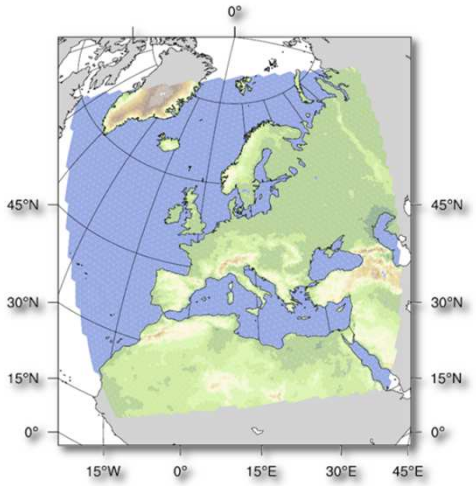
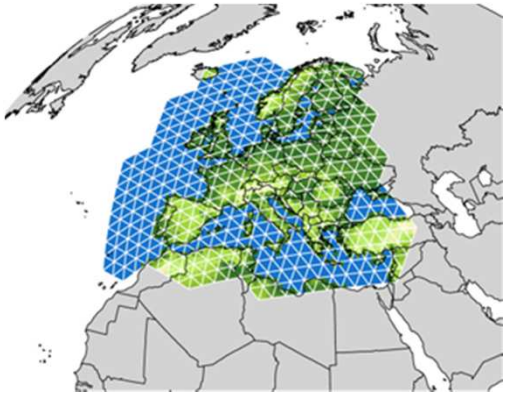
ICON-CLM
the new regional climate model for CLM-Community





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Motivation

Background:

At the moment:

- Weather forecast model: COSMO & ICON-NWP
- Climate model: COSMO-CLM

Plan after 2020:

- Switch operational weather forecast model: COSMO -> ICON-NWP
- Limited support for COSMO-CLM
- Last version COSMO 6.0
- Need for ICON based regional climate model system – a climate version of ICON-LAM

Project: ProWaS December 2017 – June 2019

Aim: ***Further developing the weather forecast model ICON-LAM to a regional climate model***

