Technical report

APN Science Bulletin
2013, Volume 13, Issue 1, 5-12, e-ISSN 2522-7971

Promoting involvement of early-career scientists from the Asia-Pacific region in regional integrated and sustainable development through active participation and networking

Shuyu Wang[a *], **Iréne Lake**[b], **Gaby S. Langendijk**[c], **Ying Yang**[d]

[a] School of Atmospheric Science, Nanjing University, 163 Xianlindadao, Nanjing, 210043, Jiangsu, China
[b] Swedish Meteorological and Hydrological Institution, , Folkborgsvägen 17, Norrköping, 60176, Sweden
[c] Climate Service Center Germany, Helmholtz-Zentrum hereon GmbH, Chilehaus - Eingang B Fischertwiete 1, Hamburg, 20095, Germany
[d] Institute of Atmospheric Physics, Chinese Academy of Sciences, 40 Huayanli, Beijing, 100029, China
[*] *Corresponding author. Email: wsy@nju.edu.cn.*

ABSTRACT

Climate change is affecting global ecosystems, natural resources, and human well-being. The near- and long-term future sustainable development of society requires robust climate change information at regional scales. To contribute to the purpose mentioned above, the World Climate Research Programme's Coordinated Regional Climate Downscaling Experiment (WCRP CORDEX) initialised a collaboration with the Asia-Pacific Network for Global Change Research (APN), as the two programmes share common goals in advocating climate science as well as transferring climate knowledge for effective management. This APN project, entitled "Promoting Involvement of Early Career Scientists from the Asia-Pacific Region in Regional Integrated and Sustainable Development through Active Participation and Networking", was a result of this collaboration. Specifically, the project was aimed at supporting early-career scientists from the Asia-Pacific region to attend an international science conference on regional climate science (ICRC-CORDEX 2019) and facilitate them in international partnership-building. It also contributed to enhancing communication and cooperation amongst regional climate research teams within and beyond the Asia-Pacific region. As one of the most important activities of the conference, the project supported an event for early-career scientists. The completion of the project consolidated global collaboration between the climate research community and that of adaptation-impact studies, as well as facilitated interaction with end-users. It was also a successful showcase of the scientific strategies of APN and CORDEX.

DOI 10.30852/sb.2023.2091

RECEIVED 28 July 2022
PUBLISHED (HTML) 8 February 2023
PUBLISHED (PDF) 8 February 2023

CITATION Wang, S., Lake, I., Langendijk, G. S., & Yang, Y. (2013). Promoting involvement of early-career scientists from the Asia-Pacific region in regional integrated and sustainable development through active participation and networking. *APN Science Bulletin*, *13*(1), 5 – 12. doi: 10.30852/sb.2023.2091

KEYWORDS

CORDEX, regional climate downscaling, impact and adaptation, international science conference

HIGHLIGHTS

- CORDEX contributes to advancing climate science and sustainability at the regional level.
- APN supported a successful event for early-career scientists as an essential part of ICRC-CORDEX 2019.
- APN-funded early-career scientists and students were active in the conference and helped in achieving the project's objectives.
- ICRC CORDEX-2019 contributed to APN's mission of promoting regional and interdisciplinary cooperation.
- ICRC CORDEX-2019 contributed to achieving APN's goal of supporting capacity development within and beyond the Asia-Pacific region.

1. INTRODUCTION

Regional climate downscaling with limited-area dynamical models and statistical models has the advantage of being able to reproduce more detailed and authentic mesoscale responses to various climate forcings. As such, the method can be applied across a range of applications, from single-event simulations (e.g., climate extremes) to integrated earth system studies (e.g., the response of the monsoon system to global warming). When the World Climate Research Programme (WCRP) endorsed the Coordinated Regional Climate Downscaling Experiment (CORDEX), it was the first global coordinated effort to identify robust climate change signals over various CORDEX domains covering most of the world's land surface, as well as provide a solid scientific basis for impact assessments of climate change at local to regional scales across the globe.

