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Three regularization models as large-eddy simulations JONATHAN GRAHAM, National Center for Atmospheric Research, PO Box 3000, Boulder, CO 80307, USA, DARRYL HOLM, Department of Mathematics, Imperial College London, London SW7 2AZ, UK and Los Alamos National Laboratory, Los Alamos, NM 87545, USA, PABLO MININNI, ANNICK POUQUET, National Center for Atmospheric Research, PO Box 3000, Boulder, CO 80307, USA — We test three regularizations, the $\alpha-$model, Leray$-\alpha$, and Clark$-\alpha$, as sub-grid models for LES by comparison with a 1024^3 direction numerical simulation (DNS), $R_\lambda \approx 800$, with a Taylor-Green forcing. Both the $\alpha-$model and Clark$-\alpha$ are able to reproduce the large-scale anisotropy of the flow as well as the time scale of developing turbulence. Leray$-\alpha$ fails in both these regards. We study intermittency corrections through pdfs and the anomalous scaling of the velocity increment structure functions. Leray$-\alpha$ is somewhat less intermittent than the DNS and produces an energy spectrum that is too shallow in the inertial range, while Clark$-\alpha$ produces a broad $k^{-5/3}$ spectrum and stronger intermittency corrections. Finally, the agreement of the DNS and $\alpha-$model spectra, in disparity with results for lower Reynolds number simulations, is worse than in the Clark$-\alpha$ model. We conjecture that this enhanced intermittency in the α model is related to the steeper than $k^{-5/3}$ spectrum now reported for the very highest Reynolds number simulations and atmospheric observations.

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