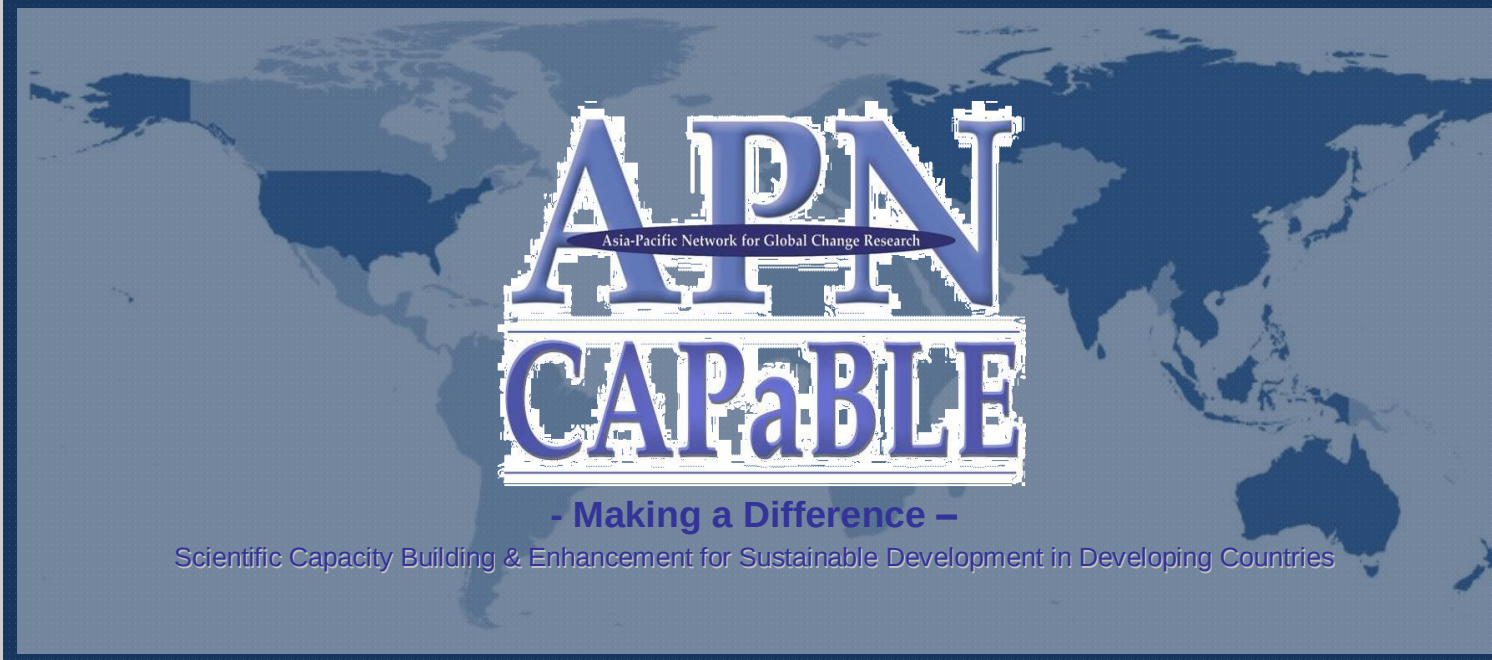
Project Reference Number: CBA2013-04NSY-WCRP

International Conference on Regional Climate - CORDEX 2013: towards improved knowledge serving society



The following collaborators worked on this project:

Project Leader R. Krishnan, Indian Institute of Tropical Meteorology, Pune, India, krish@tropmet.res.in

Collaborator F. Giorgi, International Centre for Theoretical Physics, Trieste, Italy, giorgi@ictp.it

Collaborator W.J. Gutowski, Iowa State University, Iowa, USA, gutowski@mail.iastate.edu

Collaborator M. Rixen, World Climate Research Program, Geneva, Switzerland, mrixen@wmo.int

International Conference on Regional Climate - CORDEX 2013: towards improved knowledge serving society

Project Reference Number: CBA2013-04NSY-WCRP
Final Report submitted to APN

PAGE LEFT INTENTIONALLY BLANK

OVERVIEW OF PROJECT WORK AND OUTCOMES

Non-technical summary

The **International Conference on Regional Climate – CORDEX 2013**, held in Brussels, Belgium 4-7 November, was jointly organized by the World Climate Research Programme (WCRP), the European Commission (EC) and the Intergovernmental Panel on Climate Change (IPCC), and was attended by over 500 participants from 97 countries. Thanks to the conference sponsors such as APN, about 90 participants were supported financially to attend the conference. Participation via web streaming and Twitter Questions and Answers provided opportunities for the community at large to attend the conference remotely and to interact with the audience.

The conference brought together the international community of regional climate scientists and stakeholders with a particular emphasis on the production, assessment and use of Regional Climate information and the CORDEX initiative. This landmark event provided a forum for addressing the following key challenges:

(1) Assessment and improvement of regional dynamical and statistical downscaling techniques;

(2) Development of regional climate change projections with associated uncertainties;

(3) Provision of reliable and actionable regional climate information;

(4) Use of regional climate information in vulnerability, impacts, adaptation studies;

(5) Dissemination of regional climate knowledge to policy-makers and a wide range of stakeholders and decision-makers.

