

AGU HYDROLOGY

SECTION NEWSLETTER

Members of AGU's Hydrology Section are concerned with the cycling of continental water at all scales, and with physical, chemical and biological processes driven by that cycling.

SEPTEMBER 2026

Preparing for El Niño

Thomas Piechota,
Chapman University

The 2026-27 "Super" El Niño has drawn worldwide attention. It is currently a "strong" event, as measured by the Oceanic Niño Index, and projected to be a "very strong" event by the end of 2026. The El Niño – Southern Oscillation (ENSO) is a dominant mode of oceanic and climate variability that occurs in the tropical Pacific Ocean every 2 –7 years and has global impacts. These impacts vary from very wet conditions in the southern United States and Peru, where precipitation can exceed150 – 200% of normal levels, potentially increasing flood risk and reservoir management challenges. Conversely, areas of Australia and southern Africa can experience lower precipitation, leading to drought conditions and impacts on food production (**Figure 1**).

However, responses to El Niño events vary. The 1982– 83 El Niño event led to widespread flooding in the western United States and marked the last time Lake Mead was full and water flowed over the spillway at Hoover Dam. In contrast, the 2015–16 event produced normal conditions in California, where drought conditions continue. Similar drought conditions and food insecurity occurred in East Africa, where a "typical" El Niño response is wetter conditions. These examples highlight that El Niño is only one aspect of a complex global climate system. That is why climate services such as the Climate Prediction Center assign probabilities to climate conditions being above, below or near normal (**Figure 2, next page**)

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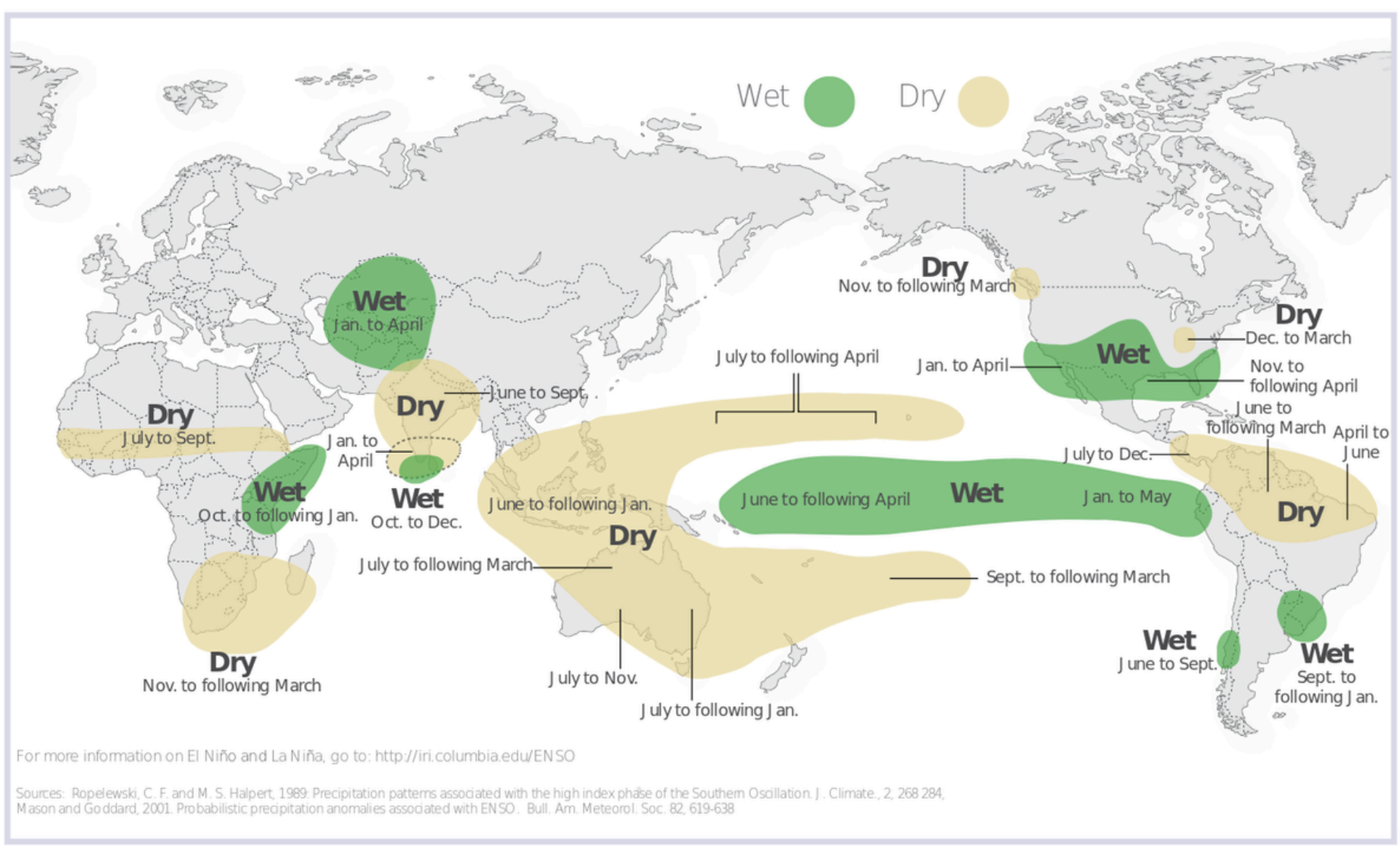


Figure 1: Typical worldwide precipitation impacts from El Niño events. Source: International Research Institute for Climate and Society, Columbia University.

Preparing for El Niño

Thomas Piechota, Chapman University

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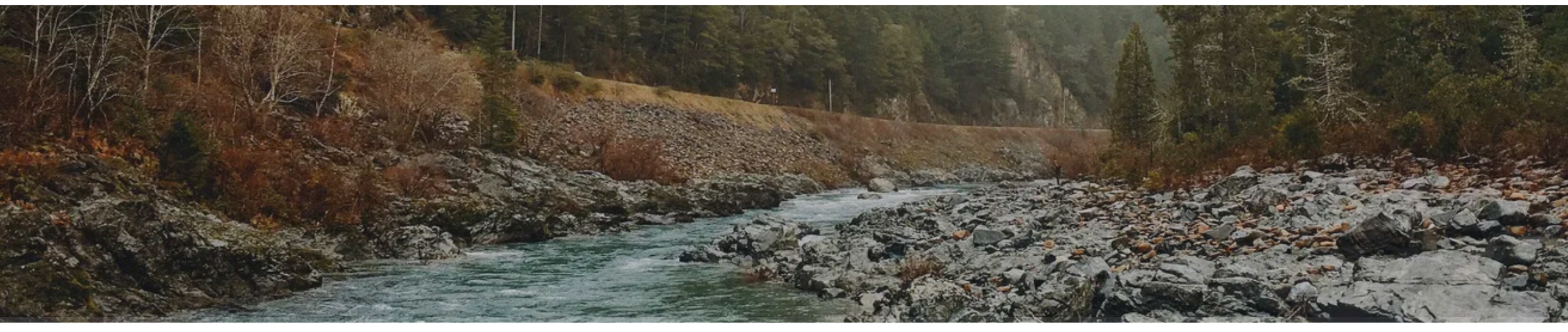
Figure 2: Spillway conditions at Hoover Dam during August 1983 in response to the 1982 –83 El Niño event. Source: University of Nevada of Las Vegas Digital Collections.

The attention surrounding the current El Niño highlights several key points for the hydrology and water resources community:

- **Non-stationarity in hydrological response**: Strong El Niño impacts may be modulated by long-term warming trends and other large scale forcing (e.g., Pacific Decadal Oscillation, Atlantic Multidecadal Oscillation, etc.), potentially producing responses that do not follow the analogs of past events of precipitation changes.
- **Soil moisture memory effects:** Pre-event drought conditions (i.e, low soil moisture) in many regions may mean initial precipitation does not translate to runoff as models predict, while saturated soils later in the event may amplify flood response.
- **Snowpack dynamics**: In snow-dominant regions, warmer temperatures associated with El Niño can shift precipitation from snow to rain, impacting the timing and magnitude of spring snowmelt that is critical for water supply forecasting.
- **Groundwater recharge opportunities**: Enhanced precipitation periods offer crucial recharge windows for depleted aquifers but require proactive managed aquifer recharge strategies.

El Niño events provide a natural experiment and a call to action for advancing hydrological science and demonstrating the role of climate information for improved water management. As the 2026-27 event continues to develop, new tools, including high-resolution satellite observations from missions such as SMAP and GRACE-FO, enable real-time monitoring of soil moisture and groundwater storage. These are key variables for assessing the influence of antecedent conditions on hydrologic responses. Forecast-Informed Reservoir Operations (FIRO)—an approach that integrates medium-range weather forecasts into water management decisions—offers opportunities to balance flood risk reduction with water supply capture and enhanced groundwater recharge. The challenge and opportunity for the hydrology community is to use enhanced monitoring to actively improve forecasts that are used in adaptive water management. All of this helps ensure that future El Niño events are better understood and managed.

