



# Science for resilience in western ecosystems the fire-water nexus

Climate change is causing forest fires and water shortages to erode the resilience of communities and ecosystems in the American West. *Science for action is the missing lynchpin that can ensure clean water supplies and sustainably living with fire.* The challenge is profound. Much of the region just emerged from the driest period in 1,200 years, reducing river flows and stored water reserves to dangerously low levels. For example, in the Colorado River system, which provides drinking water to 40 million people, flows have declined by 20% since 2000. Concurrently, the area of forest burned annually has increased by more than 1,000% since the early 1980s. The social, economic, and ecological costs of fires and water scarcity are already severe, and projections indicate that risks will continue to grow exponentially over the next 50 years.

Increased fire not only threatens people and homes, it also damages our water infrastructure, affecting water quality in myriad ways and imposing huge costs on society. For instance, the 2017 Tubbs Fire cost the city of Santa Rosa, CA an estimated \$44 million to fix their water distribution network. Sediment flows following the 2011 Las Conchas Fire in New Mexico increased turbidity in the Rio Grande River far downstream, causing the city of Albuquerque to shut down their water intake for more than 2 months.

Given trends in climate and fire, the threat to freshwater resources will only grow. Western communities face profound uncertainty about how to ensure continued access to clean water. Based on our world-renowned expertise in the science of watersheds and western fire, **Cary Institute of Ecosystem Studies and our partners are poised to rapidly advance predictive models to help local communities, water utilities, fire managers, and policymakers steward the West through a drier and more fiery future.**

Freshwater and fire are inseparably linked. Drought causes more frequent, intense fires. Fire affects water quantity by killing trees and reducing uptake. Watersheds store the water and materials that integrate and reflect ecological processes and disturbances of their surrounding regional landscapes. This makes watershed science a remarkable and relatively untapped resource for gaining insights across scales on how fire affects freshwater resources and how they can be managed to reduce impacts on people. Leveraging government water data, remote sensing, AI, and process-based simulations, we can produce rapid, convergent research that empowers environmental stewards with unprecedented information on the relationships between fire and freshwater.

While we are already making strong advances in this work, the window to act is closing. We need large investment from visionaries **now** to develop forecasts of how water will change in the future with fire. *Join us in producing science for action that will help the private sector, municipalities, water managers, and policymakers navigate a time of profound environmental challenge.*

Winslow D. Hansen is the founding director of the *Western Fire and Forest Resilience Collaborative*. A goal of this ten-team partnership is to provide robust models of how current and future forest fires may affect freshwater across the West. With seed funding from the Gordon and Betty Moore Foundation, this ambitious decade-long endeavor brings together scientists, the fire management community, and policymakers to co-create and implement a research program that ensures the predictive science of fire ecology is sufficiently mature to support effective management strategies.

Kathleen C. Weathers co-founded and led the *Global Lake Ecological Observatory Network (GLEON)*, an international network of over 900 scientists and citizen scientists who work collectively to understand how hundreds of lakes around the world respond to a changing global environment, including forest fires. Dr. Weathers has led cohorts of international graduate students who collectively address pressing environmental questions, such as what causes the contraction and expansion of hundreds of thousands of lakes in the US. GLEON collaborations are studying the downstream and downwind impacts on water quantity and quality, examining the effects of fires on freshwater through the airborne delivery of fire-fertilizers and pollutants (e.g, phosphorus, ash, and black carbon) and smoke effects on light.



Recent fires in the Vaca Mountains of California