

Testimony of

David Schimel, Ph.D.
Senior Scientist
National Center for Atmospheric Research
and
Chief Executive Officer
National Ecological Observatory Network, Inc.
Boulder, Colorado

before the

Subcommittee on National Parks
Committee on Energy and Natural Resources
United States Senate

August 24, 2009

Chairman Udall and Senator McCain, thank you for inviting me to testify in Estes Park today.

My name is Dr. David Schimel and I will discuss two items in this testimony: (1) the effects of climate change in the Rocky Mountain region, and (2) the status of forecasting climate change impacts so that resource managers can better adapt to these future impacts.

Today I represent two Colorado-based climate research organizations, the National Center for Atmospheric Research (NCAR), a world leader in modeling the climate system, and the National Ecological Observatory Network (NEON), Inc., a new NSF major facility designed from the ground up to observe climate impacts and other environmental changes. I am a Senior Scientist at NCAR currently serving as CEO of NEON, Inc. I am also a Co-Convening Lead Author of the *U.S. Climate Change Research Program's Synthesis and Assessment Product 4.3* (SAP 4.3), which addressed the "Effects of Climate Change on Agriculture, Land Resources, Water Resources and Biodiversity in the United States." SAP 4.3 was a primary source for the science on agriculture, water resources and ecosystems in the USGCRP's recent *Global Climate Change Impacts in the United States* report. SAP 4.3 covered a number of issues affecting Colorado's national parks and provides the foundation for my remarks. This said, the views expressed in today's testimony are my own, but I believe they reflect peer-reviewed assessments closely.

1. Likely to Very Likely Effects of Climate Change in the Rocky Mountain Region

There is documented evidence that our climate is changing, and changes in climate are already affecting land and water resources in the Rocky Mountain West. Observations clearly show warmer temperatures (as illustrated in Figure 1) and reduced precipitation (seen in Figure 2), which are affecting our natural resources in the region. Colorado is two to three degrees Fahrenheit warmer than a century ago.

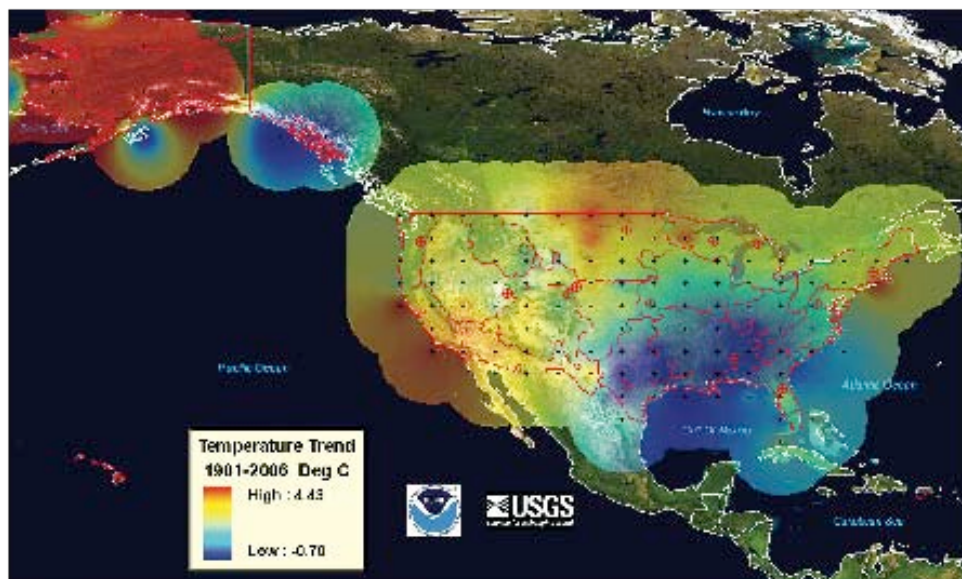


Figure 1. Trends in U.S. temperatures over the past century (from SAP 4.3)

