

Supplemental Information for

Shifting Drivers of China's Methane Emissions amid Economic Growth and Mitigation between 2019–2024

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Table S1. Regional divisions and corresponding provinces of Chinese mainland.

Region	Provinces
North China	Beijing, Tianjin, Shanxi, Hebei, Inner Mongolia
East China	Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong, Taiwan
Northwest China	Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang
Southwest China	Sichuan, Guizhou, Yunnan, Chongqing, Tibet
South China	Guangdong, Guangxi, Hainan, Henan, Hubei, Hunan
Northeast China	Heilongjiang, Jilin, Liaoning

Source: [1]

Table S2. Comparison of surface ObsPack CH₄ observations with prior and posterior inversion results.

Site	Type	Lat (°N)	Lon (°E)	r (ObsPack vs. prior)	r (ObsPack vs. posterior)	ObsPack- Prior (mean ± 1σ)	ObsPack- Posterior (mean ± 1σ)	n
TAP	flask	36.74	126.13	0.69	0.69	5.5 ± 46.6	2.3 ± 48.3	376
RYO	insitu	39.03	141.82	0.84	0.85	-1.1 ± 21.5	-2.5 ± 21.7	41151
WLG	flask	36.29	100.90	0.73	0.72	32.1 ± 21.4	32.2 ± 21.4	244
UUM	flask	44.45	111.10	0.62	0.61	11.6 ± 23.1	11.9 ± 23.2	92
AMY	flask	36.54	126.33	0.55	0.61	-4.2 ± 50.8	-11.0 ± 51.1	272

* r denotes the Pearson correlation coefficient.

* n denotes the number of valid observations included in the analysis.

* ObsPack data were obtained from the dataset

obspack_ch4_1_GLOBALVIEWplus_v7.0_2024-10-29 [2].

Table S3. Comparison of annual CH₄ emission trends from our study and existing top-down and bottom-up estimates.

Study	Time period	Trend (Tg yr ⁻²)	95% confidence interval (Tg yr ⁻²)
Our study	2019–2024	0.8	± 0.5
Our study (anthropogenic)		0.7	± 0.7
Top-down			
GONGGA-CH ₄ [3]	2014–2018	0.5	± 3.9
GCP_Surface [4]		0.0	± 1.9
GCP_Satellite [4]		0.6	± 3.1
Janardanan et al. (2024) [5]		-0.1	± 3.4
Mean ± 1 standard error		0.2 ± 0.4	
Bottom-up			
EDGAR_v8 [6]	2014–2018	0.0	± 1.4
EDGAR_2024 [7]		0.1	± 1.2
FAO [8]		0.0	± 1.3
PKU-CH ₄ v2 [9, 10]		-0.9	± 1.7
CEDS_2025_03_18 [11]		0.0	± 1.4
MMCP-v1 [12]		-0.8	± 1.3
Mean ± 1 standard error		-0.3 ± 0.4	

* Emission trends were calculated using the Mann-Kendall test.



Figure S1. Map of provincial divisions grouped by six major regions in China. The six regions include North, Northeast, East, South, Southwest, and Northwest China, as defined in Table S1.

