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Quantitative assessment of low-dimensional POD-ODE models of wall-bounded flows. JOHN GIBSON, Georgia Institute of Technology, DIETMAR REMPFER, Illinois Institute of Technology, JOHN LUMLEY, Cornell University — We examine low-dimensional ODE models of coherent structures in wall-bounded flows derived from proper orthogonal decomposition and Galerkin projection. We show that POD-ODE models of periodized boundary-layer flow are linearly stable about the mean flow for some parameter values, despite the lack of upper-surface velocity boundary conditions. However, such models are predictively and statistically inaccurate. We compare POD-ODE models of plane Couette flow to direct numerical simulations and find that the convergence rate of the modeled dynamics is very slow –much slower than the convergence of POD expansions to instantaneous velocity fields. Eddy viscosity models do not improve the convergence of POD-ODE dynamics. However, numerical results suggest that Galerkin projection is sub-optimal, and that more accurate models of the low-dimensional dynamics can be derived through empirical modeling.

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