



Effects of bias correction on the climate change signal of extreme indices of precipitation

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MODEXTREME

- Modelling vegetation response to Extreme events
- Agricultural project funded by FP7
- Improvement the capacity of agro-meteorological crop modelling to integrate climatic variability and extreme weather events

First scientific workshop:
September 10th 2015, 9am-1pm
Montpellier, France
<http://modextreme.org/event/sw1>

Climate change:

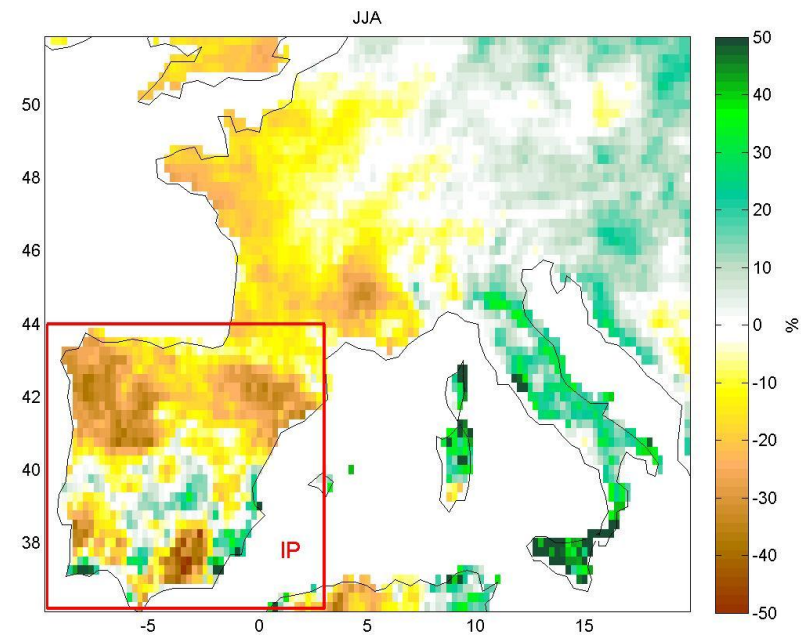
- How might more extreme weather in the future affect crop yields?

Regional Climate Models



- Nine Euro-CORDEX 11 simulations used:
 - CNRM-CM5 – CCLM4-8-17
 - CNRM-CM5 – RCA4
 - EC-EARTH – RACMO22E
 - EC-EARTH – HIRHAM5
 - EC-EARTH – CCLM4.8.17
 - EC-EARTH – RCA4
 - HadGEM2ES – RCA4
 - MPI-ESM-LR – CCLM4-8-17
 - MPI-ESM-LR – RCA4

- RCP8.5
- Present day: 1991-2010
- Timeslice: 2041-2060

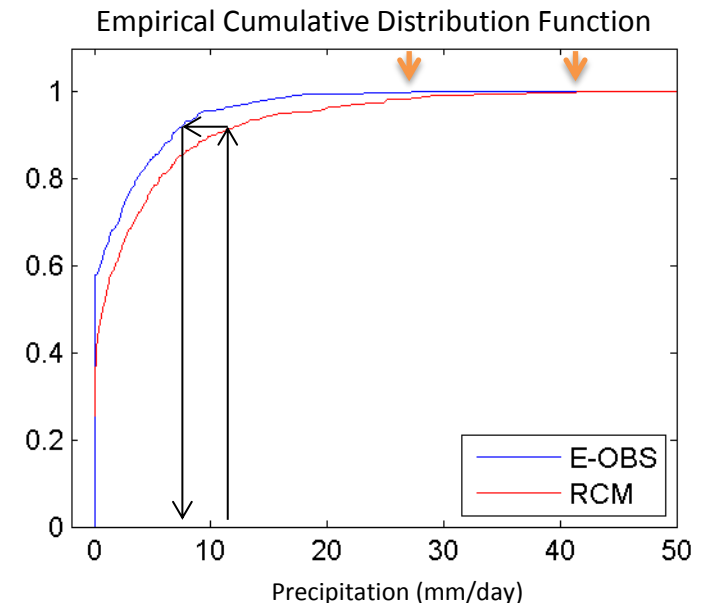
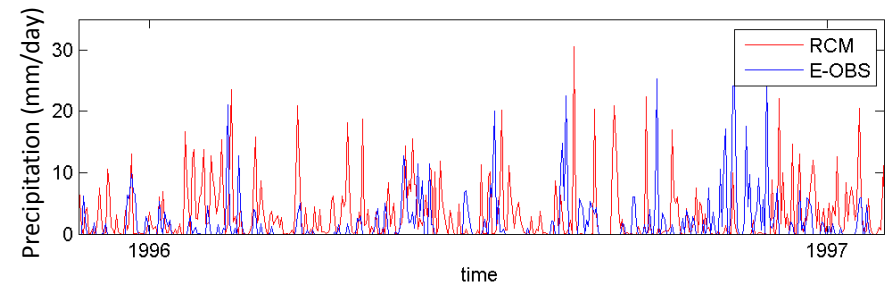


