

The US CLIVAR Working Group on Long-term Drought

US CLIVAR recently formed a Working Group to provide funding agencies and existing scientific steering groups with specific guidance on research needs for improving prediction and monitoring tools for long-term (multi-year) droughts. Such droughts have tremendous societal and economic impacts on the United States, and many other countries throughout the world. Estimates of the costs of drought to the United States alone range from \$6-\$8 billion annually with major droughts costing substantially more (e.g., \$62B in 1988 according to NOAA). The Dust Bowl drought of the 1930s, which at its maximum extent covered much of the continental U.S. (Fig. 1) is ranked as one of the top 10 domestic weather-related disasters of the 20th century (reference for this?). Recent population increases in water-limited regions has increased vulnerability to drought at the same time that climate change projections suggest that drought conditions may become more extreme in the 21st Century, particularly in the southwestern United States (NRC, 2007).

Several agencies including NOAA and NASA are in the planning phase for implementing the National Integrated Drought Information System (NIDIS, 2004). The NIDIS authorization bill was signed into law by the President in December 2006. The vision for NIDIS is a dynamic and accessible drought risk information system that provides users with the ability to determine the potential impacts of drought, and the decision support tools needed to better prepare for and mitigate the effects of drought. As the designated lead agency, NOAA is developing an interagency implementation plan. NASA is also engaged in planning for NIDIS as part of an overall strategy to implement key aspects of the international Global Earth Observation System of Systems (GEOSS) strategic plans. The U.S. Integrated Earth Observing System Strategic Plan (IEOS, 2005), this nation's contribution to the GEOSS 10-Year Implementation Plan, has embraced NIDIS as one of six high priority Near Term Opportunities.

While NIDIS has a strong focus on the U.S., it is clear that drought is a global phenomenon, both in terms of the forcing elements and the potential commonality of local processes that operate to make some regions more susceptible to drought than others. As such, confidence in our understanding of drought processes (remote and local forcing, feedbacks, etc.) will be significantly advanced by efforts to properly analyze and simulate regional drought wherever it occurs. Recent studies (e.g., Hoerling and Kumar 2003; Schubert et al. 2004; Seager et al. 2005) suggest that such simulations are feasible using current global models (Fig. 2). There are, however, still major uncertainties about the relative roles of the different ocean basins, the strength of the land-atmosphere feedbacks, the role of deep soil moisture, the nature of long-term SST variability, the impact of global change, as well as fundamental issues about predictability of drought on multi-year time scales.

This more general approach to the long-term drought problem requires advanced global modeling and data assimilation capabilities, as well as global observational data sets for monitoring and diagnosing drought, and validating and initializing models. US CLIVAR can play an important role in advancing these capabilities and integrating research on long-term drought into operational prediction and NIDIS-related planning efforts.

The primary objective of the US CLIVAR Working Group is to facilitate progress on the

understanding and prediction of long-term (multi-year) drought over North America and other drought-prone regions of the world, including an assessment of the impact of global change on drought processes. The specific tasks of the Working Group will be to: 1) coordinate and encourage the analysis of observational data sets to reveal antecedent linkages of multi-year droughts; 2) propose a working definition of drought and related model predictands of drought, 3) coordinate evaluations of existing relevant model simulations, 4) suggest new experiments (coupled and uncoupled) designed to address some of the uncertainties mentioned above, and to contribute to NIDIS-related drought risk assessment; 5) examine the prospects for using land data assimilation products for operational monitoring, assessment and hydrological applications; and 6) organize a community workshop in 2008 to present and discuss the results.

As initial products, the Working Group is compiling a list of recent papers on drought research, and an inventory of accessible data sets for observational studies. These products (still under development) can be obtained through the Working Group's web page at <http://www.usclivar.org/Organization/drought-wg.html>. The Working Group has also initiated discussion of a working definition of drought (including onset and demise) for use by both the prediction/research and applications communities. The goal of this effort will be to define drought in a way that is quantifiable and verifiable for the purpose of model prediction experiments, as well as for drought monitoring and early warning, and facilitating communication between the applications and modeling/research communities.

The working group will help coordinate key aspects of the long-term drought research agenda outlined in the recent drought workshop recommendations (e.g. Schubert et al. 2005). It will interact with the developing NIDIS program to communicate current drought prediction and attribution capabilities. The Working Group will work with the NIDIS community and the relevant funding agencies to develop guidance on drought research needs, based on assessments of prediction capabilities and input we will seek concerning stakeholder-driven prediction priorities. It will advocate the coordination of efforts among the agencies to advance drought prediction research in ways that will maximize the utility for NIDIS development.

The long-term drought problem can be an important umbrella issue to bring together the relevant research expertise of the International CLIVAR program (with its focus on large scale and ocean-atmosphere coupling), and GEWEX (focusing on regional scales and land-atmosphere coupling). To understand the mechanisms that maintain drought across the seasonal cycle and from one year to the next requires activities that span CLIVAR and GEWEX. What is the role of the land (e.g., deep soil moisture, snow, vegetation)? What is the role of the different ocean basins, including the impact of ENSO, the PDO, the AMO, and warming trends in the global oceans? To what extent can drought develop independently of ocean variability due to year-to-year memory inherent to the land?

