Observed rainfall trends and precipitation uncertainty in the vicinity of the Mediterranean, Middle East and North Africa

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Abstract

The present study investigates the century-long and more recent rainfall trends over the greater region of Middle East and North Africa (MENA). Five up-to-date gridded observational datasets are employed. Besides mean annual values, trends of six indices of drought and extreme precipitation are also considered in the analysis. Most important findings include the significant negative trends over the Maghreb, Levant, Arabian Peninsula, and Sahel regions that are evident since the beginning of the twentieth century and are more or less extended to today. On the other hand, for some Mediterranean regions such as the Balkans and the Anatolian Plateau, precipitation records during the most recent decades indicate a significant increasing trend and a recovering from the dry conditions that occurred during the mid-1970s and mid-1980s. The fact that over parts of the study region the selected datasets were found to have substantial differences in terms of mean climate, trends, and interannual variability, motivated the more thorough investigation of the precipitation observational uncertainty. Several aspects, such as annual and monthly mean climatologies and also discrepancies in the monthly time-series distribution, are discussed using common methods in the field of climatology but also more sophisticated, nonparametric approaches such as the Kruskal–Wallis and Dunn's tests. Results indicate that in the best case, the data sources are found to have statistically significant differences in the distribution of monthly precipitation for about 50% of the study region extent. This percentage is increased up to 70% when particular datasets are compared. Indicatively, the range between the tested rainfall datasets is found to be more than 20% of their mean annual values for most of the extent of MENA, while locally, for the hyper-arid regions, this percentage is increased up to 100%. Precipitation observational uncertainty is also profound for parts of southern Europe. Outlier datasets over individual regions are identified in order to be more cautiously used in future regional climate studies.

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