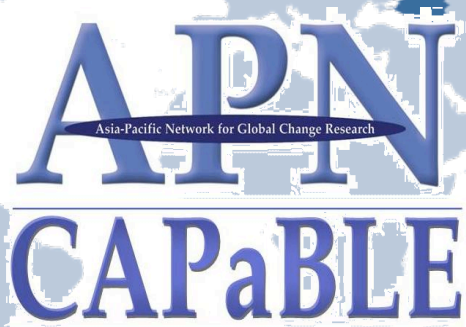


FINAL REPORT for APN PROJECT
Project Reference Number: CBA2011-03NSY-
WCRP



- Making a Difference -

Scientific Capacity Building & Enhancement for Sustainable Development in

Project Title

WCRP Open Science Conference:
Climate Research in Service to Society

The following collaborators worked on this project:

Prof Guoxiong Wu, LASG, Institute of Atmospheric Physics, China, gxwu@lasg.iap.ac.cn

Dr Ghassem Asrar, Director WCRP Joint Planning Staff, Switzerland, gasar@wmo.int



***WCRP Open Science Conference: Climate Research
in Service to Society***

**Project Reference Number: CBA2011-03NSY-WCRP
Final Report submitted to APN**

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OVERVIEW OF PROJECT WORK AND OUTCOMES

Non-technical summary

The WCRP Open Science Conference assembled over 1900 registered participants including 541 graduate students and early career scientists from 86 nations - of which more than 300 scientists from developing nations. The conference reviewed latest progress in the climate research and contributed in the “big-picture synthesis” of the current state of knowledge about climate variability and change. Particular emphasis was given to the needs for science-based climate information at regional level, of key sectors of economies, and climate related risk management.

Environmental/climate related issues and concerns that the public and decision makers are facing are complex and require trans-disciplinary approach to address them. The conference identified the need for "symbiotic" relationship between providers and users of climate information to ensure that timely, accessible, and easy to understand climate information is developed and used effectively. There is also the need for training and developing the next generation of scientists and decision makers who would be able to pursue and promote the use of actionable climate/environmental information. The outcome of the conference will be published in a book that will contain the major scientific and technical papers prepared and presented during the week, together with the overall synthesis of presentations, discussions and recommendations resulting from the sessions. The conference and its outcomes are already influencing the plans and priorities of WCRP, and the functions and structure of its affiliated Projects, Working Groups and Panels. Considering the scope and interdisciplinary nature of the scientific challenges identified at the conference and a major emphasis on a need for “actionable science” by the conference participants, the need for WCRP partnerships with sister programs at the national, regional and global level will be even greater in the future. WCRP will benefit greatly from the emerging initiatives such as the UN System led Global Framework for Climate Services (GFCS), and the ICSU Future Earth: Research for Global Sustainability initiative to fulfill its research plan and priorities during the upcoming decade.

Objectives

The World Climate Research Programme (WCRP) held a major international Conference in Denver, Colorado USA, next October 24 – 28, 2011. This was the first meeting of its kind, during the lifetime of WCRP. The goal of the conference was to develop a better identification of the scientific challenges and opportunities in understanding the behavior of the climate system and its interactions with other earth system components. The conference main objectives were:

- Identify key opportunities and challenges in observations, modeling, analysis and research required to understand and predict responses of the Earth as a system;
- Provide an internationally-based “state of knowledge” for the upcoming fifth assessment report of IPCC;
- Facilitate cooperation and coordination across the WCRP, as well as with other international research programmes, including the World Weather Research Programme ([WWRP](#)) and the Earth System Science Partnership ([ESSP](#));
- Help WCRP and its partners identify and tackle the inevitable, related climate change challenges facing all citizens of this planet.

The conference aimed to recruit and actively engage early career scientists, especially those from the regions that are most vulnerable to climate change and variability. WCRP committed to offer 200 grants to encourage students, early career scientists and scientists from developing countries to attend the conference.

Amount received and number years supported

The amount of Funding Received for 2011/2012: US\$ 60,000

Activity undertaken and Results

We received about 500 applications for financial support to attend the conference; about 60 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 chaired by the START 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 200 applicants from the total pool of applicants that were eligible to receive financial support to attend the conference. Thirty nine of the final award recipients were from the Asian-Pacific Region and one-half 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, based on the proposed matching scheme to APN.

As a part of daily activities of the conference, WCRP also organized a competition for identifying the best oral and poster presentations by students and early career scientists. This competition and evaluation process was coordinated by an independent panel of experts co-chaired by START Director and Professor Graciela-Raga of Mexico who is a member of the WCRP Joint Scientific Committee. The posters and papers presentations 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 papers and posters were identified for each day and recognized during the following day morning plenary session. The award recipients (see table <http://www.wcrp-climate.org/documents/competition.pdf>) received a certificate citing "outstanding poster/oral presentation" plus a complimentary membership or registration fee waiver for annual meetings of the American Geophysical Union, American Meteorological Society, or European Geophysical Union for one year. These awards were provided to or jointly co-sponsored with WCRP by the three professional scientific organizations

Five grand prize-winners were identified at the end of conference among the daily award recipients to receive each an Apple iPad courtesy of the WCRP, and its three major sponsors the World Meteorological Organization, Intergovernmental Oceans Commission of UNESCO and International Council for Science, and the Science and Technology Corporation.

Relevance to the APN Goals and Science Agenda, Scientific Capacity Development and Sustainable Development

This proposal addressed directly the APN Goal 3 and 4. By supporting Asian-Pacific region scientists to attend the WCRP OSC, and they had an opportunity to interact with 1900 scientists from 86 nations 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 will ultimately lead to a contribution to the APN Goal 1, since WCRP OSC helped identify key scientific issues for the region and facilitate regional and global collaborative research projects to advance our scientific understanding and predictive skills towards developing the climate information needed for regional decision makers, globally. The outcomes of the Conference will make a measurable scientific contribution to the fifth Assessment Report (AR5) of the IPCC. The conference showcased the results of climate model intercomparison project (CMIP5, <http://cmip-pcmdi.llnl.gov/cmip5/>) that provides the framework for climate change modelling research for the next five years and the bases for IPCC AR5. There was also a session on the major historical observational analysis performed by USA, Europe and Japan that will be made available to all scientists around the world through WCRP

coordinated activities in 2011 and beyond. A major plenary session was devoted to dialogue and discussion with the co-chairs of the IPCC AR5 assessment to discuss how WCRP can continue its contribution to this process in a more effective manner in the future. WCRP will convey the major recommendation of the OSC to the attention of the SBSTA, the UNFCCC Subsidiary Body for Scientific and Technological Advice.

