

THIRD INTERNATIONAL CONFERENCE ON REGIONAL CLIMATE, ICRC-CORDEX 2016

BY IRÉNE LAKE, WILLIAM GUTOWSKI, FILIPPO GIORGI, BORAM LEE



Preface

More than 300 scientists, all interested in regional climate, came together at Stockholm, University Sweden, 17-20 May 2016 for the 3rd International Conference on CORDEX (Coordinated Regional Climate Downscaling Experiment). Out of over 460 abstracts submitted to the conference, 89 oral presentations and 306 posters were presented during three of the conference days.

The aim of the conference

- To bring together the international regional climate research community, focusing on high resolution climate information and its applications to vulnerability, impacts and adaptation and the full spectrum of potential end users of regional climate information;
- To offer a platform for further capacity development, training and knowledge exchange for developing nation scientists;
- To offer an opportunity to expand existing, or build new, collaborations;
- To demonstrate success both broadly across the discipline and through case studies ('CORDEX in Action');
- To facilitate cross domain collaboration around CORDEX Challenges with potential for keynote speakers to address more broadly one of the CORDEX challenges;
- To launch, discuss and develop future plans (including Flagship Pilot Studies, Challenges, and Coordinated Output for Regional Evaluations).

Key Topics

The conference brought together the international community of regional climate scientists and stakeholders with a particular emphasis on the added value, vulnerability, impact and assessment issues and the use and future of Regional Climate information and CORDEX results. This landmark

event provided a forum for addressing the following key topics:

- (1) CORDEX in Action: Achievements and lessons learned, status and future perspectives;
- (2) Benefits of downscaling, including added value and distillation issues;
- (3) Frontier downscaling tools including human-climate interactions and empirical-statistical downscaling;
- (4) Impacts and Applications with extremes and, coupled systems and the path from observations over models to applications;
- (5) Domain-specific and cross-domain issues.

The conference was preceded by a meeting between representatives from TGICA and CORDEX where the need for regional data and products, transparency and usability of regional downscaled information, the future of TGICA and CORDEX priorities and boundaries were discussed. Furthermore, before and after the conference the CORDEX Science Advisory Team convened.

CORDEX = Coordinated Regional Downscaling Experiment

Advance and coordinate the science and application of regional climate downscaling through global partnerships. The CORDEX framework addresses climate information needs at the regional level.

<http://www.cordex.org>

The first conference day started with a plenary session where the participants were welcomed proceeded by a general introduction and discussion on the challenges we face in relation to climate and climate change where representatives from the Swedish Ministry of the Environment and Energy, SMHI, GFCS, Bolin Centre, WCRP and CORDEX co-chairs participated. This was followed by the co-chairs giving a short history of CORDEX, as well as an overview of the current status of CORDEX.



Filippo Giorgi, Rolf Brennerfelt, Bill Gutowski and Jan Olsson kicking off the conference.

Valerie Masson Delmotte and Hans Pörtner then informed about the work in IPCC WGI and II as well as giving their view on how the regional climate community and CORDEX can contribute to IPCC, AR6 and the special reports. For instance the importance of feedback on whether RCMs can be used for understanding the observed climate and climate processes was underlined. Compared to the earlier assessment reports the AR6 would need to better meet the end-user needs and more regional experts to be involved. Since CMIP6 projections will be available a bit late for CORDEX runs the AR6 can rely also on CMIP5. It's important that data is openly available and to develop a coordinated assessment of uncertainty in climate projections. What regions to be chosen for the AR6 depends on the scoping process. It was underlined that in AR6 there will be more focus on lower-end scenarios and indicated that more sophisticated methods than the simple global indices (like global mean temperatures) might be needed. As well as more research on overshoot scenarios.

Data distillation and the gap between producers and users was the next topic including the challenge in boiling down the vast amount of data with various quality, credibility, resolution and availability to something understandable. The messages from GCMs/RCMs and ESDs often differ which creates confusion among users and thus tailored information is demanded. Following this was a presentation on climate services including the question of how to interpret climate services. In this work services including data, information and knowledge supporting adaptation and disaster risk management was addressed. An idea for a European road map and how CORDEX can provide information, which would probably demand a multi-model effort, was introduced.