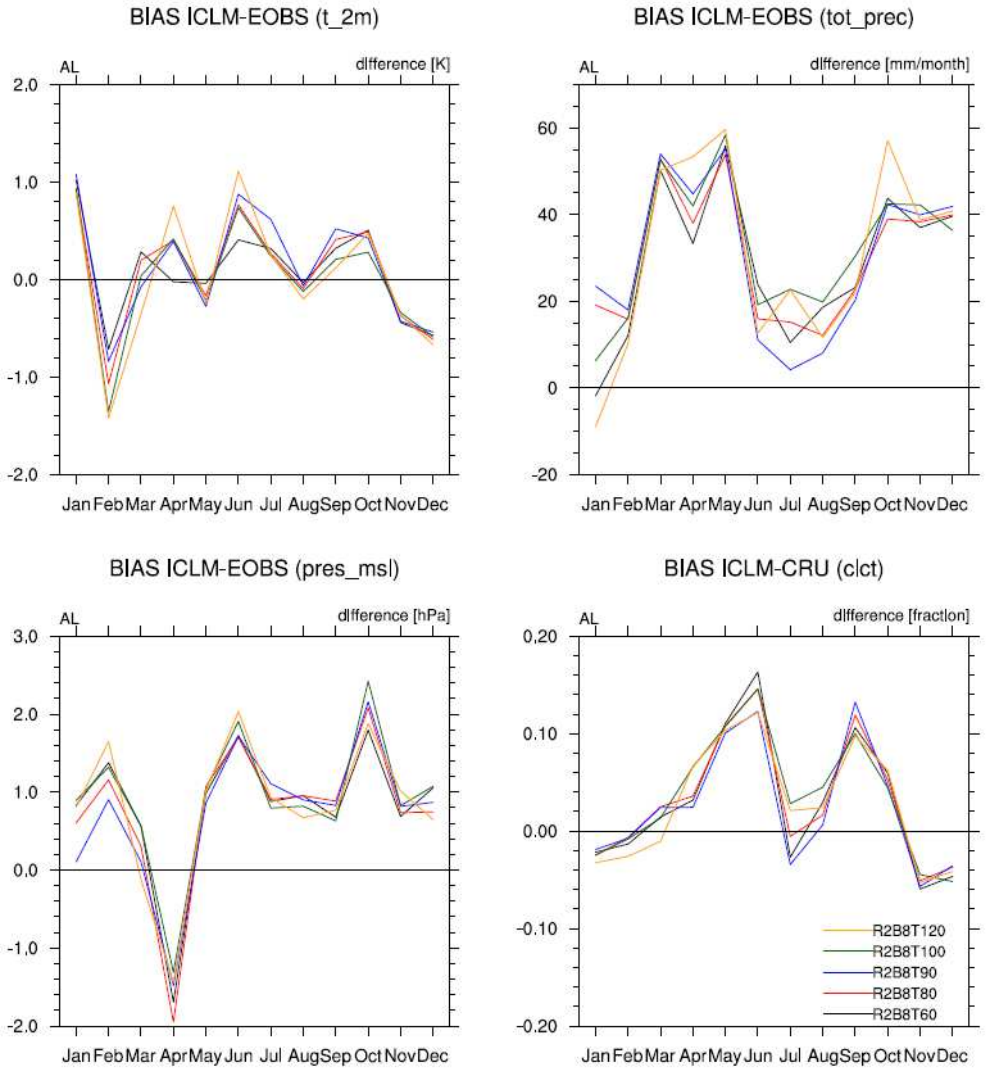
Beginning with ICON-LAM

- ICON-LAM was tested only for some days, months
  - Climate applications need long simulations up to hundreds of years
- Weather forecast model does not need time-depenpent boundary conditions (eg. SST, sea-ice were updated only monthly)
- Input data were mostly in GRIB Format
  - Climate version needs NetCDF-Format
- Technical issues for climate simulations:
  - No reset for accumulated precipitation -> would cause data imprecision in long climate simulations
  - Fixed interval for calculating tmax/min (6 hourly)
  - Fixed numbers of soil layers and soil profile -> would be different when simulating e.g. Africa
- Many issues must be tested for climate applications: Restart, soil, vegetation, albedo, etc.

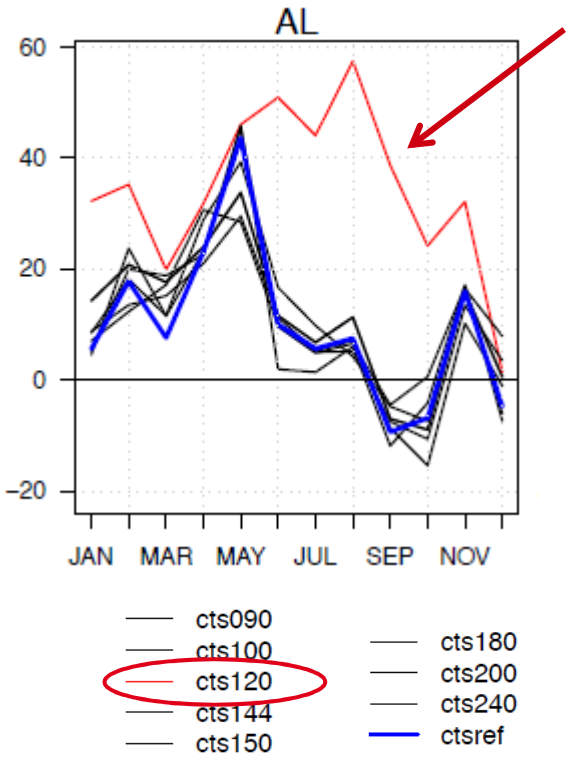
ICON-CLM Development

- Tests with Netcdf data, restart, etc…
- SST/sea-ice updated at an user-defined interval (namelist lnd_nml/sstice_mode=6)
- Time-dependent GHG. Values of GHG are read from external file
- Reset for tot_prec after an user-defined interval (io_nml/tot_prec_interval) and for tmax/min_2m (io_nml/mxt_interval)
- User-defined number of model soil layers and model soil layer depths (namelist lnd_nml/nlev_soil and lnd_nml/zml_soil)
- After recent merge (12.2018) with ICON-LAM: option of the global data nudging at upper boundary.
- Technical infrastructure:
  - ICLM-SP (ICLM Starter Package):
    - Run routine “subchain”: prep -> conv2icon -> icon -> arch -> post
    - Climatological test suite (CTS)
  - Evaluation routine ETOOLS
- ICON-CLM and ICLM-SP installed and tested on Cray (DWD) and Mistral (DKRZ)

Time step dependency tests (R2B8)



TOT_PREC Bias CCLM-EOBS



Source: B. Rockel (HZG)

