Quantification of the expected changes in annual maximum daily precipitation quantiles under climate change in the Iberian Peninsula

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INTRODUCTION

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· Local adaptation policies to climate change require the possible evolution of extreme precipitation due to its importance in, for example, flood risk or infrastructure systems safety.

· The procedure to evaluate how the climate will behave in the future is the use of Global Climate Models (GCM) via Regional Climate Models (RCM).

· This study offers a new approach to study the effect of climate change, and specially to add conclusive results, statistically based, of the change of maximum precipitation in the Iberian Peninsula in the future under RCP 4.5 and RCP 8.5.

BASE DATA

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· Data used in this study comes from the EURO-CORDEX project, as is the only region that includes the entire Iberian Peninsula.

· A total of 12 models from the EURO-CORDEX project have been selected, with a spatial resolution of 0.11° and daily frequency outputs.

Nº	Acronym	MCG	MCR	Simulation periods (Control/ Future)
1	ICH-CCL	ICHEC-EC-EARTH	CCLM4-8-17	1951-2005/ 2006-2100
2	MPI-CCL	MPI-ESM-LR	CCLM4-8-17	1951-2005/ 2006-2100
3	MOH-RAC	MOHC-HadGEM2-ES	RACMO22E	1951-2005/ 2006-2099
4	CNR-CCL	CNRM-CM5	CCLM4-8-17	1951-2005/ 2006-2100
5	ICH-RAC	ICHEC-EC-EARTH	RACMO22E	1951-2005/ 2006-2100
6	MOH-CCL	MOHC-HadGEM2-ES	CCLM4-8-17	1951-2005/ 2006-2099
7	IPS-WRF	IPSL-CM5A-MR	WRF331F	1951-2005/ 2006-2100
8	IPS-RCA	IPSL-CM5A-MR	RCA4	1971-2005/ 2006-2100
9	MOH-RCA	MOHC-HadGEM2-ES	RCA4	1971-2005/ 2006-2099
10	ICH-RCA	ICHEC-EC-EARTH	RCA4	1971-2005/ 2006-2100
11	CNR-RCA	CNRM-CM5	RCA4	1971-2005/ 2006-2100
12	MPI-RCA	MPI-ESM-LR	RCA4	1971-2005/ 2006-2100

METHODOLOGY

1. General remarks

- Annual daily maximum series (AMS).
- Three future periods: 2011-40, 2041-70 and 2071-95.
- RCP 4.5 and RCP 8.5
- Seven return periods (2, 5, 10, 50, 100, 500 and 1000 years)
- GEV distribution function through L-moments.
- Relative differences between control and future periods
- Percentiles 50 (median), 68 & 90, show the general change trend.

2. Uncertainty Analysis

The steps involved in the uncertainty analysis are show below:

1. Generation of 1000 random probability series.
2. Conversion of these probability series into precipitation series
3. Obtention of 1000 GEV frequency distributions through new AMS.
4. Chose a two-sides significance threshold (α) to evaluate if future projections are inside or outside this threshold limits from the 1000 values distribution at each return period (T).
5. Check the number of models (N) with a significant threshold.

