NWRRI - Nevada Water Resources Research Institute

Nevada Water News

November 2023


Photo by Famartin

Written and compiled by
Nicole Damon

Sensitivity of Mountain Hydrology to Changing Climate: Exploring Source Mixing and Residence Time Distributions in Basin Outflow

This project is funded through the National Institutes for Water Resources (NIWR) 104(b) grant.

Rising temperatures across the western United States will likely have significant effects on mountain hydrology, but the varied terrain and complex environmental processes make it difficult for land and water managers to predict how climate change will affect these regions. The headwaters of Lake Tahoe are an excellent example of this. Currently, air temperatures are increasing in the Lake Tahoe Basin, which means snow melts earlier, there is a greater potential for more rain-on-snow events, and the intensity and seasonality of precipitation in the basin has changed. "Hydrologic changes in the timing, intensity, and duration of water inputs such as rain and snowmelt have direct consequences on flood potential, diminished late-season streamflow, and degraded water quality," explains Dr. Rosemary Carroll, the principal investigator of the project. "Mountain streams that source from deeper groundwater could be buffered against climate extremes, but stream sources and the amount of water used by vegetation are still poorly understood. In addition, the complex interactions between surface and subsurface hydrologic systems—such as snow distribution and melt dynamics, controls on evapotranspiration, subsurface hydraulic properties, and active

This Issue

If you have questions about submitting a NWRRI proposal, email Suzanne Hudson (Suzanne.Hudson@dri.edu).

Visit the NWRRI website (www.dri.edu/nwrri) for current RFP information.

DRI

(Project Spotlight continued)

circulation depths—make it difficult to plan for a sustainable future under climate change."

The focus of the project "Sensitivity of Mountain Hydrology to Changing Climate" was to a develop a high-performance, integrated hydrologic model for the Lake Tahoe Basin that would represent the region's dynamic environmental processes and capture their responses to climate change. With help from Dr. Lazaro Perez (DRI) and collaborator Dr. Nick Engdahl (Washington State University), Carroll used the open-source, integrated surface-subsurface model ParFlow (Maxwell and Kollet, 2008) to simulate groundwater dynamics in the basin. The benefit of the ParFlow model is that it solves three-dimensional flow in the unsaturated zone, whereas many commonly used groundwater models rely on one-dimensional approximations. ParFlow also allows streams to form organically as a function of topography and subsurface flow and does not rely on predefined stream networks. The groundwater model was constructed using a 100-meter resolution grid to a depth of 100 meters for the entire western shore of Lake Tahoe (which extends from the Ward Creek to Meeks subbasins). Geologic maps, the Snow Telemetry (SNOTEL) network, and stream gage data were used to help parameterize the model. Continuing work stemming from this project includes initializing particle tracking with the help of Lawrence Berkeley National Laboratory scientist Dr. Erica Siirila-Woodburn to quantify subsurface residence time distributions across model scenarios and how this sensitivity compares to traditional hydrologic metrics such as streamflow and water table depth. The plan for future work is to link this groundwater model with the Community Land Model (CLM) (Dai et al., 2003; Lawrence et al.,

Dr. Rosemary Carroll (left) is a research professor at DRI and the PI on the project. Her research is focused on mountain hydrology in snow-dominated systems. Dr. Lazaro Perez (right) is an assistant research professor at DRI with experience in subsurface biogeochemistry. He developed the model for the western shore of Lake Tahoe. Photos by Rosemary Carroll and Lazaro Perez, respectively.

The results of this project were presented at the following conferences:

- Perez, L., and R.W.H. Carroll, 2023. High-performance hydrological model of Lake Tahoe's headwater basin. Nevada Water Resources Association. Reno, Nevada, January 31- February 2, 2023.
- Perez, L., N.B. Engdahl, and R.W.H. Carroll, 2023. High-performance hydrological model of Lake Tahoe's headwater basin. CUAHSI Biennial Meeting, Lake Tahoe, CA. June 12-14, 2023.