Keywords

International Conference on Regional Climate, CORDEX, Improved knowledge for serving society, Vulnerability, Impact and Adaptation, Policy-making, World Climate Research Programme (WCRP), Intergovernmental Panel for Climate Change (IPCC), European Commission (EC), Monsoon Asia

Amount received and number years supported

The Grant awarded to this project for 2013/2014 was **US$39985.**

Activity undertaken and results

We received about 120 applications for financial support to attend the conference; about 43 of them were from the Asian-Pacific region. A review process was established to evaluate these applications and was carried out by a panel of experts representing the main sponsors of the conference and chaired by the WCRP Director who assessed these applications based on three major criteria:

1) Scientific Background (based on CV and supporting letters for each candidate applicant);

2) Scientific quality / relevance (based on the submitted abstract);

3) Scientific Impact (judged according to abstract and applicant provenience).

The evaluation panel identified 83 applicants from the total pool of applicants that were eligible to receive financial support to attend the conference. Thirty-three of the final award recipients were from the Asian-Pacific Region. Twenty of them were supported directly by the APN grant and the remaining selected candidates were sponsored by the WCRP baseline education and capacity development funds as well as through the other co-sponsors of the conference.

As a part of daily activities of the conference, WCRP also organized a competition for identifying the best poster presentations by students and early career scientists. This competition and evaluation process was coordinated by an independent panel of experts chaired by WCRP Director. The posters were judged based on their scientific content and presentation skills of authors/speakers by a group of independent judges chosen from the conference participants with the requisite scientific expertise. The evaluation results were then synthesized by the panel of experts. The best posters were identified for each day and recognized at the daily summary plenary session. The award recipients (see http://cordex2013.wcrp-climate.org/poster_best.shtml) received a "Best poster Award" certificate, a complimentary hard copy of the book published by Asrar and Hurrell (2013) and a USB stick.

The conference results in a nutshell:

- Jointly organized between the WCRP, the EC and the IPCC
- Attendance: 500+ participants from 97 countries
- Featured key findings from IPCC WG 1 fifth assessment report and scientific results from CORDEX – Phase I
- Conference conclusions will form the basis for CORDEX – Phase II experimental design
- Great opportunity for Asian-Pacific attendees to meet with their peers and the wider CORDEX network and to contribute to the CORDEX – Phase II

Relevance to the APN Goals, Science Agenda and to Policy Processes

This proposal contribute directly all the APN Goals (APN, 2010)

1. Supporting regional cooperation in global change research on issues particularly relevant to the region;
2. Strengthening appropriate interactions among scientists and policymakers, and providing scientific input to policy decision-making and scientific knowledge to the public;
3. Improving the scientific and technical capabilities of nations in the region, including the transfer of know-how and technology;
4. Cooperating with other global change networks and organisations;

by supporting Asian-Pacific region scientists to attend the conference and offering them an opportunity to interact with the 500+ scientists from 97 nations who attended this major event, with the goal of improving the scientific and technical capabilities of nation(s) and region based on the exchange of know-how and technology. This activity *de facto* improved the networking within the Asia-Pacific region, as many CORDEX-involved scientists had never met before and were able to exchange their experience, best practices and scientific achievements and issues.

On the first day of the conference, participants were exposed to key findings from IPCC WG 1 fifth assessment report (AR5) and scientific results from CORDEX – Phase I. This High-level session was followed by a Stakeholder Dialogue session focusing on how regional climate information can best serve the needs of policy and decision-makers. This segment was intended to provide the socio-economic and policy contexts within which WCRP regional climate research activities and programmes operate.

The outcomes of the conference also made a measurable scientific contribution to the WG 2 part of the fifth Assessment Report (AR5) of the IPCC which has been released recently. The conference showcased the results of regional climate model intercomparison project and provided an opportunity to feature CORDEX and regional climate science in the overall climate science agenda. Conference panel discussions and scientific deliberations are now paving the way for CORDEX Phase II and regional climate science, and its relevance for vulnerability, impact and adaptation (VIA) efforts contributing to policy-making, fully aligned with APN goals.

Self evaluation

We believe the conference was a terrific success in achieving its scientific, technical and education and capacity development objectives. This would not have been possible without APN financial support. We believe the conference met or exceeded its objectives in overall attendance, international visibility, networking and research capacity development, especially in Asia and Africa.

In addition to the 33 students and early career scientists, WCRP also sponsored a number of senior scientists from Asia and Pacific regions who played a critical role in the conference and who are actively engaged in WCRP regional activities. As such, APN network of scientists and experts had a strong presence and played a major role in defining the CORDEX research agenda and priorities for the next decade.

We wish that we had garnered even greater level of support to engage the entire pool of applicants for financial support to participate in the conference. We will continue to invite and engage these applicants in the WCRP sponsored activities in their region in the future. We did receive many compliments and constructive feedback from all participants. The most interesting comment/suggestion we received was to convene such a regional climate conference on a regular basis. To date, we continue to receive questions about the next conference. We believe such a support/request is a very good indicator of the effectiveness of such a scientific and technical forum. The conference has generated a tremendous momentum around CORDEX, as illustrated by the strong ownership and uptake in the various CORDEX regions.

Potential for further work

We intend to follow up and continue to engage the conference participants, especially the students and early career scientists in CORDEX future activities. The ultimate goal is to have their active participation and engagement in CORDEX over the long-term. We anticipate that they in turn will help in networking with their peers and engage them as well, thus having a sustained impact on every single CORDEX region. The intent of CORDEX leadership is to convene such a conference once every 5-7 years to allow sufficient progress on the scientific and technical priorities identified in this conference.

Publications

In addition to the coverage of the conference by the media, web and social networks, we also published an extensive conference report available from the conference web page at http://cordex2013.wcrp-climate.org/. All presentations and abstracts are available from the same

web site. In addition, videos of all plenary presentations have been published, following numerous requests to exploit them as training or teaching material. The conference has also greatly facilitated the publication of peer-reviewed material, such as those listed at http://wcrp-cordex.ipsl.jussieu.fr/index.php/cordex-peer-review-publications.

