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Analysis of fractal dimension versus the integral length scales of atmospheric turbulent fluxes

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The fractal nature and the integral length scales of the turbulence of the atmospheric boundary layer on a hight of 15 m is investigated. The atmospheric turbulent fluxes in the boundary layer at large Reynolds numbers are assumed to be a superposition of periodic perturbations and nonperiodic behaviour that can obey a chaotic flow. It is of crucial importance to find a parametrization of those periodic perturbations. In this work the u, v and w components of velocity series of the wind have been measured by a sonic anemometer which was mounted on a height of 15 m in the zone of the Almaraz Nuclear Power Plant (Cáceres, Spain). The goal is to determine a model of periodic perturbations that may describe a part of the periodic character of these series and develop a technique to filter these perturbations. From the results obtained with the application of this method, we calculate the fractal dimension (Komolgorov capacity or box- counting dimension) of the bidimensional components ((u,t), (v,t), (w,t)) and also these physical spaces once filtered the perturbations. The obtained values of the fractal dimension are in a range from 1.01 to 1.11 in the lower atmosphere in most of the bidimensional physical spaces (velocity-time) of the 540 analysed series. We have calculated the integral length scales for horizontal (u,v) and vertical (w) velocity components. A method is development for estimating these integral length scales using the normalized autocorrelation function and a fit Gaussian. In this study, we investigate the fractal dimension in function of the integral length scales of these original series and of the series once filtered the perturbations. The obtained values of the integral length scales are approximately between the 5 m and the 290 m, this means that they provide a measure of the scales of eddies in the x, y or z directions of these highly turbulent flows. From our study it is shown that there is an oscillation of the fractal dimension versus the integral length scales in most of the three components of the wind (u,v,w).