Persistence of heat waves and its link to soil moisture memory

Ruth Lorenz, Eric Jäger and Sonia Seneviratne

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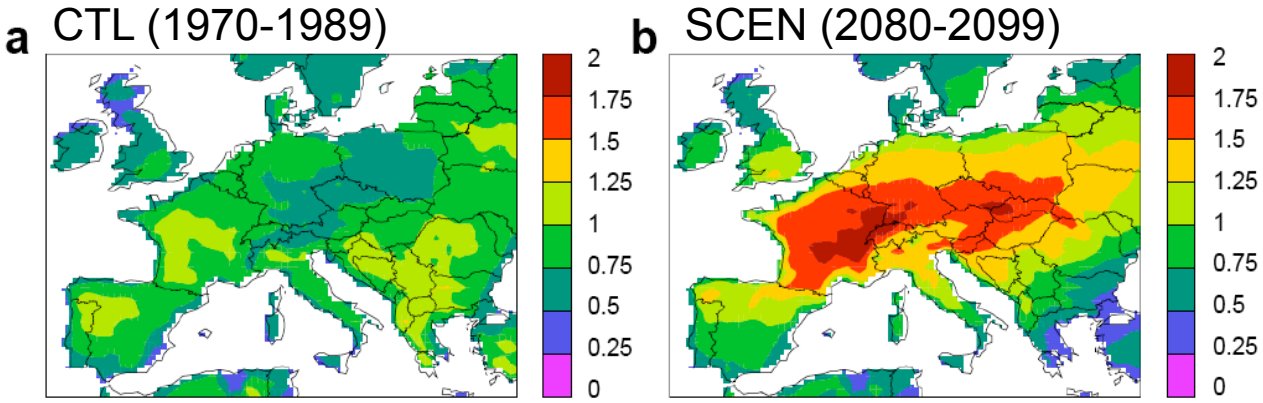
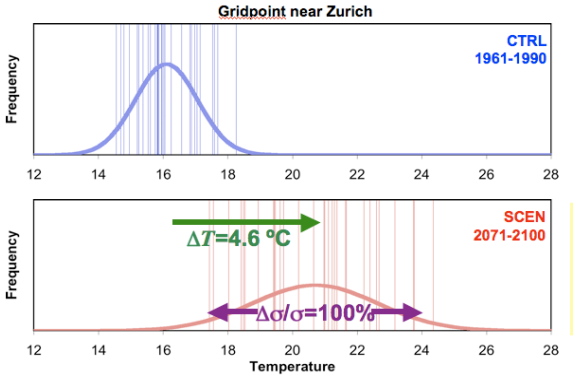
Introduction

Changes in interannual variability of summer temperature
(Standard deviation of the summer (JJA) temperature)



(Seneviratne et al. 2006, Nature)



(Schär et al. 2004, Nature)

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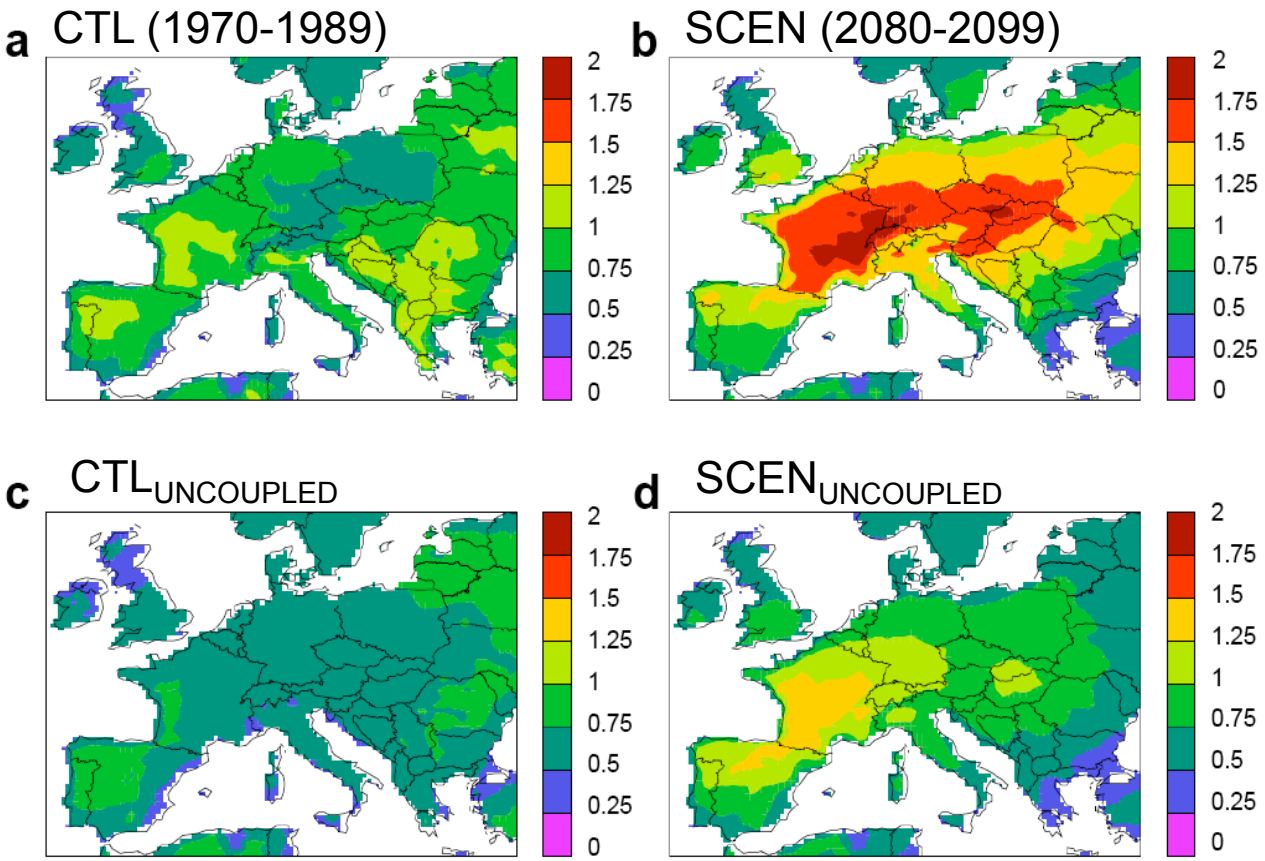
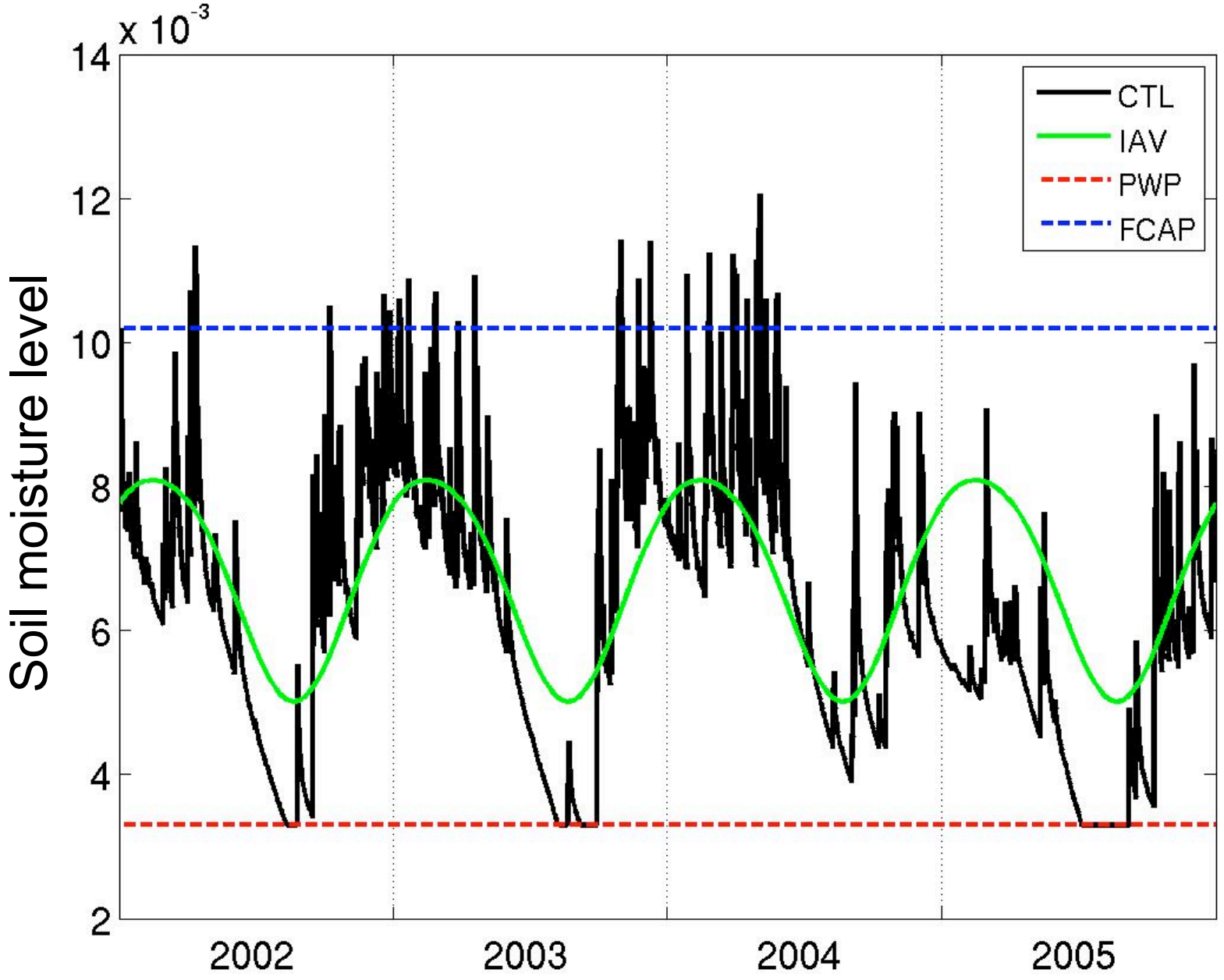


