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Mechanisms of drag enhancement on bodies settling in a linearly stratified fluid JACQUES MAGNAUDET, Institut de Mecanique des Fluides de Toulouse, CNRS and Universite de Toulouse, France, JIE ZHANG, State Key Laboratory for Strength and Vibration of Mechanical Structures, School of Aerospace, Xian Jiaotong University, China, MATTHIEU MERCIER, Institut de Mecanique des Fluides de Toulouse, CNRS and Universite de Toulouse, France — Using DNS, we compute the flow past a sphere settling with constant speed in a linearly stratified fluid over a wide range of Reynolds, Prandtl and Froude numbers. Thanks to a rigorous mathematical decomposition procedure, we identify the various contributions to the stratification-induced drag, especially that due to the dragging of light fluid around the body and within its wake, and that induced by the distortion of the vortex lines. Combining DNS results and scaling laws provided by the dominant balances in the density and momentum equations, we show how these two contributions vary with the control parameters. It turns out that for large Prandtl numbers and Reynolds numbers up to $\mathcal{O}(10^3)$, the drag enhancement is essentially due to the specific structure of the vorticity field set in by buoyancy effects, while effect of the dragging of light fluid near the body surface takes over for larger Reynolds numbers.

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