

SOLUTIONS

Research Strategies for Addressing Uncertainties

“Climate-oriented scientific needs assessments are currently at an embryonic stage of development for the Southwest as a distinct region.”

Key Messages

1

There is a need for more information and research that addresses key climate-science uncertainties and climate effects on systems—human, biophysical, ecosystems, and others.

2

Implementation of research strategies will increase understanding and improve the ability of the scientific community to anticipate the direction and magnitude of future climate-related change.

3

Concern about drought in the Southwest—and of longer, more severe droughts—is generating new research approaches that will improve policies for wildland and urban/suburban systems.

*As managers struggle to achieve natural resource goals in a changing environment, it is becoming increasingly important for them to consider the climate impacts on ecosystem structure and plant-animal interactions. Keystone species, such as *Yucca brevifolia*, a Southwest icon more commonly known as Joshua Tree, may be affected by climate change and this may have consequences for entire ecosystems.*

The twentieth chapter of the *Assessment of Climate Change in the Southwest United States* builds on descriptions of research and research needs articulated in earlier chapters. “Research Strategies for Addressing Uncertainties” describes current research efforts and the challenges and opportunities for reducing uncertainties. It explores strategies to improve characterization of changes in climate and hydrology, and emphasizes the application of research strategies to decision-making, including methods such as scenario planning.

A growing awareness of the effects of ongoing and impending climate change on southwestern ecosystems, urban areas, and socio-economic structures is creating a need to evaluate what lines of research are needed to fill information gaps. As new climate-driven natural and human community structures and relationships develop, it will be important for research strategies relating to climate effects to be tailored to address not only scientific uncertainty, but also to address our need to manage adaptively.

Developing Research Strategies

Formal determinations of confidence, weighing the level of evidence and agreement about a body of research, are seldom made; thus, confidence is not the primary factor in determining information needs on the effects of climate change.

Nonetheless there are many examples linking information needs to research strategies. On a national scale, the US Forest Service has used research needs to craft a scientific strategy and implementation plan to organize its climate-effects research along three themes: ecosystem sustainability (climate-change adaptation), carbon sequestration (climate-change mitigation), and decision support. In the Southwest, the Forest Service Research and Development program is using these broad themes to implement its climate-change research program.

Integration of Research Strategies

A number of factors can improve the dialogue about climate research findings with those who are implementing climate mitigation and adaptation programs. Chief among these factors are:

- Communication networks, science translation, and capacity for ongoing assessment
- Elimination of possible duplication and insufficient coordination of efforts among federal, state, and local agencies
- Improved access to climate change data and information
- Improved understanding of the impact of laws and regulations on adaptation policy and implementation

Strategy development can be optimized if the institutions that make decisions about climate adaptation and mitigation are involved early on. Pilot efforts by the National Park Service to test scenario planning related to climate futures are an example of one approach that is proactively integrating managers' perspectives.

Strategies to Address Climate and Hydrology

Water resource managers in the Southwest face many challenges in predicting when they will have too much or too little water. They have issued several surveys of their water users' perceived needs, including data, methods, tools, and agency capacity. Many of these surveys address implications of a changing climate for water resources and concerns about how water managers can plan for and manage such changes. A common theme among these surveys is the promotion of research and capacity-building that leads to:

- Better-quality predictions
- Better use of existing predictions while waiting for quality to increase
- Better communication of risk and uncertainty during decision-support processes

Strategies from Southwestern Ecoregional Initiatives

Landscape Conservation Cooperatives (LCC) and Climate Science Centers, funded by the Department of the Interior, are assessing resource-management priorities and related science needs across the Southwest. Climate change information needs are a major part of the LCCs' agenda to protect natural and cultural resources. The LCCs anticipate they will be able to make available in the near future a full compilation of these sources, the criteria for developing priorities among science needs, and approaches for applying the criteria. These assessments will be of immense value in the structuring of climate change-related research in the Southwest. Additionally, a number of federal, state, and local agencies, universities, and inter-organizational cooperatives in the Southwest have started to consider research needs pertaining to climate adaptation to help them achieve their missions.

An excerpt of a summary of strategies to address gaps in knowledge and data, monitoring needs, and modeling and other deficiencies that are outlined throughout the Assessment.

Water (Chapter 10)

Uncertainty theme	Research need	Research strategy
Twentieth-century water management was based on the principle that the future would look like the past. Statistical downscaling implicitly preserves stationarity in existing large-scale synoptic patterns.	A suitable replacement for the stationarity principle is needed to reduce inhibitions to the process of adaptation and the search for solutions.	Investigation into statistical approaches for dealing with time-varying baselines.
There is a mismatch between the temporal and spatial scales at which climate models produce useful outputs, and the scales of output needed by water decision makers.	Improvements in statistical downscaling methods that currently produce substantially different results. Improved depiction of factors related to fine-scale topography in climate models.	Reconciliation of downscaling methods. Guidance on best practices for interpreting the output of different downscaling methods. Improved model topography and resolution, and validation of output that uses the improved topography in order to address potential mismatches between observed and projected climate variability.
Differing responses across models, especially with respect to precipitation, lack of realistic topography, lack of realistic monsoon simulation, and lack of agreement about El-Niño Southern Oscillation (ENSO) all provide uncertainty, which is difficult to reduce.	Improving models to better simulate modes of climate variability that have important effects on the region, such as ENSO and the North American monsoon.	Conduct intensive modeling studies using models with the best representations of ENSO and North American monsoon dynamics and regional effects. Develop focused initiatives on these key processes.

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