Defining these two thresholds (α and N) significant changes can be seen

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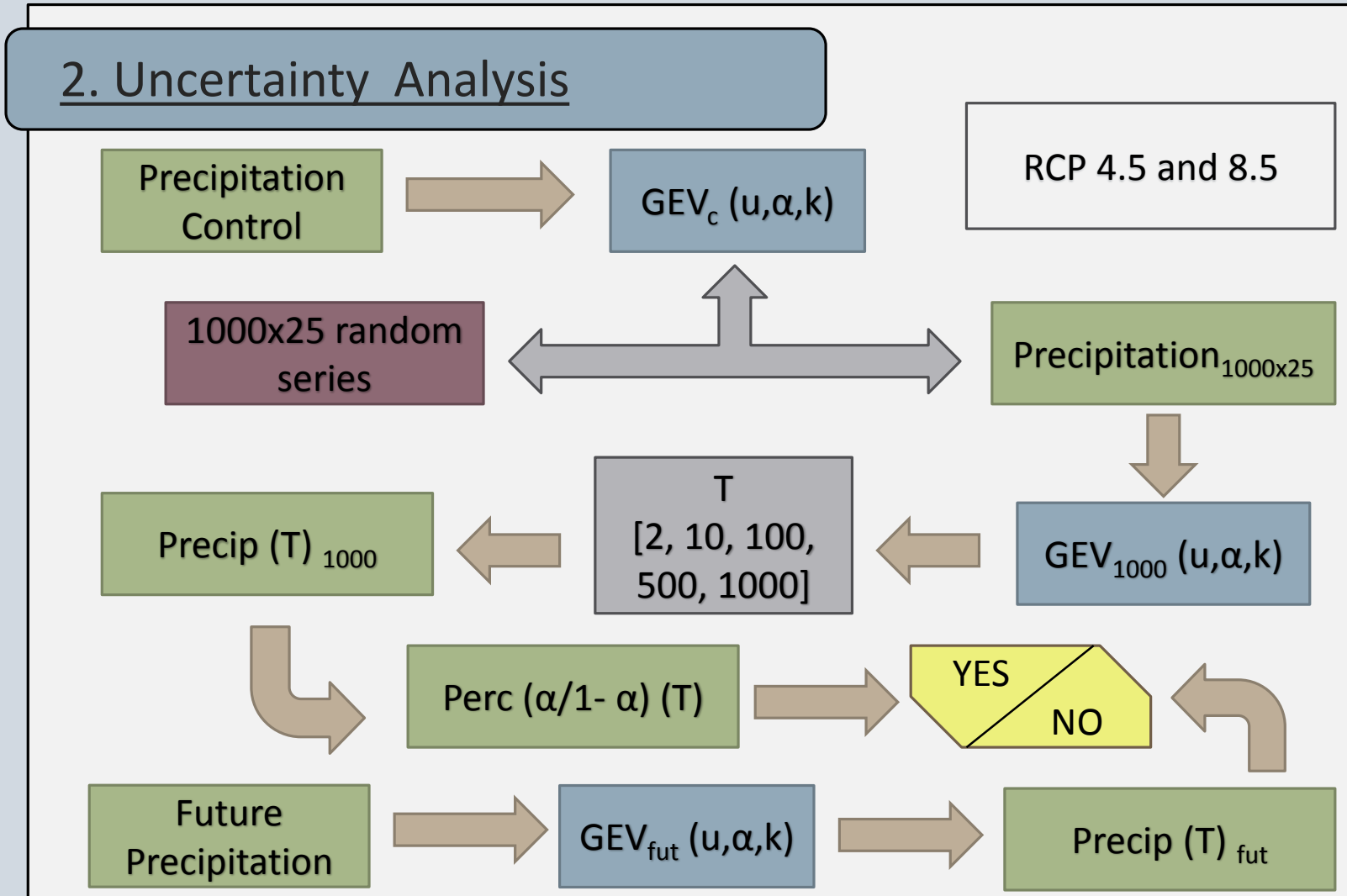
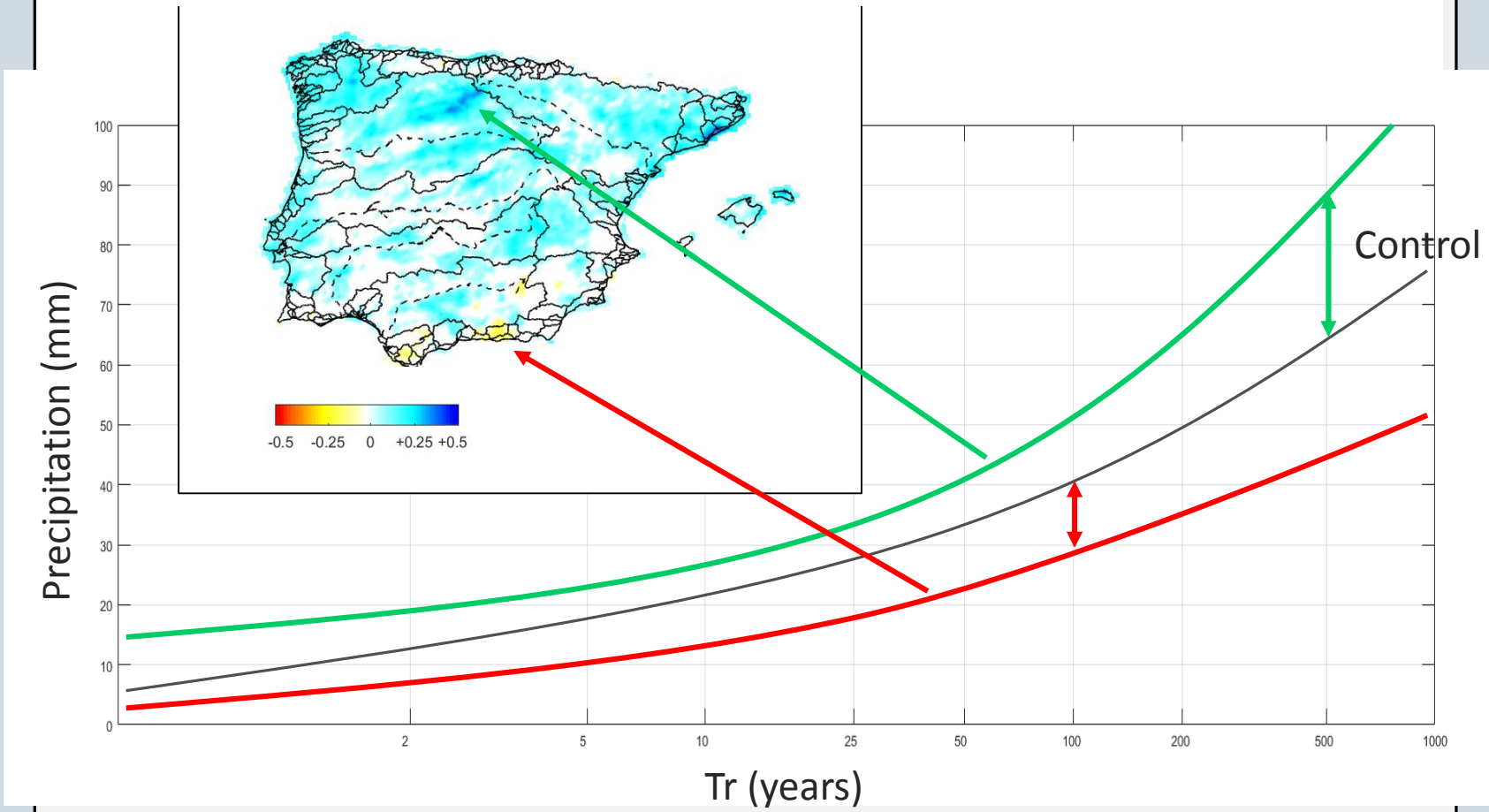
2. Uncertainty Analysis



