S. HRG. 109–1113

DROUGHT

HEARING

BEFORE THE

SUBCOMMITTEE ON DISASTER PREVENTION AND PREDICTION

OF THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION UNITED STATES SENATE

ONE HUNDRED NINTH CONGRESS

SECOND SESSION

APRIL 27, 2006

Printed for the use of the Committee on Commerce, Science, and Transportation

U.S. GOVERNMENT PRINTING OFFICE

64–376 PDF WASHINGTON : 2011

For sale by the Superintendent of Documents, U.S. Government Printing Office
Internet: bookstore.gpo.gov Phone: toll free (866) 512–1800; DC area (202) 512–1800
Fax: (202) 512–2104 Mail: Stop IDCC, Washington, DC 20402–0001

SENATE COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION

ONE HUNDRED NINTH CONGRESS

SECOND SESSION

TED STEVENS, Alaska, *Chairman*

JOHN MCCAIN, Arizona
CONRAD BURNS, Montana
TRENT LOTT, Mississippi
KAY BAILEY HUTCHISON, Texas
OLYMPIA J. SNOWE, Maine
GORDON H. SMITH, Oregon
JOHN ENSIGN, Nevada
GEORGE ALLEN, Virginia
JOHN E. SUNUNU, New Hampshire
JIM DEMINT, South Carolina
DAVID VITTER, Louisiana

DANIEL K. INOUYE, Hawaii, *Co-Chairman*
JOHN D. ROCKEFELLER IV, West Virginia
JOHN F. KERRY, Massachusetts
BYRON L. DORGAN, North Dakota
BARBARA BOXER, California
BILL NELSON, Florida
MARIA CANTWELL, Washington
FRANK R. LAUTENBERG, New Jersey
E. BENJAMIN NELSON, Nebraska
MARK PRYOR, Arkansas

LISA J. SUTHERLAND, *Republican Staff Director*
CHRISTINE DRAGER KURTH, *Republican Deputy Staff Director*
KENNETH R. NAHIGIAN, *Republican Chief Counsel*
MARGARET L. CUMMISKY, *Democratic Staff Director and Chief Counsel*
SAMUEL E. WHITEHORN, *Democratic Deputy Staff Director and General Counsel*
LILA HARPER HELMS, *Democratic Policy Director*

SUBCOMMITTEE ON DISASTER PREVENTION AND PREDICTION

JIM DEMINT, South Carolina, *Chairman*
TED STEVENS, Alaska
GORDON H. SMITH, Oregon
DAVID VITTER, Louisiana

E. BENJAMIN NELSON, Nebraska, *Ranking*
MARIA CANTWELL, Washington
BILL NELSON, Florida

CONTENTS

WITNESSES

DROUGHT

THURSDAY, APRIL 27, 2006

U.S. SENATE,
SUBCOMMITTEE ON DISASTER PREVENTION AND PREDICTION,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The Subcommittee met, pursuant to notice, at 10:05 a.m. in room SD–562, Dirksen Senate Office Building, Hon. Jim DeMint, Chairman of the Subcommittee, presiding.

OPENING STATEMENT OF HON. JIM DEMINT, U.S. SENATOR FROM SOUTH CAROLINA

Senator DEMINT. Good morning. I want to thank all our witnesses and all the folks who are here. And I want to particularly thank my Co-Chairman, Senator Nelson, for putting together this hearing on such an important subject.

So, this morning we're going to be discussing severe drought. And I look forward to your testimony. It's an issue we occasionally have in South Carolina, but not nearly as often as we do in the Midwest. So, I, again, appreciate your being here, and the whole point is to develop some constructive recommendations on how this committee and this Congress can be more effective in supporting states and communities in dealing with drought.

So, this hearing dovetails with a lot of other hearings that we've had this year. We've had one in Myrtle Beach, on hurricanes. I just got back last week from San Francisco, a hearing on earthquakes. Senator Boxer participated with me. And many times as we think about disasters we don't think about droughts, but those of you in the Midwest who have gone through it know how severe the impact is. Estimates are that the cost of droughts have been $6 to $8 billion to the whole U.S. economy in a year. We know there are numerous fires that have resulted from droughts. In the year 2000, with that wildfire season, it was particularly destructive, with $2 billion in losses. And probably most importantly, droughts can threaten lives. In 1988, from the drought and the hot weather, we had over 5,000 Americans whose deaths were attributed either to the dry weather or the hot weather. So, this is an important problem to the country.

Cloud seeding aside, there is not much we can do about the droughts themselves. It's a fact of life. It's part of our natural climate. And either we have precipitation or snowmelt, or we don't, but this doesn't mean that we're helpless in how we face a looming drought. We can prepare. We can collect data to recognize when a drought is coming and how severe its impact might be. We can sup-

port the science that would allow us to better predict the severity of a drought. And, finally, we can combine the observations and the forecasts into a proactive strategy to mitigate the impact of drought.

I'm looking forward to Dr. Wilhite's comments on the processes he's developed in preparing for a drought mitigation plan. I was pleased to see that the Administration is aware of this issue and has put $4 million in new money in their Fiscal Year 2007 budget to develop a National Integrated Drought Information System. So, it's good to see that the interest is being focused. And we want to use this committee as much as we can to focus additional attention on it.

Again, I am looking forward to your testimony. Before I introduce our witnesses, I'd like to yield to Senator Nelson for his opening statement.

STATEMENT OF HON. E. BENJAMIN NELSON,
U.S. SENATOR FROM NEBRASKA

Senator BEN NELSON. Thank you very much, Mr. Chairman. And I, too, am pleased that we're having this hearing today.

The issue of drought is one that I've been involved with for more years than I'd ever like to think about it. And I appreciate having the forum of the Disaster Prevention and Prediction Subcommittee to talk about a disaster that has had such an impact, specifically on my State of Nebraska. Fortunately, drought conditions are improving in Nebraska in many areas, but we are—we have endured a number of very difficult years struggling with the impact drought has had on our economy and environment and the social implications that go along with a disaster of this kind.

One of my biggest frustrations of the past few years, as an elected official trying to help the areas of my state devastated by drought, has been making people understand that this drought really is a disaster, as much as a hurricane or an earthquake or a tornado, just of a different kind. I even named the drought in Nebraska, Drought David, in an effort to crystallize the drought so that people could see that it's the same kind of experience, in a different way, as any other natural disaster.

Unlike other natural disasters, though, droughts are much more difficult to identify. It's hard to miss an oncoming flood or tornado or a hurricane or their immediate aftermath. Drought, and its effects, is much harder to quantify, and it develops slowly. It doesn't necessarily have a clear beginning point or a clear ending point. And it may expand—and may span over an extended period of time.

Because it's difficult to forecast and plan for droughts, it's especially important that we now have programs in place, such as the National Drought Mitigation Center at the University of Nebraska in Lincoln. The Drought Mitigation Center, among other things, maintains a web-based information clearinghouse, provides drought monitoring, prepares and provides the weekly *U.S. Drought Monitor,* which covers all 50 states, and develops drought policy and planning techniques. I'm anxious to have Dr. Wilhite, from the Drought Mitigation Center, talk more about the Center and its ac-

tivities. But I did want to highlight its importance in dealing with drought in this country.

I believe it's crucial to encourage more investment in research programs such as the Drought Mitigation Center. The research done up front in monitoring drought trends—monitoring drought trends will help our capabilities to mitigate and respond to its effects in a much more effective manner. It's cost effective to support programs such as this. And I advocate for continued support for this important program.

I've been working with Dr. Wilhite, NOAA, and the Western Governors' Association on legislation to establish the National Integrated Drought Information System—I suppose we call it NIDIS—with another alphabet group, with NOAA, for the purposes of improving drought monitoring and forecasting capabilities. Representatives Hall and Udall, on the House side, have already introduced NIDIS legislation, and I plan to introduce this legislation with Senator Domenici soon, on this side. And I'm hopeful that information that we get today will help us write a bill that will be effective and can garner widespread support.

The National Drought Policy Commission recommended, in their May 2000 report to Congress, that this country should move toward a more proactive approach to drought preparedness and response.

The call for improved drought monitoring and forecasting has also been advocated by the Western Governors' Association. And as a former Chairman of that association, I'm pleased that their interest is so significant and so positive.

The NIDIS legislation that I want to introduce with Senator Domenici will authorize the much needed drought early warning system envisioned by the National Drought Policy Commission and the Western Governors' Association. If enacted, this bill will allow our Nation to become much more proactive in mitigating and avoiding the costly impacts and contentious conflicts that so often happen today when water shortages and droughts occur.

I'll close by saying thank you, again, to the Chairman for holding this hearing. This issue is of great importance to me and my state. I look forward to the testimony. And it's, of course, a pleasure for me to welcome my former colleague and good friend from the state to the west of us, Governor Geringer, from Wyoming.

Mr. Chairman?

Senator DEMINT. Thank you, Senator.

I have a statement from the Western Governors' Association that I would like to submit to the record. So, I'd just ask unanimous consent that this be submitted.

Senator BEN NELSON. Certainly, without objection.

Senator DEMINT. Without objection. Thank you.

[The information referred to follows:]

PREPARED STATEMENT OF THE WESTERN GOVERNORS' ASSOCIATION

Mr. Chairman and members of the Committee, the Western Governors' Association commends you for holding this hearing on drought. With this statement, we would like to share with you some of WGA's perspectives and experiences with regard to drought preparedness and the National Integrated Drought Information System Act of 2006.

The Western Governors' Association is an independent, nonprofit organization representing the Governors of 19 states, American Samoa, Guam, and the Northern Mariana Islands. Through their Association, the Western Governors identify and address key policy and governance issues in natural resources, the environment, human services, economic development, international relations, and public management.

Drought is a normal part of the climate for virtually all regions of the United States, but it is of particular concern in the West, where any interruption of the region's already limited water supplies over extended periods of time can produce devastating impacts. Records indicate that drought occurs somewhere in the West almost every year. However, it is multi-year drought events that are of the greatest concern to the economic and ecological health of Western states.

Water scarcity continually defines and redefines the West. The steady growth that has been characteristic for much of the West today creates increased demands for agricultural, municipal and industrial water supplies. As municipal and industrial water use increase relative to older agricultural uses, the demand becomes more inelastic. A farmer can forgo a crop year when water supplies are tight: a municipal water system cannot cut back or shut down without serious consequences to the community served. Furthermore, such competing demands as the public's rising concern for meeting "quality of life" and environmental objectives create water supply management challenges in times of normal precipitation. Drought exacerbates these challenges.

National Drought Preparedness Act of 2005

During the 1995–1996 drought in the Southwest and southern Great Plains states, WGA created a Drought Working Group, which found that drought is a complex and widespread natural hazard, affecting more people in the United States than any other natural hazard, including hurricanes, floods, and tornadoes, and accumulating annual estimated losses between $6 and $8 billion. The magnitude and complexity of drought hazards have increased with growing population, population shifts to drier climates, urbanization, and changes in land and water use.

Although drought visits some part of the country every year and causes billions of dollars in impacts, *there does not exist a permanent national policy to monitor, prepare for and respond to drought disasters.* At the Federal level, droughts have historically been treated as unique, separate events even though there have been frequent, significant droughts of national consequences over the years. Actions are taken mainly through special legislation and ad hoc measures rather than through a systematic and permanent process, as occurs with other natural disasters. Frequently, Federal funding to assist states has been unavailable, or not available in a timely manner.

In the 1996 WGA report *Drought Response Action Plan,* the Governors emphasized the need for incorporating mitigation and preparedness measures in government drought programs, and called for the development of "a national drought policy or framework that integrates actions and responsibilities among all levels of government (Federal, tribal, state, regional and local)." Following on this recommendation, Congress enacted the "National Drought Policy Act of 1998, Pub. L. 105–109, sponsored by Senator Domenici. The law established an "advisory commission to provide advice and recommendations on the creation of an integrated, coordinated Federal policy designed to prepare and respond to serious drought emergencies." The National Drought Policy Commission's report was issued in May 2000.

Based on the recommendations in the National Drought Policy Commission's report, WGA worked with Senator Domenici and Senator Baucus to develop legislation that would establish a national drought policy. On April 14, 2005, Senators Domenici and Baucus introduced the *National Drought Preparedness Act of 2005,* S. 802.

The Domenici-Baucus bill would establish a comprehensive national drought policy through statutorily authorizing USDA as the lead Federal agency for drought, and delineating the responsibility for coordinating and integrating Federal drought assistance programs to a National Drought Council. S. 802 would encourage drought preparedness planning at all levels, and, as droughts emerge, would focus Federal funding on the implementation of these plans in order to proactively mitigate the drought's impacts. The bill would also authorize the Drought Assistance Fund, which would allow the Federal agencies to proactively implement drought programs, rather than having to wait for an emergency supplemental appropriation.

The National Integrated Drought Information System (NIDIS) authorized by the bill would coordinate and integrate a variety of observations, analysis techniques and forecasting methods in a system that will support drought assessment and decisionmaking at the lowest geopolitical level possible. NIDIS is intended to provide water users across the board—farmers, ranchers, utilities, tribes, land managers,

business owners, recreationalists, wildlife managers, and decisionmakers at all levels of government—with the ability to assess their drought risk in real time and before the onset of drought, in order to make informed decisions that may mitigate a drought's impacts.

The Western Governors' Association supports the National Drought Preparedness Act of 2005, and has urged its enactment. The Governors believe that enactment of the National Drought Preparedness Act of 2005 would move the country toward a proactive approach that will avoid conflicts and minimize the damage caused by future droughts, thereby saving taxpayers money.

The National Integrated Drought Information System Act of 2006

On June 21, 2004, the Western Governors unanimously adopted a report developed in partnership with the National Oceanic and Atmospheric Administration (NOAA) entitled, *Creating a Drought Early Warning System for the 21st Century: The National Integrated Drought Information System (NIDIS).* In the report, the Governors conclude that "Recognition of droughts in a timely manner is dependent on our ability to monitor and forecast the diverse physical indicators of drought, as well as relevant economic, social and environmental impacts." The report describes the vision for NIDIS and offers recommendations for its implementation. It is available online at *www.westgov.org*.

On behalf of the Western Governors' Association, we commend Senator Nelson and Senator Domenici, on NIDIS. In the House, H.R. 5136, "The National Integrated Drought Information System Act of 2006," was introduced by Representative Ralph Hall and Representative Mark Udall. The Western Governors support this legislation and urge Congress to authorize NIDIS this year.

There is broad basis of support for NIDIS beyond the WGA report:

- In its May 2000 report to Congress, the National Drought Policy Commission recommended improved "collaboration among scientists and managers to enhance the effectiveness of observation networks, monitoring, prediction, information delivery, and applied research and to foster public understanding of and preparedness for drought."
- The Department of the Interior's report, *Water 2025: Preventing Crises and Conflict in the West* states, "As part of the effort to establish the National Drought Monitoring Network, Interior believes that one-stop shopping for Western water users on a single government website will aid in problem solving, particularly in critical areas. Such a site can provide information on snow pack, runoff, river operations, forecasting, and drought prediction."
- The U.S. Group on Earth Observations has drafted a strategic plan for the U.S. Integrated Earth Observation System (IEOS), the U.S. contribution to the Global Earth Observation System of Systems (GEOSS). The IEOS Strategic Plan identifies the National Integrated Drought Information System as one of six "near-term opportunities."
- In June 2005, the Subcommittee on Disaster Reduction—an element of the President's National Science and Technology Council—issued its report *Grand Challenges for Disaster Reduction.* The report finds "Compared to all natural hazards, droughts are, on average, the leading cause of economic losses." The SDR report states: "The slow onset of drought over space and time can only be identified through the continuous collection of climate and hydrologic data. To enhance decisions and minimize costs, drought warning systems must provide credible and timely drought risk information including drought monitoring and prediction products." The report includes a recommendation to "build and deploy a national instrument system capable of collecting climate and hydrologic data to ensure drought can be identified spatially and temporally, and develop an integrated modeling framework to quantify predictions of drought and drought impacts useful in decisionmaking."
- The President's 2007 budget request includes $7.8 billion for NIDIS implementation and support.

