Project No. 037005

CECILIA

Central and Eastern Europe Climate Change Impact and Vulnerability Assessment

Specific targeted research project

1.1.6.3.I.3.2: Climate change impacts in central-eastern Europe

D2.6: analysis of scenarios, comparison with ENSEMBLES (2021-2050) and PRUDENCE (2071-2100) responses

Due date of deliverable: 31st December 2009
Actual submission date: 26th December 2009

Start date of project: 1st June 2006 Duration: 43 months

Lead contractor for this deliverable: CNRM

Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)		
Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Introduction

The CECILIA project has been launched two years after the ENSEMBLES project and the two projects will end at the same time in late 2009. In ENSEMBLES the regional models cover the whole Europe at 25 km resolution. In CECILIA, targetted areas over central-eastern Europe are simulated at 10 km resolution.

Two common aspects of the project will be illustrated here. The first one concerns model validation. It is based on simulations driven by ECMWF reanalyses ERA40. The second concerns model response to greenhouse gas increase. One of the two scenario time slices of CECILIA (2021-2050) is also covered by the ENSEMBLES simulation and will be compared as well. The second time-slice of CECILIA (2071-2100) corresponds to the target period of the FP5-PRUDENCE project, run at 50 km resolution. There are also a few ENSEMBLES models run till 2100, but they will not be examined here.

Validation

We compare here the available CECILIA and some ENSEMBLES simulations with CRU climatology. The validation is made with country averages for Czech Republic, Slovakia, Hungary, Romania and Bulgaria. The CECILIA models are:

- CHMI (Czech Republic, Slovakia and Hungary)
- CUNI (Czech Republic, Slovakia and Hungary)
- ELU (Czech Republic, Slovakia and Hungary)
- OMSZ (Slovakia and Hungary)
- NMA (Romania, Slovakia and Hungary)
- NIMH (Bulgaria)

Amongst the 12 ENSEMBLES regional models, we selected here The ENSEMBLES models retained here are:

- CHMI
- CNRM
- DMI
- ETHZ
- ICTP
- MPI

CHMI and CNRM are ALADIN models, as the CHMI, OMSZ and NIMH versions used in CECILIA. ICTP is a RegCM model, as the CUNI, ELU and NMA versions used in CECILIA. The other 4 models correspond to partners in the CECILIA project (or CLAVIER for MPI). The reason why we show here only one half of the ENSEMBLES results is to maintain some equilibrium with CECILIA. The comparisons are done for the four seasons of 1961-1990 averages, for temperature and precipitation.

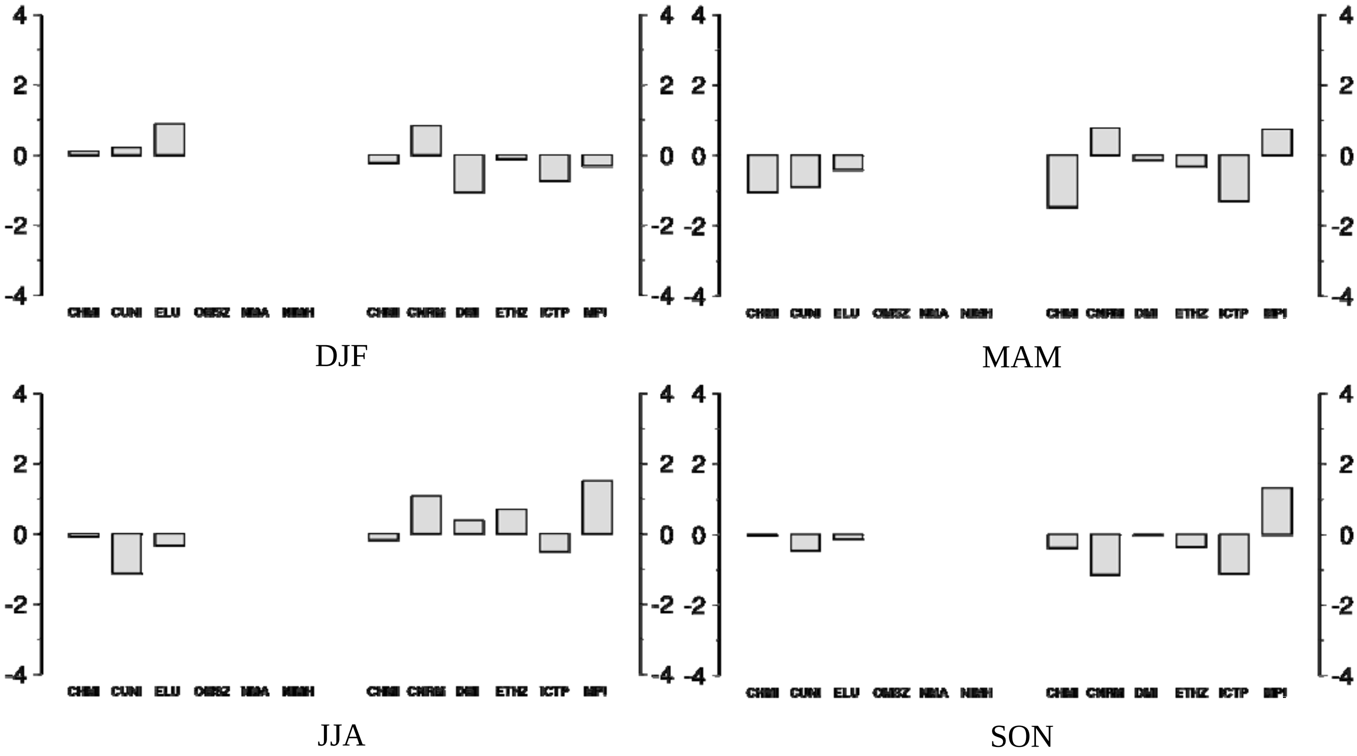

Figure 1: Systematic error for 2m temperature (°C) over Czech Republic: DJF (top left), MAM (top right), JJA (bottom left) and SON (bottom right).

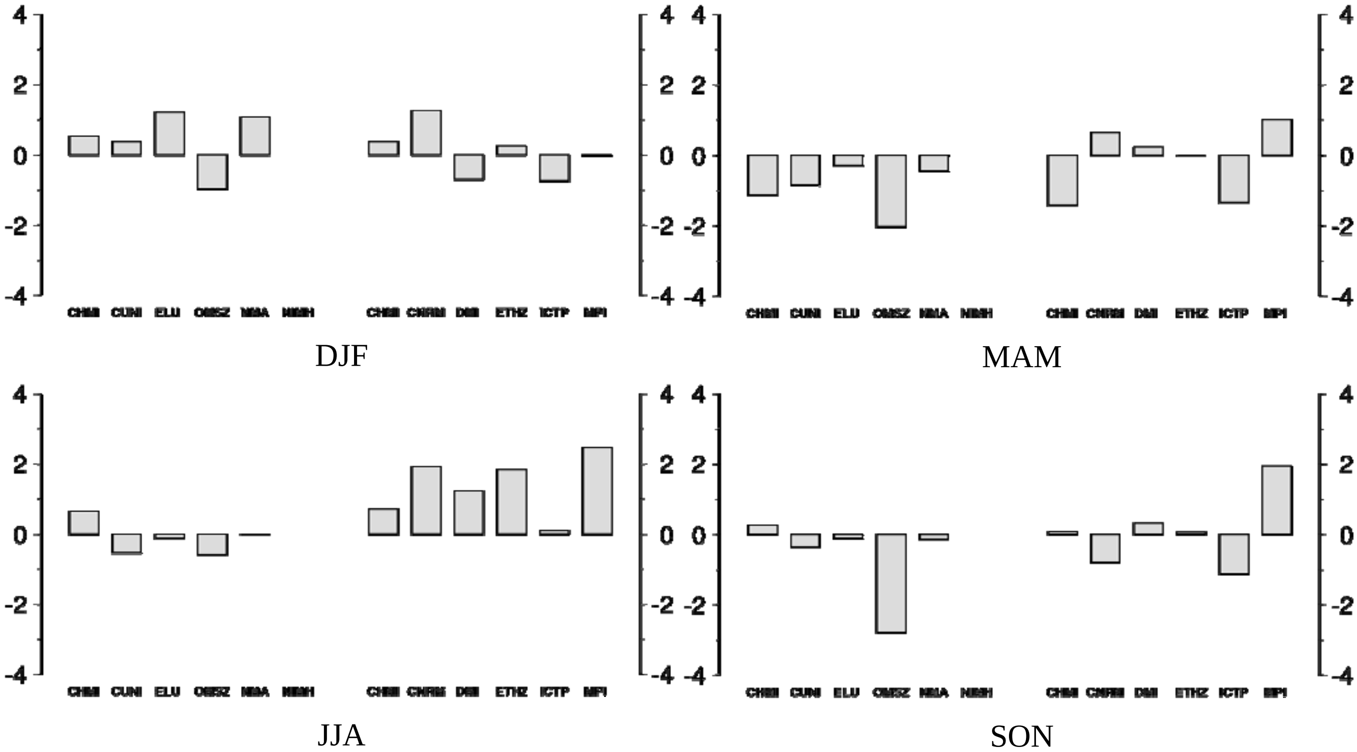

Figure 2: As Figure 1 for Slovakia.

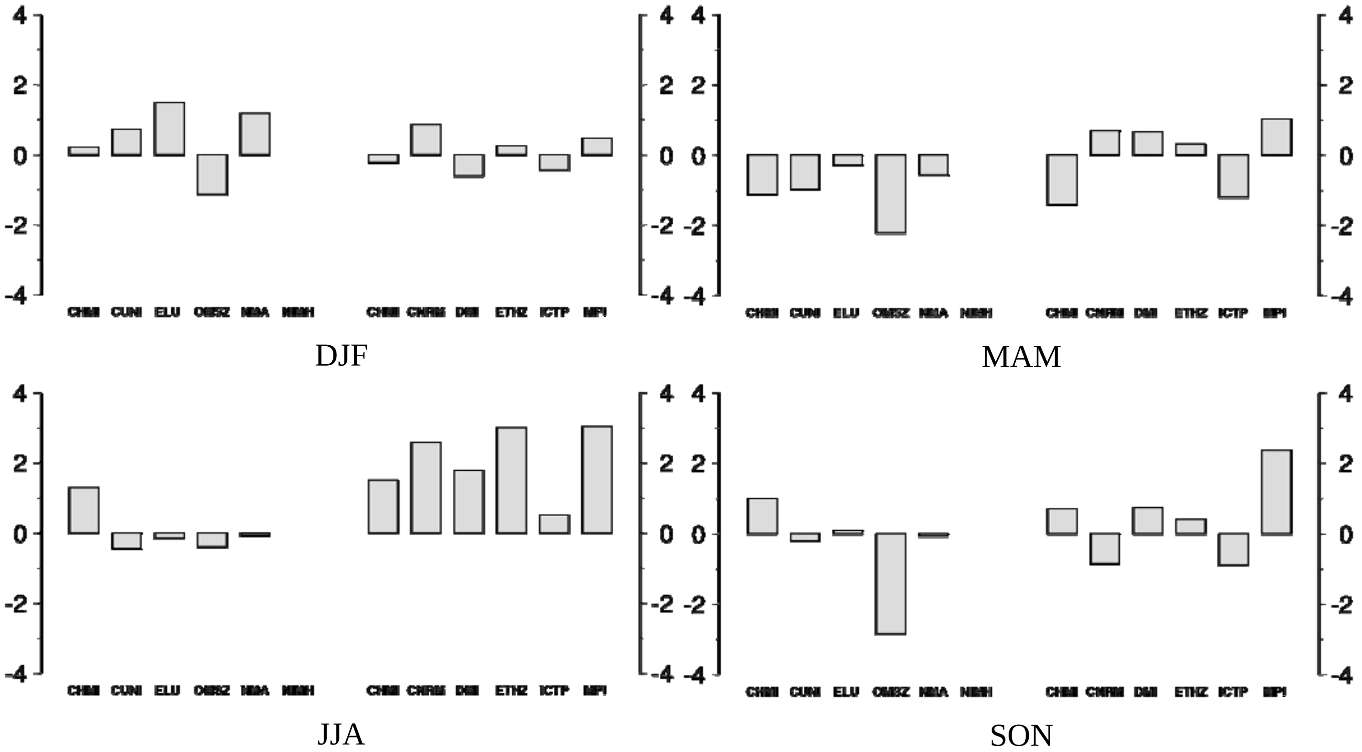

Figure 3: As Figure 1 for Hungary.

