

UC DAVIS

TAHOE ENVIRONMENTAL RESEARCH CENTER



THE TAHOE ENVIRONMENTAL RESEARCH CENTER (TERC) IS DEDICATED TO RESEARCH, EDUCATION AND PUBLIC OUTREACH ON LAKES AND THEIR SURROUNDING WATERSHEDS AND AIRSHEDS. LAKE ECOSYSTEMS INCLUDE THE PHYSICAL, BIOGEOCHEMICAL AND HUMAN ENVIRONMENTS, AND THE INTERACTIONS AMONG THEM. THE CENTER IS COMMITTED TO PROVIDING OBJECTIVE SCIENTIFIC INFORMATION FOR RESTORATION AND SUSTAINABLE USE OF THE LAKE TAHOE BASIN.

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RESEARCH UPDATES

Glider in Lake Tahoe

In collaboration with the University of Minnesota, TERC deployed an autonomous, underwater glider in Lake Tahoe between May 11 and May 20, 2013. The glider is equipped with sensors to measure temperature, light, algae, and dissolved oxygen. It was programmed to constantly travel back and forth between the west shore and the east shore, while diving to a depth of 150 meters and then rising to the surface. In all it made 17.5 crossings of the lake and collected millions of data points. The data revealed some of the highly complex spatial structure that exists in lake water quality.



GEOFF SCHLADOW

The glider before commencing its first mission



BRANT ALLEN

Drifter floating on Lake Tahoe mapping surface currents

Drifter Experiments

Over the last 6 months TERC has been releasing swarms of

floating drifters in Lake Tahoe to help map the motions of the surface

currents. The drifters communicate their

Continued on Page 3

LETTER FROM THE DIRECTOR

Why do we keep measuring water quality in Lake Tahoe? At what point will we have taken enough measurements? I frequently get asked these questions, and it is sometimes difficult to answer them without appearing to be self-serving. But in today's world, with limited budgets and increasingly demanding accountability, the questions do deserve serious consideration and the answers are important.

The obvious point at which to stop measuring and studying the lake is when it stops changing. Since the first scientific measurements, taken by University of California



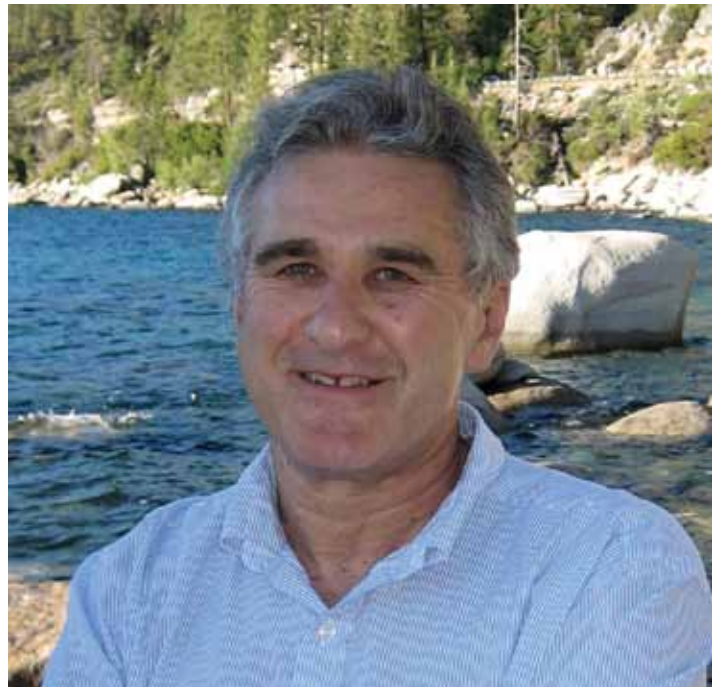
BRUCE HARGREAVES

TERC researcher Raph Townsend prepares the real-time data station for deployment into Lake Tahoe

Professor John LeConte in 1873, Lake Tahoe has exhibited change. While the decline of clarity has been slowed, there are new drivers of change – invasive species and climate change being two very apparent ones. These changes are taking place simultaneously, and interacting with each other, as well as with other anthropogenic forces on the lake.

