Atmospheric methane on the rise: investigating the drivers of methane's abrupt changes

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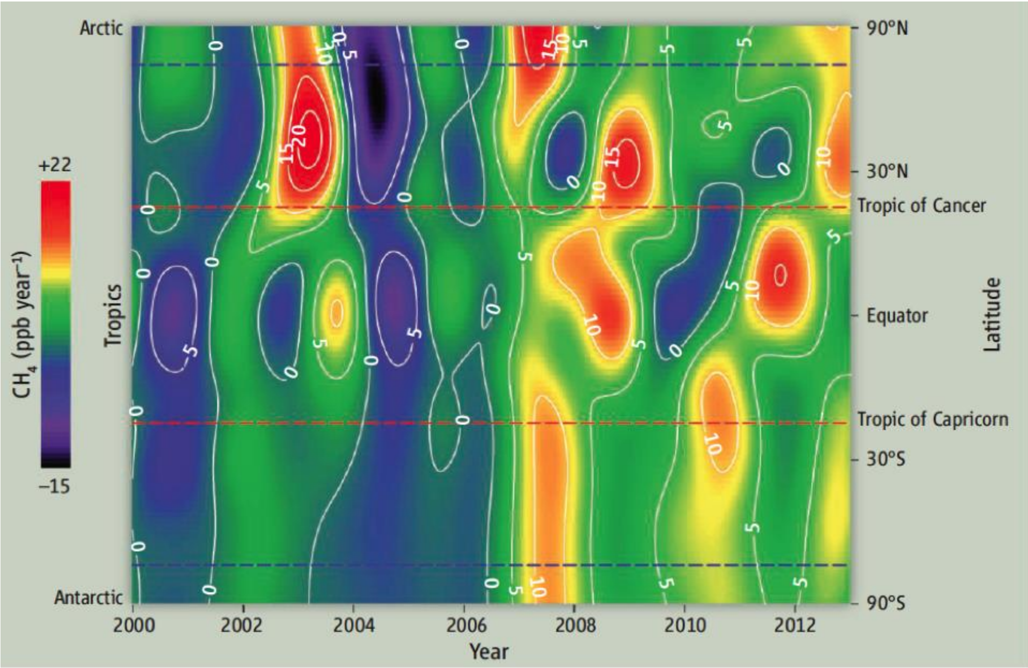
Project description :



Atmospheric methane is the second most important long-lived greenhouse gas after carbon dioxide and is responsible for ~20% of the increase in radiative forcing since the Industrial Revolution. In 2007, a sudden rise in the growth in methane concentration was observed globally (Figure 1, Nisbet et al., 2014). This rise continued to 2014, followed by another sudden increase. The implication is that methane sources and sinks have abruptly changed and then have sustained this change in growth. But why? We urgently need to understand these changes, as our lack of understanding of methane sources and sinks could have serious implications for future projections and policy.

The single largest source of methane emissions is wetlands, which are embedded within a complex global biogeochemical system. Wetlands are one of the most intriguing components of the climate system because they both contribute to climate and are themselves changed by climate.

Around the world, scientists measure methane concentrations in the atmosphere to provide a record of how the atmosphere is changing. This information is highly valuable for quantifying how much methane is emitted, but is limited in that these measurements are representative of all possible sources (e.g., wetlands, fossil fuel). New measurements have come online recently of the separate isotopologues (e.g., carbon-13 methane, 13C-CH4). This information is useful because different sources emit methane with characteristic isotopic "fingerprints". If we can understand the observed variations in the isotopic composition of methane in the atmosphere, we can begin to understand the underlying sources. Most models that simulate wetland methane emissions currently only simulate the production of carbon-12 methane but not of the different isotopologues. Simulating isotopologues could be one of most important constraints in untangling the methane story.

Firstly, the discrimination of isotopes will be implemented into a “wetland” model, which simulates the processes behind methane production in wetlands. They will then use data on the isotopic signatures of different wetland ecosystems to constrain the model using advanced and widely applicable statistical methods.

Finally, the student will use the newly created isotopic model to simulate methane isotopes in the atmosphere. Can wetlands be implicated for the sudden shifts in methane growth rate? Can wetlands explain some of the drivers of past climates observed in the ice core record? The student may have the opportunity to embark on fieldwork with leading atmospheric scientists to collect samples for isotopologue analysis.

References:

Nisbet et al., (2014) Science, 343, 493-495