Supporting Information for

Modelling wetland methane emission estimates by leveraging new observations of anthropogenic point-source plumes

Anthony Campbell[1,2], Lauren Potyk[1,3], Benjamin Poulter[1*,4]

[1] Biospheric Sciences Laboratory, Goddard Space Flight Center, NASA, Greenbelt, MD, USA
[2] Goddard Earth and Technology Research II, University of Maryland, Baltimore County, Baltimore, MD, USA
[3] John A. Paulson School of Engineering and Applied Sciences, Harvard University, Cambridge, MA, USA
[4] Spark Climate Solutions,
*Work done while at the institution

Correspondence to: Anthony Campbell (Anthony.d.campbell@nasa.gov)

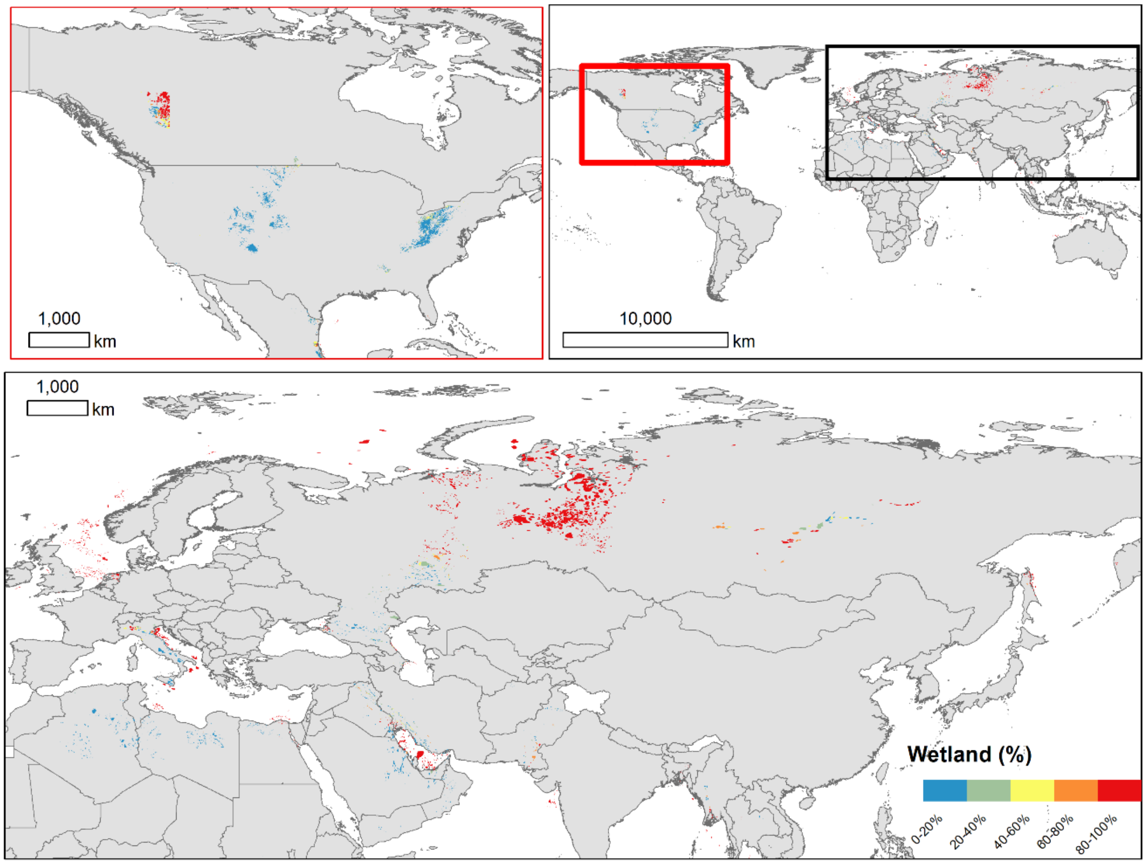

Figure S1. The percentage of area occupied by wetlands and waterbodies within individual oil and natural gas fields. Calculated using the Oil and Gas Infrastructure Mapping dataset (OGIM 1.1) and the Global Lake and Wetland Dataset (GLWD 2.0; Omara et al. 2023; Lehner 2024).