Impact of nudging at upper boundary

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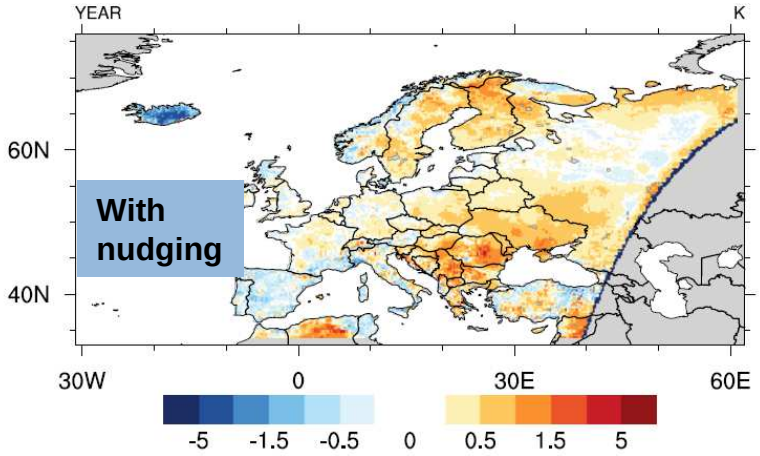
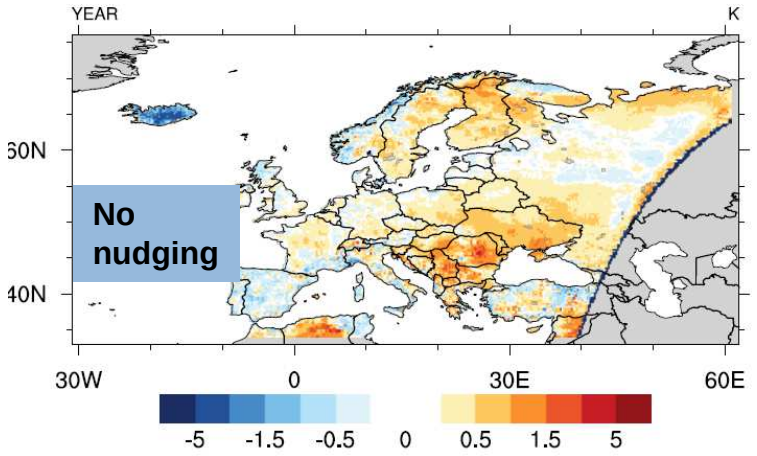
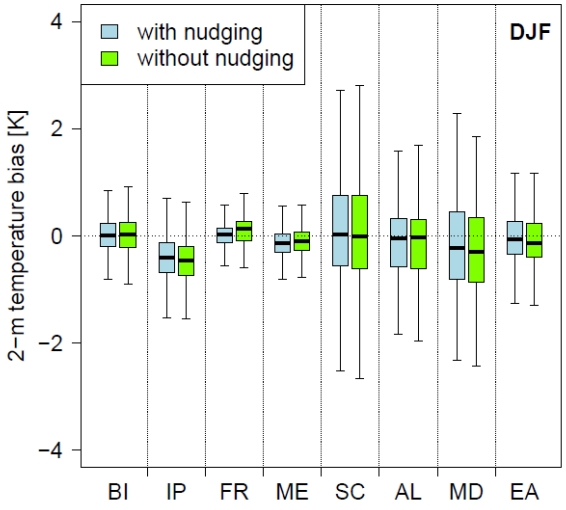
- Test the impact of nudging at model top:
  - Namelist parameter nudging_type=0/1
  - Simulation period: 1979-1988
  - Time step = 120s
  - Resolution R2B8 (~10 km)
  - Domain: EU-CORDEX
  - No significant differences in monthly, seasonal, annual biases compared with reference data.

