TAHOE: STATE OF THE LAKE REPORT 2025

SCIENCE TO SAVE LAKES

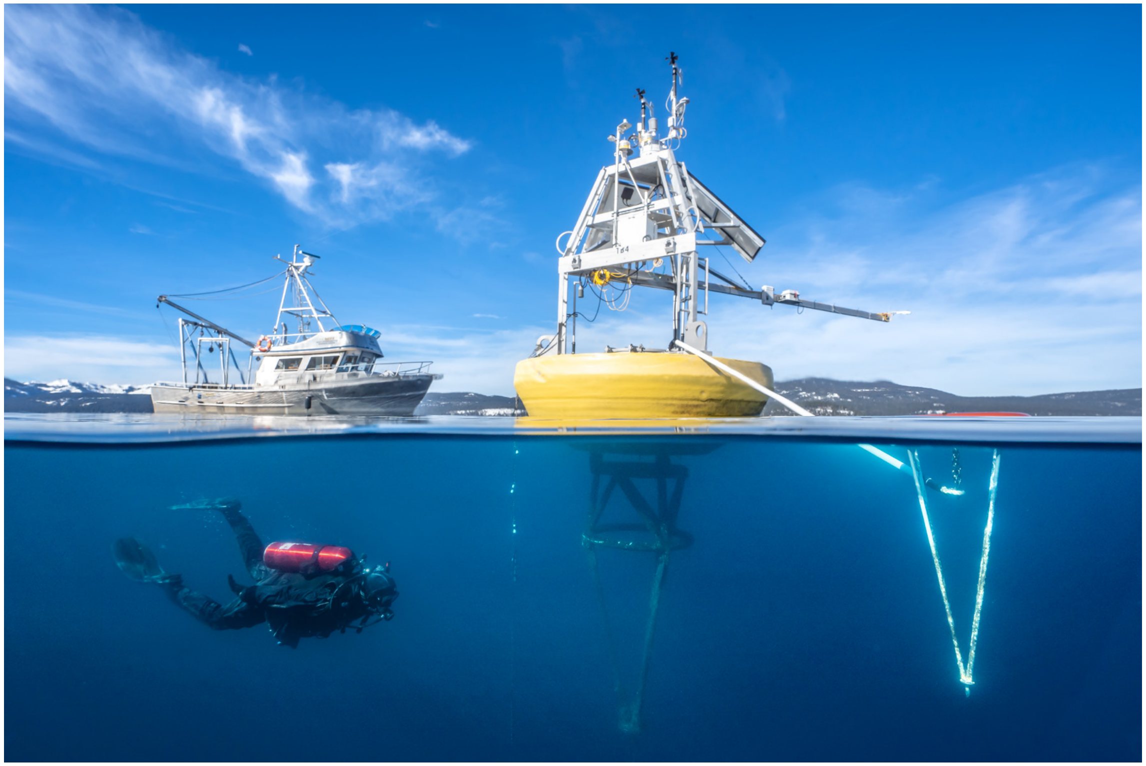
UCDAVIS
Tahoe Environmental
Research Center

tahoe.ucdavis.edu

Science to Save Lakes: Infrastructure for Understanding

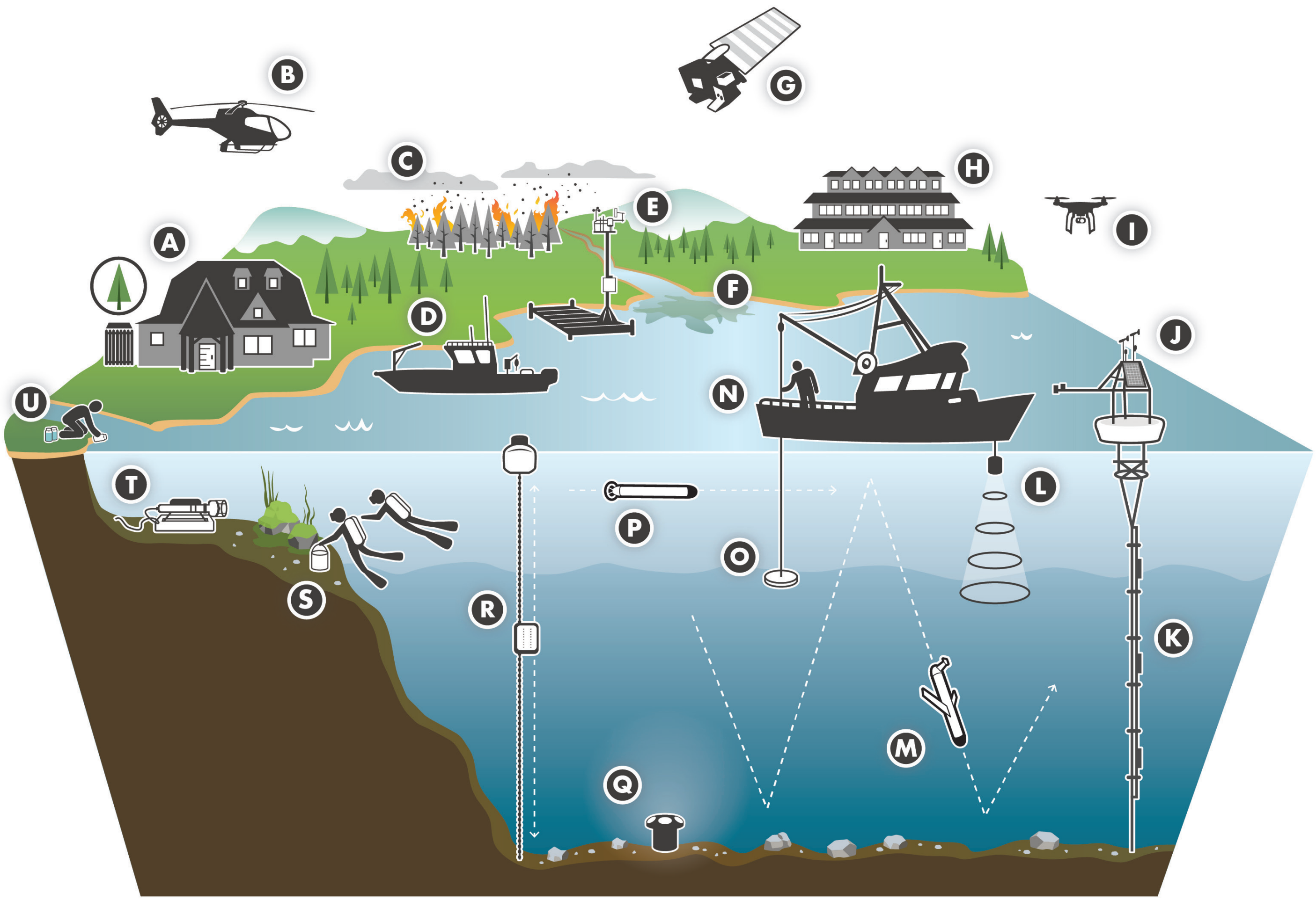
For over 60 years UC Davis Tahoe Environmental Research Center has built a robust and enduring infrastructure to better understand the Lake Tahoe system. Many people think of equipment when they hear the word "infrastructure," but we recognize that the infrastructure supporting research and monitoring is much more than that. Infrastructure includes not only technologies but also a legacy of knowledge and people who engage passionately in research, education, conservation, and management. This infrastructure is our investment in a resilient future.