In the face of the urgent requirements stemming from regional "vulnerability, impact and adaptation" (VIA), as well as from policymakers in formulating strategies and taking action in Asia and elsewhere around the world, ICRC-CORDEX 2019, an international science conference on regional climate science, was organised and invited regional climate science communities from different areas of the globe to share their achievements and discoveries on regional climate downscaling. Held from 14–18 October 2019 in Beijing, China, ICRC-CORDEX 2019 was hosted by the WCRP and the Institute of Atmospheric Physics, Chinese Academy of Sciences (IAP/CAS), with joint support from global organisations including the Asia-Pacific Network for Global Change Research (APN), Swedish Meteorological and Hydrological Institute (SMHI), Nanjing University, and others. At the conference, the overall achievements in applying advanced downscaling methods in regional studies, along with the benefits and extra information such methods provide to VIA, climate change scenarios at a regional scale, and new technology in climate studies, were presented. ICRC-CORDEX 2019 was also a platform for presenting new frontiers in regional climate science research, including the integration of biochemical processes, regional oceans, and human–climate interactions in the regional climate system, as well as the application of convection-permitting models with resolutions of less than 4 km in simulating regional climate and extreme climate events. Emphasis was placed on how the climate

change information produced by CORDEX can serve regional sustainable development such that a pathway for systematic study ranging from observations to models to applications, can be paved. The overall achievements of CORDEX in scientific understanding and its crucial role in social development were therefore fully highlighted.

For Asia, the most populated area in the world, meteorological data show that it has suffered from global change and related disasters during the past few decades, and the situation is likely to continue into the future. Considering the regional imbalance in resilience due to different levels of socioeconomic development in the Asia-Pacific region, climatologists must secure robust climate change projections at fine spatial scales, along with skillful translation of the data into effective and actionable information for end-users, policymakers and the general public. APN and WCRP CORDEX share the common goals of increasing regional coordination in the Asia-Pacific region and worldwide, and fostering communication and knowledge exchange between academic communities and users for science-based application of climate information in sustainable development. Joint efforts have been made to achieve these goals by predicting future climate change based on improved understanding of the climate system, assessing its impact, and supporting applicable policymaking and regional sustainability. With the long-term support of APN, CORDEX teams in the Asia-Pacific region have a history of collaboration in investigating various climate phenomena, boosting the level of understanding regarding climate processes and the climate system, and endeavouring to support development at a regional level. Coordinated efforts have also been put in place to support the development of regional earth system models, establish flagship pilot studies and address issues related to high-impact regional climate features and extremes. Such regional coordination and joint scientific efforts were presented to the global community during ICRC-CORDEX 2019.

With the support of APN and other funding agencies, ICRC-CORDEX 2019 provided a platform to engage scientists, end-users, and other stakeholders from various disciplines of global change science. To further facilitate the direct involvement of Asia-Pacific early-career scientists (ECSs) in such a high-level global scientific event, as well as facilitate future collaboration among the international regional climate science and adaptation research communities, a project proposal, "ICRC CORDEX 2019: Promoting Involvement of Early-Career Scientists from the Asia-Pacific Region in Regional Integrated and Sustainable Development through Active Participation and Networking", was submitted to APN and awarded.

The objectives of this APN project were to provide a platform to advance capacity development, education, and knowledge exchange at multiple levels. It was particularly aimed at providing support for ECSs and students from APN member states and developing countries, so they could be offered the opportunity to exchange experiences with their peers on topics such as generating regional climate scenarios and applying climate information for effective adaptation planning. The ECSs event, a major component of ICRC-CORDEX 2019, was successfully held with the support of APN. The project also contributed to strengthening connections among the Asia-Pacific CORDEX domains—namely, East Asia, Southeast Asia, South Asia, Central Asia, and CORDEX Australasia. Communication with CORDEX initiatives in the Asia-Pacific region, as well as with global change programmes and initiatives such as WCRP/CLIVAR, WCRP/GEWEX and IPCC, was also established. Given the emphasis on cooperation within the Asia-Pacific region among global regions and between various disciplines of regional climate change, the project fell well in line with APN's scientific goals and agendas. Through the successful completion of ICRC-CORDEX 2019, APN and WCRP CORDEX's shared vision of boosting the coordination of research and applications of climate science in the Asia-Pacific region through global partnerships was promoted.

2. METHODOLOGY

One of the priorities of CORDEX is to enhance regional capacity building and networking, especially for the next generation of climate experts. Therefore, ICRC-CORDEX 2019 put considerable effort into ensuring the attendance of ECSs and students. As APN also lists capacity development as a priority mission, the organisation committee of ICRC-CORDEX 2019 proposed a project to APN with a focus on encouraging ECSs from the Asia-Pacific region to participate in ICRC-CORDEX 2019 and to be actively involved in the conference's activities.

