ABSTRACT

Observations of atmospheric methane and their implications for emissions

Ed Dlugokencky and Dave Hofmann

NOAA Climate Monitoring and Diagnostics Laboratory, 325 Broadway, Boulder, CO 80305, USA (ed.dlugokencky@noaa.gov)

Quantitative understanding of methane sources and sinks is necessary to develop a reasonable strategy to mitigate its potential influence on climate and background air quality. We have measured atmospheric CH_4 from a globally-distributed network of background air sampling sites since 1983. The observations are used to provide the following constraints on the global methane budget:

1-Atmospheric burden: the annually averaged global CH_4 abundance in 2003 was 1755 ppb, corresponding to 4860 Tg CH_4.

2-Global annual emissions: based on a lifetime of 8.9 years, total emissions have averaged ~550 Tg CH_4 yr^{-1} from 1984-2003.

3-Decreased emissions at high northern latitudes: a decrease in the difference in CH_4 annual averages between northern and southern polar regions occurred in 1992. Comparison of the observations with CH_4 emissions inventories suggest that annual emissions from the fossil fuel sector in the former Soviet Union decreased by ~10 Tg CH_4 in the early-1990s.

4-Interannual variability in CH_4 emissions and sinks: significant variations in CH_4 growth rate were observed in 1991, 1992, and 1998. After the eruption of Mt. Pinatubo in 1991, sharp increases in CH_4 and CO growth rates were observed in the tropics and high southern latitudes. Calculations made with a radiative transfer model show that UV actinic flux in the wavelength region 290-330 nm was attenuated by about 12% immediately after the eruption because of absorption by SO_2, and that the UV flux was perturbed for up to 1 year after the eruption because of scattering by sulfate aerosols. We suggest that decreased OH led to the observed large growth rates of CH_4 and CO during late-1991 and early-1992. The CH_4 growth rate decreased at high northern latitudes during 1992 because of decreased emissions from wetlands (temporary effect) and the former Soviet Union (permanent effect). The CH_4 growth rate increased during 1998. Likely contributors were increased emissions from wetlands and biomass burning.

5-Verification of emissions inventories: Bergamaschi et al. [2005] have used most of the available European and global background measurements of CH_4 to validate European emissions reported to the UNFCCC. The US observing system is currently behind the European one, but increased vertical profiles from aircraft and quasi-continuous measurements of CH_4 from tall towers will improve US ability to constrain emissions inventories.