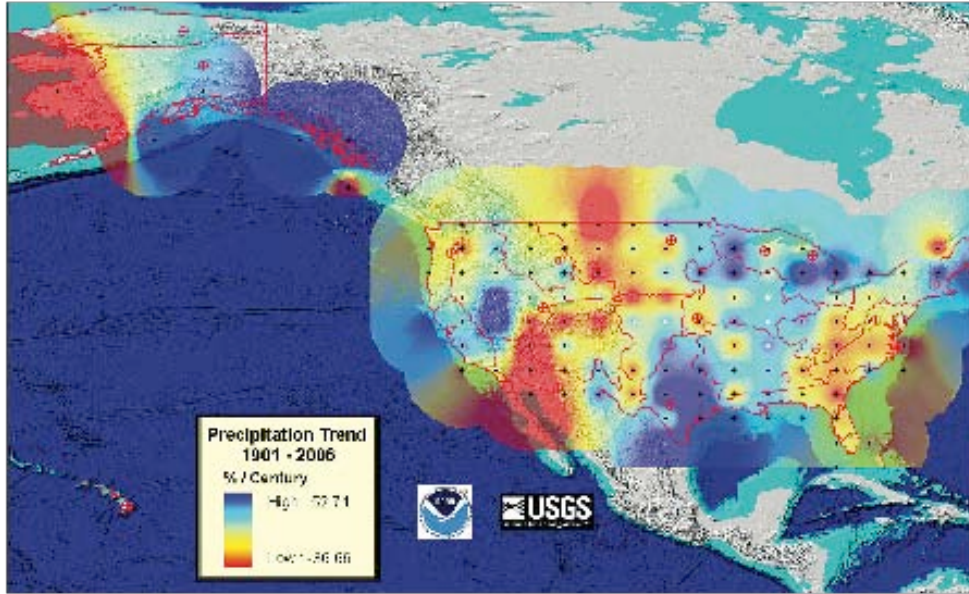


Figure 2. Trends in U.S. rainfall over the past century (from SAP 4.3)

Winter snowpack is declining and the length of the snow-covered season is decreasing. The longer snow-free seasons are not leading to a longer growing season as one might expect, but instead are resulting in more summer drought because snowpack is such an important source of water for plant growth in higher elevations. These observations correspond to recent results from climate models that show continuing warming and drying in the U.S. West. One example of such a model can be seen in Figure 3 below.

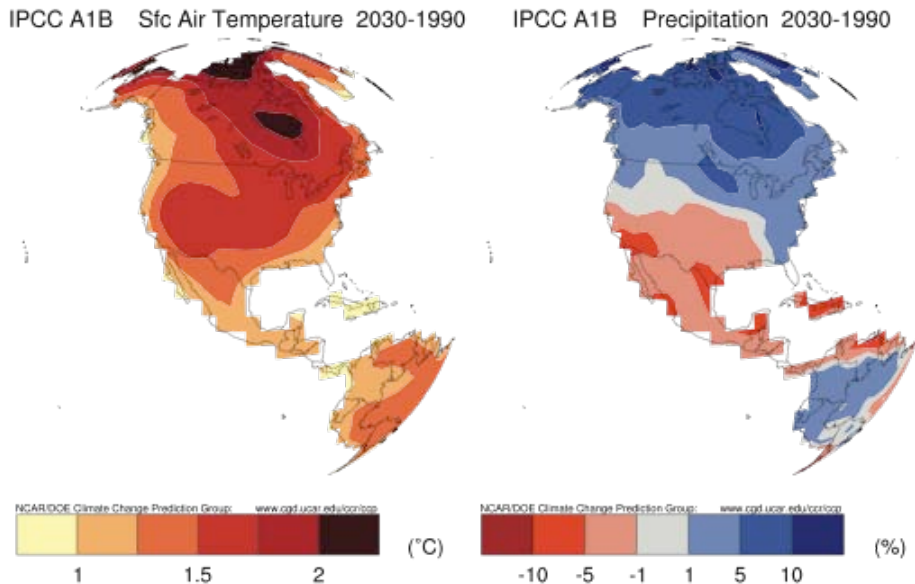


Figure 3. Projected future changes, using the NCAR Community Climate System Model, in temperature and rainfall to 2030 (from SAP 4.3)

