SUMMARY OF THE APEC CLIMATE SYMPOSIUM 2013
11-13 NOVEMBER, 2013

While there have been numerous international symposia and conferences regarding the issue of drought, few have dealt with both drought prediction and monitoring simultaneously. With the purpose of increasing the ability of APEC member economies to anticipate and prepare for periods of drought and to connect the dots between drought prediction, monitoring, and decision-making, the APEC Climate Symposium 2013, with the theme "Regional Cooperation on Drought Prediction Science for Disaster Preparedness and Management" convened from 11-13 November, 2013, in Jakarta, Indonesia. The event was organized by the APEC Climate Center and the Indonesian Agency for Meteorology, Climatology, and Geophysics, with financial support from the APEC Secretariat. Approximately 100 participants attended the symposium, representing academia, government, and the private sector. Experts presented research regarding innovative techniques in drought and seasonal climate prediction, drought monitoring and remote sensing, and drought risk reduction and policy-making at various administrative scales.

Opening Ceremony

On the morning of 11 November, 2013, Prof. Gusti Muhammad Hatta, the Indonesian Minister for Research and Technology, opened the APEC Climate Symposium 2013, noting the importance of the event in strengthening drought preparedness in order to contribute to the APEC mission of sustainable economic growth and prosperity in the Asia-Pacific region. The Ambassador of the Republic of Korea to the Republic of Indonesia, Mr. Young-sun Kim, added his sincere hope that the event could serve as a platform for building a solid regional network for further cooperation on drought prediction and monitoring among APEC member economies.

In his keynote address, Dr. Donald Wilhite, Professor at the University of Nebraska–Lincoln and founder of the National Drought Mitigation Center, commented that governments have historically done a poor job of managing drought in a proactive risk-based fashion. In light of the increasing frequency of extreme climate events and increased societal vulnerability to drought, he stressed the importance of breaking the "hydro-illogical" cycle of crisis management and the need to adopt a new paradigm for drought management that emphasizes preparedness and risk reduction. His recommendation to promote the principles of risk management by encouraging the development of reliable seasonal forecasts, early warning systems and information delivery systems, and preparedness plans at all levels of government was later echoed in the presentations during sessions on Drought Prediction and Science at Multiple Time-Scales, Drought Monitoring and Information Systems, and Utilizing Drought Information for Policy and Decision Making.

The following keynote address by Dr. Andi Eka Sakya**,** Agency for Meteorology, Climatology, and Geophysics, Indonesia focused on a potential drought monitoring information system for Indonesia. Dr. Sakya introduced the geographical and climatological conditions of Indonesia and explained other existing information systems produced by the Indonesian Agency for Meteorology, Climatology, and Geophysics, such as the Tsunami Early Warning System. Proposed indicators for integration into an Indonesian drought early warning system are soil moisture content, standard precipitation index (SPI), and number of days without rain (dry spells). He also spoke about information dissemination and the Climate Field Schools, which

facilitate end-users in deciphering technical climate information by translating that information into farming impacts and management recommendations.

Drought Prediction and Science at Multiple Time-Scales

The session was held on the afternoon of 11 November. The keynote presentation was made by Dr. Wenju Cai of the Commonwealth Scientific and Industrial Research Organisation, Australia, who also served as session chair. Additional presentations were made by Dr. Andy Hoell (Uni. Of California at Santa Barbara/USA), Dr. Nicolas Vigaud (International Research Institute for Climate and Society /USA), Dr. Jae-Kyung Schemm (National Oceanic and Atmospheric Administration /USA), Mr. Amsari M. Setiawan (Agency for Meteorology, Climatology, and Geophysics /Indonesia), Dr. Jung-lien Chu (National Science and Technology Center for Disaster Reduction /Chinese Taipei), Dr. Eun-Soon Im (Center for Environmental Sensing and Modeling /Singapore), and Prof. Dennis Lettenmaier (Univ. of Washington/USA).

The key points from this session were:

- There is a realization that drought is a very broad term and could mean different things to different people and user groups;
- The time scales under exploration varied vastly from weeks and months to years and a decadal duration and the spatial scales ranged from catchment, regions to continents;
- There is increasing evidence for long-term change in rainfall and the associated processes but it is generally difficult to identify the forcing;
- Persistent drought that occurred in countries like Australasia can be in part linked to sea surface temperature (SST) variability associated with the Pacific Decadal Oscillation;
- East Africa's long-term rain decline in the long-rain season appears to be linked to Pacific SST variability, although the pattern is not identical;
- Forcing of rainfall declines can vary significantly by seasons. At this stage, drought prediction is reasonably accurate with a one-month lag. More refined and higher spatial resolution prediction models are being attempted;
- Although long-term projection of rainfall carries significant uncertainty, we have higher confidence in projection of temperature. Rising temperature can exert a significant impact on future drought intensity and duration.

