Quantify Natural Gas Methane Emissions from a city cluster in East-China

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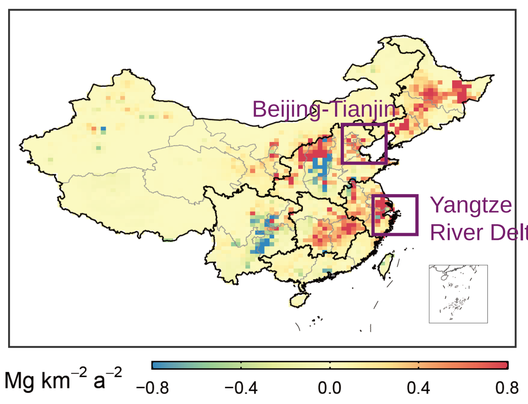
Motivation

- Natural gas (NG) account for ~60% CH_4 emissions in cities;
- NG consumption increased 2.5 times from 2010 to 2022;
- Strong increase of CH_4 emission trend in mega-city clusters



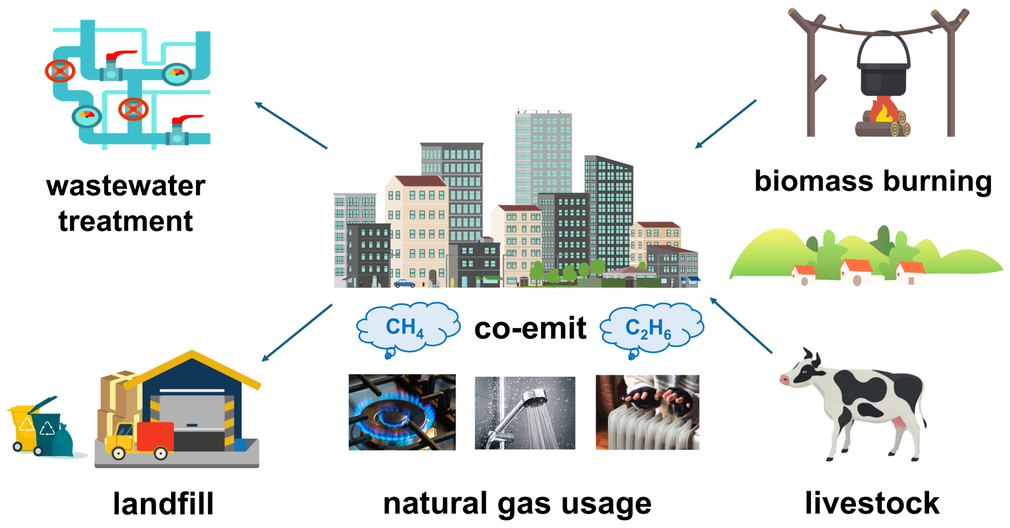
Questions:

Any contributions from natural gas usage?

Or it was wastewater or landfills?

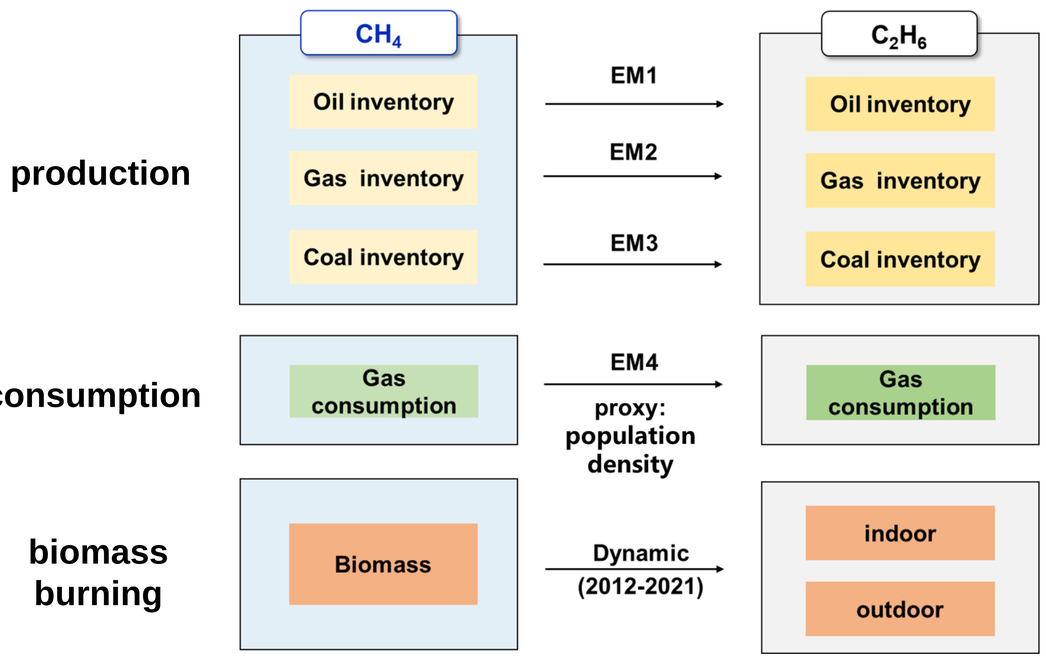
Source attribution

- Multiple CH_4 sources are co-located in cities;
- C_2H_6 is co-emit with fossil CH_4 at a constant C_2H_6-to-CH_4 ratio (EMR), which can help to constrain NG source CH_4 in cities



