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Updated Global Fuel Exploitation Inventory (GFEI) for methane emissions from the oil, gas, and coal sectors: evaluation with inversions of atmospheric methane observations

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Table S1. Methane emissions from oil and gas production by country (Tg a^{-1})[a]

	Oil production			Gas production		
	GFEI v2	GFEI v1	Lu21	GFEI v2	GFEI v1	Lu21
Russia	1.8	20.4	12.6	0.12	0.12	0.08
US	1.8	1.7	2.3	3.5	4.3	6.7
Venezuela	3.3	3.2	7.7	-	-	-
Uzbekistan	0.01	-	-	0.05	0.09	0.15
Canada	0.75	0.87	2.0	0.64	0.24	0.92
Turkmenistan	0.87	0.88	1.8	0.16	0.15	0.33
Iran	3.7	3.7	2.2	0.10	0.10	0.07
Angola	1.2	1.2	1.7	-	-	-
Côte d'Ivoire	0.72	0.85	0.94	0.02	0.02	0.02
Ukraine	0.06	0.06	0.05	0.35	0.41	0.35
Algeria	0.05	0.04	0.04	0.62	0.59	0.39
China	0.98	1.0	0.64	0.02	0.02	0.01
UAE	1.3	1.3	0.68	0.01	0.01	0.01
Nigeria	2.1	0.19	0.10	0.90	0.04	0.02
Iraq	2.8	0.04	0.05	-	-	-

[a] Oil/gas methane emissions related to exploration and production activities are shown for GFEI v1 (Scarpelli et al., 2020a) and GFEI v2 for 2016 with emissions based on UNFCCC reporting. Emissions are also shown for the inversion of Lu et al. (2021; Lu21) for 2010-2017. We include countries with GFEI v1, GFEI v2, or Lu21 oil/gas emissions greater than 1 Tg a^{-1}. US - United States; UAE - United Arab Emirates. The dash - indicates that an estimate is less than 0.01 Tg a^{-1} for a given country.

Table S2. Methane emissions from gas subsectors by country (Tg a^{-1})[a]

	Gas processing			Gas transmission			Gas distribution		
	GFEI v2	GFEI v1	Lu21	GFEI v2	GFEI v1	Lu21	GFEI v2	GFEI v1	Lu21
Russia	-	-	-	1.8	3.8	2.7	0.49	0.49	0.36
US	0.45	0.45	0.71	1.4	1.3	1.7	0.57	0.48	0.59
Venezuela	-	-	-	-	-	-	-	-	-
Uzbekistan	0.68	1.1	1.7	0.65	1.2	1.8	0.28	0.36	0.66
Canada	0.02	0.02	0.04	0.09	0.49	1.0	0.04	0.04	0.04
Turkmenistan	0.06	0.06	0.16	0.09	0.09	0.21	0.22	0.22	0.61
Iran	0.04	0.04	0.01	0.06	0.06	0.07	0.28	0.28	0.46
Angola	-	-	-	-	-	-	-	-	-
Côte d'Ivoire	0.01	0.01	0.01	0.01	0.01	0.02	0.07	0.07	0.08
Ukraine	0.02	0.02	0.02	0.11	0.21	0.21	0.53	0.40	0.40
Algeria	0.16	0.15	0.12	0.21	0.19	0.15	0.13	0.26	0.23
China	0.01	-	-	0.02	0.02	0.01	0.08	0.07	0.05
UAE	-	-	-	0.01	-	-	0.04	0.04	0.01
Nigeria	-	0.09	0.07	0.02	0.02	0.01	0.08	0.08	0.06
Iraq	-	-	-	-	-	-	0.01	-	-

[a] Oil/gas methane emissions related to gas processing, transmission, and distribution activities are shown for GFEI v1 (Scarpelli et al., 2020a) and GFEI v2 for 2016 with emissions based on UNFCCC reporting. Emissions are also shown for the inversion of Lu et al. (2021; Lu21) for 2010-2017. We include countries with GFEI v1, GFEI v2, or Lu21 oil/gas emissions greater than 1 Tg a^{-1}. US - United States; UAE - United Arab Emirates. The dash - indicates that an estimate is less than 0.01 Tg a^{-1} for a given country.

