Temperature and Precipitation extreme events in the Iberian Peninsula: Evaluation of ENSEMBLES Regional Climate Model simulations

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From the ENSEMBLES Project to CLIPE

CLIPE is a FEDER and FCT funded project which aims to study **climate change** of **extreme episodes** in the **Iberian Peninsula** and its forcing mechanisms.
http://climetua.fis.ua.pt/climetua/projects

ENSEMBLES Integration area

CLIPE Study area
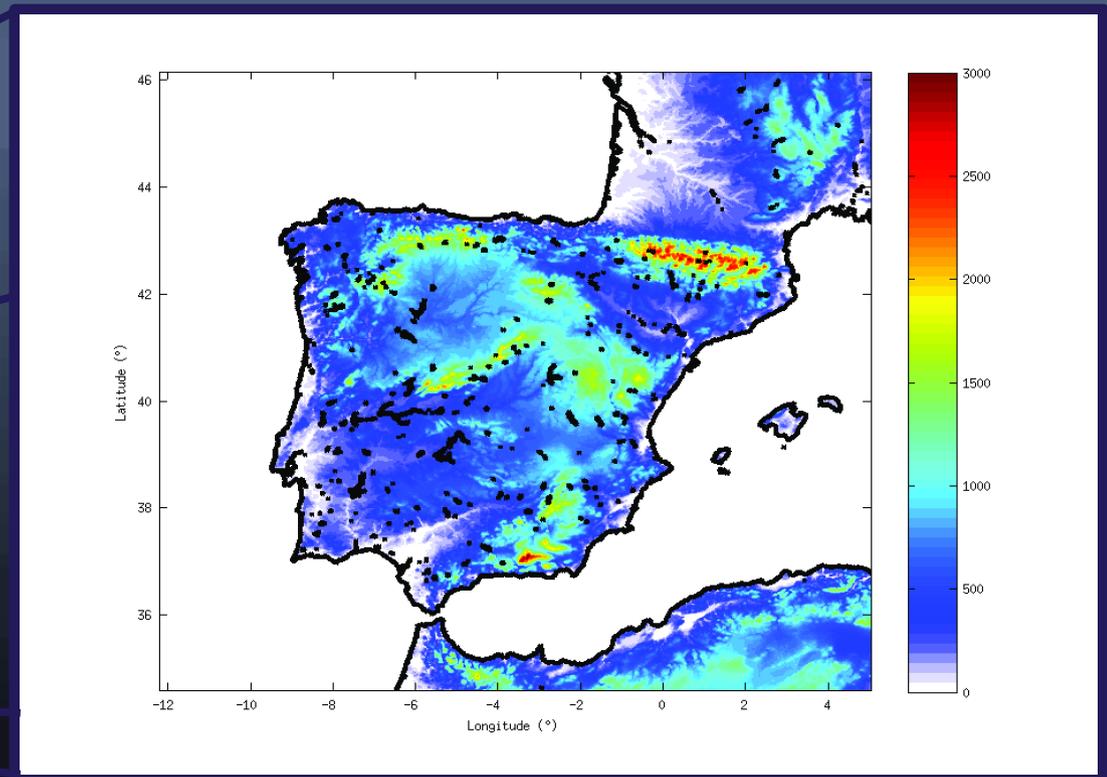
Topography of the domain - GTOPO database.

Resolution of 0.22º x 0.22º

Objective

- There are several ongoing parallel works. This particular one is focused on the reliability and uncertainty associated with climate simulations, specifically, in the ENSEMBLES simulations.

- Here, only the **ensemble** of the simulations will be discussed, not focusing on any particular model.

Which datasets were used?

RCM		BCM	ECHAM5	HadCM Low S. 3Q3	HadCM Normal S. 3Q0	HadCM High S. 3Q16	ERA40
RACMO			X				
HadRM	Low S. (3Q3)			X			
HadRM	Normal S. (3Q0)				X		
HadRM	High S. (3Q16)					X	X
REMO			X				
RCA		X	X		X		

Driving Global Climate Model (header spanning BCM, ECHAM5, HadCM, ERA40)

Combination of forcing GCM and RCM forced used for this work. Note that there are more simulations in the ENSEMBLES project.

European Climate Assessment and Dataset (ECAD) **E-OBS** dataset (with a 0.22º x 0.22º resolution in a rotated grid)

How to evaluate performance?

- ETCCDI and other extreme event definitions for both daily temperature and precipitation

Precipitation	Min. Temp.	Max. Temp.	Mean Temp.
PRCPTOT	TN10p	TX90p	TG10p
CDD	Mean Cli.	Mean Cli.	TG90p
CWD	FD		CWFI
R95p			HWFI
R95pTOT			

ETR

How to evaluate performance?

- ERA40-driven ensemble and GCM-driven ensemble (median) of the indexes were compared to E-OBS indexes:

  - Spatial average of climatologies and uncertainties of the ensembles;

  - Spatial differences between ensembles and observed climatologies of the indexes;

  - Study of the time variability of the indexes;

  - Testing the similarity of the observed and modelled time distributions of the indexes;

Climatologies

- For each index, the ERA40-driven ensemble meand and the GCM-driven ensemble mean were calculated.

- The spatial mean of their summer and winter climatologies was determined, using the data for the entire Iberian Peninsula domain.

- The spread of each of the ensembles was also determined to assess their overall variability

