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Summary

As the science of climate variability and change has advanced and as public awareness of its implications for natural resource management and economic activity has grown, demands for climate information have rapidly exceeded the capacity of experts. Significant federal investment is needed in a National Climate Service to match these growing needs. HR906 aims in that direction by calling for improved direction of federally funded climate research.

Regional focus

For several reasons, a regional focus on research and delivery of climate information is appropriate. First, economic and natural resources emphases differ starkly from region to region, and in some cases are organized regionally (for example, the Northwest Power and Conservation Council). Second, a regional focus matches regional decisionmakers and regional scientists whose very proximity permits sustained interactions, understanding, and trust to develop.

NOAA's Climate Program Office meets some needs for climate information by leading and funding efforts such as the Regional Integrated Sciences and Assessments (RISA) program. RISA projects point the way toward a new paradigm of stakeholder-driven climate sciences that directly address society's needs and concerns.

The RISA program began with university-based efforts in regions of the United States where recent advances in integrated climate sciences held the greatest promise to assist decision-making. Much of the first-generation RISA suc-

cess built on breakthroughs in predicting variability, change, and impacts of climate processes occurring in the tropical Pacific Ocean. This is the area where El Niño and La Niña conditions, which affect much of the western and southern United States, as well as Mexico, originate.

RISA scientists provide information that decision makers can use to cope with drought, understand climatic influences on wildfire, and assess climate impacts on the transportation sector, coastal communities and human health. Stakeholders can use such information to evaluate potential climate change impacts on water supplies and hydroelectric power and support disaster management planning. RISAs are helping farmers, ranchers, and fishermen use climate information to produce the nation's foods and fibers, and Pacific Islanders to figure out how to weave climate information into their quest for sustainability.

With each passing year, the impacts of climate variability and change on water availability, wildfire regimes, public health, agriculture, energy issues, and coastal communities become more acute. At the same time, climate sciences

are making great strides in producing knowledge that could aid decision makers dealing with these issues.

University of Washington's Climate Impacts Group (CIG) was the first project funded by RISA's predecessor, in 1995, and there are now a total of eight regional projects. CIG has developed close connections with the public, private, and North American tribal groups and agencies responsible for managing the region's water, forest, fishery, and coastal resources in order to ensure that our research results in information and products that are not only useful, but also used to shape decisions in the PNW. As a result of this interaction, CIG has gained a clear picture of the current use and perceived value of climate forecasts by natural resource managers, insight into their decision calendars, and an understanding of institutional barriers to adaptability. Stakeholders benefit from the development of improved tools and information for planning, such as resource forecasts and regional- and resource-specific interpretations of global climate change. Members of CIG's stakeholder community are listed in Appendix A. A sustained regional focus over the course of more than a decade has allowed deep two-way interactions to develop, with scientists learning from natural resource managers and vice versa toward a shared goal of improving resilience to climate variations and change.

In addition to regional focus, the nation's State Climatologists serve their respective states. While the primary focus of most state climatologists is delivering weather and climate data, many also develop higher-level products in response to stakeholder needs, for example, specialized tools for drought monitoring.

National expertise, sectoral focus

While regional- and state-level focus is a critical part of climate services, in a number of respects a national-level effort is also needed. National-level expertise in climate science can provide the highest-quality, most comprehensive information about patterns of climate variation and change. Such expertise can be brought to bear

on problems that may be too difficult for a single regional group to solve. For example, to properly construct probabilistic scenarios of future climate at a given location would ideally involve evaluating tens of scenarios from global climate models and weighting them appropriately according to their fidelity at simulating past climate, a task that is both computationally and conceptually challenging. Another example would be the construction of probabilistic sea level rise scenarios accounting for global sea level change, local relative land motions, possible contributions from changes in atmospheric circulation, etc. Finally, as the Federal Emergency Management Agency undertakes the re-drawing of flood plain maps nationwide, a thorough probabilistic assessment of the possible changes in flood risk associated with climate change could best be accomplished by a national-scale effort.

Preserving observation networks

As numerous reports by the National Research Council and others have documented, the nation's various observing networks and notably the Cooperative Observer Network are slowly dwindling in coverage and quality. An urgent effort is needed to preserve these networks as a legacy for future generations and as our primary source of information for documenting the changes in our environment and our climate, whether these changes be natural or man-made. See also the attached letter from the American Association of State Climatologists.