The Western Governors believe that improved drought monitoring and forecasting is fundamental to a proactive approach toward drought and water shortages. NIDIS will allow policymakers and water managers at all levels of the private and public sectors to make more informed and timely decisions about their water resources in order to mitigate or avoid the impacts from droughts.

Conclusion

As we approach summer, many of our western states—and much of the country—are seeing areas in drought. According to NOAA, about 26 percent of the contiguous

U.S. is currently affected by moderate-to-extreme drought. Much of the Southwest had less than normal winter snowpack at the end of March, despite heavy snow during the month of March. Additionally, the January–March period was the fifth warmest ever recorded in the U.S., largely due to a record warm January.

We are already seeing the impacts of drought in 2006. According to the National Interagency Fire Center, there have been 32,988 fires between January 1 and April 24 on 2,195,768 acres. This compares to the 5-year average for this time period of 23,639 fires on 485,308 acres.

We know from our past experiences, the costs of response efforts to drought have been staggering. The estimated cost of the 1988–1989 drought was $39 billion nationwide and was, at the time, the greatest single year hazard-related loss ever recorded. On average, the Federal Government spends $6–$8 billion on drought response. Federal wildfire suppression costs averaged $1.16 billion per year between 2000–2005. Additionally, much time and money have gone into trying to address the water conflicts arising in many of the large river systems in the West, including the Missouri River, the Colorado River, the Rio Grande, the Klamath River Basin, and the Snake River Basin.

The Western Governors' Association believes that enactment of the National Drought Preparedness Act of 2005 would move the country toward a proactive approach to drought that will avoid conflicts and minimize the damage caused by future droughts, thereby saving taxpayers money. As a Nation, we have successfully applied such a proactive policy toward other natural disasters through the Stafford Act. It is high time that we have a comprehensive national policy for drought.

Furthermore, the Western Governors believe that improved drought monitoring and forecasting is fundamental to a proactive approach to addressing not only drought, but water shortages. The National Integrated Drought Information System will allow policymakers and water managers at all levels of the private and public sectors to make more informed and timely decisions about water resources in order to mitigate or avoid the impacts from droughts. WGA strongly supports the National Integrated Drought Information System Act of 2006, and urges its enactment this Congress.

Senator DEMINT. Now I'd like to introduce our witnesses. Appearing this morning is Governor Jim Geringer. He's the Director of Policy and Public Sector Strategy for the Environmental Systems Research Institute, a provider of geospatial information systems. He is also Representative of The Alliance for Earth Observations. He also served as Governor of Wyoming from 1995 until 2003, during a number of droughts, so he should have a good perspective and a lot of insights for this Subcommittee.

Now, also appearing is Dr. Chet Koblinsky, the Director of the Climate Program Office at the National Oceanic and Atmospheric Administration. He will be discussing the Administration's work to more effectively monitor and predict severe drought, and I'm looking forward to his comments.

Finally appearing is Dr. Don Wilhite, from the University of Nebraska. And I would like to yield to my colleague, Senator Nelson, to introduce this Nebraska witness.

Senator BEN NELSON. Dr. Wilhite is Founder and Director of the National Drought Mitigation Center at the University of Nebraska, Lincoln. He is also a Professor in the University's School of Natural Resources. His research and outreach activities focus on issues of drought monitoring, planning, mitigation, and policy, and the use of climate information in decisionmaking. He has collaborated with many countries and regional and international organizations on drought policy and planning issues, and he has conducted numerous workshops on drought planning in the U.S. and internationally.

We're certainly happy to have him here today and share his experience, knowledge, and expertise in this area. And it's a personal pleasure for me to say welcome, Dr. Don Wilhite.

Senator DEMINT. Thank you, Senator.

And, with that, I would ask our witnesses to make a short opening statement. If you could keep your comments to 5 minutes, and then we'll have some give-and-take with some questions. And we'll start with the Governor.

STATEMENT OF HON. JIM GERINGER, DIRECTOR, POLICY AND PUBLIC SECTOR STRATEGY, ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE (ESRI); WYOMING GOVERNOR (1995–2003); REPRESENTATIVE, THE ALLIANCE FOR EARTH OBSERVATIONS

Mr. GERINGER. Well, thank you, Mr. Chairman and Senator Nelson. We appreciate the opportunity to be here.

I am with the SRI, former Governor of Wyoming, and a Representative of the Alliance for Earth Observation, so I'll speak from the perspective of each of those, at least in part.

As I approached the Hill this morning, we were curious about how hot it might be up here with all the discussion over the price of oil, the commodity of oil, the commodity of gasoline, and certainly the other commodities, like gold, that are high on everybody's agenda, but the commodity called water is going to be the dominant issue for many years to come. In fact, it will be the most significant commodity that we ever deal with from here on, considering the population and demographic distribution that we have in the world.

Mr. Chairman, you mentioned natural disasters. And natural disasters seem to be on the increase—the level, the intensity, the frequency, the type, and the expectation that something more has to be done. And the United States is expected to lead the effort to predict, respond, and recover. That seems to be our role. Yet we have finite resources for what seems to be an infinite demand. You've already mentioned the nature of drought that natural disasters—dealing with weather, I believe this Subcommittee has the title of Prevention and Prediction. In the case of weather-related circumstances, we may not be able to prevent, but we can certainly do something more to predict, as well as to manage. As you've already mentioned, we don't have to just sit by and stoically accept whatever comes along. So, prevention, maybe not; but prediction and mitigation, I think, would be the key.

Drought is different. It's slow to develop, as Senator Nelson said, sometimes lasting for years. You can't tell a beginning or an end. But drought, overall, is the absence of, or shortage of, water. It's a question of, how much are we using, how much do we have, and how much do we need?

Drought, then, will vary, depending on the circumstance. Certainly, with the *Drought Monitor* that Dr. Wilhite's organization has at UNL, we can tell from the map today where the most intense droughts are; and we quite often relate it to agriculture. But it's so far beyond just agriculture—energy production is affected, transportation, tourism, recreation, our forest health, municipal water supplies, managing for municipalities, environment, wildlife, and human health. So, the losses are far beyond the numbers you've quoted, Mr. Chairman, because of their impact, not only in direct cost or insured cost, but also in lost opportunity. The prob-

lem, as I would define it—which means the opportunities I would define—run in two main categories. The first is, our current policies and programs, as Dr. Wilhite, I'm sure, will reinforce, foster dependency, rather than enabling risk management. And the second thing I would comment on is that our Earth Observation Systems, including for drought, the technologies, the applications, the sensors that are—that could be out there, and should be out there, and even are out there, they're neither efficient nor integrated.

Now, on the first issue, our typical response to a disaster is to come in more after-the-fact than to plan better for the event or even mitigate or prevent it. The unintended consequence of always making people whole after a disaster is that we have created an unintended consequence that creates more vulnerability. People don't plan and prepare well enough for a disaster, or to anticipate it well enough to mitigate the impact on them. So, we've created a culture of expectation that government will always be there to make things whole, or at least as whole as possible. We need to break that cycle of reconstruction after destruction. We need to shift the focus to planning and prediction, even if prevention is not an option.

And, on the second part, detection, monitoring, and analysis are a fragmented patchwork. There are custom applications that are very narrowly focused in many cases, sensor-specific, not networked, not well integrated. We need a fully integrated system of systems for observing the Earth and process the data that's collected, starting with drought and ending up with overall disaster preparedness. And integration of data systems is one that I would include as Appendix B to my written testimony. But the idea is to manage risk, whether you're a water manager, a conservationist, a farmer, or a manufacturer. Greater self-reliance through risk management, the redirection of funds from assistance programs into mitigation is more likely.

I do support NIDIS, the National Integrated Drought Information System, because it allows us to enable the collection of large amounts of data, which we need, from sensors that are remote and Earth-based, data that can lead to information that leads to action and decisions. And that's the key. It's not just somebody else telling us what to do, it's how we decide, individually, as well as collectively, what to do.

We need to develop a culture among our agencies to share data, applications, and predictions. And this isn't just about the United States. Weather is local in effect, but global in generation. We need to cooperate with other countries through a Global Earth Observation System of Systems so that we can not only lead the way, but remain competitive economically in the world. Innovation is the key to competitiveness.

I would close, Mr. Chairman, with the comment that the United States element of the Global Earth Observation System of Systems is called IEOS, Integrated Earth Observation System. And I have included, as Appendix C, the most recent information about this effort. The Earth Observation System architecture, enabling an entrepreneurial environment; and the Alliance for Earth Observation, the 65 members of that, are listed in that Appendix—public sector, private sector, and academia.

I certainly support that you move forward, Senator Nelson, with Senator Domenici on introducing the NIDIS bill and making it part of an overall system of Earth observations so that we can do a better job of managing risk, making better individual, as well as collective, decisions.

And I would yield to questions.

[The prepared statement of Mr. Geringer follows:]

PREPARED STATEMENT OF HON. JIM GERINGER, DIRECTOR, POLICY AND PUBLIC SECTOR STRATEGY, ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE (ESRI); WYOMING GOVERNOR (1995–2003); REPRESENTATIVE, THE ALLIANCE FOR EARTH OBSERVATIONS

Chairman DeMint, Ranking Member Nelson, members of the Committee, special guests, ladies and gentlemen. My name is Jim Geringer. I am the Director of Policy and Public Sector Strategy for Environmental Systems Research Institute (ESRI), the industry leader for geospatial information systems. I served as Governor of Wyoming from 1995 to 2003. I am also a Representative of the Alliance for Earth Observations, a nonprofit initiative to unite the private sector in the mission to promote the understanding and use of Earth observations for societal and economic benefit. My testimony today will be from my perspective of each of these roles.

Of all the commodities sought in our marketplaces today, none will have higher priority in the future than the universal commodity—water. Not oil or gold or pork bellies, but water. Your hearing today is about water, or more specifically the absence or shortage thereof.

Situation

Natural disasters, both locally and globally, are increasing while the overall level of financial assistance available for emergency response in the world has been shrinking since 1992,[1] according to a recent statement by the Inter-American Development Bank and a separate story last week by the *Financial Times.* Tsunamis, earthquakes, floods, fires, hurricanes, volcanoes, landslides and drought are in the news with regularity. The U.S. is expected to lead the effort to predict, respond and recover. We face infinite demands with finite resources.

Much is expected of any elected or appointed official. Lives and livelihoods depend upon effectively dealing with disaster. The best way for any of us to deal with disaster is to prevent it altogether. The irony is that prevention does not attract attention and many times does not attract funding. As Governor, if I had called a press conference to announce the prevention of a disaster, I would not have drawn much of a crowd. But I'd better be prepared to react well in response and recovery if one were to happen or else face harsh criticism. In the case of weather-related natural disasters, prevention may not be within our power. That doesn't mean we stoically accept what comes along if more can be done for prediction if not prevention of drought.

Drought is different from other natural hazards or disasters. Drought is slow to develop, a silent, creeping phenomenon evolving over a period of months and sometimes lasting for years. Much of the Midwest and East Coast suffer from water shortages today, as well as Texas, Oklahoma, Louisiana, South Carolina, and Alaska. Parts of the American West are in their eighth consecutive year of a prolonged drought.*

Impacts are complex, affecting agriculture, energy production, transportation, tourism, recreation, forests, municipal water supplies, environment, wildlife, and human health. Drought is estimated to result in average annual losses to all sectors of the economy of between $6–$8 billion.[2] First responders to a disaster deserve our full support. In the case of drought, the first responders are those who are affected by the drought.

Problem

The problem is two-fold. First, our Federal policy and programs foster dependency rather than enabling risk management. Second, our Earth observation systems, including for drought, are neither efficient nor integrated.

---

[1] Inter-American Development Bank, March 2006. *http://www.iadb.org/SDS/ENV/site_2493_e.htm.*

* See (Figure 1.) on page 24.

[2] Economic Impacts of Drought and Benefits of NOAA's Drought Forecasting Services, *NOAA Magazine,* September 17, 2002. Website: *http://www.noaa.gov/magazine/stories/mag51.htm.*

On the first matter—Federal disaster relief programs for nearly every type of natural disaster are not well coordinated. They target funding for reaction rather than at planning, prevention, prediction and mitigation. The unintended consequence is that we are more vulnerable to future damage and cost because we mask the impact of the loss. For example, when a natural phenomenon such as drought occurs on a widespread basis, a disaster is declared and funds are made available to mitigate or eliminate the losses. Government's focus is on aid to victims. We have created a culture of expectation that government will always be there with money.

We need to break the cycle of expectation of reconstruction after destruction. If we don't, we will be faced with ever increasing Federal assistance. We must shift the focus to planning and prediction, even if prevention is not an option.

Second, detection, monitoring, and analysis today are a fragmented patchwork of custom applications, not networked or integrated. We cannot justify duplication of sensors, data acquisition or information infrastructure. We do not have a fully integrated system of systems for observing the Earth and processing the data collected.

We are not doing enough as a Nation to assure that proper data is on hand to deal with a disaster on the scale of Hurricane Katrina. When a severe weather event occurs, it very quickly evolves into a disaster response event, an energy event, a transportation event, or a public health event. The event is rarely just about weather, just as drought isn't just about agriculture. We as a Nation do not have an integrated base of reference data and application solutions to effectively and promptly respond. If we look at it that way—that we as a Nation do not have the tools to respond to drought and other natural hazards—we can also say, American economic competitiveness is at risk.

We must realize that any solution we develop to respond to drought and develop integrated information and tools will impact our country far beyond our original intent. Whether you are a state water manager, a conservationist, or a manufacturer, you need accurate and timely data and information to manage risk. And, that information provides great advantage to us as a nation. As Warren Isom, Senior Vice President of Willis Re Inc., and Board Member of the Weather Risk Management Association said recently, "The weather risk market—in fact the risk-management business in general—has a profoundly strong interest in serious, systematic attempts to improve, expand and intensify the capture of data relating to our planet."

Greater self-reliance through risk management will generate savings from Federal assistance programs allowing the redirection of funds rather than necessitating new taxes.

Solution: Technology

On June 21, 2004, the Western Governors unanimously adopted a report entitled, *Creating a Drought Early Warning System for the 21st Century: The National Integrated Drought Information System.* I've included a copy in Appendix A of my written testimony. I strongly support the creation of NIDIS. The strongest case for NIDIS is to enable risk management by individuals, businesses and governments—shift from reaction and response to prediction and mitigation. With better sensors, data, applications, tools and ever improving technology we can reward risk management over resignation to the elements.

Enhancing our ability to detect, monitor and respond will enable municipalities to adopt water policies that minimize or eliminate water shortages, farmers to plant alternative crops, ranchers to locate alternatives for grazing, river barges to anticipate low flows in navigable waterways, and health agencies to control disease.

We should develop a culture among agencies and levels of government to share data, applications and predictions, then serve the results to the public so that we individually and collectively are more self-reliant and less vulnerable.

The next drought or the next disaster can occur anywhere in the U.S. Strong, cooperative relationships among agencies are essential to a comprehensive integrated system. A description of applications and data approaches describing how agencies worked together in the response to Hurricane Katrina is included as Appendix B, *GIS for the Nation.*

This isn't just about the United States. Weather is local in effect but global in generation. We should cooperate with other countries to set up a Global Earth Observation System of Systems (GEOSS), and with each other to implement the U.S. component of the multinational system, the U.S. Integrated Earth Observation System (IEOS). These systems will leverage our investments, programs and data, allowing us to analyze, model, plan and act in advance to minimize weather disasters, including drought.