Results
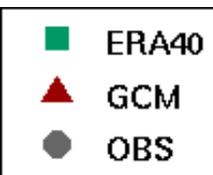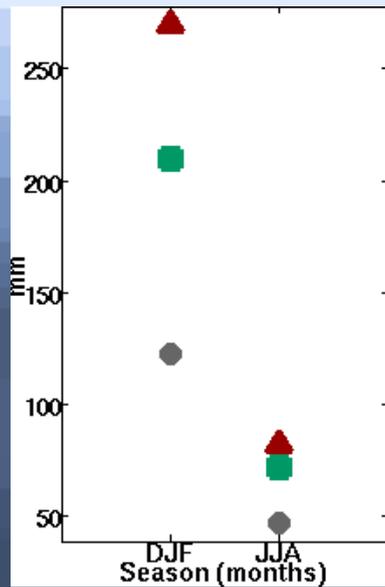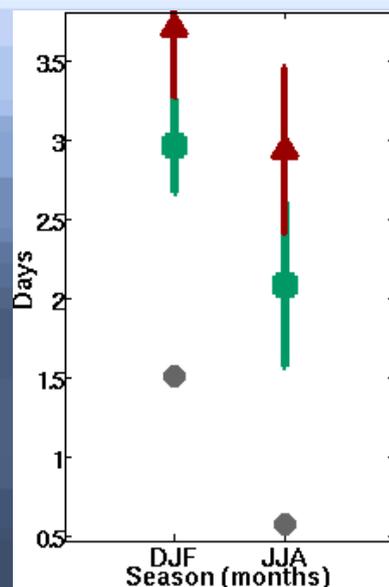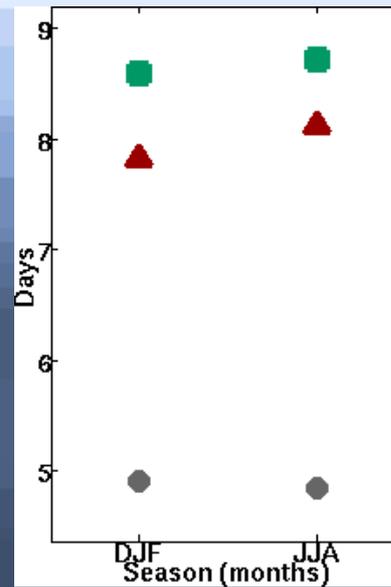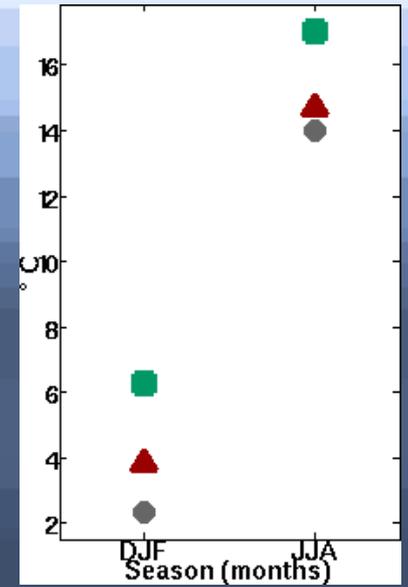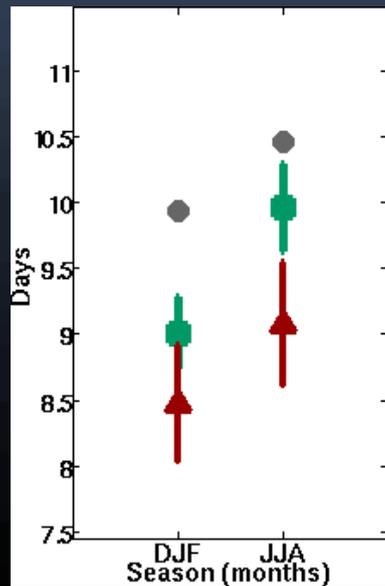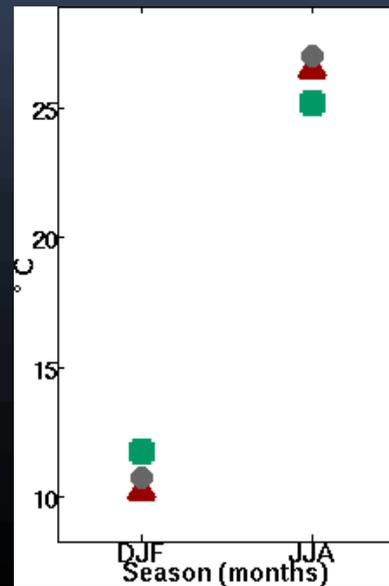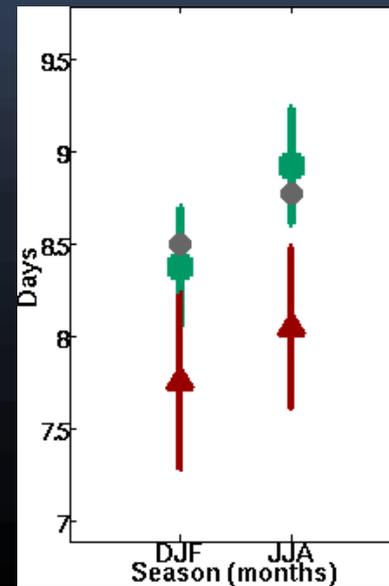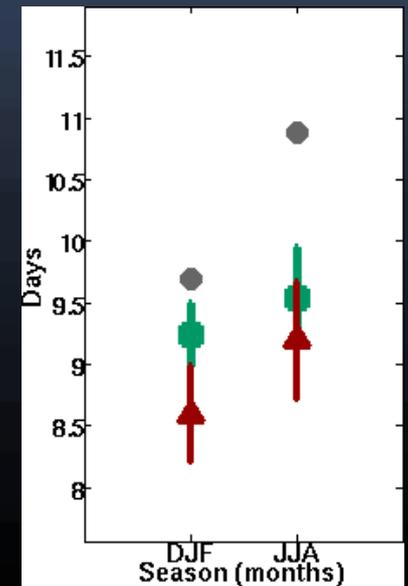
Climatology diff. fields

- Represented difference fields to examine geographical variations in ensemble performance.

- Differences only represented where their difference is statistically significant at the 95% confidence level and where the spread of the ensembles is lower than 25%

