***Supplemental Materials***

**Phytoplankton size-class contributions to new and regenerated production during the EXPORTS Northeast Pacific Ocean field deployment**

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**Figure Captions**

**Figure S1. Incubator temperature by day during the EXPORTS observational period.** Temperature (ºC) for the incubator with a chiller to maintain ambient temperature at 1% Io (blue line) and for the incubator without a chiller (black line) over the course of the observational period.

**Figure S2.** **Size-fractionated summed total versus total net primary productivity and nitrate uptake rates.** Summed totals of small (<5 µm) and large (≥5 µm) fractions versus total cells for a) net primary productivity (13C-**DIC, NPP) and b) nitrate uptake rates (15N-**NO3-) for discrete samples throughout the euphotic zone over the course of the observational period.

**Figure S3. Discrete size-fractionated 13C-**DIC and 15N-**NO3- for 6 hr incubations vs. 24 hr incubations.** Small (<5 µm), large (≥5 µm), and total a) 13C-**DIC (µmol C L-1) and b) 15N-**NO3- (nmol N L-1) from the 6 hr incubations and the 24 hr incubations within the mixed layer. A 1:1 line is noted.

**Figure S4. Daily photosynthetic active radiation.** Irradiance levels (µmol photons m-2 s-1) measured at the percent of incidence irradiance (Io) depths where sample collections occurred throughout the euphotic zone. The 6 hr primary productivity incubation periods are provided by the vertical dashed lines and the productivity saturation levels (Ek) by the horizontal dashed lines.

**Figure S5. Depth profiles of ambient macronutrient concentrations by day.** a) nitrate (µmol L-1), b) ammonium (µmol L-1), c) phosphate (µmol L-1), and d) silicate (µmol L-1) concentrations by depth and Julian day over the course of the observational period.

**Figure S6. Size-fractionated particulate carbon to chlorophyll *a* ratios.** Size-fractionated particulate carbon (PC) to chlorophyll *a* ratios for a) small fraction (<5 µm) and b) large fraction (≥5 µm) in the mixed layer throughout the observational period.

**Figure S7**. **Size-fractionated chlorophyll *a* and total particulate carbon from the Canadian Line P cruise.** a) Size-fractionated chlorophyll *a* (µg L-1) and b) total particulate carbon (PC; µmol C L-1) depth profiles from the Canadian Line P cruise on JD 264 at the EXPORTS site.

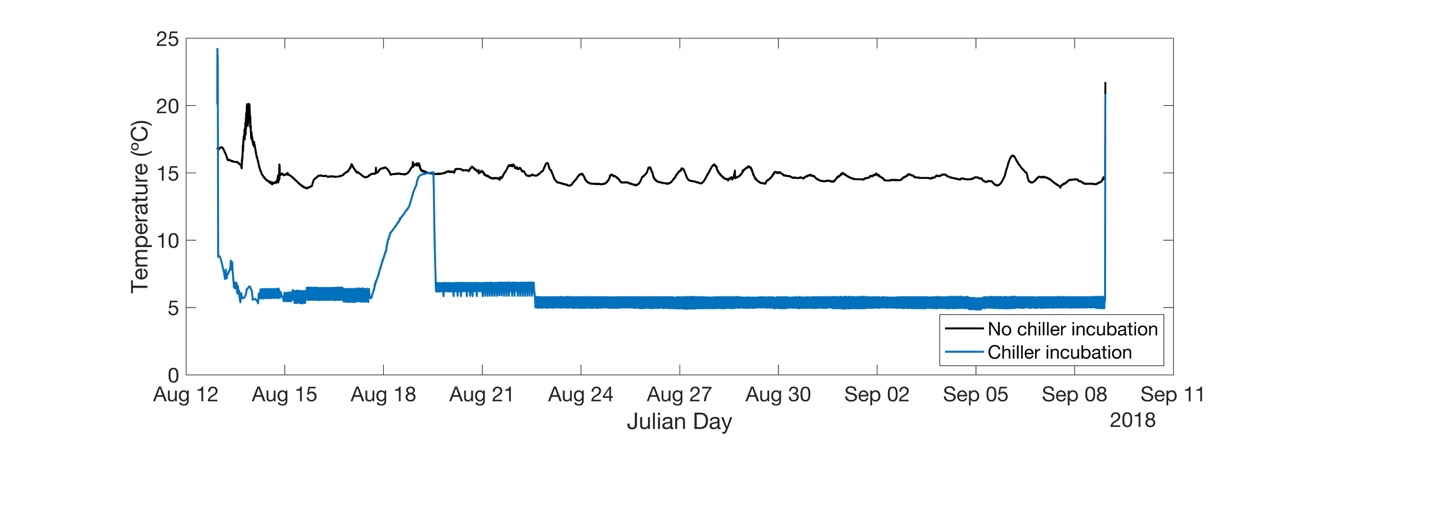
**Figure S8.** **Size-fractionated depth-integrated primary productivity** **within and below the mixed layer.** Depth-integrated total net primary productivity, new production, and regenerated production rates (mmol C m-2 d-1) a) in the mixed layer and b) from the base of the mixed layer to the base of the euphotic zone throughout the observational period.