In today's global economy, innovation is the key to competitiveness. My main message to you today is: The United States must stay at the forefront of Earth observa-

tion and geospatial technologies to better forecast and mitigate natural disasters and thereby lead the competition.

As U.S. Commerce Secretary Carlos M. Gutierrez remarked at the Earth Observation Summit III on February 16, 2005, in Brussels, Belgium:

> "I don't think I am overstating it when I say that I believe this integrated observing system will be one of those rare technologies that will fundamentally change the way we live, the way we make policy decisions, and the way we manage scarce and precious resources."

Policy

General Earth observation policies should be set by the Congress and implemented cooperatively through the President's Cabinet. The proposed legislation would set the NIDIS up under the National Oceanic and Atmospheric Administration (NOAA). While I applaud the heroic support and effort of the NOAA Administrator, VADM Lautenbacher, and his team, I submit that NIDIS—because of its significant social and economic impact—should be part of an overall IEOS/GEOSS Program Office directly under the Secretary of Commerce.

Moving Forward

NIDIS, IEOS, and GEOSS are as much about service as they are technology. The service these integrated information systems promise to provide is the mitigation of the effects of natural disasters through better risk management. The United States must continue to maintain a robust observing capability through satellites, aircraft, unmanned aerial vehicles, buoys, and river and stream gauges. Equally important, we must also continue to support the important acquisition and transformation of data, using geospatial technologies, into useful information for decisionmakers.

More than 60 countries support GEOSS. And, here in the United States, the private sector—industry, academia, and non-governmental organizations—through The Alliance for Earth Observations is working in close partnership with the government to take a proactive role in moving the IEOS/GEOSS concept forward. One of the most challenging aspects is designing the architecture of these systems. I am pleased to submit with my testimony a copy of the final workshop report, *Earth Observation System Architecture: Enabling an Entrepreneurial Environment.* Sixty-five representatives of some of the Nation's most innovative businesses and academic institutions contributed their knowledge and experience to help guide U.S. IEOS/GEOSS architecture development. A copy of the report is included in Appendix C.

Moving forward to respond to drought requires a technology solution including sensors and applications. NIDIS, IEOS, and GEOSS provide such a solution not only for U.S. response to drought, but also to various natural disasters, and build our technological capabilities and competitiveness as a nation. We must retain leadership in this critical area.

I urge the Senate to move forward with legislation to establish NIDIS, and begin development of the U.S. IEOS as a contribution to GEOSS. It will be of great benefit to our nation, its citizens, and countries worldwide.

APPENDIX A—CREATING A DROUGHT EARLY WARNING SYSTEM FOR THE 21ST CENTURY: THE NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM*

APPENDIX B—GIS FOR THE NATION

The NIDIS can be the beginning step in developing a comprehensive national data set that allows us to plan, prepare and reduce risk, and then to be more effective if and when a natural disaster occurs. The initial response to Katrina consumed at least 4 weeks while folks feverishly scrambled to assemble enough basic information to know how to manage response and recovery. At no time was there a single emergency response center for the overall operation.

The good news is the United States Geological Survey (USGS), the National Geospatial-Intelligence Agency (NGA), and the United States Department of Homeland Security (DHS) with the assistance of hundreds of state, local governments and private citizens implemented a Geographic Information Systems database for areas affected by Hurricanes Rita and Katrina. Such a database must be deployed when a major disaster is imminent in order to leverage critical but disparate datasets.

---

*The information referred to has been retained in Committee files and can also be found at *http://www.westgov.org/wga/publicat/nidis.pdf.*

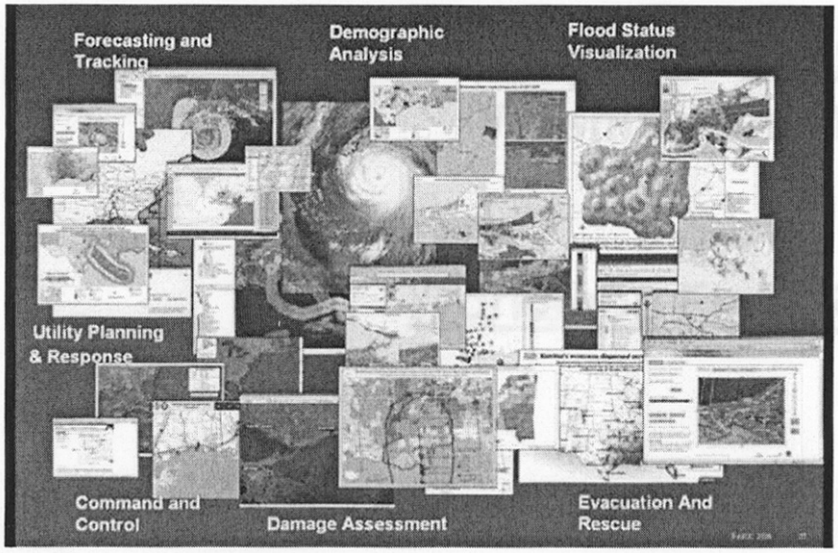
Their aim was to meet the immediate hurricane response needs, to provide a resource for long-term recovery and reconstruction efforts, and to assist in preparedness for future hurricane seasons. Their effort became known as "GIS for the Gulf," which includes the states of Alabama, Louisiana, Mississippi, and Texas. They worked to connect many different GIS systems and datasets into a greater whole. These organizations began to share, import, integrate, and synchronize information needed by the Emergency Operations Centers. The result was a comprehensive database based on a standardized, multi-scale data model, providing a consistent view of data across jurisdictional boundaries. Unfortunately, many of the most important integrated datasets were not assembled or available for use until 4 weeks after Katrina made landfall. They should have been there before.

This system should be extended to the rest of the United States as "GIS for the Nation." It has the potential to save lives and property during future events, by saving time, resources, and manpower, provided that the infrastructure and data systems are in place and accessible to those who need it prior to, during, and after an event. The concept applies directly to drought assessment and response through NIDIS, allowing better risk assessment for agriculture, economic development, health, homeland security, public safety, and transportation, and allowing government units to better prepare for and mitigate the effects of drought.

GIS for the Nation would integrate essential data and imagery related to emergency operations, structures/critical infrastructure, government units, utilities, addresses, transportation, cadastral, hydrography, environmental, land use/land cover, base-map, elevation, and geodetic control. Data providers should include local, county, state, and Federal agencies who currently have such information at their disposal, but do not have the infrastructure in place to leverage it for prediction, prevention and mitigation.

The database would consist of roughly 60 data layers, including detailed parcel information and aerial imagery, combined with a suite of applications that allows data to be viewed, analyzed, and manipulated as a decision-support system.

Pre-event preparedness, particularly a fully integrated, deployable GIS infrastructure, is the most effective and valuable action that can and should be taken. It would improve many different emergency response capabilities and processes for future events. It would also provide enormous value for long-term recovery.



This isn't just about Federal agencies. Local organizations and private industry generate and own much of the essential data and capability. An integrated information system must coordinate with statewide GIS leaders to ensure that partnerships and data sharing agreements are in place. The time to develop collaborative relationships is not during an emergency, but well before.

GIS for the Nation would facilitate the exchange of data and knowledge prior to an event, including information regarding what data exists, where it is located, who owns it, how accessible it is, and what specific security levels are needed. Much of

the base-map (framework) data has already been collected and made available through the *National Map* and through the National Integrated Land System (NILS) developed by the Bureau of Land Management (BLM). NILS represents the essential framework but does not include all of the 60 data layers that are needed.

APPENDIX C—EARTH OBSERVATION SYSTEM ARCHITECTURE: ENABLING AN ENTREPRENEURIAL ENVIRONMENT (OCTOBER 27–28, 2005)—WORKSHOP FINAL REPORT *

Senator DEMINT. Thank you, Governor.
Dr. Wilhite?

STATEMENT OF DR. DONALD A. WILHITE, DIRECTOR, NATIONAL DROUGHT MITIGATION CENTER (NDMC); PROFESSOR, SCHOOL OF NATURAL RESOURCES, UNIVERSITY OF NEBRASKA—LINCOLN

Dr. WILHITE. Good morning, Mr. Chairman. Senator Nelson, good to see you again. We worked together on Nebraska's drought plan when you were Governor, and on some sustainability issues. So, it's good to be with you again.

As mentioned, I'm Don Wilhite, Founder and Director of the National Drought Mitigation Center at the University of Nebraska, Lincoln.

I appreciate this invitation to discuss drought and drought management in the United States, the need to move this Nation to a more risk-based management approach to lessen our vulnerability to this creeping natural hazard, and the role of the National Integrated Drought Information System, or NIDIS, the role that it can play in this process.

The National Drought Mitigation Center was formed in 1995. At the time, there was no national initiative or program that focused on drought mitigation, drought monitoring and preparedness. The NDMC is unique. Our full attention is devoted to building awareness of, and reducing vulnerability to, this drought hazard. In the past 11 years, we have made considerable progress, but much work remains.

Some of the important accomplishments of the NDMC include: the development of an Internet drought portal that provides users with comprehensive information on all aspects of the drought hazard; networking with Federal and non-Federal agencies on drought monitoring, mitigation, and preparedness; a partnership with NOAA and U.S. Department of Agriculture on the development of the *U.S. Drought Monitor* product, and hosting the *U.S. Drought Monitor* web portal since its inception in 1999; assisting States, tribal, and local governments in the development of drought plans—currently there are 38 states with drought plans, and an increasing number of those states are focusing more on mitigation versus crisis management—most of these states have used a drought planning methodology that was developed at the National Drought Mitigation Center; research and development on drought mitigation and drought monitoring tools to aid decisionmakers; development of new interactive web-based decision-support tools for agricultural producers, natural resource managers, and others; conducting drought planning workshops and conferences throughout

---

*Appendix C has been retained in Committee files.

the United States; and also the development of a new tool that was introduced last summer called the Drought Impact Reporter, which allows us to track impacts across the country in various sectors.

I would like to emphasize a statement that Mr. Koblinsky is going to make in his presentation. I had an opportunity to see his oral testimony previously. He states that drought is not purely a physical phenomenon, it is an interplay between water availability and the needs of humans in the environment. This is a key point for us to consider. Although drought is a natural hazard, the way we manage or mismanage water and natural resources determines, to a large extent, our vulnerability to drought. Therefore, improving drought management is not only about improving monitoring and prediction, it is also about understanding and assessing our vulnerabilities and managing risk. Improved early warning and prediction alone will do little to reduce drought risk. We must deliver this information to natural resource managers and policymakers in a timely manner and demonstrate how this information can be applied in the decisionmaking process.

I am a strong supporter of NIDIS. It has the potential to significantly advance the science of drought management in the United States. The National Drought Mitigation Center has been involved in the evolution of this concept from the very beginning. I presented the report on NIDIS to the Western Governors at their annual meeting in June 2004 in Sante Fe. The NDMC has continued to be involved with NOAA and other Federal agencies and the Western Governors' Association in discussions on this initiative. Given the NDMC's scientific expertise on drought and our strong linkages to the user community, the NDMC can be a valuable partner to NOAA in the implementation of NIDIS in the coming years.

Mr. Chairman, this concludes my testimony. I wish to thank you for the opportunity to discuss the programs of the National Drought Mitigation Center, my vision of how to improve drought management in the United States, and how NIDIS can enhance this effort. I'll be glad to answer any questions you might have.

[The prepared statement of Dr. Wilhite follows:]

PREPARED STATEMENT OF DR. DONALD A. WILHITE, DIRECTOR, NATIONAL DROUGHT MITIGATION CENTER (NDMC); PROFESSOR, SCHOOL OF NATURAL RESOURCES, UNIVERSITY OF NEBRASKA—LINCOLN

I appreciate the opportunity to submit this statement to the Senate's Subcommittee on Disaster Prevention and Prediction. My name is Don Wilhite; I am the Founder and Director of the National Drought Mitigation Center (NDMC), located at the University of Nebraska in Lincoln. The National Drought Mitigation Center (NDMC) was formed in 1995, following a sequence of severe drought years between 1987 and 1994 that affected virtually all portions of the United States. At the time of the NDMC's formation, there was no national initiative or program that focused on drought monitoring, mitigation, and preparedness. I have been involved in drought-related research and outreach since 1980. My efforts have principally been focused on how to lessen the Nation's vulnerability to drought through improved monitoring and early warning, mitigation, and preparedness. We have made considerable progress, but much work remains. The National Integrated Drought Information System (NIDIS) has the potential to help improve the Nation's capacity to cope more effectively with severe drought episodes that create significant impacts on the Nation's economic, environmental, and social fabric.

It is imperative to point out that drought is a normal part of the climate for virtually all parts of the United States. For this reason, we need to be prepared for droughts, and focus our attention on mitigation and planning strategies that would reduce impacts before drought strikes. On average, approximately 15 percent of the

Nation is affected by drought each year, based on the historical record from 1895 to present. This drought record illustrates both single and multi-year events; in particular the droughts of the 1930s, 1950s, 1960s, 1974–1977, 1987–1994, and 1996 to present are noteworthy for their intensity, duration, and spatial extent. During the most recent drought period, 35–40 percent of the country was affected and for some regions drought conditions persisted for 5 or more years. For example, parts of the Southeast, particularly Georgia, North Carolina, South Carolina, and Florida experienced 3 to 4 consecutive years of drought between 1999 and 2002. In the West, much of the Southwest, especially Arizona and New Mexico, experienced 5 consecutive years of drought between 2001 and 2004 while much of Montana, Idaho, and surrounding states experienced severe drought for as many as 7 consecutive years since 1999. My state, Nebraska, has experienced 6 consecutive years of drought.

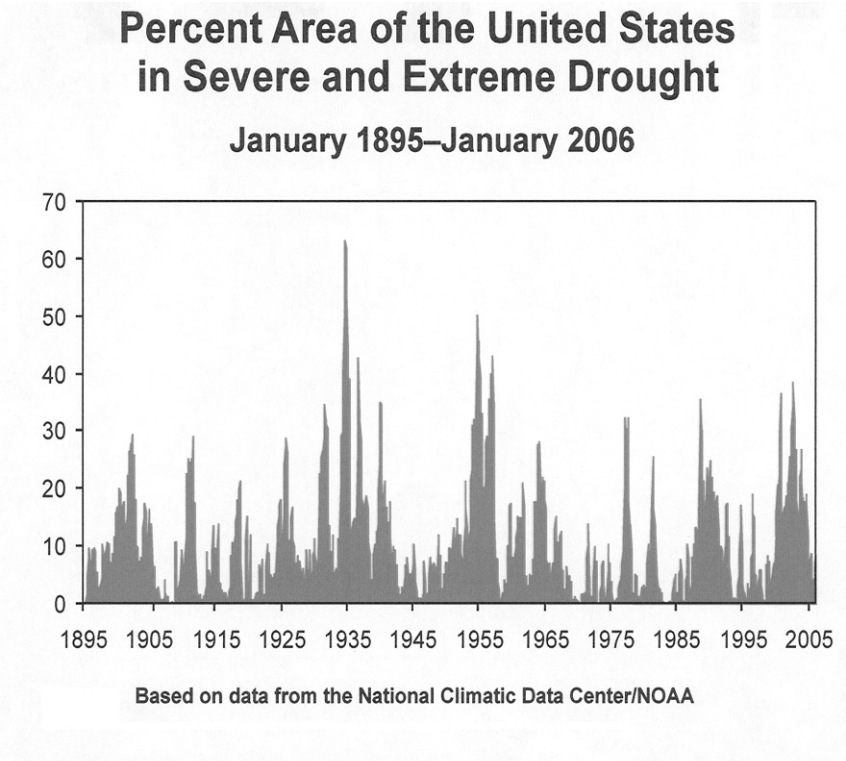


Figure 1. Percent area of the United States in severe and extreme drought.
(Source: National Drought Mitigation Center, University of Nebraska-Lincoln)

National Drought Mitigation Center: Objectives, Programs, and Activities

The NDMC's program is directed at lessening societal vulnerability to drought through a risk-based management approach. The Center's activities include promoting and conducting research and outreach activities on drought monitoring, mitigation, and preparedness technologies; improving coordination of drought-related activities and actions within and between levels of government; and assisting in the development, dissemination, and implementation of appropriate mitigation and preparedness technologies in the public and private sectors. Emphasis is placed on research and outreach projects and mitigation/management strategies and programs that stress risk management measures rather than reactive, crisis management actions. It has been demonstrated that crisis management responses, such as drought relief, actually decrease self-reliance and, therefore, increase vulnerability to future drought episodes. Mitigation and preparedness increase self-reliance and reduce vulnerability. Programs that provide incentives for mitigation and preparedness are a

very good investment for government at all levels and for the private sector as well. It has been demonstrated that for every dollar invested in mitigation and preparedness, four dollars are saved through reduced impacts when a natural disaster occurs. It is imperative that we shift the emphasis from crisis to risk management, as illustrated by the cycle of disaster management (Figure 2).

