



**NTNU – Trondheim**  
Norwegian University of  
Science and Technology



Industrial Ecology Programme  
Department of Energy and Process Engineering  
Faculty of Engineering

# **Land cover change impacts on EURO-CORDEX climate by regional climate model (COSMO-CLM) simulations**

**Bo Huang**

Xiangping Hu, Merja Tölle, Francesco Cherubini

[bo.huang@ntnu.no](mailto:bo.huang@ntnu.no)

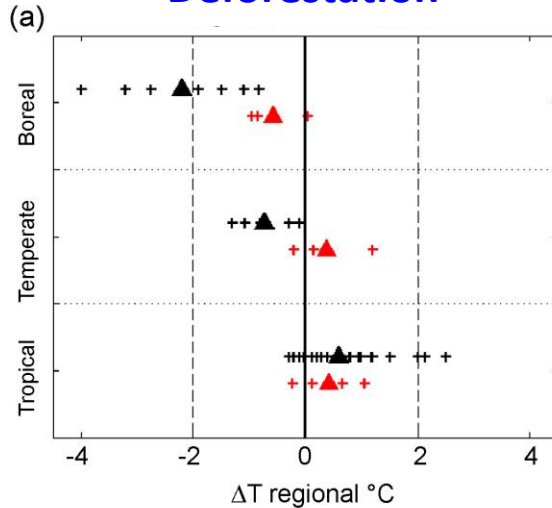
EGU Vienna, 2018.04.13



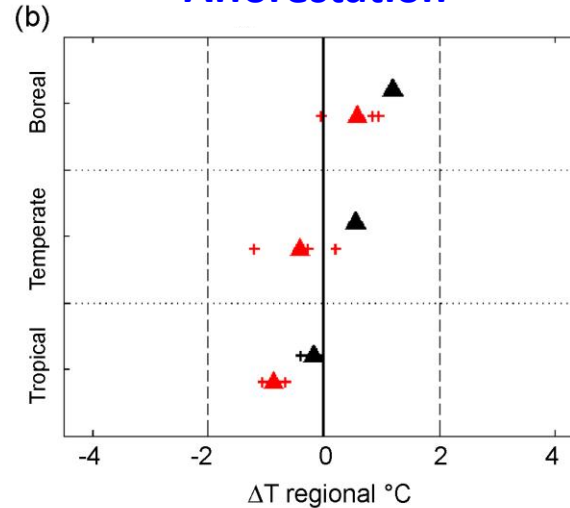
# Forest changes impact on climate

Regional

**Deforestation**

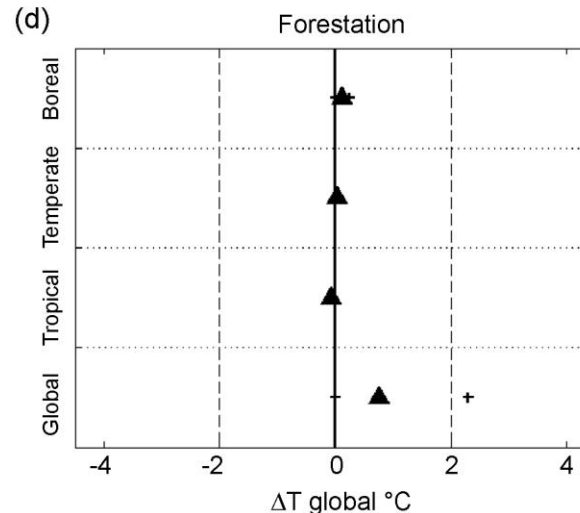
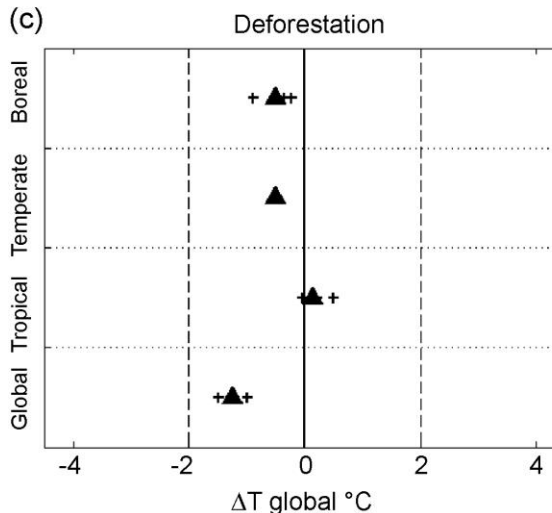


