

Supplementary Material for:

Insights from year-long measurements of air-water CH₄ and CO₂ exchange in a coastal environment

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Derivation of 10-m neutral wind speed

Previous studies on wind distortion over a large superstructure such as a ship (e.g. Moat et al. 2005) suggest that wind flow might be accelerated upon encountering the Penlee headland. To account for this flow distortion effect, we used the concurrent wind speed measurements from the (assumed to be undistorted) L4 buoy (a PML-UK Met Office collaboration) over the 7.6 months when the buoy wind data were available. The mean ratio of PPAO wind speed to L4 wind speed was first computed in 5-degree wind direction bins. This mean ratio (about 1.1 for both air-water exchange sectors) was then used to correct the year-long PPAO wind speed data for flow distortion as a function of wind direction. The 10-m neutral wind speed (U_{10n}) is derived from the distortion-corrected Penlee winds using the COARE model (version 3.5; Edson et al. 2013).



Figure S1. Map of study area. PPAO is indicated by the 4-point white star. L4 (yellow star) is 6 km south/southwest of PPAO. The approximate locations of the two eddy covariance air-water exchange footprints are shown: open water to the southwest, and Plymouth Sound to the northeast. Outflow from the river Tamar follows the western edge of the Plymouth Sound and wraps around the PPAO during ebbing tide.

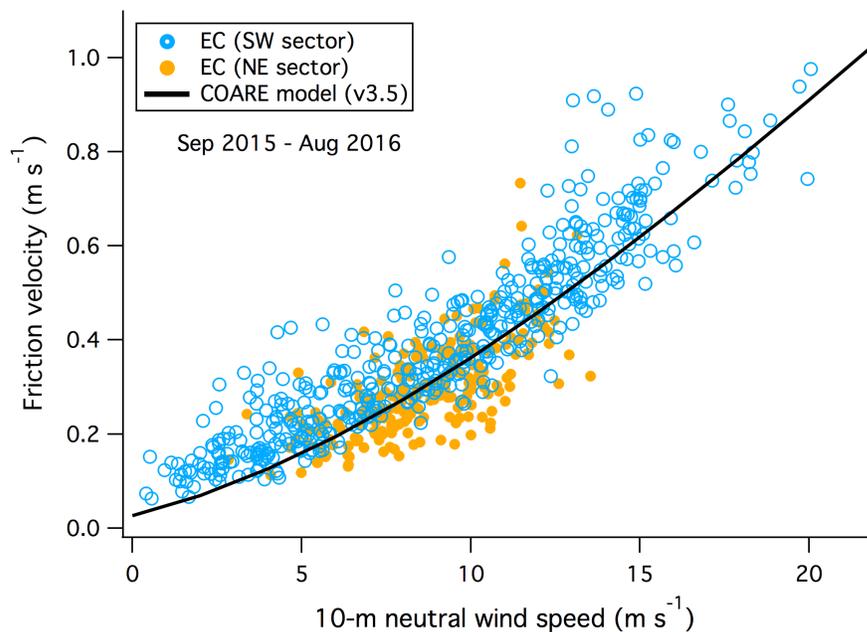


Figure S2. Friction velocity measured by eddy covariance vs. 10-m neutral wind speed (U_{10n}) for the open water (southwest) and Plymouth (northeast) wind sectors.

