# The Greenhouse Effect and Climate Change

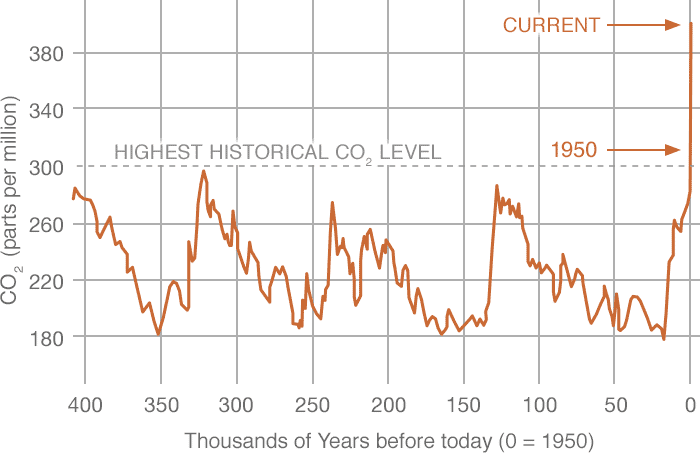
### Part 1: The Greenhouse Effect



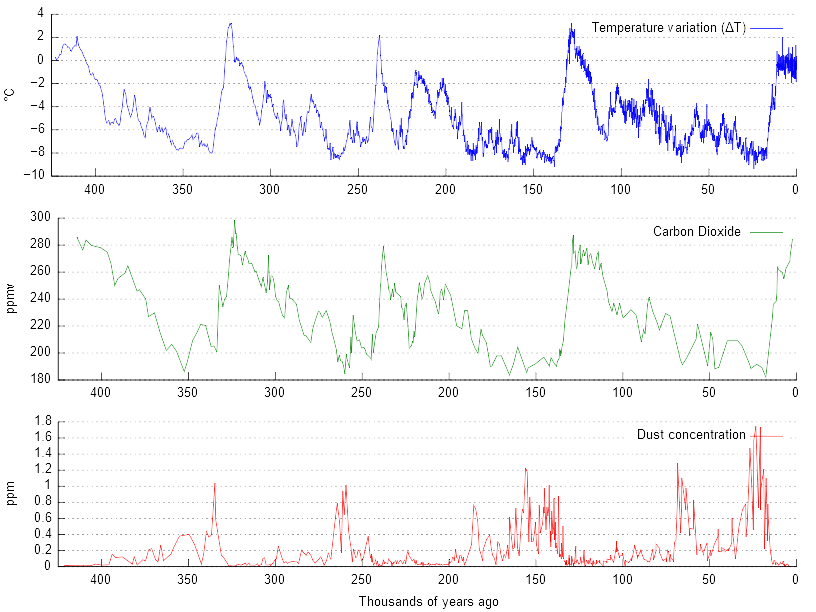
*Figure 1: This figure shows a simplified diagram of how incoming radiation from the Sun interacts with a planet’s surface and its atmosphere. Refer to this diagram when answering the questions below.*

1. If the “molecules in the atmosphere re-emit absorbed infrared radiation in random directions”, will all of that infrared radiation escape from the planet’s atmosphere? Why or why not?
2. What will be the overall effect on the temperature of the lower atmosphere and the ground as infrared radiation is absorbed and re-emitted repeatedly?
3. Why are the gases which can absorb and re-radiate infrared light referred to as “greenhouse gases”? In other words, why is this effect known as the “greenhouse effect”?
4. What would happen if something, such as a period of volcanic activity, increased the amount of greenhouse gases in the atmosphere of this planet?