The final project results will also be presented at the American Geophysical Union Fall Meeting this December:

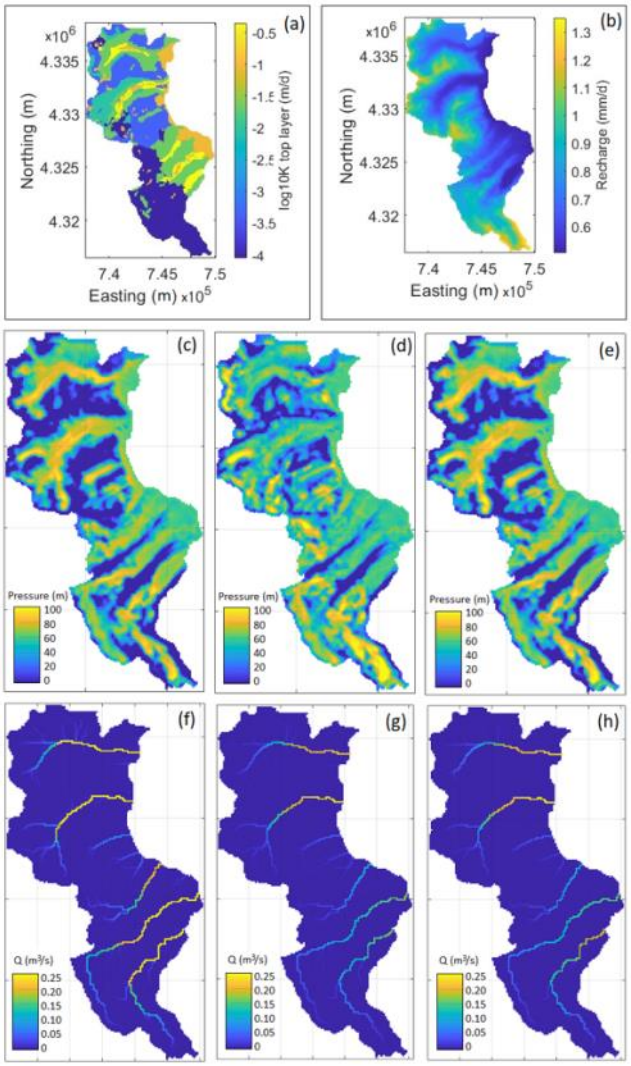
- Perez, L., N.B. Engdahl, and R.W.H. Carroll, 2023. Impacts of Climate Change on Water Outputs in Lake Tahoe Mountain System. American Geophysical Union Fall Meeting. San Francisco, CA. December 11-15, 2023.

(Project Spotlight continued)

2011), which will provide more detailed estimates of how surface processes associated with snow and evapotranspiration dynamics affect streamflow and groundwater under climate change. This will also allow for further exploration of how changes in forest structure affect snowpack and evapotranspiration, which will help land and water managers sustain recharge, streamflow, and groundwater in the Lake Tahoe Basin.

In this project, Carroll and Perez used the model to test the effects of changes in groundwater recharge and subsurface permeability on the relative sensitivity of streamflow, groundwater flux to the lake, and depth to the water table. "The current results are limited to a quasi-steady-state and do not include an evaluation of climate shocks or a shift in climate sequencing, but they do allow a first evaluation of where and under what assumptions groundwater flow in the basin is most sensitive," Carroll explains. "Our preliminary results indicate that recharge magnitude is the dominant driver of groundwater response, but the spatial variability of geologic material is more important than the spatial variability in recharge." The subbasin analysis also showed varying sensitivity to the changing inputs across the different regions of the model. For example, streamflow in the Meeks subbasin (located at the southern extent of the model domain [see figure at right]) showed the most sensitivity to the spatial distribution of recharge and the parameterization of subsurface geology, which resulted in substantial streamflow declines under drier conditions. These results suggest that data collection should be prioritized in the Meeks subbasin to minimize uncertainty in predicted streamflow behavior and that this catchment may be more vulnerable to climate change than the neighboring subbasins.

