

MEETING SUMMARIES

ADVANCING DROUGHT UNDERSTANDING, MONITORING, AND PREDICTION

BY ANNARITA MARIOTTI, SIEGFRIED SCHUBERT, KINGTSE MO, CHRISTA PETERS-LIDARD, ANDY WOOD, ROGER PULWARTY, JIN HUANG, AND DAN BARRIE

Having the capacity to monitor droughts in near-real time and providing accurate drought prediction from weeks to seasons in advance can greatly reduce the severity of social and economic damage caused by drought, a leading natural hazard for North America. The congressional mandate to establish the National Integrated Drought Information System (NIDIS; Public Law 109-430) in 2006 was a major impulse to develop, integrate, and provide drought information to meet the challenges posed by this hazard. Significant progress has been made on many fronts. On the research front, efforts by the broad scientific community have resulted in improved understanding of North American droughts and improved monitoring and forecasting

AFFILIATIONS: MARIOTTI AND BARRIE—NOAA/OAR/Climate Program Office, Silver Spring, Maryland; SCHUBERT—Global Modeling and Assimilation Office, NASA Goddard Space Flight Center, Greenbelt, Maryland; MO—NOAA/NWS/Climate Prediction Center, College Park, Maryland; PETERS-LIDARD—Hydrological Sciences Laboratory, NASA Goddard Space Flight Center, Greenbelt, Maryland; WOOD—NOAA/NWS/Northwest River Forecast Center, Portland, Oregon; PULWARTY—NOAA/OAR/Climate Program Office, Silver Spring, Maryland, and ESRL/PSD, Boulder, Colorado; HUANG—NOAA/NWS/Climate Prediction Center, Climate Test Bed, College Park, Maryland

CORRESPONDING AUTHOR: Dr. Annarita Mariotti, NOAA/OAR/Climate Program Office, 1315 East-West Highway, Silver Spring, MD 20910

E-mail: annarita.mariotti@noaa.gov

DOI:10.1175/BAMS-D-12-00248.1

In final form 22 March 2013

©2013 American Meteorological Society

NOAA DROUGHT TASK FORCE MEETING

WHAT: Over 40 participants, including Drought Task Force scientists from multiple academic and federal institutions and invitees from drought service and operational organizations, met to discuss the latest drought research advances, prospects for improving current capabilities, and outstanding research gaps.

WHEN: 25–26 October 2012

WHERE: Fort Collins, Colorado

tools. We now have a better understanding of the droughts of the twentieth century including the 1930s “Dust Bowl”; we have developed a broader array of tools and datasets that enhance the official North American Drought Monitor based on different methodologies such as state-of-the-art land surface modeling (e.g., the North American Land Data Assimilation System) and remote sensing (e.g., the evaporative stress index) to better characterize the occurrence and severity of drought in its multiple manifestations. In addition, we have new tools for drought prediction [including the new National Centers for Environmental Prediction (NCEP) Climate Forecast System, version 2, for operational prediction and an experimental National Multimodel Ensemble] and have explored diverse methodologies including ensemble hydrologic prediction approaches. Broad NIDIS-inspired progress is influencing the development of a Global Drought Information System (GDIS) under the auspices of the World Climate Research Program.

Despite these advances, current drought monitoring and forecasting capabilities still fall short of

users' needs, especially the need for skillful and reliable drought forecasts at regional and local scales. To tackle this outstanding challenging problem, focused and coordinated research efforts are needed, drawing from excellence across the broad drought research community. To meet this challenge, National Oceanic and Atmospheric Administration (NOAA)'s Drought Task Force was established in October 2011 with the ambitious goal of achieving significant new advances in the ability to understand, monitor, and predict drought over North America. The Task Force (duration of October 2011–September 2014) is an initiative of NOAA's Climate Program Office Modeling, Analysis, Predictions, and Projections (MAPP) program in partnership with NIDIS. It brings together over 30 leading MAPP-funded drought scientists from multiple academic and federal institutions [involves scientists from NOAA's research laboratories and centers, the National Aeronautics and Space Administration (NASA), U.S. Department of Agriculture, National Center for Atmospheric Research (NCAR), and many universities] in a concerted research effort that builds on individual MAPP research projects. These projects span the wide spectrum of drought research needed to make fundamental advances, from those aimed at the basic understanding of drought mechanisms to those aimed at testing new drought monitoring and prediction tools for operational and service purposes (as part of NCEP's Climate Test Bed). The Drought Task Force provides focus and coordination to MAPP drought research activities and also facilitates synergies with other national and international drought research efforts, including those by the GDIS (more information about the NOAA Drought Task Force can be found at <http://cpo.noaa.gov/ClimatePrograms/ModelingAnalysisPredictionsandProjections/MAPPTaskForces/DroughtTaskForce.aspx>).

The NOAA Drought Task Force meeting was held with the intent to assess the work status and advances after the first year of activities, develop future plans, and assess near-term research gaps (for more information regarding the Drought Task Force meeting visit <http://cpo.noaa.gov/ClimatePrograms/ModelingAnalysisPredictionsandProjections/MAPPTaskForces/DroughtTaskForce/DTFYear1Meeting.aspx>). The first day of the meeting was conducted jointly with NOAA's 37th Climate Diagnostics and Prediction Workshop in order to share Drought Task Force research with the broader community, receive feedback, and identify synergies with other activities. Day 1 included oral sessions on drought monitoring and data assimilation, drought

and hydroclimate prediction, physical mechanisms and case studies for extreme hydroclimate events, drought information and services, and an evening poster session. The multiple presentations by Drought Task Force investigators showing results from their ongoing research projects were complemented by presentations from the broader community. The second day dedicated most of its time to planning and discussion with several main goals: 1) make direct connections between the Drought Task Force participants and service organizations that have a stake in Drought Task Force research outcomes; 2) sum up year 1 Drought Task Force accomplishments and make plans for year 2; and 3) discuss near-term drought research gaps and explore linkages with the developing GDIS. Invitees of the day 2 meeting included all task force participants and selected representatives of the drought service organizations [including representatives from the Drought Mitigation Center, Regional Integrated Sciences and Assessment teams (RISAs), NIDIS pilots, and Regional Climate Centers]. Highlights of the Drought Task Force meeting outcomes are provided below.

