

Persistence of heat waves and its link to soil moisture memory

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C2SM COSMO User Workshop

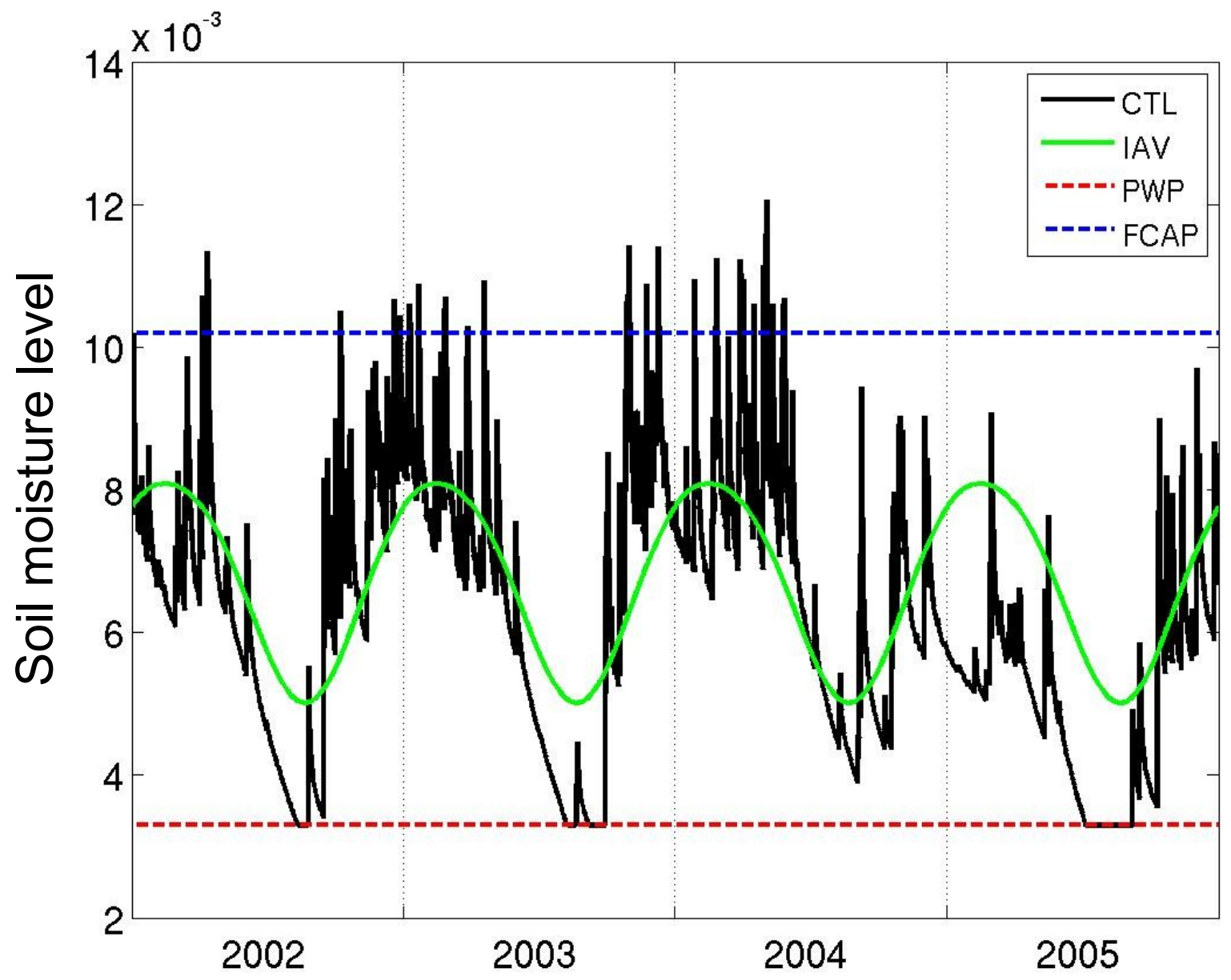
22. October 2009

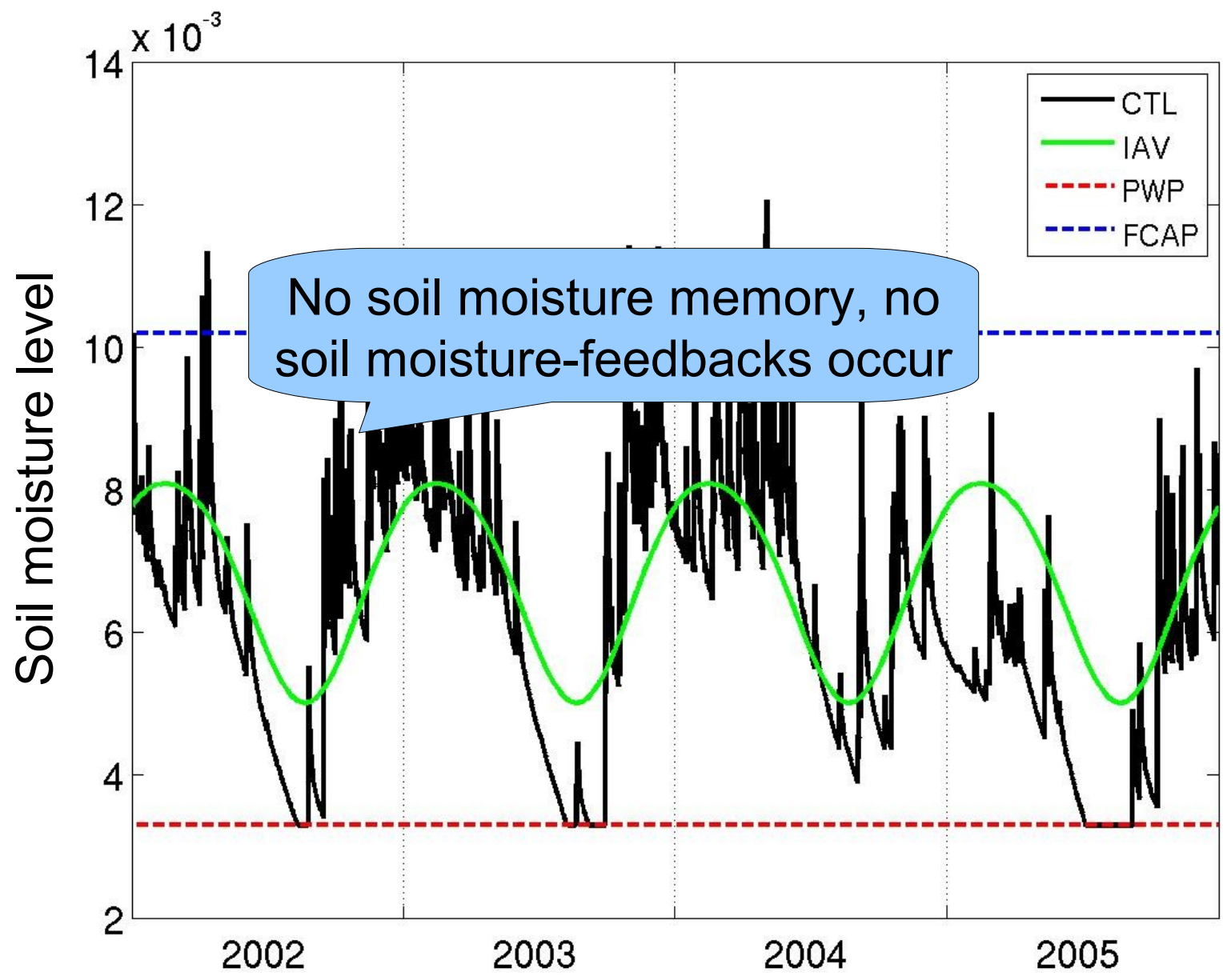
Introduction

- C-CLM study to assess role of soil moisture (SM) for heat wave persistence
- Soil moisture is important memory component in climate system
- Partitioning of surface energy into sensible and latent heat fluxes can strongly be determined by SM
- Soil moisture temperature interactions account for 50-80% of the number of hot summer days and increased heat wave duration (Fischer et al. 2007)