In summary, this was a great session covering droughts from various places, including Indonesia, Taiwan, Australia, US and Africa. In terms of drivers, the presentations cover El Niño-Southern Oscillation, the Indian Ocean Dipole, the Southern Annular Mode, the Pacific Decadal Oscillation, and climate change forcing.

Drought Monitoring and Information Systems

The session was held on the morning of 12 November. The keynote presentation was made by Mr. Neil Plummer of the Bureau of Meteorology, Australia, who also served as session chair. Additional presentations were made by Dr. Brett Mullan (National Institute of Water and Atmospheric Research /New Zealand), Dr. Lynette Bettio (Bureau of Meteorology/Australia), Mr. Gerhard Rappold (Gesellschaft für Internationale Zusammenarbeit/Germany), Dr. Jinyoung Rhee (APEC Climate Center/Korea), and Dr. Shinichi Sobue (Remote Sensing Technology Center of Japan/Japan).

The key points from this session were:

- Acknowledgment of the importance of SPI as a valuable indicator and the importance of maintaining a broad suite of products and indices for wide sector adoption;
- Ensuring that information systems meet information needs and provide tools to manage decision makers' risks, including interfacing with drought response plans;
- There is value in an end-to-end approach from data to information to intelligence, e.g. to maximized value from networks and data;
- Good information systems allow for greater capability to respond to questions on climate variability and change, including drought;
- There has been rapid advancement of remote sensing technologies and opportunities for leveraging from international programs and projects and, in particular, supplying drought information from data sparse regions;
- The growing importance of citizen science in weather and climate monitoring and how this can also foster better policy outcomes from deeper community engagement; and
- The enhanced value in coupling monitoring and prediction systems, e.g. the increased demand for seasonal forecasts whilst experiencing drought and the opportunities this presents for scientists and service providers to better inform critical decisions.

Perhaps the most important question posed in this session was "What are the requirements for successful drought information/early warning systems?" This is addressed further in the report below.

Utilizing Drought Information for Policy and Decision Making

The session was held on the afternoon of 12 November. The keynote presentation was made by Dr. Rajib Shaw of Kyoto University, Japan. Drs. Shaw and Mannava Sivakumar served as session co-chairs. Additional presentations were made by Dr. Mannava Sivakumar (World Meteorological Organization/Switzerland), Dr. Javed Hussain Mir (Asian Development Bank/Philippines), Dr. Royol Chitradon (Hydro-Agro Informatics Institute/Thailand), Dr. Rene Lobato-Sanchez (National Water Commission/Mexico), Dr. ByoungJae Lee (Korea Research Institute for Human Settlements /Korea), Prof. Greg Carbone (University of South Carolina/USA), and Ms. Ane Deister (Parsons Corporation/USA).

The key points from this session were:

- Efforts to address drought preparedness and management were shared from different levels of governance/community action - international initiatives to address policy issues, regional perspectives on utilizing drought information, national perspectives on addressing drought management, drought vulnerability and policy, and the use of drought information at the local level;
- Drought policy is currently a low priority in many countries, with no separate policies for drought. Even within national Disaster Risk Reduction policy, drought is typically given low priority;
- A major conclusion was the need for improved services to users, namely the provision of drought information in such a way to assist decision-making by individuals and organisations;

- Improved information services should involve appropriate engagement and better interaction between users and providers. There is a need for a much higher level of user involvement in all aspects of drought risk management, information delivery and use;
- There is a need for improvement of drought awareness, monitoring, early warning and information delivery systems, and decision support tools, along with a need for complete risk assessments of vulnerable sectors, population groups, and regions.

Panel Discussion

The panel discussion was chaired by Prof. Bin Wang, University of Hawaii, USA and featured Dr. Wenju Cai, Mr. Neil Plummer, Dr. Mannava Sivakumar, Dr. Dewi Kirono, and Dr. Dodo Gunawan. Prof. Bin Wang posed the following questions to stimulate discussion:

- What work is being done by scientists to provide reliable seasonal, intraseasonal and inter-annual forecasts for drought outlooks that can influence decision-making?
- What level of accuracy is reasonably attainable with drought prediction and how do scientists work with stakeholders to communicate forecast skill?
- How will climate change affect the severity and spatial extent of drought?
- How can we comprehensively monitor and characterize the magnitude, spatial extent, and duration of drought in a timely manner?
- What work is being done to create comprehensive and integrated drought monitoring systems? What indicators (climate, water, soil, crop, and/or economic variables) are selected for monitoring each type of drought and why?
- What are the requirements for successful drought information/early warning systems?
- What are the most effective and inventive systems for delivering and disseminating drought information to support decision-making (government agencies, agribusiness, and other relevant water-use sectors)?
- How can we move beyond reactive, post-impact emergency response drought policies and toward drought risk reduction (i.e. increased preparedness for drought episodes and mitigation against drought impacts)?

