01 LD 0026
1.10.2001 – 30.9.2005

IVECC

S. Kotlarski, D. Rechid, L. Kotova, D. Jacob

Max-Planck-Institute for Meteorology, Bundesstr. 55, 20146 Hamburg

kotlarski@dkrz.de; http://www.mpimet.mpg.de

Key words: regional climate model, uncertainty, climate change scenario, dynamic vegetation

1 Aim of the research within QUIRCS

The subproject IVECC (Impact of vegetation on regional climate and climate change simulations) will contribute to the assessment of uncertainties in currently used regional climate models under present-day and future climate conditions. Three 15 years long regional climate simulations will be performed using the most recent version (5.1) of the regional climate model REMO (Jacob, 2001). Boundary conditions are prescribed by ECMWF reanalysis (present-day climate) and by two runs of the global climate model ECHAM4 on a T106 resolution (control run, scenario run assuming SRES scenario B2). As it was agreed upon among the project partners these two global integrations will also be performed within the IVECC subproject. Both global and regional climate simulations are subject to an intense quality assessment and results will be distributed subsequently to the project partners. The regional climate model run for present-day climate (driven by ECMWF reanalysis) is being validated against observations in detail. Spatially distributed climate change signals (including magnitude and frequency of occurrence of extreme events) will be derived from the comparison of control and scenario runs. Furthermore, sensitivity studies will assess the influence of monthly varying vegetation characteristics and of changes in the vertical resolution of the regional climate model on the model results.

2 Recent and completed activities

GCM simulations

Two simulations of the global climate model ECHAM4 have been performed on a T106 resolution and model outputs are currently being post-processed in order to serve as input for the regional climate simulations. The global control run, assuming present day climate conditions, has been integrated for the period 1960 to 2000. The scenario run has been performed on the basis of SRES scenario B2 for the period 2070 to 2100. The following input data had to be prepared prior to the simulations:

- lower boundary conditions for SST, sea ice cover and sea ice depth were interpolated from a coupled ECHAM4/T42+OPYC3 experiment
- time series of mean annual greenhouse gas concentrations (CO_2, CH_4, N_2O, CFC)
- mean monthly concentrations of oxidants (O_3, OH, H_2O_2, NO_3)
- emissions of SO_2 and DMS

Regional climate model simulations

The baseline simulation of REMO for today's climate (boundary conditions prescribed by ECMWF reanalysis) has been performed for the years 1979 to 1993. The model output is now

being pos-processed and parts of it are already distributed to the project partners. The underlying regional model domain consists of 289x321 grid boxes with a resolution of $^1/_6$° on a rotated grid (approx. 18 km grid box length). The latest model version REMO 5.1 has been used, including a number of improvements with respect to the previous version:

- fractional amounts of sea, land and sea ice cover for each grid box with surface fluxes being calculated separately for each class
- incorporation of freezing and melting processes in the soil
- extended parameterization of snow
- influence of soil moisture on heat capacity and heat conductivity of the soil
- monthly varying vegetation characteristics (vegetation ratio, leaf area index, albedo)

Sensitivity studies

Monthly varying fields for vegetation ration, leaf area index and albedo have been implemented successfully into the regional model REMO. A test simulation has been performed for the period 1979 to 1993 in order to allow for an assessment of the influence of monthly varying vegetation characteristics on the regional climate.

3 Principle results and Conclusions

Regional climate model simulations

First comparisons of the reanalysis-driven regional climate model run to observations show a satisfying simulation of today's climate in the study area for a number of key parameters (e.g. precipitation). The annual cycle seems to be simulated in a realistic way. Nevertheless, further and more detailed validation of the model results is necessary (see contribution of BTU).

Sensitivity studies

Investigations reveal a strong influence of the new parameterisation of vegetation characteristics on the simulated regional climate, especially during the summer months. Due to a positive energy balance and less influence of advective processes the impact of surface conditions on the boundary layer climate is most pronounced during that time of the year.

4 Planned activities

All model results of the completed integrations will be pos-tprocessed, analysed in more detail and distributed to the project partners in the near future. The input for the two remaining regional climate simulations will be calculated from the GCM control and scenario run and both regional climate model runs will be integrated for 15 years each. Regional climate change signals will be derived from a comparison of the two runs. Regarding sensitivity studies, dynamically varying vegetation characteristics (depending on the simulated climate) will be implemented into REMO and the effect on the simulated regional climate will be investigated. Furthermore, the spatial variability of vegetation will be enhanced by implementing the so-called mosaic approach. Major land-use classes have already been defined and the proportionate coverage for each grid box has been calculated. A further sensitivity study will investigate the influence of an enhanced vertical resolution on the simulated regional climate.

References

Jacob, D., 2001, A note to the simulation of the annual and inter-annual variability of the water budget over the Baltic Sea drainage basin, Meteorol. Atmos. Phys. 77, 61-73.