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Extreme Precipitation Analysis and Updated IDF Curves Over MENA Region Under Future Climate Scenarios

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INTRODUCTION

Middle east and North Africa (MENA) region are considered to be a hotspot of climate change. Recently several parts in the region experienced an increase in the frequency of extreme precipitation events which impose a substantial threat to infrastructure and people. Moreover, MENA countries represent different climatic, hydrological, storms characteristics and observational capacities which increase the ambiguity and uncertainty regarding the impact of climate change over different parts of the region. Since the region lacks precipitation data, which is the basis for climate change impacts analysis, various satellite data such as CRU TS 4.04 (Climate research Unit) and GPCC (Global Precipitation Climatology Centre) were utilize for this purpose.

Objectives

By utilizing the available daily satellite data, the objectives of this study are:

- Analyze the impact of climate change on the historical precipitation trend (Annual, Seasonal, and Extreme precipitation) using Man-Kendal test.
- Examine the change in the future extreme events for all MENA countries through downscaled GCM data.
- Develop the IDF curves for the historical and future SSP5 scenario.
- Use IDF and DDF statistics for mapping extreme precipitation distribution over Oman under SSP2 and SSP5 scenarios.

Study Area

Middle East and North Africa (MENA), includes approximately 20 countries. The basic climate of the MENA can be characterized by hot and dry summer and mild winters.

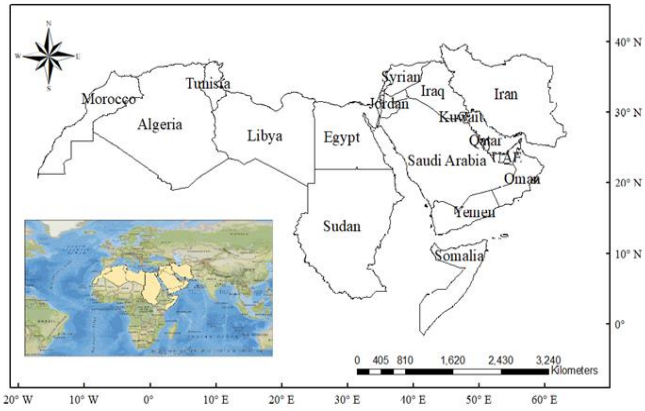

Fig 1. The study area (Middle East and North Africa)

METHODOLOGY

Modified Man-Kendal test and Sen's slope magnitude were computed using CRU TS 4.04 (Climate research Unit) and GPCC (Global Precipitation Climatology Centre) to detect the change in the precipitation trend. Serial correlation and Homogeneity were checked prior the application of Man-Kendal to detect the presence of autocorrelation and the breaking points. A statistical downscaling (Delta method) was used to generate the future precipitation under the worst scenario (SSP5) using CIMP6 model datasets (CanESM5, MICRO5, MICRO6). The downscaled data and GPCC were utilized for the construction of the IDF curves for all countries in MENA and for the spatial IDF maps under SSP2 and SSP5 over Oman.

RESULTS

The results showed some increasing trend in the extreme precipitation over Oman, Sudan, Yemen and Somalia **Fig 2**. The IDF curves for all countries have shown an increase in the precipitation intensity over different duration and return periods under SSP5 scenario. The highest and most significant increase were for Iran, Sudan, Somalia, Morocco, and Oman **Fig 3** shows the percentage of change in the precipitation intensity (historical vs future).

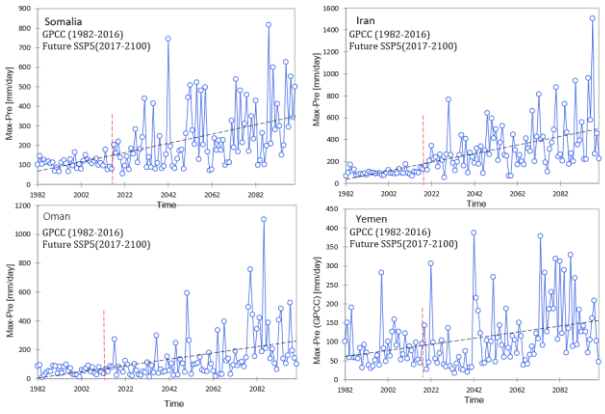

Fig 2. The most significant positive trend in extreme precipitation in future SSP5 scenario.

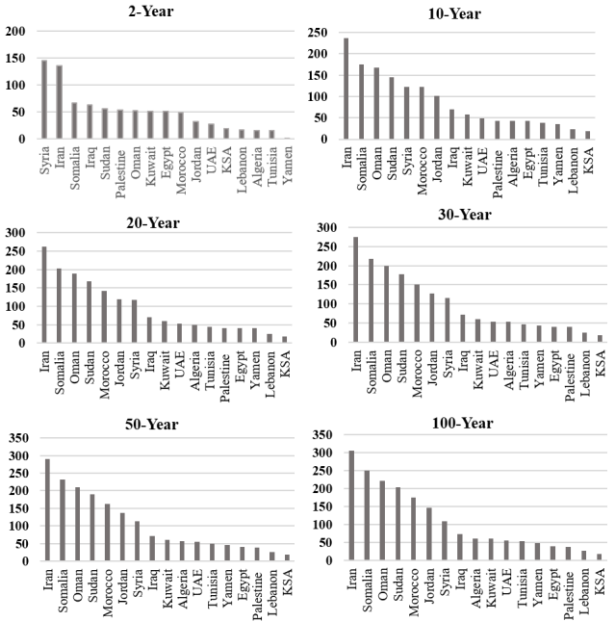

Fig 3. The percentage of change between the historical and future precipitation intensity for all countries.

The spatial representation of the change in precipitation depth between the historical and future SSP5 scenario over Oman is shown in **Fig 4.**

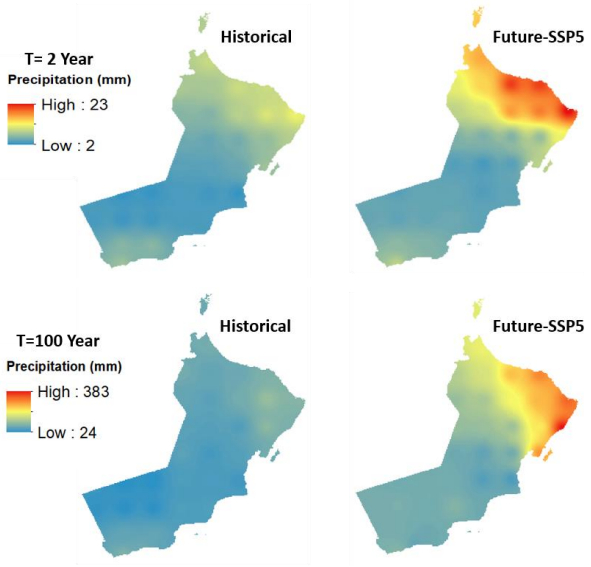

Fig 4. The change in precipitation depth in 24h-(2 and 100 return periods) for historical and SSP5 scenario.

CONCLUSION

CRU and GPCC data showed no significant trend in the extreme precipitation. Nevertheless, increasing trend were detected for some countries in the eastern part of Middle East in R5D, R20, and SDII indices. Oman, Sudan, Yemen and Somalia showed significant positive trends in the downscaled future precipitation from (CanESM5). The updated IDF curves showed a tendency towards higher precipitation intensity for all countries in the region.

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