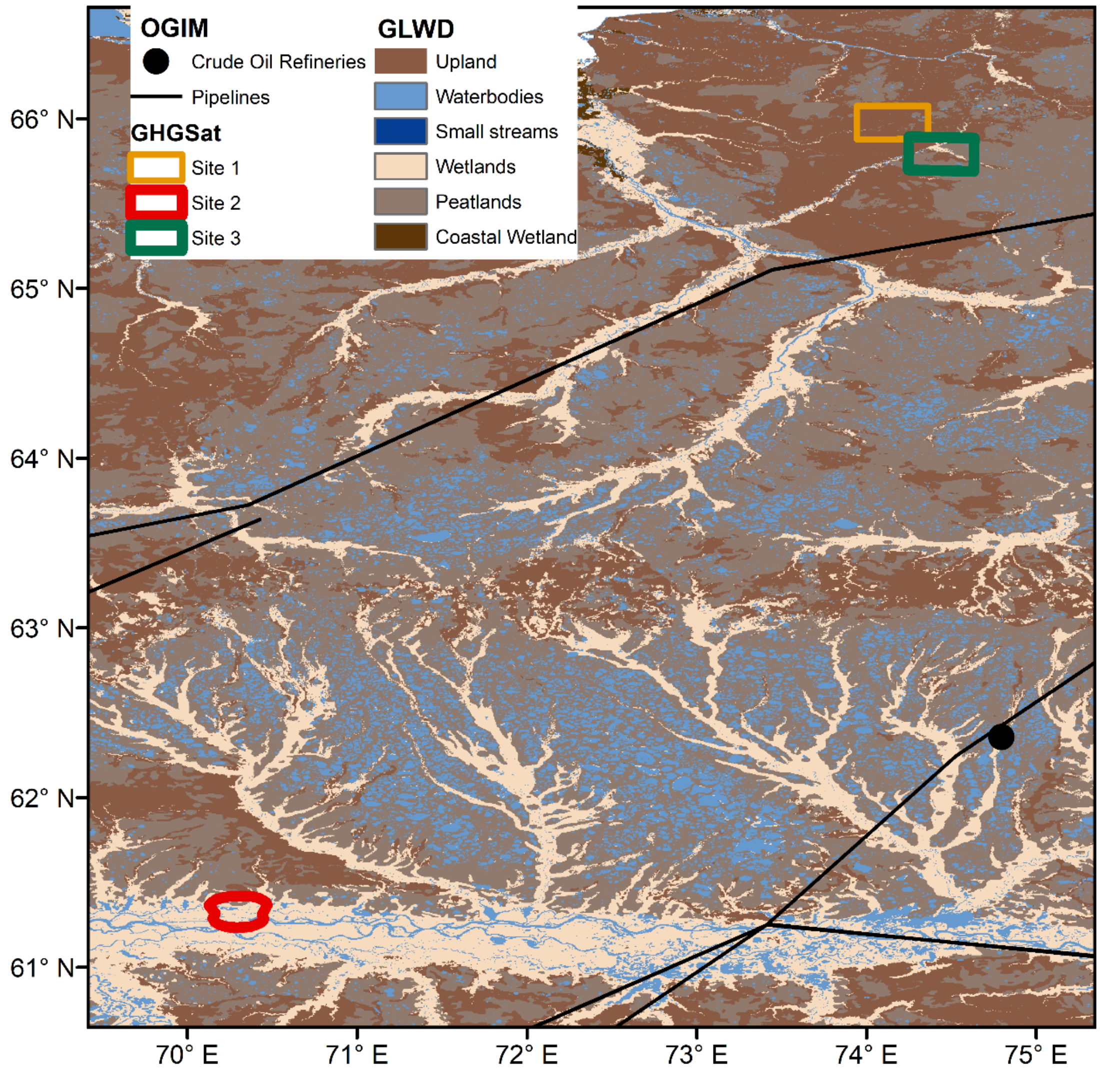

Figure S2. The location of our GHGSat sites, facilities and pipelines from (OGIM) and the extent of waterbodies, wetlands, and peatlands within the region (GLWD; Lehrner et al. 2024).