Self-evaluation

In addition to the 39 students and early career scientists, WCRP also sponsored 36 senior scientists from Asia and Pacific regions who played a critical role in the WCRP Joint Scientific Committee, Science Steering Groups, working groups. As such, APN network of scientists and experts had a strong presence and played a major role in defining the WCRP research agenda and priorities for the next decade(s). 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 totally without APN financial support. We believe the conference met or exceeded its objectives in networking and research capacity development, especially in Asia and Africa. We wish that we had garnered greater level of support to engage more than one-half of the 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 an open science conference more frequently or 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.

Potential for further work

We intend to follow up and continue to engage the Conference participants, especially the students and early career scientists in WCRP future activities. The ultimate goal is to have their active participation and engagement in WCRP 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 WCRP and its activities. The intent of WCRP 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 intend to publish the outcome of the conference in a book that will contain major scientific and technical papers prepared and presented at the conference, and the overall synthesis of presentations, discussions and recommendations resulting from the conference session. Some short news articles highlighting the major outcomes of the Conference will be also published in the scientific and technical newsletters and journals. (How about including the list of media advisories, press releases and articles such as the Nature, etc.?)

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3-4.

Acknowledgments

We would like to acknowledge the University Corporation for Atmospheric Research (UCAR) and the National Center for Atmospheric Research (NCAR) for their strong local support and the International START Secretariat for its help with the selection process for financial support grants. We thank several hundred scientists from around the world worked very hard during a period of two years to develop the conference programme, and identify invite speakers, develop community-wide position papers, organize and chair the sessions, and participate in evaluation and selection of best papers and posters at the conference. We are also grateful for the financial support from conference sponsors (see Appendix C) that made it possible to make the participation of more 1900 scientists from 86 countries affordable and possible. Without generous support of these organization could not participate in this exciting and successful event.

Preface

A better understanding of the behavior of the climate system and its interactions with other Earth-system components is critical to predicting its evolution, reducing vulnerability to high-impact weather and climate events, and sustaining life. This need is perhaps greater than ever given that humans have emerged as the dominant agent of change. Moreover, progress will require an increasingly holistic approach across scientific disciplines, as well as an unprecedented commitment to the future development of a diverse and talented workforce. The WCRP Open Science Conference provided a unique and exciting event designed to promote progress toward meeting these challenges. It assembled, for the first time, the entire WCRP research community, as well as participants from other key international research programmes. Individual participants, including many students and early-career scientists, had the opportunity not only to present their latest research and discuss it with colleagues, but also to participate in the “big-picture synthesis” of the current state of knowledge about climate variability and change. Given the theme of the conference, Climate Research in Service to Society, the OSC also stimulated new projects and initiatives, facilitated research, and developed partnerships that are critical for progress.



Dr. Ghassem R. Asrar, Director of the World Climate Research Programme, welcoming the participants of the WCRP Open Science Conference in Denver USA.

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Appendix C - Complete List of the Conference Sponsors

1.0 Introduction

The WCRP Open Science Conference (OSC), which had the theme “Climate Research in Service to Society,” was held to consult with the international community of experts on future plans and priorities for the WCRP. More than 1900 participants, including 541 young scholars from 86 nations and 300 scientists from developing nations, made the conference a success.



Conference delegates during the Plenary Session

This was the first meeting of its kind, during the lifetime of WCRP. The goal of the conference was to develop a better identification of the scientific challenges and opportunities in understanding the behavior of the climate system and its interactions with other earth system components. The conference main objectives were:

- Identify key opportunities and challenges in observations, modeling, analysis and research required to understand and predict responses of the Earth as a system;

- Provide an internationally-based “state of knowledge” for the upcoming fifth assessment report of IPCC;
- Facilitate cooperation and coordination across the WCRP, as well as with other international research programmes, including the World Weather Research Programme (WWRP) and the Earth System Science Partnership (ESSP);
- Help WCRP and its partners identify and tackle the inevitable, related climate change challenges facing all citizens of this planet.

The Conference programme was organized around daily themes that reflect integrative aspects of the WCRP programme, as well as connections to other international research programmes. Each day included plenary presentations and discussions by leading scientists and conference participants who are informed by community-based position papers. The plenary sessions were followed by parallel and poster sessions, which provided the primary means for conference participants to present their research findings. The poster sessions had their own dedicated time for viewing and one-on-one discussions with authors, thus avoiding overlap with the plenary and parallel sessions. Moreover, groups were encouraged to self-organize and submit cluster of posters addressing a specific topic, preferably as part of one of the planned sessions. All sessions were structured to foster active discussion and dialogue.

The daily themes were as follows:

- 1) The Climate System Components and Their Interactions
- 2) Observation and Analysis of the Climate System
- 3) Assessing and Improving Model and Predictive Capabilities
- 4) Climate Assessments and Future Challenges
- 5) Translating Scientific Understanding of the Climate System into Climate Information for Decision Makers



Overview of a portion of the poster area during a poster session

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 OSC actively engaged with early career scientists, especially those from the regions that are most vulnerable to climate change and variability. WCRP offered 200+ grants to students, early career scientists and scientists from developing countries who

attended the conference. Such support provided 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 the total Earth/climate system.

The participation and engagement of early career scientists in the conference ensured communication and advocacy in identifying the Earth/climate system research needs of their regions and their inclusion in the WCRP long-range research priorities. They provided input and were informed by the research agenda in support of the Earth System Science and Global Sustainability Research and the Global Framework for Climate Services. We envision that they will become the next generation of leaders who will foster the implementation and evolution of the scientific grand challenges of these initiatives in the future.

