Regional Decadal Predictions for Europe within DecReg

Project Number 0859

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Introduction

Within the MiKlip project DecReg, regional hindcast ensembles driven by the MPI-ESM-LR have been generated with the regional model CCLM. The aim of The project was to assess the decadal predictive skill and reliability of the predictions as well as the added value compared to the coarse resolution driving data. Questions include 'what is the value added by the downscaling, where do we find skill and added value, what are the metrics, variables, quantiles, etc. which yield additional information for climate prediction?' Apart from investigations into the skill, the reliability and added value, a set of sensitivity
experiments concerning land surface modeling and initialisation,
global-regional coupling has been performed for a better understanding of the regional model system.

Ensemble Generation

Driving data: MPI-ESM-LR, baseline 0/1, 1961-2010

RCM: CCLM

Methods: Dynamical downscaling (full ensemble)

Sensitivities: Resolution (0.44°, 0.22°, 0.0625°), SVATs, soil initialisation, GCM-RCM coupling …

Metrics used:

Accuracy: Anomaly correlation, RMSE, MSESS, categorical scores, …

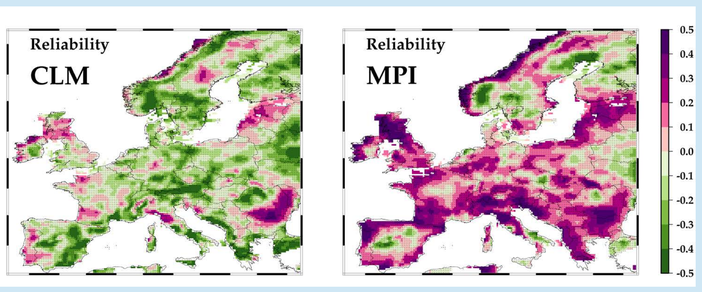
Reliability (Spread): Ensemble Spread Score, CRPSS, ...

Conclusion and Outlook

In order to develop a regional decadal prediction system, first investigations of the skill and reliability, based on regional decadal hindcasts, have been performed. The main findings are that downscaling with the regional models CCLM preserves the skill of the global driving MPI-ESM-LR model. The key aspect of the value added by the downscaling turned out to be the improvement of reliability for temperature and for precipitation (while simultaneously preserving the predictive skill), as well as a better representation of extremes. However, further analyses are needed for a comprehensive characterisation of the prospects of regional climate predictions. Thus, we need to investigate more model configurations, extremes, larger ensembles, other variables and other metrics. With the knowledge acquired now, we need to analyze further the sources of predictability and identify processes connected to potential predictive skill.

Reliability

We consider here:
- Summer precipitation anomalies, detrended
- 1961-2010, lead years 1-5
- CCLM baseline 0, 0.22°, Reference E-OBS

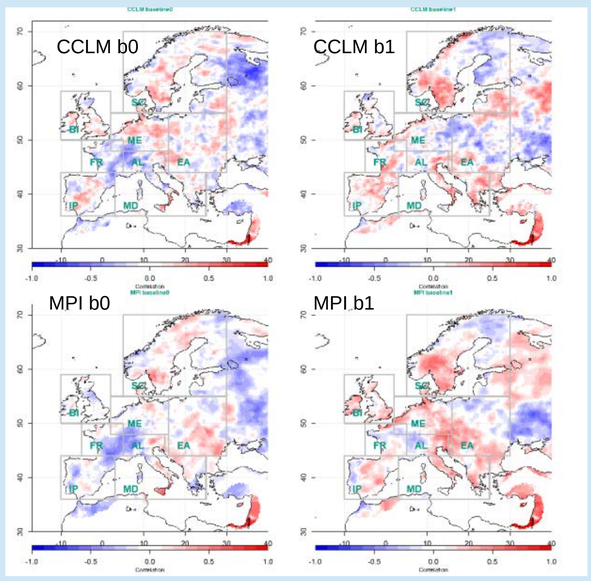


Reliability is defined as …
Reliability = 0 : Perfect, ensemble is reliable
Reliability > 0 : Ensemble is overconfident (spread too small)
Reliability < 0 : Ensemble is underconfident (spread too large)
Stippling indicates significant results

Result: Downscaling with CCLM improves the reliability for summer precipitation

Predictive Skill

Again, we consider here
- Summer precipitation anomalies, detrended
- 1961-2010, lead years 1-5
- CCLM 0.22°, Reference E-OBS