**Afforestation**



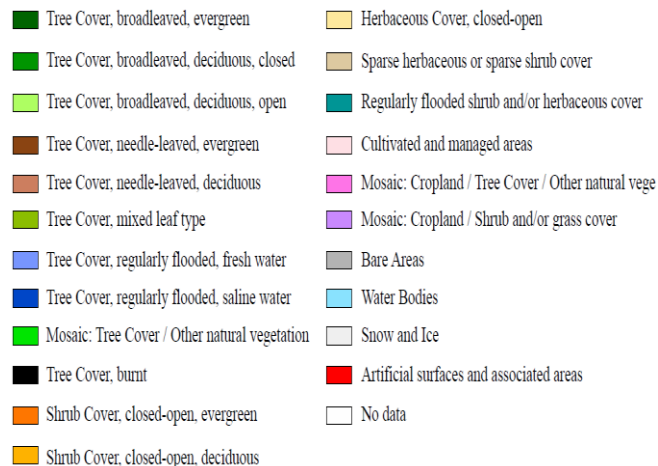
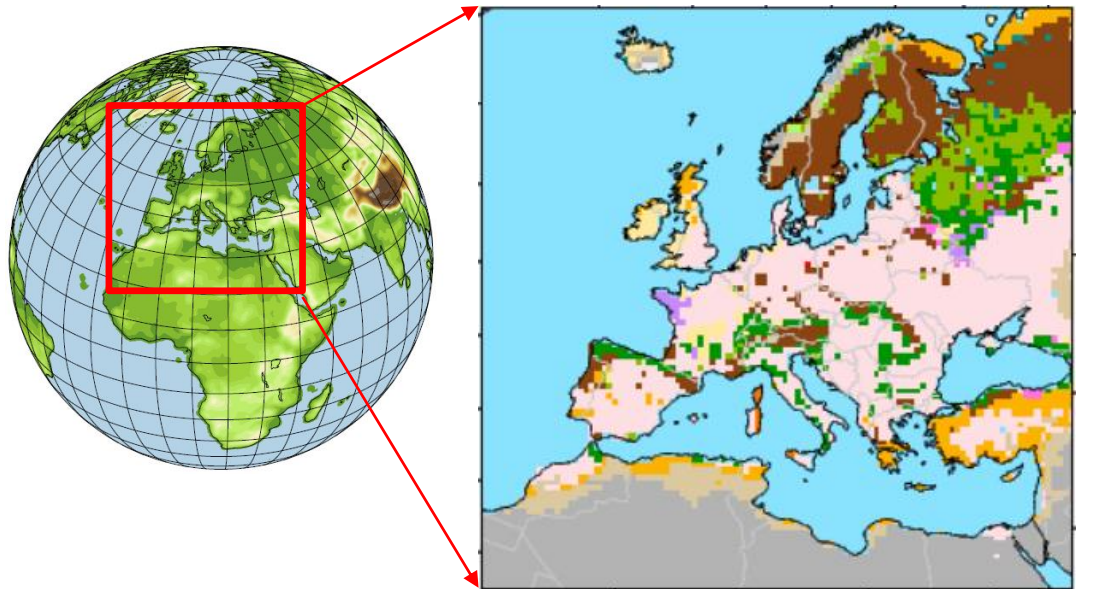
+ observation  
 + model  
 ▲ obs mean  
 ▲ model mean

Global



(Perugini et al, 2017 ERL)

# Model and Simulations



**Model:** COSMO-CLM4.8

**Driven data:** ERA-Interim

**Simulation period:** 1981-2010

**Horizontal resolution:** 0.44°

**Simulations:** control simulation  
(GLC2000) &

deforestation (forest to bare land  
and forest to herbaceous  
vegetation) &

afforestation (cropland to  
evergreen needle-leave forest and  
cropland to deciduous broad-leave  
forest)

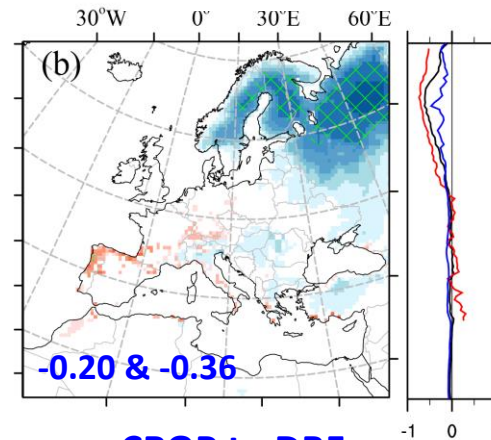
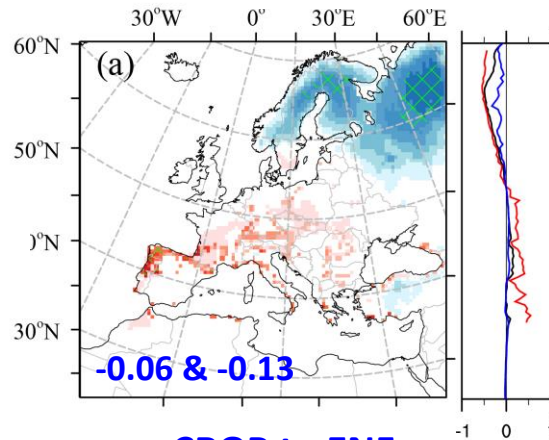
FOR to BL and FOR to HV: **1527**  
grid cell changed

