

CREST Chronicle

May – August 2026

INNOVATIVE TECHNOLOGIES TO SERVE EARTH SYSTEM
SCIENCE, ENGINEERING AND SOCIETY

Observing, modeling, and understanding a changing Earth

In focus

**WATER, INTELLIGENCE
AND THE URBAN FLOOD
CRISIS**

CUNY
SCIENCE & TECHNOLOGY

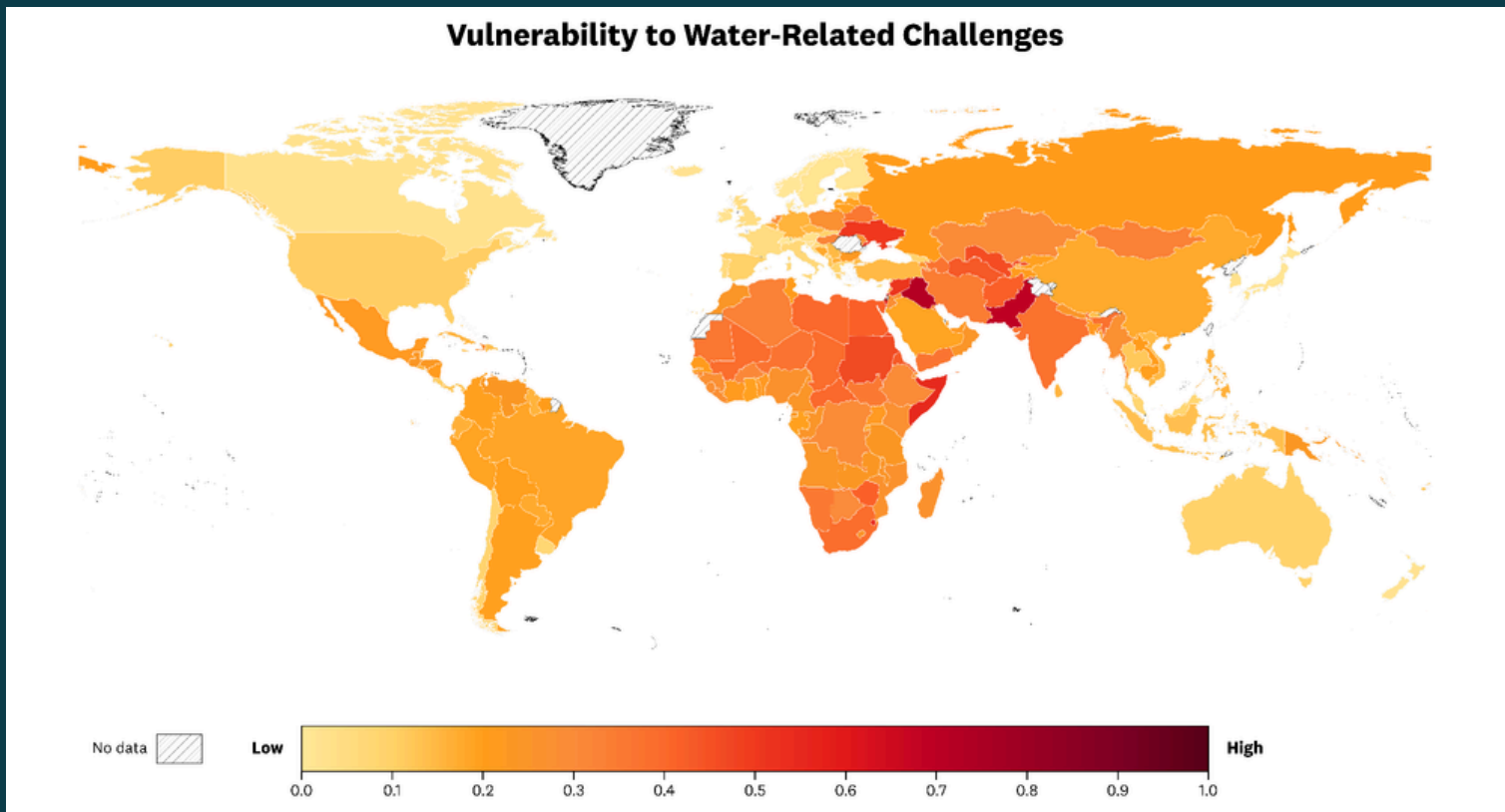
CREST
TO SUSTAIN THE EARTH



Photo credit: Global Water Bankruptcy: Living Beyond Our Hydrological Means in the Post-Crisis Era (2026)

Issue focus

Water, Intelligence & the Urban Flood Crisis



GLOBAL WATER
BANKRUPTCY

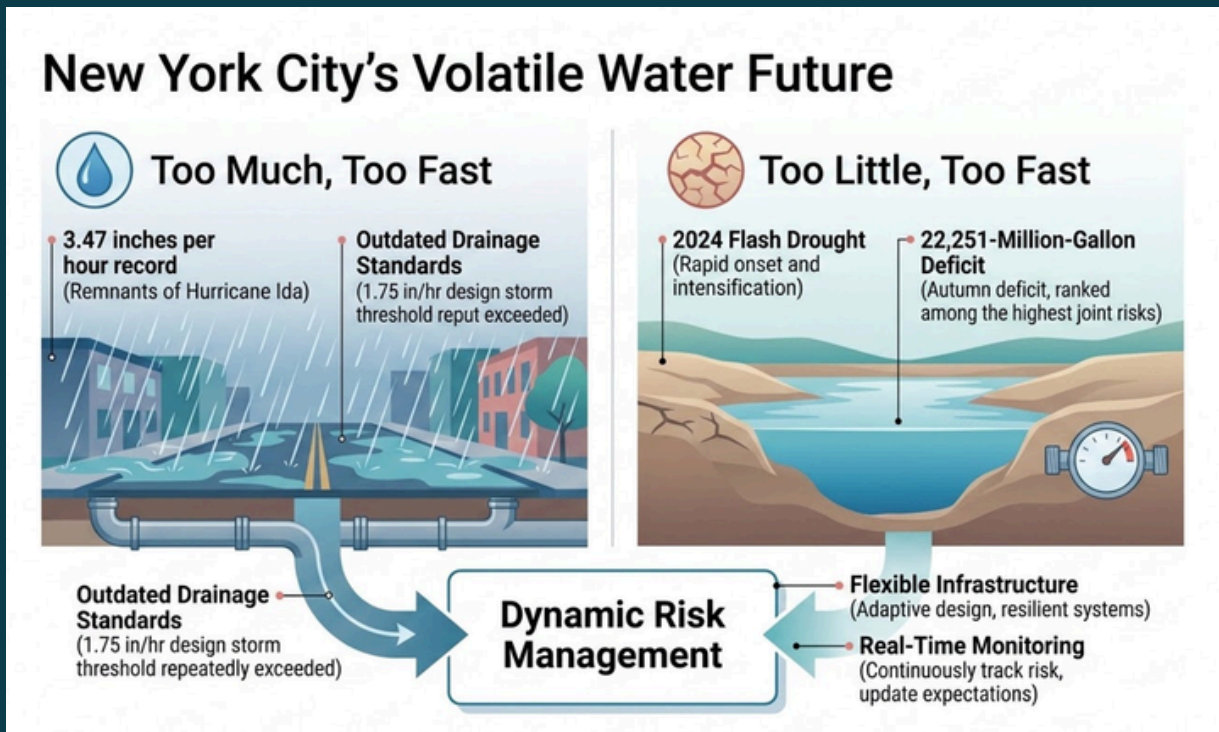
Kaveh Madani

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TRADITIONAL ECOLOGICAL
KNOWLEDGE
& WATER ECOSYSTEMS

Shakila Merchant · Vartika C.
Saman · Smita Ekka Dewan

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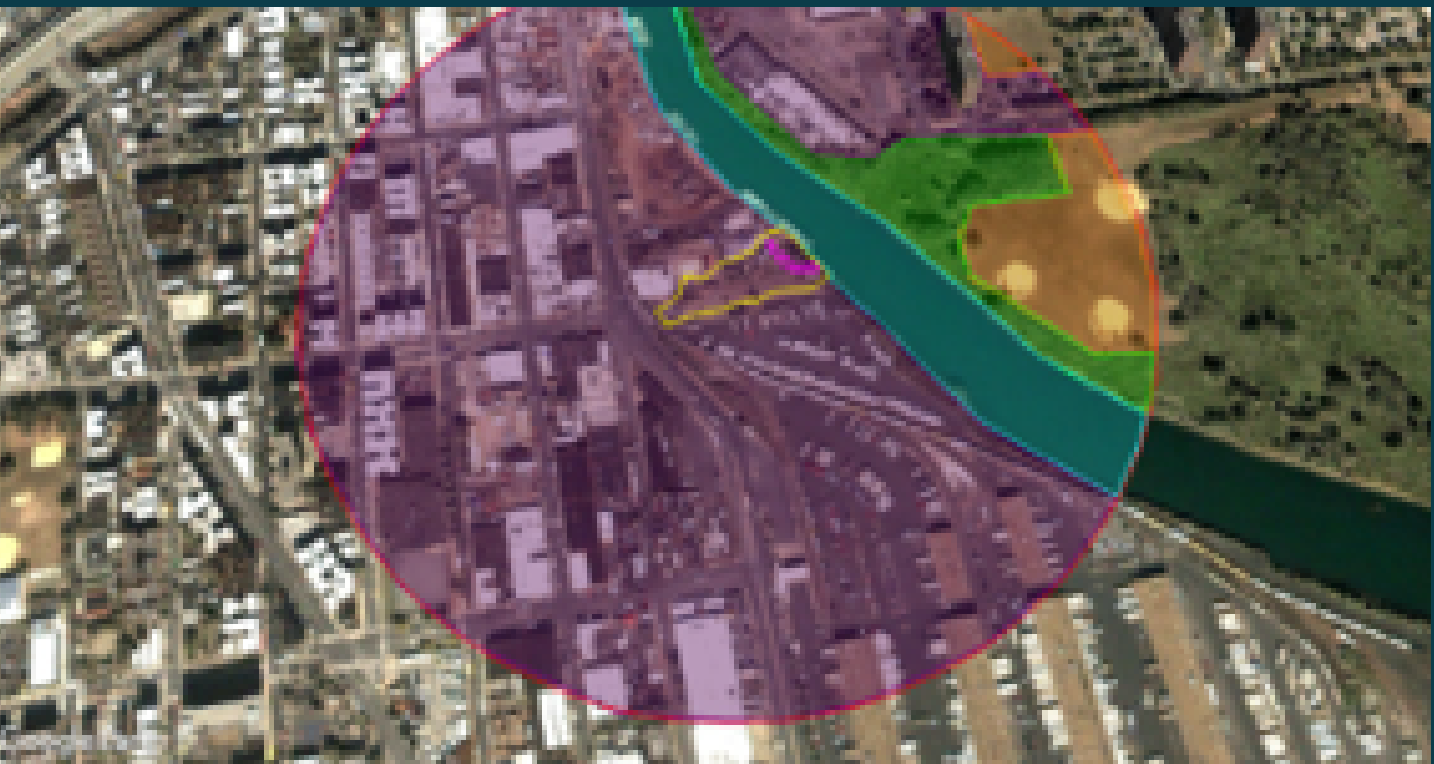
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PREFACE

Water has always played a pivotal role since the existence of life on Earth that ties our weather, climate, ecosystems, and human existence together. From aquifer depletion to drought to flood risks, from institutional gridlock to the depletion of traditional stewardship practices, the water challenges of our era are global and cannot be treated in silos and in segregation. The water problem of this century is systemic and demands systems thinking, and voices from across disciplines and communities around the world.

It is in that spirit that I am honored to introduce this second issue of the CREST Chronicle. CUNY CREST has, since its founding, understood water not as a narrow technical subject but as a lens onto climate resilience, equity, and governance – and is reflected through every page of this issue.

The research, training and community engaged around the water issues – led by the CUNY CREST doctoral scholars – Shima Kamali, Ana Mejia, and Ali Haider, alongside postdoctoral scientists Drs. Said Mejia and Seonho Kim, represents the kind of rigorous, next-generation scholarship that gives me real optimism about the future in Water Resource Leaders and Stewards. Their work that highlights integration of emerging technologies, modeling, observations, monitoring, and management challenges is a testament that CREST provides ideal training ground and learning environment to our future leaders.

