

Decreasing Anthropogenic Methane Emissions in Europe and Siberia Inferred from Continuous Carbon Dioxide and Methane Observations at Alert, Canada and Barrow, USA

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Continuous measurements of CO₂ and CH₄ have been made from at the high arctic observatories at Alert, Nunavut since 1987 and from Barrow, Alaska since 1986. The time series of CO₂ and CH₄ at both sites are frequently highly correlated in winter during well-defined episodes lasting anywhere from 2 to 5 days, primarily due to synoptic meteorology, weak vertical mixing and rapid air mass transport of cohesive plumes of pollutants mainly from Siberian and/or European source regions. Ratios of CH₄/CO₂ during these well defined episodes consistently dropped (1988 to 2005) from ~20 ppb CH₄ per 1 ppm of CO₂ to ~12 ppb CH₄ per 1 ppm of CO₂, a decrease of 40%. To estimate the spatial and temporal change in the source emissions necessary to produce these observations, the atmospheric CO₂ and CH₄ concentrations at Alert and Barrow were simulated using the NIES atmospheric transport model and NCEP reanalysis meteorology, along with CO₂ sources (biospheric, oceanic fluxes and fossil fuel) and eleven individual CH₄ sources, including gas and coal. The results for Alert show, that on average, CH₄ emissions from Europe contribute more than 50% to the short-term variability of the simulated CH₄ signal with emissions from Siberia and Asia contributing the next highest average percentages of ~35% and 12% respectively. Emissions from all other regions, including North America, were negligible. In the absence of a change in the emissions of CH₄, modeled ratios of CH₄/CO₂ showed no change at both Alert and Barrow. In order to reproduce the trend in the ratio of CH₄/CO₂ observed in the data at both sites requires a reduction in emissions of CH₄ from Siberia and Europe on the order of 25 to 35 Tg, an amount large enough to account for the leveling of the atmospheric global CH₄ burden observed over the past 2 decades.

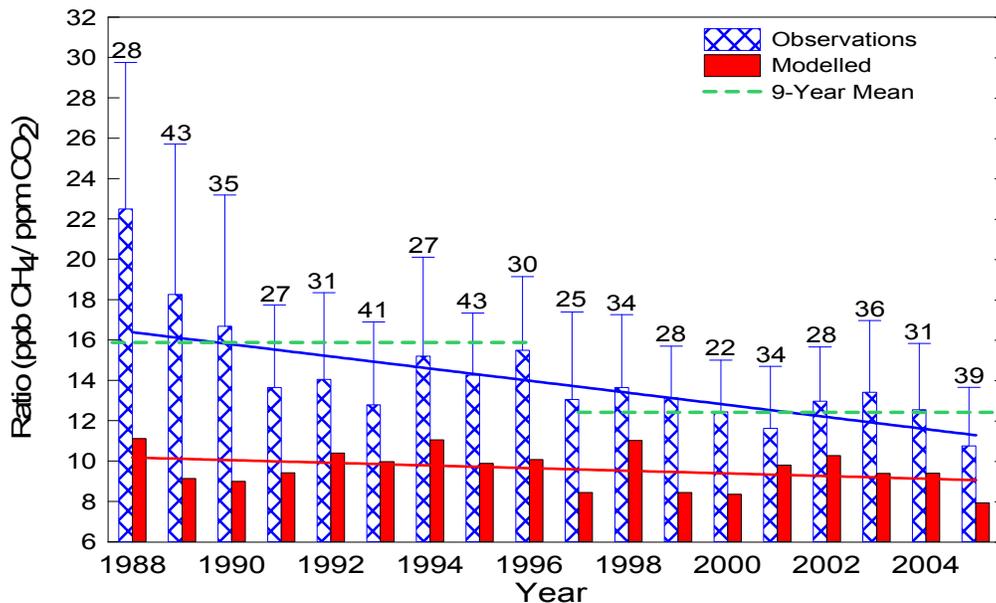


Figure 1. Showing the mean annual ratios of CH₄/CO₂ (in ppb ppm⁻¹) from 1988 to 2005 (blue – observed, red – modelled) at Alert. The blue error bars indicate the 1σ variability. The number of values used to calculate the annual mean is listed on top of the error bar.