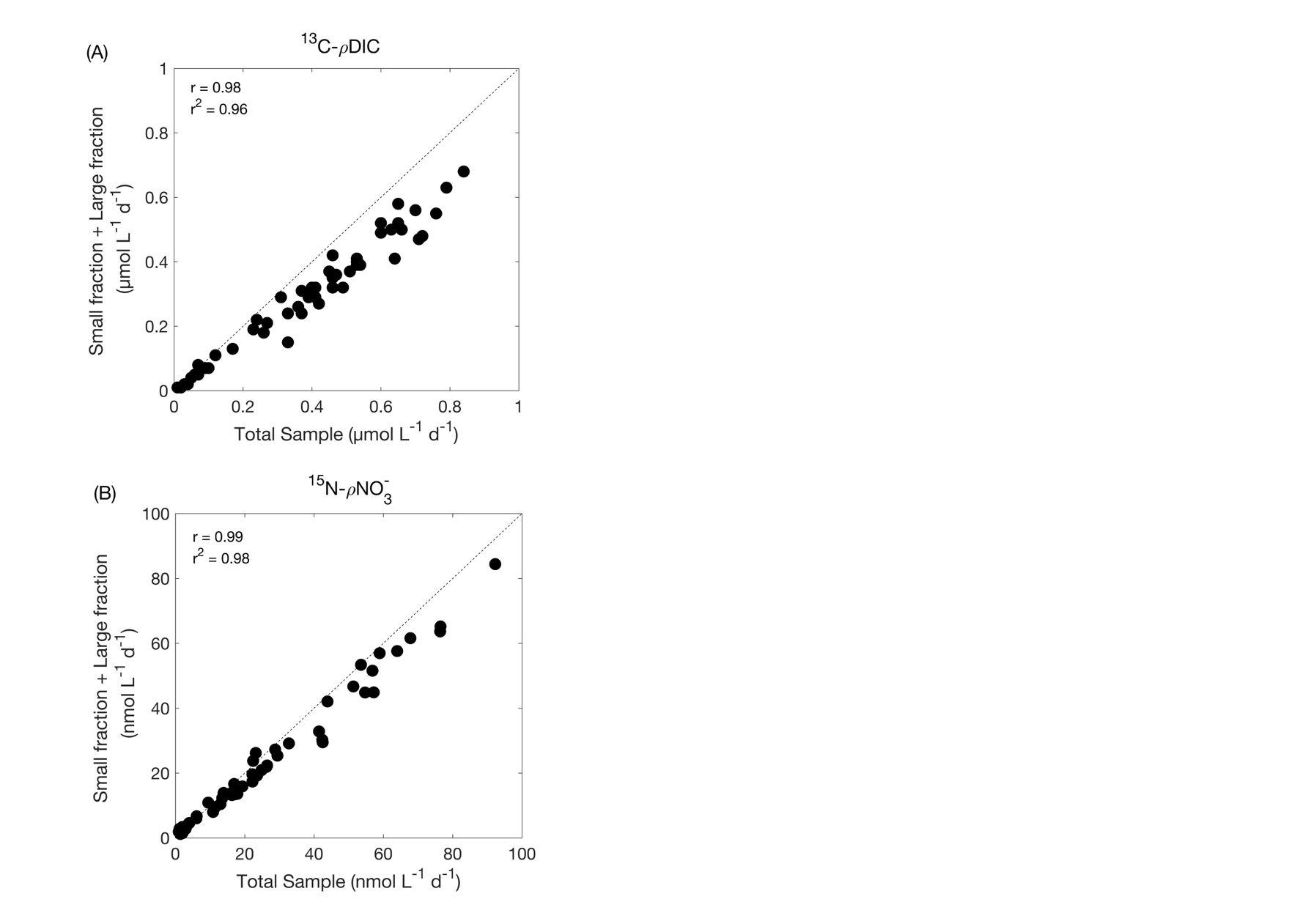
**Figure S9. 13C-**DIC, 15N-**NO3-, 15N-**NH4+, and 15N-**Urea uptake from the Canadian Line P cruise.** Depth profiles of a) NPP (13C-**DIC; µmol C L-1), b) new production (15N-**NO3-; nmol N L-1), c) ammonium uptake (15N-**NH4+; nmol N L-1), and d) urea uptake (15N-**Urea; nmol N L-1) uptake from the Canadian Line P cruise on JD 264 at the EXPORTS site.

**Figure S10. Comparison of size-fractionated f-ratios.** Comparison of the method 1 (Equation 2) and method 2 (Equation 3) for f-ratio calculations on JD 246 and 250. The average f-ratios for the small fraction (<5 µm) and the large fraction (≥5 µm) differed by 0.10 and 1.01, respectively, depending on the calculation method used. Those f-ratios greater than one indicate a majority of new production.

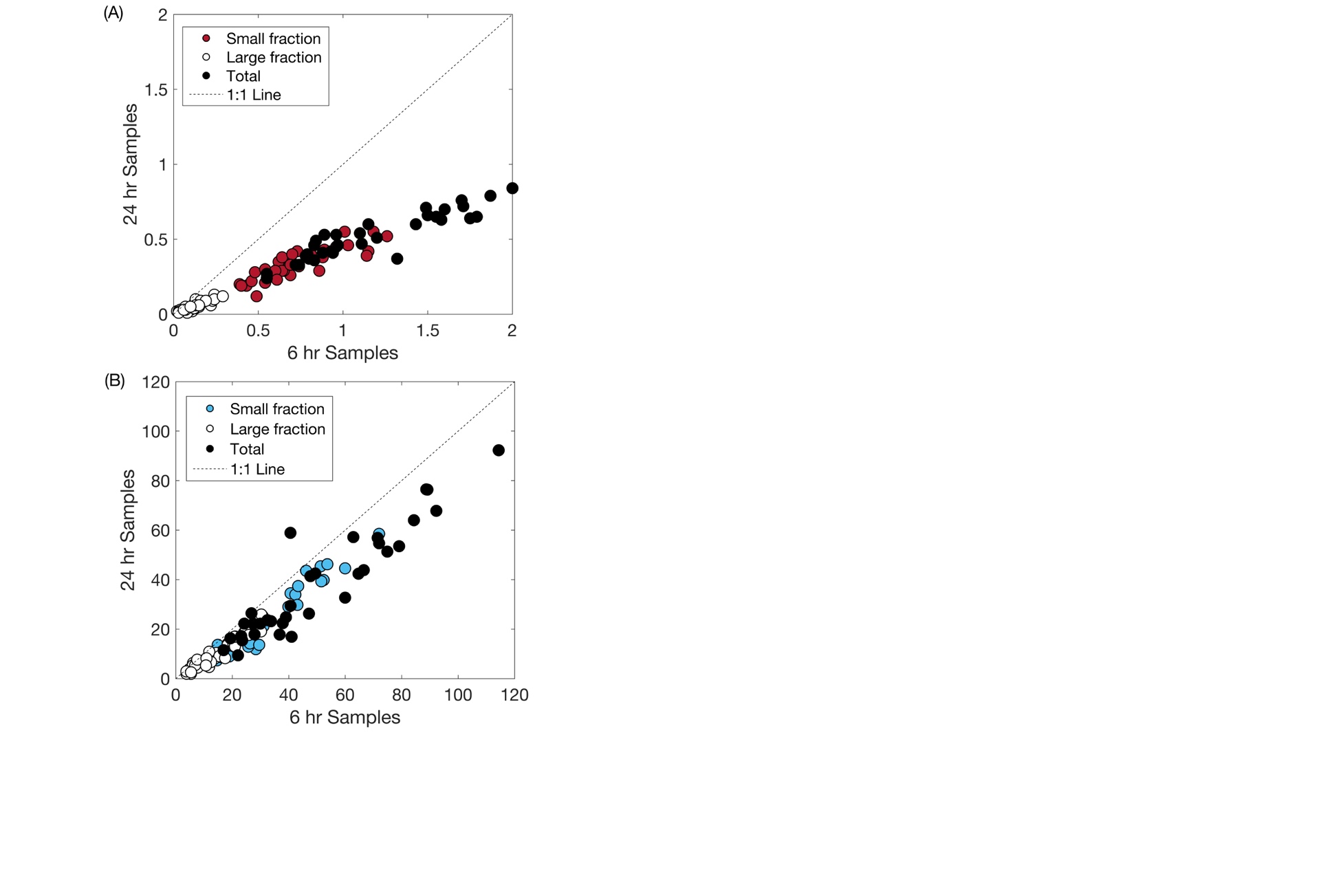
**Figure S11.** **Size-fractionated carbon and nitrate assimilation rates.** Size-fractionated biomass-normalized a) carbon uptake rates (13C-*V*DIC; d-1), and b) nitrate uptake rates (15N-*V*NO3-; d-1) for the small fraction (<5m), large fraction (≥5 m) and total integrated throughout the euphotic zone for each sample day. Carbon uptake rates are normalized by particulate carbon concentrations and nitrate uptake rates are normalized by particulate nitrogen.

