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Bioreactivity of dissolved organic matter in ponds of the ice-wedge polygonal tundra

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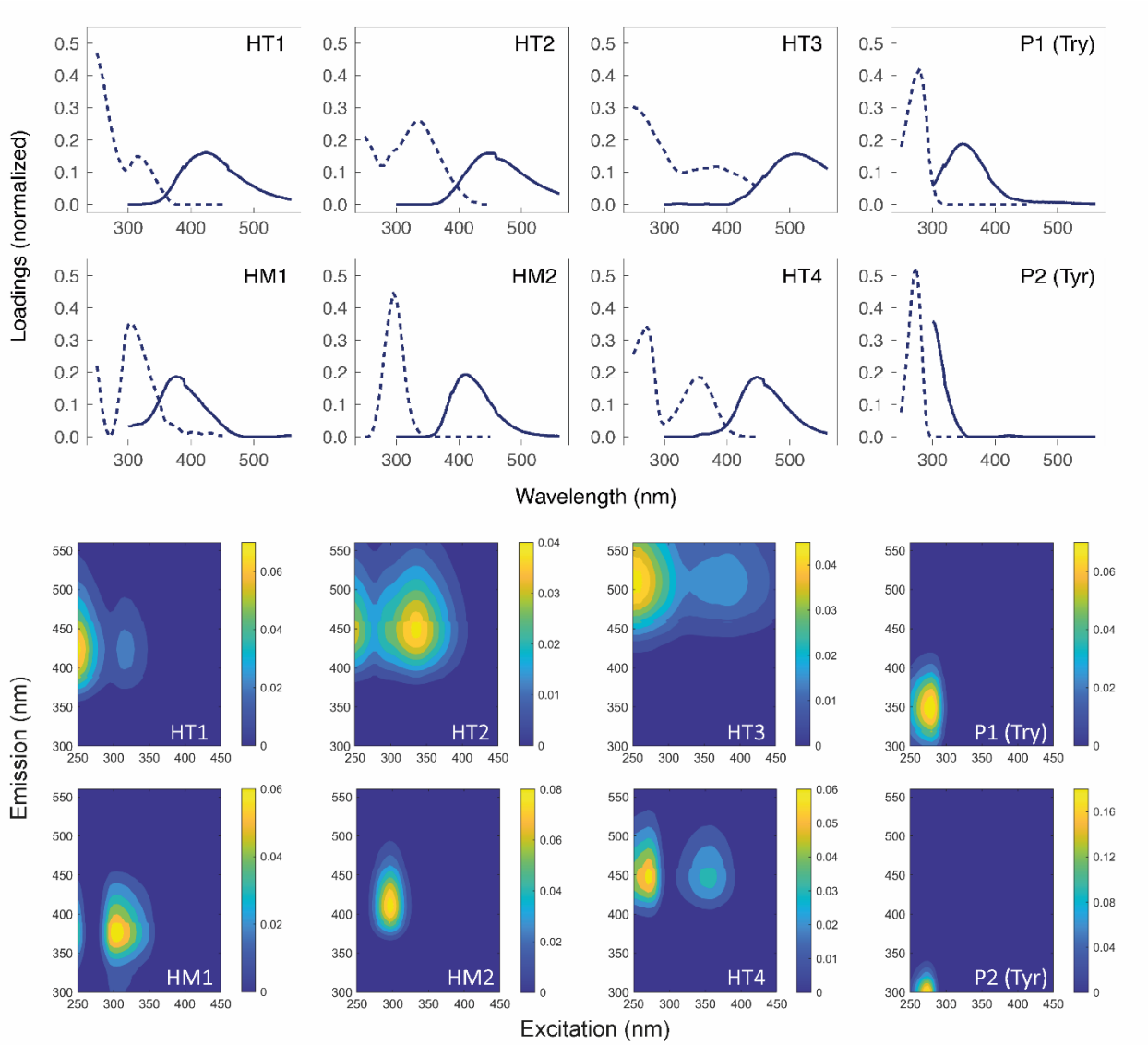

Figure S1. Spectral characteristics of the PARAFAC components identified. Top panel: excitation (dotted lines) and emission (solid lines) loadings for each component. Bottom panel: contour plots of normalized loadings, with color scales indicating relative intensity in Raman units.

