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PROWAS Klima-Projektionsdienst

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

DWD

Evaluation of an ERA-Interim steered hindcast simulation with a coupled model

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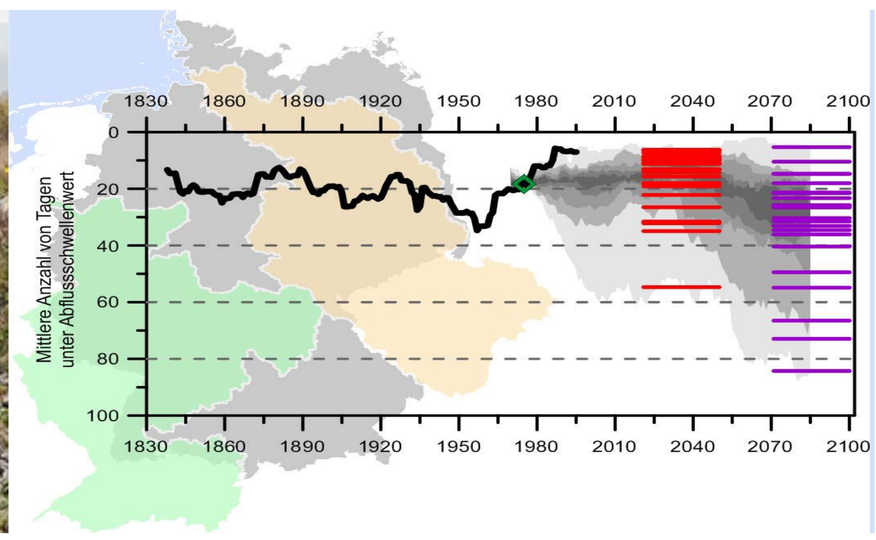
Within the context of the pilot project „ProWaS“, a hindcast simulation with ERA-Interim forcing was carried out by a regional coupled climate model. The coupled model consists of two parts, the regional atmospheric climate model COSMO-CLM (CCLM) and the regional ocean model NEMO-Nordic. Both parts are coupled with OASIS3-MCT3. The coupled hindcast run was evaluated by comparing the climatologies of meteorological fields like 2m-temperature and precipitation with observation data and an uncoupled CCLM hindcast run. The results show a good agreement between the modeled 2m-temperature and observations for Central Europe. Precipitation is overestimated in the Alps and underestimated in the Central German Uplands, mainly caused by an insufficient model resolution. The coupled run is in good agreement with the CCLM-standalone run, small differences are within the internal variability.



ProWaS – a pilot project

The pilot project ProWaS *(Projektionsdienst für Wasserstraßen und Schifffahrt, engl. Projection service for waterways and shipping)* was initiated by the German Federal Ministry of Transport and Digital Infrastructure to provide information about the effects of climate change on waterways and shipping in Germany. Exemplary, the rivers Rhine and Elbe as well as the German Bight are considered. Therefore, different federal agencies cooperate: Besides the DWD, which provides data from climate runs and does model development, the Bundesamt für Seeschifffahrt und Hydrographie (BSH) cares for further development of the ocean model and is thus in a close contact to DWD. Other partners are BfG and BAW, which process the climate data in small scale water models. The developed data, exchanged centrally via an ESGF-Data-Node located at DWD, cover a decadal time scale and are important contributions to the "German Adaptation Strategy to Climate Change" (D.A.S.).

Tab.1: Setup of the hindcast run

Model	CCLM	NEMO-Nordic
Domain	EU-CORDEX	North- and Baltic Sea
Horizontal resolution	0.22° ≈ 24km	≈ 3km
Time period	1979 – 2015	
Time step	300s	300s (summer) 150s (winter)
Coupling time step	300s	
Initial data	ERA-Interim (ECMWF)	NEMO standalone spin-up run (performed by BSH)
Boundary data	ERA-Interim (ECMWF)	ORAS-4 reanalysis (ECMWF) - River runoff: E-Hype model (adapted by BSH)

The coupled model

The coupled model consists of the ocean model NEMO-Nordic-3.3, the atmospheric model COSMO5-CLM9 (CCLM) and the coupler OASIS3-MCT3. NEMO includes i.a. the ocean general circulation model OPA and the ice model LIM. Nordic is the regional offshoot of NEMO for the North- and Baltic Sea, provided by the SMHI. OASIS couples both models by exchanging heat- and momentum fluxes, temperature and albedo as well as information about ice cover and fresh water input due to precipitation at the sea surface. For evaluation, a CCLM standalone run with SSTs from ERA-Interim was used.

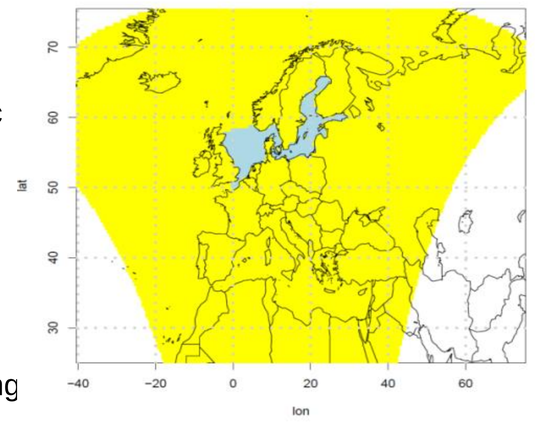


Fig.1: Model domains.
Yellow: COSMO-CLM Grey: NEMO-Nordic

Evaluation: –NAO winter 1995/1996

During winter with a negative NAO-Index, the Atlantic has a relatively small influence on the European weather and the coupling of North- and Baltic Sea gets more important. Therefore, the absolute model bias difference between coupled and standalone run was considered for the most negative NAO winter in the last 40 years, 1995/1996 (see Fig. 4). Areas with positive and negative values alternate and are within the internal model variability. Altogether, the coupled model performs as good as the standalone model.

