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Chaos Analysis of Precipitation Time Series in the upper Magdalena River Basin

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An analysis of chaos realized in the upper Magdalena River Basin (UMRB) for two precipitation time series is presented. The first time series was collected from 129 ground rain gauges stations (period 1970 to 2011, diary) located along the UMRB. The second modeled time series were derived from a Global Climate Model (GCM: MPI-ESM-MR), (1850 to 2089, diary) with a resolution 1.875°x1.875°. The time series were utilized to reconstruct the phase space by applying the Time-Delay Method, which finds an appropriate time-delay (Autocorrelation and Mutual Information) and embedding dimensions (Correlation Dimension, False Nearest Neighbors and Cao′s method) to unfold the attractor. This information was then utilized to calculate the Lyapunov exponents (-0.01 a 0.60). The Lyapunov exponents shows that 97% of ground rain gauges presents deterministic chaos for an interval of 5 days. The same pattern was found in the GCM time series for a rainfall accumulation interval of 15 days. In addition, both time series becomes completely deterministic for a rainfall accumulation of 30 days or more. These results show that the precipitation data set has deterministic chaos, which have the potential to improve rainfall forecasting.