**Fig.S1** The development over time: of DOC **(a)** during the *varied P* and **(b)** during the *varied N*, of CDOM at 325nm ($a_{325}$) **(c)** during the *varied P* and **(d)** during the *varied N*, of Spectral Slope within 275-295 nm spectral range ($S_{275\text{-}295}$) **(e)** during the *varied P* and **(f)** during the *varied N*, of spectral slope ratio ($S_{275\text{-}295}$/ $S_{350\text{-}400}$) $S_R$ **(g)** during the *varied P* and **(h)** during the *varied N*, of first FDOM component fluorescence intensity (*Comp*.1 ) **(i)** during the *varied P* and **(j)** during the *varied N*, of second FDOM component fluorescence intensity (*Comp*.2) **(k)** during the *varied P* and **(l)** during the *varied N*, of third FDOM component fluorescence intensity (*Comp*.3) **(m)** during the *varied P* and **(n)** during the *varied N*.

**Fig.S2** Spectral loadings of fluorescent organic matter developed by PARAFAC analysis, 2D view (upper panel), 3D view (lower panel).

**Section S3** $\Sigma_{chl\ a}$ and $\Sigma_{bac}$ and Δ-values of DOC, CDOM at 325nm ($a_{325}$), humic-like fluorescent component (*Comp*.1), proteinaceous amino acid-like fluorescent component (*Comp*.2), peptide amino acid-like fluorescent component (*Comp*.3) at day 8 ($\Delta_8$), used for linear regression statistical tests. The color code represents treatment colors, used throughout the manuscript.

| Mesocosm ID | $\Sigma_{chl\ a}$ (µg $L^{-1}$) | $\Sigma_{bac}$ (# $mL^{-1}$) | $\Delta_8$DOC (µmol $L^{-1}$) | $\Delta_8 a_{325}$ ($m^{-1}$) | $\Delta_8$*Comp*.1 (RU) | $\Delta_8$*Comp*.2 (RU) | $\Delta_8$*Comp*.3 (RU) |
|---|---|---|---|---|---|---|---|
| 1 | 8.1 | $1.22^{x}10^{7}$ | 21 | 0.39 | 0.014 | 0.055 | -0.043 |
| 2 | 10.0 | $9.78^{x}10^{6}$ | 16 | 0.38 | 0.012 | 0.032 | 0.007 |
| 3 | 10.0 | $9.75^{x}10^{6}$ | 21 | 0.29 | 0.013 | 0.036 | -0.030 |
| 4 | 7.4 | $9.68^{x}10^{6}$ | 15 | 0.25 | 0.010 | 0.043 | 0.006 |
| 6 | 9.9 | $1.04^{x}10^{7}$ | 31 | 0.27 | 0.011 | 0.038 | -0.061 |
| 7 | 11.0 | $9.73^{x}10^{6}$ | 20 | 0.40 | 0.017 | 0.038 | -0.005 |
| 8 | 12.8 | $9.31^{x}10^{6}$ | 37 | 0.49 | - | - | - |
| 9 | 10.7 | $8.72^{x}10^{6}$ | 57 | 0.28 | 0.009 | 0.050 | -0.007 |
| 10 | 10.2 | $1.28^{x}10^{7}$ | 19 | 0.27 | 0.007 | - | 0.029 |
| 11 | 11.5 | $9.74^{x}10^{6}$ | 25 | 0.32 | 0.017 | 0.058 | 0.016 |
| 12 | 7.5 | $9.66^{x}10^{6}$ | 18 | 0.42 | 0.020 | 0.068 | 0.010 |
| 13 | 7.5 | $9.23^{x}10^{6}$ | 17 | 0.23 | 0.015 | 0.037 | -0.006 |
| 14 | 7.7 | $9.92^{x}10^{6}$ | 15 | 0.15 | 0.012 | 0.016 | -0.013 |
| 15 | 14.1 | $1.31^{x}10^{7}$ | 41 | 0.40 | 0.017 | 0.040 | 0.010 |
| 16 | 7.3 | $9.47^{x}10^{6}$ | 7 | 0.20 | 0.013 | 0.015 | 0.021 |
| 1 | 16.5 | $8.15^{x}10^{6}$ | 58 | 0.38 | 0.017 | 0.056 | 0.086 |
| 2 | 17.1 | $1.04^{x}10^{7}$ | 52 | 0.37 | 0.016 | 0.051 | 0.039 |
| 3 | 20.3 | $1.04^{x}10^{7}$ | 56 | 0.21 | 0.012 | 0.048 | 0.046 |
| 4 | 11.3 | $1.05^{x}10^{7}$ | 49 | 0.18 | 0.007 | 0.073 | 0.009 |
| 5 | 11.3 | $1.05^{x}10^{7}$ | 52 | 0.39 | 0.017 | 0.073 | -0.053 |
| 6 | 22.7 | $1.08^{x}10^{7}$ | 65 | 0.36 | 0.022 | 0.040 | 0.036 |
| 7 | 23.7 | $1.10^{x}10^{7}$ | 65 | 0.61 | 0.028 | 0.098 | 0.088 |
| 8 | 25.7 | $1.05^{x}10^{7}$ | 71 | 0.49 | - | - | - |
| 9 | 10.3 | $9.09^{x}10^{6}$ | 41 | 0.17 | 0.017 | 0.050 | 0.061 |
| 10 | 22.6 | $8.88^{x}10^{6}$ | 79 | 0.34 | 0.019 | 0.041 | 0.046 |
| 11 | 8.2 | $8.80^{x}10^{6}$ | 38 | 0.16 | 0.012 | 0.060 | 0.006 |
| 12 | 13.5 | $8.88^{x}10^{6}$ | 62 | 0.21 | 0.009 | 0.041 | 0.048 |
| 13 | 7.2 | $8.25^{x}10^{6}$ | 37 | 0.09 | 0.007 | 0.021 | 0.150 |
| 14 | 10.1 | $7.80^{x}10^{6}$ | 47 | 0.36 | 0.010 | 0.030 | -0.057 |
| 15 | 7.0 | $7.99^{x}10^{6}$ | 32 | 0.01 | 0.004 | 0.024 | -0.006 |
| 16 | 6.5 | $7.75^{x}10^{6}$ | 45 | 0.12 | 0.004 | 0.036 | 0.113 |