Lake Tahoe is also the dominant water source of the Truckee River, so the basin has a direct effect on water resources in Nevada. The ultimate goal of the model developed in this project is to help land and water managers quantify available water and determine which basin outflows are the most vulnerable to climate change. "Understanding where and under what conditions hydrologic shifts occur in the Lake Tahoe Basin will help managers prioritize data collection and explore possible strategies to minimize these shifts," Carroll explains. "With numerical models, we



Exploring the hydrologic effects of model parameterization based on (a) surface hydrologic conductivity, *Ko*, and (b) recharge, *R*, across the western shore of Lake Tahoe. Pressure estimates for (c) spatially homogenous *Ko* and *R*, (d) spatially distributed *Ko* and homogenous *R*, (e) spatially homogenous *Ko* and distributed *R*. Streamflow estimates for (f) spatially homogenous *Ko* and *R*, (g) spatially distributed *Ko* and homogenous *R*, and (h) spatially homogenous *Ko* and distributed *R*. In his example, the mean *Ko* = 0.044 m/d and the mean *R* = 0.78 mm/y, and depth decay = 0 is the same for all scenarios. The results indicate that streamflow and depth to water table are more sensitive to geologic spatial complexity than parameterizing the spatial variation in recharge and that these sensitivities increase under a drier climate (figure courtesy of Rosemary Carroll).

(Project Spotlight continued)

Understanding where and under what conditions hydrologic shifts occur in the Lake Tahoe Basin will help managers prioritize data collection and explore possible strategies to minimize these shifts. With numerical models, we can run sensitivity tests to help determine the locations and techniques that will increase the system s resilience to climate change.
Rosemary Carroll

can run sensitivity tests to help determine the locations and techniques that will increase the system's resilience to climate change."

A key component of the NWRRI program is to support the next generation of water researchers. Carroll brought Perez, an early career scientist who started at DRI as a postdoctoral fellow and was promoted to assistant research professor, onto the project to assist in the development of the model. "Perez traveled to Washington State University to meet with our collaborator Dr. Nick Engdahl to initiate the model development, and we had biweekly meetings to discuss progress and tactics," Carroll says.

"He also presented this work at several hydrology-focused conferences and wrote a manual on model construction to aid future work." Carroll and Perez will store the model and documentation both on the DRI OneDrive and Dryad so that DRI has access to the code. From his work on the project, Perez also led a proposal effort for the Climate Adaptation Science Center (CASC) titled "Delineating appropriate hydrological response to megadrought projected impacts in the Lake Tahoe Basin with a strong DEI link to the Nevada Latinx community." Although this initial effort was not accepted, Perez and Carroll plan to refine the proposal and resubmit.

<u>References</u>

Dai, Y., et al., 2003. The Common Land Model. *Bulletin of the American Meteorological Society*, 84(8), pp. 1013-1024. doi: https://doi.org/10.1175/BAMS-84-8-1013.

Lawrence, D.M., et al., 2011. Parameterization improvements and functional and structural advances in Version 4 of the Community Land Model. *Journal of Advances in Modeling Earth Systems*, 3(1). doi: https://doi.org/10.1029/2011MS00045.

Maxwell, R.M., and S.J. Kollet, 2008. Interdependence of groundwater dynamics and land-energy feedbacks under climate change. *Nature Geoscience*, 1, pp. 665-669. doi: 10.1038/ngeo315. ■

Lake Tahoe perfectly exemplifies the coupled response between snowpack, forest water use, groundwater, and streamflow. The western shore is an important study site to develop quantitative tools to predict hydrologic change in the region because of climate change. The tools developed in this project can inform future data collection efforts and explore management alternatives. Photo taken by Christine Albano from the top of Rubicon Peak showing the field site.