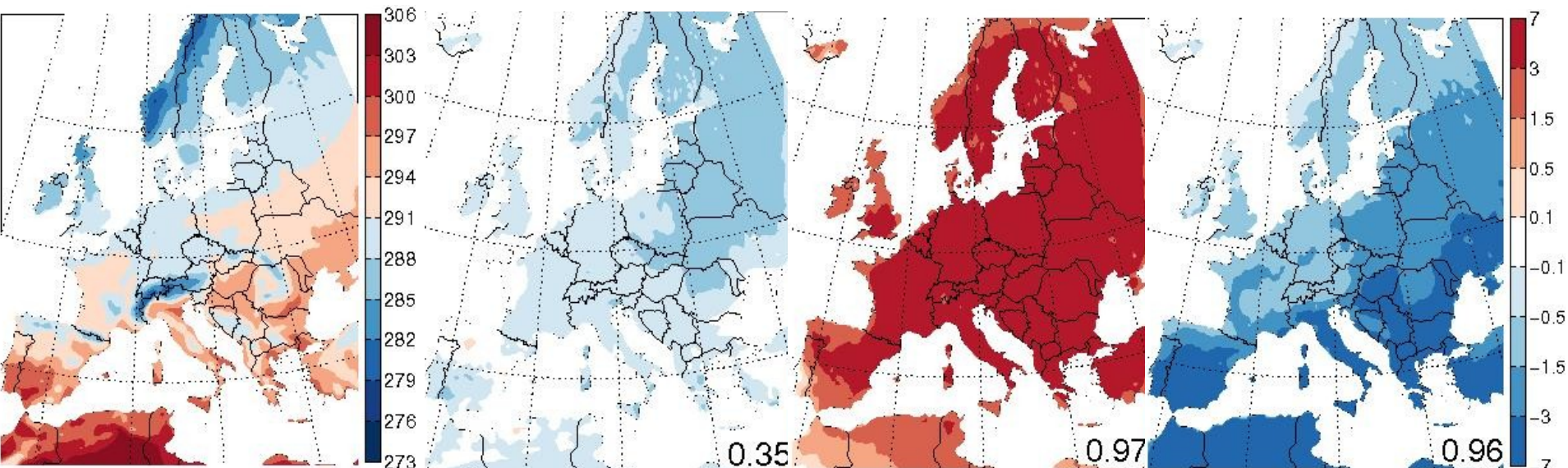
Model set up

- 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





Mean temperature



T_{2m} CTL

T_{2m} IAV-CTL

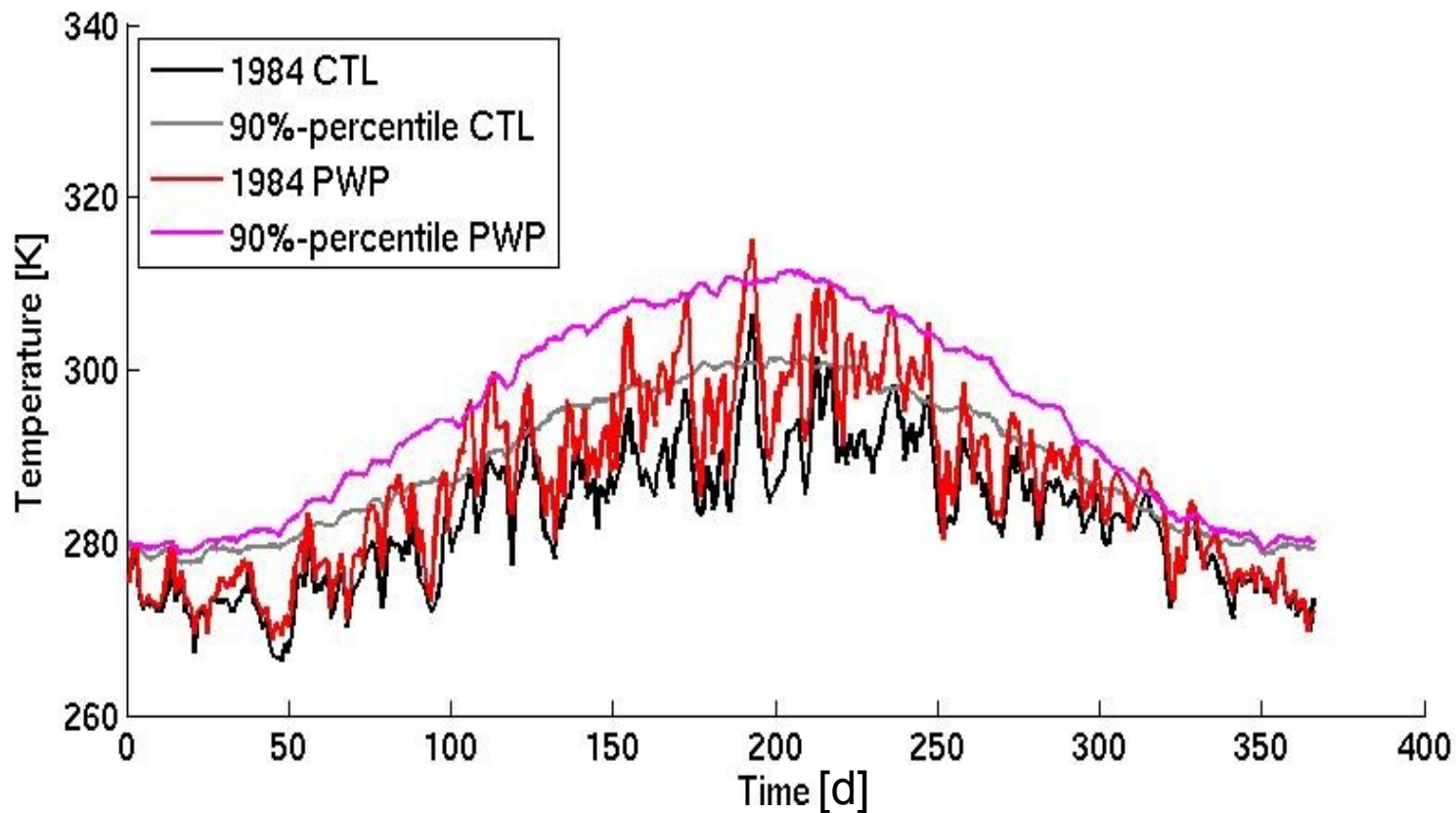
