Supplemental material

Table S1: Seawater methane samples collected for measuring the dissolved methane concentrations and the potential oxidation rates.

Stations	Depth (m)	Date collection	In-situ samples	Methane incubations
3	609	7/20/2019	x	x
3	419	7/20/2019	x	
3	310	7/20/2019	x	
3	151	7/20/2019	x	
3	71	7/20/2019	x	
3	40	7/20/2019	x	
3	7	7/20/2019	x	x
5	745	7/22/2019	x	x
5	601	7/22/2019	x	
5	455	7/22/2019	x	
5	381	7/22/2019	x	
5	175	7/22/2019	x	
5	21	7/22/2019	x	x
5	1	7/22/2019	x	x
8	561	7/23/2019	x	
8	451	7/23/2019	x	x
8	390	7/23/2019	x	
8	210	7/23/2019	x	
8	101	7/23/2019	x	
8	70	7/23/2019	x	x
8	15	7/23/2019	x	x
8	1	7/23/2019	x	
16	690	7/24/2019	x	x
16	502	7/24/2019	x	x
16	378	7/24/2019	x	
16	202	7/24/2019	x	
16	101	7/24/2019	x	
16	65	7/24/2019	x	
16	30	7/24/2019	x	

16	1	7/24/2019	x	x
20	144	7/26/2019	x	x
20	110	7/26/2019	x	
20	81	7/26/2019	x	
20	50	7/26/2019	x	
20	28	7/26/2019	x	x
20	19	7/26/2019	x	
20	2	7/26/2019	x	
21	136	7/26/2019	x	x
21	75	7/26/2019	x	
21	45	7/26/2019	x	
21	15	7/26/2019	x	
21	10	7/26/2019	x	x
23	181	7/28/2019	x	x
23	101	7/28/2019	x	
23	26	7/28/2019	x	
23	5	7/28/2019	x	x
26	208	7/29/2019	x	x
26	150	7/29/2019	x	
26	100	7/29/2019	x	
26	75	7/29/2019	x	
26	25	7/29/2019		x
26	1	7/29/2019	x	
30	251	7/30/2019	x	x
30	151	7/30/2019	x	
30	76	7/30/2019	x	
30	28	7/30/2019	x	x
30	2	7/30/2019	x	
31	207	7/30/2019	x	x
31	131	7/30/2019	x	
31	61	7/30/2019	x	
31	36	7/30/2019	x	x
31	2	7/30/2019	x	
41	380	8/1/2019	x	x

41	316	8/1/2019	x	
41	200	8/1/2019	x	
41	173	8/1/2019	x	
41	90	8/1/2019	x	
41	45	8/1/2019	x	
41	25	8/1/2019	x	x
41	1	8/1/2019	x	
52	241	8/4/2019	x	x
52	200	8/4/2019	x	
52	76	8/4/2019	x	
52	30	8/4/2019	x	
52	10	8/4/2019	x	
52	7	8/4/2019	x	x
52	2	8/4/2019	x	

Table S2: Methane sea ice data.

Sea Ice ID	Depth (cm)	T (degreeC)	d13C-CH4 (permil)	[CH4] (nM)
1	10	2.1	-37.80	3.42
1	10	2.1	-32.97	3.36
1	52	1.7	-46.32	18.18
1	52	1.7	-46.44	24.19
1	82	1.4	-46.64	10.13
1	82	1.4	-49.47	4.60
1	82	1.4	-47.25	10.69
1	117	1.3	-40.22	8.20
1	117	1.3	-39.32	8.45
1	190	1.2	-46.92	16.98
1	190	1.2	-46.36	17.25
2	20	2	-45.80	8.17
2	20	2	-38.19	7.81
2	50	1.2	-45.18	8.51
2	50	1.2	-44.90	8.42
2	70	1.2	-48.29	6.47
2	70	1.2	-46.19	6.06
2	90	1.6	-40.59	7.75
2	90	1.6	-42.62	7.82
2	100	1.7	-41.13	4.07
2	100	1.7	-37.85	4.15