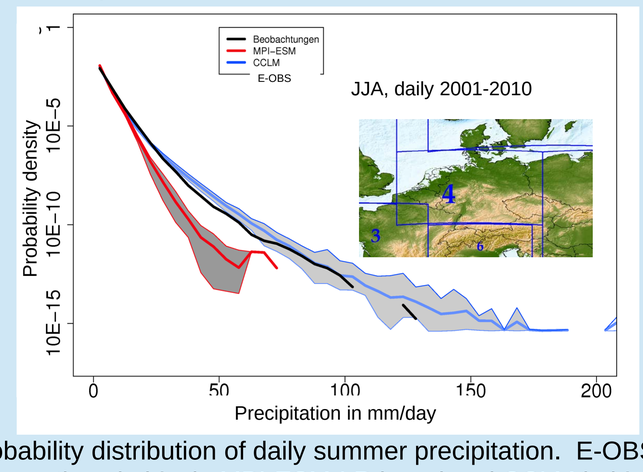
Correlation coefficient between model and observations

Result: CCLM preserves the predictive skill

Added value

One aspect of the added value of downscaling global decadal predictions is the preservation of predictive skill while simultaneously

- Improving the reliability
- Better representation of small scale features
- Better representation of extremes



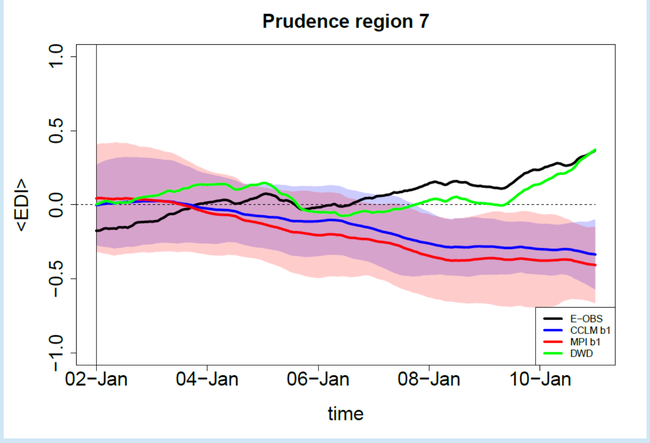
Probability distribution of daily summer precipitation. E-OBS observations in black, MPI-ESM-LR in red and CCLM in blue.

Result: considerable improvement from GCM to RCM

Validation Data and Sensitivity Experiments

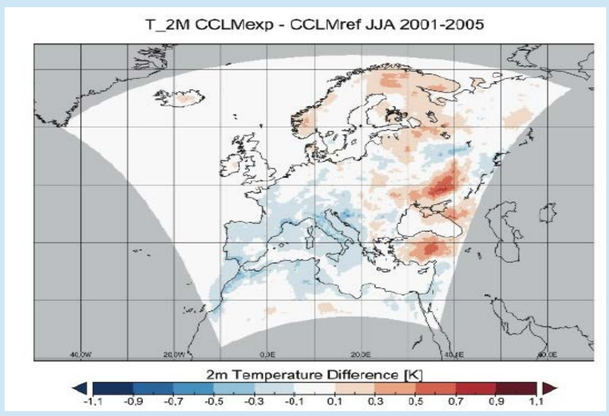
Validation Data

Within MiKlip/DecReg, the German Weather Service (DWD) produced an enhanced observation-derived data set for temperature and precipitation. Differences to E-Obs depend on the region considered. The figure below shows as an example for Prudence region 7 (The Mediterranean) the evaluation of the Effective Drought Index (EDI). During the first five years of the 2001-2010 decade, both observational data sets are within the simulation ensemble .



Effects of soil initialization

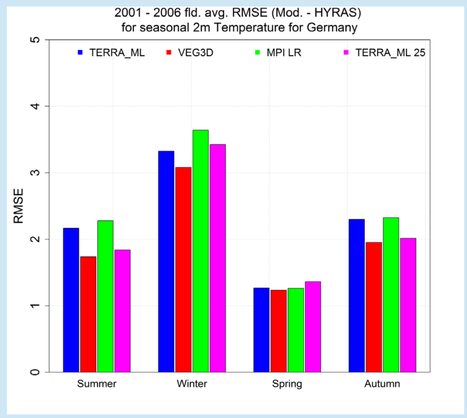
Optimization of soil initialization
Influence of the initialization during the first five years observed



New soil initialization minus old initialization, 2001-2005, summer temperature

Impact of SVAT used

Reduction of RMSE for 2m temperature in Central Europe by using the Soil-Vegetation-Atmosphere-Transfer (SVAT) Scheme Veg3d



RMSE between different model setups (SVATs) for 2001-2006 temperature in Germany

Result: a different SVAT can improve the results and enlarge the ensemble, but considerably more validation required

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