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Supplement of

Mapping pan-Arctic methane emissions at high spatial resolution using an adjoint atmospheric transport and inversion method and process-based wetland and lake biogeochemical models

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Table S1. NOAA/ESRL stations used in the inversion.

Station ID	Latitude	Longitude	Altitude [m]	Station Name
ALT	82.45	-62.52	210.0	Alert, Nunavut, Canada
ZEP	78.90	11.88	475.0	Ny-Alesund, Svalbard (Spitsbergen), Norway and Sweden
SUM	72.58	-38.48	3238.0	Summit, Greenland
BRW	71.32	-156.60	11.0	Barrow, Alaska, USA
ICE	63.34	-20.29	127.0	Heimay, Vestmannaeyjar, Iceland
CBA	55.20	-162.72	25.0	Cold Bay, Alaska, USA
SHM	52.72	174.10	40.0	Shemya Island, Alaska, USA
UUM	44.45	111.10	914.0	Ulaan Uul, Mongolia
NWR	40.05	-105.58	3526.0	Niwot Ridge, Colorado, USA
AZR	38.77	-27.38	40.0	Terceira Island, Azores, Portugal
WLG	36.29	100.90	3810.0	Mt. Waliguan, People’s Republic of China
BMW	32.27	-64.88	30.0	Tudor Hill, Bermuda, UK
IZO	28.30	-16.48	2360.0	Tenerife, Canary Islands, Spain
MID	28.21	-177.38	7.7	Sand Island, Midway, USA
ASK	23.18	5.42	2728.0	Assekrem, Algeria
MLO	19.53	-155.58	3397.0	Mauna Loa, Hawai, USA
KUM	19.52	-154.82	3.0	Cape Kumukahi, Hawaii, USA
GMI	13.43	144.78	6.0	Mariana Islands, Guam
RPB	13.17	-59.43	45.0	Ragged Point, Barbados

CHR	1.70	-157.17	3.0	Christmas Island, Republic of Kiribati
SEY	-4.67	55.17	7.0	Mahe Island, Seychelles
ASC	-7.92	-14.42	54.0	Ascension Island, UK
SMO	-14.24	-170.57	42.0	Tutuila, American Samoa, USA
CGO	-40.68	144.68	94.0	Cape Grim, Tasmania, Australia
CRZ	-46.45	51.85	120.0	Crozet Island, France
TDF	-54.87	-68.48	20.0	Tierra Del Fuego, La Redonda Isla, Argentinia
PSA	-64.92	-64.00	10.0	Palmer Station, Antarctica, USA
SYO	-69.00	39.58	14.0	Syowa Station, Antarctica, Japan
HBA	-75.58	-26.50	33.0	Halley Station, Antarctica, UK
SPO	-89.98	-24.80	2810.0	South Pole, Antarctica, USA

Table S2. NOAA aircraft profiles used for validation.

CODE	Location	Latitude (deg)	Longitude (deg)	Start Date	End Date
PFA	Poker Flat, Alaska, United States	65.07	-147.29	06/27/1999	06/05/2015
ESP	Estevan Point, British Columbia, Canada	49.6	-126.4	11/22/2002	06/09/2015
DND	Dahlen, North Dakota, USA	48.1	-98.0	09/21/2004	05/31/2015
LEF	Park Falls, Wisconsin, USA	45.9	-90.3	04/10/1998	05/28/2015
FWI	Fairchild, Wisconsin, USA	44.7	-91.0	09/20/2004	11/18/2005
NHA	Worcester, Massachusetts, USA	43.0	-70.6	09/21/2003	06/10/2015
BGI	Bradgate, Iowa, USA	42.8	-94.4	09/13/2004	11/18/2005
HFM	Harvard Forest, Massachusetts, USA	42.5	-72.2	11/11/1999	11/18/2007
WBI	West Branch, Iowa, USA	42.4	-91.8	09/14/2004	05/28/2015
OIL	Oglesby, Illinois, USA	41.3	-88.9	09/16/2004	11/19/2005
THD	Trinidad Head, California, USA	41.0	-124.2	09/02/2003	05/16/2015
BNE	Beaver Crossing, Nebraska, USA	40.8	-97.2	09/15/2004	05/11/2011
CAR	Briggsdale, Colorado, USA	40.6	-104.6	11/09/1992	04/21/2015
HIL	Homer, Illinois, USA	40.1	-87.9	09/16/2004	05/21/2015
TGC	Sinton, Texas, USA	27.7	-96.9	09/09/2003	06/05/2015
HAA	Molokai Island, Hawaii, USA	21.2	-158.9	05/31/1999	04/22/2008
RTA	Rarotonga, Cook Islands	-21.3	-159.8	04/16/2000	05/29/2015