Director's Letter

As the Director of the NWRRI, I'm very proud of the strides we've made to further water resources research in Nevada and build stronger connections with universities, water managers, utilities, and stakeholders throughout the state. In the past few years, we have collaborated closely with our Advisory Board, which is comprised of leading water officials from Nevada, to identify research topics that will address the state's most pressing water concerns. Finding ways to protect existing water supplies and investigate the impact of climate change on water quality and flood risk are three of the topics addressed by our most recently funded projects:

- "Removal of Fluoride from Groundwater in Rural Communities of Nevada": Fluoride concentration in local groundwater sources in Beatty, Nevada, has been reported to be four times the EPA guidelines, which raises concerns for local water authorities. Water defluoridation can be difficult in rural communities that don't have centralized water systems or the technical support needed to address these concerns. This project will launch a pilot study in Beatty to assess the feasibility of scaling up electrocoagulation (EC) technology developed at DRI to reduce fluoride concentrations in rural communities.
- "Applying Instrumental Neutron Activation Analysis (INAA) to Study the Concentration Variation of Heavy Metals in Lake Mead Due to Climate Change and Population Growth in Southern Nevada": The continuing drought conditions in southern Nevada have increased concerns about concentrations of heavy metals in Lake Mead. This study will use INAA to analyze the concentrations of various heavy metals in Lake Mead to determine how they are affected by climate change and population growth. The collected data will also provide a baseline for future studies.


Photo courtesy of Chuck Russell

- "A Storyline Approach to Assess the 1997 New Year's Flood in Western Nevada": More robust techniques are needed to better understand future extreme flood events, as well as the effects of climate change, urbanization, and population growth on flooding. An event-based dynamic modeling approach, referred to as a "storyline approach," will be used in this project to assess the 1997 New Year's Flood in western Nevada. The goal of this project is to use a storyline approach to provide a more realistic and consistent understanding of extreme flood predictions through a 100-year projection of the 1997 flood.

We also successfully launched the new NWRRI Undergraduate Internship Immersion Program, which supports training the next generation of water scientists. Look for interviews with the interns in this issue and upcoming issues of Nevada Water News. I'm proud of what the NWRRI has accomplished and look forward to seeing the research that will be conducting in the future.

Sincerely,

Chuck Russell ■

The NWRRI Undergraduate Internship Immersion Program

The continued goals of the Nevada Water Resources Research Institute (NWRRI) are to develop the water sciences knowledge and expertise that support Nevada's water needs, encourage our nation to manage water more responsibly, and train students to become productive professionals. The training and education of future water scientists, engineers, and technicians is also a key component of the Water Resources Act of 1984 (as amended) that created the National Institutes for Water Resources. To further support the education of future water professionals, the NWRRI launched a new program, the Undergraduate Internship Immersion Program.

The purpose of the NWRRI Undergraduate Internship Immersion Program is to provide undergraduate students with opportunities to gain direct experience in active research in water-related earth sciences. The students are paired with DRI scientists who are their advisor for the semester-long paid internship. By participating in these research projects, the interns learn valuable skills and have a better understanding of state water issues and water-related sciences that they may not have otherwise. This experience may also inspire them to pursue a water-related STEM career.

(Continued on the following page)

Events List

Please keep an eye on the event websites for changes in conference schedules.

Well Evaluation, Troubleshooting, and Rehabilitation Short Course
December 4, 2023
Las Vegas, NV
www.ngwa.org/detail/event/2023/12/04/default-calendar/23dec04sc

NGWA Groundwater Week 2023
December 5-7, 2023
Las Vegas, Nevada
groundwaterweek.com/

AGU23
December 11-15, 2023
San Francisco, CA
www.agu.org/Fall-Meeting/Pages/Attend

Efficient Water Management with the New SQE and SQFlex Controllers with Grundfos
January 11, 2024
Webinar
www.ngwa.org/detail/event/2024/01/11/default-calendar/24jan11web

AEG Southern Nevada Chapter: "Hydrogeology of the Lower Meadow Wash, near Moapa"
January 16, 2024
Las Vegas, NV
www.aegsnv.org/meetings

2024 NEPA Symposium
January 29 & 30, 2024
Las Vegas, NV
www.nvwra.org/2024-symposium

2024 NWRA Annual Conference Week
January 29-February 1, 2024
Las Vegas, NV
www.nvwra.org/2024-annual-conference-week

AEG Southern Nevada Chapter
Jahns Lecture
February 13, 2024
Las Vegas, NV
www.aegsnv.org/meetings

