NATIONAL ACADEMIES Sciences Engineering Medicine

Division on Earth and Life Studies
Water Science and Technology Board (WSTB)
Board on Atmospheric Sciences and Climate (BASC)

Drought in a Changing Climate

PROJECT CONTEXT

Drought can have a devastating effect on critical societal sectors such as agriculture, transportation, commerce, human and environmental health, and energy production. To anticipate and respond to these impacts, tools for monitoring and assessing water availability have been developed, underpinned by scientific research of drought drivers. In the United States, a robust network of drought monitoring and response mechanisms are available through programs such as the U.S. Drought Monitor, observation networks from NOAA and the Natural Resources Conservation Service, and remotely sensed platforms such as MODIS.

Probabilities and intensities of extreme drought events are changing beyond historical variability due to climate change, which affects factors such as precipitation distribution and intensity, temperature, and snowpack. This non-stationarity relative to past patterns affects current and future water use practices, as well as methods for assessing and predicting water availability and drought risk. With such a complex set of drivers for drought conditions, distinguishing between natural variability and alterations due to climate change remains challenging.

Water deficits vary over time and extent, challenging the assessment and characterization of droughts. Differentiating drought categories (e.g., drought, megadrought, aridification) conveys important information for near- and long-term planning, but there is currently no framework for quantifying drought conditions across this continuum.[1]

Near- and long-term decision-making, investments in infrastructure and development, and public policy responses to drought impacts depend on valid and useful drought assessment information. Robust data sources, metrics, methods, and systems exist for current drought monitoring and assessment. Data sources used in drought assessment range from paleoclimate records to in-situ real-time measurements of atmospheric and terrestrial conditions. Non-stationarity introduces fundamental questions for existing approaches of assessing drought risk using historical and current data and conditions, including identifying appropriate periods of record for analysis, model calibration, and indicator definition and development.

[1] Parker, B.A., J. Lisonbee, E. Ossowski, H. R. Prendeville, and D. Todey (2023). Drought Assessment in a Changing Climate: Priority Actions and Research Needs. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of Oceanic and Atmospheric Research, National Integrated Drought Information System. NOAA Technical Report OAR CPO-002. Doi: 10.25923/5zm3-6x83

In 2023, NOAA's National Integrated Drought Information System (NIDIS) and the USDA's Climate Hubs convened a workshop to consider the challenge of non-stationarity to drought monitoring and assessment.[1] Workshop participants identified priority actions and research needs across fifteen focus areas related to drought under a changing climate, including benchmarking, changing physical drivers of drought and aridification, spatial variation in non-stationarity, data, and drought indicators. One of these priority actions is a call for a National Academies study to benchmark current understanding of drought in a changing climate.

STUDY APPROACH

Statement of Task

The National Academies of Sciences, Engineering, and Medicine will convene an ad hoc committee to consider approaches for drought characterization, assessment, and response under a changing climate.

More specifically, the study will:

- Review existing and emerging approaches, both nationally and globally, for incorporating non-stationarity and climate change in drought assessment. Contrast these approaches with those of other natural hazard assessments. Are there best practices that can be applied to drought management? Are some approaches more appropriate for specific regions and/or time periods?
- Discuss the drought-to-aridification continuum and differentiate among drought, multidecadal drought, and aridification. How do factors such as periods of record, drought type, regionality, and seasonality affect these classifications? How do current periods of record affect drought outlooks and predictions?
- How could drought assessments that better incorporate climate change and non-stationarity improve decision-making in impacted sectors (e.g., disaster response, drought assistance, cities/urban water systems, ecosystems)?
- Discuss metrics and indicators used in drought assessment and identify opportunities to inform decisionmaking, including increasing integration of non-stationarity and incorporating uncertainty and/or confidence.
- Evaluate data sources currently used for drought assessment. What data will be needed to address non-stationarity? What methodologies can be used to improve drought assessment under a changing climate?

The committee will recommend a framework for incorporating non-stationarity considerations into drought assessment in a changing climate, for use across a range of geographic regions and of spatial and temporal scales and to inform decision-making for short-term risk management and long-term adaptation.

Work Plan and Timeline

This study will be conducted by an ad hoc committee of approximately 8-10 members who will be responsible for gathering and reviewing relevant literature and using its expert judgment to synthesize this information into a consensus report. The committee will include expertise in fields such as hydrology, dynamical and statistical meteorology, climatology including climate variability and climate change, weather and climate modeling, statistics, paleoclimatology, sociology, and economics. The final product is a report that will provide actionable recommendations that can be used by federal agencies, states, and other stakeholders in drought monitoring and response.

The consensus study process begins with a public call for nominations that leads to a provisional committee. The committee undergoes a thorough vetting for conflict of interest and bias. Once appointed, the committee holds a number of public information-gathering meetings, as well as closed sessions for deliberation and writing. The draft report undergoes an external peer review and is revised in response to those comments. The final report is publicly released and freely available for download.

Consensus Study Budget: The budget for this 24-month project is estimated at $775,000, of which NOAA has already committed $500,000. We are seeking additional partners to contribute to the study budget.

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