Electronic Supplementary Material (ESI) for Environmental Science: Advances.

Supplementary Online Material

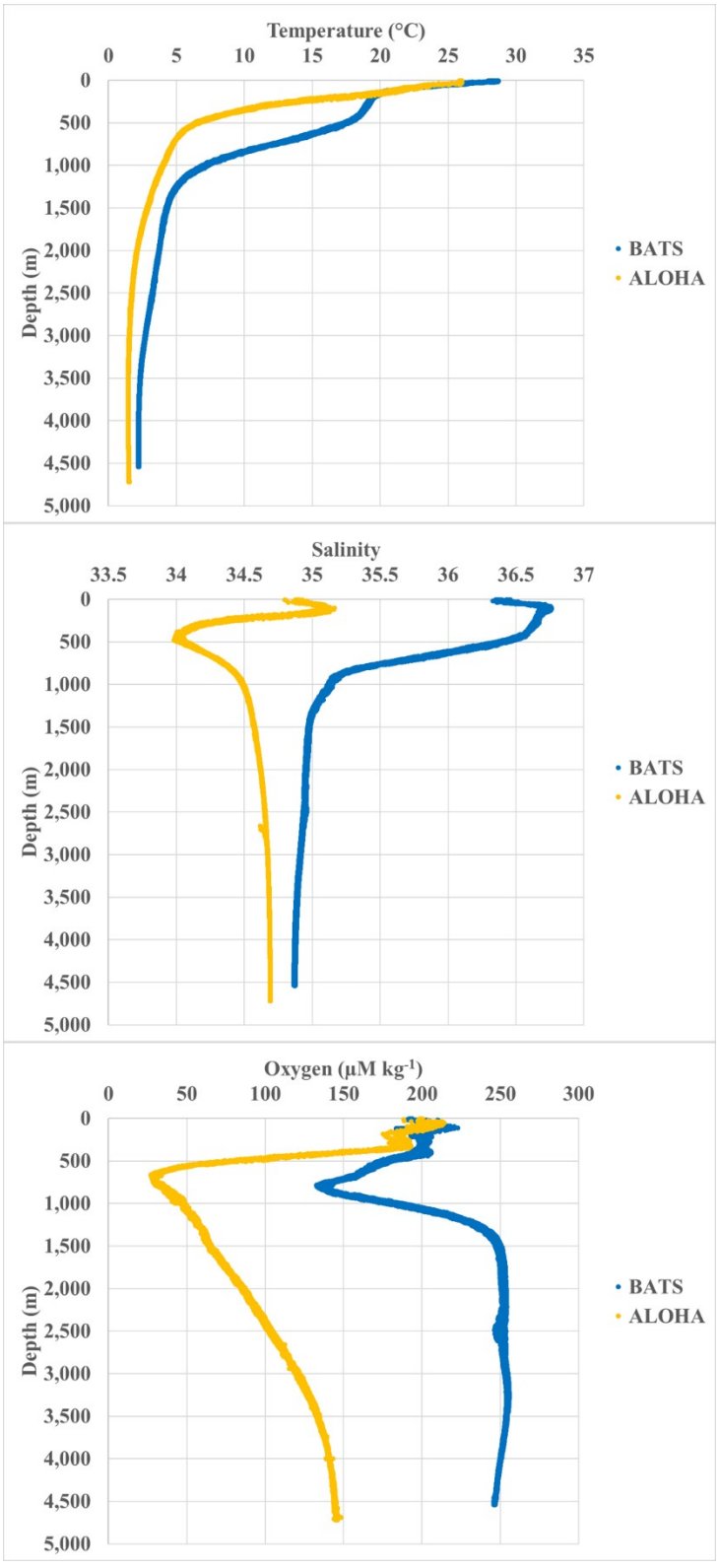


Figure S1: Comparing station BATS in the Atlantic (blue) and ALOHA in the Pacific (yellow) water column CTD profiles. Temperature (top panel), Salinity (center panel), and oxygen concentrations (bottom panel) .

