



# Urban climate modeling with COMSO-CLM

*DWD: In cooperation with*

*CNRM:*

Kristina Trusilova,

Barbara Früh,

Susanne Brienzen,

Andreas Walter

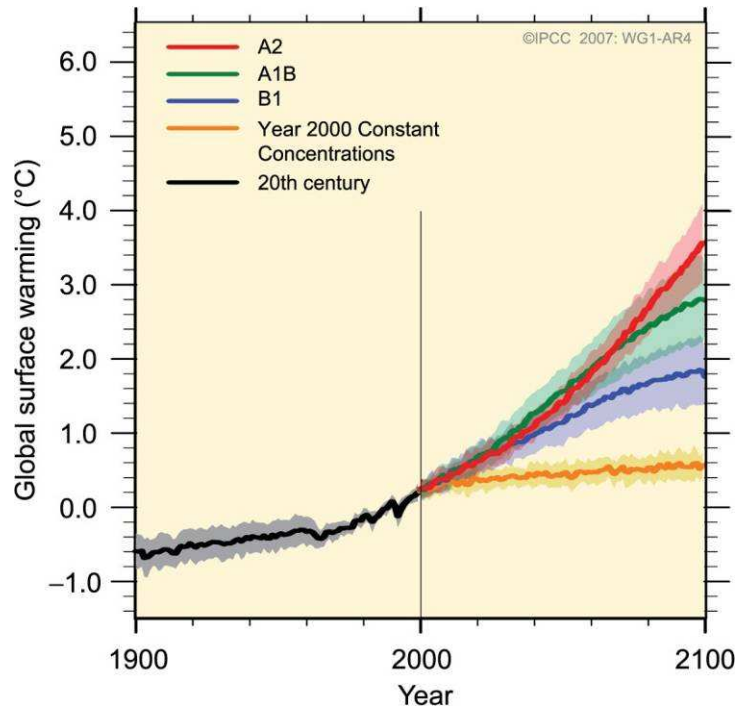
Valéry Masson,

Grégoire Pigeon





## Objectives



*Mean and spread of the surface warming from the multi-model ensemble (IPCC, AR4 WG1)*

→ Downscaling of global climate projections to the city scale (spatial resolution 1-3 km)

→ Cities of interest:

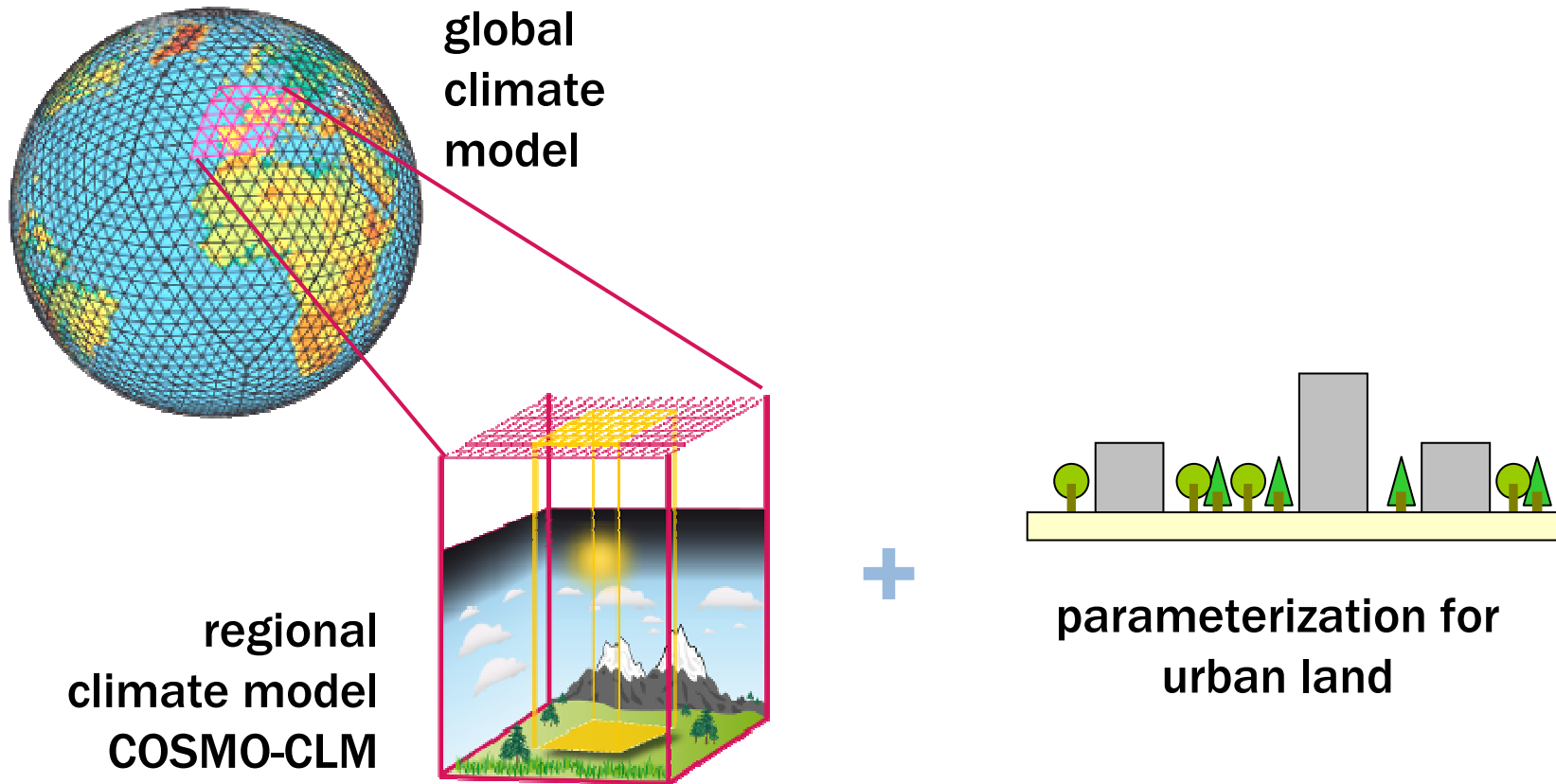
→ Hamburg

→ Munich

→ ... others



## Our instrument



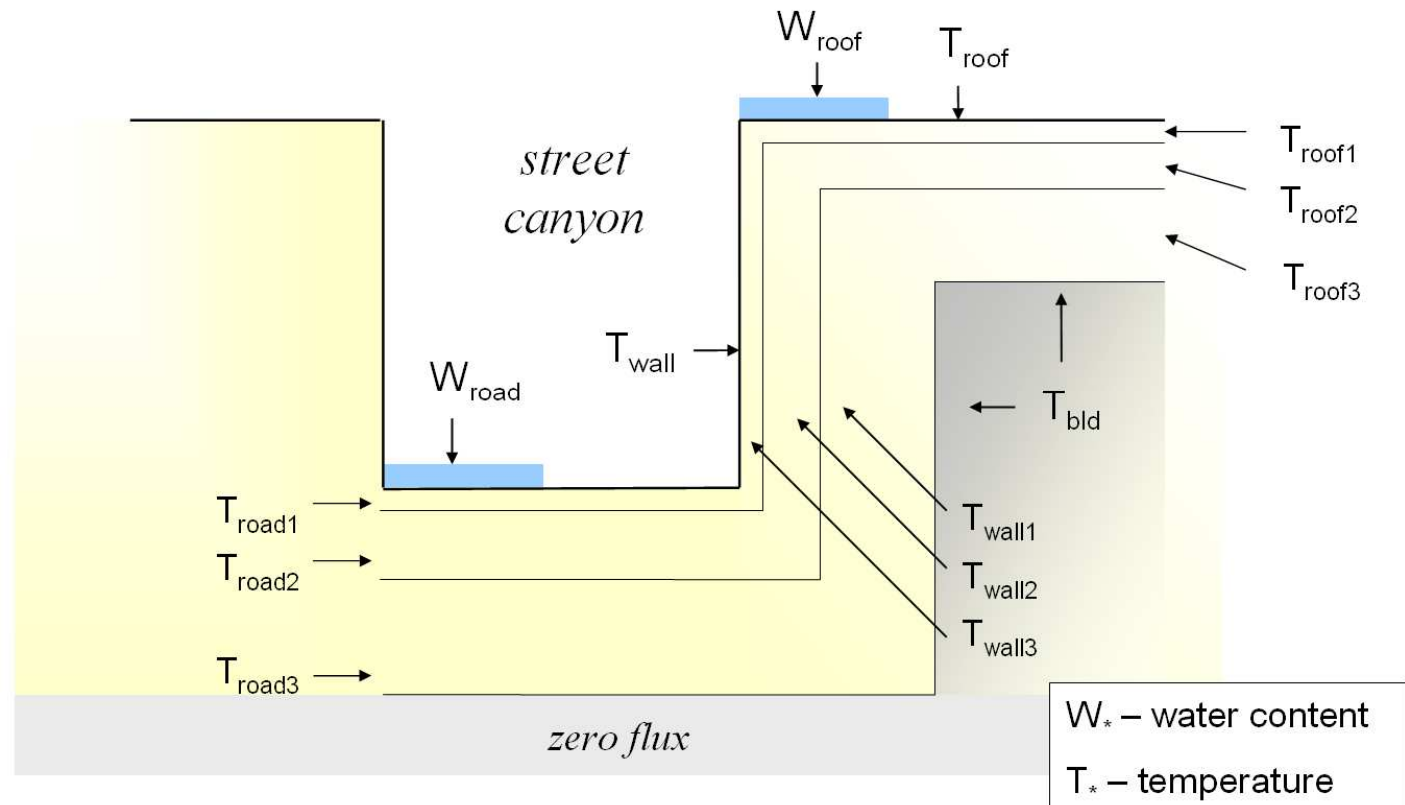


# Urban canopy model: Town Energy Budget scheme

developed by V.Masson and G.Pigeon (MétéoFrance)