R95p

Winter - DJF   Summer - JJA
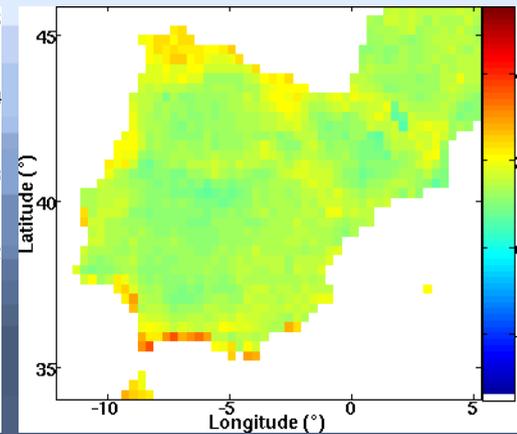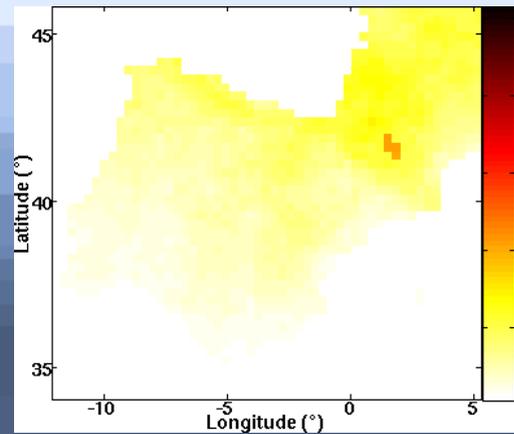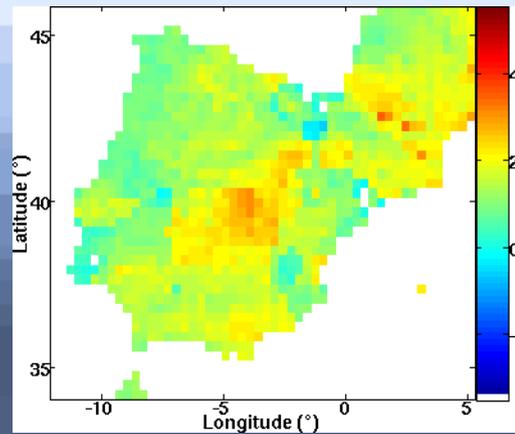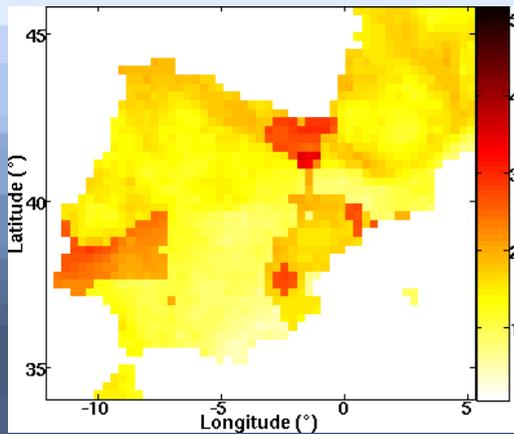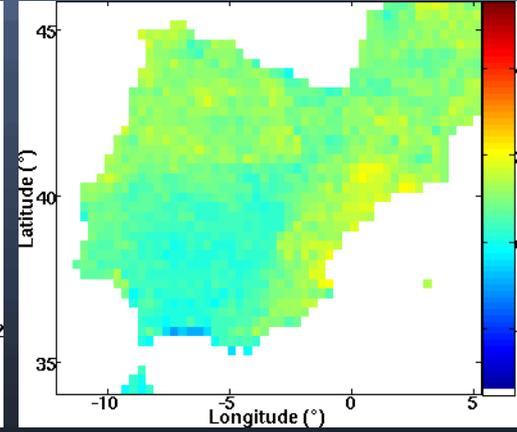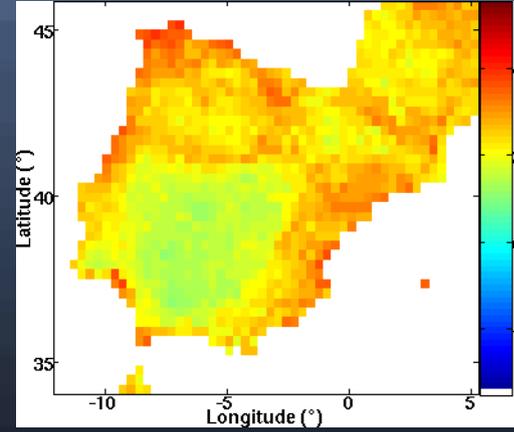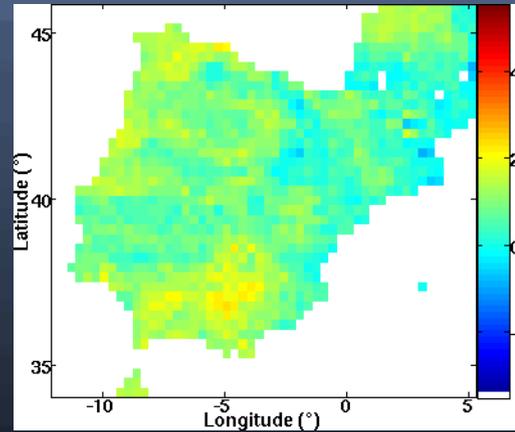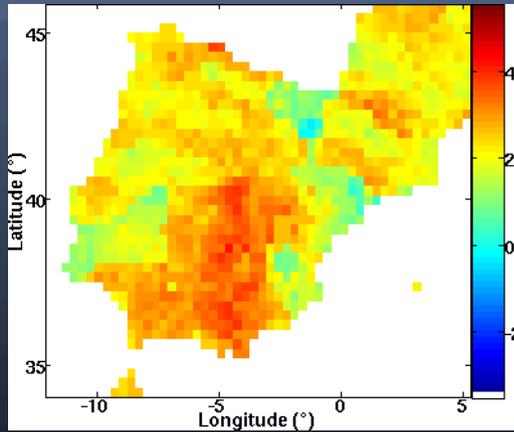
- GCM-OBS larger than ERA40-OBS, as expected;
- But low(ish) differences between ERA40 and GCM driven ensembles;
- JJA lower differences than for DJF (JJA = dry season!)
- Higher diff. DJF in SE Iberia, where lower diff. In JJA

