WRITTEN TESTIMONY OF
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HEARING ON
PREPARING FOR CLIMATE CHANGE:
CONNECTING CLIMATE SCIENCE AND DECISION-MAKING

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Chairman Rockefeller, Ranking Member Hutchison, members of the committee, thank you for the opportunity to speak with you today as you consider how best to prepare this country for the impacts of climate change. Many in this country still do not consider this topic a "front-burner" issue. But the current and potential impacts of climate change are undeniably of concern: drought and unreliable water supplies, more intense storm events, sea level rise, large wildfires and devastating bark-beetle damage to forests across the west already are attributed to global warming and are predicted to increase over time.

My name is Katharine Jacobs, and I am the Executive Director of the Arizona Water Institute, a consortium of Arizona's three state universities focused on water sustainability. Since 2003, I have been a professor in the Department of Soil, Water and Environmental Science at the University of Arizona in Tucson. For the prior 23 years I was a water manager for the State of Arizona, and for 14 of those years I was director of the Tucson regional office. I also briefly managed Arizona's drought planning program, and have worked extensively on water conservation, groundwater management, climate change, western water policy, and the Colorado River. In collaboration with a wide range of federal and university experts, I wrote the water sector chapter for the first National Assessment of the impacts of climate change, published in 2000. I currently chair a National Academy panel on Adapting to the Impacts of Climate Change.

My comments are directed towards adaptation to climate impacts, rather than on limiting carbon emissions. Although these activities need to be considered in tandem to avoid unanticipated consequences and to optimize investment, conversations about mitigation have been ongoing for some time. Discussions of adaptation are long overdue.

Translating scientific information into useful knowledge for decision-makers is my particular interest. I am focused on climate science, because better use of this information would be of enormous benefit to society in general, and water managers in particular. Two important observations: 1) although we have made great strides in understanding climate variability and climate change from a scientific perspective, much of that information is lost on the American public and on the water managers who

urgently need it to reduce risk and increase economic opportunities, and 2) most scientists have a limited understanding of the information needs of decision-makers. I have been in countless meetings where this gap between science and society has been lamented, but with a few notable exceptions, very little progress has been made in addressing this problem.

I would like to emphasize three key points in my testimony:

1. Our current ability to bridge the gap between science and decision-making is woefully inadequate, and despite billions of dollars spent on the federal climate program, it has not been as effective as it would have been if it were more focused on building adaptive capacity
2. Adaptation decisions are made at the state, regional and local levels – and the magnitude of the climate change challenge is so great that new mechanisms of engagement are required to build local and regional capacity to respond
3. The climate service needs to have a broad, inclusive vision; be adequately funded; address both climate variability and climate change at multiple time and space scales; and have the authority to either encourage or force the integration of federal science capacity to support decisions

Connecting Science and Decision-Making

In 2001-2002 I had the good fortune to take a sabbatical from the Arizona Department of Water Resources to work for what at the time was NOAA's Office of Global Programs (now the Climate Office). While there, I worked on the issue of why federal climate science often does not get used by water managers or decision-makers more generally. I spent some of that year interviewing both climate scientists and people who studied the use of scientific information, and concluded that although all of the scientists and the agencies for which they worked had good intentions, a variety of factors accounted for the failure to connect science and decision-making. I wrote a workbook based on my findings called *Connecting Science, Policy and Decision-Making: A Handbook for Researchers and Science Agencies.* I have provided copies to your staff.

A big part of the bridging problem is communication: failure of scientists to understand how the information they generate can best be used, and failure to understand the political, institutional and economic context of decisions. Meanwhile, resource managers lack trust in "academic, ivory-tower" information or mistrust the government in general; and they often are reluctant to innovate and use data and tools from new sources. At a very basic level the science and management communities often fail to understand each other's vocabulary and motivations.

A second concern is that scientists aren't always that good at talking with each other. They come from different disciplinary backgrounds (hydrologists, atmospheric scientists, oceanographers, etc.), and often "stick with their own kind." Because climate issues are by nature interdisciplinary, this can be a serious problem.

A third big problem is that to a layperson, the messages that come from scientists and science agencies often appear to be in conflict. In the case of climate change, information has been highly politicized, leading people to incorrect conclusions about the quality of the information and the degree of certainty that does exist. For reasons that are unclear, people are willing to tolerate high degrees of uncertainty in most other aspects of their lives, but the bar is set exceedingly high for climate information. This means that the context for building the proposed national climate service is especially challenging.

