# Center for Environmental & Applied Fluid Mechanics

## “Mixing Hot and Cold with Sound”


**Gregory Chini**

University of New Hampshire


The study of acoustic streaming, in which the nonlinear interaction of time-periodic sound waves drives time-mean flows, dates back to the work of Lord Rayleigh. Surprisingly, when an acoustic wave interacts with a thermally stratified fluid, a distinct and much stronger type of streaming can occur. We uncover the physical origin of this strong streaming by analyzing a system comprising an ideal gas undergoing standing acoustic wave oscillations in a channel with walls maintained at differing temperatures. In contrast with Rayleigh streaming, the emergent mean flow is shown to have an amplitude comparable to that of the acoustic wave, leading to two-way coupling between the wave and streaming. We derive a new wave/mean-flow interaction system that accurately describes this coupling while also enabling numerical simulations to be performed strictly on the slow time scale of the streaming flow. The streaming temperature field resembles that arising in buoyancy-driven convection, but the velocity field differs, being strongly confined to the periphery of the convection cells. We elucidate the physics responsible for this distinctive flow pattern and quantify the forced convective heat transport that is achieved as a function of the cell aspect ratio. Our simulations shed light on the potential for this non-classical form of acoustic streaming to be used as an effective means for thermal management in a range of Earth- and space-based applications.

## Spring 2023 CEAFM Seminar Series

**March 17, 2023 ⌘ 3:00 PM ⌘ Gilman Hall 50**