Climate Limited-area Modelling Community

January 2021

Newsletter

No. 16

Content

See YOU at

ICCARUS 2021

08 – 19 March 2021

Virtual Meeting

Announcement:

CLM-Community Assembly 2021

20 - 24 September 2021

Berlin, Germany

or

Virtual Meeting

Dear colleagues,

Welcome to the 16th CLM-Community Newsletter. We wish you all the best for 2021 and hope you and your families are doing well.

An exceptional and difficult year lies behind us. Twelve month ago, certainly nobody would have imagined what is going to happen in the upcoming months and how the world would change in the course of 2020.

Despite all the difficulties, we were able to continue our good collaboration within the CLM-Community. Virtual meetings have become part of our daily work and we learned how to efficiently organize and conduct them. Not only small discussions with colleagues from our own institution, but also larger meetings and conferences. The CLM-Community Assembly in September last year took place as virtual meeting for example, and ICCARUS 2021 will also be organized as virtual conference. For a big and distributed community like the CLM-Community, with members from all over the world, this is also an advantage. More members can participate in the conferences without traveling and if necessary, more meetings and discussions can take place in between the normal meetings we always had at ICCARUS and the CLM-Community Assembly. This certainly helps to improve the collaboration and to move the work forward. Everybody is invited to take this opportunity and to contribute to the developments and community tasks.

This issue contains an interview with Burkhardt Rockel from Helmholtz-Zentrum Geesthacht, a short update on the status of the CMIP6 downscaling activities, reviews of the CLM-Community Assembly and the Numerical Model Training 2020, an outlook to ICCARUS 2021 and of course two research notes. One from Ha Ho-Hagemann about internal model variability of the regional coupled system model GCOAST-AHOI and one from Marie-Estelle Demory about European daily precipitation according to EURO-CORDEX regional climate models (RCMs) and high-resolution global climate models (GCMs) from the High-Resolution Model Intercomparison Project (HighResMIP).

Enjoy reading! Yours sincerely,
Susanne Brienen, Anja Thomas, Christian Steger

Five questions to … Burkhardt Rockel

Helmholtz-Zentrum Geesthacht

Photo by B. Rockel

Burkhardt Rockel leads the group "Regional Land and Atmosphere Modelling" at the Institute of Coastal Research at the Helmholtz-Zentrum Geesthacht. He studied meteorology at the University of Cologne where he got his PhD in 1988. In 1990 he moved to Geesthacht and started with process studies on the energy and water cycles. During his career, he worked with several regional atmospheric models (GESIMA, REMO, HRM, COSMO-CLM, ICON-CLM) and contributed to the development of some of them. He is member of the CLM-Community since its foundation.

1. *Burkhardt, you lead the group "Regional Land and Atmosphere Modelling" at Helmholtz-Zentrum Geesthacht. Can you please tell us something about the institute, the work of your group and your tasks there?*

The institute has undergone several changes since I came to Geesthacht in 1990. Presently our name is "Institute of Coastal Research" which consists of three parts. The part me and my group belong to is named "System Analysis and Modelling". This department runs several models covering different compartments of the earth system (e.g. atmosphere, land, ocean, ecosystem). My group is in charge of atmosphere and land. We work together with the other groups in the framework GCOAST (Geesthacht Coupled cOAstal model SysTem) to investigate the feedbacks between different compartments.

2. *You are a member of the CLM-Community from the very first day. How has the community developed in the last 16 years and what has changed over time?*

During the first years of the CLM-Community there where not many but enthusiastic members working together on a new regional climate model. At that time, it was a new model amongst others that already existed and which were also based on numerical weather prediction models and diverged to models only applied for climate simulations.

The major break-through came when the CLM-Community joined forces with the COSMO-Consortium in building a model that is able to cover all time scales from weather forecast to climate. This makes the COSMO model quite unique. Another thing that has changed over time is the extension of the CLM-Community from German to European to members all over the globe. Now we are in the transition phase to ICON. What I am missing, however, is the enthusiastic spirit from the early days of the CLM-Community.

3. *Actually, you participated in the COSMO-CLM development already before the CLM-Community was established. Can you tell us something about the situation at the time, the motivation for the development and the process?*

In the nineties of the last century, our institute and the Max-Planck-Institute in Hamburg developed the regional climate model REMO based on the Europamodell of the German Weather Service. In our institute, we used the model for process studies (running the model in short time hindcasting mode) mainly in the context of the Baltic Sea Experiment (BALTEX) that was initiated by my institute leader Ehrhard Raschke. However, it turned out that for our studies a hydrostatic model like REMO did not fit since we wanted to go to convective resolving scales in the future. Therefore, I looked for an alternative model. At that time, the German Weather Service had just released the first version of the Lokalmodell (LM, which was renamed to COSMO model later) and I decided to switch to that model. Since Uwe Böhm from PIK had also already switched to the LM, we worked together for the first climate version (called CLM = Climate version of the LokalModell, which was renamed to COSMO-CLM later). My first work was implementing netCDF I/O format as an alternative to GRIB. A short time later, the CLM was chosen as the community model for climate scenario simulations at DKRZ. BTU Cottbus joined the CLM development team and applied successfully for funding to coordinate the activities. This was the start of the CLM-Community.

