GOETHE UNIVERSITÄT FRANKFURT AM MAIN

BiK F | Biodiversität und Klima Forschungszentrum

CLM Community Assembly 2014

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Book of Abstracts

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Additional Information

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BiK-F: Getting there

By public transport

- Rail: Lines S3, S4, S5 and S6 – stop at "Westbahnhof" station; 12 minutes walk
- Underground: Lines U6 und U7 – stop at "Bockenheimer Warte" station; 7 minutes walk
- Line U4 – stop at "Bockenheimer Warte" station; 7 minutes walk
- Bus: Line 32 – "Senckenbergmuseum" stop, 5 minutes walk
- Tramway: Line 16 – "Bockenheimer Warte" stop; 9 minutes walk

By car

• arriving from the south and the east:

Drive across the motorway-junction "Frankfurter Kreuz" until the "Westkreuz Frankfurt", then take the motorway A 648 (towards "Stadtmitte" - B8/44) until Frankfurt Fair (Messe), in the roundabout turn left (towards "Ginnheim / Eschersheim" - B8/40). U-turn after about 600 meters, pass the Senckenberg museum, take the second street on the right (Georg-Voigt-Straße).

• arriving from the north:

Drive across the motorway-junction "Nordwestkreuz Frankfurt" on motorway A 66 (direction "F-Miquelalle / Stadtmitte"), turn right before the end of the motorway (towards "Hauptbahnhof / Messe" – B8/40), and follow the course of the street "Zeppelinallee". After the Senckenberg museum, take the second street on the right (Georg-Voigt-Straße).

Please consider, there are no visitor parking spots available at the institute.

However, you may access to convenient public parking facilities nearby:

• Parking garage "Adalbertstrasse"; open Monday to Saturday 7.00 to 23.00; closed on Sunday and public holidays

Tow parking lots for disabled persons are located in front of the west entrance of the building (Nr. 16).

How to get from BiK-F to …

… Frankfurt city center:
Walk 7 minutes to the "Bockenheimer Warte" station of the underground Lines U6 und U7, take the U-Bahn in the direction of Enkheim or Frankfurt Ost; get off at Hauptwache. To buy a ticket at the RMV vending machine, use the button "Kurzstrecke, Erwachsene" (short trip, adult). If you travel more than three stations, use “Einzelfahrt Frankfurt” (single ticket).

… Frankfurt central railway station:
Walk to the “Bockenheimer Warte” underground station, preferably the entrance close to the Senckenberg-Museum (7 minutes), take the U4 in the direction of Enkheim. Get off a “Hauptbahnhof”.

… the airport:
Walk 7 minutes to the "Bockenheimer Warte" station . Choose a ticket “Einzelfahrt Frankfurt Flughafen (indicated by an airplane)” at the ticket machine. Take the U4 underground line to “Hauptbahnhof” (see above). Take the S-Bahn 8 or 9 (commuter train; direction Wiesbaden, the ticket is valid both for the underground and the commuter train), get off at the third stop. You can also take the regional train RE 55 in peak hours) or RE 80. Regional trains leave from the platforms in the main hall. Check www.bahn.de for timetables. See also: www.rmv.de/airport/startseite.do?lang=en for a connection planner to/from Frankfurt-airport.

How to use the ticket machines of S-Bahn and U-Bahn:
If you need to go somewhere else than the city center or airport and need more explanations, simply press a button to select a different screen language (English, French, Italian, Spanish or Turkish). These machines accept payment in coins and banknotes, specifically 5-, 10-, 20- und 50-Euro. The screen will display the banknotes accepted. This will depend on the fare amount and the change available. The possible means of cashless payment will also be indicated in the payment screen on the display.

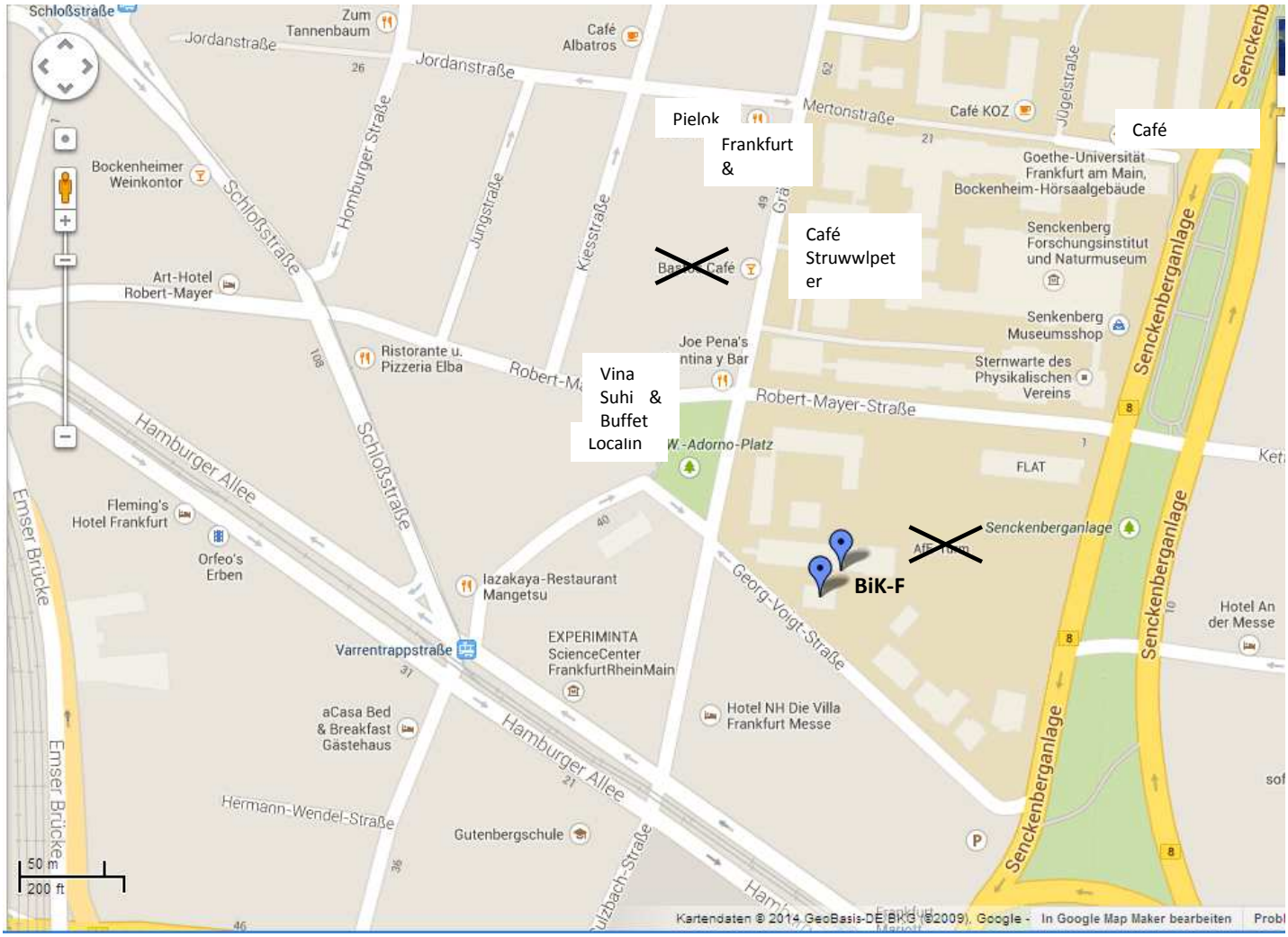
Taxi transport:
You can get a taxi at the taxi stand at the main entrance of the underground station “Bockenheimer Warte” (3 minutes walk). You can also hail a passing one or call Taxi-Frankfurt under
069 / 230001, 069 / 230033, 069 / 250001 or **069 / 792020**

Nearby Restaurants

The following restaurants are situated within only a few minutes walking distance:

- japanese: Izakaya Mangetsu, *mangetsu.de*, Varrentrappstraße 57 (5 min)
- italian: Localino Da Cimino, Robert-Mayer-Straße 17 (2 min)
- Local, seasonal, with garden terrace: cafe-albatros.de (7 min)
- international: frankfurt-and-friends.de (6 min)
- asian + Sushi: vina-sushi.de (2 min)
- mexican: joepenas.de (3 min)
- heavy, substantial („bürgerlich“): restaurant-pielok.de (5 min)

- organic and vegetarian: Bistro at the“Basic“ Organic supermarket, Frankfurt-Bockenheim, Leipziger Straße 11–11c (Soups, Pasta, Sandwiches and rolls, snacks) (ca 10 min)
- University cafeteria Campus Bockenheim (10 min): www.studentenwerkfrankfurt.de/essen-trinken/einrichtungen/goethe-universitaet/campus-bockenheim/cafeteria-bockenheim.html
- University Cafés Struwwelpeter (5 min) and Juridicum (7 min) (salads, sandwiches, snacks …): www.studentenwerkfrankfurt.de/essen-trinken/einrichtungen/goethe-universitaet/campus-bockenheim/cafe-struwwelpeter.html, www.studentenwerkfrankfurt.de/essen-trinken/einrichtungen/goethe-universitaet/campus-bockenheim/cafe-juridicum.html



Introduction and Overview

News from EXTPAR

Daniel Lüthi
Institute for Atmospheric and Climate Sciences, ETH Zürich, Switzerland

EXTPAR 2.0 has been released in February. It combines the developments from DWD, MeteoSwiss and the CLM-community into a unified version. It provides the necessary external data fields for all new options present in COSMO 5.0 and int2lm 2.0.

EXTPAR 2.0 also supports new data sets that have become available and provide the raw data at a resolution suitable for kilometer scale simulations and beyond, this includes the ASTER digital elevation data, GLOBCOVER land use data and HWSD soil data information.

The new external data fields have an impact on the external parameters used in the model even at the hydrostatic scale. It shall be shown therefore what the effect of these changes is on the climatology of the COSMO-CLM for the CORDEX-EU-044 configuration..

Latest Developments in Preprocessing and Starter Package.

Burkhardt Rockel
Institute of Coastal Research, Helmholtz-Zentrum Geesthacht, Centre for Materials and Coastal Research (HZG), Germany

On the last year's assembly in Zürich the INT2LM1.10_clm14 was presented. Since then several updates were applied to int2lm until the latest version INT2LM2.00 which is a unified version of COSMO and the CLM-Community. The major changes will be highlighted.

In climate mode the data from global climate models and reanalyses are converted to a standard netCDF format which can be read by INT2LM. An update of available data and converters will be given.

The starter package is updated generally once a year in connection with the COSMO/CLM trainings course. Since in the weather forecast part of the trainings course the new COSMO 5.0 / INT2LM 2.0 was the basis of the exercises the

CCLM starter package was also updated to the latest reunified versions. The latest changes and addition of the starter package will be presented.

