Climate Limited-area Modelling Community

July 2019

Newsletter

No. 13

Content

See YOU at the

CLM-Community Assembly 2019

16-20 September 2019

Paestum, Italy

Invited speaker:

Antonio Navarro (President CMCC)

Announcement:

ICCARUS 2020

02-06 March 2020

Offenbach, Germany

Welcome to the 13th newsletter of the CLM-Community!

In 2013, a number of scientific challenges for the future were identified during the International Conference on Regional Climate. It was recognized, that addressing these challenges requires the development of more targeted experiment setups compared to the standard experiment setup in CORDEX. This finding led to the idea of the "Flagship Pilot Studies" (FPS). Meanwhile seven FPS have been established within the CORDEX framework. Members of the CLM-Community contribute to FPS with focus regions in Europe and Africa. We will present these FPS in the next issues of the newsletter, starting with FPS LUCAS in this issues.

This newsletter also contains an interview with Ronny Petrik from Helmholtz-Zentrum Geesthacht and research notes by Roman Brogli et al. on the reason for the future Mediterranean summer warming amplification and by Niels Souverijns et al. who present results of regional climate model simulations for Antarctica. There is a report on the last IPCC meeting in Japan by Andrew Ferrone, an article about the possibility of online diagnostics with MESSy, a review of ICCARUS 2019 and the Numerical Model Training, an outlook to this years CLM-Community Assembly in Paestum and an update on the status of the new science plan. Enjoy reading.

We hope to meet many of you in Paestum in September.

Yours sincerely,
Barbara Früh, Susanne Brienen and Christian Steger

Hera Temples in Paestum (source: Oliver Bonjoch, https://commons.wikimedia.org/wiki/File:Veduta_di_Paestum_2010.jpg, License: https://creativecommons.org/licenses/by-sa/3.0/deed.de)

Five questions to …
Ronny Petrik
Helmholtz-Zentrum Geesthacht

Photo by R. Petrik

Ronny Petrik has a degree in Meteorology with different research collaborations, recently in the field of climate modelling and aerosol-cloud-radiation interactions. He is highly interested in analysing physical processes and model shortcomings using innovative coupled numerical models and elaborated statistical concepts. He brings in his long-term experience with atmospheric science as (associate) reviewer for different journals and as working group leader of CCLM-CRCS.

1. Ronny, you work at the Institute of Coastal Research at the Helmholtz-Zentrum in Geesthacht. Can you please tell us something about the institute and your tasks there?

I am working as a scientist at the institute and I'm involved in three different projects (openFRED, MarEns and SeAir). Moreover, I am contributing to two HZG-initiatives: one aims to establish a Coastal Data center, and the other aims at an Earth System model for coastal regions. Finally, I am working on proposals in the field of regional climate.

2. In which context do you use COSMO-CLM?

I have used the COSMO-CLM to establish hindcasts dedicated for energy system modelers.; i.e. modifications to the model diagnostics are introduced. Moreover, I am very interested to learn about model's shortcomings regarding the planetary boundary layer processes.

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

→

3. What is your experience with the CLM-Community?

In my opinion the CLM-Community is a very nice place to communicate about perspectives in collaboration, about recent and upcoming projects at the different institutes and about model development regarding limited area climate models. The people involved and the good mood at the meetings make the community very special. Unfortunately, not all members have taken over an active role to support the community idea. Furthermore, I would like that other models join the community to get new insights into model's capabilities.

4. You are the coordinator of the working group CRCS. Can you give us some insights in the current activities of the working group and your job as the coordinator?

The job as a coordinator is not a big deal – at a first glance. The main challenge arises from the fact that one has to be informed about new developments in the field of CRCS and to gather and create projects relevant for the CLM-Community. Here, my activities in the NWP community during the last years were very helpful.

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

I am not the person dealing everyday with shaping the ideal academic career. The main issue is to have fun with the projects I am involved in and to get insight into new fields. Thus, I am moving to work with the ICON-CLM and to investigate the impact of aerosol and cities on the atmospheric dynamics in the future.

Thank you very much for the interview!

IPCC activities

2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories

by Andrew Ferrone, Ministry of Agriculture, Viticulture and rural Development Administration of agricultural technical services Meteorological service Luxembourg

The Intergovernmental Panel on Climate Change (IPCC) met from 8th to 12th May 2019 in Kyoto, Japan. The main point on the agenda of this 49th Session was the adoption of the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2019 Refinement) overview chapter and the acceptance of it's volumes.
More than 280 scientists and experts worked on the 2019 Refinement to refine the guidance as well as the methodologies of the 2006 IPCC Guidelines for four sectors: (1) energy, (2) industrial processes and product use, (3) agriculture, forestry and other land use, (4) waste. These refinements aim to improve the transparency, accuracy, completeness, comparability and consistency of the reporting process by ensuring that the methodology used to determine these inventories is based on the latest science.
The main areas of discussion during the adoption process concerned the AFOLU volume (chapters relating to biochar, flooded land, inter-annual variability) and Energy (chapter on fugitive emissions from oil and natural gas systems).
More information on the 2019 Refinement can be found at https://www.ipcc.ch/2019/05/13/ipcc-2019-refinement/

The Panel also decided to produce a Methodology Report on Short-lived Climate Forcers (SLCF) during the 7th Assessment Cycle and a task group on gender was established to draft an IPCC gender policy and an implementation plan to be presented to the Panel next February.

Upcoming sessions:

- Special Report on Climate Change and Land (50th session, 2-6 August, Geneva, Switzerland)
- Special Report on The Ocean and Cryosphere in a Changing Climate (51st session, 20-23 September, Principality of Monaco, Monaco)

SBSTA50, SBI50: From negotiations to implementation.

by Andrew Ferrone, Ministry of Agriculture, Viticulture and rural Development Administration of agricultural technical services Meteorological service Luxembourg

The two Subsidiary bodies of the United Nations Framework Convention on Climate Change (UNFCCC) met from 17th to 27th June in Bonn Germany for their respective 50th session: the Subsidiary Body for Scientific and Technological Advice (SBSTA) and the Subsidiary Body for Implementation (SBI).

