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UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

**SUBSIDIARY BODY FOR SCIENTIFIC AND TECHNOLOGICAL ADVICE**

**Twenty-sixth session**

**Bonn, 7–18 May 2007**

**Item 3 of the provisional agenda**

**Nairobi work programme on impacts, vulnerability and adaptation to climate change**

## **Relevant programmes, activities and views on the issues relating to climate related risks and extreme events**

### **Submissions from Parties**

#### **Addendum**

1. In addition to the ten submissions contained in document FCCC/SBSTA/2007/MISC.4, one further submission has been received.
2. In accordance with the procedure for miscellaneous documents, this submission is attached and reproduced\* in the language in which it was received and without formal editing.

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**FCCC/SBSTA/2007/MISC.4/Add.1**

GE.07-61239

## SUBMISSION FROM THE UNITED STATES OF AMERICA

### **Submission by the United States of America on assessment and management of current and future climate-related risks and impacts, including those related to extreme events and in specific sectors**

The United States undertakes a number of activities, both at home and abroad, that are advancing our understanding of climate-related risks and extreme events and strengthening the infrastructure required to address these risks. Some of these activities build on our extensive experience managing the risks of climate variability and extremes that have been a mainstay of our national weather prediction, preparedness and response system. Others are specifically undertaken to address climate change risks, future impacts and extreme events. We believe these examples to be relevant to the SBSTA's consideration of scientific and technical responses to climate risks and extreme events even though some are drawn from a body of experience not specifically undertaken to address climate change as defined by the UNFCCC.

#### **THE U.S. CLIMATE SCIENCE PROGRAM**

##### ***Experience with assessment and management of current and future climate-related risks and impacts, including those related to extreme events and in specific sectors:***

The U.S. Climate Change Science Program (CCSP) recognizes the importance of determining how extreme events, such as droughts, floods, wildfires, heat waves, and hurricanes, are related to climate variability and change. Research supported by the CCSP has played a leading role in scientific advances, which have not only improved understanding of Earth system processes that underlie such variability and change, but also provided new climate information to help society better anticipate and prepare for potential effects of climate variability and change.

While progress in this area has been impressive, there still remain many unresolved questions about key aspects of the climate system, including some that have enormous societal and environmental implications. For example, we are just beginning to understand how climate variability and change influence local and regional occurrence and severity of extreme events such as hurricanes, floods, droughts, and wildfires.

One of the highest priorities for decision makers is to determine how climate variations, whether natural or human-induced, alter the frequencies, intensities, and locations of extreme events. There is now compelling evidence that some natural climate variations, such as ENSO, PDO, and the NAO, can significantly alter the behavior of extreme events, including floods, droughts, hurricanes, and cold waves. Studies of long-term trends in extreme events show that in many regions where average rainfall has been increasing, these trends are evident in extreme precipitation events (there continues to be debate on how to define such an event). For other high-impact phenomena, such as tropical storms/hurricanes, no compelling evidence yet exists for significant trends in frequency of occurrence.

##### ***Gaps, Needs, Opportunities, Barriers and/or Constraints:***

A question central to both short-term climate predictions and longer term climate change is how climate variability and change will alter probability distributions of various quantities, such as of temperature and precipitation, as well as related temporal characteristics (e.g., persistence), and hence the likelihood of extreme events. A key challenge is to develop improved methods for modeling and for downscaling climate information to the scales required for extreme event analysis. Furthermore, understanding of the processes by which climate variability and change modulate extreme event behavior is incomplete. Because the natural modes of climate variations may be altered by human influences, it is important to understand this connection to be able to predict the future behavior of extreme events.

The CCSP has identified the following as key scientific research questions:

- What is the range of natural variability in extreme events, by phenomena and region?
- How do frequencies and intensities of extreme events vary across time scales?
- What are observed and modeled trends in extreme events and how do they compare?
- How are the characteristics of extreme events changed by natural climate variations, for example, by ENSO, PDO, and NAO?
- To what extent are changes in the statistics of extreme events predictable?
- How are behaviors of extreme events likely to change over this century, and what are the mechanisms that would be expected to produce these changes?
- How can the emerging findings on climate-extreme event links be best developed and communicated to evaluate societal and environmental vulnerability and opportunities?