Recent Developments of the COSMO-CLM

Hans-Jürgen Panitz
Karlsruher Institut für Technologie (KIT), Germany

After several years of applications of the evaluated CCLM versions COSMO_4.8_clm17 and COSMO_4.8_clm18, accompanied by a variety of changes, extensions and developmets carried out by the COSMO consortium and the CLM-Community, the new unified version COSMO_5.0 had been released in November 2013.

The talk will describe the most important model changes and extensions from a more technical point of view. As far as possible the effects of these new developments will be illustrated.

News from COSMO

Ulrich Blahak
Deutscher Wetterdienst, Offenbach, Germany

The presentation will summarize news from COSMO which are of interest to the CLM-Community. This includes organizational news from the consortium as well as recent changes and updates to the NWP version of the COSMO model.

EVAL

The Inter-Sectoral Impact Model Intercomparison Project (ISI-MIP)

Andreas Dobler
Potsdam-Institut für Klimaforschung (PIK), Germany

ISI-MIP is a community-driven modelling effort with the goal of providing cross-sectoral global impact assessments based on the newly developed RCP and SSP scenarios. A quantitative estimate of impacts and uncertainties for different sectors and from multiple impact models will be derived, serving as a basis for impact model evaluation and improvement, and allowing for improved estimates of the impacts of climate change at different levels of global warming (e.g., 2, 3 and 4°C).

In the first ISI-MIP \"fast track\" phase, around 30 global climate impact modelling groups from the agriculture, water, ecosystems, infrastructure and health sector did participate. The models were provided with pre-processed, identical input data (climate and socio-economic data based on CMIP5) and the simulations followed a common simulation protocol. The fast track input and output data are available for download from the ISI-MIP ESGF node esg.pik-potsdam.de. In this presentation, the fast track outcomes (also provided for the IPCC's Fifth Assessment Report) will be shown.

Additionally, a longer-term, coordinated impact assessment effort was initialized and the second phase of ISI-MIP has recently started. This includes the sectors covered in the fast track phase plus the fisheries and energy sector, as well as regional impact models. Long-term aims of the second phase also include the improvement of impact model projections, in particular with regard to extreme events and variability. These improvements are addressed by the use of improved bias correction methods, improved model set-ups, and on high resolution regional climate projections from CORDEX. This could clearly emphasize the added value of regional climate models in the cascade of impact modelling.

Two-way coupling of ECHAM5 and COSMO using the MECO(n) system

Astrid Kerkweg, C. Hofmann
Institut für Physik der Atmosphäre, Universität Mainz
Gregor Gläser, Karlsruher Institut für Technologie (KIT)
Patrick Jöckel
Deutsches Zentrum für Luft- und Raumfahrt, IPA, Oberpfaffenhofen, Germany

The interface to the Modular Earth Submodel System (MESSy) is part of the official COSMO model since COSMO version 5.0. The one-way on-line coupling of COSMO with the EMAC (ECHAM5/MESSy for Atmospheric Chemistry) model is well established by now, i.e., the COSMO model is driven on-line by its driving model. In the mean time we are extending this one-way coupling to a two-way coupling as a part of the MiKlip project FLAGSHIP (Feedback of a Limited-Area model to the Global Scale implemented for decadal Hind-casts and Projections). In this way smaller scale processes resolved in the COSMO model are fed back to the global scale. The ECHAM model has a spectral core and is hydrostatic, while the COSMO model is a non- hydrostatic grid point model. This adds to the challenges in building a stable coupling between these two models. While the coupling of passive tracers and humidity tracers alone functions well in our test cases, the dynamical coupling proves to be an extra challenge. Here we report on the status of the dynamical coupling and show first results.

Separating dynamical and thermodynamical effects in surrogate COSMO-CLM experiments of the European summer climate

Nico Kröner, Sven Kotlarski, Daniel Lüthi, Erich Fischer, Christoph Schär
Institute for Atmospheric and Climate Sciences, ETH Zürich, Switzerland

The extraordinary summer heatwaves in 2003 and 2010 raised the interest of the scientific community in the European summer climate. Different observational studies showed that European summer temperatures were rising in the last decades especially in the upper percentiles. Future climate projections provide strong evidence for this trend to continue. However, the processes driving the observed and projected changes in European summer climate are not fully understood. Different mechanisms were proposed including changes in soil moisture regime, cloud cover changes or altered large-scale circulation patterns. Until now most studies focused on particular aspects of the driving mechanisms, but could not quantify their different contributions. In a first step towards filling this gap, we performed several surrogate climate change experiments. The basic idea of the surrogate technique is to apply a large-scale warming to the lateral

boundary conditions of a present-day reference simulation, while maintaining the relative humidity (and thus implicitly increasing the specific moisture content). The experimental suite includes six runs of the regional climate model COSMO-CLM carried out at a resolution of ~50km. The first two runs are used as reference and are a regular control (1971-2000, CTRL) and scenario (2070-2099, SCEN) run driven by the global climate model MPI-ESM-LR and assuming the RCP8.5 greenhouse gas emission scenario. The other four experiments apply some simplified warming (cooling) to the lateral boundary conditions of CTRL (SCEN). In the simplest case, this warming is vertically and horizontally homogeneous; in other experiments the warming is assumed to be a function of height (as estimated from SCEN-CTRL), thereby accounting for lapse rate changes. Our methodology is based on the assumption that the different surrogate experiments represent different parts of the climate change signal and should approximately sum up to the full climate change signal. We can show that this is indeed the case with surprisingly good accuracy. With this assumption proofed, we can quantify the different climate-change contributions due to changes in large-scale circulation and a large-scale warming. One specific goal is to understand the north-south gradient in the SCEN-CTRL temperature signal, which is a characteristic signal in all European climate projections during the summer season. Analysis shows that already a horizontally homogeneous warming leads to a stronger warming in the southern regions of Europe, and that this signal is further amplified by large-scale circulation changes as inherited from the driving GCM. We can further analyze the effects of a lapse rate change, and find that it is significant and relies on feedbacks between soil moisture as well as convective cloud cover and precipitation changes.

The application of the new IFS convection scheme in COSMO-CLM

Burkhardt Rockel, Institute of Coastal Research,
Helmholtz-Zentrum Geesthacht, Centre for Materials and Coastal Research (HZG)
Hans-Jürgen Panitz, Karlsruher Institut für Technologie (KIT), Germany

By default, the most recent versions of COSMO, respectively COSMO-CLM (CCLM), offer only one parameterization scheme for convection, namely the Tiedtke scheme (Tiedtke, 1989). However, the option exists to use the convection scheme of the Integrated Forecasting System (IFS) of ECMWF. This option was already available in previous versions of CCLM using version Cy33r1 of the IFS scheme (Bechtold, 2009). But as several studies (e.g. Brockhaus et al., unpublished manuscript) and sensitivity simulations within the frame of CORDEX showed, the IFS scheme produced to much rain of light intensity (< 3 mm), and the daily cycle of convective rain was also not correct. The precipitation maximum occurred a few hours too early, a shortcoming, which is also apparent when using the Tiedtke scheme. In summer 2013 ECMWF published a new version (Cy40r1)

of its IFS convection scheme, which improved the diurnal cycle of convection considerably (Bechtold et al, 2013), at least when being applied within the IFS. In the meantime, this new version of the IFS scheme has been implemented in CCLM and can be chosen as the single alternative to the Tiedtke scheme. CCLM Simulations applying the old and the new IFS scheme have been and are going to be carried out. On the one hand, these simulations are based on the ERA-Interim diven CORDEX Africa configuration, on the other hand it has been tried to confirm results of IFS simuation for the continental USA (Bechtold et al., 2013), but applying CCLM in connection with the new IFS scheme. Unfortunately, the latter CCLM simulations did not show improvements in the diurnal cycle of convection when compared to simulations using the old version (Cy33r1) of the IFS scheme. In collaboration with P. Bechtold from ECMWF we are going to find out the reasons for this. In the talk the current status of the development will be presented.

References:

Bechtold, P.., 2009: Chapter IV-5: Convection. ECMWF IFS documentation, www.ecmwf.int

Bechtold et al., 2013: Breakthrough in forecasting equilibrium an non-equilibirium convection. ECMWF Newsletter No. 136, 15-22.

Brockhaus et al.: The ECMWF IFS convection scheme applied in the COSMO-CLM limited-area model. Unpublished manuscript.

Tiedtke,M, 1989: A comprehensive mass flux scheme for cumulus parameterization in large-scale models. Monthly Weather Review, 117, 1779-1800.

Regional Climate modeling over a Chinese area: assessment of performances and climate projections

Edoardo Bucchignani, Myriam Montesarchio, Paola Mercogliano, Maria Paola Manzi, Luigi Cattaneo
CMCC - Euro Mediterranean Centre for Climatic Changes, Lecce, Italy,

This study presents the results of high resolution (0.125°) climate simulations over a Chinese area performed with an optimized configuration of COSMO-CLM, driven by ERA-Interim Reanalysis and by the output of the global model CMCC-CM. The main aim of this work is to assess the added value of the high resolution, taking into account the large computational costs required.

As reported in the White paper (2012), China is one of the most susceptible countries to the adverse effects of climate change, mainly in the fields of agriculture, livestock breeding, forestry, natural ecosystems, water resources and coastal zones; in fact, the Fifth Assessment Report of IPCC (2013) states that annual temperature and heavy precipitation events in China are very likely to increase in the future. The area of China, as a consequence of its large dimensions and its complex geography, exhibits a variety of different climates. General Circulation Models (GCM) are generally unsuitable to simulate climate at

local scale, since they are characterized by resolutions generally around or coarser than 100 km. For these reasons, a quantitative evaluation on the risk modifications due to climate change requires a downscaling of GCM models.

COSMO-CLM has been used to perform climate simulations at spatial resolution of about 14 km over the domain (65 - 125 E; 20 - 42 N) covering a wide Chinese area. Results of hindcast simulations have been analyzed and compared with CRU, MERRA and GPCP observational datasets. With respect to literature results and to CORDEX-EA experiments, present results have revealed that precipitation representation greatly benefits from the resolution increase, as well as the representation of temperature, even if to a smaller extent. Values of mean temperature show a negative bias in high altitude regions and a positive bias in warm dry regions. Maxima biases are confined in local areas of the domain. Concerning precipitations, overestimation is registered in the north-east area and underestimation in south-east China.

Climate projections, under the new IPCC RCP4.5 and RCP8.5 emission scenarios, highlight a general warming expected in the period 2041-2070 over the whole area considered, while no precipitation changes are expected in wide areas. Increases of precipitations are projected for both scenarios in the eastern part of the domain, from May to August, while the south-east area will be characterized by reduction in winter. These projections are consistent with other ones obtained with both global and regional models, even for different emission scenarios.

Mistral and its Siblings in RCMs

Anika Obermann, Bodo Ahrens
Biodiverisity and Climate Research Centre (BIK-F), Frankfurt, Germany

Mistral is a regional cold and dry north to northwesterly wind following the lower Rhône Valley. It causes deep-water formation in the Mediterranean Sea. Therefore it is important for modeling of the circulation in the Mediterranean Sea. Its sibling Tramontane blows in the valley between Pyrenees and Massif Central. Another similar wind is the Cierzo along Ebro Valley south of Pyrenees.

