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High Resolution Climate Change Scenarios Available in Europe for Impact Studies in Agriculture

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&
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Regional Climate Change Scenarios

FP6 Integrated Project ENSEMBLES:

- resolution 25 km for whole Europe
- period of 1950-2050 (2100), transient runs
- ~ 15 members (multiple models)
- CMIP3

EC FP6 projects CECILIA, CLAVIER:

- resolution up to 10 km for specific regions of Europe
- Time slices: 1961-1990 (2000), 2021-2050, 2071-2100
- 2(1) models

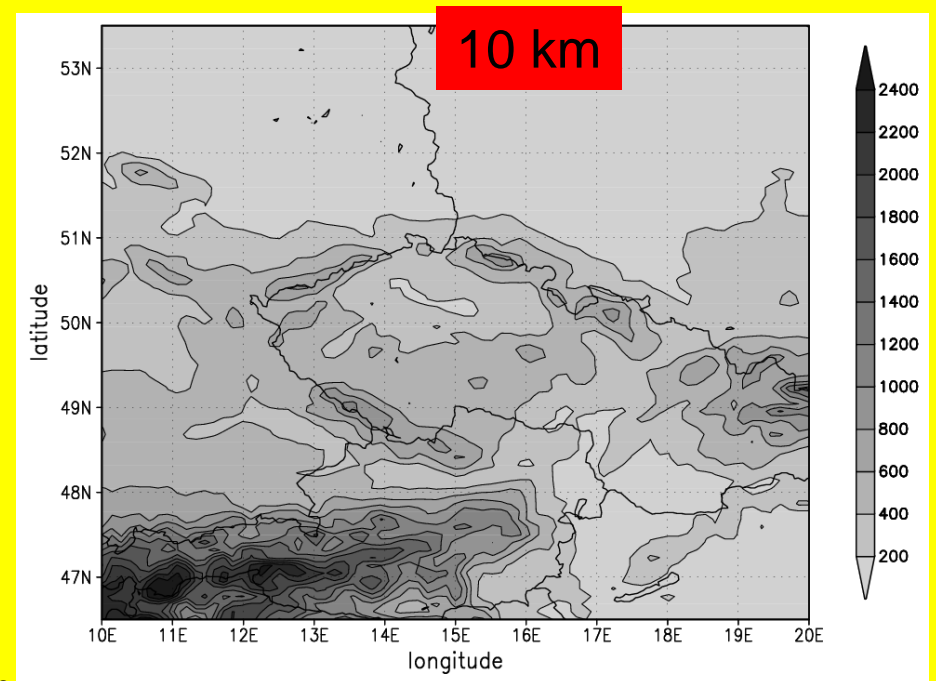
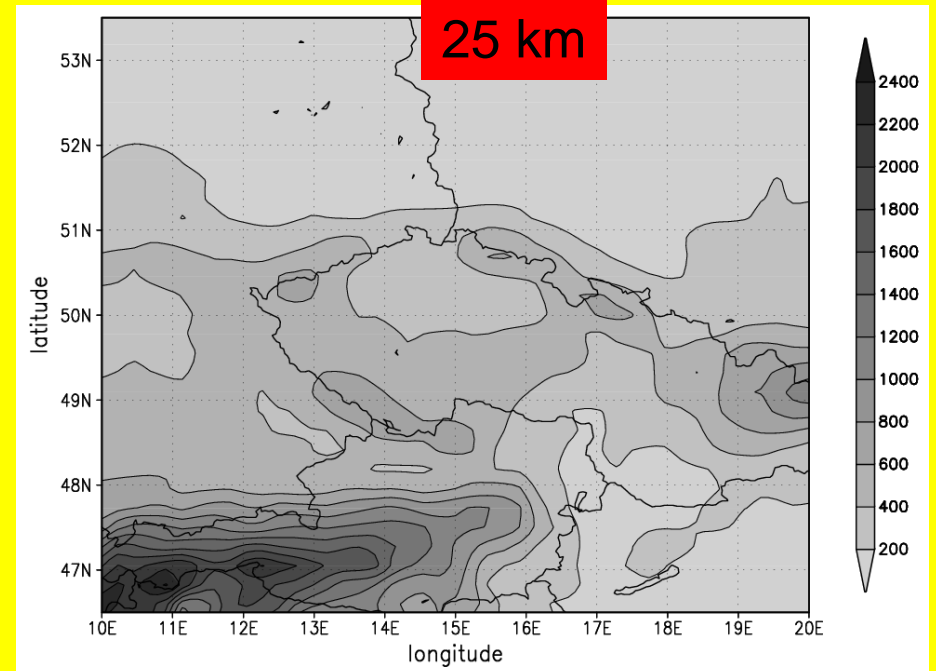
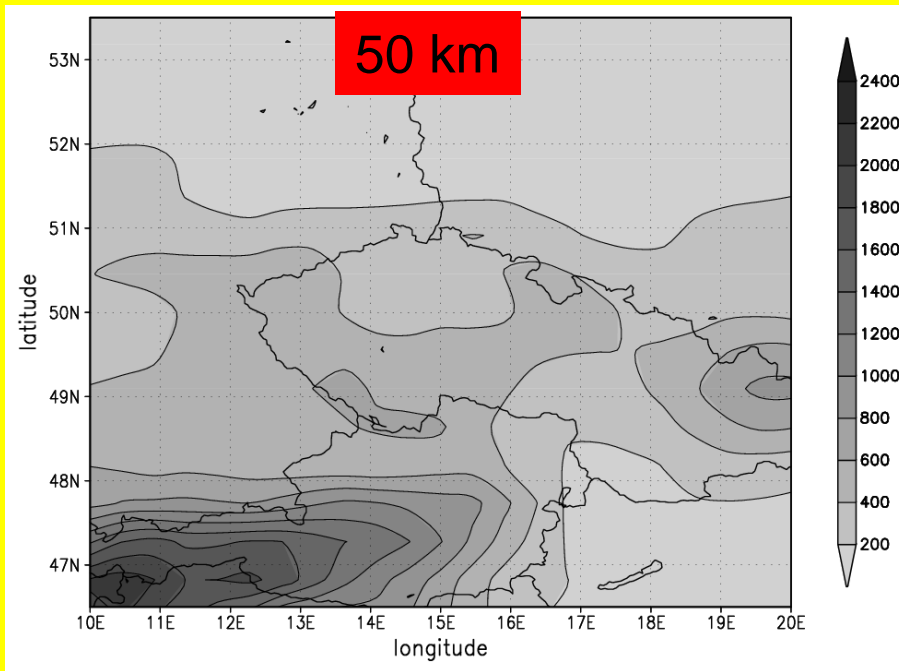
WCRP initiative CORDEX:

- resolution of 50 km at least, to provide RCM ensembles for all continents
- resolution of 10km for Europe
- period of 1950-2050 (2100), transient runs preferred
- ~ above 10 models for Africa (priority runs)
- CMIP5 (planned to be finished mostly this year)

Why high-resolution RCM?

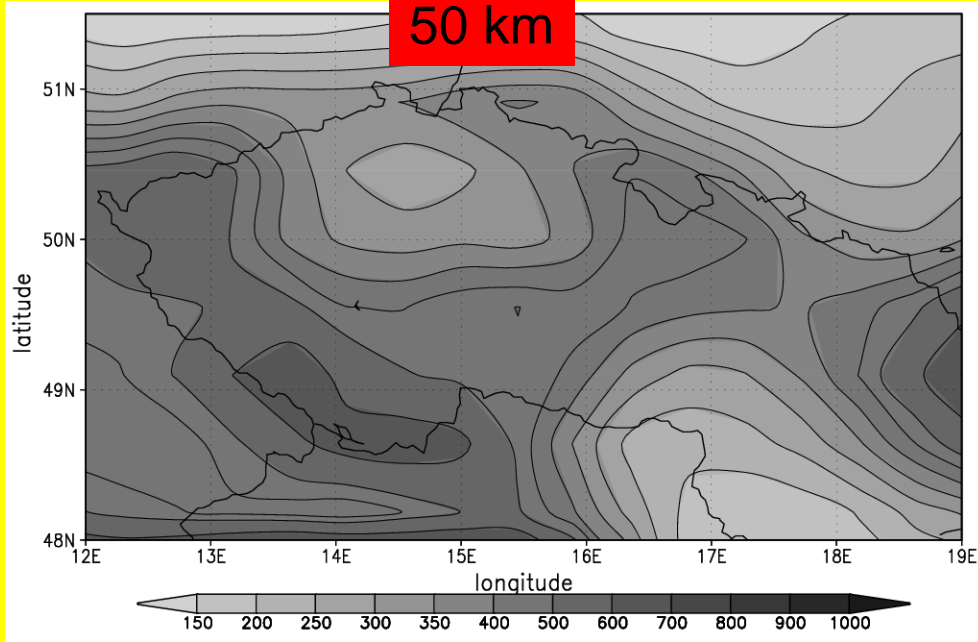
- RCMs as a tool for impact assessment to provide scientific basis for adaptation measures done mostly locally
- topography and land-use in complex terrain
- statistical interpretation of the results, get closer to station data and local information, localization
- more detailed analysis of local processes
- keeping RCM ahead of GCM aiming soon being cloud resolving



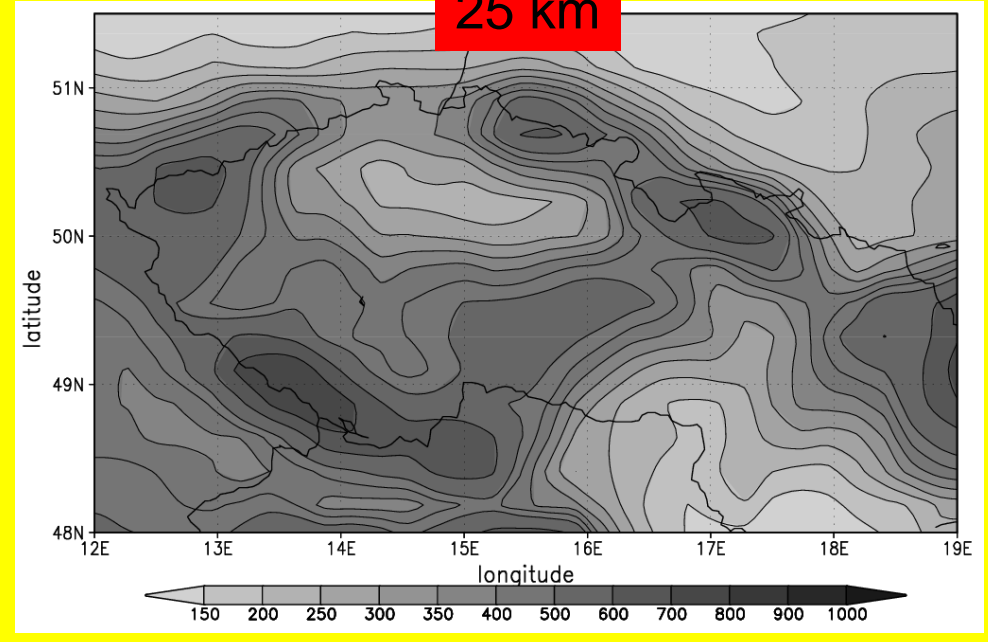


Why high-resolution RCM?

