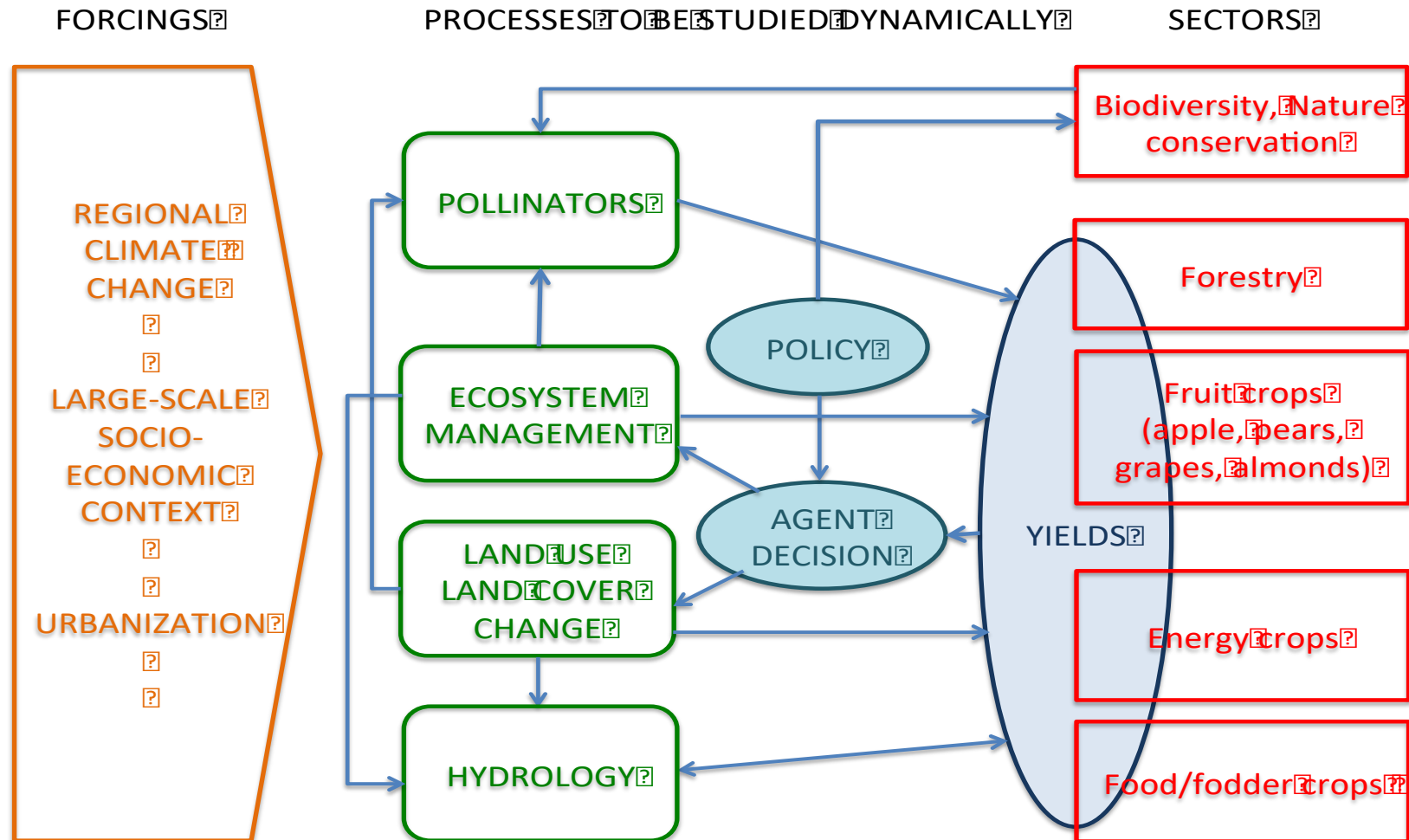


# Evaluation of hindcast COSMO-CLM simulation over Central Europe with respect to the representation of agricultural related extreme events

**Huan Zhang** and Merja Tölle

15.9.2020

## MAPPY(2019 – 2022, EU JPI Climate) Multi-sectorial Analysis of climate and land use change impacts on Pollinators, Plant diversity and crop Yields