The conference reviewed latest progress in the climate research and contributed in the “big-picture synthesis” of the current state of knowledge about climate variability and change. Particular emphasis was given to the needs for science-based climate information at regional level, of key sectors of economies, and climate related risk management. Environmental/climate related issues and concerns that the public and decision makers are facing are complex and require trans-disciplinary approach to address them. The conference identified the need for "symbiotic" relationship between providers and users of climate information to ensure that timely, accessible, and easy to understand climate information is developed and used effectively.

Several major scientific priorities emerged from OSC. These include (1) the need for prediction of the Earth system, bridging the physical climate system with biogeochemistry and the socioeconomic and humanity sciences, in a program such as the “Future Earth-Research for Global Sustainability” initiative of the International Council for Science; (2) capitalizing on the opportunity, provided by new satellite observations, to make a major leap in understanding of clouds and aerosols and their contributions to climate sensitivity; (3) the need for skillful climate information on regional scales for Global Framework for Climate Services; (4) the importance of quantifying true uncertainty in climate predictions; (5) defining the challenges and opportunities involved in predicting how the forced anthropogenic component of climate change will modify the natural modes of climate variability over the coming decades; (6) the increasing importance of establishing the predictability of polar climate, with possible opening of the Arctic, and the importance of international policy for commercial shipping and extraction of natural resources; (7) the need to better understand the causes of extreme events and to conduct attribution studies in near real time; (8) tackling the challenges to providing improved predictions of future regional sea level change; and (9) the need to train and empower the next generation of climate scientists.

Dialogue with young scholars on future education and research opportunities and how to effectively communicate climate science was a significant component of OSC. A major emerging theme was the need for actionable science. Decision makers need climate and other scientific information to guide decisions. Future water availability in a region, for example, may guide the siting of a new water treatment plant that will be operational for decades. The demand for and importance of understandable information about climate is increasing, especially as extreme weather and climate events and their adverse impacts on natural ecosystems and global economic development increase in frequency and severity.

The need for actionable science was also explored with a panel of experts from the private sector: British Petroleum, Northrop Grumman, Zurich Financial Services, Computer Sciences Corporation, and the Weather Channel. They discussed how scientists and private enterprise can better work together toward actionable information, concluding that while gaps exist today between information needs and availability, those gaps are rich with opportunity. The general consensus among the participants was that WCRP and its affiliate network of scientists and projects must move beyond understanding and predicting the Earth’s climate system to providing the resulting knowledge and information in ways that yield practical solutions to the complex and interrelated

challenges required of a sustainable Earth for future generations. More information on the conference is available at <http://conference2011.wcrp-climate.org>.



Members of the panel of experts from the private sector together with Prof. A. Busalacchi (left), chair of WCRP Joint Scientific Committee

2.0 Methodology

We provided opportunities and support for students, early career scientists and scientists from developing countries for attending the conference. The announcement for applications was posted on the conference webpage in the beginning of December 2010 with a deadline set for 15 March 2011 (see the announcement <http://conference2011.wcrp-climate.org/support.html>). The call for financial support was open to everybody however priority was given to:

- 1) **Students:** those pursuing their graduate studies (MSc, PhD)
- 2) **Early Career Scientists:** post-graduates and researchers who received their highest degree in 2005 or later
- 3) **Scientists from emerging and developing economies**

We received more than 500 applications and about 60 of them were from the Asian-Pacific region. The review process was carried out by an evaluation panel chaired by the START Director and included representatives from conference sponsors (ESA, EUMETSAT, EU), few members of the WCRP Joint Scientific Committee and the directors of the WCRP International Project Offices. The evaluation panel first decided to assess the 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)

Subsequently it was agreed to have three independent reviews for each application.

Thanks to the hard work of more than 50 independent reviewers including the members of the evaluation panel, the review process was completed by mid June 2011 and the applicants were notified on the results of the process by the end of June 2011. Two hundred applicants were selected to be eligible to receive financial support and thirty-nine of the final award recipients were from the Asian-Pacific Region. Finally about twenty-four of them were selected to be supported

directly by APN grants and the rest of early career scientists and students were sponsored by the WCRP baseline education and capacity development budget.

As part of the conference, WCRP also organized a competition for identifying the best oral and poster presentations by students and early career scientists. The posters and papers presentations 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 a small panel of experts chaired by the START Director. The best papers and posters were identified for each day and recognized during the morning plenary session. The award recipients (see table <http://www.wcrp-climate.org/documents/competition.pdf>) received a certificate citing “outstanding poster/oral presentation” plus a complimentary memberships or registration fee waiver for annual meetings of the American Geophysical Union, American Meteorological Society, or European Geophysical Union for one year. These awards were provided to WCRP by the three professional scientific organizations.



Dr. Ghassem R. Asrar with three of the five winners of iPADs.

Five grand prize-winners were identified at the end of conference among the daily award recipients to receive each an Apple iPad courtesy of the WCRP, and its three major sponsors the World Meteorological Organization, Intergovernmental Oceans Commission of UNESCO and International Council for Science, and the Science and Technology Corporation.

Prior and during the conference several events were organized for students and early career scientists:

WCRP/NCAR Workshop on Regional Climate Issues in Developing Countries

This workshop was organized by the Early Scientist Assembly (ECSA) of the National Center for Atmospheric Research (NCAR) and sponsored by the NCAR Advanced Study Programme and WCRP. Early career scientists (post-graduates and researchers who received their Ph.D. in 2005 or later) were invited to attend a 3-day workshop in connection with the WCRP Open Science Conference on 19-22 October 2011. The theme of the workshop was to examine the diversity of regional climate issues with a focus on developing countries, with topics including but not limited to: droughts,

floods, heat waves, severe storms, sea level rise, water supplies, agricultural yields, the survival of native species, pollution and human health. Forty participants were selected to explore how observations, modeling, analysis and process research can be used to address regional climate issues, to understand which developing regions are most at risk, and determine how regional climate projections can be improved. The primary goal of this workshop was to exchange ideas and establish collaborations for future work between early career scientists from across the world and those from developing countries. The workshop took place prior to the Denver WCRP Open Science Conference, at NCAR in Boulder, Colorado (near Denver). The workshop included scientific discussions, poster sessions, social activities and tours of NCAR and a nearby scientific facility. Early career scientists with backgrounds in regional climate, air and water quality and climate impacts (including societal impacts) were invited to submit an application by April 15, 2011. The selection process gave priority to studies on climate aspects in developing countries or related issues that are transferable to developing countries. The NCAR Early Career Scientist Assembly, sponsored by the Advanced Study Program was able to provide funding for lodging, per-diem and local transportation (no airline flights) for participants who require support, with a priority given to participants from developing countries. Several participants to the workshop, especially those from developing countries, were able to take advantage from their WCRP financial support to attend both the workshop and the conference.