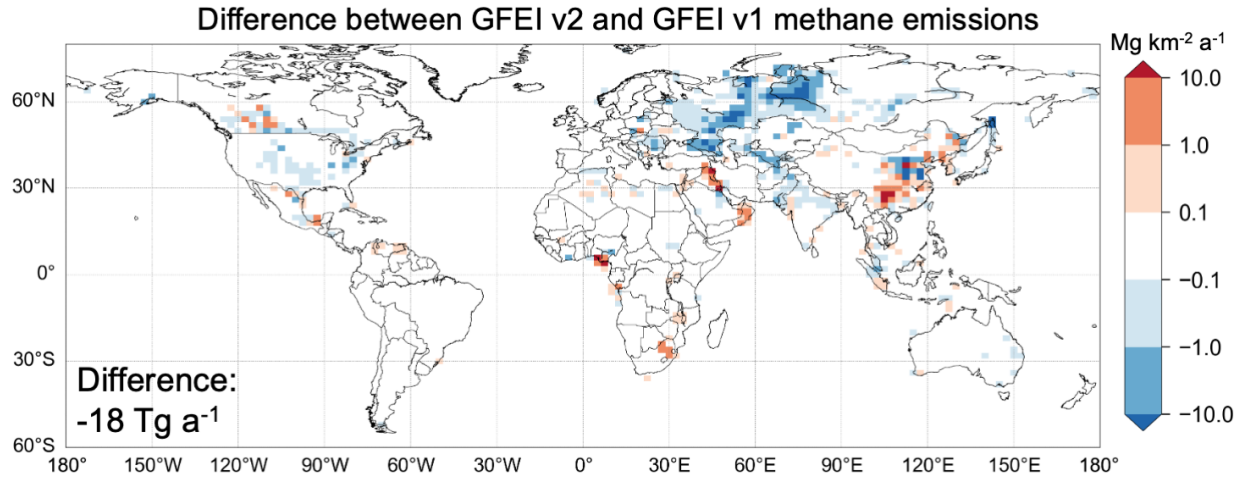

Figure S1. Methane emissions difference between GFEI v2 and GFEI v1 in 2016. Emissions are at 2° x 2.5° grid resolution with the global difference inset.

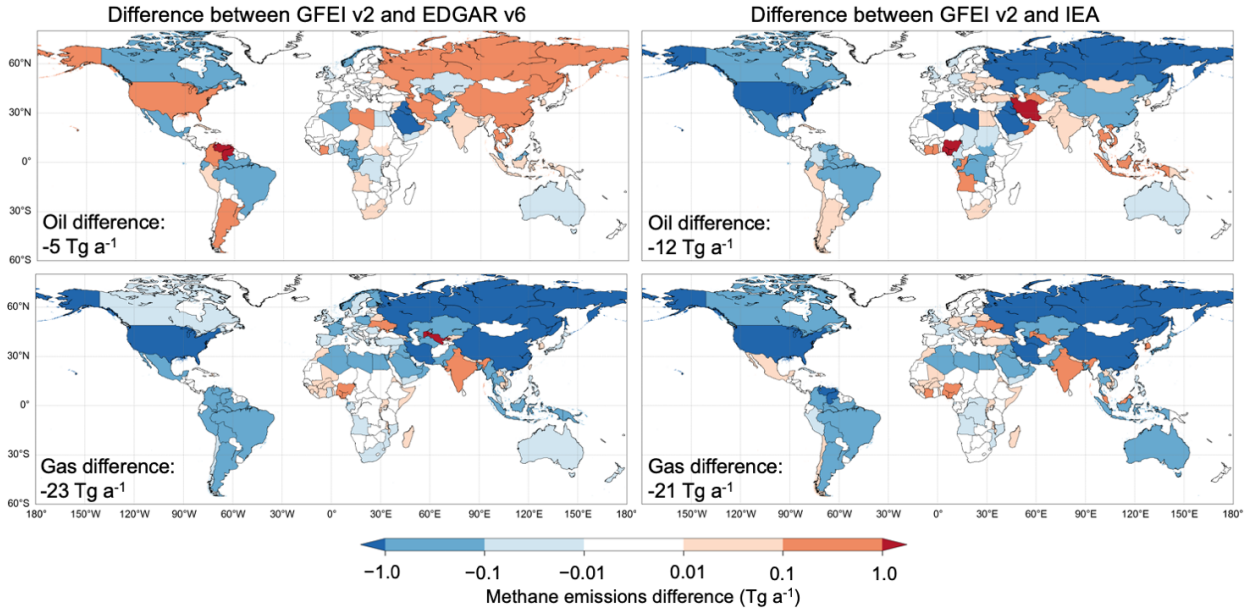

Figure S2. Comparison of oil/gas methane emissions in bottom-up inventories by country. The emissions differences by country between GFEI v2 (2018) and EDGAR v6 (2018) are shown in the first column with the global emissions difference inset. The emissions differences by country between GFEI v2 (2019) and the IEA estimates (2019) are shown in the second column.