Based on past observations and today's climate model projections, we can identify a number of key climate change impacts on resources in the Rocky Mountain region and in Colorado's national parks, including:

- **Increases to biological disturbances** such as wildfire, mountain pine beetles, and other pests and pathogens that flourish in warmer, drier conditions.
- **Changes to water resources.** Observed changes include reduced runoff and streamflow as well as reduced snowpack. Models project these trends to continue, putting additional stress on groundwater and in-stream water in the parks (see Figure 4).

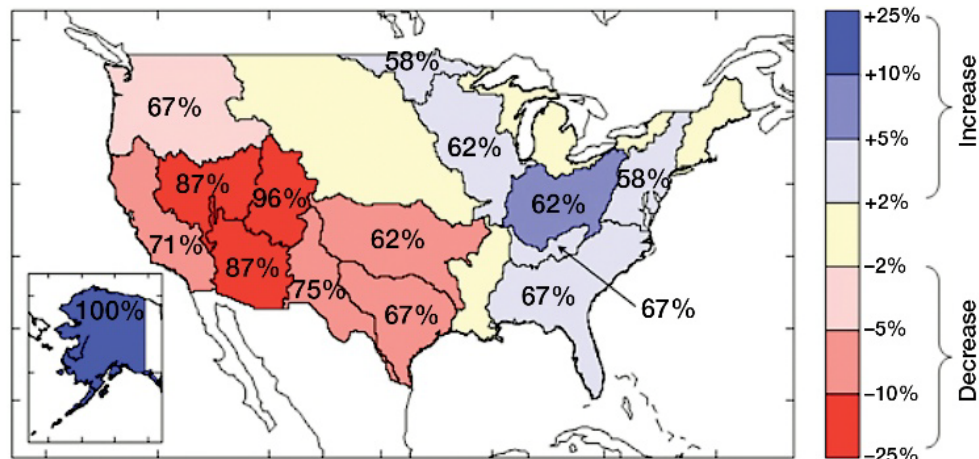


Figure 4. Projected reductions to runoff in the Western U.S. in 2050 based on 24 climate model simulations (from Milly et al., 2005)

- **Reduction of forest carbon sinks** because warmer summers and earlier snowmelt lead to less tree growth and higher forest mortality, and thus less carbon storage (as illustrated in Figure 5). Observations just south of Rocky Mountain National Park (RMNP) show that a one-month change in the timing of snowmelt reduced carbon capture in forest ecosystems by one-half.
- **Loss of native plant species.** Earlier snowmelt also affects which plants grow during what seasons in alpine meadows. Alpine ecosystems could change as some species increase in abundance. Other plants could cease to grow, possibly forever.