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4. In which context do you use COSMO-CLM today

During my participation in different working groups within GEWEX (Global Energy and Water cycle Exchanges) I became interested in using COSMO-CLM in other regions of the world (Europe became a bit crowded and boring to me). This brought me to initiate the Inter-CSE Transferability Study (ICTS) where a few interested scientist transferred their regional climate model to other regions of the world and compared them. Amongst others Bill Gutowski took part. Bill and Filippo Giorgi took over the idea later to a larger project we all know as CORDEX now. In my spare time, I still apply COSMO-CLM over Australia and did a first successful test with ICON-CLM. Unfortunately there is not much additional working time left and I have to leave most of the actual scientific work to other members in my group.

5. You will (unfortunately) retire in a not too distant future. You will of course have a lot of time to work on the community models and software then, but do you already have other plans for your retirement?

I do not plan for a part time job after my retirement. This means no work on community models and software anymore. I will transfer this work step by step during the last year before my retirement to other people. I am looking forward to have more time for gardening, travelling, hiking and other things.

Thank you very much for the interview!

Helmholtz-Zentrum Geesthacht

Centre for Materials and Coastal Research

CMIP6 downscaling activities

Christian Steger (Deutscher Wetterdienst)

This is a small update on the current CORDEX activities in the preparation for the downscaling of CMIP6 experiments, which we reported on already in the last issue of the CLM-Community newsletter. Unfortunately, the experiment protocol has not been published yet. The CORDEX community is working on a second order draft of the protocol that addresses all the comments and suggestions that have been made for the first draft. More information about the simulation protocol and the timeline are expected to become available during or after the next EURO-CORDEX General Assembly, which is organized as virtual meeting from 25 – 29 January.

WCRP CORDEX

A survey about the plans and interests of the CLM-Community members for downscaling CMIP6 simulations has been conducted in the last months to get an overview of possible contributions from the community. If you are interested in the downscaling of CMIP6 simulations, but did not reply yet, please contact the coordination office (clm.coordination@dwd.de). The aim is to coordinate the process within the CLM-Community and identify synergies between the different groups. The work for the preparation of the input data from the global models could be shared for example, or a group that is interested in running convection permitting simulations for a certain domain could get the input data from the first nesting step at 12 or 25 km from another group that has already performed such a simulation. The outcome of the survey and the further steps will be discussed in the next meetings of the working group Climate Projections. If you want to participate in these activities, but you are not a member of the working group yet, please contact the coordinator Hendrik Feldmann (KIT).

CLM-Community issues

Review CLM-Community Assembly 2020

Susanne Brienen (Deutscher Wetterdienst)

Due to the COVID-19 pandemic, it was unfortunately not possible this year to meet in person for the annual assembly. Therefore, the coordination group decided together with the local organization team to organize the meeting for the first time as a complete virtual meeting. As the meeting was originally planned to be hosted by FU Berlin, the colleagues from FU also helped the community coordination group a lot in the preparation of the event. The meeting took place as originally planned in the week 14 to 18 September 2020 and was as usual a mixture of plenary sessions and working group meetings – all held as video conferences. Even a poster session could be organized. The posters were provided some days before the session, that everybody could have a look at them in advance. During the poster session, the authors introduced their posters briefly and there was time for questions and discussions afterwards.

A big challenge for a virtual meeting is of course the lack of social contacts and small talk in between the official sessions. A small group consisting of Ivonne Anders, Jennifer Brauch, Andreas Dobler and Emmanuele Russo managed to organize at least a small virtual social event: a pub quiz. Around 15 people took the opportunity to discuss the questions in different video conference rooms (using Google to find the right answers was of course not allowed!) and compared their answers afterwards in the plenary. This proved to be quite successful and funny, as for example two groups assumed "Triskadekaphobia" to be the fear to become 30 years old whereas the right answer was the fear of number 13.

At maximum, around 40 people participated in the plenary sessions and the overall feedback was positive. Even though a face-to-face meeting is always to be preferred, this virtual meeting was nonetheless quite successful and many interesting and fruitful discussions were possible.