TX90p
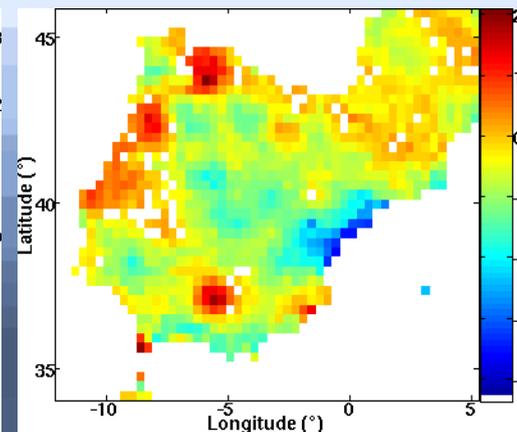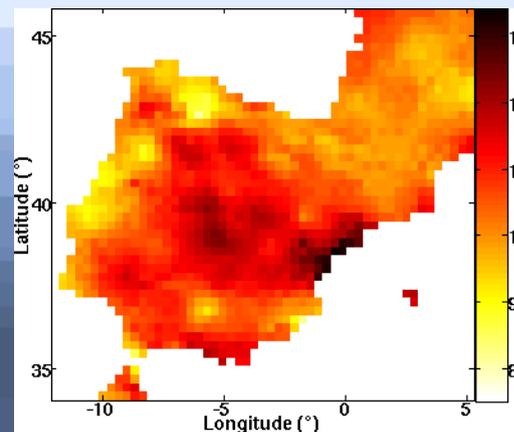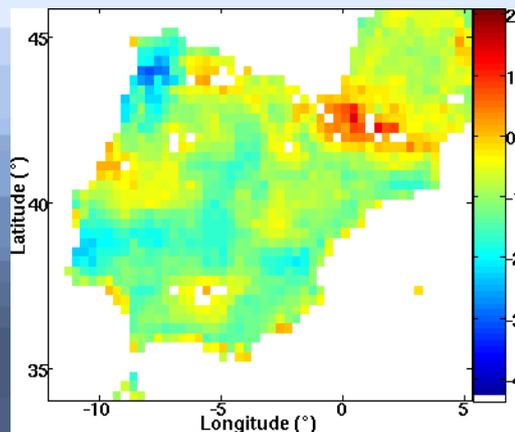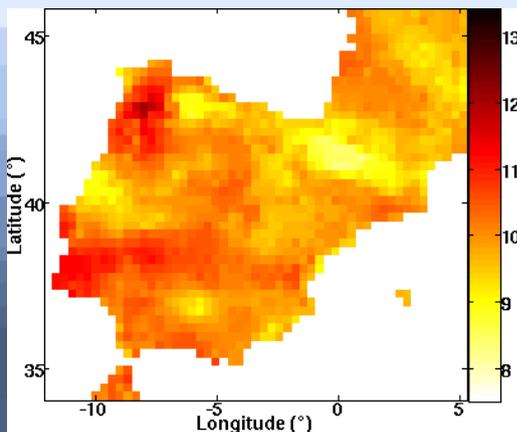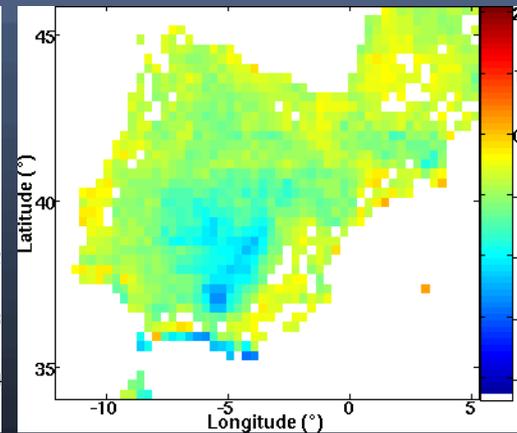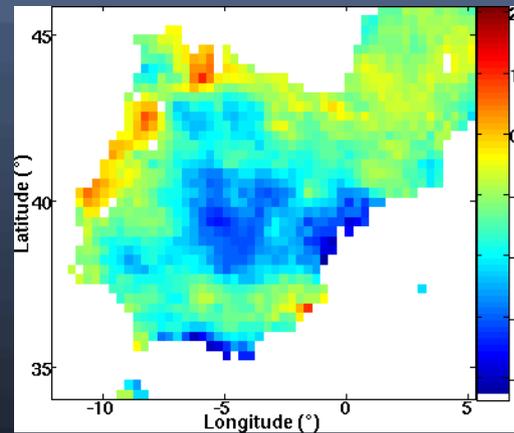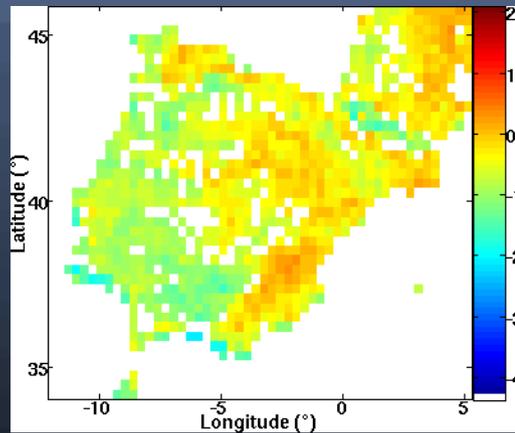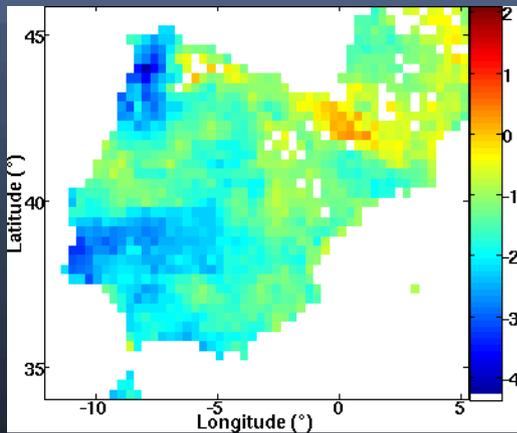
- Significant differences in the northern part of the W coast and along the Pyrenees between ERA40-OBS and ensembles in DJF;
- W Coastline large diff. Between ERA40 and OBS opposite sign but larger between ensembles in the central to eastern part of the Iberia.

TG90p
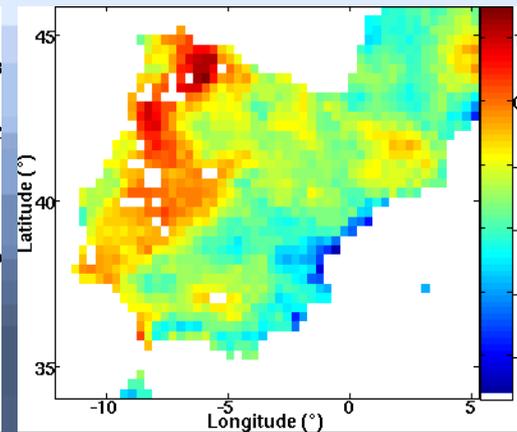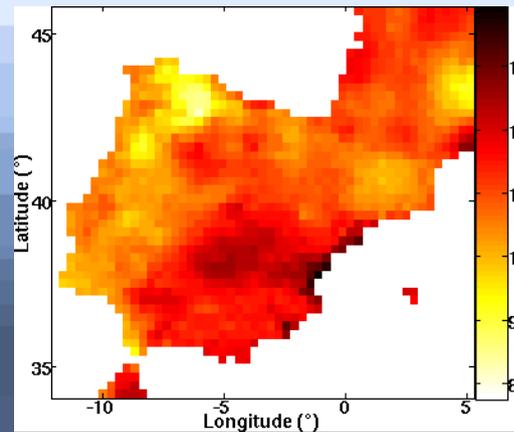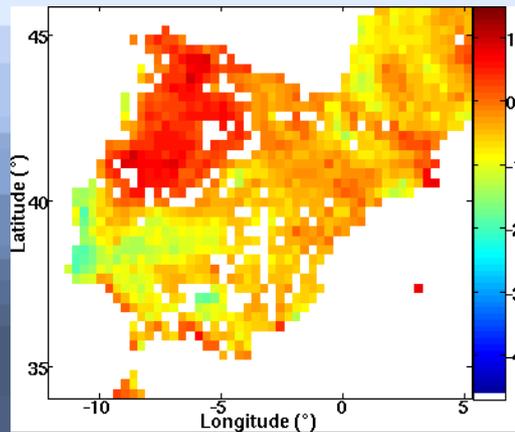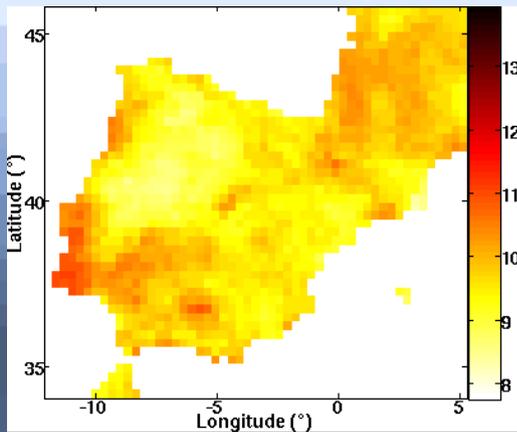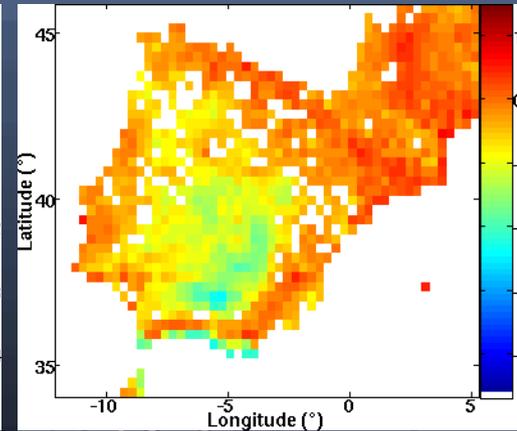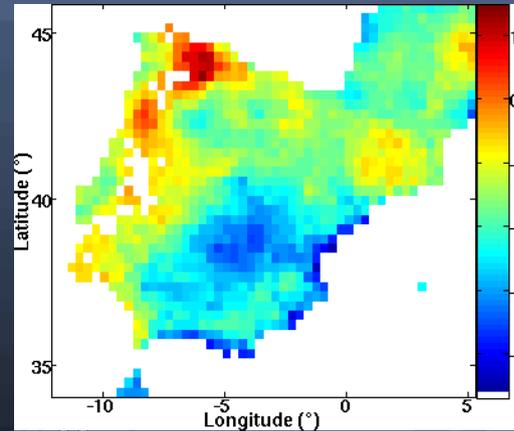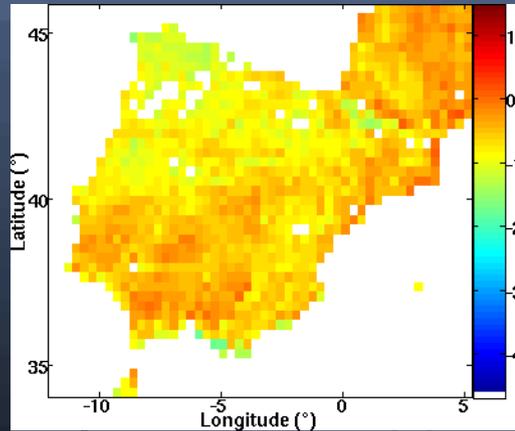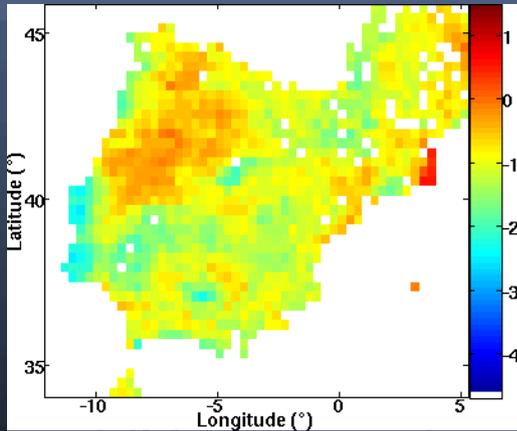
- NW area shows larger positive diff. between ERA40/GCM and OBS for both seasons;
- JJA shows large negative differences in the SE of the Iberia (which, means that the GCM-drinven enseble is underestimating the index);
- Negative diff. along the west-coast of the Iberia.

