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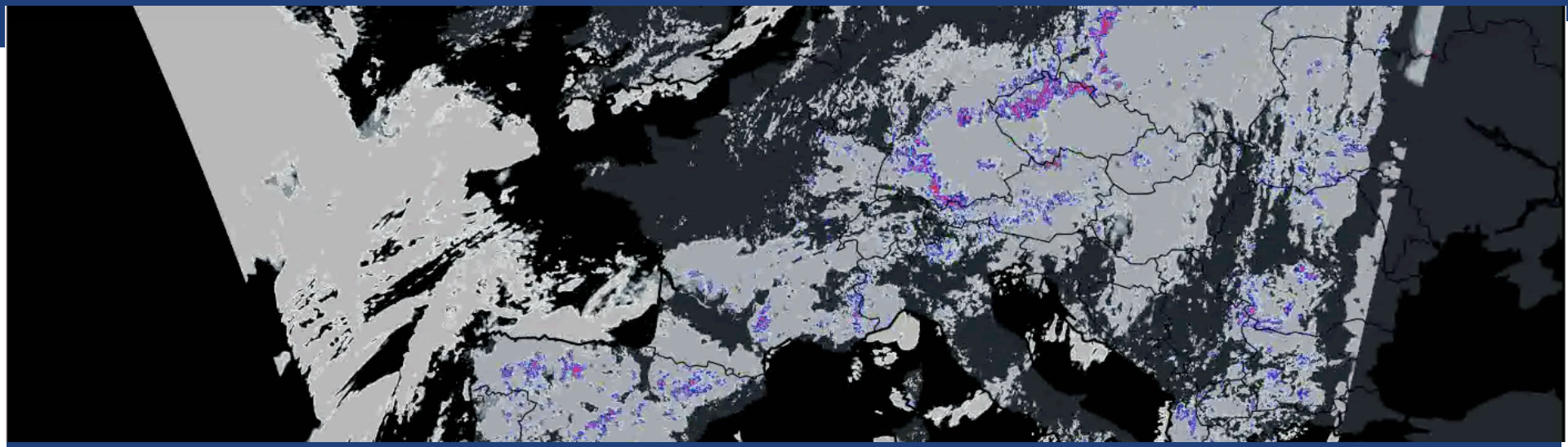

The effects of switching-off parameterized convection at grey-zone resolutions

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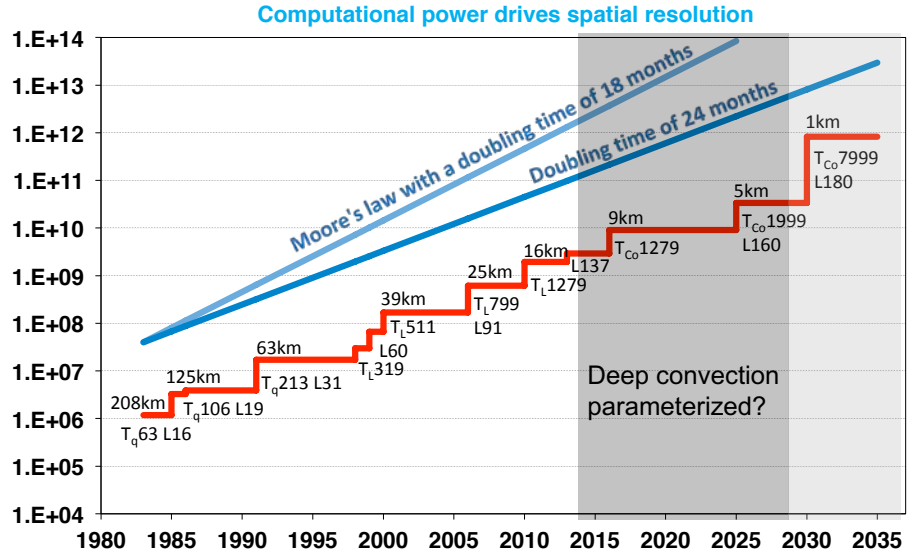
C2SM Center for Climate Systems Modeling

EUCP European Climate Prediction system

Introduction

- Global climate simulations are getting closer to horizontal resolutions laying in the so-called “grey-zone” of convection.
- Over these scales it is up for debate whether if a parameterization of deep convection is beneficial for the model.
- Overall, the current scientific consensus is that you can/should switch off the parameterizations of deep convection at resolutions of about 4-5km (Weisman 1997; Kendon et al 2017)
- **The aim of this talk is to convince you that switching it off a much coarser resolutions could be beneficial for your simulations.**

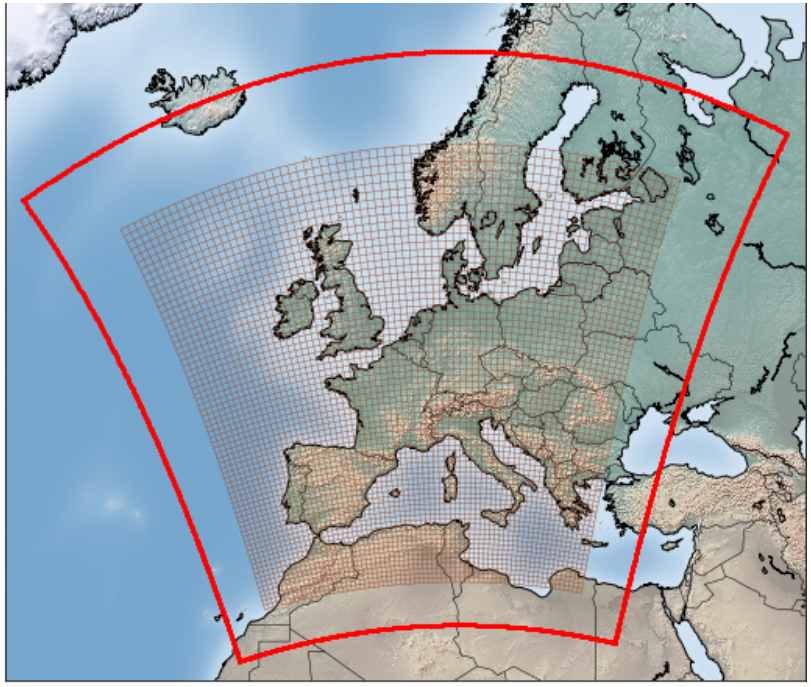


Schultess et al. 2018

Setup of the experiments

- Shortly, we run a 12km resolution simulation to drive 7 different internal domains covering resolutions in the grey-zone:

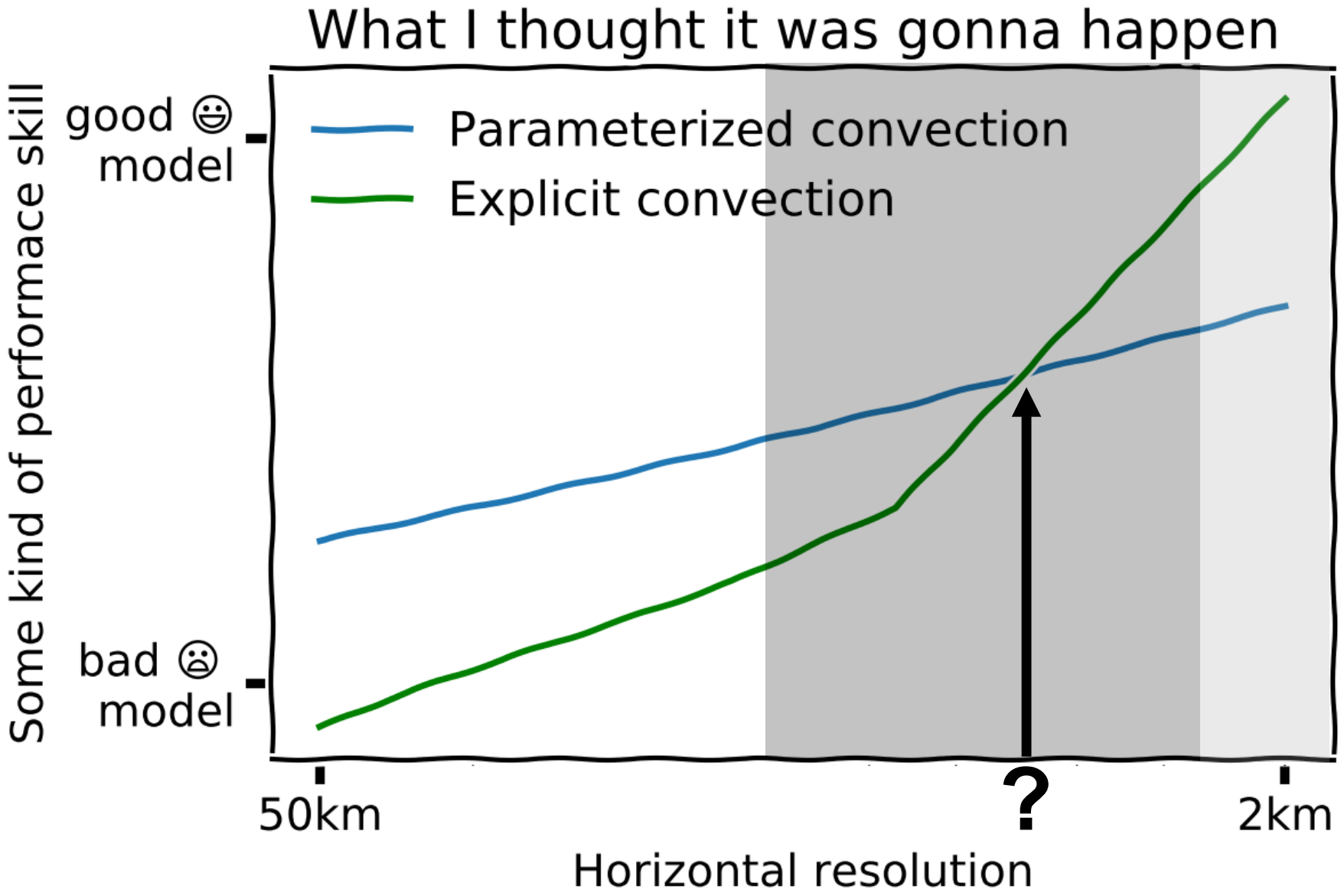
0.44 ~50 km	0.06. ~6.5km
0.22 ~25km	0.04 ~4.3km
0.11 ~12km	0.02 ~2.2km
0.08. ~9km	



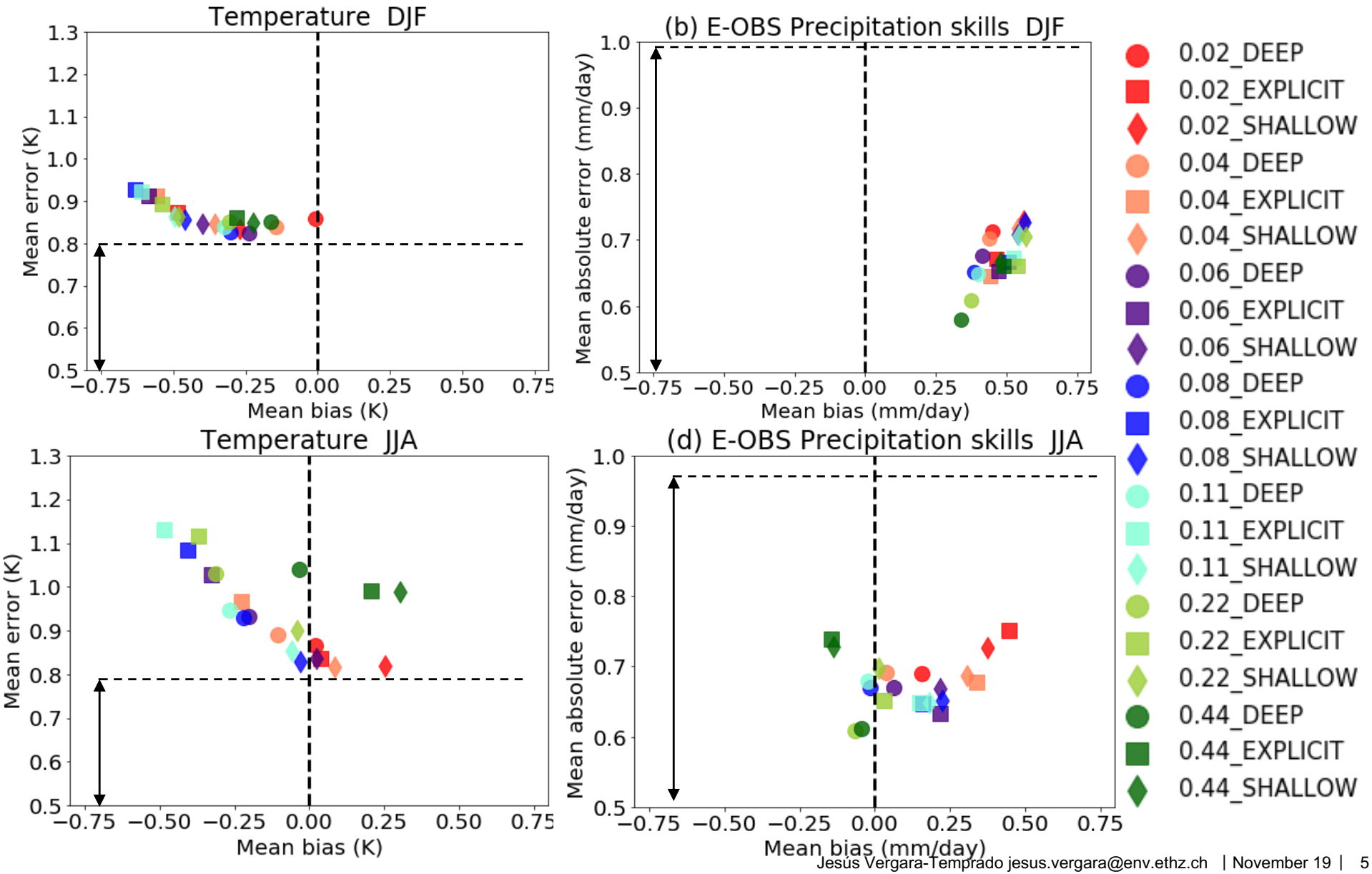
- We simulate the year 2006, characterized by a strongly convective summer over Europe. Our analysis focus mainly over summer.