Naresh Devineni – a world renowned water expert – brings a systems-level and policy-oriented perspective through his article, which highlights that too often water challenges get treated in isolation, reminding us that water risk is inseparable from the fact-paced industrialization, urban development and built environment that has long begun to mis-align and over consume our natural resources and environment. And it resonates in the community perspective article – led by Shakila Merchant, Vartika Saman and Smita Ekka Devan in partnership with Naresh Devineni and Curtis Walker & Tim Schneider from UCAR – grounded in Traditional Ecological Knowledge – which is a timely reminder that some of the time-tested water wisdom, and water memories predate our modern-day models and will outlast them, if we have the humility to listen and adopt to sustainable practices.

It gives me immense pleasure to highlight Kaveh Madani's Water Bankruptcy, who recently been honored with the Water Prize – world's highest honors for contributions to water science. Kaveh's work resonates with innumerable water experts around the world, on the concern that the world is spending water it does not have, and that the accounting is coming due. Kaveh's featured article in this issue is a fitting anchor for its broader water theme.

I congratulate CREST on assembling this issue, and setting a great example to the world on how community-grounded holistic approaches can help offer pragmatic and equitable solutions to some of the most pressing global issues – especially water.

I am glad to add my voice to it.



“Water challenges cannot be treated in silos.”
— Dr. Upmanu Lall

Professor and Director
Water Institute at the Julie Ann
Wrigley Global Futures Laboratory
Arizona State University

THEME: WATER, INTELLIGENCE AND THE URBAN FLOOD CRISIS

Water has always shaped where and how we live. It moves through landscapes and ecosystems, but also through the infrastructure, institutions, economies, and communities we have built around it. In cities, these relationships are becoming increasingly complex. Changing rainfall patterns, rising seas, aging infrastructure, growing demand, and expanding urban development are challenging how we understand, manage, and live with water.

This issue begins with a simple premise: water challenges are rarely about water alone.

When a street floods, the story does not begin with the water that appears on the surface. It begins earlier with rainfall and land cover, drainage and infrastructure, planning and investment, and decisions made over time. Its consequences extend further—to mobility, homes, livelihoods, ecosystems, public health, and everyday life.

Understanding these connections requires a different kind of intelligence.

Today, satellites observe water from space. Sensors capture conditions at street level. Models help us understand risk and uncertainty. Artificial intelligence and increasingly sophisticated data systems reveal patterns that were once difficult to see. Yet more information does not automatically lead to better decisions. The challenge is connecting what we observe with what we understand, and what we understand with how we act.

That also means looking beyond individual storms and asking deeper questions about how cities make decisions about water over time. How much pressure can our water systems absorb? Where are the limits? What information do leaders and communities need before a crisis occurs? And how can scientific knowledge better inform choices about infrastructure, investment, preparedness, and long-term planning?

At the same time, water cannot be understood through technology alone. People experience and understand water through place, ecosystems, community knowledge, and relationships built over generations. Bringing these perspectives together with science and engineering gives us a fuller picture of both the challenges and possible responses. This is where the next generation becomes essential. Preparing students to work across data, technology, disciplines, and communities is an investment in how future water challenges will be understood and addressed.

Across these pages, water becomes more than a hazard or resource. It becomes a lens through which we can understand our cities, our choices, our connections, and our future.

And perhaps that is the central question of this issue:
How intelligently can we learn to live with water?

FEATURED ARTICLES & PROJECT HIGHLIGHTS

GLOBAL WATER BANKRUPTCY • KAVEH MADANI
TRADITIONAL ECOLOGICAL KNOWLEDGE
SHAKILA MERCHANT • VARTIKA C. SAMAN • SMITA EKKA DEWAN
TOO MUCH, TOO LITTLE, TOO FAST • NARESH DEVINENI
CARIBBEAN COLLABORATIVE ACTION NETWORK (CCAN) • REZA KHANBILVARDI

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The Essentials of Global Water Bankruptcy

Kaveh Madani



Stockholm Water Price Laureate Professor Kaveh Madani is a distinguished environmental scientist, educator, and leader renowned for his interdisciplinary work on complex environmental and human security challenges. He currently serves as Director of the United Nations University Institute for Water, Environment and Health (UNU-INWEH). He also holds a Research Professorship at the City University of New York's Remote Sensing Earth Systems Institute (CUNY CREST). An expert in complex human-natural systems modeling, his work integrates mathematical, economic, and systems analysis to generate actionable policy insights. **Professor Madani is the author of the Global Water Bankruptcy Report and the 2026 Stockholm Water Prize laureate, the world's most prestigious award for outstanding achievements in water.**

For decades, we have described the world's mounting water problems as a "crisis." This word suggests a temporary emergency that arrives, demands undivided attention, and eventually passes. But, in many parts of the world, emergencies are no longer passing. Rivers are shrinking, aquifers are depleted or are rapidly approaching depletion, wetlands are disappearing, soils are degrading, and communities are repeatedly confronting shortages that were once considered momentary or exceptional. We need a more accurate diagnosis: the world has entered an era of Global Water Bankruptcy (GWB). Contrary to common misunderstanding, being in the era of GWB does not mean that the planet has run out of water. It means that many societies are, and long have been, living beyond their hydrological means to the point that past hydrological and ecological baselines cannot realistically be restored. In this sense, water bankruptcy is characterized by both insolvency and irreversibility conditions, that is, when water use (expenditure) exceeds available water supplies (renewable and non-renewable assets) over an extended period, causing irreparable damage.

Think of an isolated water system like you would a bank account. Rainfall, river flows and renewable groundwater are its income. Surface water systems and soil moisture are its checking account. Aquifers and glaciers are its savings account. For decades, we have withdrawn from both accounts faster than our income, paid to us by nature, can replenish them, while also damaging the ecosystems that store, regulate and clean our water.

Eventually, an overdraft stops being a temporary problem and becomes a structural one. That distinction matters. If we continue calling every water-related problem a "crisis," we encourage crisis-style responses, such as emergency groundwater pumping, new energy-inefficient infrastructure, temporary restrictions, and broken promises that conditions will soon return to normal. In numerous places, however, the historical normal is no longer realistically recoverable. Groundwater reserves have been depleted, wetlands have been lost, and climate change is altering the timing and reliability of water supplies.

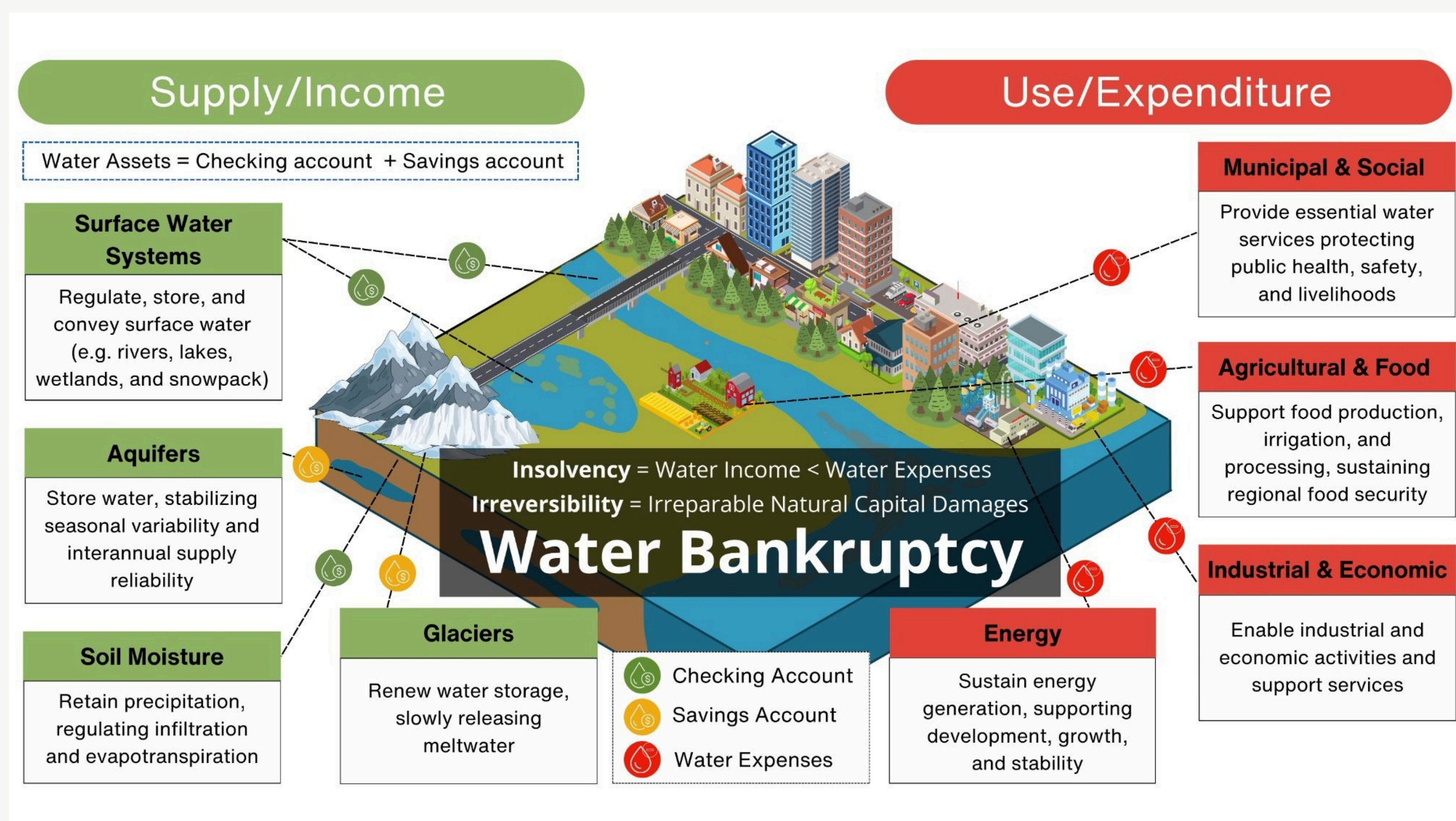
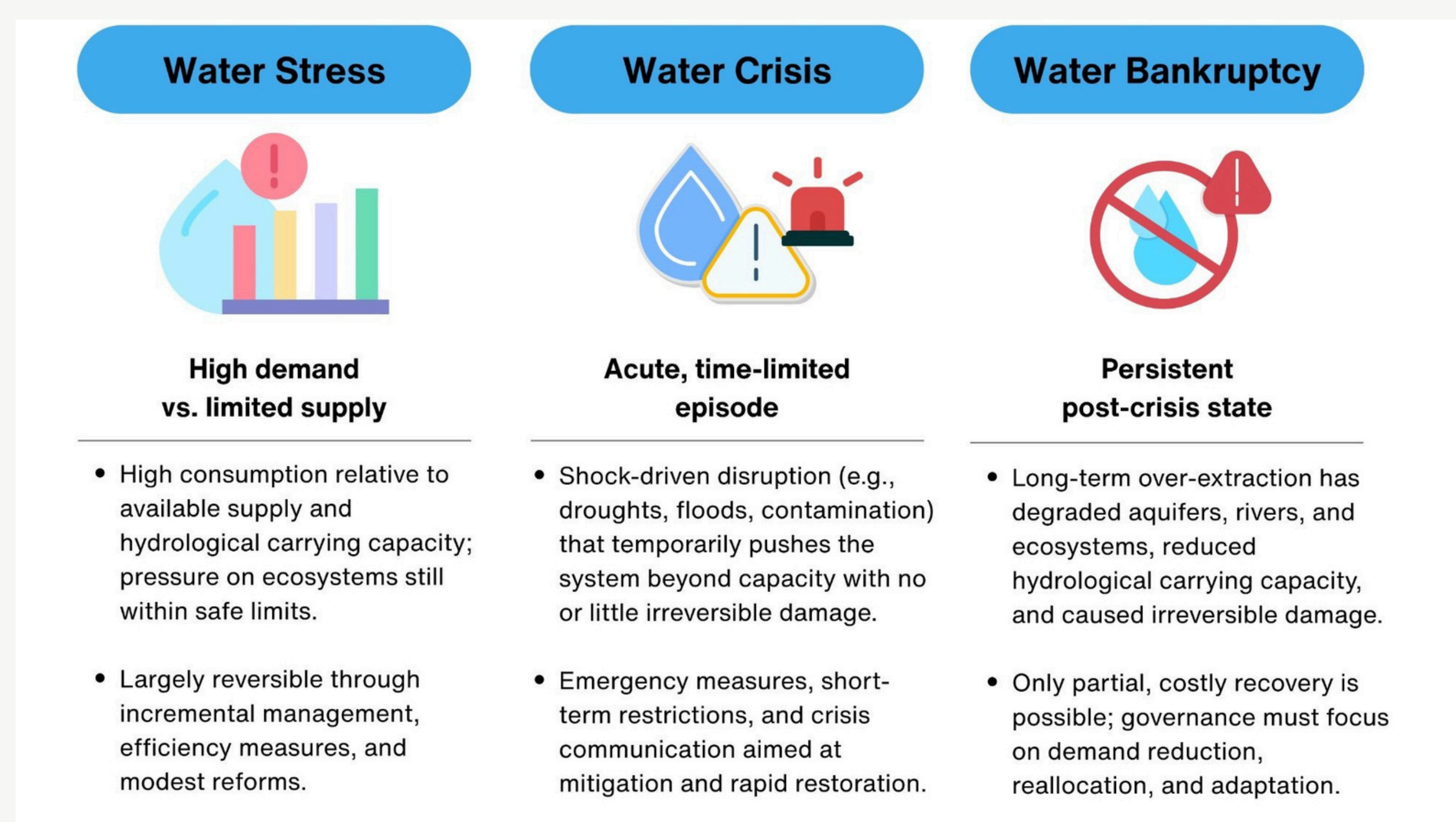