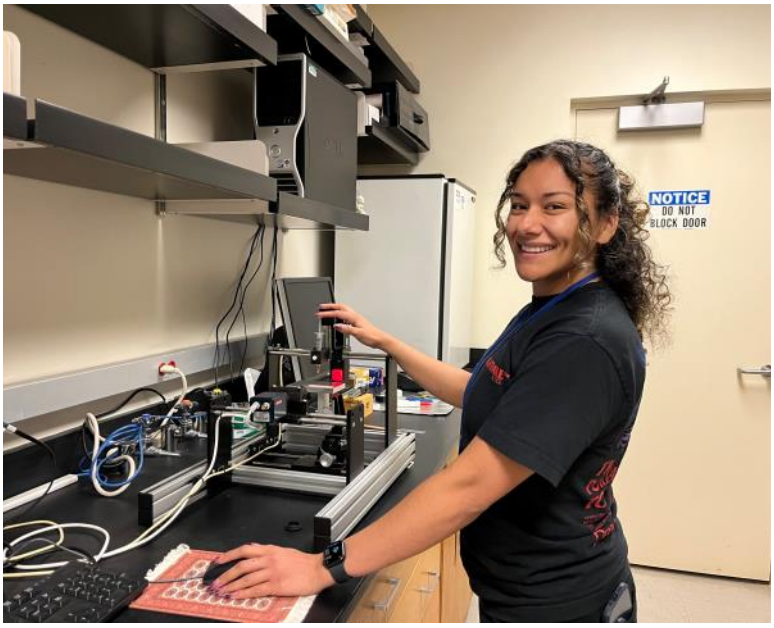
(Continued on page 11)

NWRRI Undergraduate Internship Interview: Veronica Gasca-Alcantar

Veronica Gasca-Alcantar participated in the NWRRI Undergraduate Internship Immersion Program in the summer of 2023. She worked on the project "Soil Moisture Analysis of 10 Years of Lysimeter Data" and was mentored by Dr. Markus Berli of DRI. The project involved analyzing soil and environmental data from the Scaling Environmental Processes in Heterogenous Arid Soils (SEPHAS) program to better understand the properties of arid soil, how those properties affect rainfall infiltration, and whether soil reaches full saturation during storm events. We asked her about her experience during the internship, current research, and plans for the future. Here's what she had to say:

1) What are you currently studying and how did you find out about the internship?

I graduated from Nevada State University (NSU) in Spring 2023 with a bachelor's degree in environmental and resource science. I found out about this internship through Nevada State University from Dr. Jennifer Edmonds. It was my last semester at NSU when I found out about the student internship and I was lucky to be able to accept it, even though I would be graduating soon.



Veronica Gasca-Alcantar using a goniometer to measure the curve of a waterdrop (photo by Nicole Damon).

2) The project you worked on was "Soil Moisture Analysis of 10 Years of Lysimeter Data." What did this project entail and in what ways did you participate?

My internship involved looking at a 10-year span of SEPHAS rainfall data recorded every 15 minutes. These data were further separated into 6-month intervals. I assisted in separating this large pool of data, creating line graphs from each 6-month interval, and analyzing what we were looking at with the help of Dr. Markus Berli, who was my mentor, and Ahdee Zeidman, who is a lab assistant at DRI. During my internship, I was also able to assist in washing sand with hydrochloric acid in an attempt to replicate Dr. Rose Shillito's hydrophobic sand. I then tested the acid-washed sand using a goniometer, which allows you to measure the curve of a waterdrop to observe its degree of hydrophobicity (i.e., the degree to which the soil is water-resistant).

