3.069 Global methane budget and natural gas leakage based on long-term δ13C-CH4 measurements and updated isotopic source signatures.

Early Career Scientist

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Abstract:

Quantifying and mitigating CH_4 emissions associated with extraction and use of fossil fuels (natural gas, oil, and coal) has been the focus of many measurement U.S. field campaigns, modeling studies, and policy and industry activities in recent years. While this enhances the information available to better understand the impact of fossil fuels on U.S. CH_4 emissions, global modeling studies frequently suffer from limited data to attribute total CH_4 emissions to individual sources. We generated isotopic source signature distributions based on the largest literature survey to date to better constrain global fossil fuel CH_4 emissions. These are combined with atmospheric measurements from NOAA's Global Greenhouse Gas Reference Network and the literature spanning the past three decades including globally averaged CH_4 and stable isotopes ($^{13}C_{CH4}$). A Monte Carlo box-model and a global transport model were used to estimate distributions and confidence intervals of individual emissions sources. Attributing the majority of increased CH_4 levels over the past three decades to microbial sources is consistent with $^{13}C_{CH4}$ records. The sum of CH_4 emissions from fossil fuel extraction and use and geological seepage is significantly larger than previous estimates. Finally, recently published estimates of global CH_4 emissions from the oil and coal industries are subtracted from our global fossil fuel CH_4 results to quantify global CH_4 leakage from the natural gas industry during extraction, processing, transport, and distribution. Natural gas CH_4 leakage as a fraction of total production has decreased steadily over the same period indicating industry efficiency improvements.