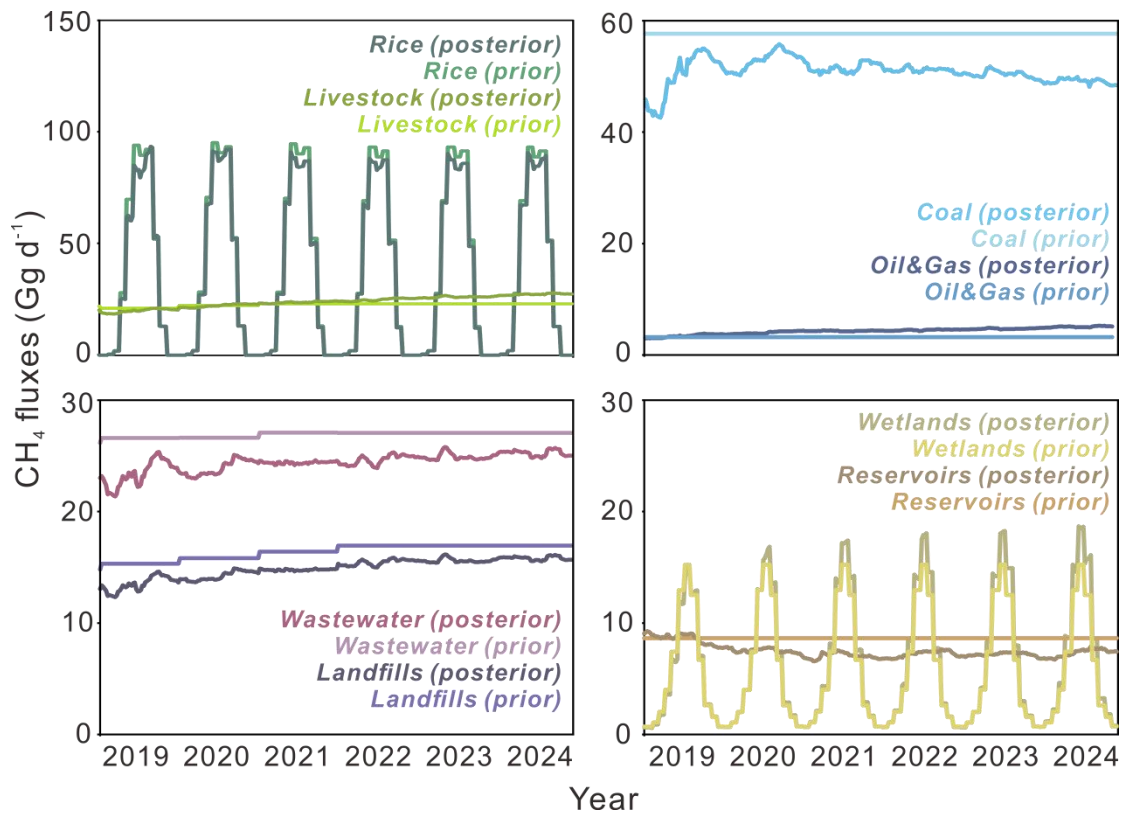


Figure S2. Weekly CH₄ emission fluxes from key sectors in China during 2019–2024. The sectors include rice cultivation, livestock, coal mining, oil and gas system, wastewater, landfills, wetlands, and reservoirs.

