

Weekly CEA FM Seminar: Fall 2014



JOHNS HOPKINS

Center for Environmental
& Applied Fluid Mechanics

Date: **Friday, September 12, 2014**

Time: 11:00 AM

Location: Gilman Hall # 132

Speaker: **Prof. Tobias Kukulka** (University of Delaware)

Title: ***“Rapid Mixed Layer Deepening by the Combination of Langmuir and Shear Instabilities: A Case Study”***

Abstract

Langmuir circulation (LC) is a turbulent upper-ocean process driven by wind and surface waves that contributes significantly to the transport of momentum, heat, and mass in the oceanic surface layer. We perform a direct comparison of large-eddy simulations and observations of the upper-ocean response to a wind event with rapid mixed layer deepening. The evolution of simulated crosswind velocity variance and spatial scales, as well as mixed layer deepening, is only consistent with observations if LC effects are included in the model. Based on an analysis of these validated simulations, the differences in mixing between purely shear-driven turbulence and turbulence with LC are identified. LC transports horizontal momentum efficiently downward leading to an along-wind velocity jet below LC downwelling regions at the base of the mixed layer. Locally enhanced shear instabilities as a result of this jet efficiently erode the thermocline. In turn, enhanced breaking internal waves inject cold deep water into the mixed layer, where LC currents transport temperature perturbation advectively. Thus, LC and locally generated shear instabilities work intimately together to facilitate strongly the mixed layer deepening process.