**How does temperature relate to concentration of greenhouse gases?**

Future of Four Seasons in Maine and the Maine Data Literacy Project

**Background**: We hear a lot about global warming in the news, and typically carbon dioxide (CO2) is blamed for the changing temperatures. But there are other gasses that are also affecting our climate and contributing to the greenhouse effect.

The graphs below are scatter plots showing the correlation between temperature anomaly and concentration of two different greenhouse gasses, CO2 and CH4 (methane), in parts per million and parts per billion, respectively. The data come from the Vostok ice core that contained 420,000 years of Earth’s climate history.

 A temperature anomaly is measured by taking the average temperature over a long period of time and comparing that average to the average temperature over a shorter period of time. For example, if the average temperature for Bar Harbor from 1900 to 1999 was 11°C and the average temperature for 1952 was 13°C, then the temperature anomaly for 1952 would be +2°C, meaning that 1952 was 2°C warmer, on average, than the long-term temperature.



Data Source: http://www.earthinstitute.columbia.edu/news/2004/story11-11-04b.html

1. Describe what the graph shows about the relationship between temperature anomaly and CO2 and CH4 concentrations.

*(Purpose here is to elicit description of what the graph shows. Sample response: In both graphs there is a good correlation between gas concentration and temperature anomaly because all of the data points are clustered around the best fit line.)*

2. I interpret the graph to mean….

*(Purpose here is to elicit an explanation (e.g. of the pattern or variability) or interpretation of the meaning in terms of the context of the question. Sample response: These graphs are evidence that CO2 and CH4 both influence climate because of the strong correlation of data points representing a very long period of time.)*

Bonus Question: If the relationships displayed in the graphs were causal, which gas is likely the more powerful greenhouse gas?

*(This question is a good opportunity to discuss the difference between causation and correlation, and it will remind students to look at axis scales when comparing scatter plots. Because the CH4 is in parts per billion, the entire range of the Y axis is less than one part per million. This means that much smaller changes in CH4 concentrations are correlated with much larger changes in atmospheric temperatures making CH4 the more potent greenhouse gas.)*