Why do we need these measurements? One obvious reason is to track the success (or failure) of ongoing efforts and investments toward lake restoration. In other words, to understand the impact of past and present actions. Clearly we cannot improve our practices or learn from mistakes without first quantifying their impacts.

A no less important reason is to provide us with the ability to predict the impacts of future actions on the lake. We do this with sophisticated three-dimensional computer models of the lake's physics, chemistry and ecology. To develop these models and build confidence in their results requires data to “drive” them and data to test them against. The



Geoffrey Schladow, Ph.D., Director Tahoe Environmental Research Center

“driver” data comes from our 13 meteorological stations on and around the lake together with the streamflow data that the US Geological Survey collects. The “test” data comes from the long-term monitoring and the individual experiments that TERC conducts.

Currently TERC researchers are working on models to predict where lake currents will carry Asian clam larvae, to learn whether pathogens may enter drinking water that is drawn from the lake, and whether life-sustaining oxygen will continue to be carried down to the deepest parts of the lake under future climate scenarios. As we learn more from these models,

and as their sophistication grows, they are becoming an indispensable part of helping stakeholders, agencies and decision makers better plan for Lake Tahoe's future.

Please stop by TERC to see some of the results of these models. The results are being incorporated in the new exhibits that are arriving this summer. Our monthly lecture series will also let you know about our latest findings and about ways that you can help sustain the science.

RESEARCH UPDATES, CONTINUED

Continued from Page 1

positions via satellite every 10 seconds. Four experiments have been conducted since December 2012. While in theory the drifters communicate their position in real-time, when they wash up on a beach this ability is lost. Thank you to all those members of the public who helped in finding and returning errant drifters!

Real-time Lake Data Station

A new water quality station measuring water temperature from the lake surface to the bottom was installed off Obexer's Marina in May. An oxygen sensor at the bottom is also revealing new information about decomposition rates in deep water. Data from and power to the station is sent via an underwater cable. Once on shore the data is immediately posted on the internet. We are working on new exhibits to have the data available at locations around the basin. The collaboration with Obexer's Marina is

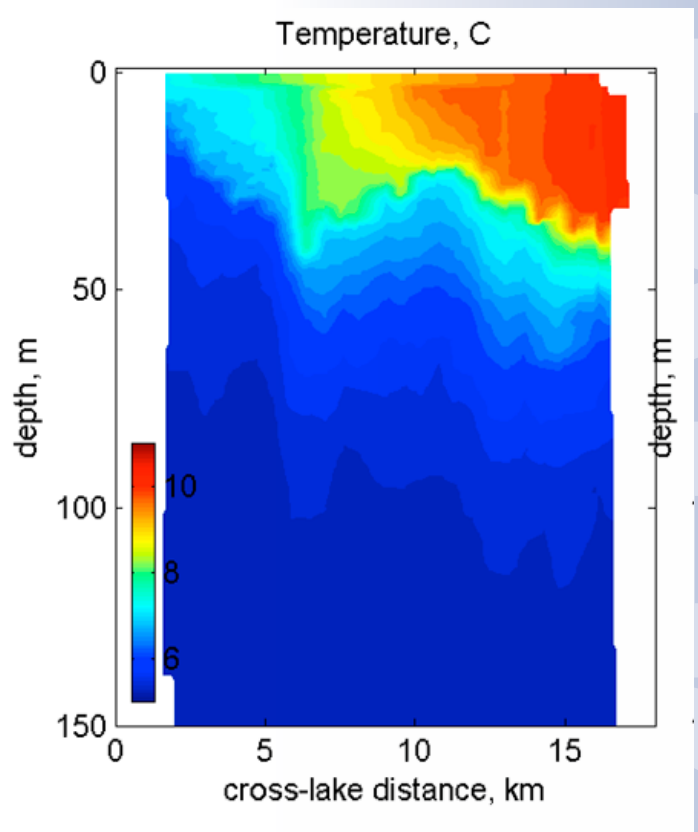
greatly appreciated, and is a great example of science partnering with the private sector.