Alongside WCRP CORDEX, IAP/CAS, and APN, many other institutions and funding agencies endeavoured to offer financial and other support for ECSs around the globe to join the conference. With this combined effort, ECSs were provided with a great opportunity to exchange their perspectives and experiences with their peers, established scientists and policymakers while gaining insight into future challenges in the development of physical climate science and its communication and communication application in the sense of sustainability. There was also an expectation that these ECSs would build connections and partnerships during the conference for future collaboration on joint proposals, research initiatives, or research papers. Of all applicants supported by APN, 21 ECSs and PhD students were granted, based on an evaluation of their scientific background and the scientific quality and relevance of submitted abstracts. The evaluation was conducted by scientists from the CORDEX Science Advisory Team and CORDEX domains, who are experts in regional climate modelling, analysis and data application.

A networking event for ECSs was funded by APN and organised to facilitate the younger generation to communicate and socialise with their peers, established scientists, and climate information users. The event was entitled "Let's focus on the users: CORDEX datasets for climate projections and applications". The event discussed the suitability of CORDEX products in a wide range of studies, as well as the prospects and scientific challenges, especially for the future. One particular aspect of the event involved inviting ECSs to highlight their perspectives on certain topics. The intention was to inspire the next generation of climate experts to engage in regional sustainability activities.

Capacity development among Asia-Pacific CORDEX teams was enhanced during and after ICRC-CODEX. For example, after face-to-face exchanges regarding the latest progress, the CORDEX Southeast Asia and East Asia teams discussed the possibility of jointly applying new projects based on common interests, including the simulation of climate extremes with high-resolution models and the assessment of climate change impacts on urban environments and human health, amongst other ideas. With their shared vision to support regional sustainable development, CORDEX Asia teams and MAIRS-FE, a Future Earth core project focusing on regional sustainability, planned to set up a new joint research initiative for a regional framework that would identify the most urgent climate–environment–sustainability challenges in the Asia-Pacific region and motivate responsive research and action through down-to-earth regional interdisciplinary collaboration.

3. RESULTS AND DISCUSSION

More than 300 participants from 44 countries and regions attended the 22 sessions of ICRC-CORDEX 2019, one side-event on risks hosted by Future Earth, and an APN-supported event for ECSs.

At the opening ceremony of ICRC-CORDEX 2019, Prof. Pavel Kabat, the WMO's Chief Scientist and Director of WCRP/WMO Research set out the challenges of the changing climate that we will face in the coming decades. Professor Panmao Zhai, Co-chair of the First Working Group of the IPCC, addressed the importance of regional climate research in the IPCC reports. Professor Ailikun, Assistant Executive Director of the Alliance of International Scientific Organisations in the Belt and Road Region (ANSO), emphasised the benefit and motivation of continuous collaboration between physical and social scientists to implement

sustainable development. Two invited speakers, Profs. Congbin Fu and Filippo Giorgi gave talks on the history and development of regional climate modelling in Asia and around the globe over the past 30 years. Representatives from WCRP Core Projects, including GEWEX, SPARC, CLIVAR, CORA, and the CMIPs impressed the audience with their latest progress and offered opportunities for cross-programme interactions with CORDEX and regional climate science.

In the following two days, four parallel sessions were dedicated to presentations and discussions on the advances in regional downscaling techniques, as well as scientific understanding and development in coupled regional earth system modelling and climate change impacts. On the evening of the second day, the APN-supported event for ECSs entitled "Let's focus on the users: CORDEX datasets for climate projections and applications" was held. The event began with an expert presentation, followed by short reflections from selected ECSs. Ending with an interactive dialogue with the audience, the event highlighted the challenges and opportunities that ECSs face in regional climate science and VIA activities. On the third day, a side-event named "Future Risk, Future Earth" was jointly hosted by two Asian Future Earth core projects and CORDEX. Held in the form of a face-to-face dialogue, this side-event was designed to raise awareness of regional climate extreme–related risk and disasters, as well as the challenges in regional sustainability research. Afterwards, a new collaboration on Asian climate change–related risk and regional sustainability was proposed based on the on-site discussion.

The three-day conference and related events showcased recent achievements in applying regional climate downscaling and associated benefits, as well as progress in developing and refining regional earth system models and advancements made in recently developed downscaling techniques such as convection-permitting modelling. It also acted as a platform to share knowledge, vision, and support for VIA and capacity development. Furthermore, researchers and teams from various CORDEX regional domains and different scientific backgrounds were able to work on networking and the communication of potential new future collaborations.

