

## Section 1. Seasonality in nutrient concentrations

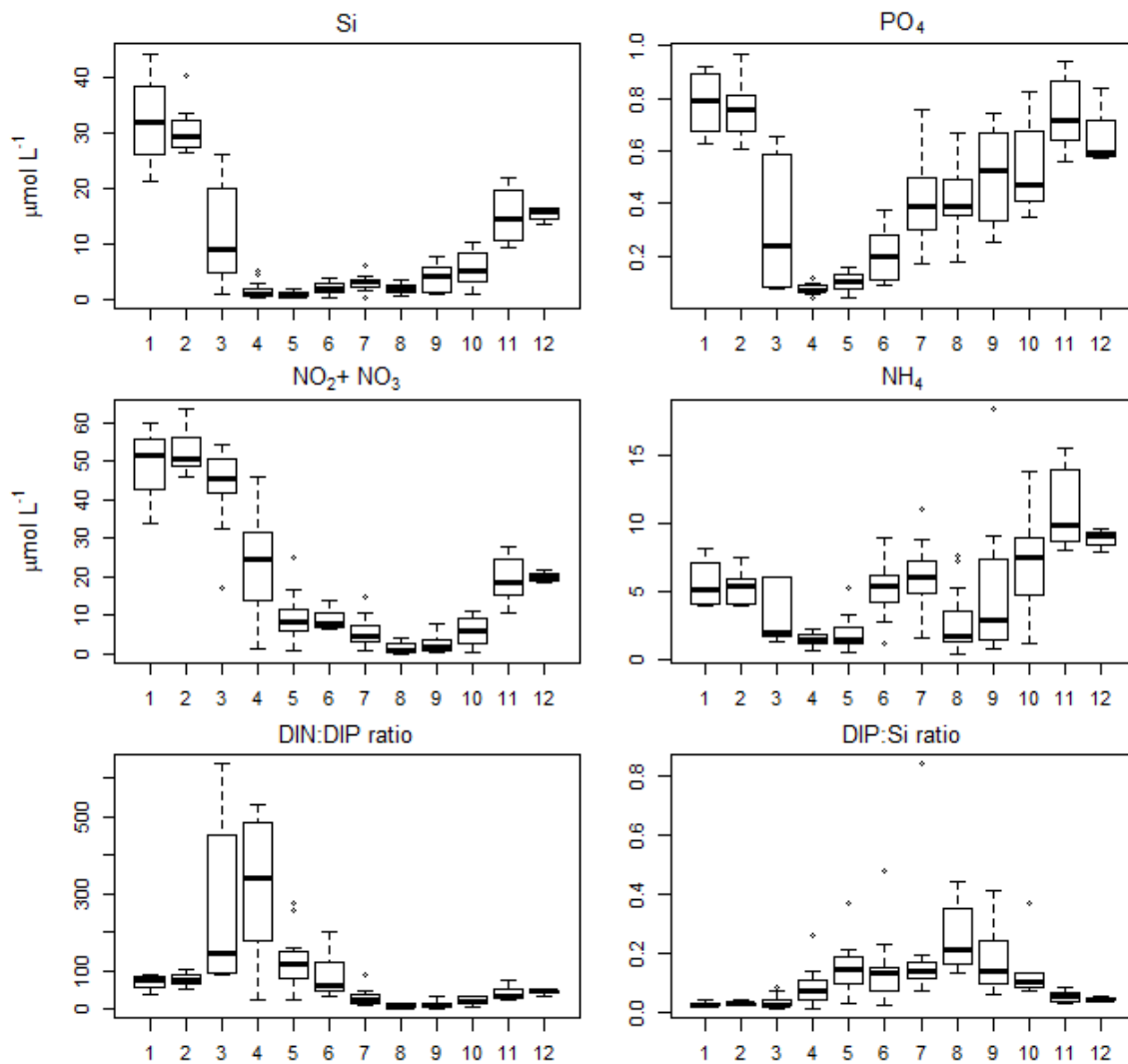


Fig. S1. Monthly concentration of dissolved silicate (Si), dissolved inorganic nitrogen (DIN), phosphate (DIP), all in  $\mu\text{mol L}^{-1}$  and DIN:DIP and DIP:Si ratios for the Marsdiep jetty in the years 2012, 2013 and 2014.

