Climate Limited-area Modelling Community
CLM-Community Newsletter

DWD

No. 7 **August 2016**

Content

Welcome to the 7th Newsletter of the CLM-Community

The publication of scientific results is an important component of our work. For the success of a scientific community such as the CLM-Community with its many different research goals but the common aim to constantly improve the model, it is also essential to be visible to the "outside" scientific world. This can be best achieved by grouping several articles. Therefore, for the second time after 2008, an effort was made to combine different publications around the development and application of the COSMO-CLM in a special issue of a scientific journal. We are happy to announce that now 8 articles are available. Due to the page limitation of a single issue, the articles are spread over two issues. The first part has now been published by the Meteorologische Zeitschrift as "Recent developments in Regional Climate Modelling with COSMO-CLM, Part 1" in Volume 25, Number 2 (see: http://www.schweizerbart.de/papers/metz/list/25#issue2).

The main topics of the eight articles in this first issue are:

- sensitivity of the climate signal: with an article by Keuler et al. on the influence of the emission scenario and the driving model on RCM simulations; and by Haslinger et al. on future drought probabilities in the Greater Alpine Region;
- convection-permitting simulations: with a contribution by Brisson et al. on new modelling strategies for convection-permitting climate simulations, one by Keller et al. on the diurnal cycle of summer convection and the comparison of parameterized and resolved convection, and one by Hassanzadeh et al. on improving the understanding for the processes initiating convection;
- model evaluation: with a contribution of Brienen et al. on the importance of using high-resolution observations for the evaluation of RCMS and one by Smiatek et al. on the importance of sophisticated information of land properties; and
- model development: where Trusilova et al. compare three urban modules with different order of complexity.

We are looking forward to the second part, which is in its final throes.

Enjoy reading the Newsletter,

Yours sincerely, Barbara Früh and Susanne Brienen

CLM Assembly 2016

All community members are invited to join this years' Assembly, which will take place in **Lüneburg**, a beautiful small city in the north of Germany.

Left: Lüneburg (photo: Moritz Maneke), right: city tour with historical costumes (photo: Birgit Jahneke)

After an introduction to new in the morning, the official program will start at 12:30 on 20 September. Three solicited talks are scheduled, with overviews on the limited-area mode of ICON, the OASIS coupler and the COPAT project. As evening keynotes, Andrew Ferrone (LIST) will talk about the IPCC agreement in Paris and Markus Meier (IOW) on the importance of regional coupled climate system models.

For some insight into the hosting city, a "time travel" tour of Lüneburg is planned.

CLM Assembly

20 - 23 September 2016

Leuphania university of Lüneburg, Germany

For details, see the webpage.

Important dates:

Abstract Submission Deadline for Oral Presentations: expired

Abstract Submission Deadline for Poster Presentations: 2 September 2016

Registration Deadline: 2 September 2016

Preview to 2017

The assembly 2017 will take place in Graz, Austria. Please note the homepage, which will soon be filled with relevant information:

https://wegcwww.uni-graz.at/clm2017

Five questions to Silje Sørland, ETH Zurich

1. Which is your main research focus when using COSMO-CLM?

I'm working in the climate and water cycle group at ETH Zurich. In this group several people are using COMSO, where the research focus is mainly on the climate system and its interactions with the water cycle, either on European scale or more idealized simulations. I am using COSMO-CLM for coarser resolution simulations (12-50km) and I am involved in projects where we use COSMO-CLM for different climate studies over Europe. Since I started I have mainly used COSMO-CLM to downscale GCMs, and these simulations will be part of the EURO-CORDEX ensemble. One of the things I'm currently looking into is to investigate if COSMO-CLM (and also RCMs in general) is improving the results compared to the GCMs.