Image: A simple illustration of water income and water expenses in a human–water system. (Credit: UNU-INWEH)

The consequences are already visible. Around 4 billion people experience severe water scarcity for at least one month each year. More than two billion people still lack safely managed drinking water, while billions more lack safely managed sanitation. The effects of water bankruptcy also manifest in less obvious ways: sinking cities, degraded ecosystems, sand and dust storms, wildfires, food-price shocks and growing tensions between communities, global markets, and governments. But the idea of water bankruptcy is not intended to promote despair. Declaring bankruptcy, in the financial world, is a process for confronting reality aimed at restructuring unsustainable obligations with the aim of beginning a fresh start. Water management needs a similar shift that acknowledges how we cannot go back in time to restore what we once had. Governments cannot keep making development promises that hydrology cannot support. So, the first step is honesty. Water accounting must become as serious as financial accounting. We need to determine how much water is actually available within constraints of sustainability, who is using it, how quickly reserves are being depleted, and which populations and ecosystems are most vulnerable. Decisions about water allocation must reflect empirical limits, not political or economic convenience.

Second, we must protect the natural capital that remains. Aquifers, wetlands, forests, rivers, lakes, glaciers, and soils are not simply environmental amenities. They are the quiet infrastructure that sustains life. When we destroy them, we weaken the systems that capture, store, clean and regulate water. Protecting these assets is often more cost- and resource-effective than trying to replicate their functions later with concrete and technology. Third, we must cease the assumption that economic growth requires ever-increasing water consumption. Universities, businesses, governments, and multilateral organizations can help develop economic models in which prosperity is decoupled from greater and unsustainable water use. Better technology matters, but efficiency alone is not enough.



“Water accounting must become as serious as financial accounting.”

Kaveh Madani

Image: Three states of concern in human–water systems. The figure illustrates the major distinctions between water stress, water crisis, and water bankruptcy. (Credit: UNU-INWEH)

Finally, water bankruptcy must be treated as a question of justice. The costs of hydrological overshoot are rarely distributed equally. Smallholder farmers, low-income urban communities, Indigenous peoples, and other vulnerable populations bear the greatest consequences while having the least influence over the decisions that ushered in the era of GWB. A successful transition cannot simply reduce water use; it must also decide fairly whose use changes, whose livelihoods are protected and who receives support.

This is where universities and students have a key role to play. Water bankruptcy is not only an engineering problem. It is an economic, political, legal, ecological, and social challenge. Solving it requires hydrologists and engineers, but also economists, business leaders, lawyers, public health experts, political scientists, journalists, and citizens who understand how complex systems interact. Young people entering these fields will inherit a world in which many of yesterday’s assumptions about water no longer hold. It may be daunting, but it is also an unforeseen opportunity. Water can also offer something increasingly rare in a fragmented world: a reason to cooperate. Rivers and aquifers do not respect political borders. Neither do droughts, floods, food markets, or climate impacts. Bankruptcy management can therefore become a practical platform for rebuilding trust within and between communities, cities, nations, and sectors. The era of GWB demands that we abandon the comforting idea that every water problem is temporary. Some losses cannot be reversed. Most old baselines cannot be restored. But acknowledging those realities is not surrender. It is the beginning of responsible action, of bankruptcy management. We cannot renegotiate the laws of hydrology. We can, however, renegotiate our relationship with water, and we will collectively decide which way the water scale tips.

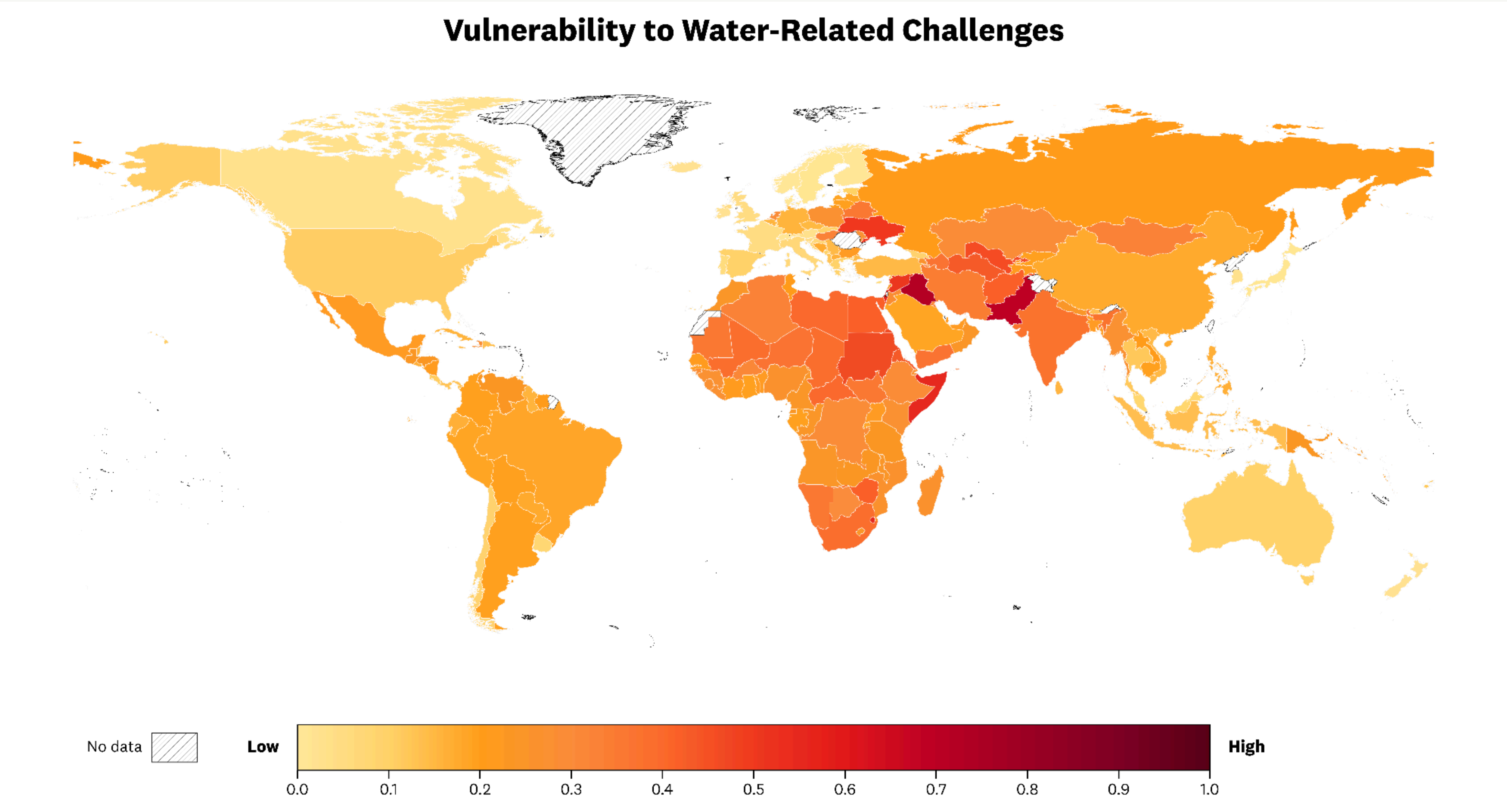


Image: Baseline vulnerability of different nations to water-related challenges. (Credit: UNU-INWEH)

“We cannot renegotiate the laws of hydrology.”
Kaveh Madani

In Conversation with Kaveh Madani

Water is often treated as a technical or environmental issue, but your work shows it is also deeply political, social, and human. How should we rethink the way we talk about water today?

We need to stop treating water as simply a resource to be managed and start recognizing it as a reflection of how societies function. Water connects our environment, economies, politics, health, and human security. When water systems fail, the causes are rarely just technical; they are often rooted in flawed decisions about governance, development, equity, and priorities. So, the conversation must move beyond scarcity and infrastructure. We need to talk about water in human terms. Who has access? Who bears the risk? Who makes the decisions, and what choices are shaping our shared future?

One of the central questions of this issue is: “What do leaders need that researchers are not yet providing?” From your experience across science, policy, and international institutions, where is the biggest disconnect?

The biggest disconnect is often not a lack of knowledge, but a lack of usable knowledge. Researchers may provide rigorous analysis, but leaders need clear options, trade-offs, and an understanding of what those choices mean politically, socially, and economically. Science cannot simply identify a problem and expect policy to follow. Researchers need to better understand the realities in which decisions are made (limited time, competing priorities, uncertainty, and political constraints, etc.). At the same time, leaders must create space for evidence to inform decisions, even when that evidence is inconvenient. Both researchers and decision-makers must work in a direct and coordinated way to address the persisting and obvious gap between the ways in which they operate, i.e., the science-policy gap.

You describe many water challenges through the idea of “water bankruptcy.” For readers new to the concept, what does it reveal about the long-term choices societies are making?

Water bankruptcy is much like financial bankruptcy. Insolvency occurs when a society chronically spends more water than it receives as renewable water “income” supplied by nature, forcing it to draw down its water “checking account,” such as lakes and rivers, and its “savings account,” such as groundwater reserves, beyond safe limits. Irreversibility is the second important characteristic of water bankruptcy and a departure from the financial analogy. It occurs when prolonged “overspending” and water quality degradation pushes a water system to a point where the old baselines and past conditions are permanently unattainable. This can manifest as groundwater depletion, loss of wetlands and glaciers, or the degradation of freshwater ecosystems. Water bankruptcy therefore captures both living beyond our hydrological means and eroding the natural capital on which future water security depends.

Water connects food, energy, health, climate, migration, ecosystems, and justice. When these challenges are so interconnected, how can institutions move beyond fragmented solutions?

This is where the idea of bankruptcy management becomes important. Once a system is bankrupt, institutions cannot solve the problem sector by sector with the naive aim of restoring the past. They must manage the new reality collectively, protecting essential human and ecological needs, reducing unsustainable demand, restructuring how water is allocated, and rebuilding resilience over time. Because food, energy, cities, ecosystems, and public health all draw on the same water systems, decisions in one area inevitably affect another. Bankruptcy management therefore requires coordinated cross-sectoral and multilateral efforts, as well as a culture of willingness to make difficult trade-offs transparently amongst decision-makers.