After the successful adoption of the Katowice rulebook at COP24 in December of last year, giving a robust framework to the Paris Agreement, there was a noticeable shift in the discussions, much more focused on implementation of ambitious climate action than negotiations.

The SBSTA chair also convened the Eleventh Meeting of the Research Dialogue (RD 11; https://unfccc.int/topics/science/workstreams/research/research-dialogue/eleventh-meeting-of-the-research-dialogue-science-for-transformation), which aims at promoting the exchange between scientists and Parties. This year's Research Dialogue was organized around the general topic of Science for Transformation and included four themes:

- Transformation of energy and other sectoral systems to achieve the purpose and long-term goals of the Paris Agreement;
- Transformative adaptation and climate resilient development;
- Changing levels of risk and the attribution of extreme climate events and impacts to climate change;
- Role of the ocean in the climate system.

Under the formal part of the conference the agenda item "Research and Systematic conversation" was considered.

In the conclusions (for further information see https://unfccc.int/sites/default/files/resource/sbsta2019_L06E.pdf?download) the SBSTA decided to hold on a regular basis an "Earth Information day" at sessions which happen in conjunctions with CoPs.
The aim of this day is to inform Parties about the latest development in systematic observations related to the climate system. A similar day was already organized in 2016 in Marrakesh and the next one will be held in December of this year in Santiago in Chile.

In Bonn Parties also had a first substantive exchange on the "Scope of the next periodic review of the long-term global goal under the Convention and of overall progress towards achieving it". The Periodic Review was initiated in 2010 in order to periodically review

- Adequacy of the long-term global goal in the light of the ultimate objective of the Convention, and
- Overall progress toward achieving the long-term global goal, including a consideration of the implementation of the commitments under the Convention.

The first Periodic Review was held from 2013-2015 and was organized in the form of at Structured Expert Dialogue (SED), which involved scientific experts, presenting the latest scientific information to Parties, including the 5th Assessment Report of the IPCC. The findings of this first Periodic Review informed the temperature goal of the Paris Agreement and the format of the Structured Expert Dialogue laid the basis of the Global Stocktake, which will take place every five years from 2023 onward under the Paris Agreement.
This is why Parties were discussing in Bonn the aim of a next period review, which should not question the Paris Agreement and not overlap with its Global Stocktake. No consensus could be reached yet and discussions on this topic will continue in December of this year in Santiago in Chile.

Upcoming meeting:

- COP25 from 11th to 22nd November in Santiago in Chile

CORDEX Flagship Pilot Study on Land Use and Climate Across Scales

Merja H. Tölle (Univ. Gießen), Marcus Breil (Karlsruhe Institute of Technology), Edouard L. Davin (ETH Zürich), Hans-Jürgen Panitz (Karlsruhe Institute of Technology), Kai Radtke (Univ. Cottbus-Senftenberg), Mario Raffa (CMCC)

The Flagship Pilot Study LUCAS (Land Use and Climate Across Scales; for further information see https://www.hzg.de/ms/cordex_fps_lucas) was initiated by the European branch of the Coordinated Regional Climate Downscaling Experiment (EURO-CORDEX) and is supported by WCRP-CORDEX. LUCAS is a coordinated effort to integrate land use change forcing into regional climate model experiments for Europe (Rechid et al., 2017). The objective is to identify robust biophysical impacts of land use changes on the European climate across local to regional scales and at various time scales from extreme events to multi-decadal trends. Three phases frame this project for these objectives in order to evaluate the validity of coupled atmosphere-land simulations and to more realistically resolve the heterogeneity of land use changes in Europe and its local impacts on climate.
In the first phase of the project, idealized experiments over Europe have been performed in order to benchmark the Regional Climate Models' (RCMs') sensitivity to extreme LULCC (Davin et al., 2019). Here, non-forested (GRASS) and maximally forested (FOREST) experiments have been performed with a set of nine different RCMs. The FOREST experiment represents a maximally forested Europe, while in the GRASS experiment trees are entirely replaced by grassland.

WCRP CORDEX
FLAGSHIP PILOT STUDIES

Comparing FOREST and GRASS therefore illustrates the theoretical effect of a full re-/afforestation over Europe. A large inter-model spread was found in the simulated climate response to re-/afforestation, see Figure 1 for temperature changes in summer.

In summer, a large part of this spread is attributed to the representation of land processes (Figure 2 as an example for the Mediterranean) rather than atmospheric feedbacks. Indeed models sharing the same Land Surface Model (LSM) exhibit more similarity in their response compared to models sharing the same atmospheric model but different LSMs. In winter, a large part of the inter-model spread can be explained by the magnitude of albedo change and atmospheric feedbacks. In summer, inter-model disagreement can be mostly linked to evapotranspiration changes, which in the case of COSMO-CLM depends on the albedo parameterization in the model (Tölle et al. 2018) among others. The implications and prospects for the next phases of LUCAS will be based on these results.

References:

Davin, E. L., Rechid, D., Breil, M., Cardoso, R. M., Coppola, E., Hoffmann, P., Jach, L. L., Katragkou, E., de Noblet-Ducoudré, N., Radtke, K., Raffa, M., Soares, P. M. M., Sofiadis, G., Strada, S., Strandberg, G., Tölle, M. H., Warrach-Sagi, K., and Wulfmeyer, V.: Biogeophysical impacts of forestation in Europe: First results from the LUCAS Regional Climate Model intercomparison, Earth Syst. Dynam. Discuss., https://doi.org/10.5194/esd-2019-4, in review, 2019.

