Supplementary Material

Variability of methane content in bottom waters of 46 African lakes

Alberto V. Borges, Cédric Morana, Loris Deirmendjian, William Okello, Patrick Omeja, Mwapu Isumbisho, Jean-Pierre Descy, Steven Bouillon

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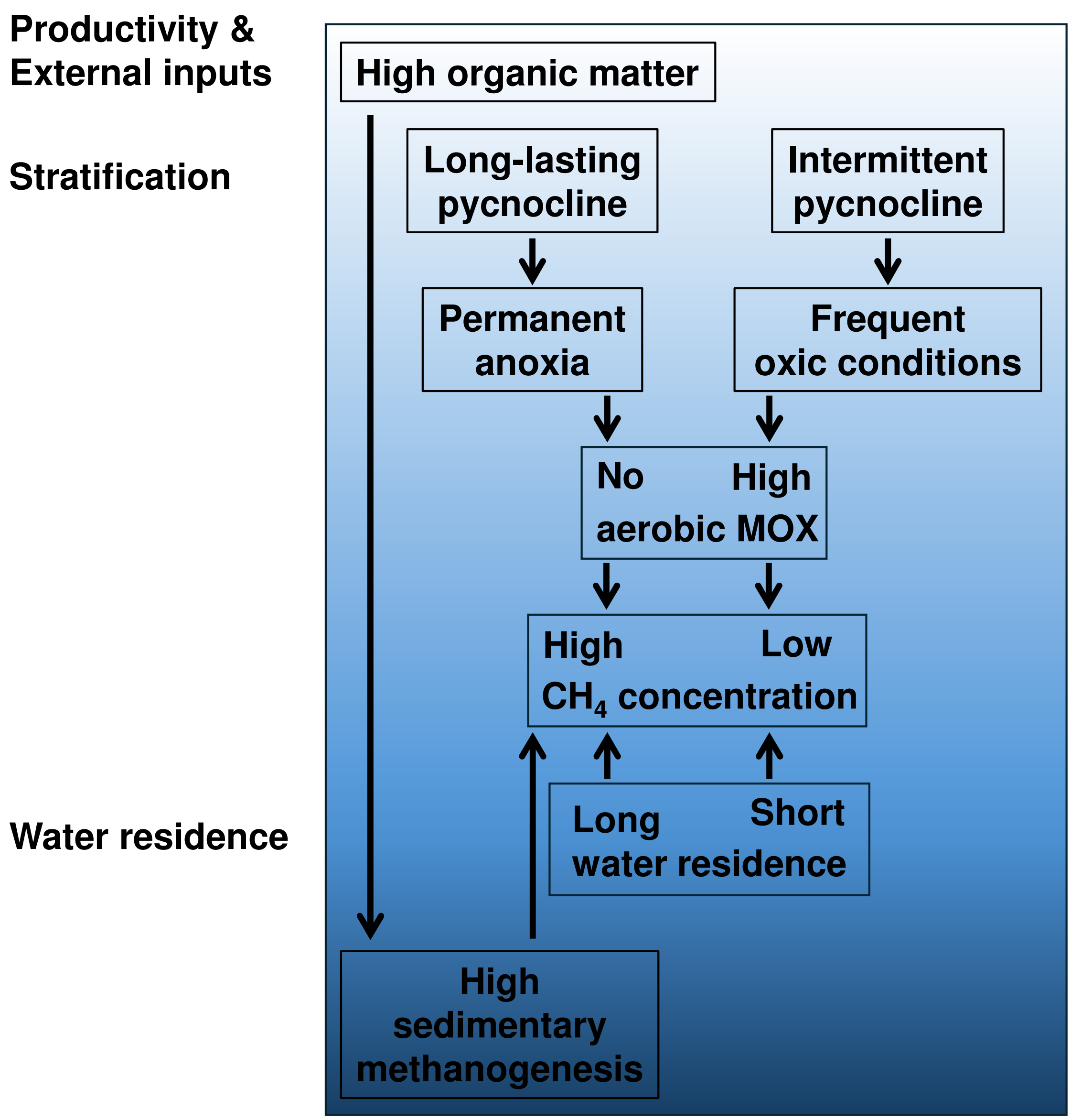

Figure S1: Summary of processes that affect bottom water CH_4 dissolved concentration in lakes, based on Juutinen et al. (2009), Kankaala et al. (2013), and Vachon et al. (2019).

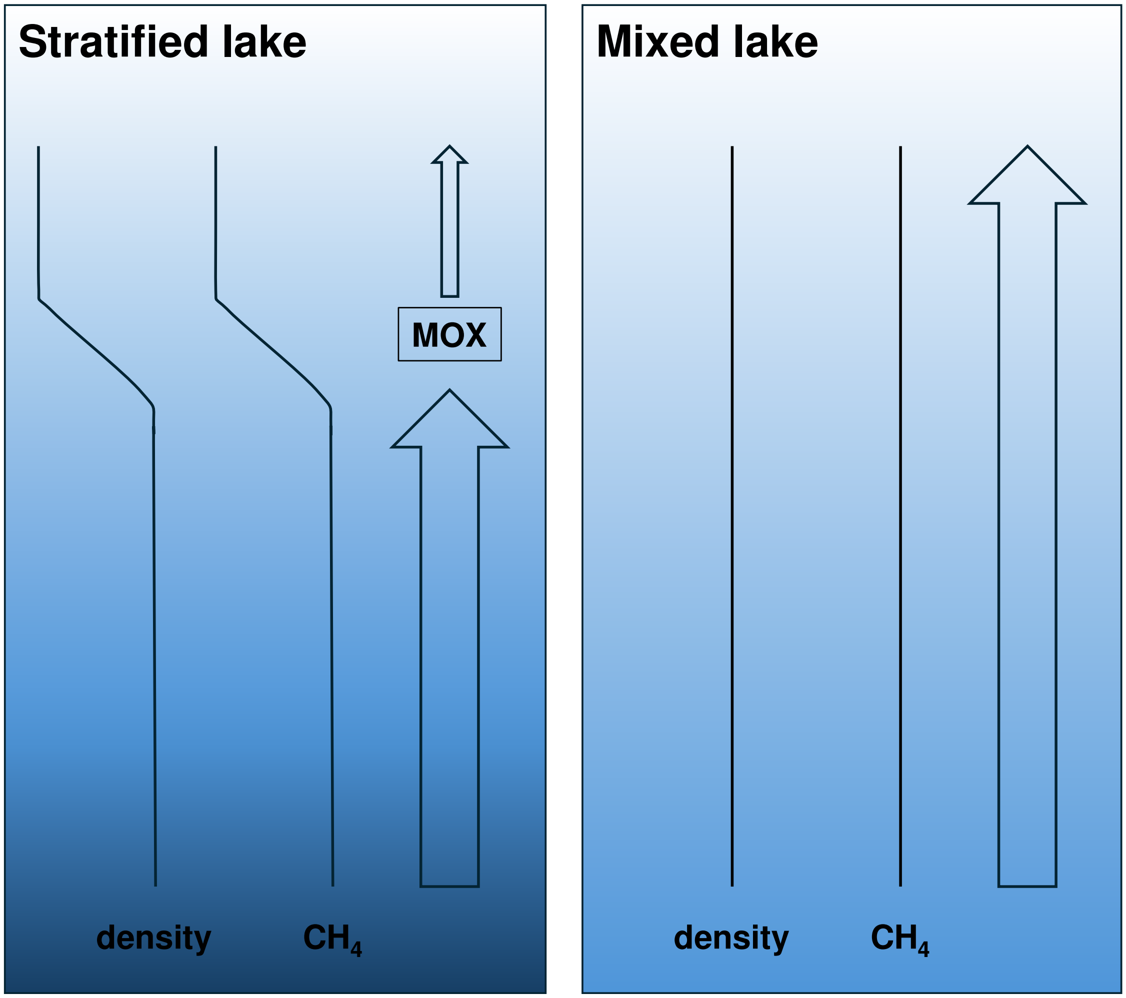

Figure S2: Schematic representation of the impact of stratification and vertical mixing on vertical distribution of density and dissolved CH_4 (solid lines), based on Juutinen et al. (2009), Kankaala et al. (2013), and Vachon et al. (2019). MOX = methane oxidation.