References

- Asia-Pacific Network for Global Change Research (2010). Third Strategic Plan 2010/2015, 22pp
- G.R. Asrar and J.W. Hurrell (2013), Climate Science for Serving Society: Research, Modeling and Prediction Priorities, Springer, DOI 10.1007/978-94-007-6692-1_1. 484pp
- WCRP (2013). Report of the International Conference on Regional Climate – ICRC 2013, 4-7 November 2013, Brussels, Belgium, WCRP report No 2/2014, 25pp

Acknowledgments

We would like to acknowledge the European Commission (EC) and the Intergovernmental Panel for Climate Change (IPCC) for their tremendous contribution to 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, session chairs and rapporteurs. We thank the many young scientists volunteers who supported the poster sessions, the twitter Q&A and session photos. We thank the experts who helped 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 APN in particular, and from EUMETSAT, ESA, SMHI, EGU and SPRINGER that made the participation of more than 500 scientists from 97 countries affordable and possible.

This APN grant was implemented by different collaborating institutions: Centre for Climate Change Research (CCCR), Indian Institute of Tropical Meteorology (IITM), Pune, World Climate Research Program (WCRP), Geneva, International Centre for Theoretical Physics (ICTP), Trieste, Italy, IOWA State University, Iowa, USA. Mr. R.D. Nair, Ms. Ashwini Bhujbal and Dr. Milind Mujumdar from IITM, Pune, Ms Roberta Boscolo (WCRP) and Eleanor Orourke (SMHI) were key resource persons for this effort and their support is gratefully acknowledged.

A final word of gratitude goes to CORDEX community at large and the participants themselves, who made this conference an enjoyable and exciting event. As Colin Jones, outgoing CORDEX co-chair, pointed out, the CORDEX future is bright, despite the many challenges ahead of us.

TECHNICAL REPORT

Preface

More than 500 scientists, all interested in regional climate, came together in Brussels, Belgium, 4-7 November 2013 for the 2nd International Conference on CORDEX (Coordinated Regional Climate Downscaling Experiment). This conference was embedded in a wider event on Regional Climate Change jointly organized by the World Climate Research Programme (WCRP), the European Commission (EC) and the Intergovernmental Panel on Climate Change (IPCC) featuring a High Level Session where the IPCC presented key findings from the Working Group I Contribution to the Fifth Assessment Report Climate Change 2013: The Physical Science Basis. The conference proposed some concrete actions for further advancing the CORDEX science and to better engage the Vulnerability, Impact and Adaptation (VIA) community.

Table of Contents

1.0 Introduction

Provision of climate information for decision making, especially at the regional and local levels, requires a better understanding of the response of regional and local climate systems to global climate, and in turn their influence on the global system. Global observations are key to understanding this two-way feedback for past and present climate conditions. Earth/climate system models are the primary tools to project/predict future changes. Based on current climate model limitations, advanced downscaling methods are required to translate coarse global scale information into fine regional and local grids. This is necessary to obtain suitable information required for assessing impacts and vulnerability of natural and human systems to such changes, and to develop ultimately the science-based information required for climate adaptation, mitigation and risk management.

The World Climate Research Program (WCRP) is leading a major worldwide effort, the Coordinated Regional Climate Downscaling Experiment (CORDEX) to address these issues, in conjunction with the corresponding CMIP5 global scale effort aiming at supporting climate assessments such as the IPCC.

The **International Conference on Regional Climate – CORDEX 2013**, held in Brussels, Belgium 4-7 November, was jointly organized by the World Climate Research Programme (WCRP), the European Commission (EC) and the Intergovernmental Panel on Climate Change (IPCC), and was attended by over 500 participants from 97 countries. Thanks to the conference sponsors such as APN, about 90

participants were supported financially to attend the conference. Participation via web streaming and Twitter Questions and Answers provided opportunities for the community at large to attend the conference remotely and to interact with the audience.

The conference provided an exclusive opportunity for worldwide scientists to interact with the CORDEX research communities from all continents to advance our understanding and prediction of regional climate variability and changes. The conference entrained as many aspiring early career scientists and students as possible from across the world, including developing and less-developed nations and regions in order to facilitate growth of the diverse future workforce needed to meet the increasingly complex scientific challenges of the sustainable development.

The **International Conference on Regional Climate - CORDEX 2013** facilitated active dialogue and discussion among the diverse international regional climate downscaling, and vulnerability, impact and adaptation research communities to address cross-cutting challenges and opportunities to further improve our understanding of regional climate variability and change, and to support climate adaptation and mitigation policies. WCRP aimed to recruit and actively engage early career scientists, especially those from the regions that are most vulnerable to climate change and variability. Specifically, the conference aimed to:

- Appraise the current state of regional climate downscaling science
- Strengthen the synergies and cohesiveness within CORDEX regions and with other regional climate research initiatives
- Identify key opportunities and challenges in observations, modeling and analysis of regional climate
- Translate regional climate science into actionable information
- Engage close dialogue between the modeling and end-users communities
- Highlight priority research in support of the UN Global Framework for Climate Services
- Prepare the grounds for future IPCC assessment reports

2.0 Methodology

As a part of WCRP's ongoing commitment to develop capacity both regionally and globally and to train the next generation of climate experts, the conference aimed at actively engaging with students and early career scientists, especially those from the regions that are most vulnerable to climate change and variability.

WCRP and conference sponsors such as APN joined their efforts to ensure the worldwide CORDEX community was given the opportunity to attend the conference, as such support was deemed to provide the opportunity for aspiring early career scientists and students to participate in this major international climate conference, and to use this forum to form new partnership in their research/education interest, and to obtain a better perspective about regional climate science and application framework, as well as the overall policy-making implications.