The author wishes to thank the contributions of Venkat Lakshmi (Johns Hopkins University) and Glenn Tootle (University of Alabama).



Announcements

AGU26 Timeline: Save the Dates

Planning is underway for AGU26, taking place **7–11 December 2026** in San Francisco, California. This year's meeting, Where Science Connects, will bring together more than 25,000 Earth and space scientists from around the world to share research, build collaborations, and connect across disciplines.

Late-breaking abstract submissions are now open, offering an opportunity to share timely research on emerging scientific developments. Submissions are due **29 September 2026**.

Attendee registration and housing are also opening, and the AGU26 program schedule will take shape in early September. Whether you are presenting, attending, or connecting with colleagues, now is a good time to start planning for December.

Click here to explore AGU26, submit a late-breaking abstract, and find the latest registration, housing, and meeting information.

Register Now for AGU Circles

The next cycle of AGU Circles starts 15 September. Connect in a small, virtual, member-led group, designed for open discussion and collaboration. Exchange ideas, solve challenges together, and gain practical takeaways you can apply to your career and research. Exclusive to active AGU members.

Choose from one of the five options:

- AGU26 Presenters - Presentation Practice & Peer Support
- Job-Seeking Peer Accountability & Support
- Taking Your First Steps in Science Policy & Advocacy
- Author Support - Publishing with AGU
- LGBTQIA+ Issues & Community Building

Register Today

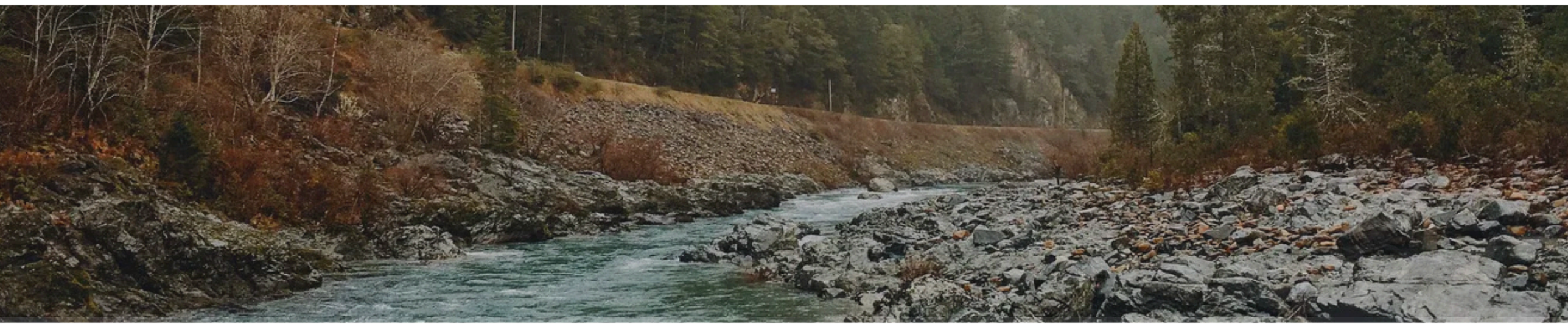
Bridges to Future Student Grants Program

The AGU Hydrology Bridges to the Future Program connects foundational work in hydrology with the next generation while honoring those who've made an impact in our field. The program provides $2,000 grants to support students facing financial barriers. Funding can support activities such as attending scientific meetings, visiting research groups, or career development.

Who Can Apply: Undergraduate, master's, and doctoral students with a demonstrated interest in hydrological sciences. Preference is given to undergraduate students, but students at 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) by October 15. Award announcements will be made in November.



Announcements

New NASA Earth Science Applications Guidebook

NASA's Applied Remote Sensing Training Program (ARSET) has shared a new **NASA Earth Science Applications Guidebook**, offering practical guidance for researchers developing and managing applied Earth science projects. Drawing on the experience of more than 50 NASA and NASA-funded researchers, the Guidebook includes expert tips, interactive examples, and downloadable resources organized around three areas:

- **Earth Science at NASA**
- **Developing Earth Action proposals**
- **Managing an Earth Action project**

The Guidebook is designed so users can quickly navigate to the information most relevant to their needs. It is particularly useful for scientists preparing proposals for **Earth Action Research Opportunities in Space and Earth Science (ROSES)** solicitations.

Explore the NASA Earth Science Applications Guidebook: go.nasa.gov/4wyTaUN
A PDF version is also available.

GeoHealth Frontlines: Flood Risk, Forecasting, and Public Health

AGU GeoHealth's *GeoHealth Frontlines* podcast explores connections between environmental change and human health through conversations with scientists, policymakers, and practitioners. In Episode 4, host Dr. Yunyao Li speaks with flood expert Dr. Nick Fang about the devastating 2025 Texas Hill Country flood and the science behind understanding and communicating extreme flood risk.

Particularly relevant to the Hydrology Section community, the conversation explores flood forecasting, hydrologic modeling, radar and real-time data, warning systems, and how changing extremes challenge traditional approaches to characterizing flood risk. The episode also considers a critical question for hydrologists: how can we better translate advances in flood science into information that helps communities prepare and respond?

Listen to Episode 4 and follow the podcast: Spotify and Apple Podcasts

Unravelling Water with Dinesh Kumar

The Institute for Resource Analysis and Policy (IRAP), a non-profit Indian research organization, has launched a new YouTube channel, *Unravelling Water with Dinesh Kumar*, focused on emerging water issues in India and globally. Hosted by water resources specialist Dr. M. Dinesh Kumar, the channel features video modules spanning hydrological assessment, water resources planning, agricultural water management, water scarcity, floods and droughts, and water and food security. The modules aim to challenge people to think differently about water by exploring less-discussed issues and bringing new perspectives to ongoing debates.

Topics include assumptions about groundwater behavior during monsoons, water accounting, groundwater resource estimation, water harvesting and recharge, groundwater–surface water interactions, and agricultural water demand. The modules draw on theoretical and empirical research conducted by Dr. Kumar and his colleagues over several decades. The channel is intended for scholars, professionals, policymakers, and those beginning work in the water resources sector.

Learn more: https://www.youtube.com/@dineshkumar2436

FELLOW SPEAKS

Binayak P. Mohanty

Texas A&M University



Binayak Mohanty with students, colleagues, and family during the AGU 2025 Honors ceremony

While becoming a Fellow of the American Geophysical Union (AGU) marks a major milestone for any Earth and planetary scientist, its true value lies in inspiring the next generation of researchers—a legacy few other global professional societies can match. The journey of every AGU Fellow is a deeply personal reflection of decades spent navigating satisfying discoveries, personal dedication, and formidable scientific challenges. I am deeply honored and humbled to be elected to the 2025 Class of AGU Fellows, and I welcome this opportunity to share my career journey with my esteemed hydrology colleagues across generations.

Reflecting on my childhood in the flood-prone state of Odisha, India, one historical figure left an indelible impression on me. Centuries ago, an ordinary citizen named Baimundi donated his life savings to the king to build a stone embankment protecting the city of Katak, which sat vulnerable between the Kathajodi and Mahanadi Rivers. Beyond its symbolic gesture, Baimundi's selfless act altered Katak's hydrology forever—a timeless testament to foresight and civic generosity. Holding his memory in deep reverence subtly steered me toward a life as an engineer-hydrologist. Over the decades, my teachers (especially Rien van Genuchten and Ramesh Kanwar), mentors, and colleagues fostered my scientific growth, while my (many) graduate students constantly nudged me to new-age challenges, technology, and alternative solutions, and my family kept me grounded!

Nature is complex, dynamic, and a grand symphony governed by fundamental physical laws. While soil, water, land, vegetation, and living systems form the surface of our Earth, the synergistic complexities among them depend heavily on our vision and vantage point. Consider soil moisture within the Earth's skin: at a local scale, it may appear static or minor, yet it is the master variable controlling a cascade of hydrological processes across space and time. It governs evapotranspiration, plant-available water for agriculture and ecosystems, droughts, floods, heatwaves, soil erosion, streamflow generation, groundwater recharge, the planetary energy balance, and the transport of environmental contaminants. For over three and a half decades, my vadose zone research group https://vadosezone.tamu.edu/ has sought to discover the foundational principles governing water, energy, and chemical transport and retention in partially saturated soils, translating these insights into local and global Earth science applications.

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FELLOW SPEAKS

Binayak P. Mohanty

Texas A&M University

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From my undergraduate studies at Orissa University of Agriculture and Technology to my graduate work at Iowa State University and postdoctoral research at the U.S. Salinity Laboratory, I have pursued a holistic understanding of interconnected hydrologic processes. My approach bridges controlled laboratory experiments, designed field monitoring, and globally accessible remote sensing with conceptual, numerical, and data-driven models.



Binayak Mohanty and his graduate students discussing over Zoom during Covid-19

Throughout this pursuit, AGU has been my intellectual home. Its flagship hydrology journal, *Water Resources Research* (WRR), has been my go-to publication since my Ph.D. days, and it remains where I encourage my students to share their work. In an era saturated with publication outlets, WRR maintains a unique standard— a forum where the best minds in hydrology offer rigorous, constructive peer review to sharpen and validate our discoveries.