However, we all hope that until autumn this year, when the next assembly is scheduled (20 – 24 September), the COVID-19 situation will have improved and that we will be able to meet again in the usual way in Berlin. ■

Review Numerical Model Training Course 2020

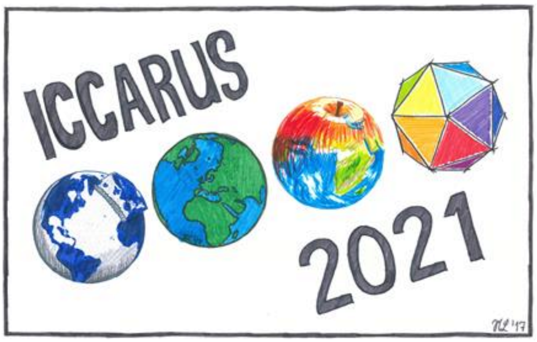
Susanne Brienen (Deutscher Wetterdienst)

The annual Training Course for new users of the model in spring 2020 had to be cancelled as well due to the COVID-19 pandemic. A training with computer exercises is even more challenging to be organized than a pure virtual meeting with "just" oral presentations or discussions. The colleagues from the research department at DWD, who already had some experience with the usage of ICON in a cloud framework, managed to provide a reduced training course with exercises for the NWP users using this cloud version. The alternative course could finally take place in November and was very successful given the circumstances and especially the fact that it was the first online course and the format and the infrastructure had to be developed from scratch in a very short time. The discussion if the training course in 2021 could be organized in a similar manner is currently ongoing. If so, the training team of the CLM-Community will also try to provide some exercise for the RCM user with ICON-CLM. ■

Outlook ICCARUS 2021

Christian Steger and Daniel Rieger (Deutscher Wetterdienst)

Last year's ICCARUS meeting had to be cancel at very short notice, because the Corona Virus started to spread in Germany and Europe at the end of February and beginning of March. This year, we will unfortunately still not be able to meet in person in Offenbach, but the organization team had now more time to adjust to the situation and ICCARUS 2021 will be hosted as a virtual seminar. The experience with online meetings has grown vastly in the last months and the organization team therefore decided to adapt the well-established schedule.



ICCARUS 2021 will be a two-week event. The first week, from 8 March to 12 March will be dedicated to plenary sessions. Please note that this includes a change in the date for the plenary sessions compared to the previously announced 15 to 17 March. The plenary sessions will take place between 09:00 and 16:30 CET and include invited talks by Steve Derbyshire (UK Met Office) about atmospheric waves and by Reiner Schnur (MPI-M) about the Land Model JSBACH. Furthermore, there will be several solicited talks by Bernhard Vogel (KIT, overview ICON-ART), Günther Zängl (DWD, overview ICON-NWP), Panagiotis Adamidis (DKRZ, overview ICON infrastructure), Marco Giorgetta (MPI-M; overview ICON at MPI-M) and Ulrich Schättler (DWD, overview COSMO). The program of the first week will also include poster sessions. On Tuesday, 9 March, a virtual social event will be organized in the evening. The working group meetings of COSMO, the CLM-Community and ICON will take place in the second week from 15 to 19 March.

The registration for the ICCARUS 2021 is still open. For registration and further information, please visit: https://dwd.de/iccarus

We are looking forward to an interesting and hopefully fruitful and successful conference and we really hope that we will be able to meet in person again in Offenbach for ICCARUS 2022.

Award for paper

Congratulations to Edoardo Bucchignani, Paola Mercogliano, Hans-Jürgen Panitz and Myriam Montesarchio. Their paper "Climate change projections for the Middle East-North Africa domain with COSMO-CLM at different spatial resolutions" (Advances in Climate Research, Volume 9, Issue 1, March 2018, Pages 66 – 80) won the Advances in Climate Change Research Great Contribution Award 2020. Here is a short summary of the paper:

As CORDEX-MENA is one of the last domains that have been defined in the frame of the CORDEX initiative, the number of papers available in the literature is still limited. In this study, projected changes in the future climate conditions for this domain over the 21st century have been investigated with COSMO-CLM. Two simulations have been performed at 0.44° and 0.22° spatial resolution, respectively, for the period 1979–2100. The historical period 1979–2005 has been simulated according with the IPCC 20C3M protocol, while the period 2006–2100 has been forced by the RCP4.5 scenario. Initial and boundary conditions are provided by the coupled atmosphere–ocean general circulation model CMCC-CM. Analyses have been performed for average values of two-meter temperature (T2m) and total precipitation. Moreover, a subset of the standard ETCCDI indices based on precipitation has been selected, in order to evaluate the skill of COSMO-CLM to simulate extreme events and to assess future changes.

Climate projections have been analyzed considering the period 2071–2100 as representative for the end of the 21st century. Both global and regional simulations suggest a general increase of temperature in the four seasons, but the simulation with the finer resolution projects a slightly lower warming.

These differences can be related to local processes linked to land processes and parameterization, a better representation of topography and the location of land and sea at higher resolution.

