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Quantifying the uncertainties of density self-correlation in RANS simulations for variable density flows JAN FELIX HEYSE, ZHU HUANG, AASHWIN MISHRA, GIANLUCA IACCARINO, Center for Turbulence Research, Stanford University, TIMOTHY CLARKE WALLSTROM, DAVID SHARP, Los Alamos National Laboratory — Variable density turbulent flows play important roles, both in natural phenomena such as supernova explosions and in industrial applications such as Inertial Confinement Fusion. Turbulence models for less expensive numerical simulation of variable density flows are therefore desirable. In second-moment turbulence closure models, e.g. those from the BHR model family, the density self-correlation, b, is very important for the production in the mass flux equation in variable density flows. From the conclusions of direct numerical simulations [Livescu et al. 2009,JoT] and experimental investigation [Tomkins et al. 2013,JFM], the production in the b evolution equation has significant value to drive the mixing initially, before it is balanced by the dissipation term when the flow is well mixed. These physics lead to significant errors and uncertainties in turbulence model predictions for such flows. In this study, we outline the framework to quantify the uncertainties from b in the BHR model. Several flows, including Rayleigh-Taylor mixing in a tilted rocket rig and variable density turbulent jets, are employed as test cases. These cases show that perturbations of b can be used to estimate the uncertainty for predictions of turbulent variable density flows.

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