USE OF AN ANALOG METHOD TO DOWNSCALE TEMPERATURE AND PRECIPITATION CLIMATE CHANGE PROJECTIONS OVER PENINSULAR SPAIN AND BALEARIC ISLANDS

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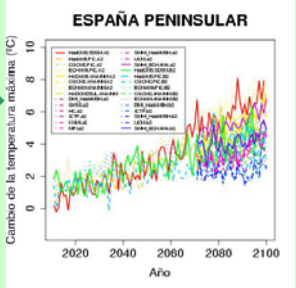
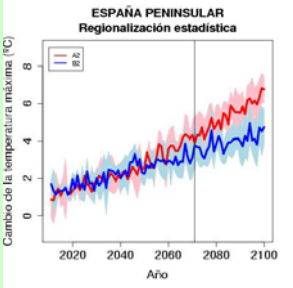
OBJECTIVES

- This work is part of a more general work aiming to obtain climatic change scenarios for Spain for the whole XXI century, by using several global climate models and regionalization techniques with diverse emission scenarios, in order to estimate uncertainties of the projections. The main results of the general work can be accessed from INM web.
- Here we show the results of one of the regionalization methods utilized, based on synoptic analogs.
- We analyse regional, annual and seasonal projections. of maximum and minimum temperature and precipitation changes, over Peninsular Spain and Balearic Islands in the period 2071-2100, with respect to the reference period 1961-1990.





DATA

- Gridded (50 km resolution) Tmax, Tmin, precipitacion daily data based on INM stations (Boren and Ribalaygua 1997)
- Reanalysis NCEP (Kalnay et al, 1996), 1961-1990
- Model climate simulations from ECHAM4 (Roeckner et al, 1996), CGCM2 (Flato and Boer, 2000), HadAM3 (Pope et al, 2000), for reference (1961-1990) and projections IPCC SRES A2 and B2 (2011-2100).

PRECIPITATION ESTIMATION METHODOLOGY (Petisco,2005)

- A weighted average of the estimation point precipitation of a number of analogs to the study day, is calculated.
- The weights depend on the disimilarity of each analog with the study day.
- The disimilarity includes the synoptic disimilariy and the disimilarity of predictors calculated on the estimation zone.
- The number of analogs and the predictors used depend on the study day synoptic pattern and the estimation point.
- Possible predictors: geopotential, wind components and vorticity at 1000 and 500 hPa.
  1000/500 thermal wind intensity and geopotential tendency at 1000 hPa.

TEMPERATURE ESTIMATION METHODOLOGY (maximum or minimum) (Borén y Ribalaygua,1997)

Linear regression equation built from a step by step method from data in the estimation point of 150 synoptic analogs to each study day.

Possible Predictors:

- 500/1000 Thickness
- Theoretical sunshine in the study day.
- Disimilarity with the study day
- Weighed average of the average temperature in the 10 days before the study day

RESULTS AND CONCLUSIONS

CHANGE (%) OF ANNUAL AND SEASONAL MEAN PRECIPITATION FOR (2071-2100) WITH RESPECT TO (1961-1990)