By engaging in activities that target climate risks and extremes, the CCSP anticipates the following results:

- Improved diagnostic capabilities to better interpret the causes of high-impact climate events, such as droughts or unusually cold or warm seasons
- Assessments of potential predictability and forecasts of probabilities of extreme events associated with natural climate variations.
- Focused research on variations and changes that generate conditions favorable for extreme events, assess the predictability of these events, and develop products useful for applications (e.g., extreme event outlooks) on seasonal and longer time scales.
- Documented impacts of climate extremes on regions and sectors, and evaluations of the implications should climate change in the future.
- Policy-relevant information on past variability and trends in extreme events, and probabilistic estimates of possible future changes in frequencies, intensities, and geographical distributions of extreme events in support of national and international assessments
- Improved anticipation of and response to extreme climate events (e.g., to reduce regional impacts of ENSO or more rapidly respond to emerging droughts)
- Increased understanding of and capabilities to project the regional manifestations of extreme climate events, to provide a sounder scientific basis for policymakers to develop strategies to minimize potential vulnerabilities.

**BOX: Climate Change Science Program (CCSP) Synthesis and Assessment Product Development:**

Currently, development of CCSP Synthesis and Assessment Product 3.3: "Weather and Climate Extremes in a Changing Climate" is on schedule to meet an approved target publication date of April 2008. An initial workshop was organized in July 2005 to bring together a number of leading scientists in the area of climate extremes and members of key segments of the stakeholder community. This workshop helped to frame the critical issues related to this synthesis and assessment.

An independent workshop, convened in October 2005, assembled climate scientists and insurers/reinsurers to assess the current state of knowledge of climate extremes. The meeting addressed anticipated changes in the frequency of extreme events in response to global warming; whether these changes could be bounded; and the observations needed to improve our knowledge. Hurricanes were of particular interest because of recent, very active seasons and the large impact on the insurance industry.

These workshops have helped to galvanize the CCSP Product 3.3 activity and identify experts to participate in this activity. The Prospectus for this Product is available online at <http://www.climate.noaa.gov/index.jsp?pg=../ccsp/33.jsp>. The first draft of the report has been presented to a National Research Council (NRC) panel established to review and comment on the content.

Other CCSP synthesis and assessment products will address state-of-the-art knowledge on ecosystem impacts. These products include: S&A Product 4.2- State-of-knowledge of thresholds of change that could lead to discontinuities in some ecosystems and climate-sensitive resources and S&A Product 4.3 - The effects of climate change on agriculture, biodiversity, land, and water resources.

In addition, CCSP S&A Product 4.6, - Analyses of the effects of global change on human health and welfare and human systems, will, in part, report on the potential human health effects of global environmental change, and on the climate, socioeconomic, and environmental information that is needed to assess the cumulative risk to health in the United States from these effects. It will also provide information on adaptations in the provision of public health and health care interventions. CCSP S&A Product 4.1 - Coastal elevations and sensitivity to sea level rise will synthesize information from ongoing mapping efforts by federal and non-federal researchers related to the implications of rising sea level.

## **THE U.S. ENVIRONMENTAL PROTECTION AGENCY**

### **EPA Global Change Research Program**

The primary emphasis of this U.S. Environmental Protection Agency (EPA) assessment-oriented program is understanding the potential consequences of climate variability and change on human health, ecosystems, and socioeconomic systems in the United States. This work entails (1) improving the scientific basis for evaluating the effects of global change in the context of other stressors and human dimensions (as humans are catalysts of and respond to global change), (2) conducting assessments of the risks and opportunities presented by global change, and (3) assessing adaptation options to improve society's ability to effectively respond to those risks and opportunities as they emerge. EPA's intramural assessment program has four areas of emphasis: (1) human health, (2) air quality, (3) water quality, and (4) ecosystem health. In an attempt to capitalize on expertise in the academic community, a significant portion of the program's resources are dedicated to extramural research grants administered through EPA's STAR (Science to Achieve Results) grants program, which supports science related to assessments of consequences of global change and human dimensions research.

EPA programs, in conjunction with other federal agencies, have produced a decision-support tool for addressing "excessive heat events" (EHEs): the Excessive Heat Events Guidebook. The guidebook provides interested public health officials with information on risks and impacts from EHEs, including guidance on EHE forecasting and identification. It also provides a menu of notification and response actions to consider when developing or enhancing a local EHE program based in part upon a review of various EHE response programs.

