Attribution of the ambiguity in methane’s growth rate shifts during 1988-2016.

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Atmospheric (CH_4) is an important greenhouse gas for mitigating climate change in the decadal scale due to its shorter atmospheric lifetime and about 30 times higher warming potential than carbon dioxide. The remarkable shift in CH_4 growth rate (decrease since early 1990s, quasi-stationary state during 1999-2005 and resume increase after 2006) has observed in past three decades (1990s-2010s). However, the attribution of these fluctuations remained highly conflicting. We have used a global inverse modeling system for constraining CH_4 emissions from 53 land regions for the period 1988–2016 using measurements from 19 sites and forward simulation by MIROC4-ACTM. The ACTM realistically represent inter-hemispheric transport and stratospheric age of air, and methyl chloroform concentration decay (proxy for loss OH concentration level) which are key elements for modelling CH4 in atmosphere. A set of 2 inversions is performed for different combinations of a priori emissions due to the wetlands and rice cultivation. We have shown that slowing down of emissions from oil and gas industry in the 1980s and Mt. Pinatubo volcanic eruption in 1991 led to a stabilization in emissions and thus the quasi-stationary state of CH4 concentration. The CH_4 growth after 2006 is attributed to increases in emissions mainly from coal industry and ruminant farming. The climatic variation due to ENSO caused significant interannual variation in the CH_4 growth rate. The role of CH_4 loss by hydroxyl (OH) reaction in CH4 growth rate variability is proposed to be not significant from inter-site differences.