3) What did you learn from analyzing the data and the

One of the main things I learned from this experience is how to sort a large pool of data into smaller comprehensible pieces. It was also interesting to see how rainfall infiltrates desert soils and observe the rain patterns.
Veronica Gasca Alcantar

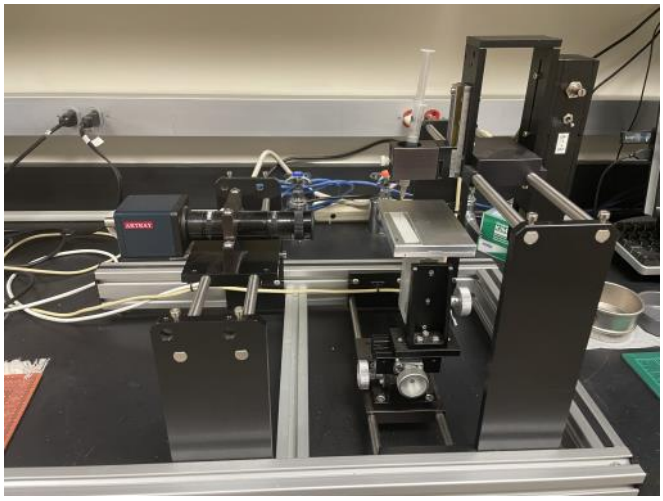
(Student Interview continued)

properties of arid soil? In what ways does collecting and analyzing this data help us understand water availability/water use in Nevada?

The goal of this research was to see whether soil reaches full saturation during storm events. As of now, predictive flood modeling assumes that the soil in arid environments is always at full saturation. However, Dr. Berli created a bar graph from the SEPHAS data that Ahdee and I sorted that says otherwise. Our 10-year data actually showed that the soil is rarely at full saturation. In fact, out of the 247 peak rain events, only 1 event reached full soil saturation. This can fundamentally change the way predictive flood modeling is used in the future.

4) What did you learn from your experience on the project? Was there anything you found particularly interesting or surprising?

One of the main things I learned from this experience is how to sort a large pool of data into smaller comprehensible pieces. It was also interesting to see how rainfall infiltrates desert soils and observe the rain patterns. For such a dry environment where you would normally not anticipate much rain, I saw many periods of intense rainfall that were either continuous or scattered across 2 or 3 days.



A close-up of the goniometer showing the syringe containing water that releases one drop onto a slide with acid washed sand, with the camera aimed at the drop and connected to a computer (photo by Veronica Gasca-Alcantar).

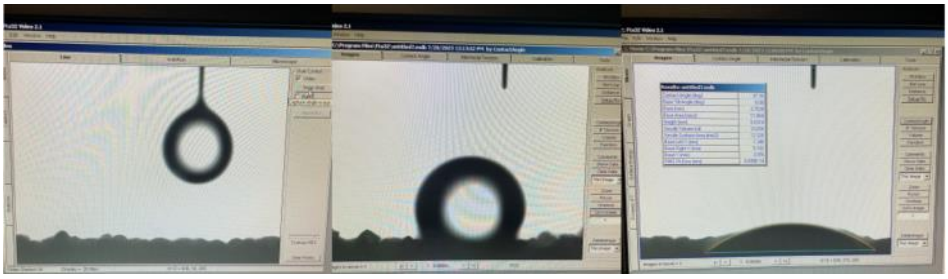
I also learned that after wildfire events, the soil becomes hydrophobic. This can lead to an increase in intense flood events that can cause a lot of damage to the surrounding environment and urban areas. The goal in acid washing the sand and testing it with the goniometer is to attempt to replicate hydrophobic sand for further study.

5) Did participating in this internship give you any ideas for your future studies that you may not have thought about otherwise?

I have always been interested in geology and water conservation, but I have never thought about studying rainfall in desert soils. It did lead me to question if there is any correlation between initial soil conditions and the intensity of a rain event.

6) What are your goals for the next steps in your studies and what career direction are you pursuing?

My next steps are to stay on at DRI as an hourly employee working under Dr. Berli. I'm also applying for the Water Resources Management graduate program at UNLV. My goal is to pursue my master of science at UNLV while working as a graduate assistant at DRI. ■



The goniometer's high-resolution camera lens captures an image of the waterdrop as it falls on the prepared acid-washed slide and displays it on a computer screen (left and center). When the drop makes contact with the slide, the computer measures the contact angle (i.e., hydrophobicity) of the waterdrop (right) (photos by Veronica Gasca-Alcantar).

