Abstract Submitted
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On the probability law of turbulent kinetic energy in the atmospheric surface layer[1] MOHAMMAD ALLOUCHE, Princeton University, GABRIEL G. KATUL, Duke University, JOSE D. FUENTES, Penn State University, ELIE BOU-ZEID, Princeton University — The probability density function $p(k)$ of the turbulent kinetic energy k is investigated for diabatic atmospheric surface layer (ASL) flows. When the velocity components are near-Gaussian and their squared quantities are nearly independent, the resulting $p(k)$ is shown to be gamma-distributed with exponents that vary from 0.8 to 1.8. A non-linear Langevin equation that preserves a gamma-distributed $p(k)$ but allows linear relaxation of k to its mean state is proposed and tested using multiple ASL data sets. The three parameters needed to describe the drift and non-linear diffusion terms can be determined from the ground shear stress and the mean velocity at height z from the ground. Using these model parameters, the Langevin equation reproduces the measured $p(k)$ with minimal Kullback-Leibler divergence. Analysis of the partial autocorrelation function is conducted to investigate the validity of the exponential decay assumption in the autocorrelation function, and numerous runs exhibit non-exponential decay. Such adjustments need not revise the linearity of the drift term and can be accommodated by assuming a relaxation time scale that is not constant or time dependent. A non-constant relaxation time is one possibility to bridge the Langevin model with super-statistics.

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