## Section 2. Analyses of the relation of photosynthetic parameters $P^{B_{max}}$ and $E_k$ to environmental variables.

Table S1. Model outcomes of relationships between  $P^{B_{max}}$  (as estimated by means of the JP model) and environmental variables. Model 1) all significantly correlated variables, model 2-4) removal of variables. For all models, p values were <0.0001. Models were constructed, excluding year as a factor (model a) or including year as a factor (model b). Outliers (n=3) values were removed (model c). The explained variance of the model ( $R^2$ ), the Akaike information criterion (AIC), the test value (F) and the two degrees of freedom are given (df). The p-values of the models were always <0.0001.

Model	description	$R^2$	AIC	F	(df)
Excluding year effect					
1a	$P^{B_{max}} \sim \text{SST} + \text{NO}_{2+3} + \text{K}_d + \text{Si}$	0.10	690	2.70	(4, 102)
2a	$P^{B_{max}} \sim \text{SST} + \text{K}_d + \text{Si}$	0.10	689	3.59	(3, 103)
3a	$P^{B_{max}} \sim \text{SST} + \text{K}_d$	0.08	<b>688</b>	4.82	(2, 104)
4a	$P^{B_{max}} \sim \text{SST}$	0.07	<b>687</b>	8.78	(1, 105)
Including year effect					
1b	$P^{B_{max}} \sim \text{SST} + \text{NO}_{2+3} + \text{K}_d + \text{Si} + \text{year}$	0.21	680	4.36	(6, 100)
2b	$P^{B_{max}} \sim \text{SST} + \text{K}_d + \text{Si} + \text{year}$	0.20	679	5.10	(5, 101)
3b	$P^{B_{max}} \sim \text{SST} + \text{K}_d + \text{year}$	0.20	678	6.26	(4, 102)
4b	$P^{B_{max}} \sim \text{SST} + \text{year}$	0.20	<b>676</b>	8.39	(3, 103)
After removing outliers					
1c	$P^{B_{max}} \sim \text{SST} + \text{NO}_{2+3} + \text{K}_d + \text{Si}$	0.30	513	8.35	(5, 98)
2c	$P^{B_{max}} \sim \text{SST} + \text{K}_d + \text{Si}$	0.28	511	13.09	(3, 100)
3c	$P^{B_{max}} \sim \text{SST} + \text{K}_d$	0.28	509	19.78	(2, 101)
4c	$P^{B_{max}} \sim \text{SST}$	0.28	<b>507</b>	39.36	(1, 102)

Table S2. Model outcomes of relationships between  $E_k$  (JP model) and environmental variables ( $n=107$ ). Model 1) all significantly correlated variables, model 2-3) stepwise removal of variables. Models were constructed excluding year as a factor or including year as a factor. The explained variance of the model ( $R^2$ ), the Akaike information criterion (AIC), the test value (F) and the two degrees of freedom are given (df). The p-values of the models were always  $<0.0001$ .

