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A Method For Estimating The Multifractality Of The Wind

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For many years now the statistical moments of the velocity increments (the structure function) have been used to analyse the turbulent statistics of the wind. Moreover, the non-linearity of the scaling exponent of the structure function is well known to be due the multi-scaling properties of the wind. We propose a method, based on the structure function, that allows one to easily estimate the Levy index α.

Using a rotated frame of reference to analyse the anisotropy of the three-dimensional wind velocity in the atmospheric surface-layer we show that the angular dependency of the scaling exponent results in either an increase or decrease in dimension. This increase or decrease in dimension causes a first or second-order phase transition respectively. When there is a phase transition the estimation of α can be seen to spuriously increase or decrease. This is the likely reason there has been a lack of agreement on the value value of α in bounded turbulent regimes. In order to reduce the effect of the changing dimension we may optimise the angle of rotation.