**TEB** resolves the energy balance of three generic surfaces :

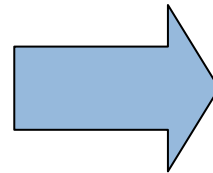
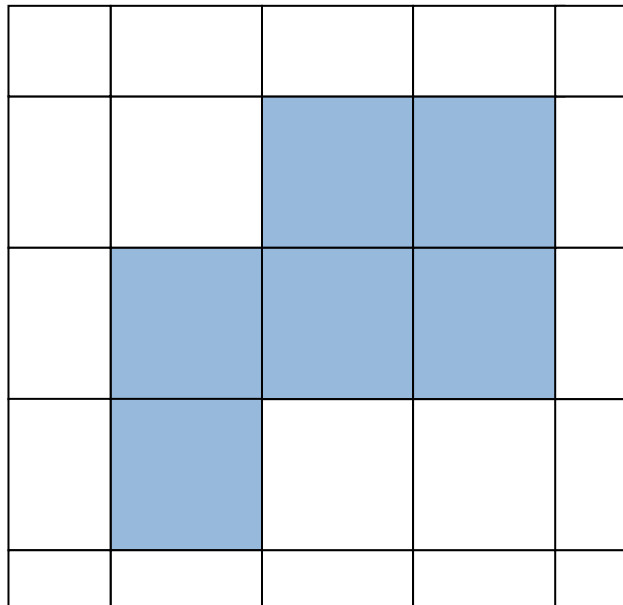
- roofs
- walls
- roads



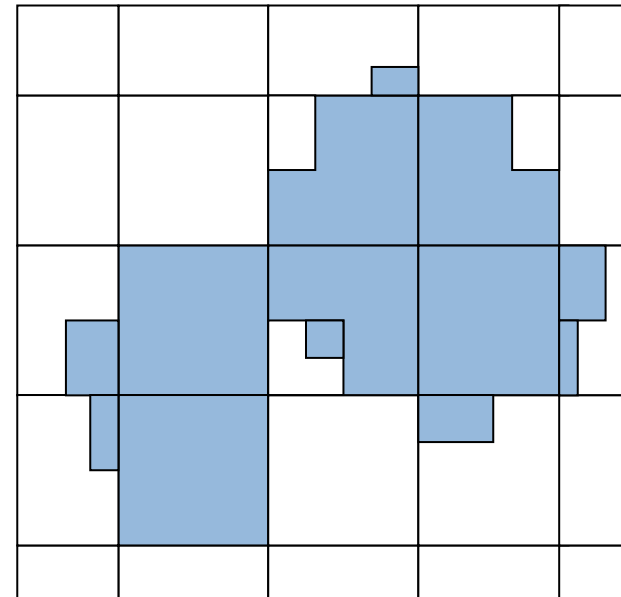


## Implementation: tile-approach

Dominant land cover  
(composite approach)

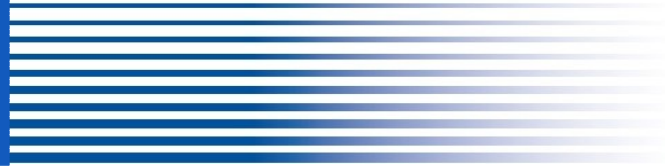


Fractional land cover  
(single class)