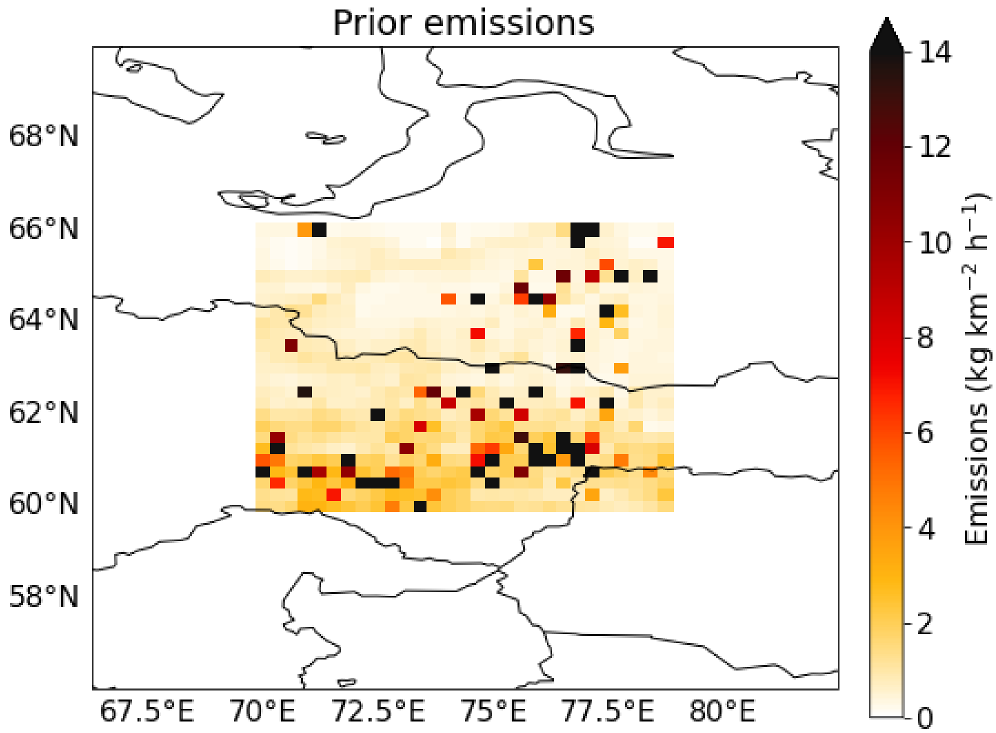

Figure S3. The result of the updated prior emissions for the Western Siberian Lowlands.

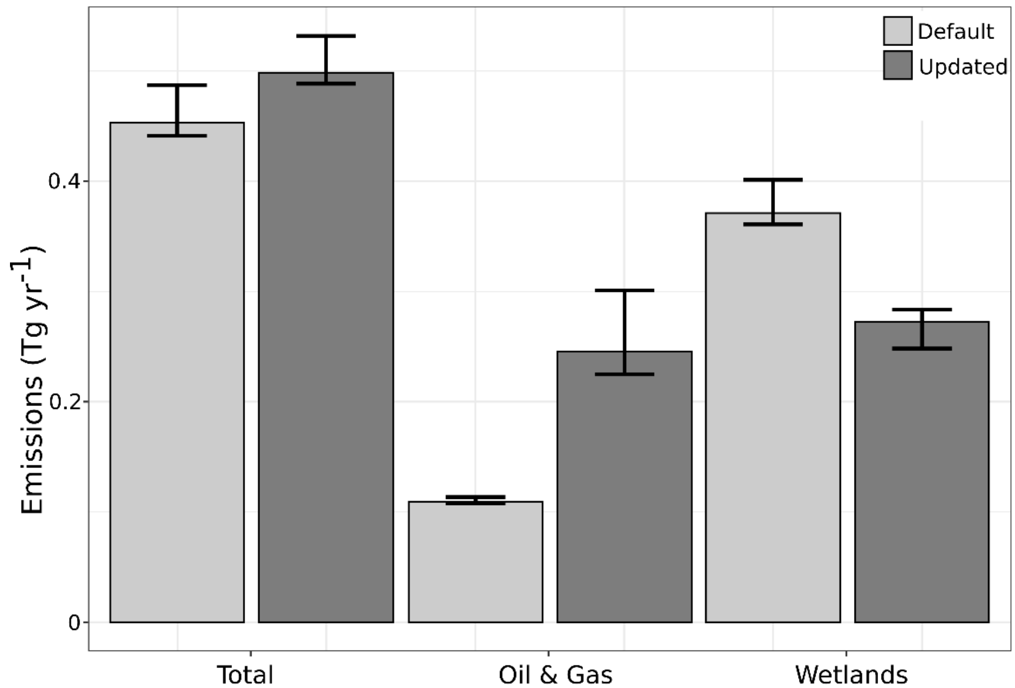

Figure S4. The posterior flux estimates scaled to only the months observed in the IMI model (06/01/2021 to 07/31/2021) total emissions, oil and gas, and wetlands for both the default and updated model runs.