CROP to ENF and CROP DBF: **1835**  
grid cell changed

# Annual mean temperature changes

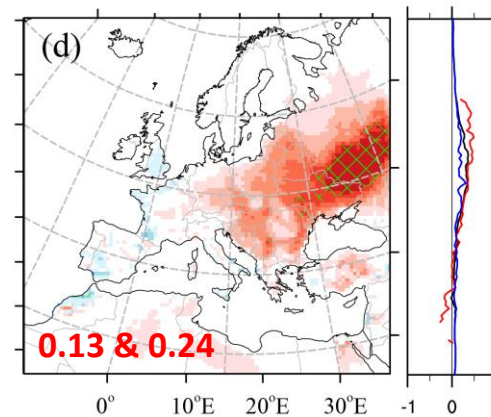
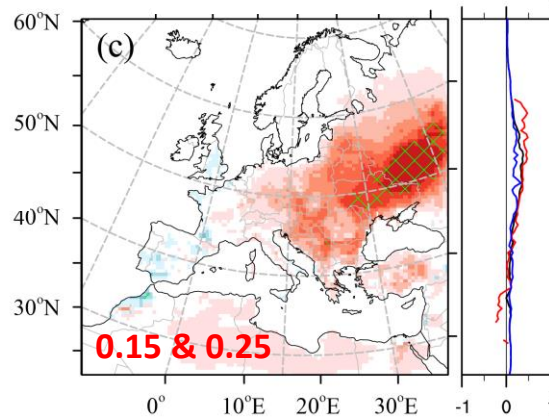
**FOR to BL**

**FOR to HV**

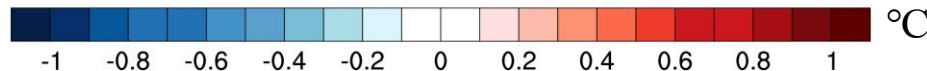


**CROP to ENF**

**CROP to DBF**



— Regional — Local changed — Local unchanged



Cooling

Latitudinal pattern  
(50° N)

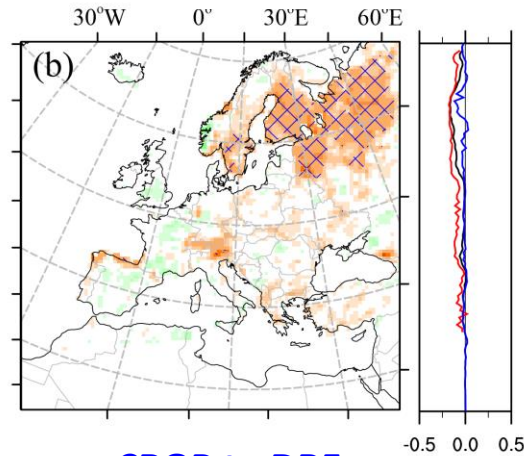
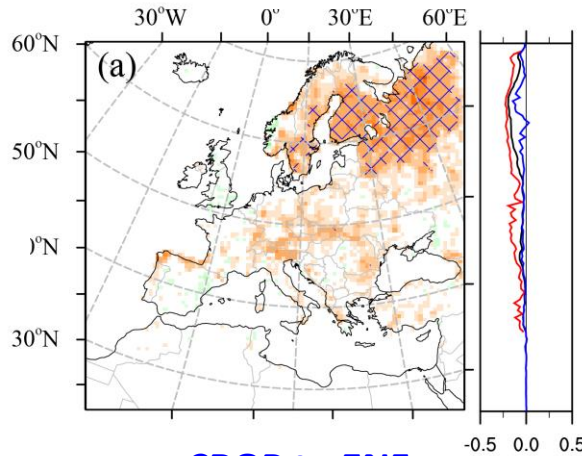
Warming

Longitudinal gradient  
(10° E)

# Annual mean precipitation changes

FOR to BL

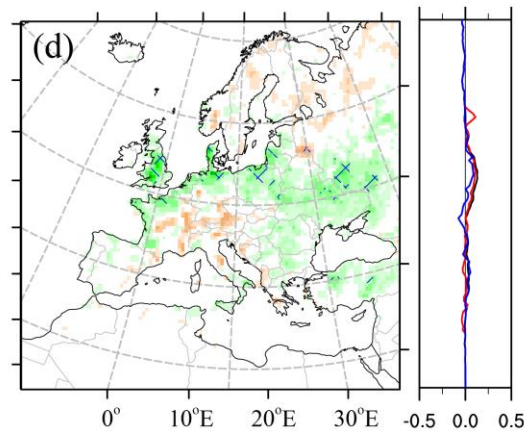
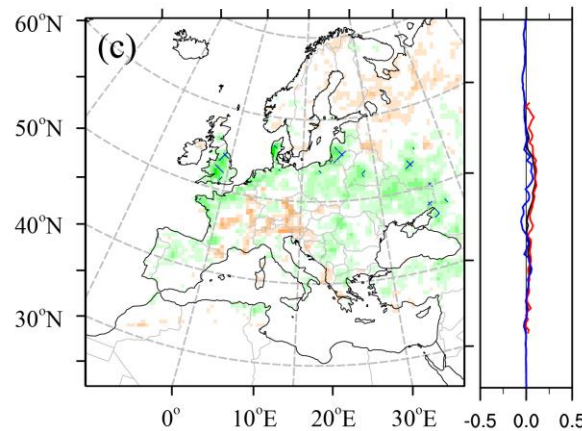
FOR to HV