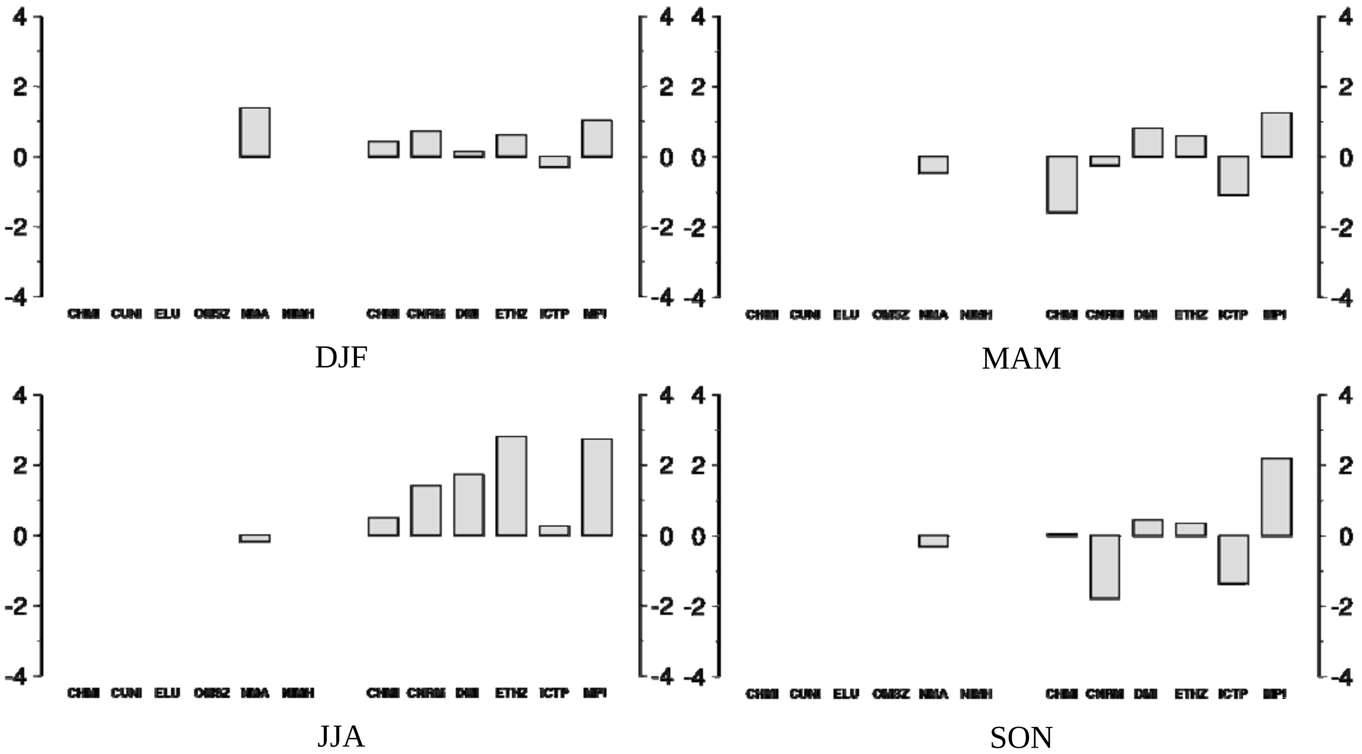

Figure 4: As Figure 1 for Romania.

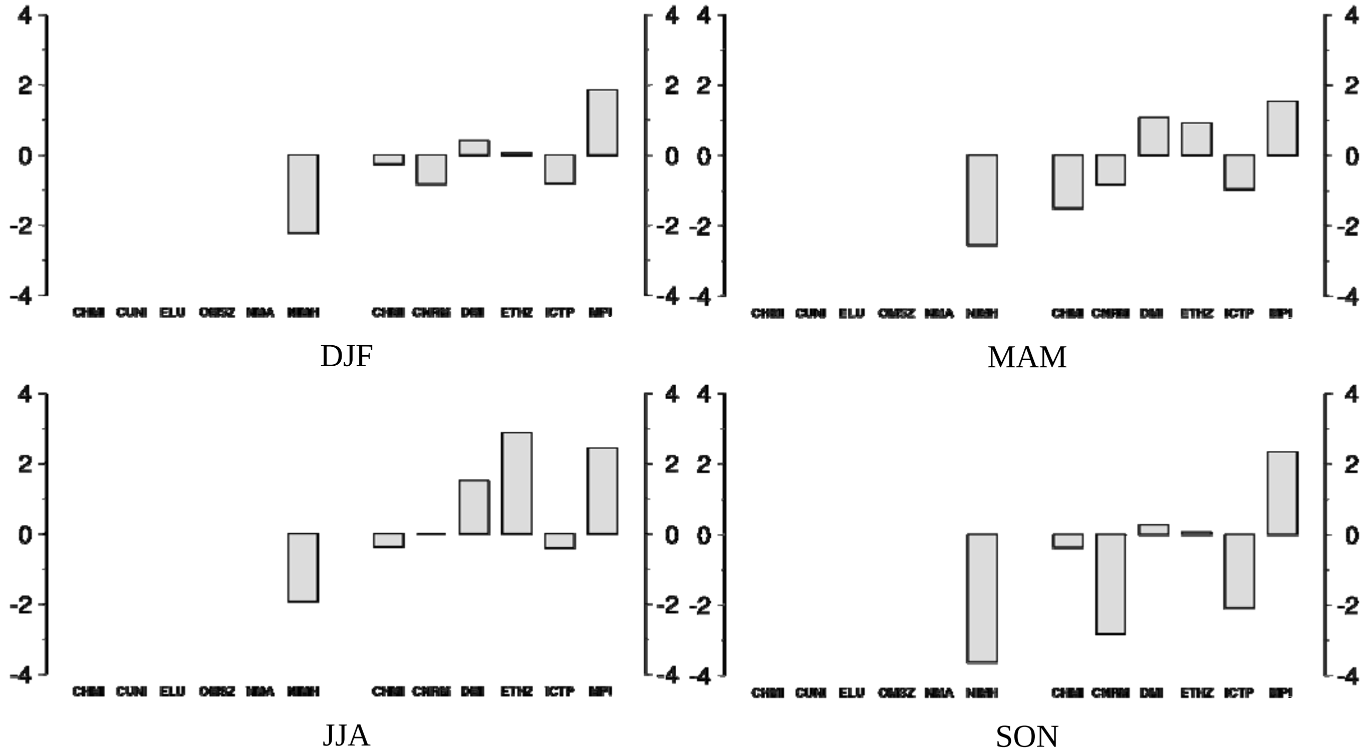

Figure 5: As Figure 1 for Bulgaria.

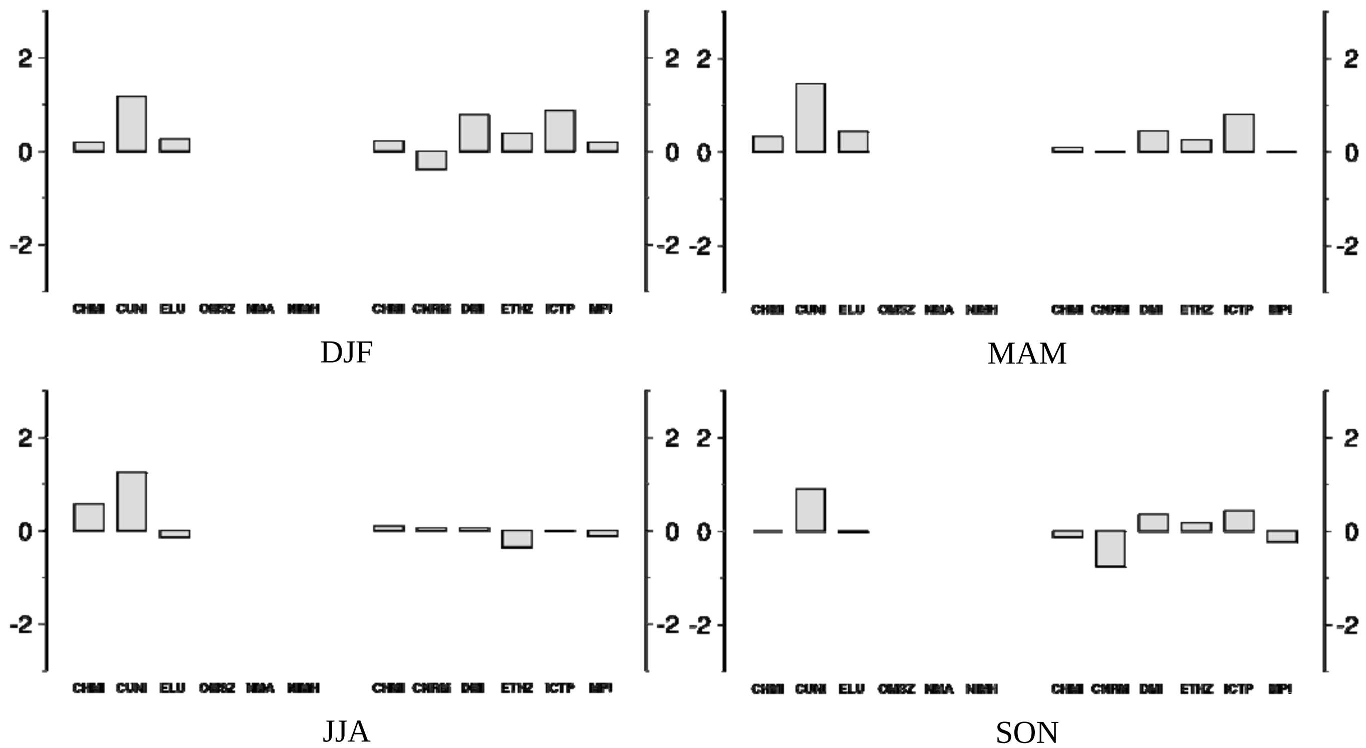

Figure 6: Systematic error for precipitation (mm/day) over Czech Republic: DJF (top left), MAM (top right), JJA (bottom left) and SON (bottom right).

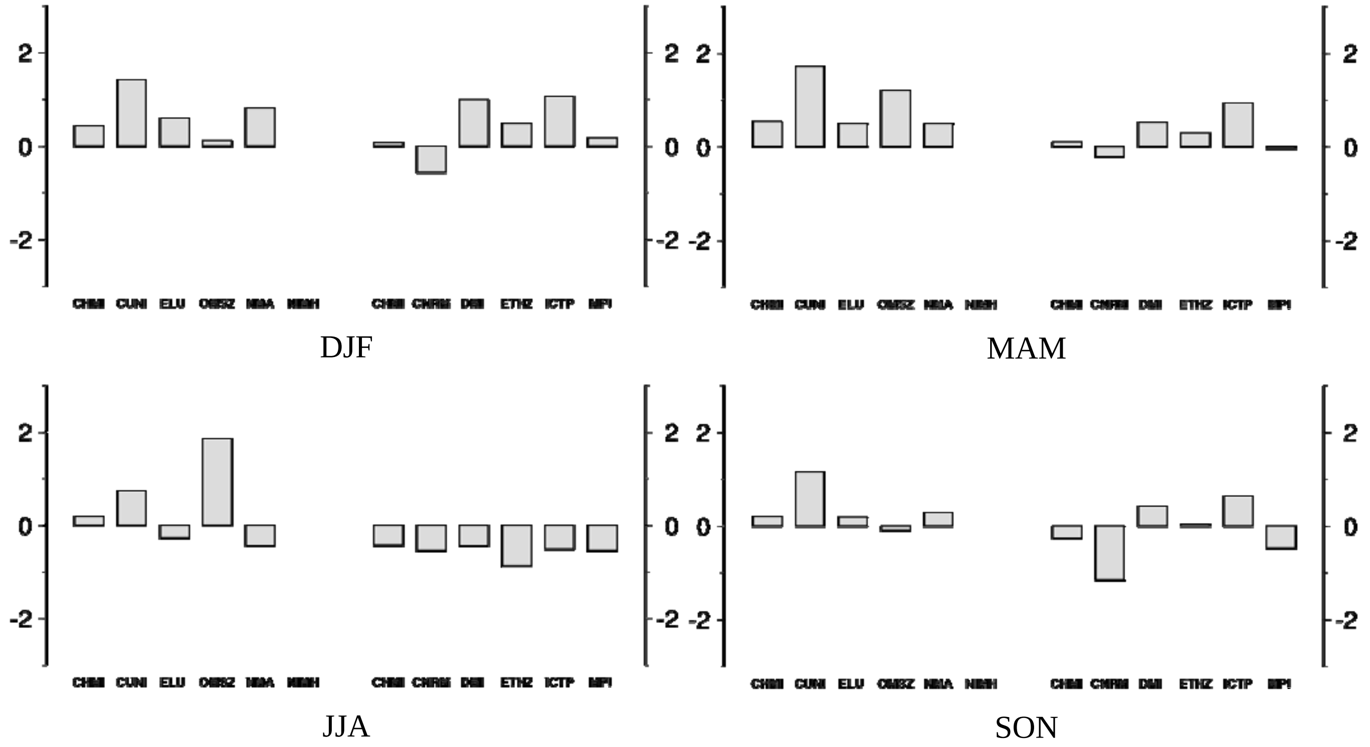

Figure 7: As Figure 6 for Slovakia.