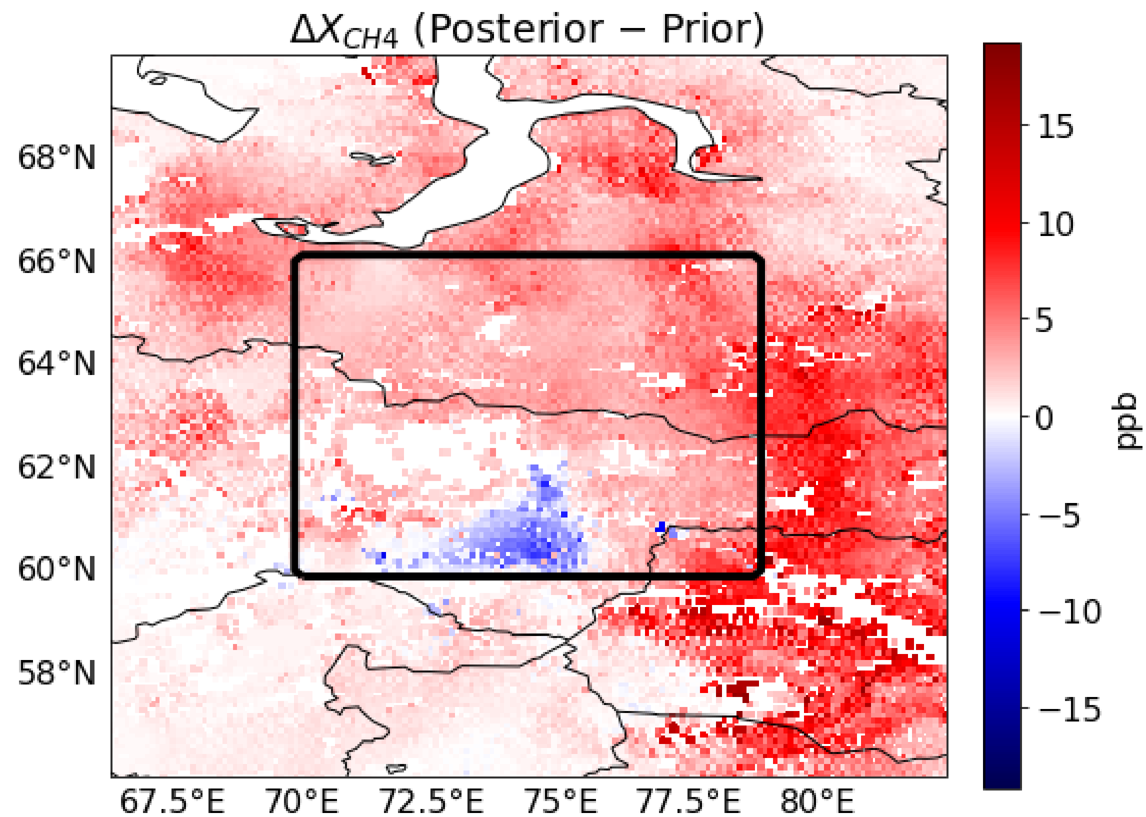

Figure S5: The difference between posterior and prior estimates for the default model.