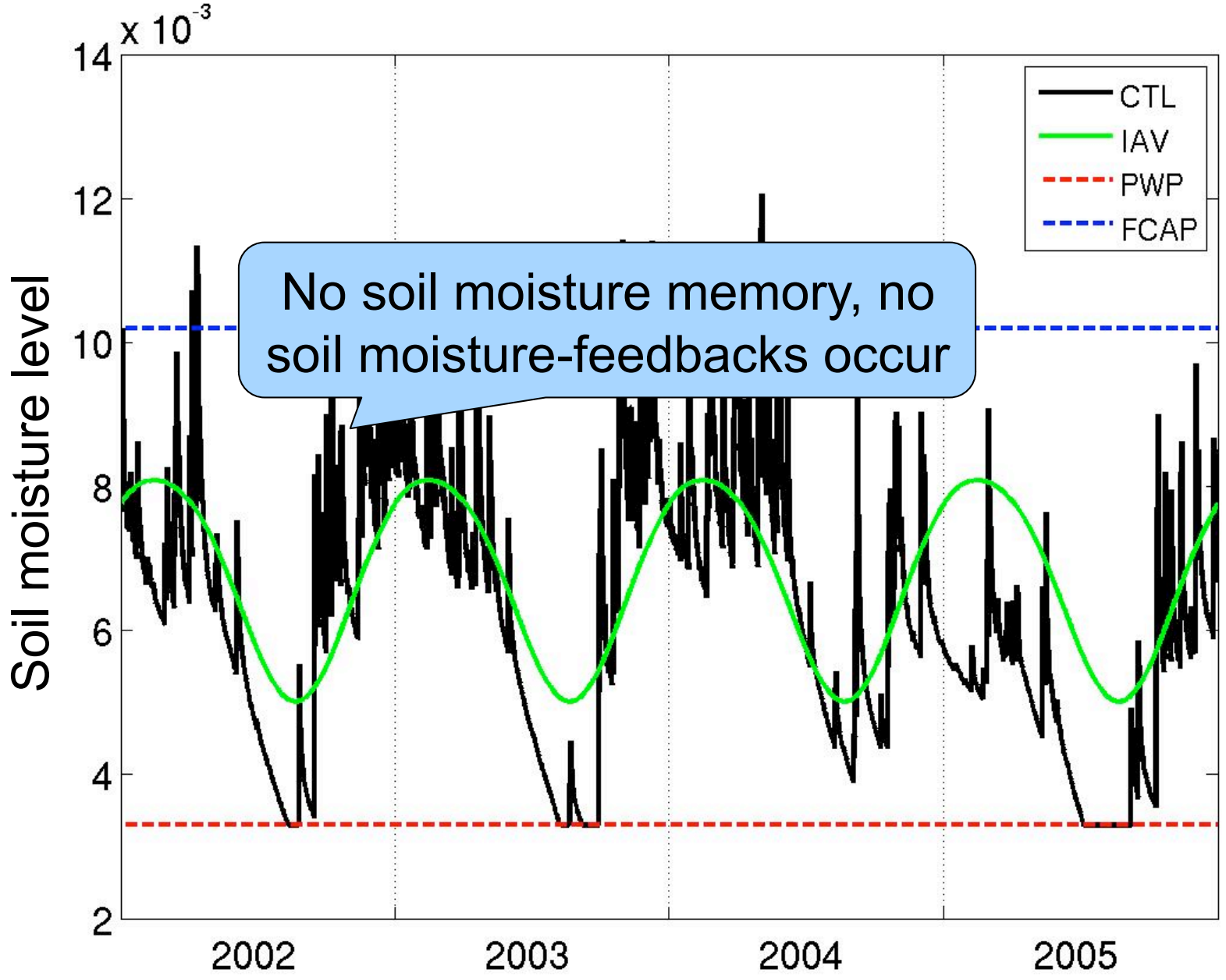
Large decrease of T° variability when effect of soil moisture is removed

(Seneviratne et al. 2006, Nature)