Participants of the WCRP/NCAR Workshop on Regional Climate Issues in Developing Countries

Breakfast for Students

This event sponsored by the NCAR Climate and Global Dynamics Division (CGD) provided an opportunity for the young participants to meet with senior scientists and leaders in climate research.

Early Career Scientists' Luncheon

The focus of this event was communicating Climate Science, it featured communications experts imparting their learning about what works and what does not and what's needed to more clearly communicate our understanding about the changing climate and its impacts. The demand for clear

information about climate is increasing as the importance of this information grows in the face of extreme weather and global economic expansion. This increased demand comes from industry, policy makers, and the general public, educators and many other sections of society. Not only is demand for clear, actionable information increasing, but so too is the complexity of the information requested. However, the majority of scientists have had little experience explaining their work except to other scientists. This is particularly true of early career scientists who can be a tremendous resource as spokespeople for state-of-the-art research and insights. Moreover, scientists are often comfortable speaking the jargon understood by peers but not others. More understandable explanations are needed to ensure we can explain uncertainties, keep expectations of our science reasonable and ensure continued support for our work.

The discussion Panel included:

- David Griggs, Monash University, Australia; climate scientist and member of the WCRP Joint Scientific Committee
- Patrick Luganda, Chairman, Network of Climate Journalists of Greater Horn of Africa (NECJOGHA)
- Andrew Freedman, Climate Central
- Alex Witze, Science News
- Matt Hirschland, UCAR Communications

A complementary buffet lunch, courtesy of the American Meteorological Society, was served to the attendees registered as Early Career Scientists.

3.0 Results & Discussion

The conference attracted more than 500 students and early career scientists. The following students and ECS were selected to receive the APN travel grant (see Appendix A for complete contact details information):

1) Lixia Zhang	China	ECS
2) Juan Li	China	student
3) Ying Feng	China	Student
4) Yanping Li	China/USA	ESC
5) Wenting Hu	China	student
6) Shan Yin	China	student
7) Cheng sun	China	student
8) Francis mani	Fiji	ECS
9) Sumita Kedia	India	ECS
10) Sunita Verma	India	ESC
11) Rohit Srivastava	India	student
12) Johnson Zacharia	India	Student
13) Artem Sherstyukov	Russia	ECS
14) Elena Kharyutkina	Russia	ECS
15) Natalia Tilinina	Russia	student
16) S.H.M. Fakhruddin	Bangladesh/Thailand	Student
17) Pradeep Khatri	Nepal/Japan	ECS
18) Sheau Tieh Ngai	Malaysia	student

19) Farah Hani Abdul Rahim	Malaysia	Student
20) Purevjav Gomboluudev	Mongolia	ECS
21) Yunden Bayarjargal	Mongolia/USA	ECS
22) Sergey Khaykin	Russia	ECS
23) Sachin Ghude	India	ESC
24) Changhyun Yoo	Korea/USA	student

About seven of them were selected as best poster or oral presentation and received the WCRP certificate and one of the awards were provided to WCRP by the three professional scientific organizations: American Geophysical Union, American Meteorological Society, or European Geophysical Union. The winners are:

Ying Feng	AGU Book
Francis Mani	AGU Membership for one year
Johnson Zacharia	AGU Membership for one year
Elena Kharyutkina	EGU General Assembly Waiver 2012
Natalia Tilinina	AGU Membership for one year
S.H.M. Fakhruddin	AGU Membership for one year
Farah Hani Abdul Rahim	AGU Membership for one year



Few winners of the poster and oral presentation competition receiving the WCRP certificate for their outstanding work.

The complete list of the award recipients is available on-line and can be downloaded from the conference webpage (<http://conference2011.wcrp-climate.org/>).

Natalia Tilinina and Francis Mani were selected to attend a 3-day workshop at the NCAR Mesa

Laboratory prior to the World Climate Research Programme (WCRP) Open Science Conference in October 2011. The workshop was organized by the Early Career Scientist Assembly (ECSA) and the Advanced Study Program of the National Center for Atmospheric Research (NCAR). Thirty-five early-career scientists from nearly 20 countries attended the workshop.

The goal of the workshop was to examine a range of regional climate challenges in developing countries. Topics included regional climate modeling, climate impacts, water resources, and air quality. The workshop fostered new ideas and collaborations between early-career scientists from around the world. The discussions underscored the importance of establishing partnerships with scientists located in typically underrepresented countries to understand and account for the local political, economic, and cultural factors on which climate change is superimposed.

One recurring issue throughout the workshop was that of managing complex impact assessments with a large range of results from global and regional models; variations between models are often not fully understood, accounted for, and/or communicated. Also problematic is the discrepancy between the spatial and temporal scales on which regional climate projections are made (tens of kilometers and ~30–100 years) and the scales that are of primary interest to many communities in developing countries (kilometers and 0–10 years) that are presently affected by climate change. Approaches for addressing uncertainty and scaling issues might include cost-effective ensemble dynamical-statistical approaches and/or coupling regional modeling efforts to better meet specific objectives (e.g., improved integration of hydrologic models). Facilitating effective “end-to-end” communication was identified as a critical research component to increase awareness of the wider challenges and opportunities facing scientists and end users alike. Such end-to-end communication would also help to ensure that research addresses the particular needs of the communities that are its focus.



Participants of the WCRP/NCAR Workshop on Regional Climate visiting the one of the NSF facilities in Boulder

Another issue discussed during the workshop was the incomplete understanding of aerosol processes and their influence on climate. There were intense discussions on the importance of observational data sets for the development and evaluation of aerosol parameterizations in climate models. Data sets are often not easy to use, and access in some countries is restricted. The need for an international open data policy was agreed upon. Chemically detailed air quality and aerosol measurements in highly polluted developing cities (e.g., in Africa) are also required, considering the significant health impact of pollutants. New collaborations from this workshop were initiated to propose observational campaigns, where the knowledge of the local investigators is indispensable for the success and long-term viability of campaigns.