Dry condition

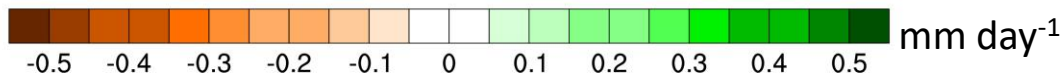
CROP to ENF

CROP to DBF



Wet climate

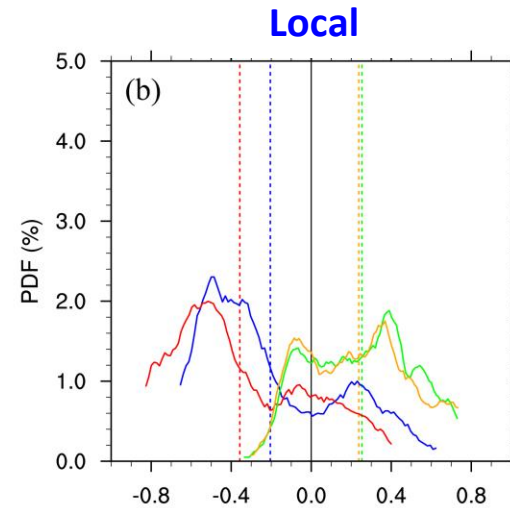
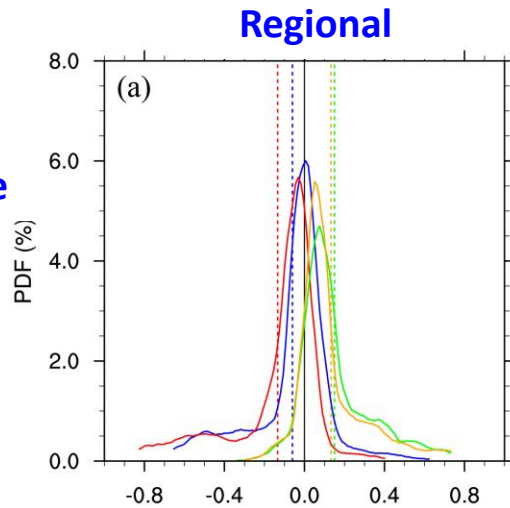
— Regional — Local changed — Local unchanged





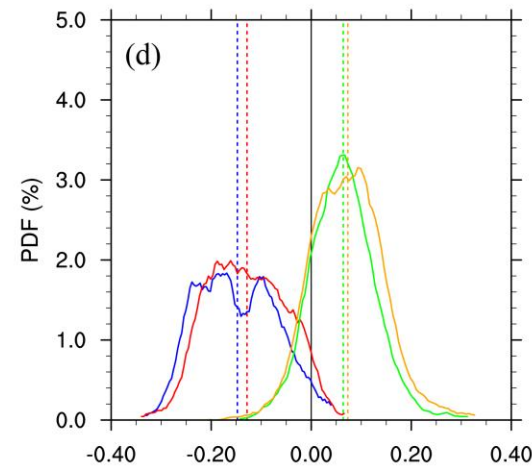
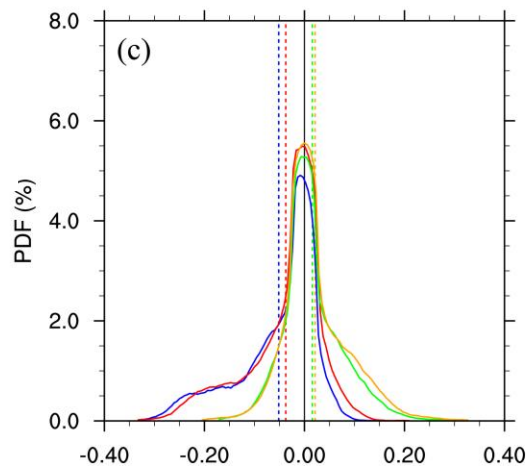
# Climate change at regional and local scale

Temperature



FOR to BL  
FOR to HV  
CROP to ENF  
CROP to DBF

Precipitation

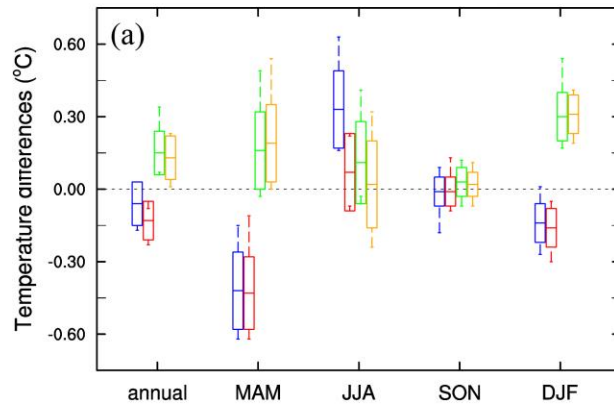


— FOR to BL — FOR to HV — CROP to ENF — CROP to DBF

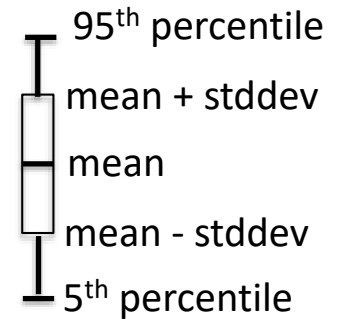
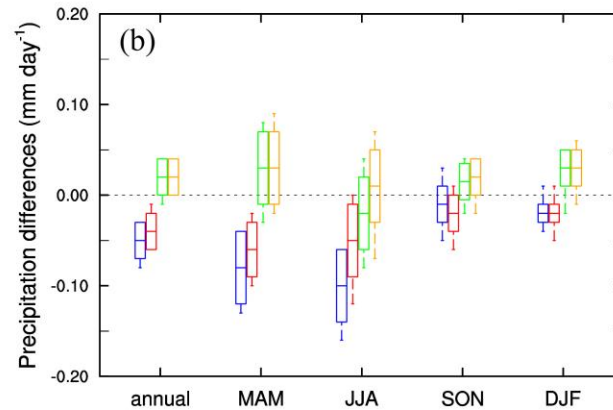
# Seasonal climate changes