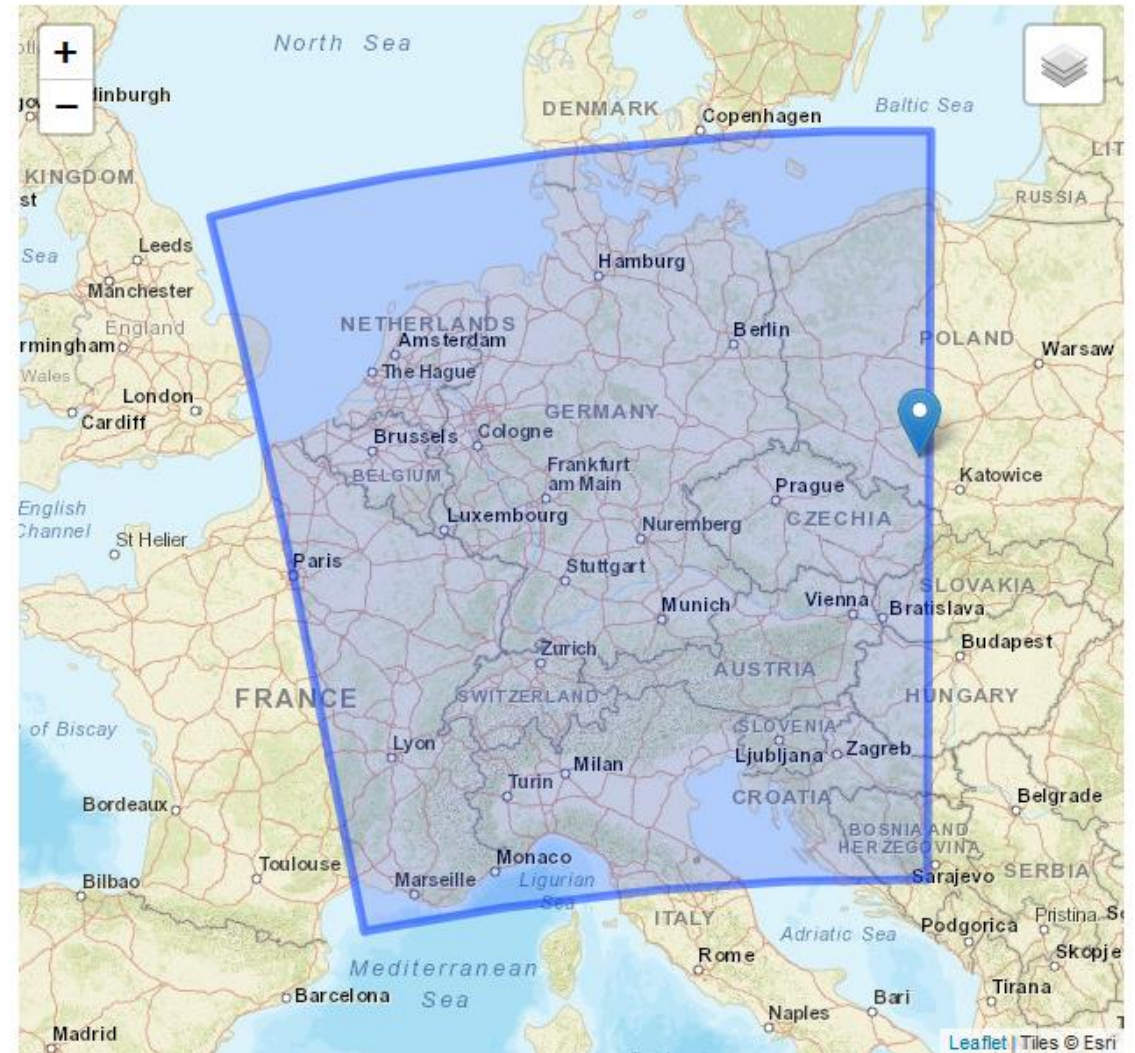
## WP1

- Downscaled CMIP5/ CMIP6 simulations ( $0.11^\circ$  resolution,  $\sim 12.5$  km)
- Downscaled EURO-CORDEX RCM projections ( $\sim 3$  km) under different Representative Concentration Pathways
- Experimental runs (with and without the modified land cover)

And will get:

- Land cover Scenarios from WP4 (the different soil types, land use, and urban areas)

	Simulation
Model	COSMO5.0-CLM9
Forcing	ERA5 0.25° (C3S 2013) 1 hr
Time period	1980-2019 with spin-up starting 1979
Land use class	ECOCLIMAP (Champeaux et al. 2005)
Soiltype/depth	HWSD (v1.2)
Aerosol	Tanré et al. (1999)
Orography	ASTER 1'' (NASA 2015)
Soil temperature	CRU 0.5° UEA
Horizontal resolution	0.0275° ~ 3 km
Atmos. levels, time step	50, 25 s
Domain	Central Europe
Time integration scheme	Runge-Kutta
Convection scheme	Shallow convection, Graupel
Configuration	COSMO-DE with modifications



## Datasets

- **CCLM: Long-term ERA5 driven simulation with 0.0275 ° (about 3 km) resolution for domain comprising the whole Central Europe region; results available from 1980 to 2000 (later 1980-2019);**
- **DWD/BfG-HYRAS data sets: High-resolution (5×5 km<sup>2</sup>) gridded daily data sets of surface air temperature (TAS), minimal temperature(TN), maximal temperature(TX) and precipitation (PR) during 1980-2000 (the whole dataset covers 1951-2015)**

## Comparisons

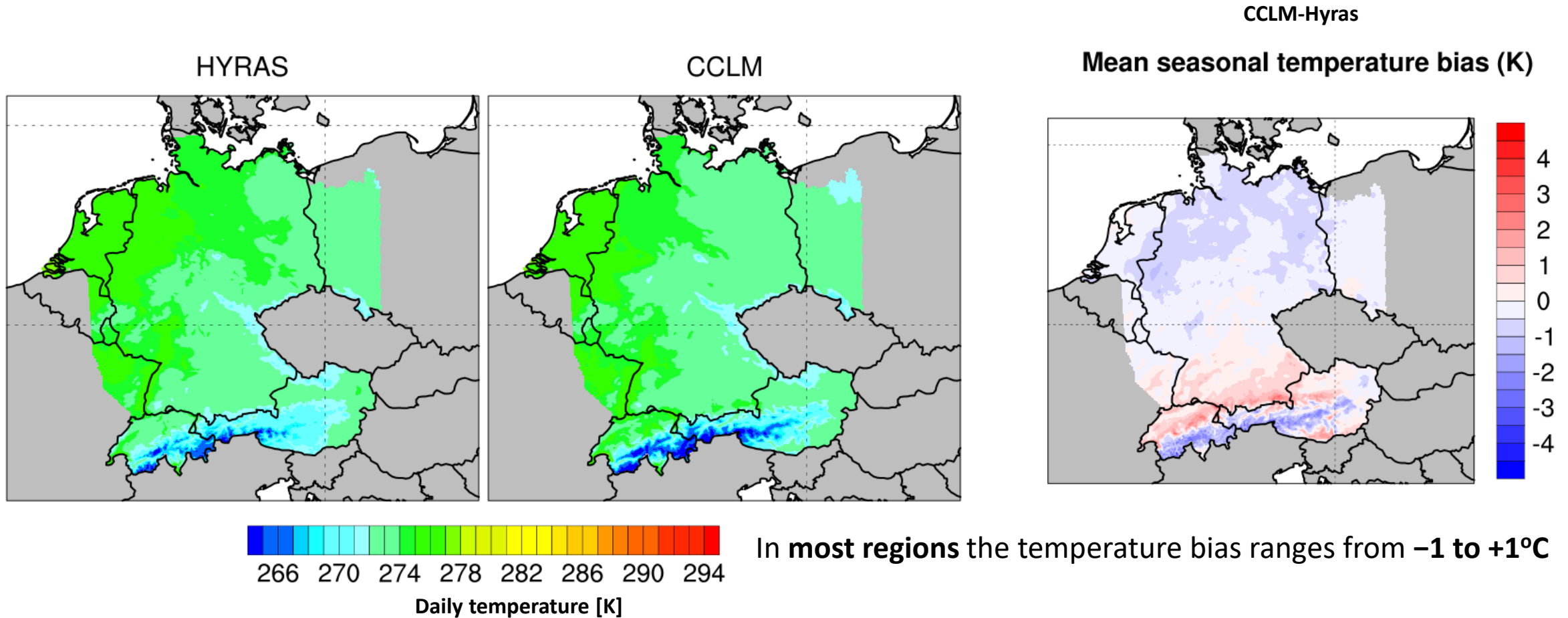
- The spatial distribution of the 20-year mean model biases for temperature and precipitation
- Probability density functions
- Selected climate indices from ETCCDI that are relevant for plant growth