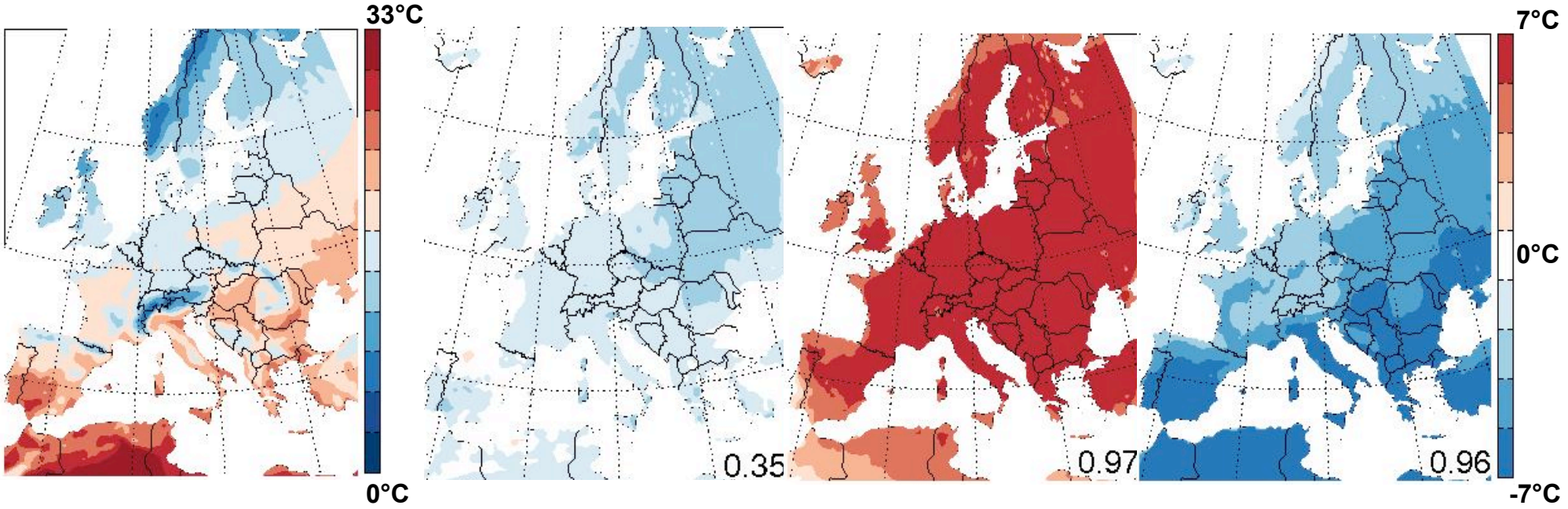
Model set up

- C-CLM version 2.4.11, 0.44° horizontal grid resolution
- Time period: 1959-2006
- Different model runs:
  - CTL: control run, driven by ERA40 and $ECMWF_{op}$
  - IAV: SM prescribed, mean climatology from CTL
  - PWP: SM prescribed, constant at plant wilting point
  - FCAP: SM prescribed, constant at field capacity


x 10^-3
14
12
10
8
6
4
2
Soil moisture level
2002
2003
2004
2005
CTL
IAV
PWP
FCAP


x 10^-3
14
12
10
8
6
4
2
Soil moisture level
2002
2003
2004
2005
CTL
IAV
PWP
FCAP
No soil moisture memory, no soil moisture-feedbacks occur

Mean Temperature

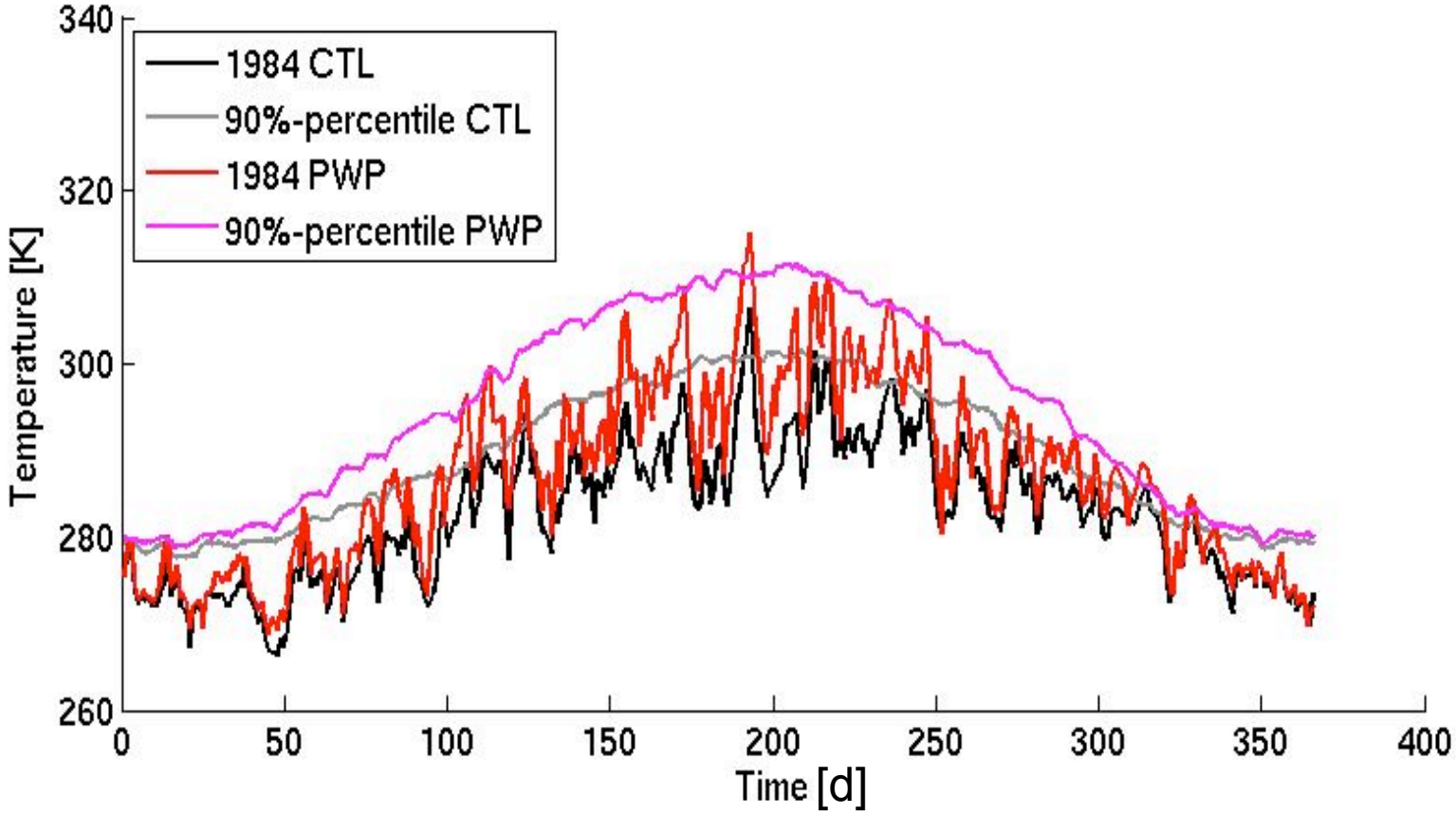


T_{2m} CTL | T_{2m} IAV-CTL | T_{2m} PWP-CTL | T_{2m} FCAP-CTL

Heat Wave Duration Indices

- Exceedance of threshold by T_{max} on minimum 2 consecutive days
- Mean exceedance length
- Threshold: long term 90^{th}-percentile
  - hwdi: 90^{th}-percentile calculated from CTL
  - hwdi*: 90^{th}-percentile calculated from actual model run (CTL, IAV, PWP or FCAP)

