SHARED STEWARDSHIP

AGU HYDROLOGY SECTION NEWSLETTER

About the theme:
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JULY–AUGUST 2025

FROM THE SECTION PRESIDENT

Floods and Fires: Earth observations for Hydrological Extremes

Venkataraman Lakshmi

Polyptych of hydrologic disasters: floods, droughts, fires, landslides

Our planet is covered in water, with oceans accounting for 70% of Earth's surface. Yet, the water most critical to human life is found on land—lakes, rivers, snow and glaciers, permafrost, groundwater, and soil moisture. Precipitation is the key flux to land, and extremes —too much or too little—trigger numerous natural disasters such as floods, droughts, thawing permafrost, landslides, and wildfires. Excess precipitation leads to floods and can cause landslides on unstable hillslopes. Too little precipitation leads to droughts, drying out vegetation—especially where roots are shallow. Dry vegetation, combined with ignition sources like lightning, errant campfires, or faulty power lines, can spark wildfires.

These events often unfold in sequences—droughts followed by wildfires, floods followed by landslides, or wildfires and intense rainfall followed by landslides—known as compound events.

Fortunately, Earth observations and hydrological modeling offer powerful tools to predict such disasters. Over the past two decades, public access to global datasets on precipitation, vegetation, surface temperature, evapotranspiration, soil moisture, and streamflow has grown significantly. These data allow scientists to evaluate conditions before, during, and after disasters.

When combined with publicly available hydrological models, Earth observations can compensate for the absence of in situ data—especially in many developing regions where data collection or sharing is limited. In these areas, satellite-derived datasets are essential for simulation, forecasting, and early warning systems.

Water-related Earth observations are foundational not only to hydrology but also to fields like ecology, weather, and climate science. Just as importantly, they contribute to societal safety and resilience. Timely predictions can save lives and stabilize economies. Investments in hydrological science and infrastructure yield high returns—advancing both knowledge and preparedness. Conversely, disinvestment threatens our ability to meet growing societal demands and to adapt to the increasing frequency of extreme hydrological events.

Assisted by Robin Kim, Ph.D Candidate, University of Virginia

This issue:

About the theme

This issue's theme, "Shared Stewardship", highlights how collaborative efforts—from riparian restoration and monitoring to ecohydrological and Earth observation research—advance resilient water systems across communities, landscapes, and technologies.

Apply Now

Bridges to the Future Student Grants

Celebrating the past and future of hydrology, the AGU Hydrology Bridges to the Future Program is intergenerational. Bridges connects foundational work in our field with the expanding range and diversity of students interested in water, and honors those who've made an impact in our field. The program program provides $2,000 grants to support undergraduate, master's, and doctoral students facing financial barriers in pursuing careers in hydrology. Funding can be used for activities like attending scientific meetings, visiting research groups, or engaging in career development.

Who Can Apply

Students enrolled full- or part-time at two-year colleges, four-year universities, or graduate programs, with a demonstrated interest in hydrological sciences. Preference is given to undergraduate students, but all career stages are eligible.

Application Materials Include

A current CV, two-page essay describing your hydrology interests and proposed activity, budget explaining how the grant makes the activity feasible, and one letter of reference confirming your qualifications and potential impact

How to Apply

Submit your application to Venkataraman Lakshmi, Hydrology Section President: vlakshmi@virginia.edu.

Deadline Extended and Approaching

Applications are due by October 31. Award announcements will be made in November. For more information, contact Tracy LaMondue, AGU Vice President for Development: tlamondue@agu.org.

AWARDEE SPEAKS

Horton Research Grant

Bas Walraven

DELFT UNIVERSITY OF TECHNOLOGY

I am delighted and honored to have been selected as one of the recipients of the 2024 Horton Research Grant. My PhD research at Delft University of Technology in the Netherlands focuses on monitoring rainfall in the tropics using opportunistic sensors, specifically commercial microwave links (CMLs). These terrestrial links are essentially radio signals used in telecommunications, transmitted between two cell phone towers. When it rains, however, this signal can be heavily attenuated, and it is this attenuation that can be used to infer the rainfall intensity along a path.