<b>CDD</b>	Consecutive Dry Days	The number of dry periods of more than 5 days, $PR < 1\text{mm}$
<b>CWD</b>	Consecutive Wet Days	The number of wet periods of more than 5 days, $PR \geq 1\text{mm}$
<b>ID</b>	Ice Days	$TX < 0^\circ\text{C}$
<b>CFD</b>	Consecutive Frost Days	The number of frost periods of more than 5 days, $TN < 0^\circ\text{C}$
<b>CSD</b>	Consecutive Summer Days	The number of summer periods of more than 5 days, $TX > 25^\circ\text{C}$
<b>GSL</b>	Growing Season Length	the number of days between: first occurrence of at least 6 consecutive days with $TG > 5^\circ\text{C}$ , first occurrence of at least 6 consecutive days with $TG < 5^\circ\text{C}$ within the last 6 months
<b>GSL2</b>	Growing Season Starting Day	The first occurrence of at least 6 consecutive days with $TG > 5^\circ\text{C}$



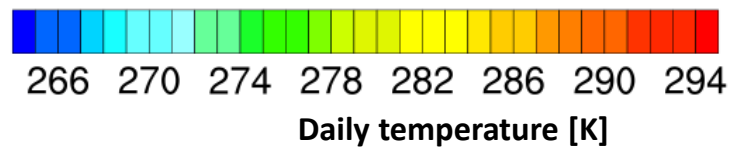
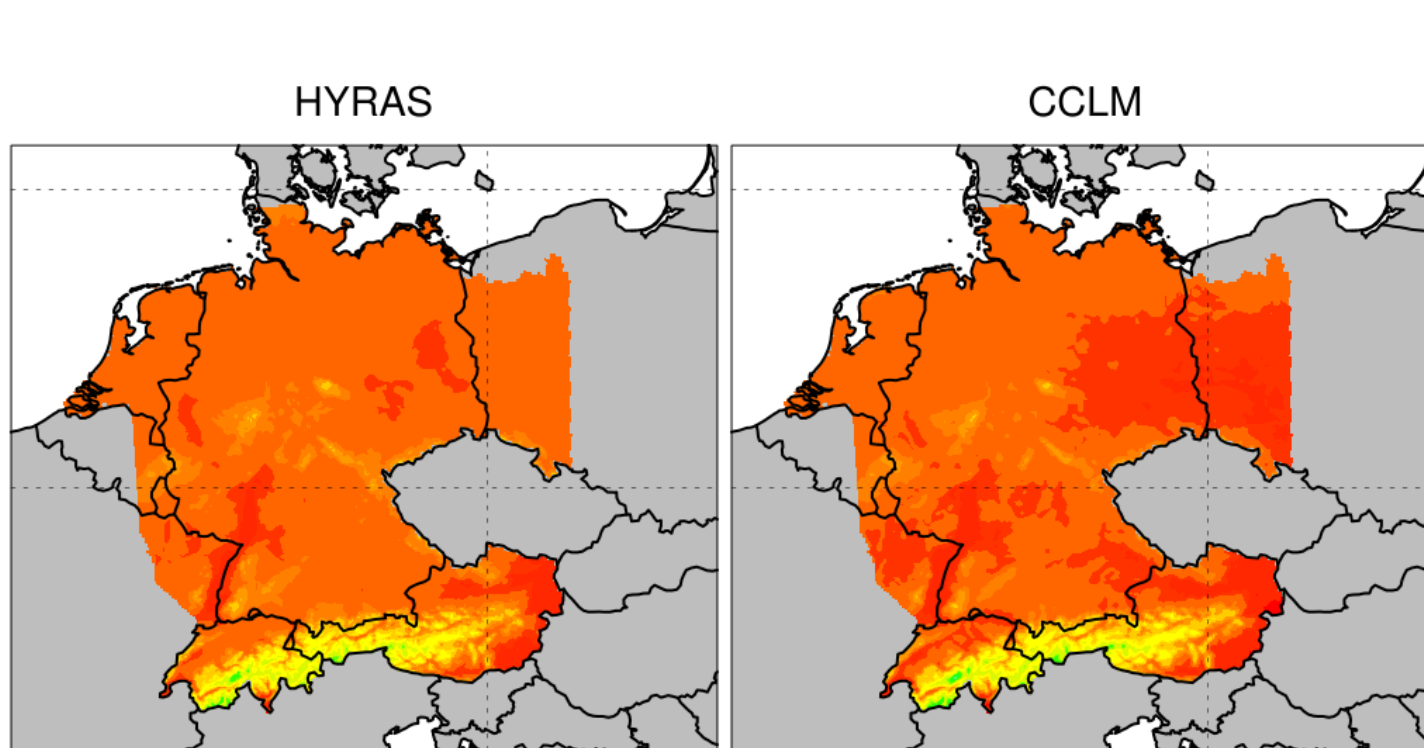
## Climatology-Temperature-DJF

Seasonal mean temperature in Winter during 1980-2000



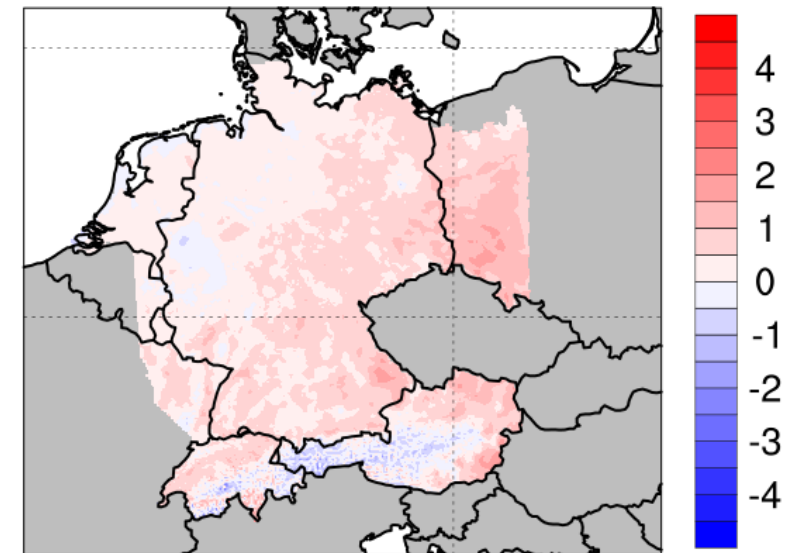
## Climatology-Temperature-JJA

Seasonal mean temperature in Summer during 1980-2000



CCLM-Hyras

Mean seasonal temperature bias (K)