Both global model and regional model suggest a significant decrease in precipitation in winter in the western part of domain. However, this area is characterized by very low precipitation values in the reference period, leading to high percentage variations even if the absolute changes are small. A band of precipitation increase on the coast along the Gulf of Guinea is visible in CMCC-CM data but not projected by COSMO-CLM. This structure could be related to a change in the West African Monsoon system, which is very difficult to capture. It has been shown that precipitation projections on this area, both in terms of average values and of extreme event indicators, largely depend on the horizontal resolution, suggesting the need for additional simulations at higher resolution. ■

European daily precipitation according to EURO-CORDEX regional climate models (RCMs) and high-resolution global climate models (GCMs) from the High-Resolution Model Intercomparison Project (HighResMIP)

Marie-Estelle Demory[1], Ségolène Berthou[2], and co-authors

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More details can be found in:

Demory, M.-E., S. Berthou, J. Fernandez, S. L. Sørland, R. Brogli, M. J. Roberts, U. Beyerle, J. Seddon, R. Haarsma, C. Schär, E. Buonomo, O. B. Christensen, J. M. Ciarlo, Rowan Fealy, G. Nikulin, D. Peano, D. Putrasahan, C. D. Roberts, R. Senan, C. Steger, C. Teichmann, and R. Vautard, 2020: European daily precipitation according to EURO-CORDEX regional climate models (RCMs) and high-resolution global climate models (GCMs) from the High-Resolution Model Intercomparison Project (HighResMIP). Geophys. Model Dev., 13, 5485–5506, https://doi.org/10.5194/gmd-13-5485-2020

Introduction

There have been two main streams of development in the climate modelling community: global climate models (GCMs) and regional climate models (RCMs). The latter were developed to alleviate the computational burden of GCMs by focusing on a particular region, where higher spatial resolution can be achieved with the same computational power. Using RCMs, the Coordinated Regional Climate Downscaling Experiment (CORDEX) has provided consistent regional climate information by dynamically downscaling the Fifth Coupled Model Intercomparison Project (CMIP5) GCMs (150–200 km horizontal grid spacing) at a common 50 km (CORDEX-44) grid spacing. The horizontal grid spacing has then been further refined to 12 km (CORDEX-11) over Europe, and a full GCM–RCM simulation matrix has been completed through the EU Copernicus Climate Change Services PRINCIPLES (Producing Regional Climate Projections Leading to European Services) (e.g. Vautard et al., 2020).

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In parallel, GCMs have developed in terms of complexity and increasing resolution, and a new high-resolution model intercomparison project, HighResMIP (Haarsma et al., 2016), has recently emerged. HighResMIP provides an evaluation framework for GCM simulations at horizontal grid spacings of 50–25 km to understand the role of increasing horizontal resolution in simulations of global climate mean, variability and extremes. It is the first time in the history of climate modelling that an ensemble of cutting-edge GCMs has reached a grid spacing comparable to that of standard RCM ensembles. In this study, we make use of the available RCM and GCM coordinated efforts (CMIP5, CORDEX, HighResMIP) to investigate the level of information given by various products in terms of daily precipitation distribution over Europe.

Method

We use the ocean–atmosphere coupled GCMs developed and run within the EU-Horizon 2020 PRIMAVERA (Process-based climate simulation: Advances in high-resolution modelling and European climate risk assessment) project (https://www.primavera-h2020.eu), which is a European contribution to HighResMIP. We also use the CMIP5-driven EURO-CORDEX (EUR-44 and EUR-11) simulations run at 0.44° (about 50 km) and 0.11° (about 12 km) horizontal grid spacings, respectively. EUR-44 horizontal grid spacing roughly corresponds to that of PRIMAVERA. EUR-11 and PRIMAVERA are based on state-of-the-art model generations. The models are compared to high spatial-resolution gridded observational datasets that include the highest station density over France-FR (SAFRAN), British Isles-BI (UKCPobs), the Alps-AL (ALPS-EURO4M), the Carpathians-CA (CARPATCLIM), and the Iberian Peninsula-IP (Spain02 v2 and PT02 v2). Over other European regions (central Europe-CE, the Mediterranean-MD, northeast Europe-NEE, and Scandinavia-SC), we consider E-OBS v17.

We compute the daily precipitation distribution using a method similar to Berthou et al. (2019), based on the ASoP1 (Analyzing Scales of Precipitation, version 1.0) diagnostics tool developed by Klingaman et al. (2017).

We calculate the daily precipitation distribution in terms of the actual contribution from 100 different intensity bins to mean precipitation.

To account for the high frequency of low-intensity precipitation events and the low frequency of high-intensity events, we use an exponential bin distribution. To calculate the contribution to mean precipitation, each bin frequency is multiplied by its average rate. We use a logarithmic scale on the *x*-axis, so the area under the curve is directly proportional to mean precipitation.

Our analyses are performed on a common EUR-44 grid (except for CMIP5, which are kept on their native grids) over the historical (1971–2005) period.

Results

Figure 1 shows the ability of PRIMAVERA and EURO-CORDEX to represent the spatial distribution of seasonal mean precipitation. The information is summarized as Taylor diagrams for all regions, seasons, and ensembles. The largest differences among PRIMAVERA, EUR-44 and EUR-11 occur in regions with complex orography and land–sea contrasts (AL, CA, IP, MD, SC; connected symbols in Fig. 1). For other regions, the ensembles perform similarly. There is quite a systematic behavior across regions, with PRIMAVERA closer to observations and EUR-44 showing an increasing error (both in terms of reduced spatial correlation and an overestimated spatial standard deviation). In winter, EUR-11 tends to overestimate even further the standard deviation, while in summer, EUR-11 tends to improve upon EUR-44. EUR-11 reaches a correlation similar to PRIMAVERA but still overestimates the observed spatial variability. Although EUR-44 uses a horizontal grid spacing that is similar to PRIMAVERA, its spatial distribution of precipitation is not as good as PRIMAVERA.