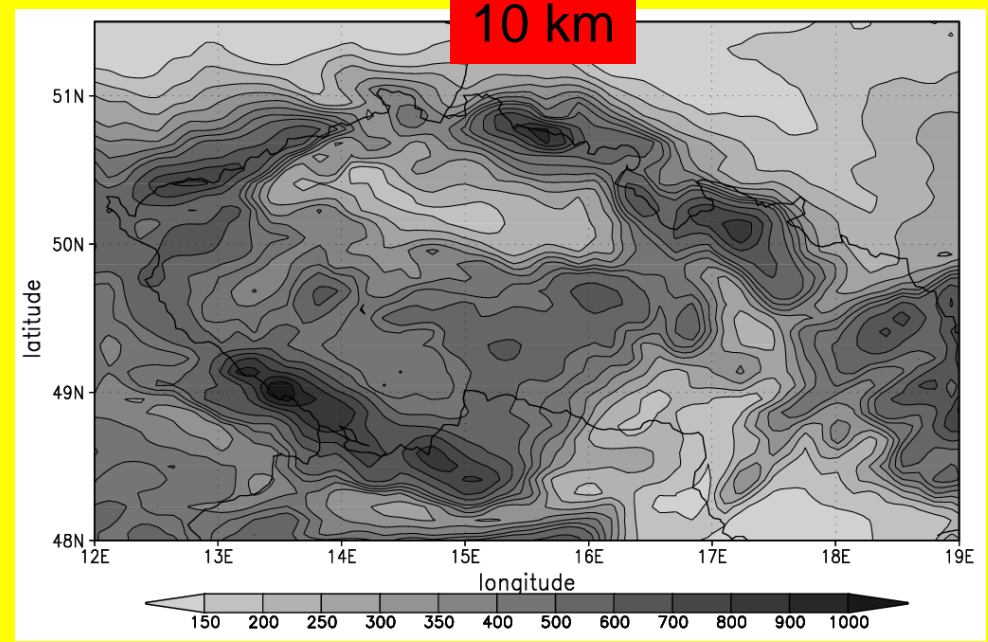
50 km



25 km



10 km



Why high-resolution RCM?

CECILIA Project



Central and Eastern Europe Climate Change
Impact and VulnerabiLity Assessment

Duration: 1 June 2006 - 31 December 2009

Number of partners: 16

Number of participating countries: 12

Coordinator: Charles University, Prague, T. Halenka



<http://www.cecilia-eu.org>



CECILIA - Central and Eastern Europe Climate Change Impact and VulnerabiLity Assessment

The primary objective of the project is to provide very high resolution climate change simulations for impact and vulnerability assessment in important human activity sectors and natural ecosystems

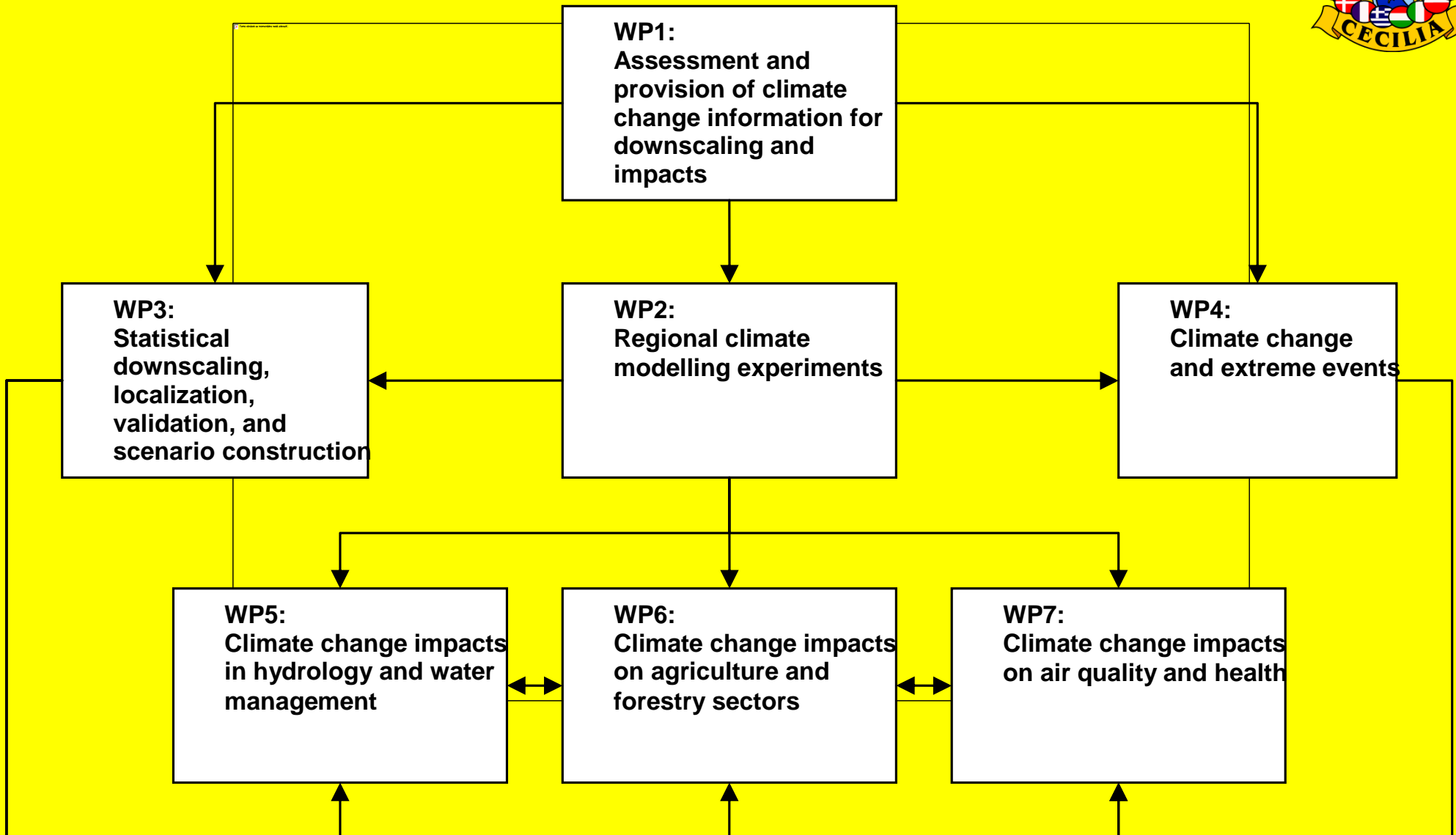
1.to integrate results from previous and ongoing modelling activities

2.to develop, adopt, adapt and use selected approaches to provide high resolution climate scenarios for impact assessment in sensitive activities and areas of CEE

- “Modelling the Impact of Climate Extremes (MICE)”
- “Statistical and regional dynamical downscaling of extremes for European regions (STARDEX)”.
- “Prediction of Regional scenarios and Uncertainties for Defining European Climate change risks and Effects” (PRUDENCE)
- “ENSEMBLE-based Predictions of Climate Changes and their Impacts” (ENSEMBLES)
- “Quantifying the Climate Impact of Global and European Transport Systems” (QUANTIFY)
- COST 734 - Climate change impact in agriculture
- CLAVIER (STREP, EC FP6) – climate change impacts on agriculture, ecosystems, water management etc.



Interactions

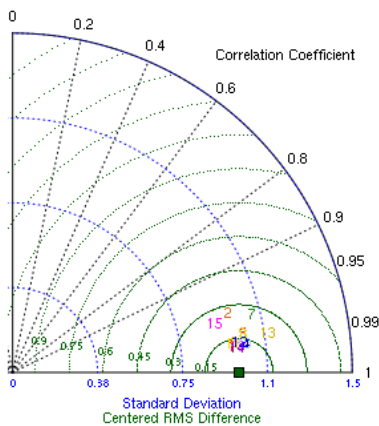


Climate change analysis for Central and Eastern Europe

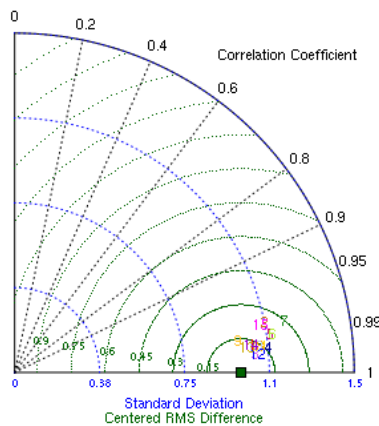


ENSEMBLES Temperature

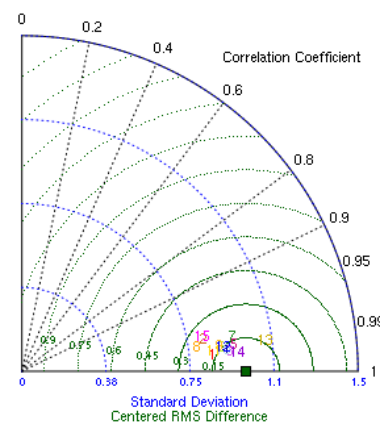
Temperature region BI



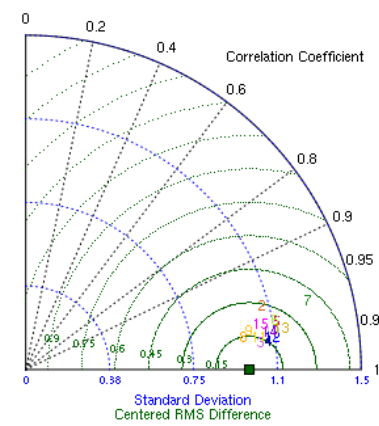
Temperature region IP



Temperature region SC

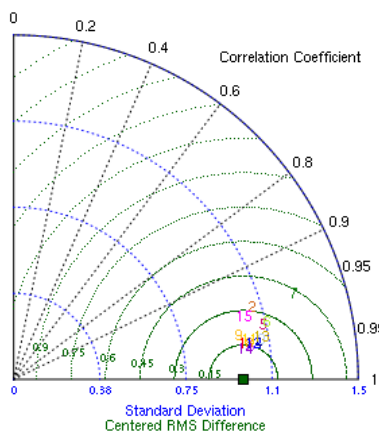


Temperature region AL

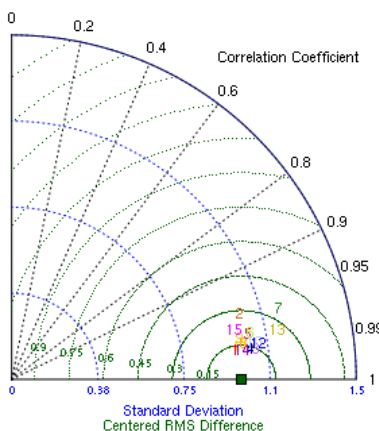


- 1 CCCI
- 2 CNRM
- 3 DMI
- 4 ETHZ
- 5 HCL
- 6 HCL_hi
- 7 HCL_lo
- 8 CHMI
- 9 ICTP
- 10 KNMI
- 11 METNO
- 12 MPI
- 13 OURANOS
- 14 SMHI
- 15 UCLM