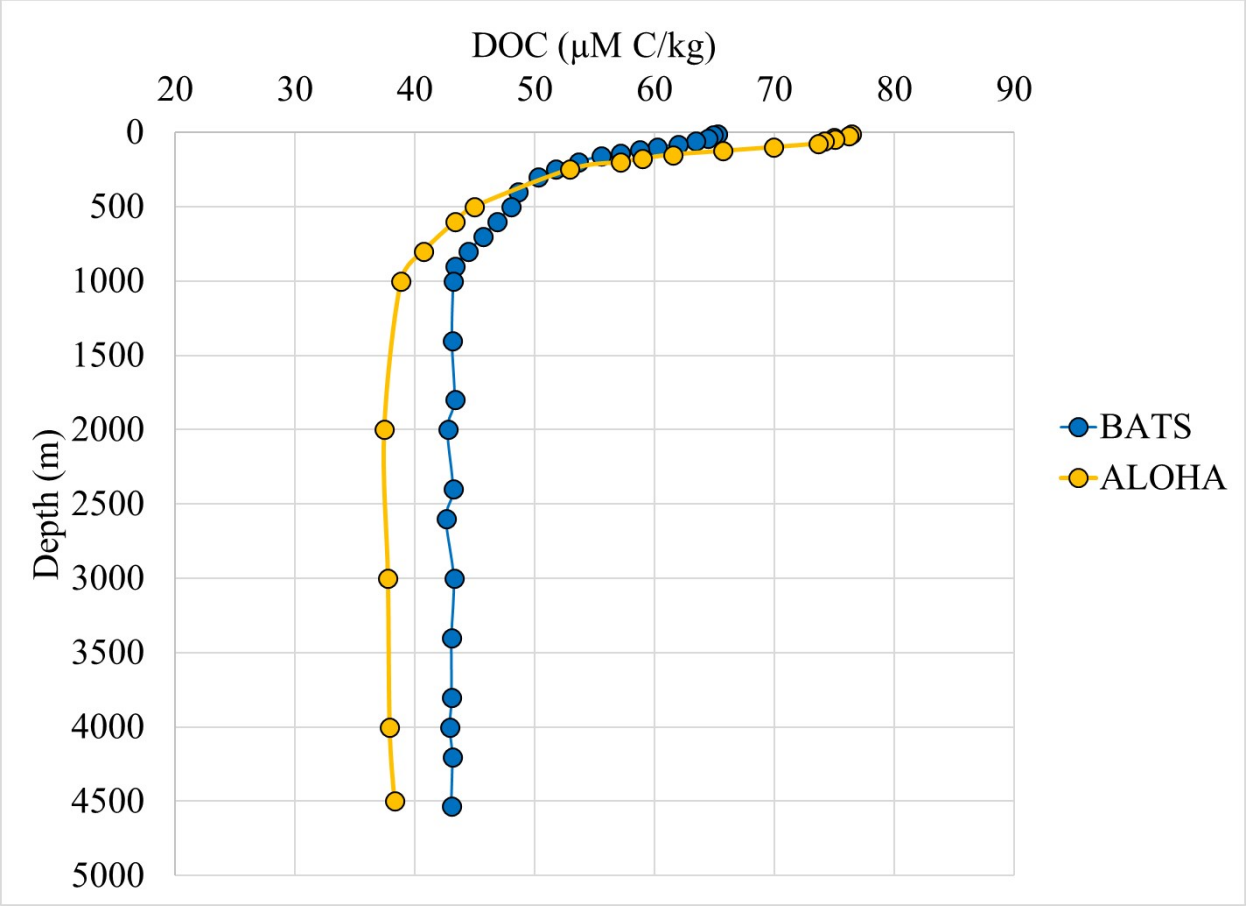


Figure S2: Historic DOC data based on long-term monitoring data at station ALOHA and BATS. *BATS data source: Johnson, R. (2019) Niskin bottle water samples and CTD measurements at water sample depths collected at Bermuda Atlantic Time-Series sites in the Sargasso Sea ongoing from 1955-01-29 (BATS project). Biological and Chemical Oceanography Data Management Office (BCO-DMO). ALOHA data source: Hawaii Ocean Time-series HOT-DOGS application; University of Hawai'i at Mānoa. National Science Foundation Award # 1756517.*