In the Arab region climate change is a rather 'new' subject. RICCAR (Regional Initiative for the Assessment of the Impact of Climate Change on Water Resources and Socio-Economic

Vulnerability in the Arab Region) was launched in 2009 where one aim is to provide a common platform for dialogue and policy formulation. In IPCC reports there is no unified region for the Arab area, CORDEX however has adopted the Arab domain as MENA domain. Some results from simulations were shown followed by examples of impact assessment studies on health and agriculture. It was pointed out that policy makers are confused by the difference between bias corrected models and raw data but have now started to discuss these issues. The speaker also mentioned that the very limited availability to data from hydrological models needs to be addressed.

Data was also the focus of the next part of Plenary I with a tour of CORDEX data archiving, available models and variables, accessibility and terms of use. Some ESGF (Earth System Grid Federation) training workshops have been held to help setting up ESGF nodes. Download statistics show that 2m-temperature and precipitation are the most popular variables. On the agenda was also a discussion on the use of non-commercial data. Other topics were uncertainties in boundary conditions, the lack of high-resolution quality-controlled observation data sets, some examples of CORDEX data use including impacts of climate change on photovoltaic power generation and examples of CORDEX use from different domains. For instance the need for high resolution in mountainous regions was described. Furthermore regional climate services built on CORDEX projections and the future of CORDEX were discussed

So in summary, the first day comprised discussions on:

- Challenges in relation to climate change.
- How IPCC best can make use of CORDEX and how do CORDEX best provides information to IPCC;
- Distillation of climate information from data and related challenges such as model spread and interface with producers and end-users, understanding and communication between sectors;
- CORDEX as a foundation for climate services;
- Science-policy interface.

The first day ended with a relaxed and welcoming ICE-breaker offering finger-food and jazz/contemporary music.



The band; Magnus Fritz, Jon-Emil Oscarsson and Esa Falkenroth, entertaining the participants Tuesday evening.

The A1-session addressed the challenges in determining RCMs added value—how Ensembles can smear out results, how processes driven by large-scale features like ENSO inter-annual variability may not be better captured by higher resolution whereas variability of other frequencies and extremes seem to be better represented by finer scale models —and went on to demonstrate that despite the uncertainties and sometimes diverging results almost systematic improvements were found in finer resolution simulations. This all points towards one of the key factors in using models results; what is the relevant temporal and spatial scales for the question to be addressed.



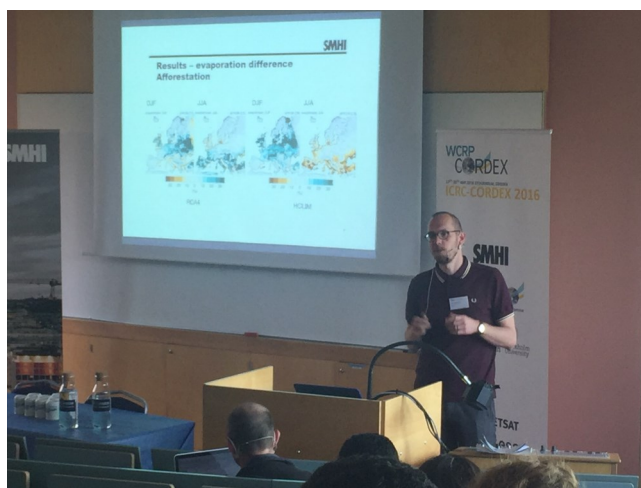
Jacob Frejdin filming Ramon Fuentes-Franco, session A2.

The A2-session on models of the coupled regional climate system presented results from both coupled system simulations—ocean-atmosphere-sea ice, hydrology-atmosphere, full Earth System Models etc—and from uncoupled simulations over many domains. The results showed that, due to incorporation of processes and feed-backs such as effects of aerosols, ice sheets and land use change not accounted for in non-coupled RCMs, the coupling generally improved the simulated climate. For instance precipitation and temperature biases were reduced and ocean – atmosphere fluxes better captured.

Session A3 on the distillation dilemma enlightened the issues of how planning and decision-making related to infrastructure increasingly rely on climate change impacts and risk estimates derived from various models with their inherent uncertainties. Is uncertainty the correct term when discussing risks - maybe this is more a question about value judgement. Studies here raised issues like how economic assumptions and expectations concerning climate impacts influences how to determine risks and adaptation level. The session also highlighted the difficulties in tackling the fact that end users want to see one single ‘number’ and not a spread and how time scales in climate science and policy planning processes need to be synchronized. There were also some examples of web processing services and other ways of presenting/communicating data/results including uncertainties to the VIA community including thoughts on web atlases like the impact2c. At the end of A3 the audience heard about the need for coordinated downscaling and distillation efforts and an example of downscaling used for adaptation studies.

