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High Resolution Measurements of Methane and Carbon Dioxide in Surface Waters over a Natural Seep Reveal Dynamics of Dissolved Phase Air−Sea Flux

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Marine hydrocarbon seeps are sources of methane and carbon dioxide to the ocean, and potentially to the atmosphere, though the magnitude of the fluxes and dynamics of these systems are poorly defined. To better constrain these variables in natural environments, we conducted the first high-resolution measurements of sea surface methane and carbon dioxide concentrations in the massive natural seep field near Coal Oil Point (COP), California. The corresponding high resolution fluxes were calculated, and the total dissolved phase air−sea fluxes over the surveyed plume area ($\sim$363 km2) were 6.66 $\times$ 104 to 6.71 $\times$ 104 mol day^{-1} with respect to CH4 and $-$6.01 $\times$ 105 to $-$5.99 $\times$ 105 mol day^{-1} with respect to CO_2. The mean and standard deviation of the dissolved phase air−sea fluxes of methane

and carbon dioxide from the contour gridding analysis were estimated to be 0.18 $\pm$ 0.19 and $^{-1}$.65 $\pm$ 1.23 mmol m−2 day^{-1}, respectively. This methane flux is consistent with previous, lower-resolution estimates and was used, in part, to conservatively estimate the total area of the dissolved methane plume at 8400 km2. The influx of carbon dioxide to the surface water refutes the hypothesis that COP seep methane appreciably influences carbon dioxide dynamics. Seeing that the COP seep field is one of the biggest natural seeps, a logical conclusion could be drawn that microbial oxidation of methane from natural seeps is of insufficient magnitude to change the resulting plume area from a sink of atmospheric carbon dioxide to a source.