NWRRI Undergraduate Internship Interview: Anntoinette Rivera

Anntoinette Rivera participated in the NWRRI Undergraduate Internship Immersion Program in the summer of 2023. She worked on the project "Flood Amid Droughts" and was mentored by Dr. Guo Yu of DRI. Although flood and drought are opposite environmental extremes, floods do occur during droughts, which exacerbates the risks associated with those floods. The focus of the project was to examine flood amid drought (FAD) events and how they affect ecosystems, agriculture, watershed management, and community activities. This involved breaking down multiple datasets to analyze where FAD events occurred and determine any historical trends. We asked Anntoinette about her experience during the internship, current research, and plans for the future. Here's what she had to say:

Photo by Marlie Gagliardo

1) What are you currently studying and how did you find out about the internship?

I am a senior at Nevada State University and I'm double majoring in biology and environmental resource science. This is my senior year and my professors encourage seniors to get involved in internships for the experience and to explore opportunities for after graduation. Dr. Jennifer Edmonds offered a variety of options in scientific career fields and after reading the descriptions of the NWRRI research projects being conducted at DRI, I knew this was where I would grow and thrive.

2) The project you worked on was "Flood Amid Droughts." What did this project entail and in what ways did you participate?

Over the summer, I learned a great deal about climatic hazards so that I could better investigate FAD phenomena. This involved reading many articles, becoming familiar with the terminology, and taking notes to help formulate the research paper manuscript. A large part of the project requires knowledge of ArcGIS software and R programming language so that the collected data can be further analyzed. I spent many hours learning how to use R through tutorials and workshops online. After I became more familiar with the program, I was able to use RStudio to integrate specific data into the program and use coding to break down the data into the necessary graphs and tables.

(Continued on page 10)

Being a part of this internship gave me a great appreciation for the research field and gave me so much insight into the process of developing scientific research articles. I feel very fortunate to have spent part of the internship learning how to use R programing language because it is a common tool used among many professions.
Anntoinette Rivera

(Student Interview continued)

3) What did you learn about the occurrence and effects of floods during drought conditions, particularly in arid regions like Nevada?

In August 2022, Death Valley experienced its second highest amount of rainfall in history in only three hours, causing damage to Daylight Pass (left) and trapping 60 cars because of a mudslide (right) at the Inn at Death Valley. These are examples of exacerbated risks that can occur during FAD events (photos by the National Park Service).

Our research is focused on the compound hazard called "flood amid drought," or FAD for short, so we want to know when a flood takes place in an area that is already experiencing a drought event, specifically in areas that have existing streamflow data. Although the data are still being analyzed, I did learn that these compound hazard events cause severe damage to the designated area and its inhabitants. Nevada experienced its second highest amount of rainfall in history within three hours in August 2022 at Death Valley. The event destroyed many roadways and a powerful mudslide trapped hikers' vehicles, which left them stranded for most of the day.

4) What did you learn from your experience on the project? Was there anything you found particularly interesting or surprising?

Being a part of this internship gave me a great appreciation for the research field and gave me so much insight into the process of developing scientific research articles. I feel very fortunate to have spent part of the internship learning how to use R programing language because it is a common tool used among many professions. This experience taught me multiple ways to conduct research and how to keep a motivated mindset even during the times that I felt stuck.

5) Did participating in this internship give you any ideas for your future studies that you may not have thought about otherwise?

The introduction to resources and software training has encouraged me to incorporate these methods into the projects I am currently working on at my university. I also never would have thought that using R and GIS software would interest me as much as it does and I'm now considering a career path that utilizes them. This was largely influenced by my mentor, Dr. Yu. His dedication to my understanding of the steps throughout my internship was indispensable.

6) What are your goals for the next steps in your studies and what career direction are you pursuing?

The project at DRI is not finished yet and there is still so much to learn, so I plan to stay on to see it through until the end. Being a part of the change for the prevention and rehabilitation of harm to our environment is a goal I want to maintain. Once I receive my undergraduate degree, I plan to pursue my graduate degree so that I can find a career that involves the integration of coding and ArcGIS software to improve public health planning and decision-making. ■

Events List Continued

Please keep an eye on the event websites for changes in conference schedules.