Lunch was served in conjunction with Poster Session A with approximately 130 poster abstracts on Benefits of Downscaling. The work presented here showed a large variety and amongst others included; how internal variability can cloud the signal, the impact of resolution and coupling as well as impact assessment and applications. Incorporation of traditional knowledge into the scientific knowledge must not be forgotten and this is also a part of the interaction with users. The session also offered posters on the added value, the importance of scales, the need for observational reference data for downscaling and contributions to capacity building. Bias-adjustment, the performance of dynamically downscaled ensembles and the number of simulations needed for producing robust climate change information were other topics of this poster session.

Wednesday afternoon offered the three B-sessions on Frontier downscaling tools. In session B1 on very high resolution modeling (time and space), the added value with resolution high enough to better capture for instance convection and precipitation and improved other processes which are specifically important for local scales versus computational costs were discussed. Resolution also often leads to reduction of bias correlated issues. Other issues were challenges in validating high-resolution data and observations because of scarcity, location (model grids and observational locations not matching) and satellite data shortcomings. In most cases it was however found that higher resolution simulations can better mimic the real world, specifically so for finer-scale processes. It should also be kept in mind that the model domain size comes into play, where too small a domain might prevent the necessary development of some physical processes.



Gustav Strandberg giving his talk in session B2.

The session on human-climate regional interactions, B2, included presentations on the effects of land use/land cover change and what temporal and spatial scales that are relevant for climate change. In B2 the audience also saw presentations on impact of aerosols and why it is important to include this in regional models, the difference in responses and feed-back of urban and rural areas to climate change and the possible shift towards less frequent but more intense extreme events. The need for consistent and coordinated models and feedback for mitigation and adaptation purposes was another topic.

These studies indicate that capturing the processes associated with LULC change, aerosols and urban effects adds value to local and regional climate change assessment.

The last Wednesday-session, B3, with the headline Empirical Statistical Downscaling (ESD), encompassed several aspects of statistical downscaling and post-processing. There were presentations on comparisons of dynamical and statistical downscaling methods. Another side is the applications (for instance in agriculture) and for which user problem and geographic area downscaling ESD is working and essential. A recurring theme was selection and optimal combination of predictors and how to communicate results to users.

In summary the sessions of the second conference day highlighted issues such as:

- the risk of losing information in ensembles
- Resolution versus computational costs
- Uncertainties and risk analysis
- Understanding feed-back mechanisms due to LULC and aerosols
- Advantages and combination of different downscaling methods
- The need for development of earth system models for a more complete understanding of regional and local change in response to climate change.

development of convective-permitting or convective-resolving scale simulations which is important when discussing the value of downscaling. As in the oral sessions there were also here presentations on environmental degradation/LULC impact on climate change.

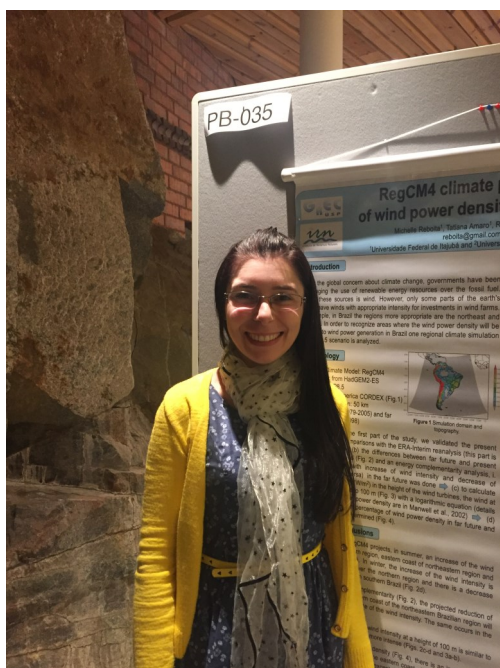
Largest of the second day side events was the European Climate Research Alliance (ECRA) bringing researchers, policy-makers and data users together to discuss the gap between global-scale climate system modelling and high resolution hydrological modelling, in response to requirements for impact assessments. It was concluded that a better understanding of future risks of extreme events and the importance of scales need the involvement of stakeholders and data users which is linked to an efficient and appropriate communication of modelling results. Accordingly, a seamless transfer of climate relevant information is a big challenge for climate services.



