

## *Supplementary Material*

### 1 Supplementary Tables

**Table S1.** Statistical results of the log - log regressions of the bulk Vm of both phosphoesterases (PME, PDE), their specific activities per unit hprok cell, per unit TChla and per unit biomass (phytoC+HprokC, see methods) versus DIP concentrations, during autumn (PERLE1) and winter (PERLE2) cruises.

	units Y*	Y mean $\pm$ sd*	Y range*	equation	r <sup>2</sup>	P
Vm PME PERLE1	nmol l <sup>-1</sup> h <sup>-1</sup>	1.1 $\pm$ 1.0	0.014-2.76	log(Y) = 2.70-2.71 log(DIP)	0.45	< 0.0001
Vm PME PERLE2	nmol l <sup>-1</sup> h <sup>-1</sup>	2.5 $\pm$ 3.4	0.018-18.8	log(Y) = 2.30-1.93 log(DIP)	0.79	< 0.0001
per cell VmPME PERLE1	x 10 <sup>-18</sup> mol hprok cell <sup>-1</sup> h <sup>-1</sup>	3.4 $\pm$ 3.0	0.09-8.9	log(Y) = 2.58-2.08 log(DIP)	0.37	< 0.0001
per cell Vm PME PERLE2	x 10 <sup>-18</sup> mol hprok cell <sup>-1</sup> h <sup>-1</sup>	5.5 $\pm$ 7.1	0.08-41	log(Y) = 2.29-1.56 log(DIP)	0.72	< 0.0001
per chl Vm PME PERLE1	nmol $\mu$ g chla <sup>-1</sup> h <sup>-1</sup>	22.4 $\pm$ 23.5	0.59-67	log(Y) = 3.19-2.07 log(DIP)	0.23	< 0.0005
per chl Vm PME PERLE2	nmol $\mu$ g chla <sup>-1</sup> h <sup>-1</sup>	7.9 $\pm$ 9.8	0.18-62	Log(Y) = 2.43-1.54 log(DIP)	0.7	< 0.0001
per biom Vm PME PERLE1	nmol $\mu$ g C <sup>-1</sup> h <sup>-1</sup>	0.15 $\pm$ 0.14	0.004-0.38	log(Y) = 1.14-2.10 log(DIP)	0.31	< 0.0001
per biom Vm PME PERLE2	nmol $\mu$ g C <sup>-1</sup> h <sup>-1</sup>	0.10 $\pm$ 0.13	0.0027-0.70	log(Y) = 0.50-1.47 log(DIP)	0.67	< 0.0001
Vm PDE PERLE1	nmol l <sup>-1</sup> h <sup>-1</sup>	1.7 $\pm$ 1.6	0.011-5.74	log(Y) = 2.66-2.60 log(DIP)	0.32	< 0.0005
Vm PDE PERLE2	nmol l <sup>-1</sup> h <sup>-1</sup>	4.3 $\pm$ 5.1	0.017-23.4	log(Y) = 2.95-2.35 log(DIP)	0.79	< 0.0001
per cell VmPDE PERLE1	x 10 <sup>-18</sup> mol hprok cell <sup>-1</sup> h <sup>-1</sup>	5.1 $\pm$ 4.8	0.07-16.1	log(Y) = 2.72-2.19 log(DIP)	0.26	< 0.001
per cell Vm PDE PERLE2	x 10 <sup>-18</sup> mol hprok cell <sup>-1</sup> h <sup>-1</sup>	10.0 $\pm$ 11.4	0.07-54.3	log(Y) = 3.00-2.03 log(DIP)	0.77	< 0.0001
per chl Vm PDE PERLE1	nmol $\mu$ g chla <sup>-1</sup> h <sup>-1</sup>	37 $\pm$ 40	0.24-168	log(Y) = 3.58-2.36 log(DIP)	0.16	< 0.05
per chl Vm PDE PERLE2	nmol $\mu$ g chla <sup>-1</sup> h <sup>-1</sup>	14 $\pm$ 16	0.17-94	log(Y) = 3.00-1.90 lo (DIP)	0.72	< 0.0001
per biom Vm PDE PERLE1	nmol $\mu$ g C <sup>-1</sup> h <sup>-1</sup>	0.24 $\pm$ 0.23	0.003-0.81	log(Y) = 1.21-2.08 log(DIP)	0.17	< 0.05
per biom Vm PDE PERLE2	nmol $\mu$ g C <sup>-1</sup> h <sup>-1</sup>	0.19 $\pm$ 0.21	0.002-1.0	log(Y) = 1.26-2.01 log(DIP)	0.75	< 0.0001

**Table S2.** Statistical results of the log - log regressions (9 single regressions and 1 multiple regression) between Vm PME rates and flow cytometric group abundances, during autumn (PERLE1) and winter (PERLE2) cruises. The range of abundances of flow cytometric groups (X variables) are indicated: Proc: *Prochlorococcus*, Syn: *Synechococcus*, Picoeuk: picophytoeukaryotes, Nanoeuk: Nanophytoeukaryotes, Crypto: Cryptophyte-like cells, HNF: heterotrophic nanoflagellates, LNA: heterotrophic prokaryotes with low nucleic acid content, HNA: heterotrophic prokaryotes with high nucleic acid content, Hprok: heterotrophic prokaryotes. We considered only layers in which all variables were available and above limits of detection simultaneously. For PERLE2 regressions: range of Vm PME (Y variable) were 0.020-18.8 nmol l<sup>-1</sup> h<sup>-1</sup>, n = 84. For PERLE 1 regressions: range of Vm PME (Y variable) were 0.048-2.71 nmol l<sup>-1</sup> h<sup>-1</sup>, n = 36. In the multiple regression, we included 8 X variables (Proc, Syn Pico Nano Crypto, HNF, LNA and HNA).\*: before log-transformation, ns: not significant.