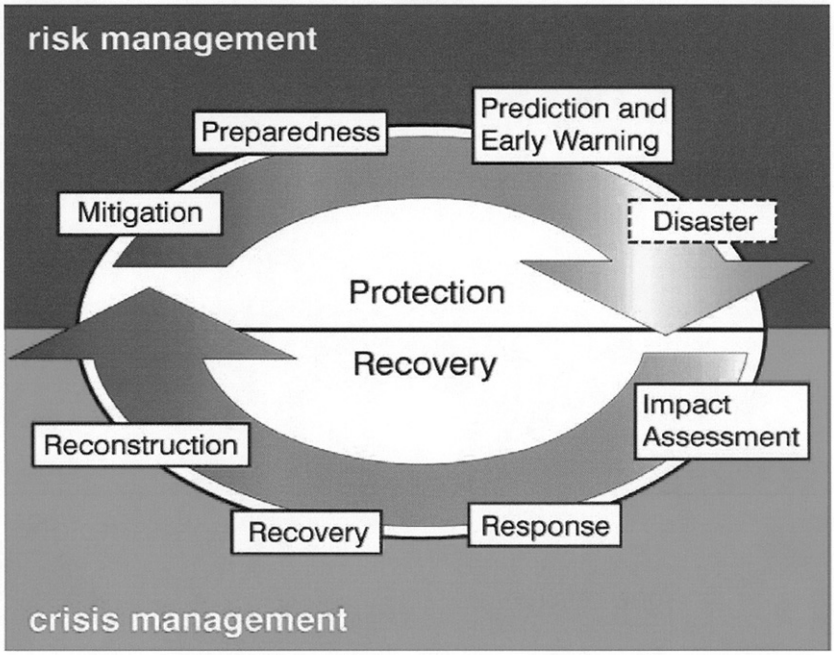


Figure 2. The Cycle of Disaster Management. (Source: National Drought Mitigation Center, University of Nebraska-Lincoln).

To respond effectively to the Nation's needs for drought early warning, mitigation, and preparedness, the NDMC has been conducting research and outreach activities since 1995 in the following areas:

- Developing and enhancing an information clearinghouse or web-based drought portal on drought early warning, impact assessment, mitigation, preparedness, and response options for decisionmakers.
- Conducting and fostering collaborative research on drought monitoring, risk management, impact and vulnerability assessment, mitigation, and preparedness techniques and methodologies.
- Assisting state and Federal agencies, tribal and local governments, and regional organizations in developing integrated assessments of drought severity and impacts, including current climate/drought and water supply assessments.
- Advising policymakers and others by providing scientific and policy-relevant information on drought and water management issues.
- Organizing workshops, conferences, and seminars on drought preparedness planning and mitigation measures to reduce vulnerability to drought.
- Collaborating with and providing training for international scientists and facilitating the timely exchange of information on drought mitigation technologies with foreign governments, international and non-governmental organizations, and regional organizations.

Understanding Vulnerability, Preparedness, and Response Strategies

Vulnerability to drought is dynamic and influenced by a multitude of factors, including increasing population, regional population shifts, urbanization, technology, government policies, land use and other natural resource management practices, desertification or land degradation processes, water use trends, and changes in envi-

ronmental values (*e.g.,* protection of wetlands or endangered species). Therefore, the magnitude of drought impacts may increase in the future as a result of an increased frequency of meteorological drought, changes in the factors that affect vulnerability, or a combination of these elements. The development of a national drought policy and preparedness plans at all levels of government that place emphasis on risk management rather than following the traditional approach of crisis management would be a prudent step for the United States to take. Crisis management decreases self-reliance and increases dependence on government, as illustrated by the hydro-illogical cycle.

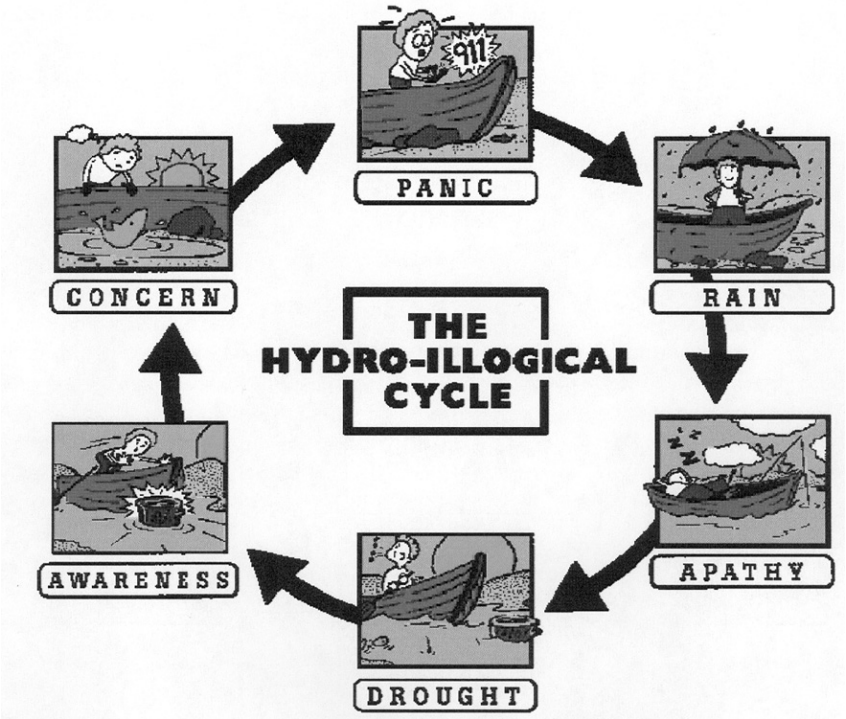


Figure 3. The hydro-illogical cycle. (Source: National Drought Mitigation Center, University of Nebraska—Lincoln)

The impacts of drought in recent years have been increasing and, it appears, at an accelerating rate, although a systematic national assessment and database of drought impacts has only recently been developed by the NDMC in the form of the web-based Drought Impact Reporter tool. FEMA (1995) estimated annual losses in the United States because of drought at $6–$8 billion, making drought the most costly natural disaster in the country. Losses from the 1988 drought have been estimated at more than $39 billion. The NDMC has estimated that losses associated with the 2002 drought exceeded $20 billion. It is important to note that these are estimates for a single drought year, while major drought events often occur over a series of years, as noted previously.

The impacts of drought have also been growing in complexity. Historically, the most significant impacts associated with drought have occurred in the agricultural sector (*i.e.,* crop and livestock production). In recent years, there has been a rapid expansion of impacts in other sectors, particularly energy production, recreation and tourism, transportation, forest and wildland fires, urban water supply, environment, and human health. The recent drought years in the western United States, for example, have resulted in impacts in non-agricultural sectors that have likely exceeded those in agriculture. In addition to the direct impacts of drought, there are also significant indirect impacts that, in most cases, would exceed in value the direct losses associated with drought episodes.

Drought Policy and Preparedness

In the past decade or so, drought policy and preparedness has received increasing attention from governments, international and regional organizations, and non-governmental organizations. Simply stated, a national drought policy should establish a clear set of principles or operating guidelines to govern the management of drought and its impacts. Creation of a national drought policy is one of the goals of the National Drought Preparedness Act (S. 802; H.R. 1386), and the National Integrated Drought Information System (NIDIS) is a component of this bill. National drought policy should be consistent and equitable for all regions, population groups, and economic sectors and consistent with the goals of sustainable development and the wise stewardship of natural resources. The overriding principle of drought policy should be an emphasis on risk management through the application of preparedness and mitigation measures. Preparedness refers to pre-disaster activities designed to increase the level of readiness or improve operational and institutional capabilities for responding to a drought episode. Mitigation refers to short- and long-term actions, programs, or policies implemented in advance of and during drought that reduce the degree of risk to human life, property, and productive capacity. These actions are most effective if done before the event. Emergency response will always be a part of drought management because it is unlikely that government and others can anticipate, avoid, or reduce all potential impacts through mitigation programs. A future drought event may also exceed the "drought of record" and the capacity of a region to respond. However, emergency response should be used sparingly and only if it is consistent with longer-term drought policy goals and objectives.

A national drought policy should be directed toward reducing risk by developing better awareness and understanding of the drought hazard and the underlying causes of societal vulnerability. The principles of risk management can be promoted by encouraging the improvement and application of seasonal and shorter-term forecasts, developing integrated monitoring and drought early warning systems and associated information delivery systems, developing preparedness plans at various levels of government, adopting mitigation actions and programs, and creating a safety net of emergency response programs that ensure timely and targeted relief. A key element of an effective drought policy is the delivery of information in a timely manner so informed decisions can be made by resource managers and others. Creation of a user-friendly drought information system is one of the principal goals of NIDIS.

The traditional approach to drought management has been reactive, relying largely on crisis management. This approach has been ineffective because response is untimely, poorly coordinated, and poorly targeted to drought-stricken groups or areas. In addition, drought response is post-impact and relief tends to reinforce existing resource management practices. It is precisely these existing practices that have often increased societal vulnerability to drought *(i.e.,* exacerbated drought impacts). The provision of drought relief only serves to reinforce the *status quo* in terms of resource management—*i.e.,* it rewards poor resource management and the lack of preparedness planning. Many governments and others now understand the fallacy of crisis management and are striving to learn how to employ proper risk management techniques to reduce societal vulnerability to drought and, therefore, lessen the impacts associated with future drought events.

In the United States, there has been some progress in addressing the impacts of drought through the development of preparedness plans. The most noticeable progress has been at the state level, where the number of states with drought plans has increased dramatically during the past two decades. In 1982, only three states had drought plans. In 2006, thirty-eight states have drought plans. The basic goal of state drought plans should be to improve the effectiveness of preparedness and response efforts by enhancing monitoring and early warning, risk and impact assessment, and mitigation and response. Plans should also contain provisions *(i.e.,* an organizational structure or framework) to improve coordination within agencies of state government and between local and Federal Government. Initially, state drought plans largely focused on response efforts aimed at improving coordination and shortening response time; today the trend is for states to place greater emphasis on mitigation as the fundamental element of a drought plan. Thus, some plans are now more pro-active, adopting more of a risk management approach to drought management. This trend needs to continue, and at an accelerated pace. States also need to be encouraged to require municipalities to develop drought preparedness plans. Some states (*e.g.,* South Carolina, Kentucky, and Texas) have already adopted this approach.

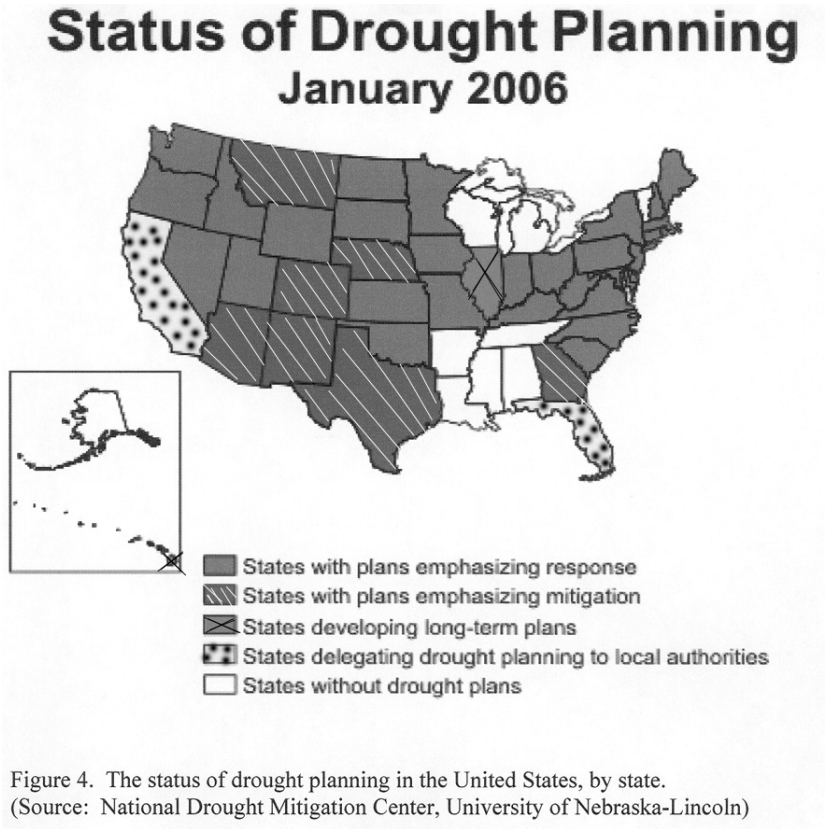


Figure 4. The status of drought planning in the United States, by state.
(Source: National Drought Mitigation Center, University of Nebraska-Lincoln)

The growth in the number of states with drought plans suggests an increased concern at that level about the potential impacts and conflicts associated with extended water shortages and an attempt to address those concerns through planning. Initially, states were slow to develop drought plans because the planning process was unfamiliar. With the development of drought planning models, such as the 10-step drought planning process developed at the NDMC, and the availability of a greater number of drought plans for comparison, drought planning has become a less puzzling process for states. As states initiate the planning process, one of their first actions is to study the drought plans of other states to compare methodology and organizational structure.

The rapid adoption of drought plans by states is also a clear indication of their benefits. Drought plans provide the framework for improved coordination within and between levels of government. Early warning and monitoring systems are more comprehensive and integrated and the delivery of this information to decisionmakers at all levels is enhanced. Many states are now making full use of the Internet to disseminate information to a diverse set of users and decisionmakers. Through drought plans, the risks associated with drought can be better defined and addressed with proactive mitigation and response programs. The drought planning process also provides the opportunity to involve numerous stakeholders early and often in plan development, thus increasing the probability that conflicts between water users will be reduced during times of shortage. All of these actions can help to improve public awareness of the importance of water management and the value of protecting our limited water resources.