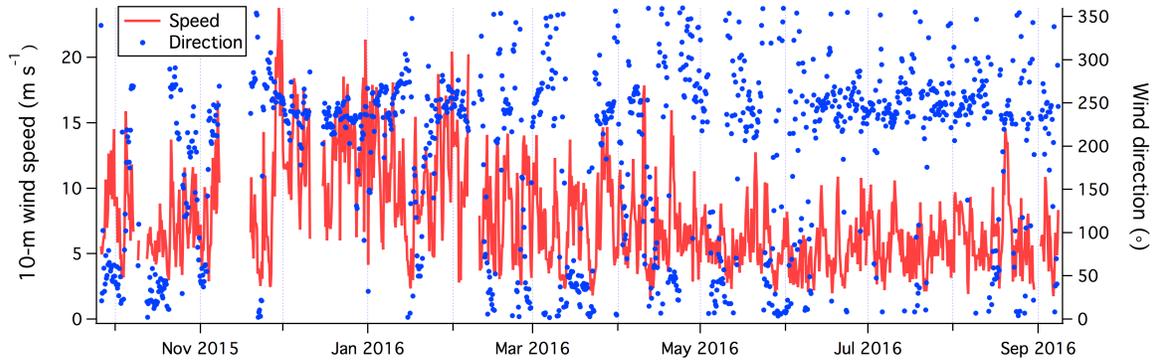


Figure S3. Time series of 10-m wind speed and wind direction at PPAO.

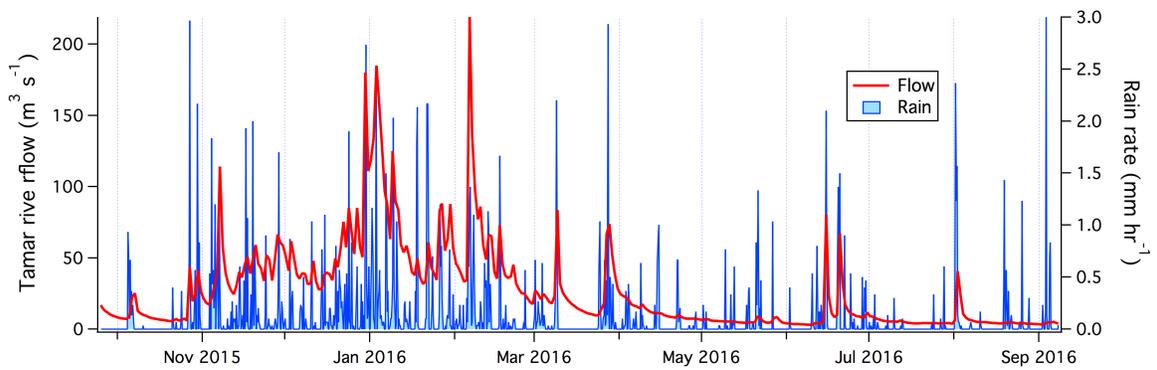


Figure S4. Time series of Tamar river flow (measured at Gunnislake) and rain rate.

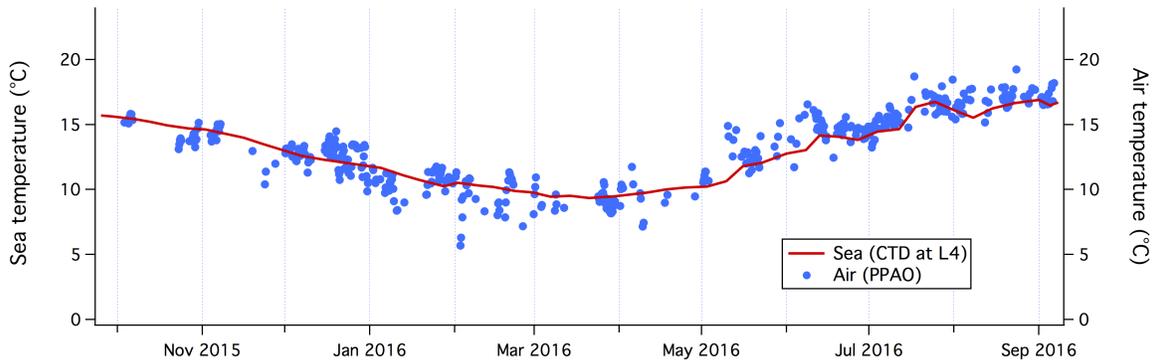


Figure S5. Time series of sea temperature at the L4 station (from CTD at 2 m depth) and air temperature at PPAO. Only air temperatures during southwesterly winds (open water sector) are shown.

