## Supplement

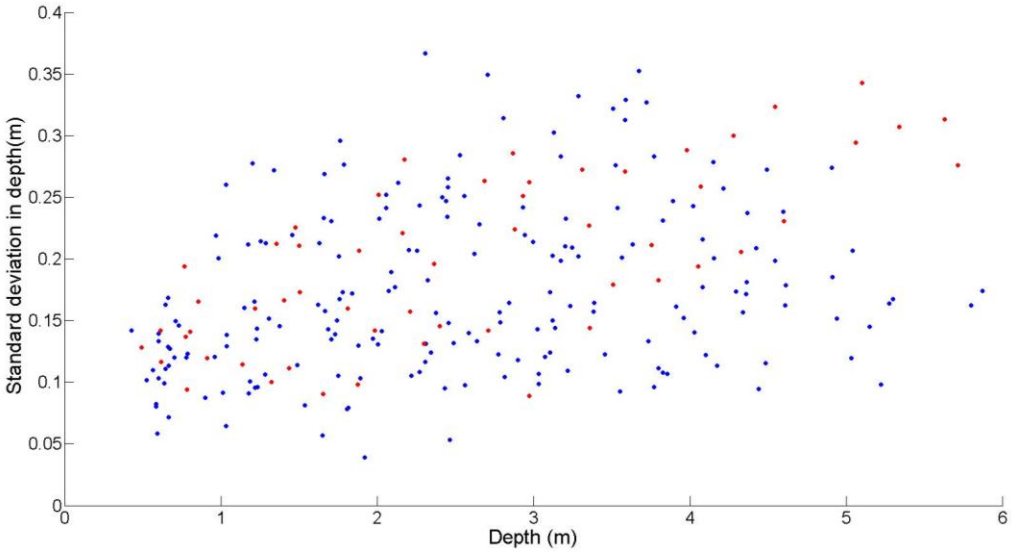


**Figure S1:** Changes in the standard deviation of the NSOP frame depth as the frame is lowered in the water column. The dataset is comprised of 17 NSOP deployments in the Central Celtic Sea. Data from deployments where the significant wave height exceeded 2.5 m are coloured in red whereas those in blue are for wave heights below 2.5 m.