This investment in all aspects of infrastructure over the years has created a network of connected understanding that drives researchers toward the most critical questions and supports the mission to find answers, ultimately leading us to our destination—a healthy and resilient watershed.



Components of TERC's infrastructure for understanding can be found all around Lake Tahoe. It takes passionate people, to gather valuable data, to deliver actionable insights, and to build resilient watersheds. (Brandon Berry, UC Davis TERC)

Science to Save Lakes: Infrastructure for Understanding

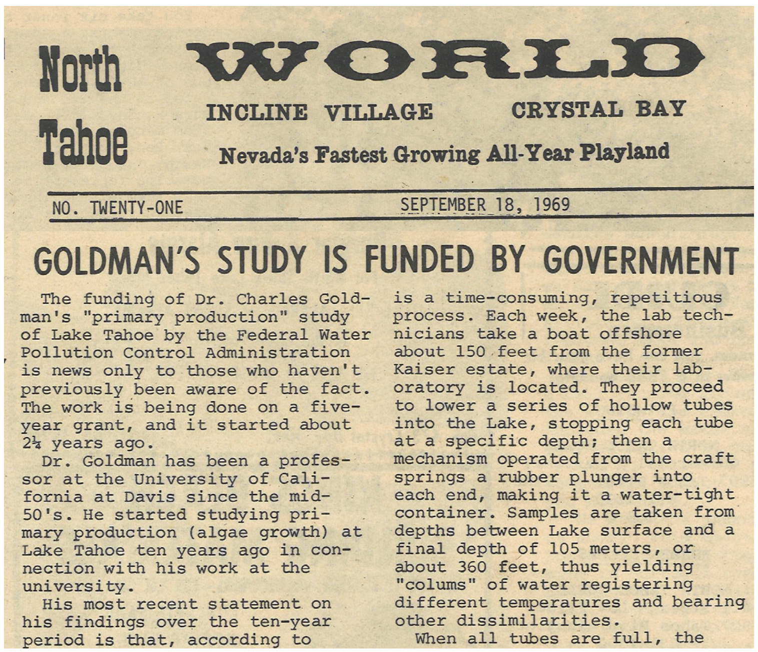


A. Tahoe City Field Station, Forest Ecology Lath House, and Eriksson Education Center
B. Helicopter
C. Atmospheric deposition samplers
D. Research vessels
E. Meteorological stations
F. Stream monitoring stations
G. Remote sensing satellites
H. Laboratories and Tahoe Science Center
I. Drones
J. NASA research buoys
K. Thermistor chains
L. Bioacoustic monitoring sonar
M. Autonomous underwater gliders
N. Vertical profilers
O. Secchi disk
P. Autonomous Underwater Vehicles (AUVs)
Q. Acoustic Doppler Current Profilers (ADCPs)
R. Wave-powered vertical profiler
S. Research divers
T. Nearshore sensor stations
U. eDNA collections

What are the Components of TERC's Infrastructure for Understanding?

Long-term dataset

Foundational to our understanding is our extensive, long-term data set, which UC Davis has been collecting and analyzing for over 60 years. This record of change is one of the longest continuous measurements collected on a lake in the United States, and it allows us to see beyond individual readings, revealing decadal scale trends. It provides researchers insight into how the environment of the Tahoe Basin is changing over time in the face of anthropogenic impacts, global change, and the introduction of new species. This data set holds the key to answering many of the most important questions we need to ask. The data comprise a critical piece of our research infrastructure, serving as a keystone to encourage collaboration, exchange of ideas, and laying the foundation for future scientific breakthroughs in the Tahoe Basin and beyond.



North Tahoe WORLD

INCLINE VILLAGE CRYSTAL BAY

Nevada's Fastest Growing All-Year Playland

NO. TWENTY-ONE SEPTEMBER 18, 1969

GOLDMAN'S STUDY IS FUNDED BY GOVERNMENT

The funding of Dr. Charles Goldman's "primary production" study of Lake Tahoe by the Federal Water Pollution Control Administration is news only to those who haven't previously been aware of the fact. The work is being done on a five-year grant, and it started about 2¼ years ago.

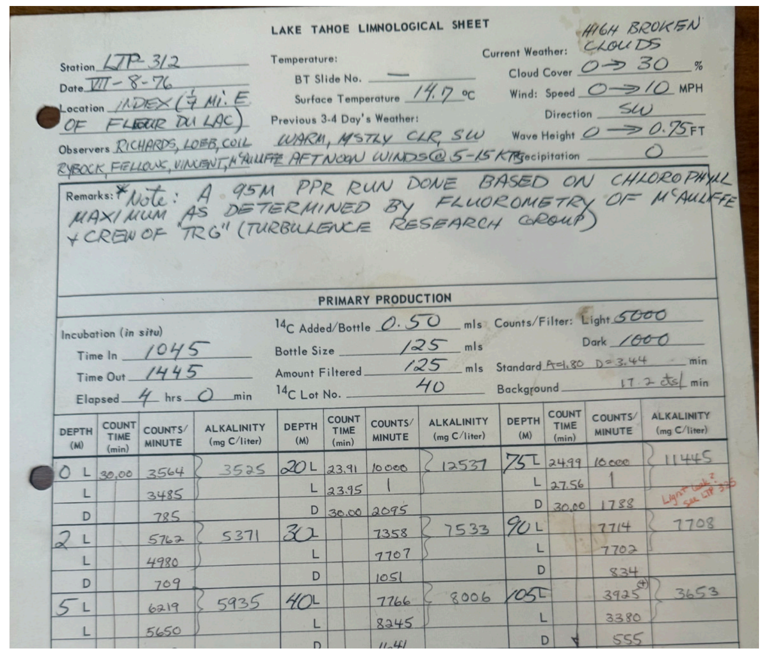
Dr. Goldman has been a professor at the University of California at Davis since the mid-50's. He started studying primary production (algae growth) at Lake Tahoe ten years ago in connection with his work at the university.

His most recent statement on his findings over the ten-year period is that, according to

is a time-consuming, repetitious process. Each week, the lab technicians take a boat offshore about 150 feet from the former Kaiser estate, where their laboratory is located. They proceed to lower a series of hollow tubes into the Lake, stopping each tube at a specific depth; then a mechanism operated from the craft springs a rubber plunger into each end, making it a water-tight container. Samples are taken from depths between Lake surface and a final depth of 105 meters, or about 360 feet, thus yielding "colums" of water registering different temperatures and bearing other dissimilarities.