**Figure S1.**

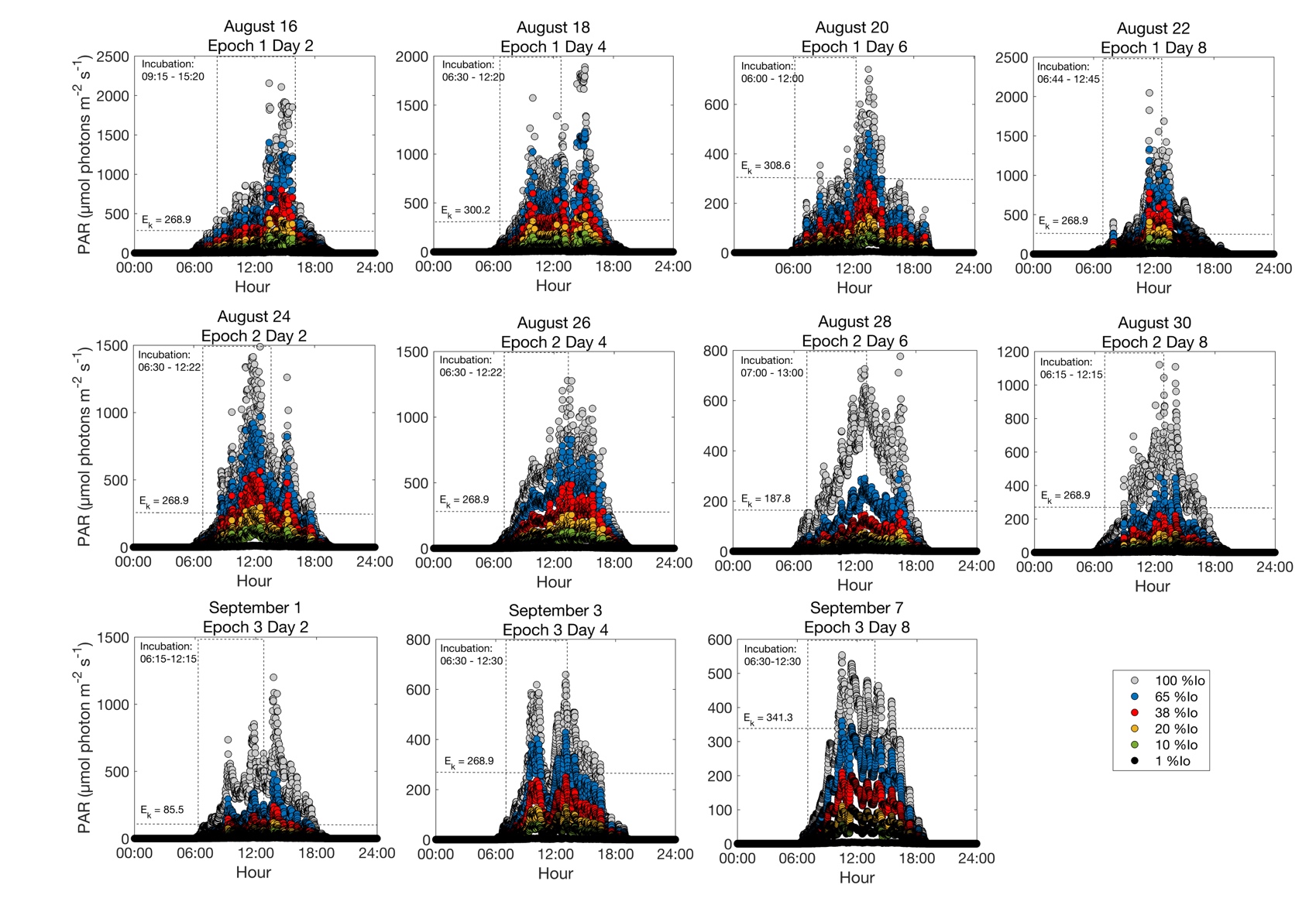


**Figure S2.**

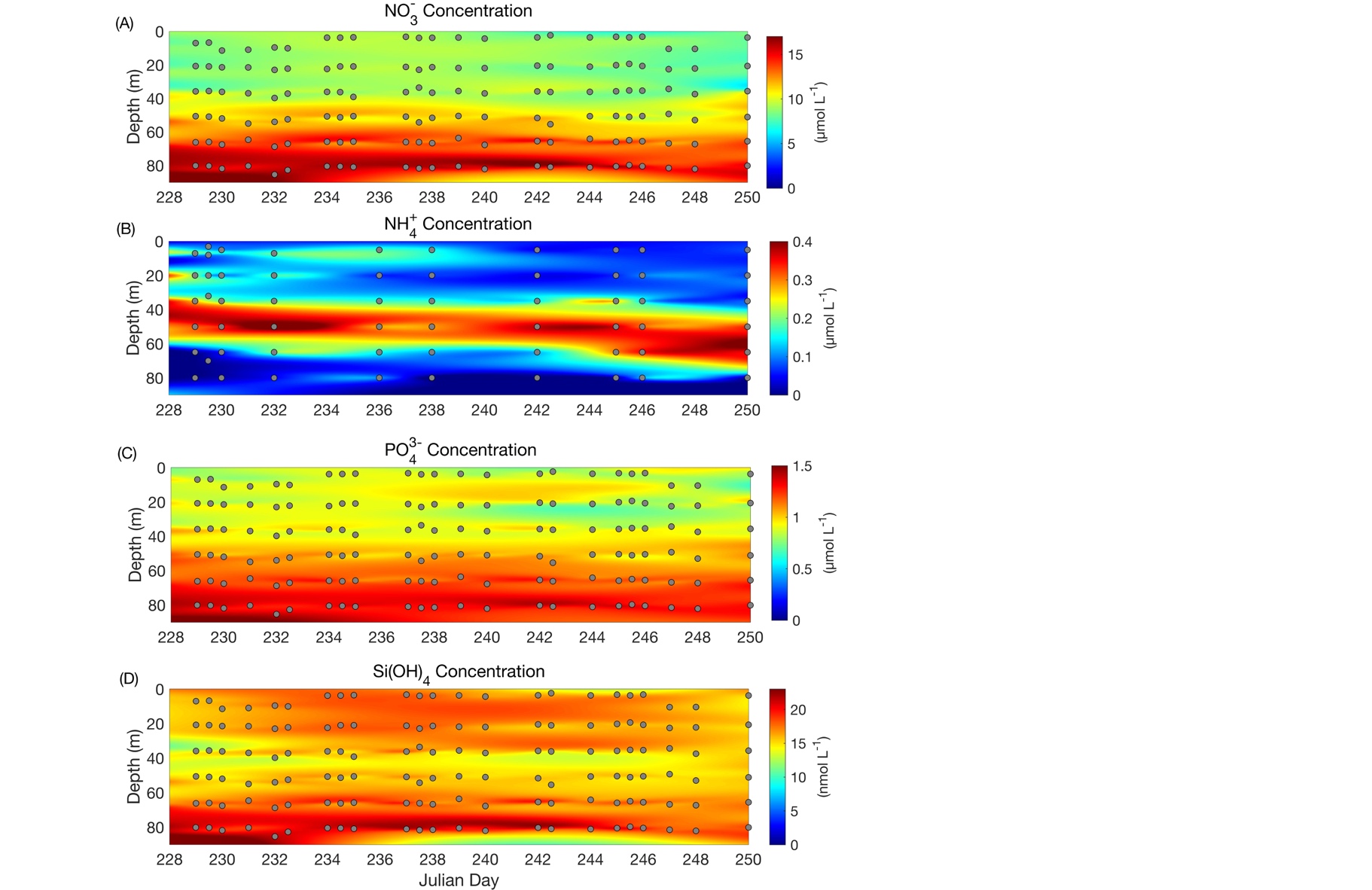