(EC-EARTH – RACMO22E)

Bias correction



- Empirical statistical quantile-quantile mapping
- E-obs v.10, 0.25 reg
- Calibration period: 1991-2010
- 31-day sliding window
- Adjust dry-day frequency
- New extremes: correction of maximum



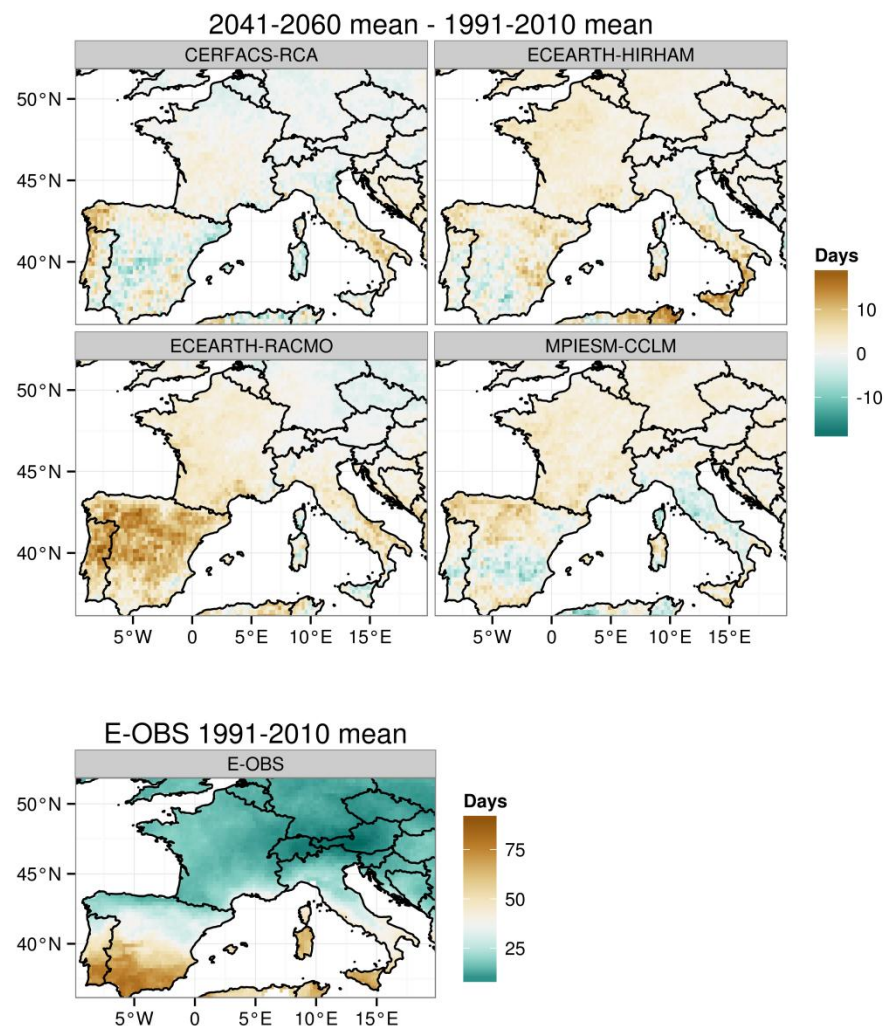
Extreme indices analysed



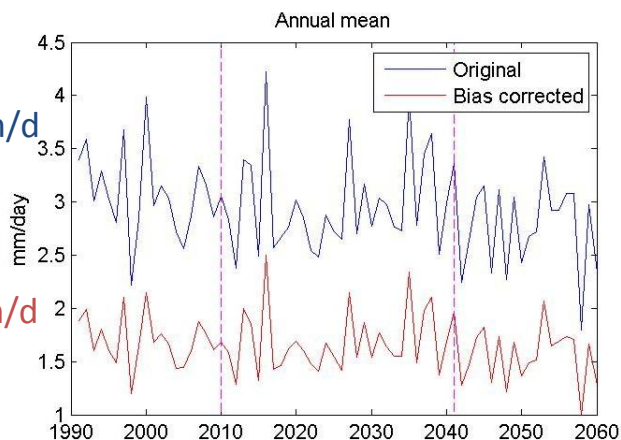