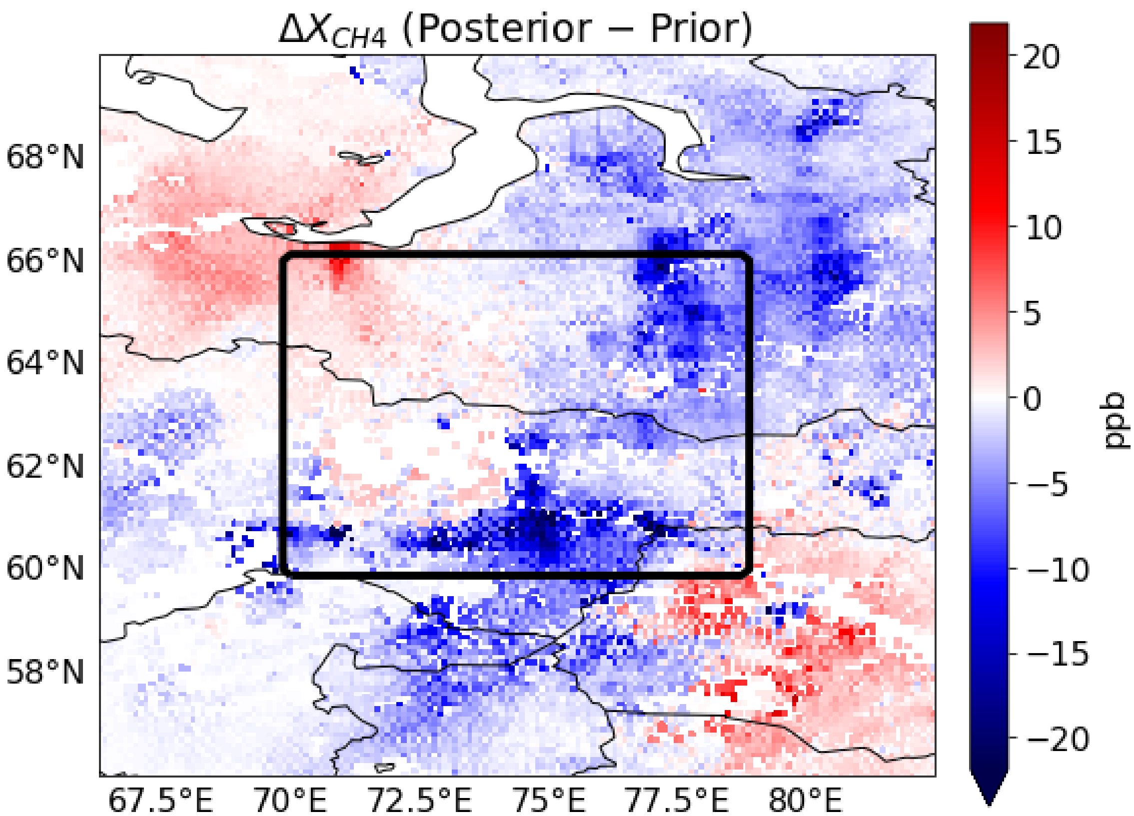

Figure S6: The difference between posterior and prior estimates for the updated model.