Regional

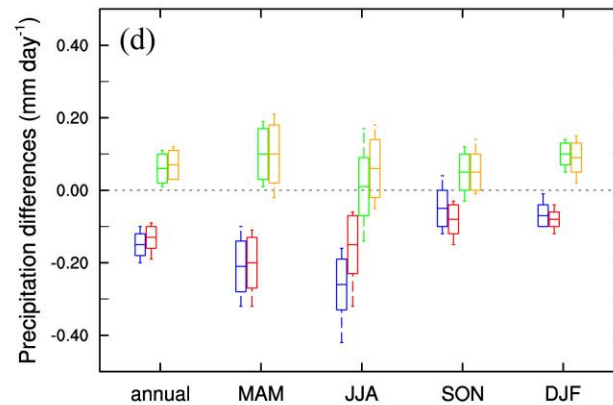
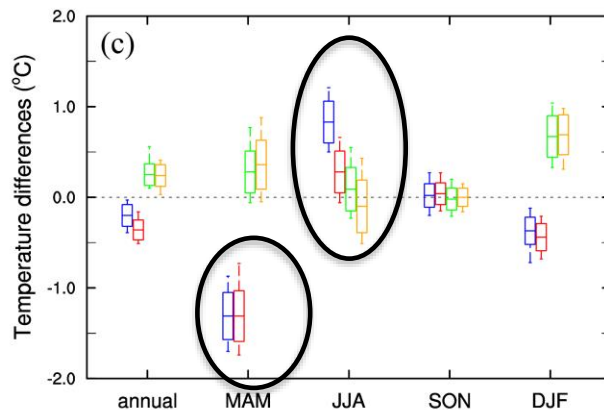
Temperature



Precipitation



Local

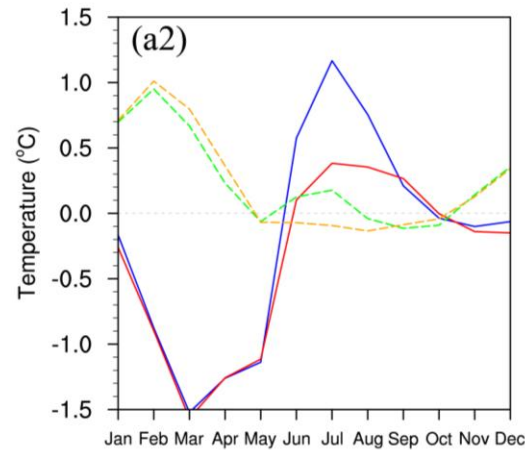


FOR to BL FOR to HV CROP to ENF CROP to DBF

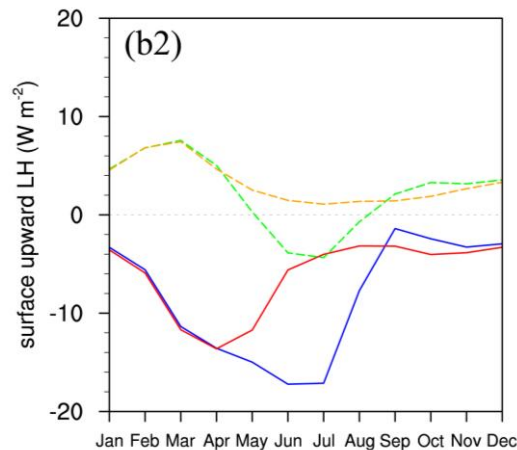
# Changes in surface heat flux on local scale

FOR to BL  
FOR to HV  
CROP to ENF  
CROP to DBF

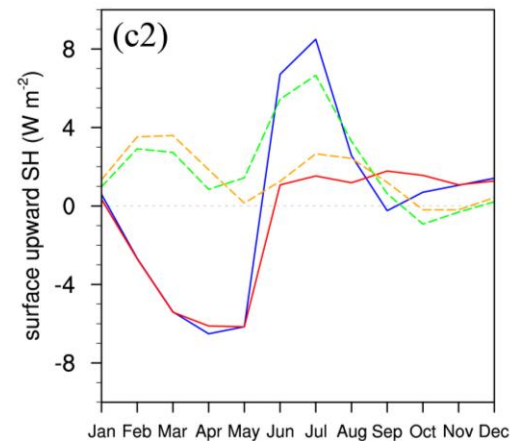
Temperature



Latent heat (LH)