Vm PME, PERLE 2	Single regressions			Multiple regression
	X range* (cells ml <sup>-1</sup> )	r <sup>2</sup>	P (F test)	p (t test)
Proc	18-5903	0.48	< 0.0001	ns
Syn	13-6317	0.78	< 0.0001	< 0.0001
Picoeuk	1-547	0.2	< 0.0001	ns
Nanoeuk	1-63	0.56	< 0.0001	ns
Crypto	1-81	0.48	< 0.0001	< 0.0001
HNF	99-409	0.04	ns	ns
LNA	122213-619930	0.22	< 0.0001	ns
HNA	34394-371834	0.16	< 0.0005	ns
hprok	155342-736928	0.38	< 0.0001	not included
<b>Vm PME, PERLE 1</b>				
Proc	106-47460	0.37	< 0.0001	ns
Syn	81-14511	0.87	< 0.0001	< 0.0001
Picoeuk	133-689	0.32	< 0.005	< 0.05
Nanoeuk	2-138	0.77	< 0.0001	ns
Crypto	2-11	0.007	ns	ns
HNF	101-274	0.14	< 0.05	ns
LNA	157346-392444	0.15	< 0.05	ns
HNA	57796-152040	0.24	< 0.005	ns
hprok	220284-545065	0.21	< 0.005	not included

**Table S3.** Statistical results of the log - log regressions (9 single regressions and 1 multiple regression) between Vm PDE and flow cytometric group abundances, during autumn (PERLE1) and winter (PERLE2) cruises. See the Table 1 legend for more details and abbreviation's code. For PERLE2 regressions: range of Vm PDE (Y variable) were 0.017-23.4 nmol l<sup>-1</sup> h<sup>-1</sup>, n = 72. For PERLE 1 regressions: range of Vm PDE (Y variable) were 0.026-5.74 nmol l<sup>-1</sup> h<sup>-1</sup>, n = 32. In the multiple regression, we included 8 X variables (Proc, Syn Pico Nano Crypto, HNF, LNA and HNA).\*: before log-transformation, ns: not significant.

Vm PDE, PERLE 2	single regressions			multiple regression
	X range* (cells ml <sup>-1</sup> )	r <sup>2</sup>	P(F test)	p (t test)
Proc	49-5903	0.38	< 0.0001	ns
Syn	13-6317	0.74	< 0.0001	< 0.0001
Pico	1-647	0.11	< 0.002	ns
Nano	1-63	0.5	< 0.0001	ns
Crypto	1-81	0.43	< 0.0001	< 0.0001
HNF	108-409	0.06	< 0.05	ns
LNA	124637-619930	0.09	< 0.05	ns
HNA	36589-371834	0.19	< 0.0001	ns
hprok	163976-736928	0.27	< 0.0001	not included
<b>Vm PDE, PERLE 1</b>				
Proc	106-47460	0.68	< 0.0001	ns
Syn	121-14511	0.58	< 0.0001	< 0.0005
Pico	133-689	0.17	< 0.05	ns
Nano	15-138	0.56	< 0.0001	ns
Crypto	2-11	0.002	ns	ns
HNF	107-274	0.02	ns	ns
LNA	157346-392444	0.11	ns	ns
HNA	61167-152040	0.12	ns	ns
hprok	220284-545065	0.01	ns	not included

## 2 Supplementary Figures

**Figure S1.** Vertical distributions of density excess (a, b, c) and Total Chlorophyll a derived from fluorescence (d, e, f). a, d: PERLE1 cruise (October 2018), b, e: Mixed stations of PERLE2 cruise (Feb-March 2019); c, f: other stations of PERLE2 cruise.

**Figure S2.** Vertical distributions of NO<sub>x</sub>:DIP ratios and V<sub>m</sub> PDE:V<sub>m</sub> PDE ratios. a: PERLE1 cruise (October 2018), b: Mixed stations of PERLE2 cruise (Feb-March 2019); c: other stations of PERLE2 cruise.

**Figure S3.** Relationships between L<sub>DOP</sub> and DOP (a) and L<sub>DOP</sub> and DIP (b) for the 2 cruises.

**Figure S4.** Vertical distributions of *Prochlorococcus* (a, b, c) and *Synechococcus* abundances (d, e, f). a, d: PERLE1 cruise (October 2018); b, e: Mixed stations of PERLE2 cruise (Feb-March 2019); c, f: other stations of PERLE2 cruise.

**Figure S5.** Vertical distributions of picophytoeukaryotes (Picoeuk, a, b, c) and nanophytoeukaryotes (Nanoeuk, d, e, f). a, d: PERLE1 cruise (October 2018); b, e: Mixed stations of PERLE2 cruise (Feb-March 2019); c, f: other stations of PERLE2 cruise.

**Figure S6.** Vertical distributions of cryptophyte-like cells (a, b, c) and heterotrophic prokaryotes (Hprok, d, e, f). a, d: PERLE1 cruise (October 2018); b, e: Mixed stations of PERLE2 cruise (Feb-March 2019); c, f: other stations of PERLE2 cruise.