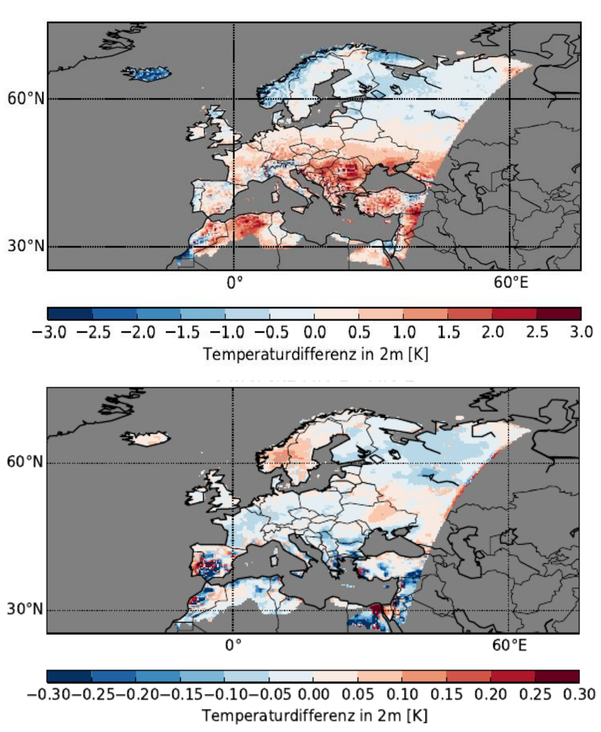


Fig.2: Top: Model bias for 2m temperature relative to E-OBS and averaged over the modeled time period. Bottom: Absolute model bias difference (ambd) between coupled run and CCLM-standalone run for 2m temperature averaged over the modeled time period. The reference is E-OBS.

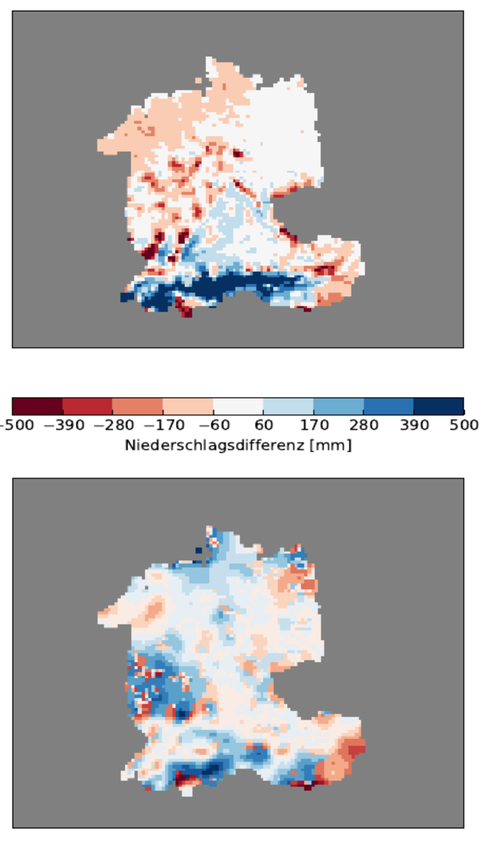


Fig.3:Same as in Fig. 2 but for yearly precipitation and referenced to observation data from HYRAS-12.5km .

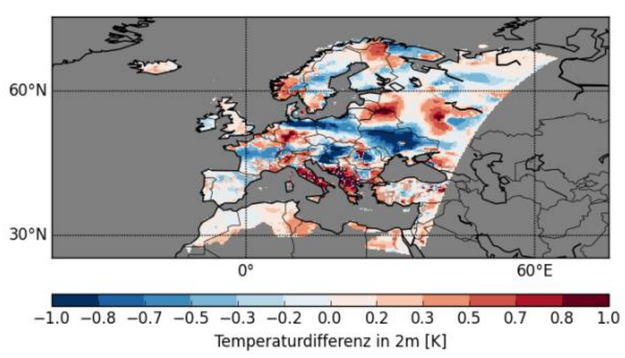


Fig.4: Absolute model bias difference (ambd) between coupled run and CCLM-standalone run for 2m temperature averaged over the winter 1995/1996. The reference is E-OBS.

Evaluation: Climatologies

As shown in Fig. 2 the 2m temperature bias of the coupled run is mostly in a range of ±2K, with strongest bias in the Balkan region. A similar structure is also produced by a CCLM-standalone run (not shown here). To compare the biases of coupled and standalone run, the absolute model bias difference (ambd) was introduced, with ambd = abs(bias stdaln) – abs(bias coup). The ambd is small and within the internal model variability. The same applies to the precipitation for Central Europe (see Fig. 3), where the bias is mainly caused by insufficient resolution of topography.

Outlook

Further evaluation is planned, e.g. all negative NAO events shall be considered. Furthermore, the model will be evaluated with extreme weather events like the precipitation which led to the Oder flood in 1997 or dry and hot summer like 2003 and 2018. It will be investigated if the coupled model has a better performance than the standalone model through the active consideration of the ocean. After that, a hindcast and a projection run (RCP 8.5 scenario) with MPI-ESM-LR-forcing is planned.

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