When all tubes are full, the

Proof we have been monitoring the lake and have been concerned about excessive algae growth for decades. This newspaper article from September 1969 reports on Dr. Charles Goldman receiving funding to conduct primary productivity (algae growth) studies in Lake Tahoe. (UC Davis TERC)



LAKE TAHOE LIMNOLOGICAL SHEET

Station LTP 3/2
Date VII-8-76
Location INDEX (½ MI. E OF FLEUR DU LAC)
Observers RICHARDS, LOEB, COIL RYBOCK, FELLOWS, VINCENT, McAULIFFE

Temperature:
BT Slide No. —
Surface Temperature 14.7 °C
Previous 3-4 Day's Weather: WARM, MSTLY CLR, SW AFTNOON WINDS @ 5-15 KTS

Current Weather: HIGH BROKEN CLOUDS
Cloud Cover 0 → 30 %
Wind: Speed 0 → 10 MPH
Direction SW
Wave Height 0 → 0.75 FT
Precipitation 0

Remarks: *Note: A 95M PPR RUN DONE BASED ON CHLOROPHYLL MAXIMUM AS DETERMINED BY FLUOROMETRY OF McAULIFFE + CREW OF "TRG" (TURBULENCE RESEARCH GROUP)

PRIMARY PRODUCTION

Incubation (in situ)
Time In 1045
Time Out 1445
Elapsed 4 hrs 0 min

^{14}C Added/Bottle 0.50 mls
Bottle Size 125 mls
Amount Filtered 125 mls
^{14}C Lot No. 40

Counts/Filter: Light 5000
Dark 1000
Standard A=1.80 D=3.44 min
Background 17.2 cts/ min

DEPTH (M)	COUNT TIME (min)	COUNTS/ MINUTE	ALKALINITY (mg C/liter)	DEPTH (M)	COUNT TIME (min)	COUNTS/ MINUTE	ALKALINITY (mg C/liter)	DEPTH (M)	COUNT TIME (min)	COUNTS/ MINUTE	ALKALINITY (mg C/liter)
0 L	30.00	3564	3525	20 L	23.91	10000	12537	75 L	24.99	10000	11445
L		3485		L	23.95	1		L	27.56	1	
D		785		D	30.00	2095		D	30.00	1788	
2 L		5762	5371	30 L		7358	7533	90 L		7714	7708
L		4980		L		7707		L		7702	
D		709		D		1051		D		834	
5 L		6219	5935	40 L		7766	8006	105 L		3925 (+)	3653
L		5650		L		8245		L		3380	
				D		[illegible]		D		555	

Historical data sheet shows that researchers had good weather on July 8, 1976, when they went out on the lake for a day of observations that included Primary Productivity studies (which is still ongoing today) and gathering zooplankton samples. (UC Davis TERC)

What are the Components of TERC's Infrastructure for Understanding?

Passionate people

The passionate and brilliant teams of interdisciplinary researchers who have called TERC home provide another key component of our long and storied history. These individuals have made their unique contributions to our understanding of the lake and the surrounding basin, building on the knowledge captured before them and making advances of their own, so that the next generation of researchers can begin at new heights.

Whether studying the ecology of the lake, the genetics of the forests, the physical movement of the water, the changes in nutrients in the water and soil, the atmospheric conditions, or people's activities in the Basin, this work becomes more than the sum of the parts when collaboration allows us to build a more cohesive understanding of our environment. Such understanding is critical to preserve and restore the ecosystems of the Tahoe Basin for both current and future generations.

While scientists and engineers turn data into knowledge, it is our partnerships that turn knowledge into action. We have collaborated with partners within the basin for decades to translate the scientific insights we provide into actionable management strategies that are implemented by government and non-profit organizations. These partnerships are crucial to translating our science into stewardship.

TERC team members gathered for a Strategic Planning session in Davis. This meeting provided a chance for the normally far-flung team to be in the same room and discuss the future of TERC. (Gayle Guest-Brown, UC Davis)

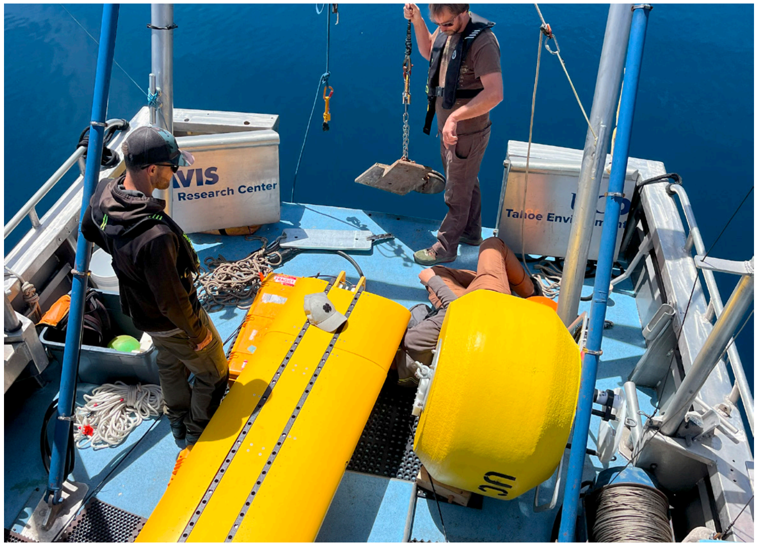
Four leaders of UC Davis research at Lake Tahoe. Left to right, Charles Goldman, Stephanie Hampton, Geoffrey Schladow, and Alex Forrest. (Heather Segale, UC Davis TERC)

What are the Components of TERC's Infrastructure for Understanding?

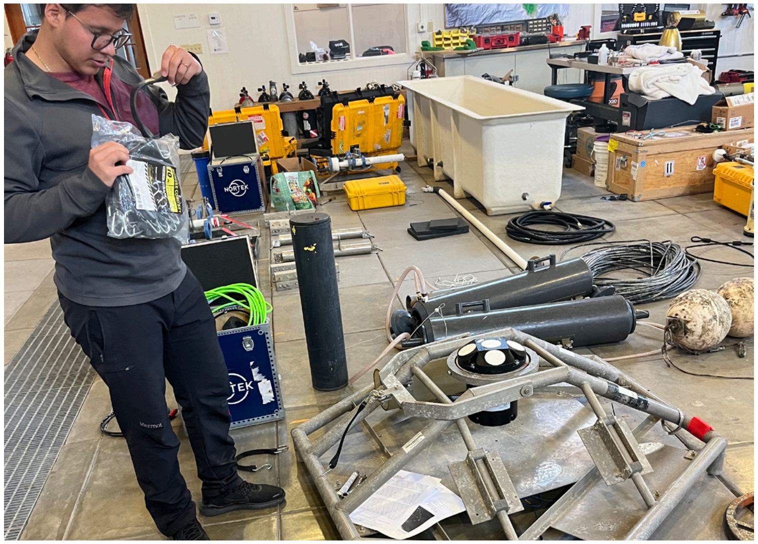
Tools and technology

TERC has Lake Tahoe and the surrounding watershed wired. Our decades-long history of interdisciplinary research and data collection set the stage for Lake Tahoe to become one of the best-monitored lakes and watersheds in the world. The TERC team has employed technology to help us research and monitor from the shallow waters to the deepest depths, shore to shore, and into the streams and trees of the Tahoe Basin.

