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Why Occam's razor doesn't work for atmospheric methane

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With the CH4 mole fraction in clean air increasing since 2007, after being relatively stable for seven years, there are a growing number of papers with different explanations. Examples include: a continuing debate about the fraction of CH4 coming from fossil fuels[1] and whether this source is increasing[2]. Then, more generally, whether increasing sources are predominantly anthropogenic[3,4] or from tropical wetlands[5-7]; and that increasing sources may also be competing with increasing removal rates[8,9].

The increasing amount of δ13CCH4 data and the recent reversal of its long-term trend should help to clarify changes in the CH4 budget, but δ13C has both nonlinear and longer term responses to changes in sources or removal than the mole fraction[10]. Furthermore, the seasonal cycle in δ13CCH4 means that it is never in equilibrium and that its short-term response to a budget change depends on the time of year when that occurs. Then to complicate matters further, while it has been shown that changes in the total removal rate cannot explain the recent δ13CCH4 observations[7], changes in the more highly fractionating removal by Cl can produce very similar responses to changes in the sources.

So far changes in the CH4 budget are only in the order of 3%, but its mole fraction is diverging from scenarios that achieve the 2°C climate change target, and at the upper end of the range considered in climate models. To understand the reasons for this requires a multidisciplinary approach with clearer links to atmospheric chemistry, more analyses of potential changes in methanogenic and methanotrophic processes, and resolving the major discrepancies between current bottom-up and top-down CH4 budget analyses. One contribution to this comes from the last 26 years of Southern Hemisphere 14CO data that are now showing OH has been quite stable, despite a large perturbation caused by the Mount Pinatubo eruption. This is also suggesting that trends seen in atmospheric transport[11,12] may now be altering the balance between sources and removal.

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