Do We Understand Recent Trends in Atmospheric CH_4?

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Direct and indirect components to anthropogenic radiative forcing by atmospheric CH_4 are estimated to be 0.7 W m^{-2}, or about ½ the contribution of CO_2. Through its chemistry, methane also affects the abundance of tropospheric ozone, a strong oxidant and greenhouse gas that impacts human health agricultural crop yields. Policies aimed at mitigating the potential environmental effects of atmospheric CH_4 require a detailed understanding of the global CH_4 budget by emission sector and how emission rates are changing with time.

At the start of our CH_4 measurement program in 1983, the rate of increase in atmospheric methane was ~15 ppb yr^{-1}, but since 1999, the growth rate has been near zero. Through 1990, the monotonic decrease in global growth rate was consistent with a system approaching steady state with constant global emissions and a lifetime of ~10 yr. Had this trend toward steady state continued, the rate of increase would have slowly approached zero. Significant interannual variability in the growth rate makes it difficult to say whether the atmospheric burden is currently increasing, stable, or decreasing, but we've observed net decreases in globally averaged CH_4 in 4 of the last 7 years (see Figure). It would be surprising if atmospheric methane were decreasing, because CH_4 emissions are not regulated and scenarios of emissions such as those used by IPCC suggest that improved living standards in the developing world and increased energy demand should result in increasing emissions, which would result in an increase in the atmospheric CH_4 burden.

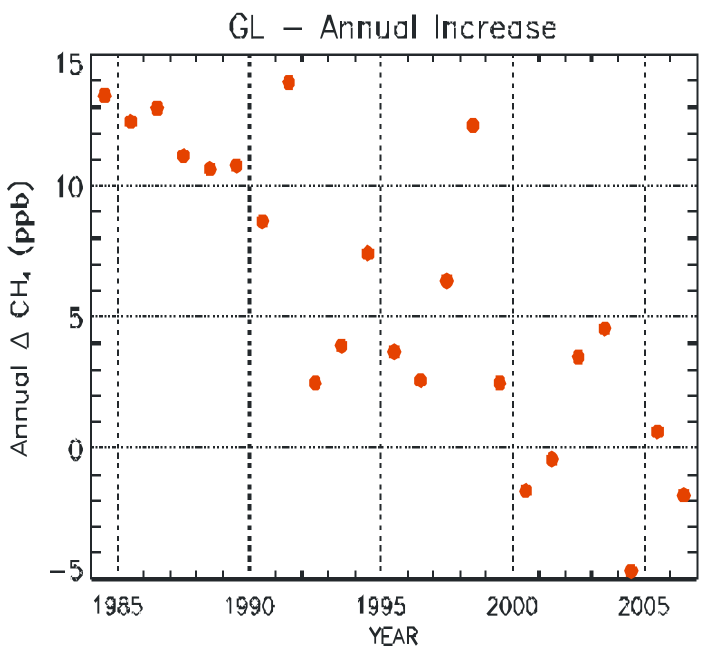

Figure 1. Annual increase in atmospheric methane from January 1 in one year to Jan. 1 in the next determined from a deseasonalized trend curve fitted to weekly CH_4 global averages.

Studies reported in recent literature contain no shortage of potential impacts on the global burden of methane. Suggestions include increasing CH_4 emissions as Arctic permafrost destabilizes, a decrease in the lifetime of CH_4 because of increased lightning in a warming atmosphere, and persistent lower-than-normal emissions of CH_4 from wetlands because of widespread global drought since ~2000. At the same time, our current knowledge of the global methane budget must be reconciled with potentially large emissions of CH_4 from vegetation under aerobic conditions and geologic sources such as mud volcanoes. In this presentation, we examine these different ideas in light of the ESRL CH_4 observations. It is easy to conclude that significantly more measurements are needed before a detailed understanding of the global CH_4 budget will be achieved.