The occurrence and characteristics of these wind phenomena depend on processes occurring in valleys (e.g. channeling) and deceleration at the valley exit as well as land and sea surface roughness. Mistral accelerates rapidly when reaching the Mediterranean Sea. A deceleration occurs after the wind has travelled some distance above water, where the surface roughness varies with wind speed. Differences in location, shape and amount of wind speed gain and loss in models and observations are studied, as well as error propagation from land to sea.

We investigate the quality of ERA-Interim driven RCM runs on the Med-CORDEX domain in the HyMeX framework in terms of surface winds and study the processes which influence the 10-meter wind speed over land and sea surface.

We compare daily mean wind speed simulations to buoy data and gridded scatterometer data of ocean winds from QuikSCAT on 0.25° resolution and SAFRAN and 0.044° DecReg daily mean wind speed over land.

Analysis of a high-resolution sea surface wind hindcast over the Bohai and Yellow Sea

Delei Li, Beate Geyer, Hans von Storch
Institute of Coastal Research, Helmholtz-Zentrum Geesthacht, Centre for Materials and Coastal Research (HZG), Germany

A 34-year (1979-2012) atmospheric hindcast with a resolution of 7 km over the Bohai and Yellow Sea was performed using the regional climate model COSMO-CLM 4.14 (CCLM), which was forced by the ERA-Interim reanalysis data. The study mainly focuses on the sea surface wind fields. On the one hand, the model results are compared with buoy observation data to validate the wind time series at specific locations, and on the other hand QuikSCAT Level 2B 12.5km (L2B12) swath data during 1999-2009 are used for the spatial validation as well as the assessment of added value from dynamical downscaling. The results show that the modeled wind speed has a good agreement with buoy observations. With the ongoing work we want to show by the use of QuikSCAT data that potential added values is generated in coastal areas with complex orography, while we do not expect obvious added value in the open ocean area. In addition, the sea wind climatology including the long-term temporal variability and spatial pattern is examined in this study.

Representation of climatic events over West Africa with a regional model and sensitivity analysis to regional and anthropogenic forcings

Mame Diarra Bouso Dieng
Laboratory for Atmospheric and Ocean Physics Simeon Fongang, Dakar, Sénégal

The west Africa remains a field experiment in understanding the climate of this part of the african continent, dominated by a highly variable climate. The spatio-temporal evolution of rainfall is marked by wet period from 1950 up to 1968 and a drastic decline in rainfall since 70s to mid 90s and "apparent return" to normal conditions during the last decade.

This new trend is associeted with a high variability of rainfall componets such as heavy rainfall, dy breaks, the beginning and end very irregular groowing seasons, such extrem wester part covering Senegal.

This variability makes the west africa very vulnerable the impacts of extreme weather events such as droughts and floods.Despite the significant progress, a major limitation of these programs is that there has been little uniformity in projects, simulations design and coordination (Giorgi et al. 2008; Gbobaniyi et al. 2011).

The work will include:

i) adapt the regional model CCLM (COSMO- limateLimited-areaModelling) in West Africa in the direction of assessing climate simulations considering different forcings (reanalysis and GCM);

ii) analyze the sensitivity of precipitation (intensity, duration, frequency) in West Africa in history and an increase of GHG by type scenarios RCP;

iii) to test the sensitivity of the model to understand the direct and / or indirect aerosol, SST (surface temperature of the ocean) on regional dynamic structures that modulate precipitation and other parameters that describe the climate.

In the end, demonstrate the important contribution that can bring the CCLM model in the study of the climate of West Africa in general, and more specifically to the extreme negative consequences especially in the context of climate change.

Improving a Wind Farm Parameterization in COSMO-CLM Using Large Eddy simulations

Fabien Chatterjee, Nicole van Lipzig, Katholieke Universiteit Leuven, Belgium
D. Allaerts, J. Meyers, Universität Köln, Germany

Offshore wind deployment is foreseen to expand dramatically in the coming years. The strong expansion of offshore wind parks is likely to affect the regional climatology of the coastal areas surrounding the Atlantic, North Sea and Baltic Sea. The main aim of this project is to assess the climate effect of a change in sea use, due to large-scale offshore wind deployment. Wind turbines are shown to have an effect on wind speed and moisture when parameterized in COSMO-CLM. However the magnitude of these is still unclear on the kilometer scale, and direct comparison with offshore wind farm data remains difficult. Large eddy simulations (LES) offer insights into processes otherwise parameterised in regional climate models, and are used to validate and improve the wind farm representation. An existing wind farm parameterisation (Fitch et. al 2012, Blahak et. al. 2010) has been implemented in an idealised version of COSMO-CLM and compared LES. In a first step, it was found that wind speeds in COSMO-CLM are about 12% too high due to a poor representation of the dissipation by the wind farm. In a second step, LES will be used to improve the representation wind farms in the COSMO-CLM.

A sensitivity study with COSMO-CLM over MENA-CORDEX domain

Salvatore Galluccio, Edoardo Bucchignani, Myriam Montesarchio,
Paola Mercogliano
CMCC - Euro Mediterranean Centre for Climatic Changes, Lecce, Italy,
Hans-Jürgen Panitz, Karlsruher Institut für Technology (KIT), Germany

The Coordinated Regional climate Downscaling Experiment (CORDEX), initiated by the World Climate Research Programme (WCRP), provides global coordination of Regional Climate Downscaling (RCD) for improved regional climate change adaptation and impact assessment. A set of common domains has been defined, encompassing the majority of land areas of the world, on which to perform RCD. In this framework climate simulations with COSMO-CLM have been performed over MENA-CORDEX domain, which includes North-Africa, southern Europe and the whole Arabian peninsula. At CMCC, regional climate modelling is a tool of an integrated simulation system and it has been used in different European and African projects to provide qualitative and quantitative evaluation of the hydrogeological and public health risks.A sensitivity analysis, made up by 26 simulations, was conducted at 0.44° spatial resolution in order to adjust the model configuration to better reproduce the present past climate of the region. Numerical simulations were driven by ERA-Interim reanalysis (horizontal resolution of 0.703125°) for the period 1979-1984 (the first year was considered as a spin up period and thus not included in the analyses). We have examined the effect of variation of the soil albedo, replacing the default dataset with a new one, derived from Moderate Resolution Imaging Spectroradiometer (MODIS), which better reproduces the reflectivity of the Earth's surface, especially over arid zones. We also analyzed the effect of new driving aerosols by NASA-GISS aerosol maps, which describe the distribution of aerosols in a more realistic way. The sensitivity analysis to tuning parameters was performed selecting those parameters that, as well-documented in literature, play an important role in determining the response of the model, mainly related to surface parameterization, convection, radiation and clouds.Model performances are evaluated by using a combination of available ground observations, satellite products and reanalysis: CRU data set was used to assess temperature, precipitation and cloud cover; GPCC and GPCP were used to assess precipitation and MERRA data set for temperature, precipitation and mean sea level pressure. In order to evaluate the correspondence degree between simulated and observed fields and to monitor changes in performances of COSMO-CLM with respect to changes in physical and tuning parameters, several statistical tools are used. Taylor diagrams are applied to assess pattern errors in the model results. Mean error or bias (ME), mean absolute error (MAE) and root-mean-square error (RMSE) are used to quantify the deviation between simulated and observed fields.The selected configuration is being used to carry out simulations on a 30-years past period starting from 1979, driven by ERA-Interim, for two horizontal resolutions, namely 0.44° and 0.22°.

Comparison of CCLM version 5.0 with version 4.8 over Europe

Klaus Keuler
Brandenburg University of Technology Cottbus (BTU), Germany

The working group EVAL has agreed on its last WG-meeting to execute a systematic series of test simulations with the new unified version CSOMO-CLM 5.0. The simulations investigate the influence of several new components and options in order to find an improved model configuration for a new recommended standard version. The simulations will be performed by several WG-members and compiled under consistent configurations in particular using the same domain and grid structure and exactly the same external forcing fields. The exact strategy for the realization of the configuration tests will be discussed at the WG-meeting during the assembly 2014. The results of this simulation ensemble will be compared with two reference runs, a simulation with the current standard version CCLM_4.8_clm19 and a simulation with CCLM_5.0_clm1 using the same recommended standard configuration for Europe. The presentation compares the results of these two reference runs and shows in a first analysis the potential influence of the new model version on standard climatological means.

Poster: Evaluation of COSMO-CLM simulations over Central Europe using the new high-resolution HYRAS precipitation climatology

Susanne Brienen, Barbara Früh, Andreas Walter, Kristina Trusilova, Paul Becker
Deutscher Wetterdienst, Offenbach, Germany

As the resolution of regional climate simulations continues to increase, also comparable data sets are required for the evaluation of the model skill on these fine scales. A new high-resolution precipitation climatology (HYRAS-PRE) is available covering the river catchments in Germany and neighbouring countries. The dataset is available for the time period 1951 to 2006 with a spatial grid spacing of 5km and daily temporal resolution. This data set is used for the evaluation of a set of simulations with the regional climate model COSMO-CLM. These simulations are done over Europe with different horizontal resolutions. The analysis is based on indices describing different aspects of daily precipitation statistics. Ten different river catchment areas in Central Europe are investigated. Additionally, a comparison with the coarser gridded data sets of E-OBS and ERA-Interim is performed and the added value of using the high-resolution HYRAS data set is demonstrated. It is found that the variability between the different data sets is very large. A benefit of the HYRAS-PRE data is seen especially in the frequency distributions and the spatial variability of the indices. An upscaling of the HYRAS-

PRE data by 5x5 grid points reveals an underestimation of all indices compared to the original HYRAS-PRE data;, maximum values are underestimated by up to 20%.

Poster: Regional decadal predictability and predictive skill from an RCM ensemble

Hendrik Feldmann, Marianne Uhlig, Sebastian Mieruch, Gerd Schädler, Christoph Kottmeier, Karlsruher Institut für Technologie (KIT), Germany

The German research program MiKlip aims at the development of a decadal ensemble predictions system. A focus within MiKlip is dedicated to develop a regional downscaling system for Europe using CCLM and REMO.

The global prediction system consists of the Max-Planck-Institute for Meteorology earth system model MPI-ESM.

A regional prediction ensemble for the hindcast period 1960 – 2010 has been generated. A set of suitable metrics have been applied to assess the skill, the reliability and the added value of downscaled decadal predictions. The results indicate a positive skill for multi-year mean temperature over Europe – depending on season, region and averaging interval. The ensemble spread is sufficient indicating reliable predictions. The skill improvement for annual mean quantities is low from the downscaling, with indications for a slightly enhanced reliability and discrimination. On the other hand, a marked added value from the downscaling was found for extreme precipitation.