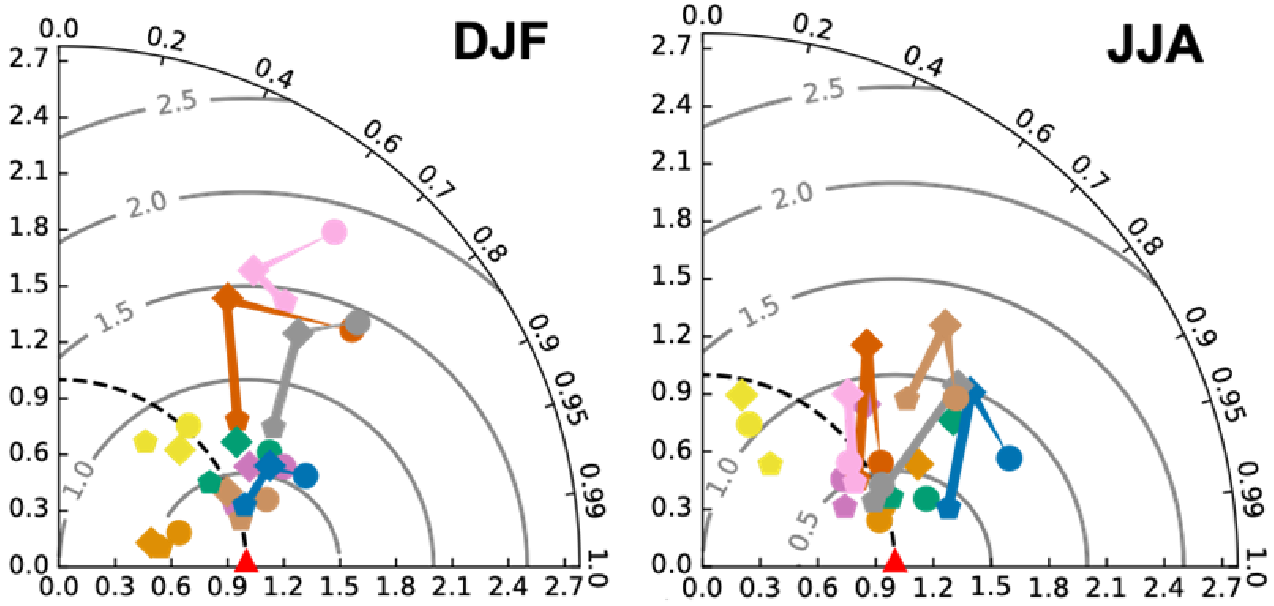

Figure 1. *Taylor diagrams performed on the spatial distributions of seasonal mean precipitation for EUR-11 (circles), EUR-44 (diamonds) and PRIMAVERA (pentagons) ensemble means for DJF (left) and JJA (right) over all regions. Symbols are connected for complex-orography and coastal regions (AL, CA, IP, MD, SC). Observational references are shown in red triangles.*

Figure 2 shows the winter (DJF) precipitation distribution for PRIMAVERA, EUR-11 and a selection of CMIP5 models, which correspond to the GCMs downscaled by EURO-CORDEX RCMs. There is a clear shift in the precipitation distribution going from CMIP5 to PRIMAVERA and EUR-11 over all regions. PRIMAVERA and EUR-11 simulate an overall decrease in low-intensity precipitation and an increase in high-intensity precipitation compared to CMIP5, which is particularly clear over coastal and orographic regions (SC, AL, IP). Both the PRIMAVERA and CORDEX ensembles improve similarly upon CMIP5. Still, there are significant differences between CORDEX and PRIMAVERA. PRIMAVERA tends to have slightly more light precipitation than EUR-11, a common issue in GCMs. The reduced mean wet bias in PRIMAVERA (Fig. 1) mostly comes from less moderate and intense precipitation (Fig. 2). PRIMAVERA has significantly less heavy-precipitation rates than EUR-11 (and EUR-44 to a lesser extent) in most regions and is closer to observations. Note that winter is the season with the largest precipitation undercatch in snow-dominated climates, so observations may be underestimated. Note also that the CORDEX ensemble is larger than the PRIMAVERA ensemble, and so is its spread, particularly in summer when RCM simulations of precipitation are less constrained by GCM large-scale circulation (not shown).