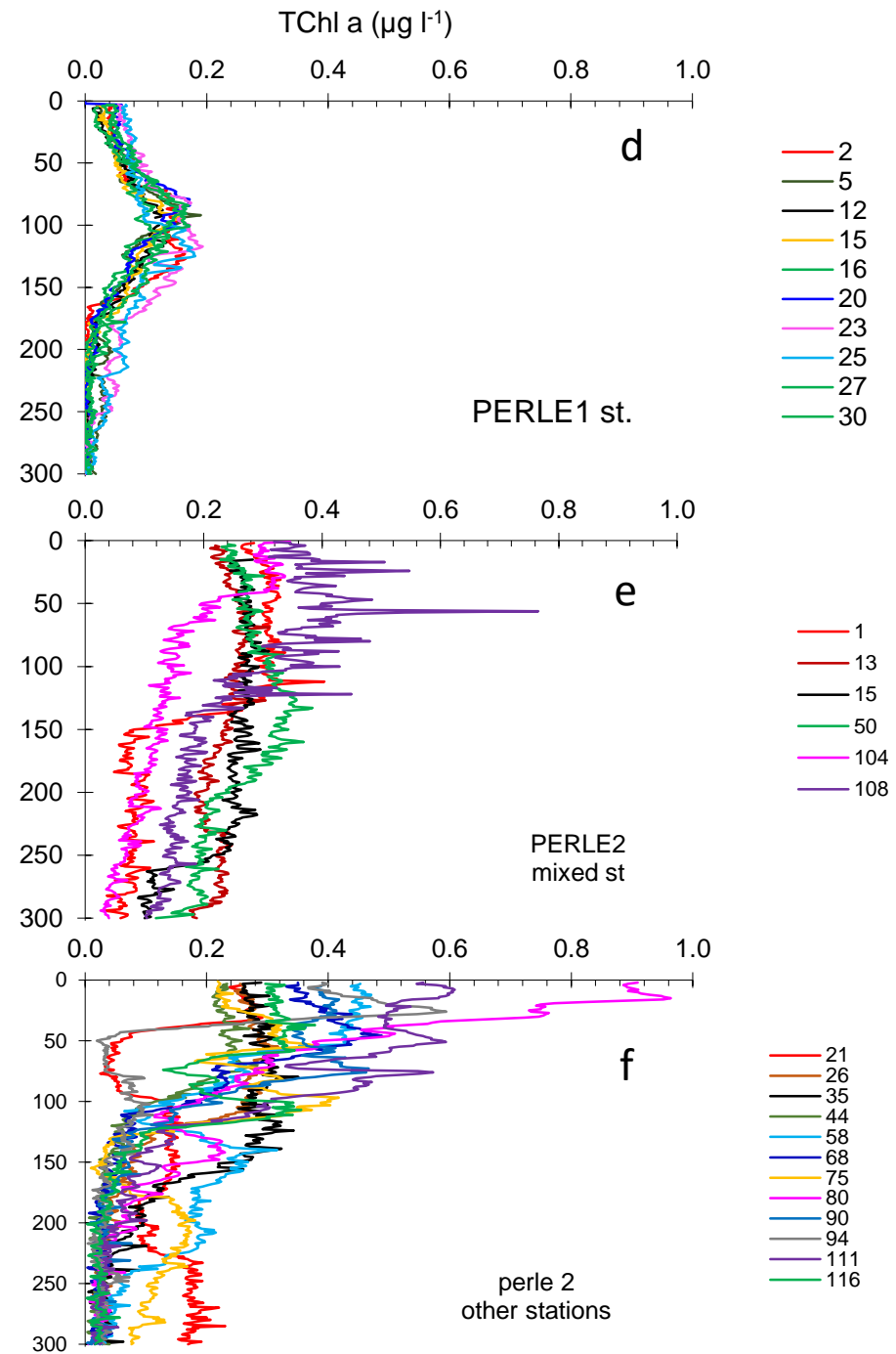
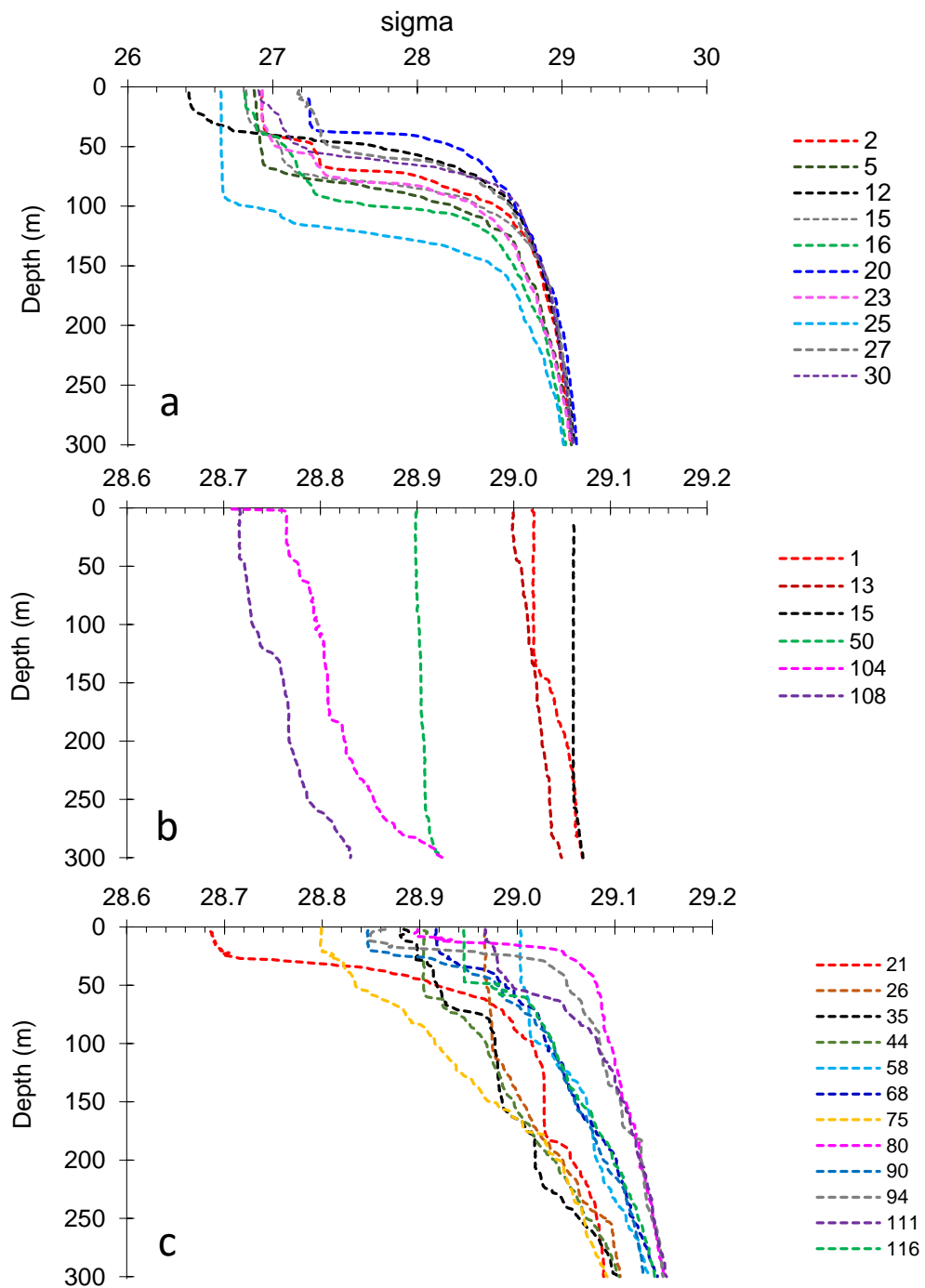