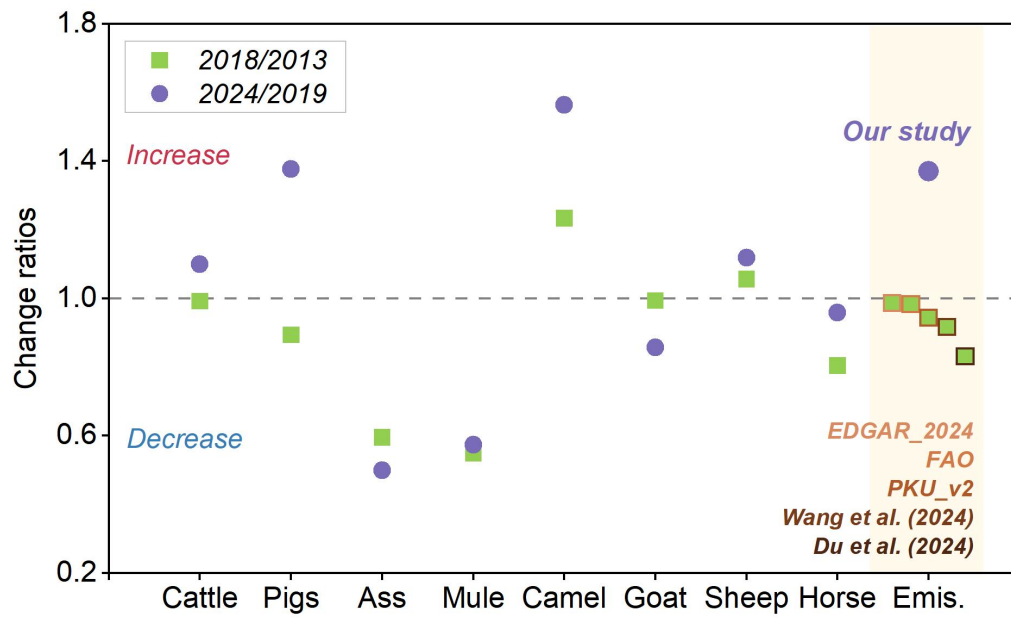


Figure S3. Comparison of livestock population and CH₄ emission changes between 2013–2018 (green) and 2019–2024 (purple). Emission ratios for 2018 relative to 2013 are derived from EDGAR_2024 [7], FAO [8], PKU_v2 [9, 10], Wang et al. (2024) [13], and Du et al. (2024) [14].

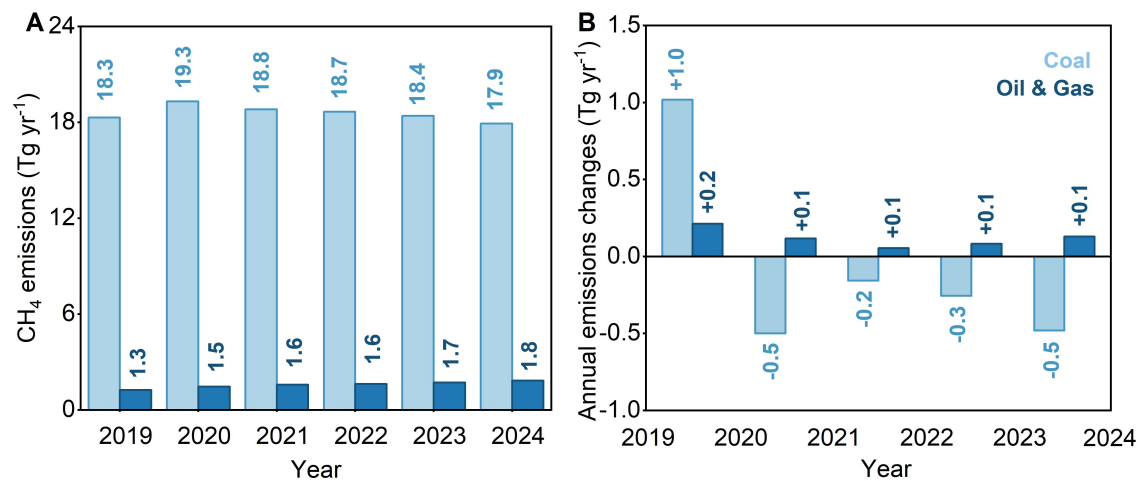


Figure S4. Annual CH₄ emissions (A) and interannual emission changes (B) for the coal and oil & gas sectors from 2019 to 2024.

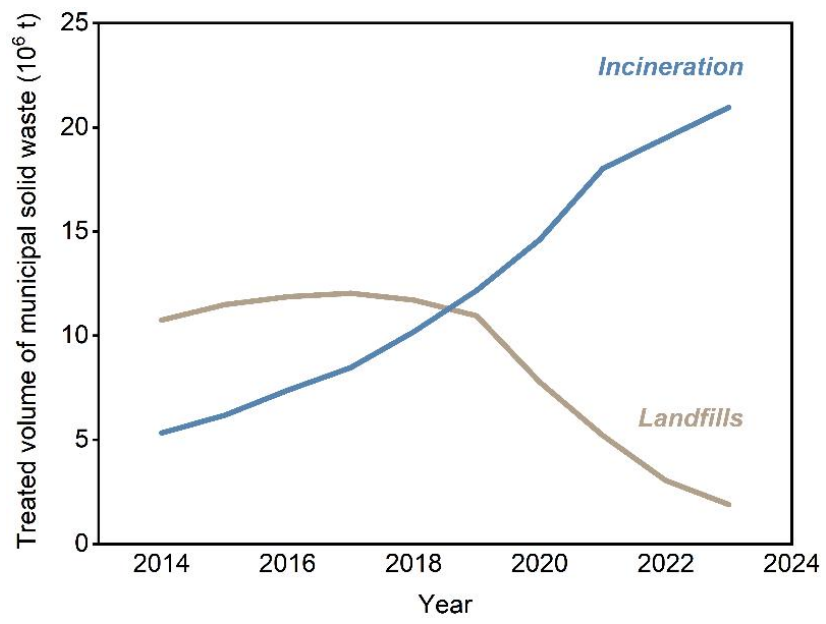


Figure S5. The treated volume of municipal solid waste by landfills and incineration.