Kaveh Madani delivers his acceptance remarks after receiving the 2026 Water Prize. (Photo credit: UNU-INWEH)

Receiving the Stockholm Water Prize is a remarkable recognition of your contributions to the global water field. What does this award mean to you at this stage of your journey, and what responsibility comes with such recognition?

The Stockholm Water Prize is a deeply meaningful honor. It reflects the passion and bravery of many colleagues, students, communities, as well as my compatriots in and from Iran, who have all shaped my thinking and work over the years. At this stage, the award gives me a larger platform to bring greater attention to the difficult realities facing our water systems and to advocate for more courageous and systems-centered approaches. Recognition matters most when it helps create greater impact.

Many students and early-career researchers want their work to make a real-world difference. What advice would you give them about building careers that are scientifically strong, socially relevant, and courageous enough to challenge existing systems?

Build a strong scientific foundation, but do not become trapped within disciplinary boundaries. The most important problems rarely fit perfectly into one single field. Learn to communicate beyond academia towards the mainstream, understand the communities and institutions affected by your work, and remain open to understanding perspectives that challenge your own. Real-world impact also requires courage: the willingness to ask uncomfortable questions, bravely question the status quo, and sometimes produce evidence that powerful actors may not want to hear. But courage must be paired with humility. The goal is not simply to challenge systems. It is to help improve them.

On a personal note, what first drew you to water and sustainability, and what continues to keep you committed to this work today?

Water has been part of my life from a very young age. Both of my parents worked in the water sector, and my mother sometimes took me on work trips, where I was exposed to water projects and the challenges surrounding them. That early experience planted the seed of my interest in water. Over time, that curiosity became a deeper commitment as I understood how closely water connects to every part of society. What keeps me engaged today is the belief that better decisions can still make a meaningful difference—and that it is not too late to protect what we still have.

Traditional Ecological Knowledge (TEK) and Water Ecosystems: Learning With Communities for a More Resilient Future



Shakila Merchant

Founding Deputy Director of the CUNY CREST Institute and an environmental scientist whose work focuses on climate resilience, ecosystem health, community engagement, and STEM education.



Vartika C. Saman

Research Scientist at the CUNY CREST Institute and an interdisciplinary social scientist working at the intersection of sustainability, organizations, education and community engagement.



Smita Ekka Dewan

Associate Professor at CUNY's New York City College of Technology and a CUNY CREST affiliate. Her work focuses on social work, human rights, social justice, and community-centered research.

Together, their interdisciplinary expertise connects environmental science, social science, and community knowledge to advance more inclusive and resilient approaches to water and environmental challenges.

Water ecosystems are more than physical systems. They are living, social, cultural, and ecological spaces that shape how communities understand their environment, prepare for change, and respond to water-related risks. As storms intensify, coastlines shift, and water-related challenges become more complex, it is increasingly important to recognize that scientific knowledge alone cannot provide all the answers.

Traditional Ecological Knowledge, often referred to as TEK, offers an important way to understand water ecosystems through lived experience, long-term observation, cultural memory, and community-based practices. TEK reflects how people understand their local environment over time, including changes in water quality, flooding, fisheries, wetlands, coastal ecosystems, seasonal patterns, and community relationships with land and water.

At CUNY CREST, we believe that meaningful water research must bring together multiple ways of knowing. This belief shaped our funded project on Traditional Ecological Knowledge and Water Ecosystems, supported through University Corporation for Atmospheric Research (UCAR). The project was designed to create space for dialogue between researchers, students, practitioners, and communities around the role of traditional, local, and scientific knowledge in understanding and protecting water ecosystems.

Through this project, our team organized four workshops focused on Traditional Ecological Knowledge and water ecosystems. These included two technical workshops and two non-technical workshops, allowing us to reach both specialized and broader audiences. The workshops were held across two regions: New York City and Maine, creating opportunities to explore water-related challenges in different ecological, social, and geographic contexts.

The technical workshops focused on connecting TEK with scientific methods, environmental data, climate research, and water ecosystem monitoring. These sessions created opportunities to discuss how traditional knowledge can complement tools such as remote sensing, hydrology, data analysis, ecological assessment, and climate adaptation planning. The non-technical workshops were designed to be more accessible to community members, students, and stakeholders who may not have formal scientific training but have deep connections to water, place, and environmental change. These conversations emphasized lived experience, community memory, cultural relationships with water, and the importance of listening to people who directly experience environmental impacts. Together, the four workshops helped us explore an important question: How can communities, researchers, and institutions work together to better understand and protect water ecosystems?



Image: Workshops organized under UCAR project in New York City

Why Traditional Ecological Knowledge Matters

Traditional Ecological Knowledge is especially important in water-related research because communities often notice environmental changes long before they appear in formal datasets. Residents, Indigenous communities, fishers, coastal communities, farmers, and local practitioners may observe changes in water levels, seasonal flooding, species movement, water quality, shoreline erosion, and ecosystem health through repeated, place-based experience.

In many cases, these observations provide context that models, maps, and satellite data may miss. Scientific tools can show where change is happening, but community knowledge can often help explain how those changes are experienced, why they matter, and what responses may be practical or culturally appropriate. For water ecosystems, this is critical. Water connects people to infrastructure, health, food systems, housing, livelihoods, culture, and identity. When a wetland changes, when flooding becomes more frequent, or when water quality declines, the impacts are not only environmental. There are also social and community impacts.

One of the most important outcomes of this project was the creation of shared learning spaces. The workshops were not designed as one-way lectures. Instead, they encouraged conversation, reflection, and exchange between participants from different backgrounds.

In New York City, discussions highlighted the relationship between urban water systems, flooding, infrastructure, coastal resilience, and community vulnerability. Participants reflected on how urban communities experience water challenges in everyday life related to flood, droughts, food insecurity, or lack access to decision-making spaces.

In Maine, the workshops created space to think about water ecosystems through ecological and community-based perspectives. Conversations included the importance of local observation, environmental stewardship, and the need to respect long-standing relationships between communities and water systems.

Across all four workshops, a common theme emerged: water challenges cannot be solved in silos. Researchers, community members, students, agencies, and funders each hold different pieces of the puzzle. The challenge is to create respectful and practical ways to bring these pieces together.



Image: Community participation in workshop.

This project is highly relevant for communities because it recognizes that people living with water-related challenges must be part of the conversation. Whether the issue is flooding, ecosystem degradation, coastal change, or water insecurity, communities carry knowledge that can improve research questions, strengthen adaptation strategies, and make solutions more responsive to local realities.

For students, the project offered a chance to think beyond traditional classroom learning. It introduced them to the importance of interdisciplinary research, community engagement, and ethical collaboration. Future water professionals will need technical skills, but they will also need humility, listening skills, cultural awareness, and the ability to work across different knowledge systems.

For researchers, the project served as a reminder that data is most powerful when it is connected to people and places. TEK does not replace scientific research. Rather, it strengthens it by adding context, history, and meaning. When used respectfully, it can help researchers ask better questions, interpret findings more carefully, and develop solutions that are more grounded in community experience. For funders and decision-makers, this work shows why supporting community-engaged research is essential. Water challenges are urgent, but urgency should not lead to top-down solutions that overlook local knowledge. Investments in TEK, community dialogue, and interdisciplinary training can help build more inclusive and effective responses to climate and water risks.

As climate change continues to intensify water-related challenges, projects like this are increasingly important. They remind us that resilience is not only about infrastructure, models, or technology. It is also about relationships, trust, listening, and respect for the knowledge that communities have carried for generations.

At CREST, this work aligns closely with our broader mission to advance interdisciplinary research, train the next generation, and support communities facing environmental and water challenges. By bringing Traditional Ecological Knowledge into conversations about water ecosystems, we can move toward research and action that is not only scientifically strong, but also socially meaningful and community-centered.

Scientific tools can show where change is happening, but community knowledge can often help explain how those changes are experienced, why they matter, and what responses may be practical or culturally appropriate

“The most meaningful and rewarding part of this project for me was seeing a long-held conviction finally come to fruition – that tackling one of our most pressing ecosystem challenges – water, demand interdisciplinary collaboration. UCAR funding made that possible.”

Shakila Merchant



Image: Four workshops organized under UCAR project in Maine

In Conversation with **Shakila Merchant, Vartika C. Saman, and Smita Ekka Dewan**

What inspired this project on TEK and water ecosystems, and how did the UCAR funding help bring the ideas to life?

This project grew out of a simple but persistent belief: meaningful water and environmental research has to bring together multiple ways of knowing. Traditional Ecological Knowledge (TEK) reflects generations of observation, experience, and relationships with the natural environment. For many Indigenous communities, water is closely connected to identity, culture, well-being, and everyday life. Our team brought together perspectives from the social and physical sciences to explore how this knowledge can complement scientific approaches to understanding water ecosystems. UCAR funding helped turn that idea into practice. It gave us the opportunity to bring community members, researchers, students, and other participants together in shared spaces where they could exchange knowledge, ask questions, and learn from one another.

For readers who may be new to the concept, how would you explain TEK and why is it important for understanding water ecosystems?

Traditional Ecological Knowledge is knowledge developed and carried across generations through close observation of and interaction with local environments. It encompasses not only what people know about water, land, plants, wildlife, and seasonal patterns, but also how these elements are understood in relation to community life.

Water is particularly important because, for many Indigenous communities, it is more than a resource—it is connected to place, identity, cultural practices, community well-being, food security, and relationships with the natural world. TEK helps us understand how ecological changes are experienced, why they matter, and what kinds of responses may be practical and appropriate within a particular place and community. It does not replace scientific research; rather, it can strengthen it by adding context, long-term observation, and meaning.

The project included four workshops (two technical and two non-technical) held in NYC and Maine. What were the main goals of these workshops, and what kinds of conversations did they open up?

The workshops were designed to create spaces where community members, researchers, students, and technical experts could learn from one another. Having both technical and non-technical sessions helped make the conversations accessible while allowing participants to explore water ecosystems from different perspectives. The discussions explored how water is connected to community identity and everyday life, how environmental changes are observed locally, and how community knowledge can inform research and practice.

Across all four workshops, one theme kept surfacing: water challenges cannot be addressed in silos. Researchers, community members, students, agencies, and funders each hold a different piece of the puzzle. The workshops therefore became not only opportunities to share knowledge, but also spaces to explore how different forms of expertise can work together.

How can we close gaps between researchers, communities, and decision-makers? What does this project teach you about the importance of listening to community knowledge in water and climate work?

This project reinforced the importance of moving beyond purely top-down approaches and creating opportunities for communities to participate meaningfully in the research process. Closing that gap takes real investment in dialogue, in building and retaining trust, and in interdisciplinary training. It also requires researchers to listen carefully and recognize that observations accumulated through generations of living with a particular water ecosystem can provide important insights alongside measurements, models, and other scientific data. The goal is not simply to consult communities, but to create stronger connections between scientific knowledge, community knowledge, and decision-making.

From your perspective, what was the most meaningful part of this project?

The most meaningful part was seeing what happened when people with different experiences and areas of expertise came into the same room and genuinely listened to one another. The conversations in New York and Maine demonstrated how deeply water can be connected to place, identity, memory, community practices, and relationships with the environment. They also showed the value of creating spaces where scientific knowledge and knowledge developed through generations of observation can inform one another. For us, that exchange was at the heart of the project. It showed that interdisciplinary work is not simply about bringing different disciplines together but it is also about learning to ask questions differently.

Given the current challenges facing water ecosystems and communities, what hope and solutions can projects such as this offer to water experts and policy stakeholders?

Kaveh Madani's Global Water Bankruptcy report (2026) makes an urgent case that many of the world's water systems are moving beyond temporary crisis toward a more persistent condition in which water use exceeds renewable supplies and safe depletion limits, with lasting consequences for rivers, lakes, aquifers, ecosystems, and communities.

In this context, projects such as ours can do more than document the state of water systems. They can help create pathways towards a community-driven solutions. Water challenges are not experienced equally, and communities that are already underserved or highly exposed to environmental risks often bear a disproportionate share of their impacts. Yet these same communities hold valuable knowledge, lived experience, and generational understanding of local water systems that can strengthen how problems are understood and addressed.