Finally, participants noted that freely available community atmospheric and impact models, data, and analysis software could facilitate new research and that new projects could be stimulated by collaborative visits to institutions with scientists who work beyond their disciplines. At least one such visit has already been arranged. Participants discussed a desire for future workshops of this kind in which a culturally and topically diverse group of scientists have a forum to exchange ideas and foster formal and informal collaborative research partnerships.

All the ECSs attending the conference were invited to attend a panel discussion on Communicating Climate Science to the Media and Public. This event took place during the lunch break on the day-3 of the conference and was sponsored by the American Meteorological Society (AMS). A panel of professional experts in communicating science presented their views and advice, the panelists were:

- Alexandra Witze, *Contributing editor, Science News*
- Patrick Luganda, *Chair Network Climate Journalists in the Greater Horn of Africa*
- Andrew Freedman, *Managing Editor of Online Content and Climate Policy Analyst*
- Professor Dave Griggs *CEO ClimateWorks Australia & Director Monash Sustainability Institute*



Members of the panel of experts in communication and media

The event included a question and answer period where the 150 ECSs attending the discussion could share their experience and doubts.

As an introduction, the panelist gave their views on the current media landscape vis a vis communicating climate science:

- There are now tremendous opportunities for ECSs to take major role in communicating online; or cultivating relationships with reporters to become a trusted source to interpret your work

or that of others.

- Number of mainstream journalists has dropped which may be bad for journalists, but has opened up new opportunities for scientists in the form of blogs and alternative reporting
- If you as scientist want to get your message out, it is an unparalleled time for using the internet. Many articles even in the New York Times are influenced by a blog.
- Climate scientists assume that people are listening, however, just getting info out is not going to change people's minds.
- Journalism is about stories – people, societal relevance – and we must become better story-tellers.

Many good pieces of advice and lessons learned were shared:

- When talking to media, scientists should lead with what they know, what they are sure about, and not the uncertainties; from journalists' perspective – you are burying your lead if you fail to do this; don't bury uncertainties, but structure info differently.
- Identify which media outlets, decision makers, are receptive to your message and work with them and develop long-term relationships, not just transactional ones.
- Many universities and institutions have communications officers who can help you navigate this field, prepare yourself and your messages.
- Many media/communications training opportunities exist – call university public affairs office – AGU; many fellowships e.g., AAAS mass media fellowship; Stanford programme; NSF; congressional fellowships
- Great communicators are not born, they are created. Becoming great is an investment in you and your science.
- Lot of bad news around; better to go for good news.
- It is our (scientists') responsibility to help journalist learn about climate and there is an appetite to learn – we need to organize ourselves to do that training.
- Step up to the plate; we need you; understand there is a reward for talking to journalist and communicating as a means to sharing the impact of your work.
- There is an institutional inertia that does not always adequately recognize this contribution and this must change.
- If a journalists calls you – you are not having a conversation; be certain about your message. It is ok to ask for a few minutes, organize your thoughts and ring him/her back.
- Read a lot – blogs, history; business publications to get perspective on this climate debate – how it fits in the larger context of societal and economic discussions and realities.
- Learn from those who are good at communicating.
- Learn basic rules of journalism.
- Scientists must learn when to stop talking; be prepared; communicate clearly.

4.0 Conclusions & Future Directions

The World Climate Research Programme (WCRP) international Conference was a great success. The event met and in most aspects exceeded its main goal to identify and develop the scientific challenges and opportunities in understanding the behavior of the Earth's climate system and its interactions with other Earth system components that require international coordination and cooperation in the next decade. Active engagement of more than 1900 scientists from 86 countries contributed to this success, and more importantly will contribute to the implementation of these research priorities.

The conference reviewed latest progress in the climate research with particular emphasis on the needs for science-based climate information at regional level, of key sectors of economies, and climate related risk management. The participants acknowledged that environmental/climate related issues and concerns that the public and decision makers are facing are complex and require trans- disciplinary approach to address them. They identified the need for "symbiotic" relationship between providers and users of climate information to ensure that timely, accessible, and easy to understand climate information is developed and used effectively.

The general consensus among the participants was that WCRP and its affiliate network of scientists and projects must move beyond understanding and predicting the Earth's climate system to providing the resulting knowledge and information in ways that yield practical solutions to the complex and interrelated challenges required of a sustainable Earth for future generations, i.e. the need for "actionable science".

The WCRP Joint Scientific Committee convened an extra-ordinary session immediately after the conference to take stock of the conference outcomes and for defining and directing the future WCRP activities and structure with a strategic vision on the role that climate research will play in planning and implementation of two major international initiatives: The Global Framework for Climate Services (GFCS) and Future Earth (FE).

The GFCS is a UN-led initiative to strengthen the development, availability, delivery and application of science-based climate monitoring and prediction services. Climate observations, research, modelling and prediction are some essential components of the Framework to characterize climate variability and change and to generate quantitative climate predictions and climate projections on a range of time and space scales. A major emphasis is given the users interface and climate information system management and delivery as well. The theme of capacity development is considered to be cross cutting across all elements of GFCS. WCRP is committed to support and contribute to the development and implementation of the GFCS.

Future Earth has the overarching strategic goal to develop the knowledge for responding effectively to the risks and opportunities of global environmental change and for supporting transformation towards global sustainability. The intent is to deliver at global and regional scales the knowledge that societies require to effectively address global change while meeting economic and social goals. Future Earth brings together an alliance of partners with long-term interests and expertise in international research collaboration on environment, science and sustainability. The International Council for Science (ICSU) includes as members disciplinary unions as well as national members, and has focused on global environmental change through programmes such as World Climate Research Programme (WCRP), International Geosphere-Biosphere Programme (IGBP), International Human Dimensions Programme (IHDP), DIVERSITAS and Earth System Science Partnership (ESSP), as well as focused efforts on climate, ocean and terrestrial observing systems, disaster risk reduction, ecosystems and oceans.

