Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Bubble induced mixing in stratified fluids within a confined domain[1] MAATHANGI GANESH, SANG KYU KIM, SADEGH DABIRI, Purdue University — A numerical study of mixing in temperature stratified fluids induced by the motion of monodispersed swarm of bubbles in a thin gap is carried out. The confinement prevents turbulent production and mixing occurs primarily due to transport by the bubble wake. The confinement also causes the bubbles to be flattened between the solid walls, with a gap to diameter ratio of 0.31. Bubbles entrain liquid from the lower, high-density layers and release it in the low density regions, thus causing mixing between the different liquid layers. Simulations are run for void fractions between 3.35% and 13.4%. The strength of stratification is varied by changing the Froude number between 4.5 and 12.74. We observe a zigzag motion of the bubbles attributed to the periodic vortex shedding behind the bubbles, quantified by the bubble velocity autocorrelations. We report the formation of horizontal clusters, the sizes of which are quantified by the cluster size index, and establish a qualitative correlation between the size of the clusters and the rise velocity of the bubbles. The mixing is characterized by three parameters namely, the COX number, diapycnal eddy diffusivity and mixing efficiency. We report an increase in the buoyancy flux across the isopycnals as void fraction increases. The fraction of energy production due to the buoyancy flux increases with the strength of stratification, giving rise to a higher mixing efficiency.

[1]Acknowledgement: Supported by NSF Grant No. CBET-1705371

Maathangi Ganesh
Purdue University

Date submitted: 31 Jul 2019 Electronic form version 1.4