REGIONAL COOPERATION ON DROUGHT PREDICTION SCIENCE FOR DISASTER PREPAREDNESS AND MANAGEMENT

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While there have been numerous international symposia and conferences regarding the issue of drought, few have dealt with both drought prediction and monitoring simultaneously. To connect the dots between drought prediction, monitoring, and decision making, the Asia-Pacific Economic Cooperation (APEC) Climate Symposium 2013 was held with the theme of regional cooperation on drought prediction science for disaster preparedness and management (www.apcc21.org/eng/acts/pastsym/japcc0202_viw.jsp?symp_yy=2013). 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.

Gusti Muhammad Hatta, the Indonesian minister for research and technology, opened the symposium, 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 South Korea to the Republic of Indonesia, 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.

APEC CLIMATE SYMPOSIUM 2013: REGIONAL COOPERATION ON DROUGHT PREDICTION SCIENCE FOR DISASTER PREPAREDNESS AND MANAGEMENT

What: Approximately 100 participants from academia, government, and the private sector presented research regarding innovative techniques in drought monitoring and seasonal climate prediction along with drought risk reduction and policy making at various administrative scales.
When: 11–13 November 2013
Where: Jakarta, Indonesia

In his keynote address, Donald Wilhite, professor at the University of Nebraska–Lincoln and founder of the National Drought Mitigation Center, presented a state-of-the-art system for monitoring drought conditions in the United States. He commented that governments have historically managed drought in a reactive fashion rather than taking a proactive risk-based approach. In light of the increasing frequency of extreme climate events and increased societal vulnerability to drought, he stressed the importance of breaking the "hydroillogical" cycle of crisis management and the need to adopt a new paradigm for drought management that emphasizes

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DOI:10.1175/BAMS-D-14-00049.1

In final form 26 November 2014

preparedness and risk reduction. His recommendation to promote the principles of risk management by encouraging the development of reliable seasonal forecasts, early warning and information delivery systems, and preparedness plans at all levels of government was echoed in the subsequent presentations.

The second keynote address, by Andi Eka Sakya of the Indonesia Agency for Meteorology, Climatology, and Geophysics (BMKG), focused on a potential drought monitoring information system for Indonesia. He introduced the geographical and climatological conditions of Indonesia and explained other existing information systems produced by BMKG, such as the Tsunami Early Warning System. Proposed indicators for integration into an Indonesian drought early warning system are soil moisture content, the standardized precipitation index (SPI), and the 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. Discussion during the meeting session on drought prediction across multiple time scales led to several key points being identified. First, there was a realization that drought is a very broad term and could mean different things to different people and user groups. In addition, the time scales under exploration vary vastly from weeks and months to years and decades and the spatial scales range from catchment to regions and continents. There is increasing evidence for long-term changes in rainfall and its associated processes, but it is generally difficult to identify the forcing. Persistent drought that occurred in countries like those of Australia and New Zealand, as well as on neighboring islands, can be in part linked to sea surface temperature (SST) variability associated with the Pacific decadal oscillation. Forcing of rainfall declines can vary significantly by season. At this stage, rainfall prediction is reasonably accurate with a 1-month lag. More refined and higher-spatial-resolution prediction models are being developed. Finally, although the long-term projection of rainfall carries significant uncertainty, we have higher confidence in the projection of temperature. Rising temperature can exert a significant impact on future drought intensity and duration.

DROUGHT MONITORING AND INFORMATION SYSTEMS. Key points from the meeting session on drought monitoring and the information systems used to track droughts included an acknowledgment of the importance of SPI as a valuable indicator and of maintaining a broad suite of products and indices for wide sector adoption. As well, there is a continuing effort to ensure that information systems meet information needs and provide tools to manage decision makers' risks, including interfacing with drought response plans. Good information systems allow for greater capability to respond to questions on climate variability and change, including drought. There has been rapid advancement in the remote sensing technologies used to monitor droughts, as well as opportunities for leveraging international programs and projects and, in particular, supplying drought information from data-sparse regions. Citizen science in weather and climate monitoring is growing in importance and its prominence can foster better policy outcomes from deeper community engagement. There is also enhanced value in coupling monitoring and prediction systems (e.g., the increased demand for seasonal forecasts while experiencing drought), and this presents opportunities for scientists and service providers to better inform critical decisions.

UTILIZING DROUGHT INFORMATION FOR POLICY AND DECISION MAKING. The session on policy makers and their use of drought information featured several topics of consideration. Among them, drought policy is currently a low priority in many countries, with no separate policies for drought. Even within national disaster risk reduction policies, 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 as to assist decision making by individuals and organizations. 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 in the areas of drought awareness, monitoring, early warning and information delivery systems, and decision support tools and preparedness plans, along with a need for complete risk assessments of vulnerable sectors, population groups, and regions.

EMERGING OPPORTUNITIES. 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 they 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). The HMNDP was organized in March 2013 by the World Meteorological Organization (WMO), the Secretariat of the United Nations Convention to Combat Desertification (UNCCD), and the Food and Agriculture Organization of the United Nations (FAO), in collaboration with a number of United Nations (UN) agencies, international and regional organizations, and key national agencies. It is important to develop national drought policies and preparedness plans that place emphasis on risk management rather than crisis management. While many countries may have drought management strategies, few have covered the full spectrum from vulnerability and impact assessments to monitoring and early warning systems to relief and response. In parts of 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. Neil Plummer of Australia's Bureau of Meteorology (BOM) analyzed the outcomes of the session entitled 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, as well as 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 recommended embedding forecast information within monitoring systems, as end users are often more interested in how a drought will continue to develop in the future, rather than in real time or in past data. 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. It is highly recommended that major operational centers use a multimodel ensemble technique to enhance their probabilistic drought forecasts for drought indices, including the Palmer drought severity index (PDSI), SPI, and the crop moisture index (CMI), to facilitate end users' decision making.

Vulnerability assessments and socioeconomic impact assessments. To support the development of national drought policies, vulnerability assessments and an 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.

Integrating climate information together 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 mostly address 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 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, Rajib Shaw of Kyoto University, Kyoto, Japan, noted the opportunity for the local community to contribute to drought early warning and forecasting through traditional knowledge and field observations. Wilhite mentioned the Drought Impact Reporter, a web-based tool that allows contributors to report what is happening on the ground, and Plummer commented on the thousands of volunteer rainfall collectors that assist Australia's BOM. 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.