A parsimonious and universal description of turbulent velocity increments

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Abstract

This paper proposes a reformulation and extension of the concept of Extended Self-Similarity. In support of this new hypothesis, we discuss an analysis of the probability density function (pdf) of turbulent velocity increments based on the class of normal inverse Gaussian distributions. It allows for a parsimonious description of velocity increments that covers the whole range of amplitudes and all accessible scales from the finest resolution up to the integral scale. The analysis is performed for three different data sets obtained from a wind tunnel experiment, a free-jet experiment and an atmospheric boundary layer experiment with Taylor-Reynolds numbers $R_\lambda = 80, 190, 17000$, respectively. The application of a time change in terms of the scale parameter δ of the normal inverse Gaussian distribution reveals some universal features that are inherent to the pdf of all three data sets.