Rechid D, Davin E, de Noblet-Ducoudré N, Katragkou E, and the LUCAS Team, CORDEX Flagship Pilot Study "LUCAS - Land Use & Climate Across Scales" - a new initiative on coordinated regional land use change and climate experiments for Europe. Solicited presentation. Geophysical Research Abstracts, Vol. 19, EGU2017-13172, 2017, EGU General Assembly 2017

Tölle, M. H., M. Breil, K. Radtke, H.-J. Panitz, 2018: Sensitivity of European temperature to albedo parameterization in the regional climate model COSMO-CLM linked to extreme land use changes, Frontiers Environmental Science, DOI: 10.3389/fenvs.2018.00123.

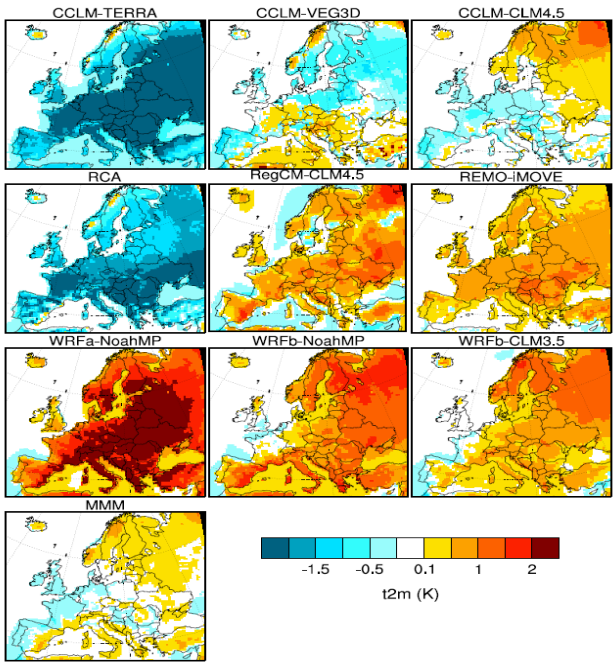


Figure 1: *Difference (FOREST minus GRASS) of 2 m temperature averaged over summer (JJA) for nine different regional climate models and the multi-model mean (MMM, source: Davin et al., 2019).*

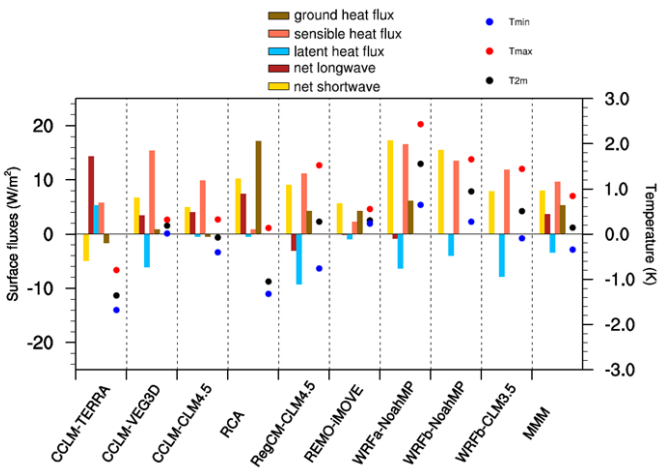


Figure 2: *Changes (FOREST minus GRASS) in temperature and surface energy balance components averaged over summer (JJA) for 9 different regional climate models and the multi-model mean (MMM) over the Mediterranean region only (source Davin et al., 2019).*

CLM-Community issues

Online diagnostics with MESSy

*Mariano Mertens (*German Aerospace Center*) and Astrid Kerkweg (Univ. Bonn)*

The steadily increasing horizontal resolution of regional climate simulations increases the amount of data written to the – usually strongly limited – disk space. Many diagnostics require model data at a very high spatio-temporal resolution. Hence, if they are calculated off-line, the availability and bandwidth of disk space limits the operability of these diagnostics.
The usage of on-line diagnostic tools can overcome these limitations. As these tools calculate the desired diagnostics during run-time, this (1) allows for a calculation of the diagnostics at high spatio-temporal resolution and (2) reduces disk space strongly, as only the complete diagnostics are written to disk instead of all variables required to perform the same diagnostics off-line. To allow such on-line diagnostics in COSMO-CLM a MESSy-fied version of COSMO-CLM is available for members of the CLM-Community. It provides:

(1) The ability to integrate tailor-made on-line diagnostics to the model without the need of modifying the code of COSMO-CLM itself.
(2) The optional output of simple statistics of model variables w.r.t. time, such as monthly mean, standard deviation, minimum, maximum or event counting.
(3) The output on distinct surfaces (e.g., pressure levels, potential vorticity iso-surfaces).
(4) Output of data along sun-synchronous satellite orbits or radiosonde, flight or ship tracks.
(5) The renaming of variables, as e.g. required by the CMOR standard.
(6) Redirection of a set of variables into specific output files, etc.
(7) Process based tendency diagnostics.

The MESSy-fied version is available to all members of the CLM-Community. Further, a training course on on-line diagnostics in COSMO-CLM is offered at HZG in Geesthacht on 23rd and 24th October 2019. Everyone interested to join the workshop is very welcome. If you would like to participate please contact Mariano Mertens (mariano.mertens@dlr.de).

CLM-Community Science Plan

Christian Steger (Deutscher Wetterdienst)

We reported in the last newsletter that a new science plan for the CLM-Community for the period 2019 – 2025 is being prepared. The Coordination Group met three times in the last nine month to discuss the structure, outline, goals and content of the new science plan. The working group coordinators, supported by the members of the different WGs, prepared contributions for the science plan for the topics related to the respective working group. A first draft was compiled until the beginning of June and the final discussion on the draft took place during the CO meeting on June 17. Meanwhile, the document has been forwarded to the Scientific Advisory Board (SAB). The SAB members agreed to review the document and their view and suggestions will certainly be very helpful and further improve the document. After the SAB review, the document will be send to all CLM-Community members by mid of August to give everybody the opportunity to read the document. The Community will vote on the new science plan during the Community meeting at the Assembly 2019 in Paestum. If the community members approve the new science plan, the document will be valid until 2025.

