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Multiscale analysis of rainfall over France in a climate scenario: Importance of seasonal variations

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As a preliminary attempt to apply multifractal techniques to climate model simulations, Royer et al (2008) have analyzed the temporal scaling of daily rainfall time series over France simulated by the CNRM-CM3 coupled climate model in an IPCC scenario (SRES) A2 over the period 1860-2100. The scaling variability of the simulated daily rainfall, quantified with the "universal multifractal" formalism by means of a few relevant multifractal exponents characterizing the intermittency and multifractality of the field as determined by the Double Trace Moment (DTM), have shown a scaling range extending from one day to more than 16 days. Though opposite trends found in the evolution of the intermittency and multifractality exponents tend to have compensating effects on the evolution of rainfall extremes, the dominant effect of the increasing intermittency leads to expect an effective enhancement of rainfall extremes for the next hundred years. In this presentation, the analysis is extended by taking into consideration the seasonal effects. Comparison of the different periods shows that in winter there is rather little change in the two parameters, except in the southern part of France. In summer however, though the geographical patterns remain rather stable, a large and systematic evolution can be seen between the successive time spans, with an increase of multifractality and a decrease of intermittency over the 21st century. This new analysis shows that the overall trends found previously in analyzing the precipitation series over the whole year are mainly produced by the variations during the summer season. The very differentiated seasonal evolution in the response of precipitation to climate change, highligh that it is necessary to take into account a seasonal evolution of the multifractal parameters for characterizing the scaling properties of the rainfall fields. In particular the changes in the scaling properties of precipitation seem to be more prominent during summer than during winter, and this can have implications for the extreme behavior of rainfall, especially at smaller scales.

References:
Royer J.F., F. Chauvin, A. Biaou, D. Schertzer, S. Lovejoy , 2008 : Multifractal analysis of the evolution of simulated precipitation over France in a climate scenario. C. R. Geoscience 340, 431-440.