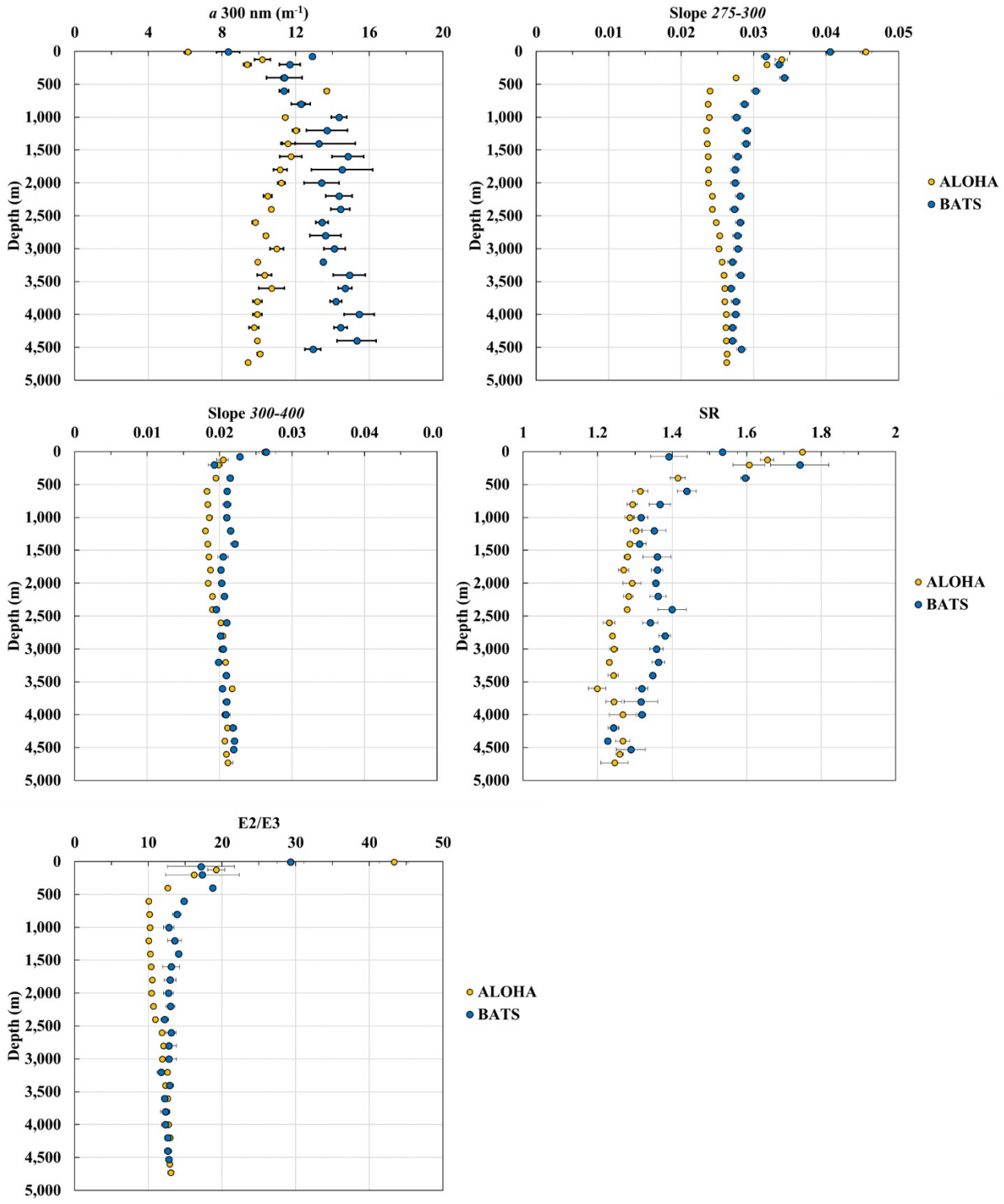


Figure S3: Depth profiles of the ALOHA and BATS optical parameters analyzed using PPL SPE-DOM (A) absorption coefficient at 300 nm (a (300)); spectral slopes (B) $S_{275–295,}$ and (C) $S_{350–400}$; (D) spectral slope ratio SR ($S_{275–295}/S_{350–400}$); and (E) absorption ratio E2/E3 (a (250)/a (365)).

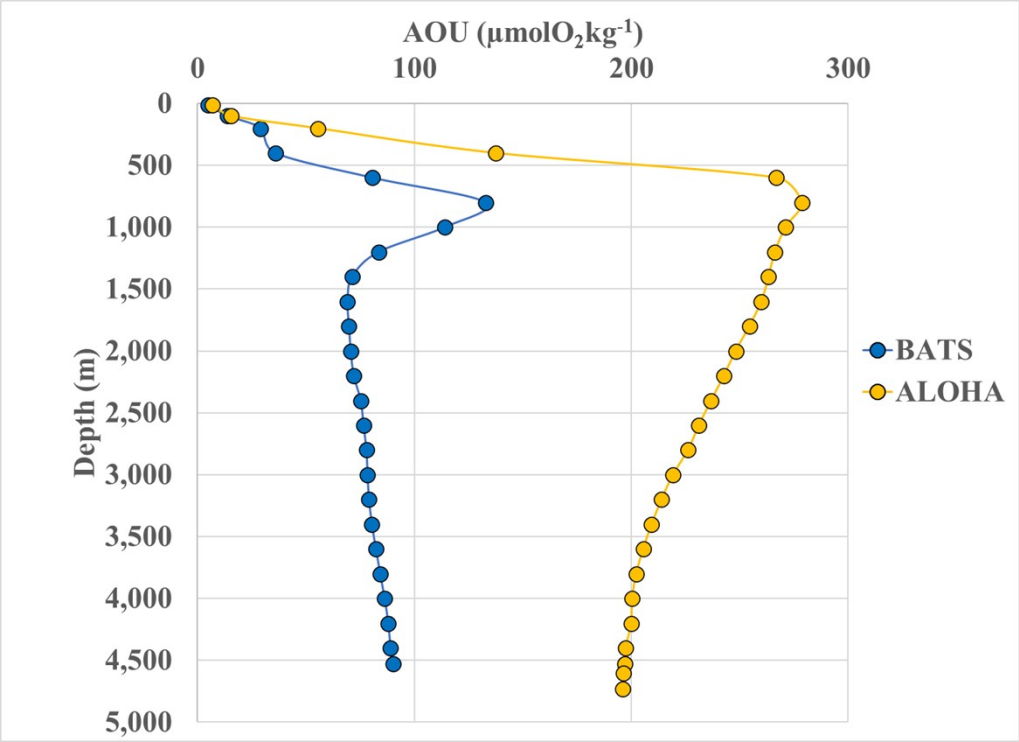


Figure S4: Depth profiles of apparent oxygen utilization (AOU) at station BATS in 2019 and ALOHA in 2021.

