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Turbulent CO_2 Transport at an Unsheared Free Surface by Coupled Quantitative Imaging Techniques[1] EVAN A. VARIANO, EDWIN (TODD) COWEN, Cornell University — We present laboratory measurements of simultaneous velocity and concentration fields for the transfer of CO_2 across a free surface. The interface is subject to turbulence generated far beneath the surface by an array of randomly firing synthetic jets. This results in turbulence with a high Reynolds number, low mean flow and extensive horizontal homogeneity. Particle image velocimetry and a pH-sensitive laser induced fluorescence allow the measurement of both velocity and scalar fields at a resolution of ~ 10 times the Kolmogorov and Batchelor microscales, respectively. From these data, we calculate the spatiotemporal scalar flux in a plane tangent to and intersecting the free surface. We discuss these measurements, from both a coherent structure and statistical viewpoint, to elucidate the fundamental physics of turbulent scalar transport at a free surface in the absence of mean shear. Quadrant analysis shows a large asymmetry in the transport process, and mass flux spectra show the relative importance of a wide range of lengthscales.

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