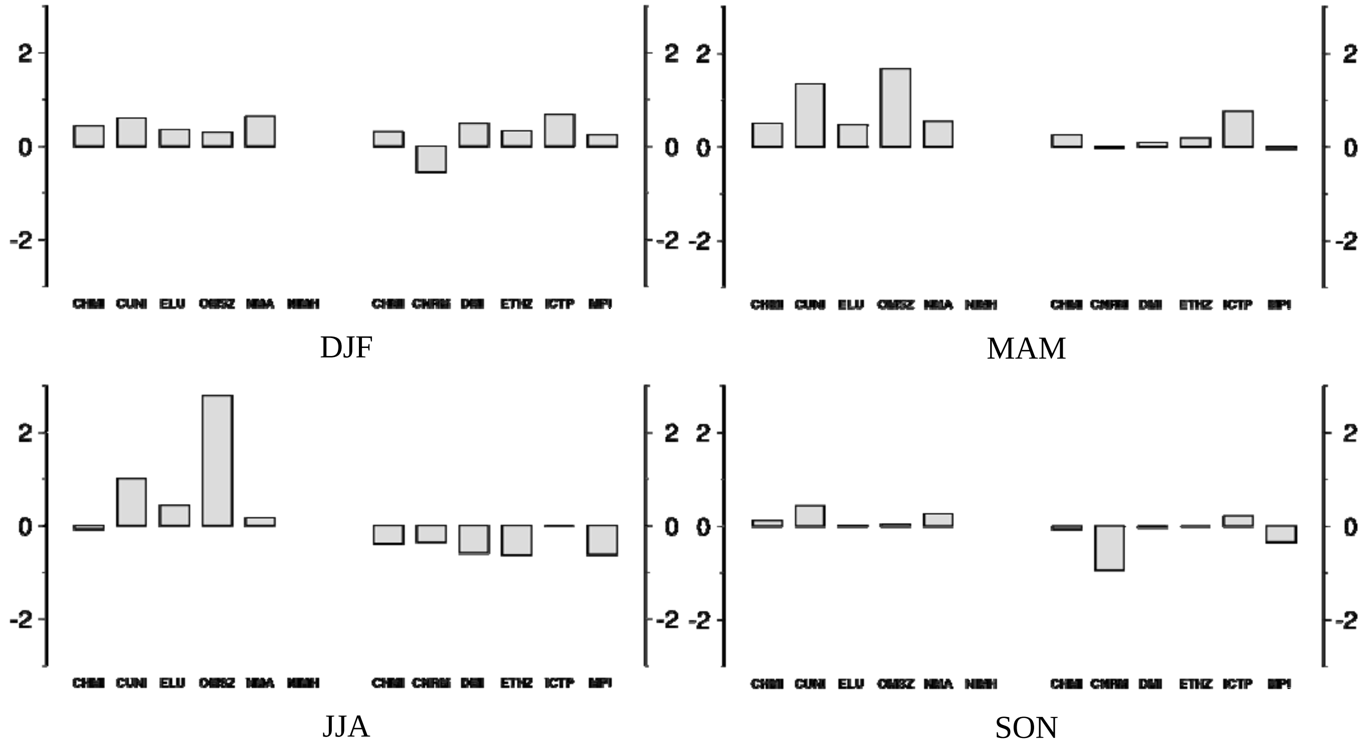

Figure 8: As Figure 6 for Hungary.

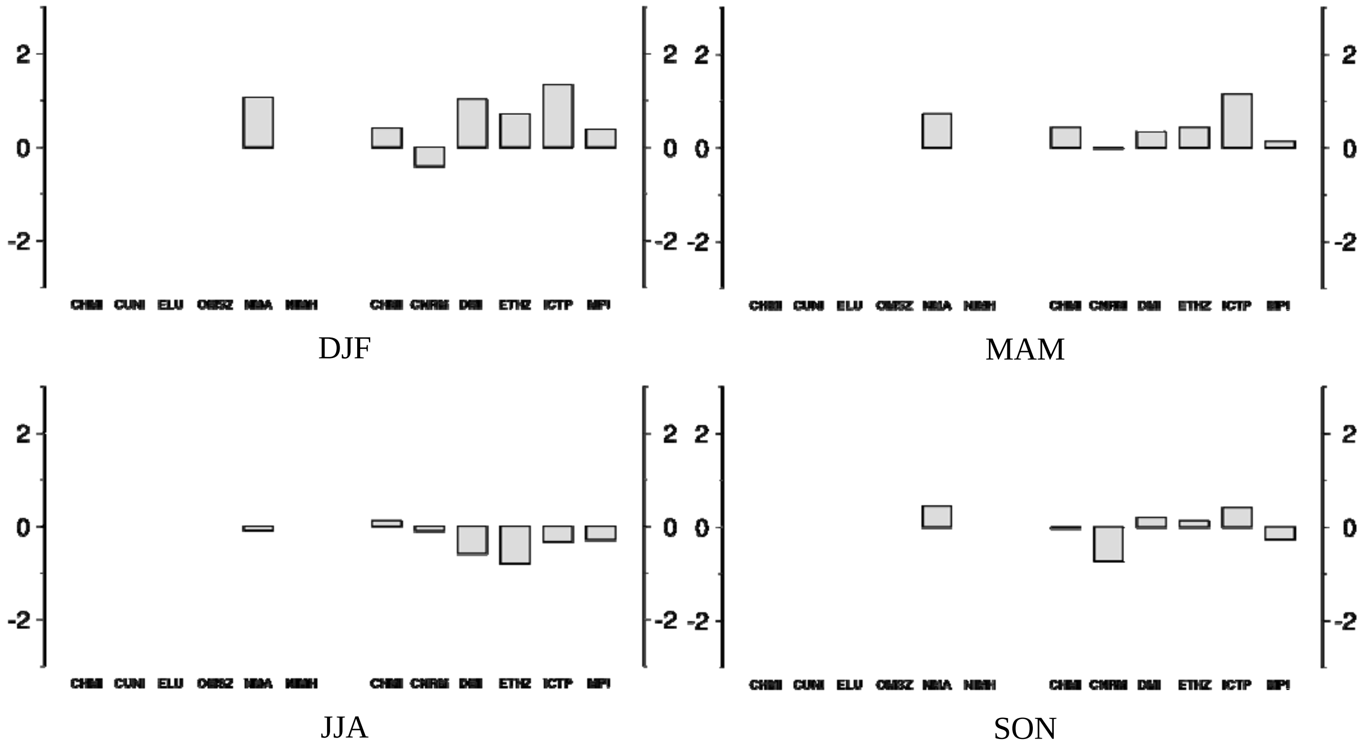

Figure 9: As Figure 6 for Romania.

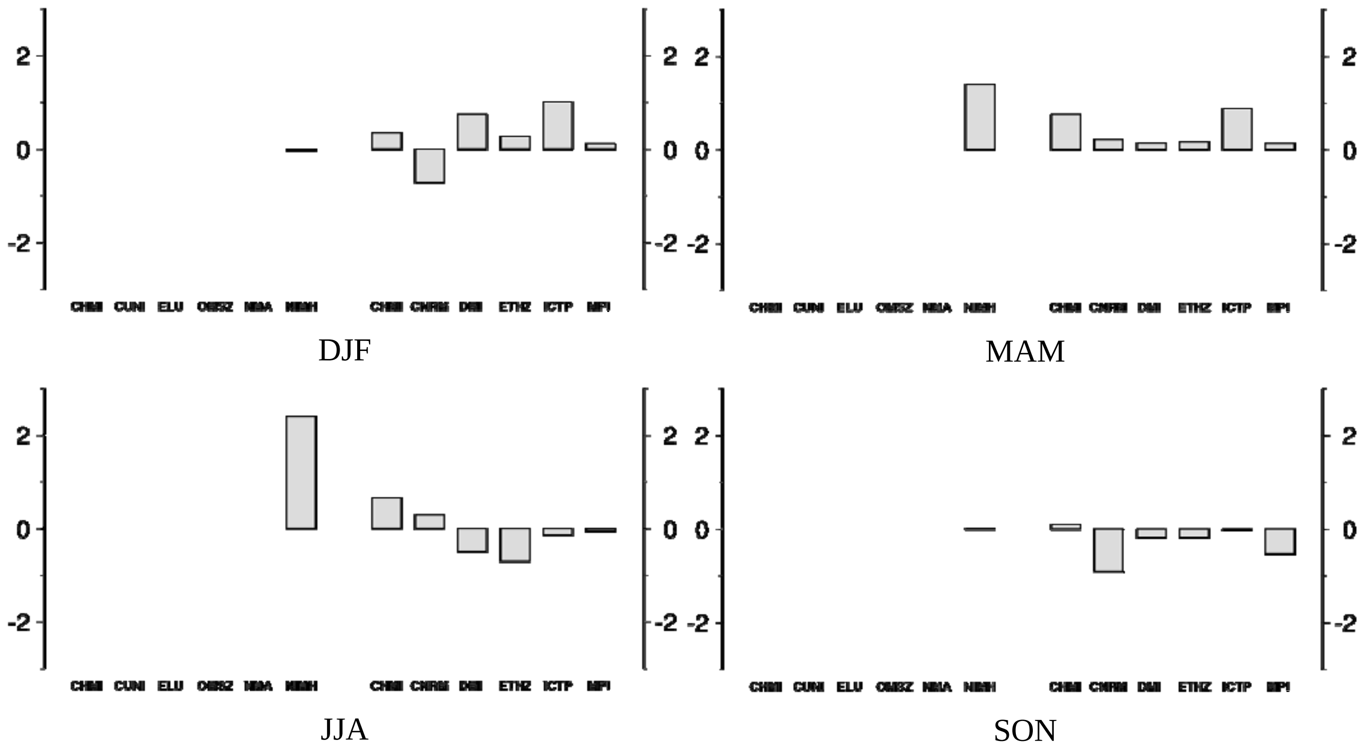

Figure 10: As Figure 6 for Bulgaria.

Scenario for the first time-slice

Here we look at the differences between 2021-2050 and 1961-1990 averages. The same countries and the same CECILIA models as in the last section are examined. The ENSEMBLES models are the same, except CHMI which was not run in scenario mode over Europe.

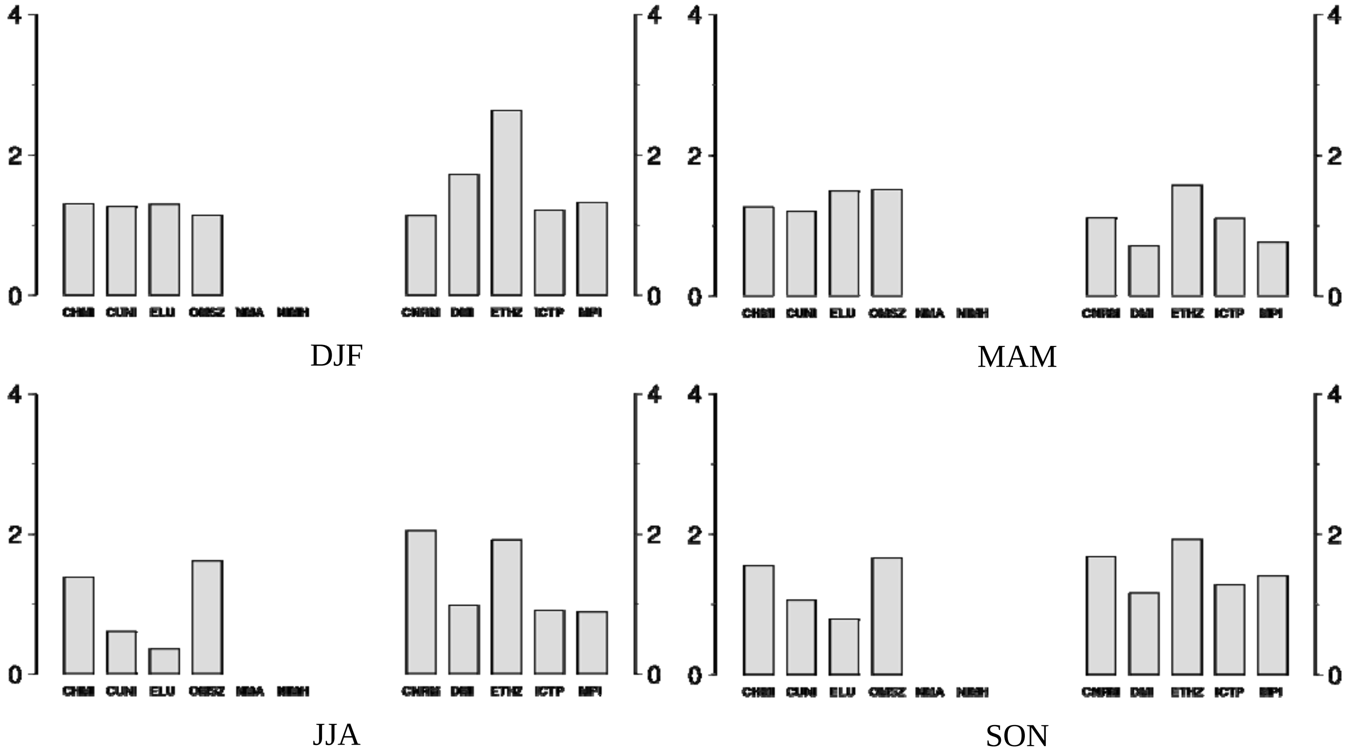

Figure 11: Mean response in 2021-2050 for 2m temperature (°C) over Czech Republic: DJF (top left), MAM (top right), JJA (bottom left) and SON (bottom right).

