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GeoDay Abstract

A history of atmospheric nitrous oxide, ocean circulation and climate change recorded in polar ice cores

Greenhouse gas forcing of the climate system is the major driver of anthropogenic climate change. However, there is still a great deal that is not understood about greenhouse gas variability and feedbacks. Of the three principal greenhouse gases measured in ice cores, nitrous oxide (N_2O) is the least studied. The purpose of this project is to quantify how the concentration and isotopic composition of atmospheric N_2O has varied over the past 140,000 years. In particular, I am interested in how shifts in ocean circulation modulate the strength of the marine N_2O source. During the last glacial period, decreased thermohaline circulation may have lead to widespread increases in the oxygenation of subsurface waters, suppressing the anaerobic respiration pathway that produces N_2O.

While some work has been done on ice core N_2O, much remains unknown. The data that exist are sparse for large intervals and there is evidence that in situ N_2O production may sometimes generate artifacts that complicate the profiles. The goals of my research are to produce a complete, high-resolution N_2O profile for the last 140,000 years, to overcome artifacts by combining profiles from multiple ice cores, and to determine how sources and sinks have varied over time using isotopic ratios. Using the NEEM core, I will also create the first northern hemisphere record of N_2O during the last interglacial, the Eemian, which may have been the best analog to the current climate. This may yield insight into the link between ocean circulation and N_2O production during interglacial conditions.