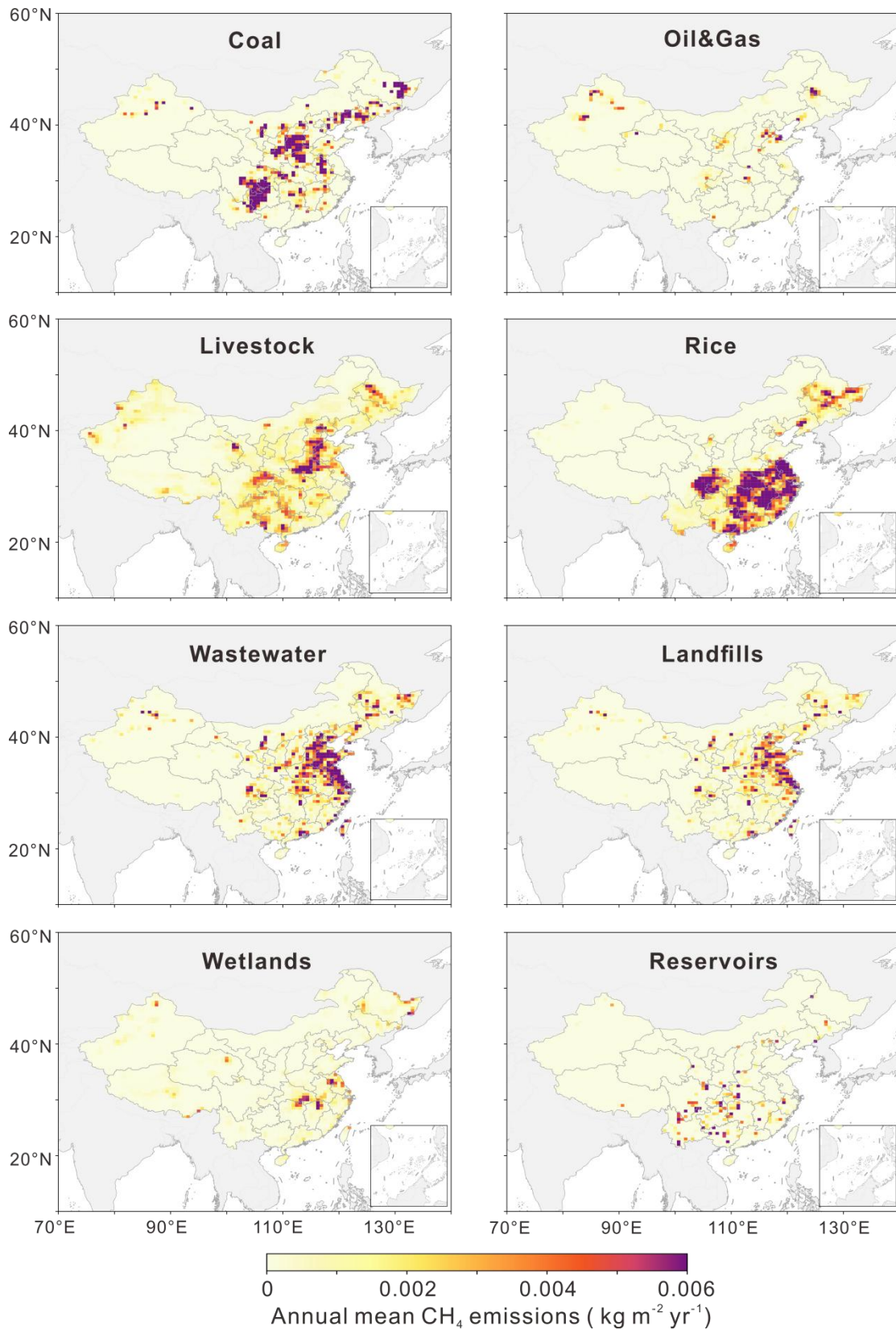


Figure S6. Spatial distribution of sectoral mean CH_4 emissions between 2019 and 2024.

