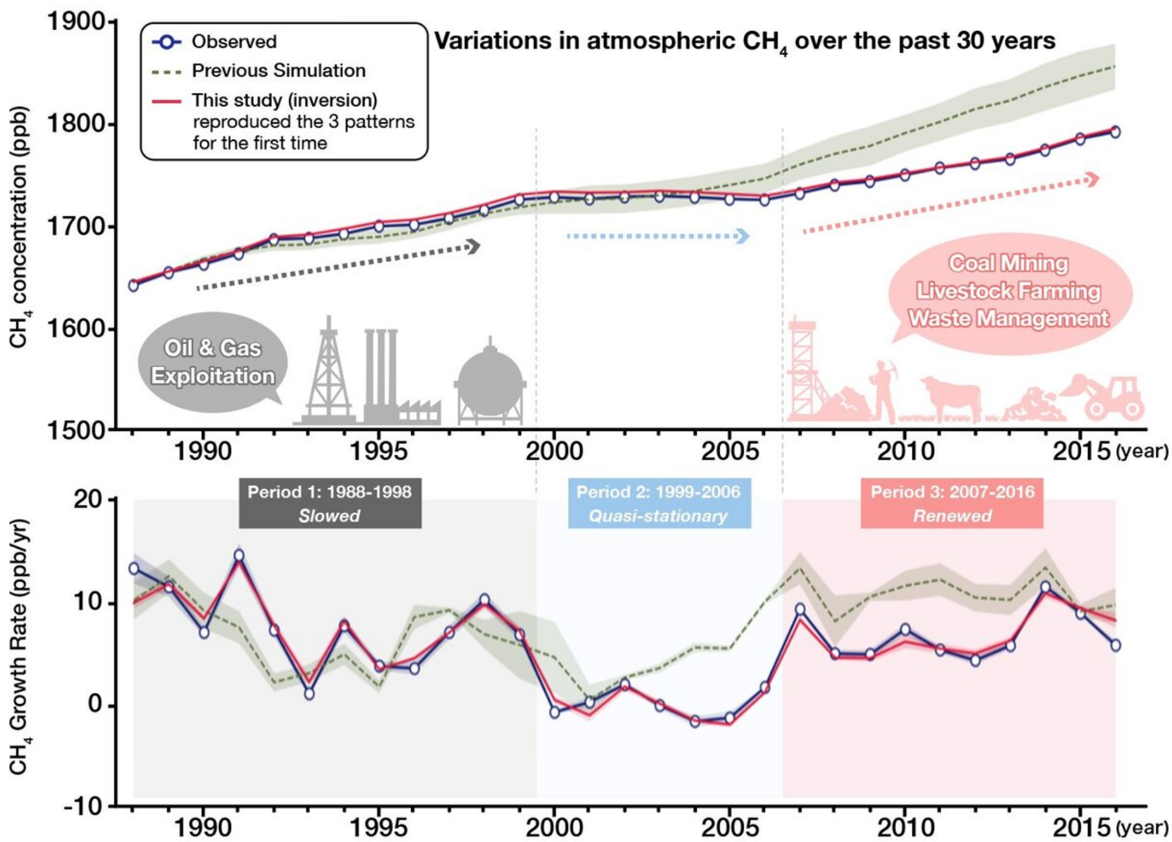
Human activity caused the long-term growth of greenhouse gas methane