## **THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)**

### **NASA Applied Sciences Program**

This program benchmarks practical uses of NASA-sponsored observations from Earth observation systems and predictions from Earth science models. NASA implements projects that carry forth this mission through partnerships with public, private, and academic organizations developing innovative approaches for using Earth system science information to provide decision support that can be adapted in applications worldwide. The program focuses on applications of national priority to expand and accelerate the use of knowledge, science, and technologies resulting from the NASA goal of improving predictions in the areas of weather, climate, and natural hazards.

## **THE NATIONAL SCIENCE FOUNDATION (NSF)**

### **NSF Decision Making Under Uncertainty Research Teams**

The National Science Foundation (NSF) supports five interdisciplinary research teams studying decisions under uncertainty that may benefit from climate-change information. The increased knowledge generated by recent scientific research on the causes and consequences of climate change and variability has led to a growing need to better understand how decision makers can incorporate climate change into a variety of significant decisions. These teams are expected to produce new insights of interest to the academic community, generate significant educational benefits, and develop new tools that will benefit decision makers and a range of stakeholders. Larger research teams are at Arizona State, Carnegie Mellon, and Columbia Universities. Smaller teams are at the University of Colorado at Boulder and the Rand Corporation in Santa Monica, California.

## **THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)**

The U.S. National Oceanic and Atmospheric Administration (NOAA) has established climate as one of its four major goal areas. NOAA's climate mission is to: "Understand and describe climate variability and change to enhance society's ability to plan and respond". NOAA's long-term climate effort are designed to develop a predictive understanding of variability and change in the global climate system, and to advance the application of this information in climate-sensitive sectors through a suite of process research, observations and modeling, and application and assessment activities.

The NOAA Climate Program Office is the agency's focal point for climate activities. It coordinates climate-related activities across all of NOAA, sponsors research and activities that respond to society's need for climate products and services, sponsors climate education and outreach activities, and coordinates NOAA's international climate activities.

The following NOAA activities are focused on the assessment and management of climate risks and extremes:

### **Climate Change Data and Detection (C2D2)**

***Experience with assessment and management of current and future climate-related risks and impacts, including those related to extreme events and in specific sectors:*** The C2D2 Program studies weather and climate extremes and their changing character, using both observational and model data (e.g., changes in weather extremes, sea ice extent, glacier volumes, sea level rise, etc.). Using paleoclimate research, C2D2 is seeking to identify and characterize historical extreme events that have severely stressed human or natural systems (e.g., the onset, duration, frequency, intensity, and decline of droughts or mega droughts, the frequency and intensity of tropical storms) and their variability, identify the space and time scales of extreme events that can be resolved in the paleo-record, and establish a common framework for paleo and modern estimates of extremes and the inter-comparison of these records.

### ***Gaps, Needs, Opportunities, Barriers and/or Constraints:***

C2D2 will seek to identify and characterize historical extreme events that have severely stressed human or natural systems (e.g., the onset, duration, frequency, intensity, and decline of droughts or mega droughts) and their variability, identifying the space and time scales of extreme events that can be resolved in the paleo-record, and establishing a common framework for paleo and modern estimates of extremes and the inter-comparison of these records. The program will also seek to determine if it is feasible to identify "early warning indicators" from the paleo record to avoid or mitigate future surprises.

### **Climate Variability and Predictability Program (CVP)**

***Experience with assessment and management of current and future climate-related risks and impacts, including those related to extreme events and in specific sectors:***

CVP has supported a number of research projects over the years that are relevant to long-term drought. These projects have mainly examined “teleconnections” in coupled ocean-atmosphere model experiments (e.g., Indo-Pacific and Atlantic teleconnections). In addition, there have been a number of recent studies on North American drought and its global context under the CVP abrupt climate change portfolio. The CVP abrupt climate change program, ARCHES, sets the goal of describing, understanding and identifying the mechanisms leading to abrupt changes in the state of the climate system and assessing the likelihood of abrupt changes in the future. ARCHES research has related decadal changes of ENSO to droughts and wet conditions over North America. Significant droughts in the Great Plains in the 1930s (the Dust Bowl), in the 1950s in the Southwest and three in the mid to late Nineteenth Century have been related by modeling to persistent La Niña conditions.