RESULTS

Tips for interpretation of the following figures:



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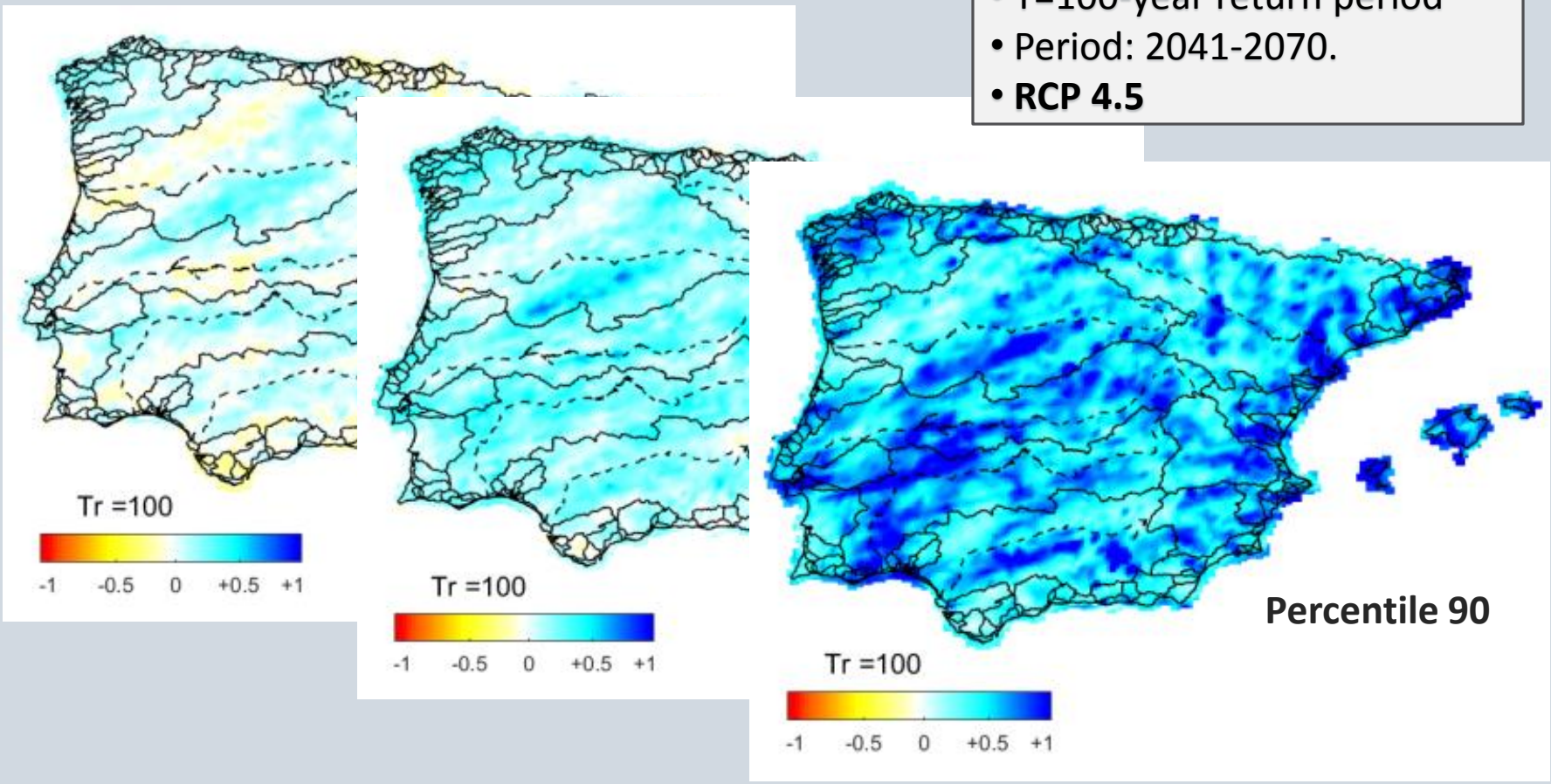
❖ Raw projections of maximum precipitation give a panoramic view of what is the general trend in the future.

