

Anonymous Referee #1

Received and published: 2 April 2019

This paper presents a statistical analysis to identify temporal trends in the frequency of dust storms, as well as their attribution to changes in a set of climatic variables. Data recorded at 25 gauging stations in Iran are selected. Five climatic variables are used: annual rainfall, annual maximum wind speed, average wind speed, annual maximum temperature and average temperature. The results of the univariate MK test show differing trends in dust storm time series. The results of the bivariate MK tests show a relationship between trends in climate variables and trends in dust storms.

A robust statistical analysis to attribute detected trends in dust storm time series in Iran is very interesting. Unfortunately, the statistic tests selected for it are not adequate. The bivariate MK tests are an extension of the univariate MK test to identify trends in the dependence structure either between or among variables. Consequently, the results included in Tables 2 to 6 actually show if the dependence structure between the climatic variables considered and dust storms changes in time. Consequently, a significant trend identified by such bivariate MK tests points to the need for using a copula with nonstationary parameters that change in time, in order to represent the dependence structure between variables adequately. Therefore, no conclusions can be obtained about how a given climate variable can explain a temporal trend detected in dust storm time series, as univariate trends in each variable change the dependence structure between them, reducing, annulling or amplifying the temporal trend in such dependence structure. However, other tests are available to attribute trends adequately, such as the partial Mann-Kendall test and Bayesian inference techniques, among others.

REPLY: The author would like to thank the reviewer comment on the methods used. It is correct that other methods may be more robust and can be used, but this study applies the multivariate MK test. So, at this stage, the author can give the reviewer's comment as a suggestion for future study in section 6.

Other comments:

- The term 'climate change' is included several times along the paper. The study do not analyse the influence of climate change on dust storms, but how a changing climate does affect the frequency of dust storms. Consequently, the term 'climate change' should be removed.

REPLY: in any place where change refers to "climate change", the term was corrected.

- The Introduction Section should be improved, including more recent studies about dust storms and attribution of trends in time series.

REPLY: A couple of recent studies were added to the literature review.

- A set of figures to show and interpret the results of Tables 2 to 6 should be included in the paper to improve its understandability.

REPLY: The figures and discussions were provided in the revised manuscript.

- The English grammar style should be reviewed.

REPLY: The author went through the manuscript and correct as many grammatical errors as possible.

- A table including the climatic variables considered would be very useful for the reader.

REPLY: As we have already 6 tables in the manuscript and the requested table does not give much information to the paper, as we have only 5 variables and they are already mentioned in the text and the caption of tables, the author thinks adding table of variables is not necessary.

- The references should be ranked by alphabetical order. In addition, spelling of references should be reviewed.

REPLY: Corrected.