Fig S1

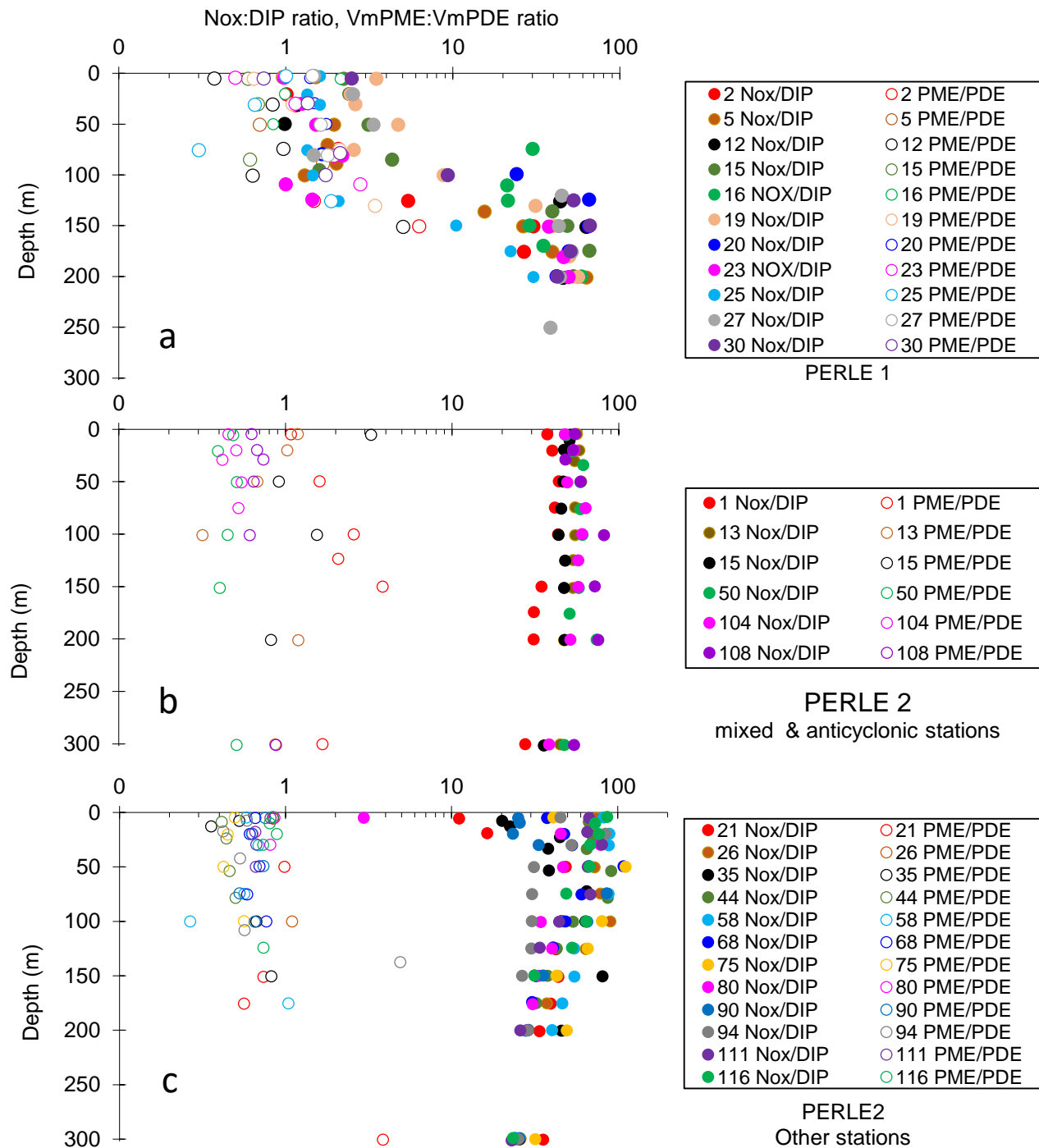


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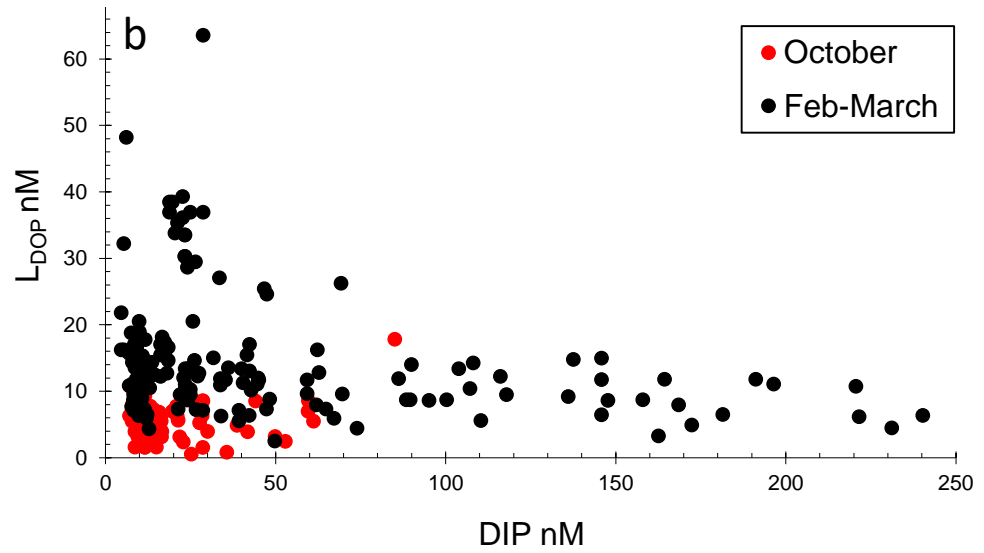
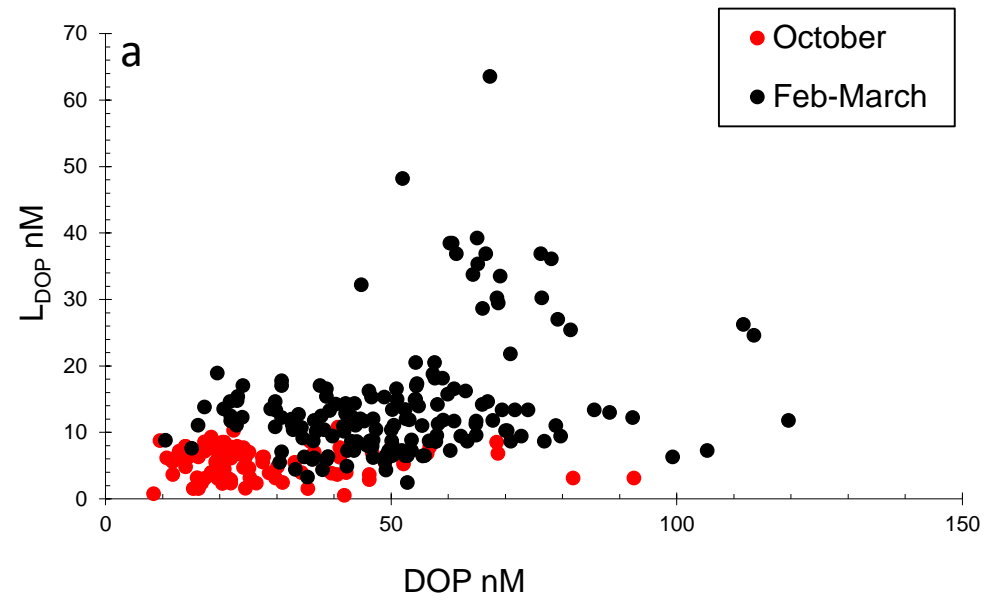