The ECRA expert panel Peter Braesicke, Filippo Giorgi, Erik Kjellström, Daniela Jacobs and the moderator Ralf Döscher.

The other side event dealt with Convection Permitting Modelling.

Thursday morning had a similar set-up with three parallel sessions (C) on Impacts and Applications. Session C1 dealt with representing and Projecting Extremes and discussed both wide questions like understanding/predicting and conveying information on weather and climate extremes and more specified topics such as difficulties in agreeing on standard definitions. Another often described problem is the observational data scarcity and observations-model scale mismatch which is also sometimes difficult to explain to users. Other topics in this session were IPCCs climate extreme indices connected to how to define extremes. And what extremes we might face even under the assumption of very limited climate change conditions. To bridge the gap between users and researchers the science community needs to make sure that projections/simulations address the user needs for instance in supporting adaptation where the hot topic impact scales versus model scales comes into play and the importance of regional/smaller scale modelling is evident. The audience could also enjoy presentations on effects of nudging and highlights on what CORDEX results can be used for as for



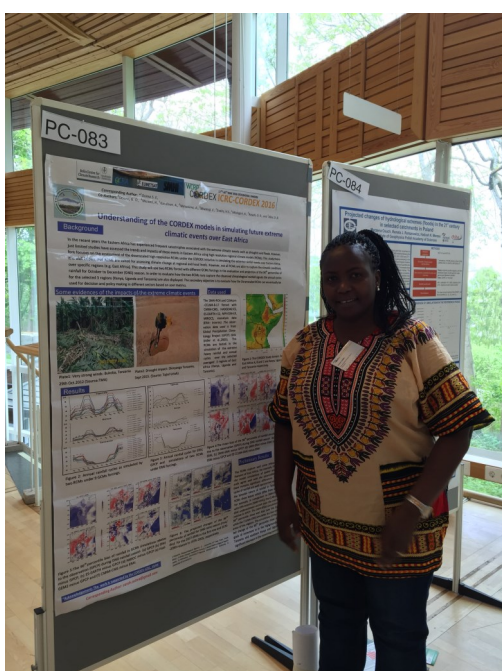
Michelle Reboita happily demonstrating her poster in poster session B.

Towards the end of the second day there were two side events that drew attention of the participants alongside the second poster session. This poster session B, with about 50 abstracts on Frontier Downscaling Tools, showcased posters with topics such as climate change impact on local water requirement for crops, spatial downscaling on gridded variables and downscaling methods and regional aerosol impact. One could also see work on climate resilience issues and on the regional differences in added value from downscaling and the

instance potential climate change implications for hydro/thermo/wind/solar-power generation and RCMS challenges and possibilities in facilitating planning. On the more technical side model physics and parametrizations yielding differences between models and between models and observations were discussed.

In the C2-session on Regional atmospheric and ocean circulation systems the question on climate change impact on energy availability and how to simulate these possible impacts was also discussed. Another interesting topic was earth-system approaches with coupled ocean-atmosphere systems examining thermohaline circulation and tidal forcing in a changing climate as well as snow-band predictability. Some future projections and uncertainties in response to various Representative Concentration Pathways (RCPs) scenarios were presented and among those the resilience of marine ecosystem to climate change and changes in coastal jets were height, wind speed and extension responses will be affected as well as other dominating wind system patterns. In all of these presentations associated aspects of modelling challenges were included.

