Boulder Fluid and Thermal Sciences Seminar Series

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https://cuboulder.zoom.us/j/95975405187 (Passcode: stokes)

The turbulent bubble breakup cascade in breaking surface waves.

RONALD CHAN
Nonequilibrium Gas and Plasma Dynamics Laboratory
University of Colorado Boulder, Department of Aerospace Engineering

Breaking waves entrain air beneath the ocean surface and produce bubbles of a broad range of sizes. These waves are generated naturally and by seafaring vessels. Air entrainment and bubble generation have significant impact on the transfer of air and moisture between the atmosphere and ocean, and thus the weather and climate. A primary mechanism for the generation of bubbles is the turbulent breakup cascade. A necessary condition for the presence of a cascade is locality in the transfer of air from large to small bubble sizes. In other words, the statistics of bubble breakup at intermediate sizes should be largely independent of very large and very small bubbles. In this talk, I discuss the parallels we identified between the turbulent energy and bubble breakup cascades, as well as our technical definition of locality. In addition, I describe how we used numerical simulations along with novel algorithms to establish the presence of locality in turbulent bubble breakup in breaking waves. The proposed theoretical framework and numerical algorithms form a toolbox for detailed analysis of two-phase simulations. In addition, locality in the mass transfer dynamics simplifies the development of subgrid-scale models for large eddy simulation of turbulent breakup in two-phase flows. I conclude the talk by discussing the possibilities created by such a statistical framework in general flow analysis and modeling.

Biography: Ronald received his B.S. in Engineering with a minor in Energy Studies from the Massachusetts Institute of Technology in 2014, and his M.S. and Ph.D. in Mechanical Engineering from Stanford University in 2017 and 2021, respectively, where he investigated the turbulent bubble breakup cascade in oceanic breaking waves. He is also affiliated with the Agency for Science, Technology and Research in Singapore. His research interests are in developing physics-based models to accelerate scientific computing of energetic flows with multiphysics. Now with the Nonequilibrium Gas and Plasma Dynamics Laboratory in the Ann and H.J. Smead Department of Aerospace Engineering, Ronald is working on simulations of electrosprays and pulsed plasmas for space propulsion and materials processing.