SUMMARY OF DROUGHT TASK FORCE YEAR 1 ACTIVITIES.

As part of its year 1 efforts, the task force has developed a drought testbed framework that individual research groups can use to test/evaluate methods and ideas. Central to this is a focus on three high-profile North American droughts, which are key areas for NIDIS early warning system development (1998–2004 western U.S. drought, 2006/07 southeastern U.S. drought, and 2011/12 Texan–Mexican drought over the southern plains). The framework facilitates collaboration among projects, defines metrics to assess the quality of monitoring and prediction products, and helps to develop an experimental drought monitoring and prediction system that incorporates and assesses recent advances. Three working groups (WG) were formed to address the major aspects of the testbed: 1) WG-Metrics, to define and apply metrics to evaluate advances in drought monitoring and prediction; 2) WG-Case Studies, to analyze drought cases by integrating all aspects of drought research; and 3) WG-Experimental System, to incorporate research advances in an experimental drought monitoring and prediction system and assess improvements. To date, the Drought Task Force has proposed a *Journal of Hydrometeorology* special collection entitled “Advances in Drought Monitoring and Prediction” that will include research papers from individual task force members as well as a number of collective papers.

DROUGHT TASK FORCE PLANS. In the coming year, the Drought Task Force plans to build on the foundation of collaboration established in year 1 by continuing to press the overarching goal of evaluating drought science and by concentrating efforts in several specific areas. High-level goals include the following:

- 1) Improving our understanding of the nature of drought, its manifestations and causes, and improving narrative communication thereof (key issues include the role of soil moisture, ocean conditions, evaporative demand, land surface–precipitation–temperature relationships, and cross-temporal and cumulative aspects of drought risk).
- 2) Quantifying current monitoring and prediction capabilities and particularly improvements attributable to the Drought Task Force projects.
- 3) Identifying and investigating areas that offer the most promise for improving operational capabilities and strengthening the drought research to operations connection with active linkages in preparation for year three.

To achieve the above goals, the task force activities will be organized around specific themes consisting of 1) drought relevant science issues, 2) drought narratives, and 3) research to operational capabilities (RtC, for short). These themes recognize the multiple and important roles the Drought Task Force can play to advance drought science and service capabilities. Specific roles include 1) stimulating progress on basic drought science issues, 2) addressing the ongoing North American drought and possible future droughts to facilitate discussions on causes and develop narrative explanations thereof, and 3) assessing recent progress in drought monitoring and prediction, with an eye toward advancing operational/service capabilities, building on the metrics and case studies framework developed during year 1. The planned “narrative” activities will occur twice a year and focus on the analysis of recent past droughts and provide a venue to discuss research results regarding manifestations and scientific explanations of the droughts. The RtC activities will also take place on a six-monthly basis and in contrast to the narrative activities will focus primarily on the three historical testbed droughts selected by the WG-Case Studies and the application of the metrics agreed upon by the WG-Metrics to provide a benchmark against which to test new operational and service capabilities. The Drought Task Force narrative activities will result in

drought reports describing and explaining, from a research perspective, recent past droughts. The findings from the RtC activities will be summarized in an RtC report, a “living document” assessing progress in capabilities that will be regularly updated.

NEAR-TERM RESEARCH GAPS. Attendees discussed near-term drought research gaps and potential future research directions focusing on drought 1) understanding, 2) monitoring, 3) prediction, and 4) improving drought information systems. Questions that stimulated discussion included: What are the current gaps in understanding the mechanisms that control the development (onset, duration, demise, intensity, and frequency) of U.S. drought in its various manifestations? Are there gaps in current capabilities to monitor U.S. drought? How does our prediction skill compare with expected predictability over the United States? What are the most promising new methodologies, models, and observations to be explored to improve drought prediction? What are the gaps in current leading drought information (monitoring and prediction) systems contributing to NIDIS? Which of these gaps are “science limited” and requiring research? What major contributions can the Drought Task Force bring in the broader international context? A collective Drought Task Force paper, in preparation for the *Journal of Hydrometeorology* special collection, will summarize major outcomes of this discussion.

Overall, the meeting represented an important milestone for the NOAA Drought Task Force. It helped assess progress since its inception and reinforce collaborations among Drought Task Force participants and make new connections within and outside of the task force. It provided a major push toward formulating a plan forward for the group that takes into account diverse input, including that of the drought research stakeholders and individual scientists involved in the research, hence building upon the foundation of user requirements, impacts assessments, applications, and on-going research projects.

ACKNOWLEDGMENTS. The Drought Task Force meeting organizers would like to thank the organizers of NOAA’s 37th Climate Diagnostics and Prediction Workshop, especially Wayne Higgins and Mike Halpert of the NOAA Climate Prediction Center. They would also like to thank the staff that worked to prepare the meeting and provide logistical support: Amy Butler and Melissa Ou from the Climate Prediction Center, Joanne Divico from Colorado State University, and William Chong from the Climate Program Office.