Geophysical Research Abstracts
Vol. 19, EGU2017-13680, 2017
EGU General Assembly 2017

Attribution of recent trends in atmospheric methane using inverse modelling

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Atmospheric methane (CH_4) accounts for approximately 20% of the total direct anthropogenic radiative forcing by long-lived greenhouse gases (0.48±0.05 Wm^{-2}), the second largest contributor after CO_2. Atmospheric observations highlight two notable changes in CH_4 since 2007. Firstly, the growth rate of methane increased to ~7ppb/yr. Secondly, the CH_4 $^{13}C/^{12}C$-ratio ($\delta^{13}C$) has become increasingly ^{13}C-depleted. One possible explanation for both of these, is an increase in ^{13}C-depleted CH_4 emissions. This could be through increases in natural biogenic sources (e.g. wetlands), anthropogenic biogenic sources (e.g. agriculture) or a combination of both. A decrease in ^{13}C-enriched non-biogenic emissions (e.g. biomass burning) could be an explanation for the ^{13}C-depletion, but does not explain the CH_4 increase. A reduction in the atmospheric concentration of OH, the main oxidant for atmospheric methane, could also explain both ^{13}C-depletion and CH_4 increase.

We have performed a synthesis inversion using a 3-D atmospheric global chemical transport model, TOMCAT, for both CH_4 and $\delta^{13}C$ from 2005-2014. The inversion uses surface observations of both CH_4 and $\delta^{13}C$ to spatially constrain source types and possible changes to OH concentration. We will use results from this synthesis inversion to attribute the upturn in CH_4 growth to specific source and sinks, and to discuss the uncertainties in this attribution.