In the most recent example, we deployed and collected data from the Wirewalker in Lake Tahoe. This wave-powered device continuously measures temperature, conductivity, turbidity (clarity), dissolved oxygen, and dissolved organic matter from the surface to a depth of 150 meters, 24 hours a day. These continuous measurements have been central to a project aimed at understanding what materials enter the lake, including sediment, nutrients, and plant materials, during the spring melt. Also deployed on this project were new Acoustic Doppler Current Profilers (ADCPs), designed to measure the physical speed and movement of water into the lake from streams. Determining empirically what materials enter the lake via inflows when the snow melts will provide important information to Basin managers when they make decisions on how best to protect the lake.



Brandon Berry and Mike Cane inspect the components of the Wirewalker before deploying the technology for the first time in Lake Tahoe. (Keeler Nelsen, UC Davis TERC)



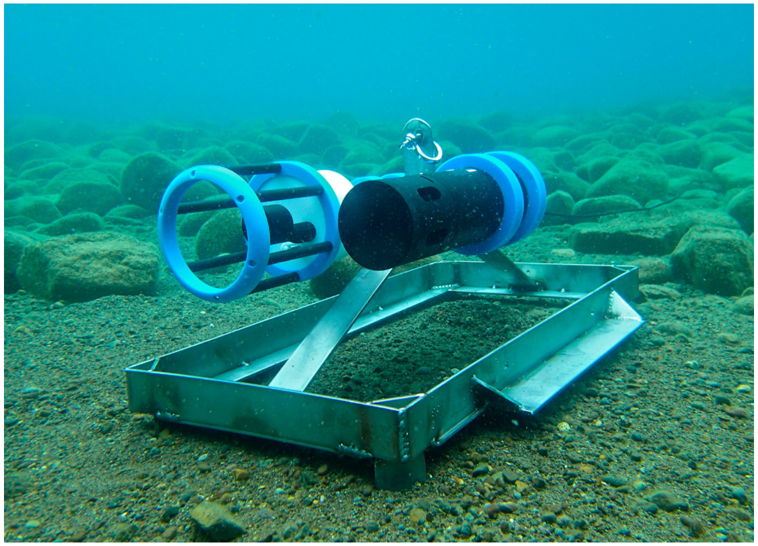
Sergio Valbuena works on metal frames that will hold the Acoustic Doppler Current Profilers (ADCPs) for their deployment on a recent project in Lake Tahoe. (Cara Hollis, UC Davis TERC)

What are the Components of TERC's Infrastructure for Understanding?

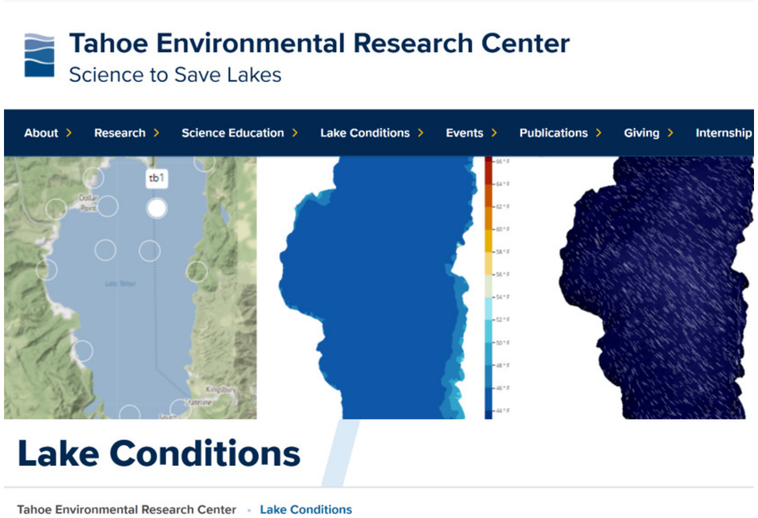
Tools and technology

Our history at the lake demonstrates that continuous monitoring is crucial for understanding this complex and dynamic environment. As such, we have built and installed 10 nearshore monitoring stations that reside permanently around the lake, continuously recording and transmitting data in real-time to not only to our team but also to our website where the public can use the data too. These sensors capture wave height, water temperature, turbidity, and dissolved oxygen.

The information collected is combined with weather data from our meteorological stations and shared on our Lake Conditions webpage at https://tahoe.ucdavis.edu/lake-conditions. This page displays current and forecasted water temperatures and wave heights, allowing residents and visitors to plan safe activities on and around Lake Tahoe. These data inform the models our researchers have constructed of the entire lake system that enables predictions of changes that may occur for Lake Tahoe in future climate scenarios.



The nearshore station is located in the shallow waters around Lake Tahoe's shoreline. TERC researchers have deployed 10 nearshore stations that collect continuous data that is utilized to populate our Lake Conditions webpage. (UC Davis TERC)



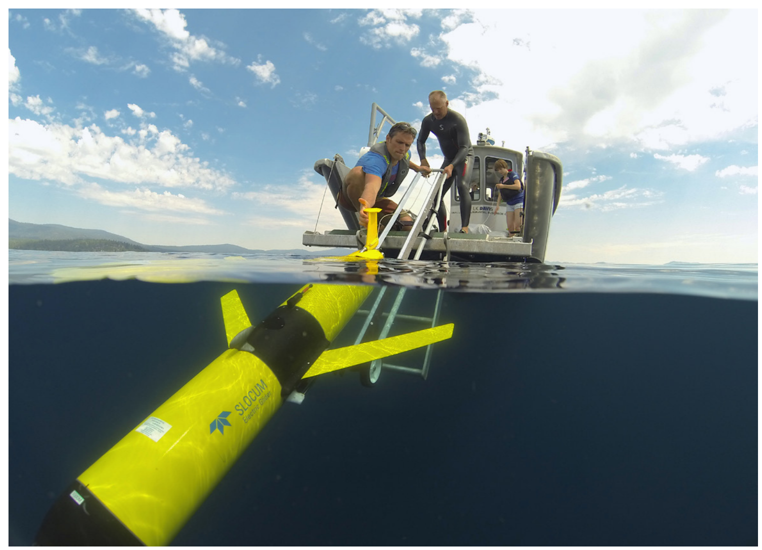
Current lake conditions are available on our website at https://tahoe.ucdavis.edu/lake-conditions. Anyone can check the current and forecasted wave heights and water temperatures to plan their trips to the lake safely. (UC Davis TERC)

What are the Components of TERC's Infrastructure for Understanding?

