Assessing a Portfolio of Approaches for Producing Climate Change Information to Support Adaptation Decisions **|** *A Climate Change and Water Working Group Workshop*

9+10 November 2010 **|** *Boulder, CO*

Workshop Summary Report

Background and Motivation

The Climate Change and Water Working Group (CCAWWG), an informal scientist-to-scientist confederation across Federal agencies working with the science or operations and management of water resources in the US, sponsored a workshop in Boulder, CO, on 9+10 November 2010, to consider how to assess methods for producing and using climate science and climate change effects information for water resource-related adaptation decisions.

One common goal of the CCAWWG partners is to protect the enormous Federal investments in water-related resources by enhancing the resilience of water infrastructure and other water-related resources and by reducing their potential vulnerabilities to climate change effects. Federal agencies that manage water-related resources are planning the climate adaptation strategies and policies that will ensure effective and efficient use of those resources on temporal scales from the near (5-10 years) to long term (10-50 years or longer). Water-resource adaptation spatial scales, like the temporal ones, vary widely too. Agencies have some questions focused on small investment areas where decisions might be sensitive to differences in information about potential climate change effects. Here, if it were available, future information that characterized or even resolved some predictive uncertainty might change the adaptation decision. But at least some initial adaptation questions concern the operation or management of investments where decision scales are broader. There, adaptation decisions can be general enough that an operating agency's decision process and outcomes would be insensitive to differences in predicted effects from uncertain climate projections.

Some CCAWWG partner agencies have begun sorting their initial climate adaptation questions by identifying the ones that are insensitive to differences in projected effects and the ones that might be sensitive to projection uncertainties. It may then be possible to recast some of the questions sensitive to projection uncertainties in a form that could use climate effects information with its current level of imprecision and uncertainty. Doing this, the CCAWWG partners recognize the important distinction made by Dessai et al. (2009) that "alternative responses to climate change [can be evaluated] without necessarily relying on accurate predictions as a key step in the assessment process." Climate change effects information need not be perfectly precise to enable agencies to take decisions and drive action on climate adaptation for water resources.

That is to say, to be useful – to be "actionable science" – for water resource management decisions, climate science and climate change effects information need not be free of prediction uncertainties. Resource management agencies already take decisions and operate within complex networks of uncertain physical, hydrologic, and biological information. Uncertain climate change information can be integrated into many of those decision networks, but that information should begin with the scales of the various adaptation questions that confront the agencies. And for all scales of questions, climate effects information has high value only when that information can influence decisions and help drive action on adaptation strategies and policies.

Those adaptation strategies and policies will in large part be locally implemented. They should also be nationally consistent but regionally tailored, so that the widely varying types of adaptation decisions confronting multiple agencies having differing missions and objectives can be usefully coordinated. This is particularly important where different agencies operate in the same basins and watersheds. Relatedly, these adaptation strategies and policies must allow agencies to continue to balance their project operations and water allocations in the future within the authorized purposes and operating parameters of their projects. This balancing also has to be done in the context of changing water needs resulting from global changes, like accelerating urbanization, in addition to climate change. Moreover, the many different agencies that operate or manage water-related resources in the US bring with them distinct sets of stakeholders and partners who are crucially important to their operations and management. All this creates a complex decision space within which to select and use climate science and climate change information for planning and executing water resource-related adaptation measures.

The approach CCAWWG partners have pursued to navigate that space is highly collaborative. Operating and management agencies work closely with climate and water science agencies to help support development of information that could inform adaptation policies and guidance. And because this happens in parallel with the development of climate science and climate change effects information, it helps build a better understanding of the meaning and effects of uncertainty and variability in current climate science and in the projections of plausible future climates. In addition, close collaboration to support policy development allows adaptation considerations to be phased into the resource management agency decision processes by identifying and working first on areas with less uncertainty or where “low regrets” measures are possible. In this way, resource management agencies can increase their capacity to understand and use climate science and the climate change information relevant to their adaptation questions by testing, applying, monitoring, and refining their decisions.

Modifying agency decision processes to accommodate continual monitoring and refining is a crucial element of the CCAWWG approach because the costs and benefits of climate adaptation decisions, like the climate change effects themselves, are dynamic and so require monitoring and changing over time to ensure continued efficiency. Adapting decision processes for continual updating implements the “learning” criterion from Hulme and Dessai’s (2008) three criteria for evaluating the success of national climate scenarios: predicting, deciding, and learning. If the predictive successes with climate information will be small increments of uncertainty reduction for the next 10-20 years, as

Hulme and Dessai argue is likely, then success using climate scenarios and projections might be better measured by indicators of how agencies make and learn from decisions when using that information. The CCAWWG Boulder workshop was organized in part as a means to explore the development and utility of possible measures for Hulme and Dessai's three criteria.

Boulder Workshop

More than 70 participants attended the Boulder 'Portfolio of Approaches' workshop, including representatives from the National Oceanic and Atmospheric Administration (NOAA), the US Army Corps of Engineers (USACE), the White House Office of Science and Technology Policy (OSTP), the US Fish and Wildlife Service (FWS), the Bureau of Reclamation (Reclamation), the Environmental Protection Agency (EPA), the National Park Service (NPS), the Bureau of Land Management (BLM), the US Forest Service (USFS), the US Geological Survey (USGS), the Federal Emergency Management Agency (FEMA), and the National Aeronautics and Space Administration (NASA). In addition, participants attended from the Oak Ridge National Laboratory (ORNL), the National Center for Atmospheric Research (NCAR), and from several universities and public-private research partnerships like the NOAA Regional Integrated Sciences and Assessment (RISA) centers.