A next step is to assess the potential for valuable information for users, which can be derived from predicting long-term variations of the European climate. The leading mode of decadal variability in the European/Atlantic sector is the Atlantic Multidecadal Variation (AMV). The AMV index is calculated from the de-trended SST anomalies over the North-Atlantic. Coincidentally, these Atlantic SST anomalies show also the highest skill in global decadal hindcasts several years ahead. The potential predictability from AMV teleconnections especially for extreme value anomalies over Europe is explored using re-analysis driven CCLM simulations. It is evaluated how such teleconnections are represented in the RCM. As an example: The multi-year mean soil water content is correlated to the AMV index in parts of Europe. This provides the potential to predict drought tendencies, which would be relevant for agricultural applications. Afterwards, it will be shown how much of the potential predictability is realized in the MiKlip decadal predictions.

Poster: Evaluating the effects of boundary condition update frequency on CCLMs climate

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In regional climate modelling it is common to update the boundary conditions of the model every six hours. This is mainly due to the fact, that reference data sets like ERA are only available every six hours. Additionally, for offline coupling procedures it would be to costly to store boundary data in higher temporal resolution for climate simulations. However, theoretically, the coupling frequency can be as high as the timestep of the driving model. Meanwhile, it is unclear if a more frequent update of the boundary conditions has a significant effect on the climate in the domain of the regional model. This study uses COSMO/MESSy (Kerkweg and Jöckel, 2012) to couple CCLM offline to the GCM ECHAM5.

For three update frequencies, namely six hours, one hour and six minutes a 30 year time slice experiment has been performed. The evaluation of means, standard deviations and statistics of the climate in regional domain shows only small deviations, some stastically significant though, of 2m temperature, sea level pressure and precipitaion.

The second scope of the study assesses parameters linked to cyclone activity, which is affected by the boundary condition update frequency. Differences in track density and strength are found when comparing between the simulations.

The precipitation bias at the domain borders, especially at the inflow boundary, is more pronounced in higher coupling frequencies. This leads to undesirable biases in snow cover and surface temperature at the outflow boundary. Furthermore, the deviations are not limited to the boundary, they reach far into the model domain.

Poster: Different Methods to Assess the Reliability of Regional Decadal Ensemble Prediction for Europe

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Within the MiKlip (Mittelfristige Klimaprognosen) project the coupled model MPI-ESM is used to perform decadal hindcast (initialized) experiments. These experiments, baseline 0, are performed at a low-resolution configuration (MPI-ESM-LR) with the latest version of the ocean model MPIOM and the atmospheric component ECHAM6. The ocean model is run at a horizontal resolution of 1.5° and 40 vertical levels. For ECHAM6 the horizontal resolution is T63 with 47 vertical levels, including the upper stratosphere up to 0.1 hPa. The initial conditions for the 10 initialized runs are taken from an assimilation experiment

using the coupled model and are perturbed by a 1-day-lagged initialization of the assimilation experiment. In the assimilation experiments, the model state is nudged towards 3-dimensional daily ocean temperature and salinity anomalies added to the model climatology. These anomalies are taken from an MPIOM experiment forced with NCEP/NCAR reanalysis. No assimilation of atmospheric parameters is applied. Several improvements on the simulations baseline 0 (B0-LR) are carried out for the MiKlip baseline 1 (B1-LR) system.

In the MiKlip project LACEPS (A Limited-Area Climate Ensemble Prediction System) the MPI-ESM-LR both B0 and B1 hindcast experiments are downscaled to the CORDEX-Europe domain with a horizontal grid resolution of 0.22° using COSMO-CLM with the version of COSMO4.8-clm17, respectively for time period 1961-2010 and 2001-2010. By using driving data MPI-ESM-LR the initial conditions perturbation strategy is implemented. The ensemble with model physics perturbation is generated varying one tuning parameter in COSMO-CLM using identical initialization and driving data. For the evaluation of the MPI-ESM as well as the COSMO-CLM hindcasts, the gridded observational E-OBS data in version 8.0 were used.

The focus of this study is on the 2-m temperature, the number of wet days (the days with precipitation ≥ 1 mm/day) and Simple Daily Intensity Index, SDII (the daily precipitation amount for wet days, mm/wet day) by the ensemble spread score (ESS), Ensemble Mean Bias (EMB), β-Score and β-Bias and Talagrand diagram (Analysis Ranked Histogram, ARH). The results from different methods are compared to have a much more accurate estimation of the reliability of ensemble system. Two time periods, 2002-2005 and 2006-2009 are considered. To filter out the systematic error, anomalies are calculated by removing the climatological mean.

Based on the initial conditions perturbation, COSMO-CLM B0 and B1 present a higher reliability in winter (DJF) than in summer (JJA) for the 2-m temperature for COSMO-CLM B0. The model physics perturbation presents a non-reliable ensemble system neither for the 2-m temperature nor for SDII. Too much wet days are observed in most parts of Europe in summer and winter, except for an underestimation of wet days mostly over the Balkan in summer by COSMO-CLM, in both perturbation strategies. There is less overestimation of the number of wet days in COSMO-CLM than in MPI-ESM. In COSMO-CLM B1, the spread of SDII in both perturbation strategies is small and it is smaller in the model physics perturbation ensemble than with the initial conditions perturbation strategy. Comparing COSMO-CLM B0 to MPI-ESM-LR B0 unveils an added value of the downscaling for the 2-m temperature in winter and summer in the Talagrand diagram. The comparison of COSMO-CLM B0 and B1 shows that they are very similar in their spatial pattern and show a similar added value in reliability.

Poster: Is there added value in regional climate models with increasing grid resolution?

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Within the BMBF funded programme MiKlip one focus is on the regional scale decadal climate predictions using regional climate models. These limited-area models are widely used as a tool to downscale information resulting from coarser-scale global climate models to smaller scales. This downscaling is usually performed onto a model grid with much higher resolution of the topography and atmosphere. Hence it should lead to a more realistic description of the atmospheric fields. However, work on exploring this added value started only recently.

In the MiKlip projects LACEPS and RegioPredict three ERA-driven evaluation runs were performed at different horizontal resolutions of 0.44°, 0.22°, and 0.11° on the CORDEX Europe model domain for the time period from 1979-2012. With these simulations different strategies to explore the added value of high-resolution models compared to models with a coarser model grid will be shown and discussed. The choice of the selected grid resolutions allows e.g. an upscaling of the high resolution results to a coarser grid and a comparison of the upscaled with the direct model results on the coarser model grids. Further, high resolution gridded observational data sets as e.g. the HYRAS data will be used to explore if an increasing grid resolution leads to a lower bias.

Poster: In-service aircraft measurement analysis combining aircraft trajectory management and multi-scale atmospheric modelling of aviation impact with MECO(n)

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Aviation emissions have an influence on atmospheric composition and climate on regional and global scales. However, uncertainties about the impact of aviation emissions exist. Aircraft measurements on in-service aircraft today measure a series of key atmospheric parameters, i.e. CARIBIC, MOZAIC, IAGOS. These in-service aircraft fly on trajectories which are defined by air traffic management (ATM) and trajectory management. Comparing such observations with dedicated

atmospheric-multi-scale-modelling allows to evaluate relevant atmospheric mechanisms, and to identify key processes which determine the fate of aviation emission in the atmosphere. With the analysis we assess to what extent observational platforms deviate from meteorological mean values due to aircraft trajectory planning, and tactical decisions, e.g. cloud avoidance.

Here, we present results achieved with the modular global-regional chemistry-climate-model MECO(n) (MESSy-fied ECHAM and COSMO models nested n-times) describing atmospheric chemistry to investigate the impact of aviation emissions on regional and global scales. Our regional COSMO nests, which are introduced into EMAC as part of the DLR-project WeCare, put particular focus on two geographic regions: the North Atlantic Flight Corridor (NAFC) and the Southern Asian region. Our analysis evaluates simulated and observed atmospheric mixing ratios and determines the influence of aviation emissions on measurements.

The highly structured Modular Earth Submodel System (MESSy) allows using specific submodels required for investigation. In our simulations we use gas phase chemistry calculated with the chemistry submodel consistently from the surface to the stratosphere. The applied chemical mechanism allows including full stratospheric complexity. We further use diagnostic MESSy submodels, which allow direct comparison of model data with observational data, with a particular focus on in-service aircraft measurements.

Poster: The influence of spectral nudging in simulating individual Vb-events with COSMO-CLM

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In previous studies certain European cyclones have been investigated in terms of related extreme precipitation events in Austria. Those systems passing the Mediterranean are of special interest as the atmospheric moisture content is increased. It has been shown in recent investigations that state-of-the-art RCMs can approximately reproduce observed heavy precipitation characteristics. This provides a basic confidence in the models ability to capture future changes of such events under increased greenhouse gas conditions as well.

In this contribution we focus on high spatial and temporal scales and assess the currently achievable accuracy in the simulation of Vb-events. The state-of-the-art regional climate model CCLM is applied in a hindcast-mode to the case of individual Vb-events in August 2002 and Mai/June 2013. Besides the conventional forcing of the regional climate model at its lateral boundaries a spectral nudging technique is applied. This means that inside the model area the regional model is forced to accept the analysis for large scales whereas it has no effect on the small scales. The simulations for the Vb-events mentioned above covering the European

domain have been varied systematically by changing nudging factor, number of nudged waves, nudged variables, and other parameters. The resulting precipitation amounts have been compared to E-OBS gridded European precipitation data set and a recent high spatially resolved precipitation data set for Austria (GPARD-6). Varying the spectral nudging setup in the short-term Vb-cases helps us on one hand learn something about 3D-processes during Vb-events e.g. vorticity and formation but on the other hand identify the model deficiencies.

The results show, that increasing the number of nudged waves from 1 to 7 as well as the choice of the variables used in the nudging process have a large influence on the development of the low pressure system and the related precipitation patterns. On the contrary, the nudging factor or the definition of the uppermost pressure level for the nudging are of low impact on the results.

Poster: Added Value of CCLM in Simulating Summer 2009 Precipitation over Ethiopia forced by EC-EARTH

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Under the European Provision of Regional Impact Assessment on a seasonal to decadal timescale (EUPORIAS) program, the regional climate model (RCM) COSMO-CLM (CCLM) is forced by fifteen EC-EARTH ensemble members to investigate the uncertainty of summer season from June to September (JJAS) precipitation over Ethiopia. JJAS precipitation gives important socio-economic benefits to the country. The rainfall system over Ethiopia is influenced by local topography and regional climate circulation systems. CCLM is used to investigate its potential to simulate the precipitation of JJAS 2009 which is the second strongest drought season since 1980. Preliminary results show that the RCM ads value compared to its driving EC-EARTH model simulations. Both observations and satellite based gridded precipitation data are used to validate the CCLM ensemble members' precipitation. WRF precipitation which is forced by NCEP-FNL lay within CCLM ensemble members spread ranges. Statistical analysis correlation, Root Mean Square Error, Brier Score, Reliability, Uncertainty and resolution are used to evaluate the potential of CCLM over five day and ten day filtered precipitation.