Drought mitigation plans have three essential components, regardless of whether they are developed at the state, national, regional, or local scale. First, a comprehensive monitoring and early warning system provides the basis for many of the decisions that must be made by a wide range of decisionmakers as drought conditions evolve and become more severe. Equally important, early warning systems must be

coupled to an effective delivery system that disseminates timely and reliable information. As drought plans incorporate more mitigation actions, it is imperative that these actions be linked to thresholds (*e.g.,* reservoir levels, climate index values) that can serve as triggers for mitigation and emergency response actions. Second, a critical step in the development of a mitigation plan is conduct of a risk assessment of vulnerable population groups, economic sectors, and region. The purpose of the risk assessment is to determine who and what is at risk and why. This is successfully accomplished through an analysis of historical and recent impacts associated with drought events. This risk assessment task is accomplished as part of the 10-step drought planning process developed by the NDMC. Third, after impacts have been identified and prioritized, the next step is to identify appropriate mitigation actions that can help to reduce the risk of each impact for future drought events. In many cases, appropriate response actions are also identified through this process, but these actions should not conflict with the basic goal of the drought mitigation plan: to reduce vulnerability to drought events. As noted earlier, some response actions may increase reliance on government and encourage the continuation of inappropriate resource management practices.

Recommendations for Improving Drought Mitigation and Preparedness

- Implement the National Integrated Drought Information System (NIDIS) through a full partnership between NOAA and other Federal agencies, non-Federal agencies, and organizations, including the National Drought Mitigation Center, in order to improve monitoring and early warning systems and seasonal climate forecasts to provide better and more timely and reliable information to decisionmakers; address data gaps in drought monitoring and enhance networks, particularly for soil moisture, snow pack, and ground water; and develop new monitoring and assessment tools/products that will provide resource managers at all levels with proper decision-support tools at higher resolution.
- Improve knowledge of the scientific and policy communities and resource managers about the drought hazard.
  1. Augment paleoclimate and historical climate research to better understand the drought climatology of all regions for more effective planning and design.
  2. Communicate information on probabilities of single- and multiple-year drought events to natural resource managers and planners, policymakers, and the public.
- Improve the reliability of seasonal climate forecasts and train end users on how to apply this information to improve resource management decisions with the goal of reducing drought risk.
  1. Develop more competitive research grant programs to fund research on drought prediction. In particular, there is a need for enhanced observations and research on both the paleoclimate record and the drought-related dynamics of ocean-atmosphere coupling.
  2. Form a consortium of scientists to encourage collaboration on drought prediction.
  3. Develop a network of scientists and end users to assess the practical needs of end users and how forecast information can be communicated more effectively to the user community to maximize its application.
- Assess the economic, social, and environmental impacts associated with drought.
  1. Develop a standard methodology for assessing the impacts of drought on multiple economic sectors and the environment and systematically assess the losses associated with drought events at the local, state, and national levels.
  2. Evaluate the effect of mitigation actions in reducing the impacts of drought at the local and state level.
  3. Improve early assessments of drought impacts through the application of appropriate models (*i.e.,* crop, hydrologic).
- Assess the science and technology needs for improving drought planning, mitigation, and response at the local, state, tribal, regional, and national levels.
  1. Evaluate current drought planning models available to governments and other authorities for developing drought mitigation plans at the state and local levels of government and require plans to follow proposed standards or guidelines.

2. Develop improved triggers *(i.e.,* links between climate/water supply indicators/indices and impacts) for the phase-in and phase-out of drought mitigation and response programs and actions during drought events.

3. Develop vulnerability profiles for various economic sectors, population groups, and regions and identify appropriate mitigation actions for reducing vulnerability to drought for critical sectors.

- Increase awareness of drought, its impacts, trends in societal vulnerability, and the need for improved drought management.

1. Initiate K–12 drought/water awareness programs/curriculum.

2. Launch public awareness campaigns for adult audiences, directed at water conservation and the wise stewardship of natural resources.

Summary

The National Drought Mitigation Center at the University of Nebraska—Lincoln strongly supports greater investment in research and policies directed at reducing this Nation's vulnerability to drought through a more risk-based approach. The implementation of the National Integrated Drought Information System is a critical step in this direction. Improved climate and water assessments, more reliable forecasts at various timescales, better decision-support tools, and more timely communication of this information to decisionmakers through an interactive delivery system will greatly enhance management of water and other natural resources. The NDMC will help NOAA develop an implementation plan for NIDIS and partner with them and other Federal and non-Federal entities to ensure the success of this program. My years of experience with drought management have convinced me that a wise initial investment in improved monitoring, early warning and prediction, mitigation, and planning will reduce this Nation's vulnerability to drought and concomitant impacts on economies, the environment, and the social well-being of its citizens.

Senator DEMINT. Thank you, Doctor.

Dr. Koblinsky?

STATEMENT OF DR. CHESTER J. KOBLINSKY, DIRECTOR, CLIMATE PROGRAM OFFICE, OFFICE OF OCEANIC AND ATMOSPHERIC RESEARCH, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA), DEPARTMENT OF COMMERCE

Dr. KOBLINSKY. Good morning, Senator DeMint, Senator Nelson. Thank you for the opportunity to testify on this important issue.

My name is Chester Koblinsky, and I'm the Director of NOAA's Climate Program Office.

NOAA's climate programs provide the Nation with services and information to improve the management of climate-sensitive sectors, such as energy, agriculture, water, and living marine resources. Our services address climate change and variability on timescales ranging from weeks to decades for a variety of phenomena, including drought.

What is drought? Well, there is no single definition of drought that meets all needs. Drought refers to a period of time when precipitation levels are abnormally low, resulting in a water shortage that impacts human activities and the environment. NOAA scientists evaluate precipitation, temperature, soil moisture, groundwater, and surface-water data for the present and recent past to determine if drought conditions exist. If we want to look to the future, NOAA scientists will use computer models, climatology, statistical outlooks, and projections to estimate what the future will bring.

Drought is not purely a physical phenomena. There's an interplay between water availability and the needs of humans and the

environment. Drought is a normal recurrent feature of climate. It occurs almost everywhere, although its features vary from region to region and from year to year. At least a part of the country experiences it at any given time.

Drought is a unique natural hazard. It is slow in onset, does not typically impact infrastructure directly, and its secondary effects, such as impacts on tourism, commodity markets, wildfires, or hydropower are frequently larger than the primary effects, such as water shortages or crop losses.

Turning my attention now to the current conditions, in the western United States the current drought started in 1999 and grew to affect 87 percent of the West at its peak, in the Summer of 2002. Although drought is continuing to affect parts of the West for the seventh consecutive year, drought conditions are much less expansive than in the past few years. At present, severe to extreme drought is restricted to a region from Arizona eastward through much of New Mexico and southeastern Colorado. Severe to extreme drought, aggravated by record heat in mid-April, encompasses the central and southern Great Plains, producing two particularly severe impacts: stressed winter wheat and dangerous wildfires. Farther south, exceptional drought, the most serious drought classification of the *U.S. Drought Monitor,* has settled into southern Texas. In the eastern states, severe to extreme drought recently developed along the northern Gulf Coast.

NOAA's outlook for the next 3 months is for these conditions to persist, with the exception of improvements on the eastern side of the Great Plains and the Gulf Coast.

The current conditions I have just described were provided by the *U.S. Drought Monitor.* This weekly report is the result of a truly collaborative effort among drought experts from NOAA, the U.S. Department of Agriculture, and the National Drought Mitigation Center at the University of Nebraska—Lincoln, with input from other Federal and State agencies, as well as a network of over 100 experts around the country. The *U.S. Drought Monitor* provides a consensus of the current state of drought in all 50 States and Puerto Rico, using multiple objective drought indicators, such as soil moisture and stream flow, combined with reports of current conditions, such as weekly crop reports.

The *Monitor* expresses drought conditions in five classes, ranging from abnormally dry, which could reflect a short-term dryness or lingering water deficits, to exceptional drought, which might reflect widespread crop losses or water emergencies. Among its varied uses, Federal officials have used the *U.S. Drought Monitor* in recent years to determine disaster assistance allocations to ranchers and farmers affected by severe drought.

The increasing demand for drought information motivated the development of a broadbased plan for a National Integrated Drought Information System that was proposed in 2004 by the Western Governors' Association. This is an ambitious program to significantly enhance the Nation's ability to monitor and forecast drought. It will create a national drought early warning system to enable the Nation to address both responses to drought and proactive approaches of risk reduction.

The implementation of the National Integrated Drought Information System will require building a National Drought Monitoring and Forecasting System, improving predictive capabilities, providing an interactive drought information delivery system for products and services, and designing mechanisms for improved interaction with the public.

In response to a recommendation from the Western Governors for NOAA to lead the National Integrated Drought Information System, we have initiated its development in partnership with other Federal, regional, and State organizations. For example, the National Integrated Drought Information System has been identified as a near-term opportunity within the U.S. Integrated Earth Observing System Strategy mentioned by Governor Geringer. And, in this context, Federal agencies have worked together to identify contributions from current infrastructure, as well as critical gaps in observations and information delivery mechanisms for drought.

If supported, we project that the National Integrated Drought Information System will take 5 to 6 years to fully implement. The President's Fiscal Year 2007 budget request for NOAA includes an increase of $5.7 million to support NIDIS. Of this amount, $4 million will support problem-focused drought-impact research specifically aimed at risk reduction, while the remainder addresses the Climate Reference Network and regional climate services. We urge the Committee to support NOAA's Fiscal Year 2007 budget request.

Mr. Chairman, this concludes my testimony. I appreciate the opportunity to testify. And I'll be pleased to answer your questions.

Thank you.

[The prepared statement of Dr. Koblinsky follows:]

PREPARED STATEMENT OF DR. CHESTER J. KOBLINSKY, DIRECTOR, CLIMATE PROGRAM OFFICE, OFFICE OF OCEANIC AND ATMOSPHERIC RESEARCH, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA), DEPARTMENT OF COMMERCE

Good morning, Mr. Chairman and members of the Committee. I am Chester (Chet) Koblinsky, Director of the National Oceanic and Atmospheric Administration's (NOAA's) Climate Program Office, which is part of NOAA's Office of Oceanic and Atmospheric Research. I am also the team leader of NOAA's Climate Mission Goal, which oversees all of NOAA's climate activities. Thank you for inviting me to discuss drought conditions in the United States and NOAA's role in drought research, monitoring, and forecasting.

NOAA's climate programs provide the Nation with services and information to improve management of climate sensitive sectors, such as energy, agriculture, water, and living marine resources, through observations, analyses and predictions, and sustained user interaction. Our services include assessments and predictions of climate change and variability on timescales ranging from weeks to decades for a variety of phenomena, including drought. In my testimony I will highlight: (1) the current drought conditions across the Nation; (2) the drought outlook for 2006; (3) NOAA's drought monitoring and forecasting capabilities; (4) the National Drought Information System (NIDIS); (5) NOAA's drought research activities; and (6) NOAA's interagency collaborations on drought.

Defining Drought

In the most general sense, drought refers to a period of time when precipitation levels are abnormally low, impacting human activities and the environment. While there is no single definition of drought that meets all needs, drought refers to a deficiency in precipitation over a period of time resulting in a water shortage. Scientists evaluate precipitation, temperature, soil moisture, ground water, and surface water data for the present and recent past to determine if drought conditions exist. Drought is not a purely physical phenomenon, but is an interplay between water availability and the needs of humans and the environment. Drought is a normal,

recurrent feature of climate. It occurs almost everywhere, although its features vary from region to region. For consistency, I will be referring to drought conditions as defined using the *U.S. Drought Monitor* methodology, unless otherwise noted, throughout the remainder of my statement.

Drought is a unique natural hazard. It is slow in onset, does not typically impact infrastructure directly, and its secondary effects, such as impacts on tourism, commodity markets, transportation, wildfires, insect epidemics, soil erosion, and hydropower, are frequently larger and longer lasting than the primary effects, such as water shortages and crop, livestock, and wildlife losses. Drought is estimated to result in average annual losses to all sectors of the economy of between $6 to $8 billion (in 2005 dollars). The costliest U.S. drought of the past forty years occurred in 1988 and caused more than $62 billion (in 2005 dollars) of economic losses. Although drought has not threatened the overall viability of U.S. agriculture, it does impose costs on regional and local agricultural economies. Severe fire seasons due to drought and frequent winds can also result in billions of dollars in damages and fire suppression costs.

Current Drought Status

Drought conditions across the United States are depicted in Figure 1. Although drought is affecting at least part of the West for the seventh consecutive year, drought conditions are much less expansive than in the recent past, with severe to extreme drought restricted to a relatively small region from Arizona eastward through much of New Mexico and southeastern Colorado.

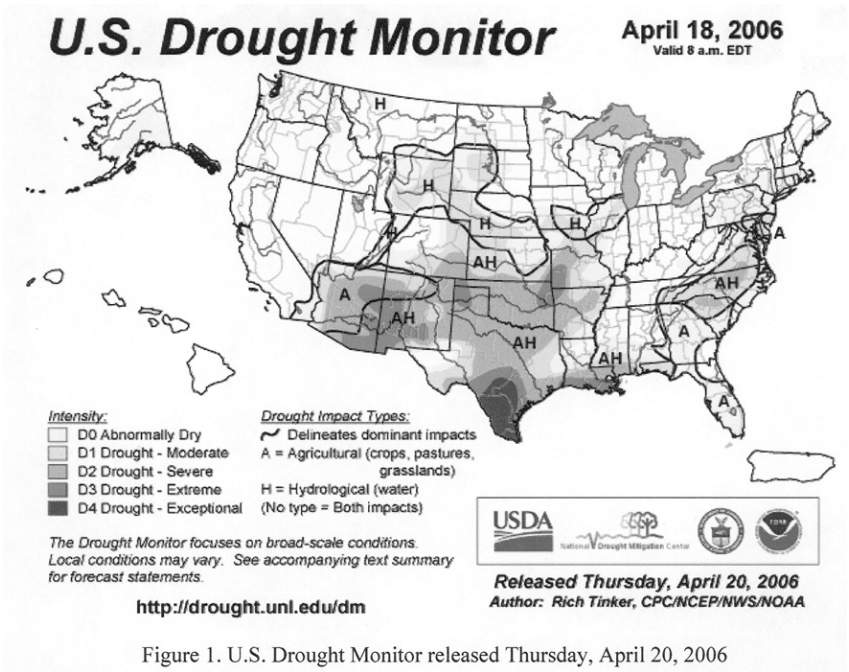


Figure 1. U.S. Drought Monitor released Thursday, April 20, 2006

The protracted, multi-year drought that had been plaguing the West has finally loosened its grip on central and northern parts of the region, where both precipitation and snowpack are near- to above-normal since the beginning of the 2005/2006 water year (October 1, 2005). This precipitation, in concert with copious precipitation that fell on central and southern parts of the West during the 2004/2005 water year, gradually eliminated drought conditions and boosted reservoir levels in most areas to the north and west of southern Colorado, although pockets of moderate drought persist in portions of Wyoming. Precipitation totals are now above-normal for time periods extending back 2 years along the West Coast and no drought conditions are reported for this region as of late April 2006.

There remain two aspects of the current drought which have not fully recovered from the multi-year dry spell, even though most of the West is no longer shown as abnormally dry in the *Drought Monitor* (Figure 1). First, ground water levels in

some areas, such as southeastern Idaho, remain exceedingly low. Second, the largest reservoirs in the West, such as Lakes Mead (58 percent full) and Powell (44 percent full), have not had enough time to recharge, and remain well below capacity.

Drought has been slowly intensifying since the start of the 2005/2006 water year across Arizona and New Mexico. During October 2005–April 2006, less than 50 percent of normal precipitation fell over most of Arizona and New Mexico, resulting in a meager snowpack and unseasonably high fire danger. During the first 3 months of 2006, wildfires consumed almost 221,000 acres of land in the Southwest Area (comprised of western Texas, the Oklahoma Panhandle, New Mexico, and Arizona), more than 5 times the average January–March total for the previous 9 years. Surface moisture shortages are also affecting agriculture with about 94 percent of New Mexico topsoils characterized as short or very short of moisture, and 67 percent of the state's winter wheat crop in poor or very poor condition as of mid-April 2006. A majority of both Arizona and New Mexico are now depicted as experiencing severe to extreme drought, according to the *U.S. Drought Monitor.* However, except for southwestern New Mexico, water supplies are not as problematic across the Southwest because of heavy precipitation that fell last water year (2004/2005) boosting reservoir levels.