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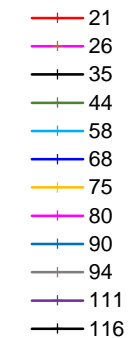
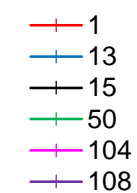
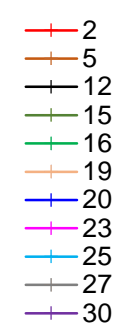
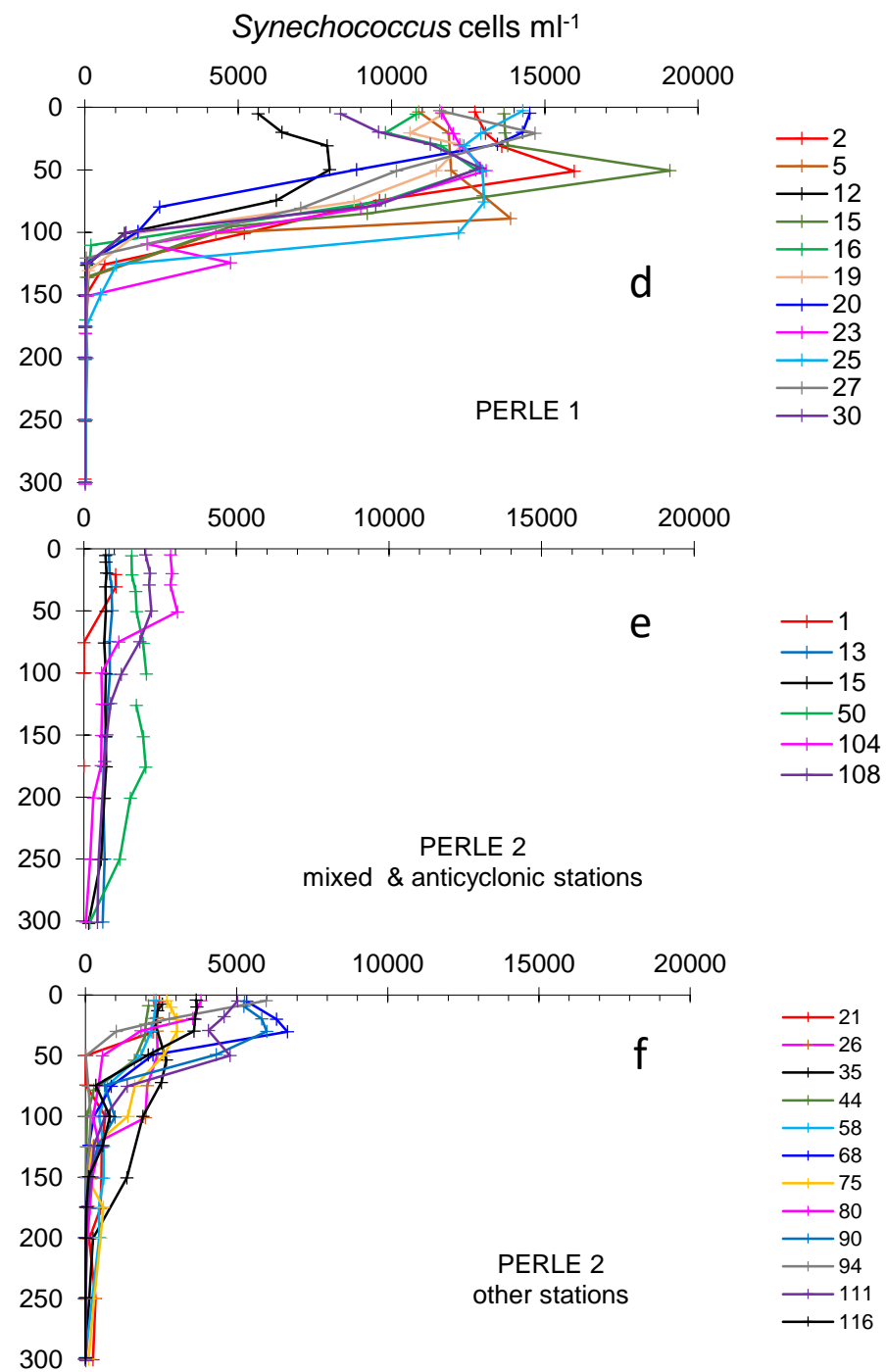