Keywords: CCLM, Ethiopia, Precipitation

Seasonal Ensemble Simulations in East Africa

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Seasonal forecasting over East Africa is a challenging concern. The European Provision of Regional Impact Assessment on a seasonal to decadal timescale (EUPORIAS) program provides a common framework to understand model uncertainties through the use of multi-member simulations. In a multi-model approach, the regional climate models (RCMs) were driven by the atmospheric-only version of EC-EARTH global climate model (GCM). An ensemble of five months (May to September) hindcast has already been produced by EC-EARTH taking into account the bias corrected sea surface temperature from ECMWF System-4 hindcast. As a first step, the performance of the RCM, COSMO-CLM (COSMO model in climate mode) was evaluated in capturing the observed regional features over East Africa for the extreme years. For investigating this, we incorporated the 15 ensemble members as simulated by CCLM and EC-EARTH models. The accuracy of the model simulations for the chosen year (June to September) was assessed using the global reanalysis data with satellite and ground-based observations. Preliminary results reveal the potential usefulness of improved ensemble simulations, especially in sub-seasonal to seasonal rainfall forecasting. This indicates the importance of RCM simulations in predicting the precipitation extremes in East Africa.

Poster: EGI : e-Infrastructure for science in Europe

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The European Grid Infrastructure (EGI) is a federation of over 340 resource centres, set up to provide computing services and resources to European researchers and their international collaborators [1]. EGI supports research collaborations of all sizes: from the large teams behind the Large Hadron Collider at CERN and Research Infrastructures in the ESFRI roadmap, to the individuals and small research groups that equally contribute to innovation in Europe.

Multinational scientific communities can draw many benefits from having a partnership with EGI: uniform access to the massive computation and storage resources, consultancy and support from the National Grid Initiatives, benefit from the workshops and forums organised by EGI, receive support on resolving specific technical issues, become involved in the user-focused evolution of EGI's

production infrastructure incorporating various storage and computing services, among others.

This poster will provide an overview of the EGI infrastructure platform [2]. Available resources can serve a large variety of scientific data processing and data mining algorithms, high-performance computing simulations, data transfer and repository applications. Relevant information on how CLM community members can profit from the EGI service catalogue will be provided, while showcasing the ongoing climate modelling work done by your peers at the EGI e-infrastructure [3,4].

References:

[1] European Grid Infrastructure: http://www.egi.eu

[2] EGI Federated Cloud: http://go.egi.eu/cloud

[3] Climate change and ozone: http://www.egi.eu/case-studies/physical-sciences/ozone.html

[4] The importance of grid computing in the investigation of climate: http://www.hellasgrid.gr/?p=1830

Poster: Mid-to-late Holocene Climate Simulations with the COSMO-CLM

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The study of climate and ecological changes of the past is of particular interest in order to investigate how different human cultures developed due to such changes.

In this project climate conditions and their impact on different cultures inhabiting Europe during mid-to-late Holocene (6000 BP – 200 BP) will be investigated.

Within a multidisciplinary approach, a complex model chain of regional climate, ecological, zoological and human-energy-balance models will be developed.

The results will be feed back to the archaeological community and will contribute to the understanding of cultural development in the region.

Numerical simulations have been performed for the considered period of time with the non- hydrostatic regional climate model Consortium for Small-Scale Modeling (COSMO) in climate mode (COSMO-CLM).

ECHAM5 General Circulation Model data, with prescribed SST and SIC, are used as external forcings for the model. The area of study covers the entire Europe and part of North Africa, with a spatial resolution of 0.44 longitude degrees.

Results here are presented for different time slices, in order to estimate the effect of changes in climate forcings and to test the ability of the model in simulating past climate for the region.

Poster: The impact of climate change and energy policy on future development of ground-level ozone and particulate matter in Germany

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High ground-level ozone and particulate matter concentrations represent a major risk to health, especially in urban areas, and to ecosystems. Anthropogenic emissions and unfavourable weather conditions are the key factors for high levels of air pollution. As a member of the European Union, the Federal Republic of Germany is committed to compliance with air quality limit values. In the case of the exceedance of these limit values measures for short-term and long-term reduction of air pollutants have to be carried out. In order to intervene in time scenarios of future development of air quality are necessary. Furthermore, the question arises: are the today planned measures adequate and effective under future climate conditions?

The objectives of our study are i) the projection of future ground-level ozone and particulate matter concentrations and ii) the analysis and future estimation of weather pattern which lead to frequent exceedance of limit values. A modelling approach based on the regional climate model CCLM and the offline coupled chemical transportation model RCG was designed. The results of a double nested regional climate projection based on the ECHAM6/RCP85 scenario serve as climatological input for RCG. Four simulations under different boundary conditions (with and without changed climate, with and without future policy scenario) allow the assessment of the effectiveness of emission reduction measures. The analysis of weather patterns on exceedance days offers the possibility to estimate future exceedance frequency without a costly modelling approach. The results of both proposed methods will be compared in this study.

DYNUM

Impact of Higher Order horizontal spatial discretisation of Euler equations in the COSMO model on regional climate over Europe

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Horizontal spatial schemes of 3rd order and above used for discretization of COSMO transport equations can be described as higher order advected gradient schemes since interpolation of the advecting velocities and the pressure gradient term remain 2nd order. Furthermore, Baldauf, 2010 has shown by von Neumann stability analysis that centered difference horizontal schemes are unstable when used together with Runge Kutta time integration compared to diffusive odd ordered upwind schemes.

We have implemented fully 4th order horizontal disretisations of the Euler equations in the COSMO model with two types of the advection term discretisation. The first is a natural extension of the COSMO higher order discretisation by introduction of 4th order interpolations of the advecting velocity, denoted as C4. The second is a symmetric type of discretization of the advection term (Morinishi, 1999) which can be shown to conserve the 1st and 2nd moments of the advected quantity if the continuity equation is satisfied, here referred to as S4. Both convective schemes can be combined with 4th order discretization of the pressure gradient term, referred to as p4. To make the spatial schemes fully 4th order, the metric coefficients and terms are discretised 4th order as well. The 4th order discretisations are referred to as C4p4 and S4p4.

The new schemes together with the existing 3rd order COSMO scheme are used for a 5year long simulation in reference evaluation configuration of the CLM Community over Europe. ERA-Interim reanalyses data are used as initial and boundary conditions for the evaluation runs. S4p4 scheme is applied in two diffusion settings, one with the recommended artificial diffusion settings, and second with the artificial diffusion completely switched off. C4p4 scheme is applied with the recommended diffusion settings since the C4p4 scheme was unstable without artificial diffusion.

Idealized and real case studies show that S4p4 scheme improves the stability of the scheme substantially for long time integration. Analyses of the results obtained

from the real case study using the new schemes compared to the 3rd order COSMO scheme reveals a number of significant improvements and modifications of the simulated regional climate. There is a weaker boundary effect in the results of S4p4, e.g. visible in the 10m wind speed and 2m temperature. The results show weaker convective precipitation of up to 25% which is consistent with increased height of the planetary boundary layer and increased eddy diffusion coefficient of momentum. Diurnal cycle of the convective precipitation simulated using the fourth order schemes also reveal a one hour shift in the peak.

Summarizing the results obtained so far, the new S4p4 scheme with or without horizontal diffusion can be recommended for regional climate simulations. Further tests for convection permitting resolutions are ongoing.

Poster: Scaling of uncertainties in RCM simulation

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Any disturbance leads to different deterministic development of the weather in the model domain. If the disturbance is sufficiently small or stochastic in nature it has no systematic effect on the regional climate. For small disturbances it can be shown that the difference between the disturbed and the undisturbed simulation is independent on the type of the disturbance and have same climatology.

Different runs with different versions of COSMO-CLM have been analysed. The scaling of the deviation between the disturbed and the undisturbed run in space and time will be discussed. It will be shown that the difference is scaling with the square root of the domain size and is inverse proportional to the time scale and the space scale of the variable for those physical quantities, which are dominated by model dynamics like e.g. velocity or precipitation. Furthermore, it will be shown that the difference convergence is decreased for quantities affected by initialisation and/or unphysical behaviour.

AIO

New ocean-atmosphere regional coupled system COSMO-CLM/NEMO-MED12 over the Mediterranean Sea

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The semi-enclosed Mediterranean Sea plays an important role in the regional climate. In this study, a new ocean-atmosphere regional coupled system COSMO-CLM/NEMO-MED12 over the Mediterranean Sea is introduced. In this experiment, the monthly mean aerosol climatology MACC is used in the atmospheric model, which significantly reduced the cold bias over the Mediterranean Sea. Both the ocean and the atmospheric models are coupled via the OASIS3-MCT2 coupler. The ECWMF, ERA-Interim reanalysis data is used to force the atmospheric model in both the coupled and atmosphere-only simulations over the period from 1979 to 2012 for the Med-CORDEX domain. The atmospheric grid spacings of 0.44o (~50 km) are used in both the coupled and atmosphere-only simulations while in coupled simulations ocean grid spacings of 1/12o (~9 km) are used. The results of the coupled simulations are in good agreement with the atmosphere-only simulations. However, some interesting differences are observed along the coastal areas. The coupled simulations showed 3-4 oC higher sea surface temperature and 1-1.5 oC 2-m temperature during the autumn and winter season. Also, the diurnal cycle of near surface parameters is more pronounced in the coupled simulation over sea.

Different coupling methods for regional atmosphere - ocean simulations

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Coupling between atmosphere and ocean in a coupled climate model system can be done via state variables and/or fluxes. Several coupling methods of field

exchange are investigated to analyze how these methods impact the simulated climate and the interactions and feedback between the atmosphere and ocean. Here, we use the atmosphere – ocean – sea ice coupled system COSTRICE that has been developed for regional climate simulations over the Baltic Sea and North Sea regions COSTRICE comprises the atmospheric model CCLM, the ocean model TRIMNP, and the sea ice model CICE, which are coupled via the coupler OASIS3-MCT2.0. In the two-way coupling setup, TRIMNP and CICE are driven by 1-hourly atmospheric state variables and fluxes of CCLM, while CCLM receives skin temperatures which are the combination of the SST from TRIMNP and the sea ice skin temperature from CICE, weighted by the sea ice concentration. Four experiments were designed for simulations covering the period 1979-2005:

(1) State variables, such as mean sea level pressure, temperature, humidity, wind, and so on, are passed from CCLM to TRIMNP, where they are used to calculate surface shortwave incoming radiation, surface longwave downward radiation, latent and sensible heat fluxes. As these fluxes are not given back to CCLM, the surface energy fluxes seen by the atmosphere in CCLM are not consistent to those seen by the ocean in TRIMNP.

(2) All surface radiation and heat fluxes are transferred from CCLM to TRIMNP, except outgoing longwave radiation that is calculated in TRIMNP using its SST.

(3) Similar to (2) but latent and sensible heat fluxes are determined in TRIMNP using state variables for the bulk formula (but not provided back to CCLM).

(4) Similar to (3) but latent and sensible heat fluxes, after calculated in TRIMNP, are passed back to CCLM. In this experiment, surface energy fluxes seen by CCLM and TRIMNP are consistent.