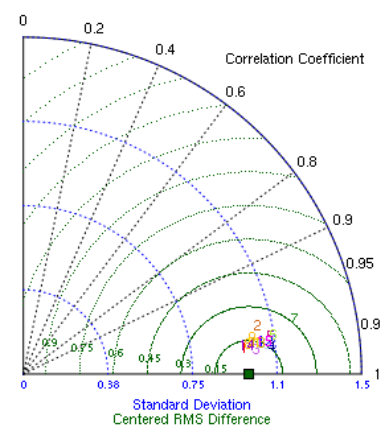
Temperature region FR



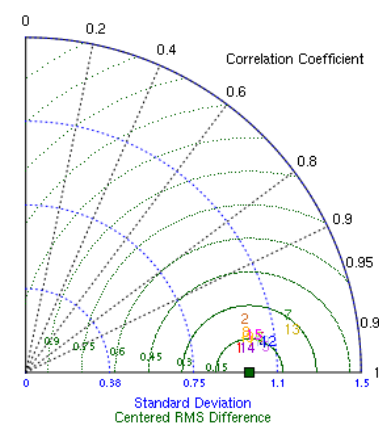
Temperature region ME



Temperature region MT

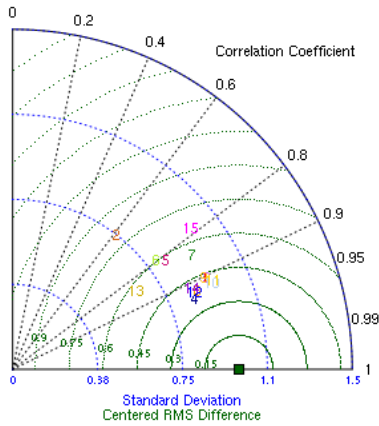


Temperature region EE

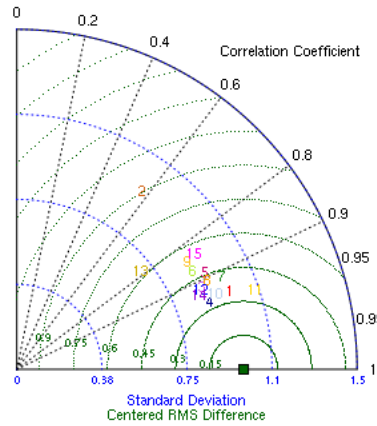


ENSEMBLES Precipitation

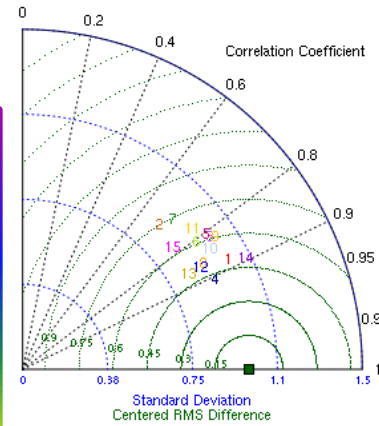
Precipitation region BI



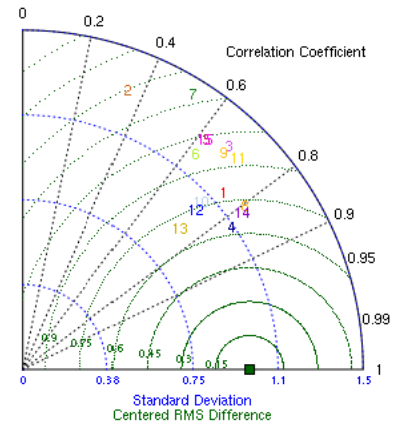
Precipitation region IP



Precipitation region SC

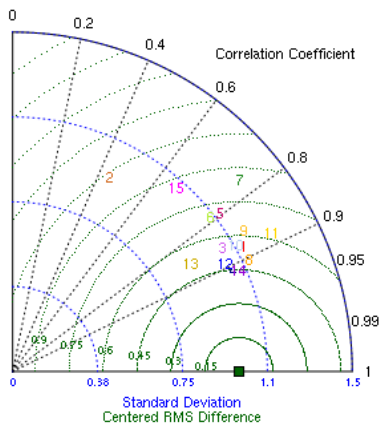


Precipitation region AL

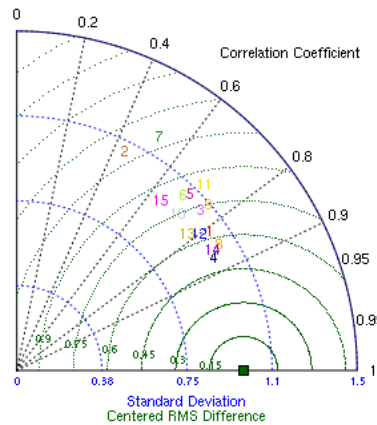


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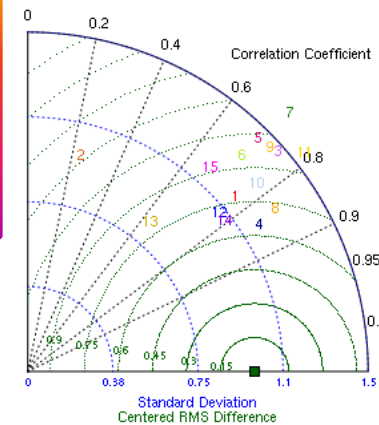
Precipitation region FR



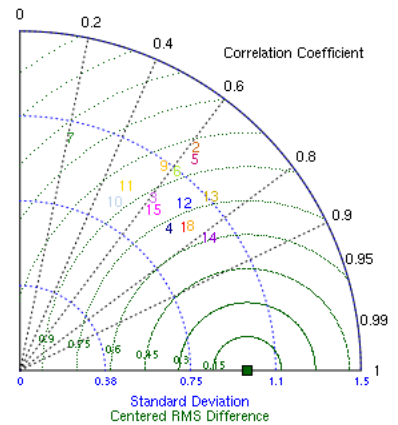
Precipitation region ME



Precipitation region MT

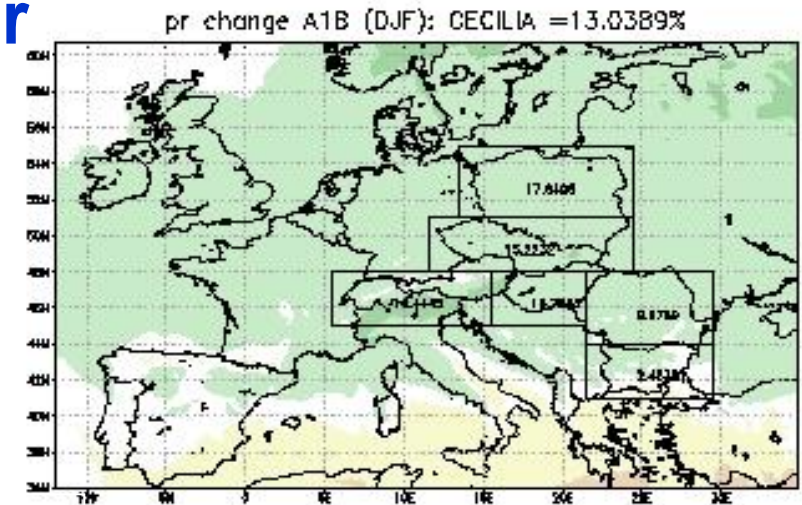
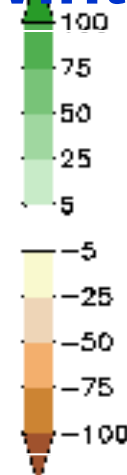
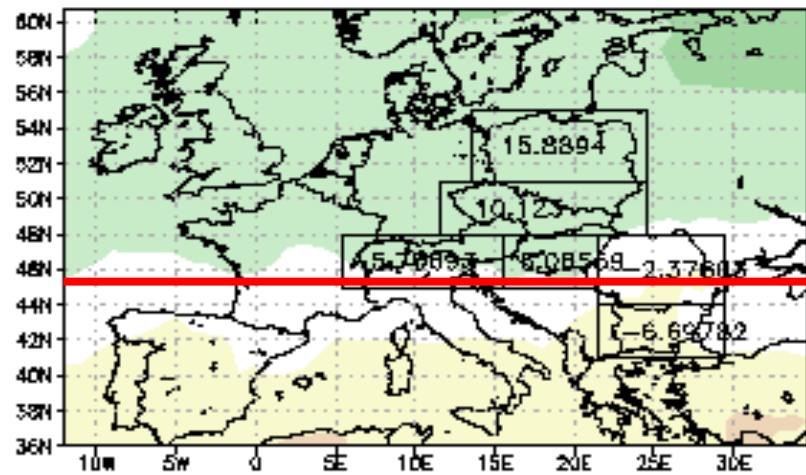


Precipitation region EE

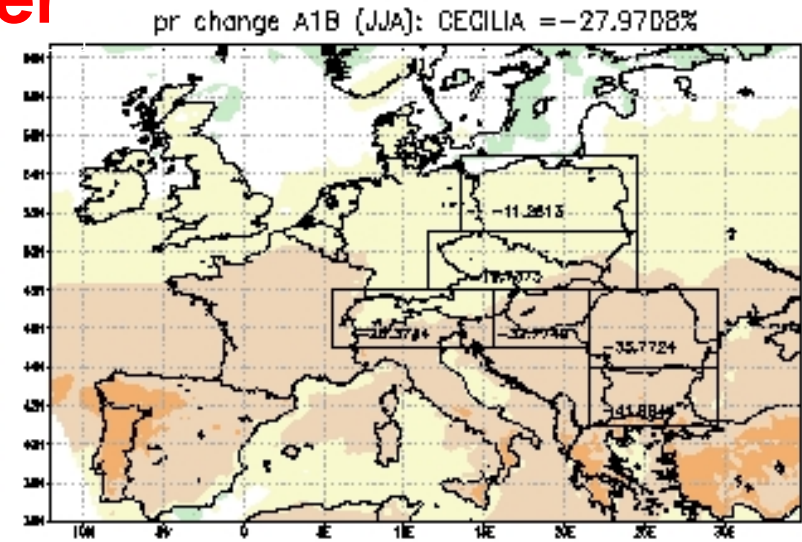
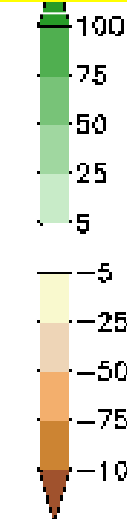
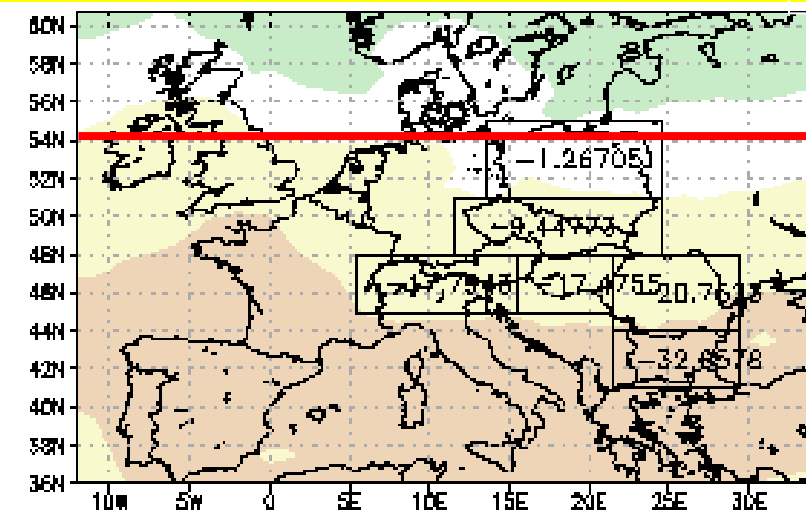