Climate Limited-area  
Modelling Community



**Deutscher Wetterdienst**  
Wetter und Klima aus einer Hand



# 1-year test application

## Part I



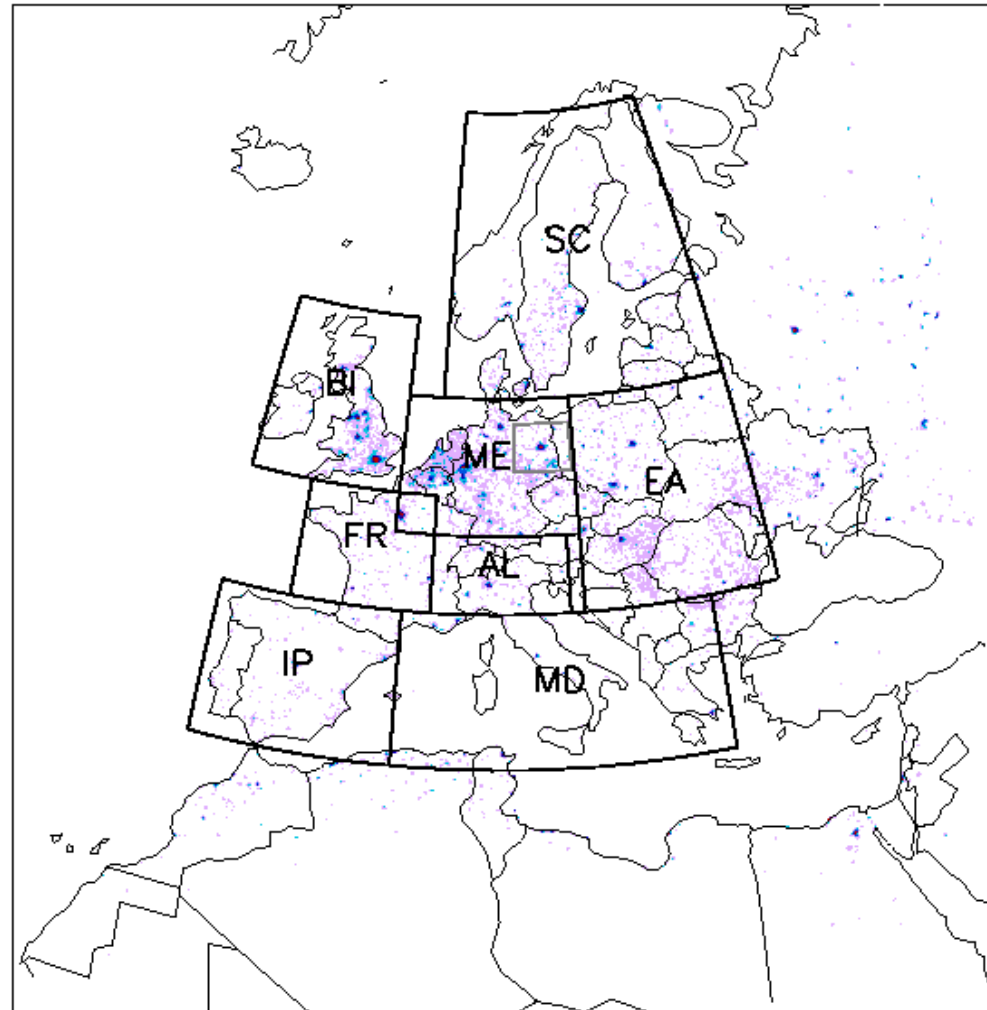


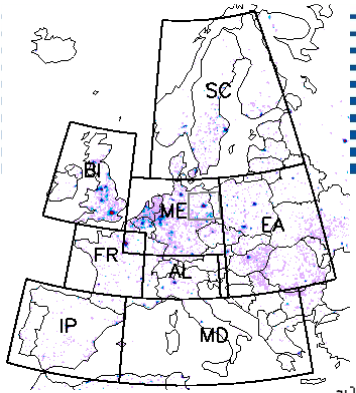
## model domain Europe

Spatial resolution: **12 km**

Simulation time: **2009**

Spin-up time: **3 months**





# Temperature at 2M

monthly mean values

bias

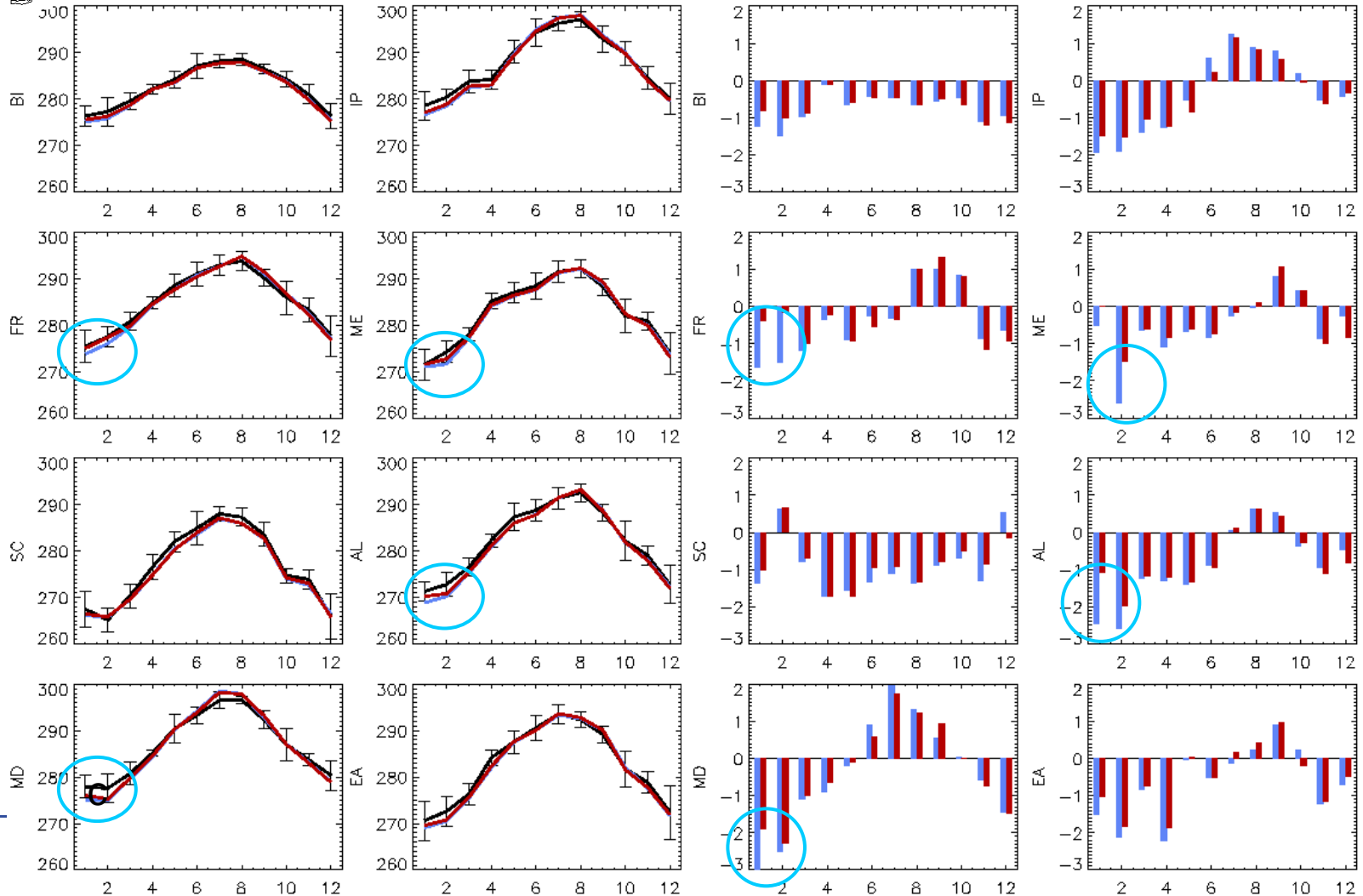
EOBSv5



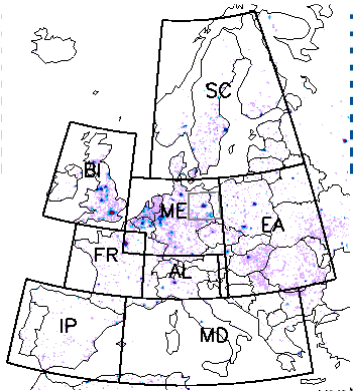
CCLM std



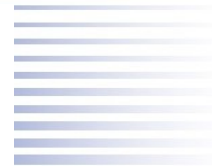
CCLM+TEB







# Precipitation



Deutscher Wetterdienst  
Wetter und Klima aus einer Hand



monthly total values

bias

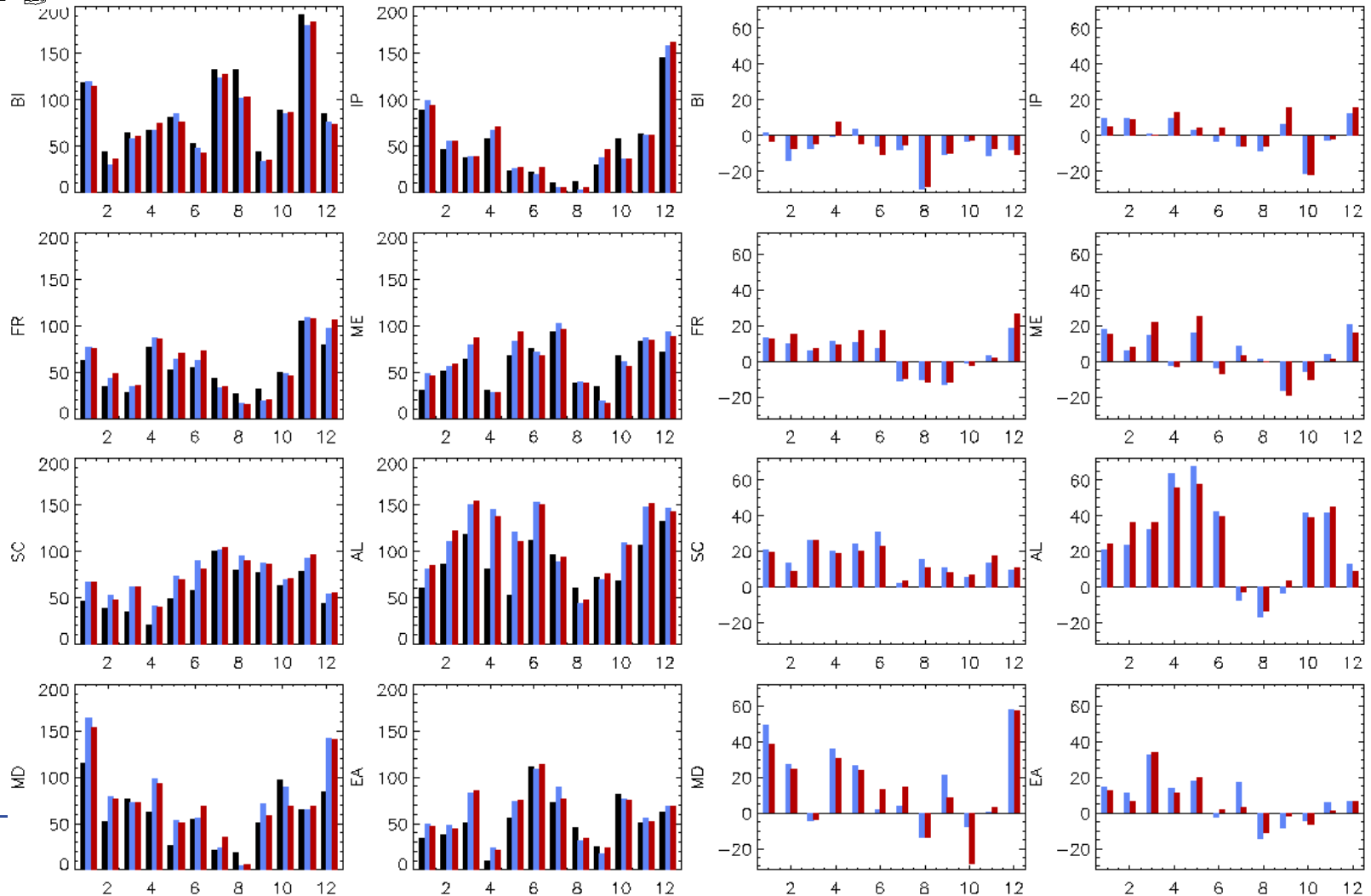
EOBSv5

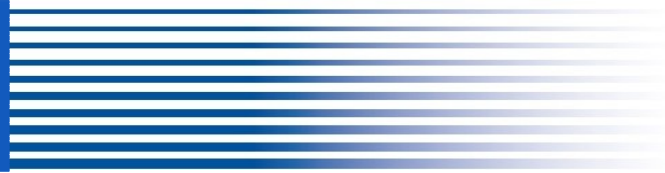


CCLM std



CCLM+TEB





