

Quantify China's methane emissions using atmospheric observations

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Methane emissions in China

China's anthropogenic methane emissions and sectoral distribution





Anthropogenic methane emissions

Methane emissions in China

Higher rate of straw returning (burning ban)





Increase in rice cultivation in cold Northeast



Observed regional emission trends linked to energy, agricultural, environmental policy

2010-2017 methane trend GOSAT + surface sites



Regional emission trends that are not well understood

2010-2017 methane trend



Increase in Northeast attributed to coal mine is inconsistent with bottomup information

Increase in Yangtze River Delta not fully explained by rice and aquaculture

Zhang et al., PNAS, 2022

Rice methane emissions observed by TROPOMI throughout different growth stages



Liang et al., in prep

Heading Ripening

Dominant water management mode indicated by observed seasonality

In collaboration with Qiwen Hu (SYU), Tingting Li (CAS)

CH4MOD simulations under different water management practices



Joint CH_4 - C_2H_6 -¹³ CH_4 simulation

Hypothesis: Increase in methane emissions over YRD driven by natural gas consumption

Nested 0.5x0.625 simulation (2012 heating season)

In collaboration with Yanli Zhang



Yujia Zhao



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Increase in urban C₂H₆ concentrations

Preliminary

In collaboration with Cheng Huang (Shanghai), Zhenning Xu (Hangzhou)



The trend is best matched with 4% leakage rate from NG consumption

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Shanghai (cold season average)

Hangzhou (cold season average)



The trend is best matched with 4% leakage rate from NG consumption

Limitation of satellite observations to constrain regional emissions

Averaging kernel sensitivities by inversion of GOSAT observations



Collecting more regional methane observations through mobile measurements







Direction

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- Model and observations are consistent in terms of regional gradients
- Difference in the magnitude of regional gradient can be used to constrain emissions





- Observed China's methane emission trends can be explained with changes in the energy and agricultural sectors.
- Joint analysis of CH₄ and C₂H₆ infers the leakage rate of natural consumption from end use.
- Long-range mobile measurements capture regional gradients that can be useful to constrain regional emissions.