Definition of hwdi and hwdi*



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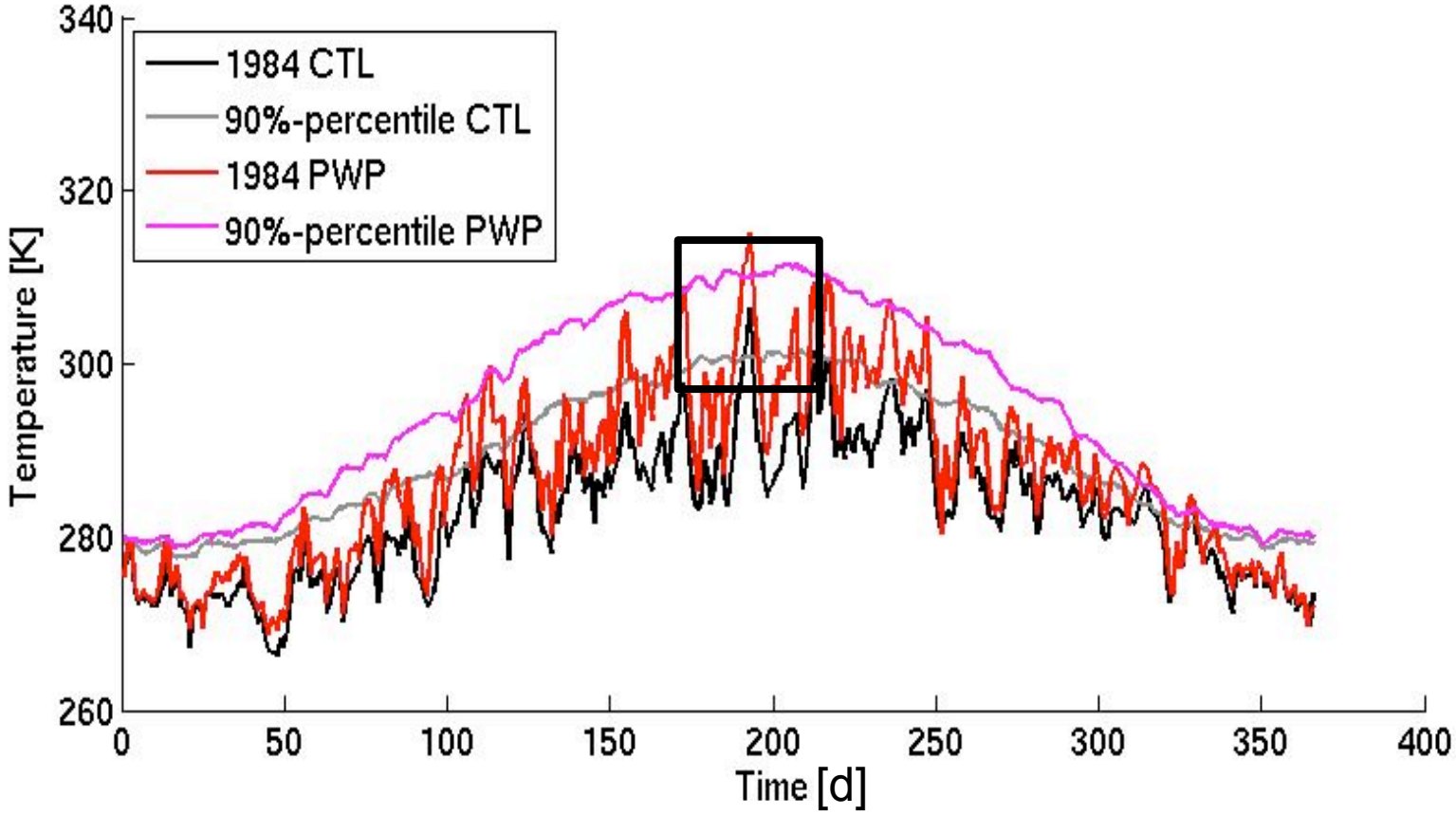

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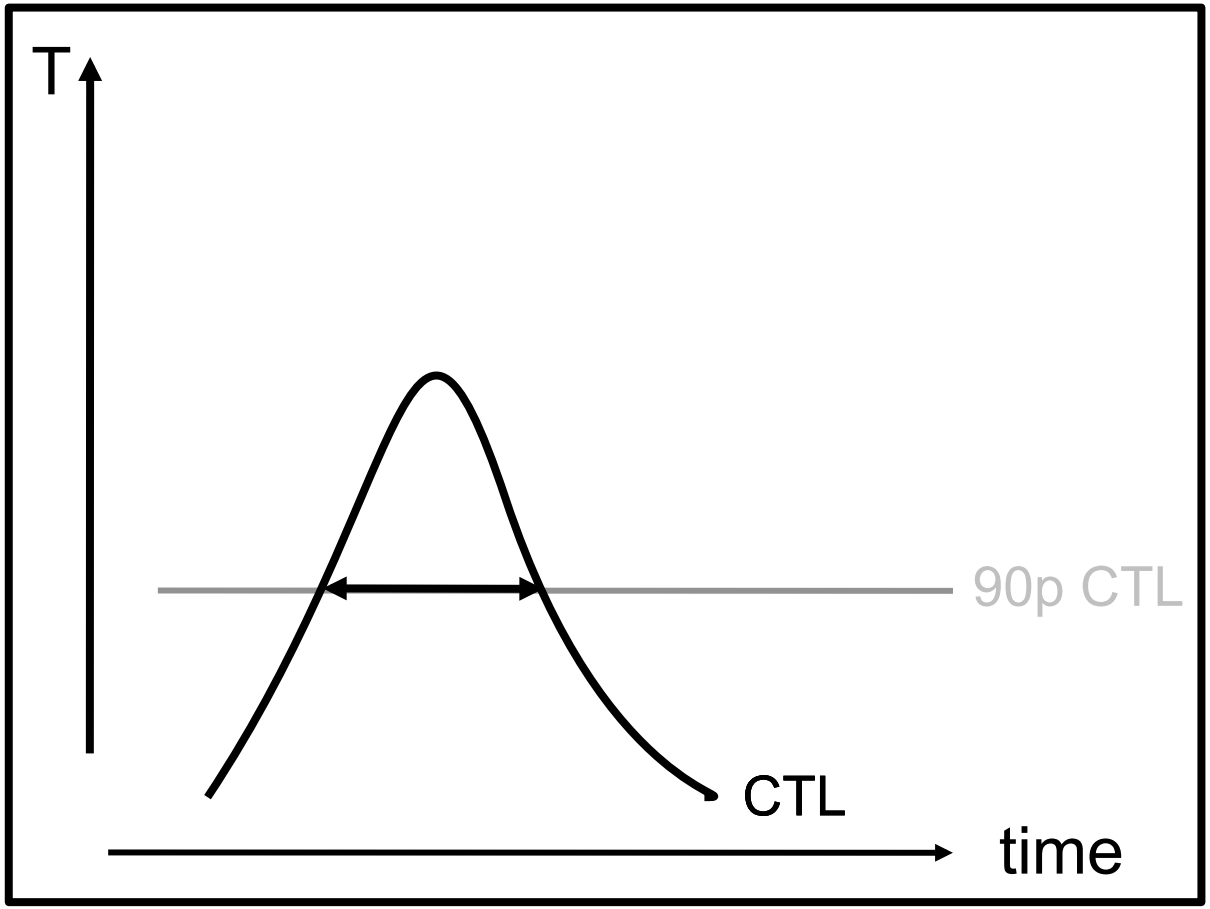