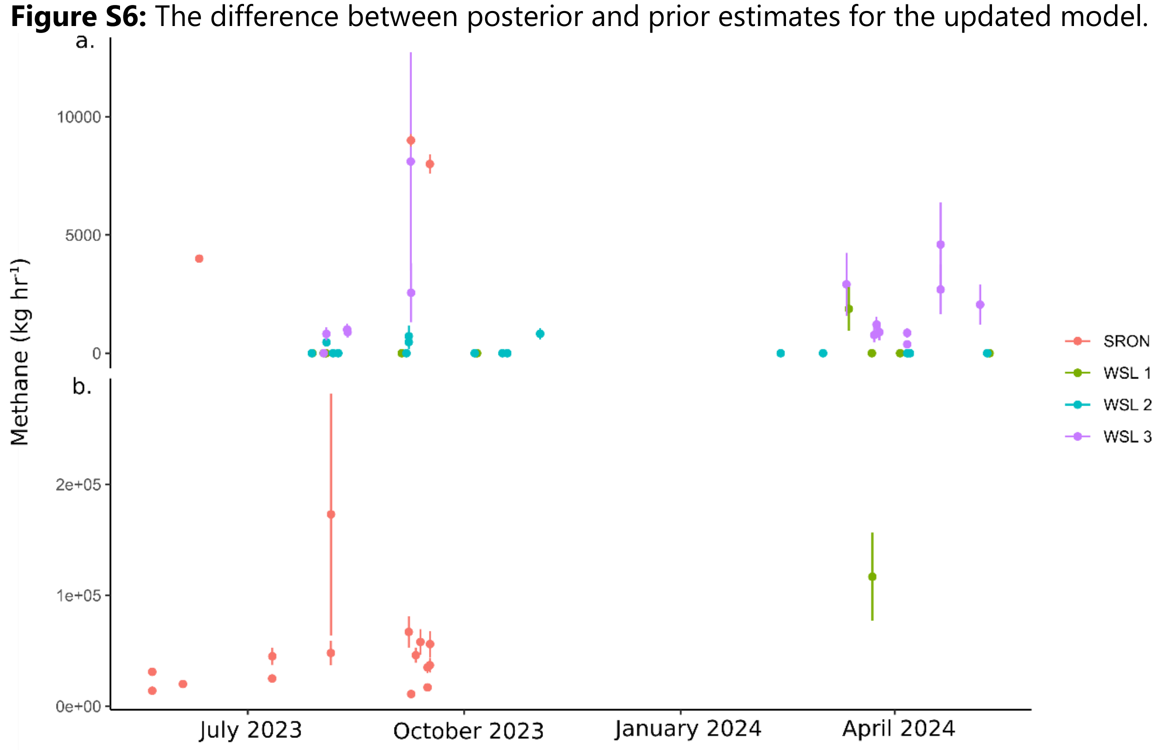

Figure S7. a. Low emissions plumes (< 10,000 kg CH_4 hr^{-1}) from SRON and GHGSat observations. b. High emissions plumes (>100,000 kg CH_4 hr^{-1}).

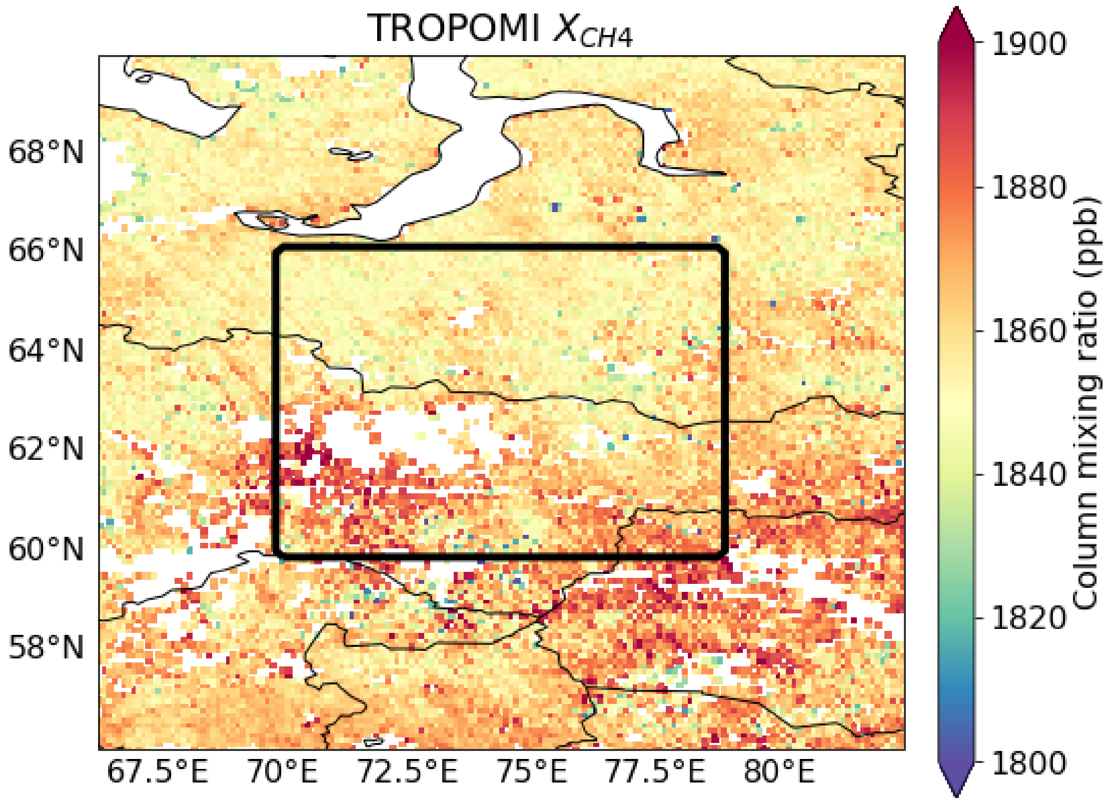

Figure S8: Mean TROPOMI XCH4 column concentration at 0.1° x 0.1°. White areas are gaps with no TROPOMI data.