Moderate drought covers a significant portion of the central Great Plains, although recent storms have erased lingering dryness in parts of the northern Plains. Severe to extreme drought, aggravated by record heat in mid-April, encompasses the southern Great Plains from southern Kansas and southwestern Missouri southward through central Texas. Farther south, exceptional drought, the most serious drought classification depicted by the *U.S. Drought Monitor,* has settled into southern Texas. Moderate to heavy rainfall during March eliminated extreme to exceptional drought conditions in southeastern Oklahoma and adjacent parts of Texas and Arkansas, with additional improvement in late April, but a broad area of severe drought lingered in its wake. Record dryness occurred in 2006 with Kansas having the driest February on record, Oklahoma the driest November to February, and Arkansas the driest October to February and March to February.

The drought in the southern Great Plains has been highlighted by two particularly severe impacts: stressed winter wheat and dangerous wildfires. As of mid-April, 78 percent of Texas winter wheat was in poor or very poor condition, as was 67 percent of Oklahoma winter wheat. In contrast, 23 percent of Kansas winter wheat and just 12 percent of Nebraska winter wheat rated poor or very poor. Through the first 3 months of 2006, fire danger was frequently high in the Southwest, the Plains, and parts of the East, but the largest and most damaging wildfires have occurred in Texas and adjacent areas. A record season continues and as of April 20, 2006, the Texas Forest Service is reporting over 1.5 million acres burned in the state during 2006.

Across northern Illinois and southern Iowa, recent heavy rains have greatly ameliorated or eliminated the long-term drought which began affecting the region during the spring of 2005.

Severe to extreme drought has recently developed along the northern Gulf Coast, as 6-month rainfall from early October to mid-April totaled less than 50 percent of normal from southern Louisiana into southern Alabama, though recent thunderstorms (especially on April 21) brought some relief. To the east, short-term dryness recently developed along the eastern half of the Gulf Coast, and the central and northern sections of the Atlantic Coastal Plain. As a result of depleted surface moisture, wildfires developed across Florida in March and April, and fire danger remained high, while the most noticeable impact of the short-term dryness from the Carolinas northeastward through southern Maine has been a sharp drop in streamflows relative to historic observations for this time of year. In the New England hydrologic region, 23 percent of reporting gauges set new daily low flows on April 20, 2006, with 13 percent setting low flows in the South Atlantic region, and 10 percent in the mid-Atlantic region. Heavy rains falling over the Appalachians, mid-Atlantic states, and New England on April 21–24 have significantly eased drought concerns for the time being.

The dryness across most of the eastern states generally developed over the course of the last few months. In the central Carolinas and adjacent Virginia, however, rainfall shortages date back much longer, affecting water supplies in some areas. Most of this region is classified as experiencing moderate to severe drought in mid-April, with the largest and longest-duration precipitation deficits observed in central North Carolina resulting in almost 10 percent of the state's population under mandatory water conservation measures.

Historical Perspective

From a historical perspective of droughts, some indicators depict the recent multi-year drought (1999–2006) as one of the most severe in the past 40 to 100 years, comparable to the severe droughts in the 1950s and 1930s in some areas. On a national scale, 51 percent of the contiguous U.S. was affected by moderate to extreme drought, as defined by the Palmer Drought Index, during the peak of the drought in the Summer of 2002. This comes in third, behind 80 percent and 60 percent at the peak of the 1930s and 1950s national droughts, respectively.

For the western United States, the current drought started in 1999 and grew to affect 87 percent of the West at its peak in the Summer of 2002. This is second only to the Summer of 1934 when 97 percent of the West was affected. In terms of the combined effects of intensity and duration, the 1999–2006 and 1986–1993 western droughts are unprecedented in the 110-year historical record. However, based on tree rings and other paleoclimatic data, droughts that have been more extreme than the current one have periodically affected the West during the last one thousand years, with some droughts lasting 20 to 30 years or longer. Paleoclimatic dating of these multi-decadal droughts coincide with evidence of societal stresses on native populations, including the Anasazi of the Four Corners Region. Recent population growth throughout the U.S. and particularly in the West has placed increased demands on water supplies, so drought vulnerability has increased because of greater numbers of water users.

The Outlook

In order to fully appreciate the long-term outlook for the drought, it is helpful to understand the meteorological causes and ongoing research issues. Recent research, much of it coming from NOAA laboratories or from NOAA-funded projects at universities and based on collections of statistical and physical models, shows the important role existing ocean and ground conditions play in establishing wind patterns leading to "blocking" in the atmosphere. Blocking is an important factor in setting up the weather conditions which cause prolonged warm and dry conditions and reduced rainfall and above-normal warmth. Climate trends should also be considered when forecasting the future evolution of a drought. Climate across much of the U.S. has been getting warmer for about 20–25 years, especially in the winter and spring. These conditions contribute to drought by increasing the rate of snow melt in the Spring and early Summer, and also by increasing water evaporation.

The seasonal drought outlook (Figure 2) incorporates medium and long-range forecasts of precipitation and temperature from NOAA's Climate Prediction Center and also considers the Spring–Summer streamflow forecasts from the U.S. Department of Agriculture and NOAA's National Weather Service. While precipitation has eliminated drought conditions across much of the West, recent precipitation in the Southwest will not be enough to make up for the extreme dryness experienced from October into early March. As of late April, mountain snow water content stood at less than 25 percent of normal for much of Arizona and New Mexico. As the dry season sets in, opportunities for further improvement will be quite limited through June. Furthermore, the official seasonal outlook produced by NOAA's Climate Prediction Center suggests that for May through July the Southwest will experience higher than normal temperatures which will increase mountain snow melt and evaporation. The latest streamflow forecasts for this spring and summer produced by USDA's Natural Resources Conservation Service and NOAA's National Weather Service indicate much below-normal streamflow for Arizona, New Mexico, southern Colorado and parts of southern Utah. Therefore, the seasonal drought outlook through July shows drought persisting over much of the region, although the monsoon season and its increased chance for showers and thunderstorms during July and August, should lead to some improvement in a few areas.

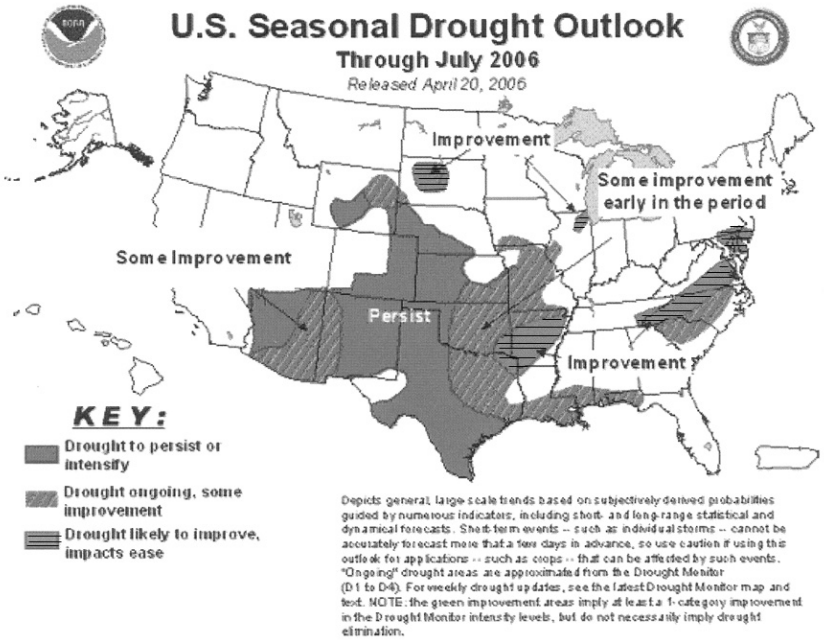


Figure 2. U.S. Seasonal Drought Outlook released April 20, 2006

NOAA's seasonal forecasts indicate that there is an increased chance for below normal rainfall during the spring and summer over the central and southern Plains. These forecasts also indicate an enhanced probability for higher than normal temperatures. Persistent drought is expected throughout July over southern and western Texas, eastern New Mexico, western Oklahoma, western Kansas, and eastern Colorado, as well as southern Nebraska. Ongoing drought accompanied by varying degrees of improvement is expected from Missouri into eastern parts of Kansas, Oklahoma, and Texas, and along the Gulf Coast, with more significant improvement over Arkansas and adjacent parts of Oklahoma and Texas.

Elsewhere, the recent rains have reduced the odds for drought expansion or intensification from the mid-Atlantic states northeastward, but near-drought conditions will likely remain a concern this spring from Florida into southern Georgia.

Drought Monitoring and Forecasting

NOAA continues to work with its partners to improve our Nation's ability to monitor drought. The *U.S. Drought Monitor* is produced on a weekly basis by drought experts from four U.S. organizations (NOAA's National Climatic Data Center, NOAA's Climate Prediction Center, the U.S. Department of Agriculture (USDA), and the National Drought Mitigation Center at the University of Nebraska) with input from other Federal and state agencies, as well as feedback from a network of over 100 experts around the Nation. The *U.S. Drought Monitor* provides a consensus on the current state of drought in all 50 states and Puerto Rico using multiple objective drought indices and indicators (*e.g.,* soil moisture and streamflow) combined with reports of current conditions and impacts (*e.g.,* weekly crop progress and condition reports) from a wide range of public and private sector partners at the Federal, state, and local levels. Among its varied uses, Federal officials have used the *U.S. Drought Monitor* in recent years to determine disaster assistance allocations to ranchers and farmers affected by severe drought.

NOAA continues to develop new products to improve our drought monitoring capabilities. More accurate precipitation mapping capabilities have resulted in experimental soil moisture products that are now being refined in collaboration with the National Aeronautics and Space Administration (NASA), Princeton University, and the University of Washington to create practical tools for monitoring soil moisture. NOAA's Climate Prediction Center operates a U.S. Precipitation Quality Control

and Analysis program that produces daily high resolution maps of precipitation. To provide better coverage and more accurate measurements to aid in monitoring drought, NOAA continues to modernize its network of cooperative observation sites as well. NOAA continues to improve its drought forecasts. NOAA's Climate Prediction Center produces a monthly *U.S. Seasonal Drought Outlook* which forecasts drought conditions over the next 3½ months. The drought outlooks combine information from NOAA's suite of forecast products, from daily to seasonal, to show where drought will likely persist, ease, or develop during the next season. NOAA's National Centers for Environmental Prediction also creates other numerous products useful for drought forecasting, such as 2-week soil moisture forecasts based on temperature and rainfall forecasts and seasonal soil moisture forecasts based on soil moisture pattern from previous years. These forecasts help farmers, land managers and others prepare for and take steps to manage the effects of drought.

NOAA can report some instances where the Agency accurately predicted several of the recent and ongoing droughts with the seasonal drought outlooks, especially in recent months. The early December 2005 Outlook predicted drought expansion in the southern Plains and the Southwest and improvement in the Northwest by February 2006. The mid-January Outlook accurately projected that drought would expand into Kansas and the Southwest, and this occurred by mid-March leading to problems with winter crops and pastures and increasing the danger of wildfires. The Outlook issued on March 16 warned of possible drought development from Florida northward into the mid-Atlantic region. By the end of March, drought had expanded northward into Virginia and Delaware and abnormal dryness had spread across Florida.

NOAA's drought monitoring is supported by critical remotely sensed data provided by NOAA's Geostationary and Polar-orbiting Operational Environmental Satellites (GOES and POES, respectively). POES satellites are used to monitor vegetation stress, a precursor for the early on-set, severity and duration of drought. In the United States, vegetation stress is an indicator used by farmers and the agricultural industry to track the condition of crops. As an indicator of biomass, satellite data are valuable in assessing wildland fire potential. NOAA's next-generation geostationary and polar-orbiting satellites—GOES–R and the National Polar-orbiting Operational Environmental Satellite System (NPOESS)—are being designed to continue these important drought monitoring capabilities. We urge the Committee to support the Fiscal Year 2007 President's budget request for these programs.

National Integrated Drought Information System (NIDIS)

Drawing from experiences with stakeholders in drought-affected regions and recent reports on drought and stakeholder needs, NOAA has identified a significant demand for a concentrated research and stakeholder interactions effort that: (1) assesses the Nation's vulnerability to drought; (2) develops products useful for drought planning; and (3) develops ongoing collaborations with stakeholders to communicate climate impact information, co-produce tools, and participate in drought planning activities. In response to this demand and a request from the Western Governors' Association (WGA), NOAA has taken the lead on the development and implementation of a National Intergrated Drought Information System (NIDIS) in partnership with other Federal, regional and state organizations.

NIDIS is an ambitious program to significantly enhance the Nation's ability to monitor and forecast drought. It will establish a modern, dense network of observing locations to observe and monitor all aspects of drought and enhance stakeholder access to information on drought conditions, impacts, and forecasts. NIDIS, in turn, will be supported by a focused drought research program. NIDIS will create a national drought early warning system to enable the Nation to move from a reactive to a more proactive approach to drought. The vision is for NIDIS to be a dynamic and accessible drought information system that provides users with the ability to determine the potential impacts of drought and their associated risks and also provides the decision-support tools needed to better prepare for and mitigate the effects of drought.

NIDIS will provide more comprehensive and timely drought information and forecasts which are required by numerous sectors to mitigate drought-related impacts. The Bonneville Power Administration and other hydropower authorities will benefit from enhanced water supply forecasts and drought information for hydropower management decisions. Water resource managers will have access to more information when balancing irrigation water rights with the needs of wildlife. Purchasing decisions by ranchers for hay and other feed supplies will be enhanced through the use of drought information to identify areas of greatest demand and the potential for shortages. Farmers will be better positioned to make decisions on which crops to plant and when to plant them. Municipalities and state agencies will have improved

drought information and forecasts when allocating domestic and industrial water usage. Since drought information is used in allocating Federal emergency drought relief, improvements in monitoring networks will also lead to more accurate assessments of drought and, as a result, emergency declaration decisions that better reach out to those communities in need of assistance.

A hallmark of NIDIS will be the provision of decision-support tools coupled with the ability for users to report localized conditions. To this end, NIDIS will link multi-disciplinary observations to "on-the-ground" conditions that will yield value-added information for agricultural, recreational, water management, commercial, and other sectors.

The four key components of NIDIS are: (1) improved integrated observations and data systems and forecasts; (2) new tools for analysis and decision-support; (3) coordinated monitoring, forecast, and impacts research and science; and (4) improved information dissemination and feedback.

The implementation of NIDIS will require: (1) building a national drought monitoring and forecasting system; (2) creating a drought early warning system; (3) providing an interactive drought information delivery system for products and services—including an Internet portal and standardized products [databases, forecasts, Geographic Information Systems (GIS), maps, etc]; and (4) designing mechanisms for improved interaction with the public (education materials, forums, etc).

NOAA will work internally to integrate planning for the observing system requirements, research priorities, and operational needs of NIDIS. A NIDIS executive team will be established to oversee implementation and coordination of NIDIS among the Federal partners [NOAA, U.S. Department of Agriculture (USDA), U.S. Army Corps of Engineers (USACE), Bureau of Land Management (BLM), Bureau of Reclamation (BOR), U.S. Geological Survey (USGS), Environmental Protection Agency (EPA), NASA] and will be facilitated by the National Science and Technology Council's Committee on Environment and Natural Resources. The result will be a sustained and coordinated interagency program, which will report regularly on its status, accomplishments, and plans for improvements.