1979-1988 averaged 2mT biases



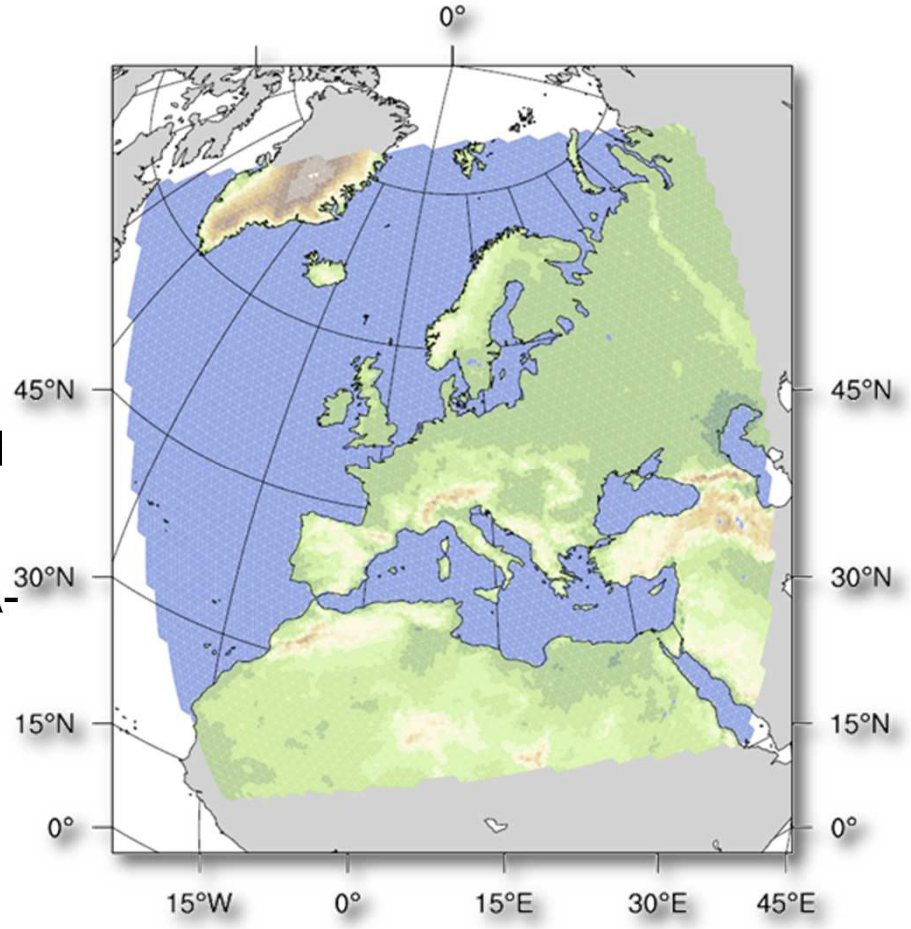


1979-1988 averaged and percentiles of 2mT biases for PRUDENCE sub-regions



ICON-CLM Experiment setup

- Domain: EU-CORDEX
- Resolution: R2B8 (~10km)
- Time steps: 120s/90s
- With nudging at model top
- Initial data: Amospheric fields from ERA-Interim; surface fields from an ICON-CLM long run
- Lateral, lower, upper boundary data: ERA-Interim
- Period: 1979-2008 (30 years)
- Model namelist settings: combined the namelist settings of R2B6 (with nest R2B7) and R3B7 with nest R3B8



ICLM vs. CCLM: 1981-2000 averages

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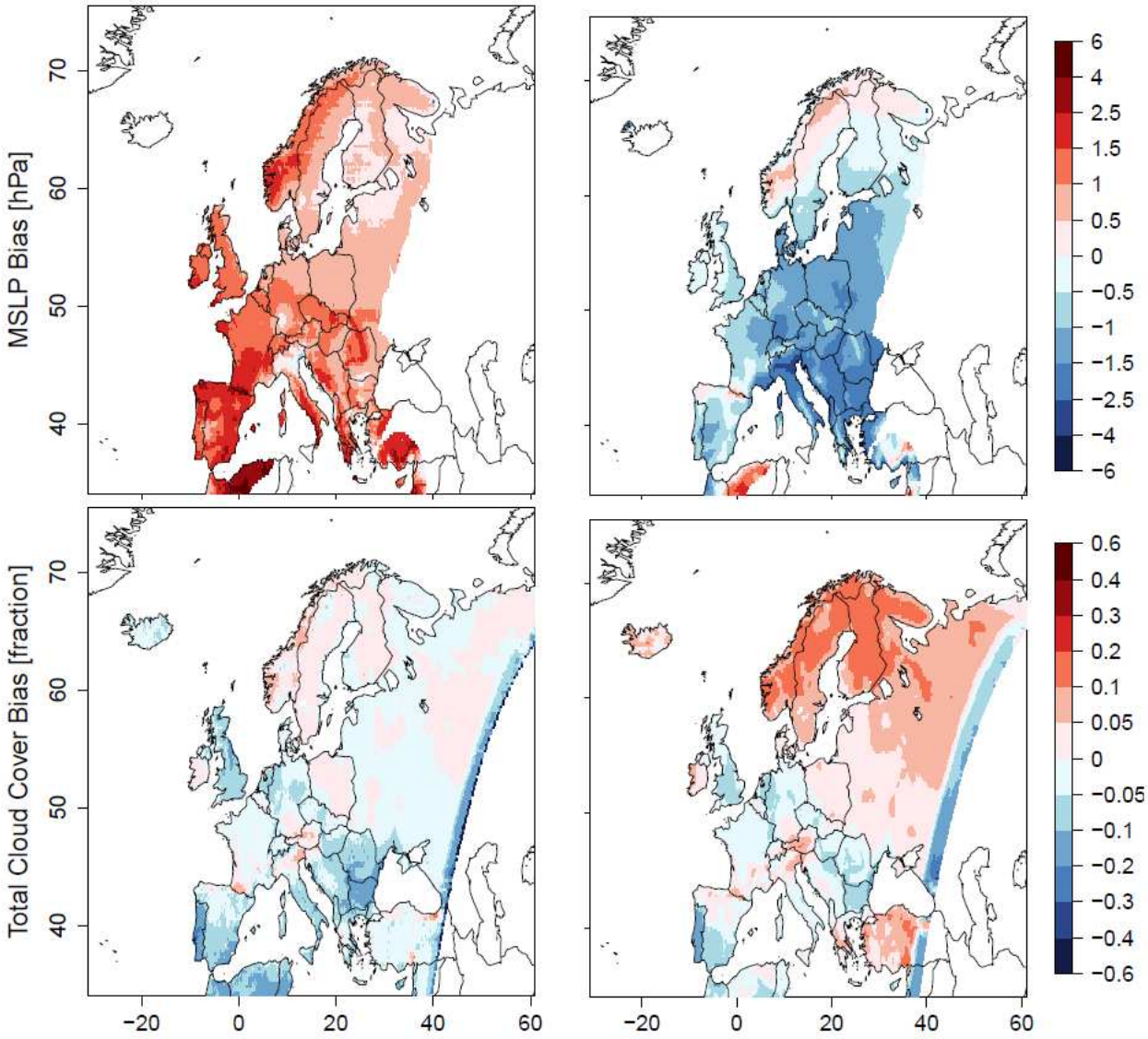
ICLM **CCLM**

