A quantile-quantile approach for the adjustment of RCM outputs to local scales: application to Platja de Palma, Spain

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INTRODUCTION

In the framework of the Consortium of Platja de Palma – an agreement signed by the Balearic Islands Government and the Ministry of Industry, Commerce and Tourism of the Spanish Government for the redesign and suitability to the needs of the 21st century of this important tourist resort (http://consorcioplayadepalma.es), we analyse the effects of climate change on this key socioeconomic emplacement. The tourist activities developed in the System of Platja de Palma (SPdP), one of the main resorts in the whole Mediterranean region, are entirely devoted to a tourism mass model and, therefore, are closely linked to its climate (Fig. 1). Planning the socioeconomic opportunities in the mid- and long-term must necessarily take into account the possible evolution of the main atmospheric drivers. To this aim, daily observed series for SPdP are analysed. For the future projections, daily data generated by an ensemble of Regional Climate Models (RCMs) integrated in the European ENSEMBLES project were used. In order to adjust the RCM data to such local scale, a quantile-quantile correction has been applied to the regional projections. The adjusted series were examined to quantify the climate change signal. Results are discussed in terms of changes in the annual and seasonal mean regimes of the analyzed atmospheric variables and in the frequency of extreme events as well.

METHODOLOGY

Overview of the study area: present climatic and socioeconomic characteristics

The climate of the Balearic Islands is characterized by the western Mediterranean region. Mean annual rainfall amount is roughly 560 mm. Mean annual minimum and maximum temperatures are 12.8 °C and 21.8 °C (Homar et al., 2010).

SPdP is located in the southwestern coast of Mallorca, neighboring the city of Palma. Its main socioeconomic activities are related with the sun, sea and sand (3S) tourism model. The average of nights per year spent by tourists in the entire Palma county was over eight million during the 1998-2008 period (INE, 2009).

Changes in the rainfall regime might necessarily take into account the possible evolution of the main atmospheric drivers. To this aim, daily observed series for SPdP are analysed. For the future projections, daily data generated by an ensemble of Regional Climate Models (RCMs) integrated in the European ENSEMBLES project were used. In order to adjust the RCM data to such local scale, a quantile-quantile correction has been applied to the regional projections. The adjusted series were examined to quantify the climate change signal. Results are discussed in terms of changes in the annual and seasonal mean regimes of the analyzed atmospheric variables and in the frequency of extreme events as well.

RESULTS

Changes in annual mean and extreme regimes

Figure 3 shows increments of 2.7 ºC and 3.0 ºC for the minimum and maximum temperatures and the later 21st century with the subsequent further intensification of the diurnal temperature range in SPdP. Annual rainfall amounts are projected to be fall by about -7% by the end of the century. 5% and 95% observed percentiles are defined as the thresholds for which we define a low and high extreme event, except for the low rainfall extreme, which is defined as a non-extreme event (Fig. 4). This indicates the projected changes on the minimum and maximum extremes (Tmin = 0.0 °C and Tmax = 32.6 °C). Temperatures are expected to shift towards higher values. A constant rise in the annual number of non-rainy days is projected, as well as a slight growth in the frequency of the extreme daily amounts.

Changes in seasonal mean and extreme regimes

Briefly, seasonal maximum temperatures show the highest growth rate in summer (3.9 °C for the late 21st century, Fig. 5a). The frequency of extreme warm days (Tmax in summer > 35 ºC) is expected to steadily increase, almost achieving the 30 days per year for the late 21st century. The projected mean-median rainfall regimes indicate an early increase in the spring and autumn total amounts (Fig. 5c). The frequency of daily non-rainy and intense rainfall is expected to generally increase (Fig. 5d).

REFERENCES


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