**Figure S3.**

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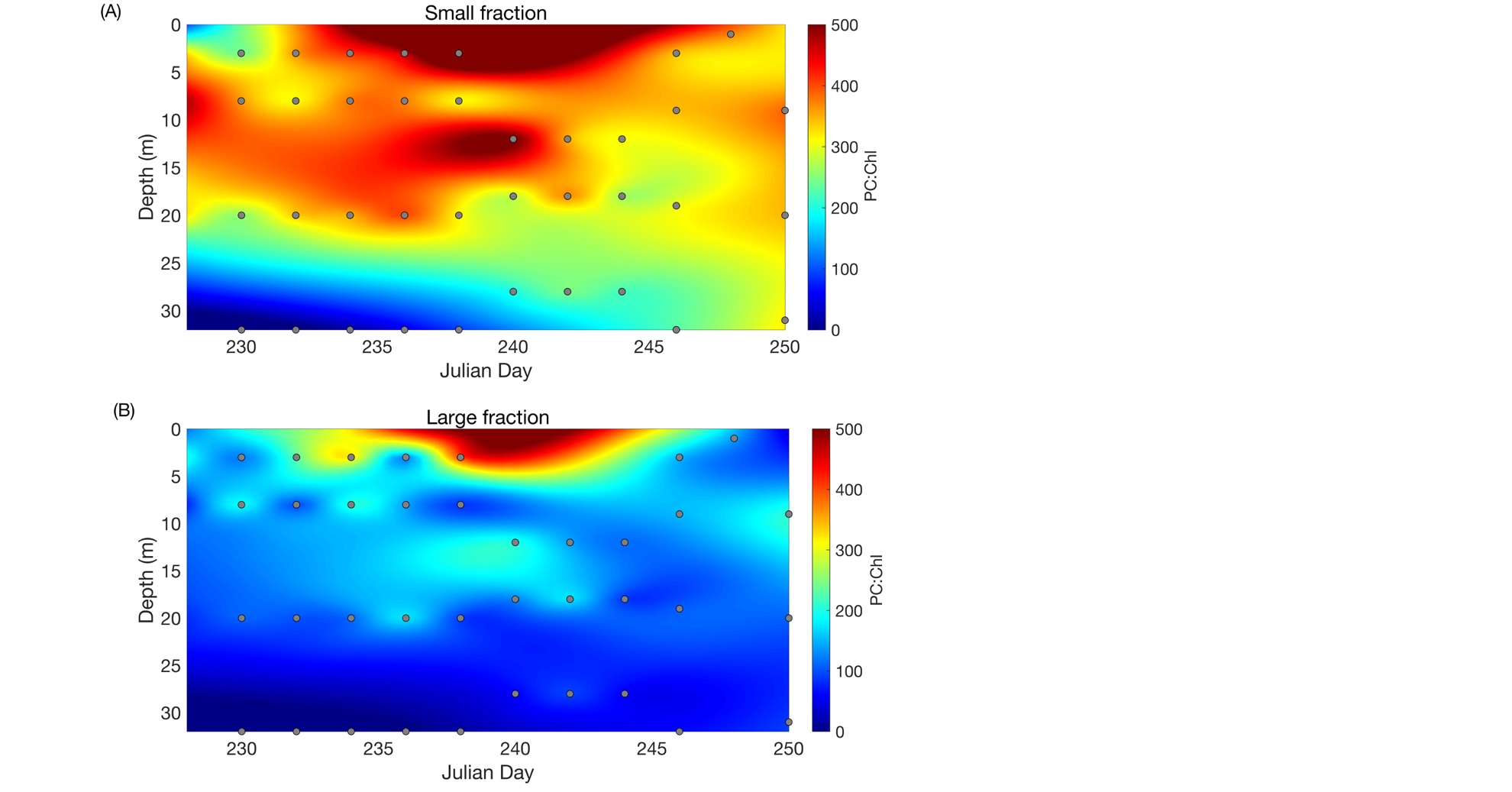
**Figure S4.**