Review ICCARUS 2019

Christian Steger (Deutscher Wetterdienst)

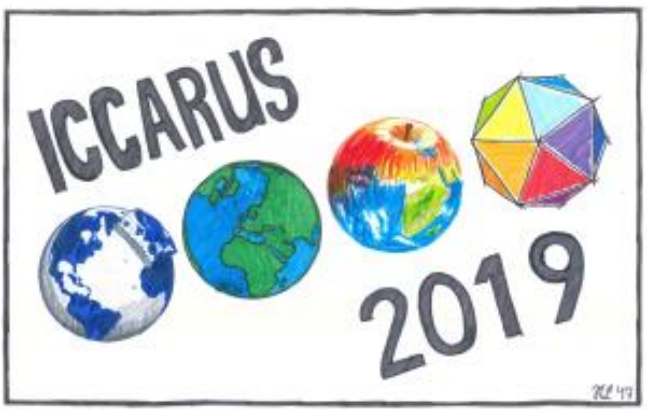
ICCARUS 2019 took place from 18th to 22nd March at the DWD (Deutscher Wetterdienst) headquarter in Offenbach, Germany. With 189 participants from 16 countries, ICCARUS is well established as platform for information exchange for COSMO/COSMO-CLM and ICON developers and users.
The conference program included 102 contributions in total. Forty-four oral presentations were given in the plenary sessions and 58 posters during the poster sessions. The plenary sessions covered the following topics: Model Infrastructure and Data Processing; Dynamics and Numerics; Soil, Vegetation and Ocean; Clouds, Chemistry, Aerosol and Radiation; Planetary Boundary Layer; Predictability and Ensemble Systems; Verification and Evaluation; NWP Model Applications and Case Studies; Climate Model Applications and Data Assimilation.

The CLM-Community members presented their work mainly in the sessions Climate Model Applications and Verification and Evaluation, but they also contributed to the other sessions.

Special highlights of ICCARUS were the invited talks. Gianpaolo Balsamo from ECMWF (European Centre for Medium-Range Weather Forecasts, Reading) talked about Coupled processes at the surface-atmosphere interface and their relevance for medium-range prediction and the ECMWF experience with this topic. Heini Wernli from ETH Zurich highlighted in his talk the importance of numerical models for the investigation of the dynamics of extratropical weather systems.

After the presentations in the plenary sessions from Monday to Wednesday, the seminar continued with the working group meetings on Thursday and Friday. The meetings of the working groups Atmosphere, Ice, Ocean (AIO), Chemistry, Clouds, Aerosols and Radiation (CCAR), Climate Projections (CP), Convection Resolving Climate Simulations (CRCS), Dynamics and Numerics (DYNNUM), Evaluation (EVAL), ICON, Soil and Vegetation (SOILVEG) took place on Thursday, while the Friday is traditionally reserved for the working group SUPort and TECHnical issues (SUPTECH) and the CLM-Community Coordination Group (CLM-CO). In addition to the normal working group meetings a combined meeting of the working groups EVAL and ICON was organized to discuss and prepare the evaluation process and comparison of COSMO 6 and ICON-CLM.

We thank all the participants for their contribution and we are looking forward to welcome all of you at ICCARUS 2020 in Offenbach from 2nd to 6th March 2020.



Review – Numerical Model Training Course 2019

Susanne Brienen (Deutscher Wetterdienst)

This years COSMO/CLM/ART Training Course took place from 8th to 12th April 2019 in Langen, Germany, under the new name "Numerical Model Training Course". The renaming was decided in order to account for the variety of models and model applications that are subject of the training course. For the first time, the course combined the training on the COSMO and the ICON model. For NWP, the transition from COSMO to ICON is already quite far in the operational application, therefore only a course on the ICON model was provided which attracted a lot of interest and the course was overbooked.

For climate application, DWD and the CLM-Community offered again a course for COSMO-CLM with lectures on the theoretical background and practical exercises with the starter package of COSMO-CLM.

In total, 55 participants from 21 countries came to Langen, from which 15 attended the COSMO-CLM exercises. From the CLM-Community, Burkhardt Rockel (Helmholtz-Zentrum Geesthacht), Merja Tölle (Justus-Liebig-University Gießen), Andreas Will (Brandenburgische Technische Universität Cottbus-Senftenberg), Christian Steger (DWD) and Susanne Brienen (DWD) prepared and conducted the exercises. Andreas Will and Anika Obermann-Hellhund (Goethe-University Frankfurt) gave talks in the theoretical part of the training course. Anja Thomas (DWD) was part of the organizational team.

On the last day of the training week, three additional courses were offered for all interested participants: one on the installation of the ICON model (from colleagues of the Romanian Met Service), one on ICON-ART (from KIT) and one on running COSMO on heterogeneous CPU/GPU computers (from MeteoSwiss).

For 2020, the transition from COSMO to ICON will continue and also the training on RCM model application will switch to the ICON model.

Outlook - CLM-Community Assembly 2019 in Paestum, Italy

Christian Steger (Deutscher Wetterdienst)

We invite all CLM-Community members to attend the 14th CLM-Community Assembly, which will take place in Paestum, Italy from 16th to 20th September 2019. Registration and submission of abstracts for posters is still possible in consultation with the local organisation team (please contact Edoardo Bucchignani (E.Bucchignani@cira.it)). The venue for this year's Assembly is Hotel Ariston Paestum (www.hotelariston.it).

For the 14th time, the members of the CLM-Community will meet to present their work and discuss scientific questions and important topics related to model development and organization of the CLM-Community. We will have several plenary sessions with oral presentations, a poster session, the CLM-Community meeting and the working group meetings. Prof. Antonio Navarra, president of the Euro-Mediterranean Centre on Climate Change (CMCC), will give an invited talk. In addition to the scientific program, we will have a comprehensive social program, including a dinner, the "Mozzarella Party" and a visit to the famous Greek temples of Paestum, which will give room for a lot of informal discussions and exchange of ideas.