- T=100-year return period
- Period: 2041-2070.
- **RCP 4.5**



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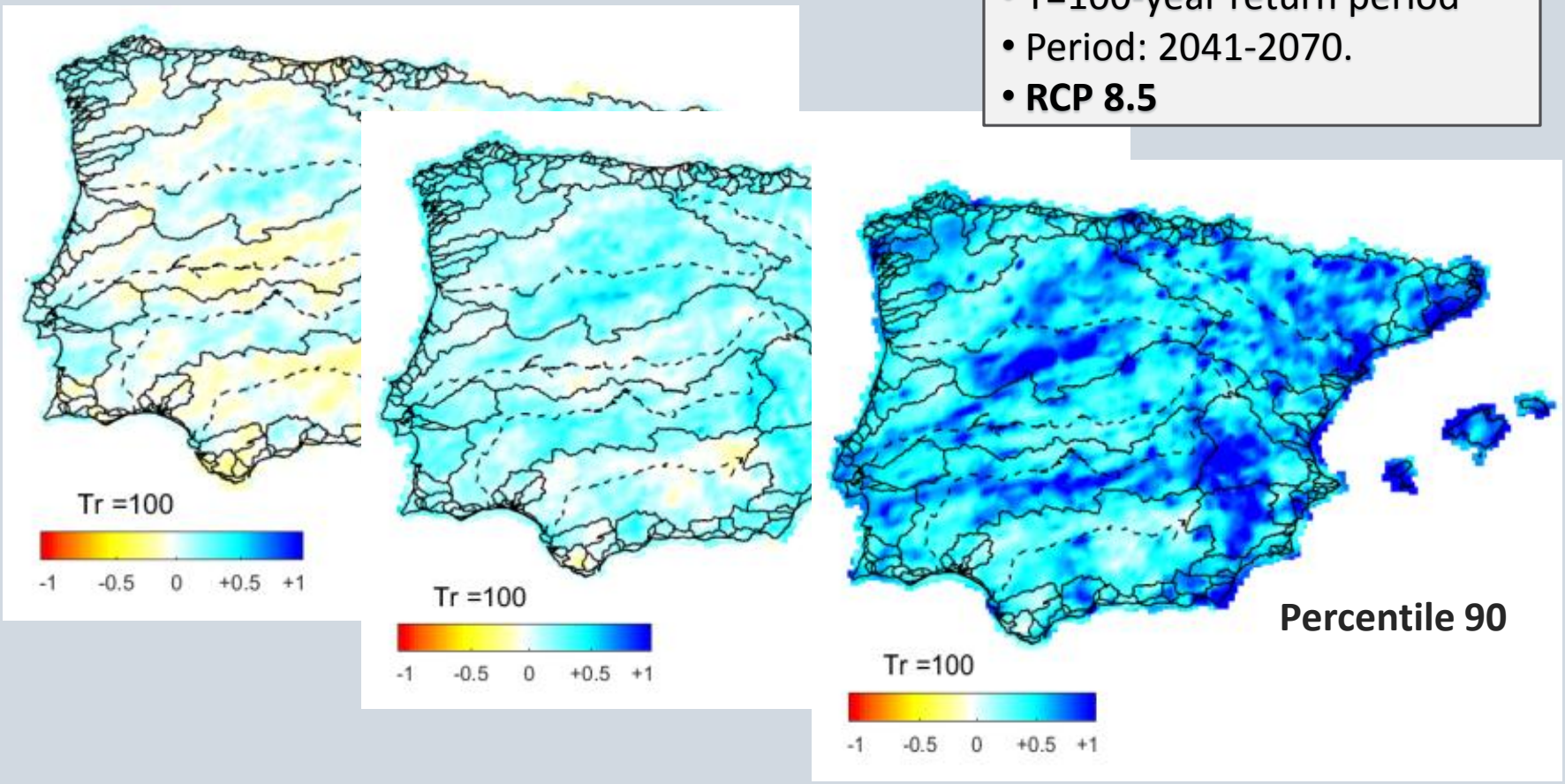
- T=100-year return period
- Period: 2041-2070.
- **RCP 8.5**



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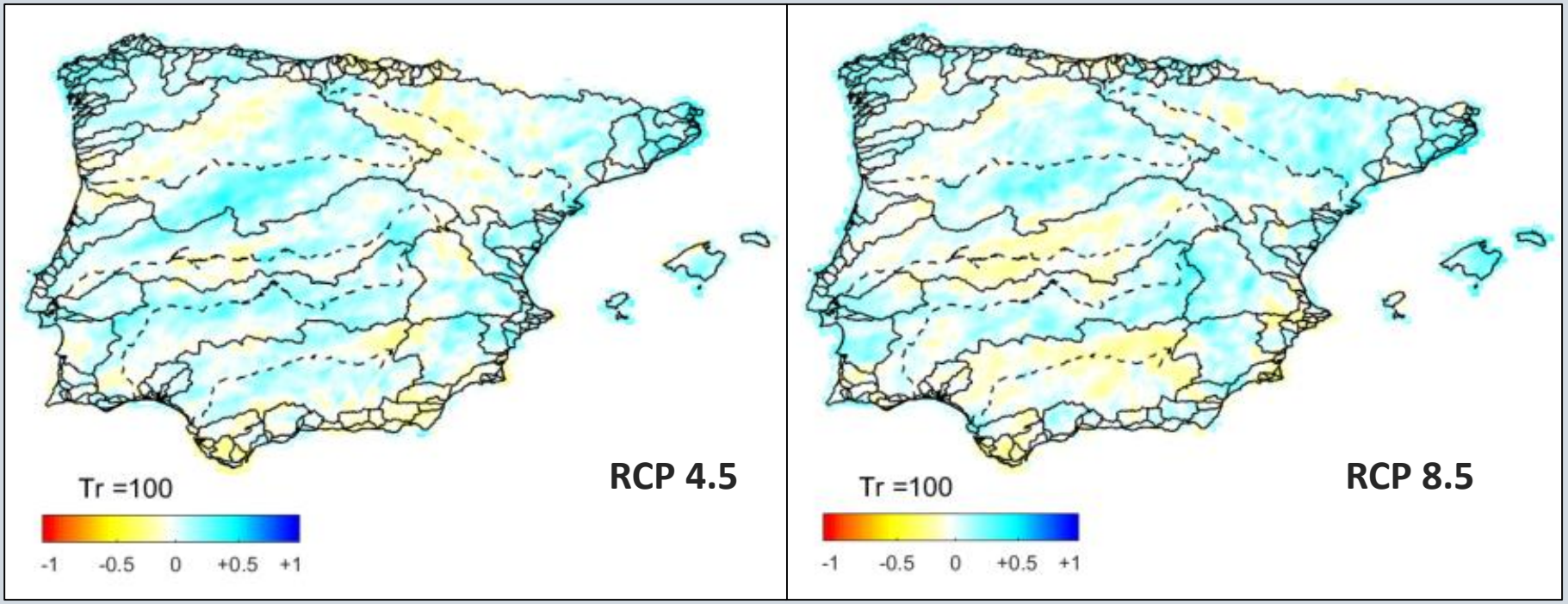
• Percentile 50 (median)



