

# Spectral Analysis of CH<sub>4</sub> and Oxygen Isotope Records From Ice Cores

by

Garvin Heath

Thesis

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## Abstract

We know much about climate forcing mechanisms and relationships between climatic variables on very long (10,000 to 400,000 years) and very short (10 to 400 years) timescales. It is in the intermediate band of climatic relationships and forcings that I have directed my research. The goal is to better understand past climates in order to make more accurate predictions of the future. I use spectral analysis to study the records of  $\text{CH}_4$  and the ratio of oxygen-isotope ( $^{18}\text{O}/^{16}\text{O}$ ) from the Greenland Ice Core Project (GRIP) ice core.

The results of my research suggest relationships between methane, an important radiatively active atmospheric gas, and local temperature ( $\delta^{18}\text{O}$  is considered to be a local temperature proxy) at periods of 1 and 4 kyr. After analyzing the timeseries of the two records, the GRIP group report a connection between the two records with a period of approximately 1 kyr. I provide statistical evidence for their assertion. They have suggested that the 1 kyr correlation is caused by changes in the North Atlantic thermohaline circulation. The origin of the relationship of period 4 kyr is unknown, but provides further evidence for the potential importance of climatic variations in intermediate timescales.

I also use spectral analysis to study  $\delta^{18}\text{O}$  records from the Greenland and Vostok ice cores. I find that the two records are correlated with periods of 1 and 6 kyr. I suggest that the 1 kyr oscillation is a record of Dansgaard-Oeschger events; rapid and high amplitude temperature oscillations due to changes in strength of the North Atlantic's heat-carrying capacity. Thus, my finding extends the significance of these events to both poles. The two records are related at period 6 kyr by an as yet unknown mechanism.

Finally, I find spectral evidence in the GRIP  $\delta^{18}\text{O}$  record of Heinrich events. The above 1 kyr, Dansgaard-Oeschger events are bundled together, each fluctuation progressively cooler, until finally, there is a massive discharge of Arctic icebergs, called a Heinrich event. It is estimated that Heinrich events occur every 7 to 12 kyr. I find that the GRIP  $\delta^{18}\text{O}$  record oscillates at periods of 7 and 12 kyr.