### ***Gaps, Needs, Opportunities, Barriers and/or Constraints:***

CVP will seek to better link and forecast the occurrence of extreme events such as hurricanes and droughts through further quantifying, refining, and predicting observed changes of the coupled climate-ocean system, particularly ocean conditions (e.g. regional Sea Surface Temperatures), as well as through the forecast of decadal variability. CVP has proposed forming a US CLIVAR Drought Working Group that has the primary objective to facilitate progress on the understanding, observing, modeling, and prediction of long-term (multi-year) North American drought, including an assessment of the impact of global change on drought evolution.

### **Climate Prediction Program for the Americas (CPPA)**

***Experience with assessment and management of current and future climate-related risks and impacts, including those related to extreme events and in specific sectors:***

The CPPA seeks to improve and transfer into operational practice intraseasonal to interannual climate and hydrological applications, including the prediction of drought and extreme events. CPPA supports several projects to develop new drought monitoring and prediction products through monitoring and predicting precipitation, temperature, humidity, surface evaporation, soil moisture, snow pack, runoff and streamflow/river discharge. These products take advantage of long-term research results from a variety of research and data assimilation and reanalysis programs relying on US precipitation data, soil moisture products, and existing seasonal hydrologic prediction systems.

### ***Gaps, Needs, Opportunities, Barriers and/or Constraints:***

CPPA will develop new drought monitoring products (short term), drought-enhanced seasonal hydro-climatic predictions (medium term) and investigate prediction skill on multi-year time scales, including the development of ensemble hydrologic forecasting to improve operational hydrologic prediction.

### **Climate Diagnostics Center (CDC)/CIRES Joint Institute**

***Experience with assessment and management of current and future climate-related risks and impacts, including those related to extreme events and in specific sectors:***

CDC will improve the current suite of probabilistic forecast products and will develop reliable short-term climate forecast products such as extreme events and hazard alerts at scales required by users. This activity will also improve the delivery of regional climate data, products and services needed to enhance public and private sector decision-making and reduce climate-related risks. Cross cutting these CDC foci will be an outreach activity to support capacity building in the policy and decision making communities facilitating the use of attribution and prediction information products, and experimental prediction services that provide timely and accurate explanations of extreme events. ***No significant gaps or opportunities identified.***

### **Regional Integrated Sciences and Assessments (RISA) Program**

***Experience with assessment and management of current and future climate-related risks and impacts, including those related to extreme events and in specific sectors:***

The RISA program supports research in several regions across the US to improve how communities, resource managers, planners, and other information users in climate sensitive sectors prepare for and adapt to a changing climate. The RISA program makes use of climate variability predictions, including information to address droughts in agriculture, forestry, and water resources management, to ***(see also NIDIS):***

- investigate vulnerability to climate variability in both rural and urban areas, how to improve climate inputs for drought planning, and climate impacts on water resources, water policy, and wildland fire.
- support emerging regional efforts to pursue integrated programs for climate risk management with an emphasis on understanding and reducing vulnerability to climate-related extreme such as drought, floods, and tropical cyclones.
- develop methods to translate regional climate forecasts into local forecasts linking them with crop and hydrology simulation models in order to enhance understanding of decision makers so they can reduce risks associated with climate variability.
- provide vulnerability assessments, climate forecasts, and paleoclimate studies designed to enhance short-term and long-term water management decisions focusing on the Colorado and Platte River Basins, including for drought planning.
- develop drought triggers and tools in response to the needs of Federal Energy Regulation Commission (FERC) relicensing process for dams and hydropower.

***No significant gaps or opportunities identified.***

### **National Integrated Drought Information System (NIDIS)**

***Experience with assessment and management of current and future climate-related risks and impacts, including those related to extreme events and in specific sectors:***

One of the major priorities for NOAA in 2007 and beyond will be supporting the US interagency National Integrated Drought Information System (NIDIS), including through its “Coping with Drought” initiative. This initiative will enhance NOAA’s capacity to analyze the social and economic impacts of drought, generate information about near-term climate variability and longer-term climate trends in relation to drought impacts, assess vulnerability to drought, and communicate findings to and collaborate with decision makers on drought issues. Through this initiative, cutting edge research on climate variability and change would be combined with in-depth analyses of public and private sector decisions regarding drought. This effort would be conducted primarily through universities with strong partnerships among federal and state agencies in drought-affected regions.

#### ***Gaps, Needs, Opportunities, Barriers and/or Constraints:***

The strategic plan for NIDIS spells out the need for social and economic impacts research and the need for improved climate information for drought planning and resource management. Climate information could include paleo and historical information about climate and its impacts, predictions based on seasonal-to-interannual climate variability, recent trends, and future projections of decadal variability and climate change. Social and economic impacts analyses could include historical perspectives and near-term trends (e.g., projections of water conflicts, water demand, population changes, land use shifts from rural to urban).

