Simulations of present climate temperature and precipitation episodes for the Iberian Peninsula

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Background

In order to assess climate change (CC) there is the need to use Global Climate Models (GCM). Recently GCMs have been used to drive Regional Climate Models (RCM) and produce higher resolution data.

The performance of these simulations can only be evaluated by using recent past (1961-2000) simulations and comparing them to observed data.

Recent past data can also be used to assess CC and how models are simulating that CC.

Motivation

This work is part of the CLIPE Project that aims to study future Climate Change using the ENSEMBLES simulations for the 2001-2100 period. In order to do so, there is the need to assess the behavior of the simulations which is only possible by comparing then to observed data which is only available for the past.

Objective

- Evaluating Model Performance;
- Determining CC in precipitation and maximum and minimum temperature in the Iberian Peninsula (IP) during the 1961-2000 period;

Data & Methods

- ENSEMBLES 1961-2000 [1]
  - GCM driven RCM (A1Bscenario)
  - ERA40 driven RCM
  - Observed data

Variables: Maximum Temperature (Tmax), Minimum Temperature (Tmin) both in °C and daily Precipitation amount (mm/m^2).

- Probability Distribution Functions (PDFs)

- Taylor Diagram (Taylor et al 2011) which take into account the Standard Deviation of a data-set, the Root Mean Square Error of the Simulations in relationship to the Observation and the Correlation between Simulations and Observations.

- Relevant CLIVAR Indexes [2] for both precipitation and temperature extremes.

This work is part of the *Climate Change of extreme episodes in the Iberian Peninsula and its forcing mechanisms – CLIPE*. PTDC/ AAC-CLI/111733/2009

Results & Discussion

Inter-model Comparison

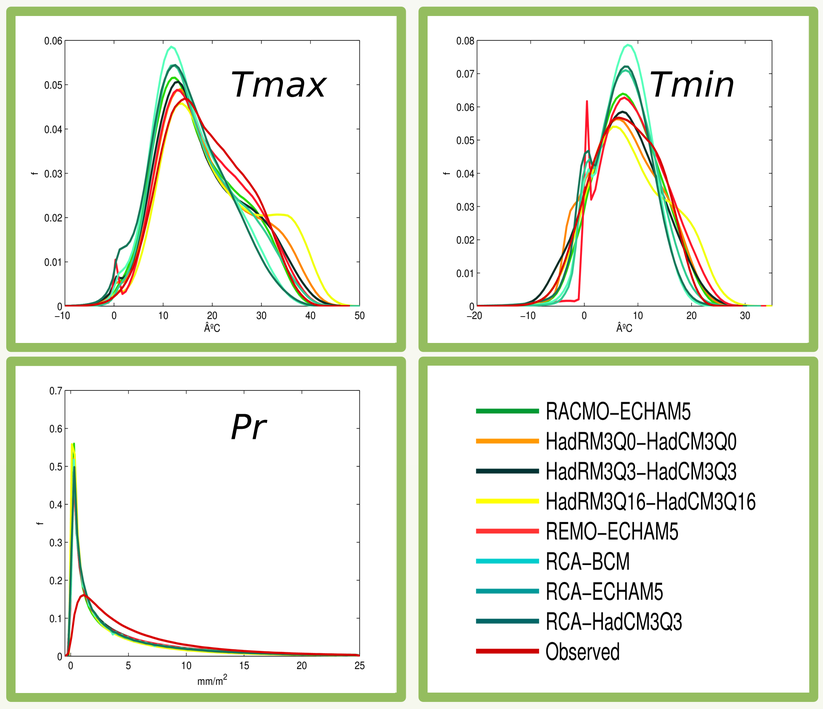

Fig 1: Probability Distribution Functions for GCM driven simulations.

