Is Atmospheric Methane on the Rise Again?

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Methane (CH_4) is the most important greenhouse gas influenced by human activities after CO_2. Its chemistry results in additional indirect climate effects from production of tropospheric O_3, which also affects air quality, and stratospheric H_2O. Natural emissions of CH_4, from Arctic wetlands and hydrates, are susceptible to changing climate, and they have the potential to cause strong positive climate feedbacks.

From 1999 to 2006, the global burden of atmospheric CH_4 remained nearly constant (see Figure), except for a small increase resulting from increased boreal biomass burning during 2002 and 2003. Since 2006, globally averaged CH_4 increased by ~13 ppb. Does this increase signal the start of increased emissions in the Arctic from permafrost or hydrates because of warming climate, or is it from increased emissions from coal production and waste processing in rapidly growing economies in Asia? We suspect it is neither.

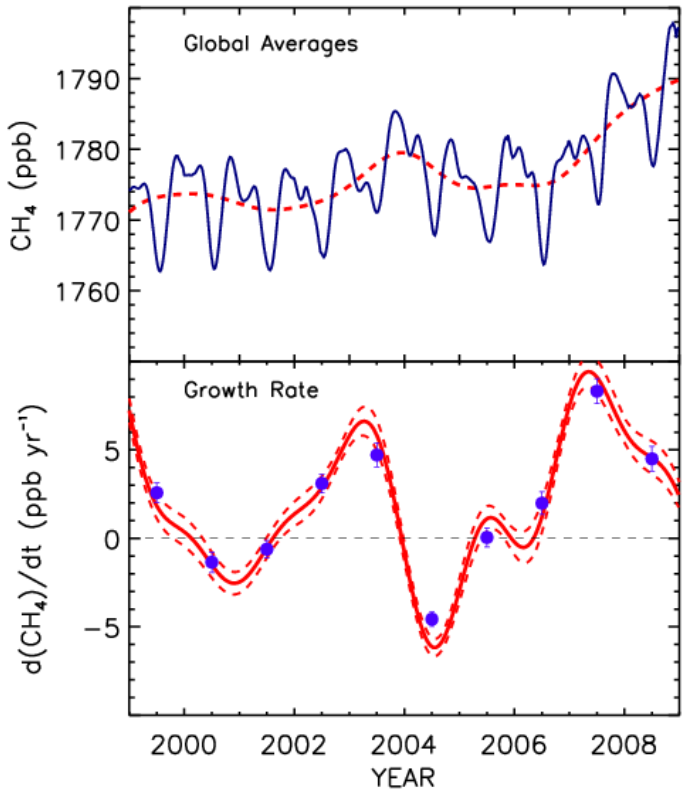

Figure 1. Preliminary globally averaged CH_4 mole fractions (blue) and trend (red) (top panel); instantaneous growth rate (red) and annual increase (blue) (bottom panel).

During 2007, globally averaged CH_4 increased by 8.3 ppb. High northern latitudes and the tropics showed the largest increases. The increase in CH_4 at high northern latitudes was accompanied by lower than average $\delta^{13}C$ in CH_4 from Alert, Canada during late-summer, which suggests greater than normal CH_4 emissions from wetlands. While NOAA surface CO data from the same samples analyzed for CH_4 suggest little potential contribution to the increase in CH_4 from biomass burning, MOPITT (Measurements Of Pollution In The Troposphere) observed positive CO anomalies up to ~90 ppb at 700 hPa during late-2006 over SE Asia. These signals may not have been observed at NOAA surface sites, because our sites may not be properly positioned to sample them.

During 2008, CH_4 at high northern latitudes remained at approximately 2007 levels, but a significant increase in CH_4 was observed in the tropics. Globally, CH_4 increased by 4.5 ppb. The causes of this increase are not clear, but La Niña conditions were observed starting in mid-2007, waned somewhat during late-2007, and then intensified during 2008. These conditions often have increased precipitation associated with them in SE Asia and eastern Amazonia. Increased precipitation would have resulted in increased emissions from tropical wetlands, the largest CH_4 source in the global budget. Other potential contributors are increased inter-hemispheric exchange, which would increase SH CH_4, and changes in [OH] that affect the CH_4 lifetime.