Tools and technology

To build these models, our researchers need not only nearshore information, but also data from deep in the lake. To explore deeper water, we deploy gliders and autonomous underwater vehicles (AUVs). The gliders are propelled by internal buoyancy changes that send them from the shallow water into the deep and then back again. As they descend and ascend through the water column, they use wings to translate the vertical to horizontal motion. We can outfit the gliders to take various measurements, including temperature, chlorophyll, turbidity, and dissolved oxygen, and then release them to traverse the lake from shore to shore and top to bottom. Gliders can operate autonomously for up to several months. When their mission is complete, they surface and wait to be picked up by our field team. AUVs are like gliders in that they can be outfitted with various technologies to take different measurements. However, they are equipped with a propeller that allows us to program them to move at specific depths or altitude above the lakebed to particular locations, allowing researchers to focus monitoring and research efforts on specific areas. These two technologies also allow researchers to understand the internal wave structures in the lake. For example, we know that Lake Tahoe is large enough that internal waves are influenced by the Earth's rotation, also known as the Coriolis effect. Understanding the Coriolis influence revealed the dynamics of currents that run along the shoreline, which helps to inform how materials or organisms may move from one part of the lake to another.

Sergio Valbuena inspects TERC's two AUVs (left) and two gliders (right) in the Hatchery in Tahoe City pre-deployment in Lake Tahoe. (Alex Forrest, UC Davis TERC)



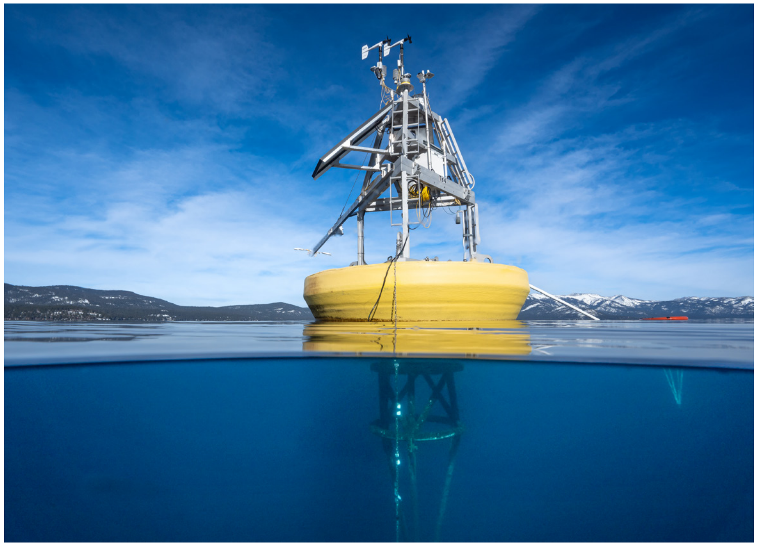
Alex Forrest deploys a glider in Lake Tahoe to facilitate research into turbidity, internal waves, and water movement around the lake. (UC Davis TERC)

What are the Components of TERC's Infrastructure for Understanding?

Tools and technology

Other information from the middle of the lake comes from four permanent buoys that we operate in conjunction with NASA, thermistor chains installed on the east and west shores, and vertical profile measurements taken from our Research Vessels: the R/V John LeConte and the R/V Bob Richards.

The buoys are permanently moored and gather meteorological data and temperature data allowing us to capture weather data from the middle of the lake, which is vital for our Lake Conditions webpage and our modeling efforts. The buoys also hold atmospheric deposition buckets that collect materials entering the lake from the sky, information that is especially important for monitoring ashfall during wildfires. One of the buoys holds a microplastic deposition bucket for our partners at Desert Research Institute, to help further their microplastic research. The buoys help measure water temperature in two ways—radiometers estimate surface water temperatures, and thermistor chains hanging at intervals 5-meters under the buoy directly measure water temperature. Having two different ways of measuring temperature provides critical calibration and validation for instruments aboard NASA satellites as they pass over Lake Tahoe on their journey to accurately record surface temperatures worldwide.



Four permanent buoys gather meteorological and surface water temperature data. Additionally, thermistor chains, seen below the buoy, measure water temperature below the surface. (UC Davis TERC)

Michael Cane puts a new atmospheric deposition bucket on top of one of the four buoys permanently moored in Lake Tahoe. (Cara Hollis, UC Davis TERC)

What are the Components of TERC's Infrastructure for Understanding?

Tools and technology

Temperature data from deeper depths is continuously captured on two thermistor chains, one on the west shore near Homewood and one on the east shore near Glenbrook. Water temperature is vital to track because during the warmer months, a layer of warm, less dense water forms in the shallow layers of the lake. This warmer, less dense water forms a barrier that functionally cuts the deep, cooler waters off from atmospheric oxygen. The temperature is critical to continue monitoring because we can see that these temperature-driven stratification periods are lasting longer as the atmosphere continues to heat up, cutting off the bottom of the lake from oxygen for longer periods. The effects of this strengthening barrier between upper and lower water on ecological and physical dynamics over the long-term represent an important area of research.

The R/V John LeConte visits the Glenbrook Thermistor Chain (whose moorings can be seen just below the surface) that continuously monitors water temperatures from the shallows to full-water depth. There is also a dissolved oxygen sensor at the bottom of this chain. (UC Davis TERC)

What are the Components of TERC's Infrastructure for Understanding?

Tools and technology

Two of the best tools we have for middle-of-the-lake monitoring are our research vessels. The boats can go anywhere on the lake to take vertical profile measurements, including measurements of conductivity (a water quality indicator), temperature, UV penetration, and particle abundance and size. Aboard the vessels, researchers take water samples to be analyzed for nutrients and particles back in our laboratory and deploy the famous Secchi disc for clarity measurements. The boats can also deploy bioacoustics sonar technology that lets us track the migration of fish and even zooplankton so that we can monitor how biological factors react to changing environmental conditions. The boats transport divers to deploy equipment, and to do algae sampling and monitoring, collecting periphyton samples at designated monitoring locations around the lake.

The Research Vessel John LeConte has been a workhorse of TERC research on Lake Tahoe, recently celebrating the 49th anniversary of her christening. (UC Davis TERC)

The Research Vessel Bob Richards is a smaller, more nimble boat that can quickly and safely get smaller teams anywhere they need to go on Lake Tahoe. (UC Davis TERC)

What are the Components of TERC's Infrastructure for Understanding?

Tools and technology

Not all the technology we use to understand Lake Tahoe is in the lake. TERC researchers are utilizing remote sensing technologies to more accurately estimate the amount and extent of nearshore algae growth. By using a drone to capture high-resolution images of designated areas of the shoreline, we can then employ machine learning techniques to categorize images and identify algae rapidly. These methods provide more accurate estimates of algae, which is vital information to put in the hands of managers and policymakers. We can then apply what we learned from the high-resolution images and expand the monitoring program to the entire shoreline by utilizing images captured by helicopters to monitor the remaining shoreline.

Brandon Berry pilots the drone as he conducts algae monitoring in Lake Tahoe's nearshore. (UC Davis TERC)

Former TERC Field Director Brant Allen poses with the helicopter, made possible by a generous donor, that we utilize for the remote sensing algae program. (UC Davis TERC)

What are the Components of TERC's Infrastructure for Understanding?