T_{2m} PWP-CTL

T_{2m} FCAP-CTL

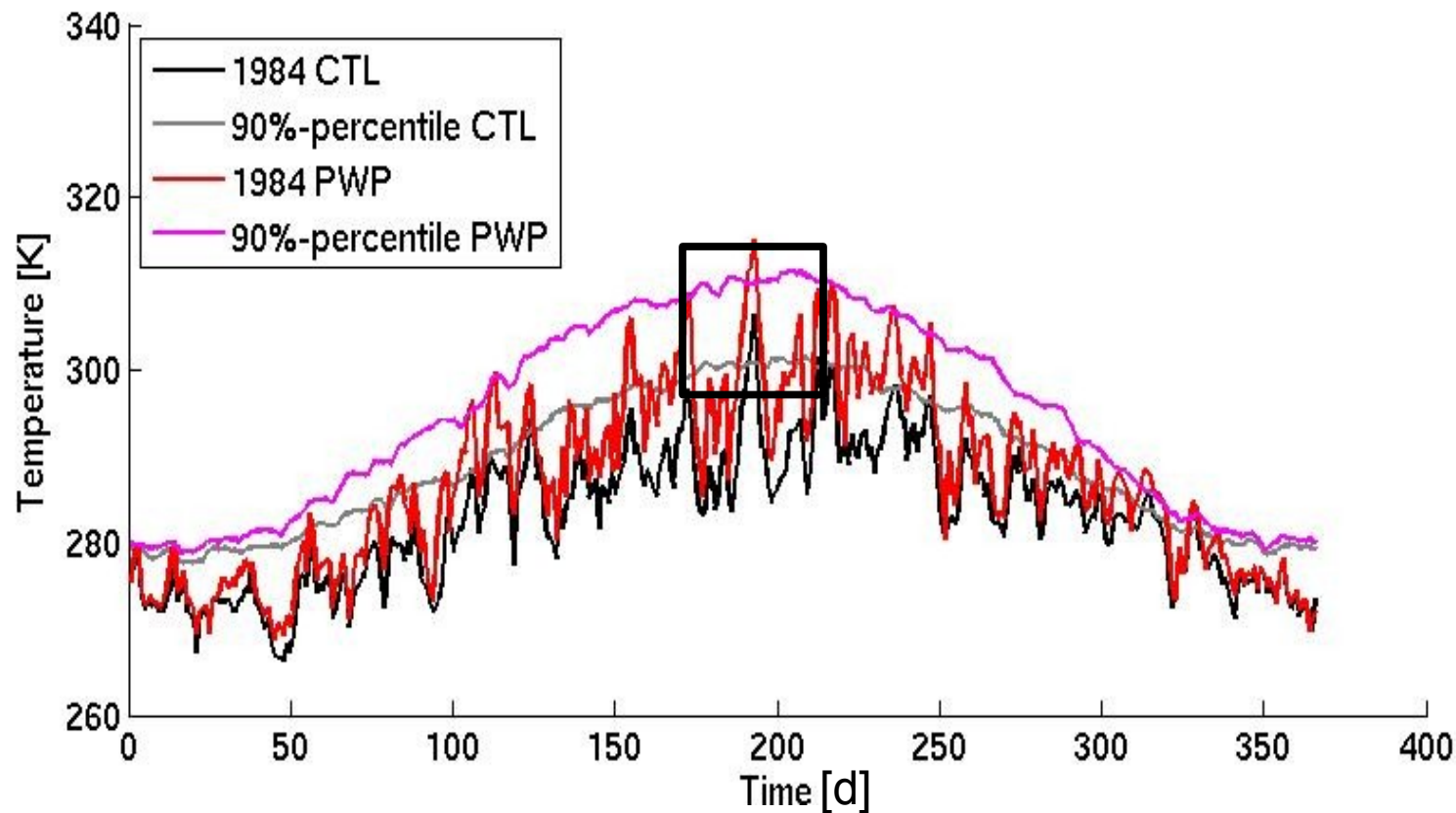
Heat Wave Duration Indices

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

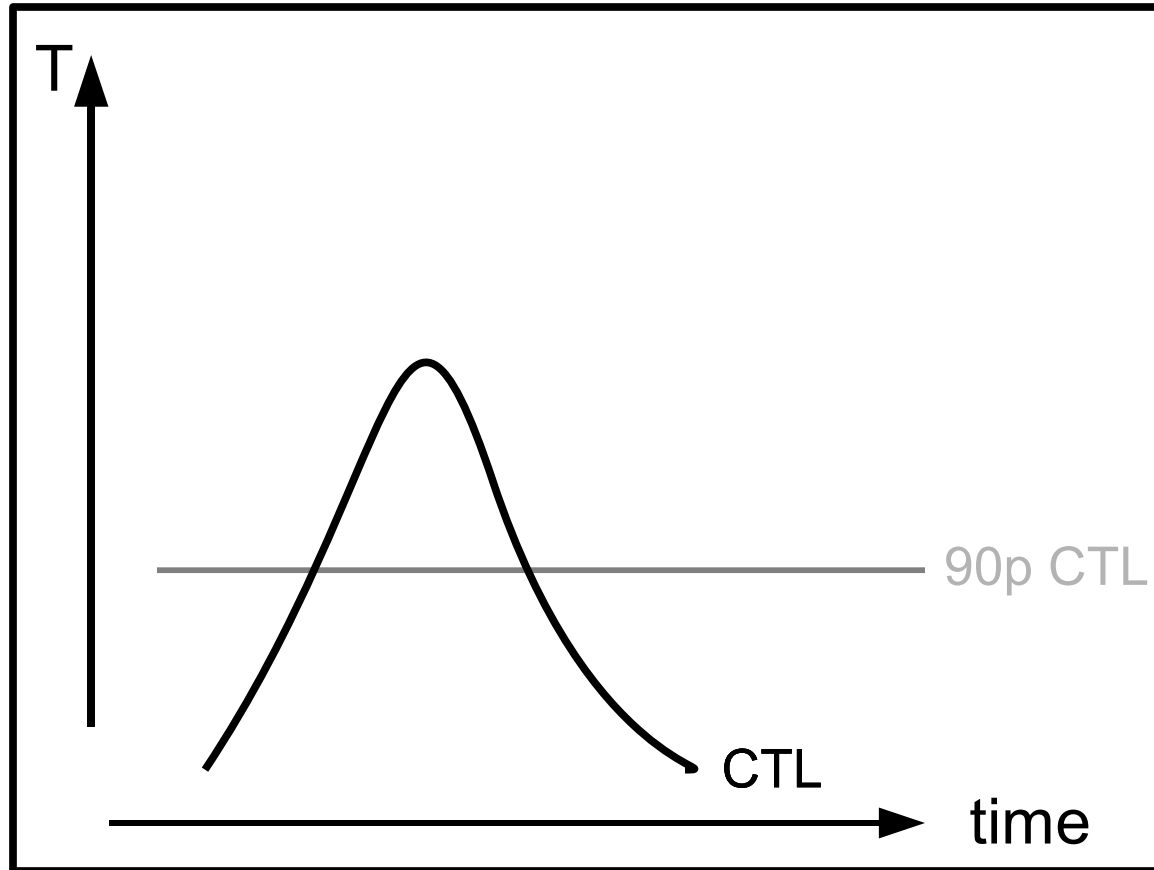