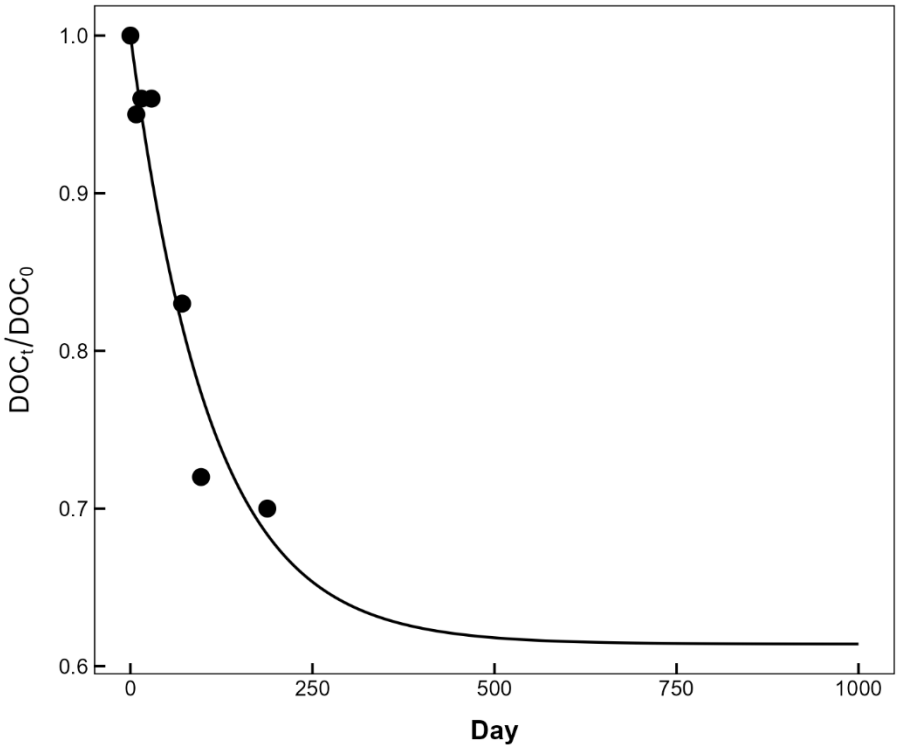

Figure S2. Exponential decay model with a residual pool fitted to the DOC decomposition time series for one unamended erosive ice-wedge trough pond (BYL117). Model predictions were extended to day 1000 to illustrate the asymptotic plateau, representing the non-decomposable DOC fraction estimated by the model.

