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Explanation for the Incorrect Prediction of Mean Velocity Gradient Near Surfaces in LES of Shear-dominated Boundary layers J. BRASSEUR, T. WEI, Penn State University — In 1992 Mason & Thomson pointed out that LES of high Reynolds number wall bounded shear flows with eddy viscosity SFS closures produces an overshoot in mean shear near surfaces. In the 15 intervening years several studies have attempted to adjust the SFS model to eliminate the overshoot, but none have been entirely successful, primarily because the reason for the overshoot is largely not understood. We believe we have successfully explained the overshoot and the basic issues that must be addressed to eliminate it. Using basic near-surface scaling arguments for DNS vs. LES of turbulent channel flow, we show that, like the inertial vs. viscous stress near a smooth wall, the SFS stress generally dominates resolved stress at the first few grid levels for multiple reasons, including inherent under-resolution of the integral scales by the grid. A numerical "viscous layer" is established with eddy viscosity closures that introduces a noninertial scaling and leads to the overshoot. We introduce a "LES Reynolds number" (Re^{LES}) and show that Re^{LES} includes grid resolution, grid aspect ratio, and model constant. Three criteria must be met: (1) a minimum Re^{LES} to maintain turbulence, (2) a larger Re^{LES} to properly resolve the inertial layer and, finally, (3) a yet larger Re^{LES} to eliminate the overshoot. We show that the final criterion can only be met by adjusting grid aspect ratio together with model constant.

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