Testing the PDF's

- For every grid point, the Probability Distribution Function of the ensembles was tested against the observed one, as well as between ensembles.

- The Kolmogorov-Smirnov Test was used and the p-value field represented for summer and winter

Testing the PDF's

TX90p
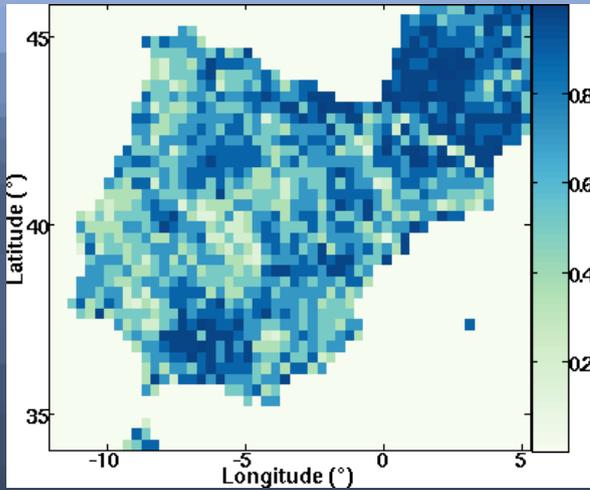
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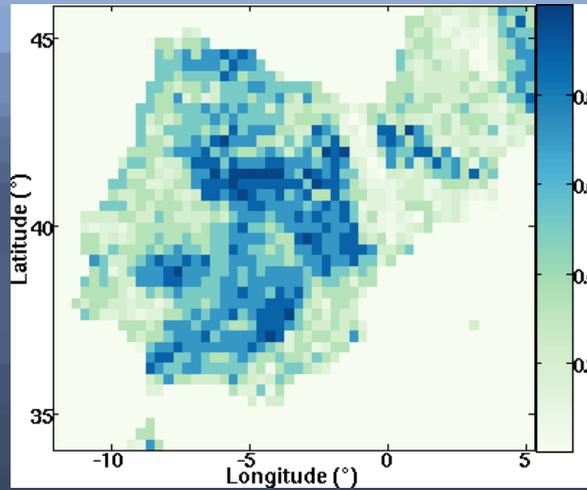
ERA vs OBS   GCM vs ERA   GCM vs OBS
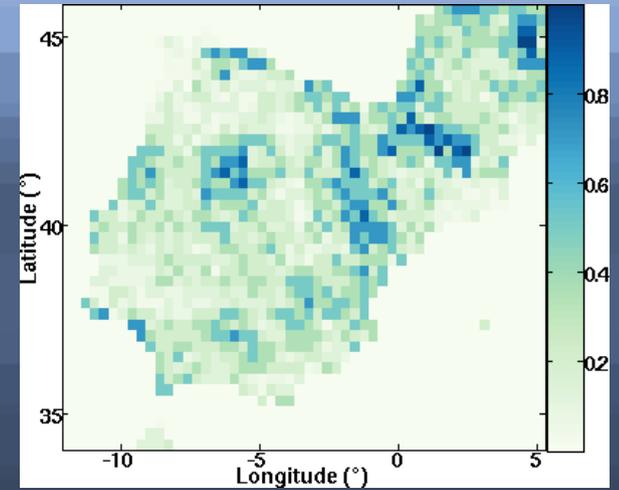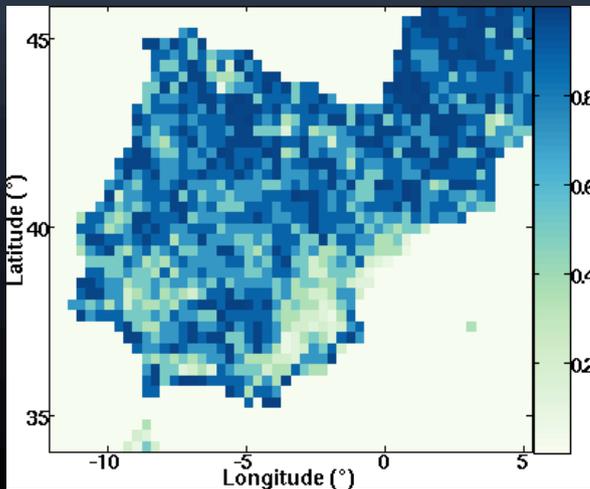
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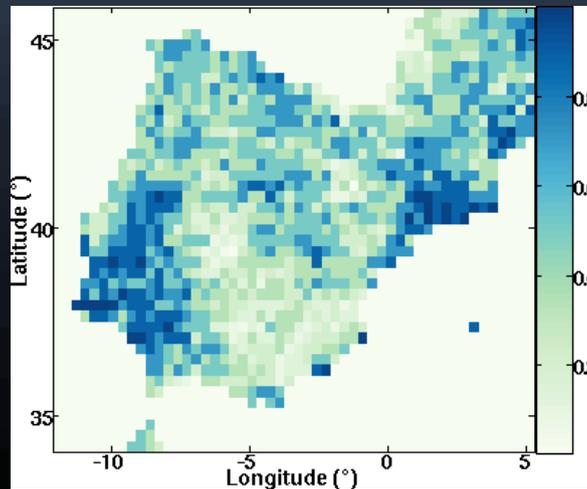
ERA vs OBS   GCM vs ERA   GCM vs OBS
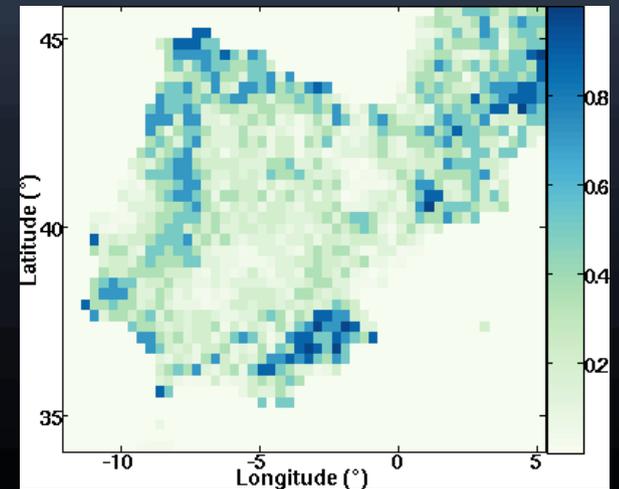
Testing the PDF's

