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Variational multiscale large eddy simulation with diffusive flux reconstruction for Rayleigh-Bénard convection DAVID SONDAK, Institute for Applied Computational Science, Harvard University, JOHN SHADID, Department of Computational Mathematics, Sandia National Laboratories, TOM SMITH, Department of Computational Science, Sandia National Laboratories, SIDAFA CONDE, Department of Computational Mathematics, Sandia National Laboratories, ROGER PAWLOWSKI, Department of Computational Science, Sandia National Laboratories — Large eddy simulation (LES) models for Rayleigh-Bénard convection are developed using the variational multiscale formulation (VMS). In the VMS formulation, a sum decomposition is used to split the fields into resolved and unresolved components. The unresolved components are modeled to be proportional to the residual of the governing equations. In this way, if the numerical solution exactly captures all scales of motion, the residual will be zero and the unresolved portion of the field vanishes. The result is a consistent numerical method and a dynamic LES model. When discretizing the resolved scales with linear finite elements, the diffusive terms in the residuals are zero and the true residual is not satisfied. In Rayleigh-Bénard convection, this unbalanced residual may negatively impact results due to the importance of boundary layer effects. In the current work, the diffusive terms are reconstructed and included in the stabilized residual. This reconstruction is shown to provide better numerical convergence to the correct solution. Moreover, coarse near-wall resolution can be partially offset by correctly reconstructing the residual. All of these effects have a bearing on the scaling of the heat transport with Rayleigh number.

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