So far, this technique has predominantly been applied in areas where rainfall information from CMLs complements dedicated sensors, such as weather radars. Conversely, my current research focuses on the use of CMLs for rainfall estimation in areas that typically lack this remotely sensed near-surface rainfall information, such as many parts of Africa. Our work has centered on the question: How should we adapt our retrieval algorithm, RAINLINK, to account for the differences in climate and CML networks between the Netherlands, where the algorithm was calibrated, and countries in the tropics?

Carrying out wet-antenna experiments at our CML test site on TU Delft's campus.

"In an era when (satellite) remote sensing precipitation data is becoming increasingly available it is tempting to solely rely on that and forget about in situ observations, especially in places where these are difficult to obtain and maintain."

Through the Horton Research Grant I will now be able to expand this research to include in situ data, specifically drop-size distribution data collected in Rwanda, to further improve rainfall estimates from CMLs in the tropics, and gain a better understanding of tropical rainfall dynamics. I am particularly happy to be setting up this small measurement campaign in collaboration with our Rwandan partners—the University of Rwanda and Meteo Rwanda.

In an era when (satellite) remote sensing precipitation data is becoming increasingly available it is tempting to solely rely on that and forget about in situ observations, especially in places where these are difficult to obtain and maintain. In fact, the number of in situ observations in sub-Saharan Africa, compared to several decades ago, has significantly declined. Therefore, I am grateful to AGU's Horton Research Grant for recognizing the value of collecting in situ hydrological data and —and thus supporting efforts to improve rainfall estimates from CMLs in regions where they are needed most.

Incorporating Traditional Ecological Knowledge (TEK) into Watershed Restoration: A Collaborative Future Ecology

Michael P. Fedoroff, CONSERVE Director, University of Alabama

The CONSERVE Research Group, housed in the Alabama Water Institute at the University of Alabama, unites interdisciplinary expertise in hydrology, ecology, anthropology, and engineering to develop nature-based solutions for water resource challenges. Bridging academic research with applied conservation, CONSERVE emphasizes community engagement, Traditional Ecological Knowledge (TEK), and cross-sector partnerships. This approach fosters resilience in watersheds across the southeastern U.S., where historical land-use changes and habitat loss have diminished ecosystem services critical to both people and wildlife.

In 2024, CONSERVE partnered with the Choctaw Nation of Oklahoma (CNO) and Westervelt Ecological Services to launch the Tuckabum Creek Ecosystem Restoration Project in Choctaw County, Alabama. Supported by Westervelt Companies' funding and facilitated by the Rivercane Restoration Alliance, this initiative represents the largest native rivercane restoration effort in Alabama's history. Embedding Indigenous perspectives and management practices from project inception through monitoring, the collaboration exemplifies solutions-oriented model for ecological restoration.

Arundinaria gigantea—or Giant rivercane—is one of North America's three native bamboo species and once formed contiguous canebrakes stretching for miles across the Southeast. These ecosystems played vital roles in nutrient cycling, bank stabilization, and habitat provision. They also hold deep cultural significance for Indigenous communities, supplying materials for basketry, housing, and ceremonial use. Today, less than 2 percent of original canebrakes remain—a decline driven by land use and altered fire regimes. Revitalizing rivercane is both an ecological imperative and a way to honor and revive Indigenous lifeways.

Between May and June 2024, teams transplanted over 250 rivercane clumps and enhanced 7,020+ existing stalks in a degraded riparian corridor (Figure 1). Initial site assessments used drone-based remote sensing to map hydrological flow paths, erosion hotspots, and vegetation cover. Guided by TEK, the team relocated rivercane clumps to mimic historical canebrake patterns, promoting natural erosion control and riparian buffer. Post-planting, hydrological monitoring tracked erosion, sediment retention, and stand development to evaluate restoration success.

Figure 1. Rivercane transplants (Tuckabum Creek, Alabama).