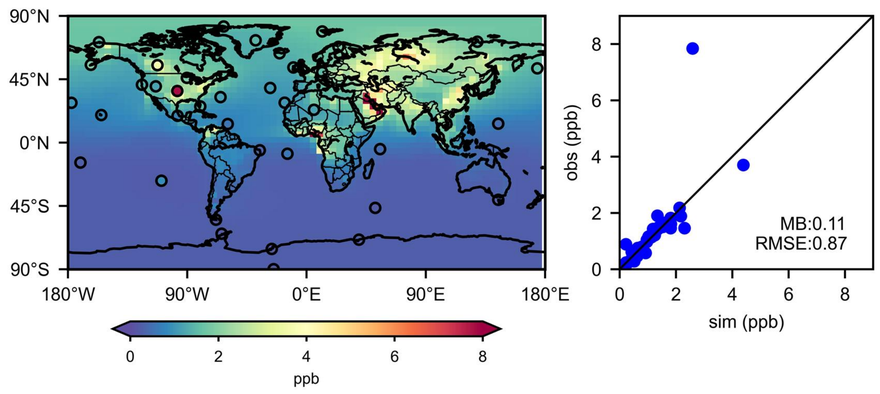
Inventory

- Previous study ignore the impact of biomass burning (North America);
- Lack of consistent CH_4 and C_2H_6 emission inventories (the same underlying activity and distribution);

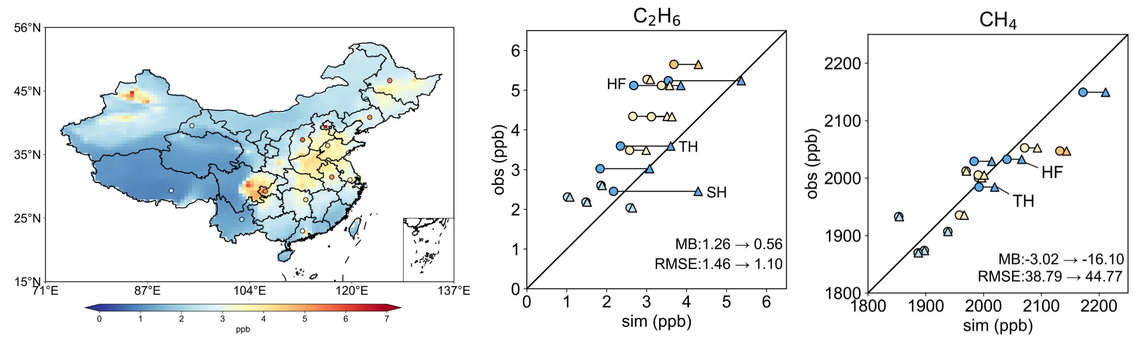


Results

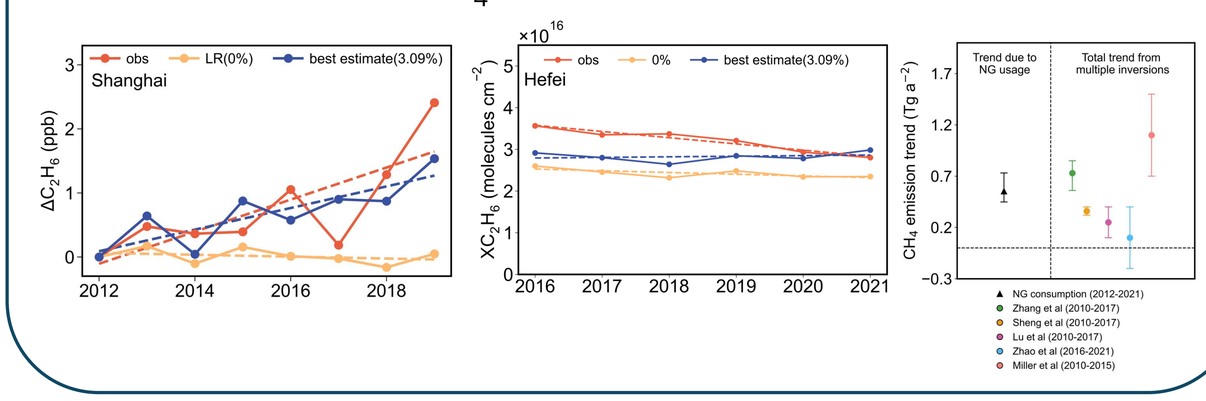
- Global simulation (4°x5°) provide boundary condition for regional simulation (0.5°x0.625°)



