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DNS of air entrainment at the air-water interface of a temporally developing turbulent boundary layer[1] FARSHAD NASIRI, ELIAS BALARAS, The George Washington University — The entrainment of air at the free-surface of a turbulent boundary layer remains a poorly understood problem. This flow, typically found at the side of surface vessels, is characterized by highly turbulent bubbly region close to the surface and two-phase mixing. In this study, we will consider a turbulent boundary layer developing over an infinitely long moving plate. Our primary objective is to test the hypothesis that there is a critical combination of Fr and We numbers -based on the local momentum thickness- that plays a critical role to the onset of entrainment. In particular, we will report two-phase, DNS of a temporally developing turbulent boundary layer with waterside Reynolds number ranging from $Re_\theta = 900$ to 1200. The computational domain is large enough to accommodate the range of eddies found in such flow. We utilize a conservative solver, where the air-water interface is sharply defined using a level-set formulation. Turbulent statistics away from the surface are presented. Rate of entrainment and the range of scales of entrained droplets are considered. Conditional averages of the flow field (i.e. vorticity, curvature, etc.) are reported to identify the mechanisms that trigger air-entrainment.

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Elias Balaras
The George Washington University

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