MSLP

Cloud cover



ICLM vs. CCLM: 1981-2000 averages

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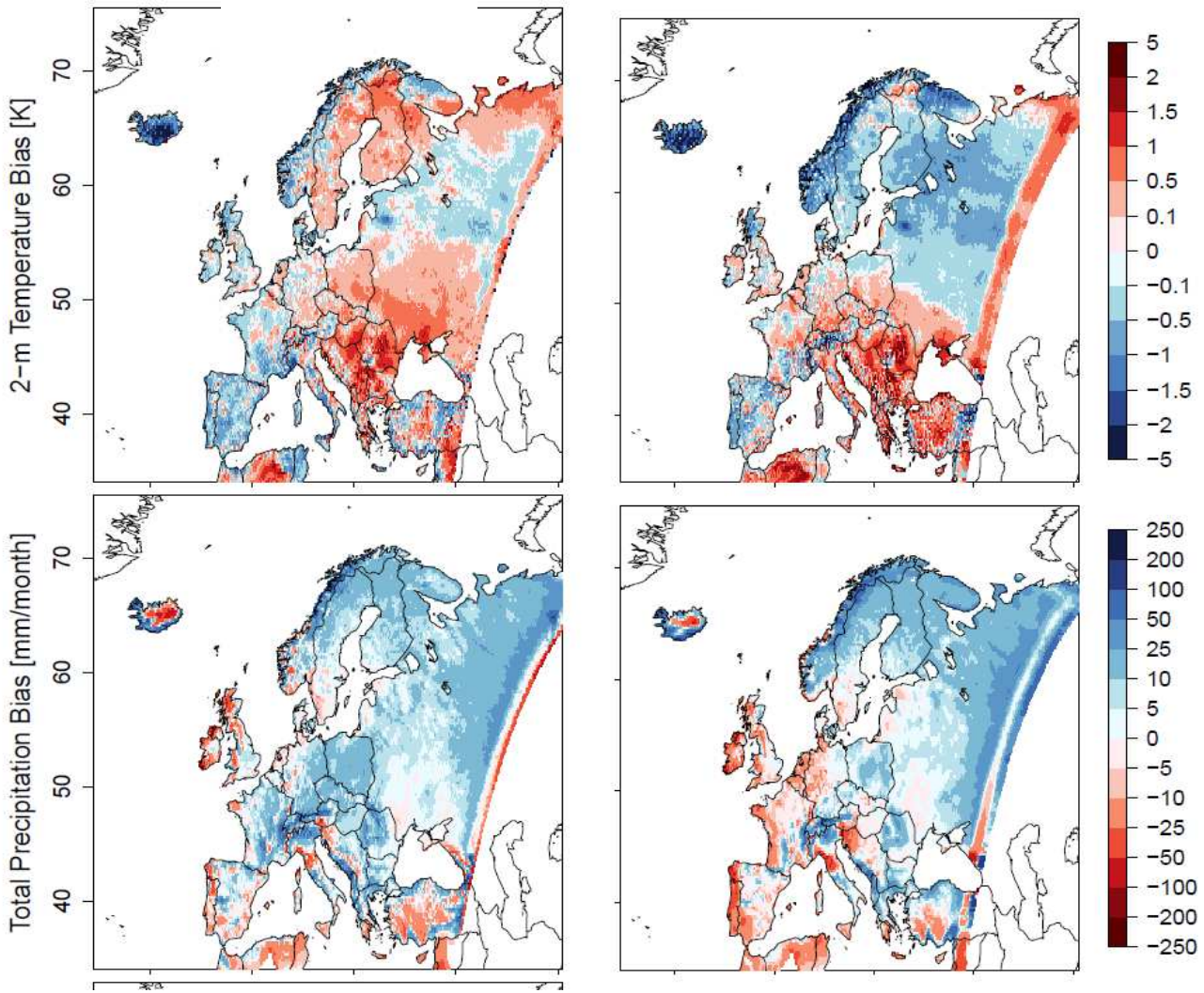
2m T