Grants were assigned based on the financial need and scientific merit of the proposed presentations described in the abstracts, the contribution to the conference and all supporting documents (see below). Priority was given to:

- Students: those pursuing their graduate studies (MSc, PhD)
- Early Career Scientists: post-graduates and researchers who received their highest degree in 2008 or later
- Scientists from emerging and developing economies

In order to qualify for financial support the applicant had to:

1. Submit an abstract of a paper to the conference, of which he/she was the principal author
2. Submit a complete financial support application

Financial support applicants had to provide and submit the following information:

- Summary of CV (education, professional experience, selected publications)
- Short motivation statement (e.g. expected benefits from attending the conference)
- Pdf files containing the signed recommendation letter from the supervisor or director of the host laboratory, the full CV, and any evidence of partial support to cover travel and/or accommodation expenses.

The number of financial support awards was limited and we recommended applicants to provide all useful information and supporting documentation to make their case. Grantees had to attend the entire conference in order to benefit from the financial support which covered the registration fees and reasonable travel and accommodation expenses.

The announcement for applications was posted on the conference webpage on 15 January with a deadline set for 1 April 2013 (see the announcement http://cordex2013.wcrp-climate.org/support.shtml) extended to a final 15 April 2013 deadline.

We received about 120 applications for financial support to attend the conference; about 43 of them were from the Asian-Pacific region. A review process was established to evaluate these applications and it was carried out by a panel of experts including the main sponsors of the conference and chaired by the WCRP Director. Thanks to the hard work of more than 15 independent referees, the review process was completed by mid June 2013 and the applicants were notified on the results of the process by the end of June 2013.

Based on the available budget, the evaluation panel identified 83 applicants from the total pool of applicants that were eligible to receive financial support to attend the conference. Thirty-three of the final award recipients were from the Asian-Pacific Region. Twenty of them were supported directly by the grant from APN and the remaining selected candidates were sponsored by the WCRP baseline education and capacity development funds as well as through the other co-sponsors of the conference.

People selected for financial support had their fees waived automatically. Those who were not selected still had the opportunity to enjoy the early bird rate or the student rate (where applicable) by paying before 20 August 2013 or to attend the conference remotely via webstreaming.

As part of the conference, WCRP also organized a competition for identifying the best posters presentations by students and early career scientists. These were judged based on their scientific content and presentation skills of authors by a group of independent judges chosen from the conference participants with the requisite scientific expertise. Each poster was reviewed by at least 3 referees. The evaluation results were then synthesized by a small panel of experts involving representatives from co-sponsoring entities and chaired by the WCRP Director. The best posters

were identified for each day and recognized at the daily summary plenary session. The 16 award recipients out of a total of 89 posters reviewed (see http://cordex2013.wcrp-climate.org/poster_best.shtml) received a "Best poster Award" certificate, a complimentary hard copy of the book published by Asrar and Hurrell (2013) and a USB stick.

3.0 Results & Discussion

The conference brought together the international community of regional climate scientists and stakeholders with a particular emphasis on the production, assessment and use of Regional Climate information and the CORDEX initiative. This conference was embedded in a wider event on Regional Climate Change jointly organized by the World Climate Research Programme (WCRP), the European Commission (EC) and the Intergovernmental Panel on Climate Change (IPCC). The first day of this important gathering featured a High Level Session with the participation of the EC Commissioners for Research & Innovation and for Climate Action, where the IPCC presented key findings from the Working Group I Contribution to the Fifth Assessment Report *Climate Change 2013: The Physical Science Basis*. This was followed by a Stakeholder Dialogue session focusing on how regional climate information can best serve the needs of policy and decision-makers. This segment was intended to provide the socio-economic and policy contexts within which WCRP regional climate research activities and programmes operate**.**

High-Level Session, from left: Rory Howlett (Chief Editor of Nature Climate Change), Michel Jarraud (Secretary- General of WMO), Connie Hedegaard (European Commissioner for Climate Action), Valentinas Mazuronis (Minister of Environment of the Republic of Lithuania), Andrea Tilche (European Commission DG Research & Innovation), Ghassem Asrar (Director WCRP), Jean-Pascal van Ypersele (Vice-Chair IPCC), Thomas Stoker (Co-Chair IPCC WG1), Kurt Vandenberghe (European Commission DG Research & Innovation)