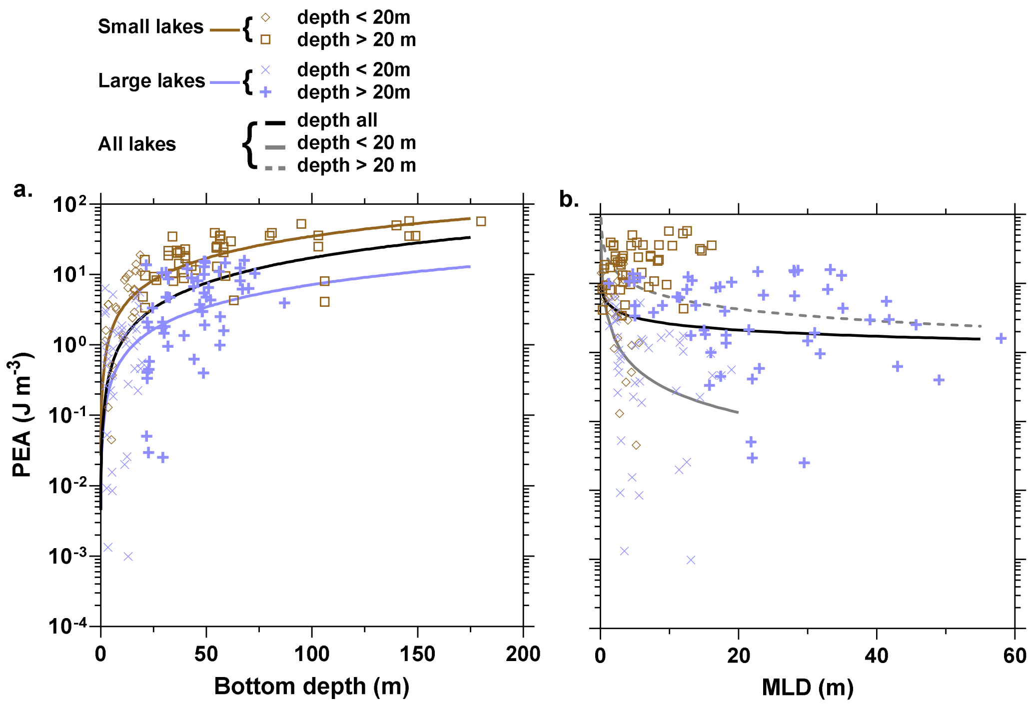

Figure S3: Potential energy anomaly (PEA in J m^{-3}) versus bottom depth (m) (a) and mixed layer depth (MLD in m) (b) in 46 African lakes (Figure 1) separated into large (surface area > 100km^2) and small (surface area < 100km^2) lakes, and data points were further separated into shallow (depth < 20m) and deep sites (depth > 20m). The solid lines show the linear regressions (details in Table S1).

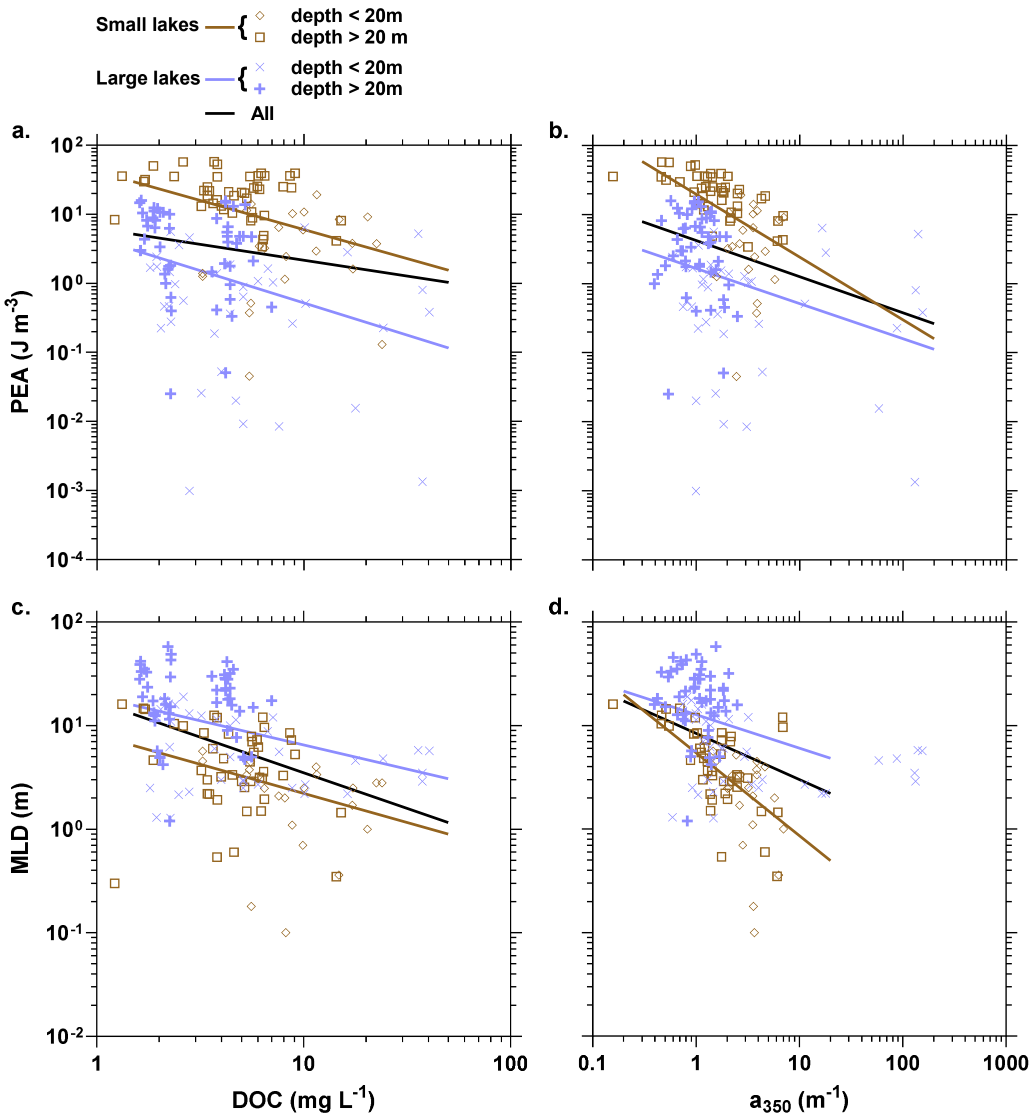

Figure S4 Potential energy anomaly (PEA in J m^{-3}) and mixed layer depth (MLD in m) *versus* dissolved organic carbon concentration (DOC in mg L^{-1}) (a,c) and coloured dissolved organic matter absorbance at 350 nm (a_{350} in m^{-1}) in 46 African lakes (Figure 1) separated into large (surface area > 100km^2) and small (surface area < 100km^2) lakes, and data points were further separated into shallow (depth < 20m) and deep sites (depth > 20m). The solid lines show the linear regressions (details in Table S1).