Precipitation



ICLM vs. CCLM: daily T range

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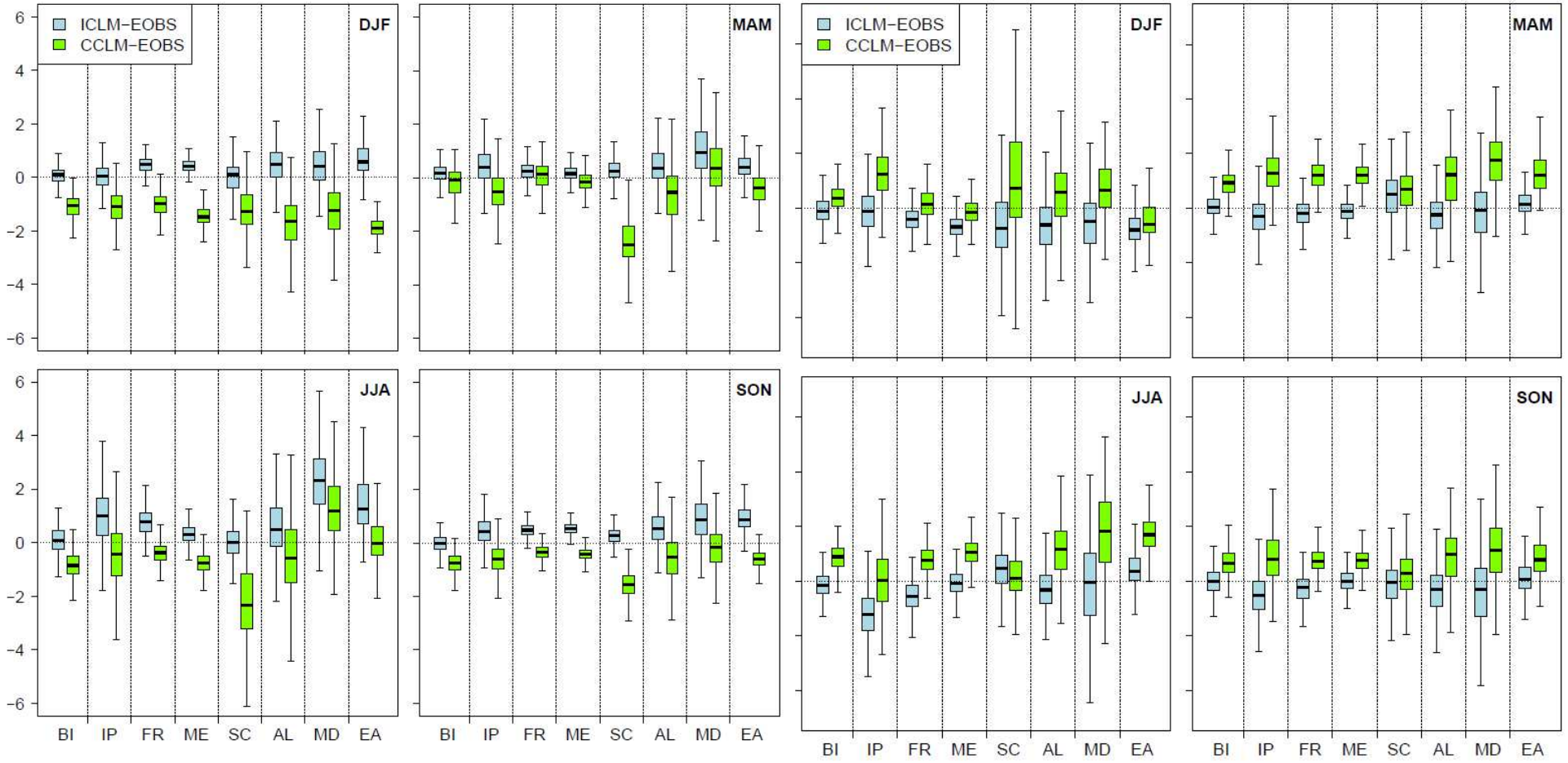
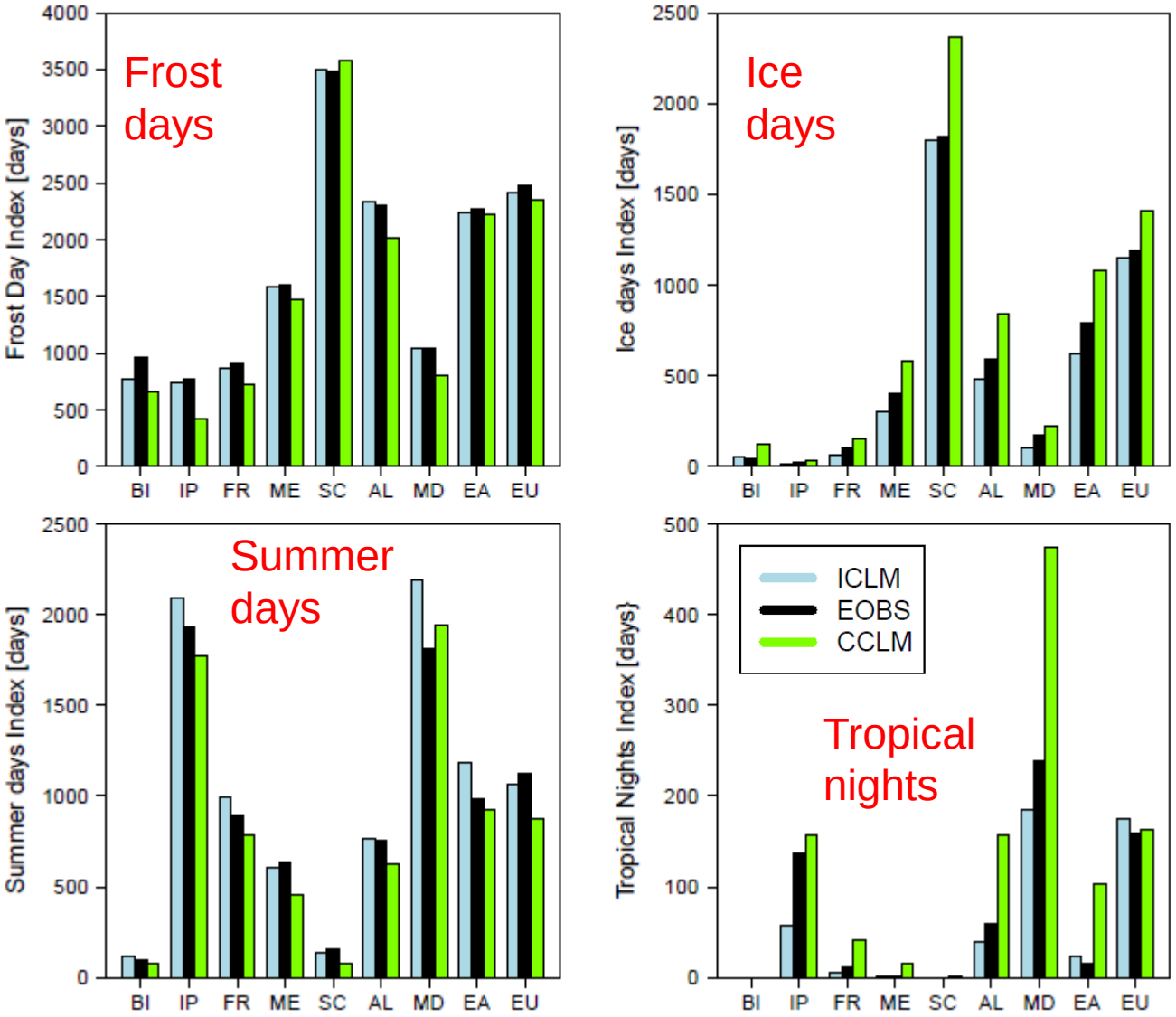
Max 2m T