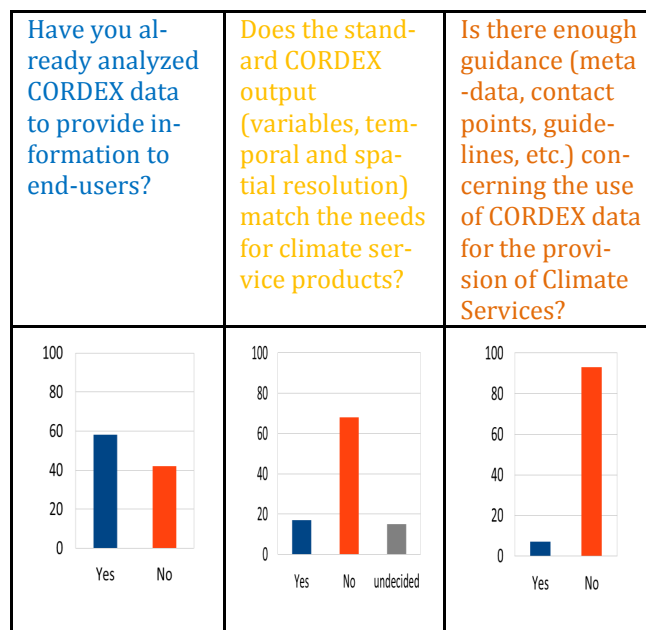
Regional scale hydroclimate: from observations to modelling applications was the title for session C3 which started with a talk on different methods for runoff projections where uncertainties from choice of GCM are larger than those from runoff models and how to convey the message to water resources planners and managers when results show a large spread. The observational data scarcity could perhaps be somewhat reduced with more use of satellite data—but can the satellite data be calibrated with coupled models? A question of importance in moving towards finer and finer resolution, which is highly in demand in for instance mountain regions, and more advanced computers is the computational efforts of downscaling methods compared to GCMS, of ensembles compared to single model simulations, of coupled models compared to stand-alone—are the higher demands on resources justified by added value?



Sarah Osima with her poster in poster session C.

As the day before lunch was served during a poster session, C, showcasing approximately 120 posters, This session further explored the Impacts and Applications theme, for instance spanning the areas of regional hydro-climate impact and assessment studies, bias evaluations and implications, high-resolution applications and the related issue of projections of extremes. Other interesting poster topics, some specifically relevant to the demand for more tailored products, were representativeness of impact projections, potential climate change impact on farming and water availability, disaster prevention planning and the severe model challenges in mountainous regions/complex terrain. There were also performance studies with various methods and in various regions, work on model simulations sensitivity to parametrization schemes, coupled models and how representation of SST influences downscaled regional climate simulations.

Six interactive, more workshop-oriented sessions covering different cross-domain topics followed Thursday afternoon. Two sessions on regional monsoons—West African and Asian/Australasian, training on the Regional Climate Model Evaluation System, statistics to make sense of data, polar CORDEX investigations and climate services.



Some information seem to be missing. Results of yes/no questions during session D1. Photo: Daniela Jacobs.

Session D1, Climate Services in the frame of CORDEX, started with talks including a demonstration of climate service products based on CORDEX data, an overview of VIACS Advisory Board for CMIP6 activities and how to make user-friendly products. After that followed team work answering questions on CORDEX output/data with respect to the quality, relevance, usage and needs for guidelines and meta-information as underlay for climate service products. The session also included a part on climate services case studies. Results from this workshop showed that more than half of the participants had analyzed CORDEX data in order to provide services to end-users but interpreted the standard output as not matching the user needs (too few ensemble members, too coarse resolution and not enough post-processing and missing variables) and lacking enough meta information (methodological description, data quality, uncertainties and usability).

Besides that bias adjusted data and more visibility was asked for. In summary the demand for climate services increases, it was however concluded that the standard output is not yet adapted to the needs of end-users and there is a demand for transparency on limitations and possibilities as well as increased visibility and support.

The D2-session; a hands-on Training Session on Regional Climate Model Evaluation System, RCMES, gathered around 50 participants who were instructed in how to install, run and evaluate climate models using RCMES and statistical downscaling on their own laptops. RCMES is a software tool, with easy access to observational data, for facilitating model evaluations and data analyses. A survey was performed and showed that the participants were satisfied with the training and planned to use RCMES in the future, several were also interested in contributing to the development of RCMES.



Discussion in session D2, here Paul Loikith in action.

Session D3 on How statistics can help making sense of data from multiple sources started with a talk on Data, models and reality with a modern statistical perspective. A key point here was to identify what data is needed to answer a question with enough/adequate degree of precision and also how to interpret information when you're working with incomplete data from multiple sources. In one of the presentations statistical downscaling had been used to assess and quantify the impact of climate change on local infrastructure. Next followed a talk on regional climate analysis based on multiple sources in Africa and how scarcity in observations as well as lack of maintenance of observational sites make validation difficult. There are also difficulties in understanding the spread in data/model output and included in this is thus sometimes outdated equipment and services for interpretation. On the agenda was also why climate science is funded and how scientists need to take into account the users' information requirements as well as the challenges in combining information from multiple sources with different scales, and built-in defects.