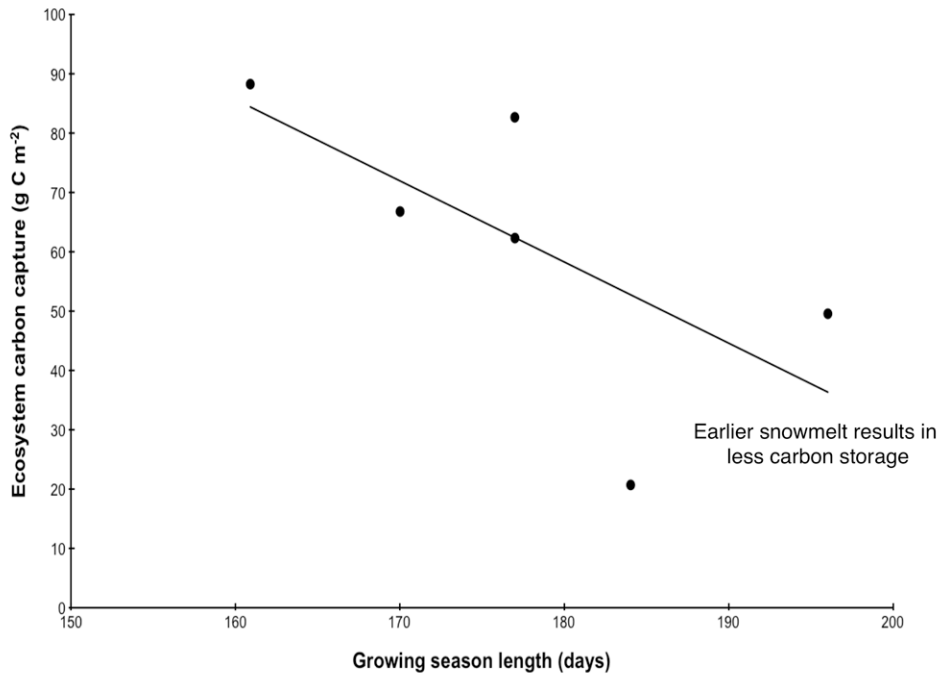


Figure 5. Reduction of carbon capture by Colorado forests with increasing growing season length, caused by increased drought stress with longer summers (from NCAR and CU researchers)

The climate change impacts described above will affect wildlife and biodiversity in natural areas. In addition, they will affect natural landscapes in the parks and recreational activities such as fishing and skiing.

2. Climate Impacts Forecasting

To adapt to a rapidly changing environment, natural resources managers need access to information on climate impacts and forecasts on potential future climate scenarios.

While models of climate are constantly improving, there is no organized, integrated observing system and corresponding climate services center for delivering information about climate impacts. Instead, there is a multitude of observing systems, each designed for one or more of yesterday's problems, and a correspondingly fragmented analysis and/or forecast system. The integration of observations and modeling of climate impacts needs the kind of coordinated attention and emphasis that weather and climate models currently receive. With such an approach, forecasting of climate impacts can achieve the maturity of physical weather and climate science.

The nation has established organizations that provide usable information about climate change to resource managers. However, research and infrastructure to support management of organizations that study the *impacts* of climate change are in their early development and supported only on a piecemeal basis. As noted in SAP 4.3, “existing monitoring systems, while useful for many purposes, are not optimized for detecting the impacts of climate change on ecosystems.”

Even with improved observations, we do not have a center or service charged with producing usable analyses and forecasting information utilizing these data. In addition, there is no clear plan to implement and sustain the generation and dissemination of regional- to continental-scale environmental information products. For future products to be accepted in decision-making, a service must also systematically document how the information was produced and the degree of confidence associated with each analysis or forecast. In the current environment, critical information for natural resource decision-making and adaptation to climate change is hard to obtain. Most forecasting of climate impacts is done by individual researchers and is not reliably available to resource managers. Thus, providing usable information about the spectrum of potential future changes to the stewards of a major national treasure like Rocky Mountain National Park is extremely difficult.

New efforts such as NSF’s NEON project and the USGS’ Climate Effects Network are beginning to address this gap in information. Colorado is a national center for integrating climate science with climate impacts, and those of us who work in the state on these global problems are motivated by proximity to Rocky Mountain National Park and Colorado’s other natural resources. NEON is developing a national network of climate impact observation sites, which have been selected to span the major wildland and managed ecosystems of the U.S., including sites in or very near a number of national parks. NEON is coordinated with NOAA’s climate observations, but also complements them with detailed measurements of the biological consequences of climate change.