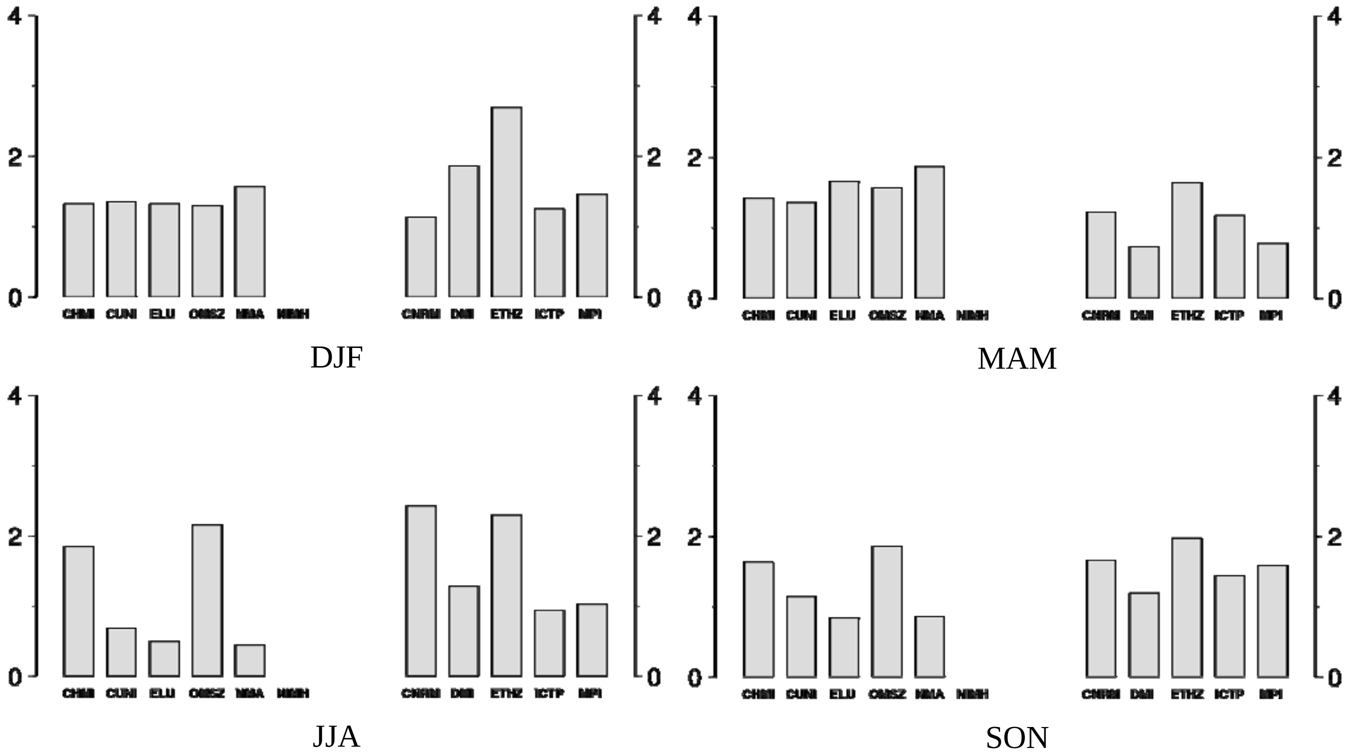

Figure 12: As Figure 11 for Slovakia.

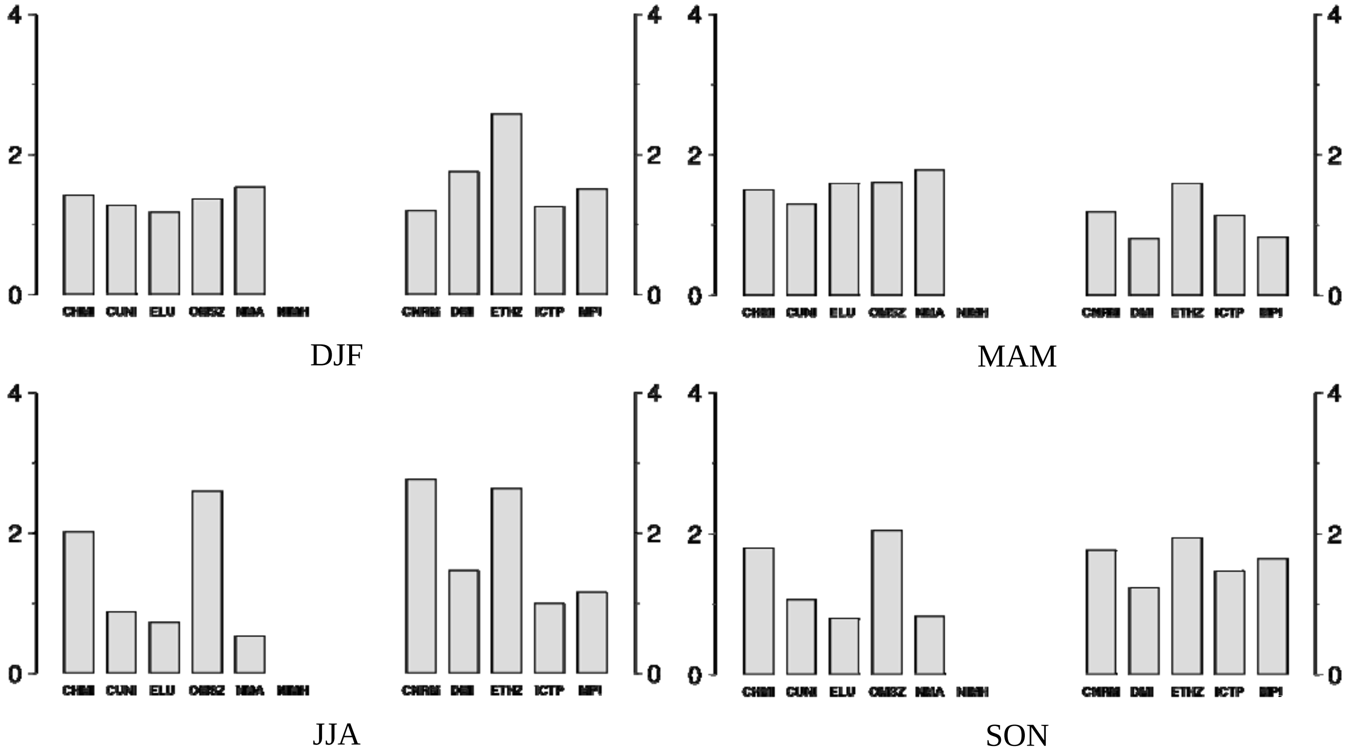

Figure 13: As Figure 11 for Hungary.

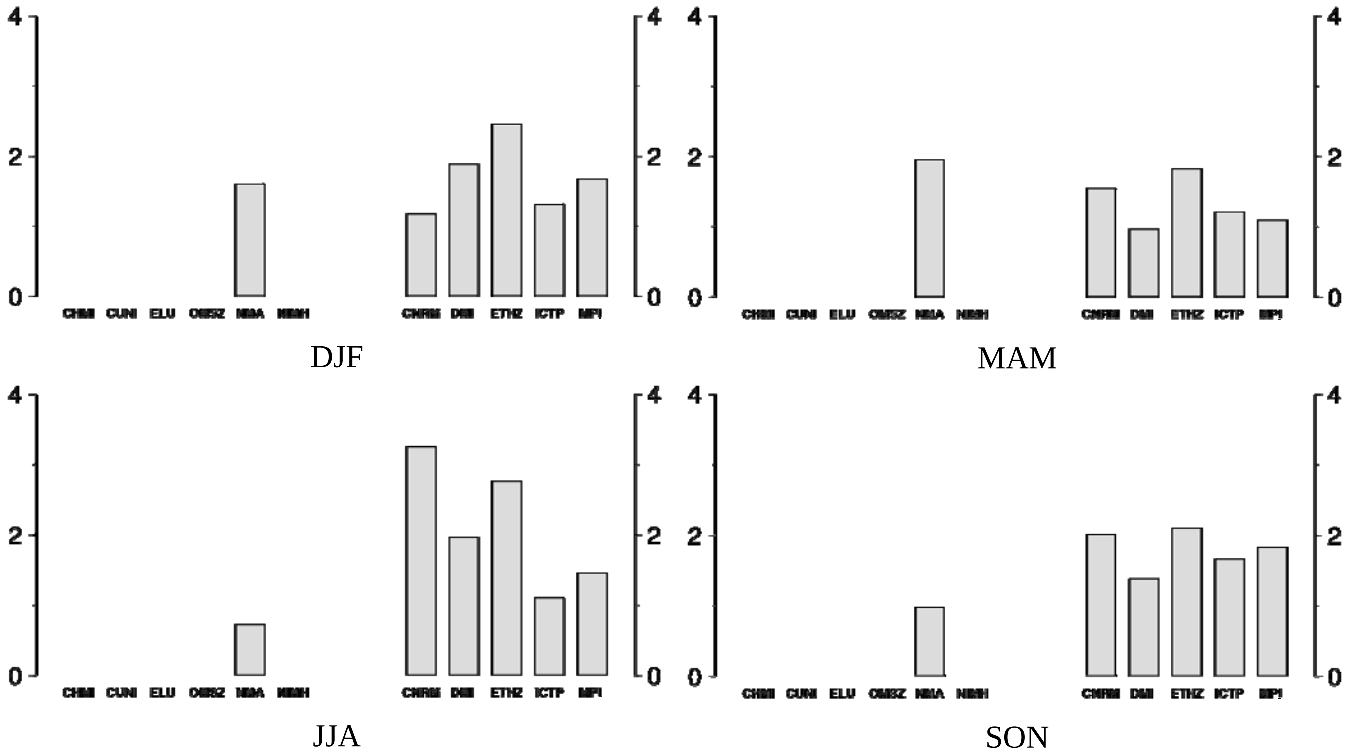

Figure 14: As Figure 11 for Romania.

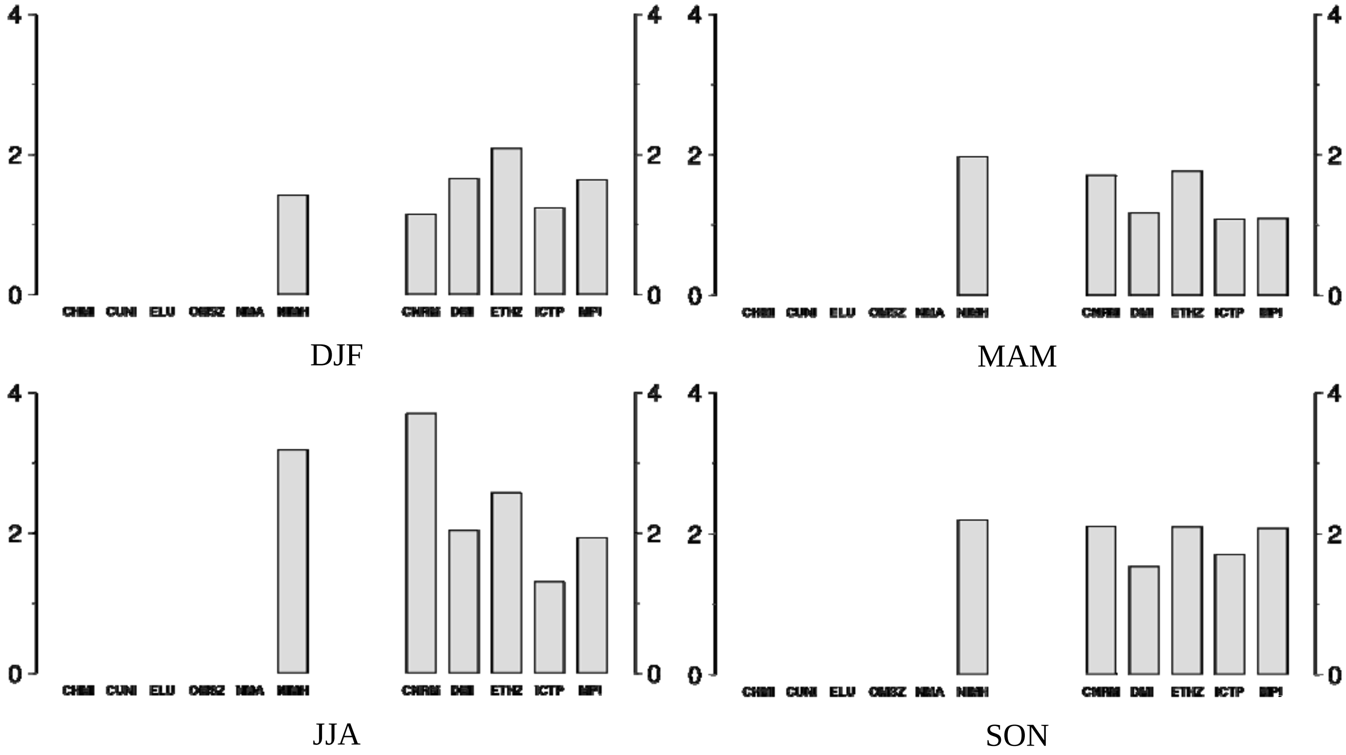

Figure 15: As Figure 11 for Bulgaria.