Polar CORDEX Investigations, the D4-session, dealt with the role of Arctic CORDEX and included presentations from the partners (13 institutes running circum-Arctic RCMs) on the status of the Arctic CORDEX work. There were discussions on the performed and planned simulations, including multi-model analysis with extremes and ocean structure and the difficulties and skills the groups have found. It also included thoughts on possible interaction with other projects such as CliC and FAMOS. The corresponding analyses and results/methods to share were also on the agenda.

Session D5 was cancelled and replaced by the side event on

coupled RCMs.

Another interactive session, D6, on the Process Based Evaluations of the West African Monsoon (WAM) in CORDEX Projections addressed the degree of understanding of the Monsoon where the problems were divided into different themes. Important is where the gaps are and how appropriate CORDEX data are for studying the WAM. And how multiple projects can work together in order to maximize scientific results and impact. A question posed was how insight into the VIA issues can help scientists in targeting the appropriate questions and focus their efforts in understanding the WAM.

Session D7 also dealt with monsoons but now the Regional Monsoon hydrological cycle over Asia and Australasia. The session started with updates of the status of CORDEX within the domains of relevance where CORDEX South Asia has progressed well with analyses of representation of the monsoon and the related dynamics. The monsoon precipitation is the primary water-supply for several countries in the region and the understanding of its response to climate change is subject to considerable uncertainties.

The third conference day in short dealt with a range of contemporary issues such as;

- Challenges in representing and projecting extremes and scale mismatch model-observations and models/ impact
- potential climate change implications for hydro/thermo/wind/solar-power generation and RCMS challenges and possibilities in facilitating planning
- model intercomparison and assessment
- altered rain and dry spell patterns
- the benefit of high resolution particularly in mountainous regions
- Statistics as a tool to interpret multi-source data
- The importance of understanding and addressing the user need at the right scale
- understanding/interpreting/predicting and conveying information on climate change and climate extremes
- Informed use of climate information/model output

So in summary; models scales need to be synchronized with impact scales, results need to be conveyed in a comprehensible way addressing the appropriate issues and decision makers/end users need local solutions! It is essential to analyze what is needed to answer the user question with enough/adequate degree of precision and how to make sure the results are used in an informed way.

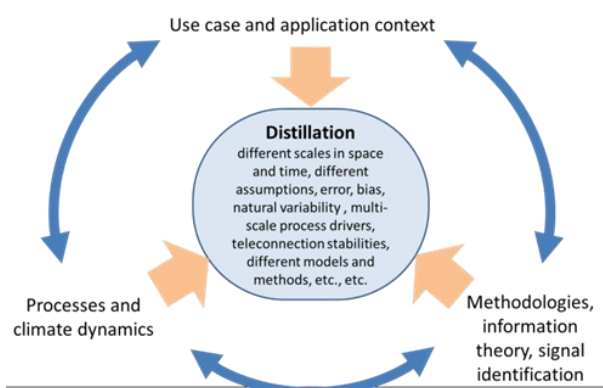
Thursday ended with four side events spanning topics of interest for the entire CORDEX community; the Early Career Scientists (ECS) event, the Distillation COST Action, Euro-CORDEX LUC and Coupled RCMS, the last replacing the formerly planned D-session 5.

The well-visited Early Career Scientists (ECS) event focused on how ECS can best communicate their research. The event started with a presentation on how effective communication is about understanding how you are heard instead of focusing on what you are saying—how to explain to laymen what you do so they understand. Four early career scientists then presented communication examples and their thoughts on how to improve science communication. Lastly the presenters participated in a panel discussion on topics ranging from miscommunication to opportunities for early career scientist to improve their communication skills.



Gaby Langendijk, Asher Minns, Shazwin Tab, Nana Klutse, Alejandro di Luca and Pushp Raj Tiwari during the ECS event.

Another side event Thursday was the Climate Information Distillation meeting which kicked off with an introduction to the distillation dilemma, that is how to make sense of data from multiple sources. To answer all the questions involved and turn the oceans of data into useful information collaboration across diverse communities and scientific disciplines is a necessity. Often producer results clash with user expectations and a quote from Andreas Hansler; 'Data is not information, information is not knowledge and knowledge is not understanding' nicely summarizes some of the difficulties involved. It was agreed to pursue a Cost-Action addressing some of the distillation issues.



