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Fractal dimension of wind velocity versus the Reynolds number and the mean wind speed

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This work is concerned with results of fractal dimension of the wind velocity in atmospheric turbulent fluxes and how the perturbations immerse in these fluxes influence on that dimension. A new technique of filtering of deterministic perturbations from power spectrum is used in real series of the wind velocities measured by a sonic anemometer. These perturbations are generated by the flow of deterministic waves over the mean wind. The model of perturbation proposed consists in an amplitude and frequency decreasing with time in an exponential way in a given bandwidth of frequency. This technique is tested in simulations of time series and afterwards we will apply it to real series of the wind velocity in turbulent fluxes in the atmospheric boundary layer. We present a method to calculate the Hausdorff - Besicovith fractal dimension of these series and it is obtained this dimension in more than 540 real series of wind velocities as well as these same series once filtered the deterministic perturbations. In this study, we investigate the fractal dimension of these series in function of some physical parameters such as the mean wind speed of the turbulent flows and the Reynolds number of the filtered perturbations. The obtained Reynolds numbers are high of an order of magnitude of 10^3 - 10^8, this means that they are highly turbulent flows. From our study it is shown that there is an increasing tendency of the fractal dimension versus a slight increase of the mean wind speed and versus higher Reynolds number of the filtered perturbations in most of the three components of the wind (u,v,w). These results may help to explain and to understand how the fractal dimension can influence in these physical parameters as the velocity and the Reynolds number of these turbulent fluxes in the atmospheric boundary layer.