Table S1. GHGSat satellite acquisitions for all regions examined for this study including # of observations and # of plume observations.

Region	Dates	Observations	Plume observations
Mississippi Delta	2023-11-05; 2024-02-21; 2024-03-12; 2023-12-19; 2024-02-20; 2024-02-06; 2023-12-19; 2023-12-06; 2024-02-18; 2024-03-26; 2024-01-20; 2024-02-04; 2023-12-15; 2024-03-22; 2024-01-19; 2024-02-02; 2023-11-04; 2024-01-31	18	1
North Slope	2023-09-25; 2023-06-24; 2023-07-01; 2023-08-05; 2023-09-27; 2024-04-11; 2023-09-29; 2023-08-06; 2024-04-09; 2023-07-10;	54	1

	2024-04-09; 2024-04-27; 2024-04-30; 2024-04-02; 2023-08-07; 2023-09-11; 2023-10-01; 2023-07-14; 2024-04-10; 2023-07-31; 2023-09-26; 2023-06-30; 2023-07-18; 2023-08-07; 2024-04-11; 2024-04-12; 2024-04-14; 2024-04-17; 2024-04-22; 2024-05-16; 2023-10-08; 2023-06-26; 2023-07-02; 2023-08-06; 2023-07-19; 2023-07-02; 2023-09-15; 2023-06-30; 2023-07-27; 2023-10-07; 2024-04-01; 2024-04-14; 2024-04-21; 2024-05-02; 2023-10-08; 2024-04-10; 2023-10-07; 2023-07-28; 2023-07-26; 2023-06-24; 2023-07-28; 2024-04-16; 2024-04-21; 2024-05-09		
Sudd Wetlands	2024-02-28; 2023-12-01; 2024-01-05; 2023-08-18; 2023-07-17; 2023-11-08; 2024-01-03; 2023-11-23; 2024-02-01; 2024-03-03; 2023-10-02; 2023-09-10; 2024-04-08; 2024-05-06; 2023-07-29; 2023-08-04; 2023-10-04; 2023-11-06; 2023-12-01; 2024-01-01; 2024-03-03; 2024-04-06; 2024-04-08; 2023-09-07; 2023-11-12; 2024-02-03; 2024-05-01	27	0
Western Siberian Lowlands	2023-08-02; 2023-09-08; 2024-04-06; 2023-09-08; 2023-08-12; 2024-03-25; 2023-08-03; 2024-03-11; 2024-03-24; 2023-08-12; 2024-03-23; 2024-04-20; 2024-05-07; 2023-10-19; 2023-08-06; 2023-09-07; 2023-10-05; 2024-03-01; 2024-02-12; 2024-04-06; 2024-04-07; 2023-08-02; 2023-08-08; 2023-09-06;	40	20

	2023-07-28; 2023-11-02; 2023-10-17; 2024-04-06; 2024-05-10; 2023-10-06; 2023-07-28; 2024-03-12; 2023-10-06; 2023-09-04; 2024-03-22; 2023-08-02; 2024-03-22; 2023-08-03; 2024-04-03; 2024-05-11		
Niger Delta	NA	NA	NA

Table S2. GHGSat satellite acquisitions including time, date and location. Acquisitions with an observation include wind speed used in calculating the emissions and emission rates and percent error. Emissions rates were calculated by GHGSat whose processing steps can be found in Jervis et al. (2021). Includes copyrighted material of GHGSat All rights reserved.