3.1. APN-supported event for ECSs

The event for ECSs entitled "Let's focus on the users: CORDEX datasets for climate projections and applications" was financially supported by APN and locally coordinated by Nanjing University and the Young Earth System Scientists community (YESS). The event focused on the suitability of climate information and modeller–user interaction; that is, how to customise CORDEX outputs and accompanying information to facilitate users' needs.

Prof. Ailikun, an expert in integrated regional studies and crosscutting research between natural and social sciences, opened the event by sharing her experience and vision on how to move forward to bring the relevant aspects of regional climate science into society. The reliability, prominence and legitimacy of climate information require the support of robust climate change data and information products. One of the main challenges to consider in the future is how to incorporate human factors into regional climate models. To tailor climate information to end-users, Prof. Ailikun emphasised the need for a co-production and co-design approach. This could help toward a better understanding of the needs of users and obtaining useful climate information on a continuous, iterative basis to support climate change mitigation and adaptation.

Four ECSs presented a brief discussion on the challenges and opportunities in applying CORDEX data and interacting with users. Ester Salimun stated that users should be made more aware of what data are available and what to do with these data. Moreover, open access to data should be improved for the impact and vulnerability communities. Anubhav Choudhary and Dhirendra Kumar discussed how to ensure that users understand the biases and uncertainties in future projections and how to recognise user needs in user-oriented workshops. Miriam Murambadoro emphasised that a better understanding is needed

of exactly who the end-user is. She also elaborated on the need for continued involvement and the integration of participatory approaches into knowledge production. After the presentations, the audience engaged in an interactive dialogue with the presenters on a wide range of topics. The discussion highlighted the need for engaging user interactions to further develop regional climate science as well as the challenge of fostering the next generation of ECSs with a user-aware scope while maintaining a solid disciplinary foundation of science. Particular emphasis was also placed on the need for capacity building and interaction platforms for users of CORDEX products.

The event for ECSs was an excellent occasion for ECSs from the Asia-Pacific region and beyond to share their perspectives and experiences. The discussion was carried out on topics relating to how to interact with potential users and accommodate their needs so as to explore the feasibility of applying CORDEX downscaling results in future research by ECSs.

In addition to attending this event, the APN-supported ECSs were encouraged to actively engage with the conference's academic activities and interact with the other participants. Selected ECSs were committed to coordinating conference sessions and events for ECSs, acting as assistant session rapporteurs and coordinators alongside the regular ones. Their reports contributed to the conference session summary and final reports. Through the proposed activities, the project's motivation to initiate partnerships and leadership in the research of ECSs to solve the challenges in regional climate science and regional development was fulfilled. By being actively involved in the conference's scientific and social events, ECSs were able to tune in to the highest level of regional climate science in theory, practice and application.

The WCRP, CORDEX Asia teams, and YESS were committed to continuing their joint efforts in increasing the visibility and engagement of Asian ECSs in the global science community with the completion of the ICRC-CODEX 2019 and the APN project. As a result, APN-supported ECSs can continuously contribute to networking in the climate change community and produce a sustained impact on worldwide CORDEX regions.

3.2. Continuation of CORDEX efforts in supporting regional sustainability

One of the objectives of APN's activities in ICRC-CORDEX 2019 was to raise awareness of the scientific and social challenges unique to the Asia-Pacific region, which include (but are not limited to) how the changing climate and air quality affect human health, the occurrence of climate extremes, and the support of natural resources to renewable energy in a changing climate. ICRC-CORDEX 2019 presented recent progress and achievements related to Asia-Pacific coordinated efforts in promoting, understanding and simulating regional earth system processes; plus, it hosted a side event to boost dialogue between climate and social scientists, thereby enhancing bilateral collaboration on climate change–related risks, disasters, and interactions between human and natural components. Nonetheless, the topics that are essential for the sustainable development of the Asia-Pacific region, e.g., those related to natural resources (e.g., water, ecosystem security, the regional cryosphere) and socioeconomic development (e.g., the ever-growing trend of urbanisation and other manmade land-cover changes, industrial restructuring to reduce greenhouse and aerosol emissions, the rapid development and application of renewable energy), were not fully presented and discussed at the conference. We realised that such issues need to be more thoroughly investigated and integrated into future regional climate change projections. We considered that it might point to a future way forward and a basis for regional collaboration between CORDEX Asia teams and application sectors (e.g., energy industries and urban development planning sections).