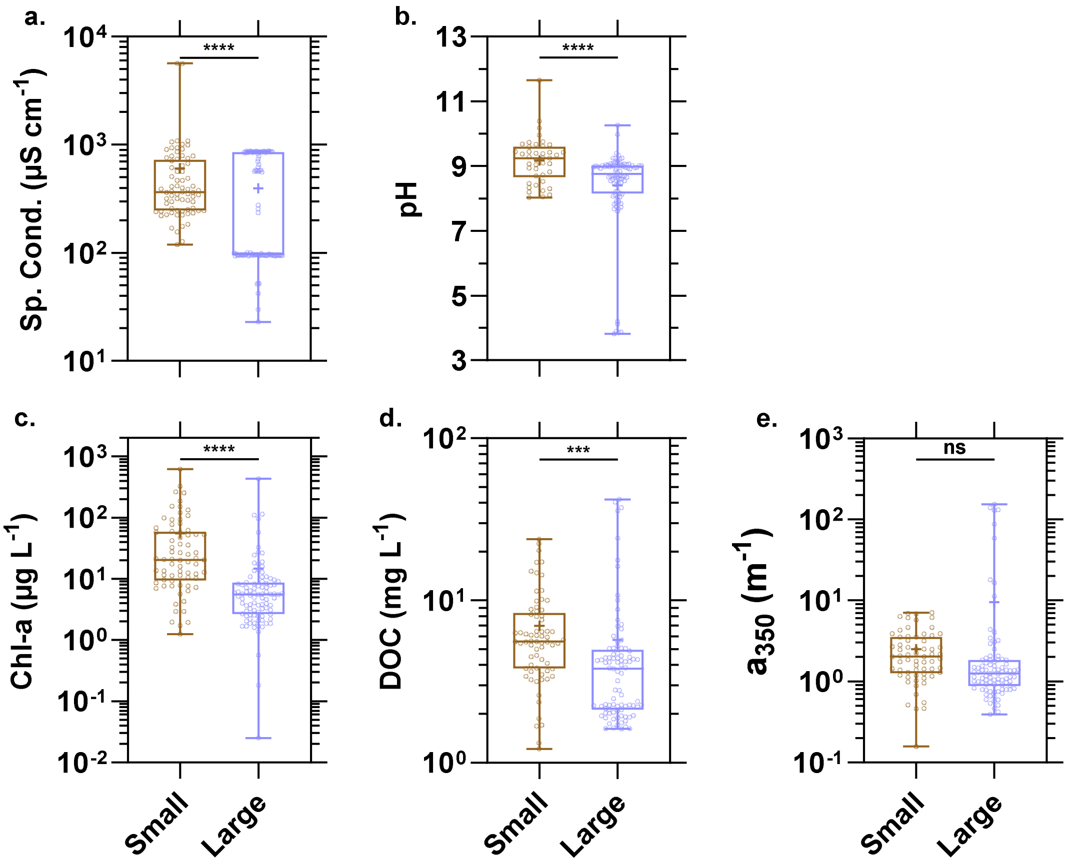

Figure S5: Box plots of specific conductivity (Sp. Cond. In µS cm^{-1}) (a), pH (b), Chlorophyll-a concentration (µg L^{-1}) (c), dissolved organic carbon concentration (DOC in mg L^{-1}) (d), and coloured dissolved organic matter absorbance at 350 nm (a_{350} in m^{-1}) (e) in surface waters of 46 African lakes (Fig. 1) separated into large (surface area > 100km^2) and small (surface area < 100km^2) systems. Box indicates the inter-quartile range, horizontal line the median, cross the mean, bars the maximum and minimum values. Results of the statistical comparison of means are summarized at the top of the figures and detailed in Table S2.

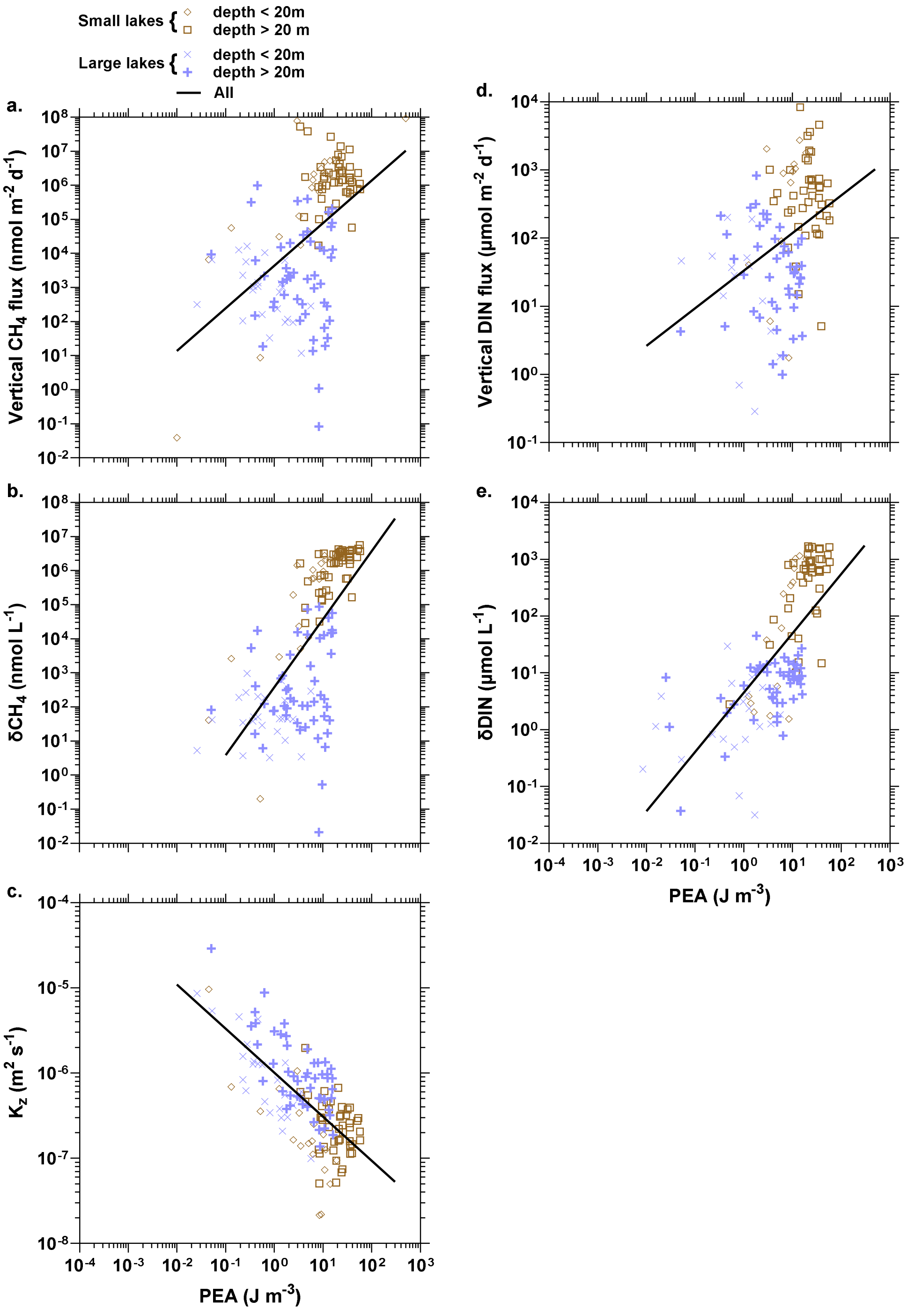

Figure S6: Vertical flux into surface waters across the thermocline of CH_4 (nmol L^{-1} d^{-1}) (a) and dissolved inorganic nitrogen (DIN) (µmol m^{-2} d^{-1}) (d), surface-bottom concentration gradient of CH_4 (δCH_4 in nmol L^{-1}) (b) and DIN (δDIN in µmol L^{-1}) (e), and turbulent diffusion coefficient (K_z in m^2 s^{-1}) (c) versus potential energy anomaly (PEA in J m^{-3}) in 46 African lakes (Figure 1) separated into large (surface area > 100km^2) and small (surface area < 100km^2) systems, and data points were further separated into shallow (depth < 20m) and deep sites (depth > 20m). The solid lines show the linear regressions (details in Table S2).