Research Agreement with K-Water

A delegation from K-Water, the South Korean Water Management Authority, visited TERC in June. The visit was organized by TERC collaborator Dr. Se Woong Chung of Chungbuk National University. An agreement was signed between TERC and K-Water for joint research, training and sharing of technology. South Korea faces numerous water quality challenges, and has developed many sophisticated approaches to them. It is anticipated that some of TERC's expertise can be used in addressing many of these challenges.



Signing ceremony for the MOU between K-Water, the South Korean Water Management Authority, and TERC in June 2013



An upwelling is revealed by the temperature data collected by the glider. Strong winds blowing from west to east (left to right) forced cooler water up toward the surface in the west and moved the warm surface water toward the east.

EDUCATION AND OUTREACH

New Exhibits at the UC Davis Tahoe Science Center

We are proud to announce the arrival of several exciting new exhibits at our Tahoe Science Center in Incline Village, Nevada (also known as the Thomas J. Long Foundation Education Center). Hands-on science exhibits such as the new “Shaping Watersheds” Interactive Sandbox (see image at right) and interactive iPad apps will join the research vessel, laboratory and award-winning 3D movie “Lake Tahoe in Depth” to provide guests with the latest Lake Tahoe science.

The “Shaping Watersheds” Interactive Sandbox is a “sandbox for grown-ups” that brings geographic and watershed concepts to life. Visitors can build mountains, lakes, rivers and other landforms and make it “virtually” rain!

Explore how water moves down mountains into streams and through a watershed. The landscape is connected by the water that flows over it. This exhibit uses augmented reality (AR) technology combining a real sandbox with a 3D camera and digital projector.

TERC’s Tahoe Science Center (sponsored by UC Davis and the Thomas J. Long Foundation) in Incline Village will be receiving new exhibits including new 3D visualizations over the next year as part of a National Science Foundation grant-funded project in partnership with the UC Davis KeckCAVES, UC Berkeley Lawrence Hall of Science and ECHO Lake Aquarium and Science Center at Lake Champlain. Information about the project underway is available at <http://lakeviz.org/>.



The Interactive Sandbox captivates young and old visitors alike with evolving color contours that reflect the sculpted sand surface, and water flow simulations show the passage of floods through the created watershed.

Lakes of the World 3-D Visualization

Water on Earth is dominated by the oceans. Freshwater lakes and reservoirs cover 2.8% of the terrestrial surface area of the Earth, but comprise only 0.002% of the water volume on earth.

The 3-D Lakes of the World exhibit shows more than 17,000 larger lakes

(those that are larger than 10 sq. km or 2500 acres) with each point on the globe representing these lakes, and bathymetry data of several lakes of importance. Fly around the globe with this 3D visualization to learn about the location, distribution, formation, size and interesting features of the lakes of the world.



Image of 3D Lakes of the World exhibit shows lakes in blue, reservoirs in orange, and rivers in green

Continued on Page 5

EDUCATION AND OUTREACH

Continued from Page 4

View this exhibit at TERC's Tahoe Science Center Tuesday through Saturday between 1 and 5 p.m. The Center is located inside the Tahoe Center for Environmental Sciences at 291 Country Club Dr. in Incline Village, on the campus of Sierra Nevada College.

Tahoe City Field Station

Summer is here and with it comes exciting summer programs at the Tahoe City Field Station. This includes the Green Thumb Gardening Series, a series of lectures on gardening in the Tahoe Basin led by the Lake Tahoe Master Gardeners. Each week a different horticultural topic is presented by a gardening expert. This year's topics include edible gardens, pest management, composting and efficient irrigation. Green Thumb lectures are held at the Field Station every Tuesday at 5:30 p.m. through August 20.

Warm weather means that the native plants in the demonstration garden are blossoming! Unfortunately, it means that the weeds are growing too. Anyone with an interest in gardening and outdoor work is invited to join TERC staff

for volunteer garden work days this summer. The Field Station, demonstration garden and Eriksson Education Center are open between Memorial Day and Labor Day from 8 a.m. to 6 p.m. daily. Visitors are welcome to explore the facility at their own pace with self-guided tours, or to meet with a volunteer docent on Saturdays from 10 a.m. – 2 p.m. for guided tours and hands-on science activities.

