As Methane Concentration Goes Up, Stable Isotopes of Methane Go Down: ^{13}C Implicates a Microbial Source Across Latitudinal Gradients

S.E. Michel[1], J.B. Miller[2], E. Dlugokencky[2], J. White[1], B. Vaughn[1], A. Sack[1] and O. Sherwood[1]

[1]Institute of Arctic and Alpine Research (INSTAAR), University of Colorado, Boulder, CO 80309;
303-492-5495, E-mail: sylvia.englund@colorado.edu
[2]NOAA Earth System Research Laboratory, Boulder, CO 80305

The mixing ratio of methane in the atmosphere has increased in recent years for reasons that are not completely understood. It is important to better understand this greenhouse gas in regard to our changing climate and its role in atmospheric chemistry. Stable isotopes allow us to elucidate sources of methane due to the relatively distinct isotopic signatures from fossil fuels, biomass burning, and biological sources. Here we examine a 15-year record of atmospheric methane to show that since 2007, atmospheric methane isotopes have decreased by an average of 0.15 permil. This decrease is evident at Arctic sites as well as in the mid-latitudes and the Southern Hemisphere. There has been no change in the inter-hemispheric difference of atmospheric methane isotopes, suggesting that the changes are occurring in both northern and southern regions. Likewise, Miller-Tans plots, which examine regional deviations from the background signal, show that sources of methane have become isotopically more depleted since 2007 across latitudes. This suggests stronger microbial emissions (such as wetlands) from tropical, temperate, and Arctic environments. We use a 2-box model to test the plausibility of increased sources of microbial methane across a latitudinal gradient, and to constrain possible additional contributions of fossil fuel and biomass burning sources to the observed variability.

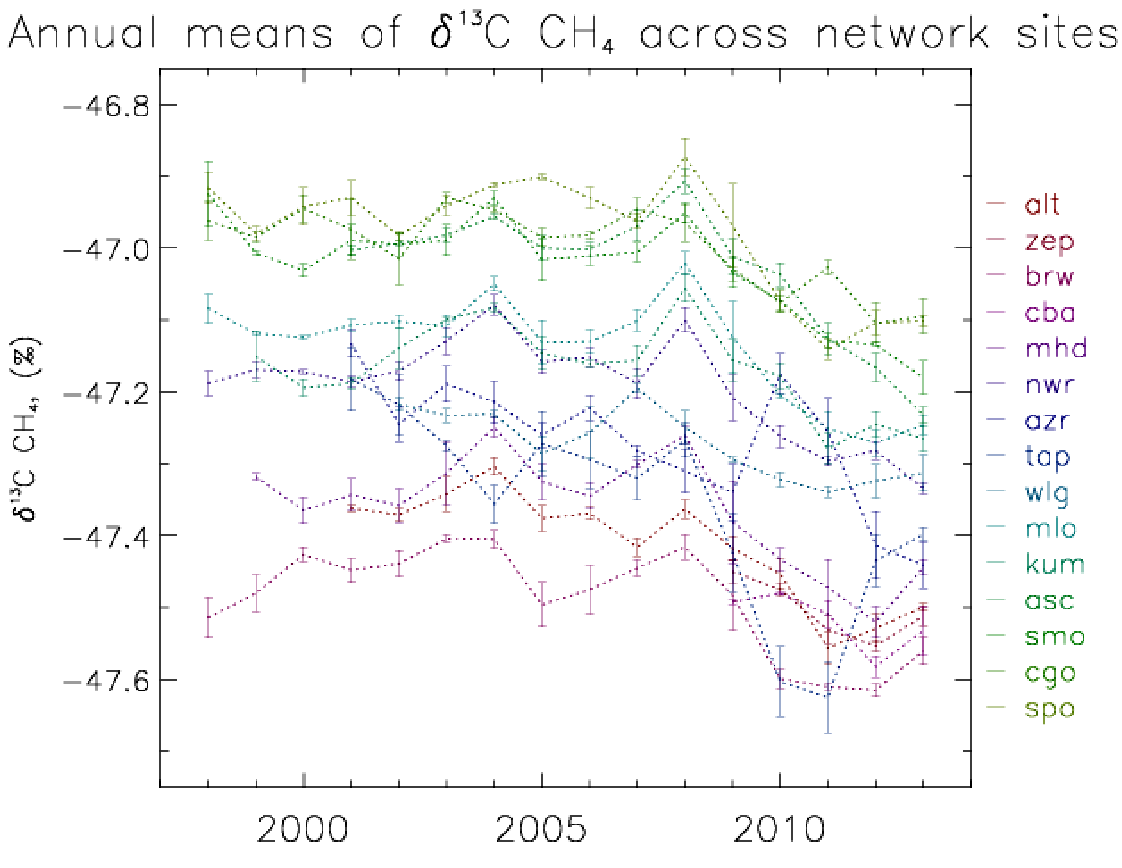

Figure 1. Annual means of $\delta\ ^{13}C$ of CH_4 across sampling sites. Error bars represent the standard deviation in the data trend; seasons have been removed.