

Multifractal characterization of precipitation in time

M.I.P. de Lima

Institute of Marine Research/ Polytechnic Institute of Coimbra, Portugal (iplima@esac.pt)

The non-linear variability of precipitation occurs over a broad range of time and space scales; in addition, at a given scale it involves a huge dynamic range. These properties often make the characterization of this process difficult, in both technical and mathematical terms. Continued efforts have therefore been made to improve our knowledge of precipitation.

The scaling structure of precipitation allows the characterization of this process over a range of scales. The use of non-scaling approaches to study precipitation often leads to problems related to artificial scale truncations and to the application of models beyond the scale for which the model was developed in first place. Moreover, scaling approaches can help to increase our understanding of the way precipitation is structured at various scales. In particular, multifractal theory/approaches can handle the full dynamic range of this process, over a wide range of time and space scales, thus also helping to improve the description of precipitation variability. Multifractal methods are innovative for the analysis of extremes, offering practical tools for assessing their probability of occurrence. Multifractal theory predicts the existence of heavy tails (i.e., power-law tails) in the precipitation intensity probability distributions.

This work discusses the results of scale invariant and multifractal analyses of the temporal structure of precipitation, using hourly point precipitation data from Portugal. The time span of the records is more than 40 years for some of the data sets. Empirical multifractal exponent functions describing the scaling statistical properties of the precipitation intensity over a range of scales are determined. The applicability to precipitation of a three-parameter multifractal model based on Lévy random variables is discussed.

This work has been carried out under research projects POCTI/ECM/48619/2002 and POCI/GEO/59712/2004, funded by the Portuguese Foundation for Science and Technology, POCI 2010 and FEDER.