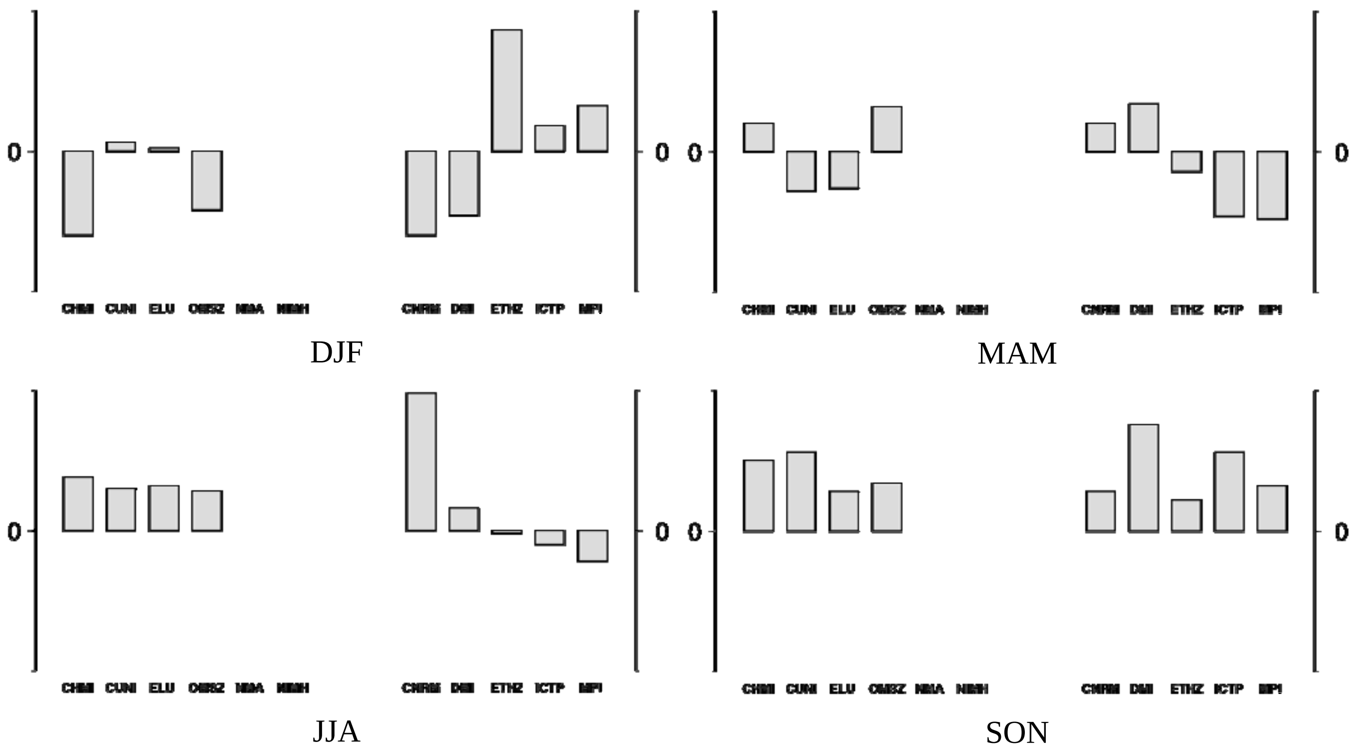

Figure 16: Mean response in 2021-2050 for precipitation (mm/day) over Czech Republic: DJF (top left), MAM (top right), JJA (bottom left) and SON (bottom right).

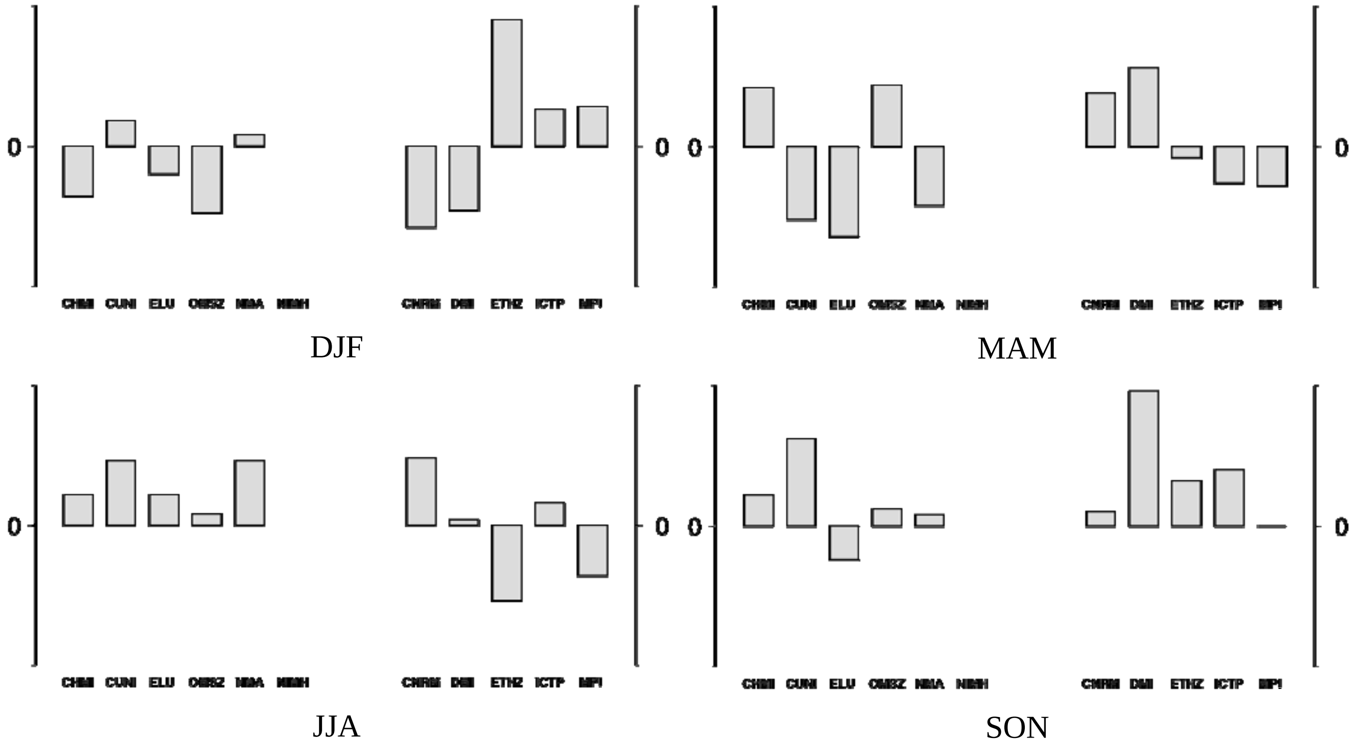

Figure 17: As Figure 16 for Slovakia.

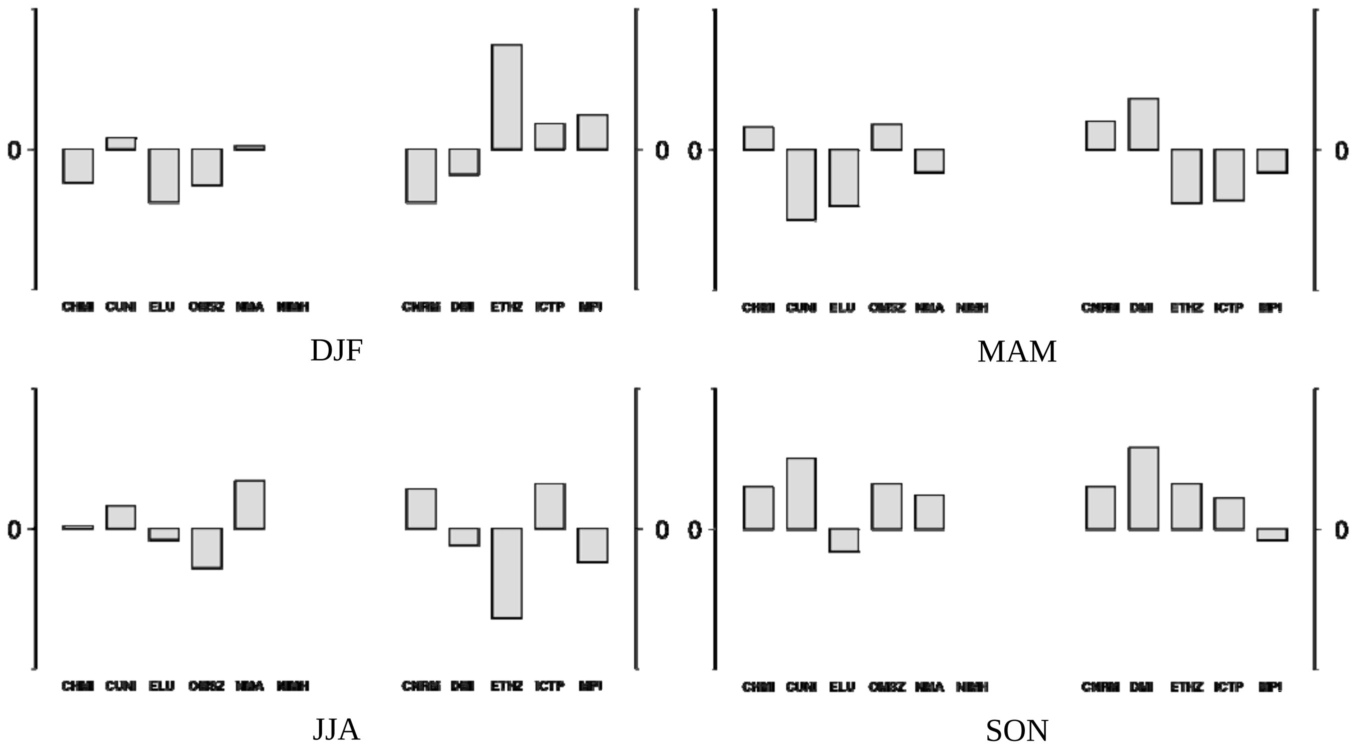

Figure 18: As Figure 16 for Hungary.

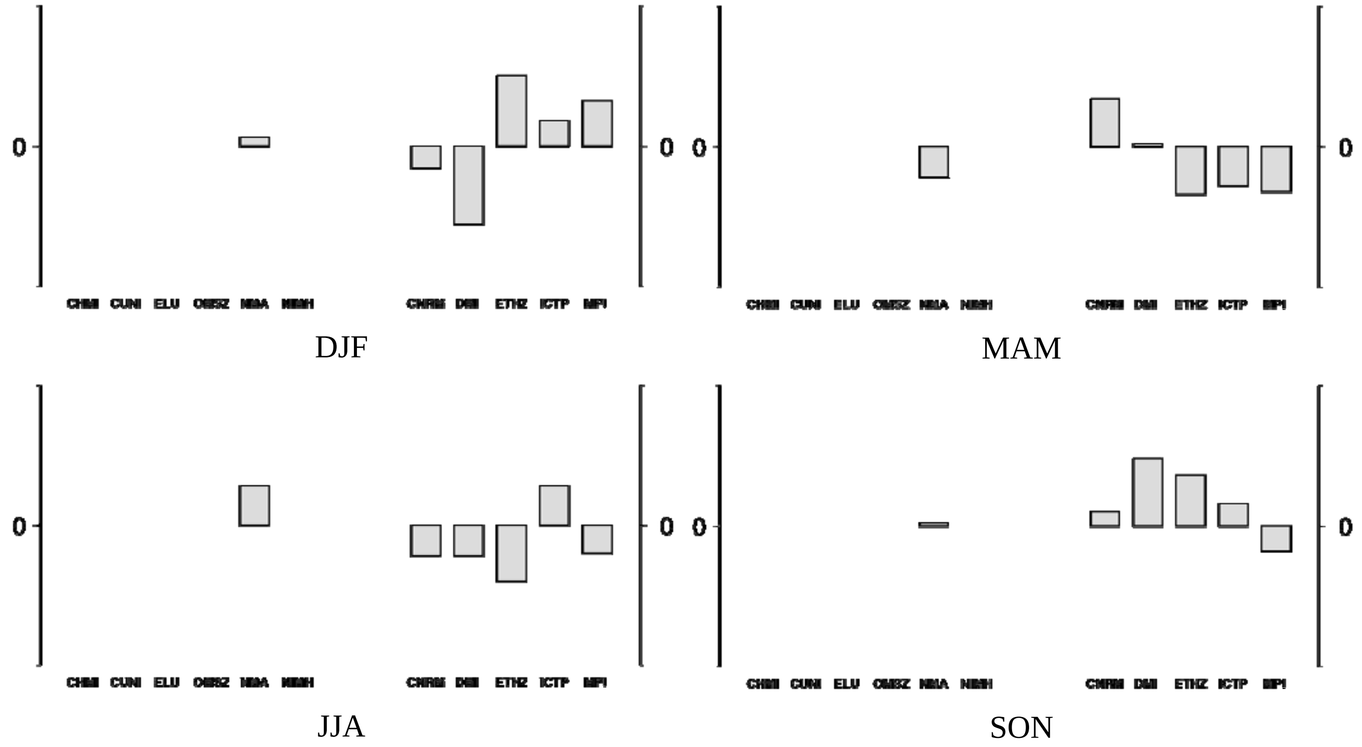

Figure 19: As Figure 16 for Romania.

