



## **Natural and anthropogenic variations in methane sources over the last 2 millennia**

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Methane is an important greenhouse gas that is emitted from multiple natural and anthropogenic sources. Atmospheric levels of methane have varied on various timescales in the past, but in many cases the causes of these variations are not understood.

Analysis of the isotopic composition of methane preserved in ice cores provides evidence for the environmental drivers of variations in methane mixing ratios, because different sources and sinks affect the isotopic composition of methane uniquely.

We present from air trapped in Greenland ice cores that the carbon isotopic composition ( $\delta^{13}\text{C}$ ) of methane underwent pronounced centennial-scale variations between 200 BC and 1600 AD without clear corresponding changes in methane mixing ratios. The long-term methane increase observed over this period is accompanied by a small overall  $\delta^{13}\text{C}$  decrease.

Two-box model calculations suggest that the long-term methane increase can only be explained by an increase in emissions from biogenic sources. The centennial-scale variations in isotope ratios must be primarily due to changes in biomass burning, which are correlated with both natural climate variability including the Medieval Climate Anomaly, and with changes in human population, land-use and important events in history.