data.html).

As you might imagine, these scenarios are extremely complex. According to the IPCC, the key drivers are:

- Population development
- World economy

That, in turn, drives the major emitters:

- The earth's energy system
- Land use and change in land use

Review the complexity of these scenarios at:

<http://www.ess.co.at/METEO/CCS.html>

and

http://www.ipcc.ch/publications_and_data/ar4/wg1/en/spmsspmpm-projections-of.html

You have previously investigated climate change through a historical perspective. Now you will use a modified version of the IPCC scenarios to investigate the possible impact of greenhouse gas emissions on temperature and precipitation in the future.

You will use a concept called **representative concentration pathways** (RCPs). From the UCAR website:

The climate change scenarios have been redesigned for the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report. Previous SRES Emission Scenarios were designed to represent socio-economic development storylines and estimate associated emissions over the 21st century. The new approach defines Representative Concentration Pathways (RCPs), which provide

concentrations of atmospheric greenhouse gas (GHG) and the trajectory that is taken over time to reach those concentrations. These RCPs are named according to the level of radiative forcing (enhanced greenhouse effect or warming) that they produce by the year 2100. The four RCPs that have been produced include one high pathway in which radiative forcing reaches 8.5 Watts per square meter (Wm^{-2}) by 2100, two intermediate 'stabilization pathways' in which radiative forcing is stabilized at 6 Wm^{-2} and 4.5 Wm^{-2} after 2100, and one low pathway in which radiative forcing peaks around 3 Wm^{-2} before 2100 and declines. This low scenario describes GHG emissions that drop below zero around 2070 and continue to decrease (carbon-negative). These RCPs themselves are not linked to any one socio-economic scenario: many different socio-economic scenarios could give rise to similar changes in atmospheric constituents. Further, RCPs should not be considered as forecasts or absolute bounds. They are representative of plausible alternative scenarios of the future but are not predictions or forecasts. **No RCP is intended as a best guess or most likely outcome.**

Procedure

1. Go to <https://gisclimatechange.ucar.edu/> and register. You will need an account to access the Climate Inspector.
2. Review the various information and modifiers found on the Climate Inspector Page.
3. Think about a question that you would like to answer using the Climate Inspector. It should be a question that you are interested in answering, not one you think I'd want you to answer. Remember to push the envelope with your thinking.
4. Note: Your research question must consider the different RCPs.
5. **Important:** Before proceeding with your data collection, have your research question approved.

Then

6. Open the [Advanced Climate Models slideshow](#).
7. Use the Climate Inspector to research the answers to your research question.
8. Be sure that the data you collect answers your research question. If you can't find the necessary data, you may need to tweak your research question.
9. Download or screen capture any appropriate maps or data to support your research question.
10. Insert your maps and/or data into your slideshow.
11. What conclusion(s) do you draw from your maps/data? Be sure to connect your maps/data to your research question.