



# COLORADO RIVER BASIN INTEGRATED SCIENCE AND TECHNOLOGY

## U.S. GEOLOGICAL SURVEY APPROACH TO CONVERGENT RESEARCH

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### USGS Regional Science Centers

Arizona Water Science Center

Grand Canyon Monitoring and Research Center

Southwest Biological Science Center<sup>4</sup>

California Water Science Center<sup>5</sup>

Southwest Regional Office (DOI Region 8 and Region 10)<sup>11</sup>

Central Energy Resources Science Center

Colorado Water Science Center<sup>9</sup>

Fort Collins Science Center<sup>3</sup>

Geosciences and Environmental Change Science Center

Geologic Hazards Science Center

Geology, Geophysics, and Geochemistry Science Center<sup>2</sup>

Rocky Mountain Regional Office (DOI Region 7)<sup>1</sup>

Nevada Water Science Center<sup>7</sup>

New Mexico Water Science Center<sup>10</sup>

Utah Water Science Center<sup>8</sup>

Wyoming-Montana Water Science Center

### USGS National Support

Core Science Systems Mission Area

Ecosystems Mission Area

Energy and Minerals Mission Area

Natural Hazards Mission Area

Water Mission Area

Climate Adaptation Science Centers

Science Analytics and Synthesis (SAS)

Office of the Associate Chief Information Officer  
Cloud Hosting Solutions (CHS)<sup>6</sup>

Earth Resources Observation and Science (EROS) Center

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The Colorado River Basin Actionable and Strategic Integrated Science and Technology project is accelerating interdisciplinary science and the application of advanced information management technology to address complex stakeholder driven challenges. The USGS supported a series of internal Science and Technology Collaboration Workshops between scientists and technology specialists to identify preliminary convergent research opportunities.

<h4>Application of Innovative Data Collection Technologies and Integrated, Multi-scale Observation Networks</h4> <ul style="list-style-type: none"><li>Evaluate solutions across remote sensing and ground truth applications to improve efficiencies in processes and approaches</li><li>Evaluate network applications, data services, and computing to expand remotely accessed data</li><li>Align multiple sensors, videos, infrared, acoustics at low cost with shared benefits to increase analytical capacity</li></ul>	<h4>Integrated Science to Address Climate Change Effects in the Colorado River Basin</h4> <ul style="list-style-type: none"><li>Jointly build a conceptual model across science disciplines of the interconnected effects of climate change across the basin</li><li>Centralize data, model, and information access to compare multi-model projections of effects</li><li>Improve understanding of compounding climate change in remote regions and its effects on underrepresented and indigenous groups</li></ul>	<h4>Groundwater Dependent Streams, Ecosystems, and Research</h4> <ul style="list-style-type: none"><li>Working with an interdisciplinary team, develop a joint vocabulary of groundwater, surface water, geologic, and ecological intersections</li><li>Investigate unexpected trends related to the long-term drought (e.g., water quality, land use change, wildfire recovery, etc.)</li><li>Compile data to prioritize locations with high anticipated risk and stakeholder interest to evaluate multiple sites or sub-regions</li></ul>	<h4>Wildfire Risk and Post Fire Impacts</h4> <ul style="list-style-type: none"><li>Work with resource managers to identify thresholds to maintain resilience and services</li><li>Consider applying the resist-adapt-direct (RAD) framework in the context of fire prediction and post fire impacts in the region</li><li>Evaluate best practices for using ecosystem services as a method to communicate impacts</li><li>Share approach with fire science community</li></ul>
<h4>Effects of Drought at High Elevations: Landcover, Forest Health, Snowpack, etc.</h4> <ul style="list-style-type: none"><li>Combine testbed projects across disciplines at multiple sites or sub-regions based on data compilation and locations with high interest</li><li>Better understand remotely sensed products and implications of errors (e.g., appropriate scales and regions of application)</li><li>Define and identify means of evaluating tipping points and transformations in a vulnerability framework for high elevations</li></ul>	<h4>Effects of Drought on the Human System and Development</h4> <ul style="list-style-type: none"><li>Evaluate existing geospatial and biophysical data relevant to development to synthesize, analyze, and construct a geospatial picture of the region</li><li>Develop a system diagram to elucidate linkages between science activities, system aspects, and stakeholder priorities</li><li>Assess capabilities across the basin with socio-economic analyses to evaluate potential applications in a variety of studies</li></ul>	<h4>Artificial Intelligence, Machine Learning, Cloud Computing and High Performance Computing Applications</h4> <ul style="list-style-type: none"><li>Implement strategies and roadmaps to integrated Findable, Accessible, Interoperable, and Reusable (FAIR) Principles</li><li>Pilot the integration of analysis-ready data repositories and model catalogs with semantic modeling to support science integration</li><li>Connect advanced information management technology resources to scientists</li></ul>	<h4>Integrating Ecosystem Responses to Drought and Climate Change</h4> <ul style="list-style-type: none"><li>Incorporate existing Standardized Precipitation Evapotranspiration Index (SPEI) models to fill data gaps across the basin at a century scale</li><li>Develop a conceptual diagram of integrated ecosystem models to evaluate interdisciplinary monitoring and data requirements</li><li>Centralize relational data needed for evaluating drought impacts to habitat and species with workflows to keep iteratively updated</li></ul>
<h4>Stakeholder Engagement Strategies and Approaches in the Colorado River Basin</h4> <ul style="list-style-type: none"><li>Coordinate engagement activities focused on integration and multidisciplinary approaches to ensure access to full USGS resources</li><li>Create a neural network of project, researcher, and stakeholder relationships in the Colorado River Basin</li><li>Co-locate employees with partners to help USGS scientists gain experience working with or in other organizations</li></ul>	<h4>Development of Science Communication Materials and Communication of Uncertainty</h4> <ul style="list-style-type: none"><li>Review existing drought and climate studies to identify key communication similarities and differences to develop common language to share with researchers in the basin</li><li>Work with USGS Climate Adaptation Science Centers on communicating uncertainty</li><li>Collaborate across Science Centers and with partners to form science communities to discuss and improve communication capabilities</li></ul>	<h4>Applications of Data and Information Visualization</h4> <ul style="list-style-type: none"><li>Identify existing visualization products and efforts in the basin and devise a unified framework to connect access for end users</li><li>Increase value of applications as end goals of projects to elevate useable data in addition to professional publications</li><li>Define visualization needs and expertise needed from a human resources perspective to evaluate existing capabilities or expand workforce</li></ul>	<h4>Drought Prediction, Integrated Predictive Modeling, and Early Warning Indicators</h4> <ul style="list-style-type: none"><li>Determine required spatial and temporal scales of predictive and early warning indicators</li><li>Look at prediction of stream intermittence across experts in groundwater and surface water systems, ecologists, wildlife biologists, and remote sensing experts to evaluate greenness in visual imagery as an indicator</li><li>Integrate the human dimension in early warning predictive methods to support end users</li></ul>

Science is continually advancing, and there is an increasing need to interpret the connections between studies to predict the effects of drought and other changes affecting the Earth-system. Working with partners across science disciplines the USGS is focused on a new approach to support interdisciplinary science integration in the Colorado River Basin.

Colorado River Basin: Actionable and Strategic Integrated Science and Technology Project

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