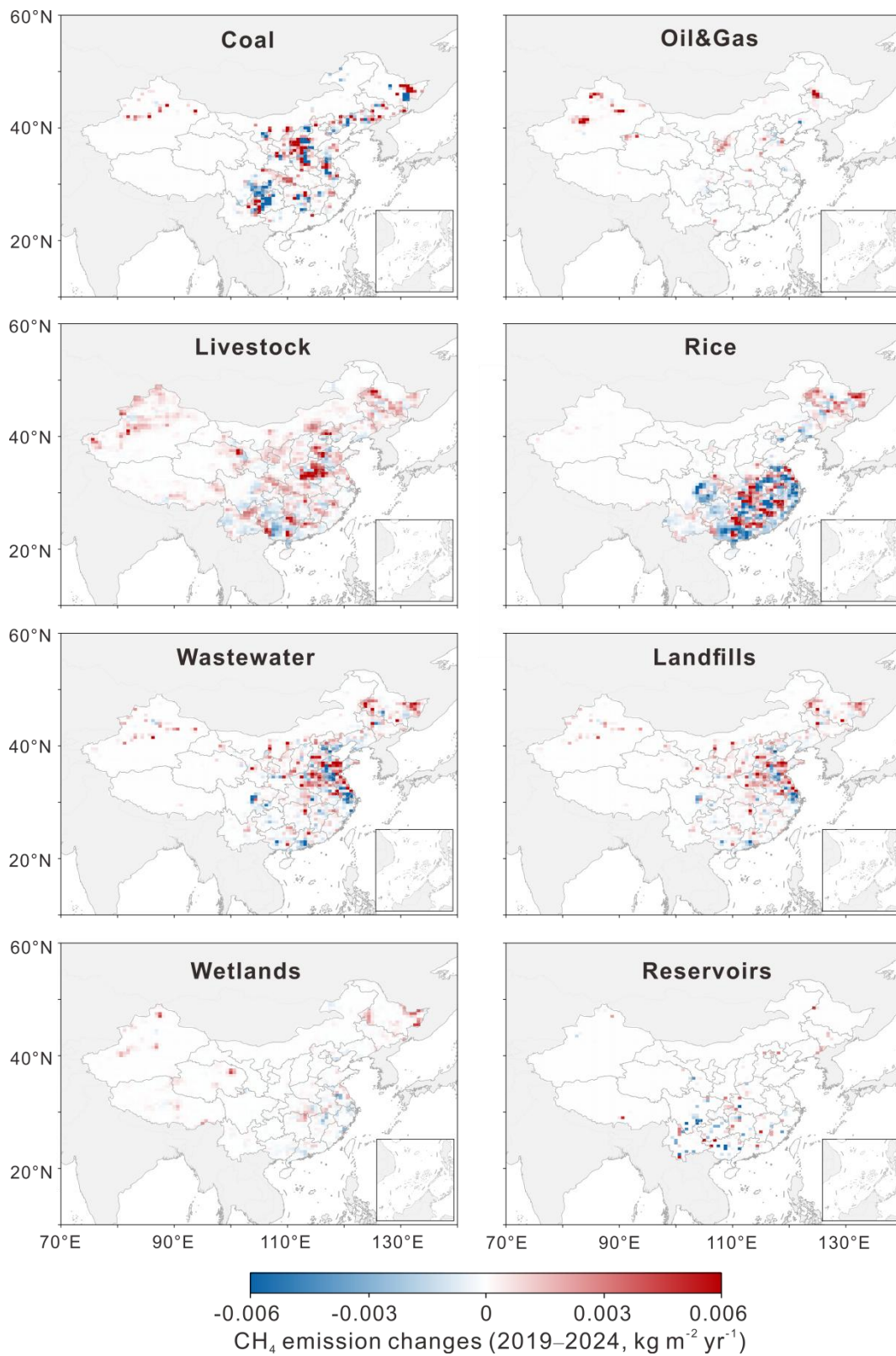


Figure S7. Spatial distribution of sectoral CH₄ emission changes from 2019 to 2024.