Simulations of the four experiments are compared to each other and to observations for the 20 year period 1986-2005. They are also compared to a standalone run of CCLM, which is forced by ERA-interim SST, to investigate the impacts of coupling on simulated regional climate. First results show that when TRIMNP calculates latent and sensible heat fluxes by itself in (1), (3) and (4), SST tends to be better reproduced than when TRIMNP is forced by all atmospheric fluxes as in (2). Wet biases over Scandinavia and cold biases over North Europe simulated by the standalone CCLM were slightly improved in the coupled experiments. In general, simulated monthly 20-year averages of SST, 2 m temperature and rainfall are similar in all experiments. However, for some extreme rainfall events, several coupled experiments showed rather good performance in capturing patterns and magnitudes of the heavy rainfall events. Reasons for the differences between the experiments in capturing these events will be analyzed in more detail.

Poster: The new version of the Arctic-optimized COSMO-CLM 5.0 (CCLM5.0-Arctic)

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For studying air-ice-ocean processes in the Arctic the new model version of COSMO-CLM5.0_clm1 (CCLM) has been adapted to the Arctic domain (CCLM5.0-Arctic). Our focus regions are the Laptev Sea and the Fram Strait. While the Laptev Sea is a crucial area of sea ice formation, the Fram Strait is the main sea ice export takes place. Both areas are connected via the Transpolar Drift.

To include sea ice and its physical interactions with the atmosphere in the CCLM, the sea ice module of Schröder et al. (2011) has been implemented with a new treatment of sea-ice thickness assimilation. In the old module the sea ice fraction (SIF) was derived from brightness temperatures measured by the AMSR-E sensor and the sea ice thickness (SIT) was set to be constantly 1 m. In the new module, the SIT is assimilated from monthly fields of the PIOMAS data set (Zhang and Rothrock, 2003). To obtain daily fields, the PIOMAS fields have been linear interpolated in time and furthermore masked with the daily SIF fields of AMSR-E. Missing SIT on CCLM grid-points was estimated using a dynamical nearest neighbour interpolation. In this study we show preliminary evaluation results of some key variables from chosen subperiods of the planned simulation period 2002-2011. CCLM5.0-Arctic is currently run at a horizontal resolution of 15 km and is driven by ERA-Interim.

The CCLM5.0-Arctic will be coupled to the ocean-sea ice model FESOM (Timmerman et al., 2009, Wang et al., 2013) of the Alfred-Wegener-Institut via OASIS to directly simulate ocean and sea ice processes. Furthermore, the resolution of the CCLM5.0-Arctic will be increased to 5 km and 1.3 km over the Laptev Sea and the Fram Strait.

Poster: Coupling of COSMO/CLM and NEMO with focus on North and Baltic seas

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The region east of the Baltic Sea has been identified as a hot-spot of climate change by Giorgi, 2006, on the base of temperature and precipitation variability. Our aim is to look at the impact of the North and Baltic seas on the climate of Central Europe. We want to look at the climate system in a more complete way with an active atmosphere-ocean-ice interaction in order to obtain a model system

that is physically more consistent with reality. For this purpose, we have coupled the atmosphere model COSMO/CLM to the ocean model NEMO, which includes the sea ice model LIM. The models are coupled via the OASIS coupler. This coupler interpolates heat, fresh water, momentum fluxes, sea level pressure and the fraction of sea ice at the interface in space and time.

For the North- and Baltic seas, the coupled run has large biases compared with the E-OBS reference data. However, these biases are in the usual range of biases found in other COSMO-CLM studies. Compared with observations, the coupled model in this study has, most of the time, smaller biases than the uncoupled atmospheric model. The spatial distribution of temperature biases in spring, summer and resemble the yearly mean distribution; however, the bias magnitudes vary among those three seasons, with summer showing the largest warm bias among the three seasons, up to 3 K in southern Europe.

CCAR

From global to regional scale: Impact of road traffic emissions on tropospheric ozone

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Road traffic is an important source of anthropogenic emissions. Especially the emissions of nitrogen oxides (NOx), carbon monoxide (CO) and non-methane hydrocarbons (NMHC) are important, as they are precursors for the formation of ozone within the troposphere.

This process of ozone formation is strongly non-linear. For example the efficiency of ozone formation depends strongly on the available amount of NOx. Therefore the amount of ozone production between rural and urban areas can differ significantly. But in current global chemistry-climate-models (CCM) with resolutions around 2° most urban areas can not be resolved explicitly, which may lead to a mixing of emissions from rural and urban areas within a grid box. Therefore an increased resolution of chemistry-climate-models is desirable to account for such regional effects.

For this reason we investigate the impact of road traffic emissions with the MECO(n) model-system (MESSyfied ECHAM and COSMO models nested n-times). This model system couples the regional scale chemistry-climate system

COSMO/MESSy (in one direction) with the global chemistry-climate system EMAC. This model-chain is as consistent as possible using the same atmospheric chemistry module MECCA and diagnostic methods on the global and regional scale. The coupling is done on-line allowing us to provide new boundary-conditions for dynamical and chemical fields every timestep of the global model.

To quantify the effects of the road traffic emissions on the tropospheric ozone we use a detailed ozone diagnostic called "tagging" method. This method is an accounting system following the reaction pathways of the different species from the different sources, accounting for the nonlinearity of the chemistry. In addition also sensitivity experiments with different emissions databases (perturbation approach) are planned.

Due to our consistent model chain we are able to compare directly our results on the global and the regional scale. Therefore we can quantify the effects of the horizontal resolution and analyze, if such increased resolutions are important for detailed ozone diagnostics. We present first results of our simulations focusing on the different effects on the global and the regional scale.

Poster: Impacts of different aerosol distributions on the European climate during the last decades

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The aerosol climatology of Tanre et al. (1984) is widely used in COSMO-CLM to consider the direct effect of the Aerosol Optical Depth (AOD) on radiative processes. Apart from a very low spatial resolution and a missing temporal variability this climatology is dominated by unrealistic high values of AOD over Northern Africa.

To investigate the impacts of different aerosol distributions on the meteorological fields the Tanre aerosol climatology is replaced by the more realistic climatology of Tegen et al. (1994) and AEROCOM (Kinne et al., 2006). In addition to three simulations with different aerosol climatology a control simulation without any aerosol feedbacks was performed from 1980 to 2010.

As the next step (in preparation, probably not finished until CLM-Assembly) the fully online coupled model system COSMO-ART will be used to consider additionally interactions of aerosols and cloud microphysics. Aerosol dynamics are taken into account within this model system. So there is also the goal to compile an up to date aerosol climatology for Europe.

Sensitivity of convective activity to varying amplitude of soil moisture content and roughness length

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Many studies have shown the role of the boundary layer in the initiation and the development of convective events. Indeed, the initiation of convective events is highly sensitive to the latent and sensible heat fluxes exchanges occurring between the surface and the atmosphere. Previous studies found that, in convective permitting simulations (CPS), the convective activities are more likely to occur with low soil moisture content owing to higher latent head fluxes. In this study, this latter finding is verified by modeling convective cases with different levels of soil moisture. In addition, the sensitivity of convective initiation to the amplitude of roughness length is also investigated. Roughness length plays a major role in the extraction of moisture from the surface to higher levels. Finally the sensitivity of buoyant convection to different spatial variability of soil moisture and roughness length is also studied. For this purpose, 18 severe convective events have been simulated using the COSMO5.0clm1. These cases were selected based on convective cells features (e.g. track length, cells velocity, etc.) and on large-scale conditions (e.g. CAPE, CIN and circulation weather type). For each of these 18 events the amplitude or/and the spatial variability of soil moisture and roughness length were altered at different levels resulting in a total of 882 simulations. In addition, these 882 simulations were repeated for different resolution (e.g. 500m, 1km, 2.8km, 6km and 12km).

The features and the number of convective cells occurring in these experiments are derived using a tracking algorithm. The different intensity of buoyancy are notably derived using the intensity of updrafts at different levels.

Estimation of the frequency and the intensity of convective events combining a statistical model and the COSMO-CLM

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Severe convective events are known to results in great damages. For this reason, Policy makers have high interest in assessing the evolution of convective events resulting from an increase in greenhouse gases concentration. However, scientists do not agree on the sign of this evolution and further research is needed in this direction. In this study the frequency and the intensity of convective events occurring in the area of Thuringia (central Germany) is assessed for a present-day and a future time-period.

The frequency of convective events is estimated using a logistic regression model. This model discriminates between two different type of convective activity; the activity characterized by long lasting intense convective cells with long tracks often associated with supercells and the one characterized by intense slow moving convective cells often associated with flash flood. The model uses radar data for calibration is applied to ERA-Interim and ECHAM6 (present-day and future periods).

The intensity of convective events is then estimated using the COSMO5clm2 at convective permitting scale (~1km). A tracking algorithm is used to derived the different features of convective cells and evaluate their possible impact in the future.

Evaluation of convection-resolving models using satellite data: The diurnal cycle of summertime convection over the Alps

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Diurnal moist convection and the associated convective precipitation is an important element of the Central European and the Alpine climate, in particular in summer when the synoptic forcing is weak. It is poorly represented in current convection-parameterizing models (CPM), often leading to large biases in the diurnal cycle (DC) of precipitation, in particular a too early onset and peak of precipitation. Preliminary experience with convection-resolving models (CRM) has shown promising results.

Here we investigate the DC of convection during 11 days in June 2007, and compare COSMO 4.25 simulations against three satellite products. The simulations use horizontal resolutions between 12 km (CPM) and 2 km (CRM), and either a one-moment (1M) or a two-moment (2M) microphysics scheme.

For CPM-1M, the outgoing thermal flux at the top of the atmosphere has a bias of -20.1 W/m² compared to GERB. For the standard CRM-1M run, the bias is reduced to -2.6 W/m². Comparisons against cloud top pressure and cloud optical thickness from the ESA Cloud CCI project and brightness temperature from SEVIRI show that these biases are mainly caused by too much high cloud cover. These cloud cover biases can be further reduced by the use of CRM-2M. The main reason for this improvement can be attributed to a neglection of cloud-ice sedimentation in the 1M. The RMSE of the de-biased domain-averaged DC of outgoing thermal flux is 6.5 W/m² for the CRM-1M run. This is mainly caused by a time-shift in the DC. Comparisons of brightness temperature observations against RTTOV-produced synthetic images from COSMO indicate that this time-shift is strongly influenced by a time-shift of high clouds in the DC of convection in the model.

In a second step regional variations of the DC are analyzed. Observed brightness temperatures do not exhibit any significant regional differences in the timing of the DC . In contrast, the 1M simulation shows peak convective activity 1-2 hours earlier over the Alps than over the adjacent regions. The diurnal peak of high cloud cover in observations is about 75% higher over the Alps than over the adjacent regions. This ratio is slightly overestimated by the CRMs and strongly underestimated by the CPM.