All relevant information including a detailed program is available on the assembly website (https://www.clmassembly2019.com).

We thank CMCC for hosting the assembly and especially the local organization team Edoardo Bucchignani and Paola Mercogliano for their efforts. Thank you very much! We are looking forward to meet all of you in Paestum in September.

The future Mediterranean summer warming amplification is caused by lapse-rate changes

Roman Brogli., Nico Kröner, Silje Lund Sørland, Daniel Lüthi, Christoph Schär- ETH Zürich

More details and references can be found in:
Brogli, R., N. Kröner, S.L. Sørland, D. Lüthi, C. Schär (2019): The Role of Hadley Circulation and Lapse-Rate Changes for thee Future European Summer Climate. *J. Climate*, **32**, 385-404, https://doi.org/10.1175/JCLI-D-18-0431.1

Introduction & Goal

Climate change projections for European summer often show enhanced warming in the Mediterranean (Figure 1a) known as Mediterranean amplification. Even though the Mediterranean amplification is a robust feature in climate projections, it is still unclear why it occurs. Our goal is to determine which changes in the climate system are responsible for the Mediterranean amplification.

Method

We downscale the three global climate models (GCMs) HadGEM2-ES, MPI-ESM-LR and CNRM-CM5 using COSMO-CLM. Herein, we present the mean of the three downscaled GCMs. The simulation domain follows the EURO-CORDEX framework. We assume the RCP8.5 emission scenario and quantify the warming between 1971-2000 and 2070-2099.

We perform so-called pseudo-global warming (PGW) simulations. This allows us to separate the projected summer warming into four contributions, each representing a different change in the climate system. That is achieved by modifying the lateral boundary conditions of the COSMO-CLM simulations with potential causes for the Mediterranean amplification. Subsequently, we test how much each potential cause contributes to the projected temperature change. Furthermore, the sum of the four contributions we analyze equals the result of the full GCM-driven climate projection.

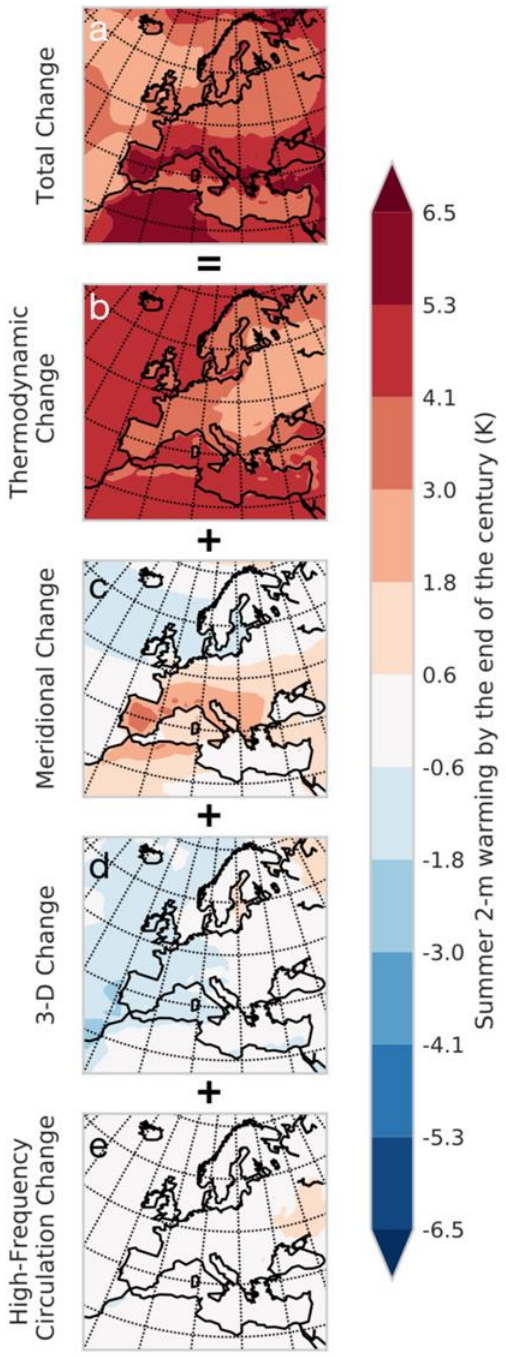


Figure 1: *Separation of the (a) total climate change signal obtained with COSMO-CLM into four (b-e) contributions. Note that e+d+c+b=a. The ensemble mean of 3 downscaled GCMs is shown.*

Results

Figure 1 shows the total climate change signal separated into the four contributions. The Mediterranean amplification is clearly visible in the full climate change signal (Figure 1a). The contribution of thermodynamic changes (Figure 1b) is responsible for most of the warming, yet it does not explain the Mediterranean amplification. The Mediterranean amplification is caused by the contribution named meridional change (Figure 1c).

The meridional change can in simple terms be described as the contribution of the zonal mean circulation & lapse-rate changes.

Thus, we analyze both zonal mean circulation & lapse-rate changes in order to assess if either one is more likely to explain the Mediterranean amplification.

Regarding circulation changes, the northward expansion of the Hadley cell could explain the Mediterranean amplification, since the subtropical climate zone would reach further north. However, we found that the Hadley circulation south of Europe does not expand northwards and is very weak in summer (see figures in Brogli et al. 2019).