### Part 2: Climate Change

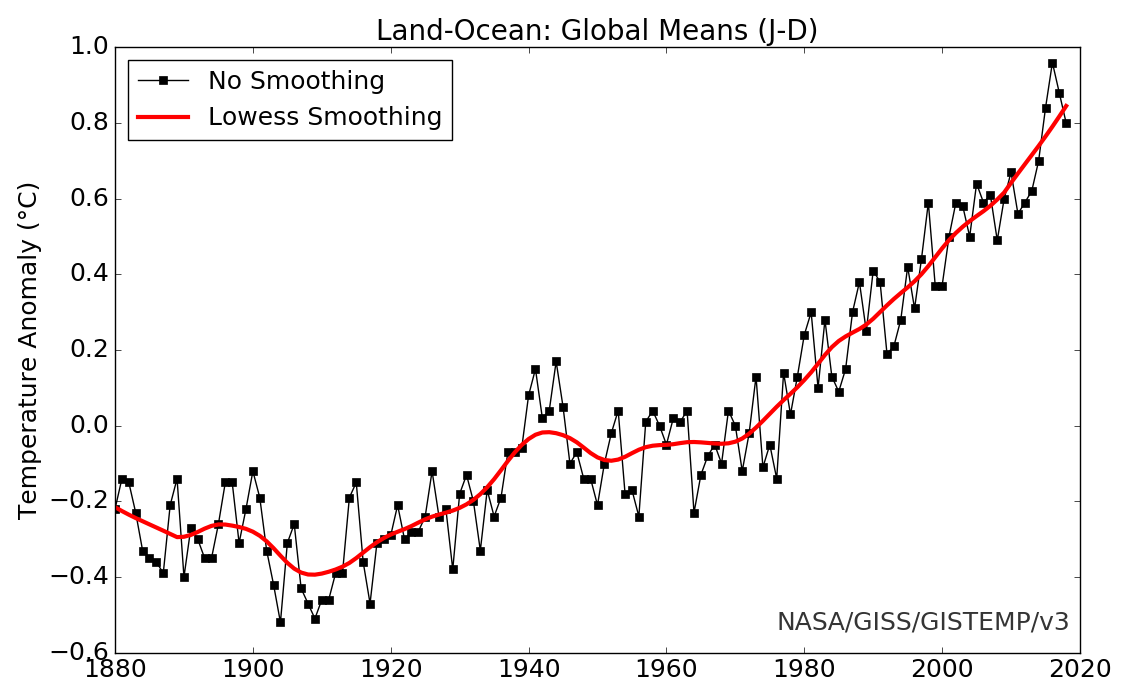
*Figure 2: This graph from NASA’s Climate Website (*[*https://climate.nasa.gov/vital-signs/carbon-dioxide/*](https://climate.nasa.gov/vital-signs/carbon-dioxide/)*) shows how carbon dioxide (CO2) levels in Earth’s atmosphere, as deduced by such methods as trapped air bubbles in Antarctic ice cores, have changed over the past 400,000 years.*

1. Is there a pattern to the rise and fall of CO2 levels over time, prior to 1950? Describe it.
2. Given that CO2 is a greenhouse gas, and the greenhouse effect discussed in the previous section, what pattern would you expect to see in global temperatures over the same time period?

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*Figure 3: This modified graph from Wikimedia Commons (dust pattern graph removed) with link at (*[*https://commons.wikimedia.org/wiki/File:Vostok\_Petit\_data.svg*](https://commons.wikimedia.org/wiki/File:Vostok_Petit_data.svg)*) shows how geological measurements of temperature variations and carbon dioxide (CO2) levels in Earth’s atmosphere for the past 450,000 years. Released under GNU Free Documentation License and Creative Commons ASA License.*

1. Are the changes in temperature and CO2 levels before 1950, as seen in Figure 3, consistent with the pattern you identified in question 5?
2. From Figure 2, is the rise in CO2 levels since 1950 consistent with the pattern you identified in question 5?
3. Why might the rise in CO2 levels since 1950 be concerning to scientists – and others?



*Figure 4: This graph from NASA’s Goddard Institute for Space Studies (*[*https://data.giss.nasa.gov/gistemp/*](https://data.giss.nasa.gov/gistemp/)*) shows the deviation of measured yearly temperatures from the long-term average temperatures.*

1. How does this graph support (or not support) your answer from question 8?
2. What do you think is the most likely cause of the rise in CO2 levels since 1950?
3. Why might politicians – and others – want to attribute this rise in CO2 levels to something other than man-made causes?
4. Two students are having a discussion.

*Student 1: “I agree that carbon dioxide levels and temperatures are both rising, but there is no evidence that the two are connected. Correlation does not imply causation.”*

*Student 2: “But the model of the “greenhouse effect” does show that carbon dioxide levels affect temperatures. Thus, the rise in global temperatures is due to the rise in CO2 levels.”*

Would you agree with either student, both, or neither? In what respects? Explain.