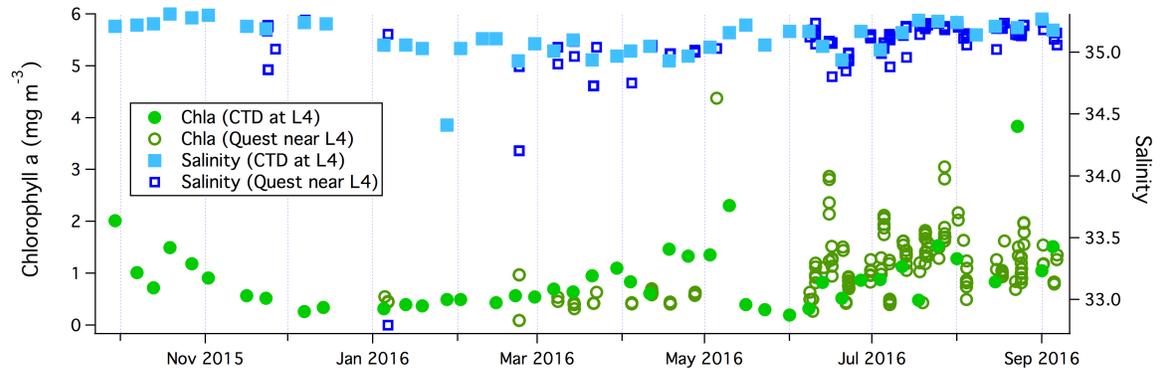


Figure S6. Time series of near surface chlorophyll a concentration and salinity, both from the CTD (2-m depth CTD cast) and from the RV Quest (underway fluorometer) at L4.

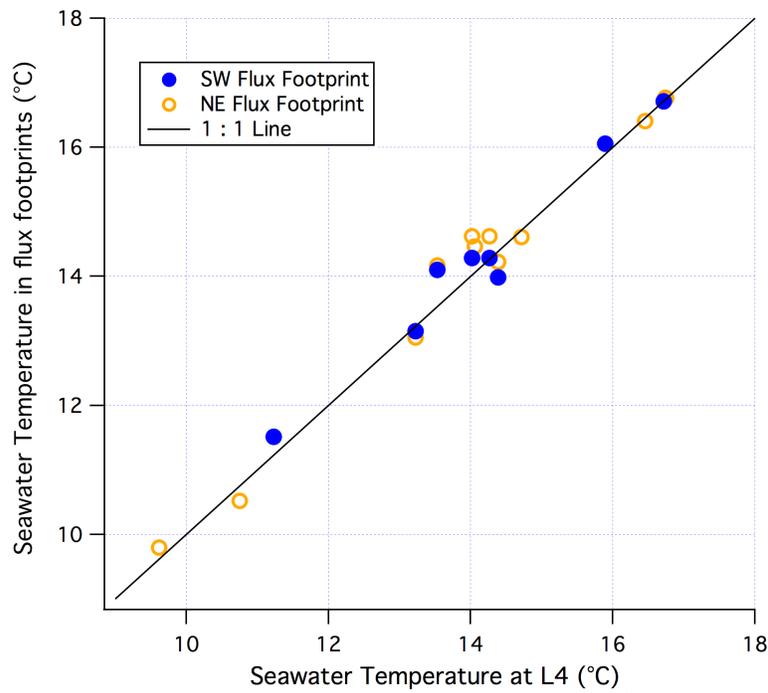


Figure S7. SST measured within the two PPAO air-water flux footprints vs. near-coincidental measurements from the *Quest* at the L4 station.