- For each of the 7 resolutions in the inner nests we perform 3 simulations with :
  - Parameterized deep and shallow convection ("_DEEP")
  - Parameterized shallow convection ("_SHALLOW")
  - No parameterization ("_EXPLICIT")

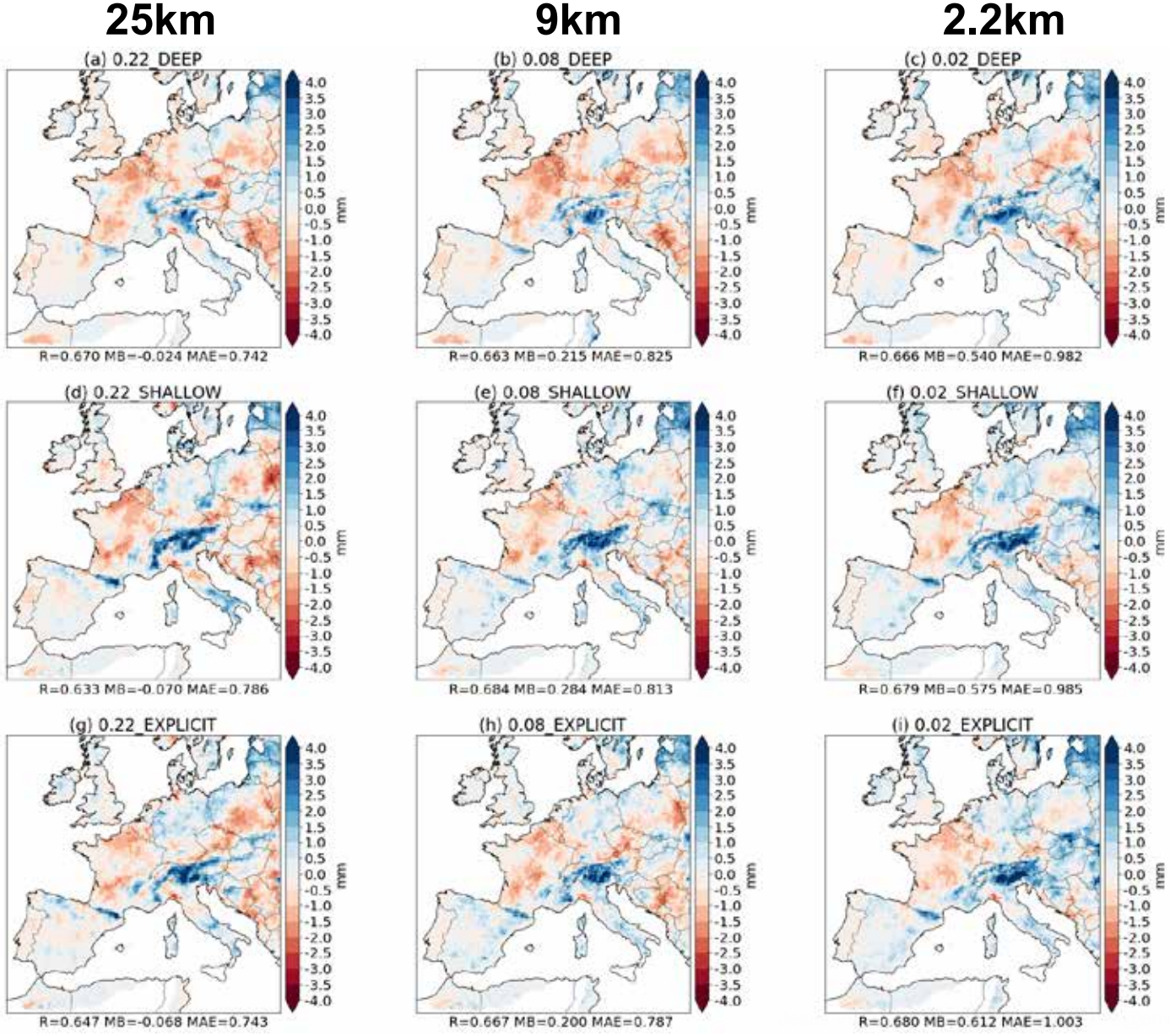
Vergara-Temprado et al. in review Journal of Climate


What I thought it was gonna happen
Some kind of performace skill
good 😀 model
bad ☹ model
Parameterized convection
Explicit convection
50km
?
2km
Horizontal resolution