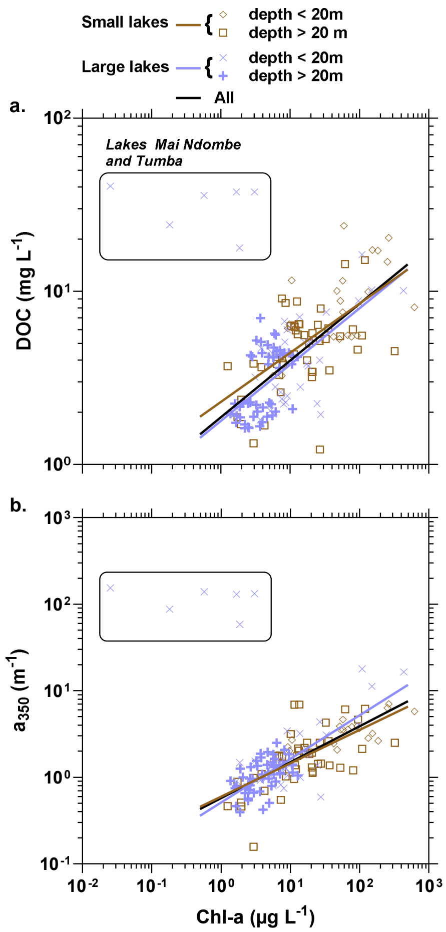

Figure S7 Dissolved organic carbon concentration (DOC in mg L^{-1}) (a) and coloured dissolved organic matter absorbance at 350 nm (a_{350} in m^{-1}) (b) versus Chlorophyll-a concentration (Chl-a in µg L^{-1}) in 46 African lakes (Figure 1) separated into large (surface area > 100km^2) and small (surface area < 100km^2) lakes, and data points were further separated into shallow (depth < 20m) and deep sites (depth > 20m). The solid lines show the linear regressions (details in Table S1). Box frame indicates data in Lakes Mai Ndombe and Tumba that drain flooded forest in the Congo basin and are very humic (data excluded from linear regression models).

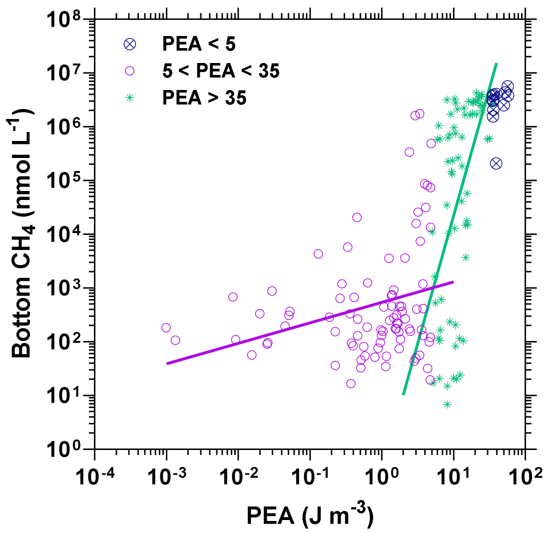

Figure S8: Dissolved CH_4 concentration in bottom waters (nmol L^{-1}) versus potential energy anomaly (PEA in J m^{-3}) separated into three groups of PEA (PEA<5; 5<PEA<35; PEA>35) in 46 African lakes (Figure 1). The solid lines show the linear regressions (details in Table S2).

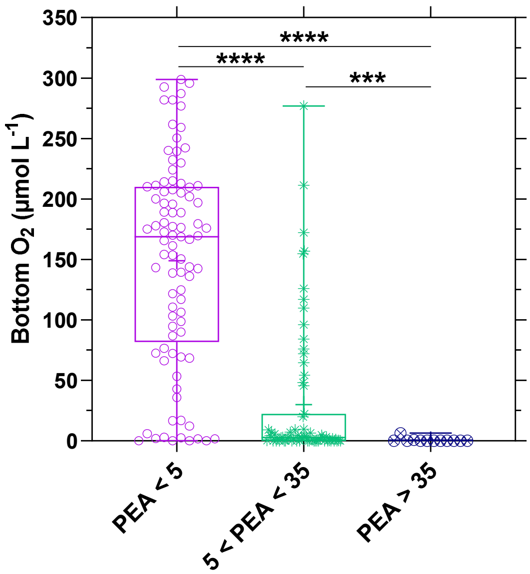

Figure S9: Box plots of bottom water O_2 concentration (µmol L^{-1}) separated into three groups of potential energy anomaly (PEA in J m^{-3}) (PEA<5; 5<PEA<35; PEA>35) in 46 African lakes (Figure 1). Box indicates the inter-quartile range, horizontal line the median, cross the mean, bars the maximum and minimum values. Results of the statistical comparison of means are summarized at the top of the figures and detailed in Table S4.

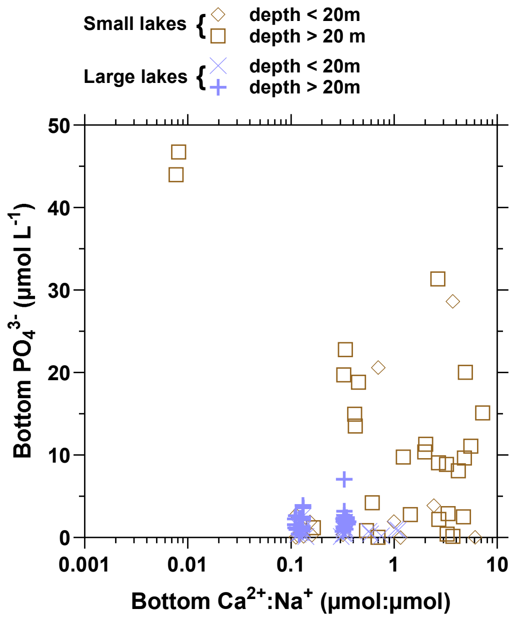

Figure S10 Bottom water dissolved PO_4^{3-} concentration (µmol L^{-1}) *versus* the Ca^{2+}:Na^{+} ratio (µmol:µmol) in 46 African lakes (Figure 1) separated into large (surface area > 100km^2) and small (surface area < 100km^2) lakes, and data points were further separated into shallow (depth < 20m) and deep sites (depth > 20m). Linear regressions are detailed in Table S2.

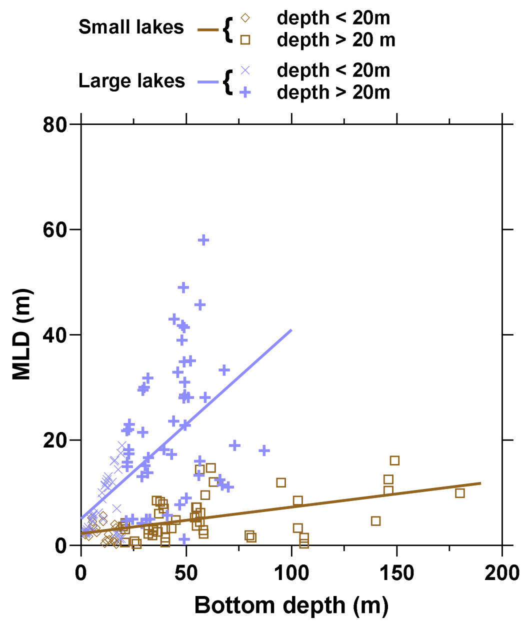

Figure S11: Mixed layer depth (MLD in m) versus bottom depth (m) in 46 African lakes (Figure 1) separated into large (surface area > 100km^2) and small (surface area < 100km^2) systems, and data points were further separated into shallow (depth < 20m) and deep sites (depth > 20m). The solid lines show the linear regressions (details in Table S2).