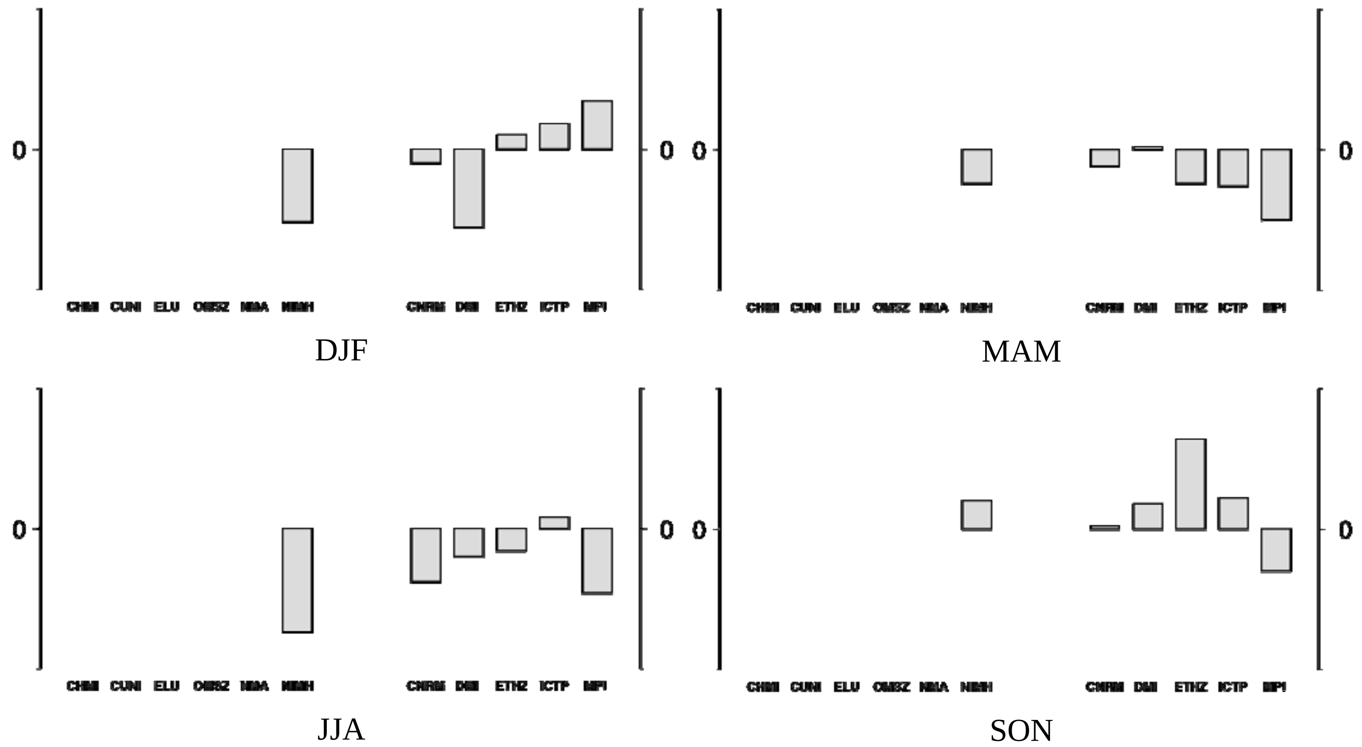

Figure 20: As Figure 16 for Bulgaria.

Scenario for the second time-slice

Here we look at the differences between 2071-2100 and 1961-1990 averages. The same countries and the same CECILIA models as in the last section are examined. The comparison is made now with

PRUDENCE models. Although the model names are the same, the models used in PRUDENCE are earlier versions of the RCMs used in ENSEMBLES.

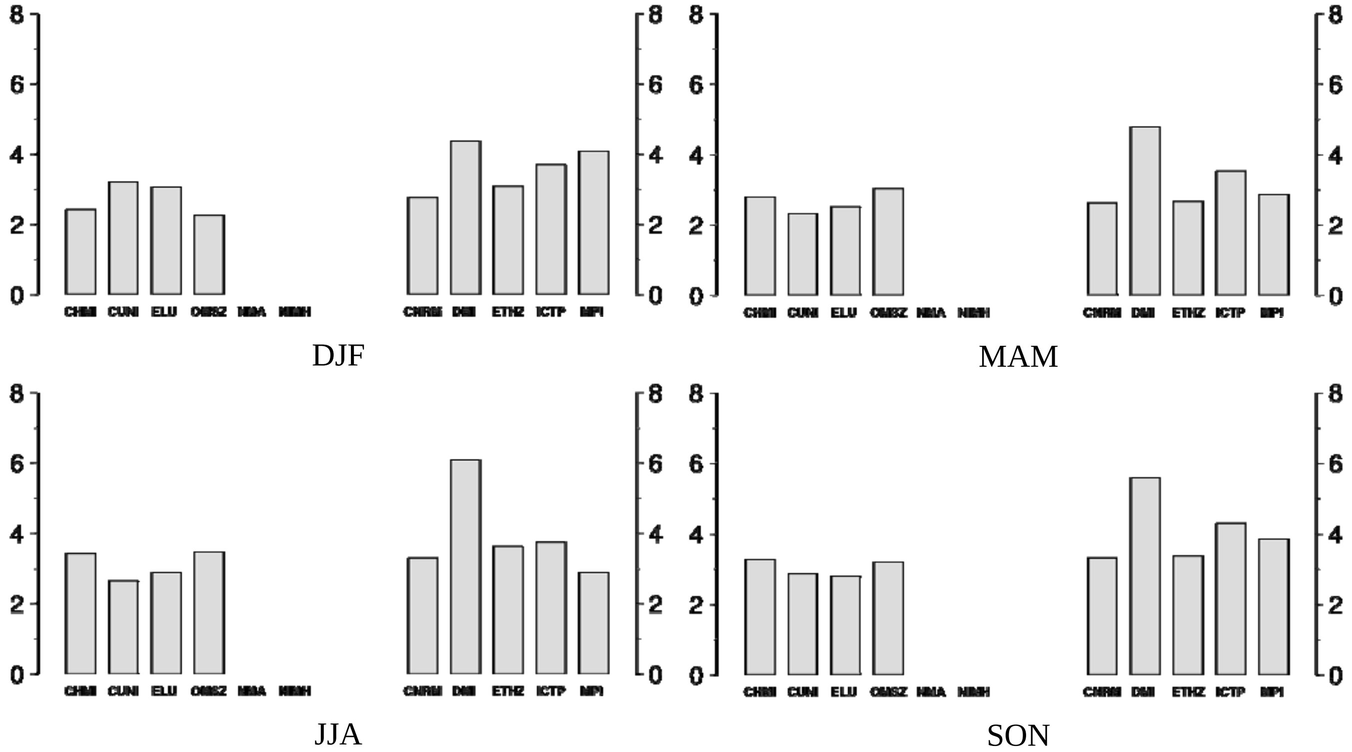

Figure 21: Mean response in 2071-2100 for 2m temperature (°C) over Czech Republic: DJF (top left), MAM (top right), JJA (bottom left) and SON (bottom right).

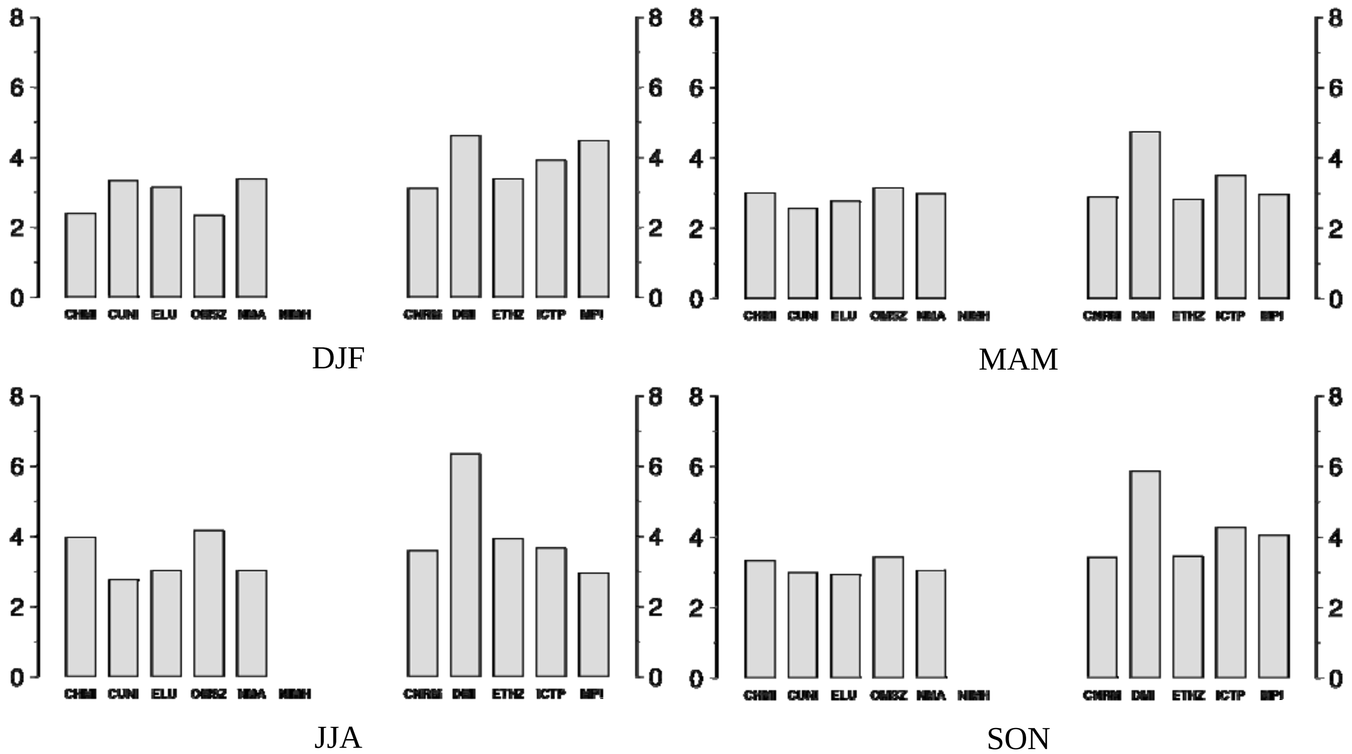

Figure 22: As Figure 21 for Slovakia.

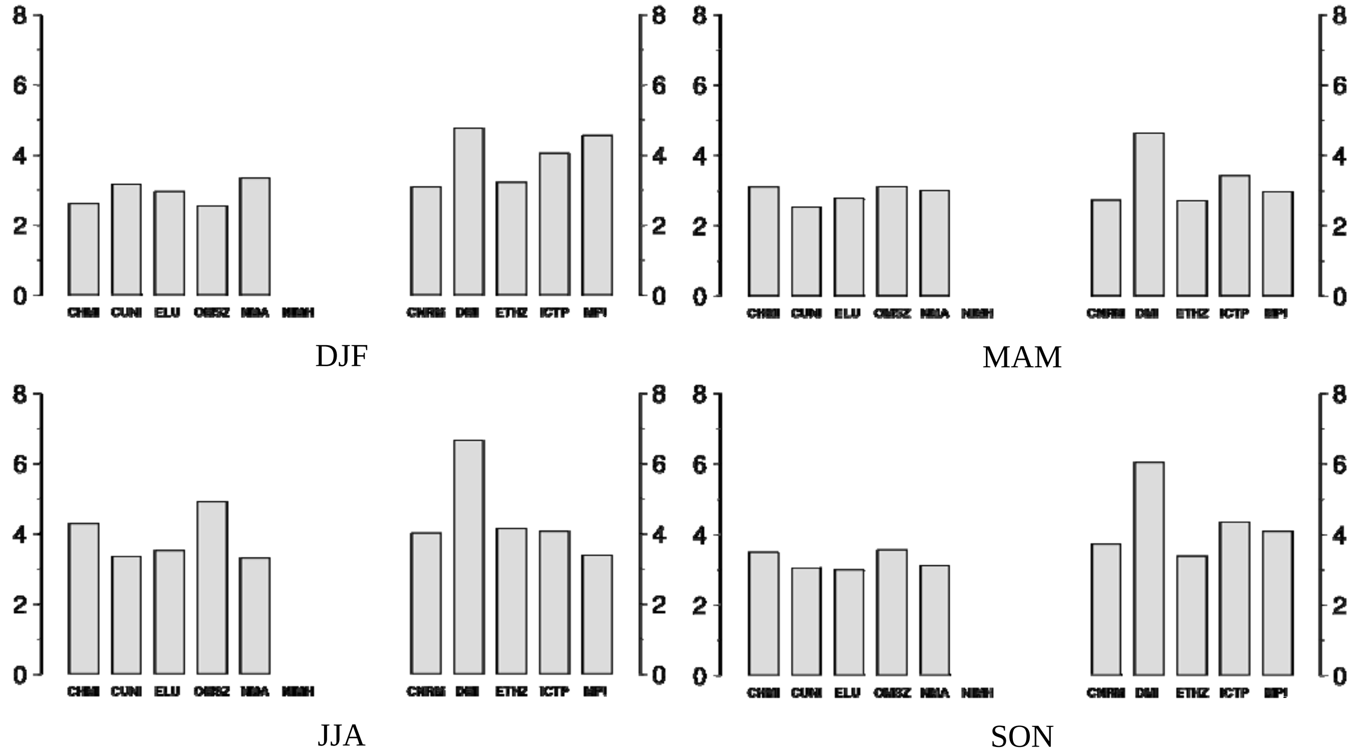

Figure 23: As Figure 21 for Hungary.

