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# Effect of wind speed on the size distribution of gel particles in the sea surface microlayer: insights from a wind–wave channel experiment

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**Supplementary Material**

## Manipulations during the experiment:

During the experiment, a series of manipulations was conducted. To stimulate phytoplankton growth, artificial illuminators were switched on from day 9 to day 16 and from day 20 to day 26, with a 12 Light: 12 Dark regime. On 14 November (day 12), nutrients were added to the concentrations of 14.7 µmol $L^{-1}$ for nitrate ($NO_3$), of 9.5 µmol $L^{-1}$ for silicate ($SiO_4$) and of 0.48 µmol $L^{-1}$ for phosphate ($PO_4$). In order to induce phytoplankton growth and exudation, ~1L of a culture of coccolithophore algae (*Emiliania huxleyi*, $4.6 \times 10^5$ cells $ml^{-1}$) was added to the tank on day 20. In addition, 6L of water enriched with organic matter, sampled from surface microlayer during previous phytoplankton mesocosm experiment, was added to the tank on day 21, and had been stored frozen at -20° for about 6 months until the addition.

## TEP and CSP developments in bulk and microlayer surface

For SML samples, figure 2 corresponded to the average gels concentration of all wind speeds conditions on each one experiment day. Sampling of SML was done at the end of each one wind speed condition. Bulk water was also sampled at the end of each one wind speed condition excepted for day 2 and day 4. On day 2 and day 4, bulk samples were collected at the first wind speed condition (morning) and the end wind speed condition (evening). Compared to the significant changes of gel concentration in SML with wind speed, the gel concertation changes with wind speed in bulk water were smaller (data not shown). Therefore, the average of gel concentration in bulk was less sensitive to wind speed changes.

The developments of TEP and CSP abundance in the bulk water and SML are shown in Figure S1. Abundance and total area of $TEP_{SML}$ declined until the addition of the *E. huxleyi*

seed culture and of pre-collected biogenic SML on day 20. The bulk water had lower TEP abundance and total area. Abundance of $TEP_{Bulk}$ increased from the initial 79.3 ± 0. $9\times10^{6}$ $L^{-1}$ on day 2 until the peak on day 22 (Fig. S1 A). Total area of $TEP_{Bulk}$ was $3.8\pm0.1\times10^{2}mm^{2}$ $L^{-1}$ initially and increased to the maximum value of 14.2 $\pm1.0\times10^{2}$ $mm^{2}L^{-1}$ on day 15 (Fig S1 B).

Similar to $TEP_{SML}$, $CSP_{SML}$ abundance and total area showed two peaks at start and end of Aeolotron experiment (Fig.2 C, D). The lowest $CSP_{SML}$ abundance was observed on day 9. Total area of $CSP_{SML}$ dropped from an initial $20.5\pm2.7\times10^{2}mm^{2}$ $L^{-1}$ to $6.39\pm0.4\times10^{2}mm^{2}L^{-1}$ on day 15 (Fig.S1 D). $CSP_{Bulk}$ concentration started with $12.9\pm10.7\times10^{6}$ $L^{-1}$ in abundance and $0.5\pm0.04\times10^{2}mm^{2}$ $L^{-1}$ in total area on day 2, respectively, increased to the first peak on day 9 for abundance, and then declined (Fig.S1 C, D). Although the concentrations of $CSP_{Bulk}$ were lower than in the SML, the peaks of CSP abundance and total area in both SML and bulk water occurred on day 24 corresponding to increasing Chl*a* concentration in the bulk water. Generally, abundance and total area in the bulk and SML were less for CSP than for TEP.

Table S1: The size of distribution of gel particles (2-16μm) in the SML.