Our project therefore focuses not only on learning from communities, but also on building capacity within them. Through workshops and hands-on engagement, students and community participants gain exposure to tools such as GIS, mapping, environmental data, and spatial analysis while connecting these technologies with local observations, cultural knowledge, and lived experience. This helps participants better understand and communicate changes occurring in their own environments and gives younger generations practical skills they can carry into education, research, planning, and community advocacy.

Interdisciplinary projects like this can provide a working model for bringing scientific knowledge, technology, and Traditional Ecological Knowledge together. They create spaces where researchers, students, community members, water professionals, and policy stakeholders can learn from one another and develop responses grounded in trust, shared knowledge, and long-term relationships.

If the emerging era of water bankruptcy requires us to rethink our relationship with water, then solutions cannot come from technology or institutions alone. Combining community knowledge with scientific tools and building the capacity of those most affected by water challenges offers an important pathway toward more inclusive, informed, and resilient water governance.

Too Much, Too Little, Too Fast

The Dimensions of New York City’s Water Risk

Naresh Devineni



Dr. Naresh Devineni is a Professor of Civil Engineering at The City College of New York (CUNY) and of Earth and Environmental Sciences at the CUNY Graduate Center. His research examines how climate variability, climate change, and human intervention interact to shape floods, droughts, and compound hazards from regional to continental scales, and what those extremes mean for water sustainability and infrastructure systems. He develops probabilistic and data-driven modeling frameworks using hierarchical Bayesian methods alongside emerging AI/ML approaches for dynamic risk analysis and decision-making in water systems, connecting fundamental hydroclimatology to applied adaptation and risk-informed planning.

He holds an M.S. and Ph.D. in Civil Engineering from North Carolina State University and completed postdoctoral research at Columbia University. He is a 2025–26 University Faculty Leadership Fellow in the CUNY Office of Research, an Early CAREER awardee of the U.S. Department of Energy’s Biological and Environmental Research program, and a member of the Fifth New York City Panel on Climate Change. He is also an affiliate faculty member with the UNU Hub on Remote-Sensing and Sustainable Innovations for Resilient Urban Systems (R-SIRUS) at CCNY, where he co-leads the Education, Training, and Capacity Building pillar. He has published more than 75 peer-reviewed articles, including in the *Nature* family of journals, and has led over \$5 million in externally funded research.

Two starkly different emergencies struck New York City just three years and two months apart.

On September 1, 2021, the remnants of Hurricane Ida unleashed 3.47 inches of rain on New York City in a single hour, the wettest hour in the record beginning in 1948. That night, eleven residents drowned in basement apartments: ten in Queens, one in Brooklyn. Just three years later, on November 18, 2024, the city declared its first drought warning in more than two decades, after enduring both the driest October on record and one of the longest stretches without measurable rain.

At first glance, these events seem like opposites » one a flood, the other a drought. But both emergencies are driven by how rapidly conditions changed: in one case, water arrived far too fast; in the other, it depleted just as quickly. That speed, whether in the form of flash flooding or flash drought, now tests New York’s water systems. The challenge is about volatility and timing, demanding a new approach to managing water in a city where too much or too little can happen too fast!

¹Mossel, C., Hill, S.A., Samal, N.R. et al. Increasing extreme hourly precipitation risk for New York City after Hurricane Ida. *Sci Rep* 14, 27947 (2024). <https://doi.org/10.1038/s41598-024-78704-9>

²Rahill-Marier, B., Devineni, N., and Lall, U.: Technical note: Modeling spatial fields of extreme precipitation – a hierarchical Bayesian approach, *Hydrol. Earth Syst. Sci.*, 26, 5685–5695, <https://doi.org/10.5194/hess-26-5685-2022>, 2022.

The Too Much Too Fast — When Design Storms Fall Behind Reality

New York’s drainage system is designed around a “1.75 inches per hour” standard rooted in intensity–duration–frequency curves developed from rainfall records between 1903 and 1951. This design storm was never once observed in Central Park until 1991. Since then, hourly totals above that threshold have been recorded five times: in 1995, 2004, 2006, 2021, and 2023. What was once a distant design case now recurs every few years.

In work with Carolien Mossel¹, we explored how the risk of an “Ida-like” hour has changed as the climate has shifted: what used to be an event with a high return period is now far more frequent. Hurricane Ida brought double the rainfall the city’s infrastructure was built to handle, overwhelming drains and flooding homes. The City’s design, once conservative, now is routinely exceeded.

The rigidity of the “design storm” also extends to geography. With Bianca Rahill-Marier², we analyzed nine long-running rain gauges around New York and found that, even at a 24-hour duration, fewer than sixty percent of annual maximum rainfall events are concurrent, even among the four closest stations most often used to inform design. The storms that matter most are spatially heterogeneous, while the city’s standards remain spatially uniform.

New York City's Volatile Water Future

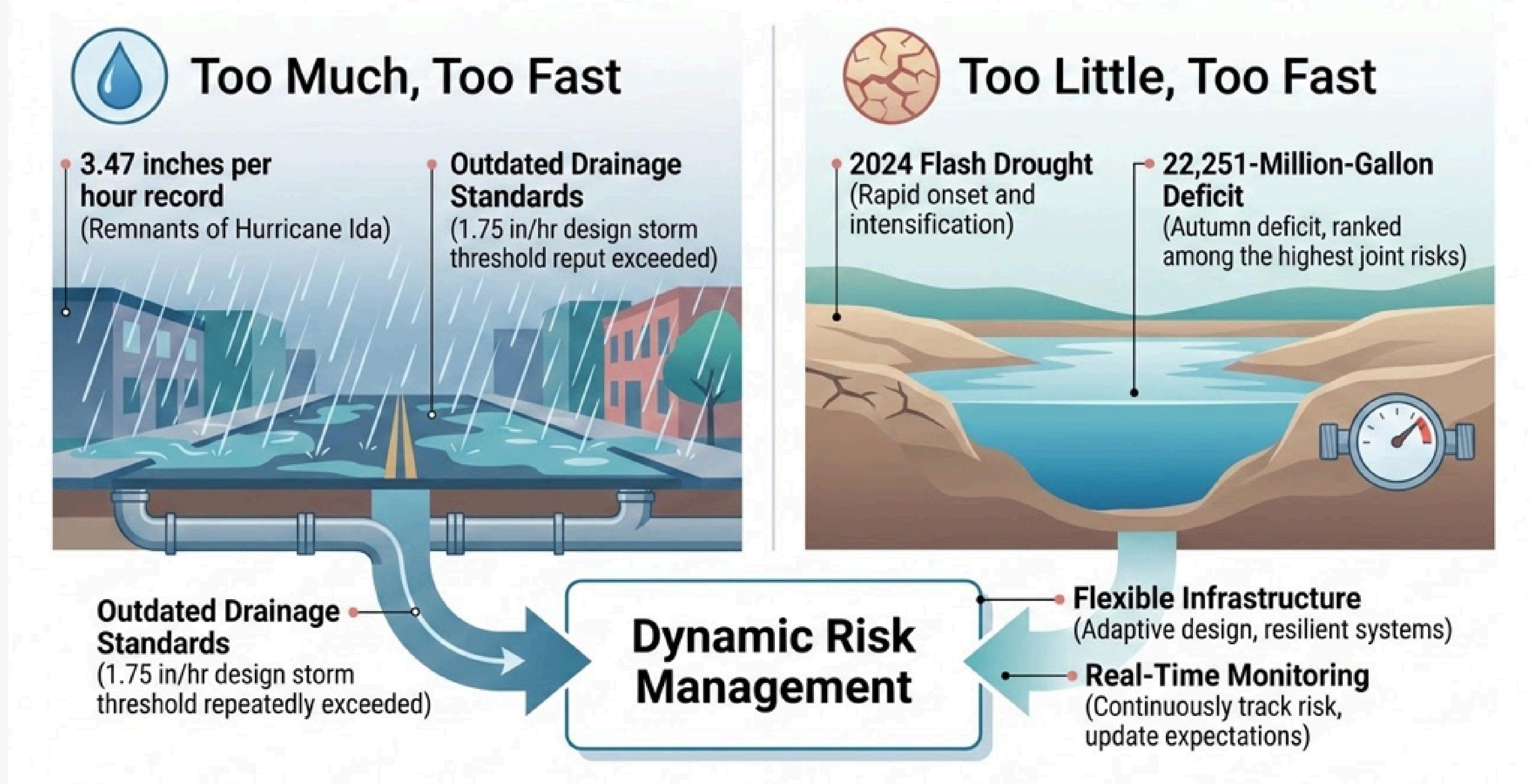


Image: New York City's water extremes demand dynamic risk management.

Residents' experiences further reveal the mismatch between design and reality. With Candice Agonafir³, we analyzed New York's 311 records, a decade of resident reports about street flooding and clogged catch basins, and found that local conditions, aging infrastructure, and historical topography play decisive roles in shaping risk on the ground.

"The lesson is to scrutinize design thresholds as the climate and city change. By watching when and where these thresholds are exceeded, New York can continually update its sense of risk, and adapt before the next crisis."

Naresh Devineni

The Too Little Too Fast — Managing Scarcity in an Accelerating Climate

In the autumn of 2024, New York City encountered a new kind of drought, defined by the speed with which it developed and the intensity of its impact. Together with New York City Panel on Climate Change (NPCC) colleagues⁴, we created a streamflow-based drought index for the Pepacton, Cannonsville, and Neversink reservoirs, measuring the cumulative gap between inflow and demand: its duration, severity, rate of onset, and recovery.

By these measures, the 2024 drought stood out. It began abruptly in mid-September and lasted eighty-seven days, accumulating a 22,251-million-gallon deficit. What set this event apart was how rapidly conditions deteriorated. At its steepest, the system lost 490 million gallons a day. Out of more than 450 drought events since 1951, this one ranked in the 94th percentile for joint risk including severity and speed, and in the 95th among autumn droughts.

The onset was sudden, triggered by a persistent ridge of high pressure after Hurricane Helene that blocked moisture from reaching the region. The city shifted in weeks from tracking a hurricane to watching reservoir levels drop at an unprecedented rate. The drought ended with rains in January 2025 restoring supplies. What emerged was a short, sharp drought, a category expected to become more common, according to the NPCC.

Our analysis also showed how sensitive drought impacts are to demand. Holding streamflow constant while adjusting demand by twenty percent in either direction shifted the drought's ranking from the 86th to the 98th percentile. In this accelerated climate, scarcity is shaped not only by weather, but by the human demands imposed on the system.

³Agonafir, C., Ramirez Pabon, A., Lakhankar, T., Khanbilvardi, R., & Devineni, N. (2022). Understanding New York City street flooding through 311 complaints. *Journal of Hydrology*, 605, 127300. <https://doi.org/10.1016/j.jhydrol.2021.127300>

⁴Devineni, N., Kim, S.-H., Rosenzweig, B., Braneon, C., McPhearson, T., Montalto, F., Bader, D., Ortiz, L., & Elszasz, H. (2026). Positioning the 2024 drought in New York City's drought history: A demand-sensitive framework for assessing risk (NASA/TM-20260007407). National Aeronautics and Space Administration. <https://ntrs.nasa.gov/citations/20260007407>

"The 2024 event highlights the challenge of managing water in an era where droughts can develop and intensify rapidly. Adapting to accelerating change means tracking not just how much water the city has, but how quickly risk can escalate, and responding with the flexibility and speed these conditions call for."

Naresh Devineni

Towards Dynamic Risk Management

The importance of climate variability and change for water systems is now well established. New York’s recent crises show that the greatest challenge is not just how much water is available, but how quickly and unpredictably conditions can shift. Predicting exactly when or where the next emergency will arise is difficult, especially as growth, land use, and new infrastructure further complicate the picture.

What is clear is that static benchmarks and fixed rules are not enough. The risks facing cities and water systems are dynamic, shifting with both climate and society. Meeting this challenge requires an approach that continuously monitors risk, updates expectations, and adapts management as conditions evolve.