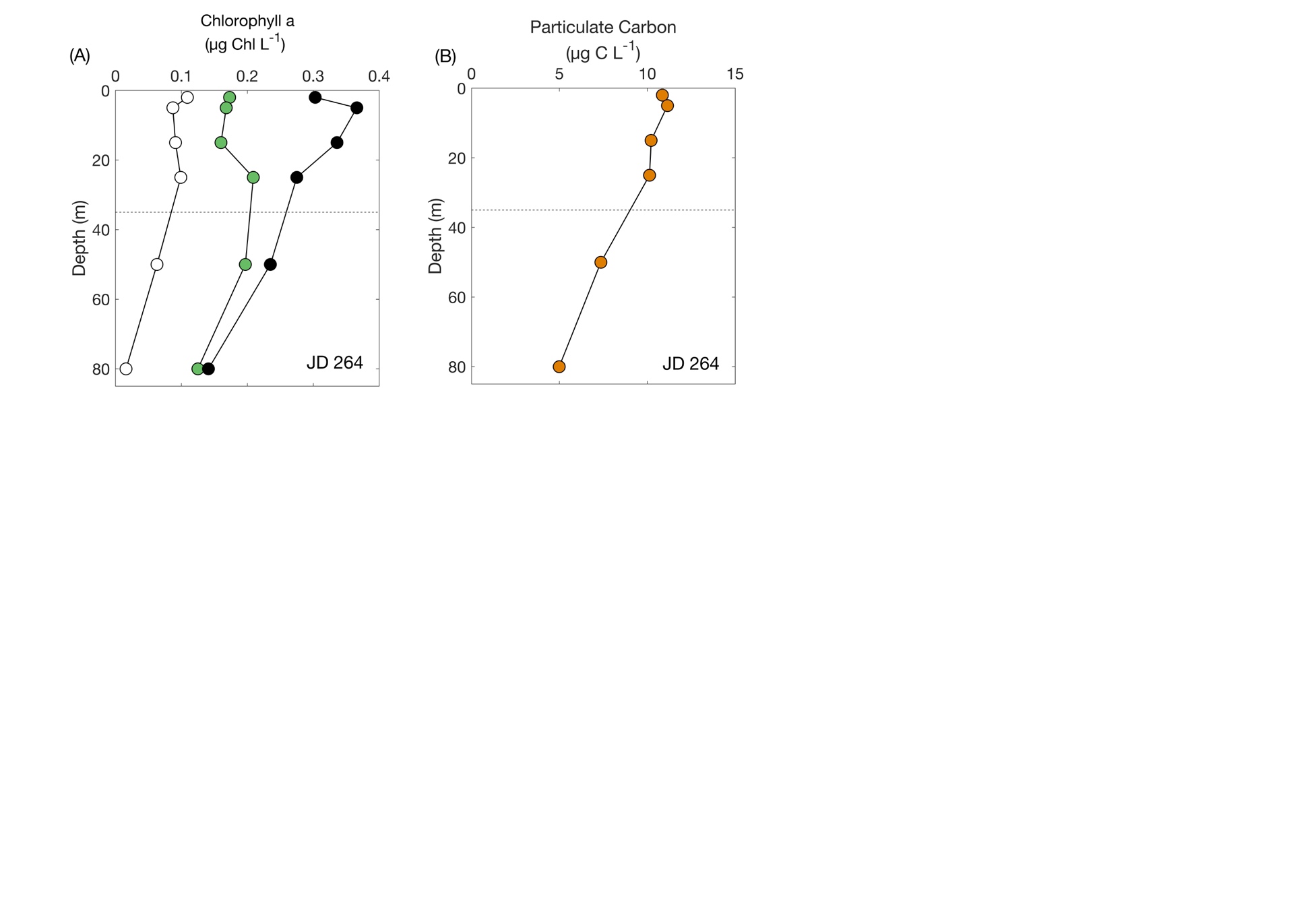
**Figure S5.**

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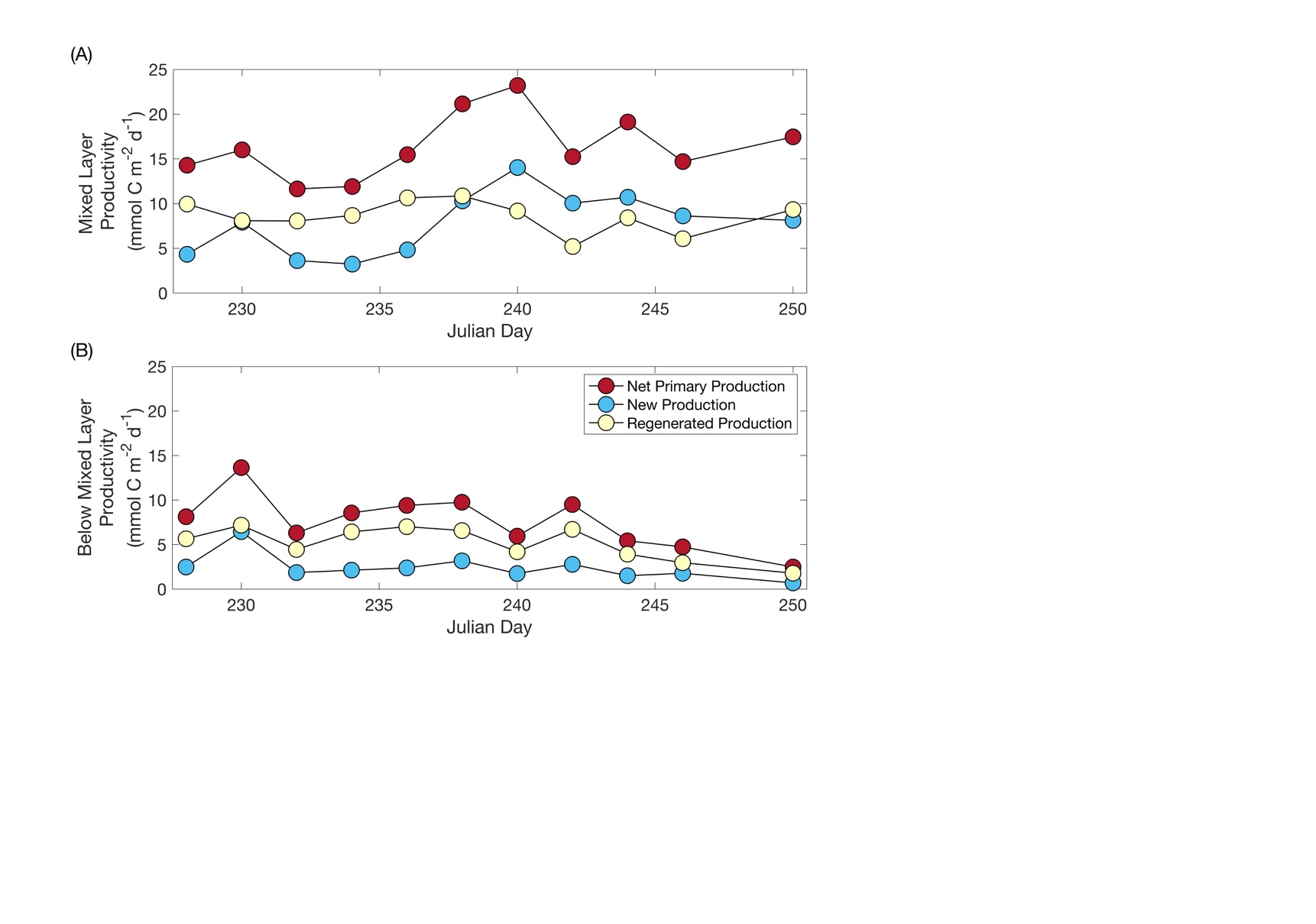
**Figure S6.**