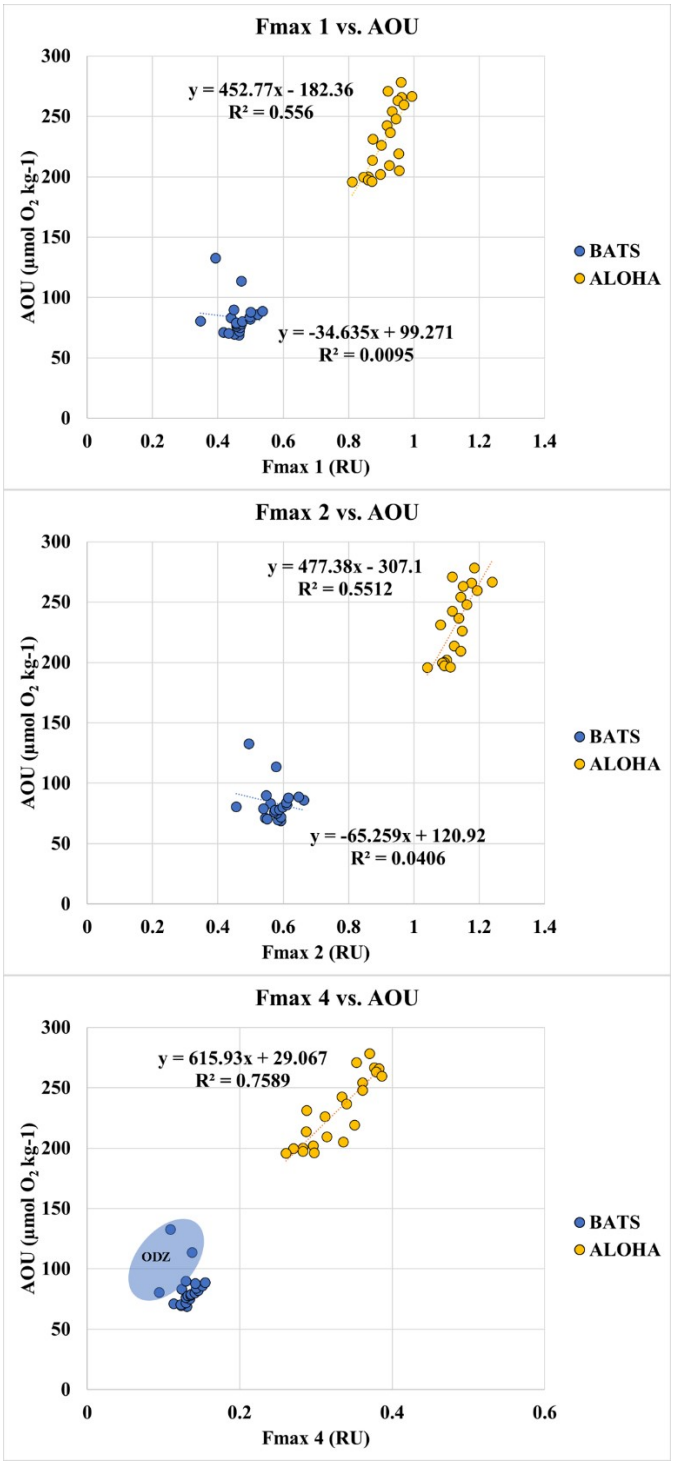


Figure S5: Linear regression analyses of apparent oxygen utilization (AOU) and EEM-PARAFAC components at station BATS 2019 and Aloha 2021. Note: blue circle highlights samples within the oxygen deficiency zone (ODZ) at BATS.

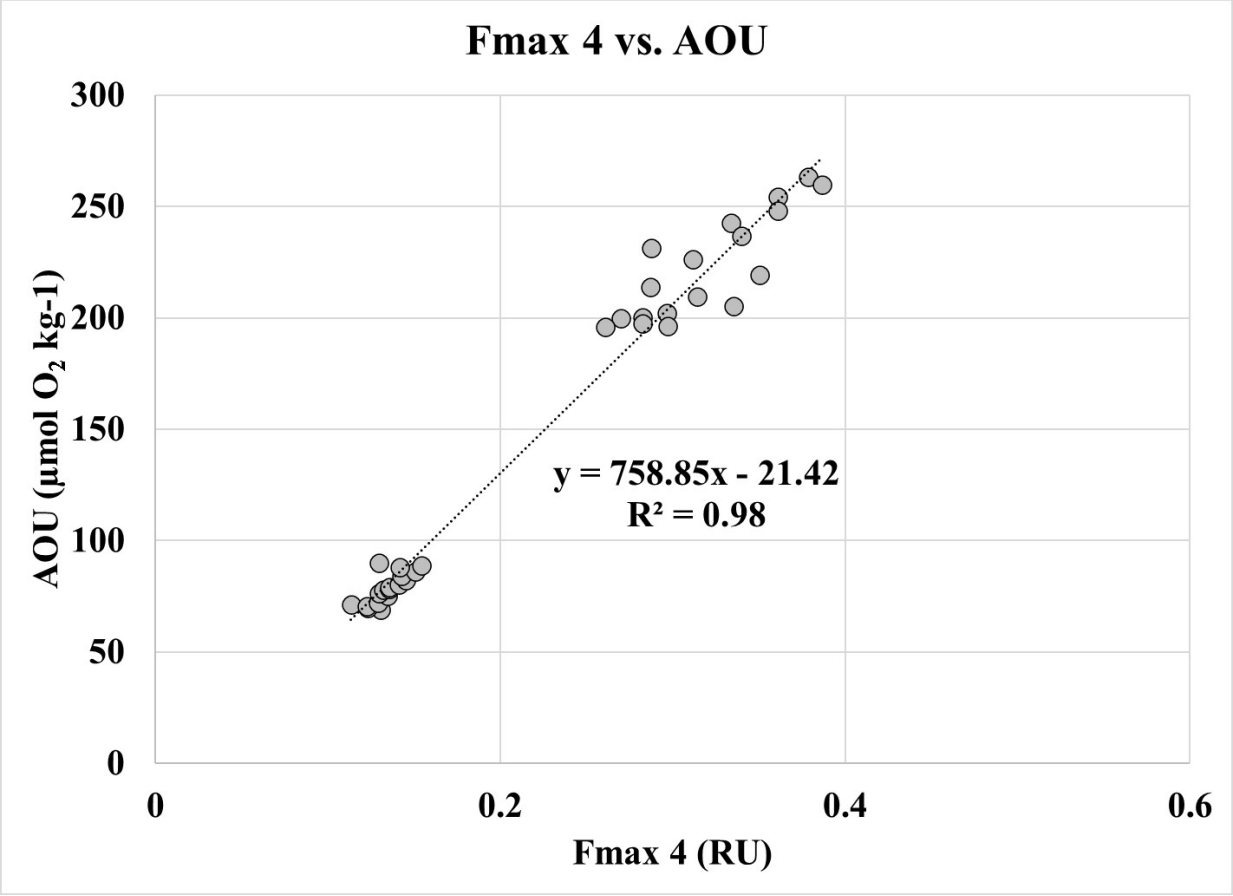


Figure S6: Linear regression analyses of apparent oxygen utilization (AOU) and EEM-PARAFAC component Fmax 4 (493nm) for all samples below 1,200 m depth.