# Are CCLM and CCLM+TEB simulations significantly different? (temperature, precipitation)





# Histograms

different medians

same distributions

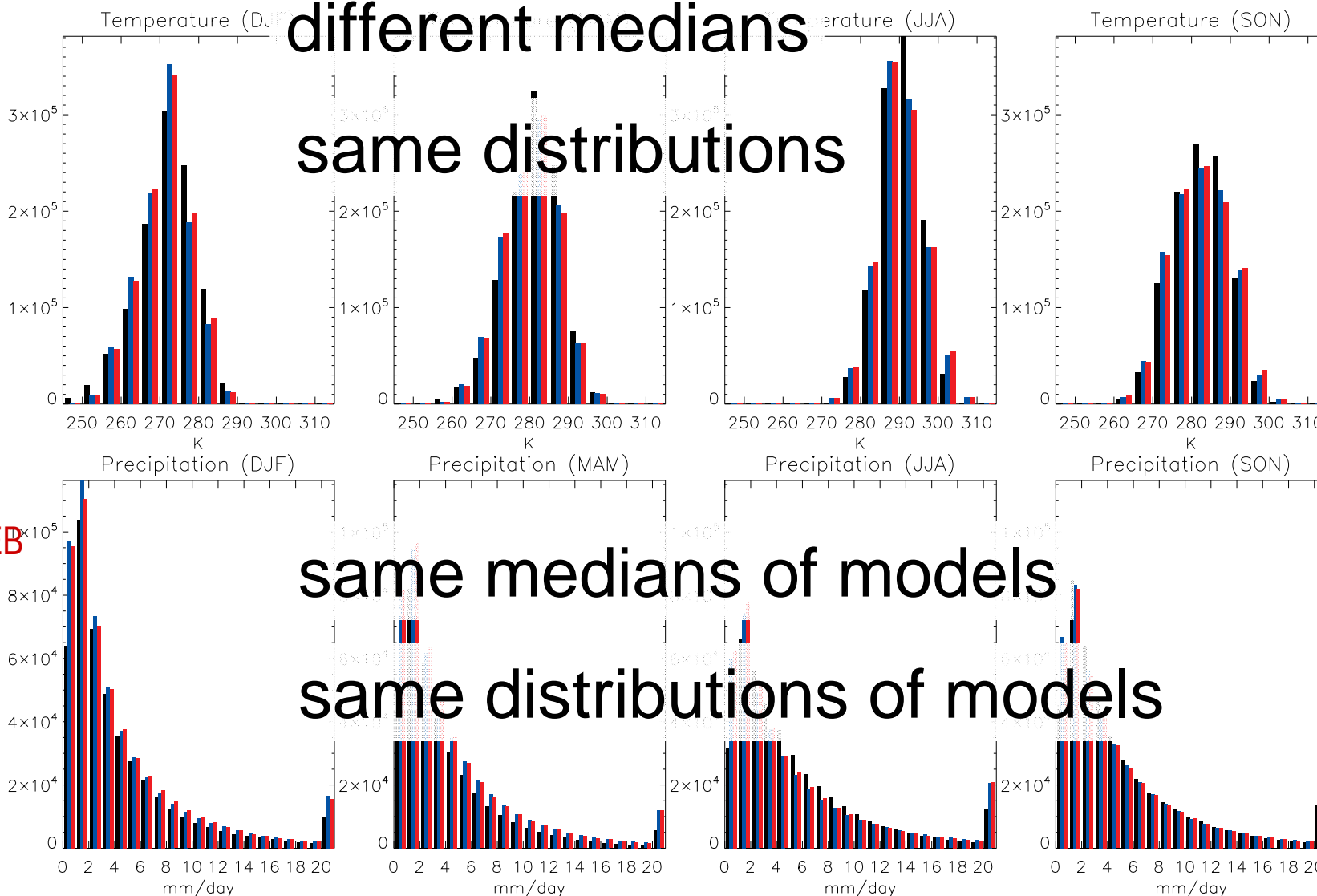
EOBSv5



CCLM std



CCLM+TEB





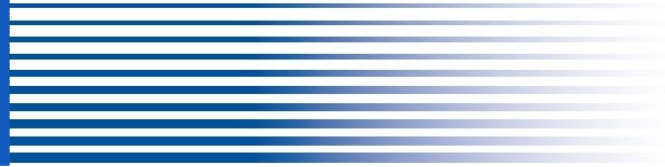
## Summary Europe

- Local effects on 2m-temperature
- No effect on precipitation
- No change of the statistical distributions for 2m-temperature and precipitation





Climate Limited-area  
Modelling Community



**Deutscher Wetterdienst**  
Wetter und Klima aus einer Hand



# 1-year test application

## Part II



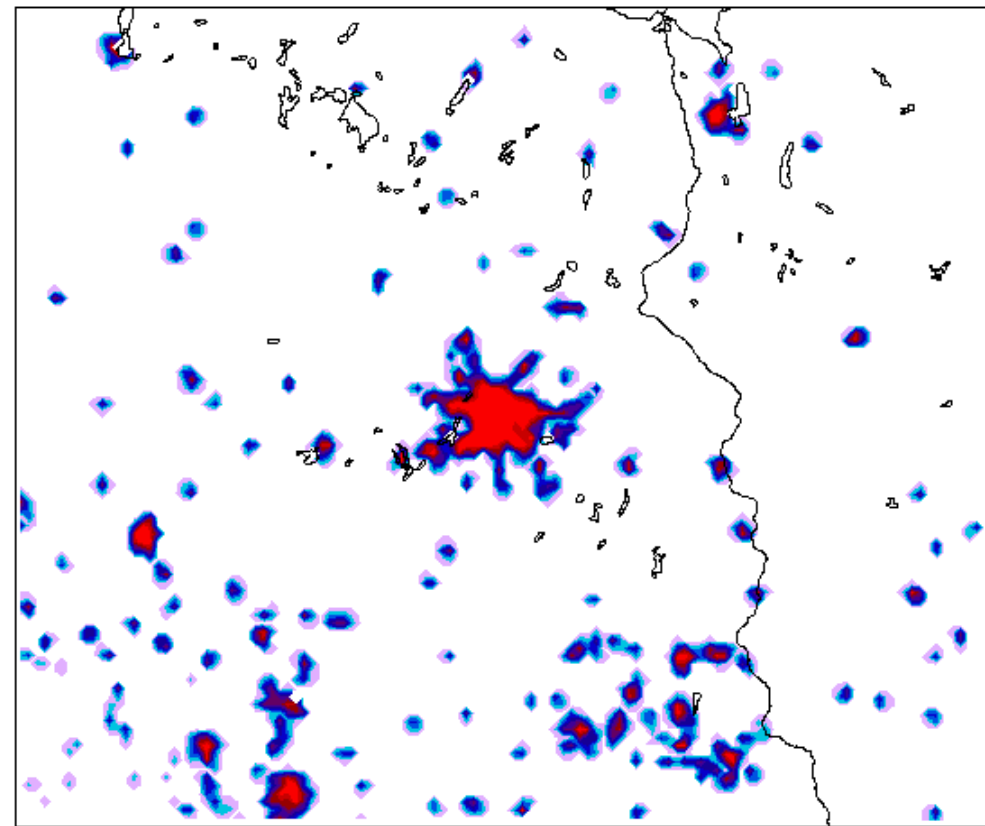
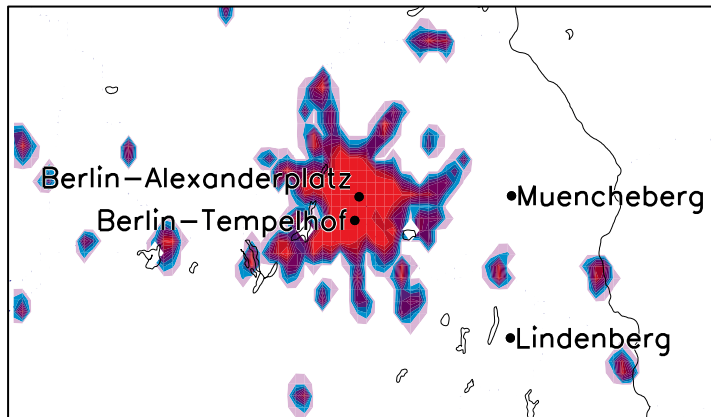


## model domain Berlin

Spatial resolution: **3 km**

Simulation time: **2009**

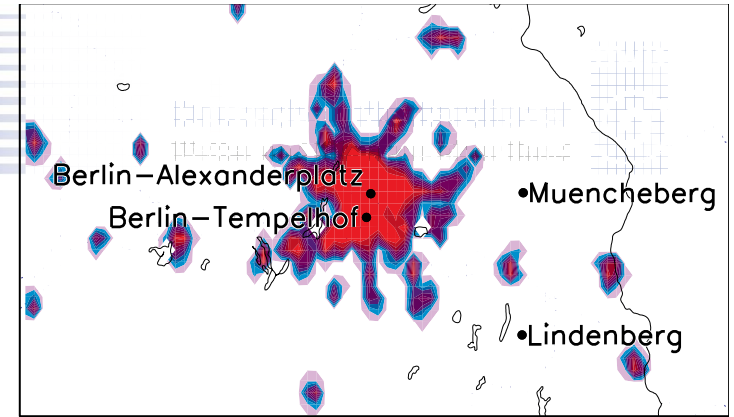
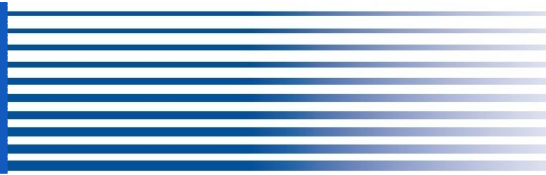
Spin-up time: **3 months**



Urban fraction

[fraction]