A persistent, fundamental challenge in hydrology remains: how do we translate measurements collected at core/column scales into meaningful representations at the macro-scales relevant to watershed or ecosystem management, Earth system science, and land surface modeling?

At the core of this challenge lies land heterogeneity. Natural landscapes exhibit immense variability in soil structure, texture, vegetation, and climate, making it difficult to define effective hydraulic properties across larger domains. Traditional upscaling methods have advanced our capabilities, but they rely on simplifying assumptions that leave cross-scale information transfer a major source of uncertainty.

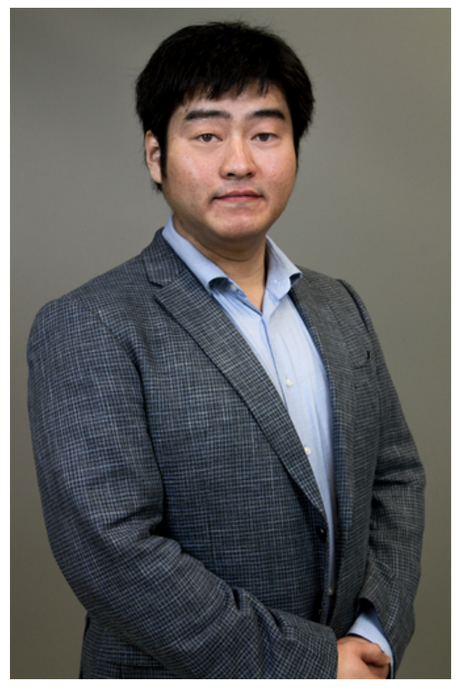
An emerging alternative asks a fundamental question: **can effective soil hydrologic properties be estimated directly at the scale of interest rather than derived through sequential upscaling steps?**

The wealth of modern satellite observations offers an unprecedented opportunity to evaluate this paradigm. Our recent work focuses on identifying observable ecosystem features that capture the integrated behavior of soil-vegetation-atmosphere systems. One key variable is active rooting depth—the portion of the root zone actively supporting evapotranspiration. By leveraging global satellite estimates of active rooting depth, we are opening new pathways to directly infer effective soil hydraulic properties and water retention characteristics at remote sensing scales. This paradigm shift moves us away from simply scaling up point measurements toward understanding emergent ecosystem behaviors, revealing the fundamental mechanisms that govern large-scale soil-water dynamics. A direction worth further exploration...

AWARDEE SPEAKS

Tiantian Yang

Hydrologic Sciences Early Career Award



Associate Professor at University of Michigan at Ann Arbor, School for Environment and Sustainability

From forecasts to decisions

I am deeply honored to receive the AGU Hydrologic Sciences Early Career Award. I share this recognition with my mentors, students, postdoctoral researchers, collaborators, and the water professionals who continually challenge me to make our science more useful. Their generosity has shaped both the questions I ask and the scientist I aspire to be.

> "The value of a forecast is realized only when it improves a decision."

My path to hydrology began in mechanical engineering at Tsinghua University and the University of California, Irvine. During my doctoral training with Drs. Soroosh Sorooshian and Amir AghaKouchak, I became fascinated by a deceptively simple question: how can reservoirs be operated safely and reliably when floods, droughts, and forecasts are uncertain? Later, developing operational river-forecasting and reservoir tools at Deltares (under the mentorship of Dr. Edwin Wells) taught me that a model is never the final product. Developing river-forecasting and reservoir tools with the National Weather Service, Bonneville Power Administration, and Tennessee Valley Authority taught me that a model is never the final product. The real product is a better decision.

Trustworthy AI for a changing water cycle

Today, my group at University of Michigan at Ann Arbor works at the intersection of hydrologic science, artificial intelligence, and managed water systems. We ask how forecasts from days to seasons can help reservoirs adapt to changing snowpack, drought, flood risk, and competing water-energy demands. Useful AI must do more than improve predictive scores: it should respect physical behavior, represent uncertainty, remain interpretable to practitioners, and perform reliably outside the conditions on which it was trained.

Recent work reflects this philosophy. We introduced a deep state-space model for rainfall-runoff simulation and tested it across 531 U.S. watersheds. We also developed mass-conserving neural-network approaches that connect deep learning with hydrologic principles, and proposed a Mamba-type model for simulating reservoir releases across 441 dams. Our NSF CAREER project extends this work by linking subseasonal-to-seasonal hydroclimate forecasts with flexible reservoir operations. In the Colorado River Basin, we collaborate with forecasting centers, U.S. Reclamation, and local water agencies help us test whether improved snow information and explainable AI can strengthen real operational choices.

Science is a relationship

The most important lesson I have learned is that impactful hydrology grows through sustained relationships. Practitioners should help frame questions, interpret evidence, stress-test tools, and define success. My students and postdocs are the central of the achievement: they bring new methods, experiences, and courage to problems no single discipline can solve. At Michigan, we hope to build a unique water program in which fundamental discovery and operational relevance advance together—and trustworthy forecasts and AI tools become responsive, meaningful, and lead to accountable actions.

Explore: Michigan faculty profile | Research group | New Postdoc and PhD position/vacancy in 2027

EARLY CAREER SPOTLIGHT

From Soil Moisture Pixels to Foundation Models

Hyunglok Kim, PhD; Assistant Professor, Gwangju Institute of Science and Technology (GIST), Korea (PhD 2022, University of Virginia)

On any given day, clouds hide much of the land from optical satellites. At microwave wavelengths, the land keeps talking. Since the late 1970s, passive and active microwave sensors have recorded how wet the soil is, how much water the vegetation holds, and when the ground freezes and thaws, day and night, through monsoon clouds and polar darkness. I have spent my career trying to hear more in that record.



At the NASA-Korea Core Validation Site in Hampyeong, Korea, with SMAP science team members Simon Yueh (NASA JPL), Dara Entekhabi (MIT), and the HydroAI Lab, 27 October 2025. The surrounding paddies show where satellite retrievals and models most need ground truth.

I trained at the University of Virginia, where I completed a PhD in civil engineering and an MS in data science with Dr. Venkataraman Lakshmi, supported by a NASA Future Investigator award. My dissertation asked a deceptively simple question: how good are our satellite soil moisture products, and how can we combine them into something better than any single sensor? Triple Collocation Analysis let us quantify uncertainty without perfect ground truth, and merging radiometer and scatterometer retrievals gave us consistent multi-decade records. As a postdoctoral researcher with D. Wade Crow at USDA-ARS, I moved from retrieval to assimilation, learning how observations can correct hydrologic models rather than merely evaluate them.

In 2023 I returned to Korea to join GIST and start the HydroAI Lab. Our central question is what comes after the retrieval era. For decades we have built one algorithm per sensor and one product per variable, each with its own assumptions and error budget. Foundation models offer another path: train a single model to learn the shared structure of land-surface water from many sensors and many years of data, then adapt it to whatever a user needs, whether filling gaps, forecasting, or detecting anomalies. My group works on both ends of that pipeline. We adapt large pretrained Earth-system models to forecast soil moisture, and we are building models that learn directly from multi-sensor microwave observations rather than from derived products. The goal is not to replace physics. It is to let the data show us where the physics and the sensors disagree, and then to build tools that agencies in Asia and beyond can actually run.

None of this works without ground truth. In Hampyeong, in the agricultural landscape of southwestern Korea, we operate the NASA-Korea Core Validation Site, which supports validation of the Soil Moisture Active Passive (SMAP) mission. Flooded rice paddies are among the hardest landscapes for any microwave retrieval or machine learning model, and among the most important for food and water security in Asia. The site keeps our models honest, and it gives my students a reason to put on boots, which I consider part of their training. The same toolkit now reaches beyond soil moisture: pan-Arctic snowmelt timing, a nationwide 1 km inland water quality dataset for Korea, and drought and flood monitoring that connects satellites to decisions. I also try to give back to the community that trained me, as an Associate Editor for IEEE Transactions on Geoscience and Remote Sensing, Vadose Zone Journal, and JGR: Machine Learning and Computation, and by co-convening AGU sessions with colleagues in the United States and Korea. Watching students and early-career researchers in the lab grow into independent scientists has been the most rewarding part of the job.

If you work on microwave remote sensing, land data assimilation, or foundation models for Earth observation, especially with ground data from landscapes where global products struggle, I would love to hear from you.

Connect or collaborate: hydroai.net | Google Scholar | LinkedIn

I thank Kristen Whitney for the invitation and for the AGU sessions we have organized together.

STUDENT SPOTLIGHT

Sumon Hossain Rabby

Ph.D. Candidate, Florida State University



Sumon Hossain Rabby, experiencing Florida's rare snowfall in January 2025—a striking reminder of environmental change.

I grew up in Bangladesh, a landscape shaped by rivers, monsoons, flooding, dense human settlements, and rapid environmental change. Experiencing this dynamic environment firsthand showed me how deeply water shapes human lives, both as a vital resource and a source of risk. What struck me most as a young boy was the contrast between the scarcity of clean water and the abundance of surface water increasingly polluted by the communities dependent on it.