The portfolio of possible approaches for producing and using climate change information for water resource adaptation questions is large and varied, and many of those approaches are in use now at agencies represented in the workshop. Each method or analytical technique in this portfolio brings uncertainties and particular deficiencies, some of which are large or only partly characterized and poorly quantified. However, operating and resource management agencies looking to use these techniques to inform their climate adaptation planning currently lack good practice guidelines for helping them assess the approaches and choose appropriate ones for particular adaptation decisions.

One objective of the workshop was to gauge support for the idea of good practice guidelines to support climate change adaptation decision-making. The workshop provided a platform for agency representatives to discuss their approaches for producing and using climate change information and to hear from climate science agencies on the possibility and desirability of establishing a multi-agency, common framework of good practices for assessing the strengths and limits of the approaches.

Good practice guidelines for water-resource adaptation decisions would draw on existing guidelines like those of Morgan et al., (2009) pertaining to uncertainty in climate decision making, and of Stocker et al., (2010) which explored methods for assessing and combining multi-model climate projections. Like those, any guidelines for water-resource adaptation decisions will not dictate individual approaches to be taken for specific applications. Rather, they will help agencies develop robust, defensible, and reproducible practices for assessing the strengths and limits of different approaches to using climate information at the various choice-points in their decision processes. The guidelines also will be structured to be flexible enough to apply to current state-of-the-science information as well as to future climate science developments.

In general, the idea of good practice guidelines received strong support in the workshop, with the caveat that many process issues remain to be described in sufficient detail to make guidelines useful for informing real adaptation decisions. Among those issues is recognition that:

1- Adaptation planning work has begun at some stage in most resource management agencies at one or more of the temporal and spatial scales of decisions introduced above.

2- Uncertainty in climate science and climate change effects information will not stop adaptation decision-making; water-resource decisions at all scales have been made under many types of uncertainty. Estimates of human population growth and urbanization trends are highly uncertain, for example, but remain useful inputs to resource decision-making.

3- Quantitative uncertainties coming from different approaches to using climate change information must be reliably attributed to the approaches; decision-makers must know whether that uncertainty would affect their adaptation decisions, some of which likely are not sensitive to the quantitative uncertainties across multiple approaches.

4- Different decisions have different decision makers and different sets of stakeholders; this means that different types of information might be necessary to inform the decisions to be taken by various groups and that the sensitivities of their decisions to differences in effects information can vary.

5- Important choice points in the adaptation decision processes at various agencies have not all been completely identified, with the result that the sensitivity of some decisions to differences in climate information – that is to say, the value of effects information for a particular adaptation decision – is not completely known.

6- The social component of climate change adaptation decision-making is enormously important; proposed approaches for incorporating climate effects information in decisions must be palatable to the decision makers and stakeholders directly involved, and the decision makers and stakeholders for different decisions can have highly varied appetites for climate effects information in their decision processes.

Presentations from agencies with biological resource management missions – NPS, USFS, FWS, etc. – emphasized to the workshop that identifying thresholds or tipping points above which climate change effects become important for managing these resources is a significant area of work. These agencies recognize that characterizing a range within which their adaptation decisions would not be sensitive to projected future climate change effects would be hugely helpful for climate scientists and for resource mangers alike. However, these biophysical thresholds are not always simple to calculate or estimate and more work is needed. Monitoring for data to help establish physical and biophysical thresholds and understanding how to use thresholds to avoid and manage disruptive global environmental change are, in fact, connected to two of the five “grand challenges” for Earth system science recently established by the International Council for Science (ICSU) (Reid et al., 2010; www.icsu-visioning.org).

The ICSU grand challenges were written to help develop strategies for coping with global change while meeting global socio-economic development objectives, admittedly a larger goal than the one for this CCAWWG workshop. Even so, it is useful to see that the first ICSU Earth system science grand challenge, “Improve the usefulness of forecasts of future environmental conditions and their consequences for people,” (Reid et al., 2010) is not expressed simply as better model forecast precision. In the CCAWWG Boulder workshop, the utility of forecasts of conditions and consequences was similarly interpreted to be broader than simply reduced uncertainty in model projections. In part, this is an expression of Dessai’s idea introduced above that adaptation decisions can be taken and learning can proceed even without precise forecasts. Furthermore, workshop participants also strongly supported the idea that numerical models of future climates and climate effects have a powerful role as engines of explanation, not only as generators of prediction. Because numerical models encode our understanding of the components and processes of climate and connected Earth system effects, they can be used to explain those components and processes that are only incompletely measured with data. Fully dynamic, coupled, process models of sub-continental-scale future climate can be used to explain, for example, how changes in the form and frequency of precipitation could change the frequency and duration of flood events. Explanation of this type is not possible from measurements alone and is not dependent on precise and certain model projections. Significant learning can be derived from using numerical models, with their current range of differences, to explain how components and processes in the Earth climate system interact.

Next Steps

In addition to this brief summary, the CCAWWG workshop organizers are writing a larger report. That workshop report will have extended abstracts of the presentations from workshop speakers along with more detail describing the portfolio of approaches to climate information for water-related adaptation decisions, and the first steps identified in the workshop for building guidelines for using those approaches. CCAWWG intends to distribute that report in mid-2011.

References

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