# 2m temperatures at 4 stations (weekly running mean)

OBS



CCLM std

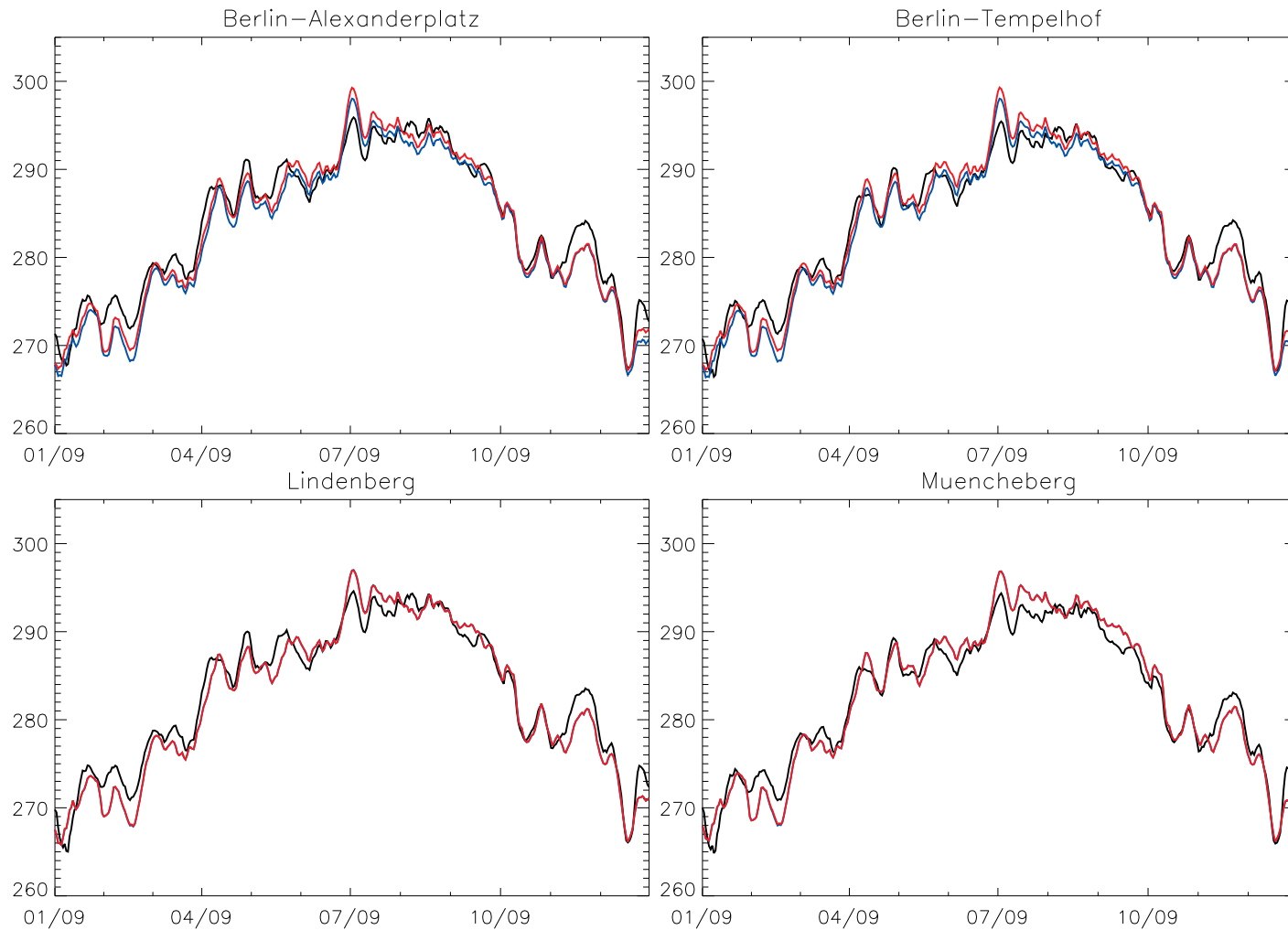


CCLM+TEB



RMSE=2.2K

RMSE=2.2K





# UHI at 4 stations (K)

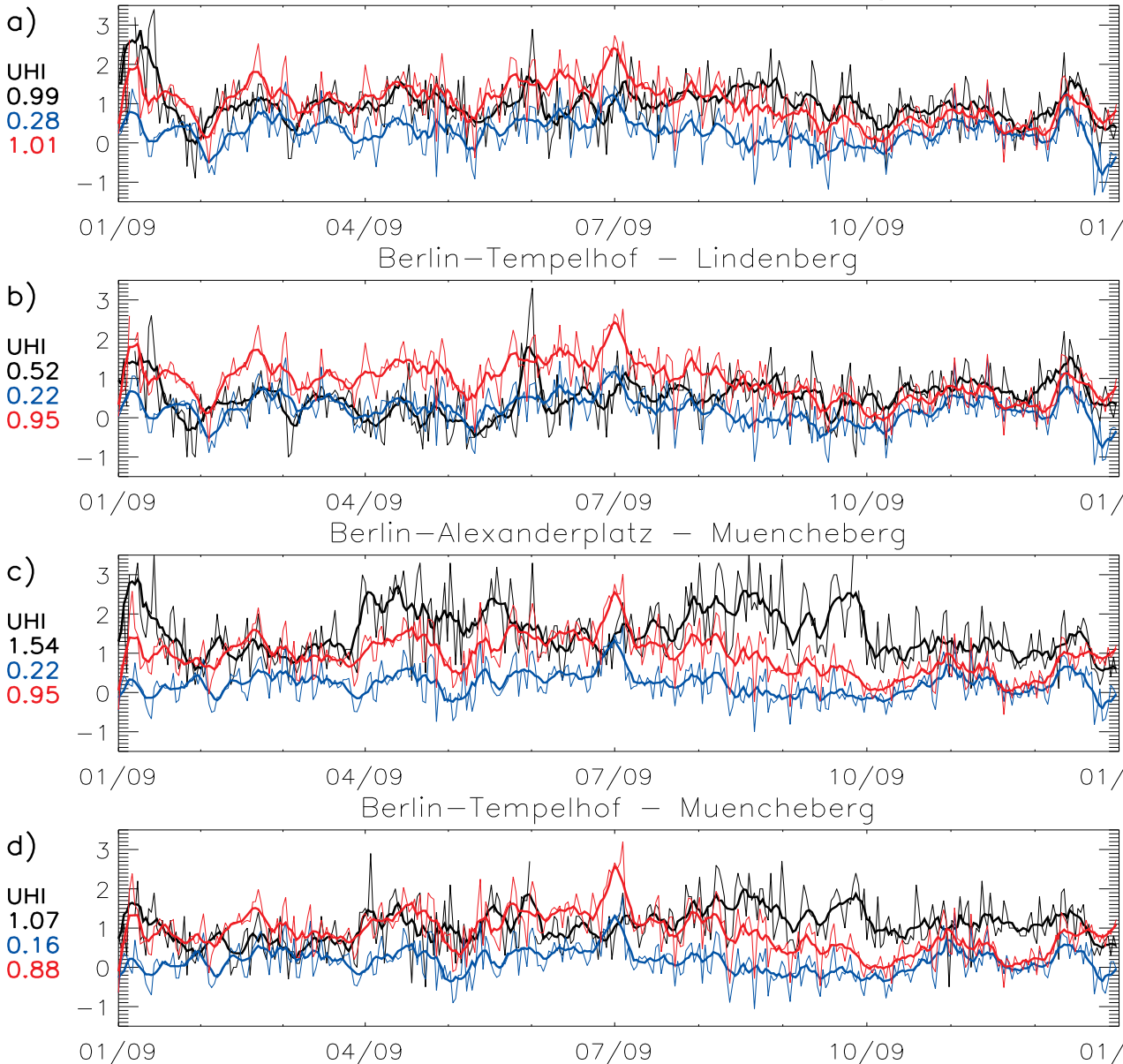
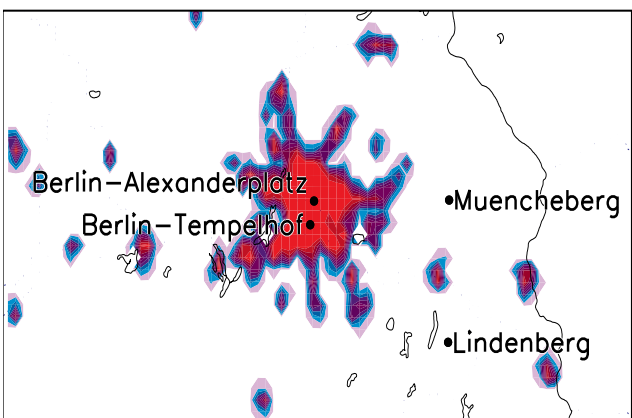
OBS