Upcoming Events

- July 17: "Dramatic Changes in Science Education" with Dr. Rick Pomeroy, UC Davis School of Education, 5:30 p.m. at Tahoe Center for Environmental Sciences
- July 23: Green Thumb "Composting", 5:30 p.m. at Tahoe City Field Station
- July 30: Green Thumb "Native Plants and Beneficial Insects", 5:30 p.m. at Tahoe City Field Station
- August 6: Green Thumb "Efficient Irrigation", 5:30 p.m. at Tahoe City Field Station
- August 7: "State of the Lake" with Director Geoff Schladow, UC



HEATHER SEGAL

Students from Tahoe Expedition Academy participate in new activity evaluation as part of the NSF Informal Science Education project in collaboration with Lawrence Hall of Science

- Davis TERC, 5:30 p.m. at Tahoe Center for Environmental Sciences
- August 10: Children's Environmental Science Day, 1 p.m. – 4 p.m. at Tahoe Center for Environmental Sciences
- August 16: Volunteer Garden Work Day, 10 a.m. – 4 p.m. at Tahoe City Field Station
- August 20: Green Thumb "The Dirt on Your Garden Soil", 5:30 p.m. at Tahoe City Field Station
- August 22: "Latest in Autism Research" with Dr. Sally Rogers, UC Davis Medical Center, 5:30 p.m. at Tahoe Center for Environmental Sciences
- September 9: Volunteer Garden Work Day, 1 – 4 p.m. at Tahoe City Field Station
- September 22: "Olive Oil" with Dr. Selina Wang, UC Davis Olive Center, 5:30 p.m. at Tahoe Center for Environmental Sciences
- November : "Water Rights" with Dr. Kate Berry, University of Nevada Reno, 5:30 p.m. at Tahoe Center for Environmental Sciences

STAFF, VISITING RESEARCHERS, AND STUDENT UPDATES

Farewell to our post-doc Allison Gamble, who has started a new position with the Minnesota Dept. of Natural Resources. Allison is continuing to collaborate with TERC on our invasive species work and research on the Mysis shrimp.

Welcome to visiting researchers Juanfran Reinoso and Carlos Leon from the University of Granada in Spain. They are collaborating with TERC on using LiDAR data to better understand the flow paths of water in the Tahoe watershed and reduce sources of urban runoff

to the lake. Also visiting for the summer from the University of Granada is graduate student Mario Acosta. So Kazama from Tohoku University in Japan is a guest of TERC's for 4 months. Bruce Hargreaves from Lehigh University, who has been on sabbatical with TERC in Davis, is now resident at Tahoe for the summer. Other short-term visitors have been Jay Austin, University of Minnesota; John Lenters, University of Nebraska; Stan Hooker, NASA Goddard; and John Morrow, Biospherical Inc. Also welcome to our new

summer interns – Misha Gehring, Jasmine Marquez, and Faye-Marie Pekar.

TERC's Heather Segale was recently awarded the Universities Council on Water Resources (UCOWR) Education and Public Service Award for 2013.

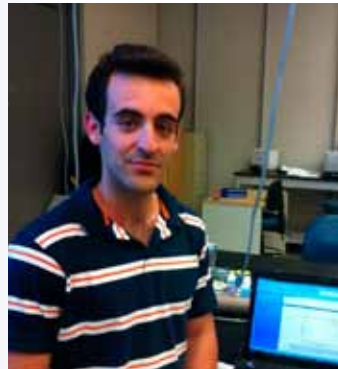
Congratulations to UC Davis TERC students Kristin Reardon and Kristen Fauria who recently graduated. Kristin Reardon is currently at UC Davis completing research papers from her Ph.D. work on sediment resuspension in Lake Tahoe. Kristen Fauria, whose MS thesis dealt with

the role of floodplain plants in trapping fine sediment, will be entering the Ph.D. program in geomorphology at UC Berkeley in the fall. Congratulations to our lab intern Jim Pollock on graduating from Sierra Nevada College.

Special congratulations to Carole Folt, a former Tahoe Ph.D. student, who has been appointed Chancellor of the University of North Carolina (after being interim-President at Dartmouth College). Once again the UC Davis Tahoe program has produced another leader in the field!