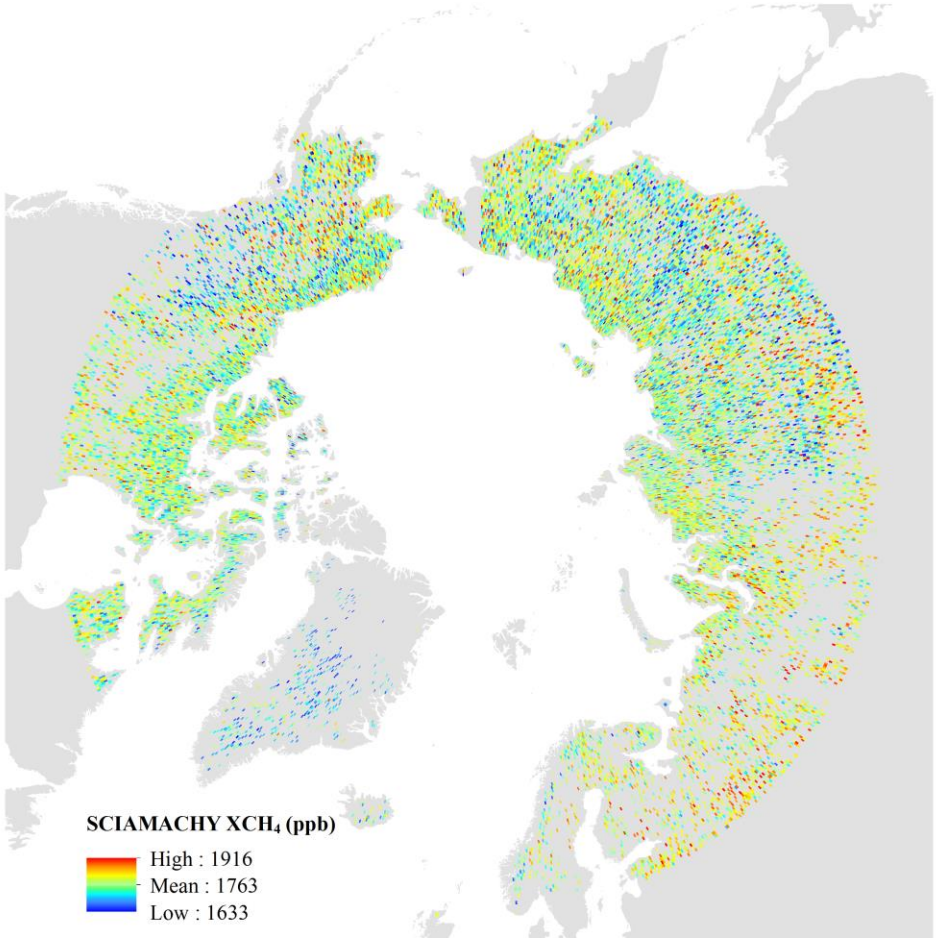

Figure S1. SCIAMACHY observations (n = 37989) of the weighted column-average CH_4 dry mole fractions for July 2004–September 2004 in the pan-Arctic that have passed all quality control tests described in Section 2.1.