Lapse-rate changes describe the fact that, in a warming climate, the atmosphere warms less at the surface compared to higher altitudes. The strength of the surface warming in summer in Europe is determined by different lapse-rate changes depending on the region as shown in Figure 2. From Figure 2 we observe that the maximum warming in our simulations is located at an altitude of around 8 km, and, at this altitude, the warming over the Mediterranean and northern Europe is the same. Yet, the lapse-rate change over the Mediterranean is much weaker than over northern Europe (i.e. the vertical gradient of the temperature change is smaller). The weaker lapse-rate change leads to stronger warming at the ground in the Mediterranean. The strong lapse-rate change in northern Europe leads to a strongly reduced surface warming. The regionally different lapse-rate changes are likely caused by differences in moisture availability. Lapse-rate changes are caused by moist-adiabatic vertical motions in a warmer climate. In the dry Mediterranean, moist-adiabatic vertical motions are uncommon which leads to weak lapse-rate changes. The strong lapse-rate changes in northern Europe are caused by more frequent moist-adiabatic vertical motions.

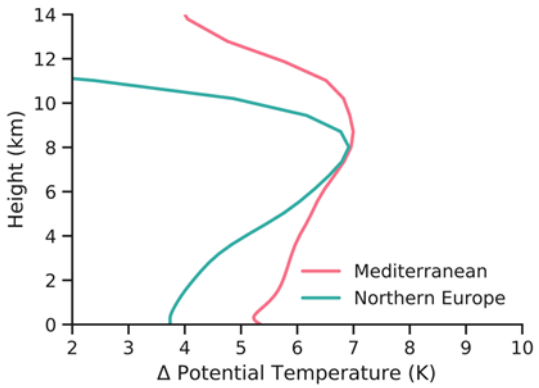


Figure 2: *Mean potential temperature change profiles averaged over land grid points for Mediterranean (red line) and Northern Europe (blue line). The ensemble mean of three downscaled GCMs is shown.*

Conclusions

The Mediterranean amplification is mainly caused by regional differences in lapse-rate changes. In the Mediterranean, lapse-rate changes are weak, which induces a stronger surface warming than in regions where lapse-rate changes are stronger.

Our findings suggest that Hadley circulation changes have no decisive influence on the future European summer climate.

Regional climate model simulations over Antarctica are few in number and limited to a few distinct models.

Nils Souverijns, Nicole van Lipzig – KU Leuven

More details and references can be found in:

Souverijns N., A. Gossart, M. Demuzere, J. T. M. Lenaerts, B. Medley, I. V. Gorodetskaya, S. Vanden Broucke, N. P. M. van Lipzig (2019): A New Regional Climate Model for POLAR-CORDEX: Evaluation of a 30-Year Hindcast with COSMO-CLM^2 Over Antarctica. *J. Geophys. Res. : Atmosphere*, **124** (3), DOI: https://doi.org/10.1029/2018JD028862

Regional climate model simulations over Antarctica are few in number and limited to a few distinct models. As such, future projections of the Antarctic climate are still mainly deduced from GCMs. These GCMs do not appropriately resolve mesoscale variability and are not fully adapted for specific Antarctic conditions. Furthermore, the spatial resolution of GCMs, usually exceeding 100 km, is too coarse to adequately capture typical Antarctic climatic features, such as katabatic winds and blowing snow. In this respect, the COSMO-CLM climate model is applied over the Antarctic Ice Sheet. Previous studies have proven the capability of the COSMO model to study short-term atmospheric processes in polar regions. As such, it is timely to apply the model for long-term simulations, addressing the requirements of the POLAR-CORDEX initiative to attain a multi-model ensemble of RCM studies over Antarctica. An Antarctic-wide simulation at 0.22° spatial resolution for the time period 1983-2016 was performed using ERA-Interim as boundary and initial conditions.

In this work, we adapted and evaluated this COSMO-CLM model simulation by comparing the model results to a set of ground-based and upper-air observations derived from several sources. Several modifications to the original setup were executed to achieve adequate performance:

- The COSMO-CLM model was coupled to the Community Land Model (COSMO-CLM^2) to improve the representation of the snow pack and snow metamorphism.
- The roughness length of snow was adapted in order to match observed wind speeds.
- The two-moment cloud microphysics parameterization scheme is added. This scheme parameterizes all relevant homogeneous and heterogeneous nucleation processes including the activation of cloud and ice condensation nuclei (CCN and IN respectively).
- The near-surface climate over Antarctica is typically characterized by an inversion, indicating a stable boundary layer limiting the amount of turbulence. The default turbulence scheme in COSMO-CLM^2 is not able to represent strong stable conditions. A sharp reduction of the minimum turbulent diffusion coefficients accounts for large improvements in surface temperature and boundary layer representation.

In general, near-surface temperatures have a Mean Absolute Error (MAE) in the range of 2-4°C compared to observations and attain very high correlation coefficients, indicating good average and temporal performance. For coastal areas, temperatures are slightly underestimated by the COSMO-CLM^2 model. This feature is persistent throughout the year, apart from the austral summer, during which the temperature match is excellent (Figure 1).

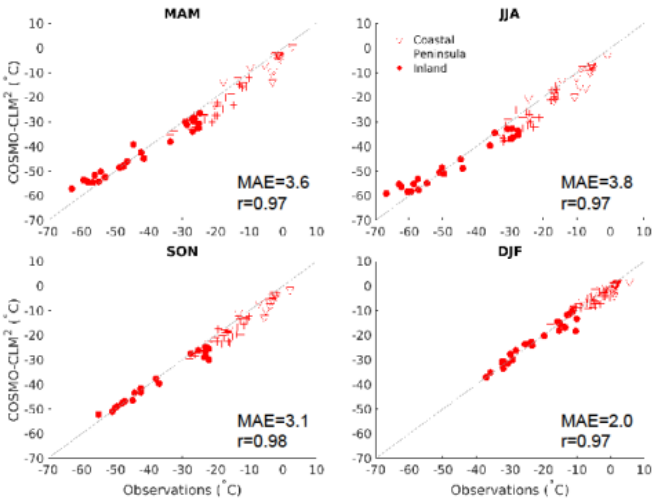


Figure 1: *Seasonally averaged 2 m temperature observations (°C) compared to the corresponding pixel in COSMO-CLM^2. MAE denotes the Mean Absolute Error, while r is the Pearson correlation coefficient, both calculated based on individual monthly observations.*

Near-surface wind speeds are generally overestimated by COSMO-CLM² in the inland of Antarctica by 2-5 ms^{-1} (Figure 2). This is related to the low roughness length of snow, representative for glazed areas and leading to higher wind speeds. However, at the coastal margins, the performance improves, showing smaller biases mainly in the austral summer period. A large variability in the performance of wind speed representation in COSMO-CLM² is present for the coastal stations and over the Antarctic Peninsula (Figure 2).
These measurement areas are often located in highly variable topography near the ice sheet margins not representative for the ice sheet surface. On the local scale, stations might be shielded from katabatic flow or located in a wind confluence zone.