TG90p
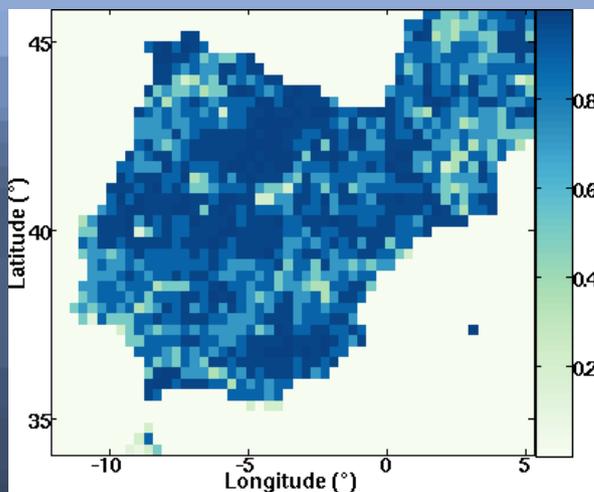
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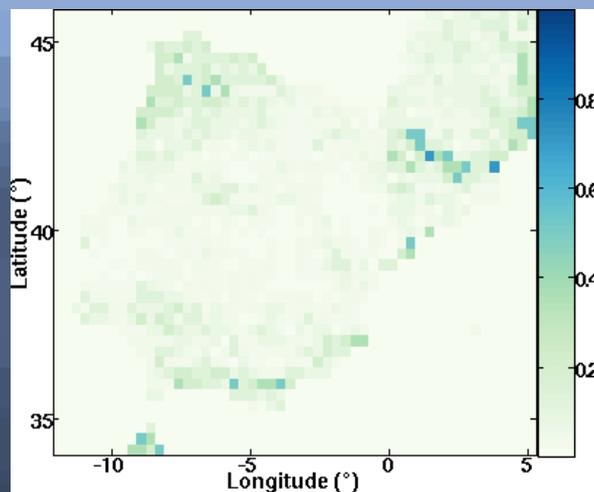
ERA vs OBS	GCM vs ERA	GCM vs OBS
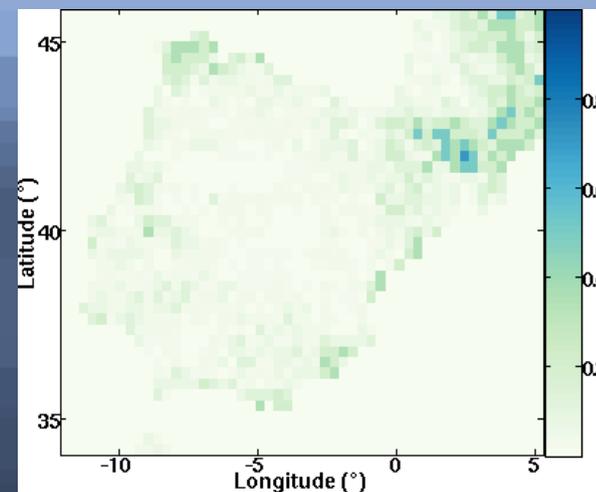
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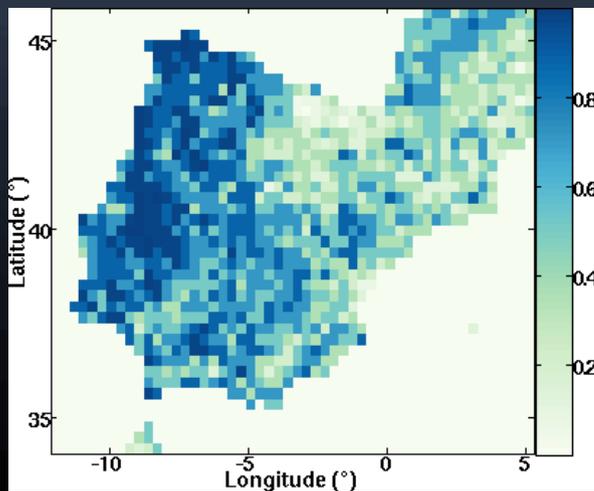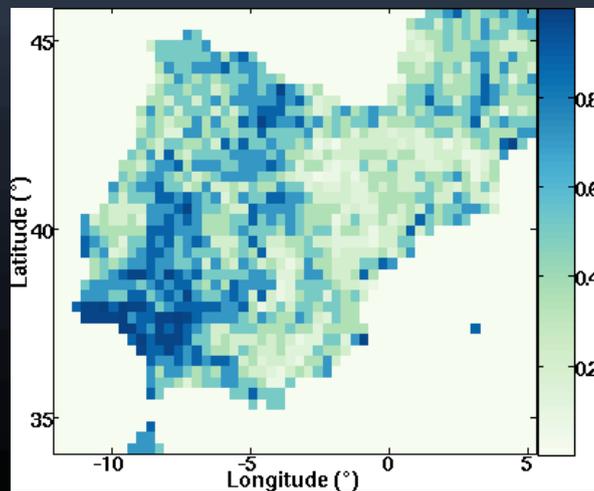
ERA vs OBS	GCM vs ERA	GCM vs OBS
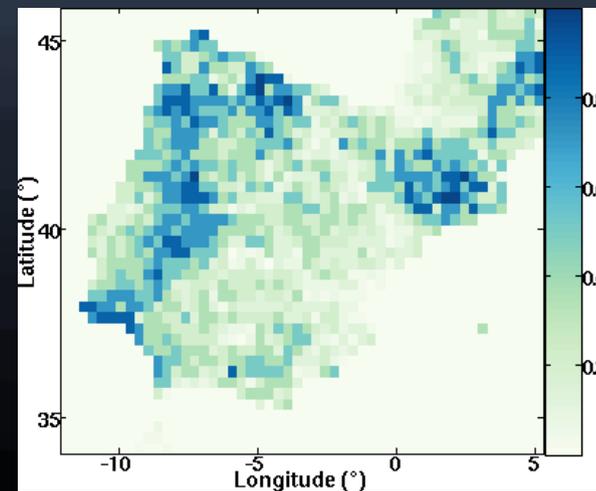
Time variability

- To assess time variability, the time series of the winter and summer spatial mean indexes was represented, together with the observed variability (shaded).