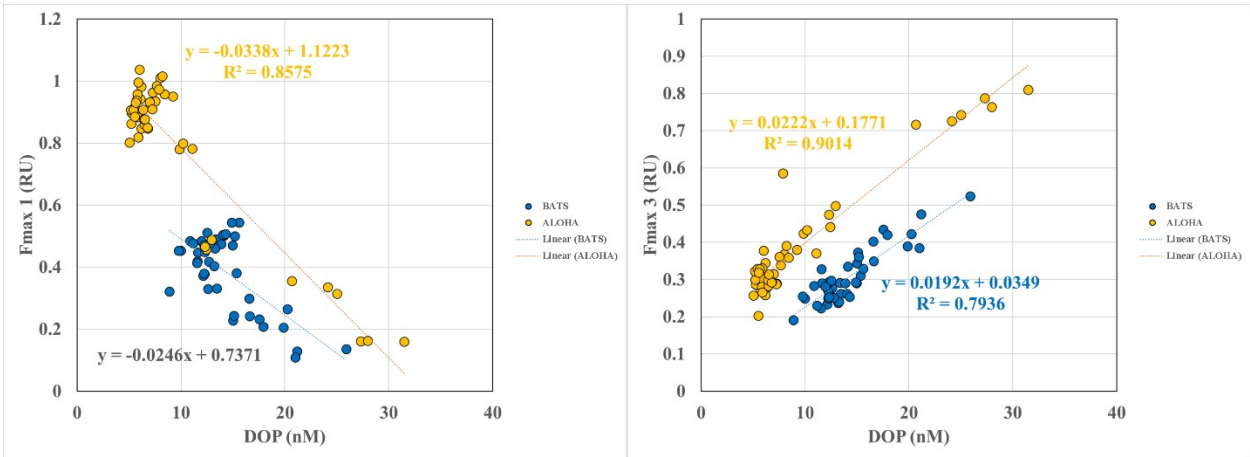


Figure S7: Dissolved organic phosphorus (DOP) concentrations (nM) vs $FDOM_H$ component Fmax1 (left) and $FDOM_P$ component Fmax3 (right) in SPE-DOM samples collected at BATS (blue dots) and ALOHA (yellow dots). The yellow line is the linear regression between Fmax values and DOP at ALOHA.

.