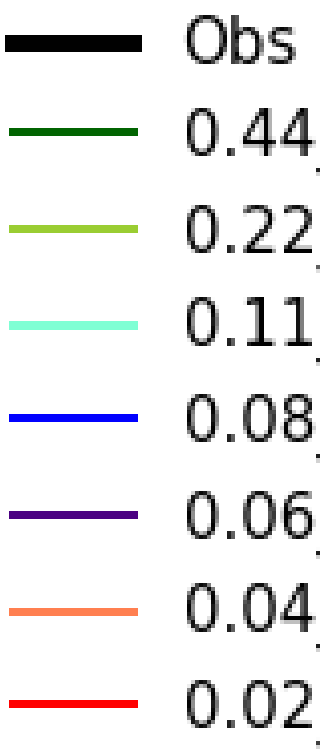
E-Obs bias/error – Europe

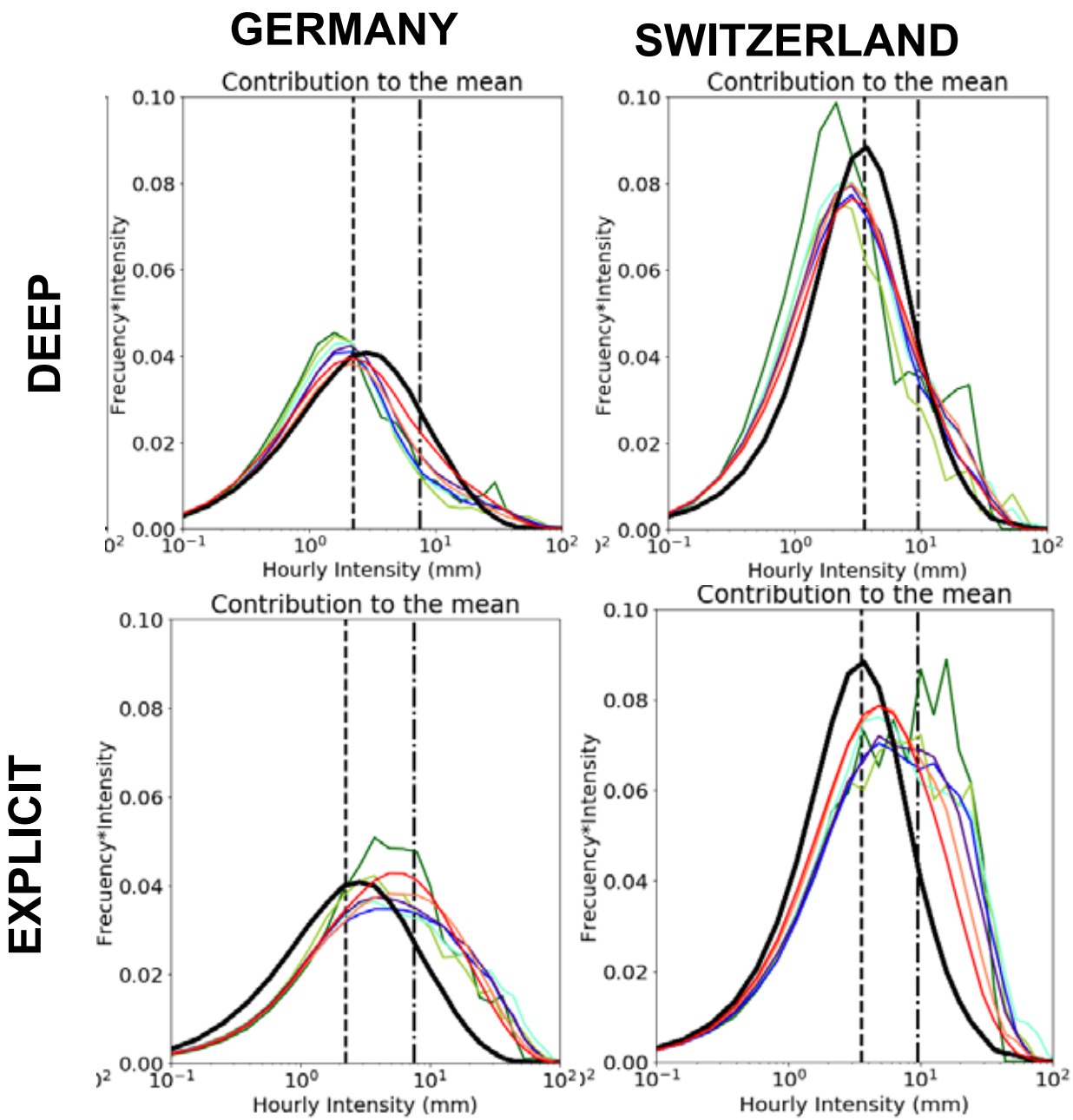


Spatial precipitation biases against E-OBS



Hourly rain

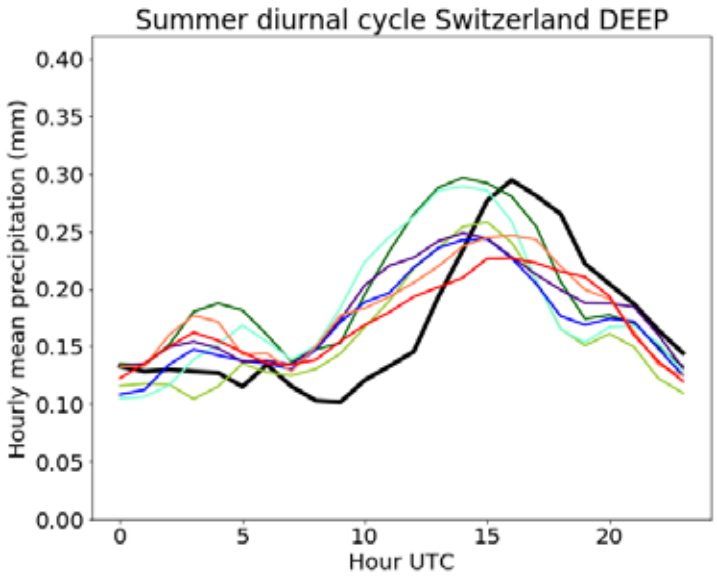

Obs
0.44
0.22
0.11
0.08
0.06
0.04
0.02

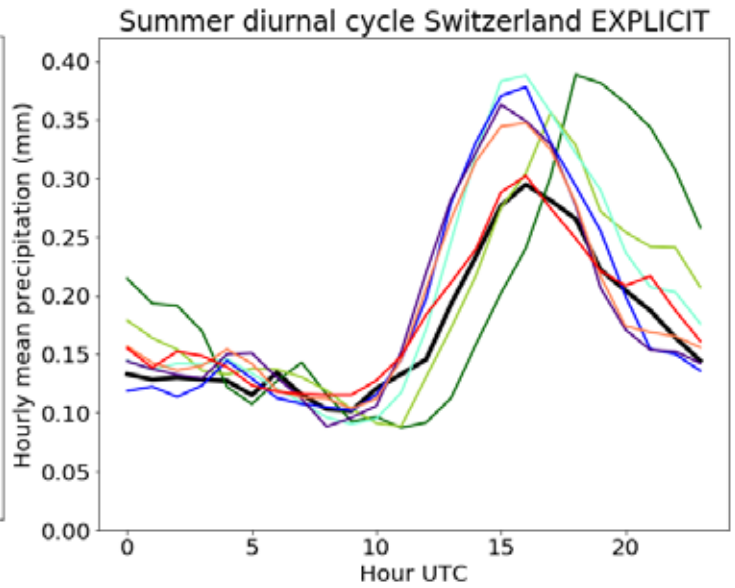

GERMANY
SWITZERLAND
DEEP
EXPLICIT
Contribution to the mean
Frecuency*Intensity
Hourly Intensity (mm)