Extreme precipitation indices

- Rx1day
- Rx5day
- SDII
- CDD
- CWD
- R10mm
- R20mm

JJA Consecutive Dry Days

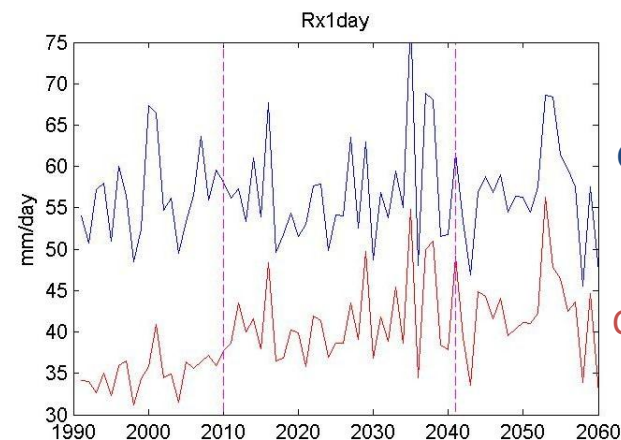


Results



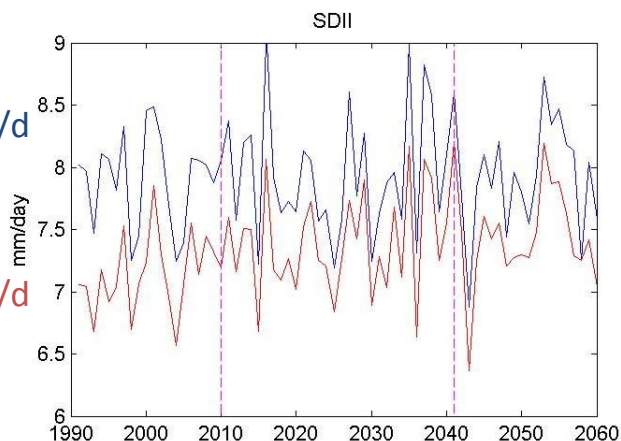
CC = $-0.30 \pm 0.13 \text{ mm/d}$
~ -10 %

CC = $-0.13 \pm 0.08 \text{ mm/d}$
~ -8 %



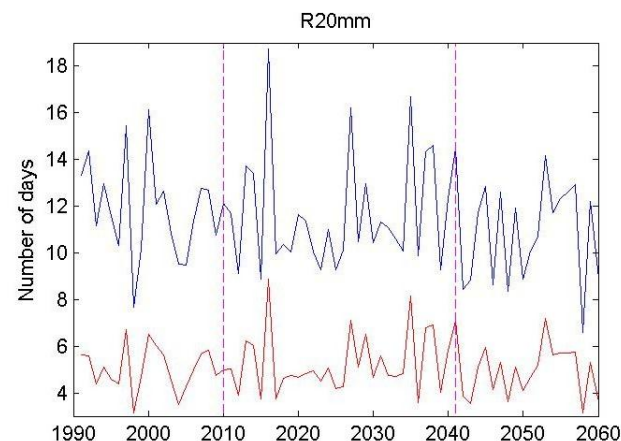
CC = $0.47 \pm 0.17 \text{ mm/d}$
~ 1.5 %