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Incorporating Traditional Ecological Knowledge (TEK) into Watershed Restoration: A Collaborative Future Ecology

Michael P. Fedoroff, CONSERVE Director, University of Alabama

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The CONSERVE Research Group led restoration design, monitoring protocols, and helped coordinate and synthesize TEK with scientific data to guide strategy. Working closely with the team, the CNO contributed traditional planting techniques, seasonal harvesting protocols, and community-based stewardship practices rooted in centuries of traditional management. Westervelt Ecological Services provided logistical support, site preparation expertise, and project funding coordination, aligning with corporate sustainability goals.

The Tuckabum project already shows rapid growth and stem density increases—key indicators of ecosystem recovery (Figure 2). Dense rivercane root networks have begun to stablize streambanks, significantly reducing sediment loss and turbidity during high-flows. This enhances downstream water quality, mitigates flood risks, and supports critical habitat for aquatic and terrestrial species. As a fast-growing perennial, rivercane also contributes to carbon sequestration and nutrient cycling, reinforcing watershed under climate variability.

Figure 2. Post restoration (12 months later).

Beyond ecological outcomes, the project has revitalized cultural connections to rivercane among Choctaw citizens. Community workshops facilitated by groups like the Rivercane Restoration Alliance allow knowledge exchange on basketry techniques, harvesting ethics, and spiritual dimensions of stewardship. Such engagements have strengthened the Choctaw Nation's conservation in their ancestral homelands and fostered intergenerational TEK transfer. Public documentaries and presentations—viewed by 400+ participants—have raised awareness of rivercane's significance, encouraging replication of the model in other regions.

The Tuckabum Creek project underscores the power of integrating TEK with conservation. High-resolution remote sensing informed site selection and performance monitoring, while Indigenous land-management principles shaped planting schedules and maintenance. This fusion has elevated adaptive management, enabling rapid adjustments based on plant performance and community feedback. Such a co-created framework offers a blueprint for scalable restoration across the historical rivercane range, from Texas to the Carolinas.

The project exemplifies how researcher, Indigenous Nation, and private-sector partnerships can deliver targeted, multifunctional outcomes for ecosystems and communities. Key lessons include the importance of early and meaningful Indigenous partner inclusiong, the value of blending TEK with hydrological data, and the need for long-term monitoring. By centering TEK alongside hydrological science, the project has reestablished rivercane's ecological functions and cultural lifeways, setting a precedent for collaborative restoration in the Southeast. As Earth observation technologies advance and nature-based solutions gain interest, integrating Indigenous knowledge systems will be essential to building resilient, culturally meaningful watersheds.
For more information contact CONSERVE at conserve@ua.edu.

TECHNICAL COMMITTEE

Ecohydrology

Sam Zipper (Committee Vice-Chair) and
Cynthia Gerlein-Safdi (Committee Chair)

Across much of North America, plants are greening up as the growing season enters full swing. Given ecohydrology's focus on interactions between ecosystems and the water cycle, this time of year holds special significance for the Ecohydrology Technical Committee, as several of our community initiatives are starting to germinate as well!

First, we just had the chance to review 2025 AGU Annual Meeting (AGU25) session proposals, and there are a variety of great ecohydrology-related topics to choose from. Pay special attention to the "Frontiers in Ecohydrology" session, sponsored by the Ecohydrology Technical Committee. This session is meant to take a broad lens and welcomes abstracts about the latest and greatest in ecohydrological research across the world! We are also sponsoring sessions on urban ecohydrology and the root-soil-water nexus, so there should be something for everyone. While we don't know the schedule yet, our technical committee will also be organizing several social events at AGU25, including an ecohydrology happy hour (traditionally following the Frontiers in Ecohydrology poster session), daily informal lunch meet-ups, and more fun stuff!

Second, we would like to announce the creation of a new AGU Ecohydrology listserv, which can be used to promote conferences and sessions, job openings, and special issues relevant to the Ecohydrology community. The listserv can be joined through a request using this page. We have also joined the Bluesky social media platform, and can be found at @aguecohydro.bsky.social. Lastly, our website has migrated, and all relevant information can now be found on a new, AGU-sponsored website, where information about upcoming events and sessions is posted. Make sure to follow us through these various channels to stay up to date on upcoming events at AGU25 and beyond!