2. Silje, as a rather new member, what is your experience with the CLM-Community so far?

I am still a quite new user of COSMO-CLM, and started to use the model in October when I began my postdoc here at ETH. When I joined the CLM-Community I was first a bit overwhelmed by all the acronyms and different groups. One of the challenges to a large community with many users is to integrate and coordinate the contributions and needs from all the different institutions. Now after that I have learned more about the structure, I think the organization of the CLM-community works well. In March I attended the COSMO user workshop, which was a great way to be introduced to the community and meet people from different institutions that are using COSMO. I particularly enjoyed the group meetings, where I participated in the EVAL and CP group meetings. It was useful to hear the discussions and opinions from the different groups and also get an overview over the latest work done by the groups, and many of the discussions were issues that I'm facing in my daily work. Collaboration between institutions that are using COSMO-CLM is important when it comes to improve the model and share experiences, and the CLM-Community is making this possible.

3. What are your expectations to the CLM-Community?

I think the CLM-Community has an important task when it comes to share information to-, and bring together, the different users so current issues and also future plans for the model can be discussed. Regional modeling is a very active research field where a lot of new things are coming up all the time, and therefore the community needs to be flexible and not too rigid to be able to adjust to these circumstances. I think the CLM-Community does this in a good way already, where for instance the user meetings and the general assembly are important platforms where the different users can meet.

4. In which way do you plan to contribute to CLM-Community activities?

As I already mentioned, I found it useful to join the EVAL and CP group meeting, and I will continue to be involved in these groups and hopefully contribute more in the future. I have briefly helped with the COPAT report, even though most of the work was done before I joined the community. I have used the recommended version of COSMO-CLM for all my simulations, so I have already taken advantage of the outcome from that report.

5. What are your personal goals with respect to your scientific career?

To be a postdoc at ETH I already feel I am achieving several of my goals, both personally and with respect to my scientific career. It is a great opportunity for me to be in Zürich in a new research group, where I can expand my scientific network and I also get the chance to experience a new country. I really enjoy doing science, especially when it comes to understand how meteorological processes might change with climate. I also like to be parts of projects like the "Swiss climate change scenario" (CH2018) and EURO-CORDEX. I find it very giving to join discussions on how to best communicate all the climate information. This is my first year as a postdoc so my scientific career is still very in the beginning, and it is difficult to say whether I will stay in science at the end. But I enjoy what I'm working on now and I learn so many new things all the time. I hope I can be a good researcher, with respect to do good research, but also to be a person that it is easy to collaborate with and that can share information in an understandable way.

Thank you very much for the interview!

IPCC activities

IPCC 6th Assessment cycle with three special reports

By Andrew Ferrone In April 2016, the Intergovernmental Panel on Climate Change (IPCC) decided at its 43rd Session on the overall timeline for the preparation of 6th Assessment Report (AR6) and the special reports that will be prepared during this cycle. The Panel decided that three special reports will be prepared:

- a special report on the impacts of global warming of 1.5 ºC above pre-industrial levels and related global greenhouse gas emission pathways (SR1.5) to be completed in September 2018, following the invitation from the United Nations Framework Convention on Climate Change (UNFCCC);
- a special report on climate change and the oceans and the cryosphere (SROCC);
- a special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems.

These three special reports will be produced as early as possible in the AR6 cycle, but a final timeline will be decided at the next session of the Panel to be held in October 2016, where the scoping of SR1.5 will also be fixed. For more details on nomination of experts, scoping meetings and some preliminary timelines, please go to ipcc.ch.

Concerning the timeline of AR6, the Panel decided that the three working group contributions should be published in 2020/2021, starting with WG1, followed by WG3 and finally WG2. The synthesis report will be published in 2022, which is in line with the first global stocktake (GST) under the UNFCCC, fixed in the Paris Agreement to take place in 2023. A possible alignment of the IPCC Assessment Cycle (currently 7 years long) and the 5 year cycles of the GST will be addressed in future sessions of the Panel.

The proposals for a special report on regional aspects and on cities, their unique adaptation and mitigation challenges and opportunities have not been retained but the Panel decided to give special attention to these two aspects in AR6.

Photo by IISD/Kiara Worth (www.iisd.ca/climate/ipcc43/11apr.html)

CLM-Community issues

COSMO/CLM/ART Training Course 2016

The 9th COSMO/CLM/ART Training took place from 15th - 23th February 2016 in the training center of the DWD in Langen near Frankfurt/Main, Germany. The 42 participants came from 21 different countries and were, this year, mainly interested in the NWP part (21). In the RCM group (12 participants), the exercises were again based on the starter package which is available to all new users (see homepage), now on the new DKRZ computer "mistral".