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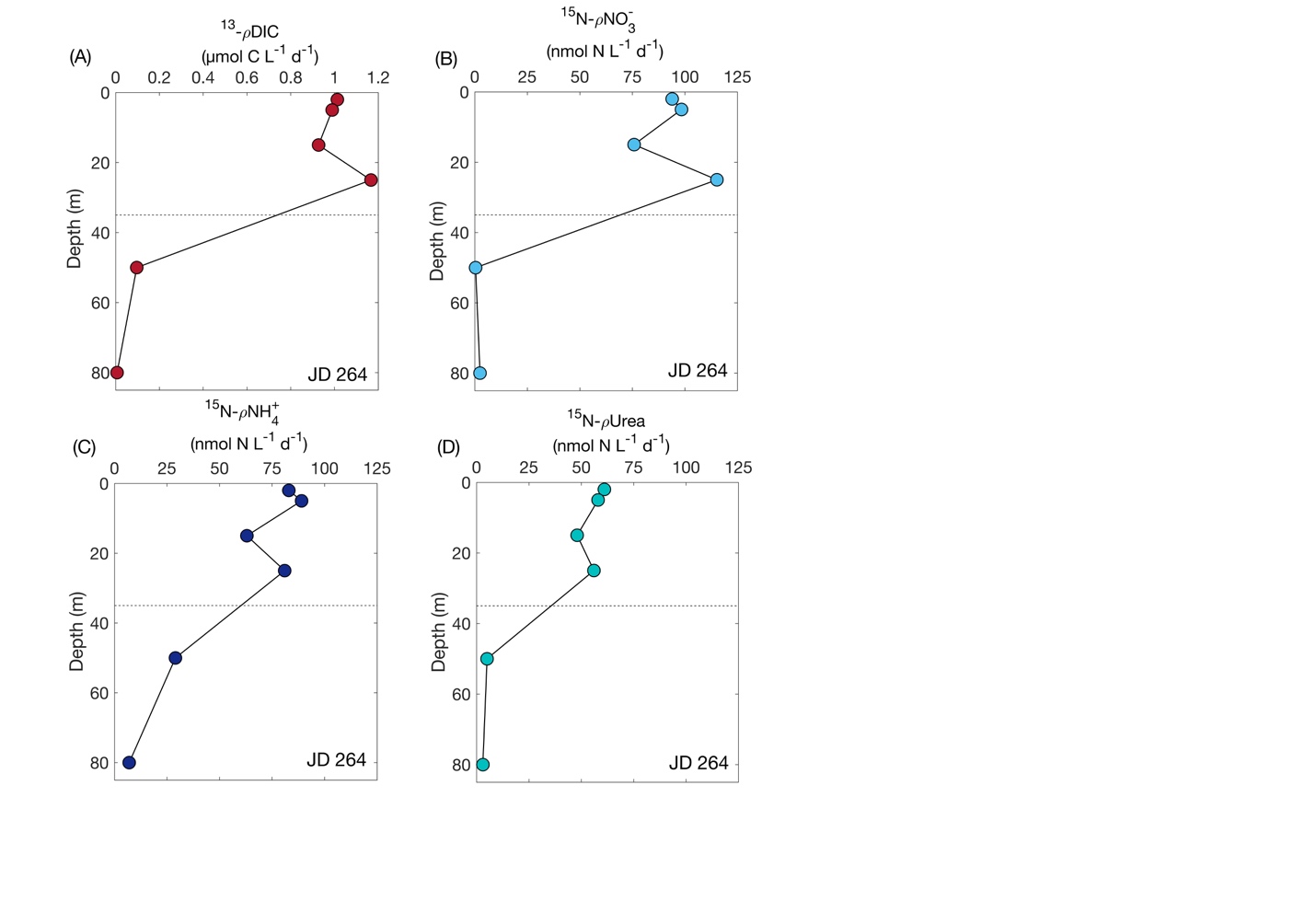
**Figure S7.**