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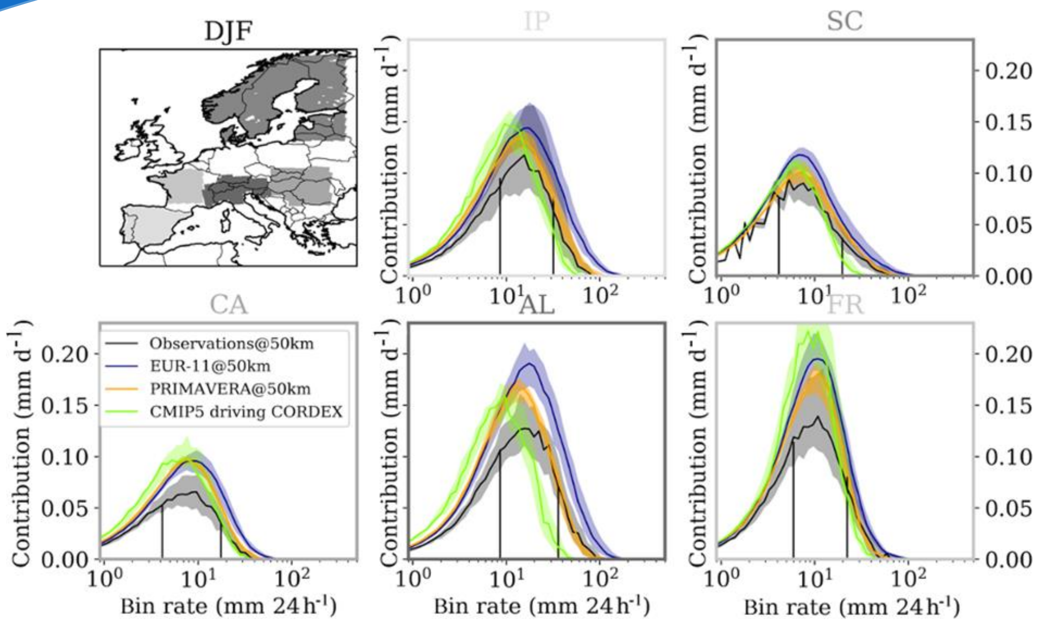

Figure 2. *Precipitation contribution (frequency x bin rate) per precipitation rate in DJF over the Iberian Peninsula (IP), Scandinavia (SC), the Carpathian region (CA), the Alps (AL), and France (FR), for a selection of CMIP5 GCMs (green), PRIMAVERA (orange), EUR-11 (blue) and observations (grey).*

Conclusion

In this study, we have considered high-resolution PRIMAVERA GCMs of HighResMIP (25–50 km horizontal grid spacing) and EURO-CORDEX RCMs (12–50 km horizontal grid spacing) historical simulations to evaluate the ability of these ensembles to represent daily precipitation distribution over Europe. Our results show that the CORDEX and PRIMAVERA ensembles give equivalent regional climate information at a horizontal grid spacing of 50 km. The differences in their precipitation distribution are smaller than differences with CMIP5, where the value of higher-resolution models is indisputable. CMIP5 models show rather different distributions, particularly shifted to lower precipitation intensities, as expected from their coarse resolution.

Although high-resolution GCMs have the potential to better simulate large-scale circulation, which should improve the regional climate, the performance of PRIMAVERA was not logically expected. In particular, the GCMs are not tuned for higher resolution, and the experimental design is rather simplified (e.g. Haarsma et al., 2016). By contrast, although RCMs downscale low-resolution coupled GCMs and so inherit their biases in terms of large-scale circulation, RCMs have the main advantage of being tuned for the region of interest and often correct the GCM biases.

Our results based on daily precipitation distribution are promising and indicate that PRIMAVERA and EURO-CORDEX (EUR-11 or EUR-44) should be considered equally credible by end users, depending on their needs, and should be combined in a joint archive.

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Internal model variability of the regional coupled system model GCOAST-AHOI

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More details can be found in:
Ho-Hagemann, H.T.M., Hagemann, S., Grayek, S., Petrik, R., Rockel, B., Staneva, J., Feser, F., Schrum, C. (2020): Internal model variability in the regional coupled system model GCOAST-AHOI, Atmosphere 2020, 11, 227; doi:10.3390/atmos11030227; pdf: https://www.mdpi.com/2073-4433/11/3/227/pdf

Introduction
Simulations of a Regional Climate Model (RCM) driven by identical lateral boundary conditions but initialized at different times exhibit the phenomenon of so-called internal model variability (or in short, Internal Variability—IV), which is defined as the inter-member spread between members in an ensemble of simulations. Our study investigates the effects of air-sea coupling on IV of the regional atmospheric model COSMO-CLM (CCLM) of the new regional coupled system model GCOAST-AHOI (Geesthacht Coupled cOAstal model SysTem - Atmosphere, Hydrology, Ocean and Sea Ice). We specifically address physical processes parameterized in CCLM, which may cause a large IV during an extreme event, and where this IV is affected by the air-sea coupling. Analyses focus on specific events during this period, especially on the storm Christian occurring from 27 to 29 October 2013 in northern Europe.