Min 2m T



ICLM vs. CCLM: Climate indices



- CCLM overestimated numbers of ice days and tropical nights
- CCLM almost doubled the number of tropical nights in Mediterranean
- In general: ICLM is better with temperature-related climate indices

ICLM vs. CCLM: Climate indices

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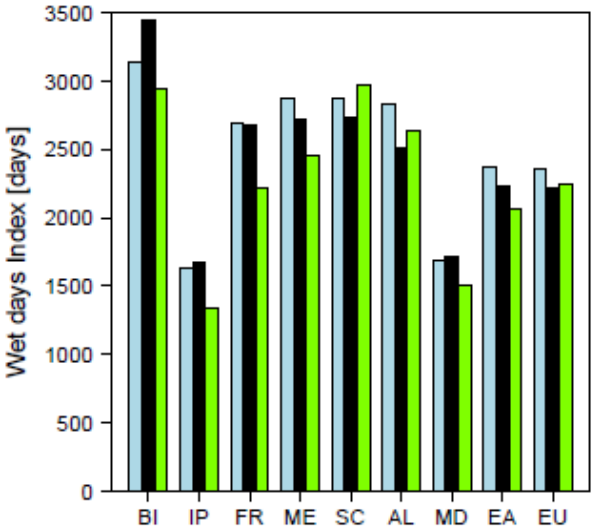
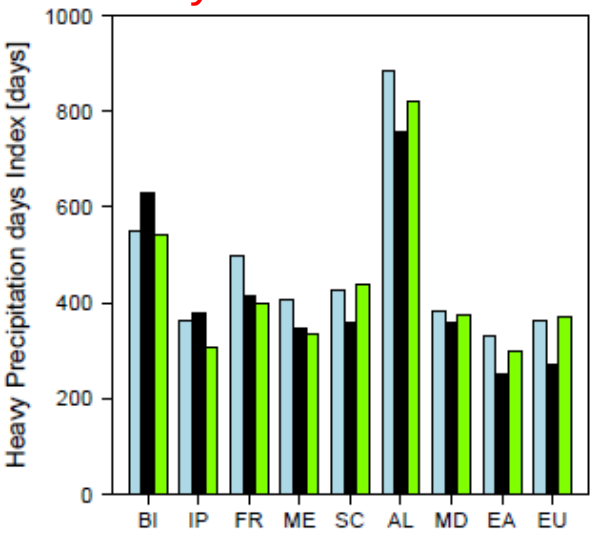
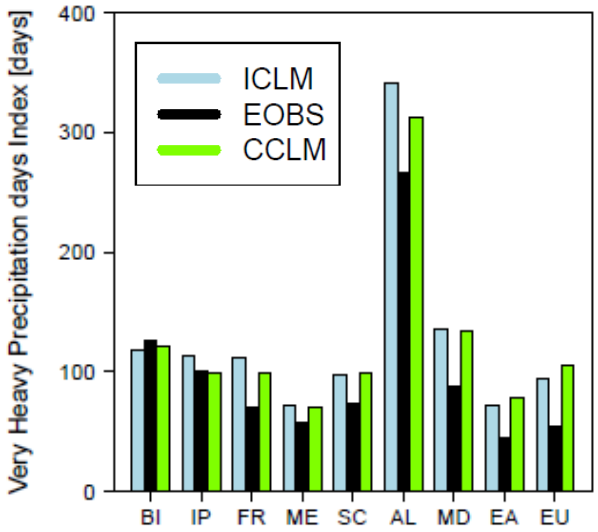
Wet days