One of the key challenges that face scientists and scientific programmes is to fully integrate natural and anthropogenic fine-scale forcings

in their climate research. CORDEX provides the solution so as to keep developing and applying high-resolution regional earth system models, which could address regional physical and biogeochemical processes in more detail (e.g., regional ocean, biomass emissions, ecosystem management). In its next stage of globally coordinated high-resolution downscaling activities (~10 km), CORDEX will not only provide reliable datasets to assess the regional natural resources but also offer opportunities to carry out crosscutting studies, e.g., the interaction between the fine-scale climatic-environmental change and the rapid development of clean-energy industries. Another big challenge is to establish effective collaboration with social sectors and policymakers by delivering applicable measures to society. Under such circumstances, CORDEX considers that closer collaboration with the Asian global change research programmes, including APN, Future Earth-Asia projects and ANSO, is crucial to identify regional issues, implement its objective to advance and coordinate the science and application of regional climate downscaling, and finally serve regional sustainability and development.

4. CONCLUSION

By presenting the Asia-Pacific region's and the international community's accomplishments in developing and applying regional climate downscaling and by enhancing the level of communication with users and stakeholders, ICRC-CORDEX 2019 achieved its objectives and exhibited CORDEX's vision to advance regional climate science and promote engagement in VIA practices with globally coordinated and region-based research (ICRC-CORDEX, 2019). The conference presented frontiers of regional climate science and techniques and showcased the knowledge-sharing of VIA practices and capacity development. Meanwhile, the conference demonstrated the globally and regionally coordinated efforts to address the processes and regional-scale driving forces that are most relevant to the Asia-Pacific region, such as the fine-scale changes of the Tibetan Plateau and their impact on Asian climate, the effects of climate change on land-surface conditions and atmospheric composition, and natural climate variability of the regional ocean and monsoon system. Special attention was paid to the challenges of emergent risks from climate extremes and weather events in regional sustainability. The success of the conference reflected APN's mission in developing scientific capabilities so as to support regional policymaking by providing reliable and actionable climate change information and by strengthening the communication and interaction between scientists and policymakers (APN, 2021) .

ICRC-CORDEX 2019 promoted intra- and cross-regional connections and networking among researchers, teams, and scientific communities. It also acted as a platform to discuss future collaborations on joint projects and scientific papers. In particular, the support of the APN grantee, the completion of the conference, and rendered the ECSs from the Asia-Pacific region to exchange their research and experiences with the global science community, thereby broadening their vision and resources. Consequently, the ICRC-CORDEX 2019 and the project entitled "Promoting Involvement of Early Career Scientists from the Asia-Pacific Region in Regional Integrated and Sustainable Development through Active Participation and Networking" have increased the global visibility of both APN and CORDEX. In addition, they have contributed to APN's scientific scope and mission in promoting effective and responsive regional collaboration to address the urgent issues for sustainable development in the Asia-Pacific region (APN, 2021; Solman et al., 2021). As the event directly involved other global and regional organisations, including the WCRP core projects, Future Earth community, ANSO, and local universities and institutions, ICRC-CORDEX 2019 also made contributions to APN's goal of enhancing regional networking and supporting joint research for the sustainable development of the Asia-Pacific region (APN, 2021).

ACKNOWLEDGEMENTS

We would like to express our thanks to the local hosts, including the Institute of Atmospheric Physics and several other Chinese universities and funding agencies; namely, Nanjing University, the National Science Foundation of China (NSFC), the China National Committee of WCRP (CNC-WCRP) hosted by the China Association for Science and Technology (CAST), and the Alliance of International Science Organziations (ANSO). Special thanks are extended to the CORDEX International Project Office (CORDEX-IPOC), WCRP, and YESS for international coordination and technical support that guaranteed the success of the event for ECSs and the project implementation. All sponsors that provided financial and in-kind support are greatly appreciated.

We would like to thank the Asia-Pacific Network for Global Change Research (APN), without whose support the project could not have achieved its objectives.

Special thanks to Ms Wenling Zhou from the Institute of Atmospheric Physics, Ms Anna Eronn, Lindha Nilsson from the CORDEX IPOC and SMHI, Catherine Michaut from IPSL, Ms Christmas Uchiyama from APN, Dr Victor Dike from YESS, and Ms Liping Shen from Nanjing University, for their support and logistical or financial coordination that guaranteed the successful completion of the project. Special thanks also to Prof. Deliang Chen from the University of Gothenburg for proofreading this paper. Finally, thanks to Miss Shuangyi Luo and Miss Mi Zhang for helping to edit the paper.

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