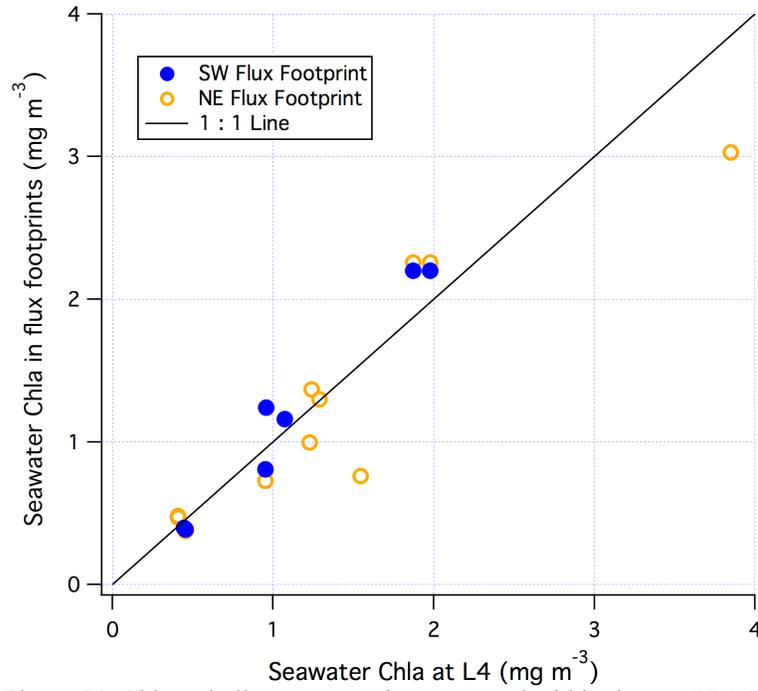


Figure S8. Chlorophyll a concentration measured within the two PPAO air-water flux footprints vs. near-coincident measurements from the *Quest* at the L4 station.

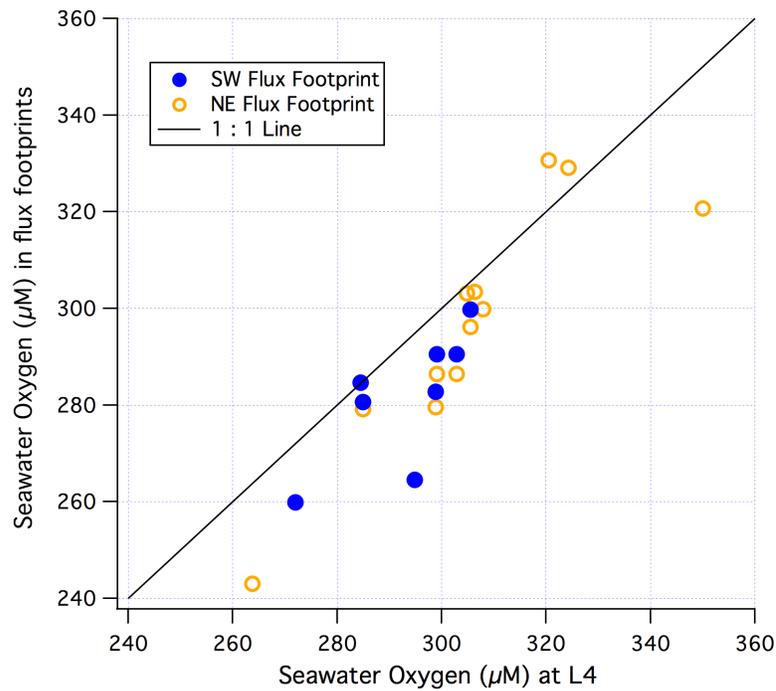


Figure S9. Dissolved oxygen measured within the two PPAO air-water flux footprints vs. near-coincident measurements from the *Quest* at the L4 station.

Edson, J. B., Jampana, V., Weller, R. A., Bigorre, S. P., Plueddemann, A. J., Fairall, C. W., Miller, S. D., Mahrt, L., Vickers, D., and Hersbach H.: On the exchange of momentum over the open ocean, *J. Phys. Oceanogr.*, 43, 1589–1610, doi:10.1175/JPO-D-12-0173.1, 2013.

Moat, B.J., Yelland, M. J., Pascal, R. W., and Molland, A. F.: An overview of the airflow distortion at anemometer sites on ships. *Int. J. Climatol.*, 25, 997–1006, 2005.