The expertise and tools of a number of NOAA programs are being brought together under the NIDIS framework to help the Nation address the challenge of drought. Climate services conducted in NOAA's National Weather Service; National Environmental Satellite, Data, and Information Service; and Office of Oceanic and Atmospheric Research will support NIDIS. NOAA's cooperative institute partners, Regional Integrated Sciences and Assessments (RISAs) teams, and Regional Climate Centers will be involved as well. NIDIS will also be supported by NOAA's current operational drought monitoring and outlook products and NOAA's applied climate research program.

The President's Fiscal Year 2007 Budget Request for NOAA includes $16.2 million for Climate Observations and Services, with a $4.0 million increase to directly support NIDIS related activities. This increase will sponsor integrated, problem-focused research and research-to-operations transition projects. Additional increases of $1.2 million for the Climate Reference Network and $0.5 million for regional climate services will help NOAA realize improvements in observation systems required by NIDIS. NOAA is projecting that it will take 5 to 6 years to fully implement NIDIS with gradual improvement in NOAA's drought monitoring and forecasting capabilities occurring throughout the implementation process.

NIDIS is part of a larger NOAA effort over the past several years to deliver climate services that are produced and delivered in on-going consultation with affected stakeholders in order to ensure that the research-based insights, information products and expert opinions delivered are of the highest relevance and utility to the set of challenges at hand.

Drought Research Activities

NOAA research activities support drought risk assessment and management. The research is focused on developing predictions of drought onset, termination, duration, and severity and the prediction of multi-year to decadal drought as a function of sea surface temperature variability, deep soil moisture/ground water variability, and other factors. NOAA's research also includes assessments of societal, economic, and environmental vulnerability to drought to inform risk reduction efforts. This work objectively quantifies drought and its associated economic impacts to accurately quantify the monetary benefits of improved drought prediction and mitigation. Our methods incorporate uncertain drought predictions to improve public and private sector planning and operational decisionmaking for water supply, transportation, hydropower, and irrigation.

An integral part of NOAA's drought research activities is NOAA's support over the last 15 years of university-based research focused on the use of seasonal and

inter-annual climate prediction information in decisionmaking across a range of sectors (*e.g.,* agriculture, water management, public health, forest fire management, fisheries). In recent years, these university-based researchers through NOAA programs, such as the Regional Integrated Sciences and Assessments (RISA), Sectoral Applications Research Program (SARP), and NOAA Climate Transition Program (NCTP), have been working with stakeholders at the local, state, and regional levels to determine what type of climate information would be useful to their decisions, and determining how scientific information could help to reduce vulnerability to drought, in particular, along with other extreme events and long-term climate trends (*e.g.,* declining snowpack). NOAA-funded researchers have been working with farmers, ranchers, state governors' offices, water management agencies, ditch companies, forest fire managers, and other stakeholders to analyze vulnerability to climate, assess the need for different types of climate information, and develop information of use to these decisionmakers. NOAA-funded drought research activities support the U.S. Climate Change Research Program (CCSP), and are in turn enhanced by the broader CCSP research going on at universities and other Federal agencies. By understanding the role of drought in human affairs and how information on the probability of drought can be integrated into existing decision environments, it is possible to move from drought response to pro-active drought management.

As NOAA's global climate models improve, particularly the land component of Earth System Models, NOAA will be able to aggressively focus on drought prediction in the United States, at seasonal-interannual timescales. In turn, as our understanding and skill at forecasting seasonal to interannual climate improves, the ability to use long-term climate models to assess regional drought risks increases as well. To better predict drought and other climate events, NOAA continues to invest in research to better understand the interdependencies of the ocean and land and their combined influence on climate.

Recent data shows a warming trend for the past several decades over much of the West, especially during the winter season. Climate models, using historical data, accurately simulate temperature increases consistent with this observed long-term warming trend. These models project the general warming trend will continue for the remainder of this century. However, neither climate model projections nor observations show any identifiable trend in precipitation, but they do reveal a changing distribution of precipitation intensity, similar to what would be expected in a warming climate. Specifically, NOAA's National Climatic Data Center and other research efforts have demonstrated that more of our precipitation is tending to fall in heavier precipitation events which can ultimately impact drought severity through changing precipitation run-off.

Research at NOAA's Earth System Research Laboratory indicates recent decadal swings in precipitation in the western U.S. may be largely attributable to decadal variations and trends in ocean temperatures, especially in the tropical Pacific and Indian Oceans. The causes of these changes in ocean temperature are not fully understood, but are likely due in part to a combination of long-term climate change and variability in the atmosphere and ocean. Even with unchanging total precipitation in the western United States, continuation of current temperature trends may significantly influence the annual water cycle as well as water demand, with subsequent implications for water management.

NOAA and sister science agencies in Mexico are co-leading the North American Monsoon Experiment (NAME), an international effort to enhance understanding of the sources and limits of predictability of warm season precipitations over North America, with emphasis on timescales from seasonal to interannual. Improved understanding and prediction of monsoon rainfall in the southwestern U.S. and Mexico is critical for water resource management in the region. NOAA's research community continues to interact with researchers, nationally and internationally, to improve climate and statistical models based on seasonal and longer-term outlooks, enabling a steady increase in our understanding of the causes of drought. Learning the mechanisms triggering drought will enable us to better forecast the likelihood of drought development months and years ahead of time.

To improve NOAA's ability to detect and analyze interannual-to-decadal variability in climate and weather-climate trends, NOAA has proposed in Fiscal Year 2007 to invest in research to analyze and understand the causes of the 1930s and 1950s Dust Bowl droughts. One component of this research will be an extension of the current model-based reconstruction of climate back beyond 1948 to cover the entire 20th century to enhance NOAA's ability to describe atmospheric conditions during the 1930s Dust Bowl. The second component in this effort will be research focusing on diagnosing the causes of 1930s and 1950s droughts and identifying opportunities to improve NOAA's capability to forecast the onset, severity and duration of

high-impact scale droughts. This work will help NOAA address concerns and questions from stakeholders about comparisons between current conditions and those of the 1930s and 1950s.

NOAA drought forecasters routinely meet with researchers to explore methods to improve the drought forecasts. Advanced forecast methods based on statistical and global numerical models will continue to be incorporated into drought outlooks, using the best forecast tools and research available. We are encouraged by recent research which helps to explain the reasons behind drought development. Realistically, it is (and always will be) a continuing challenge to produce seasonal forecasts which are consistently accurate. However, as with our weather forecasts, we believe we can continuously improve.

Collaboration With Other Agencies

NOAA collaborates with many state and Federal agencies (*e.g.,* USDA, NASA, USGS, EPA BOR, USACE, and others) and universities to understand, monitor, and predict drought. The *U.S. Drought Monitor* is only one example of this collaborative effort. NOAA works cooperatively with other agencies on research projects that can lead to improved drought monitoring tools. For example, we are currently working with NASA to incorporate additional satellite data from NASA and NOAA sensors into drought monitoring and forecasting. NOAA also works closely with the USDA on water supply forecasting in the western United States, and relies on the USGS for streamflow data critical to both water supply and flood forecasting. NOAA is also working with agencies, such as NASA, to improve seasonal drought forecasting. In May 2005, NOAA held a workshop with NASA to kick off this new effort in research collaboration. The workshop focused on what is needed to accelerate progress on drought prediction with a focus on developing capabilities and products that facilitate water management and agricultural applications for the Americas.

Drought is a climate phenomenon with major impacts in North America and around the world. In today's global economy the costs and effects of drought extend beyond international borders and the North American Drought Monitor helps address this challenge. The North American Drought Monitor is a monthly product that the U.S. drought monitoring team produces in collaboration with Canadian and Mexican meteorologists. NOAA works with the U.S. Agency for International Development's Famine Early Warning System Network (USAID FEWS–NET) to monitor drought and significant weather events affecting water and food supplies in Africa, Central America, and Afghanistan. NOAA's contribution through a United States Agency for International Development—Office of Foreign Disaster Assistance (USAID–OFDA) partnership has resulted in the production of prototype scientific decision tools, such as prediction models for hydropower resource management in Eastern Africa where more than 70 percent of the countries rely on hydropower for electricity.

Concluding Remarks

Mr. Chairman, this concludes my testimony. I thank you for the opportunity to discuss drought conditions in the United States and NOAA's role in drought research, monitoring, and forecasting. The topic is critical given the economic and environmental impacts of drought in the United States and the increasing demand for drought information to help to manage the demand for water. I would be happy to answer any questions you or other Members of the Committee may have.

Senator DEMINT. Thank you.

Let me wade in first. Obviously, we're looking for ways to prevent the damage—the impact of droughts, because we know they're coming. I think all of you mentioned the management of water, availability of water. And it seems what we're talking about is, despite precipitation, that one big part of being prepared is to have a consistent and predictable supply of water, regardless of the lack of predictability of precipitation.

And my question is—and this comes back to a project I've been working on for years in South Carolina, just trying to build a reservoir, that's on Federal land, and the permitting process of working with the Army Corps of Engineers, the EPA, Department of the Interior. And it appears—and the reason we're looking at this is, 20 or 30 years down the road, with the growth in the area we need more availability of water. But the whole process of trying to get

that done, the permitting, the environmental restrictions—it's going to take decades to do it.

And I don't know if additional reservoir or storage possibilities exist anywhere to a scale that could help us in the vast areas of the midlands of our country, but my question is, is there a way to create more predictable water supplies, more reservoirs? And what are the obstacles to doing that? And I guess any of you could answer that. But is that even an option in the areas out west—Governor, we'll start with you.

Mr. GERINGER. Mr. Chairman, I'll give you a—perhaps just a slightly different view than, say, from a researcher's perspective. Water storage, of course, is built in two ways. One is a manmade structure, such as a reservoir. And you've mentioned that. The other is underground or groundwater. The hydrologic drought in many areas of our country is more significant than the surface drought today, because the water tables are being depleted, they're being mined. That's true all along the eastern slope of the Rockies. And it's happening in many other areas, as well. With times of prolonged drought or prolonged drawdown, it takes a long time. And I don't think we know enough about underground hydrology. There needs to be more research there.

And so, it's not just about building more storage. It's better planning. I speak a lot on issues dealing with policy and technology, and trying to connect the two, but until you introduce sociology, the culture of people, that's your greatest challenge. How do you persuade people that this is not a wise choice, to build in this place or live in this place? We can say that there is a drought happening in, say, Washington, D.C. You've had a little bit less than typical precipitation here. So, it's classified as being partly in a drought. Is the Sahara in a drought? No, because it's at its normal level. People are not adapting to change and using risk management to make better choices. And I think that's the key.

We have limits to what we can do to build storage and to anticipate water usage, but at some point there has to be an informed personal choice that, "This is not a good thing for me to do," to build here, to do that, whatever it is, and then collectively, as a community, we either can provide or adopt land-use plans such that we don't exceed our capability to supply water. And that's the cultural part. That's why you're here.

Senator DEMINT. Yes, that's a very difficult issue. I know what we've dealt with, again, in South Carolina, that folks will move out into rural areas. The land's cheaper. There is no city water. There are wells. But when the drought came, they wanted city water, and wondered why they didn't have it when others did. And I see, around the country, when I go, that there are a lot of areas that are basically desert that have been heavily irrigated and depend on artificial supplies of water to maintain those wonderful lawns and golf courses. And I guess what you're saying is, that's happening everywhere as we're——

Mr. GERINGER. It's happening everywhere. And when you look at places such as Las Vegas or Phoenix and those areas that are arid, they've always been that way, they are not experiencing that much of a drought compared to other parts of the country, yet they're a popular place to live. And we've created a culture of expectation,

that somehow someone will take care of it and minimize our risk, and I think we need to shift from that to a culture of self-reliance or more self-reliance, to where we make better choices.

Senator DEMINT. But you're saying that the ability to store enough water to deal with this is unlikely.

Mr. GERINGER. There's a limit to surface-water storage. It's obviously a wise thing to do, but there has to be an evaluation as to the intended or unintended impact on others. Look at Los Angeles and the Owens Valley, the demand on the Green River, the Green/Colorado combination, where Mexico is probably hit the hardest so far, and what happens to water quantity and quality. Even though we can store more water in the Colorado, there are other demands or needs that have already historically been placed on that water, and we have to—I think that's the purpose of an integrated information system, is that, for too many years, we've looked at things in isolation, we don't see the collateral effects of choices that we're making, either individually or, say, building a dam, and managing it with an information system that has enough data feeding into it that we can narrow down the unpredictability and make wiser choices through greater certainty on predictability, and not having someone else tell us the answer, but we discover it on our own.

Senator DEMINT. Dr. Wilhite?

Dr. WILHITE. Yes, I'll elaborate on some of those key points.

I think when we think about drought management, the drought is, yes, a natural hazard, but drought management is as much a sociological sort of an issue as anything else, because, really, we're talking about human behavior. And if we look at population growth around the United States, we've seen this tremendous growth in population in the West, but also an increasing population in your area of the country, as well. I think the State of Georgia's population increased by over 25 percent between 1990 and 2000. But if you look in the West, such as Arizona, that the Governor referred to, you're looking at population growth of 40 percent in a 10-year period. And this is 40-percent population growth in an area that's already very dry and water-short.

So, if we're going to look at future water supplies and its availability, surface water augmentation, groundwater recharge is another option. But, as you stated, when it comes to building new reservoirs, the regulations, the environmental concerns, and so forth, as well as sites that are available for that throughout the country, are quite limited.

So, I think we need to be looking at conservation as a huge key to trying to improve this. We need to be looking at helping people make better decisions as to where they live and where they move, to put this additional demand on an already limited resource in many parts of the country.

We really need to move more toward this risk-management approach. And one of the things that we stress to states and tribal governments and others that we work with is doing vulnerability assessments. And certainly at a State level, in the State of Nebraska, for example, our Department of Health and Human Services did a vulnerability assessment of communities in the state as to their vulnerability related to a shortage of water during a drought situation. Identify those communities, those regions of the

country that are most at risk, and then you can put in place various kinds of programs, improve planning, develop better monitoring systems, and so forth, so that you are able to have earlier warning of possible problems in those particular areas.

Senator DEMINT. Yes, I think you mentioned development. In our area, along the coastline, the population is exploding. And they're heavily dependent on water that——

Dr. WILHITE. Right.

Senator DEMINT.—comes from other areas. And it has to pass by us, in the upstate.

Dr. WILHITE. Right.

Senator DEMINT. And the more we cutoff, the more difficult it is. If you look out, long-term—and I think I'm working my way back around to where you are with this whole integrated plan—and so, we have got to have a plan that gives people good information about the potential problems they have if they are going to live in different areas that are naturally water-short.

But, Dr. Koblinsky, did you have a comment, before I yield to the Senator for his questions?

Dr. KOBLINSKY. Thank you. I'd just add to what our—my other two colleagues have mentioned and talk a bit about how we might be able to facilitate the transfer of information from a research and operations agency like my own to users such as you've described, your own experiences in South Carolina.

And this is very—in parallel with the development of the Integrated Information System concept. We've had a great deal of success in NOAA, in the research side and in the operations side, in transferring information, sophisticated information such as forecast, outlooks, and monitoring information, to the user in the field by providing supports to centers of excellence around the country that connect in a user, problem-driven approach to what's needed. And this has been successful in Hawaii. It has been successful in California. It has been successful in Arizona and Colorado and elsewhere—primarily to transfer seasonal interannual-type forecasts, but we foresee the same type of need, especially with a—focus on drought and water supply, that would be quite useful. And this is in our solicitation for—or the budget request of FY06, this drought impact research, which would be providing—developing centers of excellence that could provide the bridge between users like yourself and sophisticated tools that we're developing in the research community so that risk mitigation and risk reduction can be done in a better setting.