Precipitation change, 2071-2100

Winter



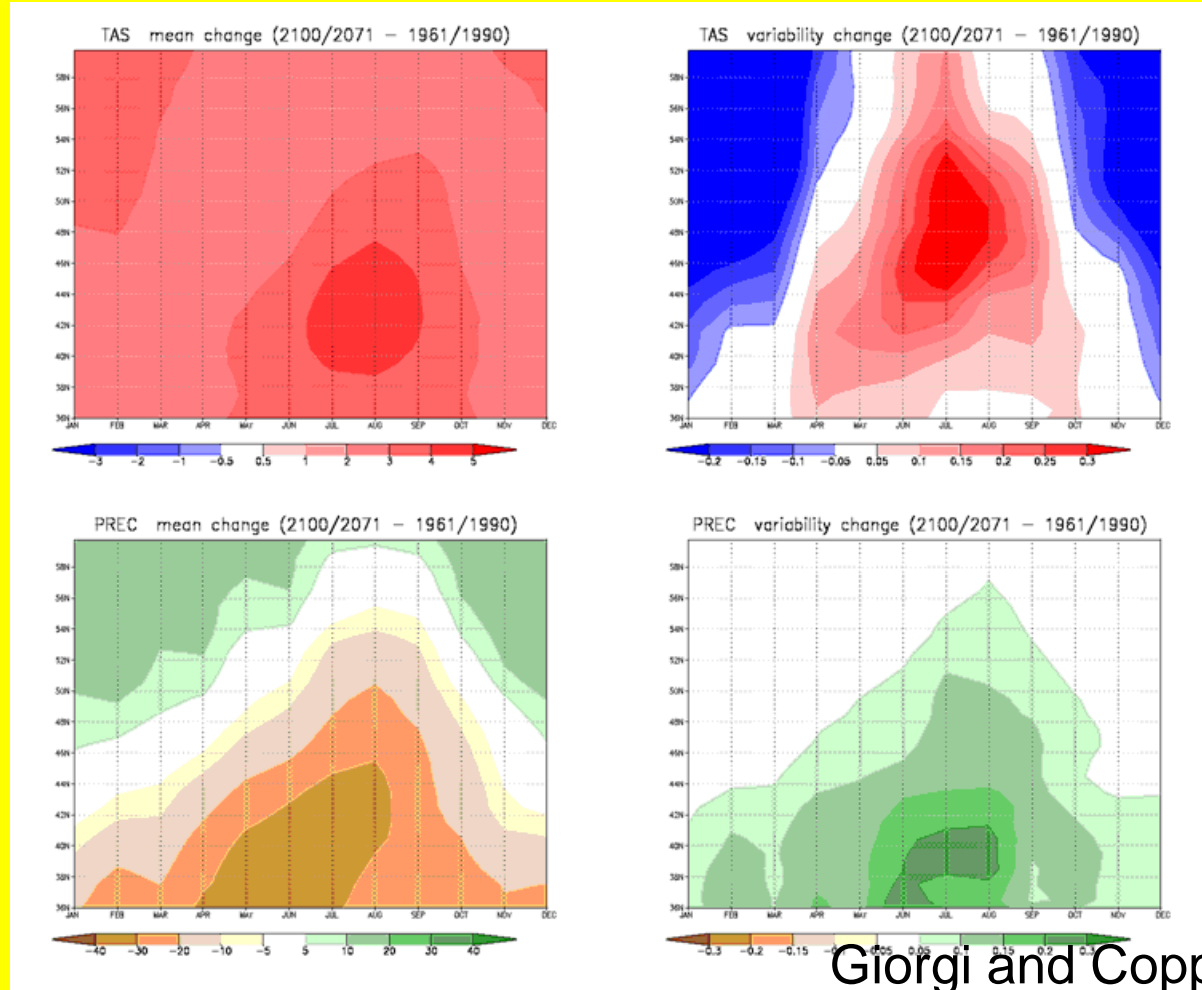
Summer



A1B Scenario, 20 GCMs IPCC AR4 (left), ENSEMBLES RCMs (right)

Giorgi and Coppola (GRL, 2007) – European Climate change Oscillation

European Climate change Oscillation (ECO)



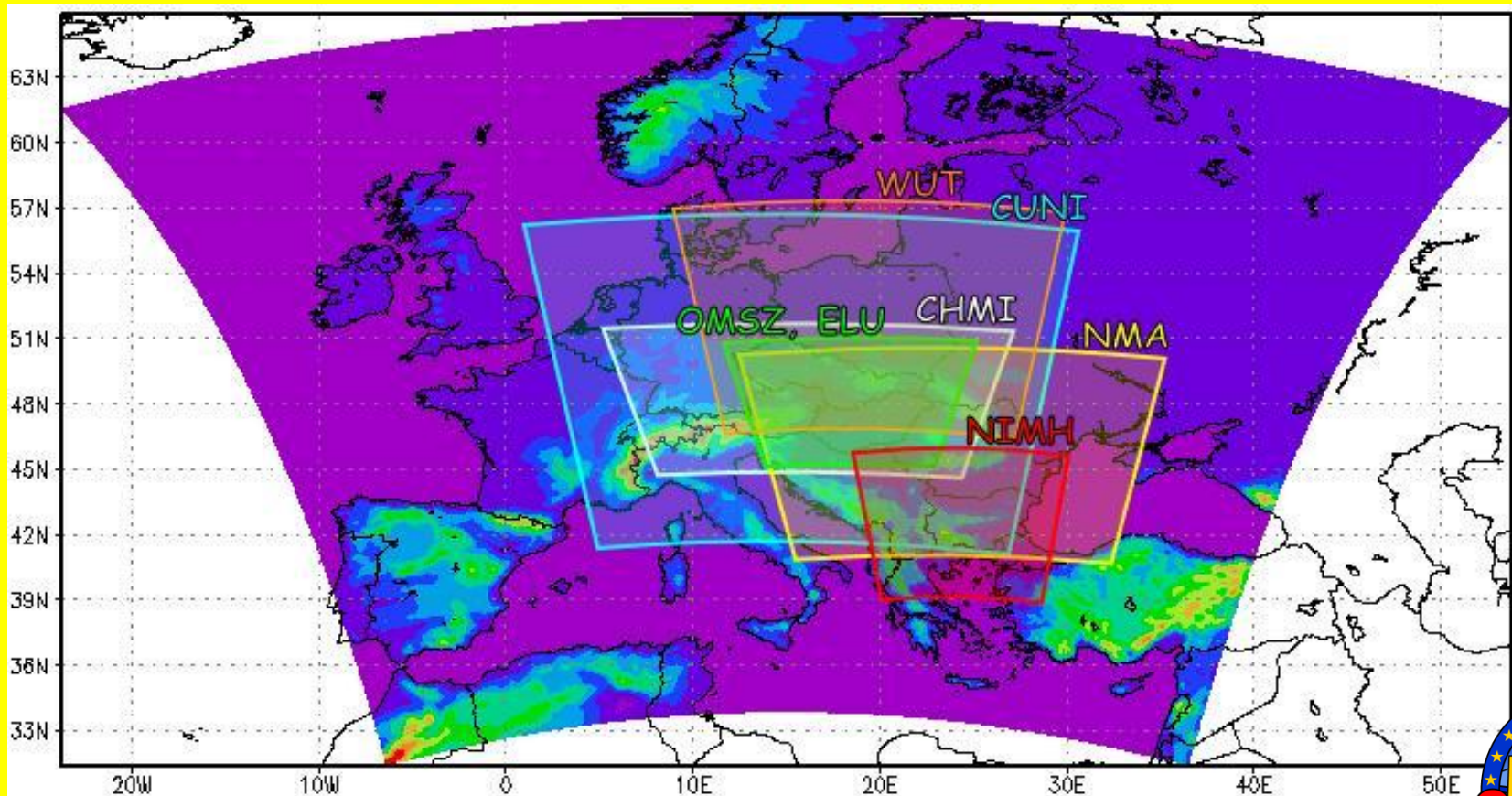
Giorgi and Coppola (GRL, 2007)

Monthly values of the zonally averaged changes in mean surface air temperature (top left panel), temperature interannual variability (as measured by the standard deviation, top right panel), mean precipitation (bottom left panel), precipitation interannual variability (as measured by the coefficient of variation) over Europe from the CMIP3 ensemble, A1B scenario, 2071-2100 minus 1961-1990. Units are degrees C for temperature and % of 1961-1990 values for mean precipitation (the coefficient of variation is unitless). The zonal average is taken over the region between 10 W and 25 E.

Regional climate modelling for CEE high-res scenarios



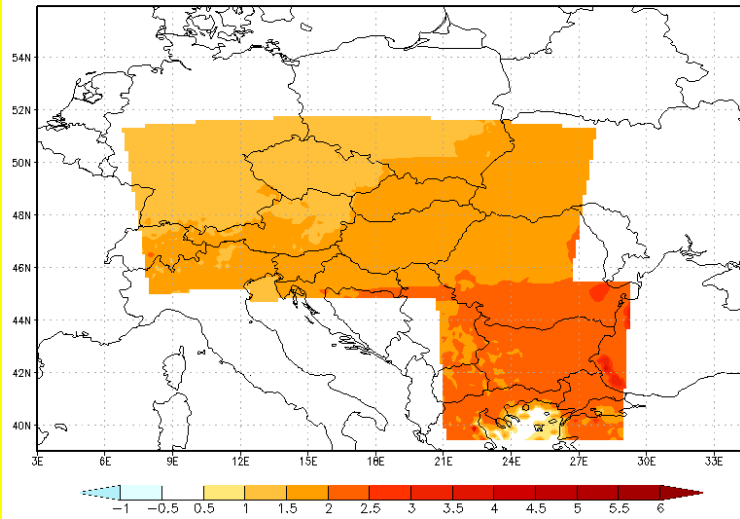
Simulation domains (10 km resolution)



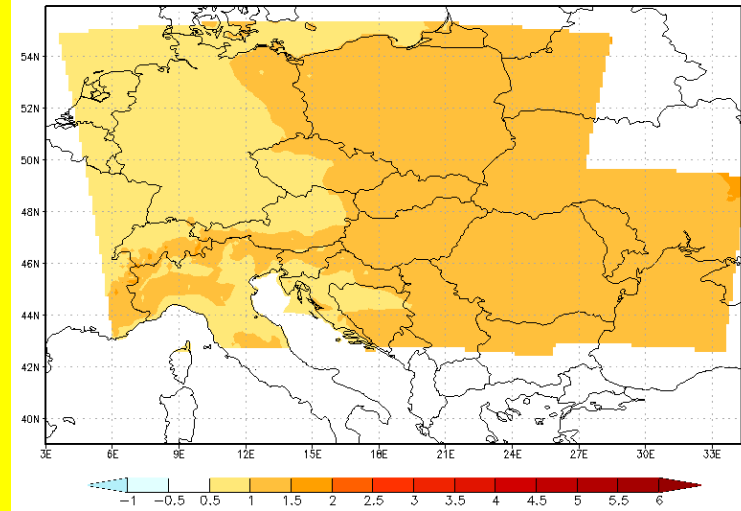
CECILIA simulations - temperature

2021-2050 vs. 1961-1990

Climate response aladin-ensemble_N



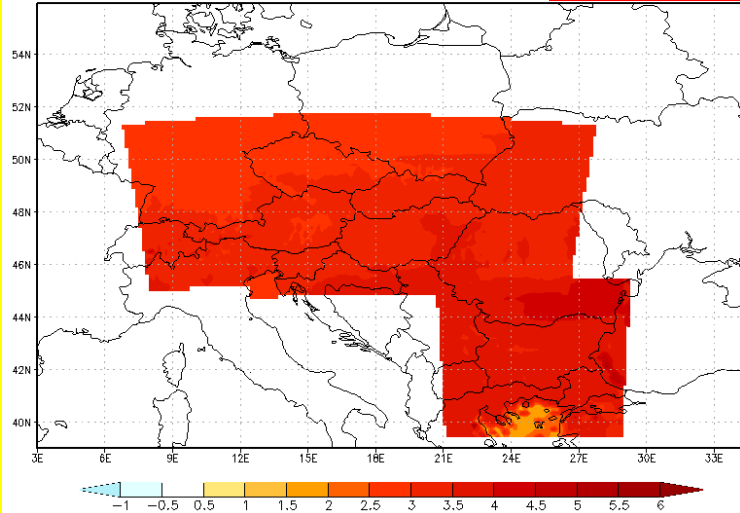
Climate response regcm-ensemble_NF tas all