Tools and technology

Stream monitoring is also a vital part of our comprehensive approach to monitoring, since streams provide a connection of the watershed with lake processes, contributing nutrients that promote algal growth and sediments that further affect water clarity. Our team regularly monitors three streams, and our partners at the U.S. Geological Survey monitor seven more for sediment and nutrient content.

Historical picture of former TERC Staff Research Associate Scott Hackley, performing stream monitoring in Ward Creek (UC Davis TERC).

Isaiah Bluestein and Aaron Vanderpool are in the same location, performing stream monitoring in 2024. TERC regularly monitors for sediment and nutrients inputs into the lake. (UC Davis TERC)

What are the Components of TERC's Infrastructure for Understanding?

Tools and technology

Another component of our monitoring is in the forests surrounding Lake Tahoe. Our Forest Biology and Conservation team have long-term monitoring locations throughout the Basin, where they track the spread of White Pine Blister Rust, check for the presence of pine beetles, monitor tree health, mortality, and look for regeneration. The team is also engaged in developing innovative forest restoration approaches for fire-burned areas and a healthy forest composition.

Forestry Team members (Left to Right) Aaron Vanderpool, Camille Jensen, Patricia Maloney, and summer intern Sydney Griscavage after a day in the field at Monitor Pass, taking soil moisture readings and watering plantings. (Aaron Vanderpool, UC Davis TERC)

Tom Burt and California Conservation Corps assists with seed planting research as part of the Forestry and Biology Conservation Labs Climate Resilient Forest Restoration Project. (Aaron Vanderpool, UC Davis TERC)

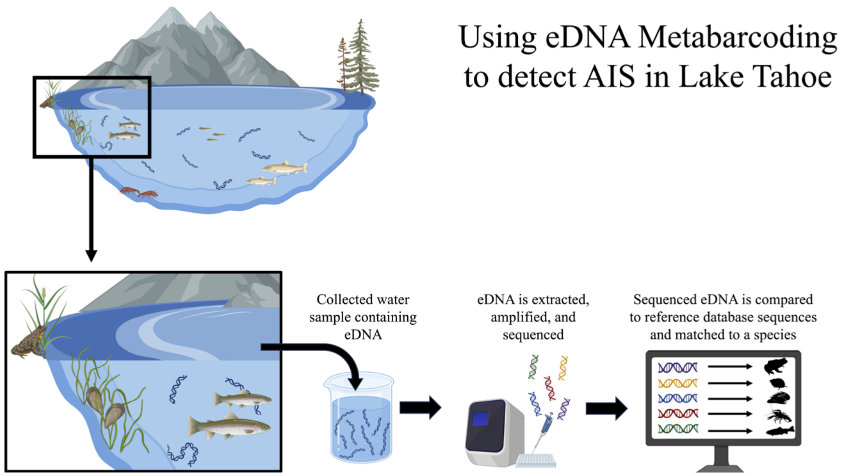
What are the Components of TERC's Infrastructure for Understanding?

Tools and technology

The quest for understanding is never over, and soon, two new technologies will be deployed for Lake Tahoe. One from the shoreline, and one from space.

New TERC Graduate Fellow Grace Rosburg-Francot will be studying the feasibility of deploying Environmental DNA (eDNA) sampling in Lake Tahoe. eDNA detection provides a sensitive, specific, non-invasive, and relatively inexpensive method to detect early invasions of aquatic invasive species (AIS) and monitor their spread. eDNA is DNA shed by organisms into the environment in skin cells, mucus, excrement, and gametes. Water containing eDNA can be collected, filtered, and genetically analyzed to detect individual or multiple species of interest. This approach makes the detection and tracking of AIS easier and faster. Beyond Tahoe, Grace is gathering and analyzing eDNA information across 20 other mountain lakes in the Sierra, in order to determine how variable lake dynamics affect eDNA detection and to improve utility of this approach. If new populations of AIS can be detected early, intervention and mediation strategies can be deployed rapidly, and hopefully prevent the new species from taking hold.

Grace Rosburg-Francot gathering eDNA water samples in the field at Susie lake. (Claire Rosburg)



Environmental DNA (eDNA) metabarcoding to detect aquatic invasive species in Lake Tahoe (Diagram created by Grace Rosburg-Francot in BioRender)

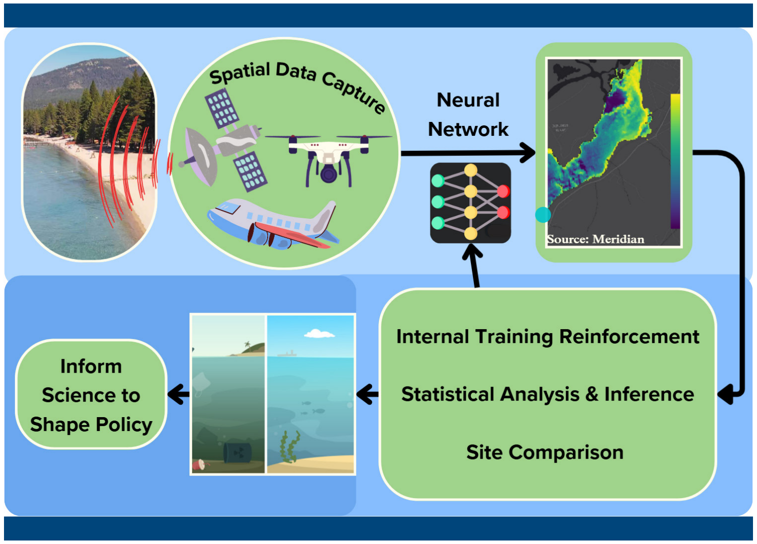
What are the Components of TERC's Infrastructure for Understanding?

Tools and technology

To continue to improve upon our algae monitoring program, new TERC Graduate Fellow Gabe Calistro will be working on utilizing multi-spectral satellite imagery to capture algae conditions across Tahoe's entire shoreline at daily to weekly time scales. The project has two major objectives: First, to develop models and workflows to classify algae from satellite imagery, enabling whole-shoreline estimates of algal biomass at weekly—monthly frequency, and second, to conduct a statistical analysis to link spatial and temporal patterns in algae cover to potential drivers, such as climate variation (precipitation, snowmelt), watershed drivers (like urban development), and within-lake factors (shoreline bathymetry, local nutrient sources, water temperatures). The ability to use satellite remote sensing will facilitate larger scale research and potentially provide less expensive and more comprehensive monitoring of algae.

These exciting new projects are part of the continual evolution of our infrastructure for understanding Lake Tahoe, and we will learn more about the lake with every passing year.

Gabe Calistro is a new research fellow working with Yufang Jin and Adrianne Smits to add cost effective ways to monitor algae blooms at larger spatial coverage using satellite technologies.