Definition of hwdi and hwdi*



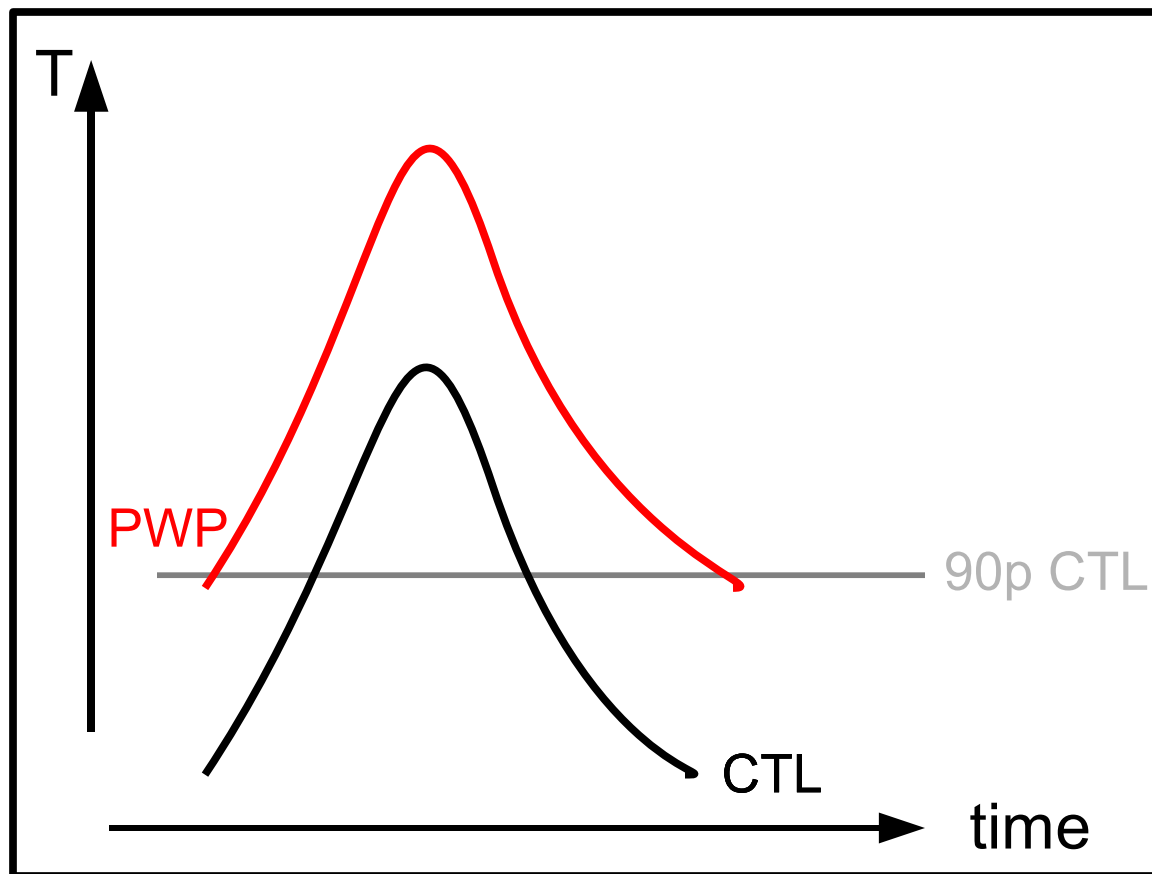
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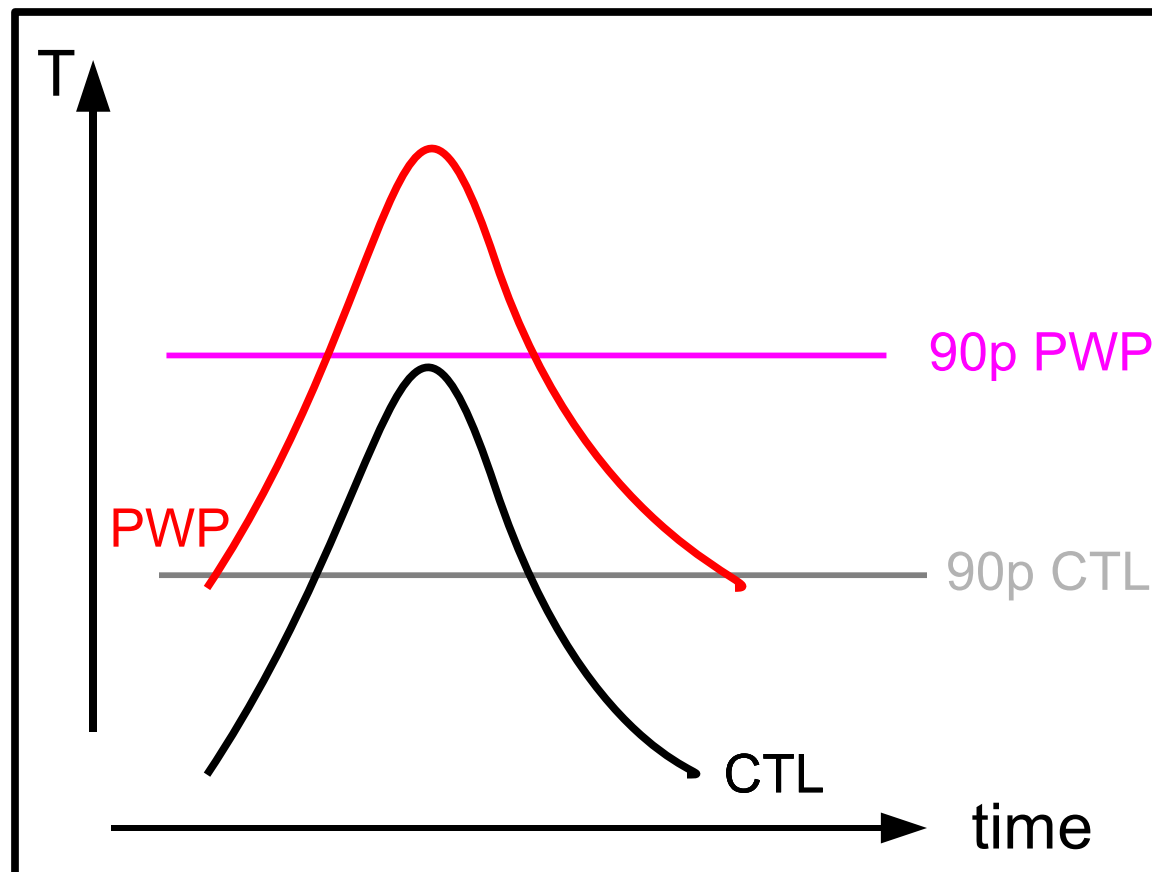