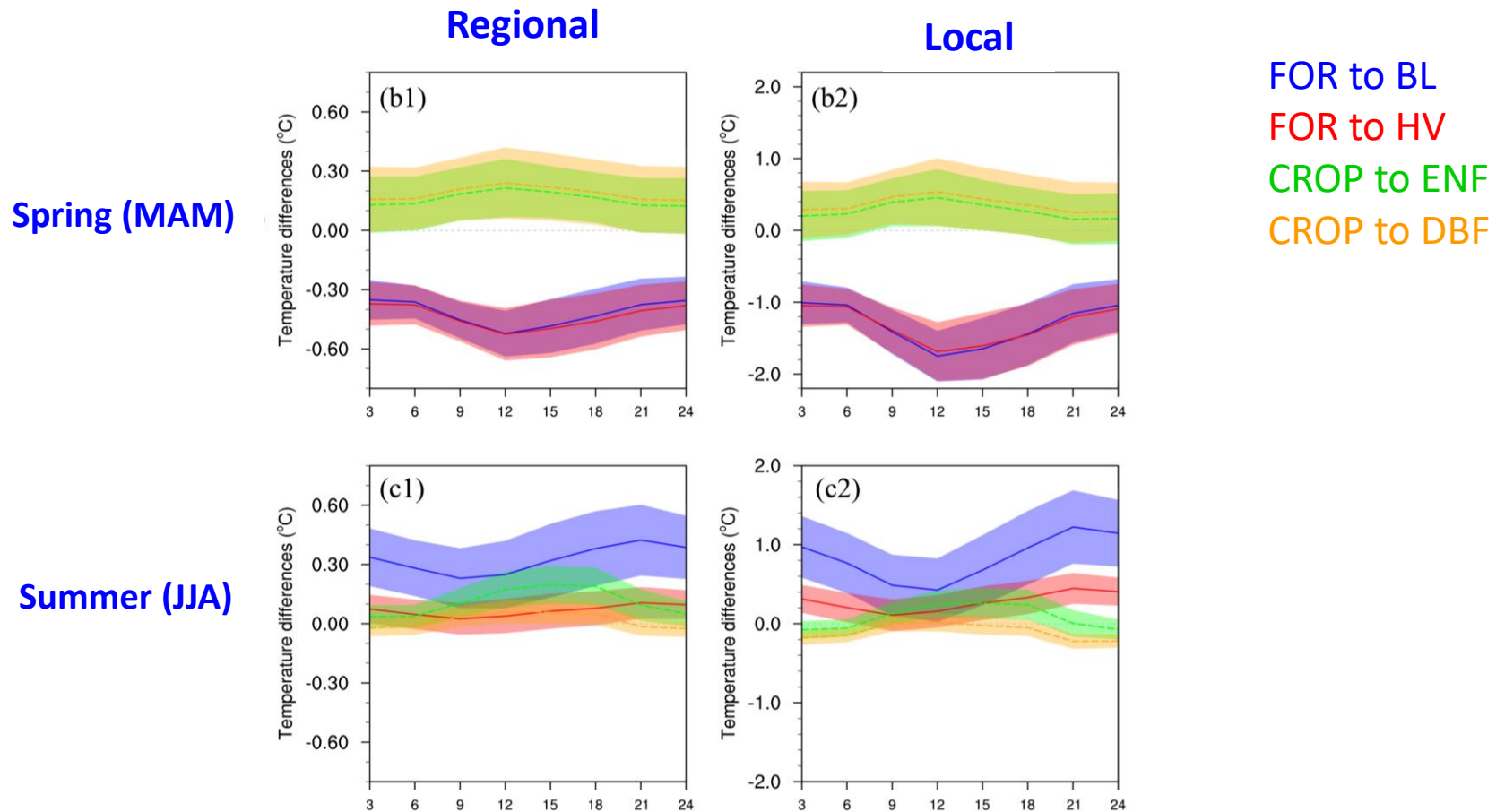


Sensible heat (SH)