Diurnal cycle

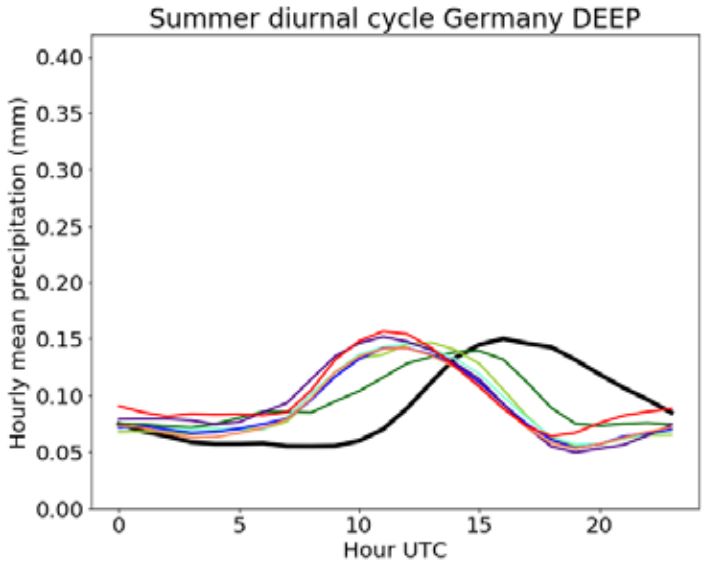
DEEP | **EXPLICIT**

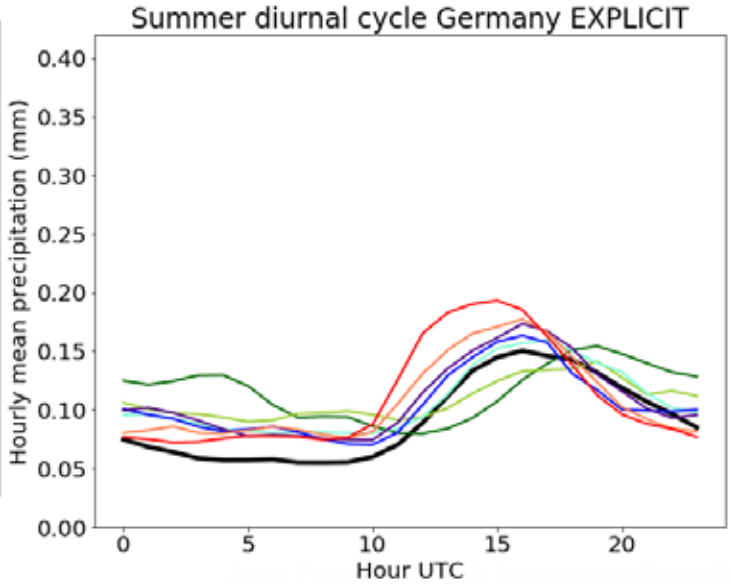
Switzerland



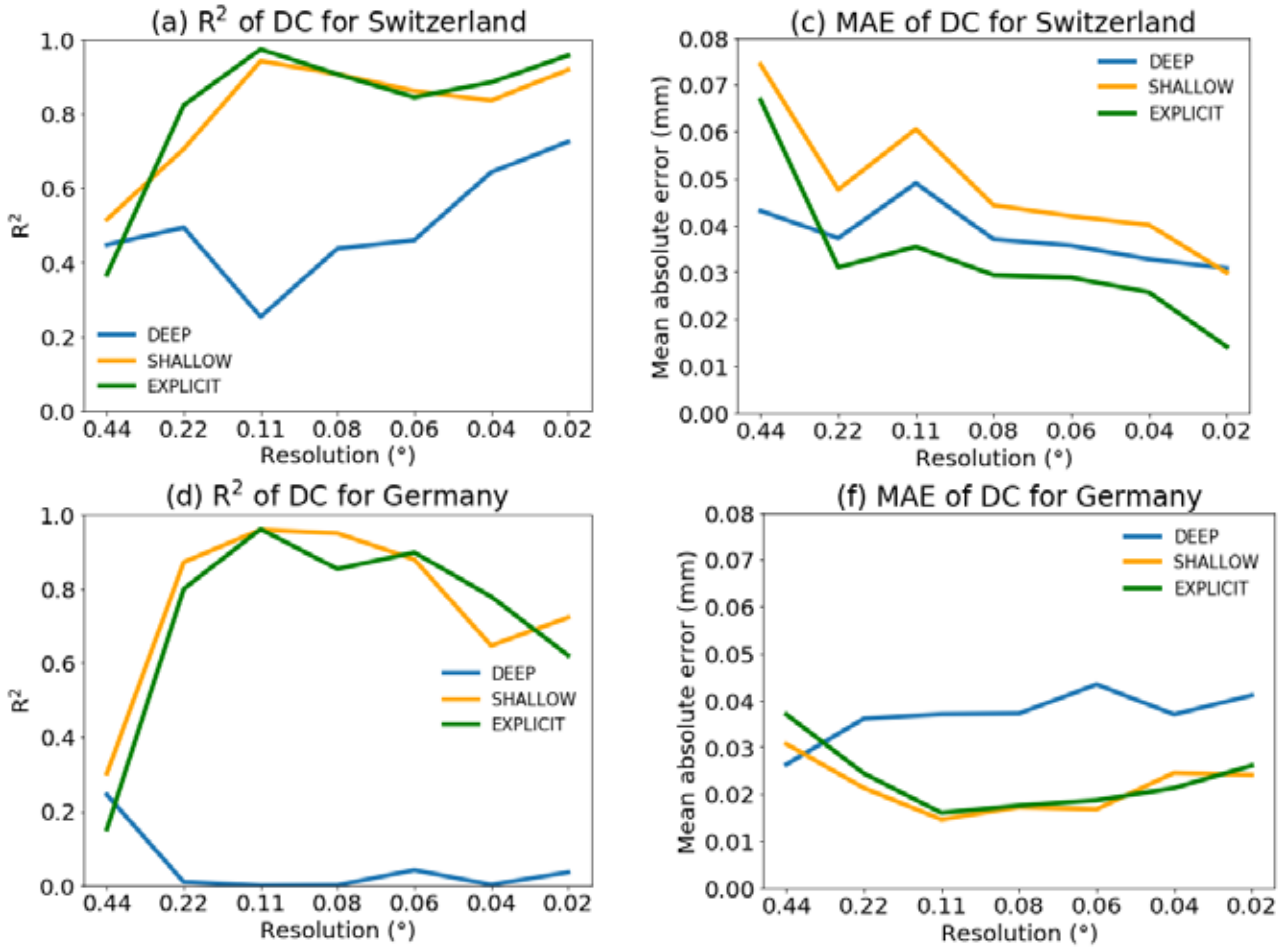


Germany

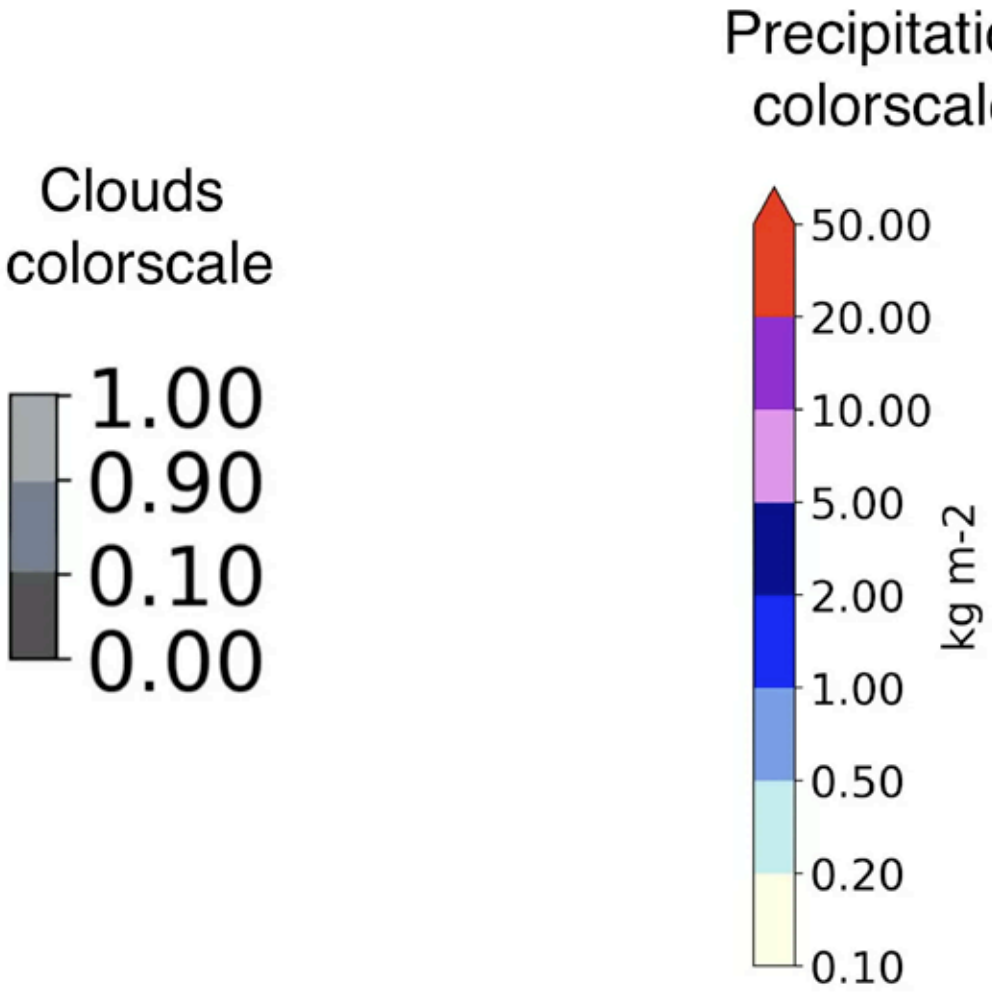