Finally, we would like to salute ecohydrologist and former Ecohydrology Technical Committee member Christina (Naomi) Tague, who was named a 2024 AGU Fellow, as well as our 2024 Tiny Grants early-career awardees (our 6th cohort!! Shown below). Congratulations to you all!

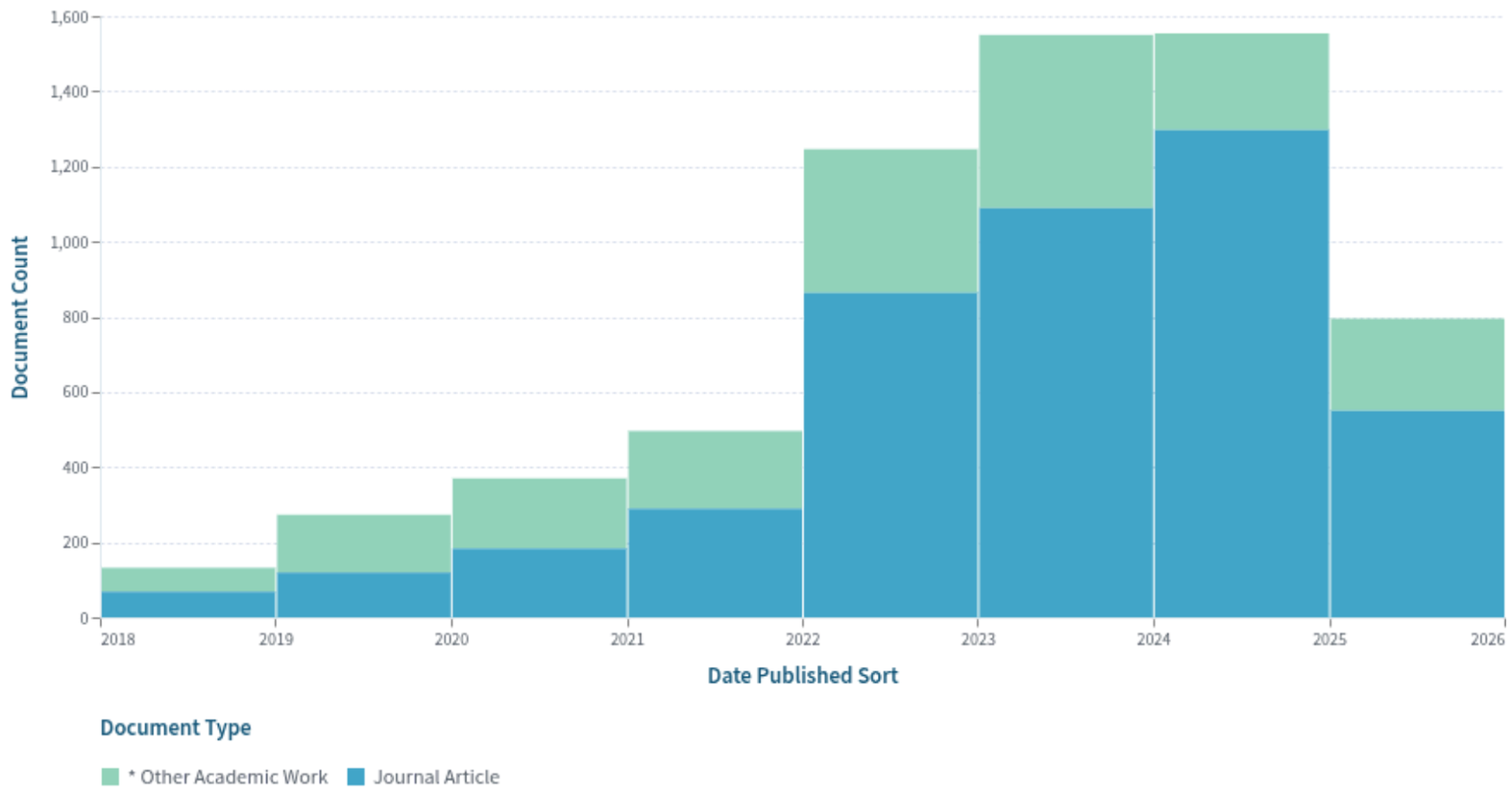
2024 Tiny Grants awardees (left to right): Mengyun Sun, Ashley Cao, Gescilam Uchoa, Araki Ryoko, Charlie Devine

