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Hybrid RANS/LES of non-equilibrium boundary layer flows ANTHONY KEATING, GIUSEPPE DE PRISCO, UGO PIOMELLI, University of Maryland — At high Reynolds numbers, large-eddy simulations (LES) of turbulent flows are presently infeasible due to their high cost. As an alternative, hybrid simulations can be performed in which different regions of the flow are modeled using different turbulence modeling methodologies. For instance, the Reynolds-averaged Navier-Stokes (RANS) equations can be used in equilibrium boundary layers, in which they give reasonably accurate results, whereas in highly non-equilibrium regions (where RANS models fail) LES can be used. We have performed hybrid RANS/LES simulations of boundary layers in favorable and adverse pressure gradients, where RANS is used near equilibrium and LES is performed in the highly non-equilibrium regions. When synthetic turbulence by itself is used to couple the RANS and LES regions, the flow laminarizes in the LES region, and the results show poor agreement with a full LES. To improve results, an overlap region is used, where forcing is applied to the LES in order to match the RANS shear stress. When this is done, the hybrid simulations show excellent agreement with the full LES. This research was supported by the AFOSR.

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