

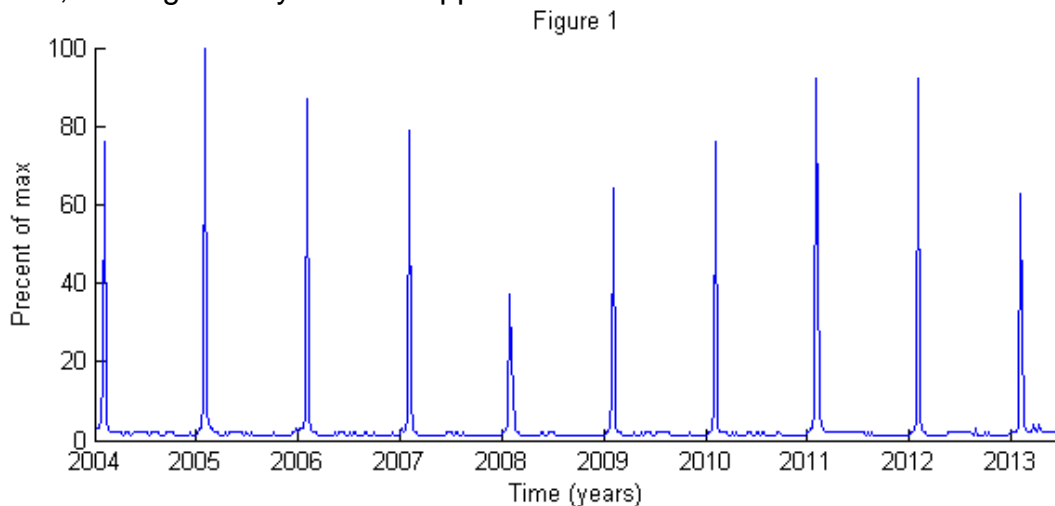
## Using Google Trends to Demystify Climate Change Data

It is important for scientists to be able to understand patterns at multiple levels of scale in order to understand the world around us. This exercise will help you train your mind to see and interpret patterns in time series data. A time series is a set of data where measurements are made at intervals through time. An example would be measurements of temperature over a day or the height of a child measured each year.

### Part 1: Identifying Patterns

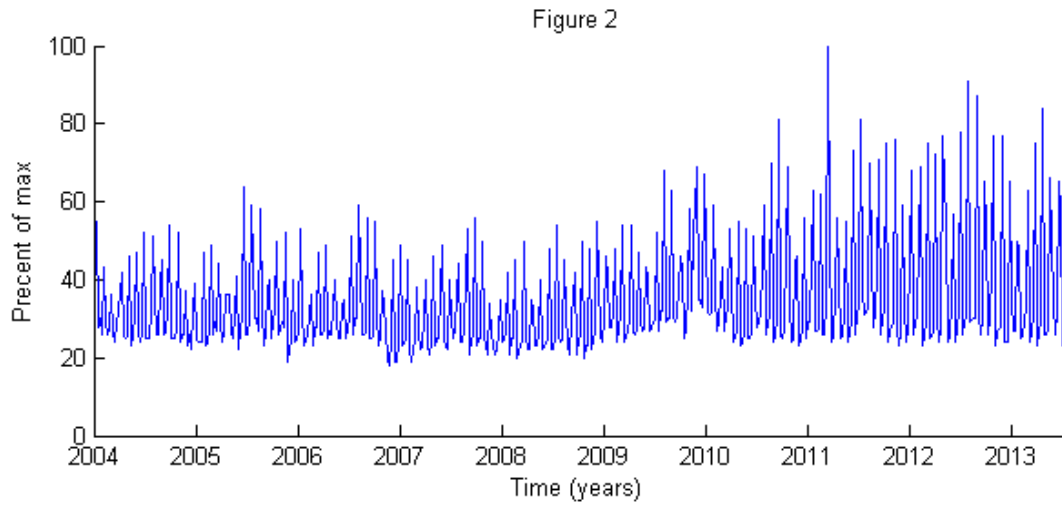
Google Trends ([www.google.com/trends](http://www.google.com/trends)) tracks how often certain words are searched for on Google. If you type in any term into the search engine it will create a graph of how often people search for that term through Google. For example, typing in the word "Oscars" creates a spike every year right around the time of the Academy Awards. Using graphs generated in this way, we'll practice identifying patterns and cycles in data.

1. For each of the following graphs write down your best hypothesis for what people were searching for to create such a pattern and your rationale. It is unlikely that you will correctly identify the answers (hint: they get harder as you go), but what is important is that you can support your hypothesis with the data. Take some time to think about the shape of the lines as well as any patterns you might see. Creative answers are welcome, so long as they can be supported!