CC = $7.31 \pm 1.30 \text{ mm/d}$
~ 22 %



CC = $0.03 \pm 0.12 \text{ mm/d}$
~ 0.4 %

CC = $0.31 \text{ m} \pm 0.11 \text{ m/d}$
~ 4.3 %



CC = -0.92 ± 0.65
~ -6.9 %

CC = -0.05 ± 0.32
~ -0.4 %

Climate change signal

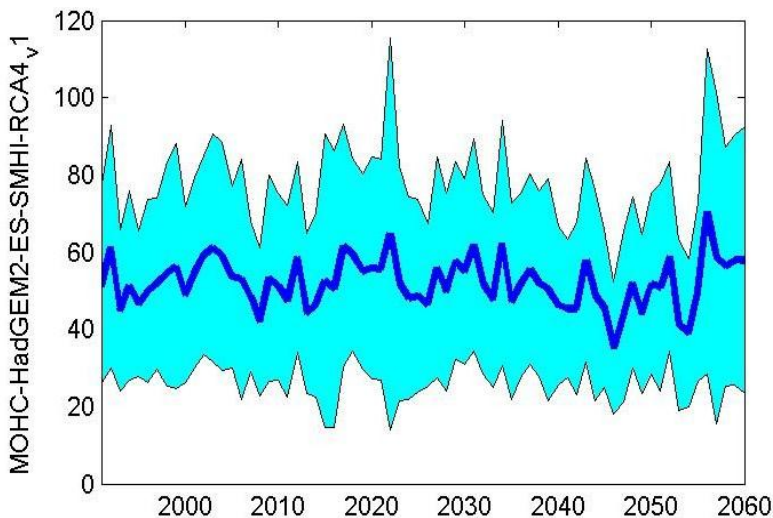
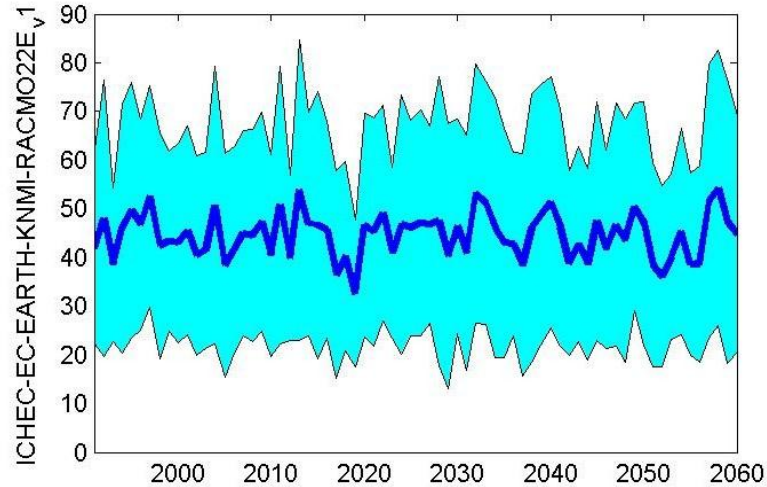


| GCM-RCM | Annual | mean (mm/d) | Rx1 | day (mm/d) | R20 | mm |
|------------------------------|---------------------------|---------------------------|---------------------------|------------------------|---------------------------|---------------------------|
| CNRM-CERFACS SMHI-RCA4 | -0.30 ± 0.13 -10% | -0.13 ± 0.07 -8% | 0.47 ± 1.72 1.5% | 7.31 ± 1.30 22% | -0.92 ± 0.65 -6.9% | -0.05 ± 0.32 -0.4% |
| CNRM-CERFACS CCLM4-8-17 | -0.26 ± 0.11 -12% | -0.15 ± 0.08 -9.4% | 2.52 ± 1.51 5.8% | 7.19 ± 1.23 21% | -0.35 ± 0.52 -2.5% | 0.09 ± 0.32 4.6% |
| ICHEC-ECEARTH CCLM4-8-17 | -0.13 ± 0.09 -7.7% | -0.13 ± 0.09 -8.5% | 3.60 ± 1.61 8.8% | 7.16 ± 1.49 21% | 0.10 ± 0.46 5.5% | 0.17 ± 0.41 7.5% |
| ICHEC-ECEARTH DMI-HIRHAM5 | -0.23 ± 0.11 -11% | -0.15 ± 0.09 -9.9% | -1.46 ± 1.97 -1.4% | 5.73 ± 1.47 18% | -0.95 ± 0.58 -8.2% | -0.43 ± 0.36 -3.7% |
| ICHEC-ECEARTH KNMI-RACMO | -0.17 ± 0.08 -8.6% | -0.09 ± 0.07 -6.1% | -0.46 ± 1.40 -0.8% | 4.29 ± 1.29 13% | -0.52 ± 0.40 -5.3% | -0.11 ± 0.34 4.1% |
| ICHEC-ECEARTH SMHI-RCA4 | -0.08 ± 0.09 -4.0% | -0.05 ± 0.07 -2.8% | 4.45 ± 1.95 9.7% | 8.04 ± 1.44 25% | 0.05 ± 0.48 6.0% | 0.29 ± 0.34 15% |
| HadGEM2-ES SMHI-RCA4 | -0.37 ± 0.09 -15% | -0.23 ± 0.07 -13% | -2.11 ± 2.18 -3.3% | 5.35 ± 1.69 16% | -1.47 ± 0.45 -14% | -0.71 ± 0.30 -7.2% |
| MPI-ESM CCLM4-8-17 | -0.24 ± 0.14 -10% | -0.15 ± 0.09 -10% | 2.92 ± 1.91 4.1% | 6.61 ± 1.34 19% | -0.26 ± 0.79 -1.9% | 0.17 ± 0.41 4.4% |
| MPI-ESM SMHI-RCA4 | -0.18 ± 0.14 -7.1% | -0.08 ± 0.08 -6.1% | 0.97 ± 2.30 2.3% | 6.80 ± 1.42 20% | -0.37 ± 0.83 -2.6% | 0.15 ± 0.39 4.2% |

