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Three regularizations as turbulent subgrid models[1] JONATHAN PIETARILA GRAHAM, NCAR, DARRYL HOLM, Imperial College & LANL, PABLO MININNI, ANNICK POUQUET, NCAR — Geophysical and astrophysical phenomena involve a huge range of scales. The number of degrees of freedom are inconceivable for numerical simulations to achieve, and truncation of the omitted scales removes important physics. Regularization subgrid models for this closure problem have recently emerged. Unlike many Large Eddy Simulations (LES), these models have guarantees on the computability of their solutions, conserve energy, and recover the physical equations as the filter width vanishes. Three regularizations can be viewed as LES with successively more complex subgrid-stress terms: the Clark, Leray, and alpha models. Comparing these, we establish the affects of each term. As each has different small-scale energy spectra this can shed light on the link between small-scale properties of the flows and their intermittent behavior. We find that Leray fails to recover large-scale anisotropy in our flow and the time scale for the development of turbulence. The Clark and alpha models both perform well in these regards but require extra dissipative for adequate computational gains. We also test the helicity of vortex tubes, Beltramization of the flow, and statistical properties for the subgrid models.

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