- Simulation captures spatial distribution of CH_4 and C_2H_6;
- Tends to underestimate C_2H_6 in fossil fuel production and consumption regions



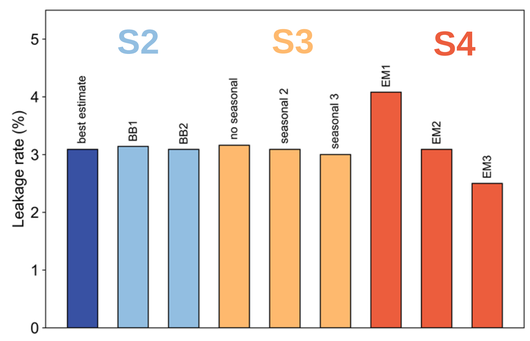
- NG consumption is the main driver of elevated C_2H_6 concentration in YRD and may also contribute significantly to recent national CH_4 emission trends.



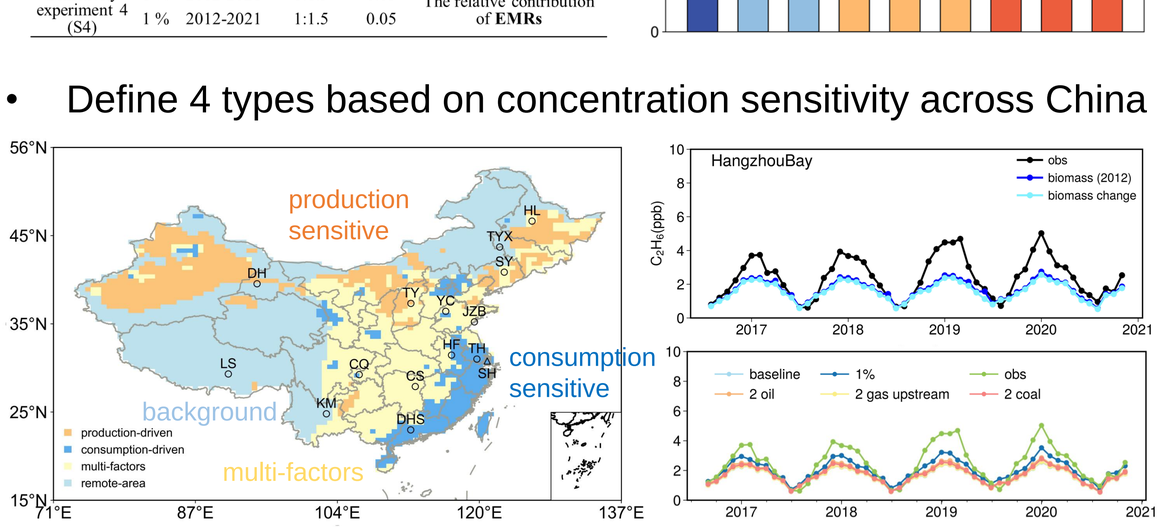
Uncertainty

- Considering biomass emissions, seasonal variation and EMR

ID	LR	Biomass burning	Seasonal variation	EMR	Major purposes
Base simulation	0%	2012-2021	1:1.5	0.04	Baseline scenario
Sensitivity experiment 1 (S1)	1 %	2012-2021	1:1.5	0.04	The relative contribution of leakage rate
Sensitivity experiment 2 (S2)	1 %	2012	1:1.5	0.04	The relative contribution of **biomass burning** spatial distribution and magnitude
Sensitivity experiment 3 (S3)	1 %	2012-2021	1:1	0.04	The relative contribution of **seasonal variation** of NG consumption in warm season vs. cold season
	1 %	2012-2021	1:1.875	0.04	
Sensitivity experiment 4 (S4)	1 %	2012-2021	1:1.5	0.03	The relative contribution of **EMRs**
	1 %	2012-2021	1:1.5	0.05	



- Define 4 types based on concentration sensitivity across China



- C_2H_6 concentrations insensitive to fossil production and biomass

Take home messages

- **NG consumption is a missing source in current inventory. It is the main driver of the elevated C_2H_6 concentration in YRD;**
- **C_2H_6 background concentration at Hefei is decline;**
- **3.09 [2.5–4.1] % of supply NG leak into atmosphere, contribute 6.4 [5.1-8.4] % of anthropogenic CH_4 emission in YRD**

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