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Equilibrium Boundary Layer Analysis of Filtered Turbulent Flow Fields PEDRAM TAZRAEI, SHARATH GIRIMAJI, Texas AM University — Analysis of equilibrium turbulent boundary layer is of fundamental value as well of practical importance in developing closure models. To date, the analysis has been performed only in the context of mean and fluctuating flow field variables, leading to important implications for Reynolds Averaged Navier-Stokes (RANS) closure models. In this work, we extend the analysis to filtered flow fields. The degree of filtering is characterized in terms of the ratio of resolved-to-total kinetic energy (k) and dissipation (). Scaling relationships between different statistics of the filtered flow-field are developed as a function of the degree of filtering. Closure-modeling analysis is performed in the context of a generic scale-resolving simulation (SRS) method. In many SRS approaches, such as the Partially-averaged Navier-Stokes (PANS) approach, the filtered flow equations are supplemented with model equations for unresolved kinetic energy and dissipation. The filtered kinetic energy and dissipation equations are subject to equilibrium boundary layer scaling, leading to closure expressions for SRS turbulent transport models. PANS simulations are performed at various Reynolds numbers and degrees of resolutions to confirm the scaling relationships and validate the transport closure models.

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