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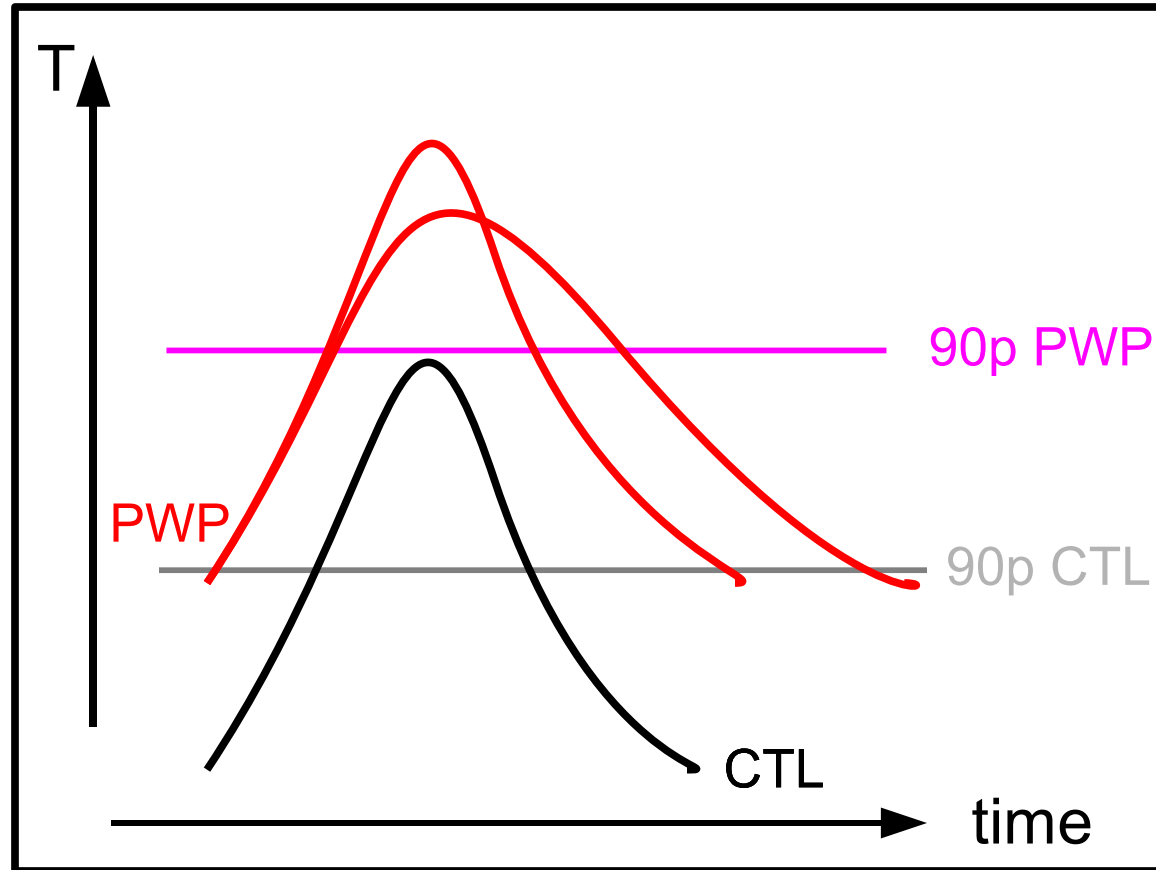
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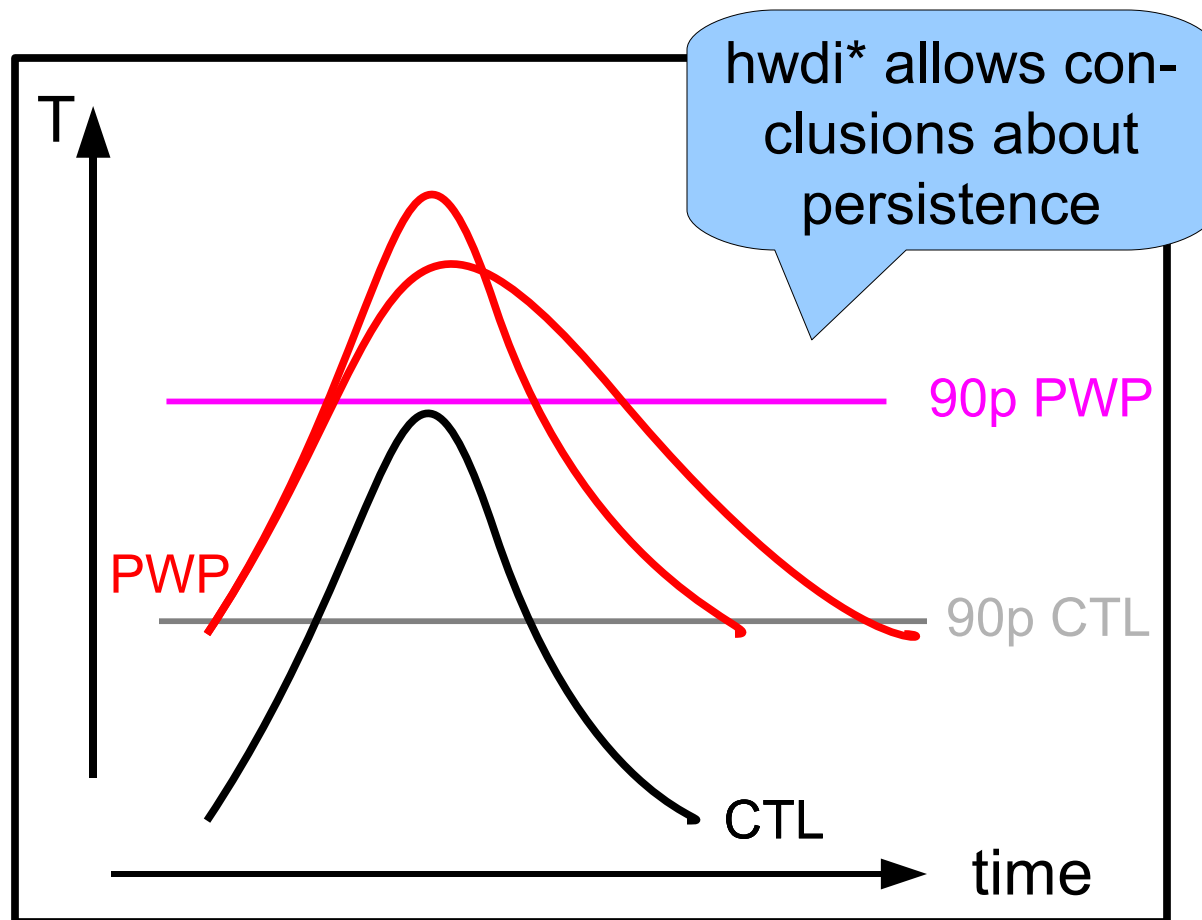
Definition of hwdi and hwdi*