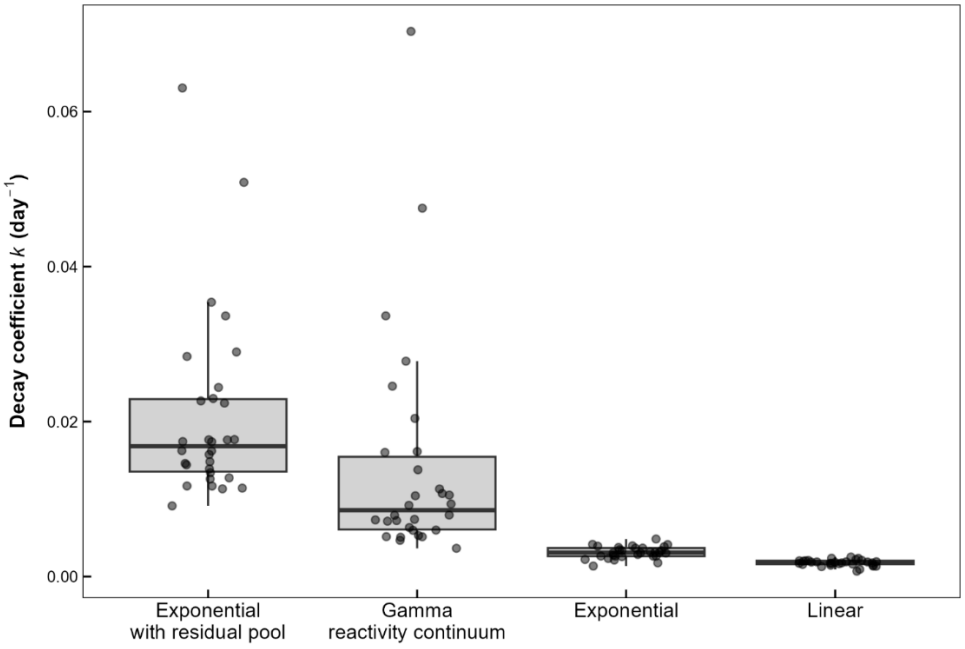

Figure S3. Distributions of DOC decay rates estimated by the different models for each sample of the bioassay under ambient and nutrient-replete conditions (data pooled). Boxplots indicate median (line), 1st and 3rd quartile (box margins), and 5 and 95% percentiles (whiskers).