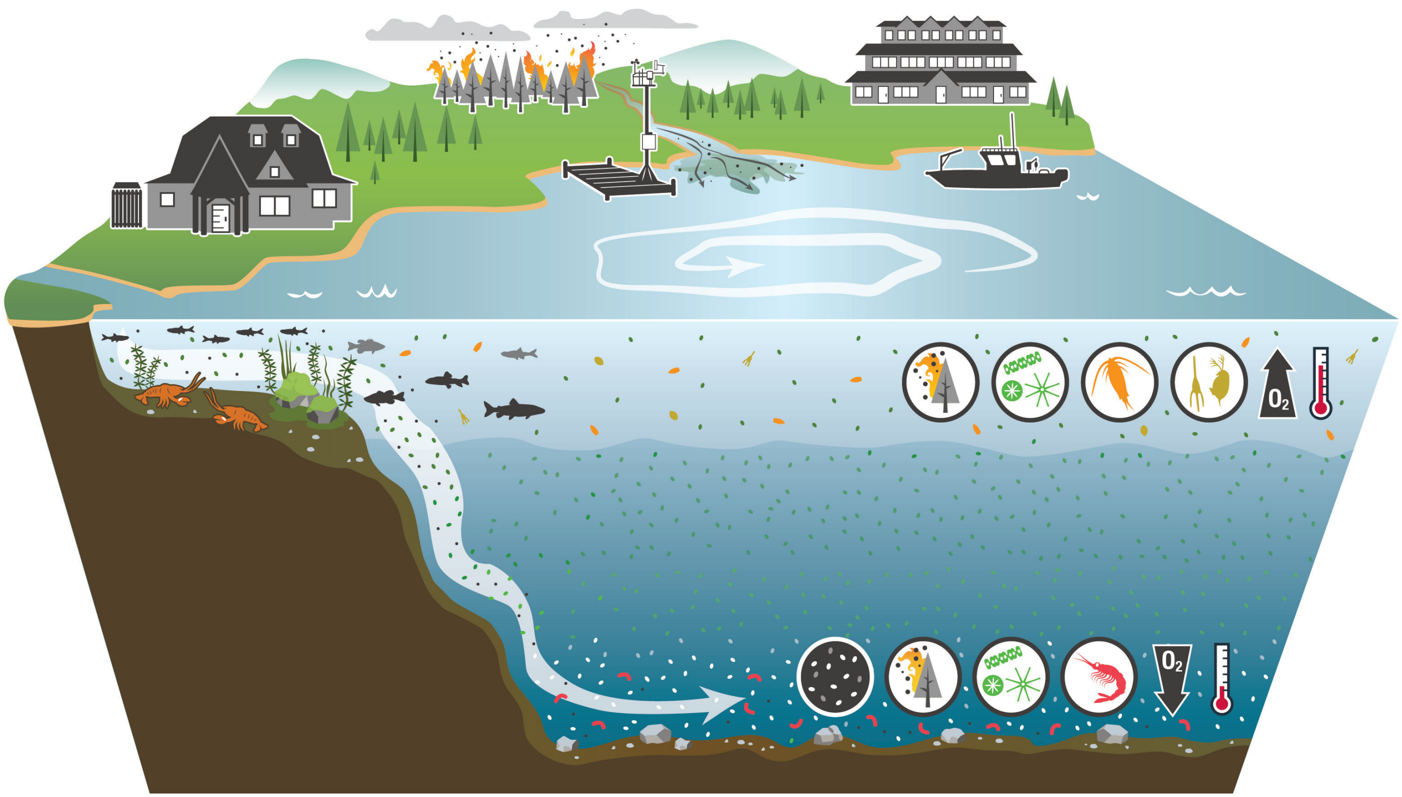


Earth observation satellites, helicopters, and drones capture imagery that can be utilized to build a neural network to increase the scale, accuracy, and speed of algae monitoring. (Diagram by Gabe Calistro)

What is the Goal of all this Work?

Resilient watersheds

Resilience. Resilient watersheds and resilient research. The health of the lake and the health of the surrounding forests, as well as the humans and other organisms contained within both, are inextricably linked. Interdisciplinary teams must work together to collect and share data, ask the right questions, and find the answers needed to keep Lake Tahoe a healthy and clean source of fresh water that sustains life in the Basin, and help to future-proof the lake for inevitable changes.



UC Davis TERC monitoring provides a model for early detection and prediction of changes in ecological function and water quality and can quantify the impacts of environmental changes and catastrophes such as wildfires. Examples of our research include investigations of forest health, meteorology, particles that impact clarity, nutrient cycling, horizontal and vertical mixing, algae composition, zooplankton, oxygen levels, temperature, and native and invasive species.

What is the Goal of all this Work?

Resilient research

With this infrastructure of interconnected data, people, and technology in place, we will find ways to persevere through a larger landscape of changes in funding and policy for environmental research. We will continue to do research and monitoring that provide valuable insights into Tahoe's health, and to support the communities of Lake Tahoe with the education and timely information needed for overcoming current and future environmental challenges. Based on the lessons learned from our technological deployments at Lake Tahoe, we also apply this knowledge to other lakes and reservoirs, sharing our expertise to enhance the understanding and management of these water bodies. Because our work extends beyond the water and into the forests and streams, we have a broad network of organizations and communities to support our work. TERC researchers apply lessons learned here to projects throughout California, the United States, and the world.

Clear Lake on a beautiful day. TERC researchers have been studying the systems of Clear Lake for years. Now the team is working to restore Oaks Arm of Clear Lake by utilizing a hypolimnetic oxygenation system. (Cara Hollis, UC Davis)

Isaiah Bluestein and Keeler Nelsen at Shasta Lake. At Shasta Lake, the team deployed ADCPs to investigate leakage into a temperature control device that selectively draws cool water from different levels of the lake. The team successfully identified the leakage, and the dam operations were able to react to control the water temperatures in the Sacramento River. (Mike Cane, UC Davis TERC)

What is the Goal of all this Work?

Tahoe is a living laboratory. The lessons learned here can be applied worldwide to help preserve and protect freshwater ecosystems and all the life they support.

The most exciting aspect of the infrastructure we have built here is that it will continue to evolve, improve, and expand. The more passionate people we can attract to come and work at Tahoe, the better our questions will be, and the more data we will collect. The more data we collect, the more questions researchers will be able to answer. The questions answered will lead us to new questions and new people to research them with the latest innovations. TERC has the necessary infrastructure to improve continually. Come with us on the journey.

