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Length-Scale Dependence of Dynamics of Homogeneous Variable Density Turbulence[1] JUAN SAENZ, DENIS ASLANGIL, DANIEL LIVESCU, Los Alamos National Laboratory — We investigate the length-scale dependence of filtered dynamical quantities that are important for modeling variable density turbulence, namely the Reynolds stress $\mathcal{T}_{\rangle|}$, mass-flux velocity a_i and density-specific volume covariance b, using theory and diagnostics from DNS of homogeneous variable density turbulence. From the perspective of length-scales resolved by filter-width w, $\mathcal{T}_{\rangle|}, \dashv_{\rangle}, \lfloor$, and terms in their transport equations vary smoothly between DNS and their classical RANS definitions at the small and large filter width limits, respectively. Further, the generalized central moments in the filtering approach (Germano '92) are expressed as inner products of generalized fluctuating quantities, $q'(\xi, x) = q(\xi) - \overline{q}(x)$, which represent fluctuations of a field variable q at points ξ with respect to its filtered value at a point x. At large w values, the generalized fluctuations become the RANS fluctuations, and realizability conditions for $\mathcal{T}_{\rangle|}, \dashv_{\rangle}, \lfloor$ become the realizability conditions for their RANS counterparts. This work supports the notion of a generalized, length-scale adaptive model that converges to DNS at high resolutions, and to classical RANS statistics at coarse resolutions.

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