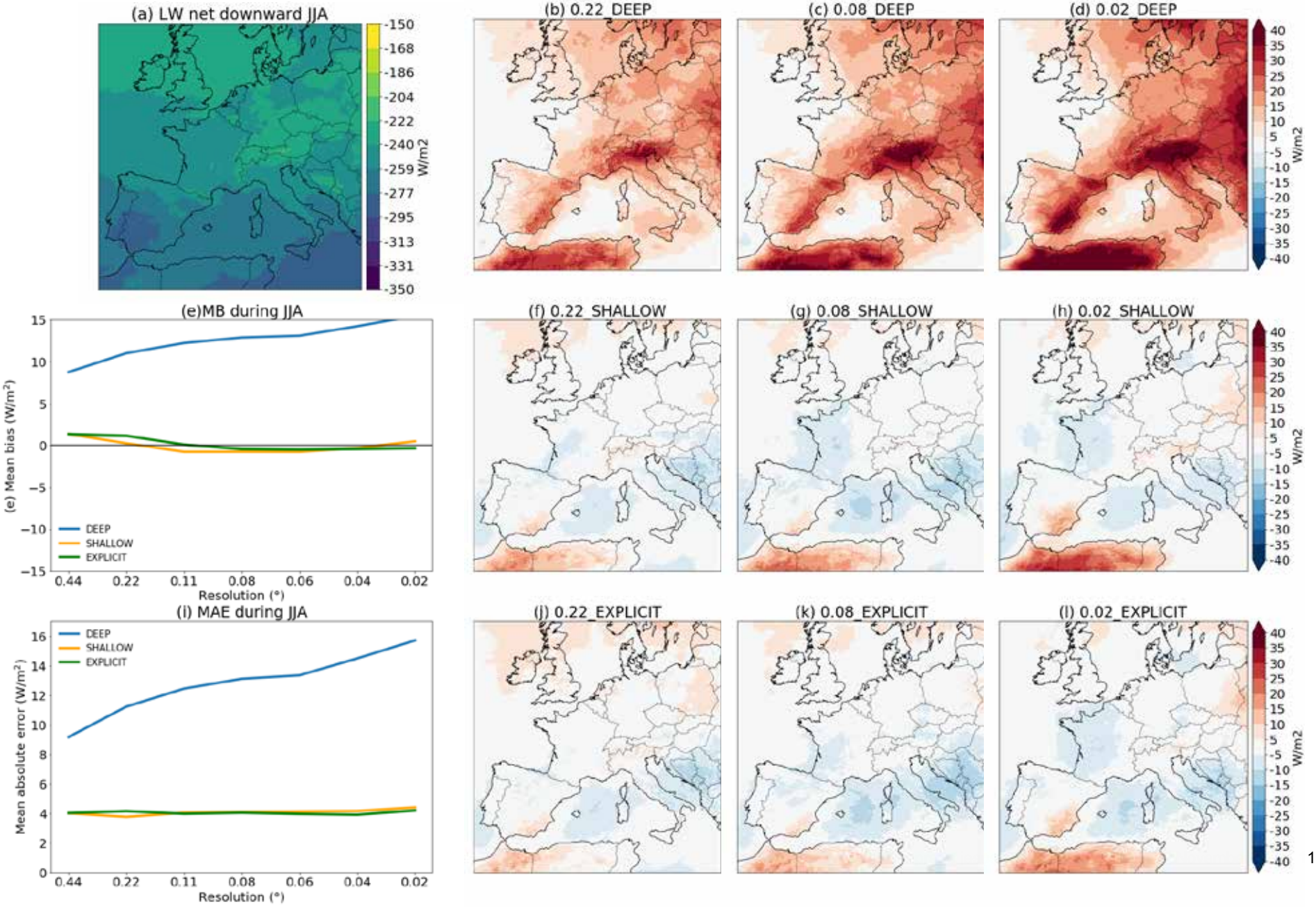
Diurnal cycle skills



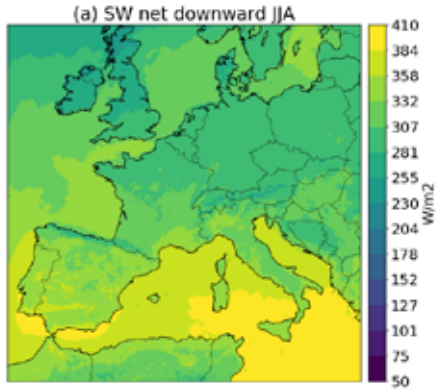
Explicit convection vs parameterized at 25, 9 and 2.2 km horizontal gridscale.
Vergara-Temprado et al.