The complex science– to –user flow, diagram by Bruce Walliser, Climate Information Distillation side event.

A third side event Thursday evening was the Euro-CORDEX-LUC workshop where ideas on new coordinated RCM land use change experiments were discussed. The concept of Land Use & Climate Across Scales (LUCAS) was introduced as well as the status of the global Land Use Model Intercomparison Project (LUMIP) within CMIP6. How to design continental

scale experiments and how to implement land use changes into the RCMS were the main topics for discussion.

There was also the Coupled RCMs side event starting with talks on the challenge in coordination of regional coupled modelling, the use of coupled RCMs including difficulties like assessing uncertainties and initializations. An open discussion on domains using coupled RCMS and related Flagship Pilot Studies followed. How much coordination between domains is required for coupled RCMs was the next topic where for instance appropriate boundary conditions, feedback processes to include and how coupled processes impact variability and change were identified as issues for a coordinated approach as well as name standards. Some of the key messages was that RCM/RESM tools have the capacity to contribute to improve knowledge on regional climate, variability and change (multi-components), to understand regional processes and to contribute to WCRP grand challenges. They can also contribute to improve the representation of regional coupled processes/phenomena in GCM and the RCM community can contribute to expand the impact studies, to serve new users and to propose new services.

Wrap-up

Friday, the last conference day, began with a conference summary and an overview of the overall goals, planning and basic framework for CORDEX by the CORDEX co-chairs Bill Gutowski and Filippo Giorgi. In the discussions of the next steps of CORDEX and this second part of CORDEX that we are in now it is of essence to discuss and revise scientific targets. Some of the comments included the notion that CORDEX is still not well defined under WCRP and also need better integration with other WCRP programs. The question on the difference between regional information and information for regions was also raised and how an integrated holistic approach may be necessary to deliver what the user needs so the user understands. New emphasis from WCRP on food basket regions was lifted as well as the demand for underlay targeting the corresponding water issues. CORDEX contributions to the coming IPCC reports was discussed and the general feeling was that more than for AR5 needs to be done.

The CORDEX scientific vision is to advance and coordinate the science and application of regional climate downscaling through global partnership'. The corresponding overall goals was presented where better understanding of smaller-scale phenomena and their variability, evaluation and improvement of RCMs, production of coordinated sets of projections and to foster communication and knowledge exchange with users are the primary ones.



Co-chair Bill Gutowski searching for answers.

The suggested CORDEX-specific scientific challenges, with the aim to target specific regional fine-scale features; added value, human element, coordination of regional coupled modelling, precipitation and local wind systems, not embedded in but partly with the WCRP grand Challenges in mind, were laid out with the invitation to react on these. To the question if there should be other categories the interaction with policy makers was raised which initiated a discussion on the boundaries of CORDEX—how far into communication do we go, where do others take over. Distillation was also suggested as a challenge candidate as well some others, such as modelling over complex terrain, which are more or less implied in the already suggested ones but that could be more explicit. There were also some questions on the division in Coordination of regional Coupled Modeling and Human Element where there are issues covering both. The coordination was by some not interpreted as a scientific

challenge. How to define and determine added value is not obvious and calls for more attention. For the human element the megacities and land use land change problems may seem obvious but transport impact, sea-level rise and human health may also be relevant.



Daniela Jacobs involved in the final discussions.

It was also pointed out that the challenges are at different levels and focus should be more regional and on complex regional issues. The idea is not, however, to have them mutually exclusive.

The sharing of information from CORDEX was another topic where some felt that the data is sometimes hard to find and especially so uniform data. ESGF is the supposed common platform for sharing data but obstacles in getting the data in the right format sometimes slow the process down.

More visibility to statistical downscaling was also asked for in the challenges as well as how to relate the downscaled results to the GCM uncertainties and how to move to seamless (in time) predictions. Other cross-cutting themes were brought up and a thought was to create more of a grid type scheme for the challenges.

After this followed a presentation on the Flagship Pilot Studies (FPS) where the idea behind and the criteria for the studies was explained, see more on cordex.org under Experiment Guidelines. The CORDEX Scientific Advisory Team (SAT) announced the first set of endorsed FPSs, selected from the applications to the first FPS call. The five proposals were briefly presented and the procedure for submitting new proposals for the coming calls outlined.