Dynamic risk management offers this path forward. By tracking how risks and vulnerabilities change over time, and by building flexibility into decision-making, we can respond more effectively to whatever comes next. In an accelerating climate, resilience will depend on our willingness to learn and adapt to risks.

In Conversation with Naresh Devineni

Your work sits at the intersection of hydrology, climate variability, risk assessment, and water systems. For a general audience, how would you explain the biggest water-related challenge cities like New York are facing today?

The biggest risks megacities like New York face today are aging infrastructure and the vagaries of climate. Climate risk can manifest as too much water or too little. In the case of flash floods, the City is wrestling with increasingly heavy storms that the system cannot handle. In the case of flash drought, the impact is gradual at first and then sudden. We can impose restrictions, but there is a limit to how much residents can cut back. Add that to the uncertainty of when the drought will end, and we are looking at a complex climate-human interaction challenge.

The theme of this issue asks: “What do residents experience when the water rises?” From your research on urban flooding and hydroclimatic extremes, what do you think communities experience that is often missing from technical models or planning conversations?

In New York City, several communities live in low-elevation areas and in basement apartments. Often, these households are economically disadvantaged too. When a flood happens, water gushes in very quickly, leaving no time to react. The streets pond just as quickly. Part of the problem is how clean our catch basins are; when they clog, nuisance flooding follows. Another issue I observe on NYC streets is the effect of parked vehicles, which locally increase water velocity and steer flowing water toward the curbs. These nuanced real-world issues are rarely incorporated in the models.

Much of your work focuses on understanding risk under uncertainty. How can cities make better water and infrastructure decisions when the future climate is uncertain, but the need to act is urgent?

We will never resolve the uncertainty. We can, however, decide what level of risk we are willing to carry. In Carolien’s work, we projected the changing risk of an Ida-like event year by year ($P(Ida)$), then carried those probabilities through a decision-tree framework used classically to make decisions under uncertainty, to derive the expected impact over the 10-, 25-, and 50-year horizons cities actually plan on. We can handle drought risk similarly. The water manager can fix a risk/reliability target, say the $P(2024\text{ Flash Drought})$ in the future, and optimize operations and storage against it. Non-stationary methods fit directly into this framework.

Your research uses tools such as statistics, climate modeling, and machine learning. How can emerging technologies help translate complex water data into practical information for city agencies, planners, community organizations, and residents?

Water data used to be scarce. We built conceptual models that parameterized processes from limited observations, then used

those models to run scenario experiments for decision-making. With big data and modern AI/ML methods, we can observe processes directly and see deeper structure. That improves the models and the predictions, which is what agencies need for prognostic management. These tools also help us communicate better and rapidly. The concept figure in this article was generated by Gemini. It read my article and created that figure in 2 minutes. In the old days, that would have taken me 2 hours :)

CREST places strong emphasis on training the next generation of researchers and practitioners. What skills do students need today to work on future water challenges, especially at the intersection of science, engineering, data, and public decision-making?

A good training in hydrology and water resources systems and management methods should be at the core. In addition, fundamental statistical methods and the ideas of inference and hypothesis testing are also a must. Once the student is well trained on this foundation, they can build on it with AI/ML methods, which are always evolving; a well-trained student can adapt to new methods. Knowing the issues practitioners face will help develop a well-rounded student. Writing and communication skills will help a lot. Mainly, students need a curious mind to identify challenging and interesting water problems.

If you could ask funders, policymakers, and cityleaders to support one major shift in how we address urban water risk, what would it be, and why?

Researchers have good ideas, and agencies like the New York City Department of Environmental Protection are already using novel approaches. What holds them back is often liability, i.e., the consequences of acting on a prediction that turns out wrong. The shift I would ask for is to lower the cost of being wrong by using a staged approach. Fund low-risk actions that pay off regardless, like cleaning catch basins ahead of an anticipated storm, and allocate resources more equitably to marginalized communities. These can start now. Long-term work like sewer capacity upgrades and nature-based solutions needs sustained support the city can build gradually.

On a more personal note, what first motivated you to pursue research on water, climate risk, and hydrology, and what continues to inspire you in this work today?

I tell this to everyone who asks, and to everyone who doesn’t! I first got inspired by hydroclimatology during my Master’s class project, which expanded into an MS thesis, then into my PhD, and continues to this day. Using climate-informed forecasts for water management excited me at the time, and I wanted to see the project end to end. What I did not realize was that seeing a project end to end means devoting your entire career to it. I don’t need new inspiration today, because the study of water is, in itself, the driving force.



Early Career & Student Highlights

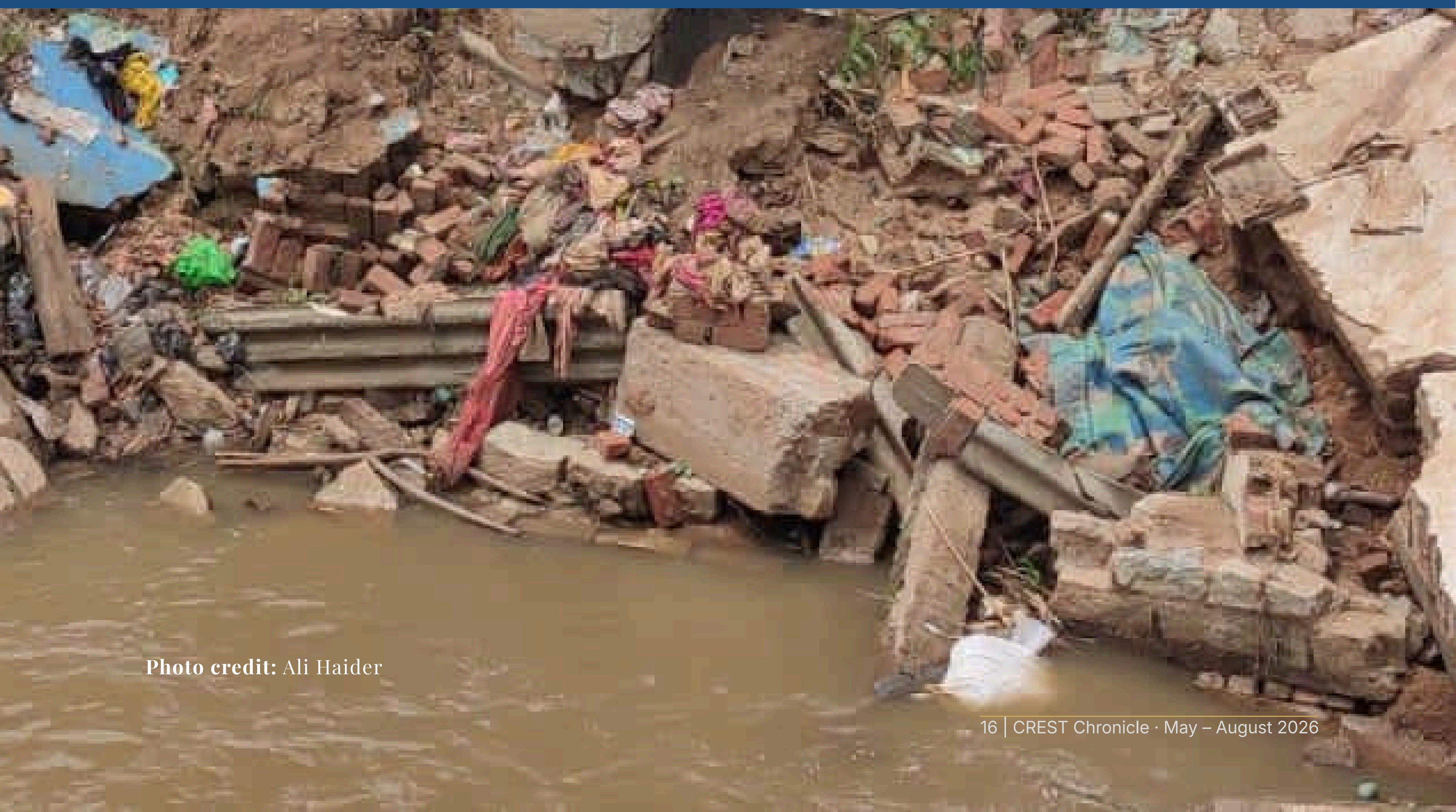


Photo credit: Ali Haider

Does Saving Water Actually Work?

Seon-Ho Kim

Dr. Seon-Ho Kim is a Research Scientist at The City College of New York, where he conducts research on sustainable water resources under a changing climate. His research interests include water resources systems, hydroclimatology, hydrologic modeling, climate change impacts, and the application of machine learning and artificial intelligence to water-related challenges. He received his Ph.D. in Civil and Environmental Engineering from Sejong University, South Korea, where he also worked as a postdoctoral researcher. Before joining CCNY, he was a visiting scholar at North Carolina State University.



Water is a fundamental resource that supports both human society and natural ecosystems. It is essential for irrigating agricultural land, cooling power plants and generating hydropower, and sustaining healthy rivers, wetlands, and aquatic ecosystems. Because water underpins food production, energy generation, and ecosystem functioning, ensuring a reliable water supply is critical. However, when water availability becomes insufficient to meet demand, the balance between supply and demand is disrupted, resulting in water stress. Persistent water stress depletes water stored in reservoirs and groundwater systems and can trigger widespread consequences, including reduced agricultural productivity, lower energy production, and an increased risk of wildfires.

Climate change and industrial development are two major drivers that are intensifying water stress. Rising global temperatures accelerate the hydrological cycle by increasing evaporation and altering precipitation patterns. As a result, dry seasons become drier due to enhanced evaporation, while wet seasons experience more intense rainfall and a greater risk of flooding. This growing contrast between periods of water scarcity and water abundance makes it increasingly difficult to maintain a stable water supply throughout the year.

At the same time, the rapid expansion of artificial intelligence and data-intensive industries is creating a new source of water demand. These industries require massive computing infrastructure and energy consumption, and the large amounts of heat generated by data centers must be removed using substantial quantities of cooling water. Together, increasingly variable water supplies and steadily rising demand are exacerbating water stress, highlighting the urgent need for effective mitigation strategies.

Historically, societies have responded to water shortages by expanding water supplies through the construction of reservoirs, canals, and other water infrastructure. Today, however, opportunities for developing new water sources have become increasingly limited. In many regions, existing water resources have already been fully exploited, while further development is often constrained by competing interests among stakeholders. As the traditional supply-oriented approach reaches its limits, reducing water demand through water conservation has emerged as a promising alternative. Various technological measures—including water reuse in buildings, leakage reduction in aging distribution systems, and recycling of cooling water—have been implemented to improve water-use efficiency. At the same time, public campaigns have encouraged individuals to reduce water consumption in their daily lives.