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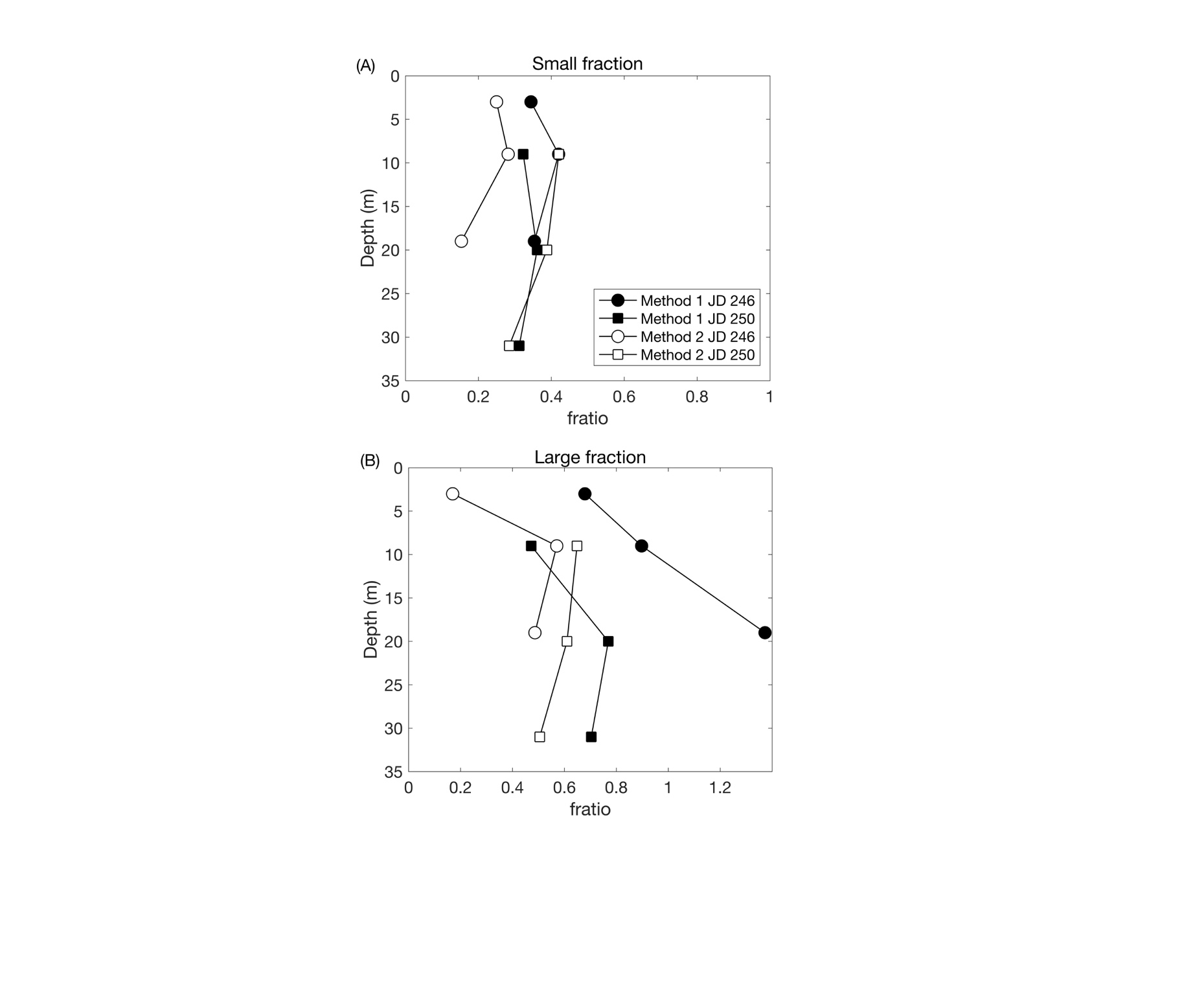
**Figure S8.**

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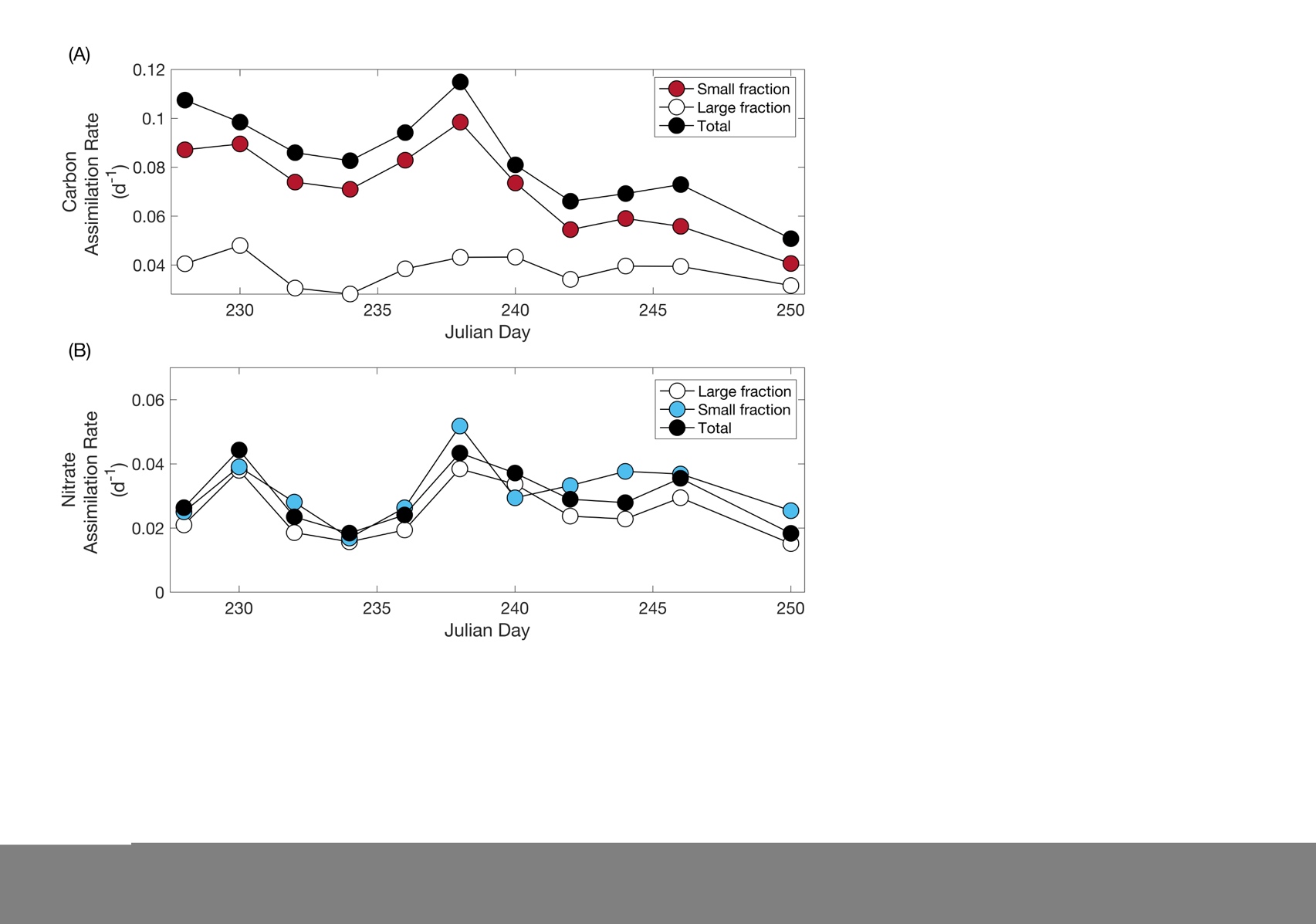
**Figure S9.**

