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Nonlinear Processes in Geophysics
Discussions
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Interactive comment on "Stratified Kelvin-Helmholtz turbulence of compressible shear flows" *by* Romit Maulik and Omer San

Anonymous Referee #2

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The authors have studied the spectra of kinetic energy, density-weighted kinetic energy and density, as well as structure functions of velocity in stratified shear flows by performing numerical simulations of inviscid compressible turbulence induced by Kelvin-Helmholtz instability, in both two-dimensional space and three-dimensional space. They have pointed out that there is a significant difference between two spectra of kinetic energy and density-weighted kinetic energy in two-dimensional turbulence due to the effect of density field, while the two spectra of kinetic energy and density-weighted energy in three-dimensional turbulence exhibit the same power-law scaling with the Kolmogorov scaling exponent -5/3. The results are interesting. There are some issues that need to be addressed.

(1) In order to examine the effect of density, two spectra of kinetic energy and density-

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weighted kinetic energy can be plotted in the same figure. Moreover, authors can plot the spectrum of the difference between the velocity u and the normalized density-weighted velocity \sqrt{\rho}u / <\sqrt{\rho}>, where <\sqrt{\rho}> is the spatial average of square root of density. The effect of density field can be clearly demonstrated by comparing the spectrum of the velocity difference and the spectrum of the velocity itself.

(2) Similar to the previous comments by referee #1, I also suggest that authors should study the spectra of the solenoidal and compressible components of velocity by using the Helmholtz decomposition. The effect of compressibility can be evaluated by the relative magnitude of the compressible component of the velocity spectrum with respect to its solenoidal counterpart.

(3) Please provide some explanations about the -6 scaling of spectra of kinetic energy at high wave numbers (in the dissipation region) since such an exponent of -6 is quite new.

(4) Please cite some recent references about the spectra of velocity and density in two-dimensional and three-dimensional compressible turbulence, and compare the present results with those in the references: (a) http://aip.scitation.org/doi/abs/10.1063/1.4892460 Density distribution in two-dimensional weakly compressible turbulence, D. Terakado and Y. Hattori, Physics of Fluids 26, 085105 (2014). (b) https://journals.aps.org/prfluids/abstract/10.1103/PhysRevFluids.2.092603 How vortices and shocks provide for a flux loop in two-dimensional compressible turbulence, G. Falkovich and A. G. Kritsuk, Physical Review Fluids 2, 092603(R) (2017). (c) https://journals.aps.org/prfluids/abstract/10.1103/PhysRevFluids.2.013403 Spectra and statistics in compressible isotropic turbulence, J. Wang, T. Gotoh, and T. Watanabe, Physical Review Fluids 2, 013403 (2017).

(5) Please plot the root mean square values of velocity and density as functions of time.

Will the results about the spectra od kinetic energy be changed if t=5 is changed to, for example, t=4?

(6) Page 10, line 9: the question mark needs to be deleted.

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