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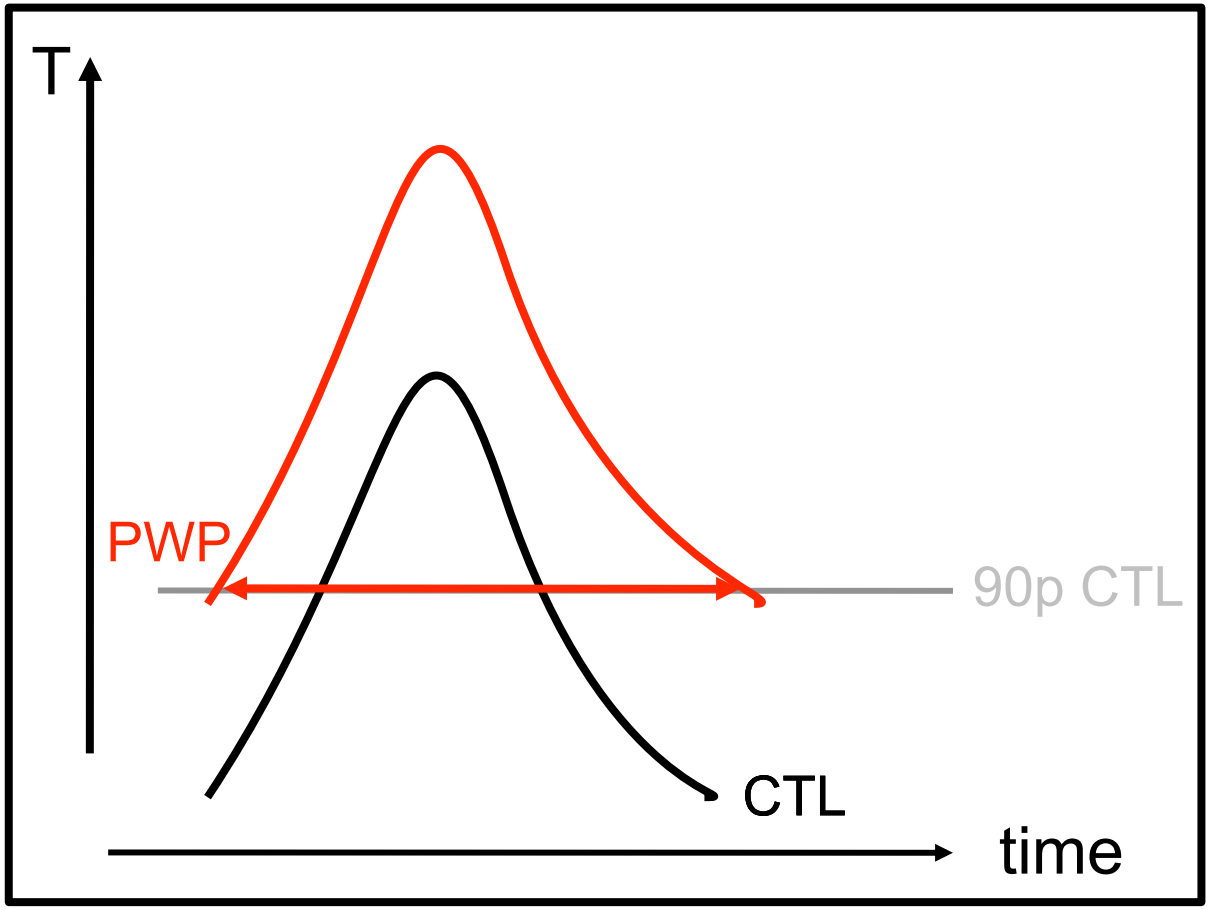

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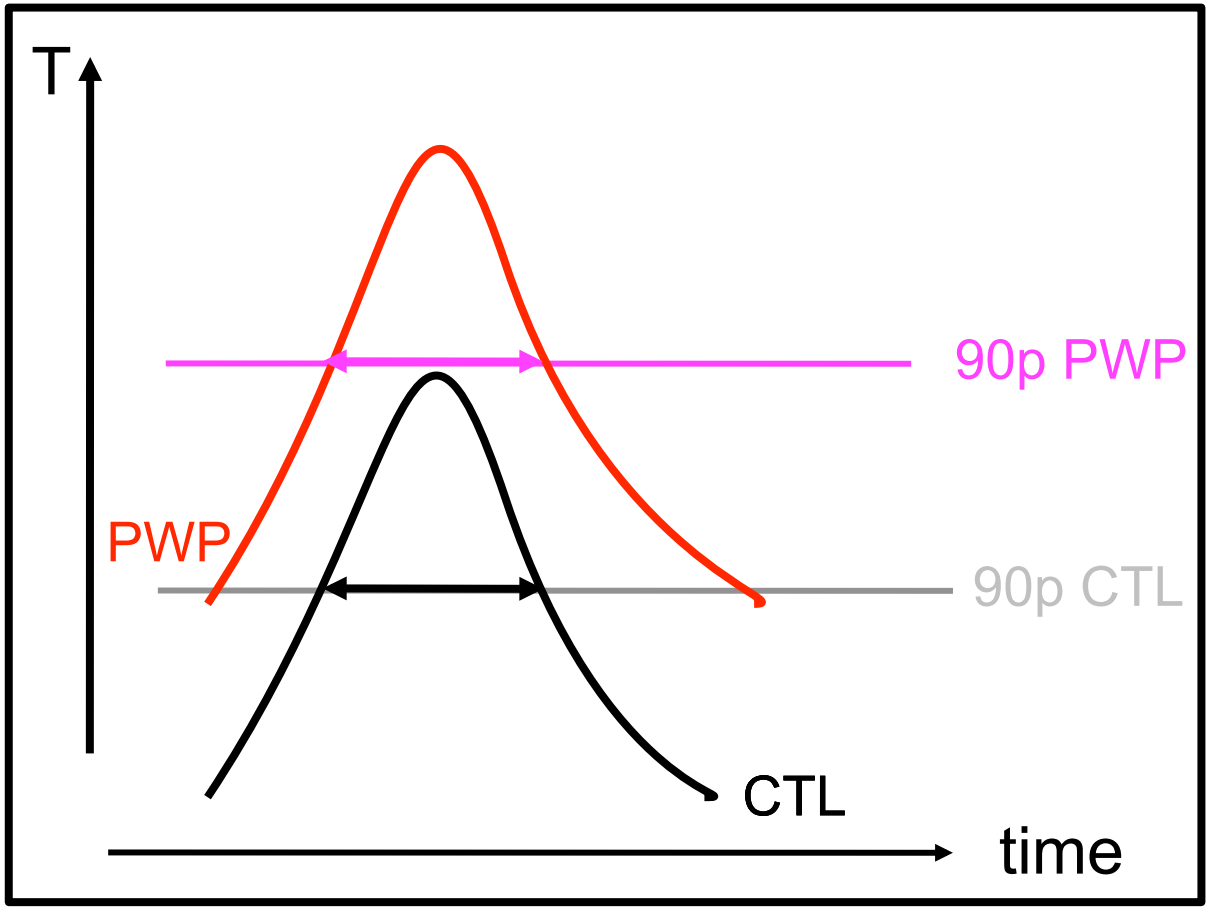