The next Training Course is scheduled for 27 March – 4 April 2017. Additionally, an ICON-LAM training is planned to be held separately on 28 February – 3 March 2017.

COSMO/CLM/ART User Seminar 2016

The COSMO/CLM/ART User Seminar 2016 was held from 7 to 9 March 2016 in Offenbach, Germany. 176 people from 13 different countries took the opportunity to discuss their experiences and results with the model.

Photo by DWD

The next Seminar is scheduled for 06 - 08 March 2017 as COSMO/CLM/ICON/ART User seminar. Then, the ICON developers and users will join the meeting.

New member institutions

Ludwig Maximilians Universität München (LMU)

(http:// www.uni-muenchen.de/index.html)

Support of model development in the Transregional Collaborative Research Center 165 (Waves to Weather), especially with regard to compatibility between different contributions to the model code.

Contact: Robert Redl

(robert.redl@lmu.de)

Indian Institute of Technology

(http:// www.iitd.ac.in/)

Studying the impact of a dynamic vegetation component, and additionally of over-pumping and irrigation scenarios, on the hydrological cycle and changes in extremes. Establishment of a suitable regional climate model for India.

Contact: Nikhil Ghodichore

(nikhilghodichore@gmail.com)

Norwegian University of Science and Technology

(http:// www.ntnu.edu/)

Addressing the interdisciplinary complexities of the land-climate nexus, with focus on boreal forest management and regional/global climate. A guidance on future strategies for resource supply and utilization in the context of climate change mitigation is seeked.

Contact: Francesco Cherubini

(francesco.cherubini@ntnu.no)

Leibniz Institute for Baltic Sea Research Warnemünde

(http://www.io-warnemuende.de/en_index.html)

Development of a fully coupled atmosphere-ice-ocean-land surface-biogeochemical model to assess climate variability and climate change in the North Sea and Baltic Sea regions. Focus on long-term changes in the ecosystems of North and Baltic Sea and on the water exchange in the transition zone.

Contact: Markus Meier

(markus.meier@io-warnemuende.de)

Research notes

Lagrangian evaluation of convective shower dynamics in a convection permitting model

E. Brisson, C. Brendel, S. Herzog, B. Ahrens

Institute for Atmospheric and Environmental Sciences, Altenhoeferallee 1, D-60438 Frankfurt/Main, Germany

More details about this work can be found in:

Brisson E, Brendel C, Herzog S, Ahrens B (2016): Lagrangian evaluation of convective shower dynamics in a convection permitting model. Meteorologische Zeitschrift (submitted)

Introduction

Currently, a large gap exists between the spatio-temporal scale required by impact researchers, stakeholders, and policy makers and the scale of climate model outputs provided in the framework of climate projections (Prein et al. 2015). Filling this gap is especially challenging when focusing on precipitation mainly because the resolution of climate models (i.e., global climate models and regional climate models) is too coarse to capture the precipitation spatial variability required by impact models. In addition, current climate models often show a poor representation of precipitation on fine temporal scales (e.g., hourly) mainly due to deficiencies of the deep convection parametrizations.

Resolving explicitly deep convection is skilful at improving the representation of both the spatial and temporal variability for precipitation or clouds (Brisson et al. 2016b). Convection permitting models (CPMs) represent more realistic precipitation structures than coarser models (Prein et al. 2013; Brisson et al. 2015). CPMs also improve the timing of the mid-afternoon convective peak and the hourly distribution of convective precipitation and clouds.

While such results are promising, evaluations are still lacking to ensure that these added values result from coherent processes and not from error compensations. In this study we propose to evaluate the representation of convective shower dynamics by CPMs. A Lagrangian approach is applied to evaluate the representation of shower temporal patterns, horizontal speeds and lifetimes in COSMO-CLM.

