CLIVAR-SPAIN CONTRIBUTIONS: Application of a statistical downscaling method in phytoclimatic studies for the Spanish National Parks

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Introduction
There are 14 National Parks in Spain covering about 3,400 km², which are distributed throughout the national territory (four in the Canary Islands, one in the Balearic Islands and nine in the Iberian Peninsula). Each National Park has its own special environment which is largely determined by the climatic characteristics of the area. Therefore, major climate changes are likely to change the natural evolution of the Park. For knowing the climate evolution for the 21st century and the implications that these changes may have on the Parks forest cover it is needed to design adaptation strategies to ensure the Park preservation and continuity.

Methodology
The work is structured in three parts:
- To study the influence of future climate change on the ground cover is necessary to have daily series of temperature and precipitation for the future (climate change scenarios). These scenarios have been calculated using a statistical downscaling methodology based on a analog technique in two steps and it has been developed by the Climate Research Foundation (FIC) with excellent results.
- The simulated data using downscaling are "real" daily series of temperature and precipitation. For these data can be used in studies of phytoclimatic character, the errors associated with this modeling have been corrected. The correction of this error has been made on a monthly basis so the data can be used in subsequent phytoclimatic studies.
- We used two phytoclimatic models based on the phytoclimatic model CLIPPIAR (García-López & Allué, 2011) for assessing the future evolution of the ground cover: the "Sub-types" Method is based on phytoclimatic vegetation cover, and the "Species" Method is based on the dominant species of the forest tree formation. Both methods use monthly variables that, by combining them in a specific way, allow to analyze the influence of local climate on vegetation, both in terms of phytoclimatic vegetation cover and forest composition. Further details on the used methodology can be found at www.climateforrest.com.

Data and Study zone
The study area comprises 14 National Parks scattered throughout the Spanish territory covering an area of 3,400 km² (Fig. 1).

Future climate scenarios
The results obtained by downscaling are "real" data, they include uncorrected errors associated to the model and to the used methodology (systematic error). As shown in Fig. 4, the results improve considerably once the systematic error is corrected, especially in the case of precipitation. In this study, the error is corrected on a monthly basis since the data used in the study are phytoclimatic monthly.

Results and Conclusions of the phytoclimatic study
There is a clear difference between the Parks located at low altitude and the ones at high altitude. For the latter is expected that the phytoclimatic diversity rise due, mainly, to the enrichment of the hardwoods species of mountain conifer forests, and also the migration in height in coniferous forests, which tend to colonize high mountain areas currently treeless. Parks located at low altitude, especially in Mediterranean areas, suffer sharp falls of the phytoclimatic diversity, mainly due to the progressive incompatibility with non-forest species, so the phytoclimatic strategies of the forest cover tend to be based on endemophilous strategies. The above shows a clear mismatch between the behavior of the phytoclimatic diversity at low and high altitude. Stations located within 1000 m have a clear tendency to decrease their phytoclimatic diversity, while those located more than 1500 m high have a tendency to increase it. The stations located between 1000 and 1500 m high have a heterogeneous behavior.

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