Nonlin. Processes Geophys. Discuss.,
https://doi.org/10.5194/npg-2017-67-RC1, 2018

Nonlinear Processes in Geophysics
Discussions
Open Access
EGU

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

Anonymous Referee #1

Received and published: 20 February 2018

1) The analysis of the flows in the paper is disappointing, since very few of the interesting tools that have been developed for analyzing compressible turbulence in particular have not been used. This includes, but is not limited to:

a) computing energy spectra (and spectral energy fluxes) from the curl-free and divergence-free components of the velocity field via a Helmholtz decomposition, particularly in 2D, since there is a heuristic idea in the literature that compressible 2D turbulence exhibits an inverse-cascade of energy in the divergence-free part of the velocity field while also losing energy to the curl-free part, where it then is transferred to small scales in a direct cascade (mostly via shockwave formation).

b) computing some of the structure functions which have been developed specifically for compressible turbulence, such as that de-

rived and measured in simulations for the 2D case in my own papers https://link.springer.com/article/10.1007/JHEP12(2015)067 (referenced in the paper in question) and https://link.springer.com/article/10.1007/JHEP08(2017)027, or those derived in the 3D case in https://www.cambridge.org/core/journals/journal-of-fluid-mechanics/article/new-relations-for-correlation-functions-in-navierstokes-turbulence/B4E931CFF282345CB20CB3619F3CA27E.

2) The type of velocity structure functions computed in this work (Eq. 20) are not very informative, since the absolute value of the velocity differences is taken inside the average. There are no predictions for the behaviour of such structure functions that do not make ancillary (and strictly invalid) assumptions about the nature of turbulence. On the other hand, the third-order velocity structure function without the absolute value taken indeed has concrete predictions, at least in the incompressible regime (4/5-law in 3D and 3/2-law in 2D). These laws have been extended to the compressible case in the aforementioned papers.

3) On page 12, lines 1-3, a kˆ{-3} scaling of the energy spectrum is incorrectly stated to be associated with the inverse-energy cascade in Kraichnan-Batchelor-Leith theory of 2D turbulence. It is associated with a direct-cascade of enstrophy in that theory, or an energy condensate otherwise.

4) It is very difficult to compare the various power-law scalings in the plots with the energy spectra or structure functions, since the power-law scalings are placed too far away from those quantities. In my experience, it is very easy to mislead readers with such plots because this style of presenting is very insensitive to errors. The most honest and unforgiving way of presenting that information is to compensate the quantities by the various power laws (i.e. divide the quantites by the expected power laws) and plot on a linear vertical scale.

5) Equation (20) has typos: the argument of the first velocity should be (x+r) and the argument of the second velocity should be (x).

6) On page 11, line 14, a spatial average over the z axis is incorrectly referred to as an ensemble average. Spatial or temporal averages are equivalent to ensemble averages only for ergodic systems, and I believe it is currentlyan open question whether and when turbulence is ergodic.

Interactive comment on Nonlin. Processes Geophys. Discuss., https://doi.org/10.5194/npg-2017-67, 2018.