The Working Group will recommend and promote a set of idealized experiments coordinated among different models to address some of the key issues outlined above (e.g., role of different ocean basins, deep soil moisture, etc.). Specific details about the experiments and diagnostic analyses are

beginning to be developed. The Working Group will coordinate with research institutes and universities active in drought research to ensure that the relevant simulations are well documented and accessible to the community.

New simulations will build upon the climate variability and change attribution activities funded by NOAA/CDEP, the attribution and prediction capabilities at various universities and research institutes, and take advantage of the many long term coupled model runs that have been conducted as part of the IPCC climate change assessment process. The upcoming DRICOMP model assessment research opportunity represents an important component of this effort.

References

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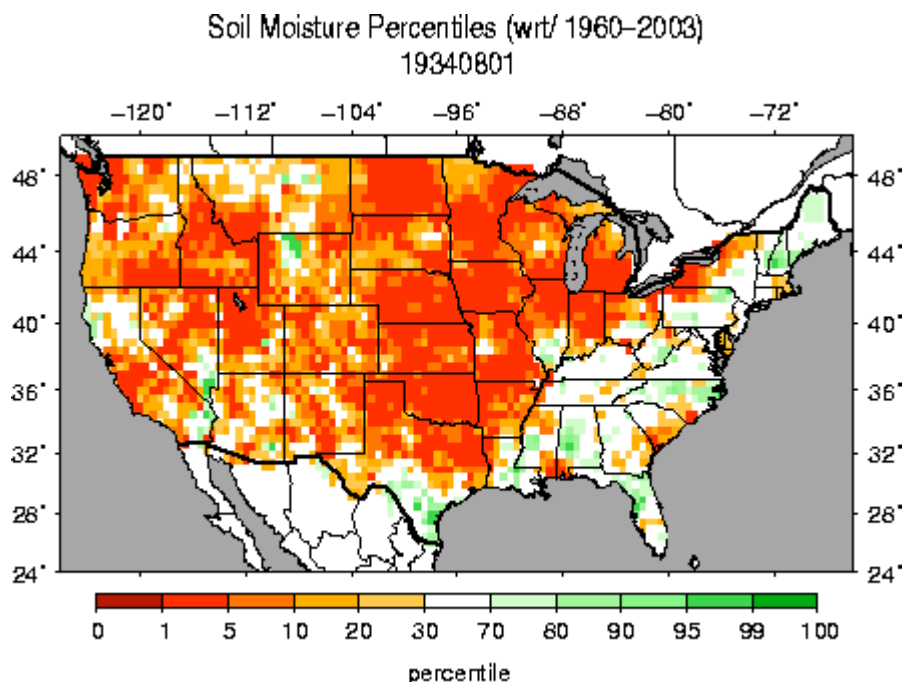


Figure 1. Spatial extent of the Dust Bowl drought of the 1930s in August 1934. Percentiles are for soil moisture relative to the 85-year period 1915-2003. From University of Washington Surface Water Monitor, available online at: <http://www.hydro.washington.edu/forecast/monitor>.

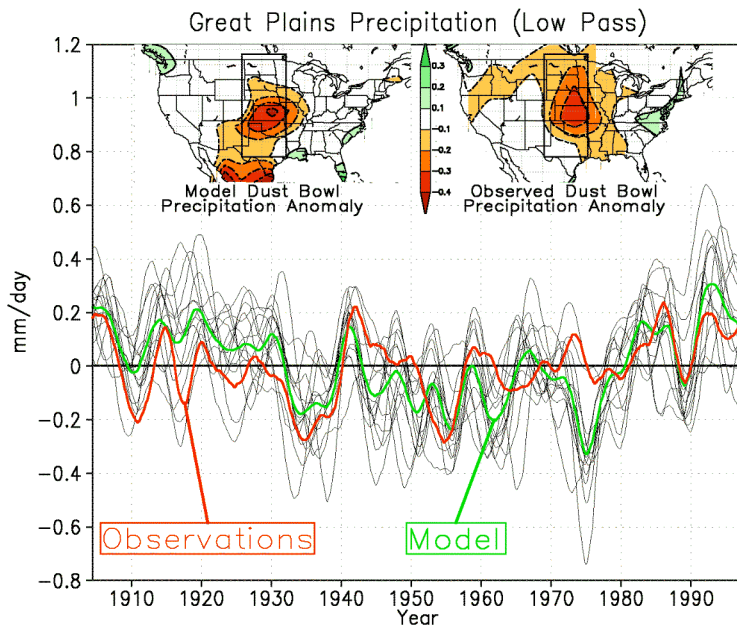


Figure 2. Time series of precipitation anomalies averaged over the U.S. Great Plains region (30°N to 50°N, 95°W to 105°W), from Schubert et al. (2004). A filter has been applied to remove time scales shorter than about 6 years. The thin black curves are the results from 14 ensemble members from C20C global model runs. The green solid curve is the ensemble mean. The red curve is based on observations. The maps show the simulated (left) and observed (right) precipitation anomalies averaged over the Dust Bowl period (1932 to 1938, units mm/day).

