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Examination of wall-model fidelity with spatially diffuse non-equilibrium forcing MICHAEL ADLER, Stanford University, DAVID GONZALEZ, Naval Surface Warfare Center, IHEODTD, LOGAN RILEY, Air Force Research Laboratory, WPAFB, DATTA GAITONDE, The Ohio State University —
Wall-flux modelling is necessary to facilitate large-eddy simulation of high Reynolds number, wall-bounded turbulence. We examine the effect of wall-model fidelity and complexity on the accuracy of wall-modeled simulations of non-equilibrium turbulent boundary layers. A database of moderate Reynolds number wall-resolved simulations of non-equilibrium turbulent boundary layers is constructed, including scenarios of adverse/favorable pressure gradient and heated/cooled walls. The non-equilibrium forcing is spatially diffuse, providing significantly large regions where equilibrium scaling laws cannot be reasonably assumed in the inner layer, and necessitating non-equilibrium models for inner-layer accuracy. A database of wall-modeled simulations is then constructed to assess the model ability to reproduce non-equilibrium effects in both the inner and outer flow. Several model classes are employed including ODE, algebraic, and dynamic slip variants. The favorable performance of several new non-equilibrium models of algebraic complexity (efficient and easy to implement) is assessed relative to the equilibrium models and benchmark wall-resolved simulations.

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