Senator DEMINT. Thank you.

Senator Nelson?

Senator BEN NELSON. Thank you, Mr. Chairman.

Dr. Koblinsky, I'd like to talk just for a minute about authorization funding levels that should be included in a NIDIS bill. The House bill currently includes a multiyear authorization with funding levels ranging from $12 million to $18 million per year over Fiscal Years 2007 to 2012. And obviously it's a multi-year authorization. Do you think these funding levels are appropriate? Or, if not, do you have other thoughts about what funding would be required?

Dr. KOBLINSKY. Thank you, Senator.

We've discussed these levels, of course, within our agency, and talked within other agencies, and this level of funding seems appropriate. Over the course of the last year or two, the community has—not only NOAA, but other agencies—have looked at this problem, especially from the observing system and information side, as I discussed, and begun to think about how we would develop NIDIS into a true national system, as is described in your plan. And we want to—we want to make sure that we address the five or six goals that are in the NIDIS plan directly. And, seeing that, it's clear that we want to start in a pilot formation system, working with states that are very interested in pilots, and communities that are affected now. So, observing system—capital investments for augmenting observing systems to meet critical needs, such as soil moisture, meeting data latency problems, for example, in well readouts and stream flows and surface temperature measurements, in those areas.

Adding to our ability to improve forecast capability, we do have a preliminary forecast capability I talked about in the Drought Outlook. And trying to improve that forecasting capability could be facilitated through some competitive research and transfer of that research into an operational framework setting.

We've talked about the drought impacts research, already, that I mentioned. Having information transfer capability is critical, so the discussion of a drought Internet portal, or portals, that would communicate information to the user in a unified setting so they don't get many different messages across the web—hopefully, they'll get a unified set of information. Taking lessons learned from individual state pilots and success stories, and transferring them to a wider audience across the Nation as we build it out.

So, certainly the level that's talked about seems consistent in the first year, and then—and we see that more of—in a development in certain regions. And then to grow it out to a national system over a 5- to 6-year period does seem appropriate, sir.

Senator BEN NELSON. Recognizing that it's difficult to get multi-year funding proposal authorization, as you might be aware, it does raise some concerns about how we have it in the current environment. The President's budget includes $7.8 million for FY07. So, being able to get there is important.

Let me ask you—and Dr. Wilhite, as well—as you think about forecasting and prediction and learning from current situations, do you believe that, by predicting, you can reduce what would be—what we would have to experience in the way of drought relief costs at a later date? In other words, by predicting and forecasting, can we reduce the ravages—financial ravage of droughts, in some cases, so that we won't have to be faced with such significant costs after the fact?

Dr. WILHITE. I can go first.

Senator BEN NELSON. Sure.

Dr. WILHITE. Yes. I mean, I think that's really the thrust of what we're trying to do here. I—when we work with State governments, for example, to help them develop a drought plan, we think there are—there are three principal components of a good drought plan, whether it's at the tribal level, local level, national/State level. And first is early warning and prediction. Second is more mitigation-ori-

ented. And then the third component is this risk and impact assessment.

The problem is, you can't do good risk and impact assessment and install good mitigation kinds of actions unless you have the good early warning and prediction information up front to give you that timely delivery. And so, that is—so, that is very, very critical.

We estimated—and if you look at some of the other natural-hazard research, it indicates that for every dollar that you invest in mitigation preparedness, monitoring, early warning, you get about $4 back, in terms of savings and impacts. If we can reduce those impacts, then we certainly reduce the need for government drought relief efforts, which takes a burden off of the national treasury and off the American taxpayer. And so, investing up front is really, I think, the key issue here.

Senator BEN NELSON. Dr. Koblinsky, do you agree with that?

Dr. KOBLINSKY. Yes, I do. I think it's very consistent with what we've been talking about within NOAA.

Senator BEN NELSON. Well, having voted twice last night for pretty expensive drought relief, I would look for a way to avoid having to do that, for a lot of different reasons, not the least of which is that if we can help people in the process of their agriculture or their overall economy not to have the costs associated with a drought, at least reduce them, certainly their lives are going to be less disrupted, our treasury will be less interrupted, and I think we'll all live better off. So, I do appreciate those thoughts.

This is for everybody. Governor Geringer recommends, in his written testimony, that NIDIS not be set up under NOAA, but, rather, be part of an overall IEOS/GEOSS program office directly under the Secretary of Commerce. Could you each maybe comment on that? And I'll let Governor Geringer bat cleanup on that, if he prefers.

Dr. WILHITE. Well, OK, I can comment, at the beginning.

Well, I certainly support the NIDIS being implemented under NOAA. I think the tricky issue with the National Integrated Drought Information System is that drought is an issue that spans so many different Federal agencies and so forth. We fragment the way we manage, monitor water in this country, and that's really not any different than any other country in the world. I mean, I see this problem all over the world. So, it's difficult to bring organizations together. So, if NOAA's the implementing agency, I think the key issue is going to be how to connect, coordinate with the other Federal agencies with non-Federal agencies to work together in the implementation of NIDIS, and how other Federal agencies that see some important needs—for example, the U.S. Geological Survey with regards to stream gauging and so on, if there needs to be an expansion of that network, that they need to be able to get access to those resources in order to do that as part of NIDIS, because it all feeds into this overall delivery system that we're talking about.

So, regardless of where the home is, it needs to be an integrated system, it needs to be coordinated underneath the implementing agency.

I do support NOAA being that implementing agency, because of their emphasis on monitoring and prediction. And we've worked

closely with them throughout our history, since we were formed, in 1995.

Dr. KOBLINSKY. Being the home agency that's being the requestor here, we certainly accept the challenge to take on the NIDIS leadership, and are very concerned and serious about making sure that this is a collaborative and cooperative venture between all Federal agencies that are appropriate, and State agencies, and regional points of view, as well as the private sector, as appropriate.

We've begun to initiate these activities. We've found tremendous enthusiasm in the community, among the parties that I've mentioned, to re-engage on this, since the plan was first developed and submitted in 2004. We look forward to hosting some workshops this summer to get this underway and develop the community view on the best path forward.

And I feel that, from the practical point of view of implementing observing systems, prediction systems, risk research and the like, that NOAA is the appropriate home. We do a lot of that work, certainly. And I'll let my bosses speak to whether or not it's appropriate to have an oversight group within the Department of Commerce or not.

Senator BEN NELSON. Governor Geringer, I guess the ball's in your court.

Mr. GERINGER. Senator, I guess I'll qualify my remarks by saying there are ways that we could do it that make a lot of sense, and then there are ways that are being done in D.C. So——

[Laughter.]

Senator BEN NELSON. I think we can all share those thoughts, yes.

Mr. GERINGER. That's why it makes a somewhat difficult question to answer. I believe it should be at the level where top policymakers act and cause things to happen. The greatest benefit of putting NIDIS within NOAA is, they can make things happen more quickly and provide a system that's targeted toward drought detection, mitigation, and information, so that we can enable things to happen.

But, just as with so many other things, we're discovering, through better technology, the greater ability to evaluate the world around us, that we need a program office that starts to pull all the disparate activities together. I believe that could be more effectively done at the department level, at the Secretaries level. There certainly is the Office of Science, Technology, and Policy in the White House, but that's not a policy group. That's just an advisory group. There are many places where they—we could put this organization. But if we want to foster the integration, there are two things that need to be done. One would be to move it to a level where it has some visibility to other departments of government, and the second is through the oversight process that you and your fellow Members of Congress use. By the nature of how you conduct business, such as this Subcommittee hearing, it tends to foster fragmentation. I think you have a—an opportunity to see how much beyond just the reach of this committee this could have an impact and help foster that through the structure of how you view

legislation, how you not only authorize funding, but appropriate money, so that there is an encouragement to agencies.

I sat through the last 2 days with a group of people, including some Federal agencies. And one of the questions I asked them had to do with benefit delivery after a major disaster, such as Hurricane Katrina. And I said, "How would you define success?" And one individual from Treasury said, "My definition of success is when my boss doesn't have to appear before Congress."

[Laughter.]

Mr. GERINGER. There's this underlying feeling that somehow an agency will be criticized if they don't do their little area that has been under the specific oversight of a Congressional Committee.

So, I guess I—my answer is in two parts. One is in your process, the other is in the organizational structure of how we can fund and engage a system that truly ought to foster integration of information so that better decisions are made.

Senator BEN NELSON. Well, in any event, it's clear that there are issues, economic issues that the Department of Commerce has an abiding and continuing interest in that need to be considered, as well. It's just the technical side of, "Here are the statistics, here's what's going to happen." So, joining those together as part of the effort will certainly be required, regardless of where NIDIS is housed.

Mr. GERINGER. Correct.

Senator BEN NELSON. I appreciate your suggestion. It's well observed and——

Mr. GERINGER. We would be——

Senator BEN NELSON.—it's a——

Mr. GERINGER.—to draft some tentative amending language, just to give you an idea how it could be articulated in legislation.

Senator BEN NELSON. Sure. That would be very welcomed, thank you.

[The information referred to follows:]

THE ALLIANCE FOR EARTH OBSERVATIONS
Arlington, VA, May 17, 2006

Hon. JIM DEMINT,
Chairman,

Hon. E. BENJAMIN NELSON,
Ranking Member,

Senate Subcommittee on Disaster Prevention and Prediction,
Commerce, Science, and Transportation Committee,
Washington, DC.

Dear Senator DeMint and Senator Nelson:

Thank you for the opportunity to testify at the April 27th Drought Hearing before the Subcommittee on Disaster Prevention and Preparedness. I hope that my testimony was useful to you and your colleagues in providing a vision for the National Integrated Drought Information System (NIDIS). and helped to highlight the need to develop technology solutions to America's resource management issues. I can think of no better area in which to demonstrate these technology solutions than the critical area of water.

In response to your request during the hearing to provide draft language for an amendment to the S. 2751, I would like to offer the following, recommended text:

> We direct the Secretary of Commerce to establish a Program Office and proceed to implement activities associated with the U.S. Integrated Earth Observation System (IEOS), which will be the U.S. contribution to the Global Earth Observation System of Systems (GEOSS). The National Integrated Drought Information System (NIDIS) will be a key component of this effort. The office will en-

sure that IEOS provides an overarching framework for NIDIS and other U.S. observing activities. and engages non-Federal stakeholders in planning and implementation to ensure responsiveness to the needs of U.S. citizens, the public and private sectors, academia. and non-governmental organizations.

Sincerely,

JIM GERINGER.

Mr. GERINGER. And then you can debate the merits, which way you want to go. Some of it has to do with how you phase it in.

Senator BEN NELSON. Sure.

Mr. GERINGER. I see NIDIS as a first step.

Senator BEN NELSON. Thank you, Mr. Chairman. I want to thank the panelists, as well. Good to see you all.

Senator DEMINT. Just one more question, about agriculture and drought. All of us in the country depend on the Bread Basket from Senator Nelson's area and all around the middle part of our country. We can't necessarily plan to move fields and, you know, thousands of acres. As we look at—is that a part of this system that we're talking about, this planning system of how we deal with supplying the Nation and a good part of the world with food when a drought could severely disrupt that? So, I mean, is that part of the system? We haven't really talked too much specifically about agriculture today. So——

Dr. WILHITE. Yes. I can comment on that.

We've just recently initiated some major research efforts, in partnership with USDA's Risk Management Agency. So, we're continuing to develop more and more decision-support tools that are primarily aimed at agricultural producers. And so, what we're trying to do is to provide better information, more timely information to them at critical points during the season to allow them to make better-informed, hopefully risk-reduction types of decisions. We think that, with the technology that's out there today, that we can really provide that information, almost down to the field level, certainly within a county level, so that they can—you know, over the next couple of years as we develop these tools, they can do a better job of assessing their risk and making those decisions based upon where they are with regards to water supply, precipitation conditions, given their soil types, I mean, using geographic information systems and so on to bring a lot of this diverse information together to help them make these kinds of decisions.

So, a lot of this is aimed at agriculture, but these decision-support tools, I feel, are also going to be very, very important for water managers, natural-resource managers, and so forth. So, agriculture certainly is the major sector that is usually associated with drought and drought impacts, but, as the Governor mentioned previously, there are a lot of other sectors that are experiencing tremendous impacts today that we didn't see so much of in the past, and we have to provide better information for those sectors, as well.

Senator DEMINT. Governor?

Mr. GERINGER. I'll add one additional remark and then give a personal experience, as well.

The greatest need is for information in context. And the geospatial systems that are available from a variety of vendors today all depend on the quality of good base information so you can draw the comparisons, overlay the influencing factors or the things

that may not have been apparently related before can be seen in context. And that's what really makes a good decision-support system.

Let me give you an experience, both as a farmer and as a Governor. The kind of down-to-the-county-level information and near-term information that could be used to decide which crop to plant—I've decided which crop to plant, be it malt barley or sugar beets, depending on a forecast for near-term, let's say 3 months—3 to 6 months. Sugar beets are a high consumer of water. So is alfalfa. I would add, in parenthesis, that turf at golf courses and on lawns is the highest consumer of water, and we have far more agriculture in lawns than we do in production agriculture in many of our areas of the country. So, that's just an aside about agriculture. So, the first choice is, what kind of crop would I plant? And would I have the information in advance to do that? And I should be able to make those decisions and take the responsibility for it.

Now, if you're a rancher, and you have, say, cattle, well, you don't just liquidate your herd, you look for alternative pasture—or an alternative way to carry through a water-short year. You can't just liquidate and buy back. You can't manage risk that—within those boundaries and make a living at it. So, there has to be a longer period of predictability.

And then, as Governor, some of the longest impact has to do with forest health, both in our western States, when the year 2000 rolled around and we had terrible fires, and also, more recently, in California, the San Bernardino Forest, with drought and the stress that resulted, beetle infestation took over, disease caused up to 80 percent mortality in some trees. We could see it coming, we could see it happening, yet people were still building homes in the wildland/urban interface. The logical thing would have been to deal with the disease as it was happening, perhaps thin some of the understory, clear it out, thin some of the trees that were dying, so that the risk of fire could be managed within certain boundaries. But there are so many contending values out there that we don't see to have a solid base of information well enough in hand to where we can make a consensus decision to take action before a disaster occurs, such as the fires that occurred in southern California.

So, there's the long-term. You need that predictability, even though it's not with total certainty, to evaluate information, to put it in a context that the objectivity emerges, and, even with conflicting values, you can make wiser choices. So, it—each of those has a period that expands from the other—near-term, longer-term, very long-term—and the decisions that are made have to be built on credible science and acceptable information systems so that people that have differing values can finally reach a consensus on a course of action.

Dr. KOBLINSKY. If I could just add to this, Senator. From the Federal perspective, there has been a long-term collaboration between NOAA and the Agriculture Department on sharing forecasts, weather forecasts and the like. And just yesterday I had a call from the Federal—Foreign Agricultural Service of the USDA with a lot of interest in engaging in NIDIS. They do the crop models across the globe and—as well as across our country. And a lot of interest

in improving their forecast and observing system information to connect for improving crop models in the United States. So, I think already we can see not only long history between NOAA and the Agriculture Department, on the Federal level, but also immediate interest in this Integrated Drought Information System that we've talked about today.

Senator DEMINT. Well, this has been excellent, and I really want to thank our witnesses. And I think that Senator Nelson and I hopefully can take this information and develop it into something constructive that's supportive of what you're already doing.

So, thank you. And thank you, again, Senator Nelson.

Senator BEN NELSON. I want to thank the panelists, as well. Thank you very much.

[Whereupon, at 11 a.m., the hearing was adjourned.]

○