Method

A two-step nesting strategy is used to downscale ERA-Interim re-analyses over central Germany using the COSMO5.0_CLM2. A 0.22° simulation (CCLM022) is performed first and further downscaled to 0.01° (CCLM001). Unlike the CCLM001, the CCLM022 does not explicitly resolve deep convection within the grid-scale, and hence, the deep convection scheme after Tiedtke (1989) is used. CCLM001 simulations are performed for specific cases only, selected using the method developed in Brendel et al. (2014). This method consists of logistic regression models which select cases with a high probability for convective activity—here defined as a large number of convective cells with precipitation intensity above 8 mm/h. In addition, the identification procedure considers two types of cells independently, namely, the long lifetime cells (LLCs) which may have a significant impact over large catchments, and slowly moving cells (SMCs), which may result in large local precipitation accumulations.

In total 78 days are compared to the RZ-Radar product of the Germany's National Meteorological Service (Deutscher Wetterdienst - DWD). This dataset covers the period 2004 to 2010, has a 5-minutes temporal resolution, and a spatial resolution of ~1 km. An algorithm developed in Brendel (2009) is used to track convective precipitation in both the radar product and the CCLM001 outputs. For each cell identified, the five-minute precipitation accumulations, the cell lifetime and the cell horizontal speed are extracted. To study the evolution of showers with different lifetimes, the quantity P' is introduced so that for a specific time step (P'_t):

$$P'_t = \frac{P_t}{\bar{P}}$$

where P_t is the precipitation intensity at time-step t and $\bar{P}$ is the mean precipitation intensity of the cell. The mean of P' is, thus, equal to 1.

Results

Fig. 1 shows the averaged temporal dynamics of precipitating convective cells. The model simulations follow the observed temporal pattern closely and explain more than 98% of the observed temporal variance. There is an overlap between the observed and the model temporal pattern of 99.6%. While the amplitude of the maximum P' is represented correctly, it is delayed by about 4% of the cell lifetime (1.6 min for a typical cell lifetime).

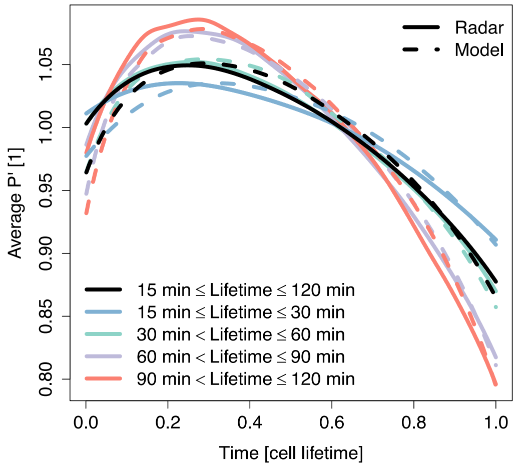

Figure 1: Averages of P' for convective cells with different lifetimes (shown in different colors). Averages derived from the radar are shown with solid lines, while those derived from the model are shown with dashed lines.

This bias mainly arises from a lower occurrence of short events (i.e., with cell lifetimes <30 min) in the simulations compared to the radar. These short events represent more than 43% of all events and are, therefore, significantly influencing the average temporal pattern of the convective events shown in Fig. 1. The very short events (i.e., with cell lifetimes of 15 min), which are characterized by lower precipitation dynamics (i.e., flattened line) were detected 34% more often in the radar dataset than in the model simulations. As discussed in Brisson et al. (2016a) this bias is likely to arise from limitations of the tracking algorithm.

The bias of P' maximum occurrence is reduced with increasing cell lifetimes (Fig. 1). The delay between the model and the observation is of 10% for short events (i.e., with cell lifetimes < 30 min) and 1% for long events (i.e., with cell lifetimes > 90 min). Although the highest values of P' are slightly underestimated by the CPM, the simulations capture the increase in temporal variability (higher maximum values) with increasing lifetimes. In addition, the probability of occurrence of events longer than 30 min in the model is close to the one observed in the radar dataset (Fig. 2).

