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High-resolution simulations of forced compressible isotropic turbulence SHRIRAM JAGANNATHAN, DIEGO DONZIS, Texas A&M University — Direct numerical simulations of compressible turbulent flows are several times more expensive than their incompressible counterparts. Therefore, using large computing resources efficiently is even more pressing when studying compressible turbulence. A highly scalable code is presented which is used to perform simulations aimed at understanding fundamental turbulent processes. The code, which is based on a 2D domain decomposition, is shown to scale well up to 128k cores. To attain a statistically stationary state a new scheme is developed which involves large-scale stochastic forcing (solenoidal or dilatational) and a procedure to keep mean internal energy constant. The resulting flows show characteristics consistent with results in the literature. The attainable Reynolds and turbulent Mach numbers for given computational resources depend on the number of grid points and the degree to which the smallest scales are resolved that are given by Kolmogorov scales. A systematic comparison of simulations at different resolutions suggests that the resolution needed depends on the particular statistic being considered. The resulting database is used to investigate small-scale universality, the scaling of spectra of velocity, density and temperature fields, structure functions and the trends towards high-Reynolds number asymptotes. Differences with incompressible results are highlighted.

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