In addition, the following needs have been identified to ensure better drought forecasts:

- Better depiction of current drought areas through improved monitoring capabilities
- More accurate forecasts of temperature and precipitation, especially for seasonal periods

- Better ways to incorporate forecasts of temperature and rainfall into forecasts of drought indices (Palmer, soil moisture, stream-flows)
- Greater understanding of surface-air feedback processes through statistical and dynamic modeling improvements
- Better ways to depict the probabilities of drought worsening or improving
- Establish long (multi-decade) climate records adequate for retrospective studies, and as required for initialization, calibration and validation
- Improve (real-time) observation/assimilation of key surface variables needed for monitoring, model initialization and/or validation (with uncertainty estimates):
- Improve coupled (atmosphere-ocean-land) model prediction system
- Improve understanding of roles of local and remote processes on drought variability and predictability, as a function of timescale
- Foster research into the mechanisms that control the land surface branch of the hydrological cycle at multi-year (decadal) timescales
- A research effort focusing on the causes of historical droughts (attribution studies):
- Improve simulations of hydrological variability on decadal time scales.
- Foster research focusing on the predictability of multiyear-to-decadal drought

Research priorities supporting drought risk assessment and drought risk management seek to enhance understanding leading to:

- Skillful predictions of drought onset, termination, duration, and severity.
- Predictions of multiyear to decadal drought as a function of SST variability, deep soil moisture/ground water variability, and global change trends
- Assessments of societal, economic, and environmental vulnerability, impacts and response capacity to drought to inform risk reduction efforts
- Development of objective quantification of drought and associated economic impacts to accurately quantify the monetary benefits of improved drought prediction and mitigation
- Methods to incorporate uncertain drought predictions to improve public and private sector planning and operational decision making for water supply, transportation, hydropower, and irrigation

### **The International Research Institute (IRI) for Climate and Society**

***Experience with assessment and management of current and future climate-related risks and impacts, including those related to extreme events and in specific sectors:***

The IRI concentrates its applied research for the sustainable development of society through its three regional programs in Africa, Asia-Pacific and Latin America and Caribbean. These Regional Programs focus on improving the operational management of agriculture, river basin management and the development of early warning systems for floods-droughts, food security, epidemics of human diseases, livestock diseases and agricultural pests. To maximize opportunities for learning and scaling up, IRI personnel work side-by-side with local and national-level stakeholders, enabling better understanding of problems and development of practical, proactive strategies for managing climate risks.

The Africa Regional Program has launched a *Climate and Society Publication Series - Innovations in climate risk management for development in Africa (January 2007)*. As consensus grows that action must be taken today to adapt to climate variability and change, it is not surprising to find parallel growth in the demand for information and guidance on the best practices and benefits of climate risk management for development and poverty reduction. The publication aims to help meet this challenge through sharing of innovative climate risk management practices. Partner institutions include DfID (UK), Africa Union (AU), UNECA, UNDP, UNEP and GCOS. ***No significant gaps or opportunities identified.***



**NOAA's Geophysical Fluid Dynamics Laboratory (GFDL) - Sahel Drought – Past Problems, An Uncertain Future**

***Experience with assessment and management of current and future climate-related risks and impacts, including those related to extreme events and in specific sectors:***

Severe droughts and famine in the late 20<sup>th</sup> century are a recurring environmental problem in the Sahel region of Africa. Using state-of-the-art global climate models, researchers have investigated both the causes of past Sahel drought and produced projections of potential 21st century trends. The late 20th century Sahel drought likely resulted from changes in sea surface temperatures over large areas — changes that GFDL research indicates are consistent with a combination of natural climate variations and human-induced atmospheric changes (increasing greenhouse gases and aerosols). The GFDL models project a drier Sahel in the future. ***No significant gaps or opportunities identified.***

**NOAA Climate Prediction Center (CPC)**

***Experience with assessment and management of current and future climate-related risks and impacts, including those related to extreme events and in specific sectors:***

CPC serves the public by assessing and forecasting the impacts of short-term climate variability, emphasizing enhanced risks of weather-related extreme events, for use in mitigating losses and maximizing economic gains. CPC products are operational predictions of climate variability, real-time monitoring of climate and the required data bases, and assessments of the origins of major climate anomalies. The products cover time scales from a week to seasons, extending into the future as far as technically feasible, and cover the land, the ocean, and the atmosphere, extending into the stratosphere. These climate services are available for users in government, the public and private industry, both in this country and abroad. Applications include the mitigation of weather related natural disasters and uses for social and economic good in agriculture, energy, transportation, water resources, and health. Continual product improvements are supported through diagnostic research, increasing use of models, and interactions with user groups.