Table S1: Morphometric variables of 46 African lakes (Fig. 1) listed alphabetically, characterized as large (surface area (SA) > 100km²) and small (surface area < 100km²) systems, Latitude (°N), Longitude (°E), Elevation (Elev. In m), SA in km², maximum effective length (MEL in km), maximum (max.) depth (in m), and number (n) of profiles (paired surface- and bottom-water CH_4 measurements).

#	Lake	Type	Latitude (°N)	Longitude (°E)	Elev. (m)	SA (km²)	MEL (km)	Max. depth (m)	n
1	Albert	Large	1.6286	30.8807	614	5,402	175.3	58.0	9
2	Bunyonyi	Small	-1.2944	29.9190	1944	53.7	7.6	39.4	2
3	Edward	Large	-0.3711	29.5653	911	2,253	83.4	117.0	32
4	George	Large	-0.0010	30.2188	912	273	22.3	3.0	4
5	Kanyamukali	Small	0.4063	30.2362	1157	0.023	0.20	13.5	2
6	Kanyongo	Small	0.6809	30.2353	1555	0.12	0.53	95.0	1
7	Kasenda	Small	0.4319	30.2903	1256	0.072	0.36	16.8	2
8	Katanda	Small	0.4807	30.2630	1341	0.40	0.79	146.0	2
9	Katinda	Small	-0.2211	30.1061	1039	0.44	0.85	21.0	3
10	Kayumba	Small	-1.3388	29.7890	1891	1.5	2.2	5.2	1
11	Kiribwato	Small	0.4309	30.3238	1228	0.12	0.62	10.6	2
12	Kyamwinga	Small	-0.1869	30.1454	1021	3.1	2.4	43.0	1
13	Kyanga	Small	0.4007	30.2339	1156	0.12	0.51	54.7	2
14	Kyashanduka	Small	-0.2903	30.0500	1010	0.51	1.0	2.0	1
15	Lugembe	Small	0.4494	30.2811	1268	0.087	0.45	19.0	2
16	Lyantode	Small	0.4889	30.2799	1433	0.14	0.52	180.0	1
17	Mai Ndombe	Large	-2.0702	18.3100	288	2,305	84.1	6.2	4
18	Mbajo	Small	0.4488	30.2745	1263	0.16	0.56	58.3	2
19	Mbalukira	Small	-1.2192	29.0311	1617	1.52	2.0	15.5	1
20	Mbita	Small	-1.2166	29.0276	1615	2.72	3.5	26.5	2
21	Mdichu	Small	0.4464	30.2701	1273	0.10	0.40	34.3	2
22	Mrambi	Small	-0.2297	30.1056	1082	0.56	0.95	20.0	2
23	Mugamir	Small	0.4204	30.2867	1198	0.28	0.71	55.2	2
24	Mulehe	Small	-1.2180	29.7223	1791	2.7	3.5	5.6	2
25	Murusi	Small	0.4269	30.2926	1223	0.23	0.58	56.8	2
26	Mutanda	Small	-1.2166	29.6737	1878	23.3	7.2	63.0	2
27	Mwamba	Small	0.4617	30.2740	1301	0.42	1.1	32.0	2
28	Mwegenyi	Small	0.4894	30.2617	1397	0.37	0.96	140.0	1
29	Ndalaga	Small	-1.2753	29.0085	1714	3.99	3.7	21.0	1
30	Nkugute	Small	-0.3243	30.0993	1407	0.93	1.4	55.0	2
31	Nkuruba	Small	0.5173	30.3025	1512	0.027	0.29	36.5	2
32	Ntambi	Small	0.4093	30.2305	1166	0.32	0.74	106.0	2
33	Nyabikere	Small	0.4970	30.3285	1379	0.44	0.98	40.1	2
34	Nyaharia	Small	0.4990	30.2866	1447	0.03	0.22	81.0	2
35	Nyamiteza	Small	0.4356	30.2256	1259	0.30	0.78	103.0	2
36	Nyamusingire	Small	-0.2876	30.0301	981	4.0	2.8	3.8	4
37	Nyamusogani	Small	0.4241	30.2294	1223	0.10	0.43	37.6	2
38	Nyanswiga	Small	0.5065	30.2875	1469	0.033	0.29	34.0	2
39	Nyarayabana	Small	0.4291	30.2490	1189	0.11	0.42	40.0	1
40	Nyinabulitwa	Small	0.5108	30.3242	1423	0.38	0.97	61.7	2
41	Rwankenzi	Small	0.4168	30.2710	1175	0.033	0.28	12.0	2
42	Rwebikere	Small	0.6876	30.2338	1576	0.078	0.40	7.5	2
43	Rwenjuba	Small	0.4415	30.2667	1251	0.22	0.67	149.0	1
44	Tumba	Large	-0.7631	18.0334	290	765	48.0	5.4	2
45	Vert	Small	-1.6119	29.1364	1469	0.20	0.70	15.9	1
46	Victoria	Large	-1.0774	32.8391	1131	67,075	332.4	79.0	45

Table S2: Equations and statistics at 0.05 level of linear regressions given in Figures.