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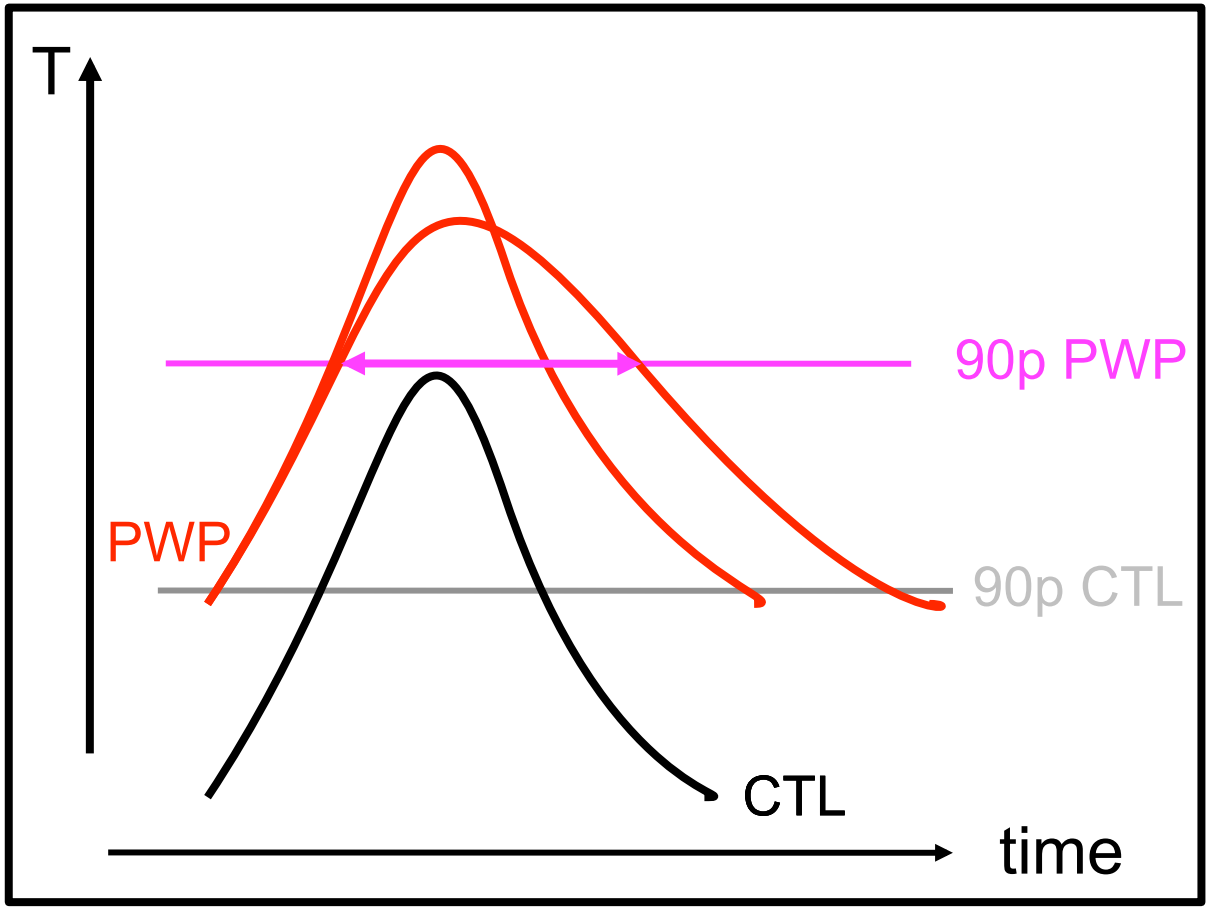

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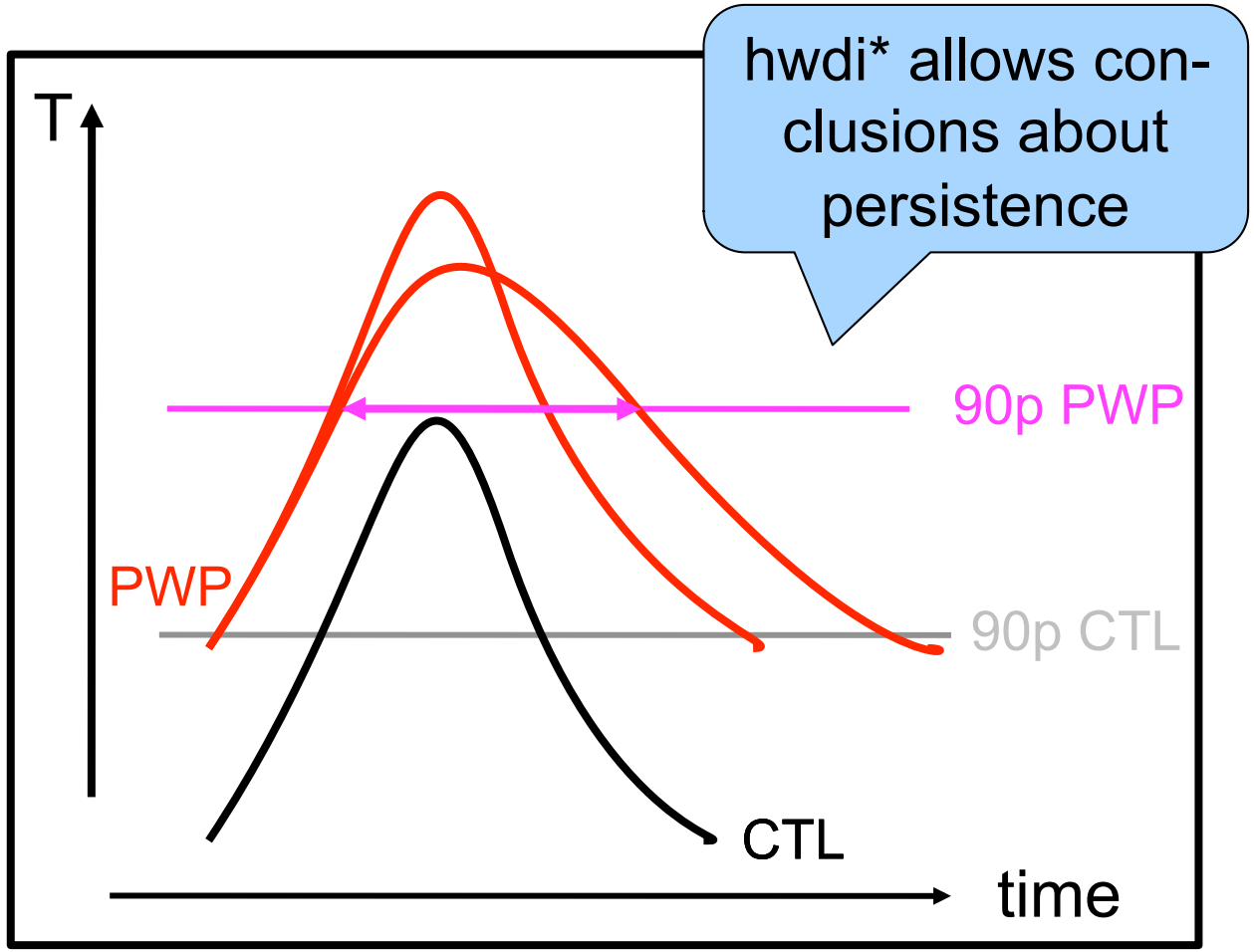
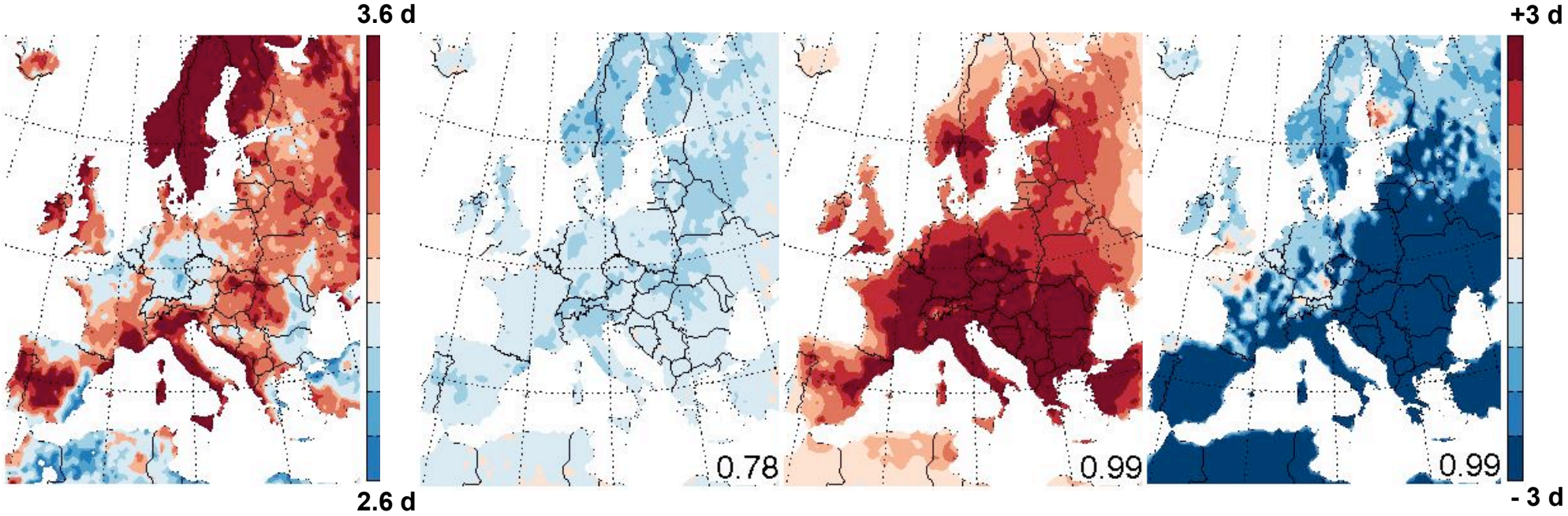
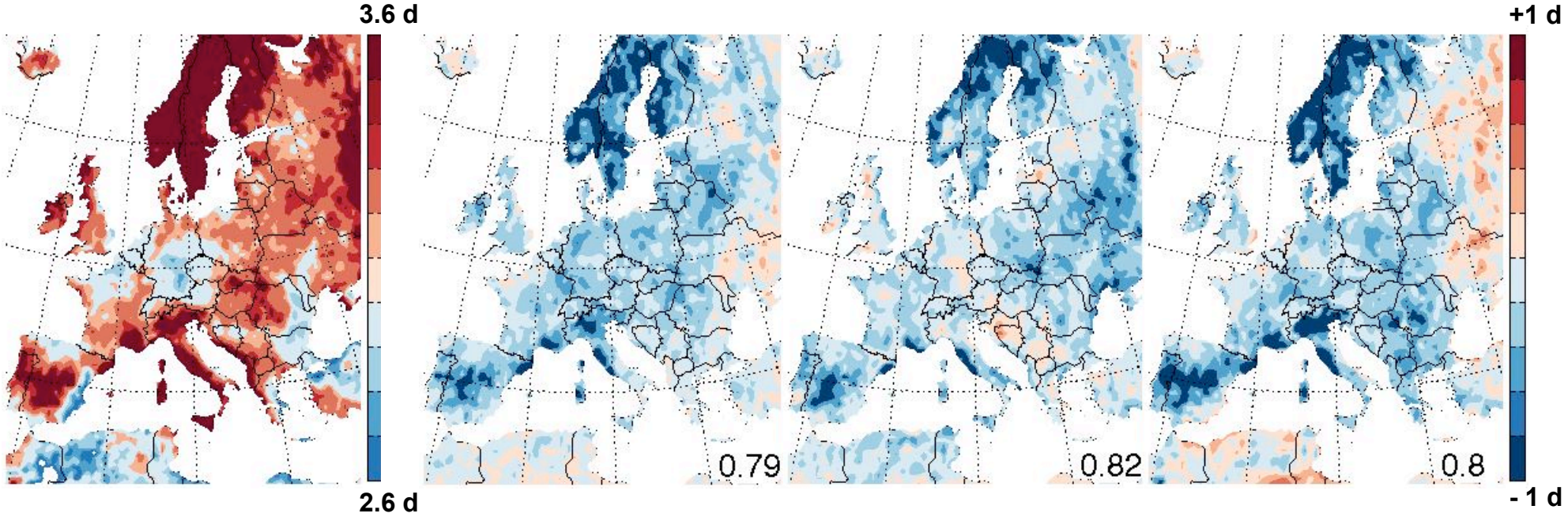