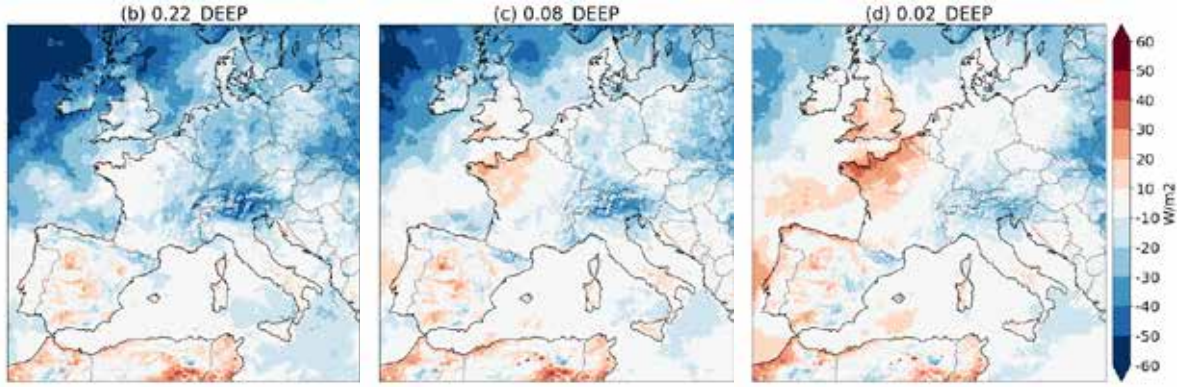


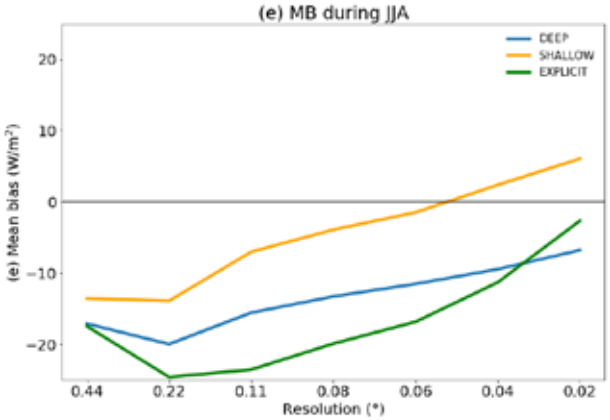
LW radiation

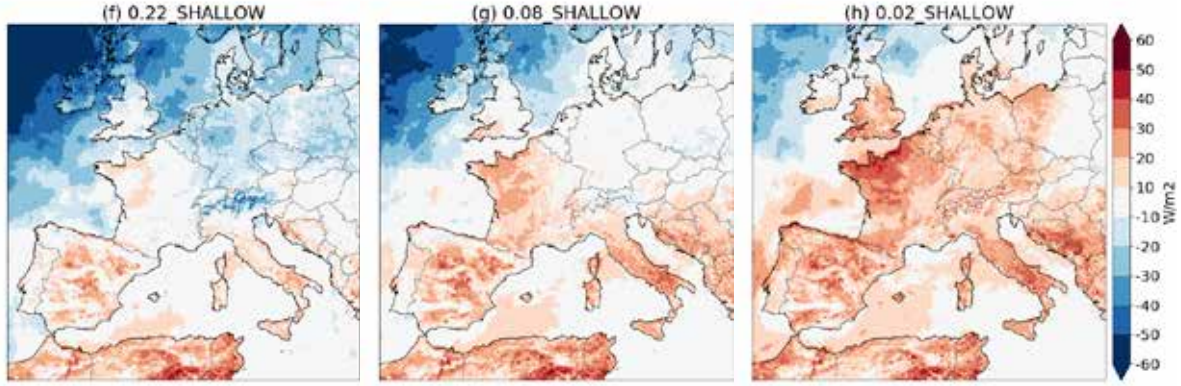


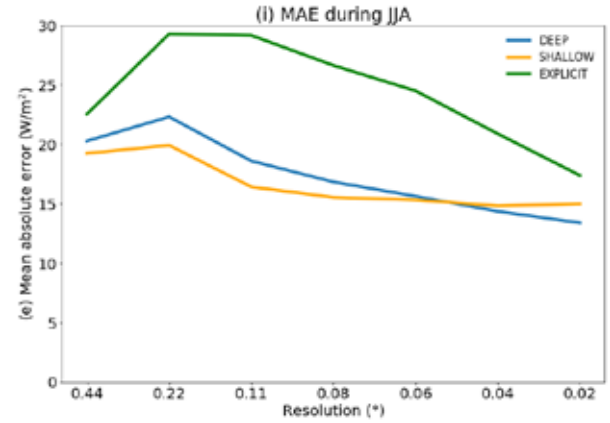
SW radiation

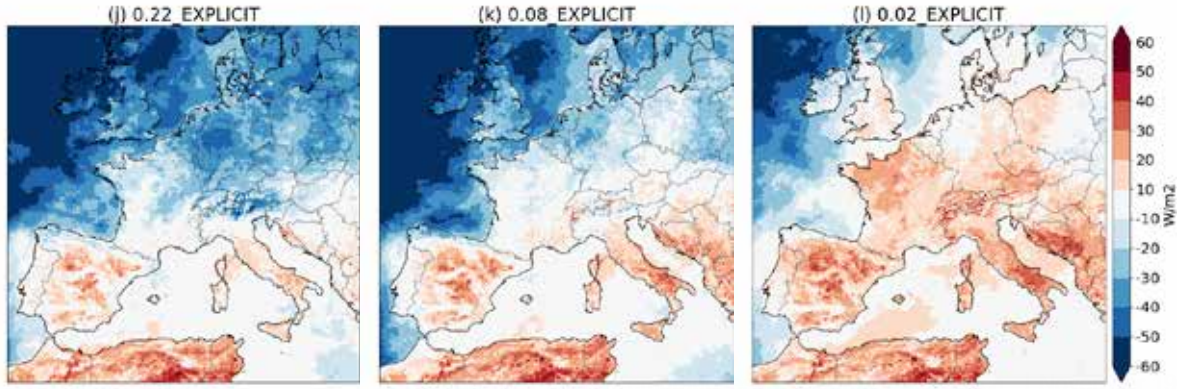












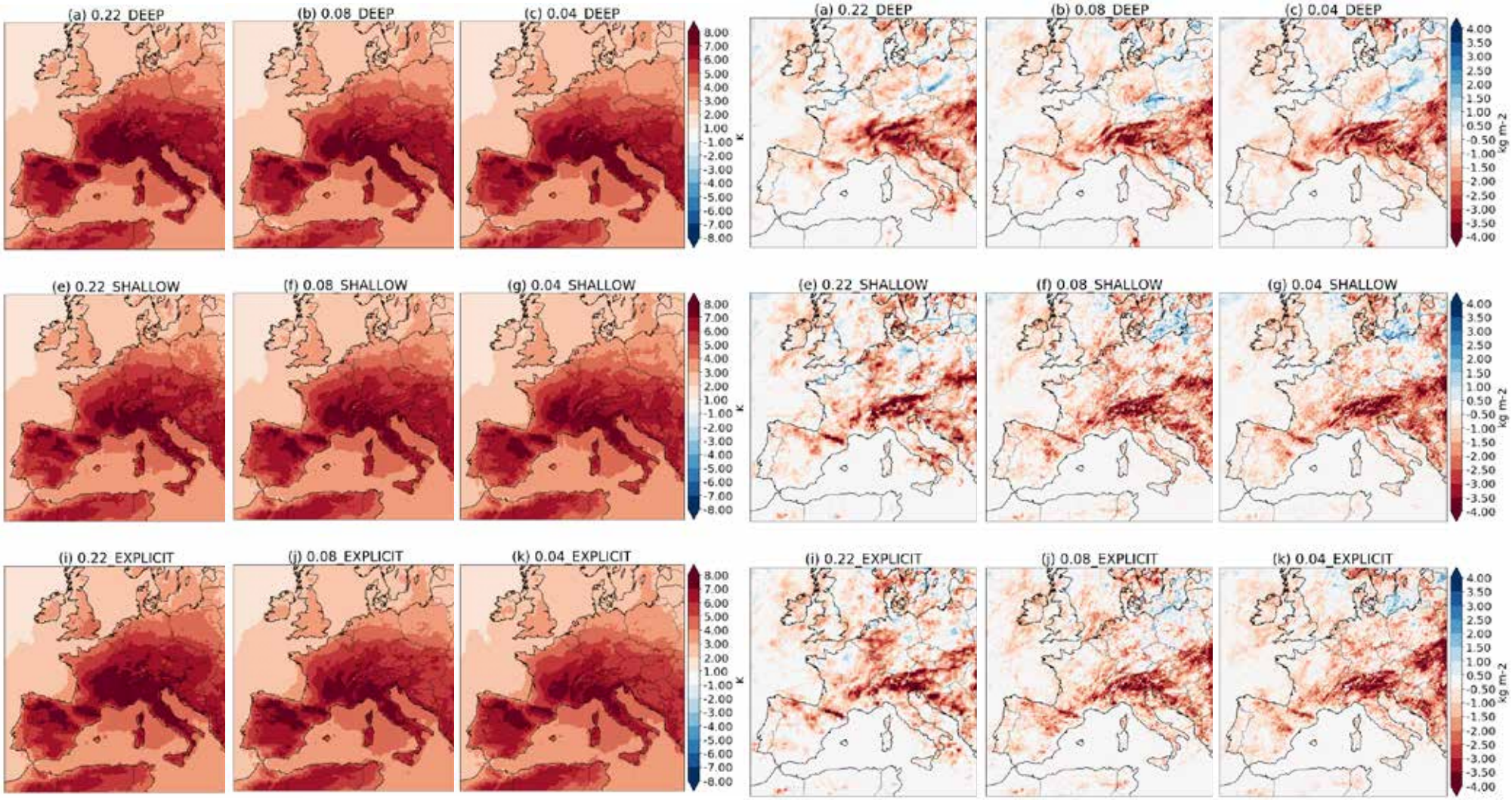
Is this important for climate projections?