A fourth challenge, possibly the biggest, is funding: a minute portion of the federal science budget is spent on translating that science into useful decision support tools and timely, relevant sources of information. There is a lot of focus, especially within NOAA and NASA, on buoys, satellites and massive computing capacity. All of these investments have dramatically improved the understanding of underlying processes, atmospheric physics, land surface-atmospheric interactions, etc. However, translating data to information, and information to knowledge, requires a larger investment in decision support tools, data access, training and capacity building.

Like many other scientific topics, climate science is complicated. Climate change presents so many scientific and social challenges, across regions and economic sectors, at multiple scales of time and space, that building more capacity to translate climate information for specific applications is a daunting task. The only way that the new national climate service will succeed is if it empowers a multitude of regional support networks and centers to engage the public and decision makers at local scales – where decisions affected by climate are made on a regular basis. Fortunately, we do have examples of successful bridging organizations, such as the NOAA Regional Integrated Science Assessment program, which are university partnerships focused on supporting the use of climate information. As has been shown in multiple cases, products that are developed collaboratively between stakeholders and researchers are more likely to be "owned" and used by the stakeholders – so the process of network-building, though time-intensive, brings multiple rewards. But this network will have to be informed by a well-coordinated federal science team – and the network itself will need to be well supported by federal money.

<u>Building Regional Capacity to Respond</u>: <u>Western Water and Climate Change</u>

During the last week I heard the result of a large-scale assessment of public opinion: less than half of Americans believe that climate change is a serious threat, and even in California roughly half connect climate change with water supply problems, though water supply impacts may be the most critical aspect of climate change and California is in the grip of a large-scale drought. According to the Pew Center for People and the Press, only 30% of Americans consider global warming to be a priority. In a recent meeting in Arizona, water utility staff noted that their elected officials show very little interest in climate change, but water supply reliability is an issue that "keeps them awake at night." Connecting the dots between cause and effect needs to be part of the "climate literacy" effort as we work to improve adaptive capacity.

Based on the findings of the International Panel on Climate Change, and the most recent reports from the US Climate Change Science Program (CCSP), the water supplies of the west are seriously threatened by climate change. This is in part because higher temperatures alone have dramatic impacts on the hydrologic cycle – drying soils, reducing runoff into rivers, causing more evaporation from reservoirs, significantly increasing the demand for water for ecosystems, landscaping, power generation and agriculture. In addition to higher temperatures, recent climate model information suggests that the southern portions of the American Southwest and northern Mexico will also experience reduced precipitation. The result could be dire consequences for the Colorado River (the current best estimate by a team of climate scientists from universities all over the west is a 20% reduction in runoff by 2050). Given rapid growth, increasing demands for water, and the over-appropriation of Colorado River water rights, this prediction is not a happy one for the nearly 30 million people who depend on the Colorado.

But most water managers do not even know about the CCSP or the 21 Science and Assessment Products that have been developed in the last couple of years. It is clear that the 13 federal science agencies that make up the CCSP do not coordinate with each other particularly well, and coherent messages regarding their work are not penetrating into arenas where they can best be used. If we are to have an effective and efficient climate science program and climate service, significant restructuring of the program will be required so that regional issues like water supply availability in the Colorado River basin can be addressed.

Ingredients of Successful Climate Services

- User-centric problem definition: to provide the most effective services, there must be an ongoing effort to identify the key decisions where climate information is needed, and to frame at least some portion of the federal research program around those decisions. This does not mean that we should halt investment in basic understanding of the climate system; it does mean that we need to measure our progress in terms of improving our adaptive capacity, limiting risk, improving quality of life and building economic advantages by developing more problem-focused climate information.
- Information at the time and space scales that decisions are made: an important component of providing services that will actually be used is building a system that provides answers at the scale of decisions, for example, focused on reservoir operations at the watershed scale. Resource managers across the board are frustrated that climate model projections are at such a large scale that they have little utility for actual decision-making. Although "downscaling" efforts are being initiated, including within my own research partnership, we are a long way from answering their questions.
- Credibility of information: A lot is riding on the decisions associated with climate predictions, in some cases billions of dollars in infrastructure investments; in other cases these decisions may make or break a family or a business. Users need to trust the source of this information. Trust comes from long-term relationships

between scientists and decision-makers; building these relationships requires a long-term commitment of funding that is not tied to the politics of individual administrations.

