Thirty Years of Global Atmospheric Methane and Ethane Monitoring: What Can Ethane Teach us About Methane?

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Methane (CH_4) is the second largest human contribution to the positive radiative forcing of the atmosphere, after carbon dioxide. Methane is also the main cause of increasing levels of tropospheric ozone, which is the third most important anthropogenic greenhouse gas. UC-Irvine has directly monitored global trace gas mixing ratios for 30 years, since 1978. Every three months ~80 whole air samples are collected in the remote Pacific Basin (71°N-46°S) and analyzed by gas chromatography for many dozens of compounds including methane, ethane, ethyne, propane, *i*-butane, *n*-butane, CFC-11, CFC-12, CFC-113, CCl_4, CH_3CCl_3, $CHCl_3$, C_2Cl_4, H-1211, CH_3Br, methyl nitrate, ethyl nitrate, *i*-propyl nitrate, and carbonyl sulfide.

This diverse suite of compounds has been used to refine our understanding of the factors that control methane's long-term and short-term growth rate variations. In the long-term, methane's annual growth rate has slowed from 15.2 (± 1.0) to 18.9 (± 1.0) ppbv yr^{-1} in the early-to-mid 1980s to –3.8 (± 1.2) to 6.6 (± 0.9) ppbv yr^{-1} since 2000. Whereas CH_4 levels have continued to slowly increase in the latitudinal band from 22-30°N, we have not seen evidence for any new CH_4 sources at northern latitudes (>60°N) in response to global warming, for example permafrost, thaw lakes or wetlands. In the short-term, CH_4 has shown positive growth rate anomalies every 3½-4½ years since 1991, the fifth and most recent of which peaked at 6.6 (± 0.9) ppbv yr^{-1} in 2007. Because CH_4, ethane and C_2Cl_4 are all OH-controlled species—but only CH_4 and ethane have common anthropogenic sources (fossil fuel and biomass burning)—CH_4, ethane and C_2Cl_4 are a powerful combination to help us determine which source and sink variations are consistent with the observed trends. For example, coincident CH_4 and ethane variations that are not matched by C_2Cl_4 point to fossil fuel and/or biomass burning influences, and help to constrain the influence of changing wetlands emissions in both the long- and short-term. These and other results will be presented and discussed at the meeting.

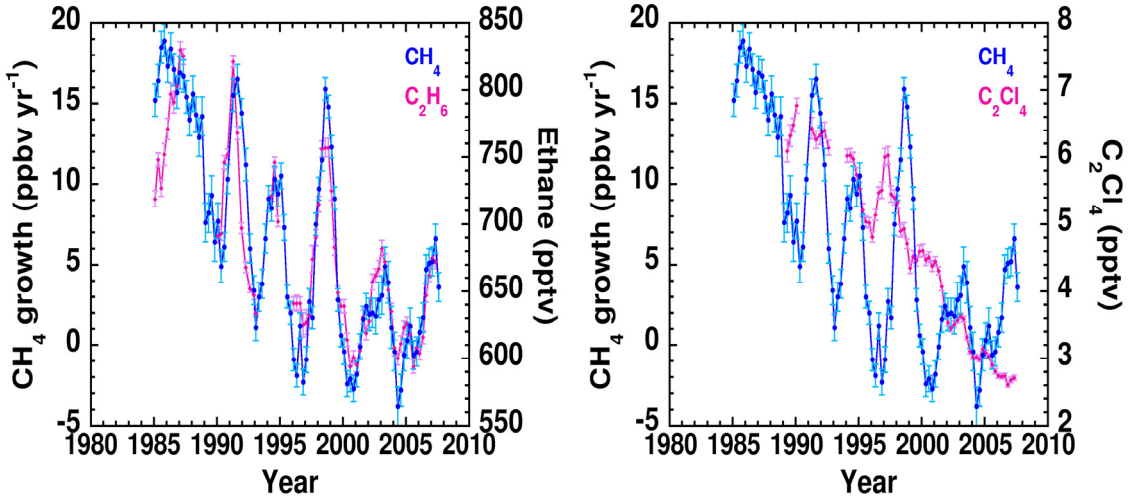

Figure 1. Global CH_4 growth rates (blue), global ethane mixing ratios (pink, left), and global C_2Cl_4 mixing ratios (pink, right). Data points are one-year running averages from 1984-2007.