These observations later shaped my academic interest in water quality. During my undergraduate studies at Bangladesh University of Engineering and Technology (BUET), I investigated urban drinking water contamination and low-cost treatment. After graduation, my focus expanded from urban drinking water to surface water quality. I worked on monitoring and analyzing water quality in major rivers across Bangladesh's coastal delta and engaged riverbank communities about river pollution. I began to realize the lack of understanding water-quality changes in increasingly stressed coastal systems, where hydrology, intensifying human activities, and climate change interact simultaneously.

That question eventually brought me to Florida, where I began my Ph.D. in Civil Engineering at the FAMU–FSU College of Engineering in 2022 under Dr. Ebrahim Ahmadisharaf. Florida offered a familiar yet distinct setting, with its warm, humid climate and coastal water quality challenges that, in many ways, echoed those I had encountered in Bangladesh. Throughout my Ph.D., I have worked on EPA-, FDEP-, and NSF-funded projects investigating nutrients and harmful algal blooms (HABs) in Florida estuaries. I examined how hydrologic variability and hydroclimatic extremes shape short- and long-term water quality dynamics. My work supports upstream nutrient management through advanced tools and frameworks I developed by combining advanced statistical and artificial intelligence (AI)-based approaches with sparse monitoring data.

My broader research interests span the land-to-coast continuum, particularly how upstream nutrients and other pollutant loads interact with downstream coastal processes to shape the biogeochemistry and ecology of the receiving waters. The intrinsic complexity of these interacting processes, compounded by limited observations, constrains our ability to understand how hydrologic variability and extremes influence spatio-temporal patterns in water quality. One aspect of my Ph.D. research examined how hurricanes and droughts influence the transport and fate of nutrients, organic carbon, trace metals, and emerging pollutants such as microplastics.

Another major component of my research focuses on HABs, particularly their relationships with environmental conditions, and their accurate prediction under both gradual and rapid environmental changes. I have investigated how hurricane-driven changes in ocean conditions can fuel post-hurricane algal blooms along Florida's Gulf Coast. More recently, I have examined the global redistribution of saxitoxin-related HAB events over the past several decades and whether the suitable thermal conditions associated with these events are changing. This work highlighted a critical gap for me: while we seek to understand how climate change alters future HAB risks, their relationships with climate indices may themselves be evolving, complicating our ability to predict those risks.

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STUDENT SPOTLIGHT

Sumon Hossain Rabby

Ph.D. Candidate, Florida State University

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Across these research experiences, I feel I have only begun to grasp some of the critical questions in coastal water quality, and have developed some technical foundation to pursue their answers. As I approach the completion of my Ph.D., I hope to carry forward these questions and pursue them throughout my future career. I am particularly interested in integrating remote sensing, high-performance computing (HPC), and emerging technologies with interpretable, process-informed data-driven approaches to uncover complex environmental patterns, bridge observational gaps, and improve predictability across scales.

Beyond research, professional communities have been central to my development as an early-career scientist. I served as an early-career session convener at major conferences, as a reviewer of leading journals, and as a contributor to national-scale discussions on advancing watershed management through emerging technologies and social equity. My research and service have been recognized through scholarships and awards. Yet, what I value most is how my doctoral journey has shaped me to work harder, pursue difficult questions more deeply, and give my best even when success is uncertain.

“What I value most is how my doctoral journey has shaped me to work harder, pursue difficult questions more deeply, and give my best even when success is uncertain.”

I thank Dr. Ebrahim Ahmadisharaf for nominating me for this spotlight.

Connect or collaborate: Google Scholar | LinkedIn

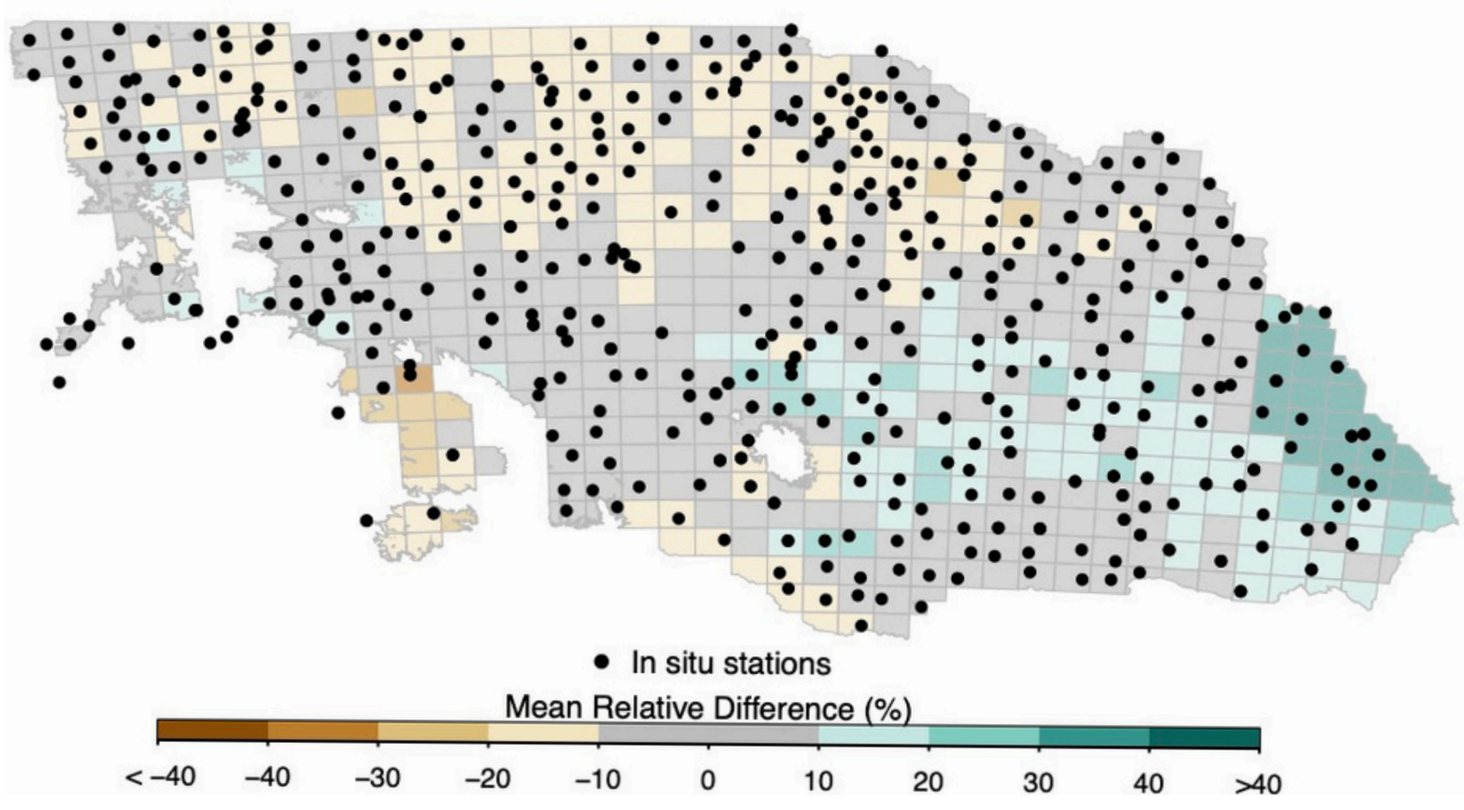
Better Together: Leveraging Satellite and Ground Soil Moisture Observations to Improve Drought and Flood Monitoring in the Upper Missouri River Basin

Manh-Hung Le, John D. Bolten, Hydrological Sciences Laboratory, NASA Goddard Space Flight Center

The Upper Missouri River Basin (UMRB) – flowing across Montana, Wyoming, North Dakota, South Dakota, and Nebraska – is frequently exposed to water extremes. A historic flood in 2011 inundated millions of acres of farmland. A record flash drought in 2017 devastated crops and rangeland across the northern plains. Yet despite the region's vulnerability, soil moisture monitoring across this vast landscape has long been too sparse to support timely, accurate drought and flood early warning. That is changing. Funded by the Infrastructure Investment and Jobs Act, the U.S. Army Corps of Engineers (USACE) is building out over 500 new soil moisture and snowpack monitoring stations across the UMRB lowlands. As of early 2026, over 360 stations are already operational, with full deployment expected by the end of 2027.

The Hydrological Sciences Laboratory at NASA's Goddard Space Flight Center is working alongside this buildout to ask a key question: can we combine what satellites observe from space with what sensors measure on the ground to produce better soil moisture information – and ultimately better drought and flood early warning? NASA's Soil Moisture Active Passive (SMAP) satellite maps global near-surface soil moisture every two to three days – but at a coarse ~36 km resolution that smooths over local variability in soil type, land cover, and topography. Retrievals can also be affected by dense vegetation and surface roughness. Ground-based measurements are therefore essential to validate and correct these estimates, especially during drought onset or pre-flood saturation, when accurate soil moisture is essential.