CCLM std



CCLM+TEB





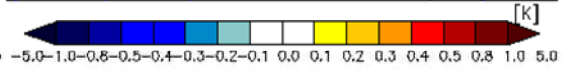
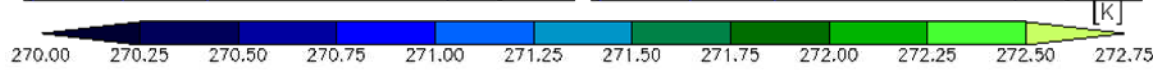
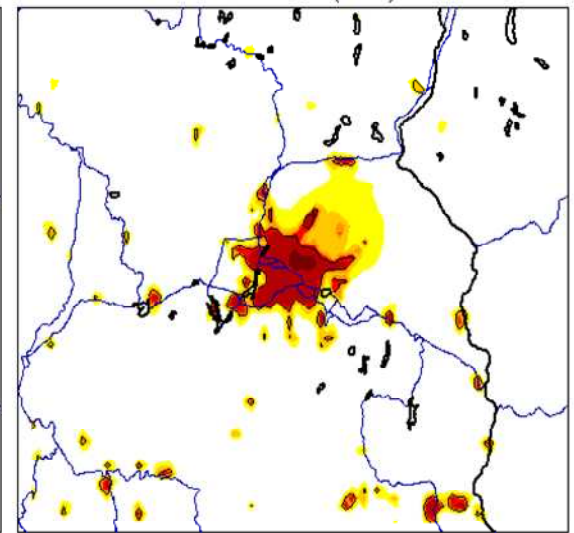
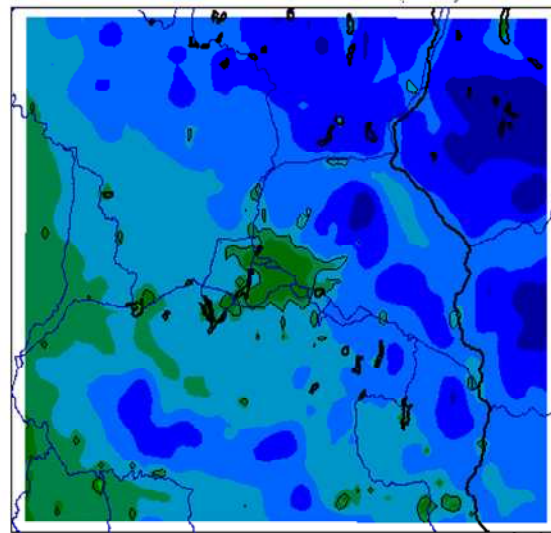
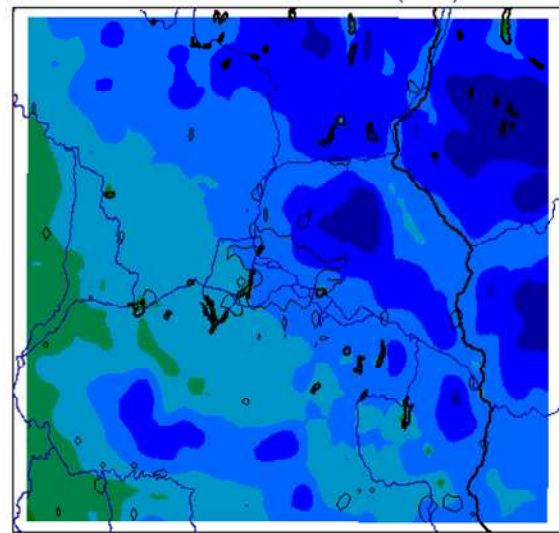
# T at 2M

CCLM std

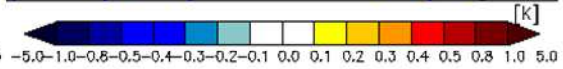
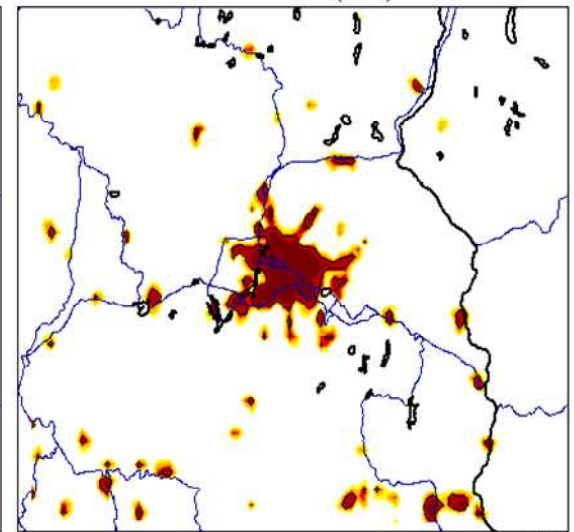
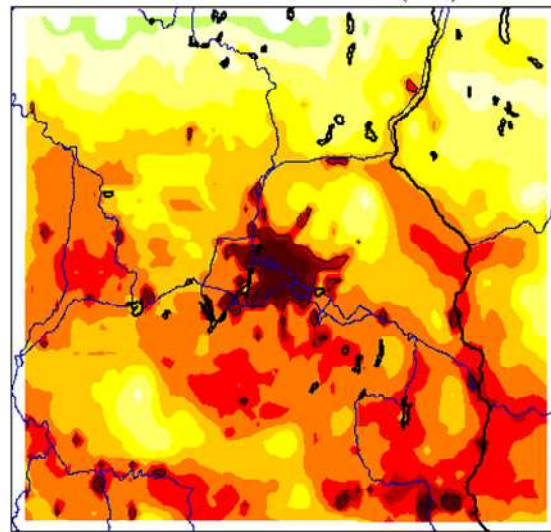
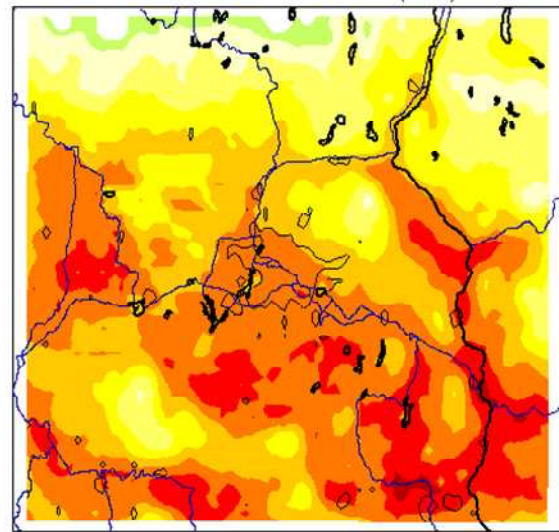
CCLM+TEB

CCLM+TEB - CCLM std

winter



summer



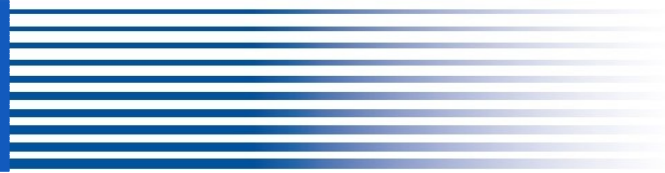


## Summary (domain Berlin)

- 3 km simulations capture the UHI of Berlin
- CCLM+TEB gives a better estimate of UHI in Berlin (**0.52 - 1.54 K**) than the std. CCLM
- summer UHI > winter UHI



