Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Wall-modeled LES of a turbulent thermal boundary layer with a non-equilibrium behavior MATTEO GELAIN, EM2C, CNRS, CentraleSuplec, Universit Paris-Saclay, SAFRAN, OLIVIER GICQUEL, EM2C, CNRS, CentraleSuplec, Universit Paris-Saclay, ALEXANDRE COUILLEAUX, SAFRAN, RONAN VICQUELIN, EM2C, CNRS, CentraleSuplec, Universit Paris-Saclay — The studied configuration features a turbulent channel flow ($Re_{\tau} = 395$) that is fully established and adiabatic in the first part of the domain and then encounters an isothermal wall. The evolution of the thermal boundary layer has previously been studied with DNS: initially at equilibrium, it is perturbed by the abrupt change of boundary conditions, and a non-equilibrium transient phase is observed downstream. The present study aims at characterizing the ability of wall-modeled large-eddy simulations to predict the boundary layer spatial evolution and the associated wall heat flux. The modeling strategy first relies on describing the unresolved inner layer by 1D equilibrium equations that are solved numerically at each wall face. The method is first validated in equilibrium channel flows before being applied to the target configuration. Results are analyzed and compared to the DNS reference results. Finally, the wall model is extended by taking into account non-equilibrium terms identified by the DNS analysis to improve the predictions.

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Date submitted: 31 Jul 2020 Electronic form version 1.4