Lake Tahoe water and sky (Aaron Vanderpool, UC Davis TERC)

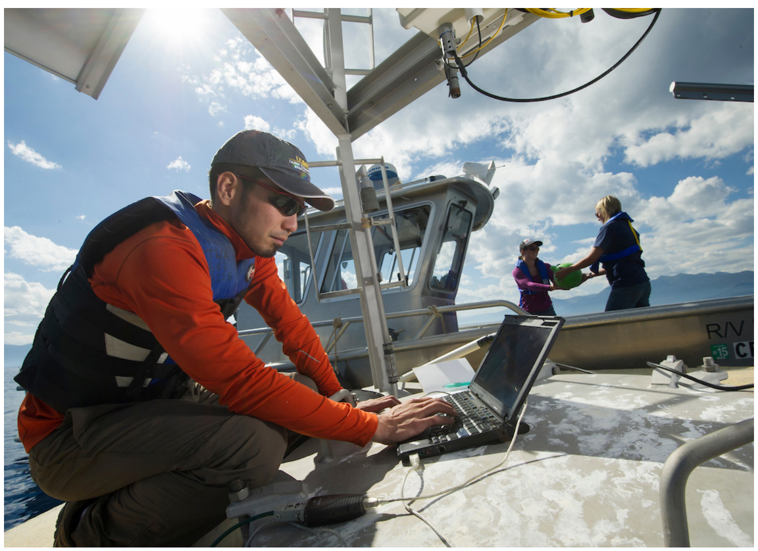
2024 Research Highlights

Utilizing long-term data to understand UV penetration fluctuations in Lake Tahoe

TERC researcher Dr. Shohei Watanabe recently led and published a study analyzing 18 years of UV penetration measurements taken during the routine monthly measurements on the lake, finding that the lake is experiencing large-scale shifts in ultraviolet radiation (UV) as climate change intensifies wet and dry extremes in the region. One of the key outcomes of the study was the discovery of a 100-fold difference in UV radiation between wet and dry years. Essentially, wet years wash more particulates and dissolved organic matter from the surrounding landscape into the lake, which blocks the UV radiation. This finding would have significant implications for lake ecosystems that increasing susceptible to greater extremes in a changing climate.

This study was only possible because of the long-term datasets that TERC researchers, collect in collaboration with their university and agency partners. One or two years of measurements would not have revealed such significant fluctuations related to climatic perturbations. Exploring decadal or longer trends in data requires robust, long-term datasets and there are very few places in the world that have curated data of these lengths.

The next steps stemming from this research will involve conducting shorter term, process driven studies to determine how these UV variations on yearly time scales affect Lake Tahoe's carbon cycle, primary productivity, and other biological processes.



Shohei Watanabe gathers UV penetration data on Lake Tahoe from atop one of TERC buoys operated in conjunction with NASA. (Karin Higgins, UC Davis)

This multi-channel radiometer is used to capture UV penetration data by lowering it into Lake Tahoe during recurring monitoring trips in various locations around the lake. (Brandon Berry, UC Davis TERC)

2024 Research Highlights

New correction model to accurately measure phytoplankton biomass

Characterizing phytoplankton (algae) biomass is key to understanding the light, nutrient, and mixing dynamics that drive lake ecosystems. In situ fluorometry is a tool that is frequently used in Lake Tahoe as part of our ongoing monitoring and a widely used technology for estimating phytoplankton biomass worldwide. However, there are inherent issues in using this technology to take daytime measurements, as daytime fluorometry signals are biased by a phenomenon known as non-photochemical quenching. Non-photochemical quenching is a process that phytoplankton use to dissipate excess light energy as heat. Non-photochemical quenching will result in contamination of daytime fluorometry measurements and cause the amount of phytoplankton to be underestimated. Up until now, even though some universal models have been proposed, there is no universal correction method for inland waters and locally developed models are required for individual lakes. This is time-consuming and not effective for comparing between different lake systems.

TERC Researcher and NASA Postdoctoral Fellow, Dr. Samantha Sharp, has published a novel model for correcting non-photochemical quenching impacts in lake systems as a simple exponential function of available light in the water column. This model was developed using data collected from two of the sites being studied by TERC researchers; Lake Tahoe and Clear Lake, CA. From the clear waters of Lake Tahoe to the productive, nutrient-rich waters of Clear Lake, these two lakes represent the endmembers in terms of lake productivity and clarity, thereby producing a model with potential application to other systems.

The results of this research have wide-ranging benefits, enabling more accurate estimation of phytoplankton biomass in lakes across diverse conditions. Research is currently underway to extend and validate this model for other lake systems that don't have such extreme conditions as the two lakes studied.

Samantha Sharp develops a new model to accurately measure phytoplankton biomass.

2024 Research Highlights

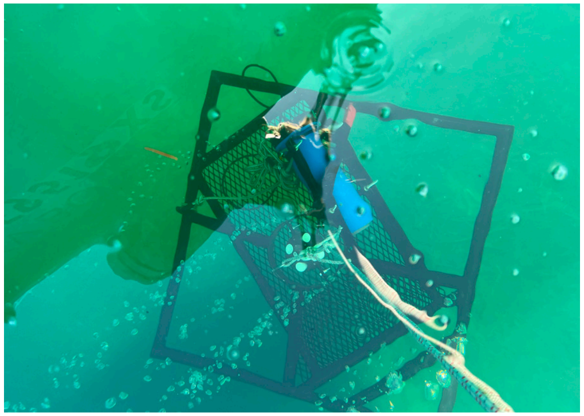
Understanding spring melt impacts on particles and nutrients

TERC researchers, led by Dr. Sergio Valbuena, have begun an exciting, multi-year project with the U.S. Bureau of Reclamation and the Tahoe Science Advisory Council to understand what is washing into the lake during spring melt. These researchers are examining the fate of clarity-reducing particles, nutrients that spur algae growth, and organic matter from the watershed. If entering streams and rivers are colder than the lake water, they will plunge to the lake bottom carrying their loads to depth. Conversely, if they are warmer than the surrounding lake water they will remain on the surface making the transported nutrients available to organisms near the surface. This work is using collected field data to calibrate hydrodynamic models to understand how these inflows will impact the lake.

To start, the TERC researchers gathered two months of continuous measurements using multiple monitoring technologies at the mouth of Incline Creek and Ward Creek. The new Wirewalker, powered by internal wave action, measured from the surface to 150 meters depth up to a maximum 28 times a day, taking water temperature, conductivity, turbidity (clarity), dissolved oxygen, and dissolved organic matter readings. Multiple Acoustic Doppler Current Profilers (ADCPs) were put in place to take continuous measurements of water movement as the creeks entered the lake to help the team understand how the creek water interacts with the lake. We also utilized our nearshore monitoring stations to measure turbidity, temperature, and conductivity, as well as taking numerous vertical profile measurements from one of our research vessels. Glider measurements were also collected to understand the spatial variability of the system. All of the data collected will be analyzed to understand not only what is coming into the lake, but also how it is distributed through the water column and how it ultimately impacts the lake. Now that the data have been collected, researchers are excited to begin the validation of the numerical models and using these to inform our understanding of the exciting and complex system.

This buoy holds the Wirewalker in place. If you see it the lake, please do not touch, it is vital to take continuous measurements. (Keeler Nelsen, UC Davis TERC)

Sergio Valbuena inspects the Wirewalker as the team works to unbox the equipment before deployment on the USBR project. (Keeler Nelsen, UC Davis TERC)



The Acoustic Doppler Current Profilers (ADCP) being lowered into place. (Keeler Nelsen, UC Davis TERC)