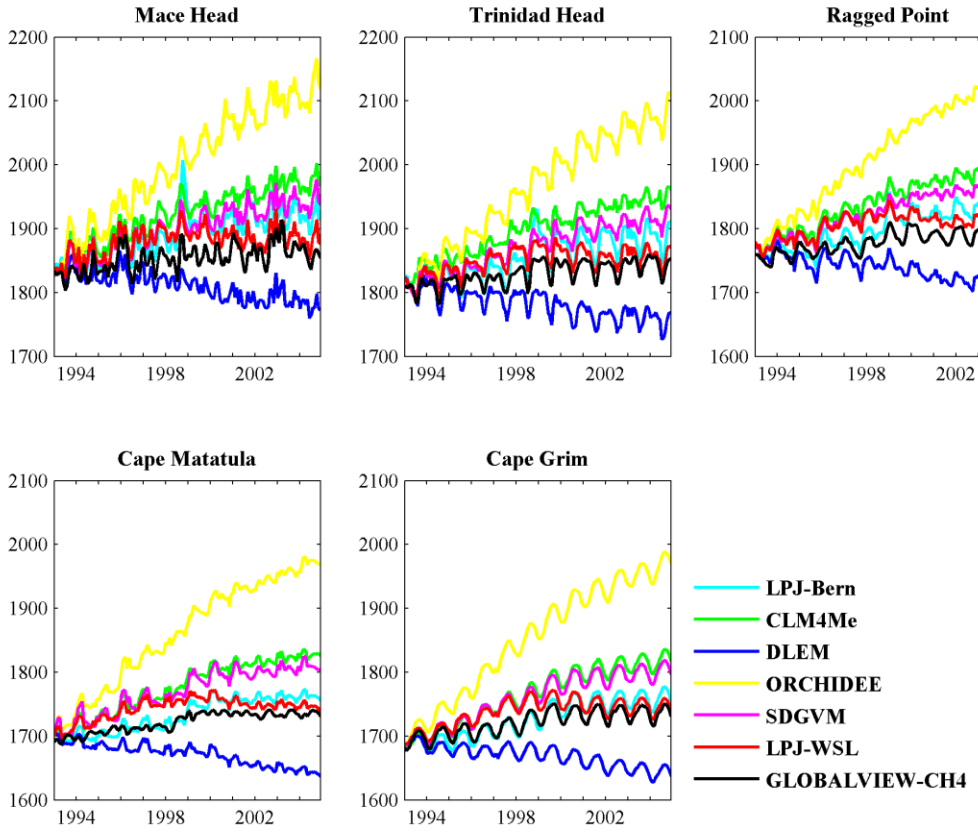

Figure S2. The comparison between the GEOS-Chem simulated and GLOBALVIEW-CH4 atmospheric CH_4 (units: ppbv) at five stations (Mace Head, Ireland; Trinidad, California; Ragged Point, Barbados; Cape Matatula, Samoa; Cape Grim, Tasmania). The wetland CH_4 emissions used are the pre-optimized model simulations provided by the WETCHIMP project.

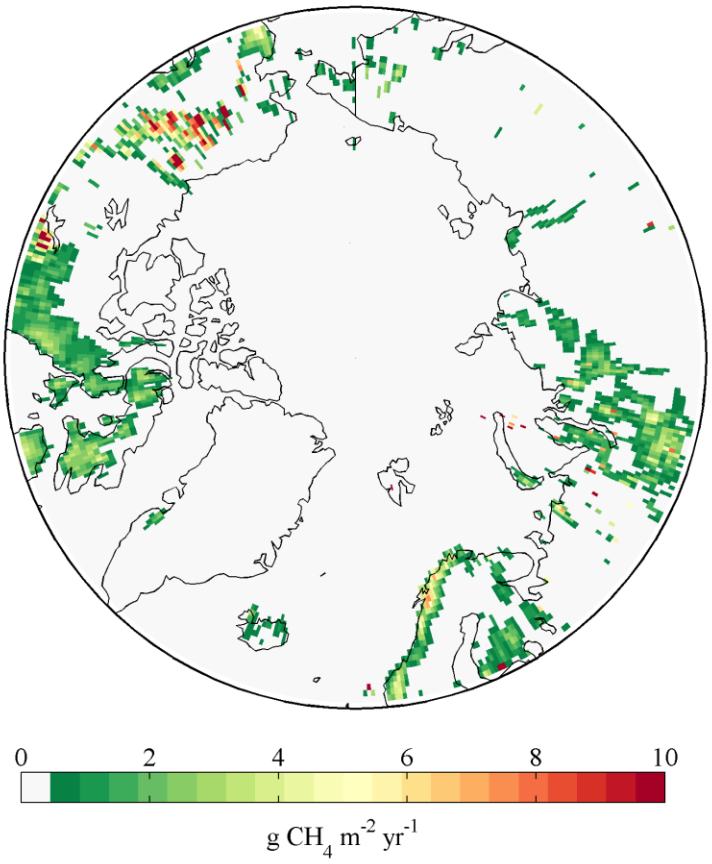

Figure S3. The posterior CH_4 emissions in the pan-Arctic for July 2004–June 2005 estimated by an inversion that does not incorporate CH_4 emissions from pan-Arctic lakes and uses the DLEM wetland scenario.