From the Seabed to the Sea Surface:
Measurements and Implications of Hydrocarbon Seepage in the Santa Barbara Channel

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Marine hydrocarbon seeps are a potential source of atmospheric methane, and hydrocarbon pollution and energy input to the marine ecosystem. In addition, they are ideal for studying the oil-gas pathway from the ocean bed to the surface. This is applicable to predicting seabed location from surface oil slicks and predicting the fate of an underwater oil spill. Bubbles released by the surface rise to the surface, exchanging gas with the ocean and releasing their contents to the atmosphere. Furthermore, dissolved seep gas may transfer into the atmosphere, while some enters is reduced by microbial action. The fates of hydrocarbon seep gas depends upon several parameters. Sensitivity studies show important sensitivities to seep depth, bubble size-flux distribution, dissolved gas concentration, and upwelling flows from the rising bubbles. Given a complete data set, numerical model validation is possible, and such a model can predict the seep gas fate for seeps spanning a wide range of conditions. Unfortunately, most of the important parameters and ambient conditions are currently unavailable in the literature.

Our group has been working to acquire a complete data set for a single seep area, Shane Seep located in the Santa Barbara Channel Coal Oil Point seepage field, a few kilometers from UCSB. A bubble measurement system was designed, tested, and deployed to measure bubble size flux distributions at the seabed and sea surface. Seepage at the site spans a wide range from extremely active mud volcanoes to single bubble trains. Thus video surveys were conducted at the site to understand spatial seepage variations. Aqueous alkane concentrations in the seep flow at the sea bed and surface and in the bubble gas were measured as was the upwelling fluid velocities. These measurements were compared with numerical model calculations.