

# Quantification of China's Methane Emissions Based on GOSAT and TROPOMI Satellite Observations



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### Greenhouse gas methane (CH<sub>4</sub>)



#### Radiative forcing

**Increases in last 40 years** 

IPCC AR6 2021

https://gml.noaa.gov/ccgg/trends\_ch4/

### **Methane emissions in China**



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## **Atmospheric methane emissions**



## Satellite as a monitoring platform for methane emissions



### Study 1: Comparison of emissions inferred from GOSAT and TROPOMI

#### XCH<sub>4</sub> observations from two different satellite instruments



Liang et al., ACP, in review https://doi.org/10.5194/acp-2022-508

### **TROPOMI inversion vs. GOSAT inversion**



## **Evaluation with independent surface observations**

● surface in situ ▲ surface column – airplane

XH: Minqiang Zhou (CAS) HF: Cheng Liu (USTC)



<sup>\*</sup>间接比较:观测2012-2014

## **Reasons for discrepancies**

### Systematic biases in satellite XCH<sub>4</sub> TROPOMI-GOSAT (ppb)



Concurrent TROPOMI and GOSAT observations

ppbv

#### **Observation coverage and density**



GOSAT inversion falsely attribute mismatch over Bangladesh to North India emissions

## Study 2: Recent trends in China's methane emissions

#### **Observations** – satellite + surface network (2010-2017)

- GOSAT CO<sub>2</sub> proxy retrieval from University of Leicester
- Surface observations



Zhang et al., PNAS, 2022

### Emission trend linked to energy, agricultural, environmental policy



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#### 2010-2017 rice methane trend



Mg km<sup>-2</sup> 
$$a^{-2}$$
 -0.8 -0.4 0.0 0.4 0.8

**Unexpected increase** as no changes in cultivation area

- Overlap spatially with aquaculture?
- Increased intensity due to more straw return?



Data source: G. Zhang 2011; Z. Shi 2016

## **Summary**

- High-quality ground-based observations are crucial for evaluating and improving the satellite-based monitoring system for methane.
- Regional trends linked to energy, agricultural, and environmental policies can be observed by atmospheric observations, demonstrating the usefulness for such a system to track regional methane emissions.



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