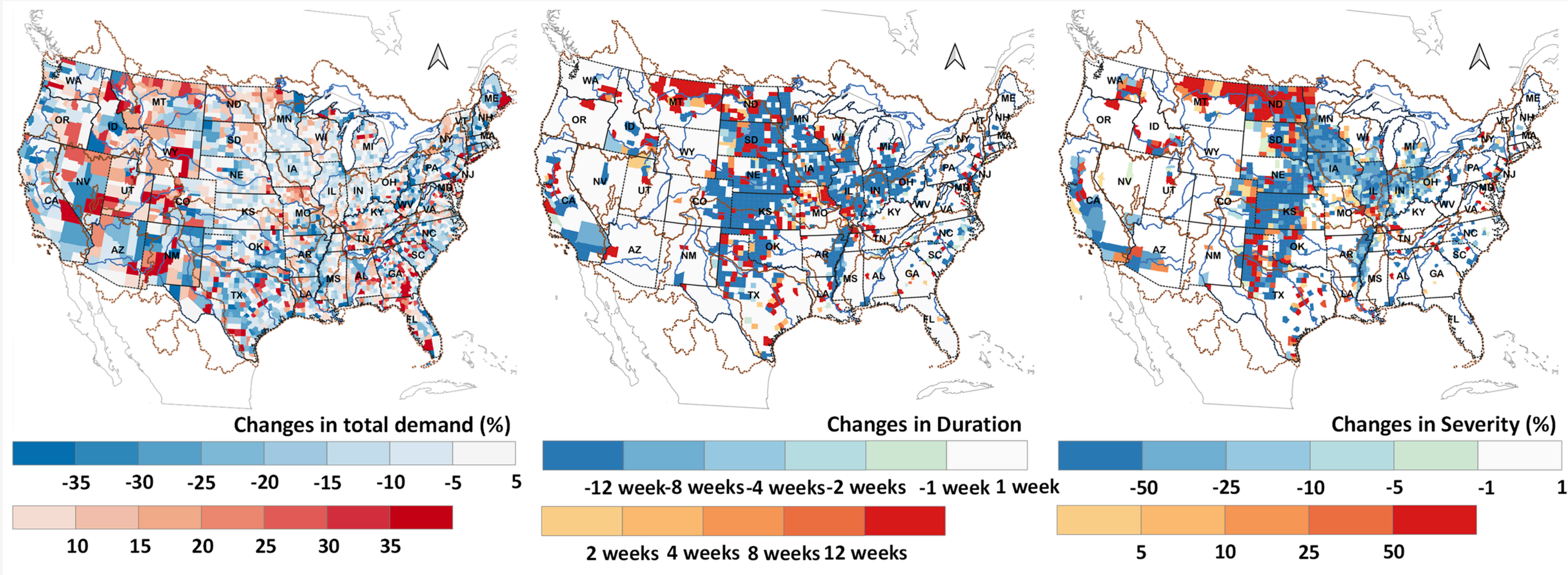


Image: Changes in water demand and water stress across the CONUS (2010–2020). Changes in total water demand (left), water stress duration (middle), and water stress severity (right). Source: Kim et al. (2026), Water Stress and Its Sensitivity to Demands across the Contiguous United States, *Communications Sustainability*.

Despite these widespread efforts, there has been limited scientific evaluation of how much water conservation has actually alleviated water stress or which conservation measures have been most effective across different regions and sectors. Without quantitative evidence of their effectiveness, it is difficult to determine where future investments should be directed or to maintain public motivation for continued participation in conservation efforts. This study addresses this knowledge gap by providing a scientific assessment of the outcomes of water conservation initiatives aimed at reducing water demand. Specifically, we quantify how sector-specific water savings in the United States over the past decade have reduced water stress and identify the regions and sectors that have contributed most to these improvements.

Our analysis shows that water conservation efforts between 2010 and 2020 reduced total water use by 4.4%, despite continued population growth across the United States. These reductions lowered the frequency of water stress events by 11.9% and reduced their severity by 14.1%. These findings demonstrate that water conservation has been highly effective in mitigating water stress in the United States. By providing quantitative evidence of the benefits of water conservation, this study helps bridge the gap between scientific research and society, offering clear and measurable feedback on the effectiveness of conservation efforts and strengthening public and policy support for sustainable water management.

Q & A with Seon-Ho Kim

Your research uses innovative modeling and data-driven approaches to better understand water systems. What problem are you most passionate about solving?

It is difficult to choose just one, but my current focus is understanding how water demand should evolve to ensure sustainable water supplies under a changing climate. As warming increases climate variability, maintaining reliable water availability becomes more challenging. My goal is to identify how the magnitude and seasonal timing of water demand across different sectors can be optimized to reduce drought impacts.

Many people interact with water every day without realizing the science behind it. Can you share an example of how your research could improve water management, forecasting, or resilience in ways that people might experience in their daily lives?

Many people conserve water in daily life without realizing how much their actions matter. Our research shows that these efforts can make a measurable difference. New York is a strong example: per-capita water use in New York City has fallen by about half since the 1980s and by 12.3% since 2010. Across New York State, we found that conservation reduced the duration of water stress by 6.4% and its severity by 2.6%. These results show that everyday water-saving choices can meaningfully strengthen water resilience.

Water research often brings together many disciplines. How has collaborating with experts in engineering, computer science, and other fields shaped your work and the questions you ask?

Collaboration is essential in water research. I frequently work with atmospheric scientists who study large-scale climate processes. Their discoveries often inspire new questions about how global climate variability affects regional water resources. In return, our work helps translate their findings into practical strategies for water management, creating a productive exchange between fundamental science and real-world applications.

Looking ahead, what do you think is one of the biggest opportunities or challenges for water research over the next decade, and how do you hope your work will contribute to addressing it?

The rapid growth of AI is driving major expansion in data centers and electricity generation, both of which can require significant water for cooling. Balancing this rising demand with sustainable water supplies will be a major challenge. I hope my research can help improve water allocation strategies that support growing industrial needs while protecting long-term water security.

What kinds of collaborations or opportunities are you currently looking for, and how can the broader research community help support emerging scientists like yourself?

I am particularly interested in collaborations involving AI and large language models (LLMs) for water research. While these technologies offer exciting opportunities, access to commercial models or the computing resources needed to deploy open-source alternatives can be costly, creating barriers for early-career researchers. Broader community support through shared computing resources, collaborative platforms, and accessible research infrastructure would help lower these barriers and enable more early-career researchers to innovate.

Since joining CUNY CREST, how has the institute shaped your research and professional development, and what aspects of the CREST community have been most valuable to your career?

The most valuable aspect of CREST has been the opportunity to collaborate with experts from diverse disciplines. These collaborations have significantly broadened my research perspective. In particular, my interest in large language models began through collaborations at CREST, and AI-based research has since become one of the major pillars of my work.

On a personal note, what inspired you to pursue water research, and what advice would you give students or early-career researchers entering the field?

My journey into water research began as an undergraduate, when a professor's passion for research inspired me to pursue a similar path. What makes water science especially rewarding is its broad reach. Water connects climate, agriculture, energy, ecosystems, and disasters, creating countless opportunities to address important societal challenges and build an interdisciplinary career.

From Satellite Observations to Flood Risk: Integrating Remote Sensing, Hydrologic Modeling, and Artificial Intelligence

Said A. Mejia-Manrique

Dr. Said A. Mejia-Manrique is a postdoctoral researcher at CUNY CREST whose work focuses on hydrology, flood risk, satellite and radar remote sensing, atmospheric retrievals, and artificial intelligence. His research integrates Earth observations, geospatial information, machine learning, and physically based models to improve the characterization of the atmosphere, extreme precipitation, and flooding. His current work includes satellite-based atmospheric retrievals using ATMS and CrIS observations, high-resolution precipitation frequency analysis, spatially distributed design storms, hydrologic modeling, and AI-based flood mapping. He is particularly interested in developing scalable approaches that connect remote sensing, atmospheric science, and hydrology to improve environmental monitoring and support more resilient communities.

Water-related hazards are becoming increasingly important as communities face intense rainfall, flooding, and growing exposure to weather and climate extremes. My research focuses on improving how we observe, understand, and model the processes that lead to these hazards by combining hydrologic modeling, satellite and radar remote sensing, geospatial analysis, atmospheric retrievals, and artificial intelligence. A central goal of my work is to strengthen the connection between environmental monitoring and hazard prediction. By better characterizing atmospheric conditions, precipitation, terrain, and surface response, we can improve our understanding of the dynamics of the water cycle and develop more effective approaches for anticipating and assessing hazards such as flooding.

One important part of this effort is understanding extreme precipitation. Rainfall intensity, duration, and frequency are fundamental for infrastructure design, hydrologic modeling, and flood assessment, yet these characteristics can vary substantially over short distances, especially in regions with complex terrain. I have contributed to collaborative research using high-resolution radar observations to examine depth-duration-frequency relationships in Puerto Rico and the U.S. Virgin Islands. This experience has strengthened my broader interest in using high-resolution precipitation information and remote sensing to better understand hydrologic processes and flood-generating conditions.

Another major part of my research focuses on satellite atmospheric retrievals. I work with observations from instruments such as the Advanced Technology Microwave Sounder (ATMS) and Cross-track Infrared Sounder (CrIS) and develop artificial-intelligence approaches for retrieving atmospheric temperature and moisture profiles from satellite measurements. These variables are essential for characterizing the thermodynamic state of the atmosphere and understanding the conditions associated with weather development and precipitation. Improving these retrievals can strengthen atmospheric monitoring systems and provide more accurate information about the processes that precede and influence extreme weather.



This atmospheric perspective is closely connected to my hydrologic research. Understanding flooding requires looking beyond the final inundation extent and examining the sequence of processes that produces it—from atmospheric conditions, to precipitation, to the movement of water across the landscape. I am developing artificial-intelligence methods for large-scale flood mapping by combining satellite-derived flood observations, radar precipitation, terrain elevation, land cover, river proximity, and other environmental variables. Deep-learning models can use these datasets to identify relationships between rainfall, landscape characteristics, and observed inundation and can complement traditional hydrologic modeling when applications cover very large regions.

My research also considers flood vulnerability from a broader perspective. Flood impacts depend not only on the magnitude of the physical hazard but also on exposure, land use, infrastructure, and social conditions. By integrating hydrologic, environmental, and socioeconomic information, I investigate approaches for identifying areas that may experience disproportionately high flood risk and for improving how these risks are characterized.

Across these research areas, the common objective is to connect observation, understanding, and prediction. Satellite and radar observations help us monitor the atmosphere and precipitation; hydrologic and geospatial information help us understand how water interacts with the landscape; and artificial intelligence provides new ways to integrate these complex datasets. My long-term goal is to develop scalable monitoring and modeling approaches that improve our understanding of Earth-system dynamics and translate that knowledge into more effective tools for predicting and assessing water-related hazards and supporting more resilient communities.

Q & A with Said A. Mejia-Manrique

Can you tell us about your current research and how it has evolved since completing your Ph.D.? What are the key questions you're working to answer?

My current research combines hydrology, flood risk, satellite remote sensing, atmospheric retrievals, and artificial intelligence. Since completing my Ph.D., my work has expanded toward developing AI-based methods for both flood applications and satellite retrieval systems. I am interested in how better observations and models can improve environmental monitoring, prediction, and understanding of water-related hazards.

Your research involves solving complex water-related challenges. What tools, technologies, or modeling approaches do you use most often, and how do they help advance your research?

I use satellite and radar observations, GIS, Python, machine learning, deep learning, and physically based hydrologic models such as GSSHA. I also develop and evaluate AI-based atmospheric retrieval models using ATMS and CrIS observations. Combining these tools allows me to study the atmosphere, precipitation, terrain, and flooding as interconnected parts of the Earth system.

How has your experience at CUNY CREST shaped your growth as a researcher? Are there any mentors, collaborations, or opportunities that have had a lasting impact on your career?

CUNY CREST has allowed me to work across hydrology, remote sensing, atmospheric science, and artificial intelligence. Mentorship from Dr. Reza Khanbilvardi and Dr. Mitch Goldberg has broadened my scientific and professional perspective. Their guidance, along with interdisciplinary collaborations and opportunities to work on satellite retrievals and operational environmental applications, has helped shape my growth as a researcher.

As an early-career researcher, what has been the most rewarding or unexpected part of your research journey so far?

One of the most rewarding aspects has been seeing my research expand beyond a single discipline. I began primarily in hydrology, but my work now includes satellite retrievals, artificial intelligence, and operational applications. Developing models that can potentially contribute to real monitoring and prediction systems has shown me how interdisciplinary research can create broader scientific and societal impact.

Where do you see your career heading over the next five to ten years? What kinds of research opportunities, collaborations, or challenges are you most excited to pursue?

Over the next five to ten years, I hope to build an independent research program connecting hydrology, satellite remote sensing, atmospheric retrievals, and artificial intelligence. I am particularly interested in large-scale environmental monitoring and flood prediction, while continuing collaborations with universities, federal agencies, and operational partners to translate advanced AI and remote-sensing research into practical tools.

What advice would you give to graduate students and aspiring researchers who hope to build a career in water research? Are there any skills or experiences you believe are especially valuable for the next generation of scientists?

I would encourage students to develop strong scientific fundamentals while learning to work across disciplines. Programming, statistics, GIS, remote sensing, hydrologic modeling, machine learning, and scientific communication are increasingly important. I also recommend gaining experience with real operational datasets and collaborative projects, because modern water and environmental research increasingly depends on connecting physical understanding with advanced computational tools.

