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Analysis of 3-D "poor man's Navier–Stokes equation" for application to LES SGS models J.M. MCDONOUGH, C.B. VELKUR, University of Kentucky, J. ENDEAN, Trinity Christian Academy, Lexington, KY — We briefly outline derivation of a discrete dynamical system (DDS) that we demonstrate is capable of producing temporal behaviors associated with incompressible Navier-Stokes (N.–S.) equation flows. We compare results from the 3-D system with those of an analogous 2-D DDS previously studied by McDonough and Huang (Int. J. Numer. Meth. Fluids 45, 545, 2004) and show that the same wide range of states is achieved in 3D, and that there are no further ones. But we show that details of results from the 2-D and 3-D equations differ, as occurs for the N.–S. equations, themselves. In particular, the 3-D results appear to be generically more anisotropic, as might be intuitively expected. We present some selected comparisons between this 3-D poor man's Navier–Stokes (PMNS) equation and experimental data and then provide a brief mathematical analysis suggesting its relationship to a symbol and pseudodifferential operator of the N.–S. equation. We argue that this relationship serves to explain the ability of the PMNS equation to faithfully reproduce physical turbulence over a wide range of conditions, thus justifying its use as part of a subgrid-scale model for LES.

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