Method
GCOAST-AHOI comprises the Atmospheric model CCLM version 5.0, the Hydrological discharge model HD version 4.0, and the ocean-sea ice model NEMO-LIM3 version 3.6, which are coupled via the coupler OASIS3-MCT version 3.0. CCLM is set up to simulate the regional climate for the EURO-CORDEX domain at 0.11° horizontal resolution and 40 vertical levels in the atmosphere. CCLM is driven by the one-hourly ERA5 reanalysis data at the lateral boundaries. HD is applied over Europe at a spatial resolution of 5 min (ca. 8 - 9 km) and a model time step of one hour. NEMO covers the region of the north-west European shelf, the North Sea, the Danish Straits and the Baltic Sea with a resolution of two nautical miles (ca 3.6 km) and 50 vertical levels.

The lateral boundary forcing for tracers (temperature and salinity) in NEMO is derived from hourly CMEMS FOAM-AMM7 model output. The coupling time step amongst these models is one hour. Two six-member ensemble simulations were conducted with GCOAST-AHOI (denoted by CPL) and the stand-alone CCLM (CCLM_ctr) for a period of 1 September–31 December 2013 over Europe. The period was chosen as a test case motivated by the occurrence of the two heavy storms Christian (27–29 October) and Xaver (4–6 December).
We started the spin-up run using CCLM_ctr at 01 August 2013 and stopped at 01 September 2013, 02 September 2013, …, and 05 September 2013 to obtain the restart conditions for five ensemble members of CCLM1-5 and CPL1-5, which all restart at 01 September 2013 but with these different restart conditions. The members CCLM0 and CPL0 use a cold start at 01 September 2013. The ensembles ens.CCLM and ens.CPL are ensemble means of the six CCLM and CPL experiments, respectively. IV is expressed by spreads within the two sets of ensembles. ERA5 reanalysis is used as initial and boundary forcing data as well as to assess simulated mean sea level pressure (MSLP), wind, temperature, and specific humidity of CCLM. For wind speed evaluation, in-situ data from the two platforms FINO1 and FINO3 (provided by FONA3), MyOcean (provided by CMEMS) and data of GTS of the WMO are used in addition.

Results
CCLM_ctr has a relatively large spread between its six ensemble members (CCLM0-5) during extreme events, which can be seen for many variables. For example, Figure 1 shows the large spread of CCLM_ctr (in blue) during the Christian storm event. In the coupled ensemble, the spread of GCOAST-AHOI (red spread) is remarkably reduced. Two members of CCLM_ctr (i.e. CCLM1 and CCLM4) with opposite behaviors are investigated over the Norwegian Sea area that is inside the coupling domain. The sign of the differences in their daily energy fluxes at the surface is opposite to that in the atmosphere. This implies a vertical energy transport to conserve total energy in the climate system as CCLM1 and CCLM4 are both forced by the same sea surface temperature. In GCOAST-AHOI, the ocean surface temperature can be modified and thus, can compensate disturbances of the energy balance that are caused by the parameterizations. Therefore, there is much less variability in the entire air column. The reduced uncertainty is also found over land in GCOAST-AHOI due to the overall stabilization effect of the coupling on large-scale circulation.

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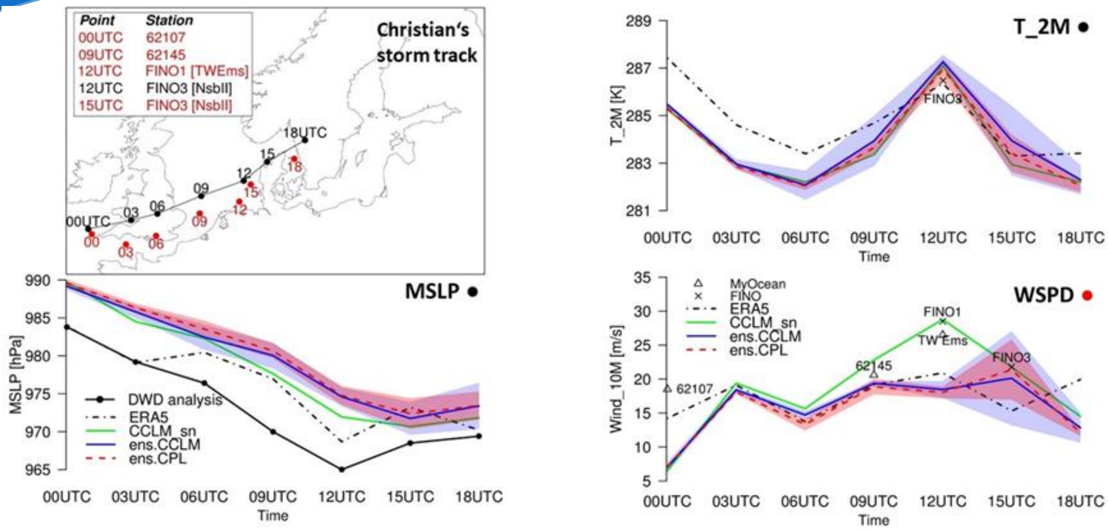

