

## ***Interactive comment on “Investigating possible changes of extreme annual rainfall in Zimbabwe” by D. Mazvimavi***

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Comments by W. Nyabeze

W. Nyabeze raised the point that local factors may affect rainfall occurrence and this should have been taken into account when selecting rainfall stations. The availability of rainfall data of sufficient length, (over 50 years) at locations in Zimbabwe was a major criterion for the selection of stations. The stations selected should have data whose quality had been examined and possible errors eliminated by the Department of Meteorological Services of Zimbabwe. Any rainfall station will reflect both the influence of local, regional and global factors on rainfall. Thus changes over time in rainfall may be due to any of these factors. The unwanted influences are those due to changes in

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the exposure of rain gauges and observational procedures. Since the stations located were official rainfall stations, the influence of such factors were eliminated during quality control by the agency responsible for meteorological monitoring.

W. Nyabeze suggests what can be done to improve rainfall measurement. W. Nyabeze notes that some rainfall stations may be located in areas that are climatically more sensitive than other locations. It is however difficult to identify these climatically sensitive areas before the development of the network of rainfall stations. The type of analysis done in this paper will hopefully assist in identifying such areas, and of course this will be of interest to science to establish the reasons for lack of sensitivity to changes in some areas. W. Nyabeze found the paper publishable and suggested that plots of variation of rainfall with time for some of the stations showing no change over time should also be included. This will be done in the revised paper.

Anonymous Referee The concern of the Anonymous Referee is that the method used by Makarau (1994) and Unganai (1996) were not included in order to determine whether quantile regression used in the paper gives better results. Makarau (1994) and Unganai (1996) fitted a linear trend line between the annual rainfall for the country and year. This was done for the 1900 to 1994 (Unganai, 1996) and 1901 to 1992 (Makarau, 1994) periods. Both authors did not explicitly state whether the negative relationships they had established were statistical significant. This method has now been incorporated in the revised paper. There was no statistically significant linear relationship between annual rainfall and year of record at each station. Similarly the average annual rainfall for the country based on the 40 stations had no significant linear relationship with year of record.

The second comment concerns the statement made in the paper that some of the significant changes noted at some stations were due to sampling errors. The wording used in the paper needs to be changed to indicate that some of the detected changes could be spurious and not due to sampling errors as stated in the paper. The author accepts the fact that different rain bearing winds dominate in different parts of the

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country. However, what has been surprising is that the study did not find consistent changes in these different parts of the country. The case for a change in rainfall would have been strong if say, stations in each of the following parts had consistent results; (a) north-east, (b) south-east, (c) southern, and (d) north-west. But when stations within these different parts of the country have inconsistent results, then this raises doubts about the physically basis of the changes detected. This additional discussion has been included to address the concerns of the referee.

Comments by A. Opere (Editor) The Editor raised an issue with the statements concerning changes in other parts of the distribution. What the author intended to communicate was that there is a possibility that changes may occur but are not reflected in the average value, e.g. high rainfall events whose effects on the average is cancelled by low rainfall events, or a change in the standard deviation but without a change in the average value. This comment is incorporated in the revised paper.

The selection of stations was guided by the availability of long-term data (over 50 year), and that these data should have been quality controlled. The stations are well spread out throughout Zimbabwe to reflect the effects of the main rain bearing winds throughout the country. Thus stations representing the north-east, south-east, western, and north-western parts were included. Of course some regions do not have as much density of stations as in other because of lack of rainfall stations. The stations selected also cover the various altitudinal regions of Zimbabwe, since altitude has a major influence on rainfall in this country. This discussion will be included in the revised paper. The Equations will be corrected to address the comments of the Editor.

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