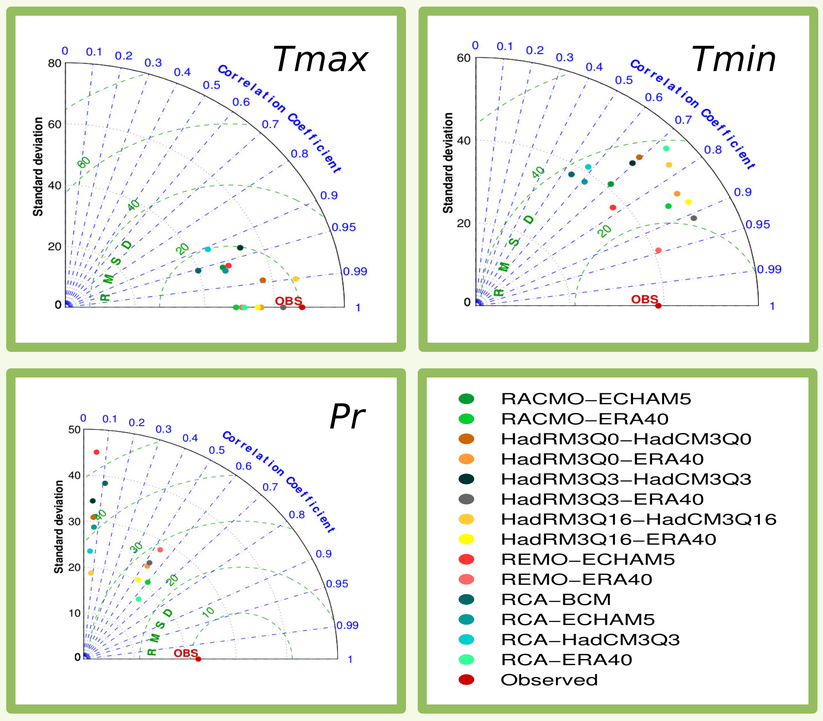

Fig2: Taylor Diagram (Taylor *et al*. 2011) for both RCM-GCM simulations and ERA40 driven simulations.

Best Performing RCM-GCM Combination:
HadRM3Q0-HadCM3Q0
(3Q0 = normal sensitivity)

This model was then used to determine a set of several of CLIVAR indexes reamed to be the most relevant, which were then compared to the observed ones.

CSU – greatest # consecutive days Tmax > 25 ºC

CFD – greatest # consecutive days Tmin < 0ºC

TR - # days with Tmin > 20 ºC

ETR – greatest temperature range: Tmax - Tmin

CDD – greatest # consec. days pr < 1 mm

CWD – greatest # consec. days pr > 1 mm

R99p - # days pr > 99th percentile of pr for wet days

- Maximum and Minimum temperature distributions are overall well represented by the simulations under study. - Precipitation simulations show similar results among models. However, observations show a smoother curve with a larger range of intensities and less localized peak. - Makes it harder to accurately predict future CC.

Temperature & Precipitation Indexes

Table 1: Trend of some of the CLIVAR indexes for both capital cities of the IP determined with both observed data and HC 3Q0 – best performing RCM-GCM Combination (colored cells have statistical significance).

Variable	Index	Lisbon		Madrid	
		Obs	HC 3Q0	Obs	HC 3Q0
Temperature	CSU	-0,1198	0,3868	0,4875	0,2350
	CFD	-0,0018	-0,0677	-0,0527	-0,1128
	TR	0,3737	0,0483	0,3061	0,1472
	ETR	-0,0828	-0,0111	0,0106	-0,0309
Precipitation	CDD	0,0968	0,1204	-0,3809	-0,0903
	CWD	-0,1159	-4.6904 x 10^{-4}	-0,0361	-0,0185
	R99p	0,0085	-0,0307	-0,0120	0,0189

Observations show:

Lisbon → lower extreme temperatures but more number of warmer nights;

→ less frequent precipitation but more intense.

Madrid → more hot days, warm nights and higher daily range;

→ Lower # frost days;

→ Precipitation has become better distributed in time with lower episodes of extreme rainfall.

Results show significant differences between the trends obtained for Lisbon and Madrid both in observed and modeled data.

Conclusions

Even though modeled trends of the CLIVAR Indexes show significant differences from the observations, these simulations are an important tool to assess changes in patters of both rain and temperature over an area.

However, a heightened horizontal resolution, together with a model ensemble would be needed to better understand the Climate responses at a local scale.

References

Taylor, K. Summarizing multiple aspects of model performance in a single diagram. Journal of Geophysical Research, 106.

[1] http://ensemblesrt3.dmi.dk/

[2] http://www.clivar.org/