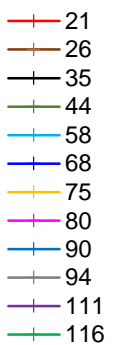
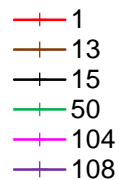
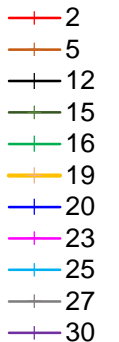
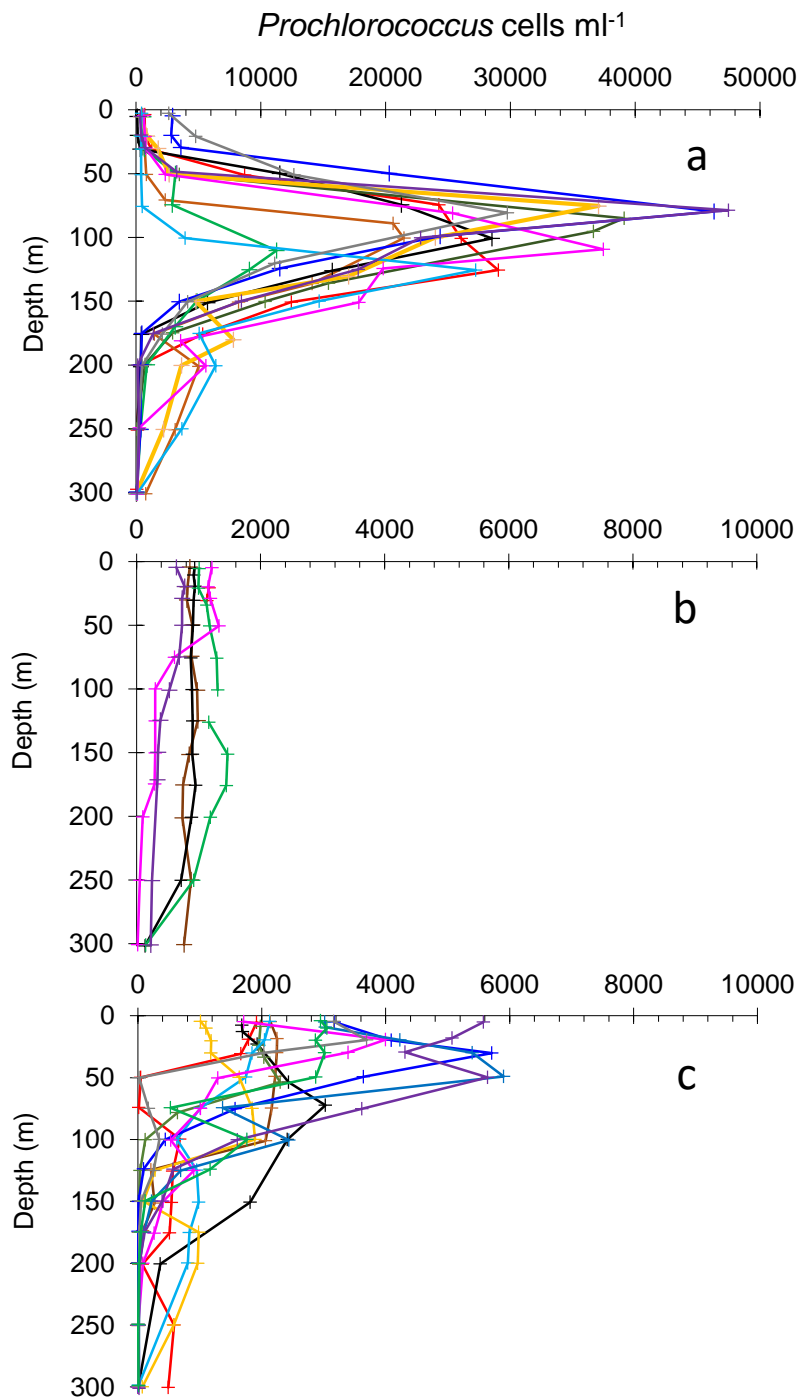
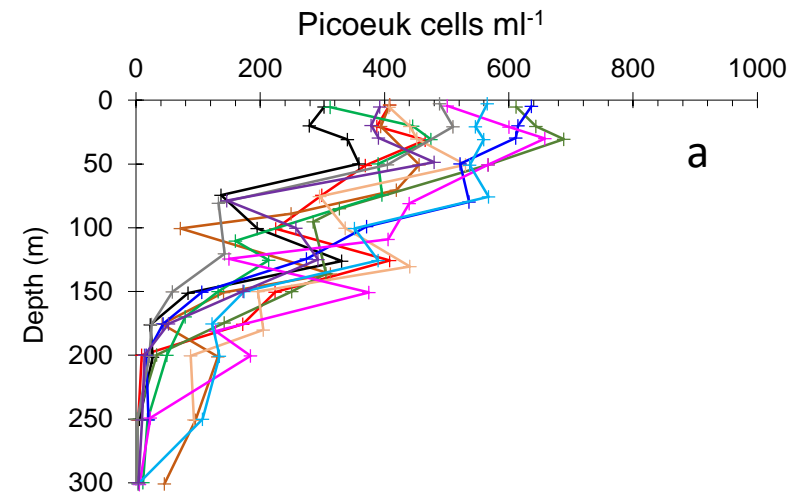
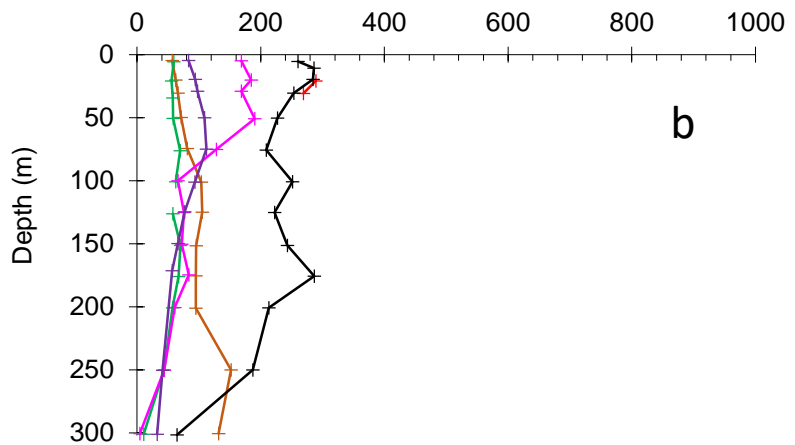