Scenario A2 | Scenario B2

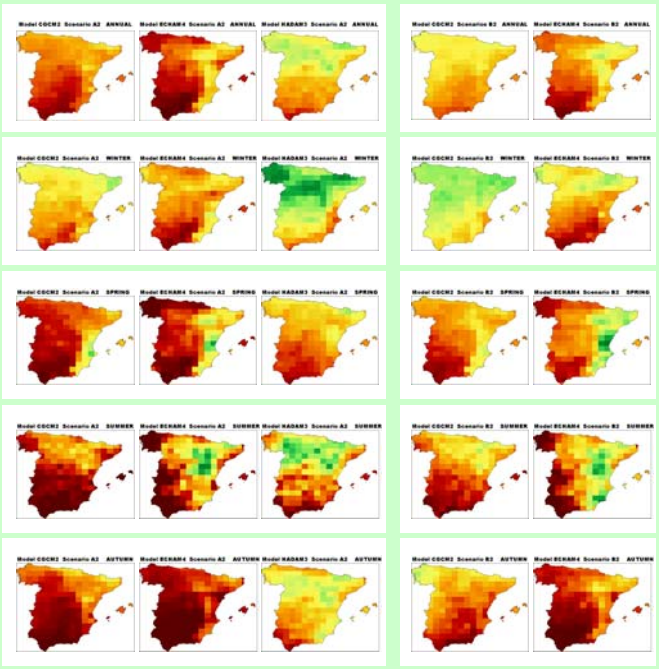
Annual

Winter

Spring

Summer

Autumn



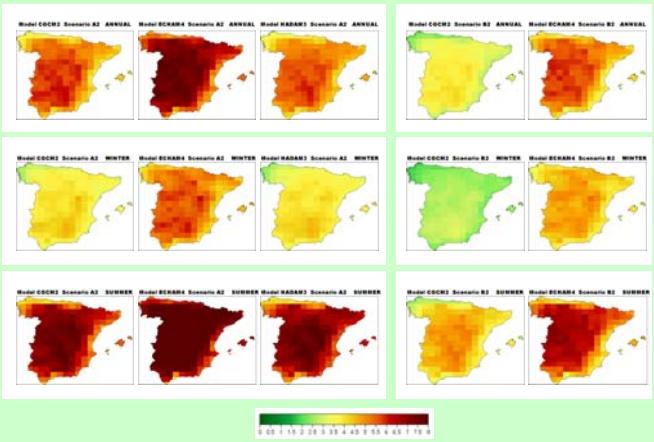
CHANGE OF ANNUAL AND SEASONAL MEAN MAXIMUM TEMPERATURE FOR (2071-2100) WITH RESPECT TO (1961-1990)

Scenario A2 | Scenario B2

Annual

Winter

Summer



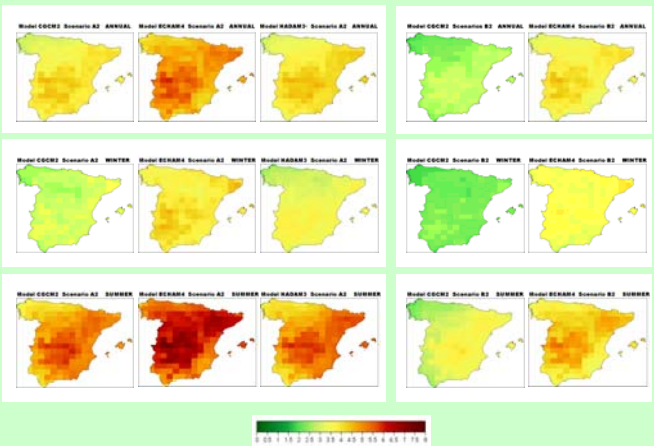
CHANGE OF ANNUAL AND SEASONAL MEAN MINIMUM TEMPERATURE FOR (2071-2100) WITH RESPECT TO (1961-1990)

Scenario A2 | Scenario B2

Annual

Winter

Summer



RESULTS

Although most of the downscaled projections were computed for the whole 21st century, only results for 2071-2100 are commented.

A) Projections of precipitation

Projections based on most GCMs and IPCC SRES show a predominant reduction of precipitation, especially under A2 scenario. The remarkable differences both in percentual value and geographical distribution highlight the big uncertainty associated to climate change precipitation projections over Spain. Nevertheless, a noticeable trend to annual reduction seems to appear over southern half of Peninsular Spain and Balearic Islands. In winter season, most projections show decreasing precipitation over almost all the southern half of Peninsular Spain, and Balearic Islands. The uncertainty is higher over the northern half, where some models y scenarios show some increase for some areas. In summer time, there appears a predominant decrease over northwest, northern coast, southern Peninsula and Balearic Islands. A smaller decrease is shown over the remaining area, where some models and scenarios even show increases. In spring, it is noticeable a predominant decrease, smaller over the eastern region with some light increases over areas of Mediterranean Coast. Finally, although some models show a slight increase over certain areas, there is a general trend towards decrease, not so clear over the eastern area.

B) Projections of maximum temperature

The pattern of maximum temperature change is rather similar for all GCMs and scenarios here considered, showing a marked increase over the whole country. Warming is greater inland and not so high over costal regions. The temperature increase shows also a noticeable annual cycle with bigger warming in summer time. As expected, temperature changes are bigger in more emitting scenarios. The projections based on ECHAM4-OPYC show a remarkable warming compared with those based on other GCMs.

C) Projections of minimum temperature

The change of minimum temperature is very coincident with Tmax, being in general lower than the corresponding for Tmax

CONCLUSIONS AND PERSPECTIVES

The usage of different AOGCMS and SRES-IPCC with the same SDS method has allowed to explore the behaviour of climate change downscaled projections at scales of 50 km. The quantification of the different sources of uncertainties was as well explored in the frame of a more general project also involving different dowscaling methods based on RCMs and SDS. This work, based on IPCC-TAR models, will be repeated with a more advance version of the method here described using more IPCC-AR4 AOGCMs and SRES-IPCC in the context of a bigger project aiming to produce downscaled climate change projections for Spain together with a comprehensive evaluation of different sources of uncertainties.

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