Figure	Y vs X	Equation	b			a			r^2	P value	n
2	maximum depth vs log(surface area) "rest"	Y=a+bX	8.7340	±	2.7400	18.8100	±	5.3160	0.32	0.0043	24
3a	log(MLD) vs log(MEL) all	Y=a+bX	0.1968	±	0.0708	0.5568	±	0.0569	0.15	0.0080	46
3b	log(MLD) vs log(Surface area) all	Y=a+bX	0.1036	±	0.0363	0.5907	±	0.0550	0.16	0.0065	46
3c	log(MLD) vs log(MEL:maximum depth) * all	Y=a+bX	-0.0464	±	0.0617	0.6533	±	0.0989	0.01	0.4564	46
3e	log(PEA) vs log(MEL) all	Y=a+bX	-0.3567	±	0.0921	1.0490	±	0.0740	0.25	0.0004	46
3f	log(PEA) vs log(Surface area) all	Y=a+bX	-0.1777	±	0.0479	0.9872	±	0.0727	0.24	0.0006	46
3g	log(PEA) vs log(MEL:maximum depth) * all	Y=a+bX	-0.4849	±	0.0695	0.3118	±	0.1113	0.53	<0.0001	46
5a	log(Chl-a) vs log(bottom depth) * small lakes	Y=a+bX	-0.7202	±	0.1305	2.4050	±	0.1997	0.31	<0.0001	71
	log(Chl-a) vs log(bottom depth) * large lakes	Y=a+bX	-0.4935	±	0.1178	1.3680	±	0.1599	0.16	<0.0001	95
	log(Chl-a) vs log(bottom depth) * all lakes	Y=a+bX	-0.4328	±	0.1053	1.5870	±	0.1510	0.09	<0.0001	166
5b	log(Chl-a) vs log(MLD) * small lakes	Y=a+bX	-0.7416	±	0.1356	1.7010	±	0.0877	0.31	<0.0001	70
	log(Chl-a) vs log(MLD) * large lakes	Y=a+bX	-0.3754	±	0.1280	1.1120	±	0.1397	0.08	0.0042	95
	log(Chl-a) vs log(MLD) * all lakes	Y=a+bX	-0.7056	±	0.0831	1.5460	±	0.0772	0.31	<0.0001	165
5c	log(Chl-a) vs log(PEA) * small lakes	Y=a+bX	-0.4241	±	0.1038	1.7680	±	0.1197	0.19	0.0001	71
	log(Chl-a) vs log(PEA) * large lakes	Y=a+bX	-0.0493	±	0.0632	0.7392	±	0.0563	0.01	0.4367	95
	log(Chl-a) vs log(PEA) * all lakes	Y=a+bX	0.0564	±	0.0557	0.9691	±	0.0563	0.01	0.3122	166
5d	log(Chl-a) vs log(Zeu:MLD) * small lakes	Y=a+bX	-0.6271	±	0.2135	1.3460	±	0.0701	0.12	0.0046	65
	log(Chl-a) vs log(Zeu:MLD) * large lakes	Y=a+bX	-0.1838	±	0.1887	0.6864	±	0.0674	0.01	0.3326	93
	log(Chl-a) vs log(Zeu:MLD) * large lakes >20m	Y=a+bX	-0.2921	±	0.1177	0.5278	±	0.0448	0.11	0.0165	52
	log(Chl-a) vs log(Zeu:MLD) * all lakes	Y=a+bX	-0.0546	±	0.1566	0.9727	±	0.0541	0.00	0.7278	158
5b	log(Chl-a) vs log(bottom NH4) * small lakes	Y=a+bX	-0.1629	±	0.0813	1.7110	±	0.1980	0.06	0.0497	60
	log(Chl-a) vs log(bottom NH4) * large lakes	Y=a+bX	0.0872	±	0.0678	0.6510	±	0.0526	0.02	0.2021	87
	log(Chl-a) vs log(bottom NH4) * all lakes	Y=a+bX	0.1771	±	0.0367	0.7644	±	0.0612	0.14	<0.0001	147
5b	log(Chl-a) vs log(vertical DIN flux) * small lakes	Y=a+bX	-0.1451	±	0.0599	1.4540	±	0.0939	0.09	0.0185	61
	log(Chl-a) vs log(vertical DIN flux) * large lakes	Y=a+bX	0.0789	±	0.0396	0.8320	±	0.0860	0.05	0.0501	79
	log(Chl-a) vs log(vertical DIN flux) * all lakes	Y=a+bX	0.1170	±	0.0252	1.0190	±	0.0487	0.14	<0.0001	140
6a	log(bottom CH4) vs log(PEA) all	Y=a+bX	1.2620	±	0.1302	3.1690	±	0.1320	0.36	<0.0001	168
	log(bottom CH4) vs log(PEA) depth < 20m	Y=a+bX	0.8381	±	0.1790	3.1000	±	0.1653	0.25	<0.0001	67
	log(bottom CH4) vs log(PEA) depth > 20m	Y=a+bX	1.7500	±	0.2331	2.7860	±	0.2493	0.36	<0.0001	101
6b	log(bottom CH4) vs log(NH4+) all	Y=a+bX	1.2540	±	0.0596	2.5590	±	0.0990	0.75	<0.0001	148
	log(bottom CH4) vs log(NH4+) depth < 20m	Y=a+bX	1.0800	±	0.1271	2.4780	±	0.1616	0.59	<0.0001	53
	log(bottom CH4) vs log(NH4+) depth > 20m	Y=a+bX	1.2860	±	0.0670	2.6170	±	0.1236	0.80	<0.0001	95
6c	log(bottom CH4) vs log (MLD) all	Y=a+bX	-1.2340	±	0.2680	4.7330	±	0.2494	0.11	<0.0001	168
	log(bottom CH4) vs log(MLD) <20m	Y=a+bX	-1.9260	±	0.3636	4.0910	±	0.2537	0.30	<0.0001	67
	log(bottom CH4) vs log (MLD) >20m	Y=a+bX	-1.9440	±	0.3363	6.0710	±	0.3555	0.25	<0.0001	101
6d	log(bottom CH4) vs log(PO43-) small lakes	Y=a+bX	0.7314	±	0.1738	5.3550	±	0.1725	0.23	<0.0001	60
	log(bottom CH4) vs log(PO43-) large lakes	Y=a+bX	0.2635	±	0.0923	2.1440	±	0.1578	0.09	0.0054	88
6e	log(bottom CH4) vs log (bottom depth) all	Y=a+bX	1.7940	±	0.2931	1.3380	±	0.4192	0.18	<0.0001	168
