Current activities in the CLM-Community

Barbara Früh & CLM WG coordinators

COSMO General Meeting
September 07, 2016
Offenbach, Germany
Overview

**CLM-Community projects**

COPAT – Coordinated Parameter Testing - Project

CECPC5 – Coordinated Evaluation of Convection Permitting climate simulations with COSMO5.0

Test suite

Regional climate system model

**Climate forecasts downscaled with COSMO-CLM**

EUPORIAS

MiKlip

**CLM-Community issues**
COPAT - Coordinated parameter testing

Pre-Phase
- preparation
  - forming a group of people and setup a wiki for coordination
  - creating a list of relevant parameters to test
  - definition of domain and time period (1979-2000)

Phase 1
- single parameter testing
  - reference simulation (on own machine if not at DKRZ)
  - sensitivity run for one namelist parameter out of a list

Phase 2
- combined parameter testing
  - sensitivity runs with combined most promising parameters from Phase 1

Phase 3
- tuning
  - tuning of 8 parameters based on the best combined run from Phase 2

Phase 4
- Final simulation at 0.165°
  - final simulation with best setup and including tuning

Final Phase
- Recommended model version
  - decision in the working group and presenting the result to the community
  - Community - decision on the new recommended model version
  - including recommended namelist into the name list tool
  - evaluation report
  - scientific publication

<table>
<thead>
<tr>
<th>Phase</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Phase</td>
<td>Preparation</td>
</tr>
<tr>
<td>Phase 1</td>
<td>Single parameter testing</td>
</tr>
<tr>
<td>Phase 2</td>
<td>Combined parameter testing</td>
</tr>
<tr>
<td>Phase 3</td>
<td>Tuning</td>
</tr>
<tr>
<td>Phase 4</td>
<td>Final simulation at 0.165°</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No. of model runs per phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979-2000 reference runs 0.44°</td>
</tr>
<tr>
<td>1979-2000 single parameter 0.44°</td>
</tr>
<tr>
<td>1994-1998 tuning runs 0.44°</td>
</tr>
<tr>
<td>1979-2000 0.165°</td>
</tr>
</tbody>
</table>

11/3/2016
11/3/2016

COPAT - Coordinated parameter testing

Final Phase
Recommended model version

new recommended CCLM model version:
COSMO5.0_clm6

Evaluation Report
in progress.

3 Poster
„COPAT - towards a recommended model version of COSMO-CLM“ at
- COSMO User Seminar 2016, March in Offenbach
- EGU 2016, April in Vienna
- ICRC CORDEX 2016, Mai in Stockholm

2 Scientific Publications (peer-reviewed)
„COPAT - towards a recommended model version of COSMO-CLM“ in e.g. GMD – Geoscientific Model Development; in progress.
Intercomparison of reference runs; no title yet. in progress.
COORDINATED EVALUATION OF CONVECTION PERMITTING CLIMATE SIMULATIONS WITH COSMO5.0 (CECPC5.0)

- Perform a systematic analysis of COSMO-CLM at the convection permitting scale (2.8 km) in climate mode

- Up to now: Setup based in NWP setups

- Be able to recommend a setup to new users in regions investigated and provide a first guess for other regions
**CECPC5.0 - People**