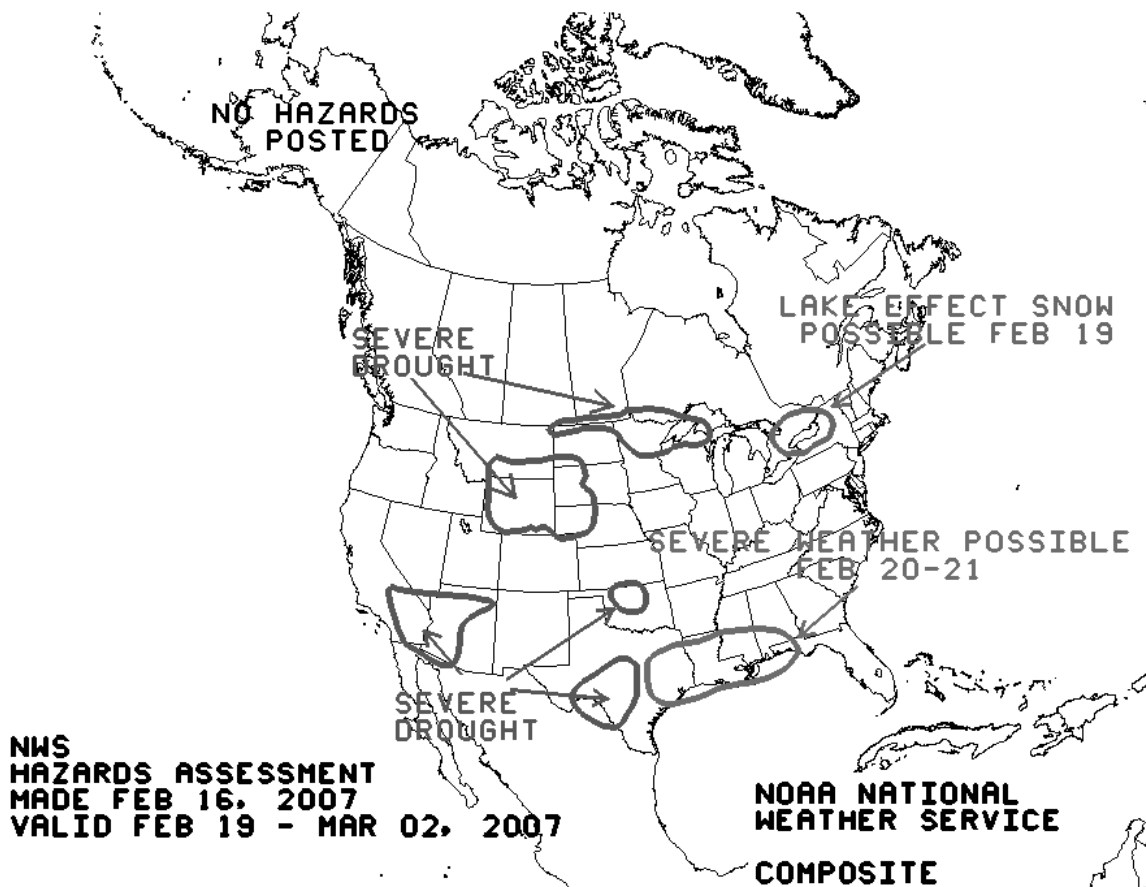
**Expert Assessments:**

Climate Prediction Center (CPC) meteorologists and oceanographers review climate and weather observations and data along with model results; assess their meaning, significance, and current status; and likely future climate impacts. Their findings are issued as assessments, advisories, special outlook discussions, and bulletins.

**Hazards Assessment:**

From Tuesday-Friday, the CPC issues an assessment of weather- and climate-related hazards to the United States for the next three to fourteen days. This Hazards Assessment is intended to provide emergency managers, planners, forecasters and the public advance notice of potential hazards related to climate, weather and hydrological events. It integrates existing NWS official medium (3-5 day), extended (6-10 day) and long-range (monthly and seasonal) forecasts and outlooks, and hydrological analyses and forecasts, which use state-of-the-art science and technology in their formulation.