	log(bottom CH4) vs log(bottom depth) small lakes	Y=a+bX	2.2050	±	0.2611	2.2920	±	0.3971	0.50	<0.0001	72
	log(bottom CH4) vs log (bottom depth) large lakes	Y=a+bX	0.4352	±	0.2072	1.9230	±	0.2814	0.04	0.0384	96
6f	log(bottom CH4) vs log (bottom O2) all	Y=a+bX	-1.2570	±	0.0551	5.1660	±	0.0941	0.76	<0.0001	168
	log(bottom CH4) vs log(bottom O2) <20m	Y=a+bX	-1.6240	±	0.1113	6.1010	±	0.2288	0.77	<0.0001	67
	log(bottom CH4) vs log (bottom O2) >20m	Y=a+bX	-1.2810	±	0.0741	5.0180	±	0.1060	0.75	<0.0001	101
66	log(bottom CH4) vs log(Δbott-surf Sp Conductivity) all	Y=a+bX	1.2000	±	0.0526	3.0000	±	0.0792	0.76	<0.0001	168
	log(bottom CH4) vs log(Δbott-surf Sp Conductivity) depth < 20m	Y=a+bX	0.9228	±	0.0942	2.8920	±	0.1222	0.60	<0.0001	67
	log(bottom CH4) vs log(Δbott-surf Sp Conductivity) depth > 20m	Y=a+bX	1.3280	±	0.0612	2.9780	±	0.0998	0.83	<0.0001	101
6h	log(bottom CH4) vs log(Chl-a) all	Y=a+bX	0.9398	±	0.2206	2.8460	±	0.2605	0.10	<0.0001	166
	log(bottom CH4) vs log(Chl-a) depth < 20m	Y=a+bX	0.7433	±	0.2344	2.1550	±	0.3335	0.14	0.0023	66
	log(bottom CH4) vs log(Chl-a) depth > 20m	Y=a+bX	2.1500	±	0.3414	2.4120	±	0.3377	0.29	<0.0001	100
8a	log(surface CH4) vs bottom depth small lakes	Y=a+bX	-0.0016	±	0.0030	3.1230	±	0.1774	0.00	0.5913	72
	log(surface CH4) vs bottom depth large lakes	Y=a+bX	-0.0191	±	0.0021	2.3970	±	0.0734	0.47	<0.0001	96
	log(surface CH4) vs bottom depth all lakes	Y=a+bX	-0.0012	±	0.0024	2.4100	±	0.1144	0.00	0.6291	168
8c	log(surface CH4) vs log(PEA) small lakes	Y=a+bX	0.2378	±	0.1981	2.8180	±	0.2273	0.02	0.2341	72
	log(surface CH4) vs log(PEA) large lakes	Y=a+bX	-0.3320	±	0.0570	1.8900	±	0.0513	0.27	<0.0001	96
	log(surface CH4) vs log(PEA) all lakes	Y=a+bX	0.1774	±	0.0843	2.2830	±	0.0854	0.03	0.0368	168
8e	log(surface CH4) vs log(MLD) lakes < 20m	Y=a+bX	-0.9318	±	0.2287	3.0690	±	0.1583	0.21	0.0001	66
	log(surface CH4) vs log(MLD) lakes > 20m	Y=a+bX	-1.0320	±	0.1799	3.1900	±	0.1901	0.25	<0.0001	101
	log(surface CH4) vs log(MLD) small lakes	Y=a+bX	-0.2573	±	0.2710	3.1580	±	0.1843	0.01	0.3458	71
	log(surface CH4) vs log(MLD) large lakes	Y=a+bX	-0.5005	±	0.122	2.347	±	0.1316	0.152	<0.0001	96
	log(surface CH4) vs log(MLD) All lakes	Y=a+bX	-0.8488	±	0.1364	3.021	±	0.1268	0.19	<0.0001	167
8b	log(surface CH4) vs log(Chl-a) lakes < 20m	Y=a+bX	0.4918	±	0.1284	1.9820	±	0.1826	0.19	0.0003	66
	log(surface CH4) vs log(Chl-a) lakes > 20m	Y=a+bX	1.2580	±	0.1746	1.1330	±	0.1728	0.35	<0.0001	100
	log(surface CH4) vs log(Chl-a) small lakes	Y=a+bX	0.4276	±	0.2041	2.4730	±	0.2993	0.06	0.0398	71
	log(surface CH4) vs log(Chl-a) large lakes	Y=a+bX	0.4591	±	0.09832	1.508	±	0.08952	0.19	<0.0001	95
	log(surface CH4) vs log(Chl-a) All lakes	Y=a+bX	0.7958	±	0.1045	1.567	±	0.1234	0.261	<0.0001	166
8d	log(surface CH4) vs log(bottom CH4) small lakes	Y=a+bX	0.0004	±	0.0000	10.3700	±	5.4870	0.51	<0.0001	72
	log(surface CH4) vs log(bottom CH4) large lakes	Y=a+bX	0.1086	±	0.0658	1.5860	±	0.1735	0.03	0.1021	96
	log(surface CH4) vs log(bottom CH4) all lakes	Y=a+bX	0.0004	±	0.0000	5.4360	±	2.3340	0.52	<0.0001	168
	log(surface CH4) vs log(bottom CH4) lakes <20m	Y=a+bX	0.0003	±	0.0000	5.8910	±	3.3450	0.70	<0.0001	67
	log(surface CH4) vs log(bottom CH4) large lakes >20m	Y=a+bX	0.0008	±	0.0001	3.1230	±	2.8340	0.49	<0.0001	101
8f	log(surface CH4) vs log(bottom O2) small lakes	Y=a+bX	-0.6486	±	0.1026	3.8000	±	0.2109	0.38	<0.0001	67
	log(surface CH4) vs log(bottom O2) large lakes	Y=a+bX	-0.4277	±	0.0667	2.4820	±	0.0953	0.29	<0.0001	101
	log(surface CH4) vs log(bottom O2) all lakes	Y=a+bX	-0.0897	±	0.1041	3.0570	±	0.1185	0.01	0.3916	72
	log(surface CH4) vs log(bottom O2) lakes <20m	Y=a+bX	0.2751	±	0.07613	1.335	±	0.1546	0.122	0.0005	96
	log(surface CH4) vs log(bottom O2) large lakes >20m	Y=a+bX	-0.2985	±	0.05395	2.699	±	0.09207	0.156	<0.0001	168