In conclusion, climate is changing and the impacts of climate change are evident in current ecosystem observations. Critical natural resources in the national parks are under stress as a result of the changing climate, and today’s models suggest these changes will intensify, further complicating the already complex set of issues facing park resource managers. Although we have a system in place for observing the current climate, today’s observing systems, analyses and forecasts are inadequate for providing park resource managers with the decision support they need for the future. Colorado’s federally funded laboratories offer the country a unique collection of facilities for integrating climate science with climate impacts assessments. Those of us working within the state on these global problems are motivated by Colorado’s natural resources and stand ready to contribute to improved natural resource management in the face of climate change.

I thank the Senators for this opportunity to provide testimony and am ready to answer any questions.

Appendix of Diagrams

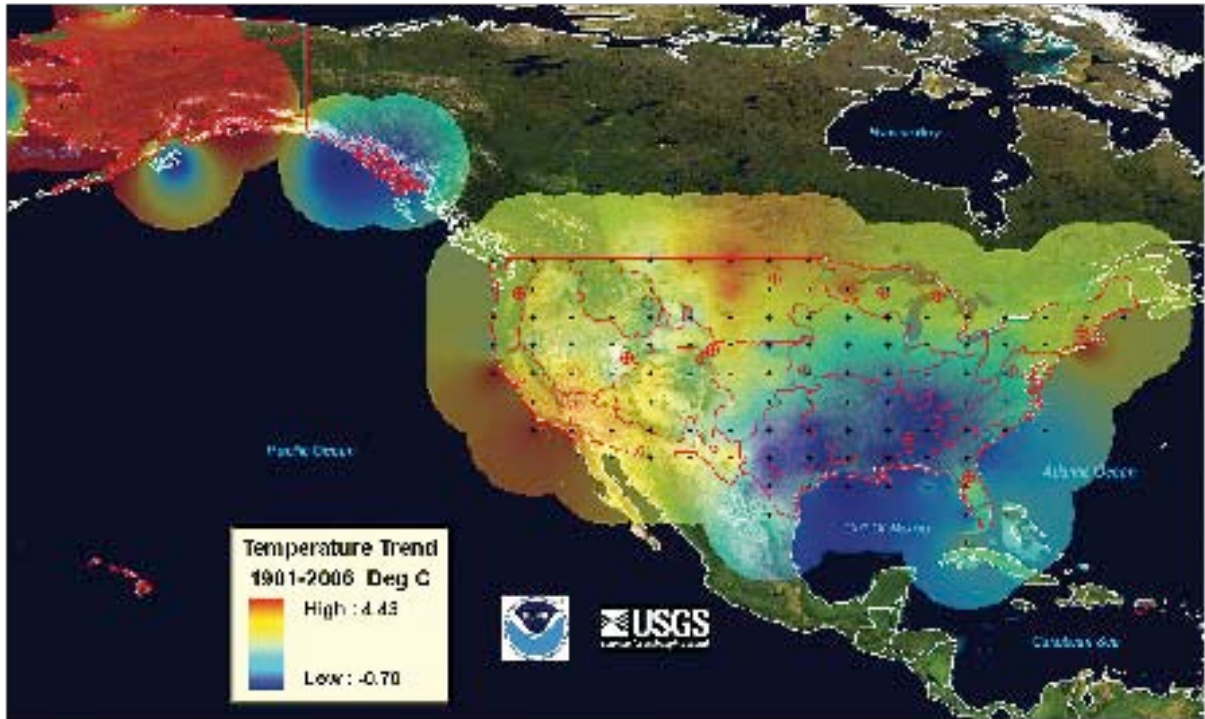


Figure 1. Trends in U.S. temperatures over the past century (from SAP 4.3)