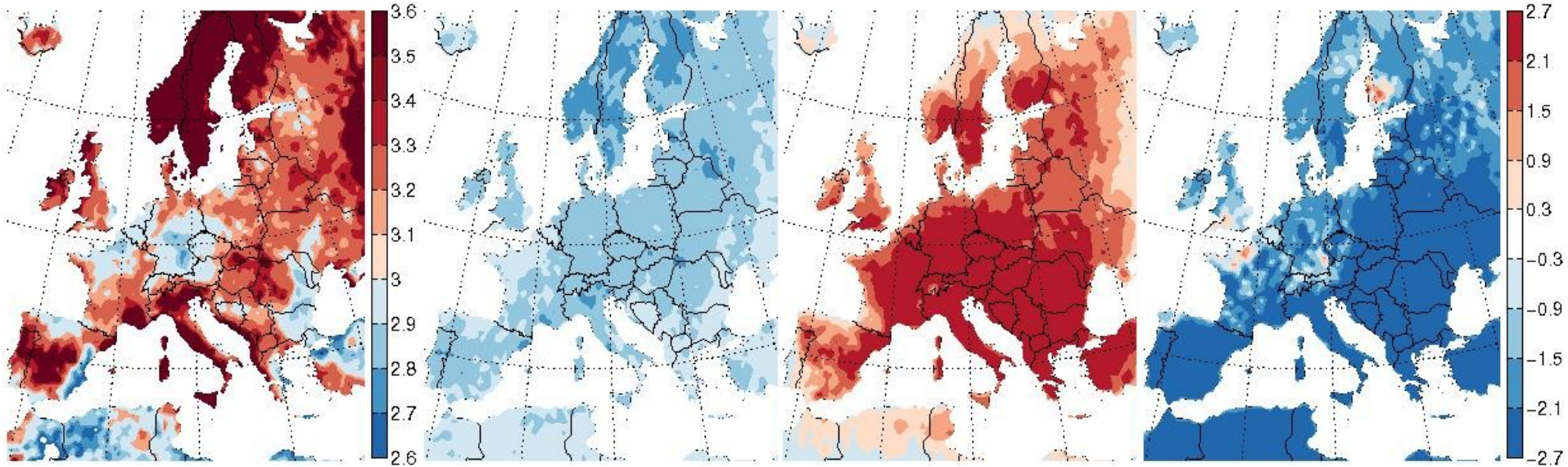
Definition of hwdi and hwdi*



Definition of hwdi and hwdi*



Heat wave duration index 'hwdi'



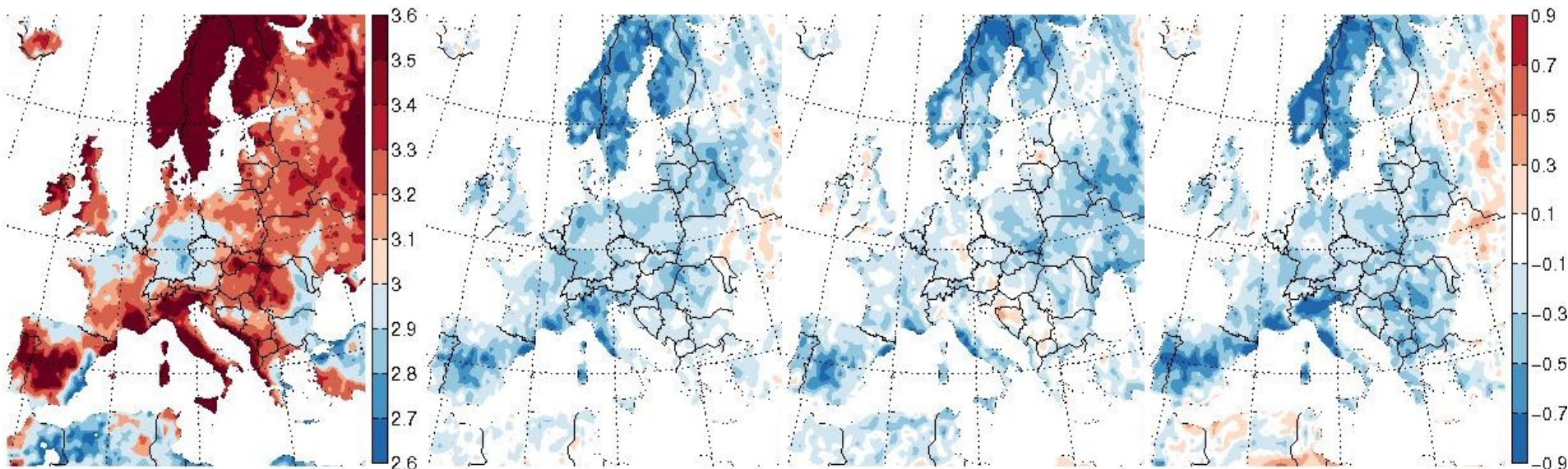
hwdi CTL

hwdi IAV-CTL

hwdi PWP-CTL

hwdi FCAP-CTL

Heat wave duration index 'hwdi*'



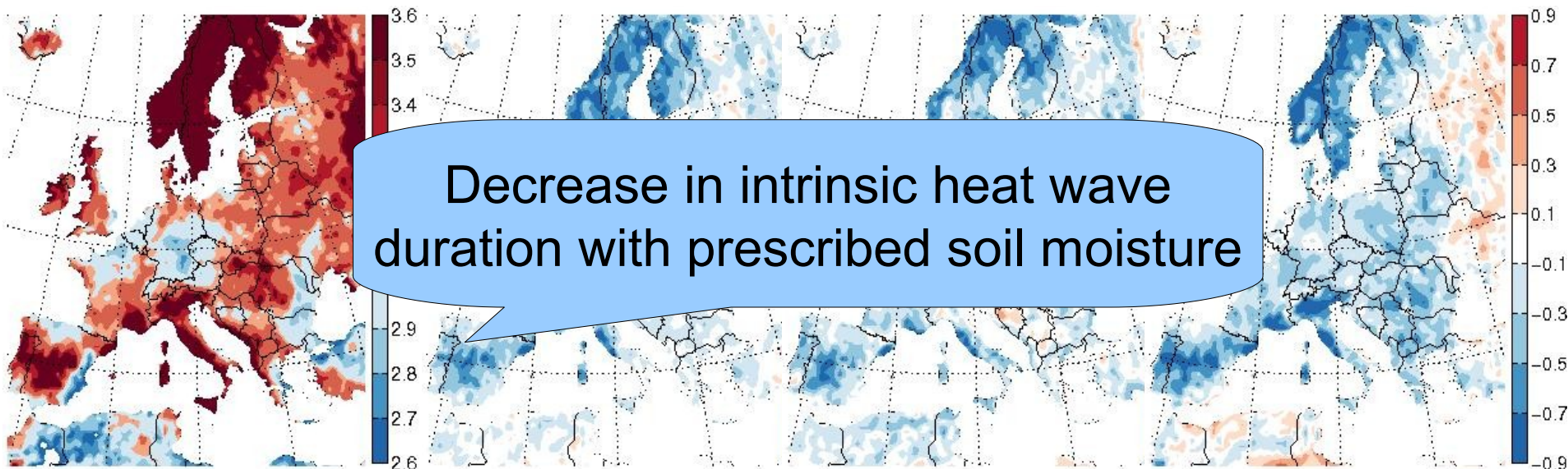
hwdi=hwdi* CTL

hwdi* IAV-CTL

hwdi* PWP-CTL

hwdi* FCAP-CTL

Heat wave duration index 'hwdi*'