We believe the Conference was also a terrific success in achieving its education and capacity development objectives. The conference aimed to recruit and actively engage early career scientists, especially those from the regions that are most vulnerable to climate change and variability. This would not have been possible without APN financial support. The conference exceeded its objective in networking and research capacity development, especially in Asia and Africa. We are grateful for the APN financial support that enabled us to support a greater number of scientists from Asia and Pacific region. We wish that we had garnered greater level of support to engage more than one-half of the pool of applicants for 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 continue to receive is to convene such an open science conference more frequently or 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.

References

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In addition to the coverage of the conference by the media, web and social networks (see <http://conference2011.wcrp-climate.org/documents.html>) we intend to publish the outcome of the conference in a book that will contain major scientific and technical papers prepared and presented at the conference, and the overall synthesis of presentations, discussions and recommendations resulting from the conference session.

Appendix A - Contact Details of APN Sponsored Young Scientists

S.H.M. Fakhrudin, Student
RIMES, Pathumthani, Bangladesh/Thailand
smfwater@gmail.com

Lixia Zhang, ECS
Institute of Atmospheric Physics, Beijing, China
lixiazhang@mail.iap.ac.cn

Juan Li, Student
Huafeng Group of Meteorological Audio & Video Information, China
lijuan@tea.ac.cn

Ying Feng, Student
The First Institute of Oceanography, China
fengying@fio.org.cn

Yanping Li, ESC
University of Hawaii, USA
yanpingl@hawaii.edu

Wenting Hu, Student
LASG, IAP, CAS, China
hwt@lasg.iap.ac.cn

Shan Yin, Student
Institute of Atmospheric Physics, CAS, Beijing China
yinshan@mail.iap.ac.cn

Cheng Sun, Student
Institute of Atmospheric Physics, CAS, Beijing China
scheng@lasg.iap.ac.cn

Francis Mani, ECS
Fiji National University, Fiji
francis.mani@fnu.ac.fj

Sachin Ghude, ESC
Indian Institute of Tropical Meteorology, Pune, India
sachinghude@tropmet.res.in

Sumita Kedia, ECS
Physical Research Laboratory, Ahmedabad, India
sumita@prl.res.in

Sunita Verma, ESC
BIRLA INSTITUTE OF TECHNOLOGY MESRA, Jaipur, India
VERMA.SUNITA@GMAIL.COM

Rohit Srivastava, Student
Physical Research Laboratory, Ahmedabad, India
rohits@prl.res.in

Johnson Zacharia, Student
Cochin University of Science and Technology, India
johnson_zacharia@yahoo.co.uk

Changhyun Yoo, Student
The Pennsylvania State University, USA
cyoo@psu.edu

Pradeep Khatri, ECS
CEReS Chiba University, Nepal/Japan
pradeep.nep@gmail.com

Sheau Tieh Ngai, Student

Research Centre of Tropical Climate Change System (IKLIM), Malaysia
sheautieh@gmail.com

Farah Hani Abdul Rahim, Student
International Islamic University Malaysia, Malaysia
farahhani@gmail.com

Purevjav Gomboluudev, ECS
Institute of Meteorology and Hydrology, Ulaanbaatar, Mongolia
p_gombo@hotmail.com

Yunden Bayarjargal, ECS
Geospatial Technology Transfer LLC, Walnut Creek, USA
ybayarjargal@gmail.com

Sergey Khaykin, ECS
Central Aerological Observatory of Roshydromet, Dolgoprudny, Russia
sehamic@yandex.ru

Artem Sherstyukov, ECS
RIHMI WDC, Russia
artem@meteo.ru

Elena Kharyutkina, ECS
Institute of monitoring of climatic and ecological systems, Tomsk, Russia
ceo@imces.ru

Natalia Tilinina, Student
P.P. Shirshov Institute of Oceanology, Russia
tilinina@sail.msk.ru

Appendix B - Feedbacks from the APN Sponsored Young Scientists

Natalia D. Tilinina, Nakhimovsky ave 36, 117997, Moscow, Russia

e-mail: tilinina@sail.msk.ru

I had two poster presentations:

- *Session C22: Reanalysis and Synthesis Methods for Climate*, poster number T234A
- *Session C39: Understanding and Characterizing Past, Present and Future Climate Extremes Through Observations and Model Simulations*, poster number TH109B.

I have won a **best poster presentation** in C39 session!!! I am so happy for that! It is so important when your efforts are ranked so highly.

Also I've attended the workshop for young scientists prior to the conference, which also was useful. The conference was extremely fitting my research interests; especially some of sections gave me a chance to really update my knowledge what is happening now in my field of research. My personal expectations were even less than I saw at the conference. I couldn't have thought that such a big event can be organized at such a high level.

The information exchange was the main goal to attend the conference. And I tried to do my best to reach this goal. I tried to find a new ways for interpretation and explanation my results. The poster session was extremely useful for that, because I really got a lot of comments from well-known scientists, and it was very surprising for me that almost all of them were open for the discussions during the poster session. I had several contacts with people whom I plan to contact for joint interesting work. One project is under development already.

For me as a PhD student this conference was the first real chance to present my research to the world scientific community. And it really was a *world scientific community*. I still found some difficulties in accessing the scientific experts for discussions. Anyway, my overall assessment a 100% positive, during the conference I found a good ideas, a knowledge and a new portion of enthusiasm for my research. I'm sending my best regards to APN and WCRP who made real my participation at the conference, winning the best poster and establishing contacts. Thank you very much.

Sunita Verma, BIT Mesra, BMBSTC, Statue Circle, Prithviraj Road, Jaipur-302001, INDIA

e-mail: verma.sunita@bitmesra.ac.in

I had my poster presentation entitled "Assessment on Aerosols Optical Properties from the Observations During AERONET Campaign Over an Urban Location in India" on Monday, 24th October 2011 at the session C12, Poster No. M52B, chaired by M. Webb.

As per the scope of World Climate Research Program, it gave me opportunity to listen to climate scientists across the world at a single platform. It was sure an effort to determine and improve our ability to predict climate and to discern human impacts on climate. The conference program, especially the session dedicated to Aerosols and clouds on Tuesday evening was very useful to me. The talks were really meaningful and conveyed the message within the time of presentation.