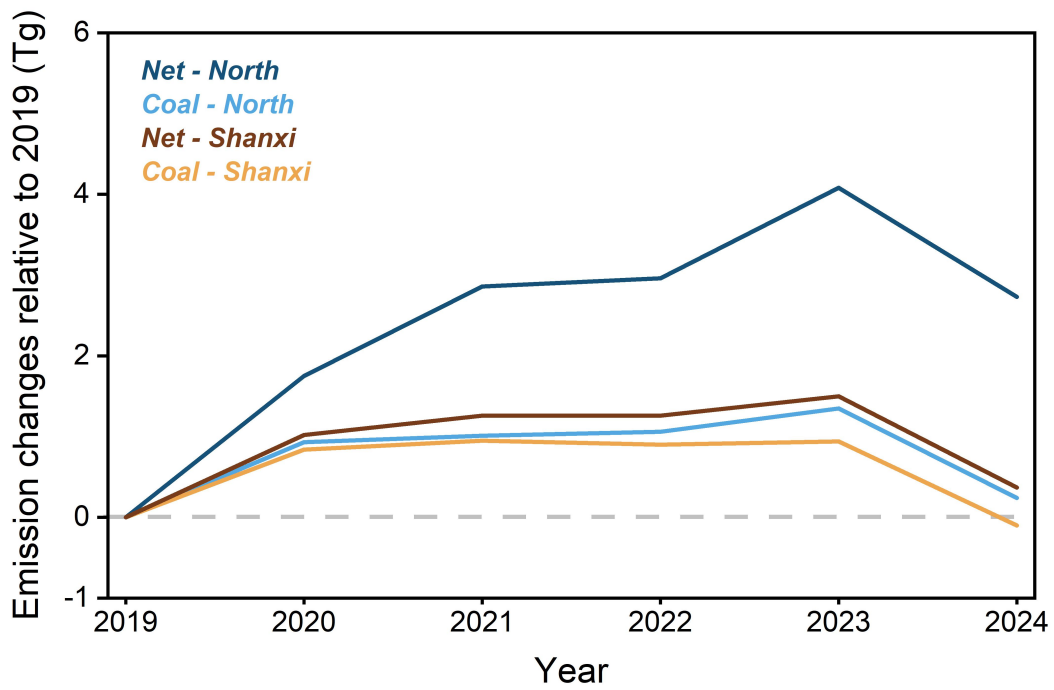


Figure S8. Annual net and coal CH₄ emission changes relative to 2019 for North China and Shanxi Province from 2010 to 2024.

