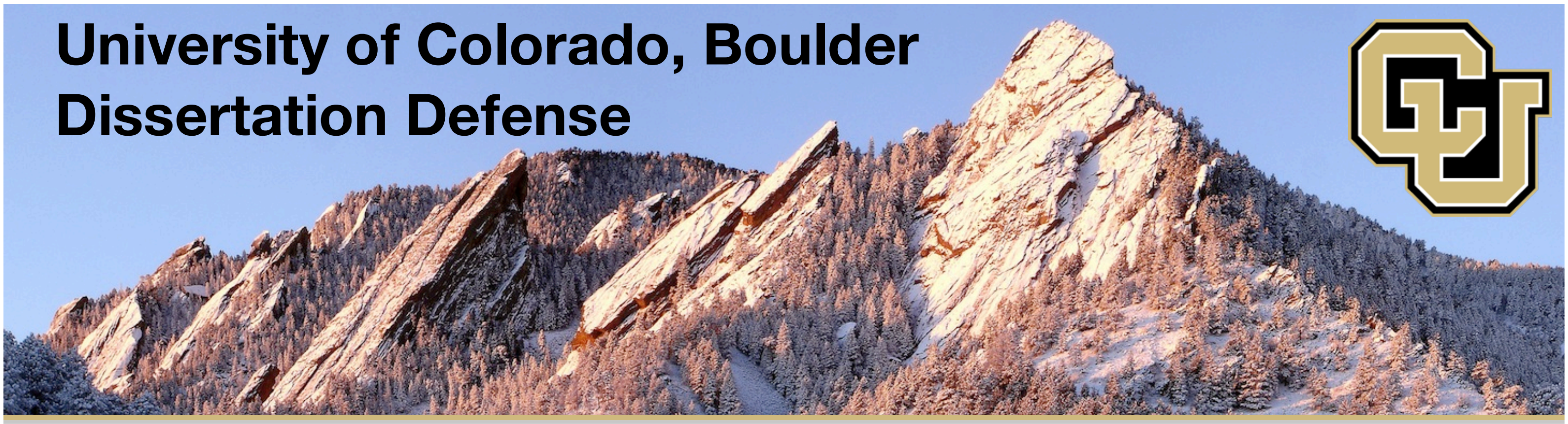
University of Colorado, Boulder
Dissertation Defense



Thursday, August 17, 2017
2:00pm-3:00pm (refreshments at 1:45pm)
Clark Conference Room (ECAD 150)
Engineering Center Administration Wing
University of Colorado, Boulder

Effects of Submesoscale Turbulence on Reactive Tracers in the Upper Ocean

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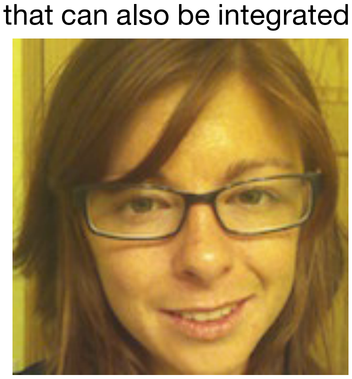
Large Eddy Simulations (LES) are used to model the coupled turbulence-reactive tracer dynamics within the upper mixed layer of the ocean. Prior work has shown that LES works well over the spatial and time scales relevant to both turbulence and reactive biogeochemistry. Additionally, the code intended for use is able to carry an arbitrary number of tracer equations, allowing for easy expansion of the species reactions. Research in this dissertation includes a study of 15 idealized non-reactive tracers within an evolving large-scale temperature front in order determine and understand the fundamental dynamics underlying turbulence-tracer interaction in the absence of reactions. The focus of this study, in particular, was on understanding the evolution of biogeochemically-relevant, non-reactive tracers in the presence of both large (5 km) submesoscale eddies and small- scale (100 m) wave-driven Langmuir turbulence. The 15 tracers studied have different initial, boundary, and source conditions and significant differences are seen in their distri- butions depending on these conditions. Differences are also seen between regions where submesoscale eddies and small-scale Langmuir turbulence are both present, and in regions with only Langmuir turbulence. A second study focuses on the examination of Langmuir turbulence effects on upper ocean carbonate chemistry. Langmuir mixing time scales are similar to those of chemical reactions, resulting in potentially strong tracer-flow coupling effects. The strength of the Langmuir turbulence is varied, from no wave-driven turbulence (i.e., only shear-driven turbulence), to Langmuir turbulence that is much stronger than that found in typical upper ocean conditions. Three different carbonate chemistry models are also used in this study: time-dependent chemistry, equilibrium chemistry, and no-chemistry (i.e., non-reactive tracers). The third and final study described in this disseratation details the development of a reduced-order biogeochemical model with 17 state equations that can accurately reproduce the Bermuda Atlantic Time-series Study (BATS) ecosystem behavior, but that can also be integrated within high-resolution LES.



Biography: Kat joined the Turbulence and Energy Systems Laboratory and CU in the fall of 2013 to pursue a PhD in Mechanical Engineering. After graduating from SFSU with a BS in Mechanical Engineering, she worked as an R&D Scientist for the DOE Idaho National Lab. In this position, she discovered an interest in complex environmental fluid flows and after obtaining her PhD, Kat plans to pursue a career in academia where she hopes to inspire the next generation of engineers and scientists through fluids research and education.