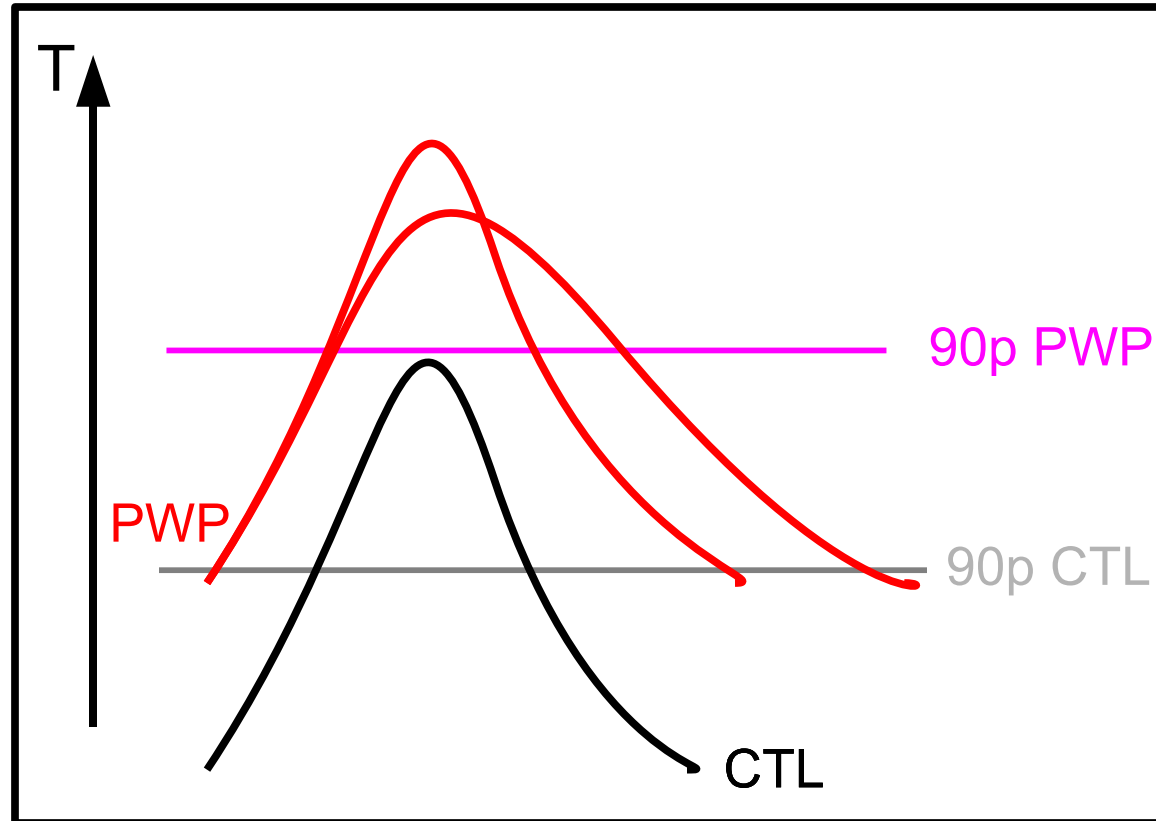
hwdi=hwdi* CTL

hwdi* IAV-CTL

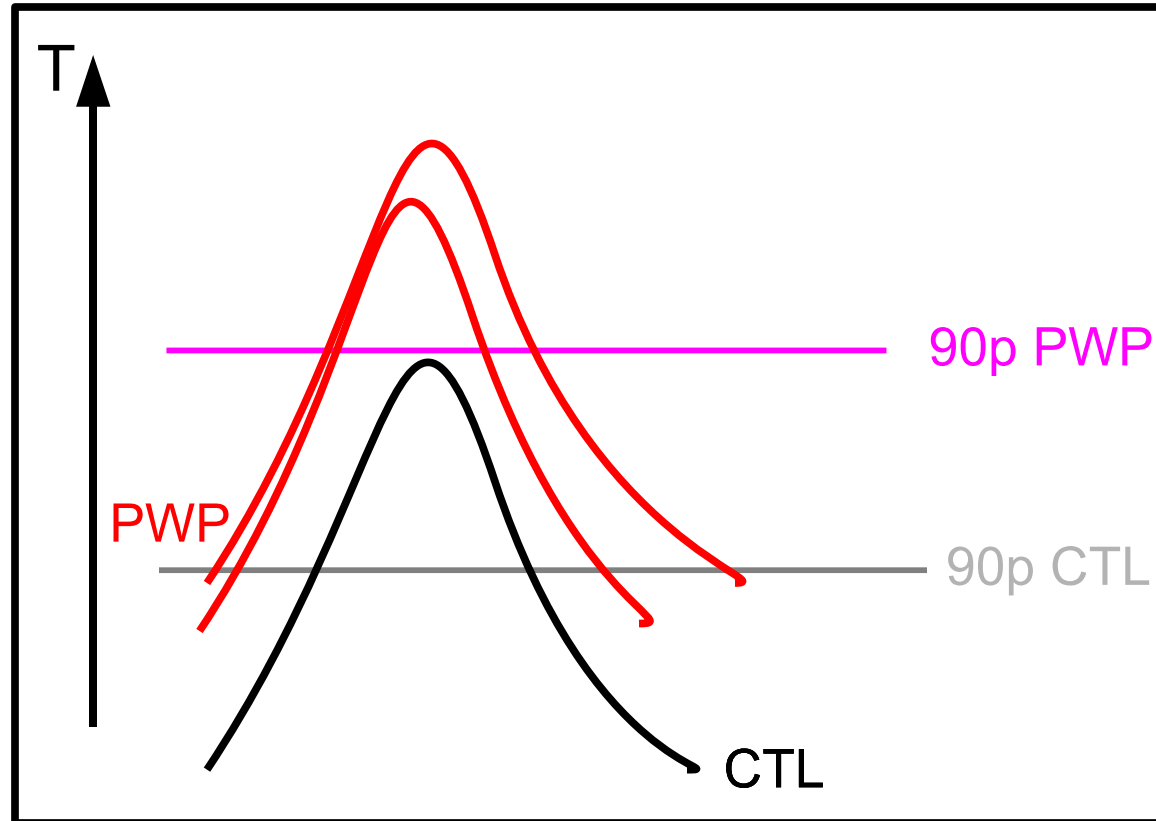
hwdi* PWP-CTL

hwdi* FCAP-CTL

Changes in hwdi*

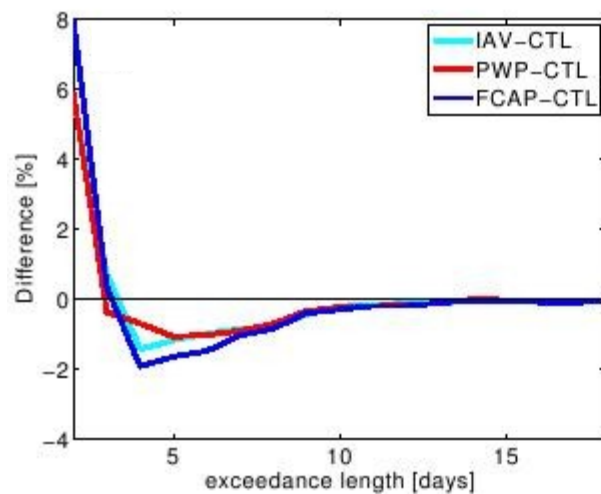


Changes in hwdi*

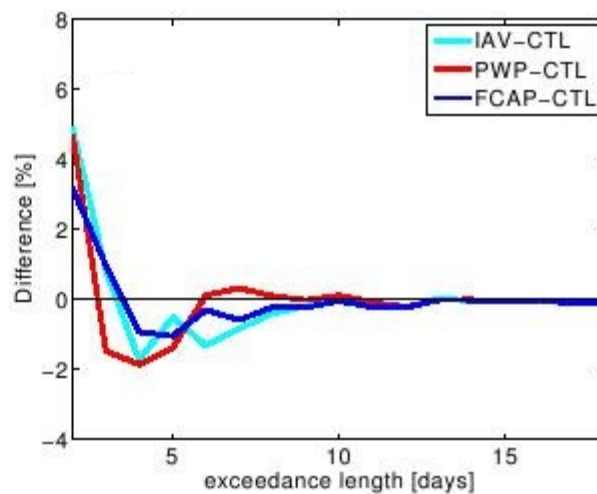


90th-percentile exceedances

- Differences in exceedance lengths



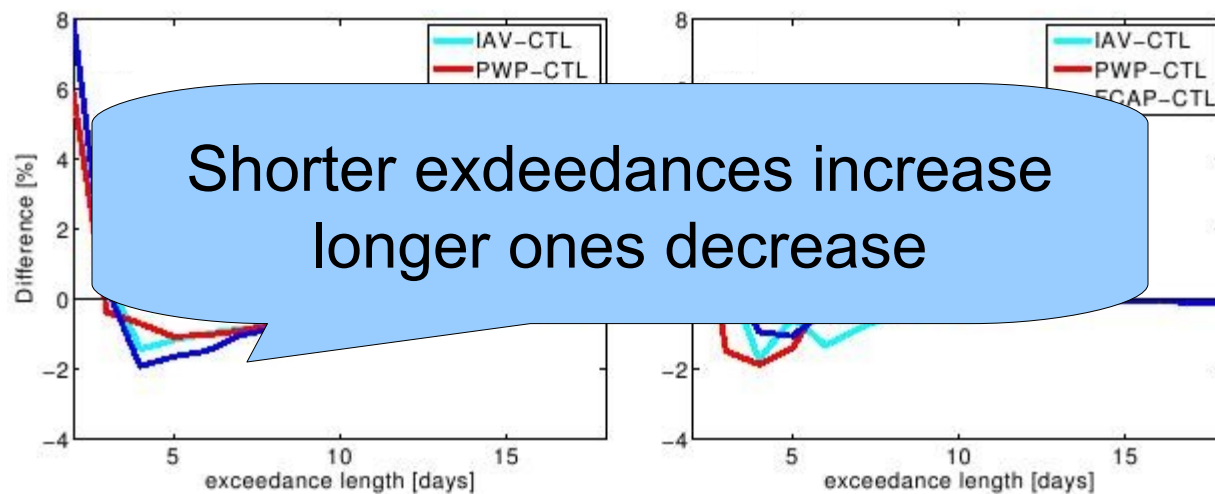
Southern Europe



Central Europe

90th-percentile exceedances

- Differences in exceedance lengths

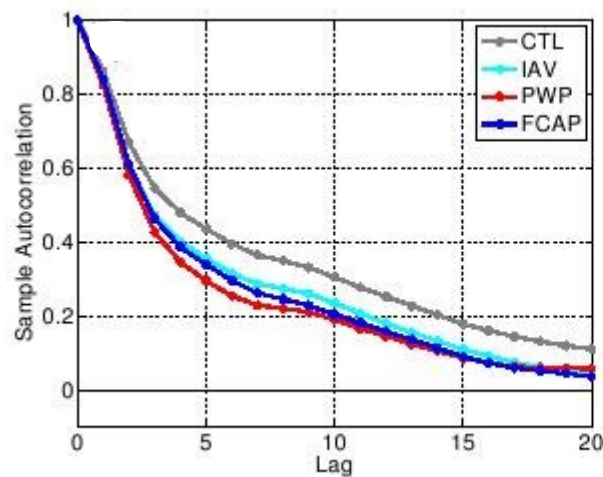


Southern Europe