Model	description	$R^2$	AIC	F	(df)
Excluding year effect					
1a	$E_k \sim \text{SST} + \text{NO}_{2+3} + \text{K}_d + \text{Si}$	0.42	1307	18.26	(4, 102)
2a	$E_k \sim \text{SST} + \text{K}_d$	0.41	1305	35.85	(2, 104)
3a	$E_k \sim \text{SST}$	0.41	<b>1303</b>	72.16	(1, 105)
Including year effect					
1b	$E_k \sim \text{SST} + \text{NO}_{2+3} + \text{K}_d + \text{Si} + \text{year}$	0.57	1279	21.90	(6, 100)
2b	$E_k \sim \text{SST} + \text{K}_d + \text{year}$	0.57	<b>1276</b>	33.16	(4, 102)
3b	$E_k \sim \text{SST} + \text{year}$	0.56	<b>1275</b>	44.25	(3, 103)

Note: removing one outlier ( $E_k=1000 \mu\text{mol photons m}^{-2} \text{s}^{-1}$ ) resulted in a much better prediction of  $E_k$ . A model without year:  $R^2=0.47$ ,  $\text{AIC}=1245$ , with year as a factor:  $R^2=0.67$ ,  $\text{AIC}=1198$ .

### Section 3. Calculating production rates in Philippart et al. (2007).

In the current study, calculated annual production rates were compared to previously reported rates (Philippart et al. 2007). However, there were differences between the previous and current study in how the production rates were calculated. In this paragraph, the differences in calculation methods used as well as the consequences for the rates are discussed. The methods used in the current study are described in the material & methods section. Philippart et al. (2007) measured carbon fixation rates at one fixed light intensity of approximately  $400 \mu\text{mol photons m}^{-2} \text{s}^{-1}$  (PAR). To calculate daily production values, a linear relation between light and fixation rate was assumed. Because the fixation rate increases with light until light intensities become saturating, assuming a linear relation between light and carbon fixation rates result in an overestimation of daily production rates if *in situ* light conditions become saturated. And, the authors calculated the vertical light attenuation based on an empirical relation with Secchi disc depth from a different system (the Eastern and Western Scheldt estuaries, The Netherlands). Comparing the attenuation coefficient based on this relation and the relation used in the current study, which is based on an empirical relation at the sampling location, it is seen that the attenuation in Philippart et al. (2007) is on average 27% higher. This means that the potential overestimation due to a linear relation with light in the calculation of the carbon fixation rate could be compensated for by a reduction in the water column production due to the higher attenuation of light in the water column. To investigate the potential errors made in calculating production rates by Philippart et al. (2007), the daily column production rates were calculated for the years 2012-2014 using the method described in that paper (Figure S2). The estimates for the daily column production of the current study were on average 8% higher.

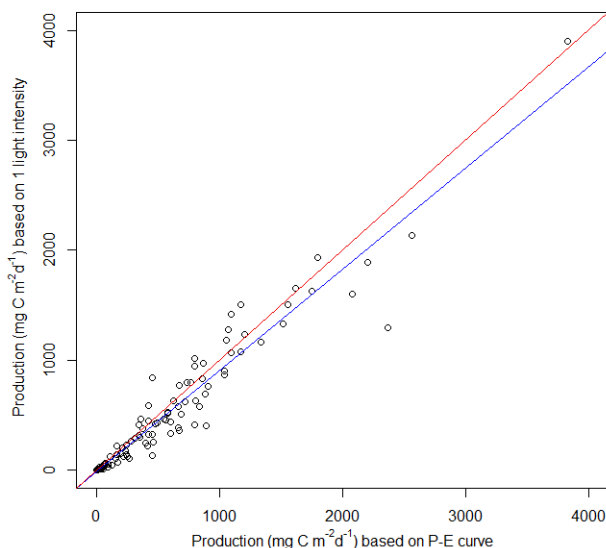


Fig. S2. The daily column production in  $\text{mg C m}^{-2} \text{d}^{-1}$  for the period 2012-2014 based on the methods described in the current study and calculated based on a method described by Philippart et al. 2007. The red line indicates the line  $y=x$ , the blue line the regression line ( $y = -16.4 \pm 21.9$  (n.s.)  $+ 0.92 \pm 0.02x$  ( $p < 0.0001$ ),  $R^2 = 0.93$ ).