Added Value of Convection Permitting Climate Simulations Under Certain Alpine Weather Conditions

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The European Alps are the home of a large variety of climate conditions which include Mediterranean climates in the South to tundra and arctic climates on mountain tops. Thereby, low valleys and high mountains are often only a few kilometers apart. State of the art climate simulations, such as those from the EURO-CORDEX project, have too coarse horizontal grid spacings to resolve such strong gradients. Additionally, important small scale processes, such as deep convection, have to be parameterized. In this study we compare the performance of the 0.44° (50 km) and 0.11° (12.5 km) ERA-Interim driven COSMO-CLM simulations from the EURO-CORDEX initiative with a convection permitting climate simulation (CPCS) with 0.0275° (3 km) grid spacing performed within the NHCM-2 project (founded by the Austrian Science Fund (FWF), project number P24758-N29; http://www.nhcm-2.eu/). The CPCS covers the European Alpine region and is nested in the 0.11° simulation for a period of 22 years (1998 to

2010). A special focus of NHCM-2 lies on the evaluation of processes which lead to orographically induced precipitation. A weather typing scheme is applied to condition the model evaluation on typical synoptic situations in the Alps. This enables us to investigate time periods where similar synoptic scale atmospheric processes are present. Since model errors depend on the underlying processes this has two major advantages: 1) model errors do not cancel out by averaging over days with similar weather patterns, and 2) model errors based on processes can strongly support model development.

Impact of forest cover and orography on convective activity in Thuringia

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Severe convective events are known to results in great damages. For this reason, Policy makers have high interest in monitoring these events. It is notably necessary for them to ensure that land use policy will not result in an increase of the frequency and intensity of convective events. Modifications of the land use are known to influence convective activities through changes in surface parameters such as the albdeo, the evapotranspiration or the aerodynamic resistance of the surface.

To investigate the impact of land use changes four extreme scenarios have been considered and applied to the region of Thuringia (central Germany). These scenarios notably consist of modification of the forest cover (e.g. no forest, forest as estimated by HWSD and forest only) and of the orography (e.g. flat terrain instead of hills). For each scenario, 18extreme convective events were simulated with the COSMO5clm2 at convective permitting scale. The results of these experiments are compared to an ensemble of simulations and to different observation including a radar dataset.

To quantify the impact of land use change on the development of convective processes, an algorithm is used to track some quantities associated with convective activities (e.g. precipitation, graupel, down/updraft).

Poster: Comparison of COSMO-CLM turbulence schemes by convection permitting simulations in the Alpine region

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Turbulence is one of the most important but poorly understood atmospheric processes. It is responsible for the transport of mass, heat, and momentum. In the planetary boundary layer, turbulence is a key process and its accurate representation in regional climate models is curtail for the quality of climate model output. This study examines the differences of the currently implemented turbulence schemes in COSMO-CLM and the new TKE-SV scheme developed by Dmitrii Mironov and Ekaterina Machulskaya at DWD. In the framework of the project “Non-Hydrostatic Climate Modelling II” (NHCM-2; www.nhcm-2.eu), funded by the Austrian Science Fund (FWF; project ID P 24758-N29), we perform convection permitting (3 km horizontal grid spacing) sensitivity experiments with COSMO-CLM in the European Alpine region driven by the Integrated Forecast System (IFS) of the European Centre for Medium-Range Weather Forecasts (ECMWF) . The simulations are validated against high resolution observation data sets from NWP products. In addition, stability indices are derived and compared with observations . On the one hand we compare area and time means of simulated and measured values, on the other hand we focus case studies also for a better understanding of the turbulence schemes in typical meteorological situations. The different behavior of some meso-scale phenomenon, like fronts and thunderstorms are also under examination. The goal of this study is to investigate the impact of different turbulence schemes on the model output quality. Furthermore, we want to gain knowledge in how small scale processes, such as turbulence, affect meso-scale phenomena.

Poster: Does high resolution convective permitting simulations modifies climate change signal over Belgium

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In this study we examined the influence of high resolution convective permitting simulations (CPS) on future climate signals over Belgium. Previous studies have shown improvement in the present day mean climate simulations when model resolution is increased. This improvement is generally associated with the better description of the surface parameters such as land use, orography etc. However it is not fully clear how increasing model resolution modifies the future climate change signals over a particular region. To investigate above question, we performed climate simulations for present day (2001-2010) and future periods (2025-2035; 2060-2069) over Belgium with COSMO-CLM regional climate model.

The initial and lateral boundary conditions to COSMO-CLM are provided from global EC-Earth climate model simulations. We applied a three step nesting approach to reach 2.8km resolution. We first downscaled the global model EC-Earth simulations to 25 km grid. The 25km run is then nested to 7km run and so on. We divided the Belgium domain into three parts coastal, plains and hilly depending on the topography and examined the climate sensitivity associated with 2.8 and 7 km run compared to 25km resolution. We found enhanced future climate sensitivity in CPS simulation (2.8km) compared to non-CPS (7km) simulation. Moreover, the climate change signals and their intensity vary over three region at very high resolution. An increasing model resolution plays important role in the regions of complex topography. The intensity and frequency of grid-cell extreme precipitation events increased significantly in CPS simulations compared to non-CPS simulation.

SOILVEG

Impact of land use and soil data specifications on COSMO-CLM simulations

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The contribution investigates the impact of time invariant lower boundary data ECOCLIMAP and Harmonized World Soil Database (HWSD) on simulations with the COSMO CLM (CCLM) model. ECOCLIMAP land use extents the vegetation characteristics information to monthly data for 215 climatic units. With the implementation of the soil characteristics data from HWSD in CCLM the spatial resolution of the soil data has been increased to 30 arc seconds together with an improved texture definition and handling in the soil model TERRA_ML. Simulations performed in the MED-CORDEX modeling domain with ERA40 reanalysis input and the period from 1986 to 2000 show in the area mean monthly temperature differences of up to 1.8 K. In the area monthly mean precipitation differences of approximately 15% can be related to the differences in the soil data input. Differences related to changes in the ECOCLIMAP land use are smaller with up to 0.5 K for monthly mean temperature and 4 % for the mean precipitation.

The contribution presents the investigated data sets, their implementation in CCLM and concentrates upon the simulation results obtained with various

changes in land use and soil data input and in context of the internal model variability.

The urban land use in the COSMO-CLM model: a comparison of three parameterizations for Berlin

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The regional non-hydrostatic climate model COSMO-CLM is increasingly used on the fine spatial scales of 1-5 km. Such applications require a detailed differentiation between the parameterization for natural and urban land uses. Since 2010, three parameterizations for urban land use have been incorporated into COSMO-CLM. These parameterizations vary in their complexity and required city parameters as well as in the computational cost. We perform model simulations with three available coupled models in the same model domain of Berlin and compare them to available temperature observations. Based on this comparison we discuss strengths and weaknesses of each implementation.

Initialization of the land surface for CCLM

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Owing to its slow variability, the deep soil has a long-term memory which offers potential predictability on a medium-range climate scale. Therefore, an initialization of the land surface state (soil moisture and temperature) as close to the truth as possible can enhance the quality of climate simulations. However, the inherent unobservability of the deep soil state requires that any observational information related to the surface has to be transferred into the deeper soil.

We discuss methods to obtain initial states for the soil using a parallized offline version of TERRA-ML, the land surface module of CCLM. A software environment has been designed to assimilate screen level variables into TERRA-ML by forcing it with suitable WATCH data. We present first results concerning new initial conditions for Africa and Europe within the MiKliP project and their impact on decadal CCLM simulations. Furthermore, we investigate the feasibility of assimilating satellite-based retriEVs of near-surface soil moisture and temperature into TERRA-ML using an ensemble Kalman filter. It is shown by twin experiments

with synthetic observations that this is principally possible, but is subject to strong restrictions in terms of data coverage and quality. A first test with real satellite data is conducted on a grid-point level.

Impact of patch size of vegetation transformation in regional climate simulations

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It is still a question of debate whether high resolution regional climate simulations are needed to study the effect of land cover transformation or a percentage of land cover change independent of the resolution will give comparable results. Here it is demonstrated that the patch size of change is of utmost importance. Two simulation experiments are carried out with 25 percent land cover change due to bioenergy plants and compared to the control case with no change. One experiment considered transformed patches of 1.3 km, the other experiment included changed fields of 13 km. Significant differences of low cloud formation and precipitation are depicted between the experiments. The larger patch size experiment also shows changes in these variables between the local and regional scale whereas for the smaller patch size experiment this effect is not visible. The latter experiment depicts local larger amounts of turbulent fluxes of latent and sensible heat with resulting local cooler maximum temperatures. Therefore, high resolution regional climate simulations are needed for improved understanding of vegetation-climate interactions with both political and economic value.

Regional characteristics of Siberian snow cover changes derived by COSMO-CLM

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This study analyzes seasonal patterns of recent snow cover changes in Siberia with respect of snow water equivalent and snow extent. Due to the limited availability of observations in that domain, the regional climate model COSMO-CLM (CCLM) has been used to provide a reconstruction of Siberian climate including historical fields of snow cover. The regional climate hindcast at 50 km horizontal resolution was driven by NCEP-R1 for the period 1948-2010. For the evaluation, the model output is compared with a satellite-derived SWE estimate

provided by ESA GlobSnow for the years 1987-2010. The comparison reveals that the reconstructed SWE fields of CCLM are in good agreement with GlobSnow during winter, whereas it overestimates SWE during the melting season.

The seasonal trend patterns for the climatological standard period of 1981-2010 of the model hindcast show strong seasonal and spatial variability. The trends of mean SWE for fall are very heterogeneous showing mainly a slight decline or increase of -5 to 5 mm per decade throughout the entire domain. Local maxima of increases in mean fall SWE occur along e.g. the Central Siberian Plateau, Sayan Mountains and Verkhoyansk Mountains. A slight decrease in mean winter SWE is evident south of Lake Baikal, northeast of Mongolia and northern China ranging from 5 to 10 mm per decade and reaching 20 mm per decade at single points in the reconstructed data. Strong significant decreases of SWE during the winter seasons in the recent decades are evident according to CCLM in the most elevated parts at the Central Siberian Plateau and Verkhoyansk Mountains up to 30 mm per decade. Snow accumulation has increased strongest west, northwest, and northeast of Lake Baikal and along the coast of Sea of Okhotsk. Along the Sayan Mountains and Stanovoy Range, CCLM presents an increase up to 20-30 mm per decade and even to 40 mm per decade in certain regions. The interannual variations of snow cover extent derived by CCLM are stronger during the transition season spring and fall than in winter. The decreasing tendency of snow cover extent during spring since the early 1980s has diminished in recent years.

Quantifying the biogeophysical impact of European forestation using COSMO-CLMsquare

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In recent years, afforestation has been proposed as a promising strategy for climate change mitigation. However, when discussing the potential place of forestry in mitigation policy, the biophysical impact of forestation, which could offset or enhance biochemical cooling at the regional scale, is often overlooked. Several studies have tried to quantify the biophysical effects of forestation for Europe, often resulting in conflicting conclusions.