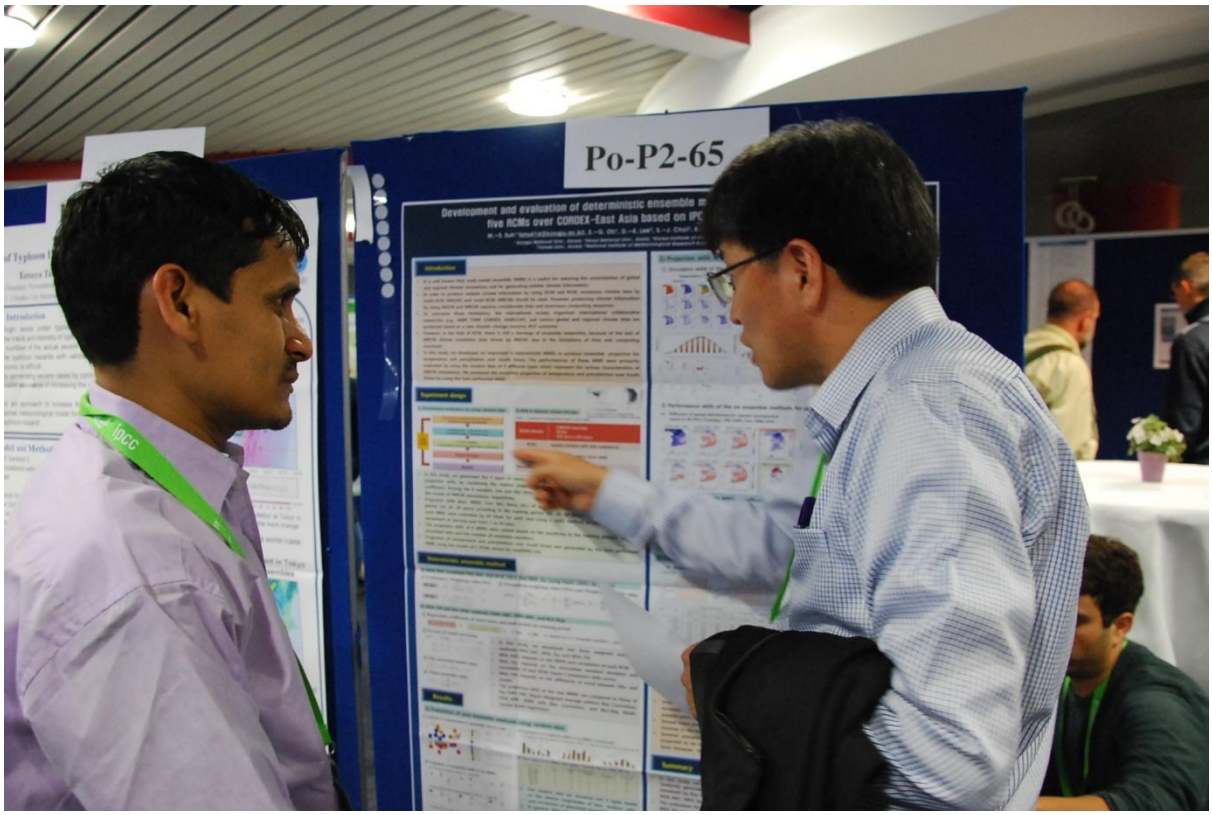
The event continued with the Scientific Segment diving into regional climate change research with particular emphasis on CORDEX (http://wcrpcordex.ipsl.jussieu.fr/). The scientific segment was developed under three main themes:

- "Evaluation of CORDEX Regional Downscaling: Present Climate and Future Change" that reviewed the existing CORDEX and WCRP regional research worldwide

- "Methodologies for Regional Downscaling" that assessed the status and progress of regional downscaling techniques from dynamical to statistical approaches as well as the availability of data for model validation.

- "Application, Impacts and Services" that explored the potential of CORDEX for climate adaptation, impacts and vulnerability studies.

During these three days dedicated to regional climate science, the oral and poster presentations highlighted the achievements of the first phase of the project (CORDEX-I). CORDEX–I has been a successful framework in which scientists around the world adopted a common protocol to guide the development of high-resolution Regional Climate Model (RCM) and empirical statistical downscaling (ESD) projections, and the intercomparison of these projections, on each continent. The conference provided evidence that much of the work underway is relevant to the climate change vulnerability, impacts and adaptation (VIA) studies and that CORDEX must address several key challenges in order to better serve these communities.



A snapshot of the poster session P2

The conference oral presentations, the pictures and videos are all accessible from the conference webpage http://cordex2013.wcrp-climate.org/programme_glance.shtml. All plenary and parallel sessions were broadcasted on-line via webstreaming, thereby allowing people not able to attend the

conference to follow the presentations and discussions remotely. A twitter account was setup to allow remote questions to be forwarded to the speakers and audience in real-time. Poster sessions throughout the three science days facilitated interaction amongst the participants especially between the students and early career scientists (ECS) and the more senior researchers.

The program featured a special CORDEX-Asia session chaired by L. Stevenson from APN, with contributions from the various efforts in the region summarized in the plenary presentation available at http://cordex2013.wcrp-climate.org/conclusions/B3_Stevenson_Kitoh_Krishnan.pdf.

The presentations in this session discussed various aspects of regional climate downscaling over Monsoon Asia (Central, East and South), Australasia and the Middle-East. The regional downscaling issues discussed for the South Asian region include – (a) Elevation dependency of temperature trends since 1950s using CORDEX regional climate models (RCMs) and validation with in-situ observations (b) Changes in the mean summer monsoon circulation and rainfall, future projections of extreme rainfall events (c) Assessment of skills of RCMs in capturing rainfall and circulation anomaly patterns during monsoon breaks over India and the associated precipitation enhancement over the Himalayan foothills (d) Simulation of orographic monsoon precipitation over the narrow Western Ghats escarpment in CMIP5 models and CORDEX RCMs. The talks relating to CORDEX East Asia discussed (a) The importance of resolution and the need for sub-domains with high-resolution to resolve the regional climatic features (b) Potential for improving interannual variability of rainfall over the West North Pacific region using regional ocean-atmosphere coupled models. In the context of dynamical downscaling for the Australasian region, the presentation highlighted the importance of the selection process of CMIP GCMs and RCMs necessary for deriving usable regional climate information. The focus of the CORDEX-MENA (Middle East and Arabian domain) presentation was on assessment of climate change impacts on water resources. The presentation highlighted the importance of RCM ensemble simulations for assessing regional precipitation changes and hydrological modeling in the Middle East and Arabian Sea domain.

A snapshot of the CORDEX-Asia oral session B3

A special event for students and ECS' was organized by WCRP in order to promote the networking and the mentoring needed for those who are beginning a career in regional climate. All students and early career scientists attending the conference were invited to a special event over lunchtime on 5 November to discuss capacity development and outreaching and to further networking with leading members of the modelling community. Leading scientists from the CORDEX community presented programmes and tools to foster greater involvement of young scholars, outlined ways to build a career in climate science and provided examples on how to communicate with key target groups. The panel discussion led to the establishment of a dedicated LinkedIn CORDEX account aiming at promoting the CORDEX network and activities, as well as fostering career opportunities.