I, along with my several colleagues, am involved and contributing to aerosols observations from base station, Jaipur, India from year 2009 onwards under AERONET south Asian network. The AERONET involves many scientists across the world but still it's unlikely to meet or know the entire involved scientist. During WCRP, I could meet a large section of scientific community, which is directly or indirectly involved in this program. It is otherwise quite impossible without a common platform such as WCRP. I could share my thoughts about the current results from our site and future aspects with lots of similar interest personnel and got new ideas. I would like to thank APN and WCRP for providing fund and giving me the opportunity to participate and present my research work.

While sharing my thoughts about the current results from our site and future aspects, I got tremendous response on how to further analyze the current observations for scientific publications like optimum use of newly available satellite techniques along with mathematical tools for estimating radiation budget over the region.

The WCRP-OSC 2011 was very successful as far as my participation is concerned. I would like to thank APN and WCRP for providing funds and giving me the opportunity to participate and present my research work.

Suggestions:

1. If there would have been a facility for a childcare like AGU, I could have been involved in many more activities.
2. I find that some of the speakers were not present during the sessions on Monday without

knowledge of respective session chair. Some participant would have happily volunteered that slot. That could have been great chance for a young scientist or a volunteer speaker to present his/her work.

Lixia Zhang, State Key Laboratory of Numerical Modeling for Atmospheric Sciences and Geophysical Fluid Dynamics (LASG), Institute of Atmospheric Physics (IAP), Chinese Academy of Sciences, P.O. Box 9804, Beijing 100029, People's Republic of China.

email : lixiazhang@mail.iap.ac.cn

I did a poster presentation in the WCRP OSC on 25th Oct. I participated in the visit of the National Center for Atmospheric Research (NCAR) in Boulder, Welcome Reception Early Career Scientists Lunch and the Conference Gala at the Denver Art Museum.

My major research interests include change of monsoon climate and upper-tropospheric temperature changes. This conference was very useful to my study and greatly improved my understanding about climate change. My former study mainly focus on the interannual variability of climate. In this conference, I realized the importance of global warming and the potential impact on climate, such as ENSO, AMO and monsoon. I found that in this conference, climate change about monsoon, spatially on the East Asian monsoon is relatively less. It inspires me to do some study on the impact of global warming on the East Asian summer monsoon. I believe it will largely improve my understanding on the monsoon climate. In this conference, I made some new friends who were interested in monsoon precipitation.

Thanks very much for such a good conference and the good coffee break. I will be very happy to participate in its next conference.

Pradeep Khatri, Center for Environmental Remote Sensing (CEReS), Chiba University, 1-33 Yayoi-cho, Inage-ku, Chiba, 263-8522 JAPAN

Email: pradeep.nep@gmail.com

I had a poster presentation. The conference met my expectations professionally and personally. I found it a very nice platform to exchange research ideas with many well-known scientists. I got some new ideas for my current and future research plans. It was indeed an excellent platform for me to increase my contacts and network. It was excellent from each point of view. Please continue to give opportunities to young researchers to attend the future conferences and meetings.

Kharyutkina Elena Valeryevna, Institute of Monitoring of Climatic and Ecological Systems, Siberian Branch of Russian Academy of Science (IMCES SB RAS); Laboratory of Physics of Climatic Systems, Russia, 634055, Tomsk, 10/3, Academicheskii ave., of. 401

E-mail: ceo@imces.ru

I had a poster presentation. I received several interesting comments and suggestions how to improve and develop my study. I established new contacts and networked with other peers pursuing their education/research close to my field of interest. I hope they will be useful. The Conference had a high level of organization. I was glad to take part in this Conference. Thank you!

Purevjav GOMBOLUDEV, Institute of Meteorology and Hydrology, National Agency for Meteorology and Environmental Monitoring, Juulchiny gudamj-5, Ulaanbaatar-46, Mongolia

e-mail: p_gombo@hotmail.com

I participated as poster presenter of C27 session named on Coordinated Regional Downscaling Experiment, CORDEX. My poster title was “High Resolution Projection of Climate Change and Climate Extremes (Drought/Zud) in under Increasing Green House Gas”.

Overall the conference program fully met my expectations, especially I was very impressed by the plenary and parallel sessions where well-known scientists gave very interesting talks.

The Aerosol effect in the cloud and its contribution to radiation forcing, the idea of right scaling being more important when considering regional statistic and dynamic downscaling, the ensemble method in climate prediction and simulation, and CMIP5 were the most useful information during the conference.

During poster session, I exchanged my idea with other colleague. Among these, I got new ideas considering my future research work which are related to synoptic pattern of extreme events using reanalysis data, influence of synoptic airflow on daily precipitation extremes, observed relationships and regional climate model validation and implication of climate change for water resource and agriculture.

I have met several old friends as well as contacting many new friends during conference. We shared knowledge about our current research work and possibility to cooperate future as well.

I think overall workshop programs and activities were excellent in terms of all kind matters such as food, accommodation and service. It was well organized.

Finally, I would like to express my thanks to APN and WRCP for sponsoring my whole travel expenses. It was great contribution to my future research work. Thanks again.

Farah Hani Abdul Rahim, Institute of Space Science (ANGKASA), Universiti Kebangsaan Malaysia

Email: farahhani@gmail.com

I presented a poster titled “GPS Precipitable Water Vapor Variability over Northern Borneo Region During ENSO 2003-2007”.

Personally, the conference programme was awesome! The plenary sessions met my professional expectations albeit a few rather monotonous (pitch-wise) plenary speakers. A few of the parallel sessions overlapped my research interest, which became very difficult in deciding which sessions to attend to. Moreover, some of the parallel sessions were below my expectations. I felt I could have benefited more if the parallel session presentations were of plenary session quality. Perhaps that is asking for a wee bit too much but we should always strive to improve for the future.

Most of the information exchanged during the Conference was useful in my research work. The issues brought forward widened my outlook about climate research especially since my education background is engineering. Furthermore, the conference helped put climate issues in a better perspective for me so that I know better now how and what to pursue for my future research work.

