US CLIVAR
DROUGHT WORKING GROUP PROSPECTUS

16 July 2006

I. Motivation and Timing

Drought, especially prolonged multi-year drought, has 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., $39B in 1988).

In April 2003 the Western Governors in partnership with NOAA wrote a report, *Creating A Drought Early Warning System for the 21st Century: The National Integrated Drought Information System (NIDIS, 2004)*. The basic idea behind NIDIS is that with increasing vulnerability to drought, a shift is needed to a risk-based approach aimed at better monitoring, early warning and prediction of drought. A risk-based approach will encourage wiser stewardship of our agricultural lands, forests and water resources.

Both NOAA and NASA are in the planning phase for NIDIS. In particular, NOAA (as the designated lead agency) is developing an interagency implementation plan. NASA, in coordination with NOAA, 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. In fact, the U.S. integrated Earth Observing System Strategic Plan (IEOS, 2005), as this nations contribution to the GEOSS 10-Year Implementation Plan, has embraced NIDIS as one of 6 high priority Near Term Opportunities (NTOs).

As part of the planning for NIDIS, the agencies are looking to the research community for specific guidance on research priorities for improving drought prediction and monitoring tools. In that regard, NOAA and NASA recently funded a workshop on drought prediction[1]. Results presented at the workshop indicate that a shift to risk management incorporating climate prediction is now feasible because research has advanced to the point that 1) the causes of multiyear droughts are being unraveled and 2) skillful probabilistic forecasts of precipitation and soil moisture can be performed on the seasonal to interannual timescale. Subsequent work has shown that tropical SSTs are important for forcing the continental circulation anomalies associated with drought, thereby reinforcing the hope that drought conditions (potentials) can be predicted (nowcasted) with useful lead times on interannual and longer timescales.

II. Objectives

The primary objective of this working group is to facilitate progress on the understanding and prediction of long-term (multi-year) North American drought, including an assessment of the impact of global change. The working group will help coordinate key aspects of the long-term drought research agenda outlined in the recent drought workshop recommendations, and will

[1] S. Schubert, R. Koster, M. Hoerling, R. Seager, D. Lettenmaier, A. Kumar, and D. Gutzler, 2005: Observational and Modeling Requirements for Predicting Drought on Seasonal to Decadal Time Scales, Available at: http://gmao.gsfc.nasa.gov/pubs/

interact with the developing NIDIS program to communicate current drought prediction and attribution capabilities, provide input to NIDIS research planning, and ensure relevance to the NIDIS user communities.

As mentioned above, we are now beginning to develop a physical understanding of the causes of long-term drought in a number of regions around the world. 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 these long time scales. While modeling studies will play a key role in addressing these issues, it is important to also encourage continued observationally-based studies of previous droughts to suggest mechanisms and validate model simulations. *The working group will help focus modeling and observational studies to address these issues: activities that span a number of major modeling groups, universities, and programs including US CLIVAR and GEWEX.* In fact, we believe that the long-term drought problem can be an important umbrella issue to bring together the relevant research expertise of the US CLIVAR program (focus on large scale and ocean-atmosphere coupling), and GEWEX (focus on regional scales and land-atmosphere coupling).

Specifically, we will focus attention on the mechanisms that maintain drought from one year to the next. 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? We will examine the extent to which droughts can develop independently of ocean variability due to year-to-year memory that maybe inherent to the land. We will also work towards developing a working definition of drought (onset and demise) that is useful to 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. We believe that having a good working definition of drought is critical for making progress in a number of areas, including model validation ad intercomparison, drought monitoring and early warning, and facilitating communication between the applications and modeling/research communities.

The specific tasks of the working group will be to 1) propose a working definition of drought and related model predictands of drought, 2) facilitate the evaluation of existing relevant model simulations, 3) suggest new experiments (coupled and uncoupled) designed to address some of the outstanding uncertainties mentioned above, 4) coordinate and encourage the analysis of observational data sets to reveal antecedent linkages of multi-year droughts and 5) organize a community workshop to present and discuss the results. We will work with key NIDIS stakeholders (as represented in the NIDIS implementation and planning activities including state climatologists, water managers, etc.) and the greater research community to define drought in a way that is useful to both the modeling communities and real world monitoring and other user communities with a particular focus on quantifying the onset and demise of drought conditions. We will work with the national labs, various research institutes and universities (e.g., GMAO/NASA, GFDL/NOAA, NCEP/NOAA, NCAR, COLA), to ensure that the relevant simulations are well documented and accessible to the community. We 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 IPCC. We will work and coordinate with interested researchers and groups (e.g. NCAR CVWG, C20C project) to simulate past-long term droughts, and to develop a set of idealized experiments with a number of different models that are designed to address some of the

key issues outlined above (e.g., role of different ocean basins, deep soil moisture, etc.). The results of our activities will be presented and discussed at a workshop that will be held near the end of the two-year term of this working group.

A. Timeline/Activities

- 26-28 July 2006 US CLIVAR Summit – present prospectus to panels
- August – finalize membership and prospectus, first telecon to begin planning experiments, discuss roles and activities
- Monthly Telecons: progress on coordination, experiments, develop drought definition – include key members of the NIDIS planning and implementation teams
- 11-15 Dec 2006 – Special Session at AGU on drought (with Jin Huang, Ronald Stuart, Miguel Cortez)
- Spring 2007 – WG meeting engaging NIDIS and GEWEX – discuss progress on experiments and drought definition
- Spring 2008 - drought workshop/WG meeting
- Spring 2008 – write workshop report

B. Anticipated Outcomes and Benefits to US CLIVAR

US CLIVAR will play a key role in enabling long-term drought research by coordinating and defining model experiments, assessing existing experiments, interacting with and contributing to NIDIS research planning, and developing a working definition of drought that is useful to both the research/prediction and applications communities.

III. Publication and Outreach

Website – summarize monthly activities
Summary of relevant simulations
One article to US CLIVAR Variations newsletter
Workshop report

IV. Reporting Plan

Based on the US CLIVAR Summit and the Panel TOR, we see the greatest relevance of the drought WG to the PPAI and POS panels. Thus, we propose to report our progress to, as well as seek support through, both of these panels. In addition, we propose to report progress at the annual US CLIVAR executive/summit meeting. We will also provide reports to the relevant entities within GEWEX and NIDIS in order to convey progress as well as to entrain partnership and engagement.

V. Suggested Leadership and Membership

Siegfried Schubert – NASA/GMAO drought activities, link to NIDIS
Dave Gutzler – University of New Mexico, observations/analysis of drought, link to NIDIS
Marty Hoerling – NOAA/CDC attribution

Arun Kumar – NOAA/CPC attribution, prediction
Randy Koster –NASA/GMAO, soil moisture and land-atmosphere interactions
Mingfang Ting - LDEO/Columbia University, drought diagnostics
Bradfield Lyon – IRI, drought diagnostics, applications
Tom Delworth – GFDL, coupled model simulations, climate change and drought
Richard Seager – LDEO/Columbia University, prediction/attribution
Dennis Lettenmaier – University of Washington, hydrology, experimental prediction
Sumant Nigam – University of Maryland, observations/analysis of drought
Ning Zeng – University of Maryland, carbon cycle/vegetation-climate interaction
Jonathan Overpeck – University of Arizona, paleoclimatic studies

VI. Resources

2 WG meetings
1 workshop
1 newsletter article
1 workshop report

VII. Proposed Period of WG

August 2006 to July 2008