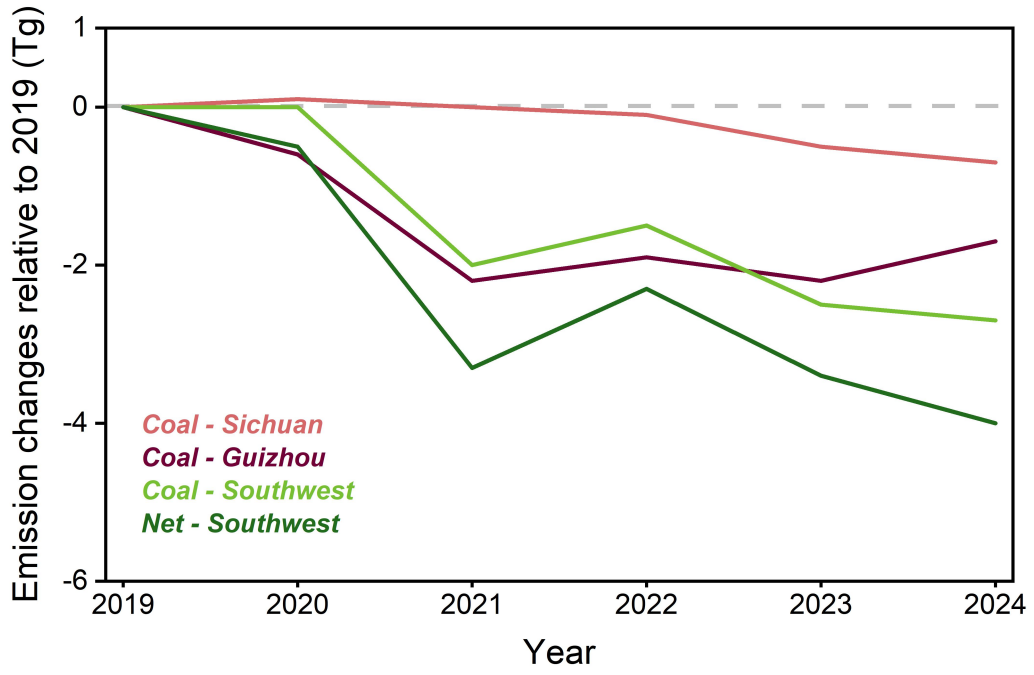


Figure S9. Annual net and coal CH₄ emission changes relative to 2019 for Southwest China, Sichuan Province, Guizhou Province, and Chongqing City.

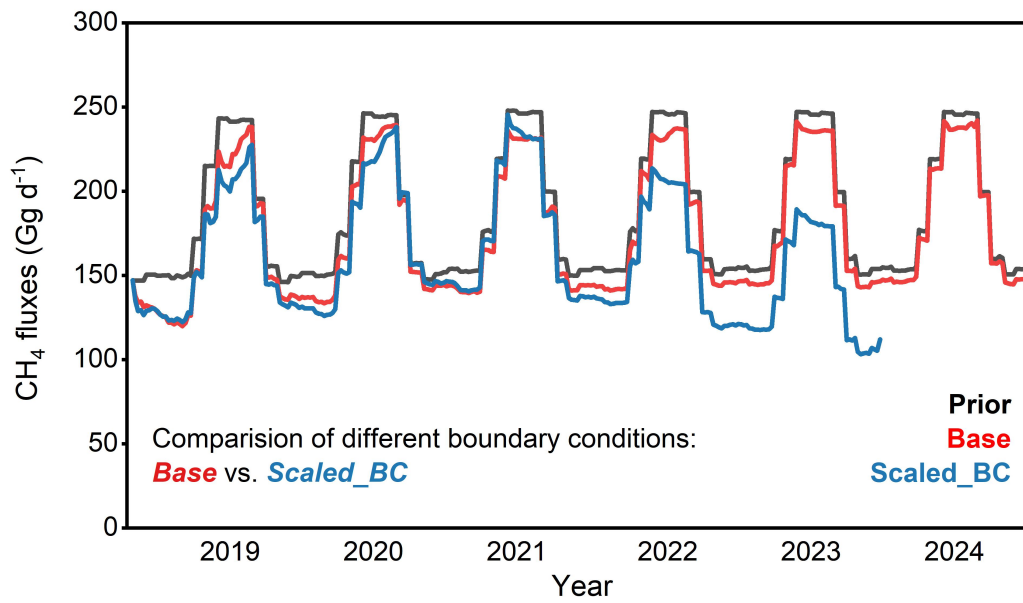


Figure S10. Comparison of China's weekly CH₄ emission fluxes under different boundary condition configurations.