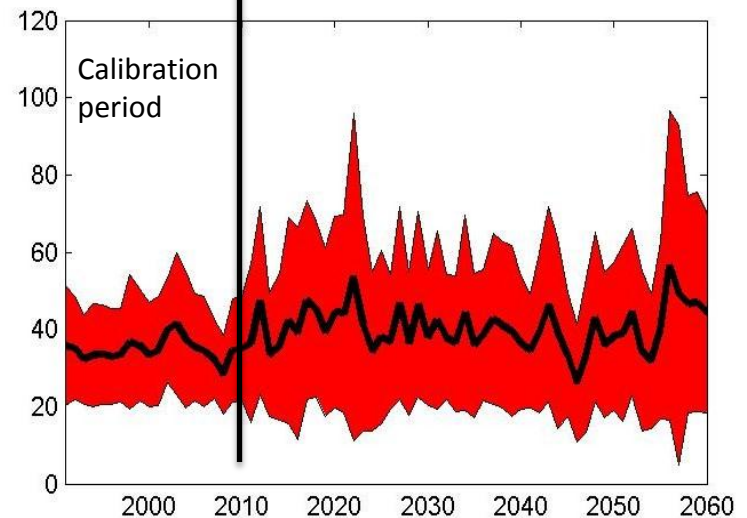
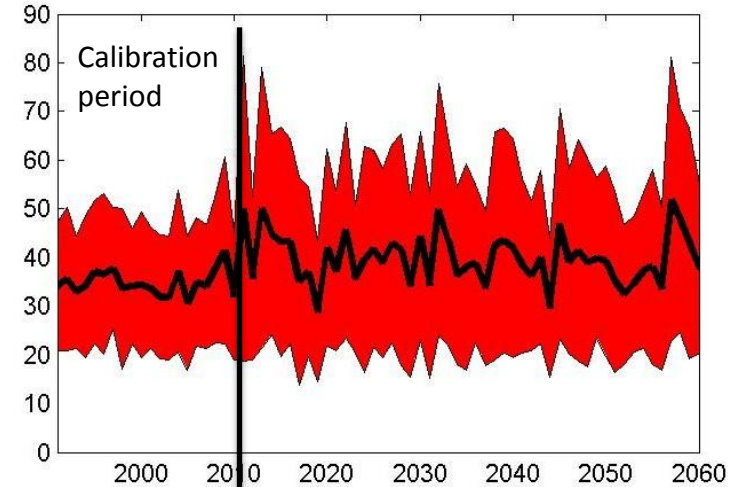
Rx1day (two models)



Original RCM data



Bias corrected RCM data



Conclusion



- Bias correction using empirical quantile-quantile mapping influences extreme precipitation indices, in particular Rx1day.

If extreme indices like Rx1day of bias corrected data are important, use functions to model the cumulative distribution function



Acknowledgement

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