3	10	1.8	-44.48	10.44
3	10	1.8	-41.10	10.17
3	30	1.3	-48.00	7.10
3	30	1.3	-46.40	6.77
3	60	0.9	-50.57	5.95
3	60	0.9	-52.19	6.60
3	90	0.9	-48.01	11.37
3	90	0.9	-43.04	11.88
4	20	1.4	-43.26	6.55
4	20	1.4	-37.03	6.53
4	30	0.9	-40.76	6.01
4	30	0.9	-36.53	5.91
4	90	0.4	-38.82	5.68
4	90	0.4	-35.89	5.61
4	130	0.1	-43.67	7.41
4	130	0.1	-37.90	7.28
4	146	0.1	-39.39	6.27
4	146	0.1	-45.92	6.46
5	10	0.4	-40.76	6.01
5	10	0.4	-36.53	5.91
5	20	0.5	-42.25	18.36
5	20	0.5	-45.90	19.61
5	50	0.9	-40.87	6.28
5	50	0.9	-39.96	6.03
5	70	1.2	-47.33	20.83
5	70	1.2	-47.97	20.66
5	91	1.3	-35.17	8.19
5	91	1.3	-38.29	8.24
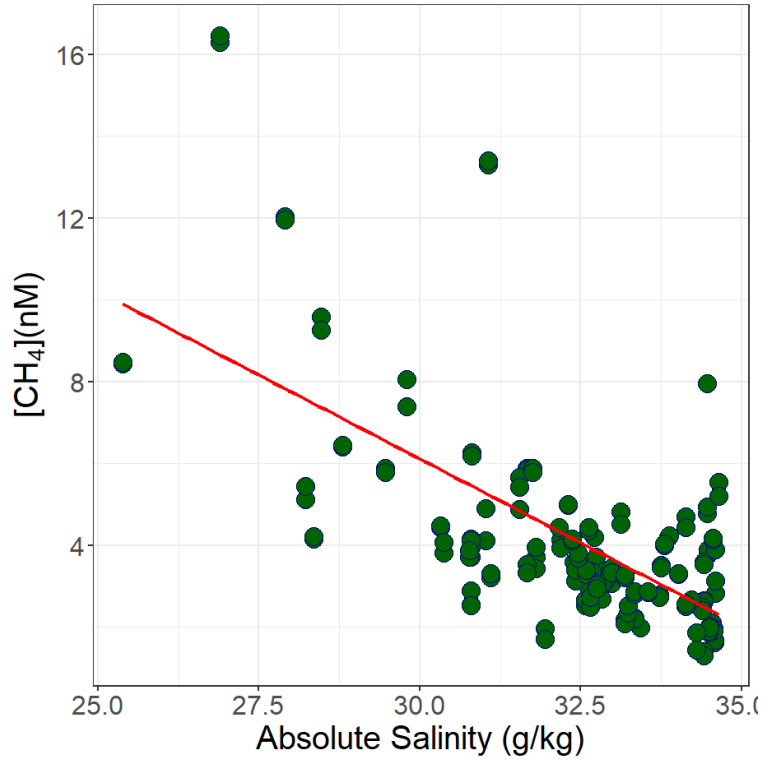
Figure S1: linear regression between the in-situ methane concentration and the absolute salinity (R-squared: 0.4223, p-value: < 2.2e-16).
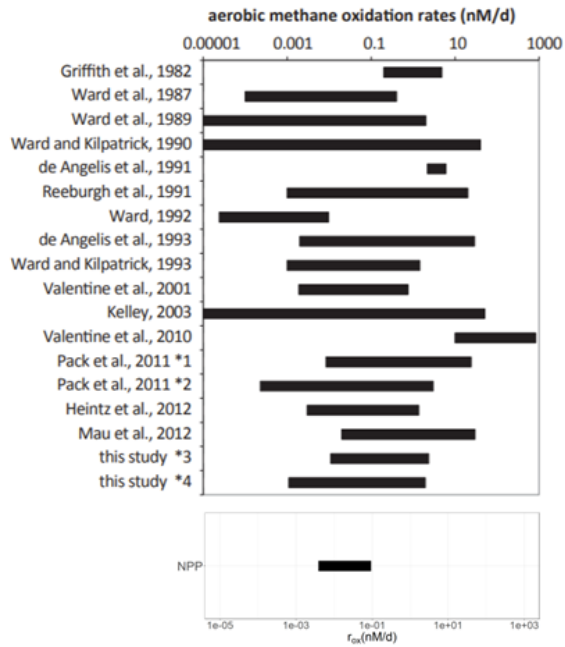