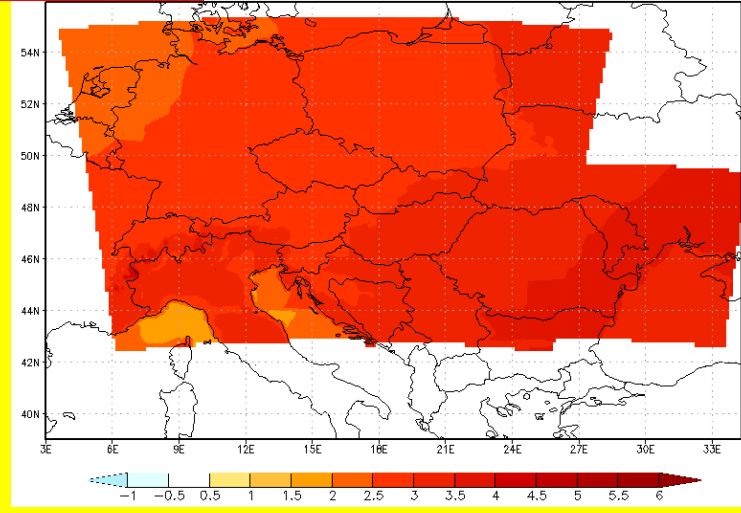
ALADIN

2071-2100 vs. 1961-1990

Climate response aladin-ensemble_FF



Climate response regcm-ensemble_FF tas all



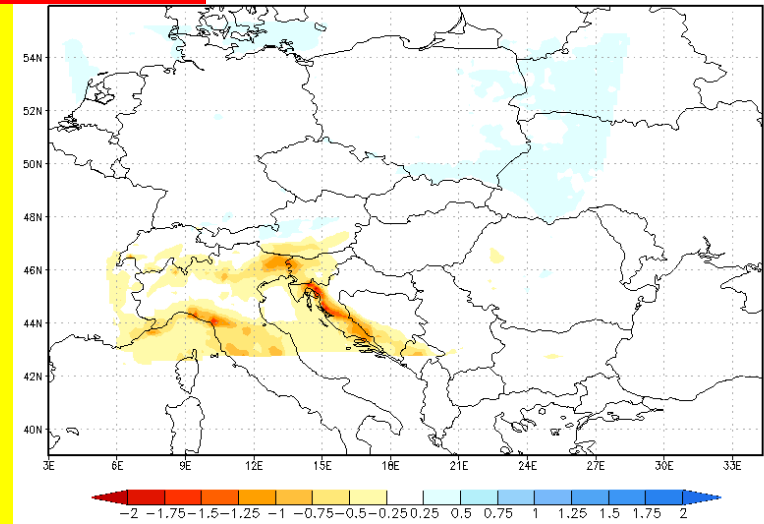
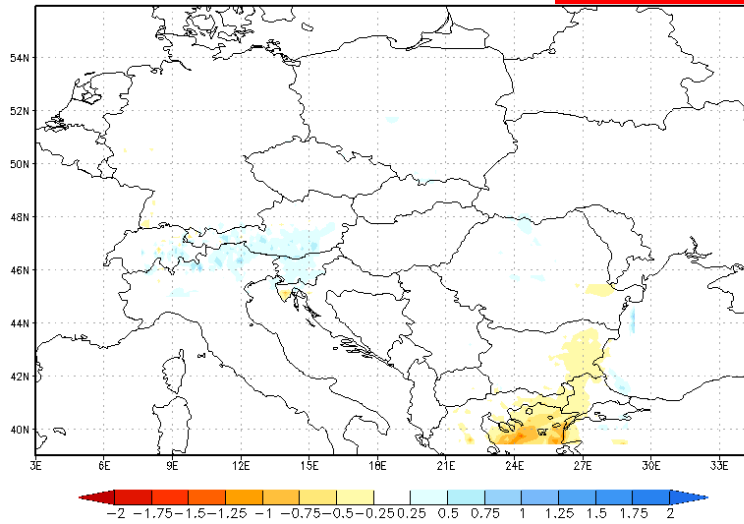
RegCM3

CECILIA simulations - precipitation

2021-2050 vs. 1961-1990

Climate response aladin-ensemble_N

Climate response regcm-ensemble_NF pr all



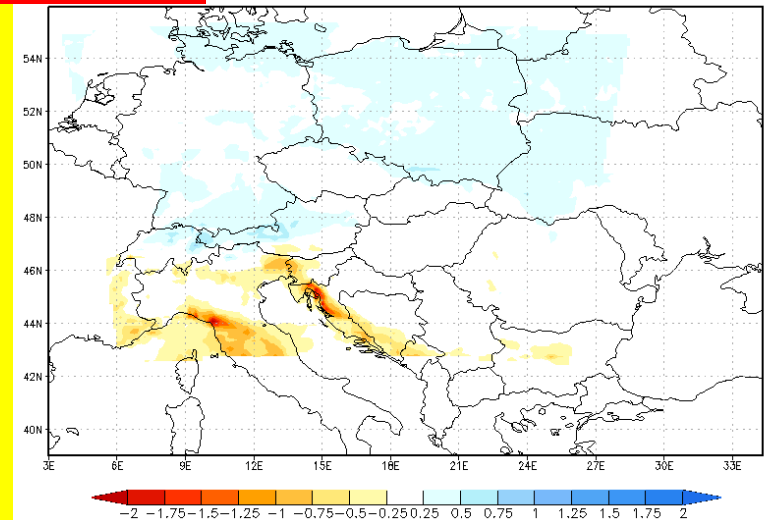
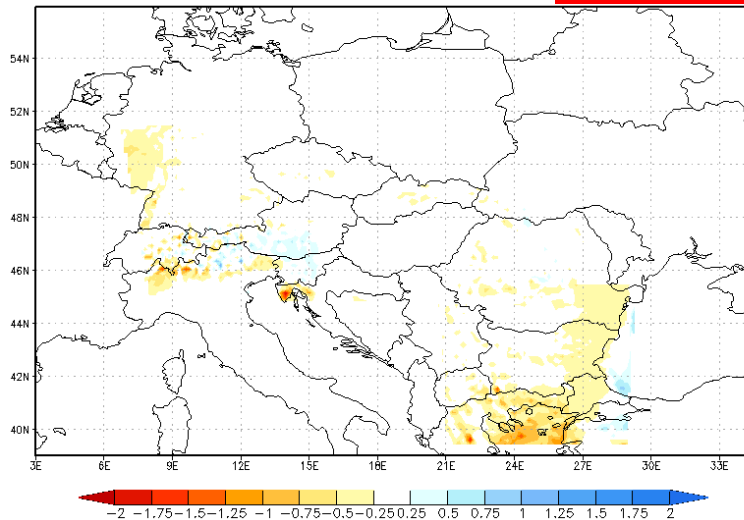
ALADIN

