Recent Acceleration of Methane Growth Rate: Leading Contributions from Tropical Wetlands and China

Y. Yin[1], F. Chevallier[2], C. Frankenberg[3], P. Ciais[2], P. Bousquet[2], M. Saunois[2], A. Bloom[3], and J. Worden[3]

[1]California Institute of Technology, Pasadena, CA 91125; 949-345-9733, E-mail: yiyin@caltech.edu
[2]Laboratoire des Sciences du Climat et de l'Environnement (LSCE), Institut Pierre-Simon Laplace, Orme des Merisiers, France
[3]NASA Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109

An acceleration of the methane (CH_4) growth rate has been observed at background marine surface stations since 2014, from 5.7±1.1 ppb a^{-1} during the post-stagnation period (2007–2013) to about 9.2±2.7 ppb a^{-1} (2014–2017). While causes for the early 2000s stagnation and the re-growth since 2007 are still not well determined, the recent increase occurred in a period with better observational coverage from both surface stations and satellites. Using atmospheric inversions that map observed changes in CH_4 concentrations to fluxes while accounting for the dynamics of atmospheric transport and changes in chemically related tracers, we find consistent interannual variations in the global CH_4 emissions based on surface or satellite observations during the 2010–2017 period, whereas very small changes are noted in the OH sink. The global CH_4 emissions increased by more than 15 Tg CH_4 a^{-1} between 2010–2013 and 2014–2017, yielding an average trend of ~4 Tg CH_4 a^{-2} during the eight study years. Based on the spatial distribution of different emission sectors in the prior, the largest contributions come from tropical wetlands (~30%) and anthropogenic emissions in China (~25%). The unexpectedly rapid increases in both the natural CH_4 emissions and the continued growth in anthropogenic emissions push the climate towards warmer temperatures.

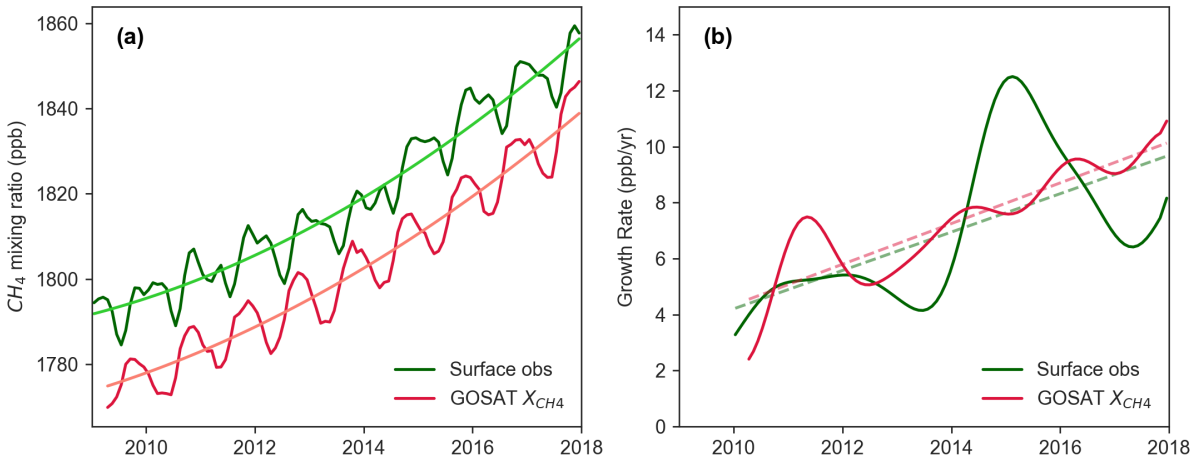

Figure 1. Global mean atmospheric methane mixing ratios and growth rates. (a) Monthly methane mixing ratios measured from background surface stations and from the GOSAT total column retrievals X_{CH4} over land. (b) Methane growth rate.