- This was done after applying an 11-year running mean to remove decadal variability.

Time variability

Time variability

Legend: ERA40-ensemble, GCM-ensemble, OBS
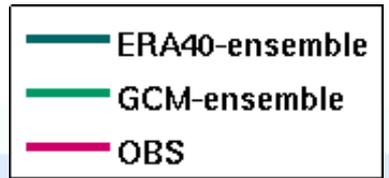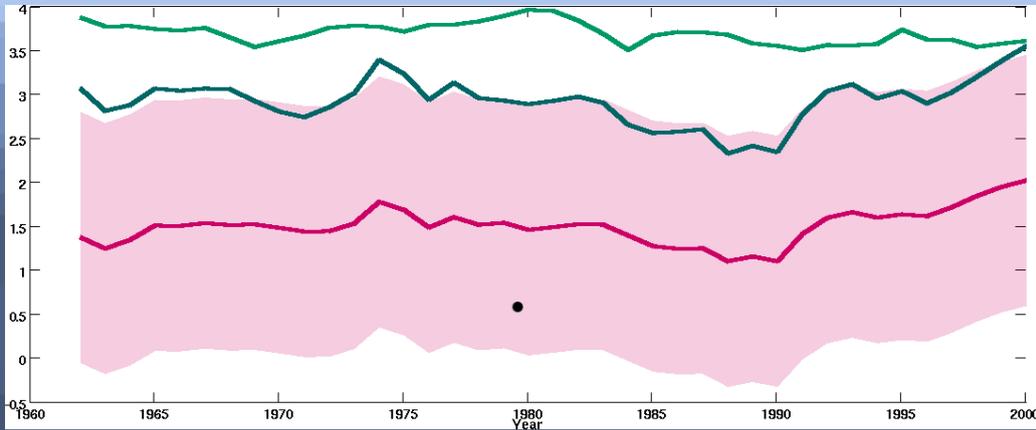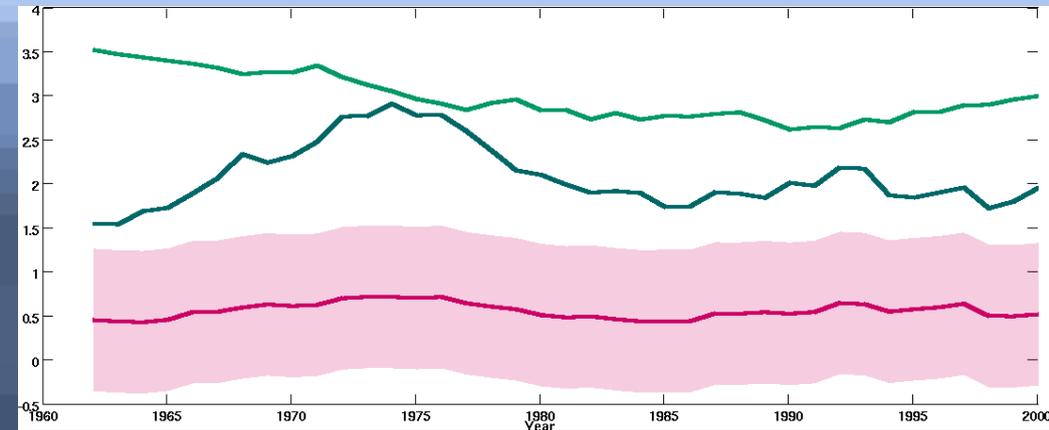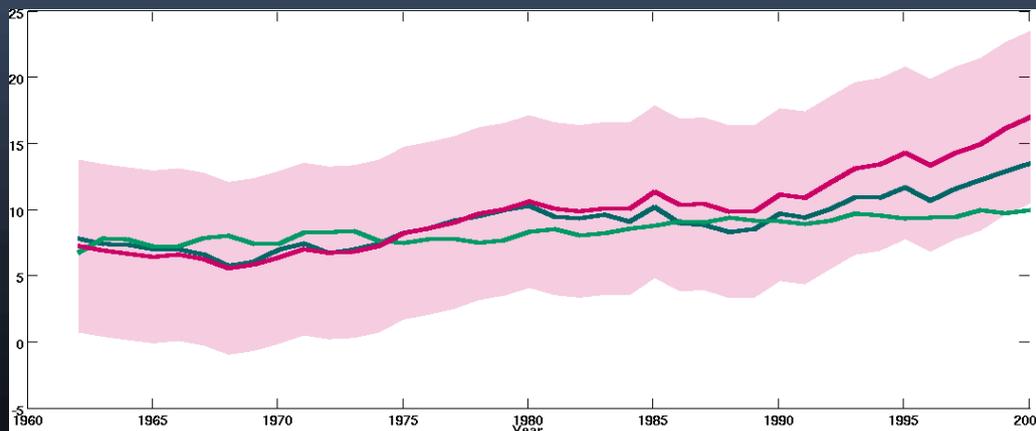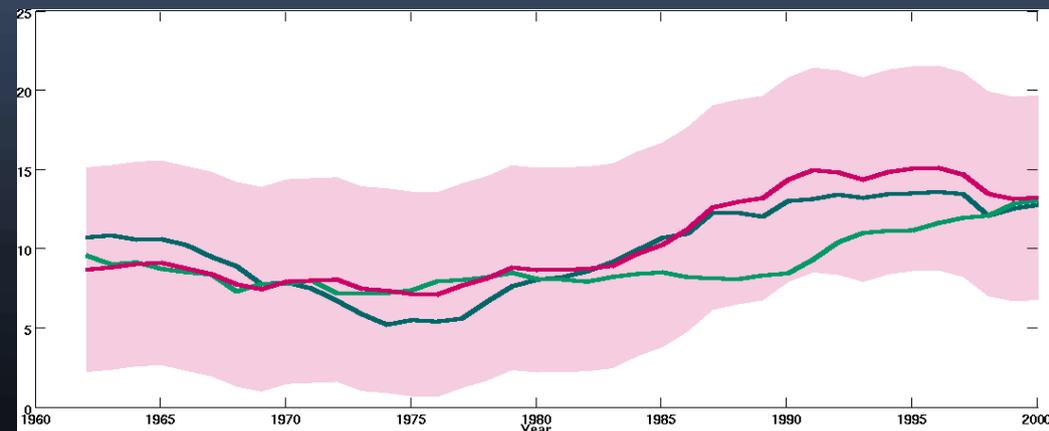
TG10p
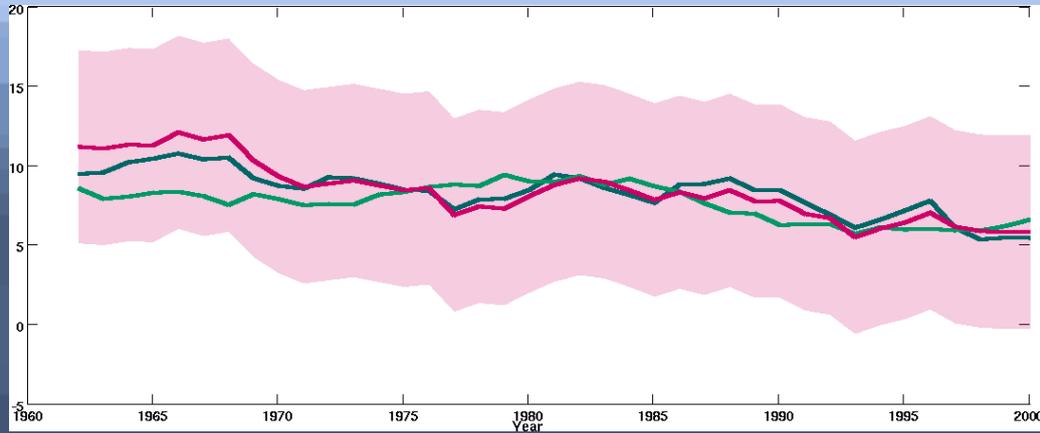
Winter - DJF