Through communication with established scientists, I was able to come up with better ways of data presentation and analysis. Presently, I am implementing those newly learned techniques in my doctorate thesis. I'm happy to report that through these new contacts, I am now in the process of applying for a post-doctorate position as a testament of the positive outcome of the Conference.

WCRP OSC was an excellent platform for Ph.D. students and early-career scientists (ECS) to engage with scientists in climate research. However, many of the scientists were more occupied with discussion with other scientists and it was not all that easy for students and ECS to approach them. Although notable efforts in engaging with students and ECS were seen from **leading** scientists, the same cannot be said from other scientists. This issue was also brought up by Sir Brian Hoskins during the wrap up session on Friday, October 28th.

Yanping Li, Postdoc Fellow in IPRC, University of Hawaii at Manoa, 2525 Correa Road, Honolulu, HI 96822

I had a poster presentation in WCRP OSC with the title “Rainfall over the Tropical Western Pacific in relation to SST and mesoscale gradients thereof”. I also attended all the conference sections during the whole week and the receptions and the nighttime events in Mon, Tue and Wed.

The conference programme covered many aspects of current climate change research, which helped me to learn the most recent progress of the climate research and future research direction. The conference attendees were from many countries over the world, it was very exciting to meet our international colleague.

By talking to the scientists I met in the conference, I received a lot of information about future job opportunity, external funding resources. By explaining my current research project to other scientists, I received many useful comments and suggestions. For example, one is to expand my method to the study of the initiation of hurricane, which is a good idea that I would like to try in the next step of my research.

I met many scientists in person whose name is familiar to me from the literature. I got the chance to talk to them and exchange the contact information with them. They also gave me a lot of useful suggestions about possible research direction, recently released satellite data, updated model development, etc.

I think this conference was in general very successful, with its large scale, thousands of attendance from most of the countries over the world. By attending this conference, early career scientists like me are able to gain a general idea about current research hotspots within a week, which is a very efficient way.

I am not sure if the open science conference will be held every year, if so, I would be very interested in attending it again. I also want to thank APN and WCRP for offering me the travel fund to attend this conference. I really appreciate that.

Ngai Sheau Tieh, 10, Jalan BK3/10A Bandar Kinrara, 47180 Puchong, Selangor, Malaysia.

Email address: sheautieh@gmail.com

The Conference programme met my expectations professionally and personally. I found information exchanged during the poster presentation very useful for my research and education. I gained some new ideas for my current research (e.g., data analysis). I made new contacts and network with those research close to my field of interest. Overall, the Conference was really useful for me. Besides, I have found new ideas for my current research and also new interest for future research during the poster and oral presentation. I would like to suggest having more sessions for oral presentation by students or early scientists.

Cheng Sun, 40# Huayanli, Beichengxilu, ChaoYang district, Beijing, China

Email: scheng@lasg.iap.ac.cn

I gave a poster presentation. The oral presentations were great, and I learned a lot from them. I met several scientists and students and talked about our work. Their ideas and research methods can be useful to my research. I figured out what are the hot spots in current climate research, especially in the research of large-scale climate variability, such as two types of ENSO and the coupling between stratosphere and troposphere. I talked to several students and took their contact information. It was a very successful event. Maybe next event can be hold in a warm season.

Shan Yin, National Key Laboratory of Atmospheric Sciences and Geophysical Fluid Dynamics (LASG), Institute of Atmospheric Physics (IAP), Chinese Academy of Sciences (CAS), P.O. Box 9804, Beijing 100029, China

E-mail: yinshan@mail.iap.ac.cn

I showed my poster on Monday October 24st 2011. The title is Influences of the preceding winter Northern Hemisphere annular mode on spring extreme low temperature events in the north of eastern China. I met outstanding professors and colleagues during the conference and talk to them about my work. They gave me many suggestions, which is very helpful to my work. I am trying those new ideas we discussed in the conference now. I exchanged my contact information with some people and introduced our institute or college with each other.

It was a great event that brought researchers, students and other people related together to exchange their information and news for work. The conference was well-organized and outstanding oral presentations and posters delivered a comprehensive assessment of climate research, which will help my work a lot. Thanks for the conference organizing committee and APN for providing students like me this distinct opportunity to attend this great conference.

Sherstiukov Artem, 6, Korolev St., Obninsk, Kaluga Reg., 249035, Russian Federation.

e-mail: artem@meteo.ru

I presented a Poster. Frankly speaking, I didn't expect that there will be so many interesting talks and scientists as well as to find so well organized conference. I have found a lot of interesting information. I have taken pictures of some information (some of posters) and I think I will use this in future. After the Conference I became better informed on the current tasks and directions of development of science, also I expanded my perception about what and how scientists are doing in other countries. I have established some contacts and I even made a couple plans of future joint papers. It was a really great wonderful conference. Time and place was selected very rightly too. Thanks a lot to all people who have worked and taken part in this conference. I hope I will take part in this conference again in future.

Appendix C - Complete List of the Conference Sponsors

Financial support for the conference and related activities has been generously provided by the organizations listed below. The World Climate Research Programme, its network of scientists and the conference participants are grateful for this support.

National Oceanic and Atmospheric Administration (NOAA)

National Aeronautics and Space Administration (NASA)

United States Department of Energy's Office of Science (DOE-SC)

Asia-Pacific Network for Global Change Research (APN)

Office of Naval Research (ONR)

Earth System Science Interdisciplinary Center (ESSIC)

Canadian Space Agency /Agence Spatiale Canadienne (CSA)

University Corporation for Atmospheric Research (UCAR)

American Geophysical Union (AGU)

European Commission, Directorate-General for Research and Innovation
European Space Agency (ESA)
European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT)
Ball Aerospace and Technologies Corp.
Prince Albert II of Monaco Foundation
NCAR Climate and Global Dynamics Division (NCAR-CGD)
Cooperative Institute for Research in Environmental Sciences (CIRES)
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Global Change System for Analysis Research and Training (START)
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NEON Inc.
American Statistical Association
Life Science Journals Marketing
European Geophysical Union (EGU)
College of Atmospheric and Geographic Sciences and the National Weather Center at the University of Oklahoma