Our approach integrates downscaled 1-km SMAP retrievals with in situ observations from the growing UMRB mesonet network. We examine SMAP-derived Mean Relative Difference to characterize where and how much soil wetness varies across the basin, providing guidance on the ideal placement of in situ sensors for representative soil moisture monitoring. The Lifted SM approach is applied to increase the availability of near-surface soil moisture estimates at in situ locations, supporting satellite soil moisture calibration and validation. Geospatial and AI/ML techniques are explored to convert point-based in situ measurements into Land Surface Model (LSM)-compatible gridded data. Together, these steps produce a harmonized soil moisture product that captures both the spatial breadth of satellite observations and the precision of ground-based measurements. To this end, our methodology will enable in situ network data providers and regional stakeholders to operationally apply the refined data to their LSM-based decision making applications including streamflow forecasting, agriculture management, and regional drought assessment. You can visit this research and learning page to learn more about our work.



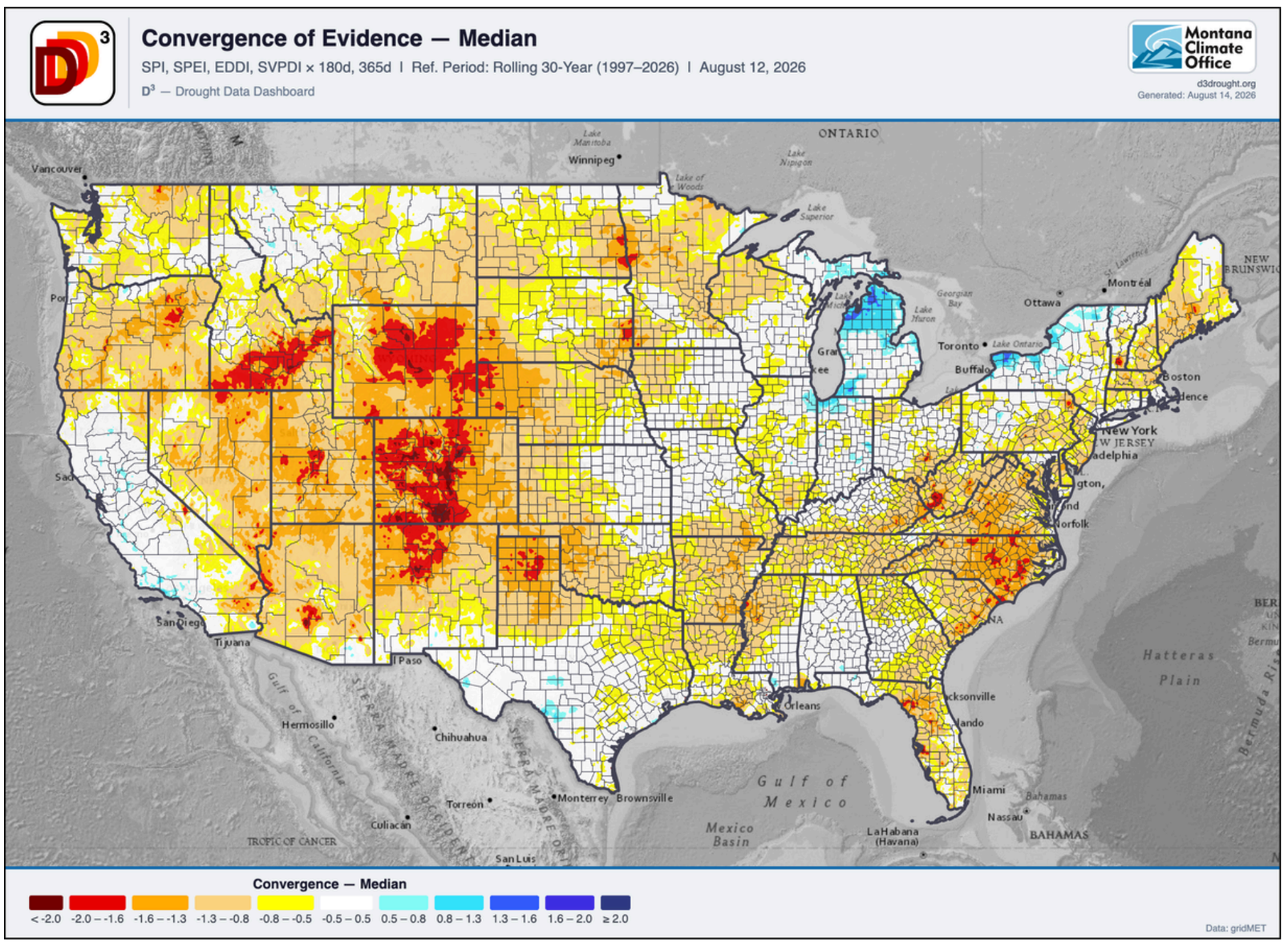
Spatial distribution of SMAP-based Mean Relative Difference (MRD) across 540 USACE grid cells in the Upper Missouri River Basin. MRD, derived from time stability analysis, indicates how wet or dry each location is relative to the rest of the basin. Black dots represent soil moisture stations from the newly built-out USACE-funded the UMRB Consortium of Mesonets and existing state mesonet networks, together providing broad monitoring coverage across the basin. Station locations shown reflect the network as of early 2026

The Drought Data Dashboard (D^3): An Operational System for Open, Transparent, and Localized Drought Monitoring

Zachary H. Hoylman (Assistant State Climatologist, Montana Climate Office, University of Montana)

When drought intensifies, decisions cannot wait. Ranchers decide when to move livestock, water managers balance reservoir operations, and emergency managers coordinate drought response. Yet the information guiding those decisions is often scattered across multiple websites, difficult to compare, and challenging to translate into action.

To help close that gap, the Montana Climate Office has launched the Drought Data Dashboard (D^3, pronounced "D three"), a free, open-source web platform that delivers daily drought information across the contiguous United States. Designed for drought assessors, producers, water managers, researchers, and the public, D^3 brings together leading drought datasets into a single interactive platform while making every method, dataset, and line of code accessible and transparent.



D^3 is the culmination of nearly a decade of collaboration. The platform grew from the Upper Missouri River Basin Drought Dashboard, developed after the 2017 Northern Plains flash drought exposed the need for more transparent and accessible drought information. With support from NOAA's National Integrated Drought Information System (NIDIS), the Montana Climate Office worked closely with the Montana Department of Natural Resources and Conservation (DNRC); Montana's Governor's Drought and Water Supply Advisory Committee (DWSAC); agricultural producers; Tribal, state, and federal partners; and other collaborators to build a tool around real operational needs. Rather than developing technology first and searching for applications later, the dashboard evolved through continuous feedback from the people responsible for drought monitoring, planning, and response. The new dashboard will serve as a forum for enhanced coordination and co-development of modern drought assessment approaches.

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The Drought Data Dashboard (D^3): An Operational System for Open, Transparent, and Localized Drought Monitoring

Zachary H. Hoylman (Assistant State Climatologist, Montana Climate Office, University of Montana)

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D^3 provides daily drought information across the contiguous United States. Users can explore precipitation, atmospheric demand, temperature, snowpack, streamflow, and multiple drought indicators across timescales ranging from 15 days to two years. They can compare conditions across space and time, retrieve values for any location, overlay U.S. Drought Monitor classifications and administrative boundaries, and incorporate observations from United States Geological Survey (USGS) streamgages and thousands of Global Historical Climatology Network (GHCN) climate and weather stations.

Several innovations distinguish D^3 from traditional drought monitoring platforms. Users can choose among multiple climatological reference periods, including a rolling 30-year baseline, the World Meteorological Organization's 1991–2020 climate normal, and the full period of record, making processes like aridification something users can explore rather than simply read about. The dashboard also includes a Convergence of Evidence tool that allows users to combine multiple drought indicators into a single composite map with reproducible and transparent methods, reflecting the way climatologists evaluate drought by considering multiple lines of evidence instead of relying on a single index. Regional datasets, including observations from state mesonet weather and soil moisture networks, can also be integrated through flexible plugin architecture that allows local information to appear seamlessly alongside national products.

Beyond visualization, D^3 serves as an operational data platform. Every layer is published as a Cloud-Optimized GeoTIFF and can be accessed directly from GIS software, R, Python, or other scientific workflows. Whether someone wants to view conditions on a smartphone, prepare a drought assessment, or build a new application, everyone is working from the same openly available information.

D^3 can also support future decision-support tools developed across the drought monitoring community. As new datasets, methods, and products become operational, they can be incorporated into the platform, helping connect advances in drought science with the evolving information needs of drought assessors, water managers, producers, and other decision-makers.

The release of D^3 comes as the drought community is increasingly focused on modernizing drought assessment. The recently released National Academies of Sciences, Engineering, and Medicine consensus study, Improving Future U.S. Drought Assessment, calls for drought assessments that integrate multiple lines of evidence, use transparent and reproducible methods, and better account for climate nonstationarity.

At its core, D^3 is built on the idea that drought information should be treated like public infrastructure: open, transparent, and available to everyone who depends on it. The platform was shaped through years of engagement with the drought community and designed around the practical needs of drought assessment and decision-making. Whether someone is managing a ranch, allocating water, preparing for wildfire, or conducting research, they should be able to access the same high-quality information, understand how it was produced, and use it with confidence.