The conference presentations described the extent of existing research and scientific understanding of the processes and mechanisms that control rainfall and other variables relevant to drought in different areas and shared the ways that governments and stakeholders have begun to use drought prediction information to prepare for extreme events. Throughout the presentations and discussion, several themes began to emerge, highlighting areas of opportunity for the scientific community to support drought preparedness and management.

Development of National Drought Management Policies

Several speakers touched upon the recommendations and outputs of the High-level Meeting on National Drought Policy (HMNDP), notably Prof. Donald Wilhite in his keynote speech and Dr. Mannava Sivakumar in his presentation of the meeting outcomes. The HMNDP was organized by the WMO and the Secretariat of the United Nations Convention to Combat Desertification (UNCCD), in collaboration with a number of UN Agencies, International and Regional Organizations and key national agencies in March 2013. The need for a proactive, risk management approach to developing national drought management policies is clear. While many countries may have drought management strategies, few have covered the full spectrum from vulnerability assessments, to monitoring and early warning systems, to relief and response.

Rather than only relying on drought management plans, a policy that has been legislated and become a law is much more powerful and makes the government accountable for helping citizens cope with drought. In the Asia-Pacific region, the issue of drought gets less priority in national Disaster Risk Reduction policies due its slow/gradual onset, less frequent occurrence compared to other extreme events, and the impression that it is solely an agricultural or water resources management issue. There is a definite role for scientists to provide information to underpin and enhance the development of effective national drought policies.

Requirements for Successful Early Warning Systems

Mr. Neil Plummer analyzed the outcomes of the session on Drought Monitoring and Information Systems by returning to the key question of what elements are necessary for effective drought early warning systems. In line with the Science Document produced as part of the HMNDP, he noted that we have seen some great progress in drought monitoring systems in the past five years, especially in terms of integrating multiple climate, soil, water and crop data and parameters and improving seasonal outlooks and forecasts. However, observing networks, coordination and data sharing between institutions, vulnerability assessments, user engagement, and communication and adoption of drought information need more work. Some participants also raised the recommendation of embedding forecast information within monitoring systems, as end-users are often more interested in how the drought will continue to develop in the future, rather than real-time and past data. Both monitoring and forecast data and information are more valuable if they are integrated. Additionally, there is a need to include a broad suite of information products and/or indices to support adoption across a wide range of sectors.

Vulnerability Assessments and Socioeconomic Impact Assessments

To support the development of national drought policies, vulnerability assessments and analysis of the social impacts of drought should be conducted. Defining the areas that are most vulnerable to drought can help governments determine which areas to target for drought preparedness and relief. While drought is often acknowledged as an agricultural problem, the sectors impacted by drought (energy, transportation, tourism, health, etc.) are more diverse and complex. Comprehensive risk assessments are required to determine the vulnerable sectors, population groups, and geographic regions – we are doing the public a disservice by targeting agriculture alone.

Integrating climate information along with the socioeconomic impacts of drought gives decision-makers a better depiction of the real effects of drought and allows them to assess the cost of drought impacts versus the costs of drought mitigation. At the moment, projections of future drought under climate change are mostly projecting the physical aspects, but the socioeconomic impacts should also be included. Scientists working on more local-level projects emphasized that in addition to delivering information at the multiple time scales, drought information and impact assessments should also be provided at appropriate spatial scales.

Opportunities for User Engagement through Citizen Science

In his keynote presentation, Dr. Rajib Show noted the opportunity for the local community to contribute to drought early warning and forecasting through traditional knowledge and field observations. Prof. Donald Wilhite also mentioned the Drought Impact Reporter, a web-based

tool that allows contributors to report what is happening on the ground, and Mr. Neil Plummer commented on the thousands of volunteer rainfall collectors that assist the Australian Bureau of Meteorology. Encouraging citizen science is key to engaging communities and improving databases. Receiving information about the locally felt impacts allows scientists to assess how accurate their climate monitoring products are at reflecting local-level conditions and can allow them to hone their products to provide a more robust spatial characterization of drought.