Heat wave duration index 'hwdi'



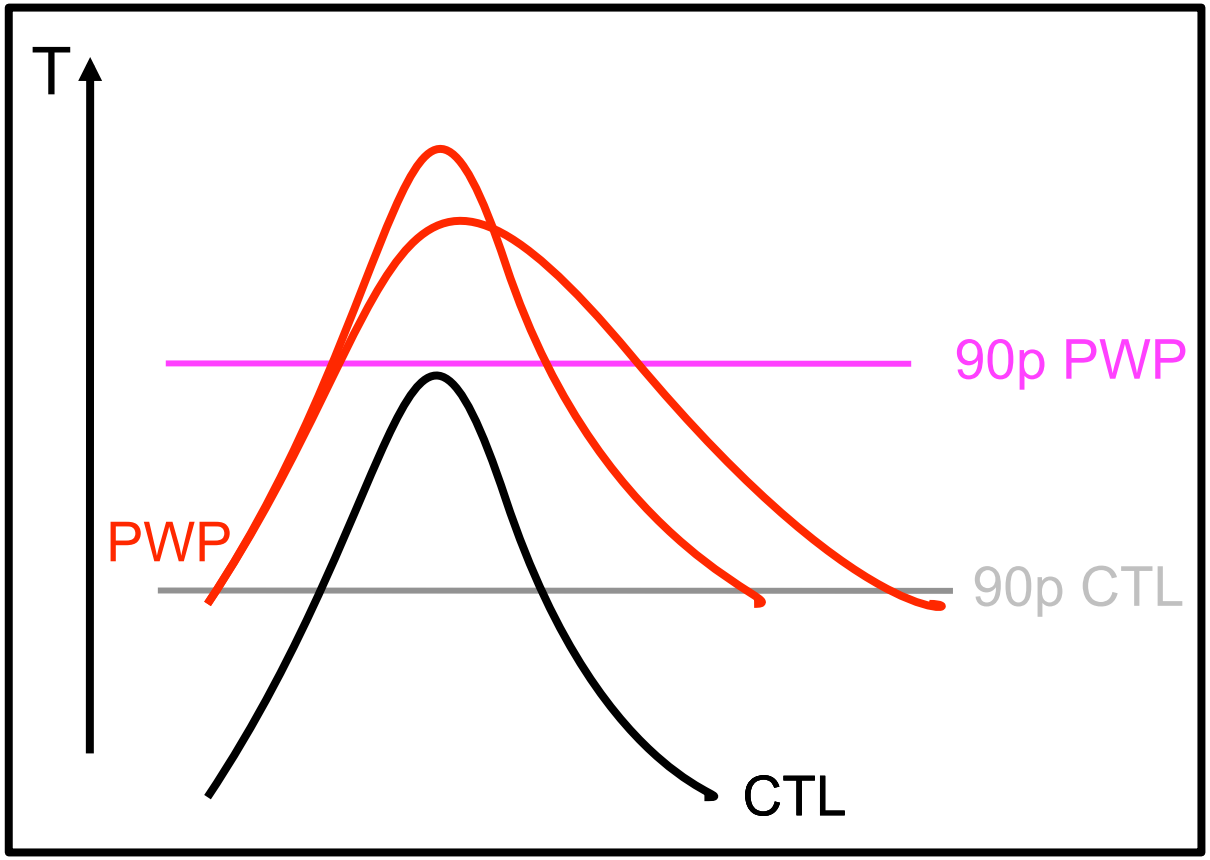
hwdi CTL | hwdi IAV-CTL | hwdi PWP-CTL | hwdi FCAP-CTL

Heat wave duration index 'hwdi*'