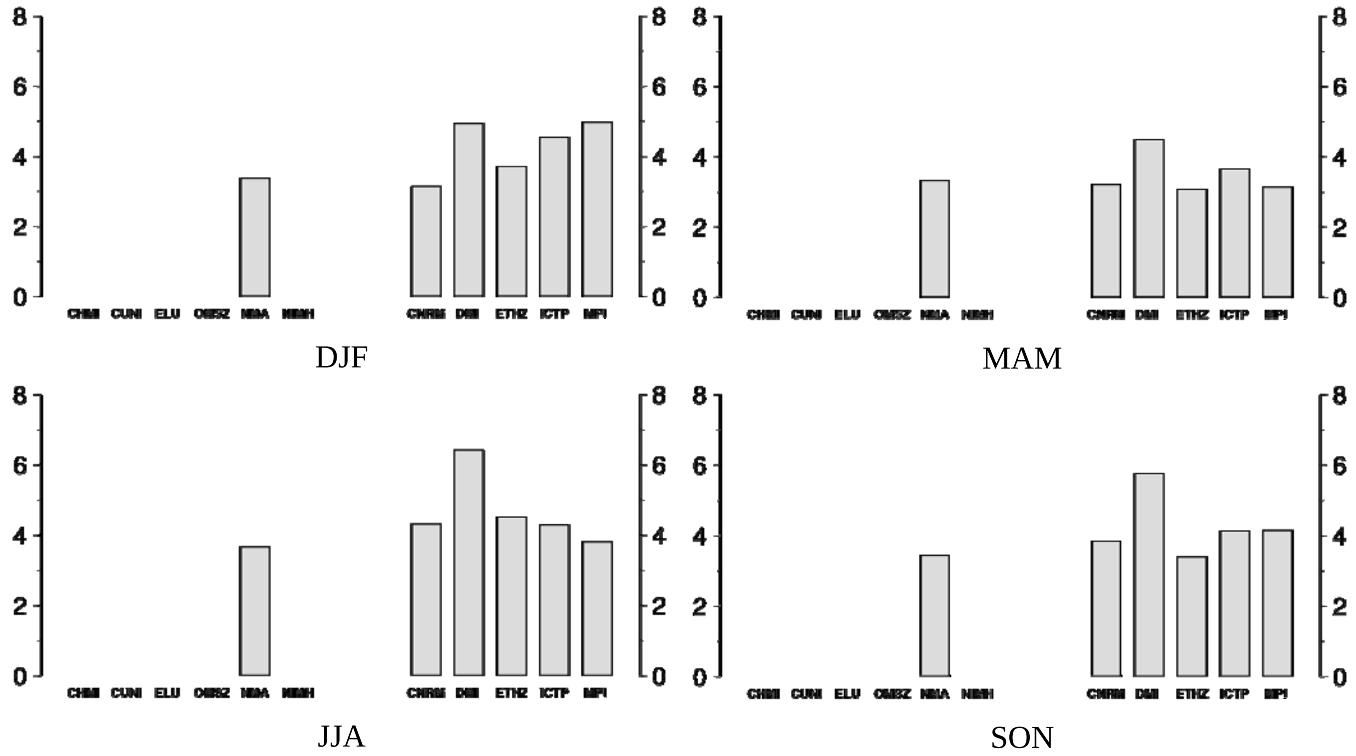

Figure 24: As Figure 21 for Romania.

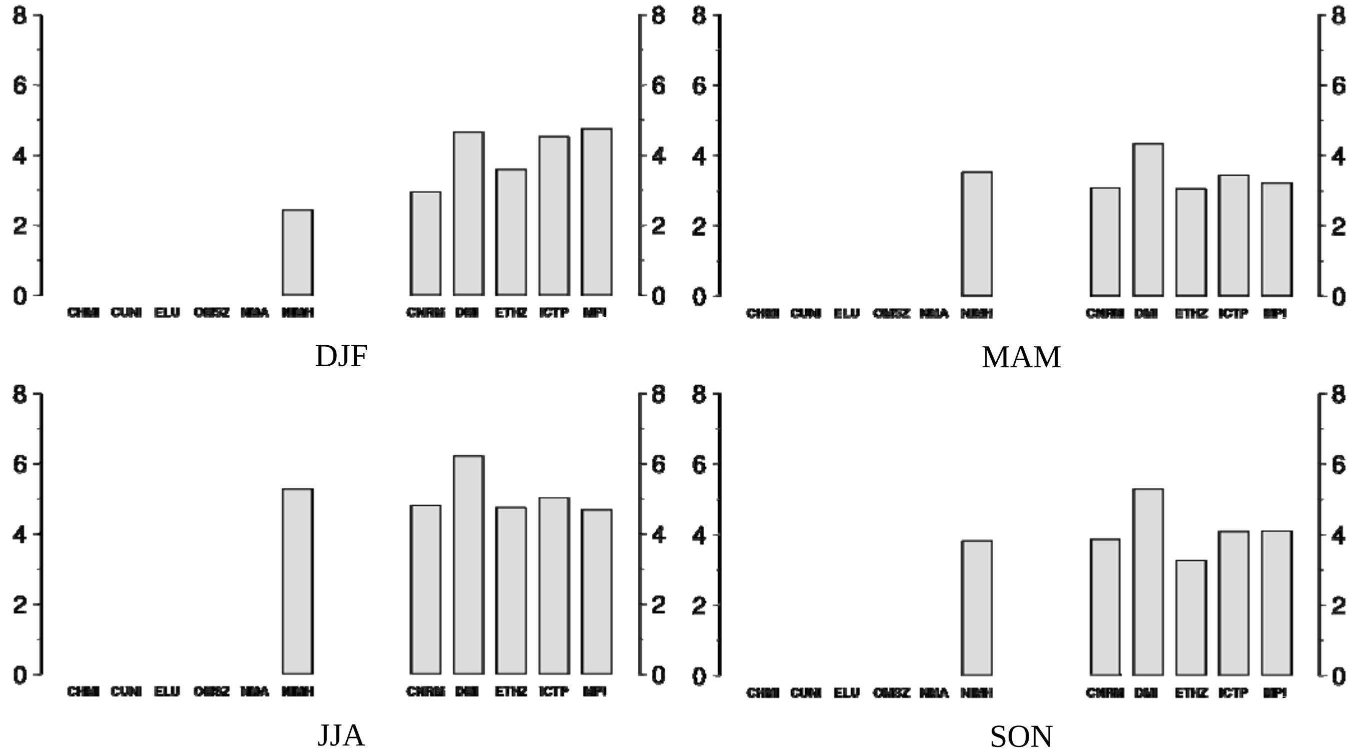

Figure 25: As Figure 21 for Bulgaria.

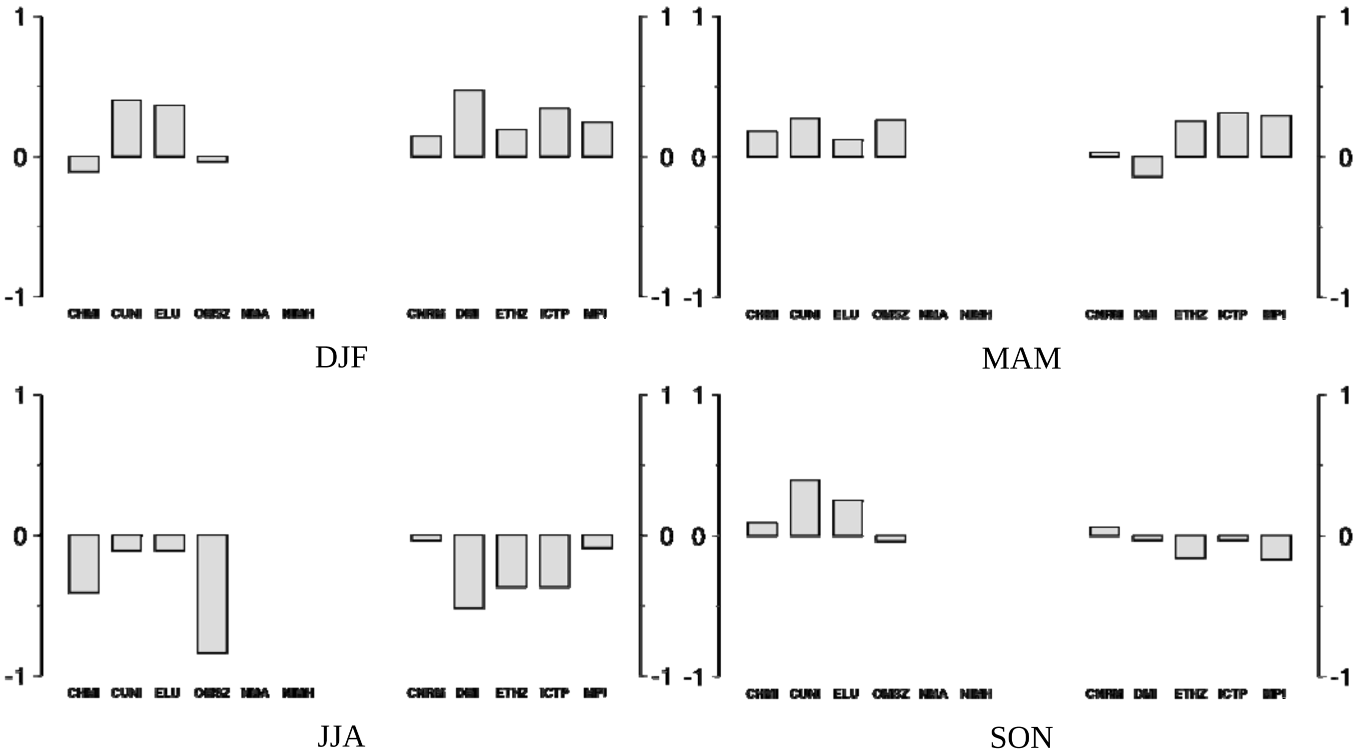

Figure 26: Mean response in 2071-2100 for precipitation (mm/day) over Czech Republic: DJF (top left), MAM (top right), JJA (bottom left) and SON (bottom right).

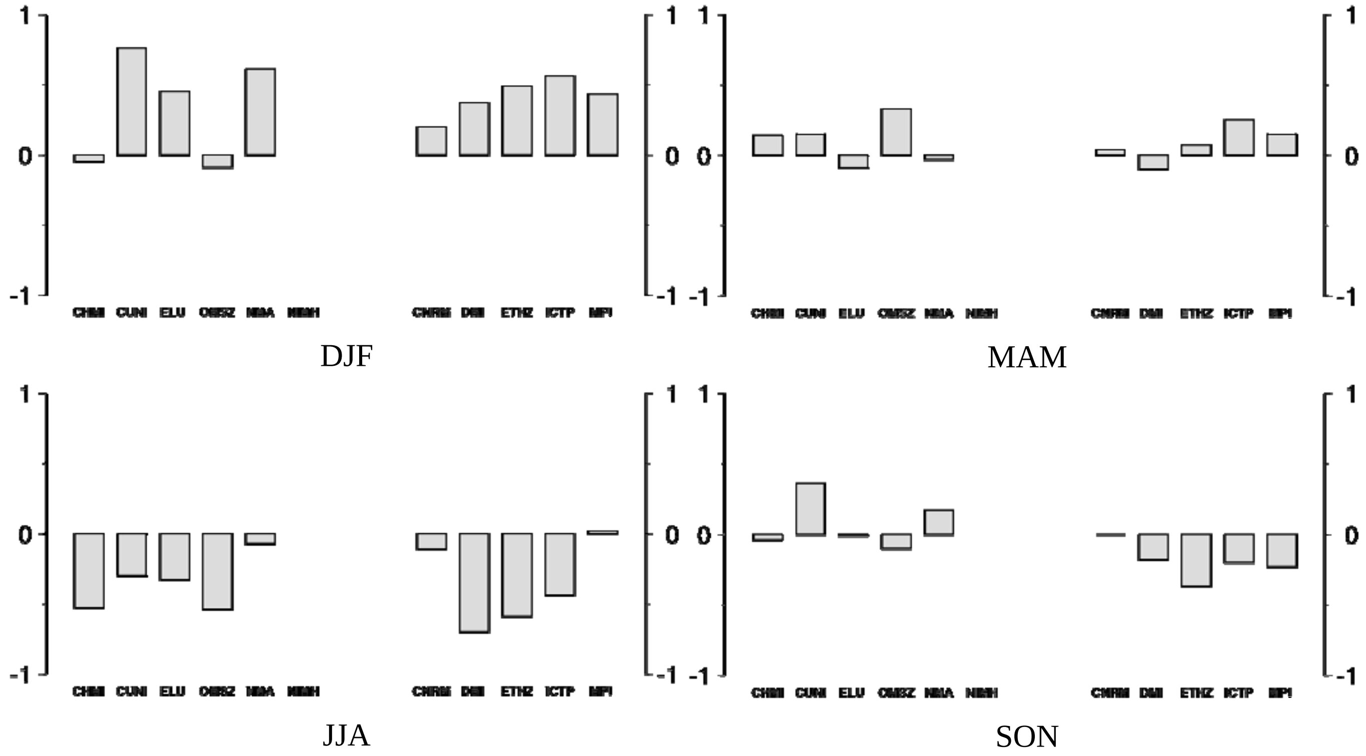

Figure 27: As Figure 26 for Slovakia.

