A Limited-Area Climate Ensemble Prediction System (LACEPS)

Project title:

A Limited-Area Climate Ensemble Prediction System (LACEPS)¹

LACEPS (Förderkennzeichen 01LP1154A) is one project of the BMBF funded research programme MiKlip² ("Mittelfristige Klimaprognose", 01.09.2011 – 31.08.2015) in Module C (Regionalization) proposed by Deutscher Wetterdienst (DWD).

Abstract:

To support policy making decisions on national and regional level with respect to climatological issues the downscaling of global climate predictions to the regional scale is essential for the economic and social benefits of climate forecasts on all time scales and, thus, also on the decadal time scale. The main goal of LACEPS is the development of a limited-area ensemble prediction system for medium-range climate prediction on the regional scale using the COSMO-CLM regional climate model.

The general goal of a regional climate ensemble prediction system is to span the complete space of all possible outcomes responding to the incomplete knowledge and uncertainties of the model input data and the model's inherent uncertainties. From the resulting ensemble probability density functions for each climate variable may be derived. Although an ensemble prediction system large enough to completely represent the probability density function of all possible forecasts would be desirable, it is practically impossible. This implicates that LACEPS can only be a sample of the full probability density function and to establish an adequately dispersive ensemble prediction system of equally likely members approximating the probability density function best. From the transfer of well-established methods from the probabilistic weather forecast framework to the decadal climate prediction system synergetic benefits can be expected.

The ensemble prediction system will be established in LACEPS for the region of Europe and surrounding countries (EURO-CORDEX domain). In the first project phase the horizontal resolution of the model domain is 0.22°, in the further phases it is intended to enhance the grid resolution to 0.11°. The driving data are results of MPI-ESM calculated during the CMIP5 project. The generation of the ensemble will be done by applying 3 different techniques: 1.) perturbations of the initial values by using driving data from MPI-ESM runs started at different days, 2.) perturbations of physics by varying tuning factors and constant values used in physical parameterizations as well as using different physical parameterizations, and 3.) perturbations of boundary data by varying e.g. the sea surface temperature. The simulations will be evaluated by a comparison with the observational data set E-OBS 6.0 available for Europe at 25 km resolution for the daily mean 2 m air temperature, 2 m minimum and maximum air temperature, the daily precipitation sum and the daily mean of sea level pressure for the time period between 1950 and 2011.

As meteorological parameters the focus will be on the 2 m air temperature and the precipitation amount. These parameters are selected because of their high impact on

¹ http://www.fona-miklip.de/en/320.php

² http://www.fona-miklip.de/

economy, agriculture, policy, and society as well as on the daily life of the citizens. Further interest will be on the atmospheric humidity as well as the liquid water and ice phase since these parameters are decisive for the onset and intensity of precipitation. Furthermore, liquid water and ice content are used in various parameterization schemes for precipitation. In addition, these parameters determine the fraction of cloud cover and, thus have an important impact on the radiation processes and feedback on the 2 m air temperature.

In the case of a positive result of the research programme MiKlip it is planned to resume the ensemble prediction system into the operational agenda of DWD.

Project leader and contact address:

Dr. Barbara Früh Deutscher Wetterdienst Zentrales Klimabüro Frankfurter Str. 135 63067 Offenbach/Main Tel: 069/8062-2968 Fax: 069/8062-2993 Email: <u>barbara.frueh@dwd.de</u>

External reviews:

LACEPS is part of the BMBF funded research programme MiKlip. Thus, the proposal passed a review process. The work progress will be externally reviewed by BMBF in August 2014.

Types and amounts of resources at DKRZ needed:

The vast part of the COSMO-CLM simulations needed to establish the ensemble system will be done on the high performance computer SX8R of DWD at Offenbach. In 2013 it is intended to run in total about 5 COSMO-CLM simulations on blizzard at DKRZ. One of these runs will be done using identical input parameters and input data as on SX8R at DWD. The purpose of this run at DKRZ is the determination of the uncertainties in the model results with respect to different computing architectures and differing compiler. About 4 COSMO-CLM runs will be performed in the context of perturbing the model physics by varying model tuning parameters.

A decadal run of COSMO-CLM with the specifications needed in LACEPS requests about 140000 CPU hours on blizzard. The planned 5 runs of COSMO-CLM at DKRZ equal to 50 years of model run and summarize to about 700000 CPU hours. For postprocessing and CMORizing of the model results additional 20000 hours of CPU time is needed. These steps are necessary to provide the results to all MiKlip project partners on the recently opened MiKlip data server at DKRZ. Hence the total request for computing time is 720000 CPU hours.

The data output of COSMO-CLM for one decade is about 8 TByte. Due to data transfer to DWD and to the MiKlip data server in total 20 TByte is sufficient as working space. Archiving the results will be done at DWD and therefore archive space is not needed.