US CLIVAR
DROUGHT WORKING GROUP PROSPECTUS

12 December 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). 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.

In April 2003 the Western Governors' Association, in partnership with NOAA, wrote a report entitled *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 drought policy should shift toward a proactive, risk-based approach based on 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 as mandated by the recent passage of NIDIS-enabling legislation by both houses of Congress. 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. 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 6 high priority Near Term Opportunities (NTOs).

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 simulate regional drought where ever it occurs. This more general approach to the 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.

The Working Group proposed here will provide funding agencies and existing scientific steering groups with specific guidance on research needs for improving drought prediction and monitoring tools. Such guidance should include information on how funding agencies can best coordinate existing drought-related research, as well as an assessment of the important missing research elements. In that regard, NOAA and NASA recently supported a workshop on drought prediction[1]. Results presented at the workshop indicate that a shift to risk management incorporating climate

[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/

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 can be predicted 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) 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 working group will help coordinate key aspects of the long-term drought research agenda outlined in the recent drought workshop recommendations. **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. We will advocate the coordination of efforts among the agencies to advance drought prediction research in ways that will maximize the utility for NIDIS development.**

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 across the seasonal cycle and 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 and 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) coordinate evaluations 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 coordinate with the national labs, various research institutes and universities (e.g., GMAO/NASA, GISS/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 the IPCC climate change assessment process.

We will collaborate 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.). Specific details about the experiments and diagnostic analyses will be developed during the initial meetings (most likely teleconferences) of the working group. The model experiments need to be scientifically useful and, as much as possible, aligned with existing efforts of the major modeling centers, since it is unlikely that there will be time for the groups to obtain substantial additional resources. In that regard, it is important that the modeling groups that are most likely to contribute to this effort be represented on the working group.

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
- Aug-Oct 2006 – 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 in DC area 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 both of these panels and seek their advice and support. 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

The following lists the proposed membership of the working group. While it is a rather large group, we believe it is indicative of the scope of the problem and the strong interest in drought by the research community. We encourage the working group members to include any junior colleagues (e.g., graduate students and post docs) to participate in all aspects of the working group's activities. We also include a few researchers from outside the U.S. (or in the case of the IRI, within the U.S., but focusing on international activities) to ensure a global perspective on the drought problem. We include them as Ex Officio members mainly because we anticipate very limited resources for travel, and interactions with them may be on a rotating basis.

<u>US Membership:</u>

Siegfried Schubert – NASA/GSFC - cochair
Dave Gutzler – Univ New Mexico - cochair
Marty Hoerling – NOAA/CDC
Arun Kumar – NOAA/CPC
Randy Koster – NASA/GSFC
Sumant Nigam - Univ Maryland

Mingfang Ting – Columbia Univ/LDEO
Tom Delworth – NOAA/GFDL
Richard Seager - Columbia Univ/LDEO
Wayne Higgins – NOAA/CPC
Kingtse Mo – NOAA/CPC
Roger Pulwarty – NIDIS Director
David Rind – NASA/GISS
Ning Zeng – Univ of Maryland
Dennis Lettenmaier - Univ of Washington
Rong Fu - Georgia Institute of Technology

International Membership: Ex Officio

Ronald Stewart - Canada
Victor O. Magaña - Mexico
Jozef Syktus – Australia
Bradfield Lyon -link to IRI activities

VI. Resources Requested

2 WG meetings
1 workshop
1 newsletter article
1 workshop report

VII. Proposed Period of WG

November 2006 to October 2008