Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Subgrid-scale Modeling of Bubble Breakup in Large Eddy Simulations of Breaking Waves[1] WAI HONG RONALD CHAN, ADRIAN LOZANO-DURAN, PARVIZ MOIN, Center for Turbulence Research, Stanford University — Turbulent breaking waves entrain air cavities that break up and coalesce to form polydisperse clouds of bubbles. We have recently provided theoretical and numerical justification that the dominant mechanism for bubble generation is a fragmentation cascade from large to small sizes sustained by turbulent velocity fluctuations. This behavior should be universal across various turbulent bubbly flows because of the size locality inherent in a cascade. Universality simplifies the development of subgrid-scale (SGS) breakup models in two-phase large eddy simulations (LES). We formulate an SGS model based on a breakup cascade in accordance with the LES paradigm, where large bubbles are resolved through a two-phase Eulerian description, while small bubbles are separately modeled and tracked as Lagrangian point particles. This model requires the generation and breakup of Lagrangian particles from underresolved Eulerian bubbles with suitable distributions for breakup rates and child bubble sizes. Model distributions are inferred from earlier breaking-wave simulations. Candidate breakup models are tested using a Monte Carlo simulation that mimics the breakup of Lagrangian particles, and then implemented in a coarse breaking-wave LES with validation against previous finer simulations.

[1]Agency for Science, Technology and Research, Singapore

Wai Hong Ronald Chan
Center for Turbulence Research, Stanford University

Date submitted: 20 Jul 2020 Electronic form version 1.4