| Day | Wind speed | TEP | | | CSP | | |
|---|---|---|---|---|---|---|---|
| | | $k(L^{-1})$ | δ | $R^2$ | $k(L^{-1})$ | δ | $R^2$ |
| 2 | 3.98 | 1.02E+09 | -2.93 | 0.999 | 6.14E+08 | -2.77 | 0.997 |
| | 5.38 | 1.31E+09 | -2.69 | 0.984 | 3.87E+08 | -2.80 | 0.983 |
| | 11.1 | 2.72E+09 | -4.05 | 0.999 | 2.26E+08 | -3.07 | 0.993 |
| | 17.9 | 2.18E+09 | -3.86 | 0.998 | 9.78E+08 | -3.35 | 0.995 |
| 4 | 2.09 | 2.95E+08 | -2.31 | 0.999 | 2.42E+08 | -2.63 | 0.965 |
| | 3.44 | 1.98E+08 | -2.20 | 0.999 | 9.38E+08 | -2.95 | 0.942 |
| | 4.31 | 1.51E+08 | -2.17 | 0.999 | 4.15E+08 | -2.75 | 0.991 |
| | 8.31 | 1.81E+09 | -3.69 | 0.988 | 1.86E+08 | -3.06 | 0.882 |
| | 14.2 | 6.64E+08 | -3.47 | 0.995 | 3.44E+08 | -3.35 | 0.946 |
| 9 | 1.54 | 1.93E+08 | -2.03 | 0.994 | 2.92E+08 | -2.59 | 0.999 |
| | 2.40 | 2.34E+08 | -2.33 | 0.999 | 7.17E+07 | -2.41 | 0.993 |
| | 4.07 | 1.14E+08 | -2.12 | 0.998 | 8.41E+07 | -2.45 | 0.995 |
| | 5.29 | 8.36E+07 | -1.99 | 0.997 | 1.03E+08 | -2.57 | 0.989 |
| | 11.1 | 2.66E+08 | -3.11 | 0.999 | 1.19E+08 | -3.46 | 0.998 |
| 11 | 3.93 | 4.74E+08 | -3.88 | 0.994 | 5.58E+08 | -2.63 | 0.994 |
| | 8.03 | 3.70E+08 | -3.65 | 0.811 | 1.34E+09 | -3.78 | 0.941 |
| | 14.0 | 2.64E+08 | -3.41 | 0.820 | 2.59E+08 | -3.06 | 0.962 |
| | 18.2 | 2.32E+08 | -3.01 | 0.957 | 1.24E+08 | -3.13 | 0.992 |
| 15 | 2.58 | 3.01E+08 | -2.37 | 0.998 | 5.20E+08 | -3.07 | 0.861 |
| | 4.99 | 1.82E+08 | -2.18 | 0.996 | 1.30E+08 | -2.63 | 0.971 |
| | 6.42 | 1.04E+08 | -2.06 | 0.992 | 2.93E+08 | -2.96 | 0.953 |
| | 11.1 | 2.49E+08 | -2.20 | 0.994 | 4.32E+08 | -3.09 | 0.980 |
| | 18.1 | 3.85E+08 | -2.52 | 0.997 | 5.97E+08 | -3.09 | 0.984 |
| 22 | 1.37 | 1.09E+08 | -1.32 | 0.829 | 1.68E+08 | -2.17 | 0.972 |
| | 4.53 | 3.17E+08 | -1.74 | 0.965 | 3.07E+08 | -2.17 | 0.971 |
| | 6.10 | 4.67E+08 | -2.15 | 0.996 | 1.73E+08 | -2.24 | 0.990 |
| | 11.3 | 3.38E+08 | -2.41 | 0.997 | 8.95E+07 | -2.36 | 0.994 |
| | 18.7 | 1.78E+08 | -2.39 | 0.996 | 1.26E+08 | -2.50 | 0.995 |
| 24 | 1.44 | 2.28E+08 | -1.92 | 0.998 | 6.14E+08 | -2.31 | 0.968 |
| | 2.65 | 4.43E+08 | -2.11 | 0.940 | 1.83E+09 | -2.58 | 0.994 |
| | 4.27 | 4.43E+08 | -2.26 | 0.953 | 1.39E+09 | -2.50 | 0.972 |
| | 5.38 | 3.89E+08 | -2.33 | 0.924 | 1.29E+09 | -2.60 | 0.985 |
| | 11.4 | 1.16E+08 | -2.48 | 0.998 | 1.77E+08 | -2.32 | 0.955 |
| | 18.1 | 1.56E+08 | -2.68 | 0.999 | 2.04E+08 | -2.35 | 0.932 |