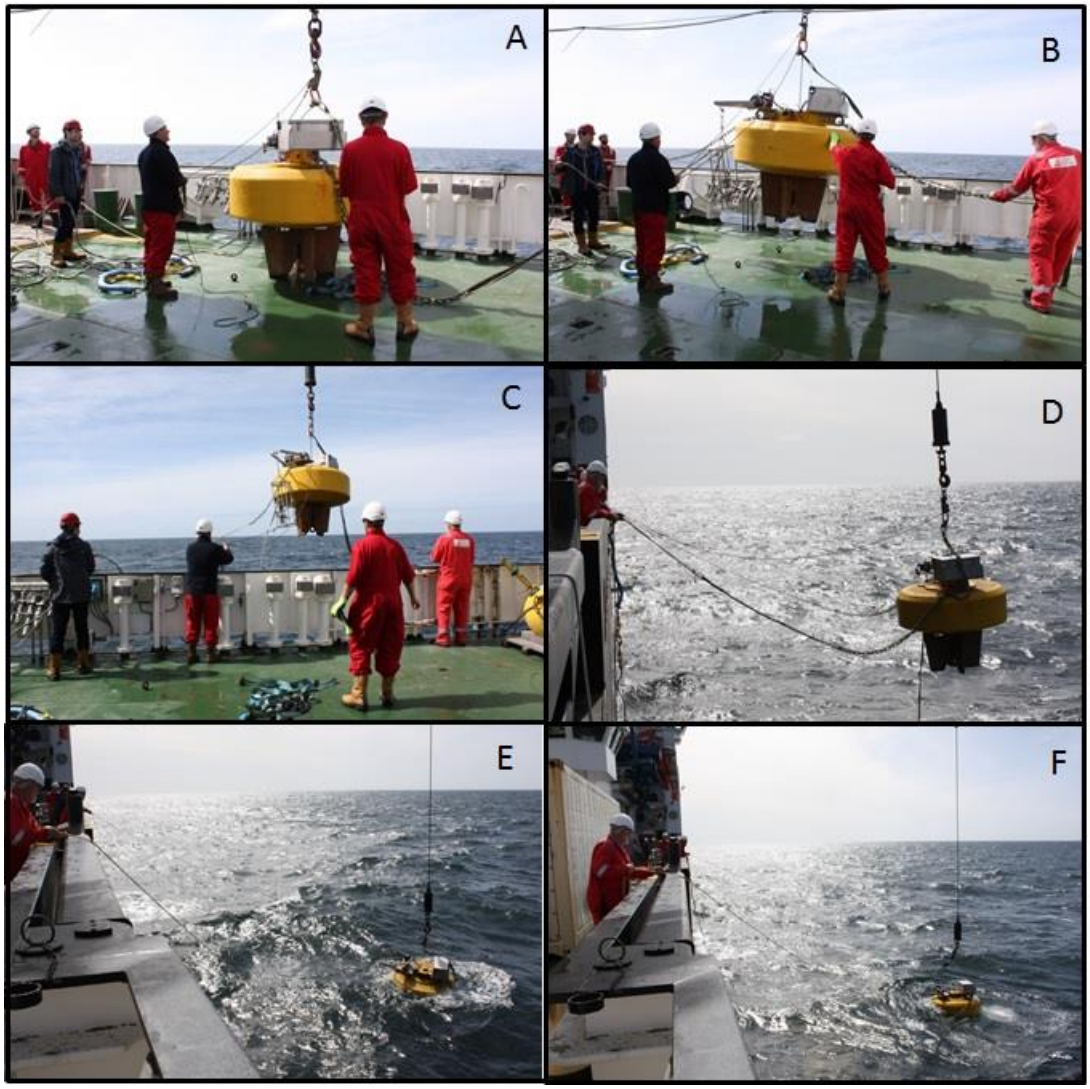


**Figure S2:** Photographs of a Near Surface Ocean Profiler deployment.Panels indicate, the system setup before lifting (a), lifting and steadying with slack lines (b), lifting and deployment over the balwark of the ship (c), lowering to the sea surface (d), contact with the sea surface (e) and quick release activation and seperation from the crane (f).

**Total Alkalinity (TA) analysis**

Samples were analysed for TA (cell potentiometric titration, SOP#3B; Dickson et al., 2007). Analysis was performed on a versatile instrument for the determination of total alkalinity (VINDTA) (Marianda: Vindta 3C; Schuster et al., 2014). Certified reference materials for TA (Scripps Institution of Oceanography; batch 142) were run every 12 hrs. Replicate samples were collected at the surface of each profile, allowing measurement accuracy for TA and was determined as ±1.502.

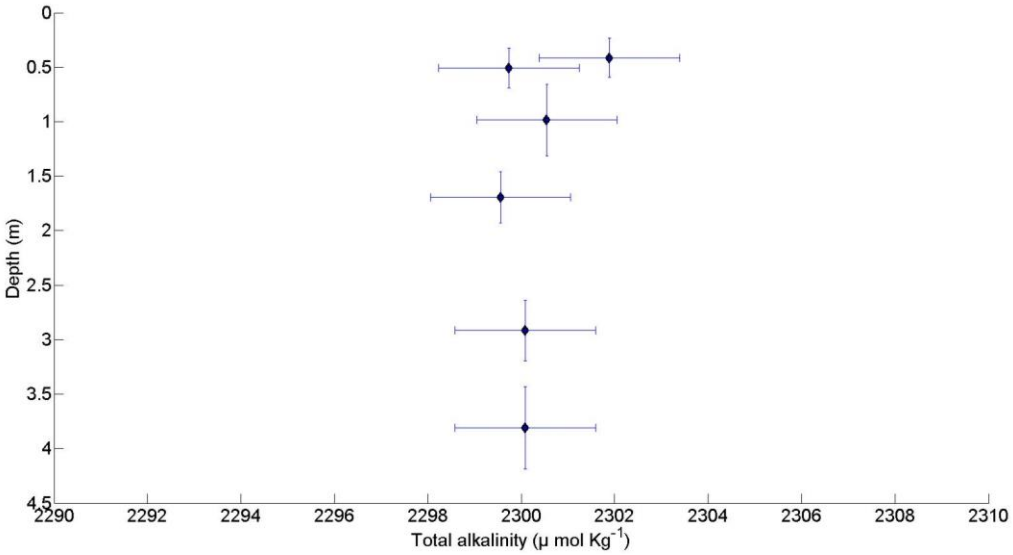


**Figure S3:** Total alkalinity samples collected using NSOP in the Celtic Sea on the 19th July 2015. Water sample depth is calculated as described in Section 2.7 of the main text.