Figure S2: comparison between methane oxidation rates measured in our study (NPP) and previous literature. The box on the top (from Mau et al., 2013) showed the range of methane oxidation rates measured at different locations in the ocean water column derived from tracer incubations using ^{3}H-CH$_4$ (Reeburgh et al., 1991; Valentine et al., 2001, 2010; Heintz et al., 2012, Mau et al., 2012) or ^{14}C-CH$_4$ (all others). Pack et al. (2011) compared incubations with ^{3}H-CH$_4$ (*1) and incubations with low-level ^{14}C-CH$_4$ (*2) that were measured with accelerator mass spectrometry. In this study, Mau et al. (2013) compared incubations with ^{3}H-CH$_4$ (*3) and incubations with ^{14}C-CH$_4$ (*4). The box in the bottom showed the methane oxidation rates measured during the NPP expedition. The x axis is in log scale.
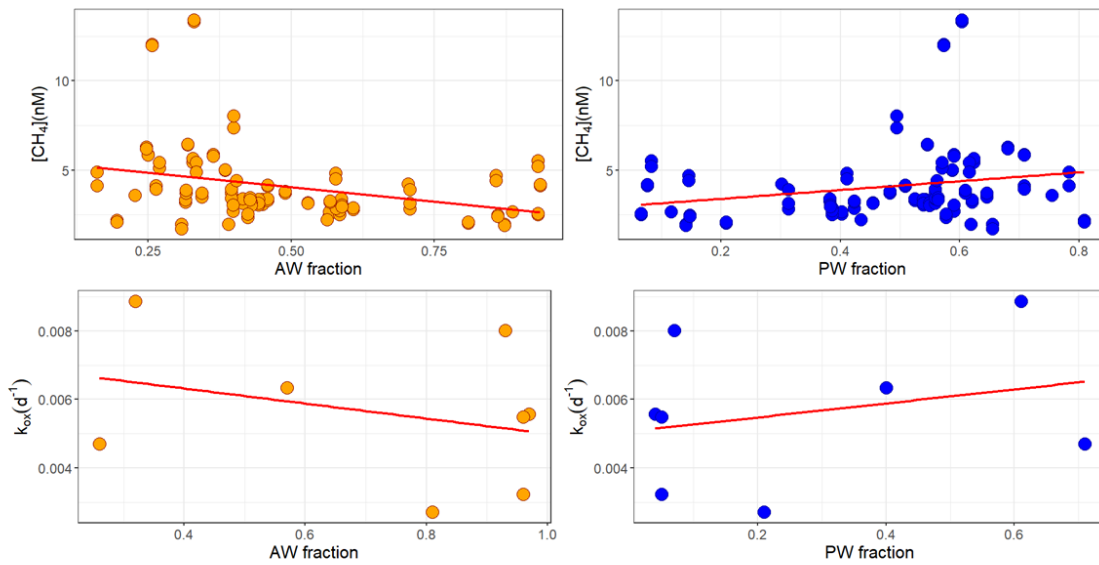
Figure S3: Dissolved in-situ methane and methane oxidation rate constant against the source water masses within the CAA.