Among the participants there were 60 students, 37 early career scientists (ECS) and 35 scientists from developing countries, with 83 of them being the recipients of the travel grant to attend the conference.

The following students and ECS were selected to receive the APN travel grant (see Appendix A for complete contact details information):

Abhishek	Lodh	India	Student	MALE
Anshul	Agarwal	Thailand/India	Student	MALE
Ashu	Mamgain	India	ECS	FEMALE
Avit	Bhowmik	Germany/Bangladesh	Student	MALE
Faye Abigail	Cruz	Philippines	ECS	FEMALE
Hui	Pinhong	China	Student	FEMALE
Huikyo	Lee	United States/South Korea	ECS	MALE
Jagadishwor	Karmacharya	United Kingdom/Nepal	Student	MALE
Kaustubh	Salvi	India	Student	MALE
Liwei	Zou	China	ECS	MALE
Millind	Mujumdar	India		MALE
Md. Mizanur	Rahman	Bangladesh	Student	MALE
Mohan Kumar	Das	Bangladesh	Student	MALE
Natalia	Malygina	Russian Federation	ECS	FEMALE
Paul	Loikith	United States	ECS	MALE
Pushp Raj	Tiwari	India	Student	MALE
Sridhara	Nayak	India	Student	MALE
Suman	Maity	India	Student	MALE
Umesh Kumar	Singh	Belgium/India	ECS	MALE
Xiaodan	Guan	China	ECS	FEMALE

Amongst those, two of them were selected for the best poster award and received the WCRP certificate together with a copy of the Asrar and Hurrell (2013) book and a USB stick:

Faye Abigail	Cruz	Philippines	ECS	FEMALE
Xiaodan	Guan	China	ECS	FEMALE

The complete list of the award recipients is available on-line (http://cordex2013.wcrp-climate.org/poster_best.shtml).

Recipients of the Best Poster Award of Poster session P3 - Regional focus: Faye Abigail Cruz, Nana Ama Browne Klutse, Caroline Mourao, Andre Lyra, Wim Thiery

Recipients of the Best Poster Award of Poster session 4 – Applications: Xiaodan Guan, Madaka Tumbo, Joseph Daron

4.0 Conclusions

We believe the conference was a terrific success in achieving its scientific, technical and education and capacity development objectives. This would not have been possible without APN financial support. We believe the conference met or exceeded its objectives in overall attendance, networking and research capacity development, especially in Asia and Africa.

In addition to the all supported students and early career scientists, WCRP also sponsored a number of senior scientists from Asia and Pacific regions who played a critical role in the conference and who are actively engaged in WCRP regional activities in the Asia-Pacific region. As such, APN network of scientists and experts had a strong presence and visibility and played a major role in defining the CORDEX research agenda and priorities for the next decade.

The following main conclusions emerged following the deliberations during the conference:

1. the need to establish a two-way dialogue with the end users of regional climate information so as to ensure an appropriate tailoring of the CORDEX outputs to the decision makers' needs;

2. the demand for training activities that build capacity for interaction among practitioners, policymakers, scientists and other societal decision making groups;
3. the importance of high-resolution observational data sets, and availability and accessibility of model products in support of the evaluation of regional climate simulations;
4. the need to develop mechanisms to communicate the scientific uncertainty generated by regional climate modeling and the implications that post-processing techniques such as bias corrections and those uncertainties can have on VIA studies.

These issues revolved around a recurrent theme of "added value" of the regional dynamical and statistical downscaling methods especially as currently challenged by the advent of high-resolution global models. As a result there was consensus on the need to rigorously demonstrate the reliability and usefulness of the CORDEX outputs as well as to improve the representation of the physical processes in regional models.

The breadth and depth of oral and poster presentations illustrated the relevance of CORDEX on the climate change agenda and the expected contribution to impacts, vulnerability and adaptation applications in areas such as water availability, agriculture and food security, health, and disaster risk reduction.

A wrap-up side meeting held on Friday 8 November in the European Commission premises involved the participation of the CORDEX leadership and many representatives from the CORDEX community, in particular those from monsoon Asia, Central-Asia, Middle-East North Africa, Europe, and the Polar regions, who further refined the outcomes of the conference into the following highlights:

• **Dialogue and co-exploration with end-users:** Participants recognized the need for a paradigm shift in which regional climate science operates by placing end-users expectations and needs at the heart of the development of regional climate information through a change in perspective on the analysis and exploitation of climate model outputs, leading to new science-policy approaches. For example, co-development and co-exploration amongst climate scientists and practitioners and stakeholders would ensure the appropriate tailoring of climate information at relevant spatial and temporal footprints with more effective two-way communication leveraging regional and local know-how. The need for capacity building and innovative information and knowledge transfer would provide the necessary instruments for effective delivery of climate services contributing to the WMO-led UN Global Framework for Climate Services (GFCS) and the Future Earth (FE) initiative.

• **Added value of regional climate information:** Presentations and discussions have highlighted the need to assess the potential of regional climate information to add value to the decision-making process, as compared to global climate simulations. In numerous cases, mean biases of Global Climate Models (GCMs) and Regional Climate Models (RCMs) are still of similar magnitude. Added value is best illustrated in higher order statistical analysis at the regional and local topographic and process level but much remains to be done to improve the physics of regional models, to demonstrate the robustness of results and to ensure the systematic skill enhancement of downscaling exercises. High-resolution observational data sets and archiving infrastructures such as the Earth System Grid Federation (ESGF) will be instrumental in supporting necessary model development and evaluation, and in gaining confidence in regional climate projections.