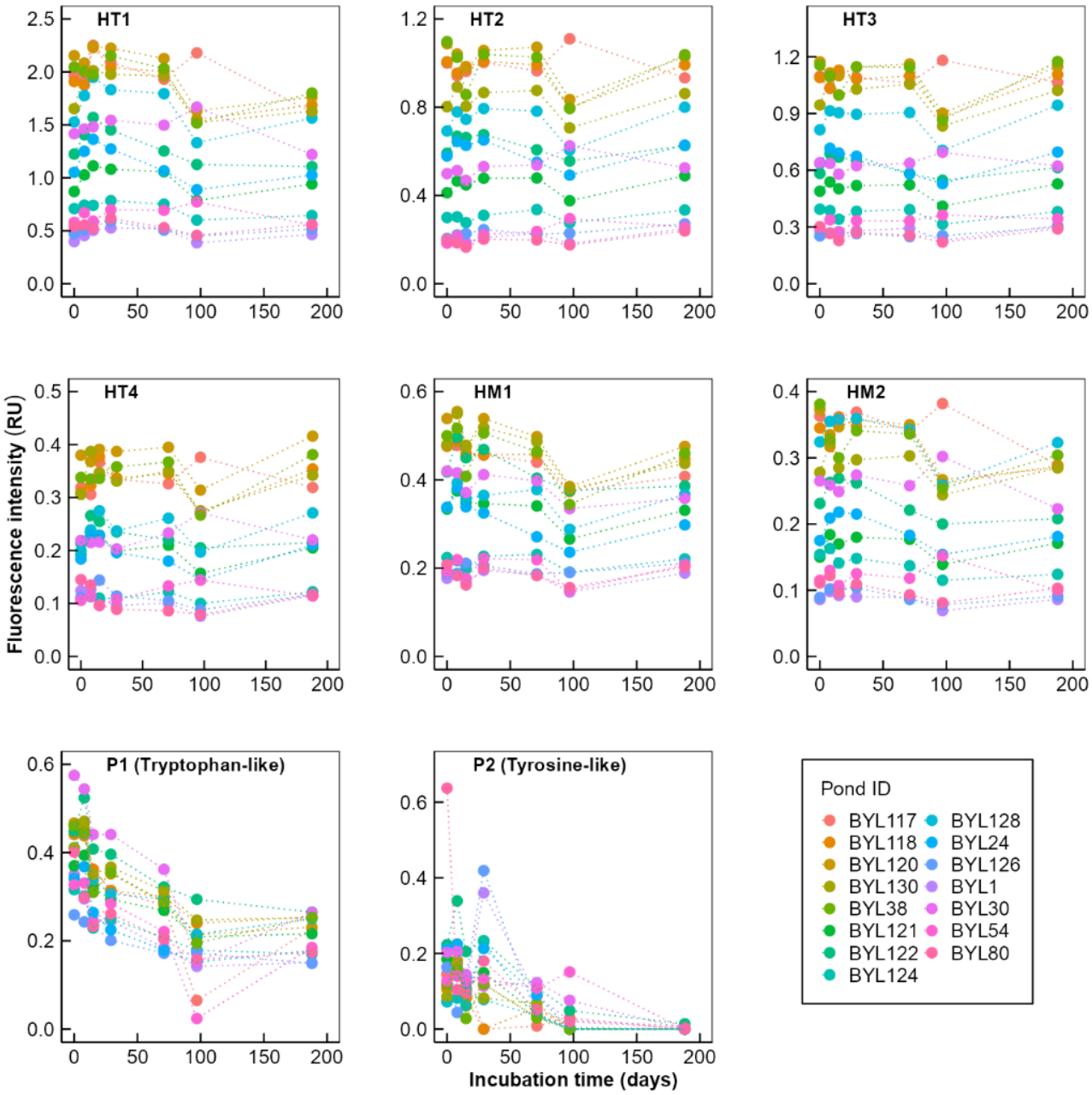

Figure S4. Dynamics of the fluorescence components identified by PARAFAC analysis (four terrestrial humic-like HT, 4 microbial humic-like HM, and two protein-like P) over the 188-day dark bioassay for erosive ice-wedge trough ponds (BYL117, BYL118, BYL120, BYL130 and BYL38), stable ice-wedge trough ponds (BYL121, BYL122, BYL124, BYL128 and BYL24) and coalescent polygon ponds (BYL126, BYL1, BYL30, BYL54 and BYL80) under ambient nutrient conditions.

Table S1. Dissolved organic carbon (DOC) loss; expressed as both absolute and relative concentration decrease, measured over the 188-day dark bioassay for the three pond categories (mean ± SE; n=5), as well as for all 15 ponds combined, under ambient and nutrient-replete conditions.

	Eroding ice-wedge troughs (eIWT) ponds		Stabilized ice-wedge troughs (sIWT) ponds		Coalescent polygon (CP) ponds		All ponds	
	Ambient	Replete	Ambient	Replete	Ambient	Replete	Ambient	Replete
Day 8								
mg L^{-1}	1.0 ± 0.2	1.7 ± 0.2	1.0 ± 0.3	1.5 ± 0.3	1.5 ± 0.3	2.0 ± 0.3	1.2 ± 0.2	1.7 ± 0.2
%	5.8 ± 0.9	9.5 ± 1.3	6.8 ± 2.0	10.2 ± 2.1	11.5 ± 2.3	14.7 ± 1.3	8.0 ± 1.2	11.5 ± 1.1
Day 15								
mg L^{-1}	1.0 ± 0.2	1.3 ± 0.3	1.4 ± 0.2	1.9 ± 0.2	1.7 ± 0.4	1.9 ± 0.4	1.4 ± 0.2	1.7 ± 0.2
%	5.6 ± 1.0	7.4 ± 1.9	9.8 ± 1.4	13.1 ± 1.6	12.8 ± 2.6	14.0 ± 2.4	9.4 ± 1.2	11.5 ± 1.3
Day 29								
mg L^{-1}	1.1 ± 0.3	1.0 ± 0.4	1.0 ± 0.6	1.6 ± 0.5	0.9 ± 0.5	1.2 ± 0.3	1.0 ± 0.3	1.3 ± 0.2
%	6.2 ± 1.7	5.8 ± 2.2	7.1 ± 3.6	10.6 ± 3.2	8.1 ± 3.7	9.3 ± 1.8	7.1 ± 1.7	8.6 ± 1.4
Day 71								
mg L^{-1}	3.3 ± 0.2	3.4 ± 0.3	3.2 ± 0.1	4.3 ± 0.7	3.7 ± 0.4	4.1 ± 0.3	3.4 ± 0.1	3.9 ± 0.3
%	19.2 ± 1.0	19.8 ± 1.9	22.2 ± 1.7	28.8 ± 2.9	27.9 ± 1.7	31.4 ± 2.1	23.1 ± 1.3	26.6 ± 1.8
Day 97								
mg L^{-1}	5.1 ± 0.1	4.8 ± 0.5	4.9 ± 0.4	5.5 ± 0.8	5.0 ± 0.5	5.2 ± 0.5	5.0 ± 0.2	5.1 ± 0.3
%	29.1 ± 0.5	27.4 ± 2.9	33.2 ± 1.5	37.0 ± 3.2	37.2 ± 1.3	38.7 ± 0.9	33.2 ± 1.1	34.4 ± 1.9
Day 188								
mg L^{-1}	5.3 ± 0.4	4.6 ± 0.7	5.0 ± 0.5	5.7 ± 0.7	4.7 ± 0.4	5.1 ± 0.6	5.0 ± 0.3	5.1 ± 0.4
%	30.4 ± 1.7	26.2 ± 3.9	34.2 ± 2.9	38.3 ± 2.5	35.5 ± 1.3	38.2 ± 2.1	33.4 ± 1.3	34.2 ± 2.2