Figure 1: *The storm track of the storm Christian from DWD analysis (black line and points) and locations of maximum wind speed (red points) (top left). The three-hourly evolution of mean sea level pressure MSLP (hPa) (bottom left) and 2-m air temperature T_2M (K) (top right) at the black points, and 10-m height wind speed Wind_10M (m/s) (bottom right) at the red points. Blue and red shades indicate the ensemble spreads of ens.CCLM and ens.CPL, respectively. Period: 00UTC-18UTC, 28 October 2013.*

a) COUPLED SYSTEM MODEL

b) ATMOSPHERE ONLY MODEL

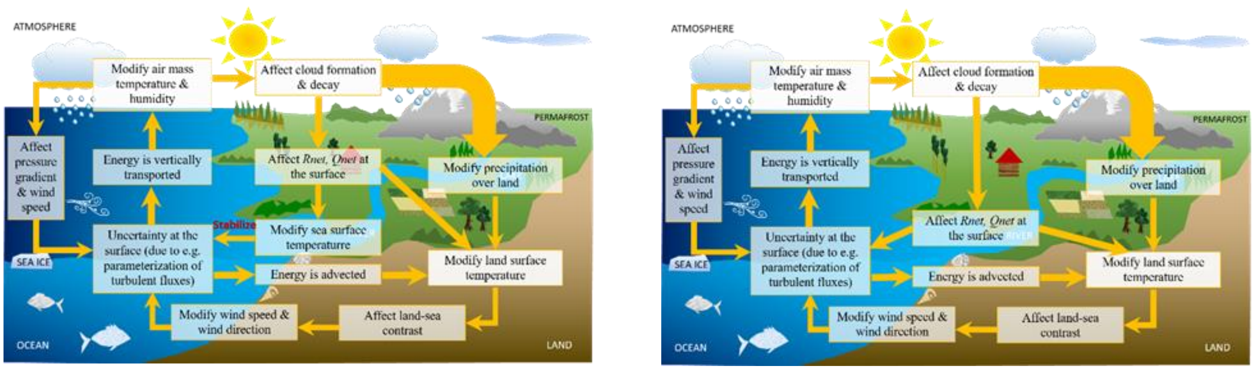

Figure 2*: Energy-cloud feedback, air-sea and land-sea interactions in the climate system in a) the coupled system model and b) atmosphere only model.*

Conclusions

The large uncertainty in CCLM_ctr is caused by a combination of uncertainty in cloud-radiation interaction in the atmosphere, and the lack of an active two-way air-sea interaction. The uncertainty in cloud parameterization could cause uncertainty in simulations of cloud cover and radiative transfer processes that result in an uncertainty in the energy budget, temperature, and humidity of an air mass. Consequently, an uncertainty in air pressure and wind speed on the regional scale in turn could modify the large-scale circulation. Then, locations of low and high-pressure centers are shifted and might have an effect on the storm path as well as propagation speed and intensity. Figure 2 shows briefly the physical mechanism of this feedback loop. When CCLM is two-way coupled with the ocean model in GCOAST-AHOI, the spread is not only remarkably reduced over the ocean where the coupling is done, but also over land due to the land-sea interactions. The reduction of internal model variability due to coupling was also indicated in other publications (e.g. Ho-Hagemann et al., 2017, Wiese et al., 2020).

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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 the publication is related.

2020

Ahrens, B., T. Meier, E. Brisson (2020): Diurnal Cycle of Precipitation in the Himalayan Foothills – Observations and Model Results. Himalayan Weather and Climate and their Impact on the Environment, pp 73-89, https://doi.org/10.1007/978-3-030-29684-1_5

Brecht, B.M., G. Schädler, J.W. Schipper (2020): UTCI climatology and its future change in Germany – an RCM ensemble approach. Met. Z., 29, 2, p. 97 - 116, DOI: 10.1127/metz/2020/1010

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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.

Petrik, R., B. Geyer, B. Rockel (2020): On the diurnal cycle and variability of winds in the lower planetary boundary layer: evaluation of regional reanalyses and hindcasts, Tellus A: Dynamic Meteorology and Oceanography, 73, 2021 - Issue 1, https://doi.org/10.1080/16000870.2020.1804294

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Topic: *Prediction of surface temperatures for the assessment of urban heat island effect over Ahmedabad city.*

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Austria

[(https://www.uibk.ac.at/index.html.de)](https://www.uibk.ac.at/index.html.de)

Topic: *Convectio-permitting climate downscaling over mountainous regions*

Contact: *Emily Collier*

Friedrich-Alexander-Universität Erlangen-Nürnberg - Germany

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Topic: *Mesoscale Processes in Ecuador*

Contact: *Nadja Landshuter*

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2021

January 25 – 29 EURO-CORDEX General Assembly, Virtual Meeting

March 08 – 19 ICCARUS, Virtual Meeting

April 19 – 30 EGU, Virtual Meeting

June 07 – 11 ICAM 2021, Short Online Event

September 20 – 24 CLM-Community Assembly, Berlin, Germany or Virtual Meeting

2022

September 05 – 09 EMS Annual Meeting, University of Bonn, Germany

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