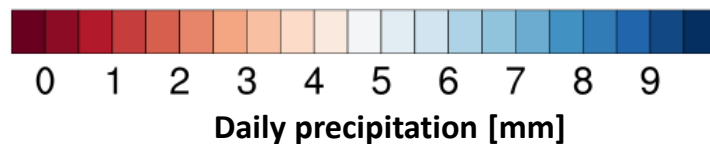
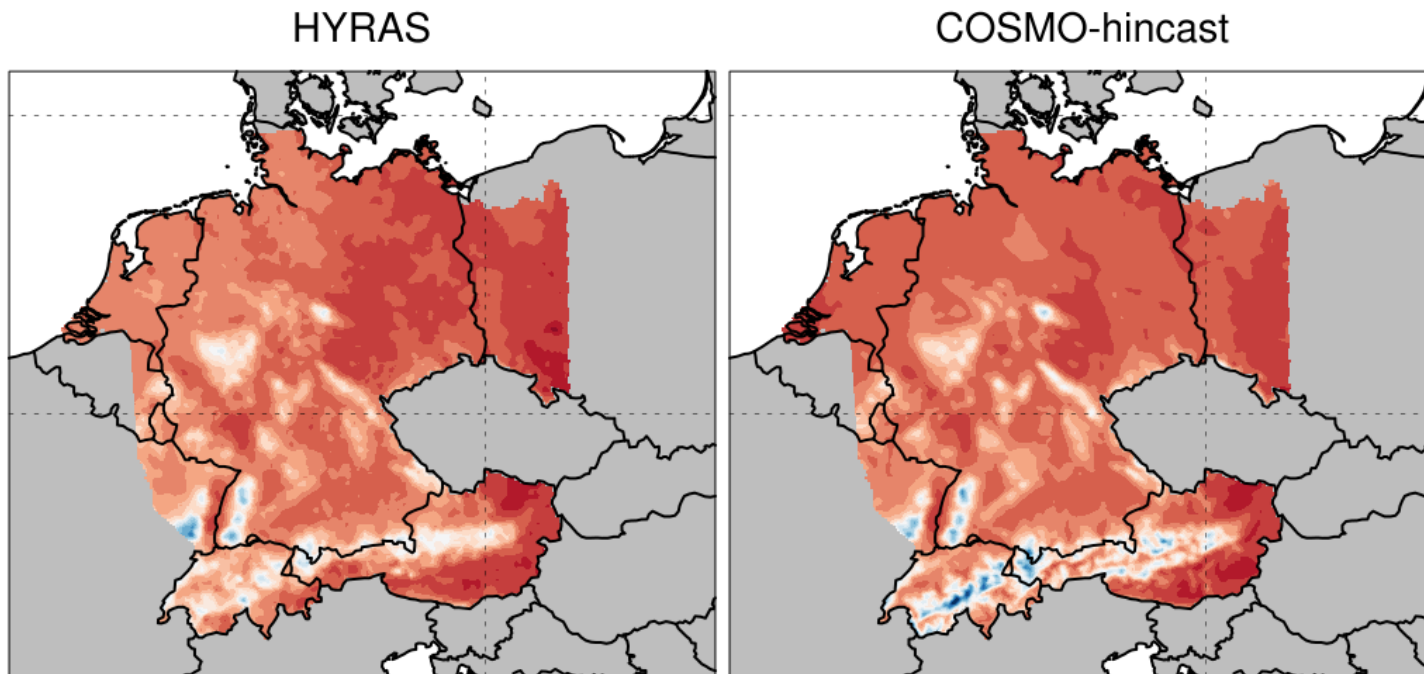


In most regions the temperature bias ranges from  $-1$  to  $+1.5^{\circ}\text{C}$