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**Figure S10.**

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**Figure S11.**

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**Table S1. Percent deviations of the means for chlorophyll *a*, net primary productivity (13C-ρDIC), and nitrate uptake rate (15N-ρNO3-) measurements for the small fraction (<5m) and large fraction (≥5 m) from JD 228-250 during the Northeast Pacific EXPORTS field campaign. For chlorophyll *a*, n = 3, and for productivity, n = 2.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Chlorophyll (%)** |  | **13C-ρDIC (%)** |  | **15N-ρNO3- (%)** |  |
| **Day** | **Small** | **Large** | **Small** | **Large** | **Small** | **Large** |
| 228 | 12.47 | 16.55 | 6.41 | 62.59 | 5.66 | 11.96 |
| 230 | 7.31 | 18.53 | 7.02 | 36.56 | 14.20 | 16.42 |
| 232 | 8.51 | 25.89 | 7.88 | 22.97 | 9.44 | 10.33 |
| 234 | 6.36 | 9.39 | 4.84 | 54.62 | 6.49 | 22.07 |
| 236 | 13.62 | 13.98 | 7.05 | 47.08 | 5.95 | 10.20 |
| 238 | 5.09 | 11.81 | 4.69 | 34.07 | 11.87 | 5.08 |
| 240 | 6.18 | 13.74 | 6.49 | 7.96 | -- | -- |
| 242 | 6.33 | 6.58 | 7.09 | 10.81 | 8.95 | 6.01 |
| 244 | 4.13 | 11.27 | 11.06 | 21.72 | 8.41 | 9.72 |
| 246 | 3.68 | 9.15 | 6.24 | 25.80 | -- | -- |
| 250 | 5.08 | 10.27 | 10.47 | 19.97 | -- | -- |
| NP EXPORTS average: | 7.16 | 13.38 | 7.20 | 31.29 | 6.44 | 8.34 |

**Table S2. Mixed layer f-ratios calculated from 24-hour incubations and 6-hour incubations and the percent difference between the two values.**

-- indicates outlier

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Date** | **Julian day** | **Depth** | **24-hour incubation** | **6-hour incubation** | **Percent difference** |
| 8/16/2018 | 228 | 3 | 0.39 | 0.19 | 51.05 |
| 8/16/2018 | 228 | 8 | 0.24 | 0.12 | 49.76 |
| 8/16/2018 | 228 | 20 | 0.30 | 0.21 | 32.02 |
| 8/18/2018 | 230 | 3 | 0.53 | 0.30 | 22.17 |
| 8/18/2018 | 230 | 8 | 0.54 | 0.29 | 41.52 |
| 8/18/2018 | 230 | 20 | 0.42 | 0.33 | 32.64 |
| 8/20/2018 | 232 | 3 | 0.41 | 0.24 | -- |
| 8/20/2018 | 232 | 8 | 0.38 | 0.25 | 44.81 |
| 8/20/2018 | 232 | 20 | 0.26 | 0.26 | 41.72 |
| 8/22/2018 | 234 | 3 | 0.26 | 0.14 | 27.81 |
| 8/22/2018 | 234 | 8 | 0.32 | 0.18 | 39.80 |
| 8/22/2018 | 234 | 20 | 0.28 | 0.20 | 40.89 |
| 8/24/2018 | 236 | 3 | 0.28 | 0.17 | 27.75 |
| 8/24/2018 | 236 | 8 | 0.36 | 0.21 | 42.11 |
| 8/24/2018 | 236 | 20 | 0.32 | 0.23 | 47.59 |
| 8/26/2018 | 238 | 3 | 0.55 | 0.32 | 31.48 |
| 8/26/2018 | 238 | 8 | 0.53 | 0.28 | 47.94 |
| 8/26/2018 | 238 | 20 | 0.52 | 0.35 | 34.39 |
| 8/28/2018 | 240 | 12 | 0.72 | 0.38 | 30.97 |
| 8/28/2018 | 240 | 18 | 0.63 | 0.41 | 42.91 |
| 8/28/2018 | 240 | 28 | 0.33 | 0.23 | 27.62 |
| 8/30/2018 | 242 | 12 | 0.69 | 0.39 | -- |
| 8/30/2018 | 242 | 18 | 0.61 | 0.44 | 47.81 |
| 9/1/2018 | 244 | 12 | 0.66 | 0.35 | 25.45 |
| 9/1/2018 | 244 | 18 | 0.54 | 0.40 | 23.00 |
| 9/1/2018 | 244 | 28 | 0.26 | 0.20 | 49.25 |
| 9/3/2018 | 246 | 3 | 0.72 | 0.37 | -- |
| 9/3/2018 | 246 | 9 | 0.65 | 0.19 | 29.97 |
| 9/3/2018 | 246 | 19 | 0.50 | 0.35 | 46.11 |
| 9/7/2018 | 250 | 9 | 0.54 | 0.31 | 41.80 |
| 9/7/2018 | 250 | 20 | 0.41 | 0.33 | 18.86 |
| 9/7/2018 | 250 | 31 | 0.36 | 0.34 | -- |

|  |  |  |  |
| --- | --- | --- | --- |
|  | **r** | **r2** | **p** |
| **Mixed layer** |  |  |  |
| **Small fraction (<5 m)** |  |  |  |
| Carbon uptake assimilation rate | 0.30 | 0.09 | <0.001 |
| Nitrogen uptake assimilation rate | 0.23 | 0.05 | >0.001 |
| **Large fraction (≥5 µm)** |  |  |  |
| Carbon uptake assimilation rate | 0.23 | 0.05 | <0.001 |
| Nitrogen uptake assimilation rate | 0.40 | 0.16 | <0.001 |
| **Euphotic zone** |  |  |  |
| **Small fraction (<5 m)** |  |  |  |
| Carbon uptake assimilation rate | 0.77 | 0.60 | <0.001 |
| Nitrogen uptake assimilation rate | 0.12 | 0.02 | <0.001 |
| **Large fraction (≥5 µm)** |  |  |  |
| Carbon uptake assimilation rate | 0.16 | 0.03 | <0.001 |
| Nitrogen uptake assimilation rate | 0.92 | 0.84 | <0.001 |

**Table S3**. **Correlation analysis results between size-fractionated chlorophyll *a*-normalized 13C and 15N assimilation rates and photosynthetic active radiation (PAR).**