Heavy precipitation days



Very heavy precipitation days



- Both ICLM and CCLM overestimated extreme precipitations
- It is not clear which model is better with precipitation-related climate indices

Plan

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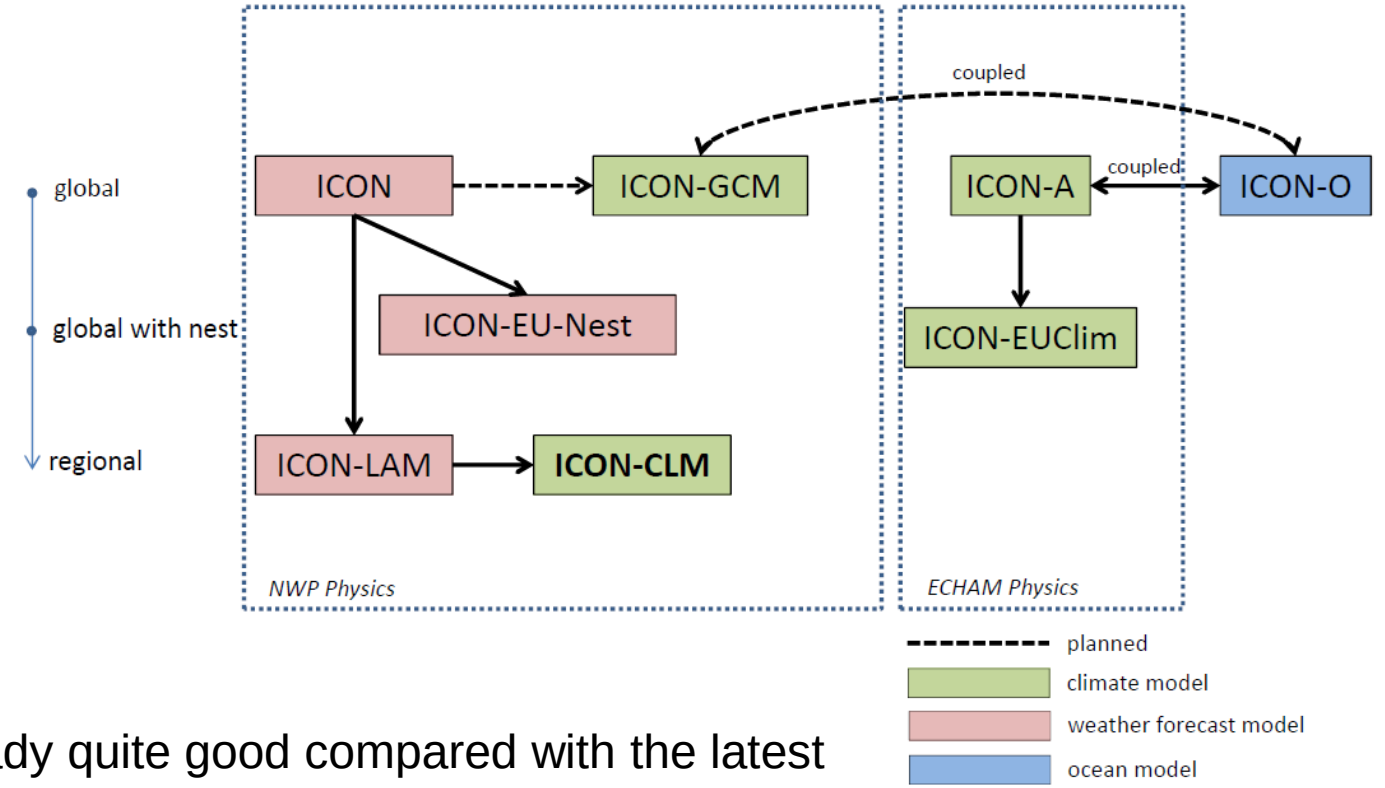
Pham et al., *ICON-Climate model in Limited Area Mode: the new generation of regional climate model,* Geoscientific Model Development (in preparation).



- ICON-CLM already quite good compared with the latest COSMO-CLM
- PG-ICON: Steps towards the first released version
- From 07.2019 IAFE Project:
  - global climate ICON model based on ICON-NWP
  - Coupling with ICON-O