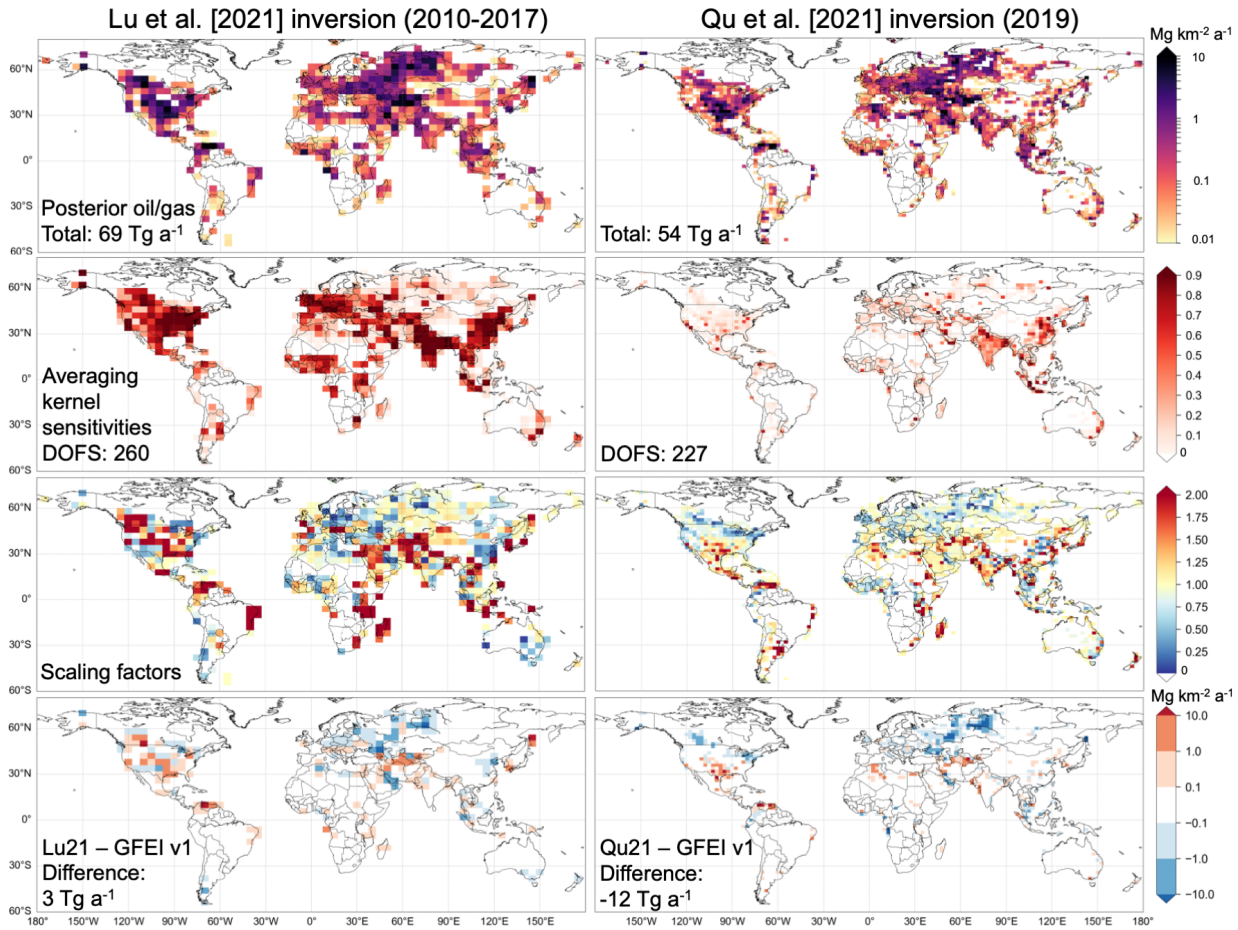

Figure S3. Global posterior distribution of oil/gas methane emissions in the Lu et al. (2021; Lu21) and Qu et al. (2021; Qu21) inversions. Both inversions use GFEI v1 as a prior estimate. The top row panels show the posterior oil/gas emissions at 4° x 5° for Lu21 and 2° x 2.5° for Qu21. The corresponding averaging kernel sensitivities, scaling factors, and absolute emissions difference are also shown. For all plots we only show results for grid cells with posterior oil/gas emissions of 0.01 Mg km^{-2} a^{-1} or greater.