We are always enthusiastic about new members, particularly at the graduate student and postdoctoral levels. It is a great way to grow your professional network! If you would like to join, please email the Ecohydrology Technical Committee Chair, Cynthia Gerlein-Safdi (cgerlein@berkeley.edu), and the Vice-Chair, Sam Zipper (samzipper@ku.edu).

Transitioning AI/ML into Operational Hydrology

Grey Nearing and Frederik Kratzert, Google Research

Interest in machine learning (ML) within hydrology has surged, with a more than tenfold increase in ML-related hydrology publications over the last five years (Figure). As researchers continue exploring possibilities, operational agencies are beginning to act, investing in real-world systems built on ML (Table provides examples). This shift raises the question: How do we move from research to reliable, sustained operations? Our position developing an operational flood forecasting system within an AI company has given us experience with this question.



Scholarly Works' counts for 'Machine Learning' filtered by all 'Field of Study' categories containing the word 'Hydrology' from www.lens.org (accessed May, 2025).

Organization	Sector	Status
NOAA National Weather Service	National Government	Under development
California Department of Water Resources (DWR)	State Government	Standards development + some operational applications
Environment Canada	National Government	Under development
DHI	Private	Operational across a range of applications
Google FloodHub	Private	Operational for flood forecasting
Upstream Tech	Private	Operational for river forecasting
ECMWF	Multinational Government	Under development
World Meteorological Organization (WMO)	International Government	Call to action

Our Journey with FloodHub

We began in 2018 with pilot alerts in India and Bangladesh, and by 2023 our FloodHub system expanded to over 80 countries. This system now provides real-time alerts to millions of people, many of whom live in areas with limited prior warning capacity.

We leverage ML for river forecasting, particularly its utility in locations with limited long-term flow records. Training an ML model on diverse global hydrological data allows us to extrapolate effectively to data-scarce regions. While acknowledging the importance of addressing training bias due to unequal global data distribution, ML models demonstrate a smaller performance disparity in areas with less training data compared to traditional hydrology models.

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Transitioning AI/ML into Operational Hydrology

Grey Nearing and Frederik Kratzert, Google Research

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What We've Learned

Trust leads to adoption. Information only becomes valuable when it's utilized, and transparency is crucial for building trust in new technologies. While time and resource intensive, developing open-source tools is a vital part of this process. Our approach has been to develop open-source model components and community datasets that closely mirror our training data. We offer open and free access to real-time forecasts via FloodHub and our historical reforecast dataset (API access is currently in beta).

Align research with operations. Running an operational system helps ground research priorities in concrete, real-world needs. Our current research focuses on lowering access and interaction barriers through methods like using local data for fine-tuning and data assimilation, and to leverage incomplete inputs. Problems identified by agencies that we work with include sub-daily prediction and developing generalizable models of anthropogenic processes like dam operation.

While academia enjoys the freedom of curiosity-driven research, our challenge is to remain flexible to adopt new techniques as they emerge, avoiding over-engineering for specific modeling approaches. This is especially important in a fast-evolving ML landscape.

Collaboration is essential. Transformative AI/ML applications arise from cross-disciplinary collaboration. The development of ML models differs significantly from traditional models, necessitating expertise from both domains. One difference is that ML models should be developed at large scales, rather than developed locally (e.g., in research catchments) and then expanded to larger scales. We've observed several AI/ML hydrology initiatives fall short of their potential due to a lack of understanding regarding these fundamental differences, and how important it is to co-design with experts in both disciplines.

