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Rainfall dynamics at different temporal scales: A chaotic perspective

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Abstract. This study of the behaviour of rainfall dynamics at different temporal scales identifies the type of approach most suitable for transformation of rainfall data from one scale to another. Rainfall data of four different temporal scales, i.e. daily, 2-day, 4-day and 8-day, observed over a period of about 25 years at the Leaf River basin, Mississippi, USA, are analysed. The correlation dimension method is employed to identify the behaviour of rainfall dynamics. The finite correlation dimensions obtained for the four rainfall series (4.82, 5.26, 6.42 and 8.87, respectively) indicate the possible existence of chaotic behaviour in the rainfall observed at the four scales. A possible implication of this might be that the rainfall processes at these scales are related through a chaotic (scale-invariant) behaviour. However, a comparison of the correlation dimension and coefficient of variation of each of the time series reveals an inverse relationship between the two (higher dimension for lower coefficient of variation and vice versa). The presence of a large number of zeros in the higher resolution time series (that could result in an underestimation of the dimension) and the possible presence of a higher level of noise in the lower resolution time series (that could result in an overestimation of the dimension) might account for such results. In view of these problems, it is concluded that the results must be verified using other chaos identification methods and the existence of chaos must be substantiated with additional evidence.

Keywords: rainfall, chaos, scaling, correlation dimension, number of variables, coefficient of variation, data size, noise, zeros

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