Summer - JJA
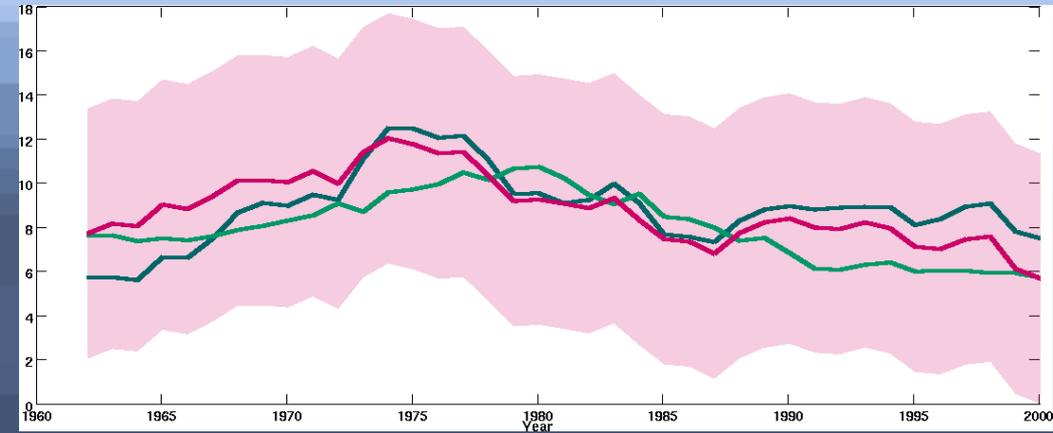
TG90p

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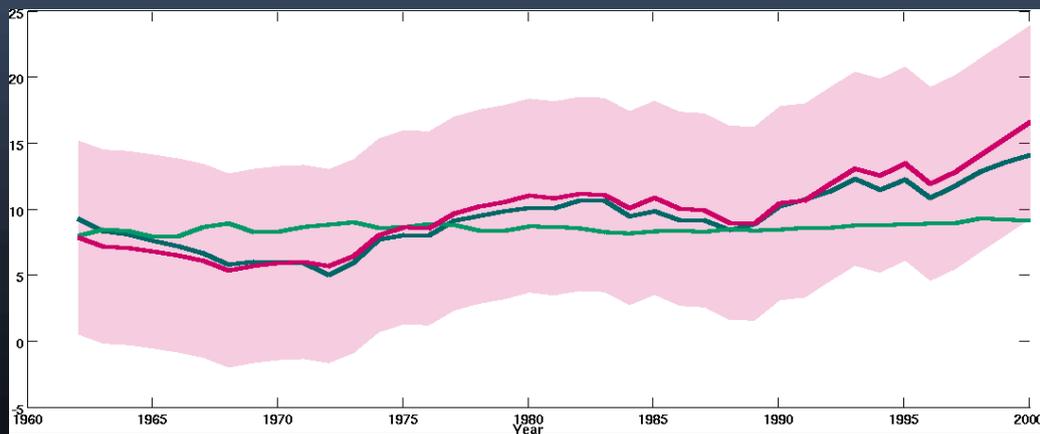
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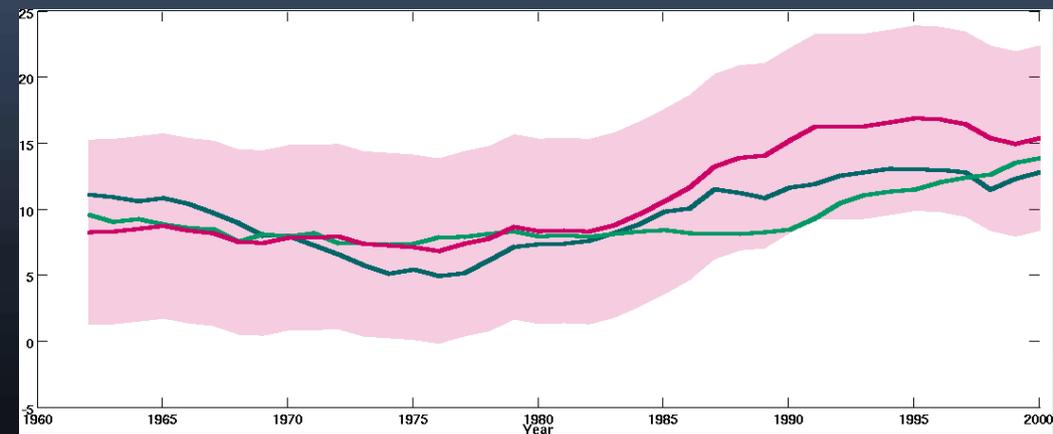
Concluding remarks

- GCM-driven and ERA40-driven ensembles show better performance for temperature indexes than for precipitation ones;

- High spatial variability in performance, with lower one near coastlines and in areas of more complex topography;

- Climatologies show better performance than percentile-related indexes;

- Higher level statistical analysis shows lower performance than simpler ones (e.g.: climatologies).

Further work...

- Using these results to separate the Iberian Peninsula into regions and evaluating performance in those regions seperately;

- Analysing climate change projections using ETTCDI indexes (and other tools), keeping in mind the results from this analysis

- ...

Acknowledgments

Thank you for your time!