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High Resolution Simulations of the Kelvin-Helmholtz Instability and Stratified Shear Turbulence: The Impact of Stratification on Shear-Layer Morphology, Transition to Turbulence, and the Restratified End State. JOSEPH WERNE, NorthWest Research Associates, BJORN ANDERS PETTERSSON-REIF, Forsvarets forskningsinstitutt — Results are reported for high-resolution direct numerical simulations of the Kelvin-Helmholtz instability and ensuing turbulence for three different values of the Richardson number: Ri=0.05, 0.15, and 0.20. Flow morphology and evolution are found to depend strongly on Ri. Whereas the lowest Ri (i.e., the least stable) case exhibits coherent KH "billows," whose round cross-section and rapid solid-body rotation stabilizes them and delays the onset of turbulence in the billow cores, perhaps ironically the highest Ri (or most stable) case displays flatter billows which transition to turbulence immediately upon billow formation. In marked contrast, the lowest Ri, least stable case exhibits a much more complex transition to horizontally homogeneous turbulence, characterized by a sequence of distinct steps which include 1) layered billow formation, 2) secondary instability of billow edges, 3) vigorous turbulence in the braid region between billow cores, and 4) development of turbulence in the cores. Nevertheless, despite the dramatic differences in the flow evolution and dynamics, the final states exhibit nearly identical mid-layer stability profiles and shear/buoyancy timescale ratios.

Joseph Werne
werne@cora.nwra.com
NorthWest Research Associates

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