2071-2100 vs. 1961-1990

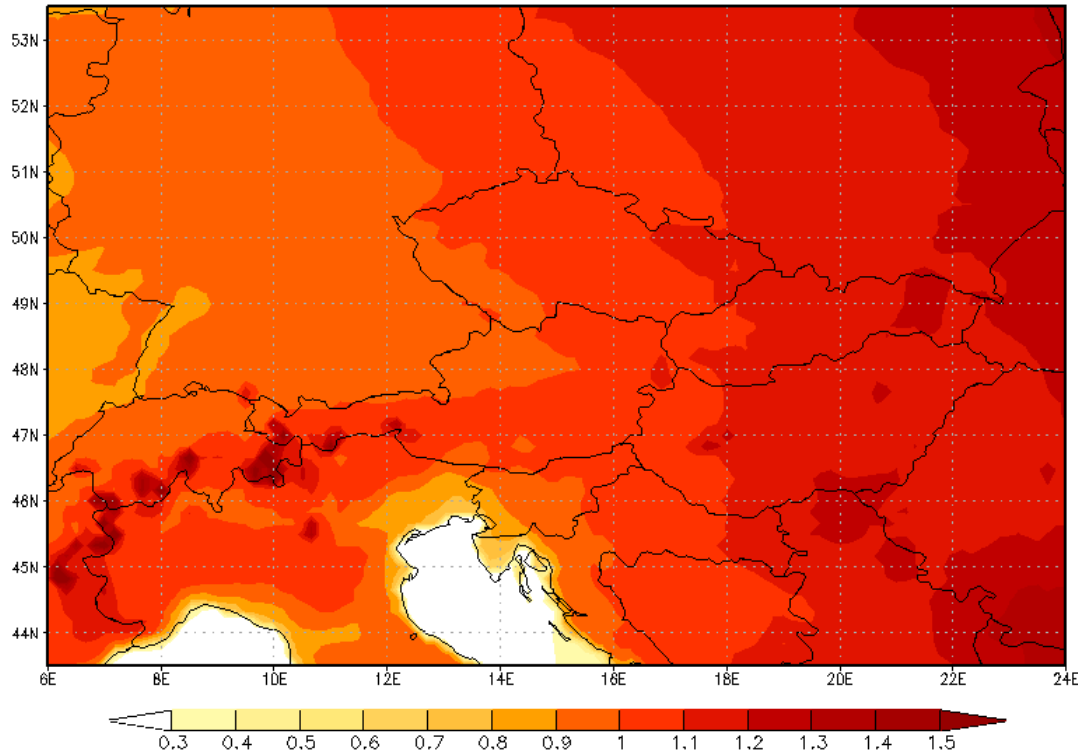
Climate response aladin-ensemble_F

Climate response regcm-ensemble_FF pr all

RegCM3

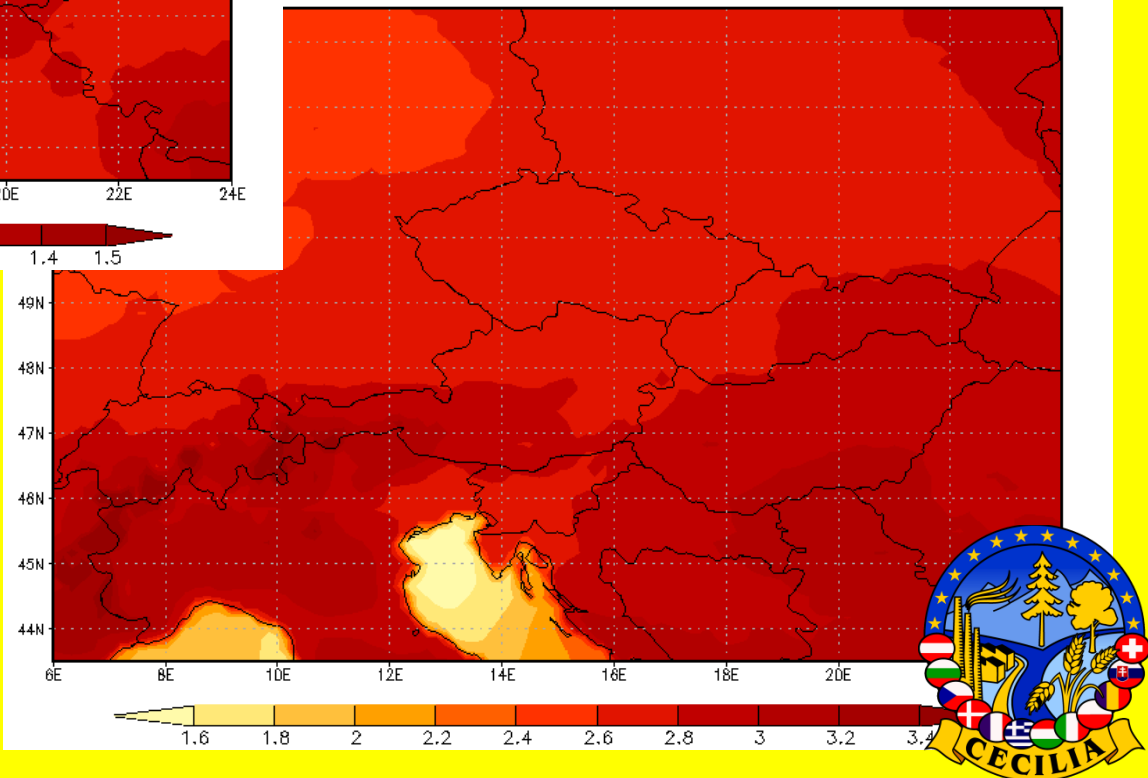


2021-2050 vs. 1961-1990



A1B scenario,
driven by ECHAM5
driven RegCM@25km,
temperature

2071-2100 vs. 1961-1990



A1B scenario temperature - seasons

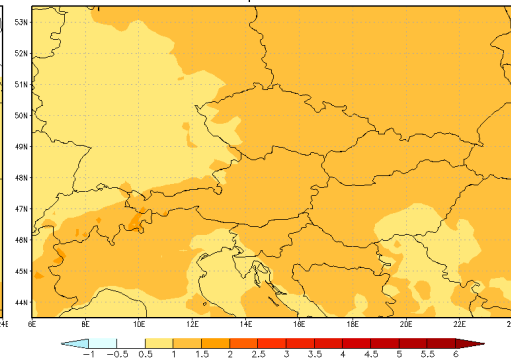
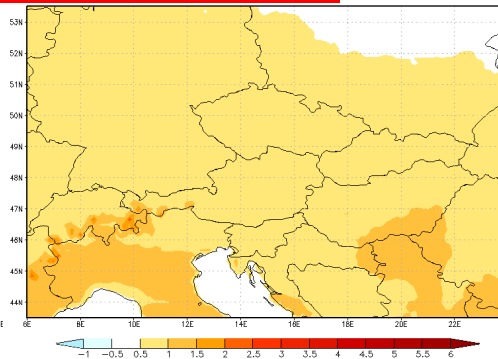
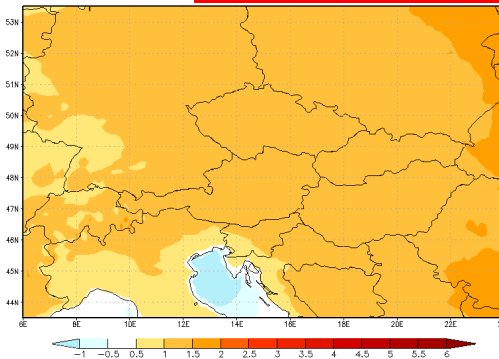
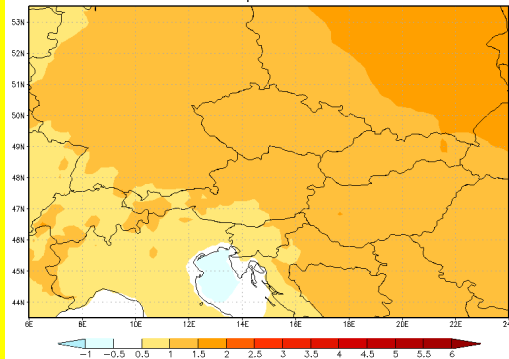
2021-2050 vs. 1961-1990

Climate response NF TA DJF

Climate response NF TA MAM

Climate response NF TA JJA

Climate response NF TA SON



DJF

MAM

JJA

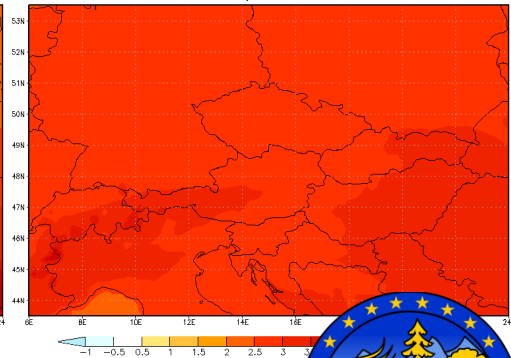
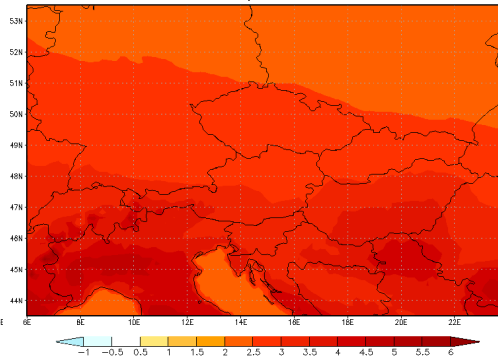
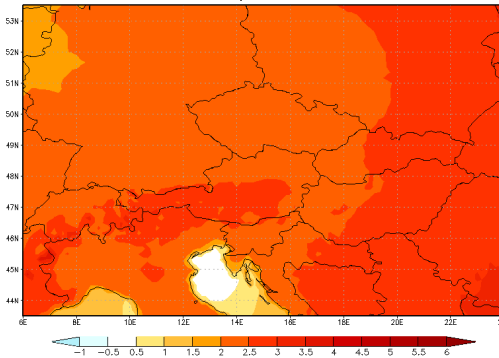
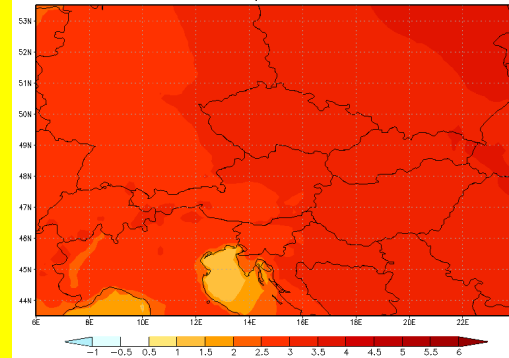
SON