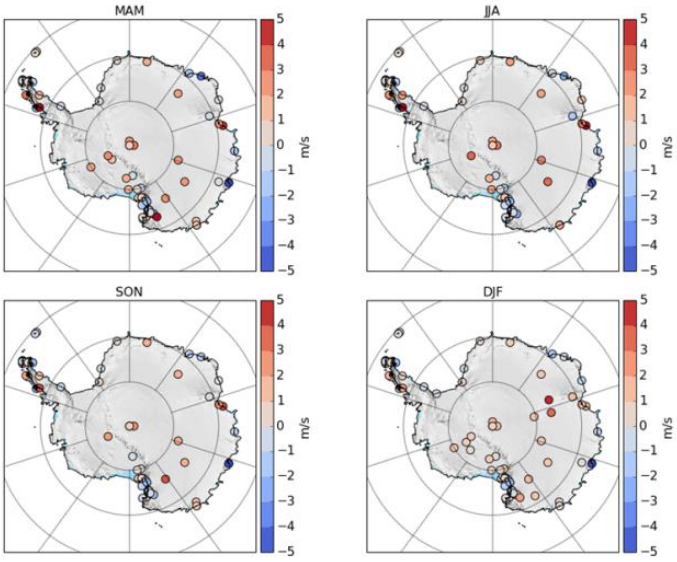


Figure 2: *Wind speed bias between seasonally averaged near-surface observations and the corresponding pixel in COSMO-CLM².*

Apart from near-surface meteorology, upper air patterns are adequately simulated. Additionally, the estimation of the surface mass balance of Antarctica falls within the range of other models. However, improvements regarding the representation of albedo and the distribution of the snowfall pattern persist. Further enhancements to these features will be pursued by the new PARAMOUR project at KU Leuven.

Recent publications

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

2019

Avgoustoglou, E., E. Bucchignani, A. Voudouri, G. Varlas, P. Mercogliano, P. Katsafados, P. Skrimizeas (2019): Installation and Testing of the Regional Climatic Model COSMO-CLM (CCLM) at the Hellenic National Meteorological Service. EasyChair Preprint 823

Breil, M.,N. Laube, J.G. Pinto, G. Schädler (2019): The impact of soil initialization on regional decadal climate predictions in Europe. Clim. Research, 77, Issue 2, p 139-154

Brogli, R., N. Kröner, S.L. Sørland, D. Lüthi, C. Schär (2019): The Role of Hadley Circulation and Lapse-Rate Changes for the Future European Summer Climate. J. Climate, 32, 385-404, https://doi.org/10.1175/JCLI-D-18-0431.1

Brunner, D., G. Kuhlmann, J. Marshall, V. Clément, O. Fuhrer, G. Broquet, A. Löscher, Y. Meijer (2019): Accounting for the vertical distribution of emissions in atmospheric CO2 simulations. Atmos. Chem. Phys., 19, 4541-4559, https://doi.org/10.5194/acp-19-4541-2019

Di Virgilio, G, J.P. Evans, A. Di Luca, R. Olson, D. Argüeso, J. Kala, J. Andrys, P. Hoffmann, J.J. Katzfey, B. Rockel (2019): Evaluating reanalysis-driven CORDEX regional climate models over Australia: model performance and errors. Clim. Dyn., pp 1–21, https://doi.org/10.1007/s00382-019-04672-w)

Dobler A, E.J. Førland, K. Isaksen (2019): Present and future heavy rainfall statistics for Svalbard - Background-report for Climate in Svalbard 2100. NCCS-Report 3/2019

Feldmann, H., J.G. Pinto, N. Laube, M. Uhlig, J. Moemken, A. Pasternack, B. Früh, H. Pohlmann, C. Kottmeier (2019): Skill and added value of the MiKlip regional decadal prediction system for temperature over Europe. Tellus, Series A: Dynamic Meteorology and OceanographyOpen Access, 71, Issue 1, p 1-19

Hanssen-Bauer, I., E.J. Førland, H. Hisdal, S. Mayer, A.B. Sandø, A. Sorteberg, (2019): Climate in Svalbard 2100 2100 – a knowledge base for climate adaptation. NCCS Report no. 1/2019

Li, J., F. Pollinger, H.J. Panitz, H. Feldmann, H. Paeth, H. (2019): Bias adjustment for decadal predictions of precipitation in Europe from CCLM. Clim.Dyn., p 1-18

Mathias, L., P. Ludwig, J.G. Pinto (2019): Synoptic-scale conditions and convection-permitting hindcast experiments of a cold-season derecho on 3 January 2014 in Western Europe. Nat Hazards Earth Syst Sci., 19:1023-1040, doi:10.5194/nhess-19-1023-2019

Meredith, E.P., U. Ulbrich, H.W. Rust (2019): The diurnal nature of future extreme precipitation intensification. AGU 100, https://doi.org/10.1029/2019GL082385

Noyelle, R., U. Ulbrich, N. Becker, E.P. Meredith (2019): Assessing the impact of sea surface temperatures on a simulated medicane using ensemble simulations. Nat. Hazards Earth Syst. Sci., 19, 941-955, 2019 https://doi.org/10.5194/nhess-19-941-2019