Climate Limited-area  
Modelling Community

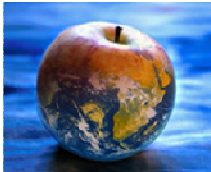


**Deutscher Wetterdienst**  
Wetter und Klima aus einer Hand



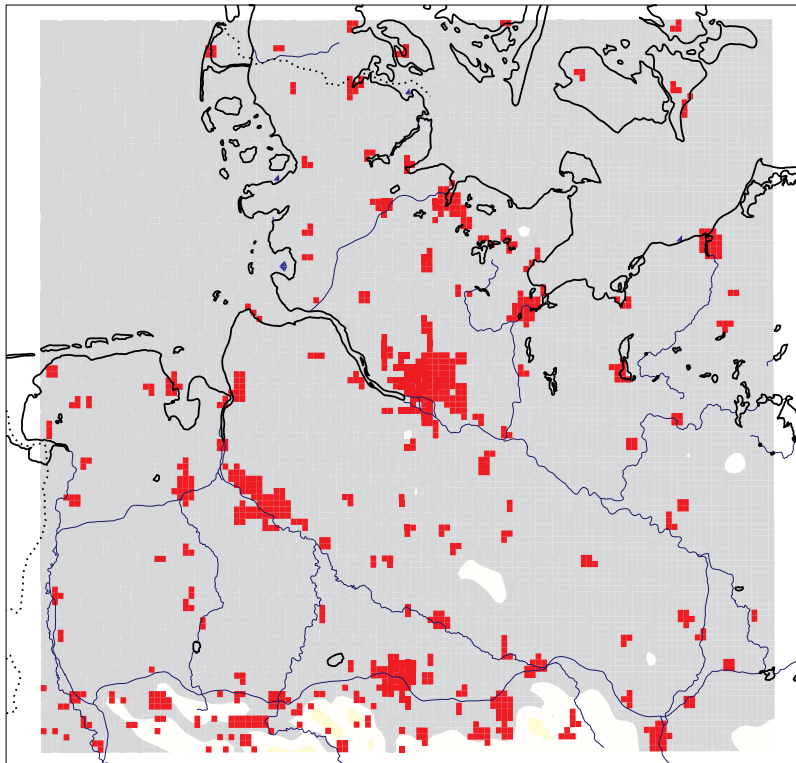
## Next applications



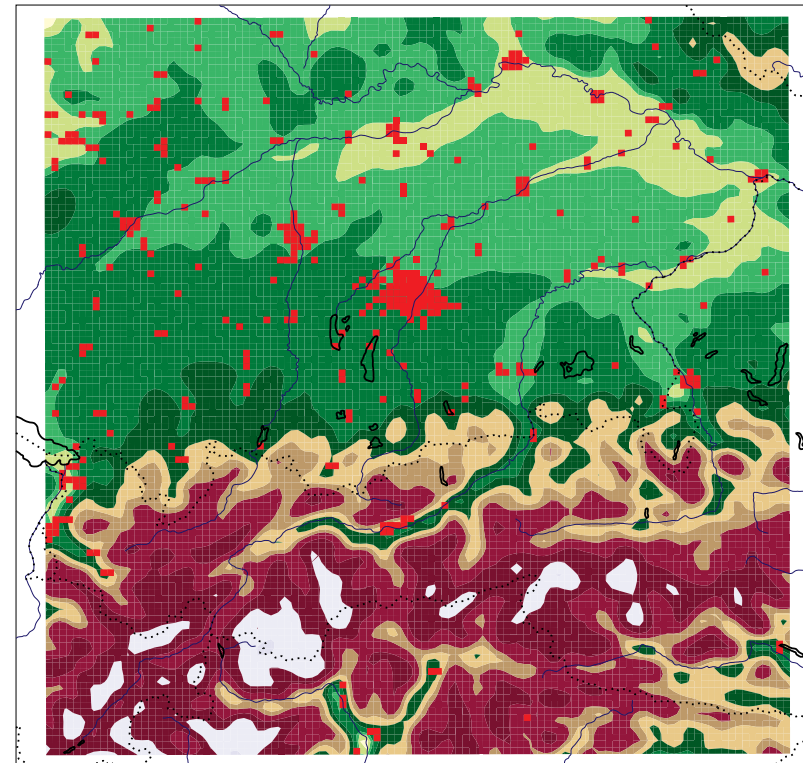


## Next applications of CCLM+TEB

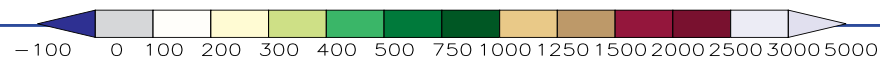
Hamburg

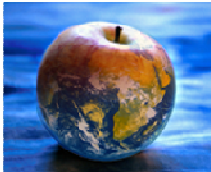


Munich

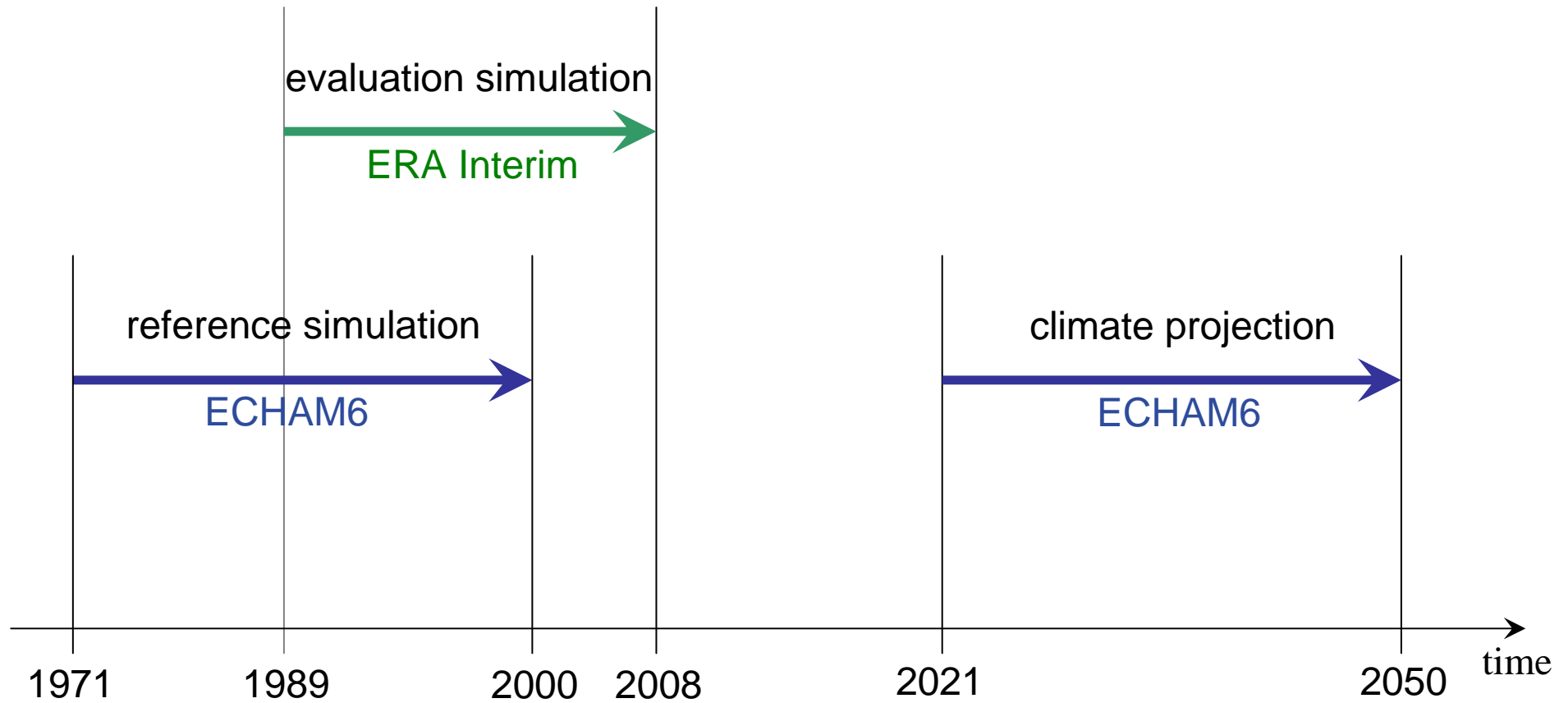


Elevation [m]



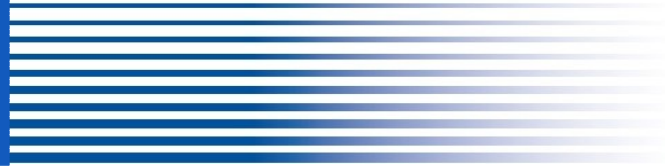


## Next applications of CCLM+TEB





Climate Limited-area  
Modelling Community



**Deutscher Wetterdienst**  
Wetter und Klima aus einer Hand



**Thank you!**





**Deutscher Wetterdienst**  
Wetter und Klima aus einer Hand



# 20-year test application (1989-2008)



## model domain Europe (12 km)

→ Simulation 1: CCLM v 4.8\_clm17

CORDEX EU 12 km (Klaus Keuler, University of  
Cottbus)

1989-2008

→ Simulation 2: CCLM v 4.8\_clm17 + **TEB**

CORDEX EU 12 km

1989-2008



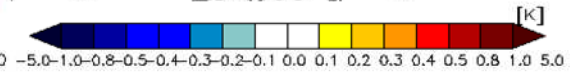
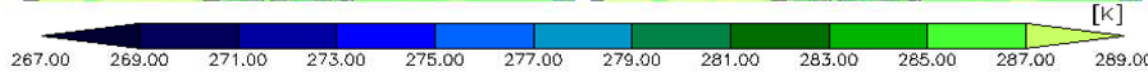
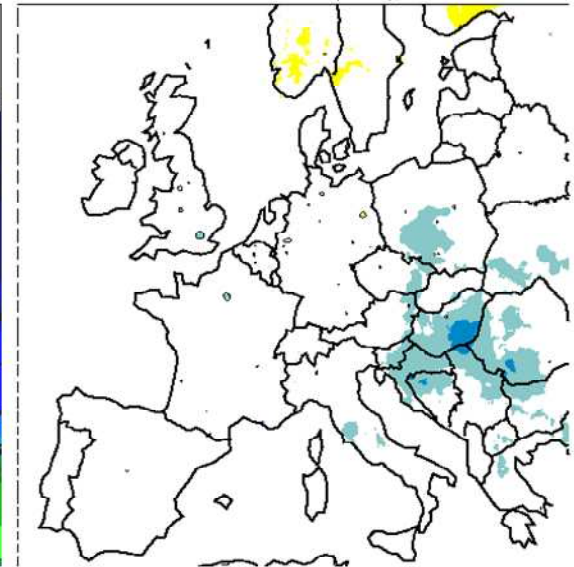
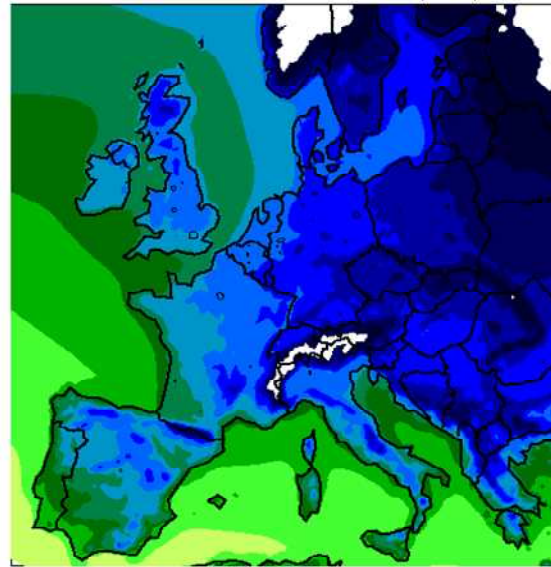
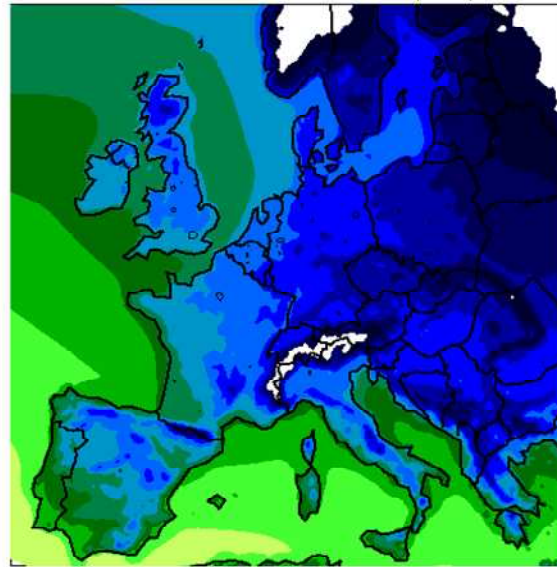
# T at 2M

