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On one-component turbulence

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Very stable boundary layers occur in polar regions and during nighttime under the influence of large stratification when net radiation is strongly negative. They are characterized by small-scale, intermittent turbulence and large influence of non-turbulent motions such as gravity waves, micro fronts, meandering etc. Strongly stratified turbulence is not only highly anisotropic but also mostly one-component, with large horizontal and negligible vertical velocity variances. Stiperski and Calaf have shown that such one-component turbulence diverges from the standard scaling frameworks such as local or z-less scaling and to show some characteristics of two-dimensional turbulence.

Here we use twelve datasets from flat to highly complex terrain to investigate the scale-wise characteristics of one-component turbulence. We focus on the physical processes that lead to its occurrence, the persistence of distortion through stratification across scales and the possibility of a similarity-scaling framework that unifies one-component turbulence.