Russo,E., I. Kirchner, S. Pfahl, M. Schaap, U. Cubasch (2019): Sensitivity studies with the Regional Climate Model COSMO-CLM 5.0 over the CORDEX Central Asia Domain. Geosci. Model Dev. Discuss, https://doi.org/10.5194/gmd-2019-22

Vanden Broucke, S.,H. Wouters, M. Demuzere, N. van Lipzig (2019): The influence of convection-permitting regional climate modeling on future projections of extreme precipitation: dependency on topography and timescale. Clim. Dyn., 52, Issue 9-10, 1 May 2019, Pages 5303-5324

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Akhtar, N., J. Brauch, B. Ahrens (2018): Climate modeling over the Mediterranean Sea: impact of resolution and ocean coupling. Clim. Dyn., 51, p 933-948

Brousse, O., S. Georganos, M. Demuzere, S. Vanhuysse, H. Wouters, E. Wolff, C. Linard, N.P.M. van Lipzig, S. Dujardin (2018): Using Local Climate Zones in Sub-Saharan Africa to tackle urban health issues. Urban Climate, 27, 227-242, https://doi.org/10.1016/j.uclim.2018.12.004

Dieng, D., P. Laux, G. Smiatek, D. Heinzeller, J. Bliefernicht, A. Sarr, A.T. Gaye, H. Kunstmann (2018): Performance Analysis and Projected Changes of Agroclimatological Indices Across West Africa Based on High-Resolution Regional Climate Model Simulations. J. of Geophysical Res.: Atmospheres, 123, p 7950-7973

Fallah, B., E. Russo, W. Acevedo, A. Mauri, N. Becker, U. Cubasch (2018): Towards high-resolution climate reconstruction using an off-line data assimilation and COSMO-CLM 5.00 model. Climate of the Past, 14, p 1345-1360

Køltzow, M., A. Dobler, S.S. Eide (2018): Lightning in Norway under a future climate. MET-Report 09-2018

Li, D., H. Von Storch, B. Geyer (2018): Testing reanalyses in constraining dynamical downscaling. J. of the Met. Society of Japan, 94, p 47-68

Macias, D., E. Garcia-Gorriz, A. Dosio, A. Stips, K. Keuler (2018): Obtaining the correct sea surface temperature: bias correction of regional climate model data for the Mediterranean Sea. Clim. Dyn., 51, p 1095-1117

Remember!

… part of your scientific success relies on the work of those people providing the reference model setup, 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 community jointly further developed by the CLM-Community" in each publication.

Meredith, E.P., H.W. Rust, U. Ulbrich (2018): A classification algorithm for selective dynamical downscaling of precipitation extremes. Hydrol. Earth Syst. Sci., 22, 4183-4200, 2018, https://doi.org/10.5194/hess-22-4183-2018

Meyer, M., J. Pätsch, B. Geyer, H. Thomas (2018): Revisiting the Estimate of the North Sea Air-Sea Flux of CO2 in 2001/2002: The Dominant Role of Different Wind Data Products. J. of Geophysical Res.: Biogeosciences, 123, p 1511-1525

Reszler, C., M.B..Switanek, H. Truhetz (2018): Convection-permitting regional climate simulations for representing floods in small-and medium-sized catchments in the Eastern Alps. Nat. Haz. and Earth System Sciences, 18, Issue 10, p 2653-2674

Schädler, G., H.J. Panitz, E. Christner, H. Feldmann, M. Karremann, N. Laube (2018): Regional climate simulations with COSMO-CLM: Ensembles, very high resolution and paleoclimate. High Performance Computing in Science and Engineering' 17: Transactions of the High Performance Computing Center, Stuttgart, p 411-429

Schultze, M., B. Rockel (2018): Direct and semi-direct effects of aerosol climatologies on long-term climate simulations over Europe. Clim. Dyn., 50, p 3331-3354

Sedlmeier, K., H. Feldmann, G. Schädler (2018): Compound summer temperature and precipitation extremes over central Europe. Theoretical and Applied Climatology, 131, p 1493-1501

Tölle, M., L. Schefczyk, O. Gutjahr (2018): Scale dependency of regional climate modeling of current and future climate extremes in Germany. Theoretical and Applied Climatology, 134, Issue 3-4, p 829-848

Varentsov, M., H. Wouters, V. Platonov, P. Konstantinov (2018): Megacity-induced mesoclimatic effects in the lower atmosphere: A modeling study for multiple summers over Moscow, Russia. Atmosphere, 9, 50

Welcome to new Members

Swami Vivekananda Institute of Science & Technology - India

(https://www.svist.org/index.html)

Topic: *Projecting thermal stress over urbanized Kolkata, India*

Contact: *Sourabh Bal*

Agence Nationale de la Météorologie - Burkina Faso

(http://www.meteoburkina.bf)

Topic: *Climate Modeling*

Contact: *Ouedraogo Ousmane Aly Yabyoure*

Aristoteles University of Thessaloniki - Greece

(https://www.auth.gr/en)

Topic: *Solar flares and their spectrum*

Contact: *Ioanna Katsi*

Luxembourg Institute of Science and Technology

(http://www.list.lu)

Topic: *Regional Downscaling of Seasonal Forecasts*

Contact: *Mauro Sulis*

Upcoming events 2019

Aug 21 – 23	Symposium "High-resolution climate modeling: Perspectives and challenges", Zürich, Switzerland
Sep 09 – 13	COSMO GM, Rome, Italy
Sep 09 – 13	EMS Annual Meeting, Lyngby, Denmark
Sep 16 – 20	OceanObs, Honolulu, Hawaii
Sep 17 – 20	CLM-Community Assembly, Paestum, Italy
Oct 14 – 18	International Conference on Regional Climate, ICRC-CORDEX, Beijing, China

Upcoming events 2020

2020

Mar 02 - 06	ICCARUS, Offenbach, Germany
Mar 30 - Apr 03	Numerical Model Training Course, Langen, Germany

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