**LIST -** Andrew Ferrone (coordination)

**ZAMG -** Ivonne Anders

**GUF -** Erwan Brisson

**Wegener Center -** Andras Csaki, Marie Piazza, Heimo Truhetz

**KU Leuven -** Matthias Demuzere, Nicole van Lipzig

**DWD -** Susanne Brienten, Barbara Früh

**BTU -** Klaus Keuler

**KIT -** Hans-Jürgen Panitz,

**HZG -** Burkhardt Rockel
### CECPC5.0 - Parameters to be investigated

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Standard</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>ilake</td>
<td>FALSE</td>
<td>TRUE</td>
</tr>
<tr>
<td>itype_fast Waves</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>hd_corr_trcr_bd</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>iadv_order</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>lconv</td>
<td>TRUE</td>
<td>FALSE</td>
</tr>
<tr>
<td>lrad_topo</td>
<td>FALSE</td>
<td>TRUE</td>
</tr>
<tr>
<td>v_scalar_advect</td>
<td>BOTT2_STRANG</td>
<td>BOTT4, BOTT2</td>
</tr>
<tr>
<td>itype_aerosol</td>
<td>1</td>
<td>2(Tegen)</td>
</tr>
<tr>
<td>itype_evsl</td>
<td>2</td>
<td>3,4</td>
</tr>
<tr>
<td>itype_turb</td>
<td>3(?)</td>
<td>1,2(?)</td>
</tr>
<tr>
<td>lsso (?)</td>
<td>TRUE</td>
<td>FALSE</td>
</tr>
<tr>
<td>itype_root</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>itype_heatcond</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>itype_albedo</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>
CECPC5.0 - Regions

Two regions:
- Alpine region: will be nearly identical as in FPS
- Lowland: setup expected to be transferable to FPS region

→ collaboration with CORDEX Flagship studies (FPS)
CECPC5.0 - Time period

- One year runs (to limit CPU needs)

- Based on an analysis of the following parameters
  - frequency of days with precipitation > 15 mm/day
  - maximum precipitation intensity
  - frequency of 10-day dry period
  - longest dry period

- year 2007 was selected for analysis
  (storm Kyrill happened on 17th January 2007)
• Version 1.0 of the COSMO-CLM Testsuite is completed
• The Testsuite consists of two parts
  • A Technical test
    • based on the Meteorological Testsuite of Meteo Swiss with additional checks for the climate mode (netCDF files, restarts, SAMOA)
  • A Climatological test
    • 5 Years simulation
      • compared to observations (presently PMSL, T_2M, TMAX_2M, TMIN_2M, TOT_PREC from EOBSv13.1)
      • Standard plots (Bias, QQ, Probability density function agreement, Equal sided skill score, Taylor diagrams)
• Discussion on additional features in CLM-Community Coordination and SUPTECH groups
• Use for judging COSMO-CLM development
Regional Climate System Model
Unified OASIS3-MCT interface for coupling with regional oceans, land surface and global atmosphere models

A. Will and S. Weiher (BTU), N. Akhtar (GUF), J. Brauch (DWD), M. Breil (KIT), E. Davin (ETH), H.T.M. Ho-Hagemann (HZG), E. Maisonnave (CERFACS), M. Thürkow (FUB)

<table>
<thead>
<tr>
<th>Model Systems Coupled with 4.8 (and 5.0)</th>
<th>Institution</th>
<th>Coupled Model Component</th>
<th>Coupling mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCLM+CLM</td>
<td>ETH</td>
<td>CLM</td>
<td>Sequential</td>
</tr>
<tr>
<td>CCLM+VEG3D</td>
<td>KIT</td>
<td>Veg3D</td>
<td>Sequential</td>
</tr>
<tr>
<td>CCLM+NEMO-MED12</td>
<td>GUF and DWD</td>
<td>NEMO-MED12</td>
<td>Concurrent</td>
</tr>
<tr>
<td>CCLM+TRIMNP+CICE</td>
<td>HZG</td>
<td>TRIMNP</td>
<td>Concurrent</td>
</tr>
<tr>
<td>CCLM+MPI-ESM</td>
<td>BTU and FUB</td>
<td>ECHAM</td>
<td>Sequential</td>
</tr>
</tbody>
</table>

„Description, Performance and Optimum Configuration“, see Will et al. (2016), Geoph. Model Dev.
MiKlip Ensemble System (Global: MPI-ESM)
Annual Starting Years 1961 – 201x

Baseline0 b0 (=CMIP5)
- MPI-ESM-LR
- 3(10) member
- Initialization
  - Ocean:
    - Anomaly T&S from NCEP forced MPIOM
  - 1-day time lagged init.

