

## **Miklip**

### **„Regional Decadal Predictability“ - DecReg „Decadal Prediction of African Rainfall and Atlantic Hurricane Activity“ - DEPARTURE**

#### **Abstract**

In the framework of the BMBF project MIKLIP a regional model system will be developed to project the probable climate change within a time period of about 1 to 10 years. Within MIKLIP the sub-projects DecReg and DEPARTURE are aiming at the improvement of decadal predictions with regional climate models. Regional climate data with a spatial resolution in the order of several km constitute the link between the results, provided by coupled atmosphere-ocean global circulation models at resolutions around 100 km, and the scale of data needed for designing adaption measures and performing impact studies, which is in the order of kilometers. Although of primordial importance, the feasibility, added value and limitations of downscaling GCM decadal predictions to scales on the order of a few kilometers has not been studied yet. For this study the focus area of DecReg is Europe, and for DEPARTURE it is Africa.

Our contribution to DecReg and DEPARTURE consists in the investigation of the impact of soil initial and boundary conditions. Within this work package we plan to perform sensitivity studies with respect to initialization of soil moisture and temperature, and also to develop a surface analysis framework that allows proper initialization of all soil strata by combining different data types. This framework will apply an Ensemble Kalman Filter, which treats nonlinearities and the intermittent character in soil processes adequately. Localization is not necessary in land assimilation because of the independent modeling of the soil columns in present-day SVATs. Instead the focus will be in the joint estimation of both, initial state and model parameters through data assimilation. This allows for adaptation of not well-known model parameters (e.g., quasi-static vegetation parameters or deep strata soil textures) that, if not adapted, simply render the model unable to produce correct states or flux values.

#### **Summary of requested resources**

This study requires the performance of several regional climate simulations. These simulations will be done with the regional climate model COSMO-CLM. The COSMO-CLM (CONsortium for Small-scale MOdeling-Climate Limited-area Model) is a state-of-the-art non-hydrostatic RCM (see <http://www.clm-community.eu>). It is the climate version of the COSMO-model (see <http://www.cosmo-model.org>), which several European weather services use for mesoscale weather forecasting.

The planned simulations will be driven with 6-hourly data of global climate simulations performed by ECHAM6 and HadCM3. The simulations for the African domain will be performed with a horizontal resolution of  $0.44^\circ$ , while the simulations for Europe will have a resolution of  $0.22^\circ$ . For each domain one reference run and one test run with over 20 years are planned for both driving datasets. Finally decadal hind-cast simulations are planned for the time period 1960 to 2010.

## Estimation of required resources

The assessment of computational requirements are basing on previously done COSMO-CLM simulations.

- African domain with resolution of  $0.44^\circ$ ,  $255 \times 103$  grid points, and a time step of 150s, requires about 500 CPUh/ simulation year
- European domain with resolution of  $0.22^\circ$ ,  $244 \times 238$  grid points, and a time step of 75s, requires about 2200 CPUh/ simulation year

Domain	Driving data	Resolution	Simulation period	CPUh	Data
Africa	MPI-ESM	$0.44^\circ$	1991-2010	10000	875 GB
Africa	MPI-ESM	$0.44^\circ$	1991-2010	10000	875 GB
Africa	HadCM3	$0.44^\circ$	1991-2010	10000	875 GB
Africa	HadCM3	$0.44^\circ$	1991-2010	10000	875 GB
Europe	MPI-ESM	$0.22^\circ$	1991-2010	44000	1.9 TB
Europe	MPI-ESM	$0.22^\circ$	1991-2010	44000	1.9 TB
Europe	HadCM3	$0.22^\circ$	1991-2010	44000	1.9 TB
Europe	HadCM3	$0.22^\circ$	1991-2010	44000	1.9 TB
Africa	MPI-ESM	$0.44^\circ$	1961-1970	5000	438 GB
Africa	MPI-ESM	$0.44^\circ$	1971-1980	5000	438 GB
Africa	MPI-ESM	$0.44^\circ$	1981-1990	5000	438 GB
Africa	MPI-ESM	$0.44^\circ$	1991-2000	5000	438 GB
Africa	MPI-ESM	$0.44^\circ$	2001-2010	5000	438 GB
Africa	HadCM3	$0.44^\circ$	1961-1970	5000	438 GB
Africa	HadCM3	$0.44^\circ$	1971-1980	5000	438 GB
Africa	HadCM3	$0.44^\circ$	1981-1990	5000	438 GB
Africa	HadCM3	$0.44^\circ$	1991-2000	5000	438 GB
Africa	HadCM3	$0.44^\circ$	2001-2010	5000	438 GB
Europe	MPI-ESM	$0.22^\circ$	1961-1970	22000	950 GB
Europe	MPI-ESM	$0.22^\circ$	1971-1980	22000	950 GB
Europe	MPI-ESM	$0.22^\circ$	1981-1990	22000	950 GB
Europe	MPI-ESM	$0.22^\circ$	1991-2000	22000	950 GB
Europe	MPI-ESM	$0.22^\circ$	2001-2010	22000	950 GB
Europe	HadCM3	$0.22^\circ$	1961-1970	22000	950 GB
Europe	HadCM3	$0.22^\circ$	1971-1980	22000	950 GB
Europe	HadCM3	$0.22^\circ$	1981-1990	22000	950 GB
Europe	HadCM3	$0.22^\circ$	1991-2000	22000	950 GB
Europe	HadCM3	$0.22^\circ$	2001-2010	22000	950 GB
Total			$\approx 360$ years	486000	$\approx 25$ TB

The total computational demands amount to about 486000 CPUh. The simulations will produce a data volume of about 25 TB. Long time archiving of these data will be at the Goethe-University Frankfurt. In order to provide parts of the data for other Miklip sub-projects, it would be useful to archive these on HLRE. For this purpose, a data capacity of 5 TB should be sufficient.