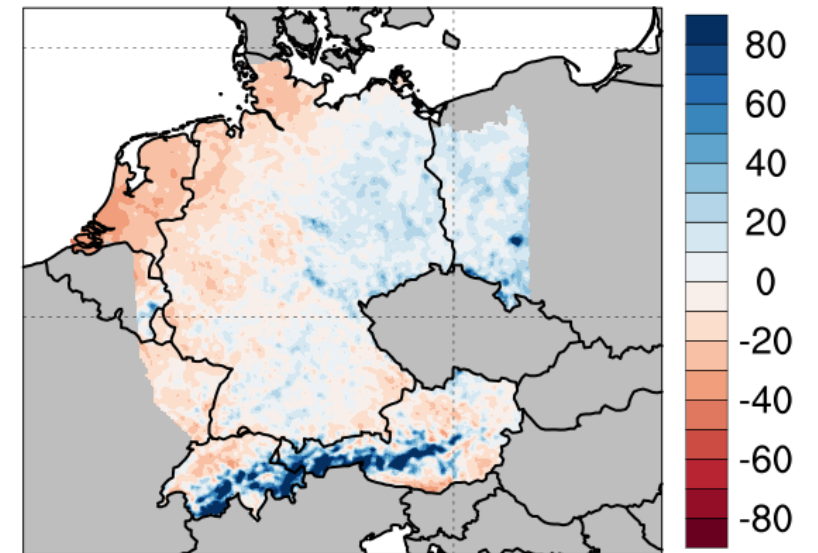
## Climatology-Precipitation-DJF

Seasonal daily Precipitation in Winter during 1980-2000



CCLM / Hyras - 1

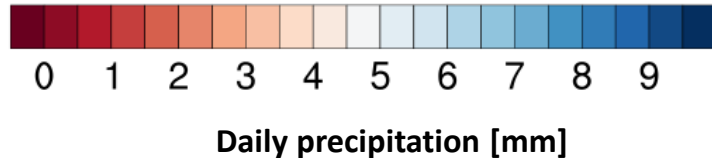
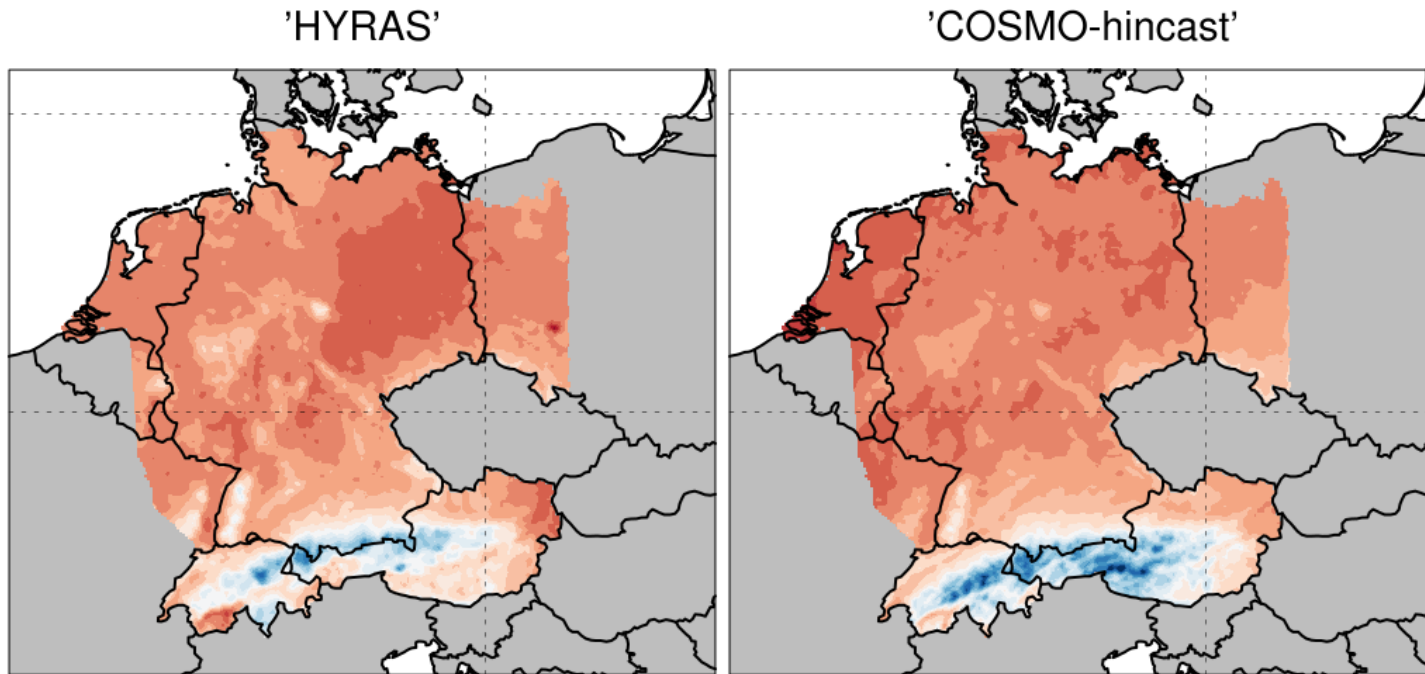
Mean seasonal precipitation bias (%)



In most regions the precipitation bias ranges from **-20 to +20%**

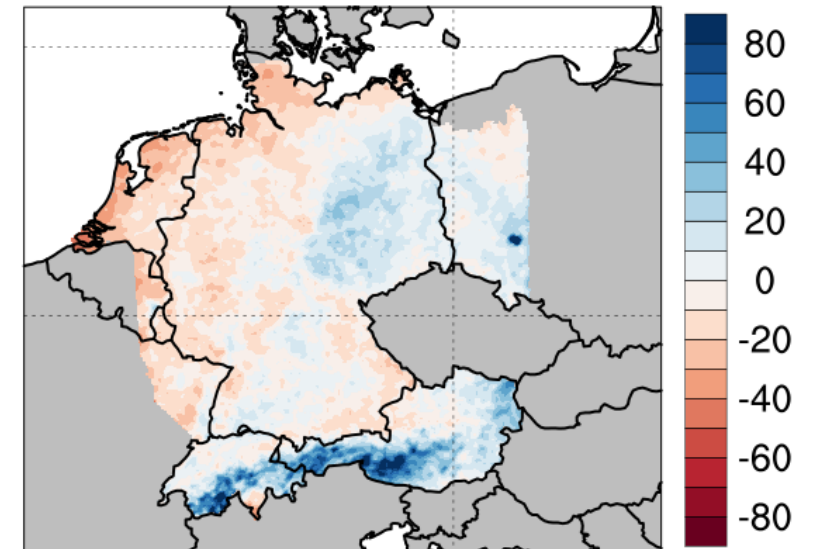
## Climatology-Precipitation-JJA

Seasonal daily Precipitation in Summer during 1980-2000



CCLM / Hyras - 1

Mean seasonal precipitation bias (%)