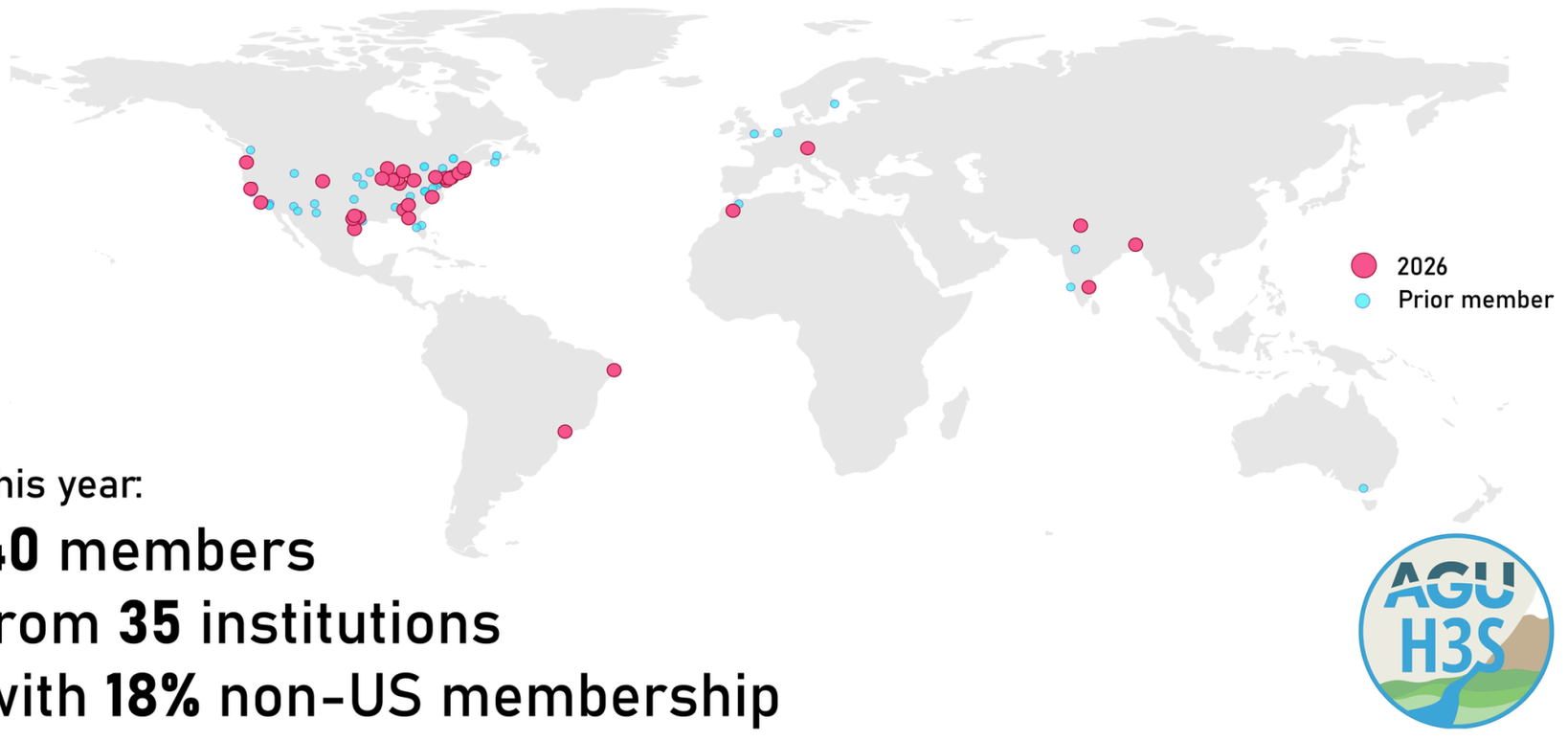
The Drought Data Dashboard is available free of charge at d3drought.org.

TECHNICAL COMMITTEE

What's Ahead for AGU H3S This Fall: New Members, NAW Webinars, Fall Meeting, and Catchment Cup 2026

Valerie Smykalov (Pennsylvannia State University)

The American Geophysical Union Hydrology Section Student Subcommittee (AGU H3S) welcomed 26 new members this spring, expanding our team to 40 total members from 35 institutions, with nearly 20% of our members located outside of the United States! Since expanding our team this past spring, H3S committees have been working hard to develop exciting programming for the community, continuing our tradition of helping student and early career hydrologists navigate their science, career, and activism.



This fall, we will be continuing our annual Navigating (Beyond) Academic Waters (NAW) series, which we co-develop with the Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI). These webinars will feature exciting speakers talking about pertinent issues facing today's early career hydrologists. Upcoming webinars include:

- **September 10**: *The Scientist Behind the Science: The Power of Storytelling in Academic and Professional Spaces*
- **October 8**: *Navigating Today's Federal Job Market*
- **November 19**: *The Connected Researcher: Building Networks That Bridge Academia, Industry, and Beyond*

Past NAW webinars have had >100 participants, and all past recordings can be viewed on YouTube: https://www.youtube.com/@CUAHSI/playlists.

We are also continuing our tradition of convening several sessions at the AGU Fall Meeting, including our annual Thinking Outside the Box Plot: Communicating Science Beyond the Paper session (https://agu.confex.com/agu/agu26/prelim.cgi/Session/280379), which focuses on creative methods of science communication. We are also hosting a town hall about career possibilities for graduate students called From Graduate School to Possibilities: Careers Across Academia, Industry, and Beyond, and one union session called Navigating Broader Impacts in Changed Political Climate (https://agu.confex.com/agu/agu26/prelim.cgi/Session/282446).

Finally, stay tuned for the annual 2026 Catchment Cup (formerly known as River Cup), which will be starting in October! In this flagship H3S community event, you can learn about diverse catchments from around the world and vote for your favorites all month long. Follow this event and our other programming through our various social media platforms and website:

- **Email**: h3s.agu@gmail.com
- **Link Tree:** https://linktr.ee/H3S.AGU
- **Website**: https://www.agu-h3s.org/
- **Bluesky**: @agu-h3s.bsky.social
- **LinkedIn**: https://www.linkedin.com/in/agu-h3s/
- **Instagram**: @agu.h3s
- **Facebook**: https://www.facebook.com/people/American-Geophysical-Union-Hydrology-Section-Student-Subcommittee-H3S/100085410937806/?locale=pt_BR#

TECHNICAL COMMITTEE

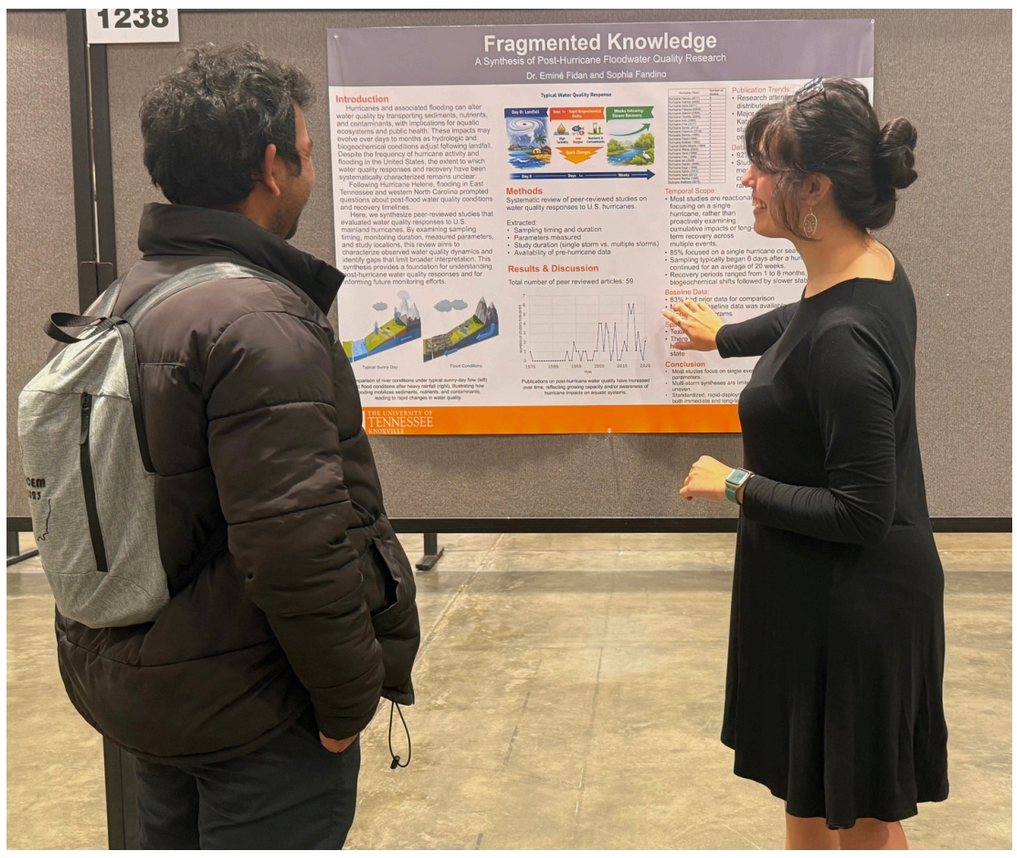
Water Quality

Frederick Cheng (University of Virginia), Emine Fidan (University of Tennessee), Sushant Mehan (South Dakota State University)

Water quality science has rarely felt more connected to the challenges playing out beyond our research community. From harmful algal blooms and nutrient enrichment to emerging contaminants such as PFAS, questions about what moves through our waters, and how we monitor, predict, and manage it, continue to have direct implications for ecosystems and communities. These water-quality challenges remind us of the importance of research that connects fundamental processes with observations, models, and management.

