Quantifying the decrease in anthropogenic methane emissions in Europe and Siberia using modeling and atmospheric measurements of carbon dioxide and methane from Alert, Canada.

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Canada’s GHG Air Sampling Network
- In situ and flask CO, CO₂, CH₄, N₂O, SF₆, Flask H₂, and CO₂ isotopes
- Flask CO, CO₂, CH₄, N₂O, H₂, SF₆ & CO₂ isotopes only (Estevan Point)
- Proposed CCP and IPY sites
- Aircraft vertical profiles (NOAA)
Ratio of CH₄ to CO₂ (Long-term trend & seasonality removed)
P. Bergamaschi et al. (2006):

Satellite cartography of atmospheric methane by extending the CH$_4$ dataset retrieved from SCIAMACHY & inverse model simulations for 2003 (using NOAA flask CH$_4$ measurements & TM5 transport model).
Atmospheric CH₄ at Alert is simulated using the NIES atmospheric transport model and NCEP reanalysis meteorology.
Relative CH4 contribution by region

In situ/model CH4 comparison

Jan. 1 to Feb. 6 1991
Modeled CH₄/CO₂ comparison
**Western Siberian** CH₄ source change of 3.4 Tg/yr changes the ratio by 1 ppb/ppm

If change occurs only in Western Siberia this would result in a 14 Tg/yr source change

**European** CH₄ source change of 8.36 Tg/yr changes the ratio by 1 ppb/ppm

If change occurs only in Europe this would result in a 33 Tg/yr source change
Change in anthropogenic CH$_4$ emissions: 1990-2000 (source: EDGAR)
Change in anthropogenic CH$_4$ emissions 1990-2000 (source: EDGAR)

Europe (-14 Tg/yr)
- Energy: -8.1
- Animal: -5.3
- Waste: -0.5

W. Siberia (-2 Tg/yr)
- Energy: -1.6
- Animal: -0.5
- Waste: 0.02

E. Siberia (-0.08 Tg/yr)
- Energy: -0.12
- Animal: 0.02
- Waste: 0.02
Summary:

1. The time series of \( \text{CH}_4/\text{CO}_2 \) ratios at Alert observatory during well-defined episodes primarily originating from Siberian and/or European source regions dropped by \( \sim 40\% \) from 1988 to 2005.

2. Time series of modelled \( \text{CH}_4/\text{CO}_2 \) ratios (using the NI ES atmospheric transport model and NCEP reanalysis meteorology, along with annual reported \( \text{CO}_2 \) sources and individual \( \text{CH}_4 \) sources for 2003) showed no change over the same time period.

3. Partitioning the simulated \( \text{CH}_4 \) events into contributions by region showed that on average, fossil fuel emissions from Europe accounted for more than 50\% of the signal with Western Siberia having the 2\textsuperscript{nd} largest contribution.

4. To reproduce the trend in the ratio of \( \text{CH}_4/\text{CO}_2 \) observed in the data requires a reduction in emissions of \( \text{CH}_4 \) on the order of 14 to 33 Tg/yr, depending on the regions contributing to this decrease.

5. If the EDGAR emissions changes for Europe of 14 Tg/yr are correct our analysis suggests a emissions change for Western Siberia of 7 Tg/yr.

6. If the Bousquet et al. estimate (see Poster) of emissions changes for Europe of about 30 Tg/yr is correct our data would agree and Edgar would be wrong by a factor of two.

7. Study is still on-going.