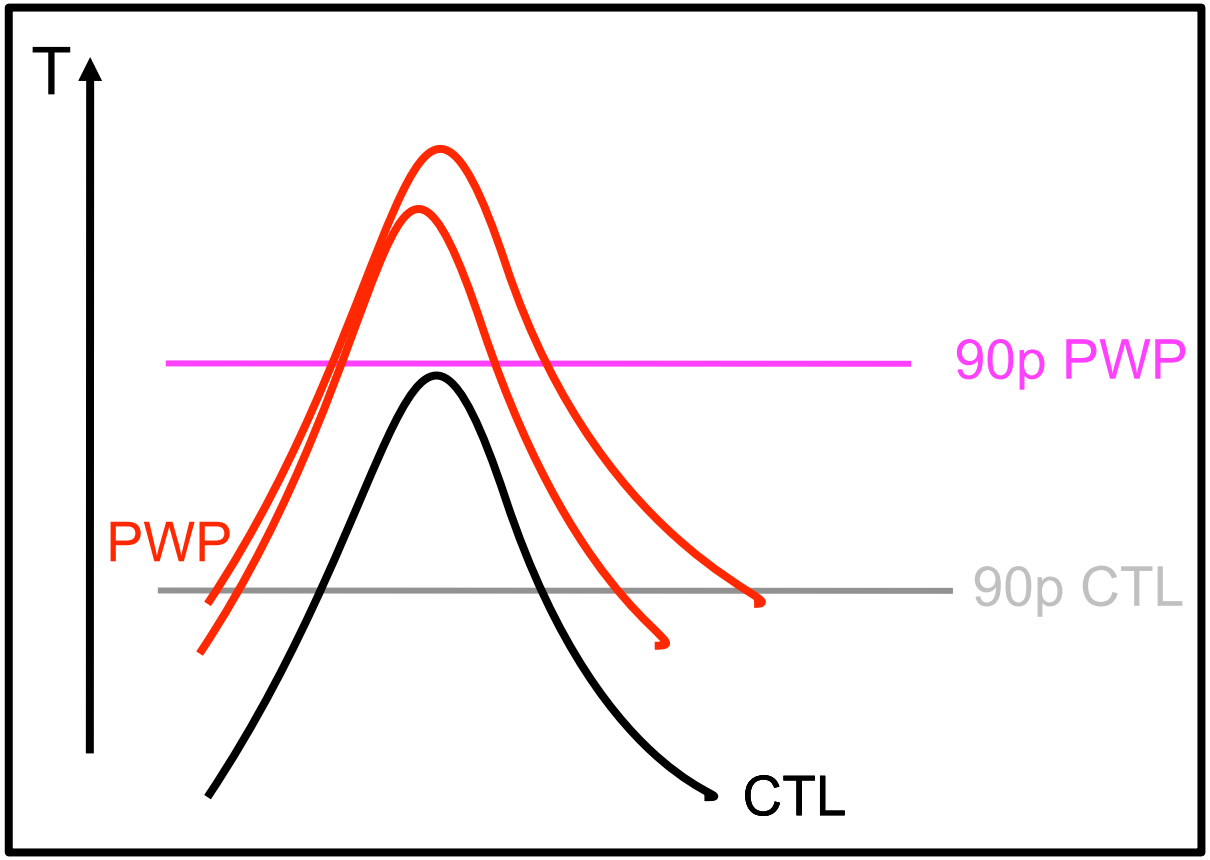


hwdi=hwdi* CTL | hwdi* IAV-CTL | hwdi* PWP-CTL | hwdi* FCAP-CTL

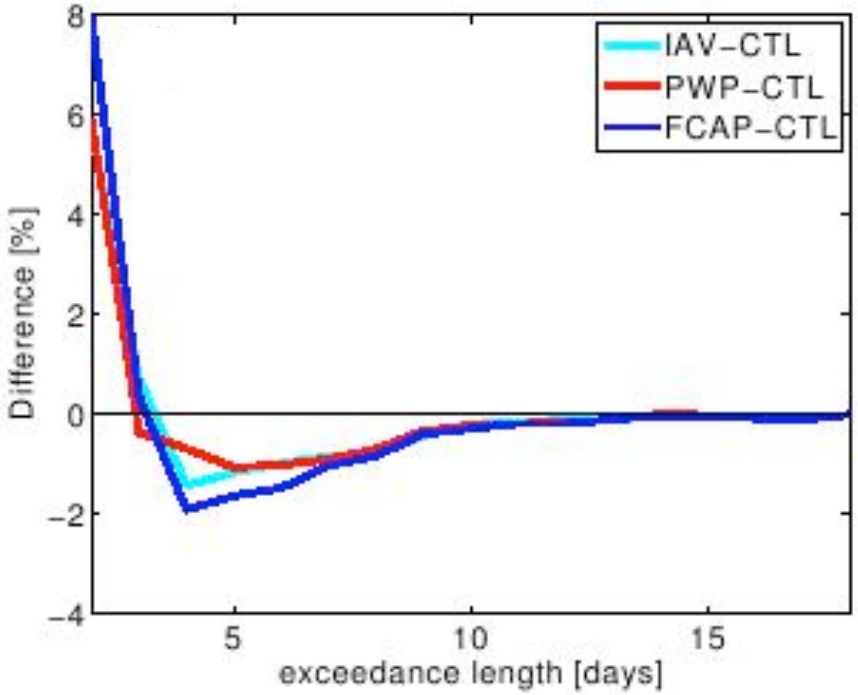
Changes in hwdi*



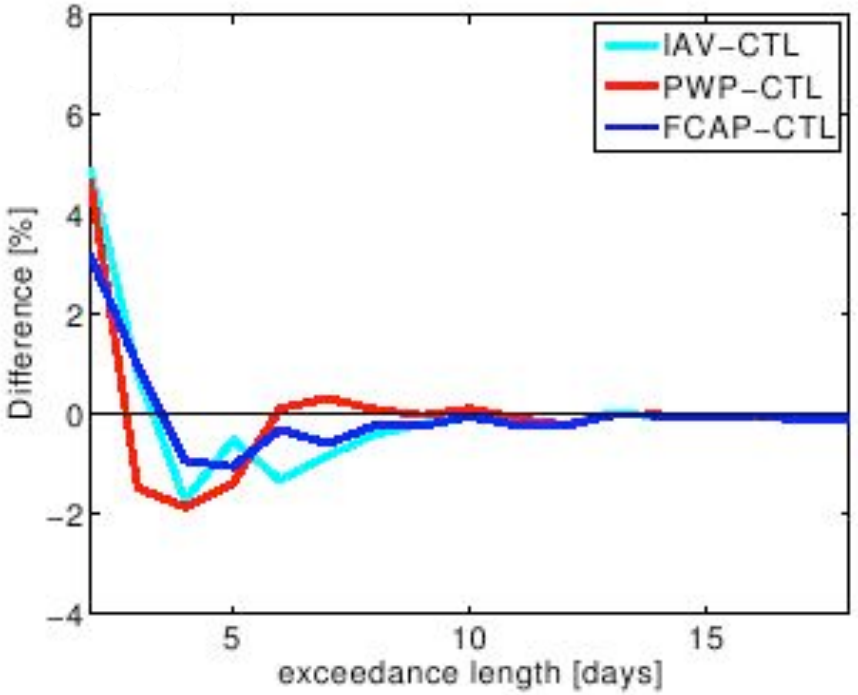
Changes in hwdi*



Differences in 90th-percentile exceedance lengths



Iberian Peninsula



Mid-Europe

Conclusions

- Definition of indices important
- choice of threshold may change sign of signal
- Decreasing persistence
- Important role of soil moisture memory for persistence of heat wave events

Thank you for your attention!

Questions?