Climate response FF TA DJF

Climate response FF TA MAM

Climate response FF TA JJA

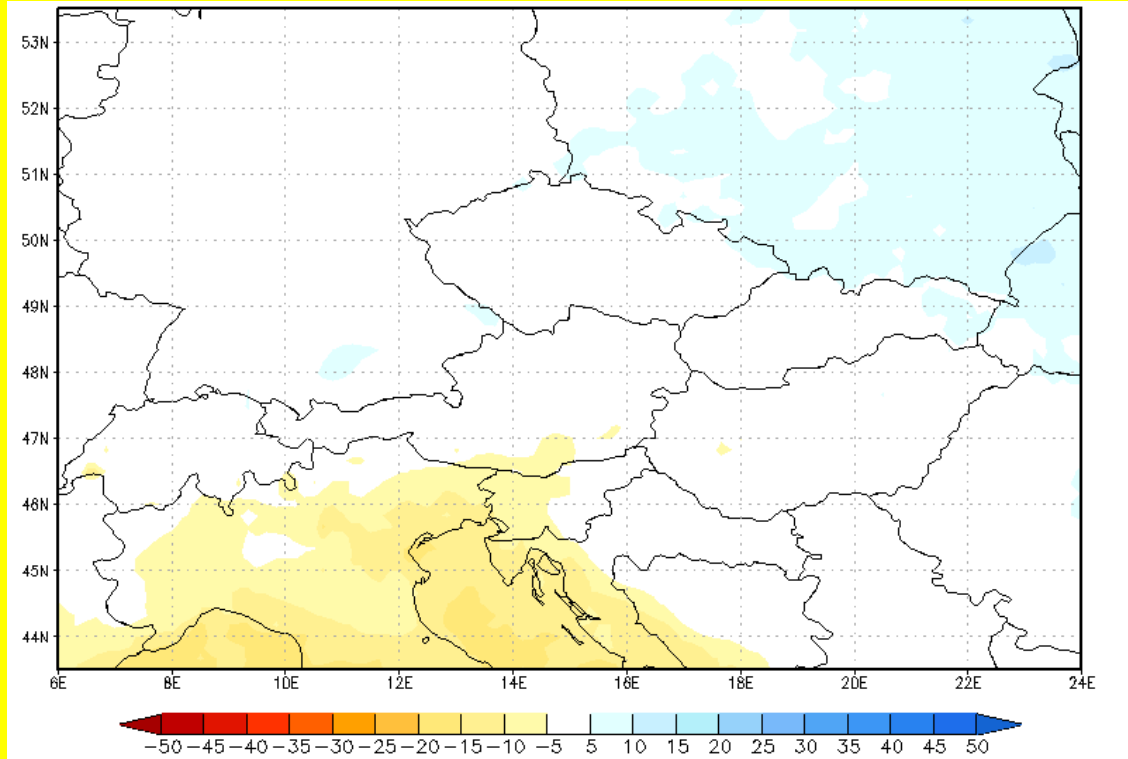
Climate response FF TA SON



2071-2100 vs. 1961-1990

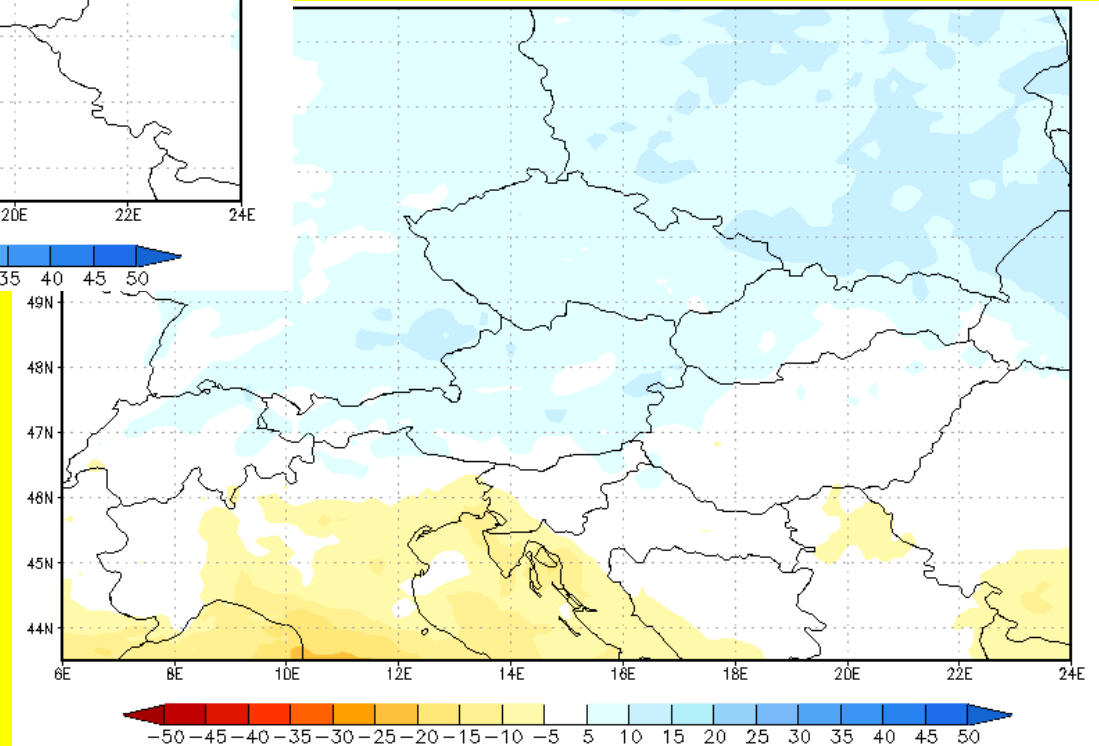


2021-2050 vs. 1961-1990



A1B scenario,
driven by ECHAM5
driven RegCM@25km,
temperature

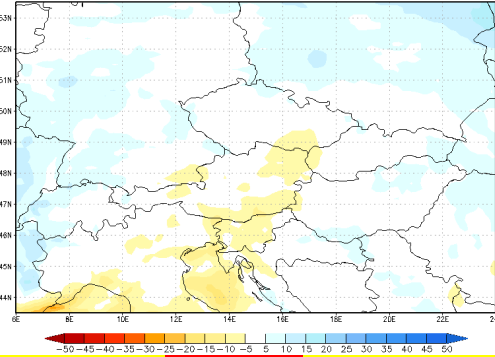
2071-2100 vs. 1961-1990



A1B scenario precipitation - seasons

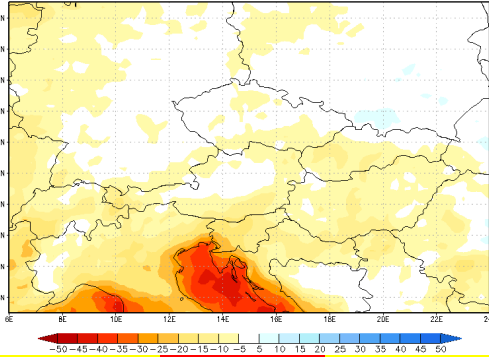
2021-2050 vs. 1961-1990

Climate response NF RT DJF



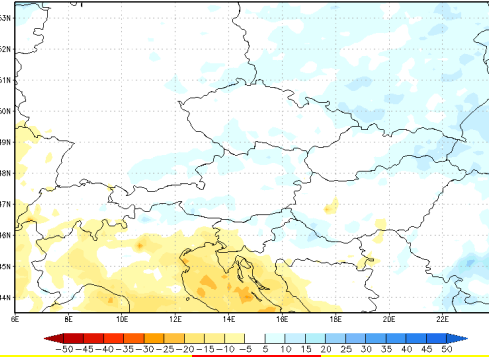
DJF

Climate response NF RT MAM



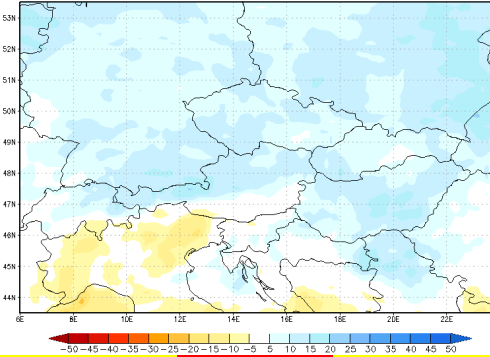
MAM

Climate response NF RT JJA



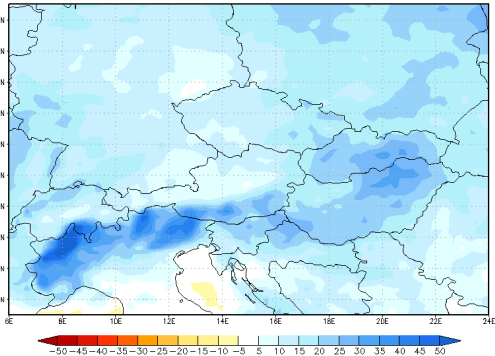
JJA

Climate response NF RT SON

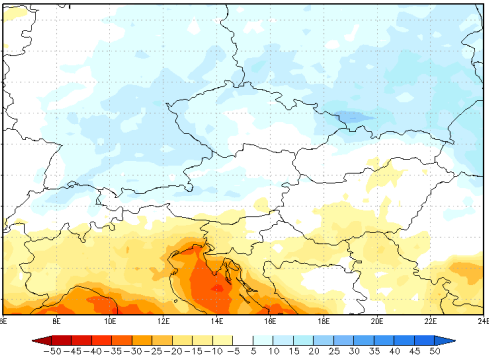


SON

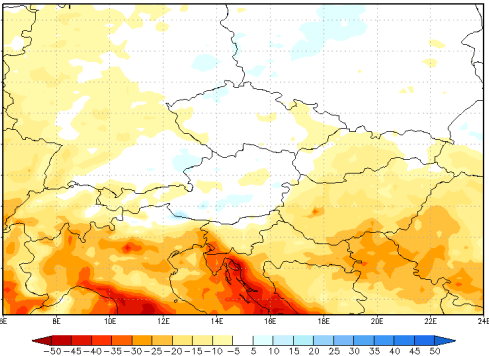
Climate response FF RT DJF



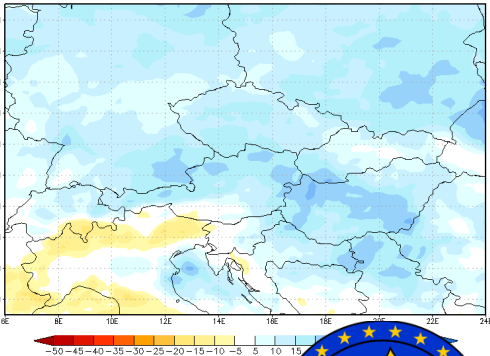
Climate response FF RT MAM



Climate response FF RT JJA



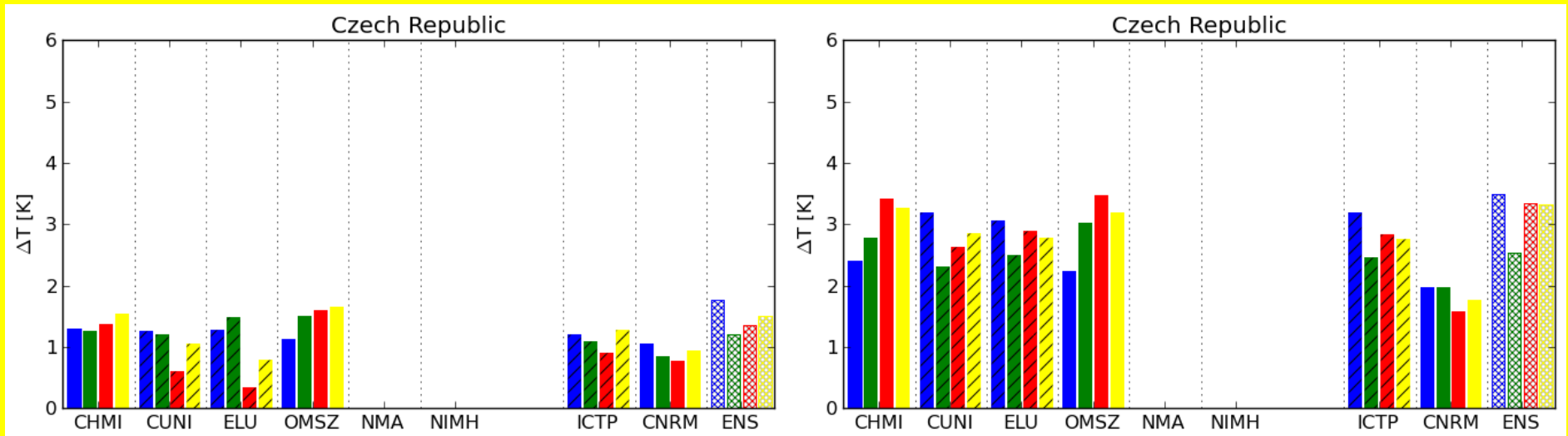
Climate response FF RT SON



2071-2100 vs. 1961-1990

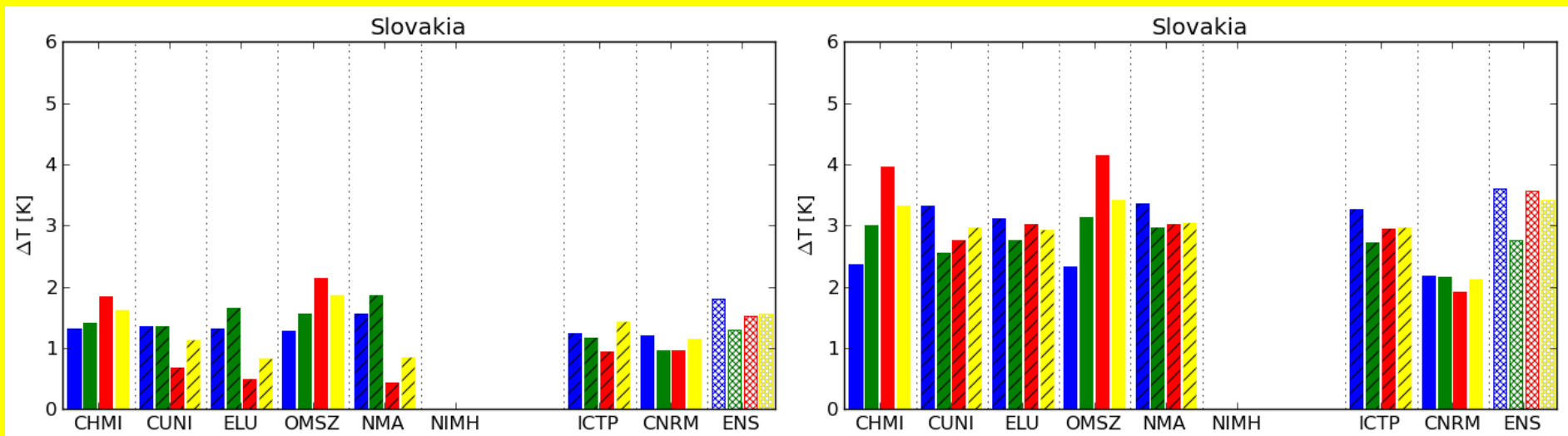


Climate Change Signal - TEMPERATURE

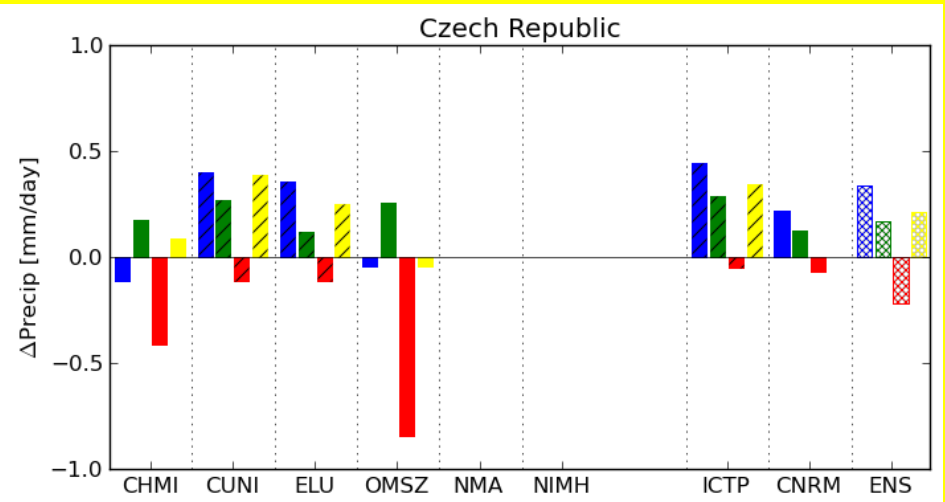
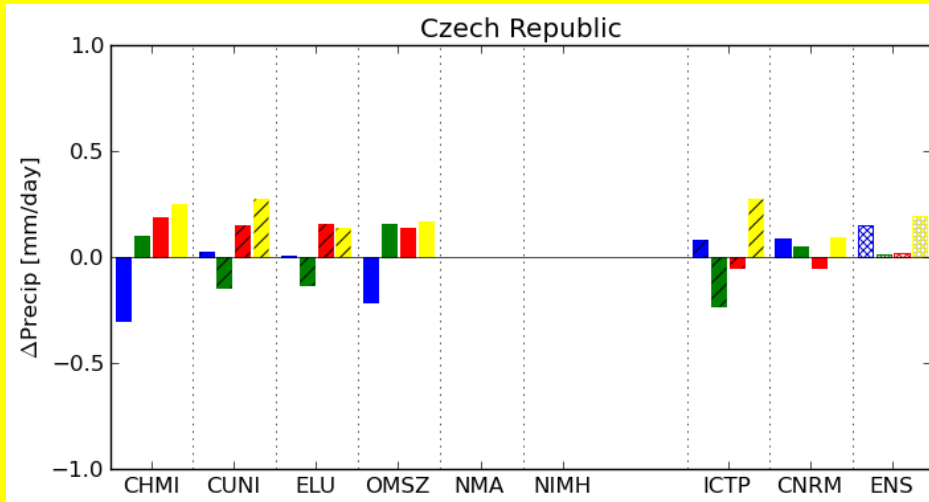