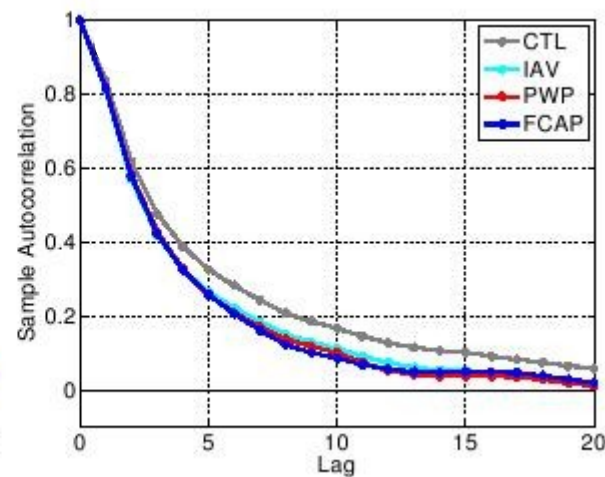
Central Europe

90th-percentile exceedances

- Autocorrelations



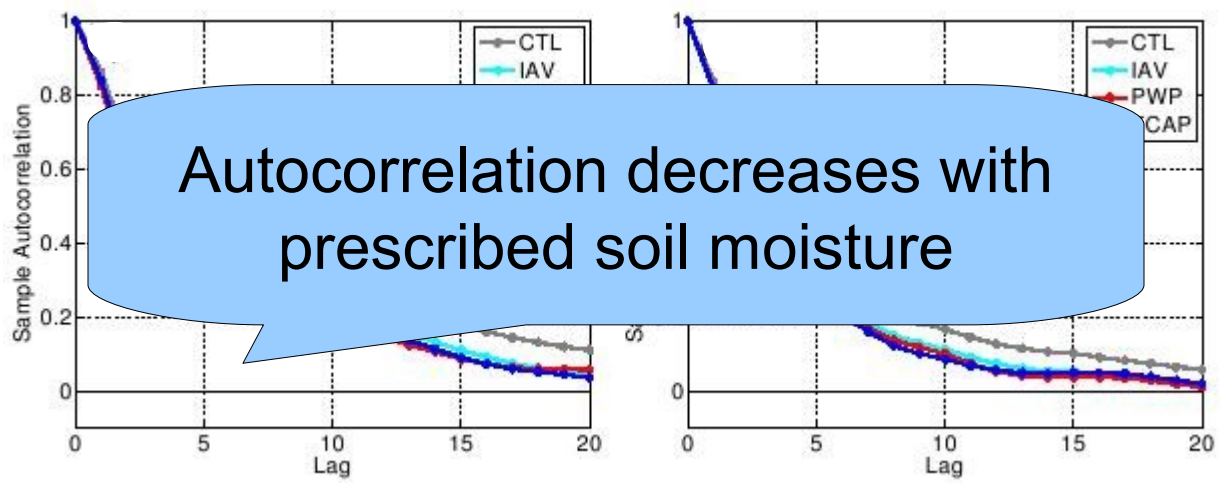
Southern Europe



Central Europe

90th-percentile exceedances

- Autocorrelations



Southern Europe

Central Europe

Conclusions

- Definition of heat wave duration indices influence results
- PWP: choice of threshold even leads to opposite signals
- Decreasing persistence of high temperatures when SM is prescribed for wet as well as dry runs
- Important role of soil moisture memory for persistence of heat wave events