**Analyzing Current and Past Climate Data**

Today we will be analyzing current and past temperature and CO2 data in order to interpret how current climate change is related to climate over the past 450,000 years. The data has been made into figures for you, but the reference for all data is provided.

**Objectives:**

* Are global temperatures rising?
* Are CO2 levels rising?
* What is the relationship between CO2 and temperature?
* How does current warming relate to past warming?

**Recall:**

1. What controls Earth’s temperature?
2. What is the difference between climate and weather?
3. What is the difference between climate change and natural variability?

**Predictions**

In the space below, predict what slope would indicate a warming Earth, cooling Earth or temperature not changing Earth:

oC

oC

oC

time

time

time

 cooling warming no change

**Global Temperature**

Below is air temperature data compiled by the Goddard Institute for Space Studies (<http://www.earth-policy.org/data_center/>) from 1880-2014.

1. Since 1880, how much has global temperature changed?
2. What is the rate of air temperature change since 1880?
3. Given the information provided, is the Earth warming? How do you know?

1. How much has temperature changed since 1950?
2. What is the rate of temperature change from 1950 to 2014?
3. Is the rate of global average temperature change greater or less since the 1950s compared to since 1880? Why or why not?

**Changes in CO2**

Below is atmospheric CO2 data from Mauna Loa, Hawaii (<http://www.esrl.noaa.gov/gmd/ccgg/trends/>) from 1959-2016.

1. How much has CO2 changed since 1959?
2. What is the rate of CO2 chance since 1959?
3. Since 1959, has atmospheric CO2 concentration increased or decreased? What could cause this?
4. Based on global temperature and atmospheric CO2 data you have seen, what do you hypothesize is the relationship between CO2 and temperature?
5. Based on our discussion and the figure of CO2 vs. temperature on the board, could atmospheric CO2 explain the increase in global temperature?

**Global Temperature through Time**

Below is global temperature from the Vostok Ice Core from the Carbon Dioxide Information Analysis Center ( <http://cdiac.esd.ornl.gov/>). This temperature data was calculated from the relative proportions of hydrogen isotopes (2H: 1H), otherwise known as delta D. Paleo-climate temperature at Vostok was calculated using the empirical relationship between temperature and deuterium concentration: Temperature (in degrees C) = -55.5 + (delta D + 440) / 6

1. How would you describe the trends in temperature change over the past 450,000 years?
2. Do you think these data are a good representation of pre-historic rates of change?
3. Are we currently in a glacial or interglacial period?
4. How long do glacial and interglacial periods last?
	1. Glacial
	2. Interglacial
5. What is the fastest rate of temperature change?

**Atmospheric CO2 through Time**

Below is atmospheric CO2 from the Vostok Ice Core from the Carbon Dioxide Information Analysis Center ( <http://cdiac.esd.ornl.gov/>).

1. According to the CO2 data from ice cores, during which time frame(s) was there the greatest rate of change in atmospheric CO2 concentrations? What is the rate of change?
2. How does the change in atmospheric CO2 concentration correspond with what you saw in the ice-core temperature record?
3. How do CO2 concentrations recorded over time in the ice core compare to the current values for today, which you can see on the Mauna Loa web site (<https://www.esrl.noaa.gov/gmd/ccgg/trends/monthly.html>)?

**Summary**

Compare the fastest natural rate of change with the modern rate of change. (Remember to check your units are equivalent). How do current (i.e., in the past ~200 years) changes in atmospheric CO2 concentration and average global temperature compare to pre-historic (i.e., in the past hundreds of thousands of years) changes in these variables? What does this suggest about whether recent changes in temperature are due to natural or anthropogenic (human) factors? It is plausible that recent increase in atmospheric carbon dioxide is a result of natural fluctuations and not human-induced?