Table S2. Akaike weights and root mean square errors (RMSE) calculated for each time-series of dissolved organic carbon (DOC) decomposition on the 15 studied ponds under ambient and nutrient-replete conditions.

	Linear		Exponential		Exponential with residual pool		Gamma reactivity continuum	
Sample	Akaike weight	RMSE	Akaike weight	RMSE	Akaike weight	RMSE	Akaike weight	RMSE
BYL117	0.0134	0.0426	0.7361	0.0397	0.1486	0.0302	0.1019	0.0319
BYL117 replete	0.0051	0.0563	0.1112	0.0598	0.6726	0.028	0.2111	0.0331
BYL118	0.0324	0.0416	0.5654	0.0455	0.2132	0.0318	0.1891	0.0323
BYL118 replete	0.0802	0.0641	0.6506	0.0784	0.1096	0.0613	0.1595	0.0581
BYL120	0.0017	0.0482	0.1096	0.0438	0.6982	0.0204	0.1905	0.0245
BYL120 replete	0.0375	0.0481	0.6442	0.0529	0.1622	0.039	0.156	0.0393
BYL130	0.0167	0.062	0.6338	0.0608	0.2322	0.0426	0.1173	0.047
BYL130 replete	0.0173	0.068	0.7259	0.0657	0.1591	0.0495	0.0977	0.0531
BYL38	0.0187	0.0421	0.4508	0.0441	0.3004	0.0283	0.2301	0.0294
BYL38 replete	0.0419	0.0437	0.1591	0.0596	0.3795	0.0319	0.4195	0.0314
BYL121	0.0216	0.053	0.2639	0.0612	0.424	0.0347	0.2904	0.0366
BYL121 replete	0.0456	0.0764	0.6464	0.0863	0.1581	0.064	0.1499	0.0645
BYL122	0.0449	0.0459	0.5064	0.0536	0.1944	0.0372	0.2543	0.0358
BYL122 replete	0.0016	0.0808	0.1013	0.0736	0.7198	0.0338	0.1773	0.0412
BYL124	0.0009	0.0505	0.0298	0.0506	0.7378	0.0194	0.2315	0.0229
BYL124 replete	0.0123	0.0811	0.6362	0.0761	0.223	0.0536	0.1285	0.058
BYL128	0.0001	0.0634	0.997	0.0678	0.0019	0.032	0.001	0.0368
BYL128 replete	0.0073	0.0489	0.2126	0.0498	0.4714	0.027	0.3087	0.0286
BYL24	0.0074	0.06	0.1741	0.0629	0.4424	0.0334	0.3761	0.0342
BYL24 replete	0.0006	0.0598	0.0008	0.0945	0.056	0.031	0.9427	0.0207
BYL126	0.018	0.0627	0.0557	0.088	0.1897	0.0448	0.7367	0.0369
BYL126 replete	0.0317	0.0789	0.3402	0.0927	0.3106	0.0569	0.3175	0.0568
BYL1	0.0084	0.0667	0.3154	0.0655	0.4812	0.0374	0.195	0.0425
BYL1 replete	0.0113	0.0702	0.7725	0.0633	0.1285	0.0496	0.0877	0.0524
BYL30	0.001	0.0683	0.0785	0.0765	0.6355	0.0235	0.285	0.0268
BYL30 replete	0.0531	0.0751	0.6778	0.086	0.1278	0.0662	0.1413	0.0653
BYL54	0.0656	0.0813	0.3449	0.1058	0.1847	0.0702	0.4048	0.0627
BYL54 replete	0.0193	0.0743	0.0457	0.1082	0.1773	0.0541	0.7578	0.0439
BYL80	0.0007	0.0698	0.029	0.0674	0.8475	0.0252	0.1229	0.0332
BYL80 replete	0.0067	0.0839	0.1287	0.0907	0.6216	0.0439	0.2429	0.0502
∑Akaike weights	0.623		11.1436		10.2088		8.0247	
∑ RMSE		1.8677		2.0708		1.2009		1.2301