- We use the Pseudo Global Warming approach (PGW).
- ERA Interim fields from the year 2006 are perturbed with the climate change signal from the MPI model
- The same set of simulations is run and the projections are calculated.

- We do not attempt to do an “operative” climate projection but rather to see the differences in the projected changes between resolutions and treatments of convection.
- The results I am going to show are so far very preliminary.

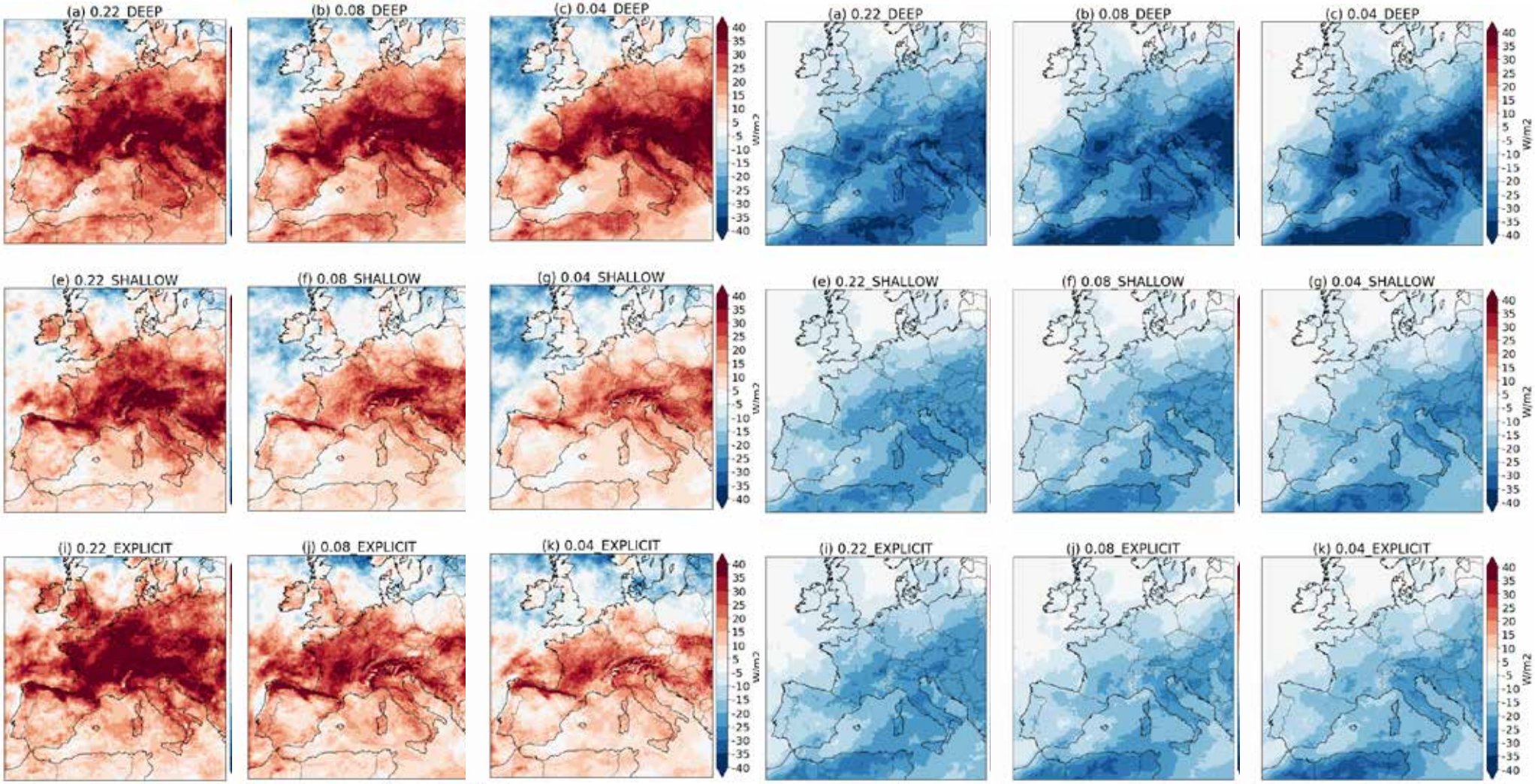
Temperature

Precipitation



SW radiation

LW radiation



Conclusions/Discussion

- Explicit convection works at much coarser scales than usually considered for climate simulations, therefore the use of a parameterization for deep convection at those scales should not be considered a "requirement".
- The added value of high-resolution simulations is seen more clearly when looking at the representation of clouds and radiation.
- Similar results are obtained in the tropical Atlantic (Hentgen et al. in preparation).

- The term "convection-permitting" only implies that the model resolution does not inherently block convection from happening.
- The resolutions presented here should also be considered "convection-permitting" although people would not generally identify them as such.
- The term is currently being incorrectly used to refer to a different type of modelling ("km-scale modelling"; which is also "convection-permitting").

- Projecting into future climate: Overall, the patterns of **mean** temperature and **mean** precipitation projections seems "relatively" consistent across resolutions and methods of treating convection.
- Clouds feedbacks on the other hand, depend very strongly on the resolution and the representation of convection.