• **Uncertainty:** Uncertainty cascading, whereby imperfect regional climate knowledge is transferred into the application arena for vulnerability, impacts and adaptation (VIA) studies was recognized as a key challenge faced by the CORDEX joint science decision-making undertaking. Regional climate downscaling relies on approximate information and a number of necessary assumptions (lateral boundary conditions, future forcing, model physics, etc) impacting results, and their relative contributions to uncertainty ought to be understood. The use of multiple RCMs or multiple downscaling methods appears to increase uncertainty, especially at smaller scales and there is a need to develop robust methods to characterize and communicate uncertainty to the various end-

users and stakeholders. Better uncertainty characterization would also help set priorities for improving downscaling. Multi-model ensembles of dynamical and statistical downscaled products require further innovative post-processing approaches to distil, fuse and possibly reconcile imperfect, and sometimes contradictory, information.

• **Future simulation framework (CORDEX-II):** The uptake of CORDEX data for regional climate analysis and VIA assessment has been encouraging and widespread, including in the developing countries. A critical mass of multi-model multi-method experiments is needed to capture the uncertainty for robust decision-making and policy challenges. The growing range of practical applications will also require more complex models towards a better representation of the Earth System through Regional Earth System Models (RESMs). In addition, as the resolution of global models increases, it is recognized that regional downscaling tools should also aim at increasingly finer scales to provide added value and useful information for VIA applications. This may require revisiting the CORDEX domains and developing a clear science-based procedure for their selection. Furthermore, end-to-end pilot studies over selected subregions are needed to provide test-beds to explore a range of critical issues, such as: (a) Development of targeted as well as transferable analysis metrics to quantify where and when high resolution downscaling gives added value (b) Process-based analysis of models, in part through targeted regional experiments (c) Assessment of regional feedbacks (e.g. soil-atmosphere interactions) (d) Intercomparison of different methods (e.g. dynamical vs. statistical downscaling) (e) Detailed uncertainty analysis (f) Co-exploration of regional and local scale information for VIA application (g) Development and exploitation of high resolution observation datasets to support all of the above (h) Such pilot studies can also provide frameworks of interactions with major international programs, most noticeably GEWEX and CLIVAR.

Conclusions were highly relevant to the Asia-Pacific community, which repeatedly expressed the strong need to build capacity in the region, including access to observational data sets and computing resources, training on regional modeling and building a comprehensive matrix of ensemble simulations to capture uncertainties towards robust decision-making.

5.0 Future Directions

The CORDEX I experiment has been undoubtedly a successful framework to federate regional downscaling initiatives around a common experimental design through regional ownership and application. The aforementioned points illustrate the need to now adapt this framework to enhance the dialogue with end-users so as to meet the growing demand for tailored regional climate information and in particular towards updated regional climate assessments and truly operational regional climate services. These challenges will require underlying model developments, infrastructures and tools supporting the provision, assessment, processing, distillation, dissemination and informed use of regional climate information, and necessary training and capacity building efforts, especially in the developing world.

The aim of the science segment of the conference was to review the current progress on regional climate science with a particular emphasis on CORDEX so as to review its overall experimental design leading into the second phase of CORDEX (CORDEX II).

The conference proposed some concrete actions for further advancing the CORDEX science and to better engage the VIA community:

1. Revisit the CORDEX domains and develop a clear-science based procedure for their selections;

2. Support the development of high-resolution observation datasets and archiving infrastructures such as the Earth System Grid Federation (ESGF);
3. Develop metrics to assess the added value of the regional downscaling model outputs as compared to global climate simulations;
4. Establish end-to-end pilot studies over selected sub-regions together with other WCRP regional initiatives and in partnership with the WCRP Working Group on Regional Climate;
5. Review the multi-model multi-method matrix of simulations to ensure a robust characterization of climate uncertainties;
6. Design and implement capacity building activities that bring together information providers and decision makers towards meeting regional needs.

These proposed actions resulted from the various scientific sessions that are summarized in the conference report (http://cordex2013.wcrp-climate.org/cordex2013_documents/ICRC2013_report.pdf) and which will help improve the experimental framework leading into the second phase of CORDEX (CORDEX-II). It is hoped this will represent another milestone towards the effective delivery of climate services.

Whilst these future directions are relevant to all CORDEX regions, the conference also recognized the need to address particular requirements, user-needs and challenges specific to every single CORDEX region. Improved networking amongst Asia-Pacific scientists has generated tremendous momentum such as the establishment of the new CORDEX Southeast-Asia effort. Central-Asia will also soon be established, benefiting from the existing and growing effort on the continent, thanks to the instrumental role of APN in promoting and supporting CORDEX.

Appendix A - Contact Details of APN Sponsored Young Scientists

Mr. Abhishek Lodh
Indian Institute of Technology
Centre for Atmospheric Sciences
ROOM NO. 328 , BLOCK - VI , CAS- IITD
New Delhi 110 016, India
abhishek.lodh@gmail.com

Mr. Anshul Agarwal
Asian Institute of Technology,
Water Energy Management,
58 M009, 12120 Khlong Luang,
Pathumthani, THAILAND
anshulagro1983@gmail.com

Ms Ashu Mamgam
Indian Institute of Technology Delhi
Centre for Atmospheric Sciences
Hauz Khas, New Delhi – 110 016, India
ashumam@gmail.com

Mr. Avit Bhowmik
University of Koblenz-Landau
Institute for Environmental Sciences, QLE
Fortstraße 7, Landau in der Pfalz 76829
Rheinland-Pfalz, Germany
bhowmik@uni-landau.de

Ms. Faye Abigail Cruz
Manila Observatory
Ateneo de Manila University Campus, Loyola Heights
1108 Quezon City, Philippines
faye.cruz@gmail.com