Build with the community. Operational progress depends on shared tools and data. Initiatives to increase access to data, like Unidata, Dynamical, CaSPAr, and ECMWF's transition to open data, support collective progress. Our Caravan dataset helps standardize streamflow prediction across basins and institutions. As a non-traditional forecast provider, our goal is to support and not replace national agencies. This is especially challenging when working across geographies, cultures, and socioeconomic conditions. Technology transfer across a range of technical capacities is an unsolved problem at a global level, but can be approached through collaboration with multinational organizations that exist, in part, for this reason.

Looking Ahead

Google's efforts are part of a broader shift. Agencies and companies are moving from research to deployment. ML in hydrology is not about automation—it's about service. A forecast is valuable if it informs action.

As hydrologists, we have an opportunity to build systems that reach people who previously had no forecasts, no warnings, and no protection. ML offers tools to help close those gaps, but success depends on whether we design systems people understand, trust, and ultimately use.

SISTER ORGANIZATION

NASA's Water and Energy Cycle Focus Area: Overview and Year Ahead

Craig Ferguson and Jared Entin

The Research and Analysis Program (R&A) of NASA's Earth Science Division (ESD) supports foundational scientific research needed to advance the nation's capability to observe, understand, and predict the distribution, movement, and transformation of water and energy within the Earth System. This is primarily done through its Water and Energy Cycle Focus Area (hereafter WEC), more information on which can be found here. WEC integrates the efforts of Earth observing missions (e.g., SMAP, SWOT, GRACE-FO) and their associated science and applications teams, along with programmatic investments (e.g., Terrestrial Hydrology, NASA Energy and Water Cycle Study), including airborne field campaigns (e.g., SnowEx, SMAPVEX), NASA Center-led projects, and ROSES-competed research projects (e.g., S2S Hydrometeorological Prediction, Ecohydrology). WEC investments are connected with international efforts, such as the Global Energy and Water Exchanges Program (GEWEX), to further support the AGU community.

WEC operates in coordination with ESD partner programs in Flight, Earth Science Data Systems, Earth Action, and the Earth Science Technology Office to enact ESD's Earth Science to Action (ES2A) Strategy. The ES2A strategy ensures that NASA 'firsts' in space-based observation and predictive intelligence translate into tangible real-world outcomes, including NASA-enabled decision-making frameworks.

A summary of top R&A discoveries in 2024 is on the Year in Review website. WEC is particularly proud of the accomplishments of the SMAP Science and Applications Team, which celebrated its 10th anniversary (shown in the image to the right). Its groundbreaking Early Adopter Program led to adoption of mission products by USDA, has developed mission add-on data products, such as sea surface salinity and vegetation optical depth, and furthered assimilation of NASA satellite data into ESM systems (e.g. GMAO). Beyond SMAP, another example of WEC driving real-world societal benefit is the USGS Water Information from SPace interactive dashboard. This dashboard represents a successful SWOT Early Adopter.

Image: SMAP Science and Applications Team Meeting, April 2025, Los Angeles, CA

The year ahead holds several important developments: The release of NLDAS-3, the first "LDAS" to employ multi-satellite land data assimilation; the launch of the NISAR satellite, delivering hyper-resolution maps of soil moisture and all-weather land inundation, among other products; and a winter field campaign with Idaho Boise State University, NASA-ESTO and USACE, which includes NISAR under flight helicopter lidar snow depth surveys, to support the development of experimental NISAR snow products. Also, a reorganization within NASA R&A will merge WEC's efforts with physical oceanography and precipitation measurement programs to create a new Hydrosphere program. Please look to engage with us at future workshops on "satellite-based water cycle science and application opportunities unique to NASA."

Community Resources

Unlock powerful resources to help you grow in your career

Take full advantage of tools and opportunities designed specifically to support your professional growth—don't miss out!

- Learn and Develop | AGU: Grow your skills and career with learning tailored for Earth and space scientists
- Resource Guides:
  - Careers in Geosciences Resource Guide
  - Graduate School Resource Guide
- AGU Weekly eNewsletter: delivered to your inbox every Thursday!