<table>
<thead>
<tr>
<th>MPI-ESM-</th>
<th>Atmosphere</th>
<th>Ocean</th>
</tr>
</thead>
<tbody>
<tr>
<td>LR</td>
<td>T63L47</td>
<td>1.5° L40</td>
</tr>
<tr>
<td>MR</td>
<td>T63L95</td>
<td>0.4° L40 TP</td>
</tr>
<tr>
<td>HR</td>
<td>T127L95</td>
<td>0.4° L40 TP</td>
</tr>
</tbody>
</table>
Initialized vs. un-initialized ensembles

7 member CCLM 4.8_17, 0.44°, forcing MPI-ESM-LR historical
7 member CCLM+REMO, 0.44°, forcing MPI-ESM-LR initialized b1
EUPORIAS

EUropean Provision Of Regional Impact Assessment on a Seasonal-to-decadal timescale

**main task:**
- Task 21.2 Dynamical Downscaling over East Africa

Institutes involved => DWD, SMHI, ENEA, UC, UL-IDL, Met Office
Seasonal forecasting over East Africa

Summer mean rainfall
(June-to-September; 1991-2010)
MME=CCLM4, RegCM4, RCA4, WRF, WRF
Wp21.2 partners: SMHI (lead), DWD, ENEA, UC, UL-IDL, Met Office U.K.

Brier Skill Score (BSS)
perfect score: BSS = 1
good skill: BSS > 0
no skill: BSS = 0
bad skill: BSS < 0
CLM-Community Special Issue

Part I
Meteorologische Zeitschrift - Vol. 25 Issue 2 (8 articles)
published in May 2016

Part II
to be published in September 2016
Meteorologische Zeitschrift - Vol. 25 Issue 5 (5 articles)
http://www.schweizerbart.de/papers/metz/list/25#issue2
CLM-Community Special Issue

PART I:
1. Keuler et al.: Regional climate change over Europe in COSMO-CLM: Influence of emission scenario and driving global model
2. Haslinger et al.: Future drought probabilities in the Greater Alpine Region based on COSMO-CLM experiments – spatial patterns and driving forces.
3. Brisson et al.: Modelling strategies for performing convective permitting climate simulations
4. Keller et al.: Evaluation of convection-resolving models using satellite data: The diurnal cycle of summer convection over the Alps
5. Hassanzadeh et al.: Impact of topography on the diurnal cycle of summertime moist convection in idealized simulations
6. Brienen et al.: A Central European precipitation climatology – Part II: Application of the high-resolution HYRAS data for COSMO-CLM evaluation
7. Smiatek et al.: Impact of land use and soil data specifications on COSMO-CLM simulations in the CORDEX-MED area
8. Trusilova et al.: The urban land use in the COSMO-CLM model: a comparison of three parameterizations for Berlin
CLM-Community Special Issue

PART II:

1. Schulz et al.: *On the ground heat flux simulated by the land surface scheme TERRA of the COSMO atmospheric model*

2. Ogaja et al.: *Fourth Order Conservative Discretisation of Horizontal Euler Equations in the COSMO Model and Regional Climate Simulation*

3. Pardowitz et al.: *Estimating uncertainties from high resolution simulations of extreme wind storms and consequences for impacts*

4. Gutjahr et al.: *Impact of the horizontal resolution on the simulation of extremes*

5. Hübener et al.: *Evaluation and projection of high and low precipitation extremes simulated by COSMO-CLM4.8 for four small river catchments in Hessen, Germany*
CLM-Community Assembly 2016

September 20 – 23, 2016

Leuphania University

Lüneburg, Germany
CLM-Community Assembly 2017

September 19 - 22, 2017

Karl-Franzens-Universität Graz / University of Graz
Wegener Center for Climate and Global Change
Austria

http://wegcenter.uni-graz.at/de/wegener-center/
Thank you very much for your attention!!!
CLM-Community development

Barbara Früh  
COSMO General Meeting, Offenbach, Germany  
September 07, 2016
CLM - Community development of publications

![Bar chart showing the number of annual publications and 4-year average over years 2002 to 2016.](chart.png)
Aim: Coordinated parameter testing to give a recommendation on the parameters to the users and have an evaluated community version in the end based on COSMO5.0 including an evaluation report