Next up was the Common Regional Experiment framework (CORE), also in consideration on the next steps of CORDEX. One of the motivations for this is IPCC calling for a larger role of CORDEX in the next assessment report. A CORDEX based 'Atlas'- like product could perhaps be useful. The present CORDEX framework has large inhomogeneities in information and simulations across domains and also relatively coarse resolution in relation to the planned CMIP6.

Thus a succinctly structured core set of RCMs to downscale a core set of GCMs for each CORDEX domain and for a core set of scenarios would constitute this CORE. This would in the future be incrementally enlarged with further models and simulations. The question is how to choose these models, how many models to include, how much data to store, how to coordinate with CMIP6 etc.

Resources and time are critical parameters here and if contribution to the 1,5 report is in question time is very limited, whereas otherwise the time constraint is weaker. Since it is not obvious that the same set of models should be used in all domains the experiments may not be completely homogeneous but adequate.

It is obvious that the CORDEX community needs to show what gaps that can be filled with the results and products from regional downscaling.

For the CORE it is essential to examine what has already been done and start with that. CORE design and output would be directed towards the AR6 whereas contributions to the 1,5 special report may be more of a fast-track process. For CORE it is important, in the choice of models, to look at region specific problems and share knowledge and/or resources with regions that have not so far done simulations with CMIP5.

Another topic brought up was documentation of what has actually been done— papers on added value, what RCMs have been used etc and it was suggested to set up a working group as some sort of editing body. How data is used and what/how analyses are done should also be more varied and elucidated.

Three outstanding posters by young scientists were awarded at the end of the closing ceremony.



Bill Gutowski, the three winners of best poster awards; Andreas Prein, Raul Wood, Csaba Zsolt Torma plus Filippo Giorgi and Erik Kjellström.

Main outcome

The outcomes from the conference included;

- The CORDEX Community worldwide continues to advance scientific understanding of regional climate and regional downscaling and could be seen as a foundation for climate services;
- Growing IPCC interest in information for regions is providing new opportunities for CORDEX contributions;
- The interface between regional climate science and climate services needs further exploration in order to make optimum use of climate research and experience with providing services ;
- The CORDEX community demonstrated the added

ICRC-CORDEX 2016 web-page :

<http://www.icrc-cordex2016.org/>

value of regional downscaling and recognized the need to further communicate this with policymakers;

- A coordinated set of CORDEX experiments, CORE, will be designed and performed and will among others be used as input to AR6;
- The most important scientific challenges, targeting regional features, can be divided into various themes where all will probably overlap more or less why a matrix/grid type of representation of the challenges could be beneficial.

Some recurring dilemmas stood out during the wrap-up discussion:

- Lack of observations;
- Lack of coordination of modeling/modelers;
- Distillation of information from data;
- The mismatch of scales, both within scientific disciplines and between data sources as well as between models and impacts scales;
- Absence or invisibility of links to other initiatives;
- Uncertainties, risks, refinement versus economy
- Interface/communication with users and stakeholders including how to make sure results are understood and implemented in an intelligent way;
- Organization with respect to societal issues;
- WCRP boundaries; where does CORDEX end? How far into services does CORDEX go and where are the boundaries towards the VIA community?

The present audience agreed that there is a need and demand for definitions of the role, the priorities and the boundaries of CORDEX.



The organizers.

Acknowledgements

The Conference was organized by the International Project Office for CORDEX (IPOC), on behalf of the World Climate Research Programme (WCRP). The organizers acknowledge the generous support provided by the Bolin Centre for Climate Research, which enabled the success of the conference. We thank the scientific committee of the conference who worked very hard to develop the conference programme and to identify invited speakers and session chairs. We thank the young-scientist volunteers who helped with the preparations for the conference and practicalities around sessions. We thank the experts who helped with the evaluation of abstract and best posters. The in-kind web and logistics support from Catherine Michaut, IPSL, is hereby deeply acknowledged. Last but not least, we are truly grateful for the financial support from the World Climate Research Programme (WCRP), The Swedish Meteorological and Hydrological Institute (SMHI), the Swedish Research Council for Environment, Agricultural Sciences and Planning (FORMAS), the Asian Pacific Network (APN), the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT), the European Space Agency (ESA) and the European Climate Research Alliance (ECRA) who made the participation of more than 300 scientists from 38 countries affordable and possible.



Conference participants outside the main venue

A final word of gratitude goes to the CORDEX community at large and the participants themselves, who made this conference an enjoyable and exciting event.