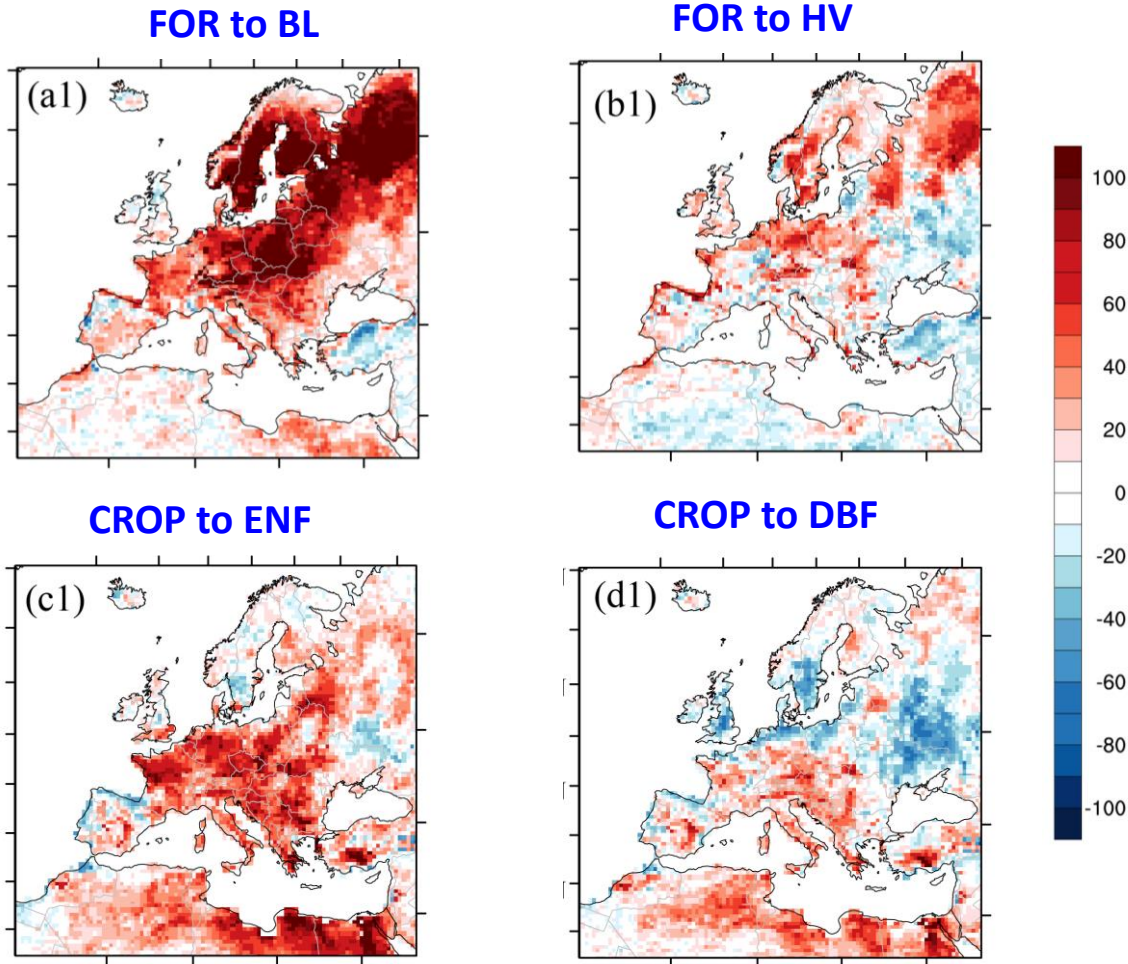




# Changes in diurnal cycle of temperature



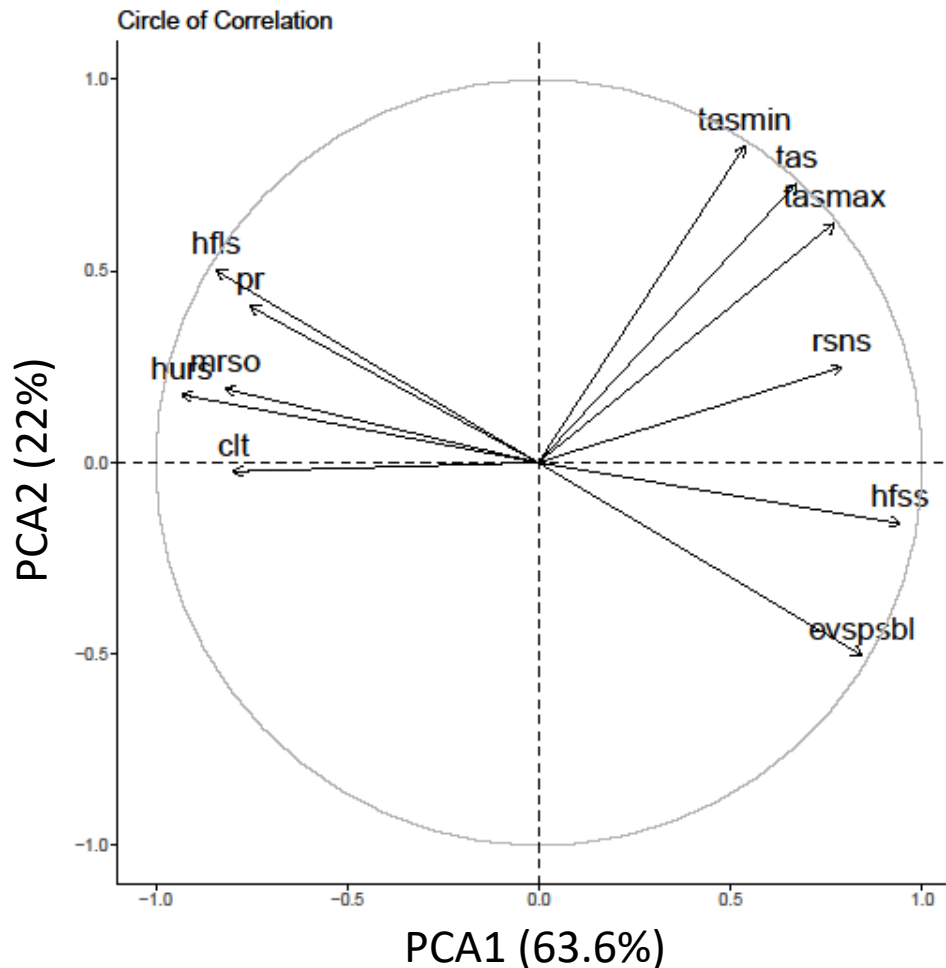
# Changes in the frequency of hot days



95<sup>th</sup> percentile of the maximum daily temperature (Tmax)