***No significant gaps or opportunities identified.***



#### US AGENCY FOR INTERNATIONAL DEVELOPMENT (USAID)

##### *Experience with assessment and management of current and future climate-related risks and impacts, including those related to extreme events and in specific sectors:*

USAID has been involved in assessments of vulnerability and adaptation options for over ten years. USAID works to incorporate climate change adaptation planning into mainstream development assistance activities, recognizing that a robust and diverse economy is less vulnerable to climate risks and that resilience to the impacts of climate change contributes to the success of development efforts. USAID works with development partners to reduce the vulnerability of individual projects to the impacts of climate change. Climate variability and change are viewed as factors that could reduce the effectiveness and sustainability of development assistance projects, but factors whose impact can be minimized if properly considered in the design of projects. USAID has developed a *Climate Change Adaptation Guidance Manual* to enable development partners to assess and understand the vulnerabilities of projects and adapt their designs to increase resilience. Pilot project have examined coastal development vulnerable to flooding and storm surge, infrastructure projects in urbanizing areas, farming practices in dry areas, and fisheries and livelihoods.

##### *Gaps, Needs, Opportunities, Barriers and/or Constraints:*

Data, and access to data, are major impediments to more sustainable project design. There is a need for historical weather data; though that cannot be created now, efforts to recreate such data through proxies or through local knowledge would be useful. Baseline data – tomorrow’s historical record – should be gathered and kept. (It should be noted that the US, through GCOS and GEOSS, is contributing to these efforts. USAID is working with GCOS partners to develop tools and methods for gathering data, interpreting it, and applying it).

***Local knowledge:***

A central tenet of USAID's approach is that stakeholder involvement is critical. Local partners bring data, knowledge of local conditions, and understanding of acceptable approaches to dealing with variability. Their involvement promotes local ownership of the project, which also contributes to the long term success of the project. Local or traditional practices may help avoid maladaptation. USAID found in some of its pilots that poor planning and practices in the recent past were compounding the impacts of weather risks. In Niger, changes in forestry rules have enabled farmers to allow trees to grow, improving soil conditions, water infiltration, and diversifying farmer income. In South Africa, stakeholders pushed the water utility to consider demand-side management techniques to extend water supplies, rather than constructing new reservoirs. Simple, low cost measures can be taken now that could reduce risks now and in the future.

***Promoting understanding of Impacts, etc.:***

By working with USAID Missions, other development partners, and stakeholders to improve development project design, USAID is raising awareness of the role climate change could play in affecting development assistance. Through close collaboration with local partners, we are building capacity among partners to assess vulnerability and design adaptation options.

**JOINT USAID/NASA PROGRAMS**

**NASA and USAID Geospatial Information For Development**

The National Aeronautics and Space Administration (NASA) and the U.S. Agency for International Development (USAID) are developing tools to apply remotely sensed information to development assistance. Based on the successful web-based SERVIR model in Central America, this activity will develop a platform that integrates satellite and other geospatial data for improved scientific knowledge and decision making by managers, researchers, students, and the general public. The activity is expanding to serve other parts of the world. SERVIR addresses the nine societal benefit areas of the Global Earth Observation System of Systems. For example, SERVIR can be used to monitor and forecast ecological changes, as well as to respond to severe events such as forest fires, red tides, and tropical storms.

**JOINT USAID/NOAA PROGRAMS**

**FEWSNet Program**

USAID and NOAA collaborate with developing country partners to operate the Famine Early Warning System Network (FEWS), which combines data from satellite observations with local meteorological, crop, and livelihood information to provide decision makers with early warnings of food security risks. FEWS operates in 21 countries and has been providing early warnings for 20 years. Similar programs are being developed to warn of risks of malaria, meningitis, and pests.

**NOAA's International Applications Program (AIP)**

***Experience with assessment and management of current and future climate-related risks and impacts, including those related to extreme events and in specific sectors:***

The International Applications Program (AIP) supports the United States Agency for International Development, Office for Foreign Disaster Assistance (USAID-OFDA) mission, which is saving lives and reducing loss of property overseas from impacts of natural disasters such as drought, storm surges and floods. The first step to addressing disasters is to use science-based climate information to help determine how to better manage disaster risks. It is within this framework that NOAA acts as a connection between the provision of climate science and its application to reduce the vulnerability of society to climate disasters.

