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Variational Multiscale Large Eddy Simulations of Rayleigh-Bénard Convection at High *Ra* DAVID SONDAK, Harvard University, Institute for Applied Computational Science, THOMAS SMITH, ROGER PAWLOWSKI, Sandia National Laboratories, Computational Science Department, SIDAFA CONDE, Sandia National Laboratories, Computational Mathematics Department, JOHN SHADID, Sandia National Laboratories, Computational Mathematics Department, Department of Mathematics and Statistics, University of New Mexico — Large eddy simulations (LES) of two- and three-dimensional Rayleigh-Bénard convection are performed up to $Ra = 10^{14}$ for $Pr = 1$ and $Pr = 7$. These simulations are performed using novel LES models based on the variational multiscale (VMS) formulation. The new model is presented as a mixed model which combines the VMS formulation for Rayleigh-Bénard convection with an eddy viscosity model (EVM) to capture the effects of the Reynolds stresses in high Ra convection. In the present work, the Wall-Adapting Local Eddy-viscosity (WALE) model is used as the EVM. The new models were implemented in the finite element code Drekar and simulations were performed using continuous, piecewise linear finite elements. The two dimensional simulations were performed in a domain with aspect ratio 2 while the three-dimensional simulations were performed in a cylinder of aspect ratio 1/4. Least squares fits to the Nu-Ra data show $Nu_{2D} = 0.127Ra^{0.284}$ and $Nu_{3D} = 0.104Ra^{0.310}$.

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