The selection procedure, described in Section 2, considers two different types of cells, namely, the long lifetime cells (LLCs) and the slowly moving cells (SMCs). In the following work, the events are classified based on whether they occur during a day with a high probability for the occurrence of LLCs or SMCs. As shown in Figs. 2 and 3, the duration and horizontal speed distribution of the LLCs and SMCs differ significantly from each other. The Perkins skill scores (PSSs) between the LLCs and SMCs reached ~0.67 and ~0.25 for the duration and the horizontal speed respectively; Perkins et al. (2007) state that two distributions deviate significantly from each other if the PSS is below 0.7.

The LLCs feature a higher probability for long lasting events (> 1 hour) and a lower probability for short events (< 1 hour) than the SMCs. This feature is well reproduced by the model, and PSSs of 0.96 and 0.90 were found for the LLCs and SMCs respectively.

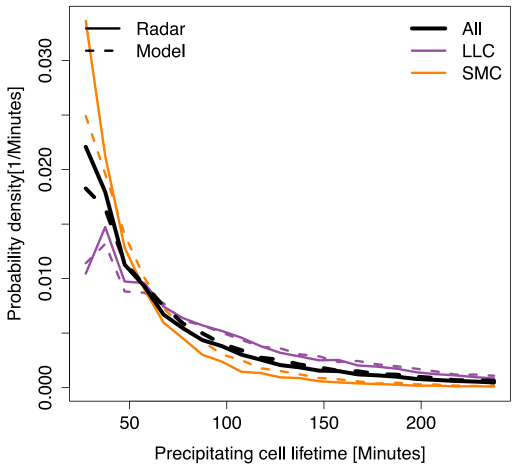

Figure 2: Cell lifetime probability density for all cells (in black) and for the two different types of convective cells, namely, the long lifetime cells (LLCs - in purple) and the slowly moving cells (SMCs - in orange). Probabilities derived from the radar are shown with solid lines, while those derived from the model are shown with dashed lines.

As shown in Fig. 3, the model produces the close-to-observed horizontal speed distribution for each of the cells types (i.e., LLC and SMC). The PSS notably reached 0.86 for the LLCs and 0.89 for the SMCs. Surprisingly, the PSS was higher (0.96) when considering all events. This results from compensation of biases between the two types of cells. The speeds of the slowest SMCs (LLCs)— < 50 m/s — were underestimated (overestimated), while the speeds of SMCs (LLCs) faster than 50 m/s were overestimated (underestimated).

Conclusions

The results of this study show that except for very short events (i.e., with cell lifetimes <30 min), for which there exists high evaluation uncertainty due to the methodology, most convective shower features are well reproduced by the COSMO-CLM at the convection permitting scale. The number, lifetime, temporal dynamics, and horizontal speed of precipitating convective cells are all close to observed values. These results provide further confidence that the COSMO-CLM at convective permitting scale is an asset for deriving robust climate projections of convective precipitation.

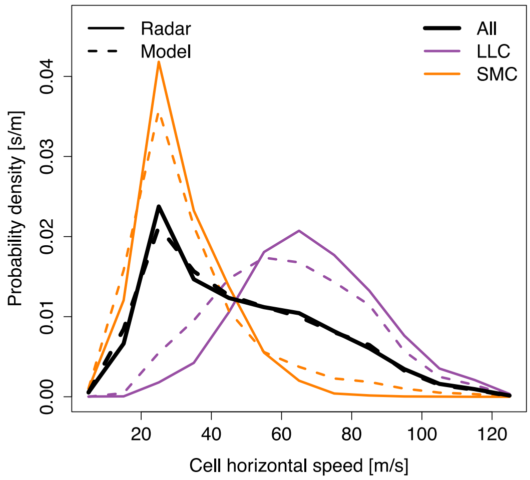

Figure 3: Cell horizontal speed probability density for all cells (in black) and for the two different types of convective cells, namely the long lifetime cells (LLCs - in purple) and the slowly moving cells (SMCs - in orange). Probabilities derived from the radar are shown with solid lines, while those derived from the model are shown with dashed lines.

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Brendel C, Brisson E, Heyner F, et al (2014) Bestimmung des atmosphärischen Konvektionspotentials über Thüringen. Berichte des Dtsch Wetterdienstes 72.