Ms. Hui Pinhong
Nanjing University
School of Atmospheric Sciences
Hankou Road
Nanjing 210093, Jiangsu, China
huipinhong@126.com

Dr. Huikyo Lee
Jet Propulsion Laboratory, Caltech
4800 Oak Grove Street, M/S 300-233
91001 Pasadena, CA, USA
huikyo.lee@jpl.nasa.gov

Mr. Jagadishwar Karmacharya
University of Oxford

School of Geography and the Environment
South Parks Road
OX1 3QY, Oxford, United Kingdom
jagadishwor.karmacharya@ouce.ox.ac.uk

Mr. Kaustubh Salvi
Indian Institute of Technology
Civil Engg. Department,
Opp. Main Building
Mumbai – 400 076, India
kaustubh.iitm@gmail.com

Dr. Liwei Zou
Institute of Atmospheric Physics,
LASG, HuaYanLi No.40, QiJiaHuoZi,
ChaoYang District
100029, Beijing, China
zoulw@mail.iap.ac.cn

Mr. Mohan Kumar Das
SAARC Meteorological Centre (SMRC) Theoretical Division,
Plot E-4/C, Sher-E-Banglanagar
Agargaon, 1207, Dhaka, BANGLADESH
mohan28feb@yahoo.com

Dr. Milind Mujumdar
Centre for Climate Change Research
Indian Institute of Tropical Meteorology
Pashan, Pune 411008, India
mujum@tropmet.res.in

Mr. Md. Mizanur Rahman
SAARC Meteorological Research Centre (SMRC)
Plot No# E-4/C, Agargaon
Sher-e-Bangla Nagar
Dhaka-1207, BANGLADESH
mrahman426@yahoo.com

Ms Natalia Malygina
Institute for Water and Environmental Problems, Chemical Analytical Centre
1, Molodezhnaya, Barnaul 656038
Russian Federation
natmgn@gmail.com

Dr. Paul C. Loikith
California Institute of Technology Postdoctoral Scholar
Jet Propulsion Laboratory
4800 Oak Grove Dr, Pasadena, CA 91106, USA , Tel: (818) 354-9193
paul.c.loikith@jpl.nasa.gov

Mr. Pushp Raj Tiwari
Research Scholar
Centre for Atmospheric Sciences
Indian Institute of Technology Delhi
Hauz Khas, New Delhi- 110016, India
pushprajiitd@gmail.com

Mr. Sridhara Nayak
Indian Institute of Technology,
Centre for Oceans, Rivers, Atmos.& Land Sciences (CORAL)
Kharagpur, West Bengal, India
sridhara.iitkgp@gmail.com

Mr. Suman Maity
Indian Institute of Technology (IIT)
Centre for Oceans, Rivers, Atmos.& Land Sciences (CORAL)
KHARAGPUR 721302, WEST BENGAL, India
suman.buie@gmail.com

Dr. Umesh Kumar Singh
Earth and Life Institute, UCL
Georges Lemaitre Center for Earth and Climate Res.
Louvain la Neuve, Ottignies 1348, Belgium
umeshsing@gmail.com

Ms. Xiaodan Guan
Lanzhou University,
College of Atmospheric Sciences,
222 Tianshui South Road,
730000, Lanzhou, Gansu, China
guanxd@lzu.edu.cn

Appendix B – List of conference main organisers and co-sponsors

CONFERENCE ORGANISERS

CO-SPONSORS

Additional financial support for the conference and related activities has been generously provided by the organizations listed below. The European Commission (EU), the Intergovernmental Panel on Climate Change (IPCC) and the World Climate Research Programme (WCRP), its network of scientists and the conference participants are grateful for their contribution.

PLATINUM SPONSOR	GOLD SPONSOR
Asia-Pacific Network for Global Change Research	**EUMETSAT**
SILVER SPONSOR	**BRONZE SPONSOR**
European Space Agency	**Swedish Meteorological and Hydrological Institute**
CONTRIBUTING SPONSORS	**SUPPORT**
European Geosciences Union	**Institut Pierre Simon Laplace**
Springer Verlag	

The final project report must follow the template outlined in this document. Use Calibri font size 12 for all the headings and font size 11 for the text.

The report is to be submitted **one month before the end the Contract Period** in the following

1. By airmail to the address below:
   a. **Soft Copy – 2 CD-ROMS**, appropriately labeled and covered using the design and information on the cover page of the Report Template
   b. **Hard Copy – 2 bound copies** appropriately labeled and covered using the design and information on the cover page of the Report Template

   Dr. Linda Stevenson

   APN Executive Science Officer

   APN Secretariat

   4F East Building

   1-5-2 Wakinohama Kaigan Dori

   Chuo-Ku, Kobe 651-0073 JAPAN

2. By e-mail and addressed to Dr. Stevenson (lastevenson@apn-gcr.org) and Ms. Dyota Condrorini (dcondrorini@apn-gcr.org).

   Kindly note that our server can also receive attachments of up to 10MB file size. In case that the final project report file size exceeds 10MB please try any of the following options:

   a. For a file size of more than 8MB but less than 10MB please send the report to our Gmail account at apngcr@gmail.com and notify us in our APN account so we could check for it immediately.
   b. For a larger file size please try the following:
      - Upload on your institution's ftp server and provide to us the download details (i.e. IP address, login details, etc)
      - Send through any of the free file hosting available in the internet. Please note that these free file hosting save your files for a limited number of days so it is very important to notify us immediately. Some of these are the following:
        - http://www.filefactory.com/
        - http://www.mediafire.com/
        - http://www.yousendit.com/
3. A separate **CD** containing other project outputs (i.e. publications, photos, etc)