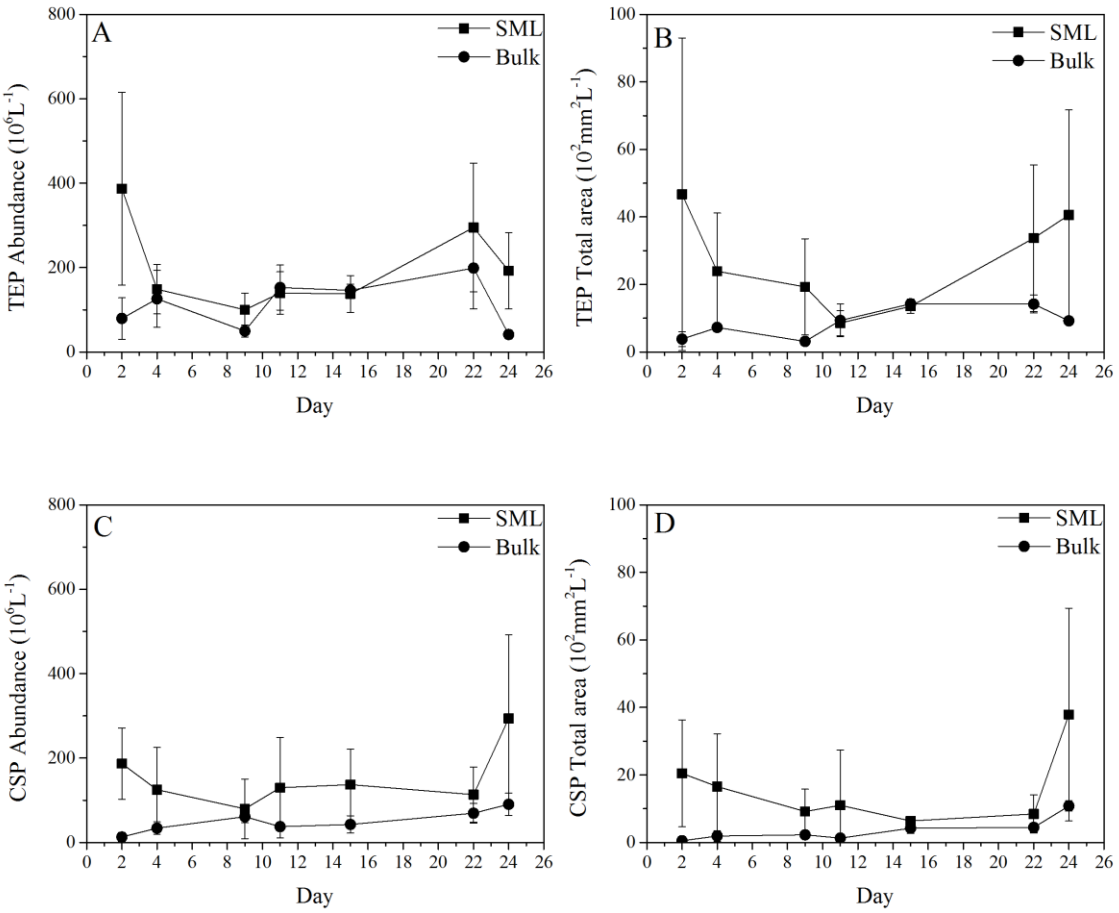


Figure S1 A-D: Developments of TEP and CSP in the SML and the bulk water in the course of the Aeolotron study; A) TEP abundance; B) TEP total area; C) CSP abundance; D) CSP total area, the error bars indicate ±1 SD.

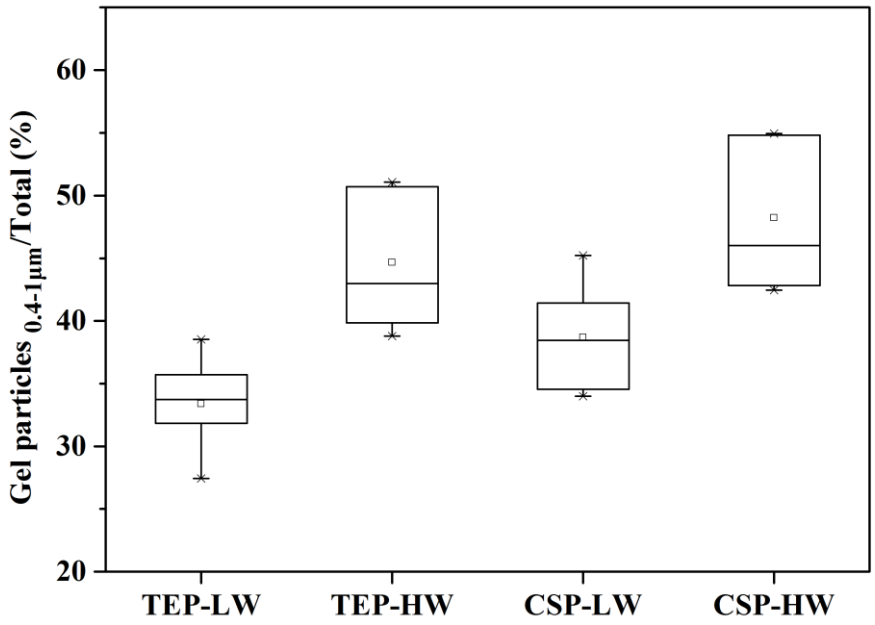


Fig. S2: The abundance fractions of submicron particles (0.4-1μm) in the SML at low wind (LW, $<6ms^{-1}$) and high wind (HW, $>6ms^{-1}$).