Participants
Susanne Brienen (DWD), Andrew Ferrone (LIST), Beate Geyer (HZG), Klaus Keuler (BTU), Daniel Lüthi (ETHZ), Anne Roches (ETHZ), Hans-Jürgen Panitz (KIT), Meriano Mertens (DLR), Jan-Peter Schulz (DWD), Hendrik Wouters (KUL), Ivonne Anders (ZAMG)

Domain and Setup:

Model version:
COSMO5.0_clm1; COSMO5.0_clm3a
together with int2lm2.0

Spatial resolution:
0.44° for all testruns, 0.165° for final evaluation run

Forcing:
ERAinterim 1979-2000)
(preprocessed data available via DKRZ)
Cooperation between COSMO Consortium and CLM Community

is highly desirable

... some collaborations already exist

- External parameters for COSMO (NWP) and COSMO-CLM (climate)
  EXTPAR/PEP Source Code Administration (SCA) D. Lüthi

- Closely cooperating Working groups
  - WG2/WG DYNNUM
  - WG3b/WG SOILVEG

... but it could still be improved!
New 4th order discretisation is implemented in COSMO 5.0:

- full 4th order horizontal discretisation of the Euler equations
  \[
  \text{l\_higher\_order\_ss} = \text{.TRUE.}
  \]

- new kinetic energy conserving symmetric advection scheme (*Morinishi et al. JCP 1998, 2010*)
  \[
  \text{ladv\_symmetric} = \text{.TRUE.}
  \]

Climate simulations (18km, 7km) and idealised test cases reveal:

- Model stability without any explicit or implicit horizontal diffusion
- Increased effective model resolution by approximately factor 2
- 2% additional computing costs
- Tuning of physical parameterizations (convection, turbulence) necessary

COSMO-DE test simulations: successful for 1 month
1. Effective model resolution
see Ogaja&Will (2016) Meteorol. Z. for details

Kinetic energy spectra for COSMO 4.24, CORDEX-EU configuration

4th order symmetric (new)

\[ S_{4^*} := \frac{9}{8} U^{O4,\lambda} \delta_\lambda u - \frac{1}{8} U^{O4,\lambda} \delta_{3\lambda} u \]
\[ + \frac{9}{8} v^{O4,\phi} \delta_\phi u - \frac{1}{8} v^{O4,\phi} \delta_{3\phi} u \]

Observations (Lindborg)

3rd order upwind (reference)
Scalability and Performance
COSMO 5.0, COSMO-EU configuration

Scalability of 4\textsuperscript{th} order symmetric [ Total CPU time ] and Difference of Computing Costs (+/- n\%) in comparison with 3\textsuperscript{rd} order upwind

Mistral: DKRZ

- Total CPU time: + 2%
- Fast Wave solver: + 3%
- Advection: +10%
News from CCAR

Implementation of the aerosol module M7 with simplified chemistry in COSMO-ART/M7 finished.
Evaluation with respect to tropospheric gas phase chemistry of COSMO-CLM/MESSy and first studies involving complex chemistry finished.

Comparison of COSMO-CLM/MESSy with aircraft in situ data over Europe (CARIBIC).
Mertens et al., 2016

95 percentile of the contribution of road traffic emissions to ground level ozone over Germany for the period JJA 2008.
Reliability

Ensemble Spread Score (ESS)

annual temperature, years 2-9

Baseline0 CCLM and MPI-ESM-LR

\[ ESS = \frac{\text{Ens}_{\text{Spread}}}{\text{Ens}_{\text{Mean Error}}} \]
Optimum configuration:
Time to Solution (vertical axis) and Costs (surface)

Results:
- Costs of field exchange and communication by OASIS negligible
- Scalability problems identified
- Unnecessary additional costs identified

Additonal costs [%]
in comparison to COSMO-CLM

Machine: blizard, DKRZ
Domain: CORDEX-EU

Machine: blizard, DKRZ
Domain: CORDEX-EU