Fig S4

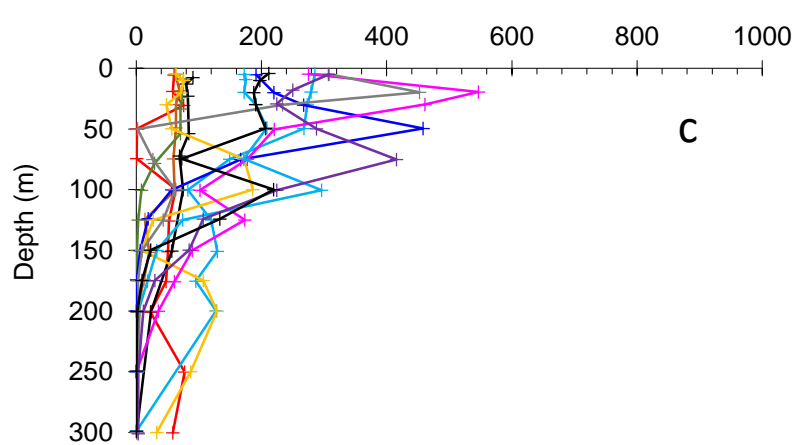




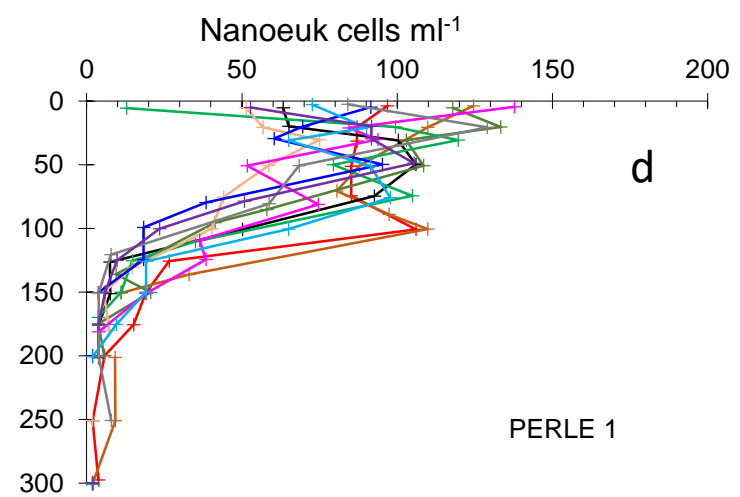
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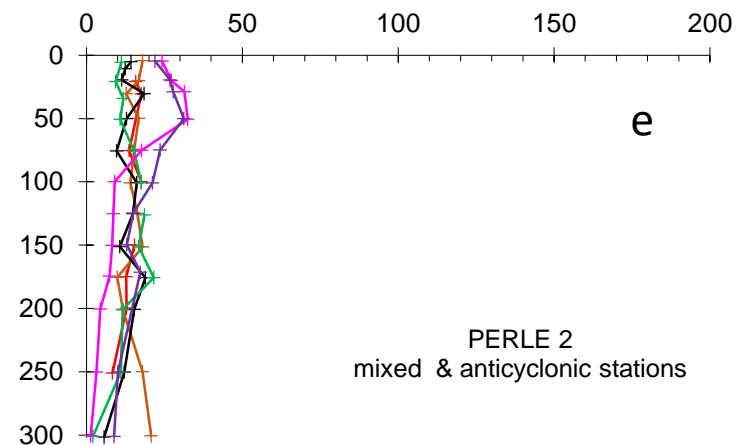
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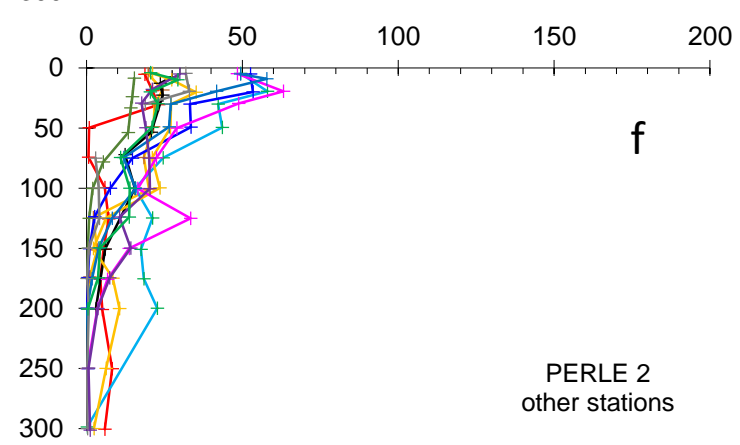
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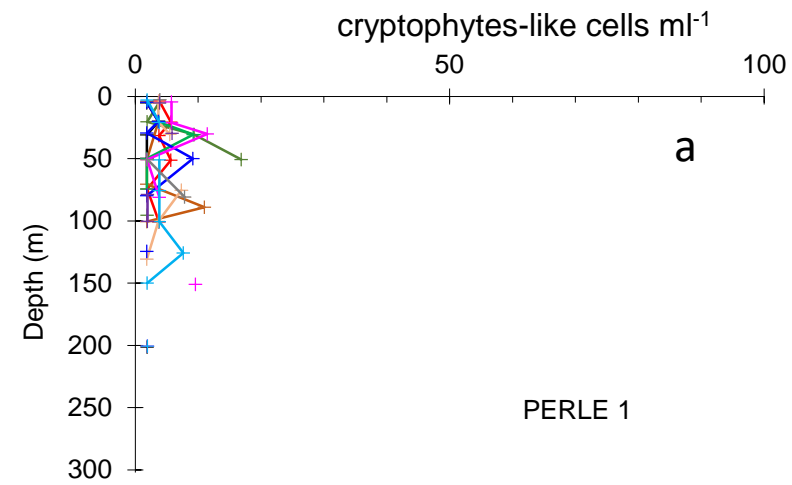


