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Towards a more robust statistical technique of break detection in rainfall time series.

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Climate change is characterized by a significant change in the mean values of climate variables. However, detection of trends in climate variables depends on the methods applied. In this study, three widely used statistical methods, Pettitt's test, Lee and Heghinian's bayesian method and Hubert's segmentation are compared to the Cross-Entropy method. The latter is a stochastic optimization technique initially developed for assessing the number and the position of breakpoints in continuous biological data. From a theoretical view point, the approaches of Pettitt as well as Lee and Heghinian provide only one breakpoint. The Hubert's segmentation gives multiple breakpoints but within a series even just one extreme value could result as a break. As for the cross entropy method, it provides multiple breakpoints and offers the possibility for the user to choose the number of breakpoints desired. The four methods were applied to 17 rain gauges of the Benin part of the Niger River basin whose data cover the periods 1970-2010 (12 gauges) and 1981-2010 (5 gauges).The likelihood of detecting a breakpoint with the Pettitt's test, the Hubert's segmentation, the Lee and Heghinian's method and the cross entropy method was 16 %, 28%, 72% and 100% respectively. We also noticed that the cross entropy method was 100% and 78% of the times able to replicate a breakpoint detected by the Pettitt and Hubert's approaches and the Lee and Heghinian's method respectively. On the other hand, there was 52% of chance for the Lee and Heghinian's method to reproduce a breakpoint indicated by the cross entropy method. These results suggest that the cross entropy method outperforms the three others and should be considered in statistical climate change studies. However, further studies are necessary to confirm the performance of the novel method in comparison to the three others.

Keywords: Climate change, Breakpoint detection, Cross- Entropy method, Niger River basin