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Figure 2 — Water Resource Vulnerability

MANY CONTRIBUTING INFLUENCES

The historical climate of Colorado illustrates major floods and extended periods of drought. Extreme cold and warmth have also always been a part of Colorado weather. In terms of water resources, the state has faced extended periods of drought, as well as years of generous water supply. On the longer time period, as illustrated in Figure 1, periods of extreme drought and wet periods have been even more pronounced than in the historical record of the last century and the late 1800s.

This figure, from a study led by researchers at the University of Arizona, uses tree rings to extend precipitation data back to well before humans directly measured rain and snow. In this data set, for Lee Ferry along the Colorado River, severe droughts lasting decades, such as one in the 12th century, are clearly evident. In the period of around 800 AD to 2004 AD, for example, there was a period of 25 years with 87 percent less precipitation than in the 1906 to 2004 mean.

Excessively dry periods occurred without any significant interference of humans in the climate system. Multi-decadal global model predictions of the climate in Colorado actually present a less serious threat to the state's water supply than if one of the extended past droughts reoccurred.

An assumption that projecting climate is easier than predicting weather is not correct, in my view. No global model has been able to replicate and explain the large natural variations in climate that are evident in Figure 1. In reality, the climate is highly non-linear, in which the effect on the climate system from forcings is often episodic and abrupt, rather than slow and gradual. Large, long term variations in regional climate are the norm, as illustrated in Figure 1. The human effect on the climate system through such forcings as added CO_2, land use change, and the input of pollution particles from fires, vehicles and industrial activity, only add to the complexity of the climate system response.

Moreover, water resources are affected by a variety of human and natural effects beyond long term climate variability and change, as illustrated in Figure 2. These effects also interact with each other in complex nonlinear ways.

We therefore need a new approach. A way forward with respect to more effective water resource policies is to focus on the assessment of adaptation and mitigation strategies that reduce the vulnerability of Colorado water resources to both natural and human caused climate variability and change, as well as all other threats. Effective adaptation strategies include developing environmentally sensitive way to accumulate water during wetter-than-average periods and building the infrastructure to transport water across large distances. They reduce the state's vulnerability to periods of drought, regardless of how climate changes naturally and in response to human climate forcings in the coming decades.

This framework for a vulnerability assessment of Colorado water resources focuses on the water required for the state's economic, social and environmental activities. This is in contrast to the GCM-focus of multi-decadal global model predictions downscaled to Colorado. A top-down approach from a global perspective, in which the skill is dependent on the forecast accuracy of these global models offers a much smaller set of future scenarios for Colorado than are actually possible.

The vulnerability focus permits a much more comprehensive framework to assess threats to Colorado's water resources. Variability and changes in the climate are just one threat to water resources. The current climate models present only a subset of the possible risk, even from climate variability and change.

The vulnerability approach uses water resource specific models and observations to determine the thresholds at which negative effects occur with the state's water supplies. Using mitigation and adaptation, we need to prevent crossing the thresholds.

A vulnerability perspective, focused on regional and local societal and environmental resources, is a more inclusive, useful and scientifically robust framework to use with policymakers. In contrast to the limited range of possible future risks by current climate models, the vulnerability framework permits the evaluation of the entire spectrum of risks to the water resources associated with all social and environmental threats, including climate variability and change. ❑

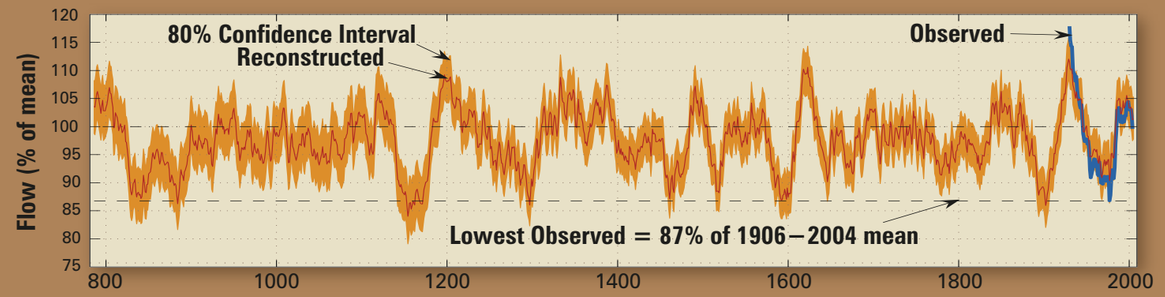

Figure 1– Ending Year of 25–yr Running Mean