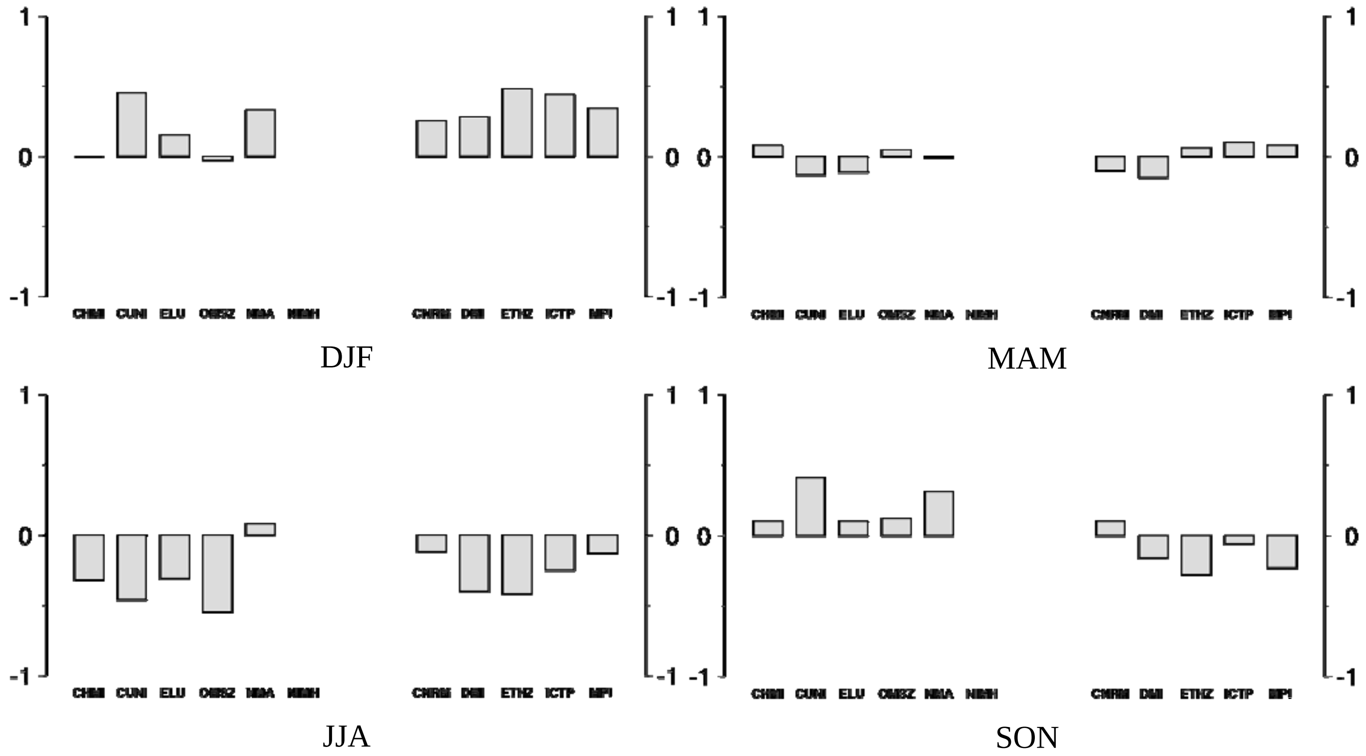

Figure 28: As Figure 26 for Hungary.

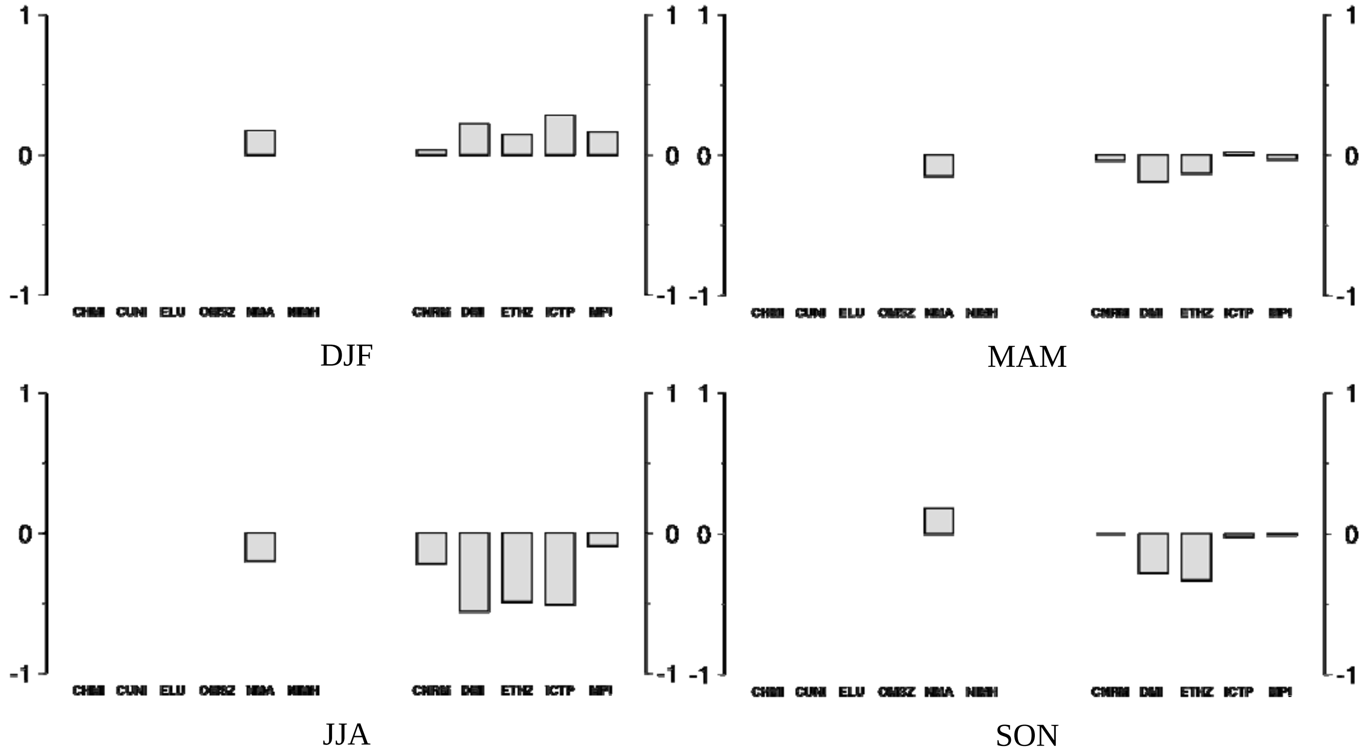

Figure 29: As Figure 26 for Romania.

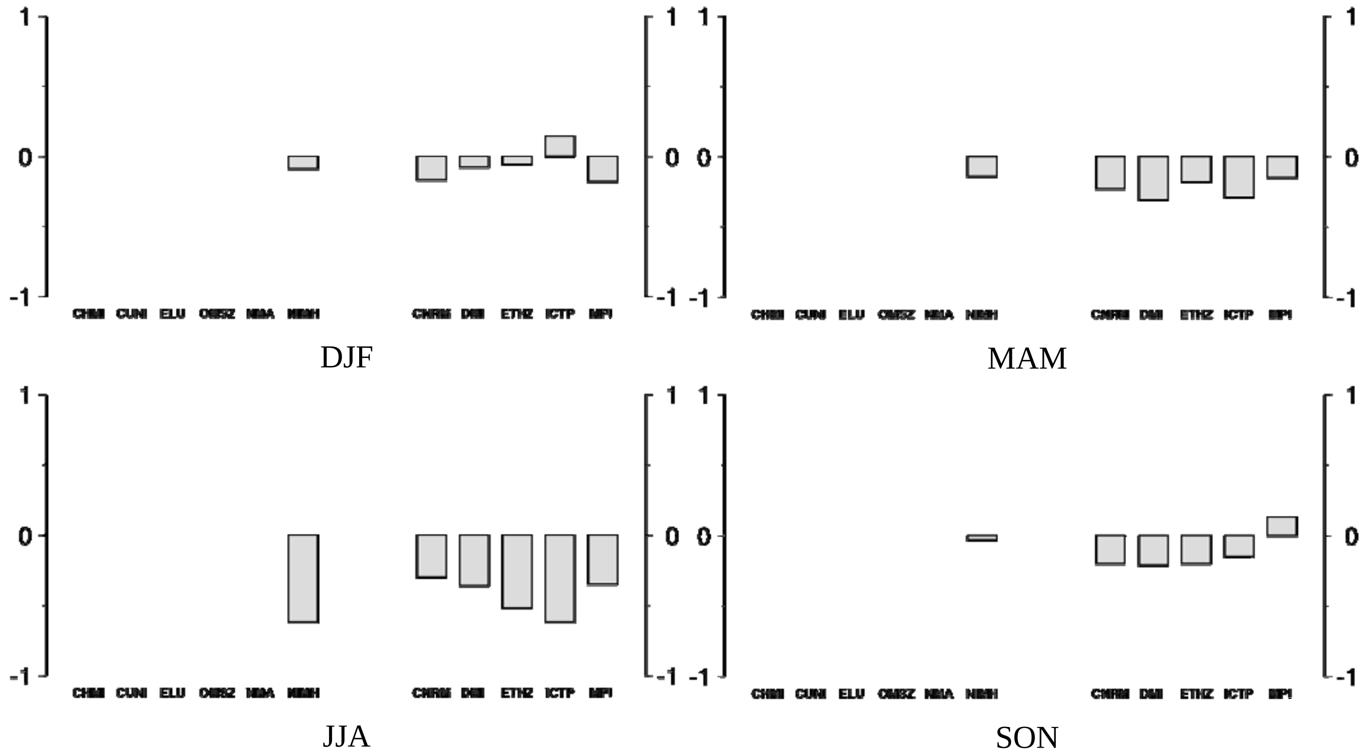

Figure 30: As Figure 26 for Bulgaria.

Synthesis per country

To avoid fastidious repetitions, we will name C-models the models from CECILIA, when there is an agreement of most available models. We will name E-models the models from ENSEMBLES when there is an agreement of a majority of models, and similarly P-models the models from PRUDENCE. When one half of the models have the opposite signal of the others, no comment is given.

Czech Republic

The C-models are too cold in all seasons except winter. The E-models are too cold in winter, spring and autumn, but too warm in summer. C-models and E-models are too wet in all seasons, particularly in winter. The mid-21st century warming is similar in C- and E-models. C-models increase precipitation in summer and autumn, whereas E-models increase it in all seasons save spring. The late-21st century warming is similar in C- and P-models. They increase winter and spring precipitation and decrease summer precipitation.

Slovakia

Slovakia, as Hungary, is covered by all C-models, except NIMH. They are too warm in winter and too cold in other seasons. The E-models are too warm in summer (typical warm dry bias in eastern Europe). C-models aree too wet in all seasons, particularly in winter, whereas E-models are too wet in winter and spring, but too dry in autumn. The mid-21st century warming is similar in C- and E-models. C-models increase precipitation in summer and autumn, and decrease precipitation in winter and spring. E-models increase it in winter and autumn. The late-21st century warming is similar in C- and P-models. They increase winter and spring precipitation and decrease summer precipitation. They disagree in autumn however, with wetter C-models and drier P-models

Hungary

The C-models are too warm in winter and too cold in spring, whereas the E-models are too warm in summer. The C-models are too wet in all seasons, whereas the E-models are too wet in winter and too dry in summer. The mid 21st century warming is similar in E-models and in C-models. The C-models decrease precipitation in winter and spring, increase precipitation in summer and autumn. The E-models increase it in winter and autumn. The late-21st century warming is similar in C- and P-models. They increase winter precipitation and decrease summer precipitation. They disagree in autumn however, with wetter C-models and drier P-models

Romania

Romania is covered by a single C-model (NMA) which is too warm and too wet in winter.The E-models are too warm in winter and summer; they are too wet in winter and spring and too dry in summer. During the first time slice, NMA exhibits a similar warming to E-models, but in spring NMA response is stronger and in summer NMA response is weaker. NMA decreases precipitation in spring and increases it in summer, whereas the E-models decrease precipitation in spring and summer, and increase it in autumn. During the second time slice, NMA warming is similar to the E-model responses. The NMA precipitation response is positive in winter and autumn, negative in spring and summer. The E-models increase precipitation in winter and decrease it the other three seasons, particularly in summer.

Bulgaria

Bulgaria is covered by a single C-model (NIMH) which is too cold in any season (which may be explained by the high elevation of the country at high resolution) and too wet in spring and summer. The E-models are too warm in summer. They are too wet in winter and spring, too dry in autumn. The mid-21st century warming is similar in C- and E-models. NIMH response is drier in all seasons except autumn. The spring and summer drying is in agreement with the E-models. The late-21st century warming is similar with NIMH and P-models. They exhibit a precipitation decrease which is maximum in summer.

Conclusions

Two main conclusion may be drawn from the examination of the above 120 diagrams.

Despite the reduction of integration domain size and the increase in horizontal resolution, the CECILIA large scale (i.e. country level) systematic errors are not reduced, and in some cases worsen with respect to the ENSEMBLES models. If the CECILIA models bring an added value, it must be at smaller scales. This strongly advocates for statistical calibration of CECILIA results before they are entered into application models. This is the typical drawback, with respect to statistical downscaling: results are poorer in present climate and expected to be better in future climate, because less conservative hypotheses are done.

When ENSEMBLES or PRUDENCE models agree on the climate change (which is the case for temperature and sometimes for precipitation), CECILIA models agree as well. When there is some spread amongst the responses, there is also some spread in CECILIA models. Using a higher resolution is not a way to reduce uncertainties.