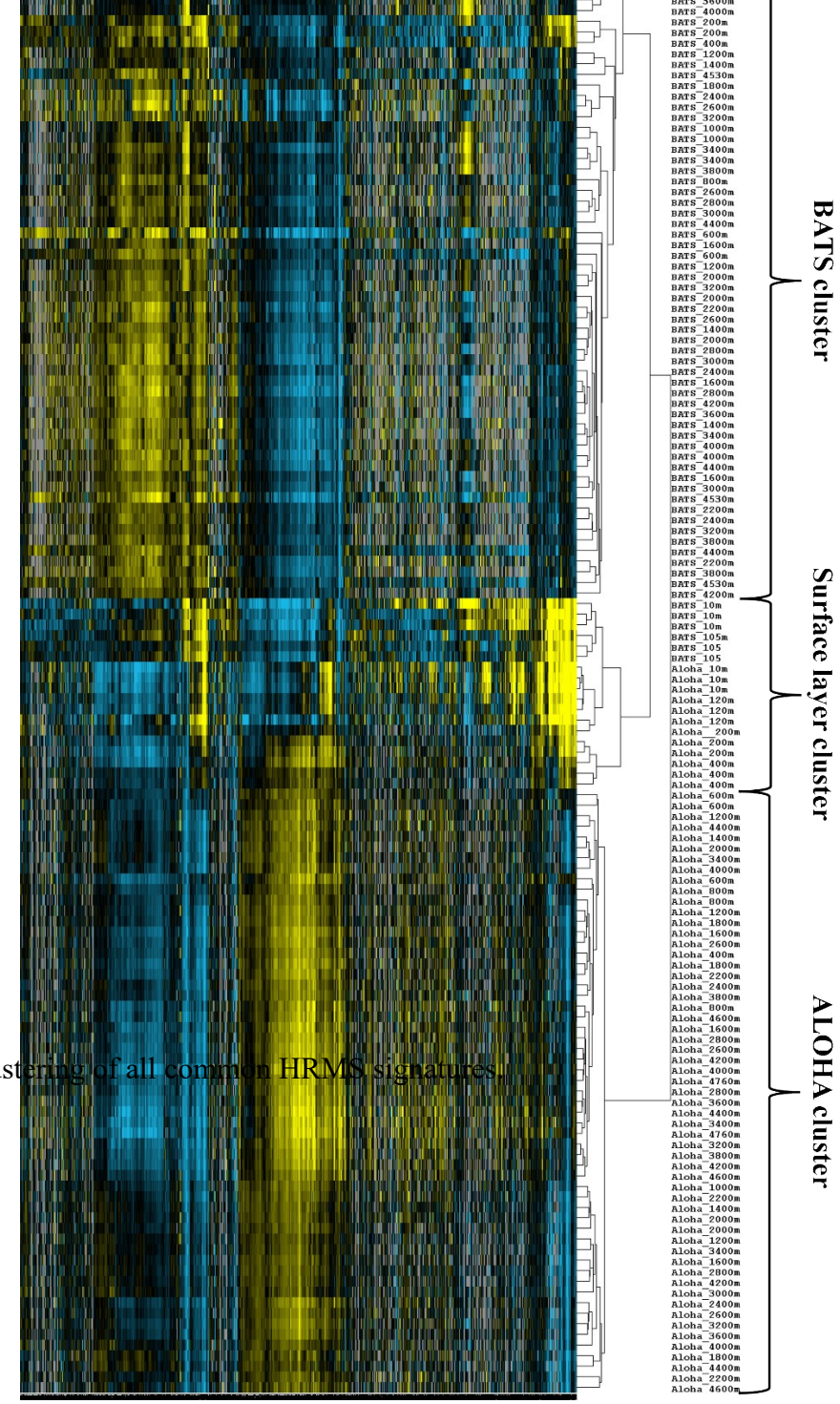
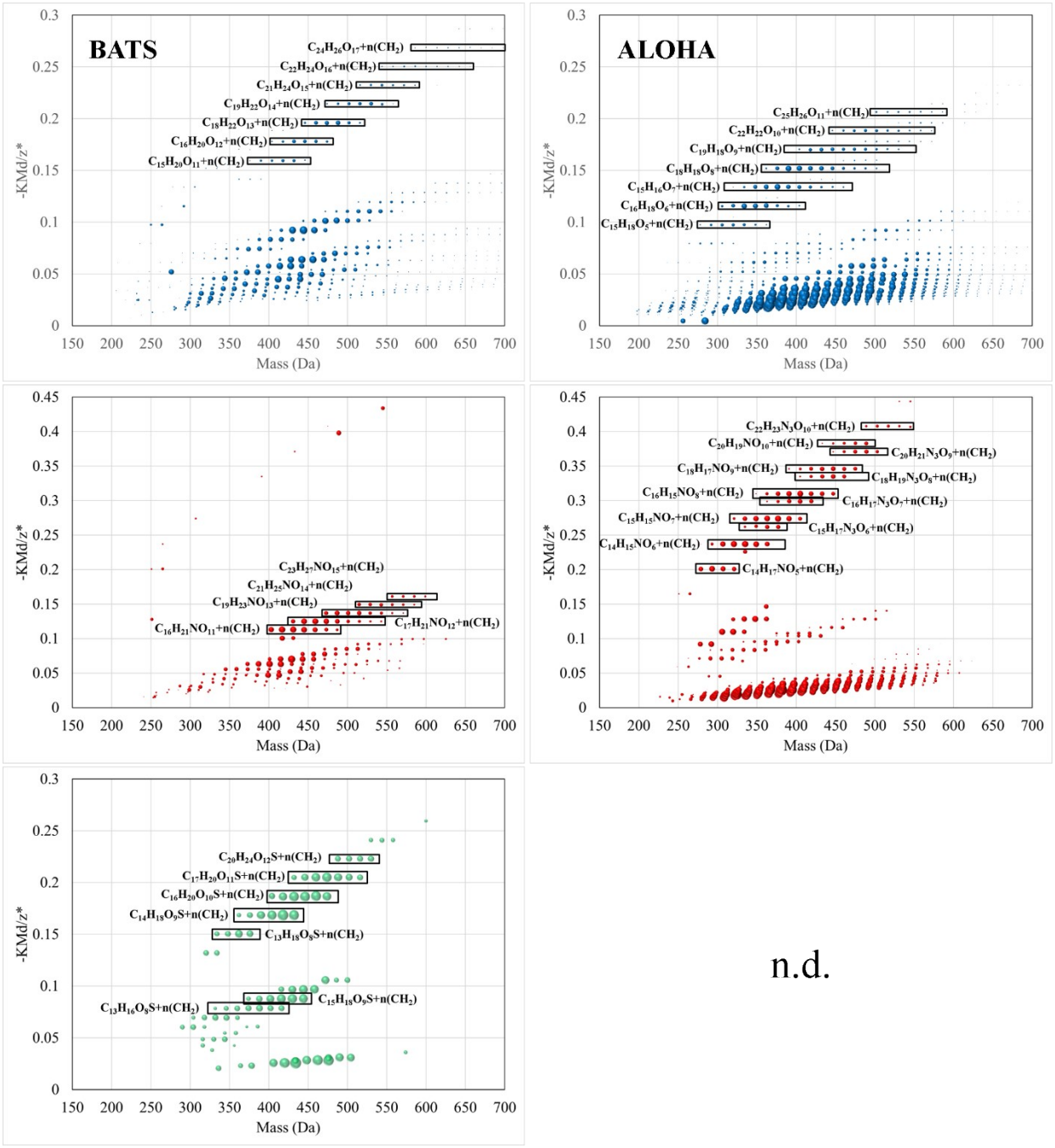


Figure S8: Hierarchical clustering of all common HRMS signatures.



n.d.

Figure S9: Mass-edited kmd/z* plots of fundamental abundance differences amongst common molecular signatures at BATS (left panels) and ALOHA (right panels). Note: blue color corresponds to CHO, red to CHNO and green to CHOS signatures; bubble size indicates relative abundance within each pool.

