Limitations of NOAA ESRL Measurements of Atmospheric CH_4 for Source Attribution

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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. It is estimated that the increase in atmospheric methane abundance over the past 200 years is responsible for half the increase in background tropospheric ozone levels; moderate ozone levels affect human respiratory function, while higher levels lower agricultural crop yields and damage natural ecosystems. 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.

During the past 2 decades, the globally averaged CH_4 growth rate decreased from ~14 ppb yr^{-1} in 1984 to near zero recently (Figure 1). Since 1999, the global methane budget appears to be at steady state, with emissions and sinks each at ~550 Tg CH_4 yr^{-1}. This large-scale constraint on the global CH_4 budget is one of many strengths of the GMD CH_4 measurements. Even at regional scales, the data can usefully constrain emissions. For example, analysis of changes in the N/S gradient of atmospheric CH_4 indicate that widespread concerns of substantially increased emissions from melting permafrost have not yet been realized, and increases in these emissions on the order of 10 Tg CH_4 yr^{-1} can be observed with the existing network. On the other hand, our sampling network is insensitive to two new results concerning CH_4 emissions in the tropics. One of these studies indicates that CH_4 emissions from vegetation, particularly in the tropics, is a large newly discovered source. Other work suggests that commonly used distributions of CH_4 emissions from wetlands in S. America are wrong, and significantly more CH_4 is emitted from the Amazon Basin relative to the Pantanal region further to the south. In these cases, the GMD surface measurements are limited by relatively few sites, all far from source regions, and strong vertical transport that quickly dilutes surface signals. The GMD surface measurements will continue to provide strong constraints on the global CH_4 budget, but further advances in understanding regional scale emissions, especially in the tropics, will require satellite measurements such as those from AIRS and SCIAMACHY. Satellite measurements will be especially useful when they are validated by GMD vertical profiles, especially those in the tropics.

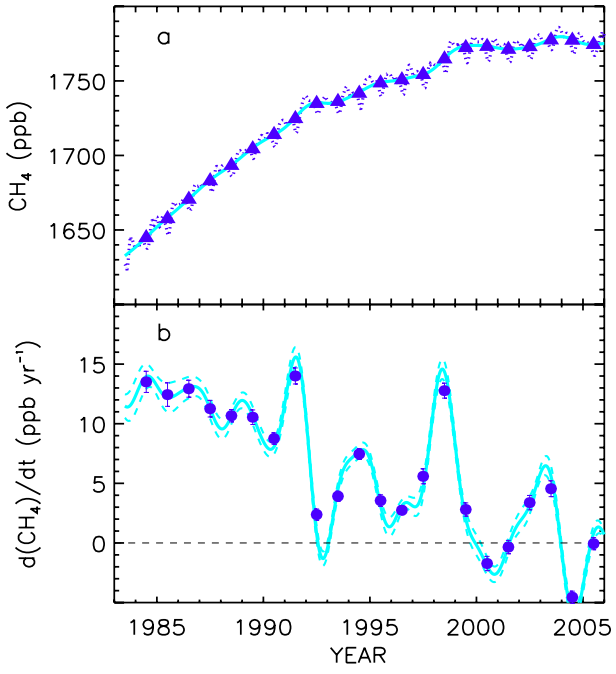

Figure 1. a) Globally-averaged CH_4 is plotted as a dotted line; solid line is the deseasonalized trend and triangles are annual means. b) Rate of increase from (a); uncertainties are 1σ. 2005 is preliminary.