- Adequate funding and independent budget authority: Because the problem requires building decision support infrastructure (training programs, data access systems, monitoring and assessment capacity, etc.), it does not lend itself well to an ad-hoc funding source that is based on the good will of individual decision makers within the 13 federal science agencies. There needs to be significant, centralized coordination with budget authority to ensure that structural support is built and that outcomes are delivered. There will also need to be priority-setting based on risk and vulnerability (among other considerations) and the process of priority setting will need to be de-politicized. Every sector and every region has needs, but we will not be able to meet all of the needs that are identified.
- Clear leadership and authority focused on management for societal outcomes: Because this assignment is so daunting and will involve so many people at various scales, there needs to be central leadership that is empowered to achieve outcomes that are valued by decision-makers and can cause agencies to engage through incentives and if necessary, through clear articulation of expectations at a high level. Leaders of this program will need to have the courage to take bold steps, including harvesting science outcomes that may not be viewed by some as "ready for prime time" and testing their utility for improving decisions.
- Buy-in, coordination and engagement of federal agencies beyond NOAA: Although the roles of the various federal agencies in the climate service have not been identified, NOAA clearly can not and should not try to create the climate service on its own. Whatever coordination and management system is developed will need to provide incentives for all of the agencies to work together towards common goals. There is no time and no money for turf battles over the components of this system. NOAA will play a key role, but this project will require a variety of innovative partnerships with local and regional entities and universities as well as functional partnerships between federal agencies. The capacity to do all of this coordination does not currently exist within NOAA.
- A central portal for information (clearinghouse function/informatics): Because providing decision support that is timely, relevant and credible at a range of time and space scales will be very expensive, we must harness information technology to provide the tools that local, regional, state, tribal and sectoral decision-makers need. In many cases, providing better tools over the internet and more useful ways to manipulate and visualize data may move us a long ways forward. Major investments are required in the "cyberinfrastructure" of the climate service. Significant progress is being made along these lines in the context of the National Integrated Drought Information System (NIDIS) and at the National Climate Data Center.
- Adequate interface with communities, states, sectors, regions, tribes, etc: The engagement strategy needs to include ways to entrain, leverage and expand existing operational capacity (including the NOAA Regional Integrated Science Assessment Programs; science translation capacity within universities, including the Cooperative Extension Programs; natural resources management NGOs and a

variety of private sector interests, and local and regional jurisdictions and interest groups). This interface needs to be managed on an ongoing basis to ensure we are answering the right questions, that there is two-way communication, and that there is ongoing assessment of progress (in terms of both outcomes and process).

- Capacity building and training programs: Because there are few people who are qualified to do science translation for specific policy applications, a deliberate effort to expand the community of people who can tailor science information for specific applications is needed. This will involve partnerships with universities as well as training programs for scientists, resource managers and elected officials.
- Enhanced, strategic observation and modeling capability: Despite my strong advocacy for more focus on engagement and decisions, there is a major disconnect between adaptation in regions and sectors and the types of monitoring that are currently underway. Although we have made great progress in remote sensing, and satellites can provide reams of new information at very useful scales, our ground-truthing capacity is totally inadequate. One of the biggest travesties is the disintegration of the USGS stream gage program at exactly the point in time when we need more and better gaging information. We also need more snow monitoring sites, more soil moisture measurements, etc. Strategic design of the monitoring program to focus on answering important management questions and to detect trends in real time is critical to better adaptive capacity.
- Avoiding maladaptive decisions: Many past decisions have increased our vulnerability to climate events (e.g., allowing construction in floodplains and in low-lying coastal areas, subsidies for agricultural activities that increase demands for water and power without providing commensurate benefits, etc.). In the context of the stimulus bill we are engaging in building significant quantities of new infrastructure. A critical feature of adaptation is learning from past mistakes: let's make sure that this new infrastructure is designed for changing climate conditions, including using new engineering standards that recognize non-stationarity in the climate system and the already-evident increase in extreme events such as flooding, coastal erosion and storm surges.

Conclusions

By some accounts, the US government has spent more than $30 billion in the last 8 years on climate science, and perhaps $100 billion total. Given the magnitude of this investment, it is clearly time to take stock of what we do know, and though we haven't answered every question, empower decision makers to access and use that information with full understanding of its limitations. Improvements in forecast skill will always be welcome, but lack of skill is not the real reason that climate information is under-used. If provided with the tools to assess the quality of the information, and with access to "science translators," the resource managers of this country will make their own judgments about the types of information that could be useful to them. They are eager to have more tools at their disposal. Clearly we need to keep investing in research on both climate variability and on climate change – but it is time to get more value out of the investments that we have made.

Thank you very much for the opportunity to comment on this extremely important topic. After having worked on this subject for years, it is gratifying to see that we are on the brink of making significant progress in this arena and of joining forces with the rest of the world to limit the impacts of climate change through building adaptive capacity as well as by limiting this country's contributions to greenhouse gas emissions.

If you have any questions I would be very happy to respond.