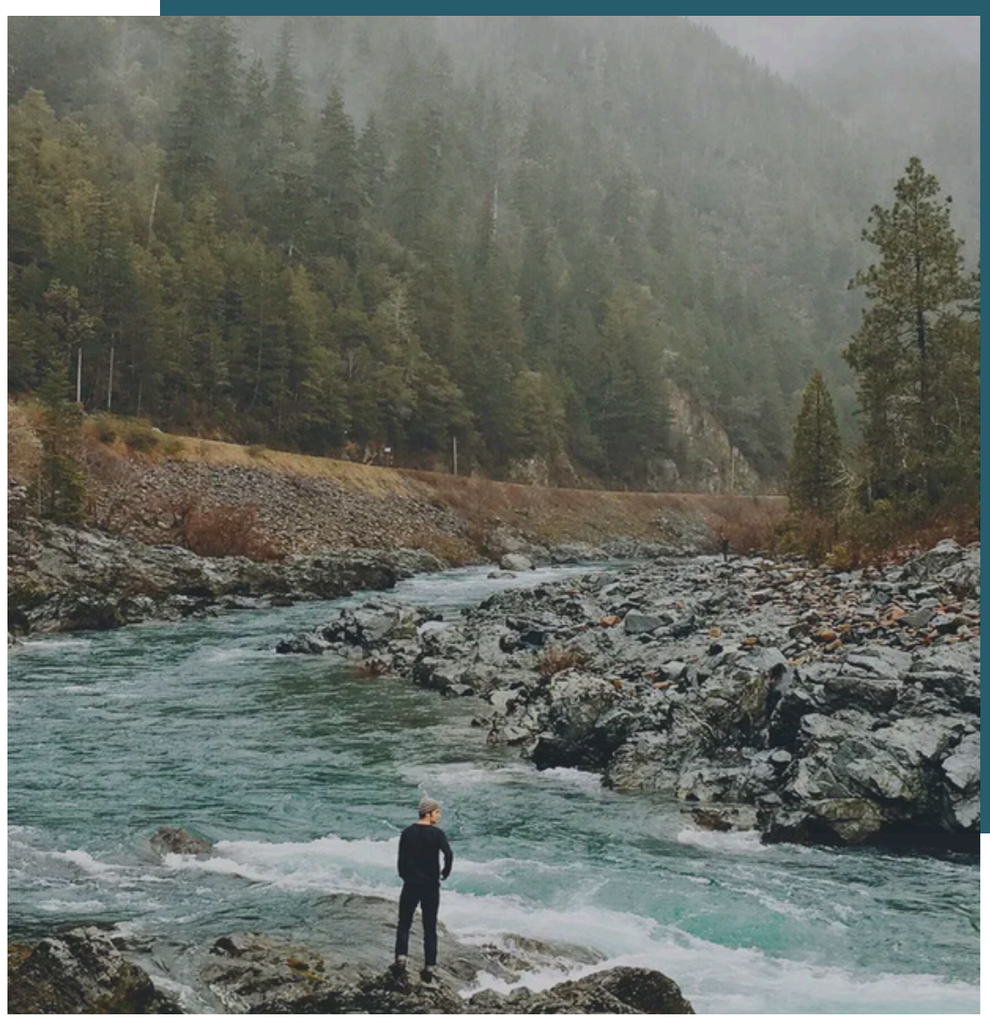
Impacted AGU Member Support Community

AGU has set up a community on AGU Connect for members impacted by job and funding losses. Please share this with your Section members. Participants can use this forum to share information and resources with one another. Our global community is dedicated to advancing discovery in Earth and space sciences for the benefit of humanity and the environment-and we do that best by lifting up one another. You may also want to add this information to your Section newsletters or other modes of communication. If you have any questions, please reach out to AGU's Section Support Team (agu-SectionHelp@agu.org).

Open Channel

Email:

agu.hydro.news@gmail.com

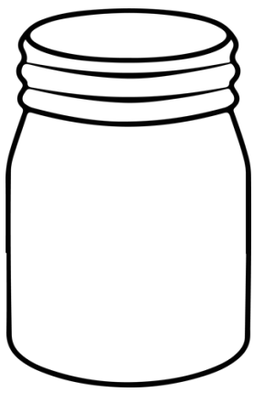


CALL FOR CONTRIBUTORS: SCIENCE TO SOLUTIONS

Have a story of hydrology making real-world impact? We're seeking contributions that connect science with policy, practice, and community—through citizen science, interdisciplinary work, communication, and more. Nominate yourself or a colleague to share meaningful work, inspire others, and help bridge hydrology and solutions.