Visiting researcher Juanfran Reinoso, University of Granada, Spain



Visiting graduate student Mario Acosta, University of Granada, Spain



Visiting researcher Bruce Hargreaves, Lehigh University, Pennsylvania



Intern Misha Gehring working on Emerald Bay Asian clam data



Visiting researcher Carlos León Robles, University of Granada, Spain



Visiting researcher So Kazama, University of Tohoku, Japan



Interns Jasmine Marquez and Faye-Marie Pekar present density activity



Heather Segale accepts award on behalf of TERC Education Team

STAFF HIGHLIGHT: CHRISTINE ALBANO

Christine Albano has been a researcher with UC Davis TERC and the Southwest Climate Science Center since spring of 2012.

With a background in aquatic and terrestrial ecology, she has a lot of expertise to contribute to TERC. After working with the US Geological Survey on water quality assessments on streams in Utah, Wyoming, and Idaho, Christine attended graduate school at

Colorado State University, completing a Master of Science degree in Ecology and studied the effects of diversion dams on macro-invertebrate populations in Rocky Mountain streams.

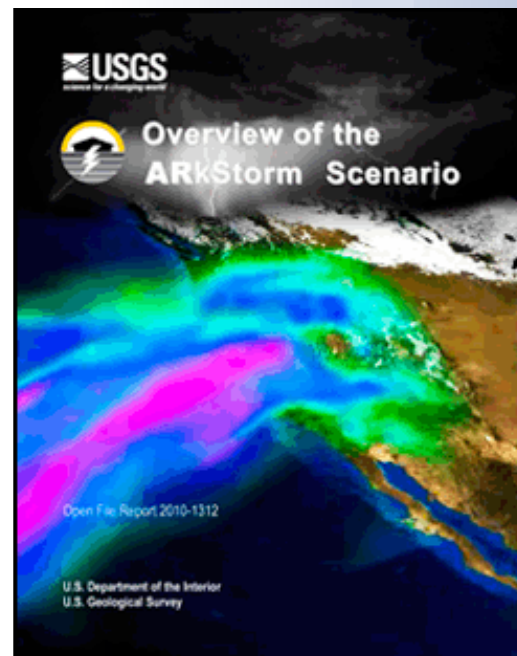
Since moving to Tahoe, she has been analyzing geophysical attributes (i.e., soils and topography) of landscapes in the southwestern United States to determine which might provide the greatest potential for allowing species to persist and adapt

to climate change. Areas that have a great degree of topographical variance and consist of a variety of microclimates are more likely to facilitate the persistence of species that are unable to move long

distances than less physically diverse areas because the species don't have to move as far to find more hospitable climate conditions. Identification and conservation of landscapes that bolster species' resilience to climate change is critical to maintaining high biodiversity.

In the past year, Christine has also been working on projects specific to the Tahoe basin. Mainly she is helping the USGS and the Tahoe Science Consortium with the ARkStorm at Tahoe initiative, working with other researchers to model the potential impacts of a ~500-year atmospheric

river storm event in the greater Lake Tahoe, Reno, and Carson City areas. Atmospheric river storms are extreme precipitation events that can cause intense flooding (the winter storm of 1997 that caused extensive flooding is one example) and these may increase in frequency and severity as a result of climate change. The ARkStorm at Tahoe research team will work with local emergency response planners, business owners, public utilities, water managers, and land managers to identify options to prepare for and minimize the social and ecological impacts of an ARkStorm.



Modeling extreme events such as the ARkStorm scenario described by USGS hazards experts allows officials to be prepared when disaster strikes.



BRETT DICKSON

Christine Albano, researcher with UC Davis TERC and the Southwest Climate Science Center, is focused on better understanding and preparing for climate change impacts.

GIVING TO THE TAHOE ENVIRONMENTAL RESEARCH CENTER

Charitable gifts to the Tahoe Environmental Research Center provide crucial support for research, teaching and public outreach that helps promote understanding and conservation of the Lake Tahoe Basin and other lake

systems. Your gift helps ensure the Center's continued excellence in restoring Lake Tahoe and other lakes around the world - now and for generations to come. Thank you!

- YES, I wish to support the Tahoe Environmental Research Center with the gift amount shown below.
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