# Analysis of some meteorological variables time series relevant in urban environments by applying the multifractal analysis

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The time series corresponding to variables related with the climate have been frequently studied by using the descriptive statistics. However, as several works have suggested, other approaches such as the multifractal analysis can be taken into account to complete the information about some climatic and environmental phenomena obtained from the standard methods. As a consequence, the main aim of this work was to check whether some meteorological variables relevant in urban environments (i.e. air temperature, rainfall, relative humidity, solar radiation and surface wind velocity and direction) exhibited a multifractal nature. The analysis was extended to several time scales determining the multifractal parameters and exploring the existing relationships between them and those reported by the descriptive statistics. The daily time series studied in this work were recorded in Córdoba (37.85ºN 4.85ºW), southern Spain, from 2001 to 2006. The altitude of this location is 117 m and the climate of this location can be defined as a mixture of Mediterranean characteristics and Continental effects.

The multifractal spectra showed convex shapes for all the considered variables, confirming the presence of a multifractal type of scaling that was kept for time resolutions ranging from one day to six years. In the case of rainfall, the observed range of time scales that exhibited a multifractal nature was more restrictive due to the presence of many zeros in the daily data that characterized the precipitation regime in some places of southern Spain.

The multifractal spectra corresponding to surface wind velocity and rainfall showed longer left tails implying greater heterogeneity in the time series high values. However, the multifractal spectra obtained for the rest of meteorological variables exhibited the opposite behavior meaning that the low data in the time series had more influence in the distribution variability. The presence of rare low values was significant for surface wind direction and mean temperature according to the accumulation of points in the extreme of the spectra right tails. This fact confirming that the knowledge of the relationships between the multifractal parameters helps to complete the information regarding to the influence of rare values in the time series.

With respect to the relationships between the parameters of the multifractal spectra and those calculated from the descriptive statistics for the meteorological variables considered here, a strong correlation was detected between the rare high values, represented by the extreme points in the spectra left tails, and the leptokurtic shape of the frequency distributions. In addition, for the same rare high values it could be checked a significant negative correlation between them and the coefficients of variation. The spectra left tails, corresponding to high values in the time series, exhibited greater amplitudes for those variables distributions that showed higher dispersion and positive coefficients of skewness.

The multifractal analysis has shown itself to be a suitable and efficient approach to characterizing the most important meteorological variables affecting cities environment providing information that can be applied to increase the knowledge on the urban climate dynamics.