Abstract Submitted
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Large-eddy simulation of bubble-driven plume in stably stratified flow.[1] DI YANG, University of Houston, BICHENG CHEN, Penn State University, SCOTT SOCOLOFSKY, Texas A&M University, MARCELO CHAMECKI, Penn State University, CHARLES MENEVEAU, Johns Hopkins University — The interaction between a bubble-driven plume and stratified water column plays a vital role in many environmental and engineering applications. As the bubbles are released from a localized source, they induce a positive buoyancy flux that generates an upward plume. As the plume rises, it entrains ambient water, and when the plume rises to a higher elevation where the stratification-induced negative buoyancy is sufficient, a considerable fraction of the entrained fluid detrains, or peels, to form a downward outer plume and a lateral intrusion layer. In the case of multiphase plumes, the intrusion layer may also trap weakly buoyant particles (e.g., oil droplets in the case of a subsea accidental blowout). In this study, the complex plume dynamics is studied using large-eddy simulation (LES), with the flow field simulated by hybrid pseudospectral/finite-difference scheme, and the bubble and dye concentration fields simulated by finite-volume scheme. The spatial and temporal characteristics of the buoyant plume are studied, with a focus on the effects of different bubble buoyancy levels. The LES data provide useful mean plume statistics for evaluating the accuracy of 1-D engineering models for entrainment and peeling fluxes. Based on the insights learned from the LES, a new continuous peeling model is developed and tested.

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