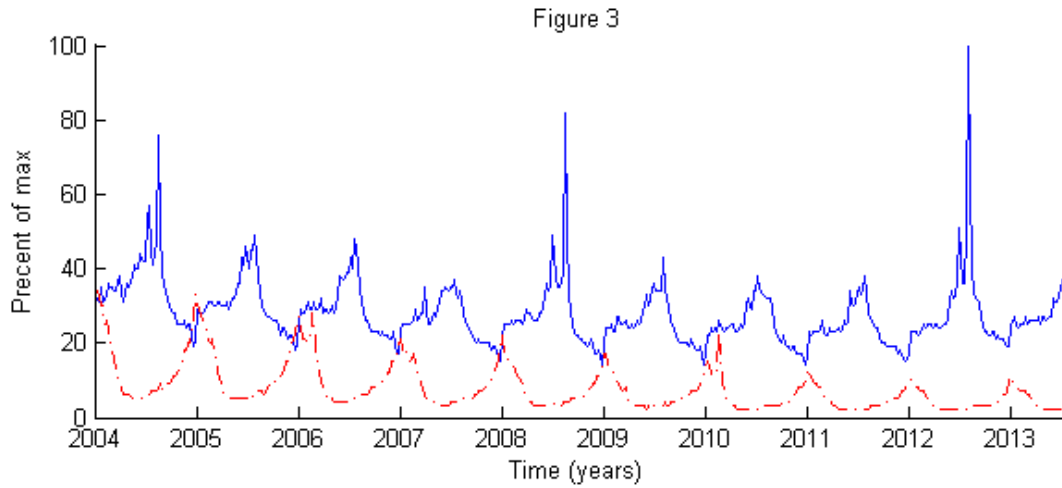
1a. Term Guess:

Support:



1b. Term Guess:

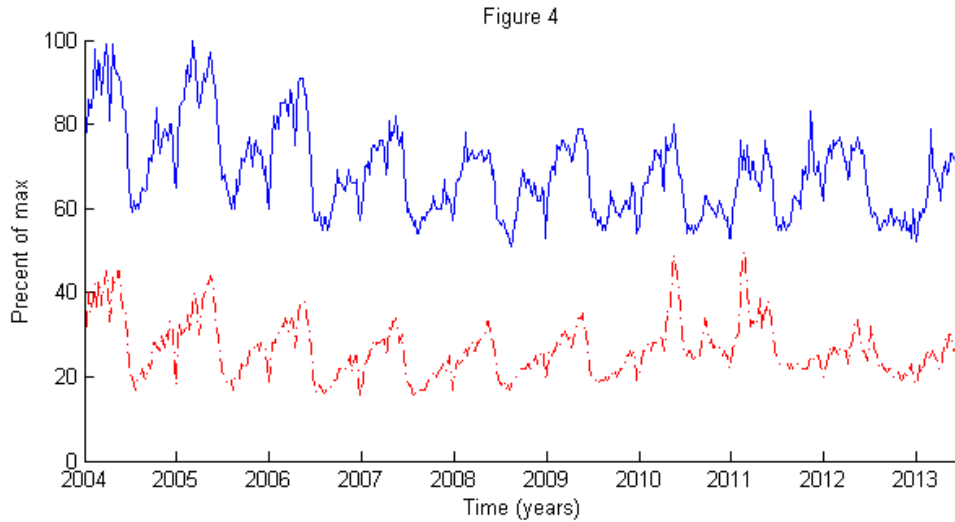
Support:



1c. Blue Solid Term Guess:

Red Dashed Term Guess:

Support:



1d. This one is very tricky, just give your best shot:

Blue Solid Term Guess:

Red Dashed Term Guess:

Support:

2. Look at graphs A and B. What is the most striking difference between them? What are these types of cycles called?

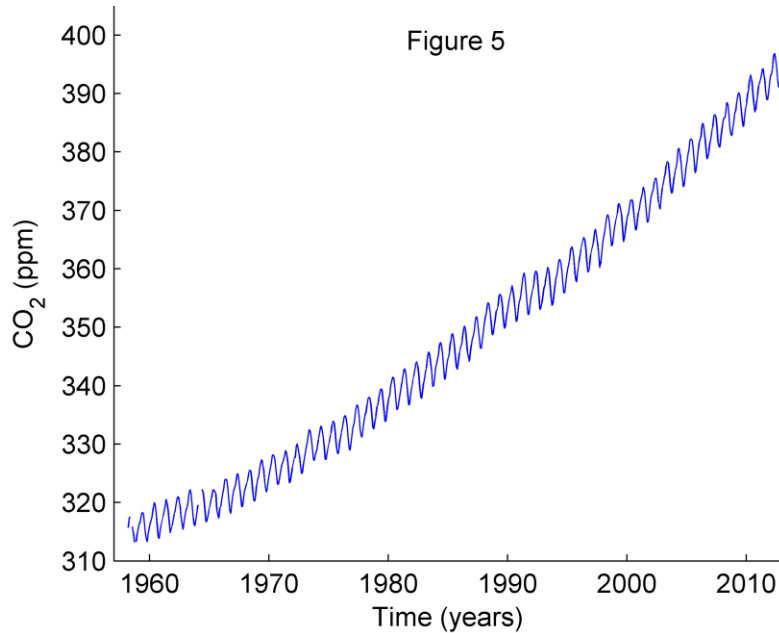
3. Describe the major difference between the patterns shown in Graphs C and D using the terms "phase" and "anti-phase."