CCLM std

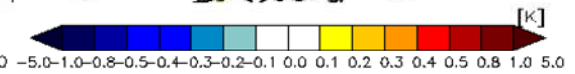
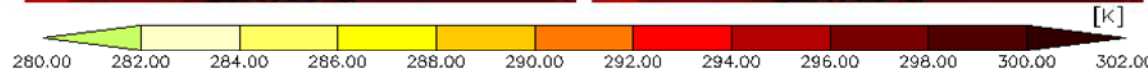
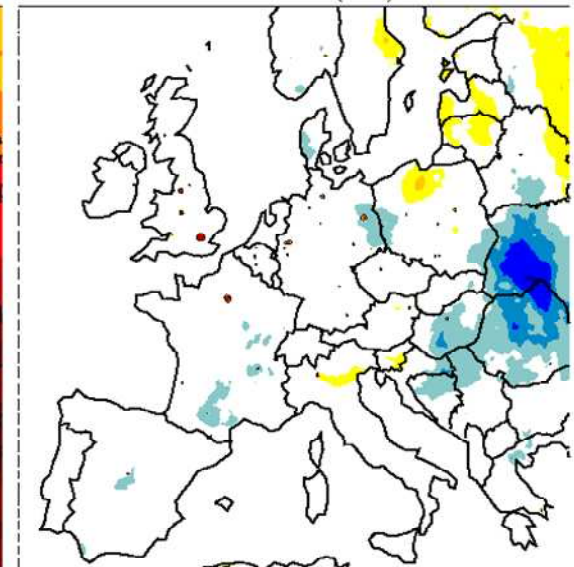
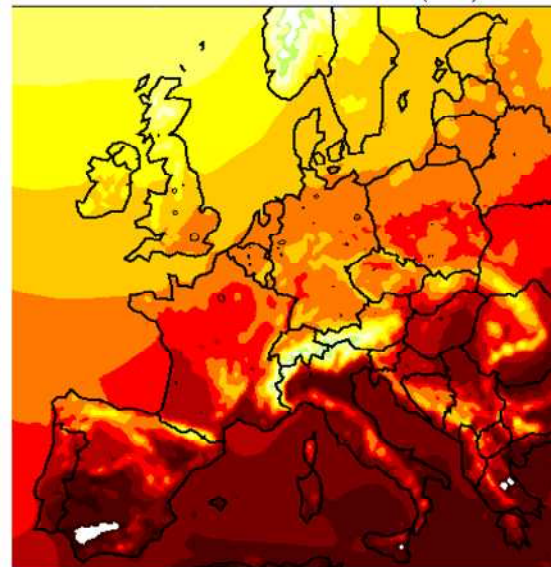
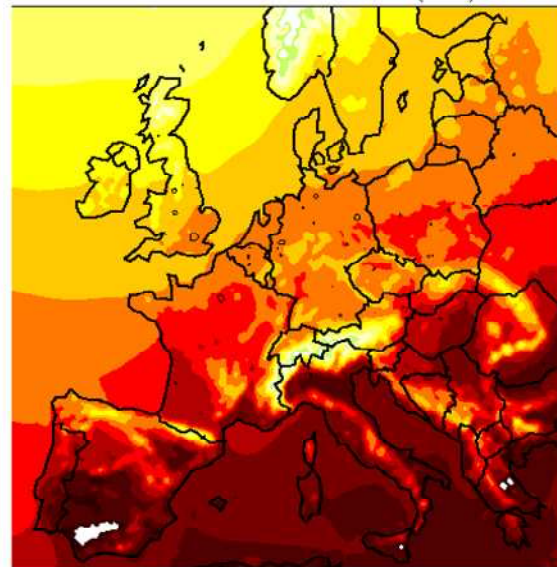
CCLM+TEB

CCLM+TEB - CCLM std

winter



summer





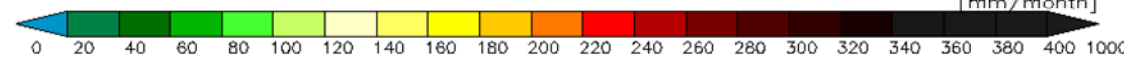
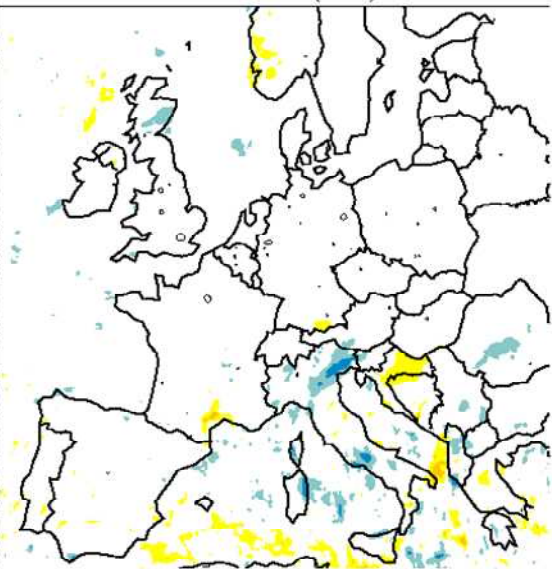
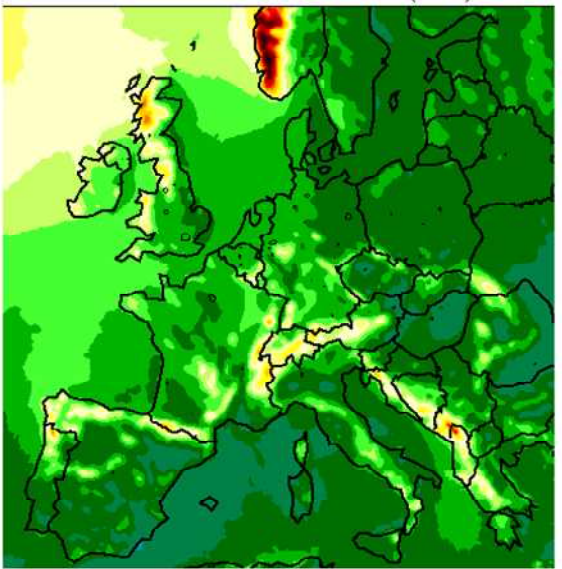
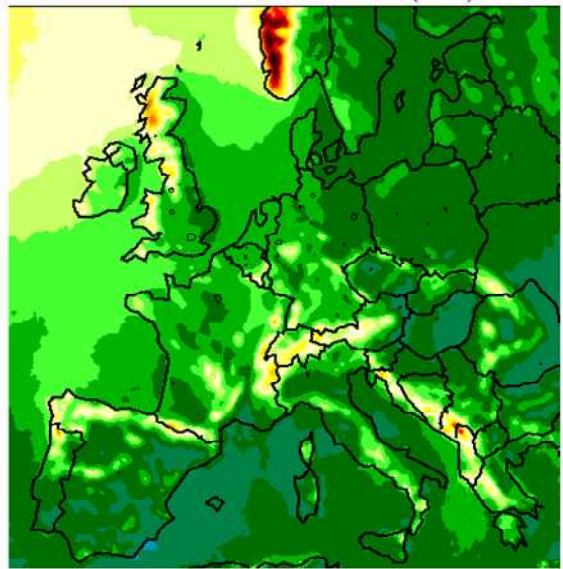
# TPREC.

CCLM std

CCLM+TEB

CCLM+TEB - CCLM std

winter



summer