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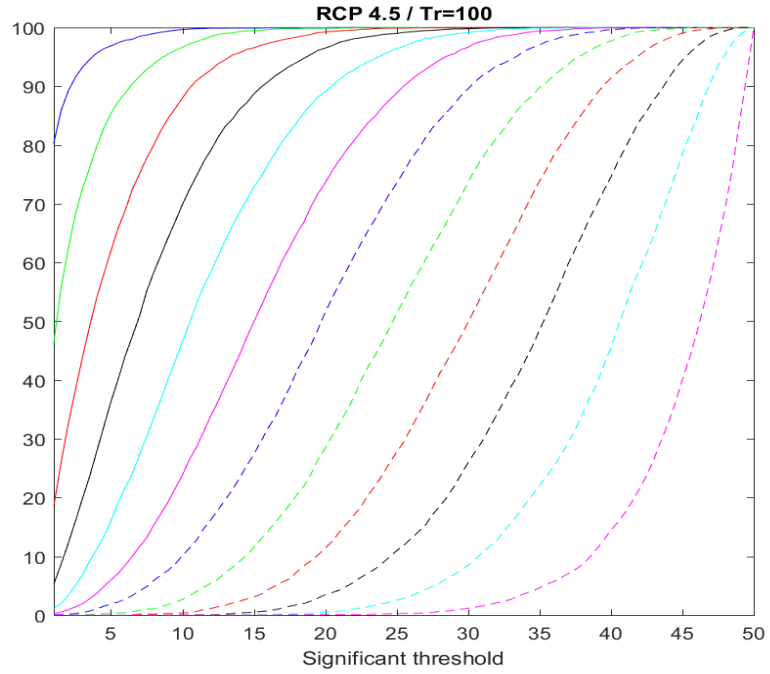
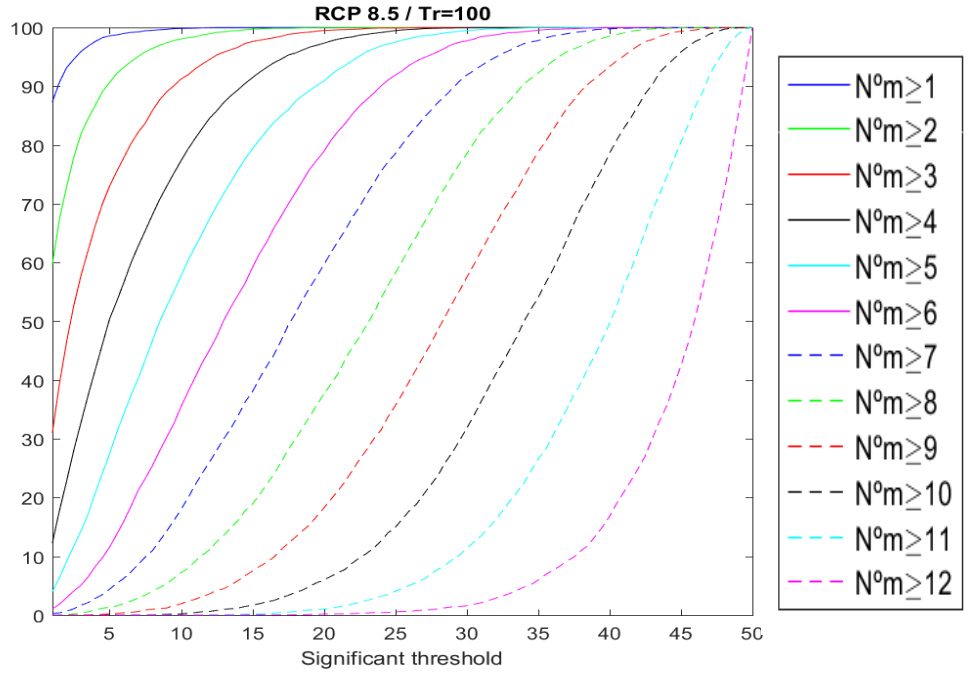
❖ Searching for appropriate significance threshold, two-sides significant limits (here represented as on-side limit; α) were plotted vs the average percentage of cells per model with change.

