Abstract Submitted
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Reynolds Stress/Flux/Variance Modeling and DNS of Stratified Shear Layers NAMAN JAIN, XINYI HUANG, Penn State University, Mechanical Engineering, HIEU PHAM, University of California San Diego, Mechanical and Aerospace Engineering, XIANG YANG, Penn State University, Mechanical Engineering, SUTANU SARKAR, University of California San Diego, Mechanical and Aerospace Engineering, ROBERT KUNZ, Penn State University, Mechanical Engineering — Buoyant shear layers and wakes are often characterized by high Reynolds and Froude numbers, as well as very large computational space/time domain sizes, and these limit the applicability of DNS and LES modeling. On the other hand, many of the important physical mechanisms in these systems inherently render eddy viscosity-based RANS modeling inappropriate (e.g., stress/variance anisotropy/budgets, stabilization, regime transition), particularly at high Richardson numbers. Accordingly, we pursue Full Reynolds Stress/Flux/Variance modelling in this context. Here, we have applied such modeling to several lower Reynolds number non-stratified and stratified shear layers for which DNS data is available. 7-equation and 11-equation modeling is used, respectively. A range of sub-model complexity is applied for diffusion of stresses, density fluxes/variance, pressure strain/scrambling, and dissipation. We take the approach of evaluating these sub-models: 1) in terms of how the model itself it represented by DNS in comparison to the exact Reynolds averaged terms, and 2) in terms of how RANS carries over the predictive performance of the sub-models to the full model. It is found that there are numerous striking shortcomings with well established sub-models. Approaches to improve these are proposed and tested.

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