Table S3. Multiple linear regression models predicting DOC loss at day 97 or 188 of the incubation or the decay coefficient (*k*). The table includes the multiple and adjusted coefficients of determination (R^2), degrees of freedom (df), log-likelihood (logLik), corrected Akaike Information Criterion (AICc) rank, difference in AICc relative to the top-ranked model (ΔAICc), and Akaike weight. Bolded coefficients in the Model column indicate statistical significance ($P < 0.05$, t-test).

Response variable	Model predictors	Multiple R^2	Adjusted R^2	df	logLik	AICc	ΔAICc	Akaike weight
DOC loss at day 97	**P1**	0.49	0.45	3	-12.51	33.2	0.00	0.449
	Chl*a* + **P1**	0.53	0.46	4	-11.76	35.5	2.32	0.141
	P1 + TP	0.52	0.44	4	-11.96	35.9	2.72	0.116
	P1 + $SUVA_{254}$	0.50	0.41	4	-12.37	36.7	3.54	0.076
	P1 + P2	0.49	0.41	4	-12.39	36.8	3.57	0.075
	a_{320} + **P1**	0.49	0.41	4	-12.41	36.8	3.62	0.074
	P1 + TN	0.49	0.40	4	-12.48	37.0	3.75	0.069
DOC loss at day 188	**P1**	0.40	0.36	3	-16.53	41.2	0.00	0.433
	Chl*a* + **P1**	0.44	0.34	4	-16.09	44.2	2.94	0.100
	a_{320} + P1	0.42	0.32	4	-16.29	44.6	3.35	0.081
	P1 + P2	0.41	0.32	4	-16.38	44.8	3.52	0.074
	P1 + TP	0.41	0.31	4	-16.43	44.9	3.62	0.071
	P1 + TN	0.40	0.31	4	-16.48	45.0	3.72	0.067
	a_{320}	0.23	0.17	3	-18.43	45.0	3.80	0.065
	P1 + $SUVA_{254}$	0.40	0.30	4	-16.53	45.1	3.82	0.064
Decay rate *k*	**a_{320}**	0.40	0.35	3	56.83	-105.5	0.00	0.410
	a_{320} + TN	0.43	0.34	4	57.24	-102.5	2.99	0.092
	a_{320} + P2	0.43	0.34	4	57.19	-102.4	3.09	0.088
	TP	0.26	0.20	3	55.22	-102.2	3.22	0.082
	a_{320} + $SUVA_{254}$	0.42	0.32	4	57.10	-102.2	3.28	0.080
	a_{320} + Chl*a*	0.41	0.31	4	56.97	-101.9	3.54	0.070
	a_{320} + P1	0.41	0.31	4	56.95	-101.9	3.57	0.069
	a_{320} + TP	0.41	0.31	4	56.91	-101.8	3.65	0.066