Submit your nominations: agu.hydro.news@gmail.com.

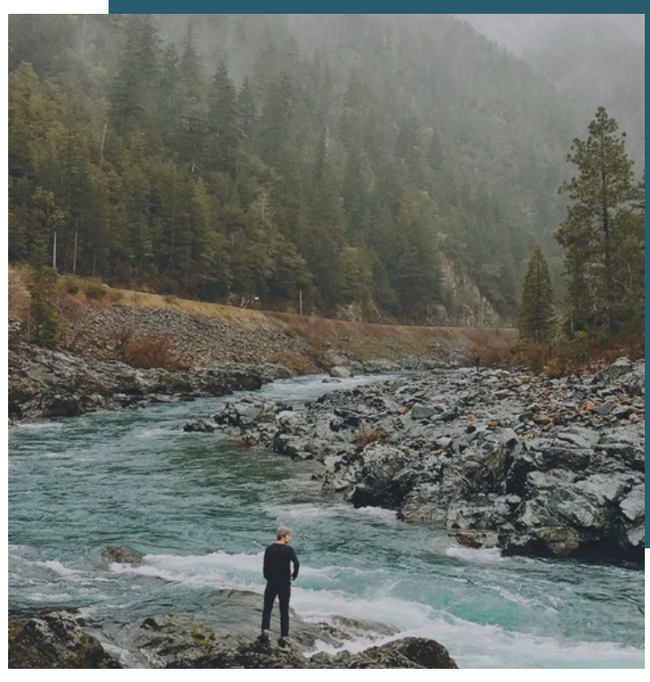
ANONYMOUS COMMENT JAR



Favorite part of this issue? Thoughts on future issues? Nominations for contributions?

Drop your comments in the jar (HERE)—anonymously if you prefer.

Community Resources



AGU Hydrology Section

Website: connect.agu.org/hydrology
BlueSky: @hydrology-agu.bsky.social
X: @Hydrology_AGU

Technical Committee Links

Catchment Hydrology

Website: hydrocatch.weebly.com
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LinkedIn: AGU Catchment Hydrology
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Distributed Sesning

Website: connect.agu.org/hydrology/about/tc-committees/sensing
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Groundwater

Website: connect.agu.org/hydrology/about/tc-committees/groundwater
X: @AGU_GWHydro

Hydrologic Uncertainty

X: @AGU_HU

Hydrology Section Student Subcommittee (H3S)

Website: agu-h3s.org
X: @AGU_H3S
LinkedIn: American Geophysical Union Hydrology Section Student Subcommittee (H3S)

Hydrogeophysics

Website: connect.agu.org/hydrology/about/tc-committees/hydrogeophysics
X: @AGUhydrogeophy
Instagram: @aguhydrogeophysics

Justice, Equity, Diversity, and Inclusion (JEDI)

Website: connect.agu.org/hydrology/about/tc-committees/hydrojedi

Precipitation

Website: connect.agu.org/hydrology/about/tc-committees/pretech
Facebook: AGU Precipitation
X: @AGUPrecip
Instagram: @AGU_precipitation
Linkedin: AGU Precipitation

Remote Sensing

Website: connect.agu.org/hydrology/about/tc-committees/remote-sensing
LinkedIn: AGU Hydrology Section's Remote Sensing Technical Committee group

Soil Processes and Critical Zone

Website: connect.agu.org/biogeosciences/tc-committees/soils-spcztc

Unsaturated Zone

Website: connect.agu.org/hydrology/about/tc-committees/unsat
X: @UnsatHydro

Water and Society

Website: connect.agu.org/hydrology/about/tc-committees/water-and-society
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Google: groups.google.com/agu-water-and-society

Water Quality

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