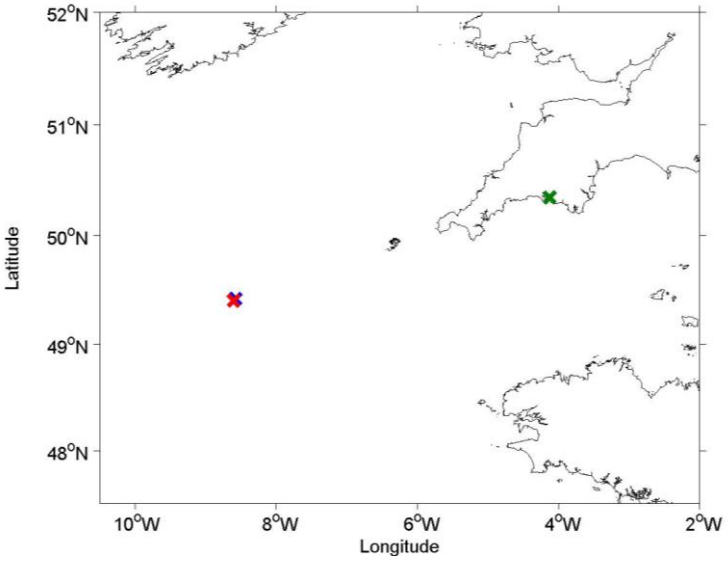


**Figure S4:** Map of sites. The $CO_2$ deployment site in the Central Celtic Sea is marked with a red cross, the near surface temperature mooring with a blue cross and the DMS deployment in the Plymouth Sound with a green cross.

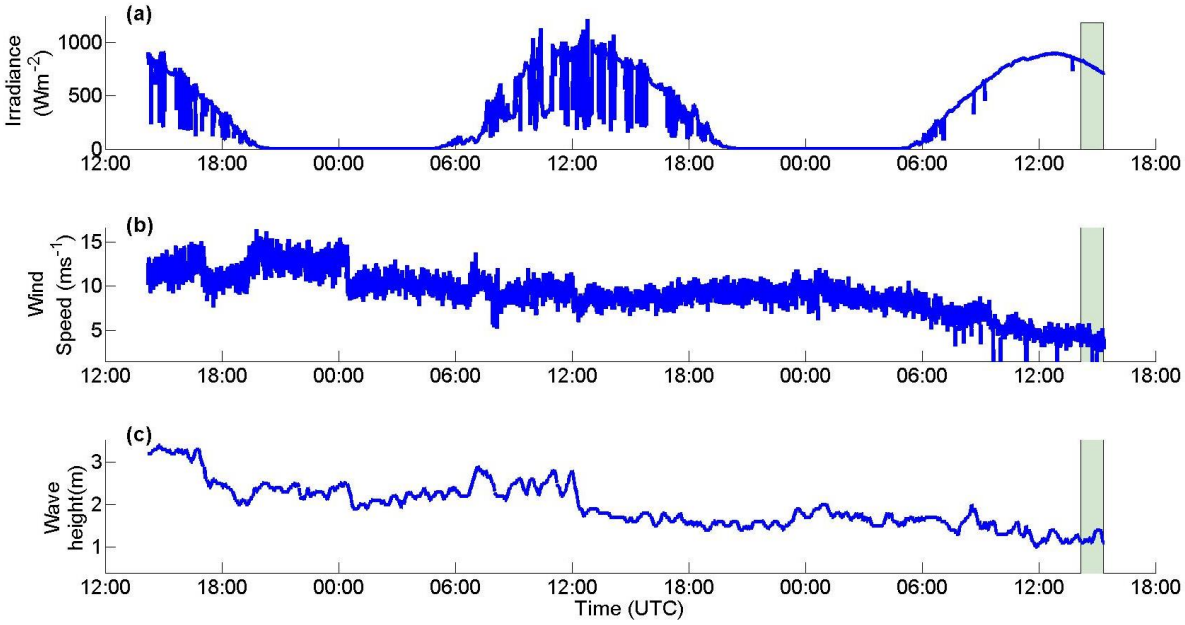


**Figure S5:** Timeseries of meteorology and sea state variables in the Celtic Cea in July 2015 while the ship was on station: (a) irradiance; (b) wind speed; and (c) significant wave height. The data begin 48 h before the start of the profile at 14:05 hrs (UTC). The vertical grey bar indicates the period when NSOP was profiling.

## Equilibrator cleaning

Lab experiments were conducted with two Liqui-Cel 2.5 x 8 units before and after cleaning. In a relatively new Liqui-Cel (< 2 yr old) that had been infrequently used and repeatedly cleaned, there were significant flow rate dependences prior to cleaning. In the gas phase, an increase in gas flow from 10 to 100 ml reduced the efficiency to 98.9%. In the water phase, reducing the water flow from 4 L $min^{-1}$ to 1 L $min^{-1}$ reduced the efficiency to 99.6%. These efficiency reductions are smaller than those reported for the older unit (see Section 2.3.1) but are still significant.

As recommended in the Liqui-Cel cleaning guide (biological fouling section), the unit was cleaned in sequence using 3% HCl and 5% W/W NaOH solutions. The Liqui-Cel was drained and rinsed with fresh water after each cleaning solution was used. Capping the bench-side (lower) liquid port and pouring acid or base solution into the upper port until overflow was ineffective as the solution did not fully drain through the membrane. In order for chemicals to flush through the Liqui-Cel, each solution was circulated with a peristaltic pump for 2 hrs in the opposite direction to the usual seawater flow. We recommend that the efficiency is assessed regularly and cleaned as appropriate (Sect 2.3.1).