Why undertake a new National Assessment

In the roughly ten years since the first National Assessment was begun, the science of climate change has advanced immensely. Atmospheric general circulation models (AGCMs) have been replaced by climate system models that simulate also the ocean, land surface processes, sea ice, and even components of the biosphere and carbon cycle in tremendous detail. Hundreds of simulations have been performed with these models describing the evolution of the climate

from 1900 to 2100, allowing comparisons with past climate and projections of future climate. Attribution of climate change to human activity can now be performed not just for globally averaged temperature but for sub-continental temperature changes and also for changes in other, more societally-relevant climate variables. Paleoclimate research has dramatically improved our understanding of past climate variability and change. Finally, regional climate modeling has also advanced, permitting much higher resolution simulations and better information over complex terrain such as the mountainous West. A comprehensive effort at regional modeling is underway, called North American Regional Climate Change Assessment Program (NARCCAP), coordinated by the National Center for Atmospheric Research.

In addition to significant advances in the science, a second reason to undertake a new National Assessment is that attitudes toward climate have advanced. Officials with federal, state, regional, local agencies, private companies, consultants, and others, are wondering how to incorporate the best information about climate change into plans, policies, and reports. Members of RISA teams, like the Climate Impacts Group, are straining to meet the demands for information. These requests come to CIG in the form of specific questions, requests for academic papers, requests for data including detailed probabilistic climate scenarios, in-person presentations at the rate of about 150/year, media interviews, analysis of climate variables, explanations of or comments on controversial points, and requests to review reports, web sites, and the like. These questions can be answered in limited fashion by the existing network of RISA programs and state climatologists.

Far better would be to match national capabilities in science research with regional and sectoral needs for climate information, especially if a national assessment led to creation of a National Climate Service that included additional regional teams covering areas of the country not currently served by the RISA program. These capabilities were suggested in the President's Climate Change Science Program, in which one

of the goals was Decision Support, but few resources were devoted to making decision support a reality.

Tasks to create a National Assessment and National Climate Service

Creating new regional teams and strong sectoral assessment capabilities would require significant agency investment not just in dollars but in effort and time. A thorough assessment would require tens of millions of dollars per year, scaling up the funds that support the existing eight regional assessment teams in the RISA program to a comparable effort that would serve the entire nation geographically and in addition would create sectorally based assessment efforts. As was learned in the first national assessment, substantial effort is required to get federal agencies to work together for a common purpose. Finally, the timeline should be at least three years from the availability of funding to the delivery of a report. This amount of time is required to constitute new teams, forge partnerships between key stakeholders and scientists, and write and peer-review a set of reports.

Beyond the production of a report, the National Assessment should catalyze the creation of networks for delivering useful climate information and reducing societal vulnerability to climate variation and change. A useful prototype of such a network is the National Integrated Drought Information System, which seeks to combine the skills and resources of federal agencies in producing timely drought analysis and warnings, and in finding ways to reduce societal vulnerability to drought.

Appendix A. Stakeholders of UW's Climate Impacts Group

Local level

City of Tualatin, Oregon
King County, Washington
Local watershed planning units
Portland Water Bureau
Puget Sound Clean Air Agency
Seattle City Council
Seattle City Light
Seattle Public Utilities
Tacoma Power and Light
Thurston County, Washington

State Level

Alaska Department of Fish and Game
California Department of Water Resources
Idaho Department of Water Resources
Oregon Department of Agriculture
Oregon Department of Land Conservation and Development
Oregon Department of Water Resources
State Governor's Offices (Washington, Oregon, Idaho)
State Legislatures (Washington, Oregon, Idaho)
Washington Department of Agriculture
Washington Department of Ecology
Washington Department of Fish and Wildlife
Washington Department of Health
Washington Department of Natural Resources
Washington Division of Emergency Management
Washington State Office of Financial Management

Regional or Federal Level

Bonneville Power Administration
International Pacific Halibut Commission
National Marine Fisheries Service [Northwest Fisheries Science Center and the Alaska Fisheries Science Center]
National Oceanic and Atmospheric Administration, River Forecast Center
National Park Service
U.S. Army Corps of Engineers
U.S. Bureau of Land Management
U.S. Bureau of Reclamation

U.S. Congress, PNW delegation
U.S. Department of Agriculture, Natural Resource Conservation Service
U.S. Department of Energy, Pacific Northwest National Laboratory
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Geologic Survey

Tribal

Columbia River Inter-Tribal Fish Commission
Northwest Indian Fisheries Commission

Other

BC Hydro (British Columbia, Canada)
Idaho Power Company
National Wildlife Federation
North Pacific Fisheries Management Council
Northwest Power and Conservation Council
Oregon State University, Coastal Impacts
PNW news media (print and broadcast)
Puget Sound Energy
Sustainable Development Research Institute, University of British Columbia
University of Idaho
University of Victoria
Wild Salmon Center