January 29 2021



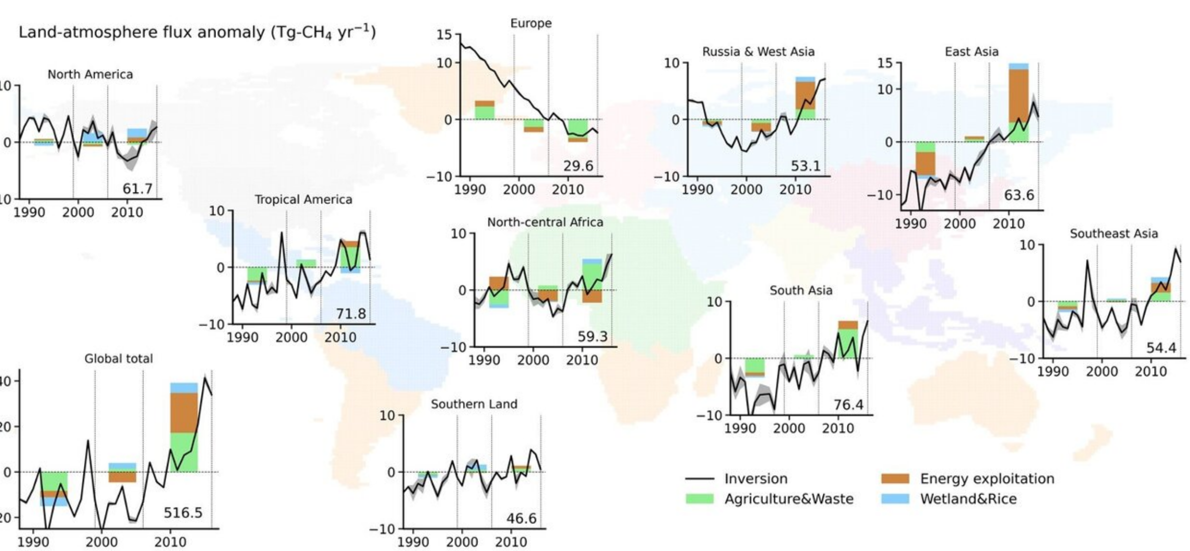
Evolution of the observed and simulated concentrations (top) and growth rates (bottom) in the southern hemisphere (SH) during 1988-2016. Measurement data from four remote marine stations in the SH (namely, Cape Grim, Palmer Station, Syowa and South Pole) are used. The shaded background in the bottom panel shows the 3 distinct CH4 growth rate phases (Periods 1, 2 and 3). Also shown in the top panel are human-induced emissions that played important roles in the growth rate variations of atmospheric CH4. Credit: NIES

Methane (CH_4) is the second most important greenhouse gas after carbon dioxide (CO_2). Its concentration in the atmosphere has increased more than twice since the preindustrial era due to enhanced emissions from human activities. While the global warming potential of CH_4 is 86 times as large as that of CO_2 over 20 years, it remains in the atmosphere for about 10 years, a much briefer span than CO_2, which can remain in the atmosphere for centuries. It is therefore expected that emission control of CH_4 could have beneficial effects over a relatively short time period and contribute quickly to the Paris Agreement target to limit the global warming well below 2 degrees.

A study by an international team, published in *Journal of Meteorological Society of Japan*, provides a robust set of explanations about the processes and emission sectors that led to the hitherto unexplained behaviors of CH_4 in the atmosphere. The growth rate (annual increase) of CH_4 in the atmosphere varied dramatically over the past 30 years with three distinct phases: the slowed (1988-1998), quasi-stationary (1999-2006) and renewed (2007-2016) growth periods (Fig. 1). However, there is no scientific consensus on the causes of CH_4 growth rate variability. The team, led by Naveen Chandra of National Institute for Environmental Studies, combined analyses of emission inventories, inverse modeling with an atmospheric chemistry-transport model, and global surface/aircraft/satellite observations to address this problem.

They show that reductions in emissions from Europe and Russia since 1988, particularly from oil and gas exploitation and enteric fermentation, led to the slowed CH_4 growth rates in the 1990s (Fig. 2); reduced emissions from natural wetlands due the effects of the Mount Pinatubo eruption and frequent El Niño events also played roles. This period was followed by the quasi-stationary state of CH_4 growth in the early 2000s. CH_4 rose again from 2007, which was attributed to increases in emissions from [coal mining](), mainly in China, and intensification of livestock (ruminant) farming and [waste management]() in tropical South America, north-central Africa and south and southeast Asia. While the emission increase from coal mining in China has stalled in the post-2010 period, the emissions from the oil and gas sector in North America has increased (Fig. 2). There is no evidence of emission enhancement due to climate warming, including in the boreal regions, during the analysis period.

These findings highlight key sectors (energy, livestock and waste) for effective [emission]() reduction strategies toward climate change mitigation. Tracking the location and source type is critically important for developing mitigation strategies and the implementation of the Paris Agreement. The study also emphasizes the need for more atmospheric observations with space and time densities greater than existing analyses.



Timeseries (1988-2016) of regional CH4 emission anomalies as derived from the inverse analysis, and the emission changes from 3 aggregated sectors during the three distinct phases of the growth rate (bar plots). The figure shows the emission anomalies from the long-term (2000-2016) mean for each region. The numbers in each panel are the long-term mean of the a posteriori emissions (in Tg yr-1). Credit: NIES

More information: Naveen CHANDRA et al, Emissions from the Oil and Gas Sectors, Coal Mining and Ruminant Farming Drive Methane Growth over the Past Three Decades, *Journal of the Meteorological Society of Japan. Ser. II* (2020). DOI: 10.2151/jmsj.2021-015

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