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Abstract Book

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Local climate change assessment at five pilot sites in the Mediterranean region

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ABSTRACT

The objective of this study is to provide an overview of local climate change over the Mediterranean (MED) area under the scope of the InTheMED project, EU funded in the framework of the PRIMA programme. Future precipitation and temperature projections are assessed until the end of this century for five different pilot sites, located in the MED region. To this end, the outputs of 17 Regional Climate Models under the RCP4.5 and RCP8.5 scenarios are used. For each pilot site, the raw climate model data were downscaled at each monitoring station location and bias-corrected on the basis of observations recorded in a 30-year historical period. The changes in the annual precipitation are heterogeneous across the five pilot sites: a negligible variation is expected for some areas and a decrease of up to 30% for others. On the contrary, a significant increase in temperature is expected for all sites, confirming the ongoing warming in the MED region.

1. Introduction

InTheMED aims to implement innovative management tools and remediation strategies for inland and coastal aquifers in the MED basin with the aim to mitigate anthropogenic and climate change impacts. The analyses are performed considering five pilot sites, located between the two shores of the MED: Requena-Utiel (Spain), Tympaky (Greece), Castro Verde (Portugal), Konya (Turkey) and Grombalia (Tunisia). The present study provides future projections of precipitation and temperature in the five study areas under different scenarios. In particular, we made use of climate model data given by Regional Climate Models (RCMs) developed in the context of the EURO-CORDEX project (Jacob et al., 2014). Two scenarios, the so-called Representative Concentration Pathways (RCPs), adopted by the IPCC for the Fifth Assessment Report (AR5) were considered. In order to assess the uncertainty of the predictions, we adopted a multi-model approach in which different RCMs, which have a grid resolution of about 12.5 km, are downscaled from different General Circulation Models (GCMs, with a scale of hundreds of kms) to form a large ensemble of simulations. In the following sections, we describe the available historical and climate model data, the methods used to manage the historical series and perform the local downscaling and bias correction of climate models. Then, we present the main results and conclusions.

2. Data and methods

The analysis is performed considering an ensemble of 17 climate models, which are a combination of different GCMs and RCMs, and the RCP4.5 and RCP8.5 scenarios. The climate model data need to be downscaled and bias-corrected on the basis of precipitation and temperature data recorded in a historical period in order to well represent the climate variability at the local scale; we made use of the data recorded in the 30-year historical period 1976-2005. The number of available rain and temperature gauges considered for each pilot site is reported in Table 1. Since a continuous set of observations is needed to perform the bias correction, the gaps in the observations were filled following the FAO method (D'Oria et al., 2017): the missing data are replaced using linear relationships between the data in the stations to be filled and the best correlated neighboring station that presents contemporary records.

Table 1. Number of precipitation and temperature gauging stations for each pilot site.

	Requena-Utiel (Spain)	Tympaki (Greece)	Castro Verde (Portugal)	Konya (Turkey)	Grombalia (Tunisia)
Precipitation station	8	2	60	18	6
Temperature station	1	2	4	18	1

Then, to obtain the climate model data at the gauging station location, we adopted an inverse distance interpolation method considering the nine RCM cells closest to the specific station. Finally, the climate model data have been bias-corrected using the Distribution Mapping method (D'Oria et al., 2017) so that their cumulative distribution functions, at monthly scale, agree with the ones of the observed data in the historical period. The same correction is then applied for the future projections.

3. Results

The results indicate different precipitation changes in the future for the five sites. According to the annual mean, negligible or no variations are detected for some areas (Spain, Turkey, Tunisia), while moderate decreases are expected for Tympaky (Greece) and Castro Verde (Portugal). However, the inter-model variability often exceeds the mean variation in the projection period, denoting a large uncertainty in the future estimation of the precipitation. The analysis of the annual mean temperature denotes progressive warming in all the analyzed MED pilot sites. For the sake of brevity, Figure 1 reports the annual precipitation and the annual mean temperature for the Tympaky gauging station. A decrease in annual precipitation is expected in the future, more evident under the RCP8.5 scenario; the variability between the RCMs remains high. For the temperature, an evident increasing trend is shown for both scenarios. According to the median values, an increase in the mean temperature of about 1.5 °C is expected over the century under the RCP4.5 and of about 5 °C under the RCP8.5.

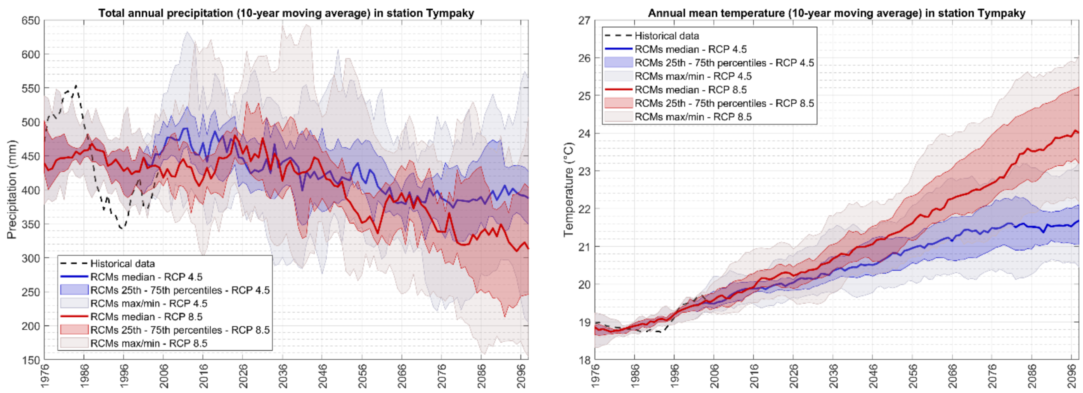

Fig. 1. Total annual precipitation (left) and annual mean temperature (right) in terms of 10-year moving average observed and simulated by the 17 RCMs under the RCP 4.5 and RCP 8.5 scenarios for the station Tympaky (Greece).

4. Conclusion

In this study, we assessed the local climate change at five pilot sites in the MED region by means of precipitation and temperature projection until 2100. Regarding the annual precipitation, no systematic changes are expected in the future, but decreases are detected for some of the investigated pilot sites. On the contrary, all RCMs agree on the progressive increase in the annual mean temperature for all the case studies, especially for scenario RCP8.5. Further analysis will concern the computation of drought indices for some pilot sites with the aim to evaluate the impact of climate change on droughts and then water resources.

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