Chapman Conference: Remote Sensing of the Water Cycle
February 13-16, 2024
Honolulu, HI
www.agu.org/Chapman-Remote-Sensing

AGU Ocean Sciences Meeting
February 18-23, 2024
New Orleans, LA
www.agu.org/ocean-sciences-meeting

AEG Southern Nevada Chapter: "A Novel Approach for the Remediation, Reclamation, and Development of the Three Kids Mine Site for Residential Reuse"
March 5, 2024
Henderson, NV
www.aegsnv.org/meetings

2024 Pacific Northwest Ground Water Exposition
March 15-16, 2024
Vancouver, WA
pnwgwa.org/


Photo by Teresa Wriston

AWRA 2024 Geospatial Water Technology Conference
March 25-27, 2024
Orlando, FL
www.awra.org/Members/Events_and_Education/Events/2024-GWTC-Conference/2024_GWTC_Conference.aspx

AWRA 2024 Spring Conference
April 8-10, 2024
Tuscaloosa, AL
www.awra.org/Members/Events_and_Education/Events/2024-Spring-Conference/2024_Spring_Conference.aspx

AEG Southern Nevada Chapter: "The Las Vegas 50-Year Water Plan"
April 9, 2024
Las Vegas, NV
www.aegsnv.org/meetings

Groundwater in the PFAS Era: Stressors, Protection, and Compliance
April 16- 17, 2024
Tucson, AZ
www.ngwa.org/detail/event/2024/04/16/default-calendar/24apr5010

20th Annual Truckee River Field Study Course
May 2-3, 2024
Reno, NV
www.nvwra.org/2024-truckee-river-tour

AEG Southern Nevada Chapter: "Can We Mine Our Way to a Less-warm Planet"
May 14, 2024
Las Vegas, NV
www.aegsnv.org/meetings

GSA 2024 Joint Cordilleran and Rocky Mountain Section Meeting
May 15-17, 2024
Spokane, WA
www.geosociety.org/GSA/Events/Section_Meetings/GSA/Sections/cd/2024mtg/home.aspx?hkey=88411fd7-3278-41be-aa78-f451032e17f3

SSSA Conference: Common Ground – Soils Beyond Borders
June 9-13, 2024
San Juan, Puerto Rico
www.sacmeetings.org/

AGU WaterSciCon
June 23-28, 2024
St. Paul, MN
www.agu.org/waterscicon

NWRRI - Nevada Water Resources Research Institute

Success and the dedication to quality research have established the Division of Hydrologic Sciences (DHS) as the Nevada Water Resources Research Institute (NWRRI) under the Water Resources Research Act of 1984 (as amended). As the NWRRI, the continuing goals of DHS are to develop the water sciences knowledge and expertise that support Nevada's water needs, encourage our nation to manage water more responsibly, and train students to become productive professionals. The work conducted through the NWRRI program is supported by the U.S. Geological Survey under Grant/Cooperative Agreement No. G21AP10578. The Desert Research Institute (DRI) administratively houses and logistically supports the operations of the NWRRI.

About DRI

The Desert Research Institute (DRI) is a recognized world leader in basic and applied environmental research. Committed to scientific excellence and integrity, DRI faculty, students who work alongside them, and staff have developed scientific knowledge and innovative technologies in research projects around the globe. Since 1959, DRI's research has advanced scientific knowledge on topics ranging from humans' impact on the environment to the environment's impact on humans. DRI's impactful science and inspiring solutions support Nevada's diverse economy, provide science-based educational opportunities, and inform policymakers, business leaders, and community members. With campuses in Las Vegas and Reno, DRI serves as the nonprofit research arm of the Nevada System of Higher Education. For more information, please visit www.dri.edu.

For more information about the NWRRI, contact:

Suzanne Hudson, Business Manager
702-862-5464
Suzanne.Hudson@dri.edu

Charles Russell, Director
702-862-5486
Chuck.Russell@dri.edu

Nicole Damon, Communications/Information Transfer
702-862-5531
Nicole.Damon@dri.edu