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Multiscaling properties of tropical rainfall: Analysis of rain gauge datasets in Lesser Antilles island environment

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Changes in rainfall seem to be the main impact of climate change in the Caribbean area. The last conclusions of IPCC (2013), indicate that the end of this century will be marked by a rise of extreme rainfalls in tropical areas, linked with increase of the mean surface temperature. Moreover, most of the Lesser Antilles islands are characterized by a complex topography which tends to enhance the rainfall from synoptic disturbances by orographic effects.

In the past five years, out of hurricanes passage, several extreme rainy events (approx. 16 mm in 6 minutes), including fatal cases, occurred in the Lesser Antilles Arc: in Guadeloupe (January 2011, May 2012 and 2013), in Martinique (May 2009, April 2011 and 2013), in Saint-Lucia (December 2013). These phenomena inducing floods, loss of life and material damages (agriculture sector and public infrastructures), inhibit the development of the islands. At this time, numerical weather prediction models as WRF, which are based on the equations of the atmospheric physics, do not show great results in the focused area (Bernard et al., 2013). Statistical methods may be used to examine explicitly local rainy updrafts, thermally and orographically induced at micro-scale.

The main goal of the present insular tropical study is to characterize the multifractal symmetries occurring in the 6-min rainfall time series, registered since 2006 by the French Met. Office network weather stations.

The universal multifractal model (Schertzer and Lovejoy, 1991) is used to define the statistical properties of measured rainfalls at meso-scale and micro-scale. This model is parametrized by a fundamental exponents set (H,a,C1,q) which are determined and compared with values found in the literature. The first three parameters characterize the mean pattern and the last parameter q, the extreme pattern. The occurrence ranges of multifractal regime are examined. The suggested links between the internal variability of the tropical rainy events and the multifractal properties found, are preliminary discussed.

References

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