# Circle correlation between variables

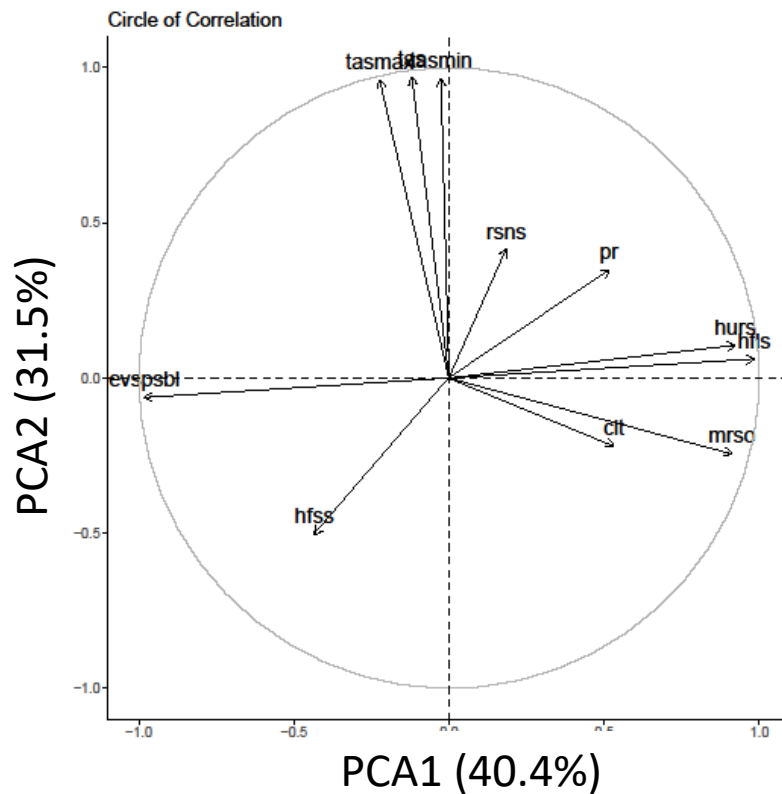
## Annual mean



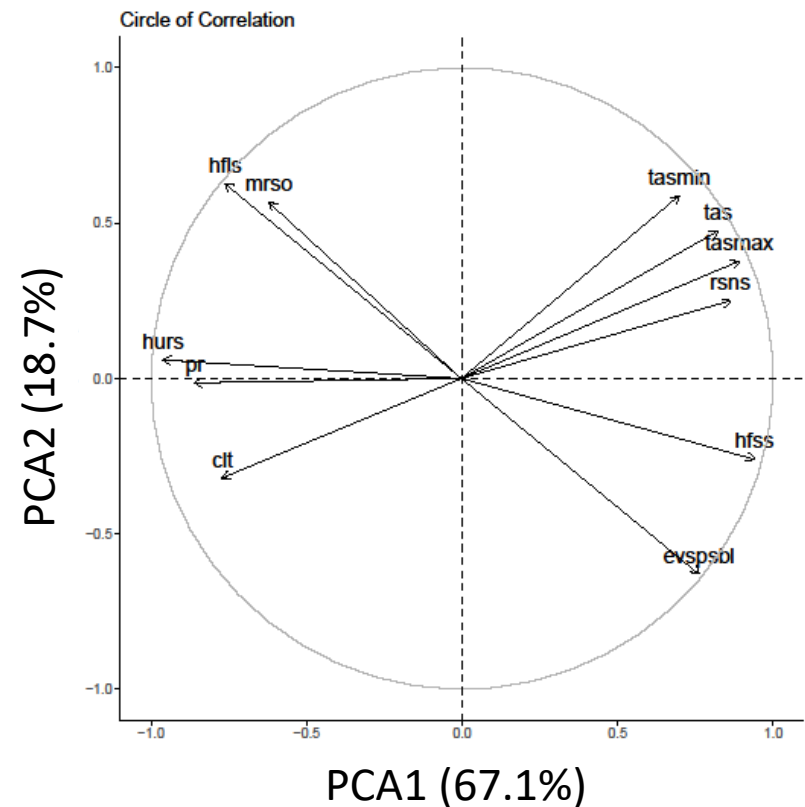
clt: total cloud cover  
tas: 2m temperature  
pr: total precipitation  
tasmin: minimum 2m tas  
tasmax: maximum 2m tas  
evspsbl: surface evaporation  
hurs: 2m relative humidity  
rsns: surface net downward  
shortwave radiation  
mrso: soil water content  
hfss: surface sensible heat flux  
hfls: surface latent heat flux

# Circle correlation between variables in winter and summer

Winter



Summer



# Summary

- Annual mean cooling of  $-0.06 \pm 0.09$  °C for conversion to BL and  $-0.13 \pm 0.08$  °C to HV
- Annual mean warming of  $0.15 \pm 0.09$  °C and  $0.13 \pm 0.09$  °C for conversion to ENF and DBF
- Deforestation causes a **dry condition** and afforestation leads to a **wet climate**
- From south to north, deforestation impacts on mean temperature change from positive to negative at **around 50° latitude**, and causes the **strongest cooling in spring** ( $> 2$  °C at high latitudes) but warming in summer ( $> 1$  °C in some locations), when it increases the average **number of hot days**
- Afforestation leads to **a major warming in winter** ( $0.69 \pm 0.22$  °C at a local scale), where it reduces the frequency of **cold temperature extremes**



谢谢  
Thank You