“Water quality science has rarely felt more connected to the challenges playing out beyond our research community.”

The Water Quality Technical Committee brings together researchers working across this broad spectrum, including nutrients, sediments, contaminants, biogeochemistry, watershed processes, monitoring, modeling, and water-quality management. A central goal of the committee is to create opportunities for these communities to interact and to highlight emerging directions in water-quality science. We are looking forward to continuing those conversations at the AGU Annual Meeting in San Francisco. Based on this year’s proposed sessions and abstract submissions, AGU26 is shaping up to feature a broad range of water-quality science. Proposed sessions span contaminant fate and remediation, harmful algal blooms, microplastics, artificial intelligence for water-quality science, and connections between watershed research and management. Among these, look forward to two flagship sessions run by WQTC members: *Frontiers in Water Quality and Water Quality and Watersheds: From Scientific Innovations to Actions.* We also encourage attendees to look out for the *Undergraduate Research on Water Quality and Water Resources* session as an opportunity to support and engage with emerging water-quality scholars. While the final program is still being developed, we are encouraged by the breadth of water-quality research represented in this year’s submissions and look forward to highlighting these contributions in San Francisco.



We would also like to welcome our incoming Water Quality Technical Committee Chair, Sushant Mehan, and thank our outgoing co-chairs, Emine Fidan and Frederick Cheng for their service to the committee. Their efforts have helped sustain and grow the water-quality community within AGU, and we look forward to building on that momentum in the coming year.

The WQTC is always interested in new ideas and new participants, particularly graduate students, postdoctoral researchers, and early-career scientists. Whether you have an idea for a future session, an activity for the water-quality community, want to keep an eye out for our annual call for #HaikuYourResearch, or simply want to become more involved, check out our website (https://aguwaterquality.org/) for all of the above! We look forward to seeing many of you in San Francisco!

SISTER ORGANIZATION

Global science initiative

Science and Action for a Melting World: The Decade of Action for Cryospheric Sciences (2025-2034)

Anil Mishra, Wei Yang, Alexandre Germouty and Abou Amani

The cryosphere - including ice sheets, glaciers, sea ice, permafrost, snow cover and seasonally frozen ground - is a fundamental component of the Earth system and of the global water cycle. It stores most of the world's freshwater, regulates river flow and climate, sustains ecosystems and livelihoods, and influences sea levels from mountains to coasts, yet their rapid decline threatens water supplies, ecosystems, infrastructure and global sea levels.

Polar and high-elevation regions are warming two to four times faster than the global average. Glaciers and snowpacks are shrinking, Arctic sea ice is declining, permafrost is thawing, and land ice is raising sea level. Around two billion people depend on mountain snow and ice for water, while more than 15 million are exposed to glacial lake outburst floods. The consequences extend through water, food and energy security, infrastructure, ecosystems, and coastal resilience.

> More than 35,000 glaciers have been identified across over 110 UNESCO sites, covering around 100,000 km^2,approximately 15% of the world's glaciers and glacierized area. However, projections indicate that glaciers in one-third of these sites will disappear by 2050 regardless of the climate scenario, including all remaining glaciers in Africa.

In response to this urgent planetary challenge, the UN General Assembly adopted resolution A/RES/78/321 declaring 2025-2034 the "Decade of Action for Cryospheric Sciences". UNESCO has been entrusted to lead its implementation through the Intergovernmental Hydrological Programme (IHP) with efforts to boost climate research, to advance interdisciplinary, and foster cross-sectoral and inclusive global cooperation. The Decade is a global framework to translate cutting-edge cryospheric science into practical, decision-ready intelligence for climate mitigation, adaptation and disaster risk reduction, which links risk and vulnerability assessments with early warning systems and operational decision-support tools.

The implementation of the Decade is organized around five connected Overarching Challenges (OCs): OC1, Global Cryosphere Monitoring, which aims to identify observational gaps and improve the accessibility and interoperability of cryosphere observations ; OC2, Actionable Cryosphere Projections, focused on advancing predictive capabilities and communicating uncertainty to support decision-making; OC3, Cryospheric Risk Management Solutions, linking risk and vulnerability assessments with early warning systems and decision-support tools; OC4, Adaptation to Cryosphere Loss, integrating science knowledge with community-led and policy responses; and OC5, Amplify the Impact of Cryospheric Science, through policy engagement, communication, education and capacity building.

The main goal is to transform cryospheric science into inclusive, decision-ready intelligence that enables societies to anticipate, manage, and adapt to cryosphere loss. A proposed Cryosphere Intelligence Platform will connect observations, models, risk information, adaptation guidance and policy support in a trusted and accessible environment.

The proposed governance mechanism operates at three levels. UNESCO's Intergovernmental Hydrological Programme hosts the Secretariat and provides coordination and administrative support. An Executive Steering

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Committee will offer strategic oversight, while a Strategic Management Committee will coordinate the Decade and its five thematic Working Groups. At the strategic level, a proposed Indigenous Advisory Committee, the Alliance for the Cryosphere and the Cryosphere Finance Dialogue will support inclusive participation, wider partnerships and financing. Implementation will be undertaken by the five thematic Working Groups (WG1-WG5) corresponding to the five Overarching Challenges and by partner institutions, with progress reviewed at Triennial Cryosphere Summits.

The Decade is therefore both a scientific agenda and a mechanism for collective action, and needs the hydrological community: snow/glacier hydrologists, modelers, data specialists and water managers. Its success will depend on whether stronger knowledge enables earlier warning, safer development, resilient communities, and faster climate action. Working Groups info and ways to contribute is at www.un-cryosphere.org or from cryosphere@unesco.org.

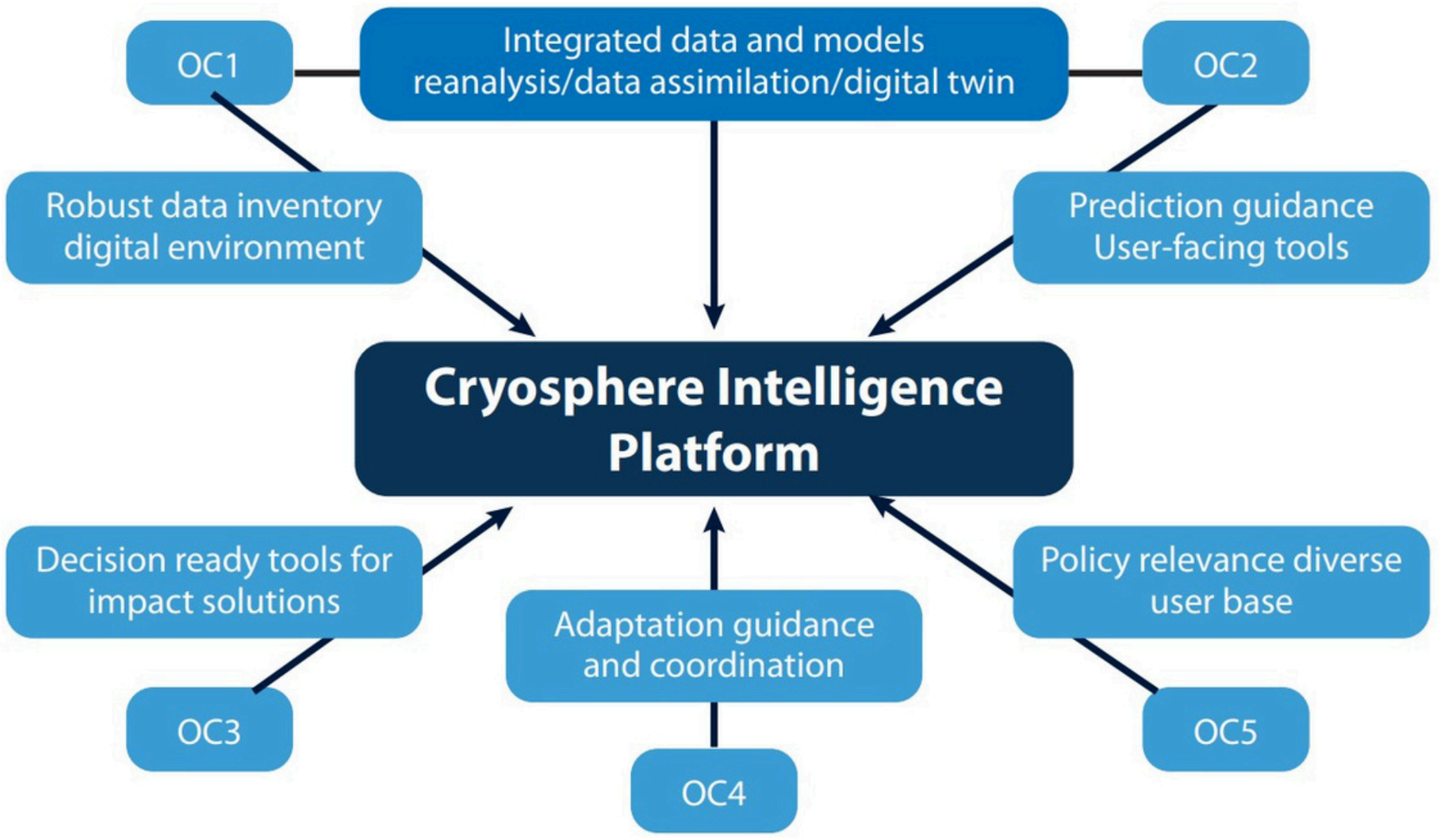


Figure 1. The Decade's five overarching challenges converge on a Cryosphere Intelligence Platform, linking observations, models, risk information and adaptation guidance to real-world decisions. Source: UNESCO (2026).