Therefore, the goal of this study is to contribute to the understanding of the biophysical impact of forestation in Europe on climate. In this presentation, results for two main research topics will be discussed. First, an evaluation has been performed. In this evaluation, we determine if our regional climate model of choice, COSMO-CLM2 (COSMO4.8-CLM11 coupled to Community Land Model 3.5), is able to simulate the local climate impact of a land use transition from forest to open land (pasture or cropland) or vice versa. To do this, we compare model

simulations to observations from various locations in Europe where such a land use transition takes place and (eddy-covariance) measurements are available.

The observational data shows a few clear impact mechanisms consistent across our European locations: generally, open land sites are characterized by higher albedo and a significantly lower sensible heat flux. During daytime, these differences lead to higher near surface temperatures in summer and slightly lower near surface temperatures in winter. At night, however, open land sites appear to be consistently cooler than forests (-1 to -5 K depending on location), with little to no seasonal variation. When comparing these observational trends to our model simulations, performance seems adequate for daytime, but the nighttime impact on near surface temperature is missing completely. The reasons for this will be discussed in the presentation.

In a second part, we try to determine the maximum possible impact of land use change for Europe by comparing COSMO-CLM2 simulations for two extreme land use scenarios (a fully forested Europe versus a Europe consisting entirely of open land). The main goal here is to determine the sign for such a land use transition (cooling or warming, increased or decreased evapotranspiration, etc.), as well as to determine those regions in Europe most sensitive to land use change. Focusing on daytime (because of the nighttime bias discussed above), results show increased winter near surface temperatures for the full forestation run, especially in Europe's mountainous areas and in the southern part of our domain.

In summer, the increased surface roughness associated with forests becomes an important factor, leading to an increased heat transfer from the surface to the boundary layer. Because of this, surface temperatures for forests are actually cooler during summer in many areas, despite lower albedo. Temperatures higher up in the boundary layer, however, are significantly higher. Finally, COSMO-CLM2 also simulates higher evapotranspiration over forests, mainly for the southeastern part of our domain during summer. Associated with this change and the increase in turbulent heat flux, summer precipitation in this region increases with up to 60mm.

The seasonal dependency of the Belgian urban heat island intensity in CCLM + TERRA-URB

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Changes in the landscape by urbanization have lead to drastic climate modifications, which ranks among the most significant human impacts on the environment. Most remarkable is that cities are exposed to higher air temperatures than those in the natural surroundings. This phenomenon - known as the urban heat island - causes serious health risks for many people in the city. Especially in

large cities, mortality rates are higher during heat waves, such as that of the European summer of 2003. It is expected from global climate change that cities are more often exposed to extreme weather, including the increased number of strong heat waves.

Sensitivity experiments with the regional climate model CCLM coupled to a new efficient urban land-surface parametrization TERRA-URB over Belgium have led to an overall better understanding of the climatic drivers of the urban heat island and their seasonal dependency at the regional scales. It turns out that both urban structure and energy waste into the atmosphere by human activity, but also their interaction determine the seasonal variability of the urban heat island intensity. Remarkably, the averaged contribution of urban structure to the nocturnal urban heat island for the cities in and around Belgium (+0.41 K for Brussels) is smaller than that from the energy waste (+1.24 K) during winter. Conversely, the contribution of urban structure (+1.97 K) dominates that of the energy waste (+0.68 K) during summer. The respective contributions mostly counteract each other during summer (-0.21 K), whereas they enhance each other during winter (+0.25 K).

The above-mentioned findings allow to take wiser decisions for keeping the climate in cities comfortable within the context of climate change and urban expansion. Hereby, it is recommended to account for both the impact of urban structure, energy waste, their interactions and their seasonal dependency on urban climate. Hereby, the respective influences on the urban thermal comfort both in the positive as in the negative sense needs to be considered. It is expected that putting in place policies in terms of urban modifications – that are needed to temper climate change on the global scale - will influence the climate in cities on the local scale as well.

Poster: Regional Climate Simulations with COSMO-CLM for West Africa using different soil-vegetation-atmosphere-transfer (SVAT) module

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Climate predictions on decadal timescales constitute a new field of research, closing the gap between short-term and seasonal weather predictions and long-term climate projections. Therefore, the Federal Ministry of Education and Research in Germany (BMBF) has funded the research program MiKlip (Mittelfristige Klimaprognosen), which aims to create a model system that can provide reliable decadal climate forecasts.

Recent studies have suggested that one region with high potential decadal predictability is West Africa. Therefore, the project DEPARTURE (DEcadal Prediction of African Rainfall and ATlantic HURricanE Activity) was established

within the MiKlip program to assess the feasibility and the potential added value of regional decadal climate predictions for the West African Monsoon system. To quantify the potential decadal climate predictability, a multi-model approach with the three different regional climate models REMO, WRF and COSMO-CLM (CCLM) will be realized.

The presented research will contribute to DEPARTURE by performing hindcast ensemble simulations with CCLM, driven by global decadal MPI-ESM-LR simulations. Thereby, one focus is on the dynamic soil-vegetation-climate interaction on decadal timescales. Recent studies indicate that there are significant feedbacks between the land-surface and the atmosphere, which might influence the decadal climate variability substantially. To investigate this connection, two different SVATs (Community Land Model (CLM), and VEG3D) will be coupled with the CCLM, replacing TERRA_ML, the standard SVAT implemented in CCLM. Thus, sensitive model parameters shall be identified, whereby the understanding of important processes might be improved.

As a first step, TERRA_ML is substituted by VEG3D, a SVAT developed at the IMK-TRO, Karlsruhe, Germany. Compared to TERRA_ML, VEG3D includes an explicit vegetation layer by using a big leaf approach, inducing higher correlations with observations as it has been shown in previous studies. The coupling of VEG3D with CCLM is performed by using the OASIS3-MCT coupling software, developed by CERFACS, Toulouse, France. Results of MPI-ESM-LR driven decadal hindcast CCLM simulations (1966 - 1975) using both SVATs are analysed and compared for the DEPARTURE model domain. Thereby CCLM simulations with VEG3D showed better agreement with observational data than simulations with TERRA_ML. Additionally, results of several sensitivity studies with VEG3D driven by ERA-Interim, concerning soil moisture, plant cover and root depth are analysed and presented.

Poster: Present and future potential evapotranspiration levels for different locations in Luxembourg

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Evapotranspiration stands as an important interface between the atmosphere and the soil in the water cycle. It is characterized by a complex interaction between atmospheric parameters, such as temperature, radiation, humidity and wind speed, soil parameters, such as soil type and structure, and characteristics of the vegetation cover, such as plant species, density, age and stomata resistance. Accurate estimation of the potential evapotranspiration is essential to many applications in water resources management, hydrology, climatology, and agriculture.

Precipitation and evapotranspiration largely control water availability. Hydrological regimes are driven by spatial and seasonal variability in precipitation and evapotranspiration. The availably of water for plant growth is equally strongly depending on evapotranspiration. With thresholds eventually characterizing the interplay between fundamental hydrological and ecological functions of catchments (e.g. water collection/mixing, storage and release in the unsaturated and saturated zones), we need to account for changes in evapotranspiration under a warming climate to define future adaptation strategies.

Here, we use an approach proposed by the Food and Agriculture Organization (FAO) to analyse data from i) a long-term measurements site in Luxembourg and ii) outputs from a model run with a spatial resolution of 1.3 km using COSMO-CLM. The high resolution runs are driven by ECHAM5 (forced by A1B scenario) for time-slices in the present climate (1991-2000), as well as the near (2041-2050) and far future (2091-2100).

We compare results from the FAO formulation and the internal computation of evaporation by the COSMO model, both for the absolute values and the climate change signals. The high resolution of the runs shed new light on regional differences within Luxembourg.

Poster: Comparison of CCLM climate predictions and projections using TERRA_ML and VEG3D

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Within the German research program MiKlip, the module DecReg aims to assess the feasibility and potential added value of decadal regional climate predictions. For that purpose, hindcast ensembles downscaled from global predictions for Europe are used. One focus is to evaluate the role of soil as a slow component of the climate system by analyzing simulations with different soil-vegetation schemes (SVATs) in different configurations. As regional climate model we use COSMO-CLM along with the SVATs TERRA_ML and VEG3D.

The main difference and advantage of VEG3D in comparison to TERRA_ML is the explicit vegetation layer for which water and energy budgets are calculated and good agreement with observations can be achieved as has been shown in previous studies. The updated stand alone version has been examined in several sensitivity studies with resolutions of 0.0625° and 0.025°. CLM climate predictions with ERA40 and ECHAM6 as forcing data were used as input for the SVAT. Additionally, a climate run was simulated for 1971-2000. Overall, the updated standalone version seems to be warmer in Central Europe. In a next step VEG3D is coupled to COSMO-CLM with the OASIS-3MCT coupler. The coupled simulations for Germany have a resolution of 0.0625° and the results are eveluated. To estimate the influence of the coupling with VEG3D Temperature,

Precipitation, fluxes and soil variables like temperature and water content are analyzed.

Poster: Climate change in 2050 in Hamburg region estimated with COSMO-CLM

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Within the project MegaCity-Hamburg the current and the future climate for the region of Northern Germany is analyzed. The non-hydrostatic climate model COSMO-CLM coupled to the Town Energy Budget model (Masson, 2000) is used on the spatial resolution of ~3 km for estimating future changes of temperature, precipitation, global radiation and wind for the region and particularly for the city of Hamburg. Three model simulations are carried out: 1) evaluation run over 1989-2008, 2) reference run for 1971-200, and 3) climate projection run for 2021-2050. The first results of the project are presented and discussed.

IPCC AR5

The COSMO-CLM simulations within the MedCORDEX initiative

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A set of ERA-Interim driven simulations are carried out using different domains in order to compare the relative importance of COSMO dynamics inside the domain (whose importance is expected to increase with the domain size and drives the COSMO's results away from ERA-Interim) and boundary forcing (which constrains the COSMO's simulation to ERA-Interim). The simulations cover the 1979-2011 period on a rotated grid at 0.44 degs resolution adopting three different domains denoted as EU GRID+, MEDCORDEX GRID, EAST EU GRID. The MEDCORDEX grid and the EU GRID+ correspond to the recommended domain of the

MEDCORDEX and EuroCORDEX experiments, respectively. The EAST EU GRID is a smaller domain centered on the Balkan peninsula of the MEDCORDEX GRID. These simulations are validated against EOBS observational dataset and compared to the simulations uploaded in the MedCORDEX archive discussing how COSMO compares to other models. The Med-CORDEX initiative is the component of the CORDEX project focusing on the Mediterranean region, which because of strong land-sea contrast, land-atmosphere feedback, intense air-sea coupling, a very active regional thermohaline circulation and aerosol-radiation interaction is an important case study for regionalization studies. Further, an ERA-INTERIM driven high resolution simulation (0.11degs) and RCP4.5 and RCP8.5 simulations are performed.