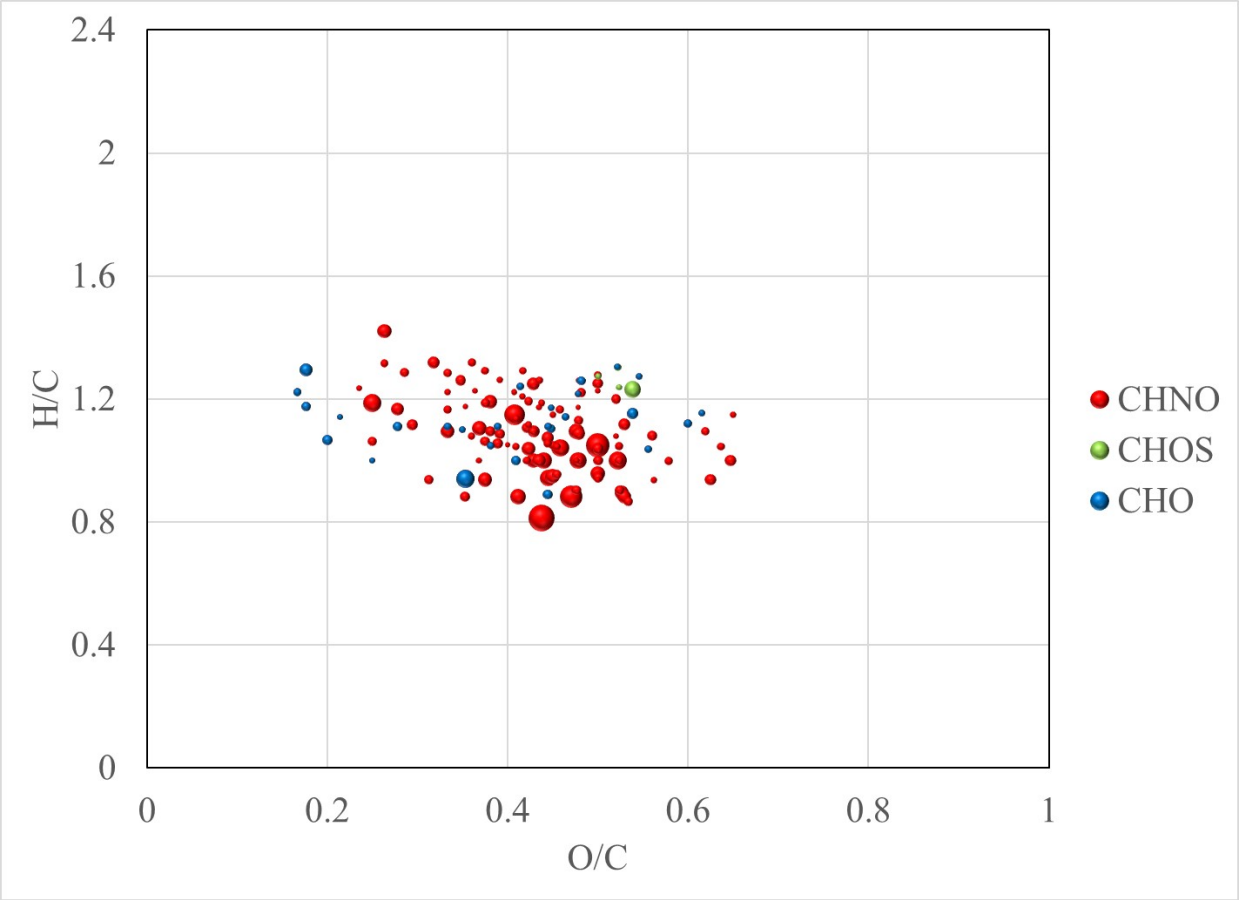


Figure S10: SOFAR analysis of the correlation between FTMS and the humic-like components of the EEM-PARAFAC data depicted in van Krevelen space. Note: bubble size corresponds to the loading from the SOFAR analysis.

Table S1: Linear Regressions between PARAFAC components (Fmax1, 2, 3, and 4) and DOP, DOS, and S:P ratios in PPL SPE DOM samples. R^2 values ≥0.9 are highlighted in yellow, those <0.9 but ≥0.70 are highlighted in green, and those <0.70 but ≥0.5 are highlighted in blue.

	ALOHA		***BATS***	
	Slope	R^2	Slope	R^2
Fmax1 vs. DOP	-0.034 ± 0.002	0.86	0.004 ± 0.007	0.01
Fmax2 vs. DOP	-0.035 ± 0.002	0.86	0.014 ± 0.009	0.06
Fmax3 vs. DOP	0.022 ± 0.001	0.90	0.036 ± 0.005	0.51
Fmax4 vs. DOP	-0.013 ± 0.001	0.68	0.001 ± 0.002	0.01
Fmax1 vs. DOS	-0.010 ± 0.001	0.54	0.000 ± 0.001	0.00
Fmax2 vs. DOS	-0.010 ± 0.001	0.52	0.001 ± 0.001	0.02
Fmax3 vs. DOS	0.007 ± 0.001	0.64	0.004 ± 0.001	0.34
Fmax4 vs. DOS	-0.004 ± 0.001	0.45	0.000 ± 0.000	0.00
Fmax1 vs. S:P	0.105 ± 0.009	0.74	-0.039 ± 0.033	0.03
Fmax2 vs. S:P	0.106 ± 0.010	0.71	-0.062 ± 0.043	0.05
Fmax3 vs. S:P	-0.068 ± 0.006	0.76	0.036 ± 0.005	0.51
Fmax4 vs. S:P	0.042 ± 0.005	0.63	-0.008 ± 0.009	0.02

Table S2: Assigned molecular formulae of WAX SPE-DOM and their abundances in total ion counts (TIC).