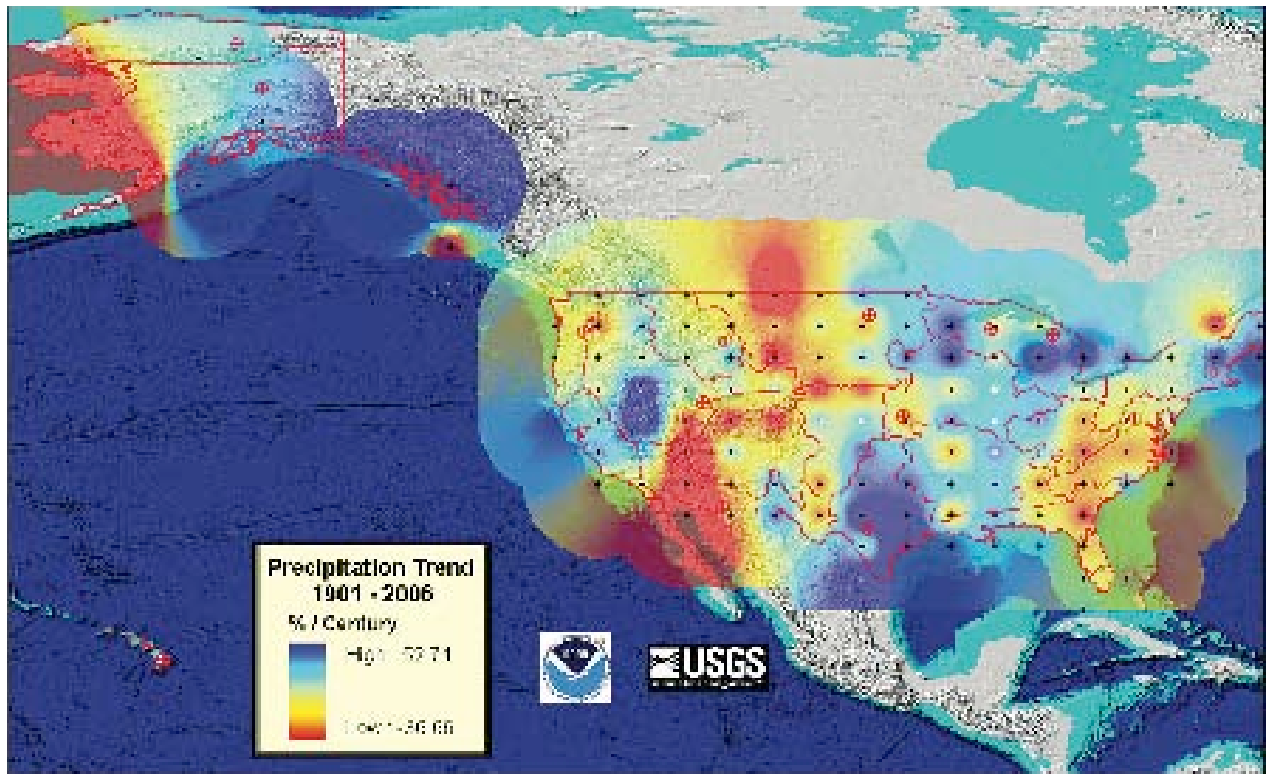


Figure 2. Trends in U.S. rainfall over the past century (from SAP 4.3)