### Section 4. Long-term nutrient concentrations in the Dutch coastal zone.

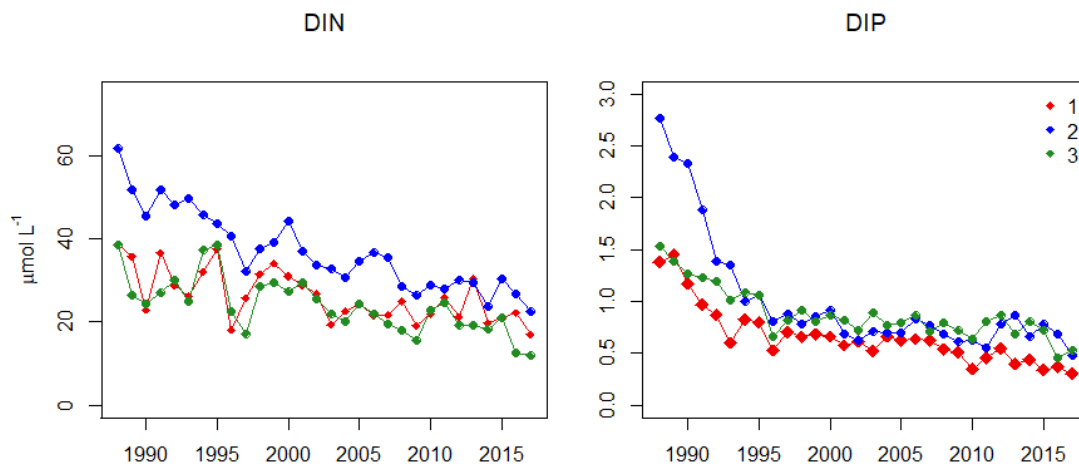


Fig. S3. The long-term year average concentrations (1988-2017) for dissolved inorganic nitrogen (N-DIN) and inorganic phosphate (P-DIP) in  $\mu\text{mol L}^{-1}$ , for three stations along the Dutch coastal zone. Station1: Marsdiep North, station 2: Noordwijk 2km off the coast, station 3: Walcheren 2 km off the coast. Data was collected and provided by Rijkswaterstaat ([www.waterinfo.nl](http://www.waterinfo.nl)).

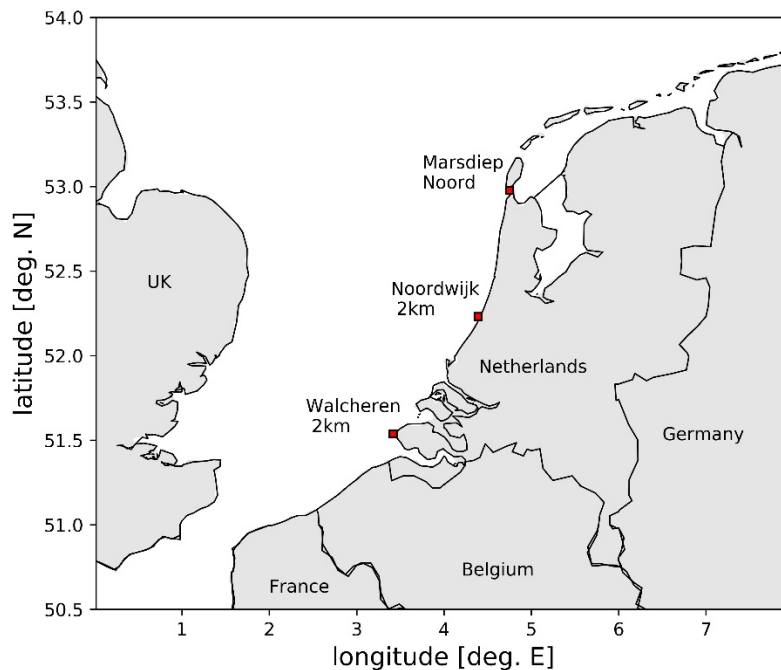


Fig. S4. Map showing the three sampling locations.