(M-H)-	**M**	**mass error (ppm)**	**Formulae**	**BATS surface (TIC)**	**ALOHA surface (TIC)**	**BATS 2000 m depth (TIC)**	**ALOHA 2000 m depth (TIC)**
383.0983	384.1056	0.08	C17H20O10	10467564	3299716	4433605	n.d.
399.0933	400.1005	0.10	C17H20O11	8395396	2914129	3261160	n.d.
369.0827	370.0900	0.08	C16H18O10	8092160	3388261	4086391	n.d.
413.1089	414.1162	0.14	C18H22O11	7804542	2785488	n.d.	n.d.
411.0933	412.1006	0.01	C18H20O11	7602791	2723498	3204007	n.d.
357.0827	358.0900	0.03	C15H18O10	7592203	2662907	3968020	n.d.
439.0881	440.0954	0.16	C19H20O12	7512791	2432750	2447354	n.d.
355.1034	356.1107	0.14	C16H20O9	7407746	n.d.	3255731	n.d.

371.0984	372.1057	0.00	C16H20O10	7275802	2837495	3288355	n.d.
455.1195	456.1267	0.07	C20H24O12	7269488	n.d.	n.d.	n.d.
441.1039	442.1111	0.00	C19H22O12	7222973	2868715	n.d.	n.d.
425.1089	426.1162	0.11	C19H22O11	7168753	n.d.	n.d.	n.d.
341.0878	342.0951	0.08	C15H18O9	6747876	3134911	3897085	2434621
453.1038	454.1111	0.12	C20H22O12	6593772	n.d.	2406249	n.d.
397.0776	398.0849	0.04	C17H18O11	6501022	2671858	3111391	2193452
353.0878	354.0951	0.05	C16H18O9	6450178	2121895	3226963	n.d.
343.1035	344.1108	0.10	C15H20O9	6445792	3376469	2849745	n.d.
427.0882	428.0955	0.10	C18H20O12	6357749	2791190	2385821	n.d.
381.0827	382.0900	0.02	C17H18O10	6317424	n.d.	3671348	n.d.
385.1140	386.1213	0.02	C17H22O10	6179959	2395168	2319179	n.d.
395.0983	396.1056	0.10	C18H20O10	5888724	n.d.	2321874	n.d.
369.1191	370.1263	0.14	C17H22O9	5875214	n.d.	2397832	n.d.
469.0986	470.1059	0.30	C20H22O13	5726904	n.d.	2356961	n.d.
423.0933	424.1006	0.09	C19H20O11	5625559	n.d.	2910152	n.d.
409.1140	410.1212	0.16	C19H22O10	5605991	n.d.	n.d.	n.d.
385.0776	386.0849	0.01	C16H18O11	5440103	2773519	2799931	n.d.
359.0984	360.1057	0.12	C15H20O10	5371828	2355527	n.d.	n.d.
313.0929	314.1002	0.01	C14H18O8	5365061	2148448	2821374	n.d.
357.1192	358.1264	0.11	C16H22O9	5332247	2172810	n.d.	n.d.
329.0878	330.0951	0.05	C14H18O9	5298957	2298886	n.d.	n.d.
429.1038	430.1111	0.11	C18H22O12	4991751	n.d.	n.d.	n.d.

355.0671	356.0744	0.09	C15H16O10	4947575	3651776	3632803	n.d.
327.0722	328.0795	0.10	C14H16O9	4933566	3004260	2717836	n.d.
299.0772	300.0845	0.00	C13H16O8	4925967	2173501	2424283	n.d.
415.0881	416.0954	0.24	C17H20O12	4901508	n.d.	n.d.	n.d.
457.0988	458.1060	0.02	C19H22O13	4825555	n.d.	2379698	n.d.
451.0881	452.0953	0.32	C20H20O12	4802902	n.d.	2787023	n.d.
301.0929	302.1002	0.03	C13H18O8	4752112	n.d.	n.d.	n.d.
481.0986	482.1059	0.32	C21H22O13	4731657	n.d.	2383353	n.d.
401.1089	402.1162	0.13	C17H22O11	4638836	n.d.	2205407	n.d.
367.0670	368.0743	0.13	C16H16O10	4574968	n.d.	2620109	n.d.
383.0620	384.0693	0.02	C16H16O11	4529372	n.d.	n.d.	n.d.
325.0929	326.1002	0.07	C15H18O8	4500623	n.d.	3169129	n.d.
409.0776	410.0848	0.17	C18H18O11	4447316	2266750	2461946	n.d.
413.0725	414.0798	0.10	C17H18O12	4349547	n.d.	2393404	n.d.
339.0722	340.0795	0.17	C15H16O9	4346112	n.d.	2732871	n.d.
387.0933	388.1006	0.06	C16H20O11	4278272	n.d.	n.d.	n.d.
315.1086	316.1159	0.13	C14H20O8	4187648	n.d.	n.d.	n.d.
315.0722	316.0794	0.02	C13H16O9	4089852	n.d.	n.d.	n.d.
483.1142	484.1215	0.45	C21H24O13	3893654	n.d.	n.d.	n.d.
283.0823	284.0896	0.04	C13H16O7	3875739	n.d.	n.d.	n.d.
437.0726	438.0799	0.14	C19H18O12	3658983	n.d.	2659726	n.d.
399.1297	400.1369	0.03	C18H24O10	3635862	n.d.	n.d.	n.d.
311.0772	312.0845	0.13	C14H16O8	3240850	n.d.	n.d.	n.d.

411.0568	412.0641	0.23	C17H16O12	3039316	2236188	n.d.	n.d.
343.0671	344.0743	0.06	C14H16O10	2969814	n.d.	2227396	n.d.
443.0831	444.0904	0.04	C18H20O13	2921606	n.d.	n.d.	n.d.
371.0621	372.0693	0.19	C15H16O11	2826251	n.d.	n.d.	n.d.
345.0828	346.0900	0.14	C14H18O10	2779881	2401146	2198964	n.d.
313.0565	314.0638	0.02	C13H14O9	2141122	n.d.	n.d.	n.d.