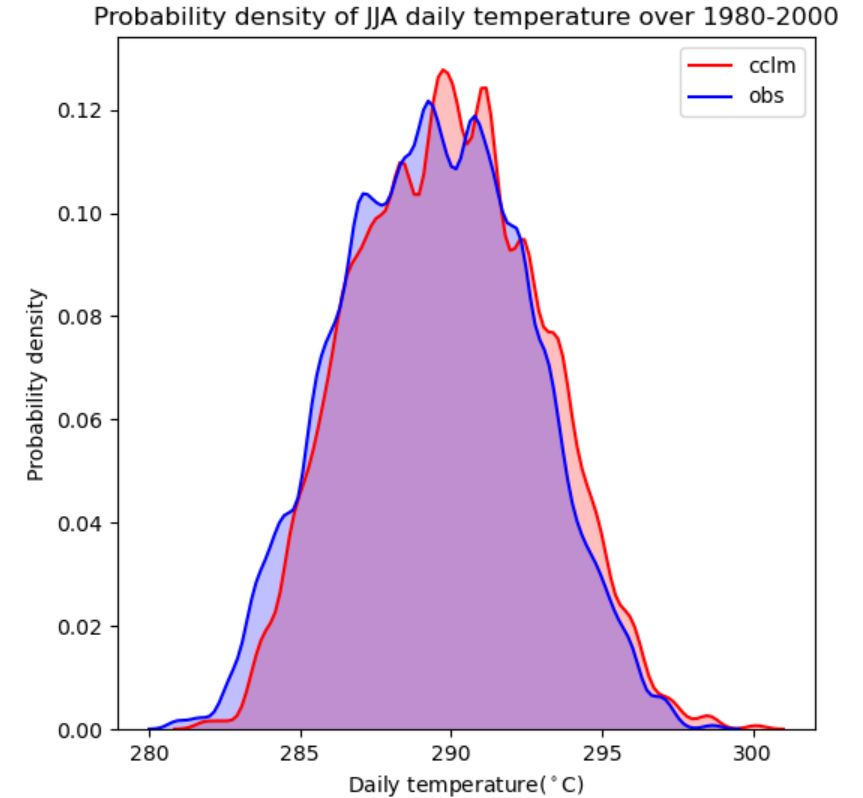
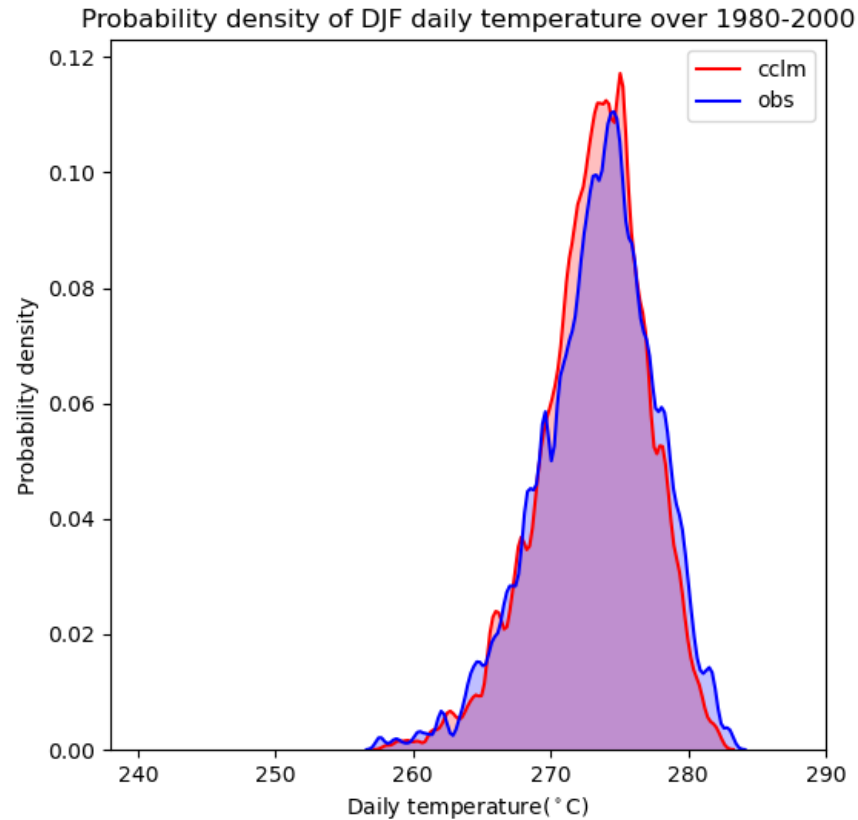


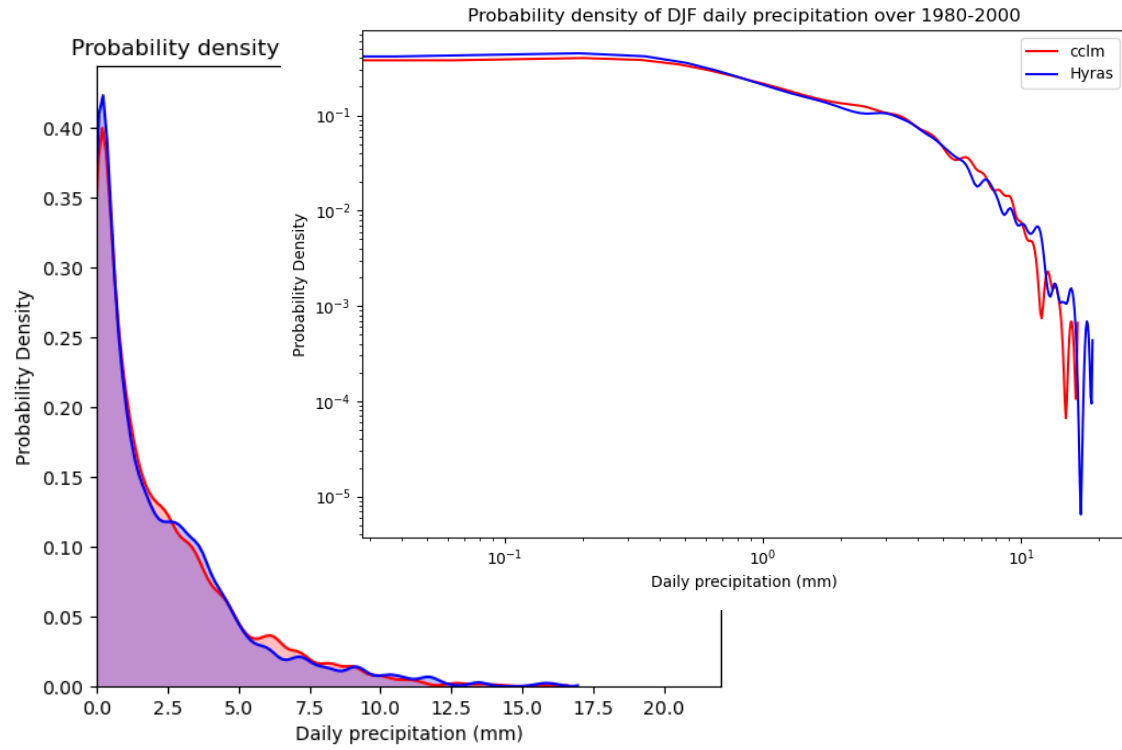
In most regions the precipitation bias ranges from **-20 to +20%**