Site	Latitude (°N)	Longitude (°E)	Date	Time (UTC)	Wind Speed (m/s)	Q-IME [kg/hr]	Q-IME Error [%]	Satellite
WSL 1	65.9770	74.1451	28/07/2023	09:30:13	NA	NA	NA	C3
WSL 1	65.9783	74.1381	03/08/2023	04:35:36	NA	NA	NA	C8
WSL 1	65.9780	74.1617	04/09/2023	09:45:26	NA	NA	NA	C5
WSL 1	65.94434	74.13145	12/03/2024	09:47:13	2.00	1873	49	C3
WSL 1	66.02041	74.05847069	22/03/2024	09:41:15	4.43	116739	34	C5
WSL 1	65.9803	74.1469	11/05/2024	05:09:27	NA	NA	NA	C2
WSL 1	65.9774	74.1382	03/04/2024	04:37:06	NA	NA	NA	C8
WSL 1	65.9782	74.1475	06/10/2023	09:32:49	NA	NA	NA	C4
WSL 1	65.9714	74.1385	06/10/2023	05:03:56	NA	NA	NA	C4
WSL 1	65.9773	74.1336	02/08/2023	04:30:18	NA	NA	NA	C6
WSL 1	65.9801	74.1358	22/03/2024	04:29:24	NA	NA	NA	C5
WSL 2	61.3311	70.3077	06/09/2023	09:19:03	NA	NA	NA	C5
WSL 2	61.38222	70.2461	07/09/2023	09:35:47	1.1	471	61	C3
WSL 2	61.37997	70.29975	07/09/2023	09:35:47	1.1	719	61	C3
WSL 2	61.3281	70.3183	08/08/2023	09:40:19	NA	NA	NA	C5
WSL 2	61.3246	70.3007	05/10/2023	09:20:19	NA	NA	NA	C3
WSL 2	61.32387	70.29163	02/08/2023	09:27:33	5.03	462	35	C5
WSL 2	61.32344	70.29168	02/11/2023	05:07:03	5.56	824	30	C6
WSL 2	61.3243	70.3042	12/02/2024	09:42:24	NA	NA	NA	C3
WSL 2	61.3245,	70.3020	01/03/2024	09:37:4	NA	NA	NA	C3

WSL 2	61.3258	70.2965	06/04/2024	04:53:26	NA	NA	NA	C4
WSL 2	61.3295	70.2926	07/04/2024	09:26:31	NA	NA	NA	C4
WSL 2	61.3267	70.2896	28/07/2023	04:42:37	NA	NA	NA	C6
WSL 2	61.3248	70.2912	17/10/2023	04:53:35	NA	NA	NA	C6
WSL 2	61.3247	70.2903	10/05/2024	04:49:39	NA	NA	NA	C6
WSL 2	61.3215	70.3009	19/10/2023	06:11:07	NA	NA	NA	C1
WSL 2	61.3290	70.3036	06/08/2023	05:10:52	NA	NA	NA	C2
WSL 2	61.3297	70.3042	06/04/2024	09:43:05	NA	NA	NA	C8
WSL 3	65.78584	74.43366	03/08/2023	09:12:44	4.48	818	35	C5
WSL 3	65.7798	74.4294	02/08/2023	06:16:50	NA	NA	NA	C1
WSL 3	65.78619	74.43384	12/08/2023	04:37:07	7.84	1000	26	C8
WSL 3	65.78569	74.43477	12/08/2023	09:15:08	7.53	892	25	C3
WSL 3	65.78816	74.4456	08/09/2023	05:18:22	1.32	8108	57	C2
WSL 3	65.78677	74.43096	08/09/2023	09:20:40	2.01	2557	49	C3
WSL 3	65.78739	74.42406	11/03/2024	09:32:01	2.72	2912	46	C5
WSL 3	65.785921	74.43434306	23/03/2024	04:34:22	3.33	771	41	C8
WSL 3	65.78653	74.433139	24/03/2024	04:35:46	7.63	1215	27	C6
WSL 3	65.7856768	74.43461851	25/03/2024	09:23:44	3.51	891	39	C3
WSL 3	65.785748	74.434388	06/04/2024	05:14:52	8.1	859	23	C2
WSL 3	65.78945	74.445596	06/04/2024	05:14:52	8.1	378	25	C2
WSL 3	65.74970	74.408897	20/04/2024	09:30:59	3.43	2694	39	C5
WSL 3	65.78241	74.418002	20/04/2024	09:30:59	3.43	4596	39	C5
WSL 3	65.785827	74.433633	07/05/2024	04:35:28	3.14	2056	41	C6

References

Jervis, D., McKeever, J., Durak, B.O., Sloan, J.J., Gains, D., Varon, D.J., Ramier, A., Strupler, M. and Tarrant, E., 2021. The GHGSat-D imaging spectrometer. *Atmospheric Measurement Techniques*, *14*(3), pp.2127-2140.