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Extension of Boussinesq turbulence constitutive relation for partially-averaged velocity fields SUNIL LAKSHMIPATHY, SHARATH GIRIMAJI, Texas A&M University — Boussinesq hypothesis is still widely used to model Reynolds stresses in turbulent flows. Recently, there have been many attempts to extend the Boussinesq constitutive relation for modeling the sub-grid scale stresses (SGS) for filtered or partially-averaged velocity fields, for example, limited numerical scales method (LNS), flow simulation methodology (FSM), unsteady Reynolds averaged Navier-Stokes (URANS), very large eddy simulation (VLES) and partially-averaged Navier-Stokes (PANS). The major proposals can be classified into two categories. In VLES, FSM, and LNS the effective SGS viscosity is given by: $\nu_T = f C_\mu \frac{k^2}{\varepsilon}$ where f is determined by the filter size. In PANS, the SGS viscosity is given by $\nu_{Tu} = C_\mu \frac{k_u^2}{\varepsilon_u}$ where k_u and ε_u are the unresolved turbulent kinetic energy and dissipation rate respectively. The validity of these two proposals is investigated in two turbulent flow fields: (i) flow past a circular cylinder; (ii) flow past a backward facing step. We investigate the degree of eddy viscosity reduction obtained *a posteriori* in the computations and compare them to the prescribed value. The effect of the two viscosity reduction proposals on the unsteadiness of the computed velocity fields is also examined.

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