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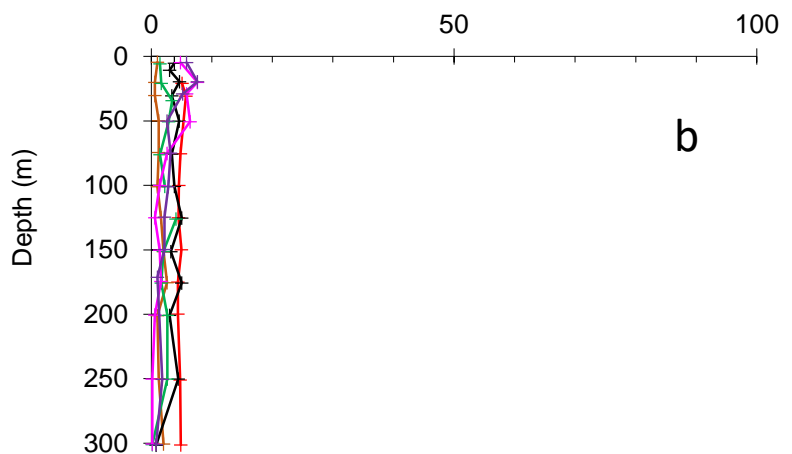


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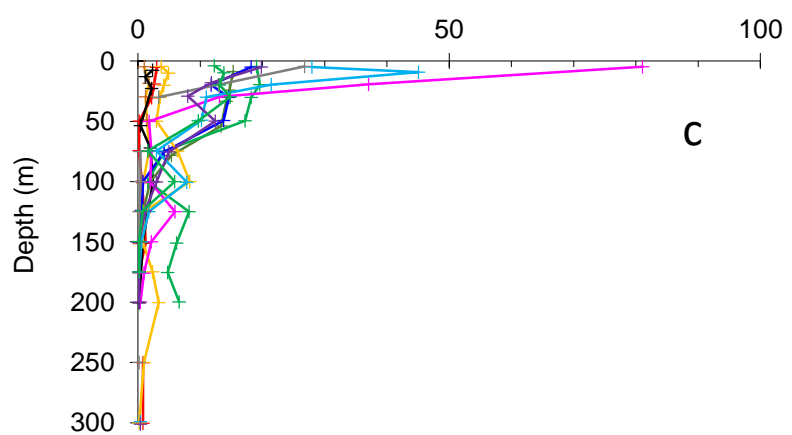
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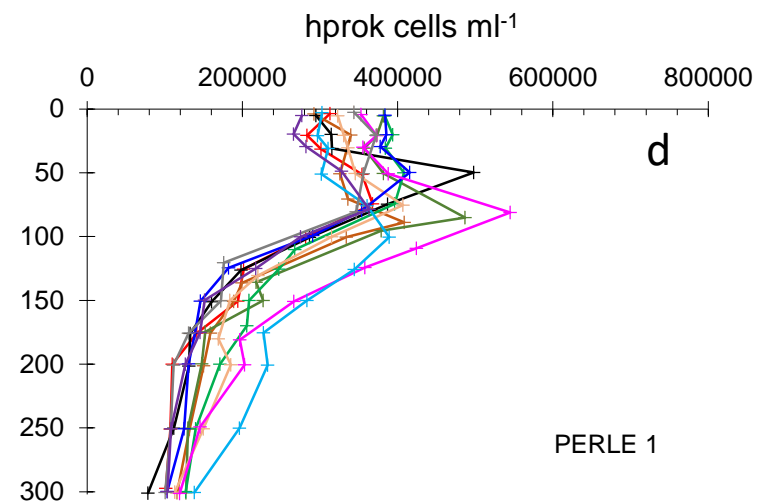
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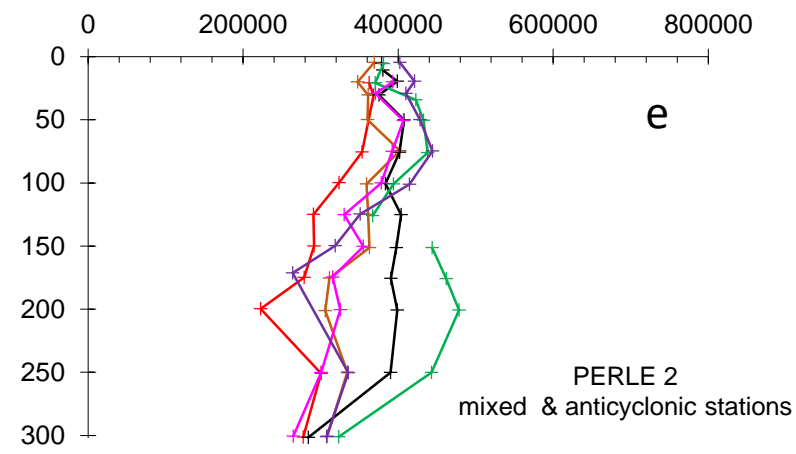
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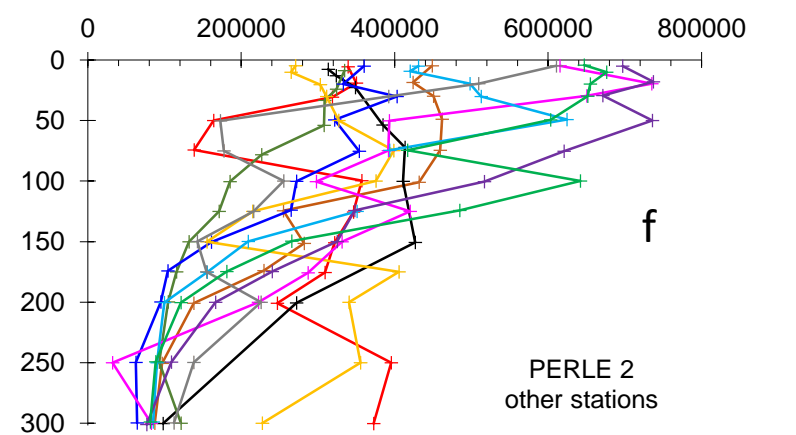
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Fig S6