NOAA's partnership with USAID-OFDA has created a client base for increased climate science research and its application in regions such as Africa, Latin America and the Caribbean, South East Asia, and the South Pacific. The practical application of research deliverables such as climate models and seasonal climate forecasts is important for USAID's strategic disaster response planning internationally. The program focuses on applying the evolving understanding of the physical dynamics of the climate system to reduce the vulnerability of society and ecosystems to the adverse impact of climate variability and change. AIP helps to build expert capacity and institutions as well as community preparedness by supporting the development and dissemination of specific research applications. This capacity includes malaria forecasts to enhance public health and disaster response, and models for predicting food security scenarios and for water resources management, e.g., hydropower resource management to minimize power outages during drought periods. The AIP works with a range of partners and constituencies, including research and university institutions both in the U.S. and abroad, operational entities such as the national hydro-meteorological services, regional climate prediction, monitoring, and assessment institutions such as the Drought Monitoring Centers (DMCs) in Africa and U.S. international mission agencies such as, the USAID-OFDA, the U.S. State Department, and decision makers in various climate sensitive sectors such as agriculture, water resources, public health etc. ***No significant gaps or opportunities identified.***

#### **Regional Climate Outlook Forums (RCOFs)**

***Experience with assessment and management of current and future climate-related risks and impacts, including those related to extreme events and in specific sectors:***

RCOFs in Africa have facilitated access to probabilistic forecast information by the regional institutions mentioned above. RCOFs represent an international framework for generating and sharing annual climate guidance in advance of the rainfall season in Africa including communication, dissemination and verification. The seasonal forecast guidance is a blend of local and international expert knowledge and therefore commands considerable trust and confidence. The importance of building understanding and trust cannot be overstated, accounting for why individuals and institutions build what they believe to be credible climate information into their risk management strategies and for. The COFs have promoted regional cooperation and integration, especially among the National Meteorological and Hydrological Services (NMHS), policymakers and the user communities. The interactions and dialogue between the policymakers and the scientific community during the fora have resulted in the development of policies for regional and national response to hydro-meteorological disasters. In the event of another catastrophic ENSO event such as that in 1997/98, the post-disaster cost to these nations may not be as high due to the support from USAID, NOAA and their partners. USAID/NOAA and partners have supported 36 regional COFs from 1998 to date. The COFs will continue to provide a platform for productive dialogue and feedback among the scientific community, and the institutional and individual users of seasonal climate forecasts. ***No significant gaps or opportunities identified.***

#### **US DEPARTMENT OF TRANSPORTATION (USDOT)**

**The Center for Climate Change and Environmental Forecasting: Impact of Climate Variability and Change on Transportation**

***Experience with assessment and management of current and future climate-related risks and impacts, including those related to extreme events and in specific sectors:***

The Center is beginning to work with Metropolitan Planning Organizations to assemble best practices and lessons learned for incorporation of climate change issues into the planning process. The complexity of transportation and climate change issues and the lack of related expertise pose major challenges for transportation decision-makers and planners. Decision-makers, who are often unfamiliar with how

transportation contributes to and will be affected by climate change, are making choices with significant long-term implications for climate change.

Ongoing Projects:

- Effects of Sea Level Rise on National Transportation Infrastructure. The study uses multiple data sources to quantify the potential impact of sea level rise on land and transportation infrastructure in coastal areas of the eastern United States.
- Transportation and Climate Change Study. The Center is partnering with the Transportation Research Board of the National Academies to conduct a study to examine strategies to reduce greenhouse gas emissions as well as transportation policy options for adapting to the potential impacts of climate change.
- Workshop on Impacts of Global Climate Change on Hydraulics and Hydrology and Transportation. The Center is partnering with the Center for Transportation and the Environment at the North Carolina State University to develop guidelines for practitioners dealing with the consequences of climate change.
- The Impacts of Climate Change and Variability on Transportation Systems and Infrastructure: Gulf Coast Study. The DOT Center is partnering with the U.S. Geological Survey to undertake a multi-year research program to study how short and long-term changes in climate could affect transportation systems in the U.S. central Gulf Coast region, and how transportation decision-makers could address possible impacts.

***No significant gaps or opportunities identified.***

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