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Brisson E, Demuzere M, Lipzig NPM Van (2015) Modelling strategies for performing convection-permitting climate simulations. *Meteorol Zeitschrift*. doi: 10.1127/metz/2015/0598

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Prein AF, Langhans W, Fosser G, et al (2015) A review on regional convection-permitting climate modeling: Demonstrations, prospects, and challenges. *Rev Geophys* **53**:323–361. doi: 10.1002/2014RG000475

Tiedtke M (1989) A Comprehensive Mass Flux Scheme for Cumulus Parameterization in Large-Scale Models. *Mon Weather Rev* **117**:1779–1800. doi: 10.1175/1520-0493(1989)117<1779:ACMFSF>2.0.CO;2

Is land surface processes representation a possible weak link in current Regional Climate Models?

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More details about this work can be found in:

Edouard L Davin, Eric Maisonnave and Sonia I Seneviratne (2016), Is land surface processes representation a possible weak link in current Regional Climate Models? *Environmental Research Letters*, Volume **11**, Number 7, doi:10.1088/1748-9326/11/7/074027.

It is a frustrating fact in the history of regional climate modelling: Regional Climate Models (RCMs) performance in simulating past climate did not substantially improve over time. At least, hard evidence is still lacking. The successive generations of RCM intercomparisons over Europe (PRUDENCE, ENSEMBLES, EURO-CORDEX) provide a striking example. No clear overall improvement in RCM performance could be identified in EURO-CORDEX compared to previous generations and some long-standing biases are still present (Kotlarski et al., 2014). But who should take the blame? Undoubtedly, the representation of many physical and dynamical processes has been improved in RCMs over the last decades. But these improvements were not necessarily evenly distributed. In particular, we argue that land surface processes were, to a certain extent, left behind in the race to improve RCMs and thus represent a potential "weak link". A quite clear mismatch indeed exists between the relatively simple Land Surface Models (LSMs) used in current RCMs and the current level of understanding of land processes as crystallized in the most advanced LSMs (Davin et al., 2011).

In this study, we highlight the added value of coupling COSMO-CLM with the Community Land Model, a state-of-the-art LSM. In the context of ERA-interim-driven simulations over Europe, we find that the coupled system, referred to as COSMO-CLM², substantially improves the representation of surface fluxes and tempera-

