Quantifying nutrient fluxes through kelp, coral, and aquatic vegetation

By

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Abstract

Collections of aquatic organisms with complex morphologies pose unique challenges because of the complicated and difficult to measure current patterns in these collections. Through a combination of tracer and direct velocity measurements, transport was quantified across three of these collections: a kelp forest, a coral reef, and a bed of floating vegetation. Using these results with water chemistry measurements, ecologically important fluxes such as nitrogen uptake and oxygen consumption and production were modeled. These three case studies illustrate an approach for an environmental fluid mechanician to collaborate with aquatic ecologists on long-term ecological research.

In the first case study, we delineate how nitrogen gets to a giant kelp forest (e.g. upwelling, internal waves, or local streams) and how supplies vary spatially across a forest. For example, the large surface areas of giant kelp blades facilitate uptake by individuals, yet these blades also damp currents and take nitrate from the water column reducing supplies to neighbors within a forest. Moving to the tropics, we investigate patterns of benthic metabolism across a coral reef as a function of season, waves, and light. Finally, we model dissolved oxygen level reductions caused by an invasive plant along the 150 km freshwater tidal portion of the Hudson River. Locally, the plant creates anoxic shoals and regions that tidally oscillate between anoxic and nearly saturated.