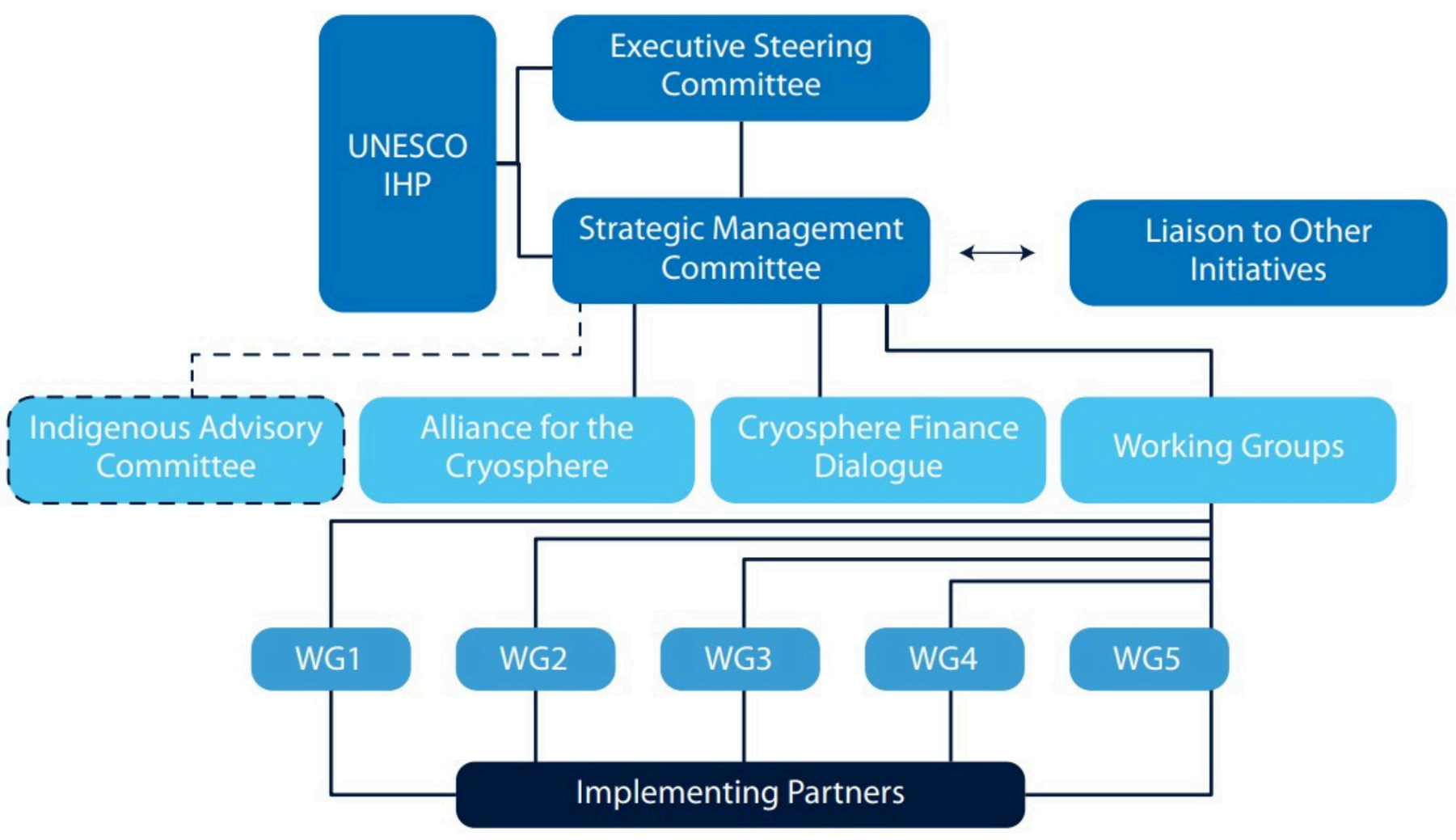


Figure 2. Proposed governance structure of the Decade of Action for Cryospheric Sciences: UNESCO (2026).

References

- United Nations General Assembly (2024). Resolution 78/321: Decade of Action for Cryospheric Sciences, 2025-2034.
- UNESCO/UN-Water (2025). The United Nations World Water Development Report 2025 - Mountains and Glaciers: Water Towers
- UNESCO (2026). Synthesis of the Decade of Action for Cryospheric Sciences 2025-2034.
- El-Enany, K. (2026, March 18). Speech by Mr. Khaled El-Enany, Director-General of UNESCO, on the occasion of World Water Day and World Day for Glaciers. UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000397717

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. Participants can use this forum to share information and resources with one another. If you have any questions, please contact AGU's Section Support Team (agu-SectionHelp@agu.org).



Interviews with Interesting Hydrologists

The AGU Hydrology Section offers a video series featuring interviews with eminent hydrologists reflecting on key achievements in the field during the 20th century. These videos highlight the progression of hydrological science and offer valuable insights for scientists and educators alike.

Community Resources

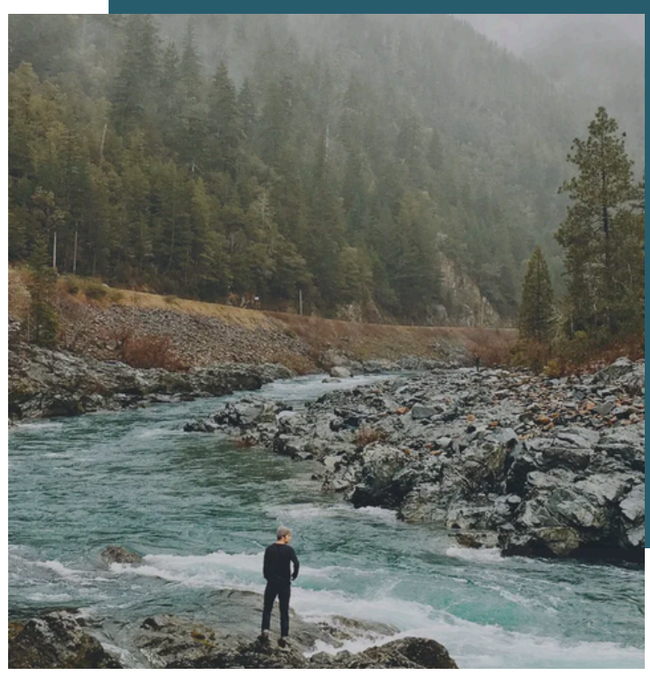
HydroShare Data Repository

HydroShare is CUAHSI's free, open-source water data repository, built to support open data sharing and collaboration in alignment with FAIR (Findable, Accessible, Interoperable, and Reproducible) data principles. It enables users to store, manage, share, and publish a wide variety of data and model formats in a citable and discoverable manner, including the option to permanently publish research products with a citable Digital Object Identifier (DOI) to meet funder and journal requirements.

CUAHSI Job Board

The CUAHSI job board is a shared resource for both job recruiters and job seekers looking for opportunities relevant to the broader water science community. Please fill out this form to post open opportunities.

Community Links



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
BlueSky: @agucatchhydro
LinkedIn: AGU Catchment Hydrology
X: @AGUCatchHydro

Distributed Sesning

Website: connect.agu.org/hydrology/about/tc-committees/sensing
BlueSky: @agu-sensing.bsky.social

Ecohydrology

Website: connect.agu.org/hydrology/about/tc-committees/ecohydrologymain
X: @AGUecohydro

Groundwater

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

Hydrologic Uncertainty

Website: connect.agu.org/hydrology/about/tc-committees/hydro-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
BlueSky: @aguprecip.bsky.social
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
X: @AGU_WS
Google: groups.google.com/agu-water-and-society

Water Quality

Website: aguwaterquality.org/
X: @AGU_WQ