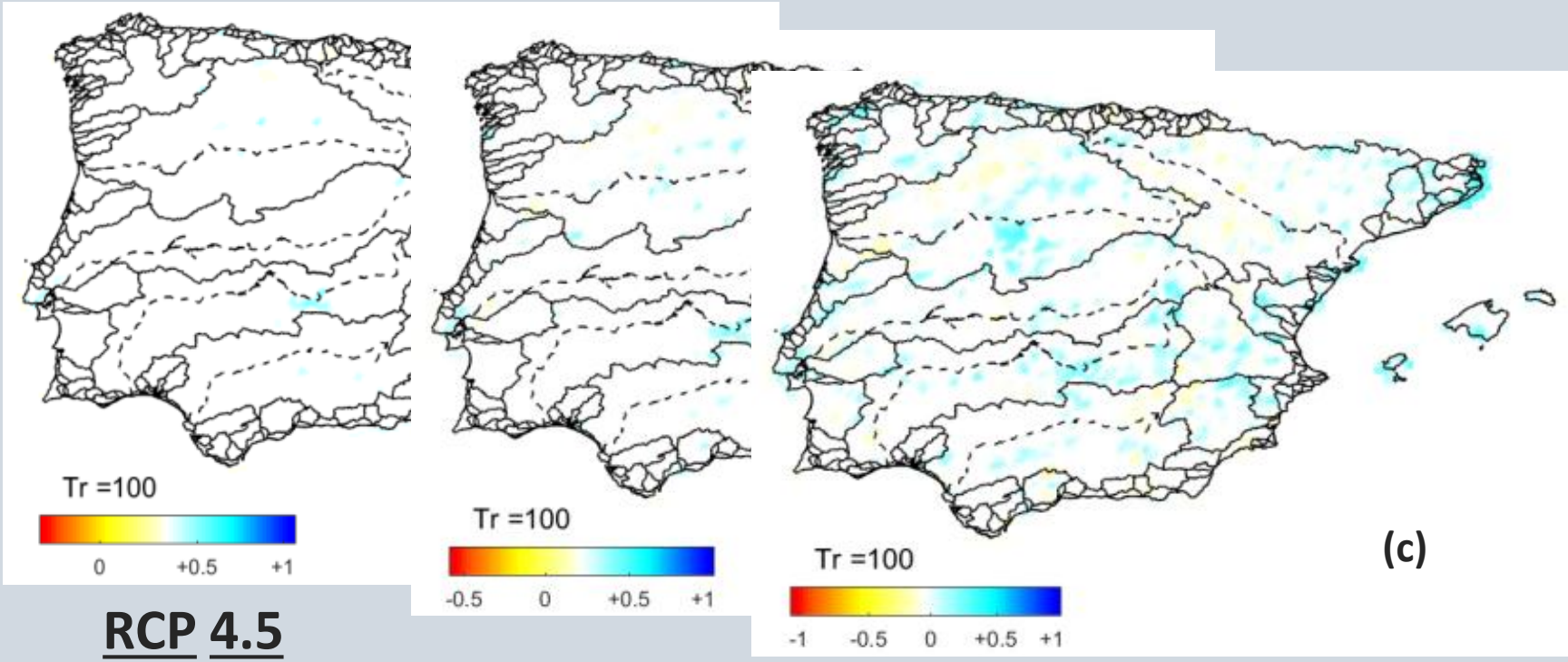
❖The minimum number of models with change per cell threshold (N) was also plotted (coloured lines).





❖ Exploring further about significant thresholds, spatial distribution of cells with significant change for various thresholds were outlined. A minimum number of models with change equals to 6 was selected.