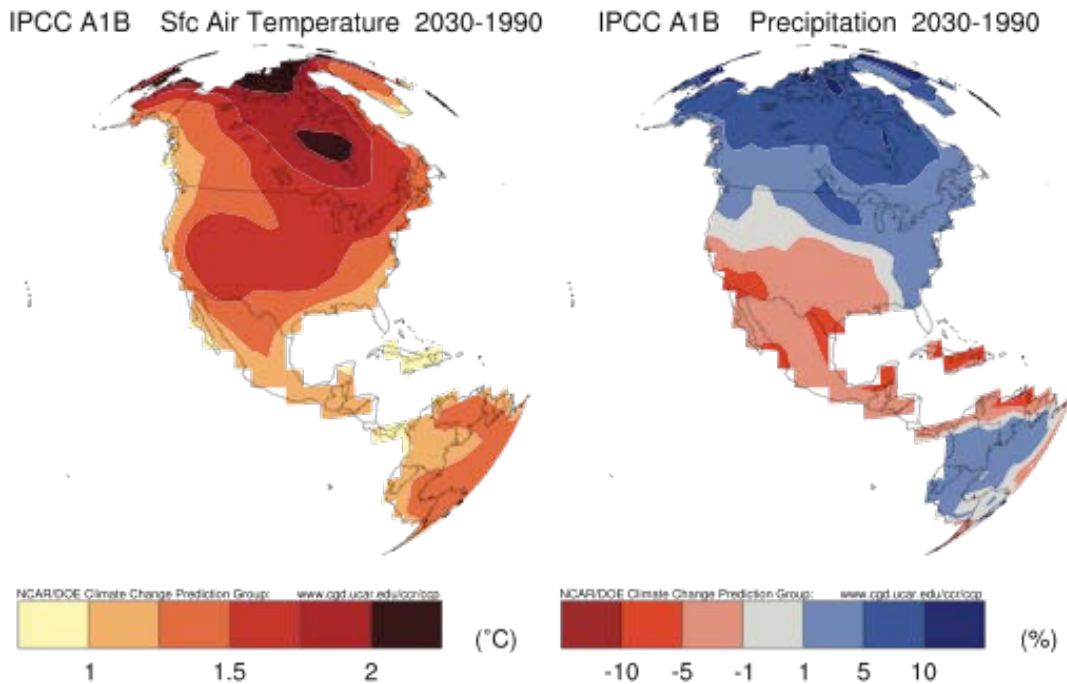


Figure 3. Projected future changes, using the NCAR Community Climate System Model, in temperature and rainfall to 2030 (from SAP 4.3)

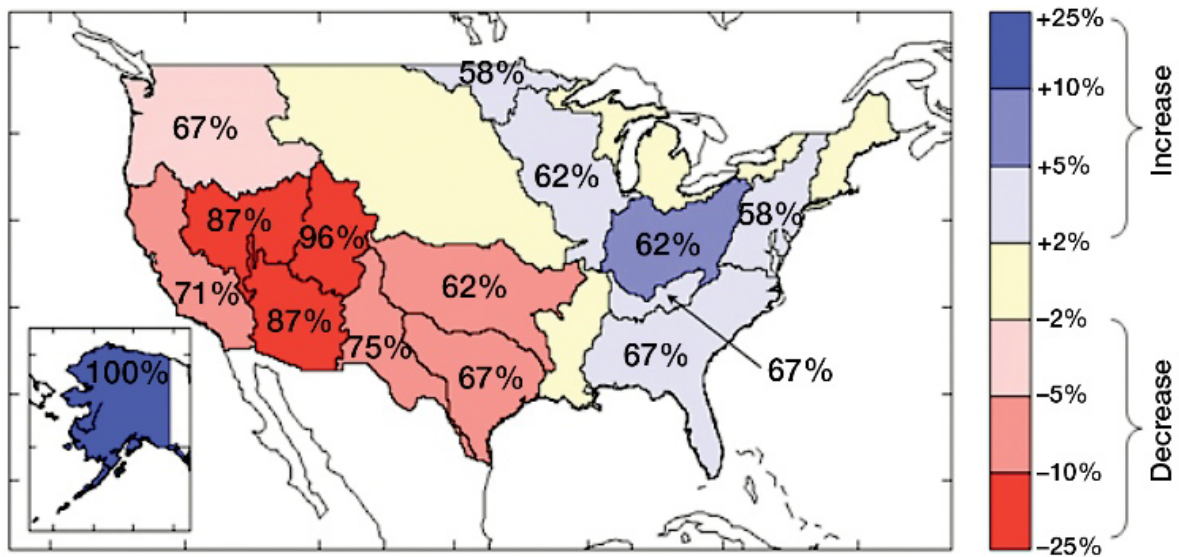


Figure 4. Projected reductions to runoff in the Western U.S. in 2050 based on 24 climate model simulations (from Milly et al., 2005)

