



Modeling of rainfall events and trends through multifractal analysis on the Ebro River Basin

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Water supplies in the Ebro River Basin present high seasonal fluctuations, with extreme rainfall events during autumn and spring, and demands are increasingly stressed during summer. At the same time, repeated anomalous annual fluctuations in recent decades have become a serious concern for regional hydrology, agriculture and several related industries in the region. In fact, it has had a devastating impact, both socially and economically. In addition it has resulted in debate over the changing seasonal patterns of rainfall and the increasing frequency of extreme rainfall events.

The aim of this work is to evaluate these challenges on the Ebro River Basin. For this purpose, 132 complete and regular spatial rainfall daily datasets (from 1931 to 2009) were analyzed. Each dataset corresponds to a grid of 25 km x 25 km and belongs to the area studied.

First, classical statistical tests were applied to the series at annual scale to check the randomness and trends. No trends were found. Then, we analyzed the change in the rainfall variability pattern in the Ebro River Basin. We have used universal multifractal (UM) analysis, which estimates the concentration of the data around the precipitation average (C_1 , codimension average), the degree of multiscaling behavior in time (α index) and the maximum probable singularity in the rainfall distribution (γ_s). Daily rainfall series were subdivided (1931–1975 and 1965–2009) to study the difference between the two periods in these three UM parameters, in an attempt to relate them to geographical coordinates and relative positions in the river basin.

The variations observed in C_1 and α in some areas of the Ebro River Basin indicate that a precipitation regime change has begun in the last few decades, and therefore, this change should be considered in terms of its potential effects on the social and economical development of the region. This confirms some postulates drawn by conservative scientists who reject a catastrophic interpretation and suggest that there is a weak trend towards a new climatic situation that includes the precipitation regime.