4. Many different types of scientists look at time series data like what you just saw. Give three examples of time-series data that scientists likely analyze.

**STOP.** Wait for your teacher to discuss the answers with you before continuing.

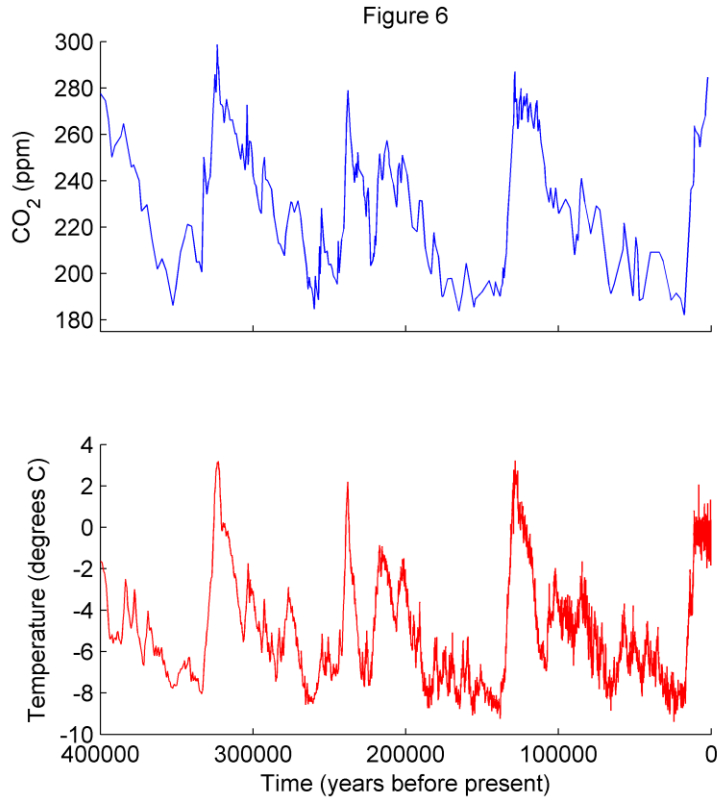
**Part 2: Interpreting Climate Data**

The graph below is from the Mauna Loa Observatory in Hawaii. Scientists there have been tracking atmospheric carbon dioxide concentrations there for several decades.



5. What are the x and y-axis labels and ranges for the above graph?
6. What general trend do you see in the data?
7. What do you think causes the annual cycle in this graph? (Hint- it has to do with plants in the Northern Hemisphere)
8. This graph is composed of an annual cycle with a strong trend. Do you think the increasing trend might also be part of a cycle? What would we need to look at to test this?

Scientists working in Antarctica have been able to reconstruct temperature and CO<sub>2</sub> over the past 450,000 years (see graph below). This should give us a long enough scale to see if there are any interesting patterns.



9. What are the x and y-axis labels and ranges for the above graphs?

10. Are CO<sub>2</sub> and temperature in phase or anti-phase?

11. About how long does each cycle last for CO<sub>2</sub> and temperature?

12. Is there a general trend in this data? Do CO<sub>2</sub> and temperature increase, decrease, or stay the same through time?

13. This graph ends at zero, which is the year 1950, so the most recent years are missing. Look at the graph of CO<sub>2</sub> measured at Mauna Loa for the year 2010 (page 5). Place a dot on the graph for the CO<sub>2</sub> concentration in 2010 and draw the line to connect it to the rest of the graph.

14. Given the previous pattern, what do you expect temperature to do in response to the increase in CO<sub>2</sub> and why? Draw this on the graph above.

15. Does the portion of the graph you just drew look different than you would expect given the last 450,000 years? Why or why not?

16. Imagine you are the scientist that led the research on this ice core. How might you explain the pattern between CO<sub>2</sub> and temperature, both over the past 450,000 years and the recent increase?