❖Here three significance thresholds are shown: 5% (a), 10% (b) and 20% (c) for the 100-year return period precipitation and period 2041-2070.



RCP 4.5

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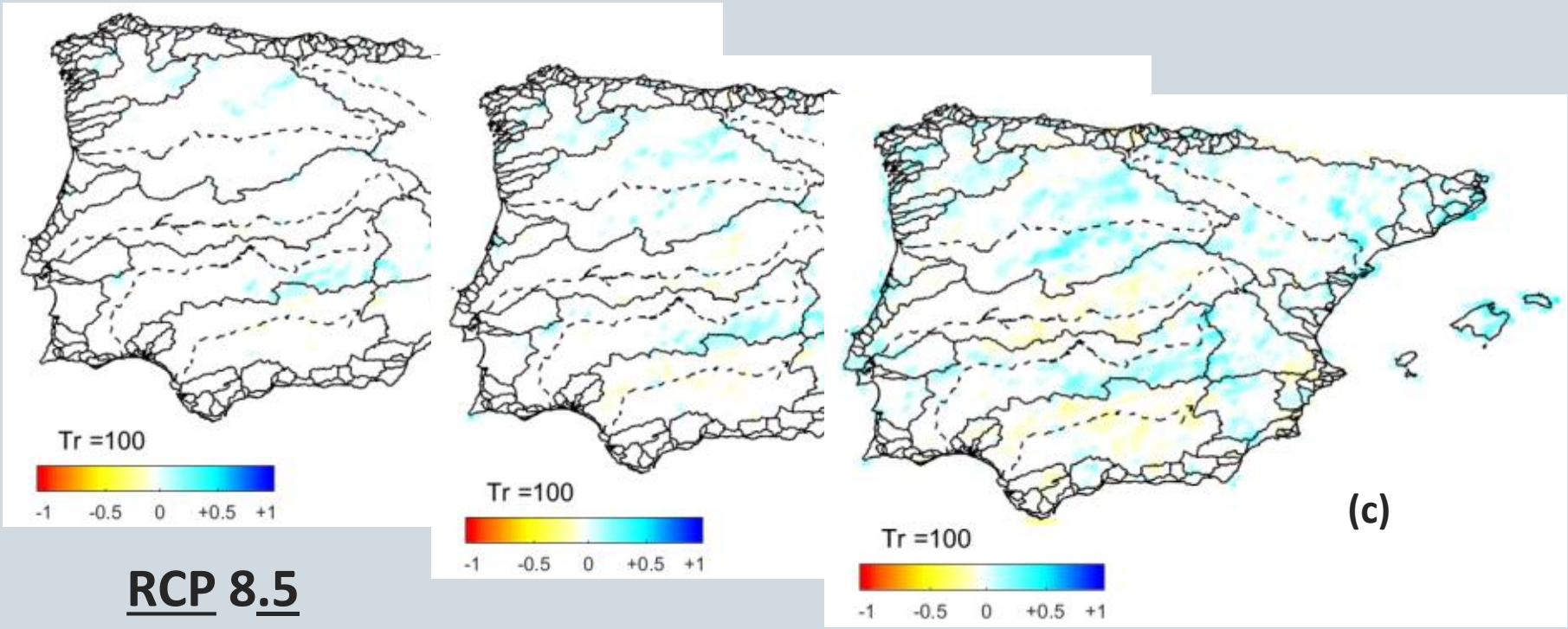

RCP 8.5

DISCUSSION & CONCLUSIONS

MAIN CONCLUSIONS

- Results show the difficulty in selecting a threshold, both for significance values and minimum number of models, as both scenarios behave in a similar way.
- The minimum number of models threshold used in this study were the half (six models), as it is a common practice.
- The choice of the significance threshold depends on the scientific rigor required. With a threshold of 5% some areas can be identified, but most of the changes come from a single cell with change, known as the 'island effect' problem.

MAIN CONCLUSIONS

- Regarding results obtained for 100-year return period precipitation in future period 2041-2070:
  - **Positive changes** in both scenarios are the upper part of Guadiana river basin, the central part of Duoro river basin and some specific areas of the Mediterranean coast.
  - **Negative changes** can be found in RCP 8.5 in the Tagus river basin and southest Spain.
- This last trend partialy agree with findings in other studies, nevertheless, here many more areas with positive change were found.

THANK YOU FOR YOUR ATTENTION