Table S2 continued

9a	log(surface CH4:Bottom CH4) vs bottom depth * small lakes	Y=a+bX	-0.0165	±	0.0038	-1.7140	±	0.2236	0.22	<0.0001	72
	log(surface CH4:Bottom CH4) vs bottom depth * large lakes	Y=a+bX	-0.0283	±	0.0039	0.1763	±	0.1366	0.36	<0.0001	96
	log(surface CH4:Bottom CH4) vs bottom depth * all lakes	Y=a+bX	-0.0256	±	0.0031	-0.5066	±	0.1459	0.29	<0.0001	168
9b	log(surface CH4:Bottom CH4) vs MLD * small lakes	Y=a+bX	-0.1328	±	0.0424	-1.8750	±	0.2476	0.12	0.0025	71
	log(surface CH4:Bottom CH4) vs MLD * large lakes	Y=a+bX	-0.0343	±	0.0072	-0.1039	±	0.1422	0.19	<0.0001	96
	log(surface CH4:Bottom CH4) vs MLD * all lakes	Y=a+bX	0.0076	±	0.0104	-1.4930	±	0.1601	0.00	0.4649	167
9c	log(surface CH4:Bottom CH4) vs log(PEA) * small lakes	Y=a+bX	-1.6830	±	0.2009	-0.7924	±	0.2306	0.50	<0.0001	72
	log(surface CH4:Bottom CH4) vs log(PEA) * large lakes	Y=a+bX	-0.4799	±	0.1012	-0.5771	±	0.0911	0.19	<0.0001	96
	log(surface CH4:Bottom CH4) vs log(PEA) * all lakes	Y=a+bX	-1.0850	±	0.0981	-0.8852	±	0.0994	0.42	<0.0001	168
9d	log(surface CH4:Bottom CH4) vs log(bottom O2) * small lakes	Y=a+bX	0.8187	±	0.1119	-2.4910	±	0.1274	0.43	<0.0001	72
	log(surface CH4:Bottom CH4) vs log(bottom O2) * large lakes	Y=a+bX	1.1280	±	0.0736	-2.7640	±	0.1495	0.71	<0.0001	96
	log(surface CH4:Bottom CH4) vs log(bottom O2) * all lakes	Y=a+bX	0.9584	±	0.0486	-2.4670	±	0.0830	0.70	<0.0001	168
9e	log(surface CH4:Bottom CH4) vs log(FCH4) * small lakes	Y=a+bX	0.5090	±	0.1560	-3.9280	±	0.4814	0.13	0.0017	72
	log(surface CH4:Bottom CH4) vs log(FCH4) * large lakes	Y=a+bX	0.6970	±	0.1499	-1.8230	±	0.2729	0.19	<0.0001	96
	log(surface CH4:Bottom CH4) vs log(FCH4) * all lakes	Y=a+bX	-0.1657	±	0.1147	-1.0360	±	0.2804	0.01	0.1507	168
S3a	log(PEA) vs log (bottom depth) * small lakes	Y=a+bX	1.0360	±	0.0999	-0.5250	±	0.1527	0.61	<0.0001	70
	log(PEA) vs log (bottom depth) * large lakes	Y=a+bX	1.0590	±	0.1825	-1.2600	±	0.2479	0.26	<0.0001	96
	log(PEA) vs log (bottom depth) * all lakes	Y=a+bX	1.1950	±	0.1244	-1.1490	±	0.1783	0.36	<0.0001	166
S3b	log(PEA) vs log(MLD) * small lakes	Y=a+bX	-1.0890	±	0.2571	0.5456	±	0.1779	0.22	<0.0001	66
	log(PEA) vs log log(MLD) * large lakes	Y=a+bX	-0.5709	±	0.1209	1.3730	±	0.1278	0.18	<0.0001	101
	log(PEA) vs log log(MLD) * all lakes	Y=a+bX	-0.3010	±	0.1392	0.7174	±	0.1295	0.03	0.0321	167
S4a	log(PEA) vs log(DOC) * small lakes	Y=a+bX	-0.8437	±	0.2538	1.6250	±	0.2036	0.14	0.0014	68
	log(PEA) vs log(DOC) * large lakes	Y=a+bX	-0.9355	±	0.2799	0.6506	±	0.1859	0.11	0.0012	89
	log(PEA) vs log(DOC) * all lakes	Y=a+bX	-0.4590	±	0.2256	0.7909	±	0.1640	0.03	0.0436	157
S4b	log(PEA) vs log(a350) * small lakes	Y=a+bX	-0.9071	±	0.1938	1.2930	±	0.0849	0.26	<0.0001	65
	log(PEA) vs log(a350) * large lakes	Y=a+bX	-0.5083	±	0.1610	0.2216	±	0.0984	0.10	0.0022	90
	log(PEA) vs log(a350) * all	Y=a+bX	-0.5240	±	0.1466	0.6256	±	0.0799	0.08	0.0005	155
S4c	log(MLD) vs log(DOC) * small lakes	Y=a+bX	-0.5627	±	0.1923	0.9097	±	0.1543	0.11	0.0047	68
	log(MLD) vs log(DOC) * large lakes	Y=a+bX	-0.4672	±	0.1268	1.2810	±	0.0842	0.14	0.0004	89
	log(MLD) vs log(DOC) * all	Y=a+bX	-0.6881	±	0.1152	1.2340	±	0.0838	0.19	<0.0001	157
S4d	log(MLD) vs log(a350) * small lakes	Y=a+bX	-0.8016	±	0.1429	0.7395	±	0.0626	0.33	<0.0001	65
	log(MLD) vs log(a350) * large lakes	Y=a+bX	-0.3235	±	0.0709	1.1060	±	0.0433	0.19	<0.0001	90
	log(MLD) vs log(a350) * all	Y=a+bX	-0.4469	±	0.0769	0.9253	±	0.0419	0.18	<0.0001	155
S6a	log(vertical FCH4) vs log(PEA) all	Y=a+bX	1.2520	±	0.1358	3.6420	±	0.1319	0.24	<0.0001	140
S6b	log(vertical FDIN) vs log(PEA) all	Y=a+bX	0.5509	±	0.1299	1.5220	±	0.1327	0.14	<0.0001	113
S6c	log(vertical delta_CH4) vs log(PEA) all	Y=a+bX	1.9950	±	0.1883	2.5810	±	0.1830	0.45	<0.0001	140
S6d	log(vertical delta_DIN) vs log(PEA) all	Y=a+bX	1.0450	±	0.0943	0.6542	±	0.0977	0.50	<0.0001	126
S6e	log(Kz) vs log(PEA) all	Y=a+bX	-0.5170	±	0.0456	-5.9930	±	0.0443	0.48	<0.0001	140
S7a	log(DOC) vs log(Chl-a) * small lakes (*)	Y=a+bX	0.2830	±	0.0436	0.3616	±	0.0645	0.39	<0.0001	67
	log(DOC) vs log(Chl-a) * large lakes (*)	Y=a+bX	0.3248	±	0.0417	0.2516	±	0.0383	0.43	<0.0001	83
	log(DOC) vs log(Chl-a) * all (*)	Y=a+bX	0.3273	±	0.0266	0.2728	±	0.0319	0.51	<0.0001	150
S7b	log(a350) vs log(Chl-a) * small lakes (*)	Y=a+bX	0.3849	±	0.0479	-0.2224	±	0.0706	0.51	<0.0001	65
	log(a350) vs log(Chl-a) * large lakes (*)	Y=a+bX	0.5050	±	0.0475	-0.2932	±	0.0436	0.59	<0.0001	79
	log(a350) vs log(Chl-a) * all (*)	Y=a+bX	0.4144	±	0.0299	-0.2397	±	0.0359	0.57	<0.0001	144
S8	log(bottom CH4) vs log (PEA) * PEA < 5	Y=a+bX	0.3803	±	0.1452	2.7310	±	0.1168	0.08	0.0105	86
	log(bottom CH4) vs log (PEA) * 5 < PEA < 35	Y=a+bX	4.7460	±	0.9177	-0.4211	±	1.0120	0.29	<0.0001	68
	log(bottom CH4) vs log (PEA) * PEA > 35	Y=a+bX	1.2140	±	1.3000	4.4430	±	2.1100	0.08	0.3724	12
S10	bottom PO43- vs log(Ca2+:Na+) * small lakes	Y=a+bX	-5.0440	±	2.4530	9.4460	±	1.7770	0.10	0.0465	41
	bottom PO43- vs log(Ca2+:Na+) * large lakes	Y=a+bX	-0.2074	±	0.5351	1.4540	±	0.3671	0.00	0.6997	62
S11	MLD vs bottom lakes (small lakes)	Y=a+bX	0.0503	±	0.0095	2.2590	±	0.5669	0.29	<0.0001	71
	MLD vs bottom lakes (large lakes)	Y=a+bX	0.3600	±	0.0502	5.0070	±	1.7650	0.35	<0.0001	96
	MLD vs bottom lakes (all lakes)	Y=a+bX	0.0816	±	0.0269	7.7900	±	1.2710	0.05	0.0028	167

(*) excluding L. Mai Ndombe and Tumba

Table S3: Results of upaired two-tailed t-test with Welch's correction (t-statistic (t), degree of freedom (df), P value and corresponding summary, and sample size of each group (n1,n2)).

Figure	Variable	Groups	t, df	P value	Summary	n1	n2
3	average MLD	Large vs Small	t=6.070, df=43.51	<0.0001	****	40	6
3	average PEA	Large vs Small	t=5.296, df=37.80	<0.0001	****	40	6
4a	log(PEA)	Large vs Small	t=7.588, df=163.9	<0.0001	****	72	96
4b	log(MLD)	Large vs Small	t=7.919, df=149.6	<0.0001	****	71	96
4c	log(surf CH4)	Large vs Small	t=9.051, df=106.1	<0.0001	****	72	96
4d	log(bott CH4)	Large vs Small	t=15.91, df=113.0	<0.0001	****	72	96
4e	log(surf NH4+)	Large vs Small	t=2.563, df=153.4	0.0113	*	67	91
4f	log(bott NH4+)	Large vs Small	t=14.08, df=106.8	<0.0001	****	60	88
4g	log(surf PO43-)	Large vs Small	t=1.145, df=100.6	0.2551	ns	67	90
4h	log(bott PO43-)	Large vs Small	t=4.412, df=80.21	<0.0001	****	60	88
S5a	log(sp. Cond.)	Large vs Small	t=4.356, df=161.3	<0.0001	****	73	95
S5b	log(pH)	Large vs Small	t=4.166, df=125.4	<0.0001	****	42	90
S5c	log(Chl-a)	Large vs Small	t=7.116, df=146.6	<0.0001	****	72	95
S5d	log(DOC)	Large vs Small	t=3.713, df=155.3	0.0003	***	69	89
S5e	log(a2350)	Large vs Small	t=0.8251, df=146.4	0.4106	ns	65	90

Table S4: Results of one-way analysis of variance (ANOVA) and Tukey's multiple comparisons test (F value, degree of freedom (DF) of treatment (between columns) (DFn) and of residual (within columns) (DFd), mean 1 and 2, mean and standard error (SE) of difference of means (diff.), n1, n2 Adjusted P value and corresponding summary as shown in figures), assuming a log-normal distribution (comparison of geometric means).

Fig.	Variable tested	F (DFn, DFd)	P value	Tukey's multiple comparisons test	Mean 1	Mean 2	Mean±SE of diff.	n1	n2	Summary	Adj. P Value
S9	bottom O2	F (2, 165) = 72.62	P<0.0001	PEA < 5 vs. 5 < PEA < 35	79.180	2.484	31.880 ± 0.155	89	67	****	<0.0001
				PEA < 5 vs. PEA > 35	481.600	0.164	481.600 ± 0.294	89	12	****	<0.0001
				5 < PEA < 35 vs. PEA > 35	15.110	0.164	15.110 ± 0.300	67	12	***	0.0004