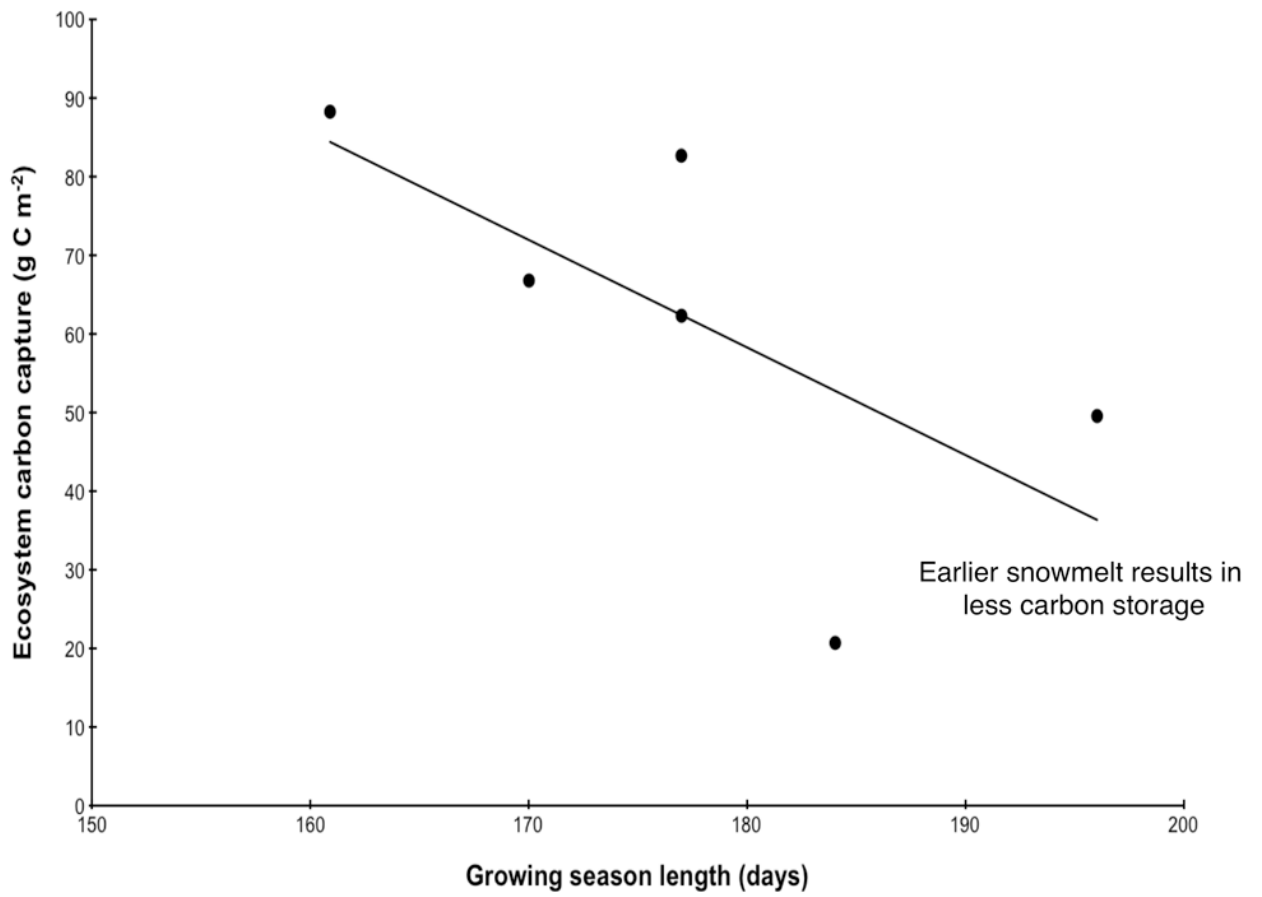


Figure 5. Reduction of carbon capture by Colorado forests with increasing growing season length, caused by increased drought stress with longer summers (from NCAR and CU researchers)