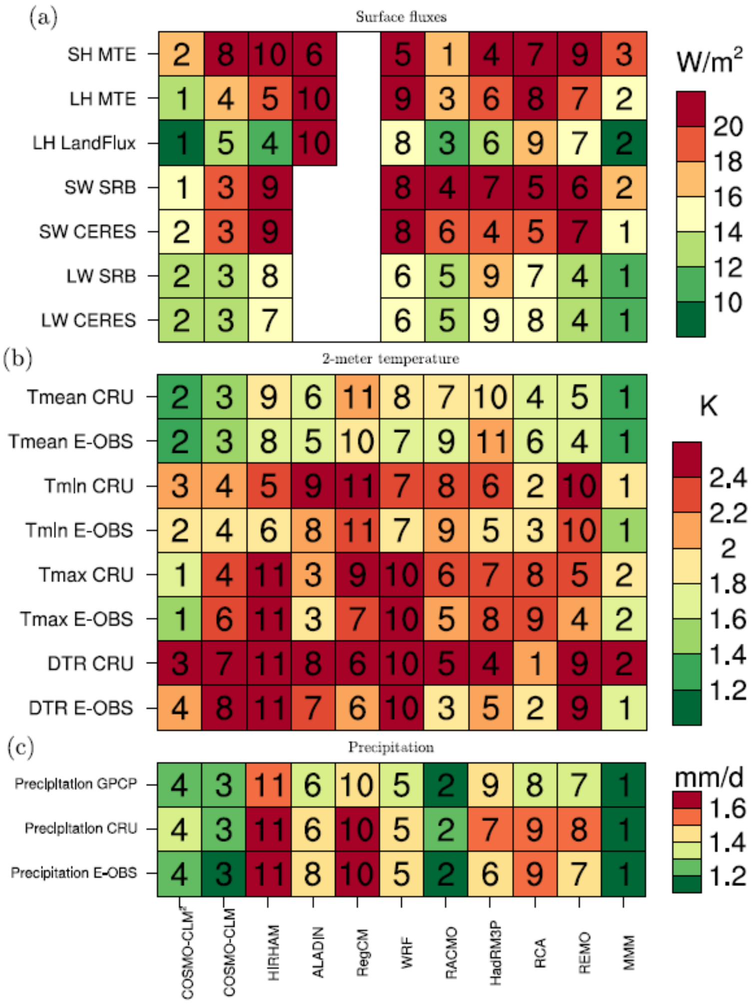

Figure 1 RMSE-scores (colour) and model ranking (numbers) integrating both spatial and temporal model performance. RMSEs are calculated across all land grid points over Europe (-10W 30E; 36N 70N) based on monthly values over multiple years. MMM: multi model mean of EURO-CORDEX excluding COSMO-CLM². Taken from: Davin et al., ERL, 2016.

ture compared to COSMO-CLM (see Figure 1). In general, the improvement stems from more realistic surface fluxes, in particular concerning the partitioning of turbulent fluxes. Temperature biases over Northern Europe tend to be radiation-driven and the improved turbulent energy partitioning at the surface positively affects the simulated cloud cover and thus radiation. In contrast, the reduction of temperature biases over Southern Europe involve more direct couplings between evapotranspiration and surface temperature and between ground heat flux and surface temperature.

Moreover, COSMO-CLM^2 even outperforms the other EURO-CORDEX models for most variables analyzed except precipitation. In other words, the gain that can be obtained from improving land processes is very critical as it may help to go beyond the current range of RCM performance.

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Kotlarski S et al 2014 *Geosci. Model Dev.* **7** 1297–333

Remember

… part of your scientific success relies on the work of those people providing the reference model, maintain the codes, etc. Therefore, it would be more than a sign of courtesy to offer them co-authorships once in a while.

Please, do not forget to state that you used the "COSMO model in Climate Mode (COSMO-CLM)" and, please, also include the statement "COSMO-CLM is the community model of the German regional climate research" in each publication.

Upcoming events

- **2016 September, 05th - 09th**, COSMO General Meeting, Offenbach, Germany
- **2016 September 11th - 16th**, EMS & ECAC, Trieste, Italy
- **2016 September 19th - 23rd**, CLM-Community Assembly, Lüneburg, Germany
- **2017 February 28th – March 03rd**, ICON-LAM Training, Langen, Germany
- **2017 March 06th - 10th**, COSMO/CLM/ICON/ART User Seminar, Offenbach, Germany
- **2017 March 27th – April 04th**, COSMO/CLM/ART Training, Langen, Germany

see also

http://www.clm-community.eu/index.php?menuid=203

Please send all information on new publications related to COSMO-CLM (peer-reviewed as well as reports, theses, etc.) with corresponding links to clm.coordination[at]dwd.de for listing on the community web page and in the Newsletter. Please do not forget to name the project in the topic browser to which it is related.

Recent publications

2016

Brienen S., B. Früh, A. Walter, K. Trusilova, P. Becker (2016): A Central European precipitation climatology - Part II: Added value of the high-resolution HYRAS climatology for COSMO-CLM evaluation. *Met. Z.*, Vol. **25**, DOI: 10.1127/metz/2016/0617

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Cheneka, B.R., S. Brienen, K. Fröhlich, S. Asharaf, B. Früh (2016): Searching for an Added Value of Precipitation in Downscaled Seasonal Hindcasts over East Africa: COSMO-CLM Forced by MPI-ESM. *Advances in Meteorology*, Vol. **2016**, Article ID 4348285

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Li, D.: Added value of high-resolution regional climate model: selected cases over the Bohai Sea and the Yellow Sea areas; Int. J. Climatol. DOI: 10.1002/joc.4695

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Smiatek, G., J. Helmert, E.-M. Gerstner (2016): Impact of land use and soil data specifications on COSMO-CLM simulations in the CORDEX-MED area. *Met. Z.*, **Vol. 25 No. 2**, DOI: 10.1127/metz/2015/0594

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