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Investigation of conditional subgrid-scale scalar flux and its production rate QINGLIN CHEN, DANHONG WANG, HENGBIN ZHANG, CHENNING TONG, Clemson Univerisity — The effects of the subgrid-scale (SGS) velocity and scalar and SGS models on the resolvable-scale joint probability density function (JPDF) are studied. It is shown that the SGS turbulence evolve the JPDF though the conditional mean SGS stress and flux, their production rates, and the SGS scalar variance production rate. The mean SGS stress and scalar flux production rate are predicted using Lumley's assumption. Analyses using data obtained in a slightly heated turbulent jet show that the mean SGS stress, scalar flux, and their production rates have filter-scale dependences consistent with predictions, suggesting that the SGS turbulence has diminishing influence on the lower-order resolvable-scale statistics for inertial-range filter scales. The Smagorinsky model predictions also have similar filter-scale dependences, suggesting that the models have diminishing effects on lower-order LES statistics. The measured conditional SGS stress and SGS flux as well as the conditional production rates decrease much slower than the predicted filter dependences, indicating that the SGS turbulence has non-trivial effects on the high-order resolvable-scale statistics even for inertial-range filter scales. The Smagorinsky models predictions of these conditional statistics decrease slower with the filter scale than predictions but do not agree with measurements; therefore the models are likely to influence the high-order LES statistics but in ways different from that of the SGS turbulence.

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