2021-2050 vs. 1961-1990

2071-2100 vs. 1961-1990

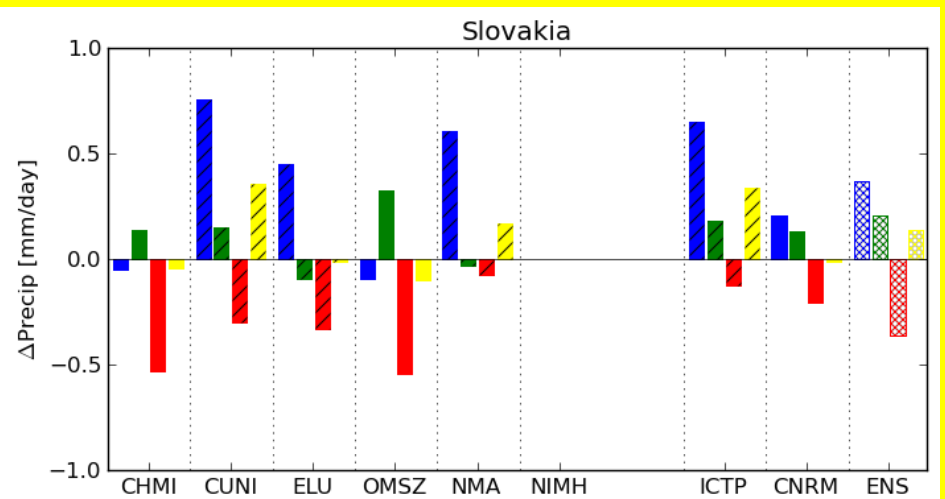
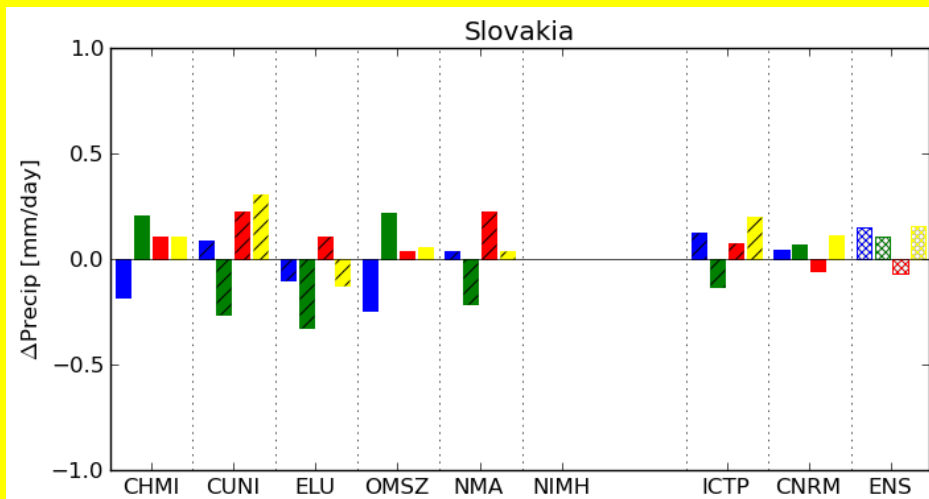


Climate Change Signal - PRECIPITATION



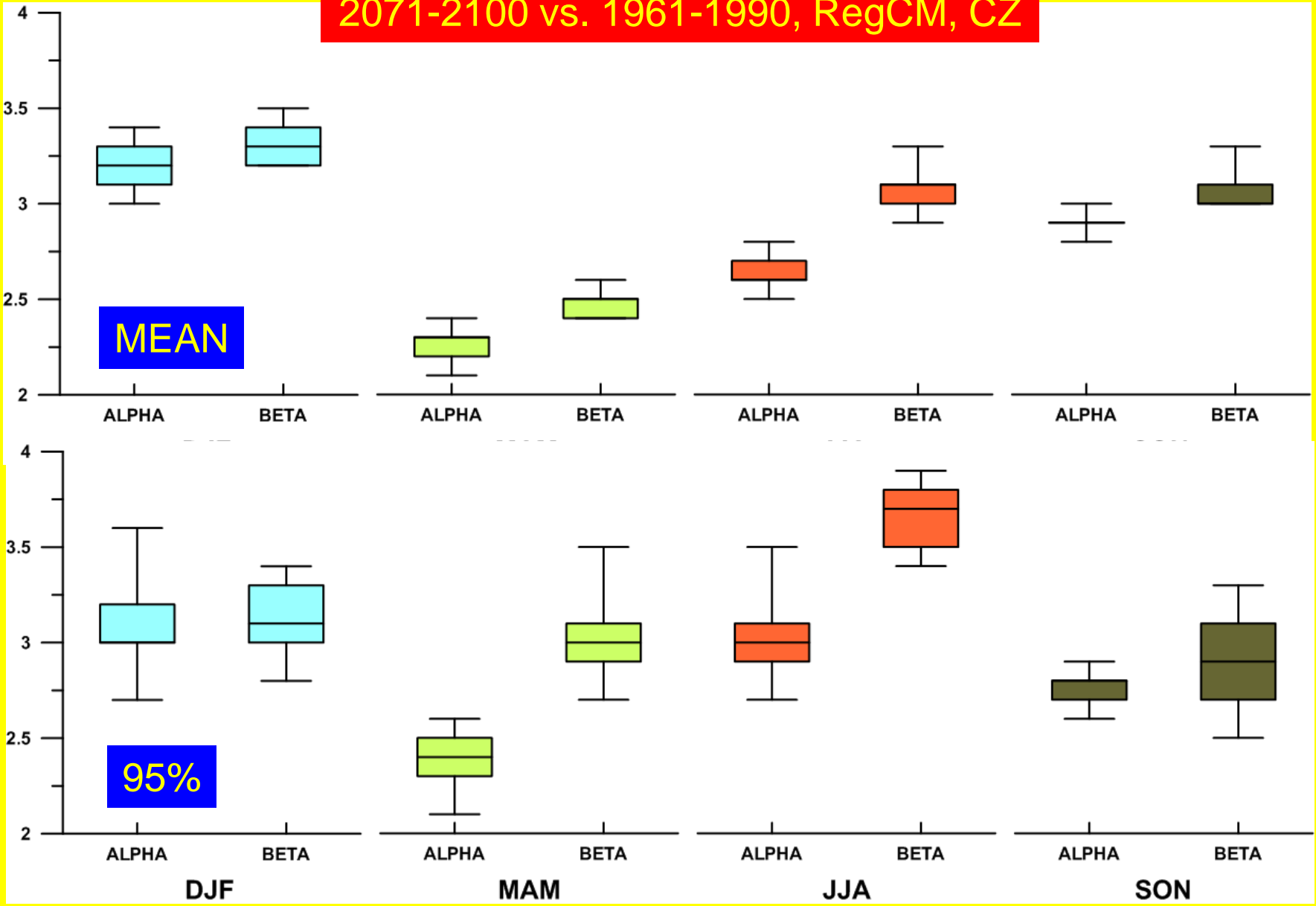
2021-2050 vs. 1961-1990

2071-2100 vs. 1961-1990



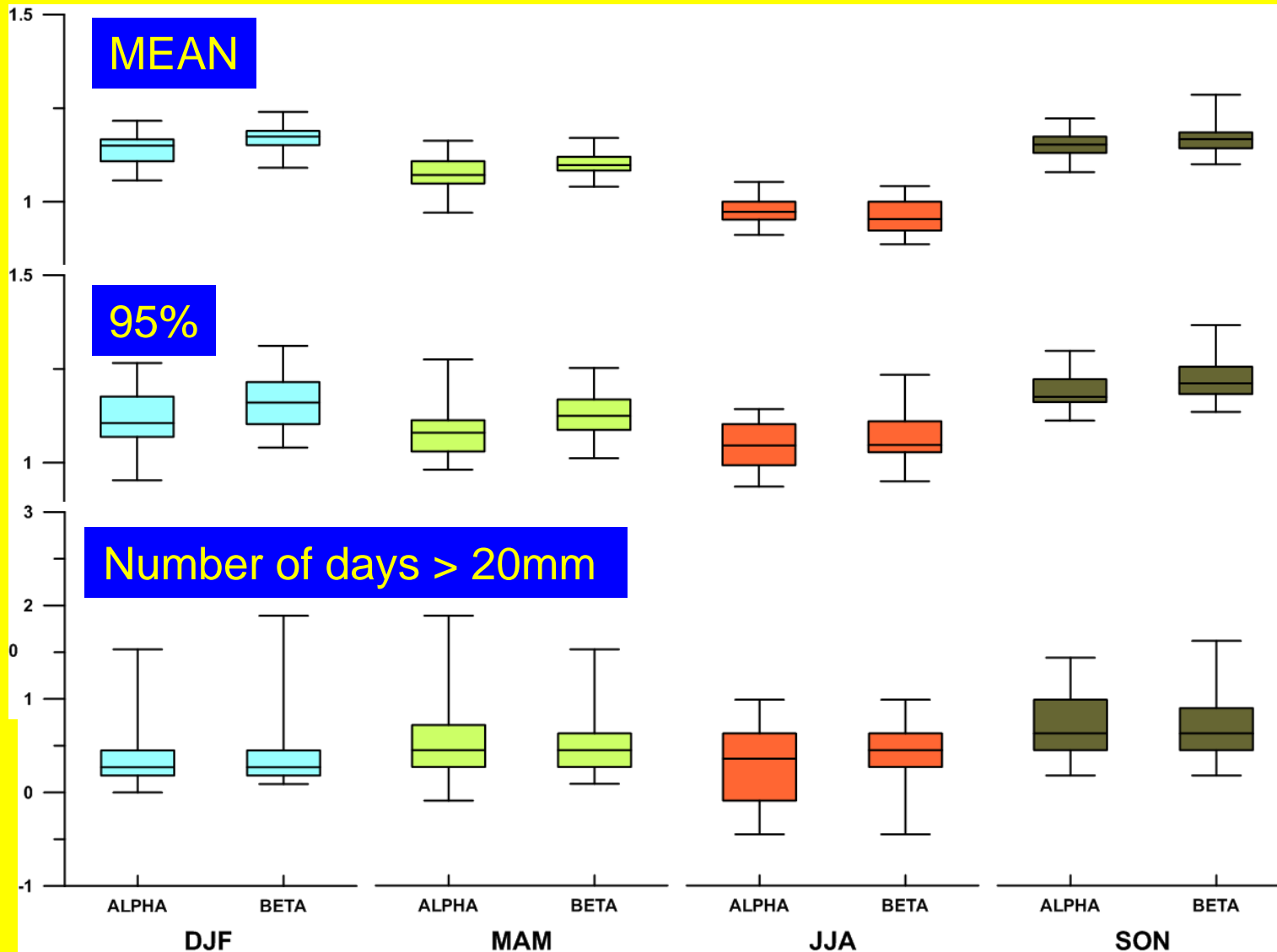
Climate Change Signal - TEMPERATURE

2071-2100 vs. 1961-1990, RegCM, CZ



Climate Change Signal - PRECIPITATION

2071-2100 vs. 1961-1990, RegCM, CZ



Conclusions

- increase of precision, but accuracy ????, eventhough some footprint of enhanced topography description
- 10km resolution is bringing benefits for further postprocessing
- 10km resolution **seems** to provide useful more detailed information for further application in impact studies
- however, due to biases still difficult to use direct climate outputs for impact studies
- further development of the models, introducing better parameterizations and more efficient schemes should move the high resolution RCMs closer to become useful tools in climate change impact assessment, diminishing the need for statistical postprocessing
- high-res RCM seems to be necessary for more detailed adaptation options



Acknowledgment

Thanks for your attention

<http://www.cecilia-eu.org>

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Supported in framework of COST734
Funded by COST supporting local MSMT grant
OC10061
Partial support provided under Research Plan
of MSMT, No. MSM 0021620860**