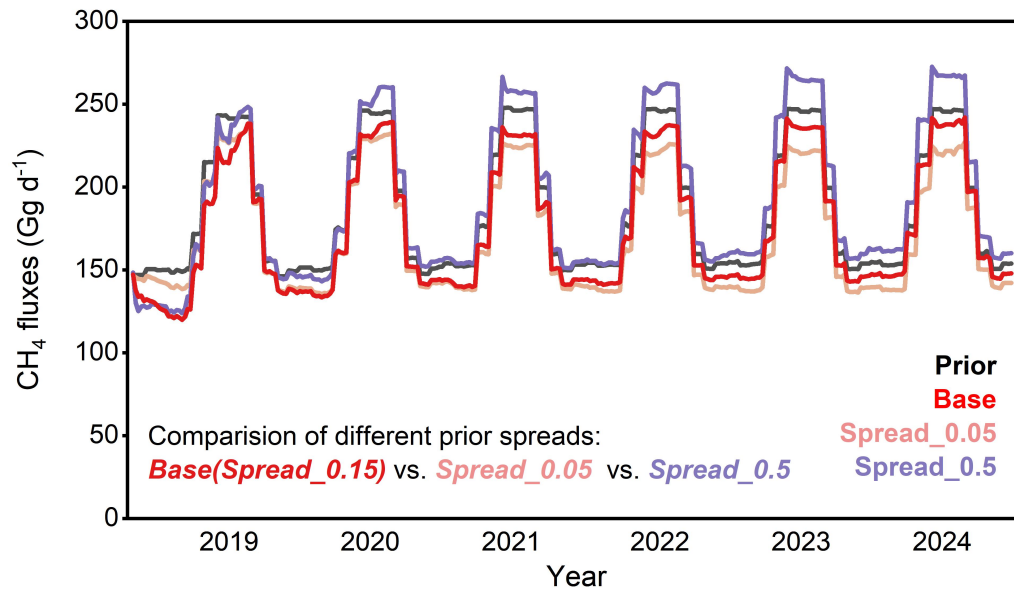


Figure S11. Comparison of China's weekly CH₄ emission fluxes under different prior spreads settings.

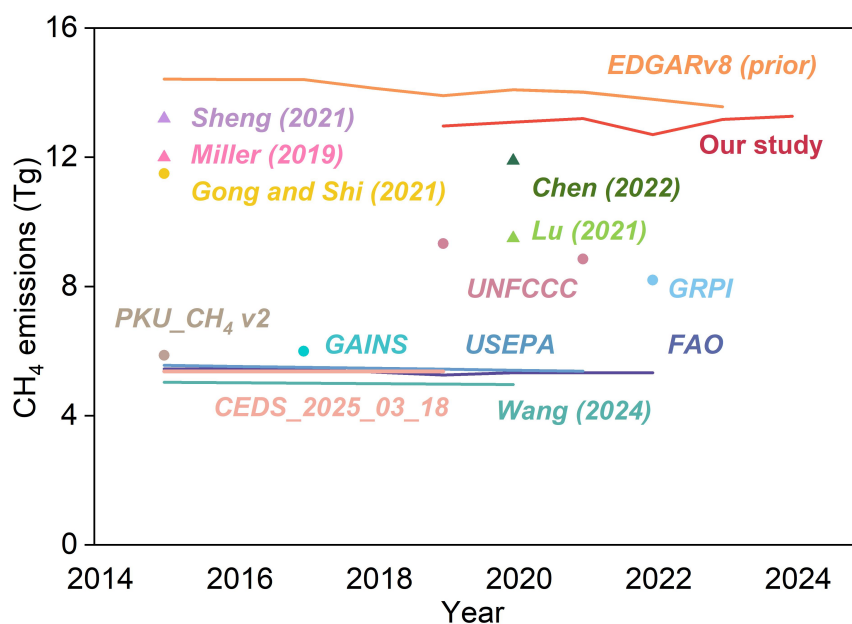


Figure S12. Comparisons of China's CH₄ emissions for rice cultivation between 2015 and 2024. Previous estimates includes Sheng et al. (2021) [15], Miller et al. (2019) [16], Gong and Shi (2021) [17], Huang et al. (2019), Chen et al. (2022) [18], Lu et al. (2021) [19], Wang et al. (2024) [20], PKU-CH₄ v2 [10, 21], United Nations Framework Convention on Climate Change (UNFCCC) [22], EDGARv8 [6], Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) model [23], CEDS_2025_03_18 [11], USEPA [24], FAO [25], and GRPI [26].

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