## PDF-Temperature

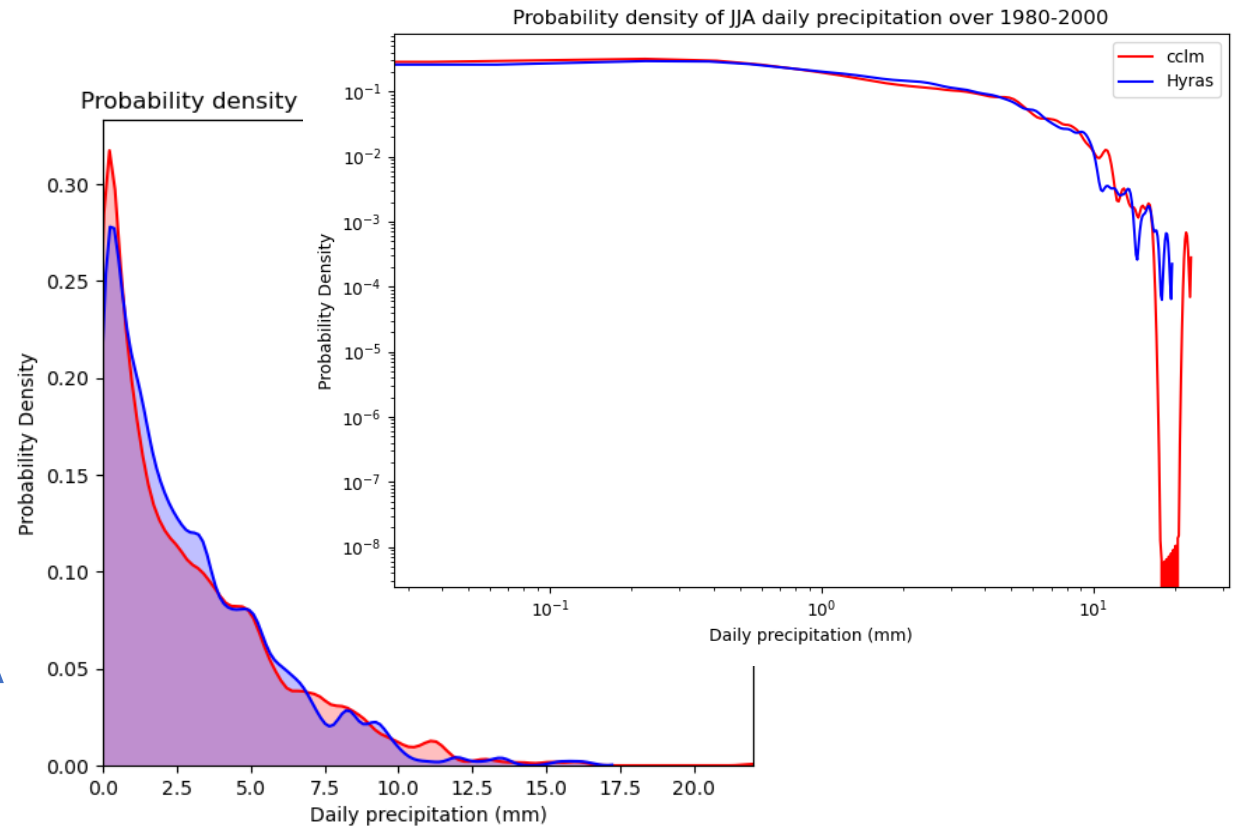
### DJF

### JJA



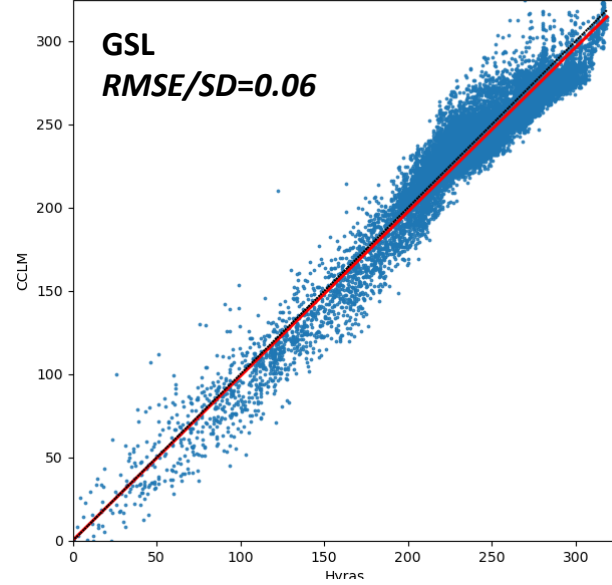


DJF

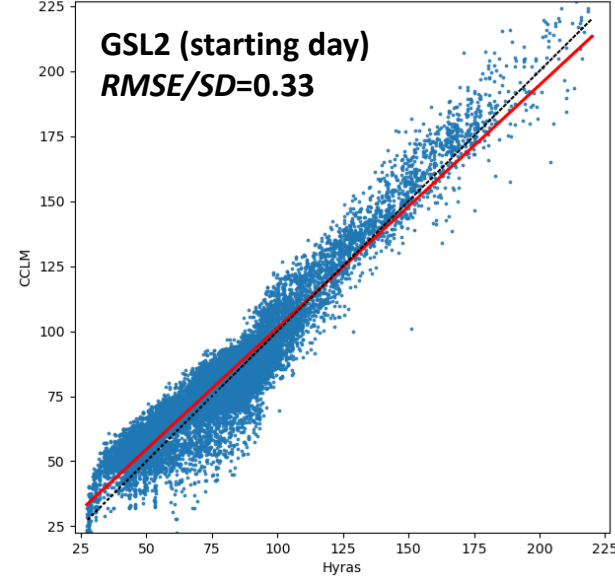


JJA

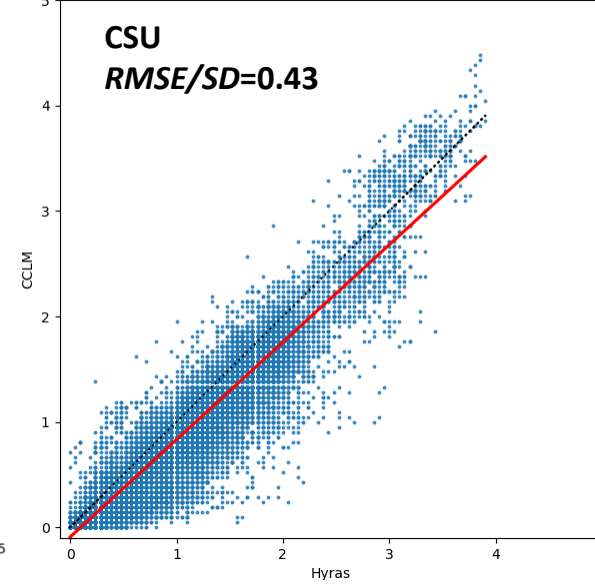
Yearly average GSL during 1980-2000



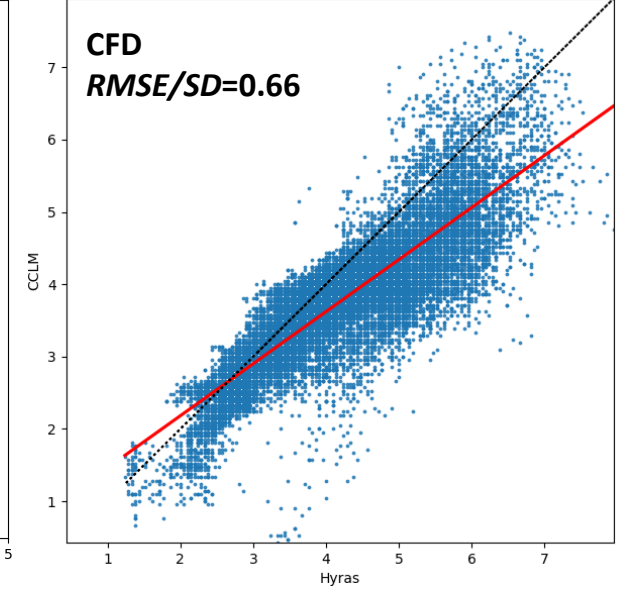
Yearly average start day of the growing season during 1980



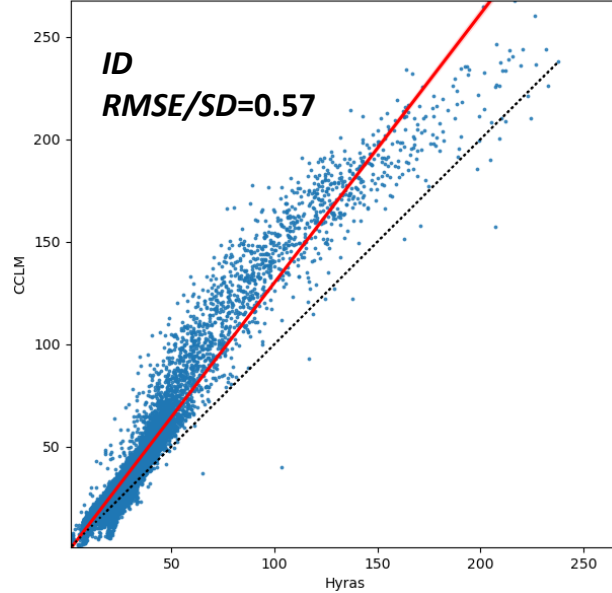
Yearly number of CSU periods during 1980-2000



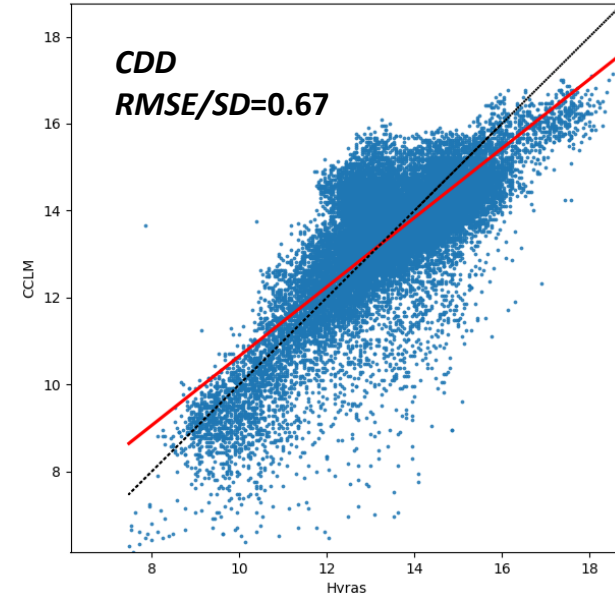
Yearly average CFD periods during 1980-2000



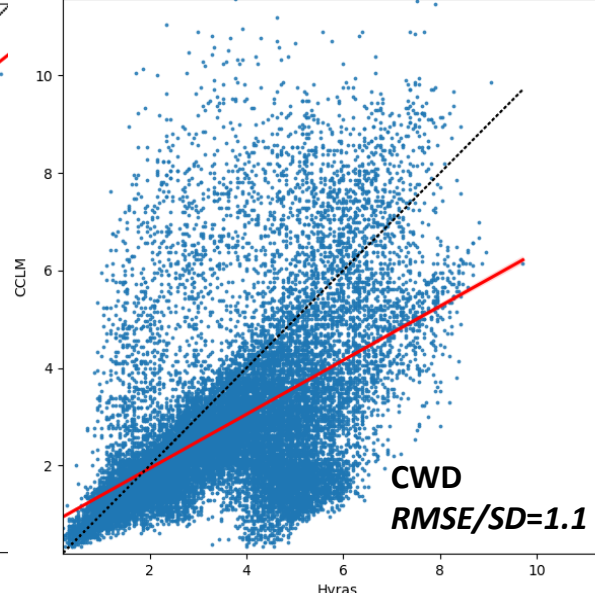
Yearly average number of ice days during 1980-2000



Yearly average CDD periods during 1980-2000



Yearly average CWD periods during 1980-2000



$$\frac{RMSE(I)}{SD(I)} = \frac{\sqrt{\text{mean}((cclm(I)_s - obs(I)_s)^2)}}{SD(obs(I))}$$

**RMSE/SD < 0.5: well-reproduced**  
**Otherwise: biased**

Climate Scenarios and Agricultural Indices:  
A Case Study for Switzerland  
(Tschurr et al. 2020)



## Summary

### Preliminary results (20 years) from our on-going simulations

- driven by ERA5 instead of ERA-Interim
- slight winter cold bias; slight summer warm bias
- pronounced cold and wet bias in mountainous regions
- relatively well represent growth season length, its starting date, warm periods

### Discussion

- The most extreme events tend to more extreme in CCLM, for example maximum 1-day precipitation
- The meteorological events (cold spells, warm spells, droughts, floods) tend to occur less frequent in our CCLM simulations

# THANK YOU

- Any questions?

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