Modeling Flood Extent Under Different Storm Scenarios in Puerto Rico

Ana Maria Mejia Manrique



Ana Maria Mejia Manrique is a Ph.D. student in Civil Engineering at The City College of New York. Originally from Colombia, she began her doctoral studies in Fall 2023. Her research focuses on water resources, particularly developing flood risk maps to identify vulnerable areas and support more resilient communities. She is also part of the Caribbean Collaborative Action Network (CCAN), which connects communities, researchers, and regional partners to advance climate adaptation in Puerto Rico and the U.S. Virgin Islands. In addition, she is affiliated with the United Nations University Hub on Remote Sensing and Sustainable Innovations for Resilient Urban Systems (R-SIRUS) at CCNY, which supports interdisciplinary research and innovation in climate, water, sustainability, and urban resilience.

Flooding is one of the most significant natural hazards affecting Puerto Rico, particularly during tropical storms, hurricanes, and other extreme rainfall events. The island’s complex terrain and highly variable precipitation can produce very different flooding conditions from one watershed to another. Although existing flood hazard maps provide valuable information for planning and emergency management, there is still a need to better understand how flood inundation may change under storms of different durations and return periods, particularly across inland and watershed areas.

My research focuses on developing flood extent maps for Puerto Rico under different design-storm scenarios. Rather than evaluating only a single extreme event, the objective is to simulate storms with different durations and recurrence intervals and determine how the resulting inundation extent changes across the landscape. This approach can provide a broader picture of potential flood conditions and complement existing flood hazard information.

To accomplish this, the research combines high-resolution rainfall information with hydrologic modeling. Radar-based

Depth–Duration–Frequency (DDF) curves are used to define extreme rainfall amounts for different storm durations and return periods, while historical rainfall events are analyzed to better represent how rainfall is distributed throughout a storm. These design storms are then introduced into the Gridded Surface Subsurface Hydrologic Analysis (GSSHA) model to simulate the resulting flooding.

The resulting maps can help identify areas that may be affected under different storm scenarios and provide additional information for flood risk management, infrastructure planning, emergency preparedness, and community resilience. By examining a range of return periods, the research aims to provide a more comprehensive understanding of how flood extent may evolve as storm severity changes.

The current study area is the Añasco watershed in western Puerto Rico, where the modeling framework is being developed and evaluated. The broader goal is to establish an approach that can be applied to other watersheds across Puerto Rico to support improved flood hazard characterization throughout the island.

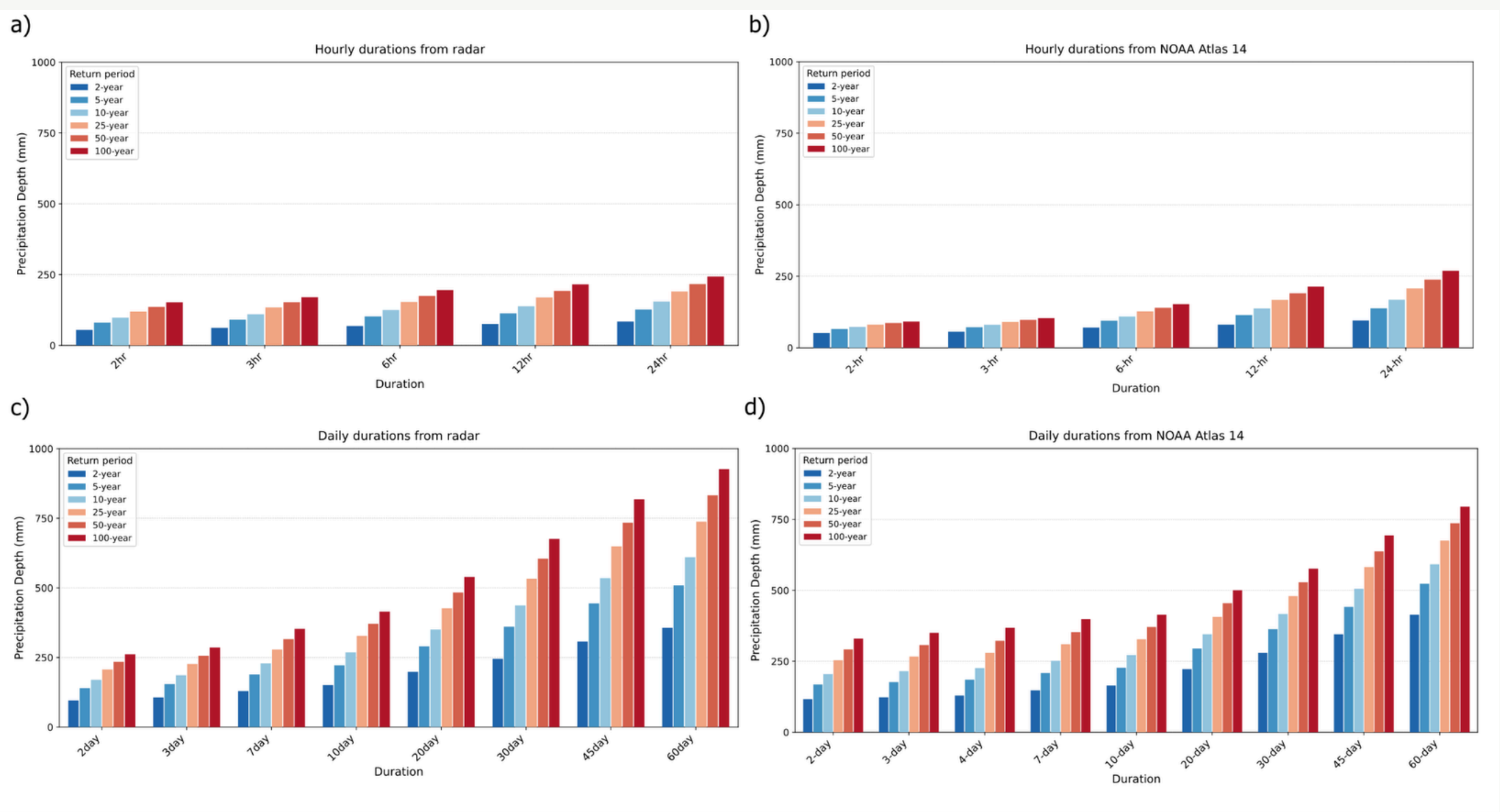


Image: Depth–Duration–Frequency values from two sources: radar-derived estimates from the collocated 1 km × 1 km grid cell (panels a and c) and NOAA Atlas 14 precipitation frequency estimates (panels b and d). Panels a) and b) show hourly durations, while panels c) and d) show daily durations.

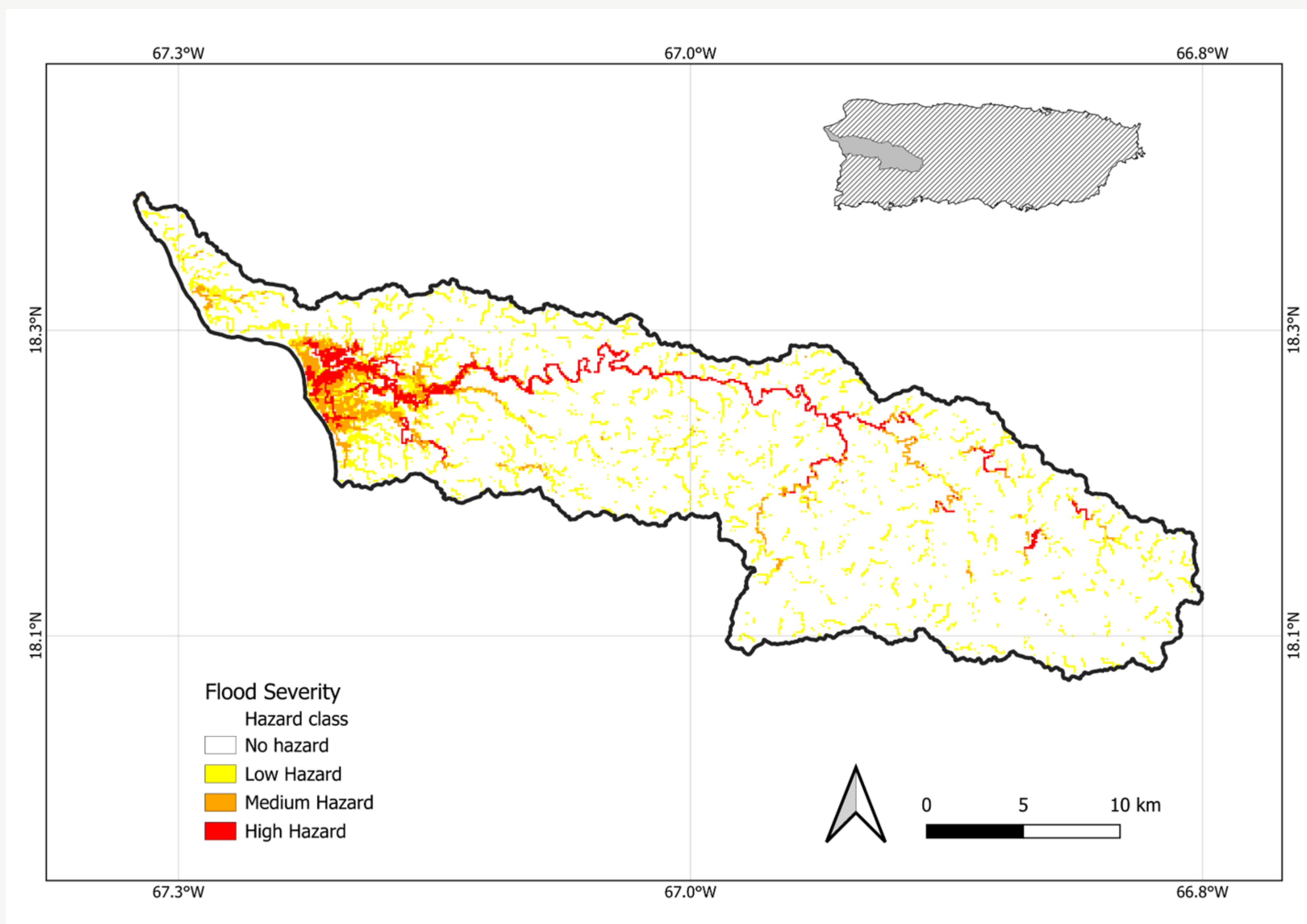


Image: Flood Hazard Classification at 100 m Resolution (12-Hour, 2-Year Return Period).

Q & A with Ana M. Mejia Manrique

Can you tell us about your current research and what inspired you to pursue this area of study? Why do you think your work is important for advancing water research?

My research focuses on developing flood risk maps for Puerto Rico. I chose Puerto Rico because its Caribbean location makes it highly vulnerable to tropical cyclones, extreme rainfall, and flooding. Its complex terrain also makes it an important study area. This research can improve flood understanding, support vulnerable communities, and contribute to more effective water-risk management.

How has your experience at CUNY CREST shaped your growth as a researcher? Are there any mentors, collaborations, or opportunities that have had a lasting impact on your journey?

CUNY CREST has contributed greatly to my personal and professional growth as a researcher. The professors and mentors within the institute have supported my development by sharing their expertise, providing guidance, and encouraging the exchange of ideas. These interactions have expanded my knowledge, strengthened my research skills, and created valuable opportunities for collaboration.

As you work toward completing your Ph.D., what do you see as the next step in your career? What kinds of opportunities or research directions are you hoping to pursue?

As I work toward completing my Ph.D., I hope to continue advancing my research in Puerto Rico while extending the methods developed there to other regions facing similar flood challenges. I am also interested in expanding my work in artificial intelligence, exploring how AI can be applied at a larger scale to improve flood prediction, risk assessment, and water-related decision-making.

Research often comes with both challenges and rewarding moments. What has been the most memorable experience during your Ph.D. journey so far?

Some of the most memorable experiences during my Ph.D. journey have been the opportunities to present my research at major conferences, participate in panels alongside well-known researchers, and exchange ideas during seminars hosted by CUNY CREST. These experiences have strengthened my confidence, broadened my perspective, and helped me grow as a researcher.

What advice would you give to students who are considering pursuing graduate research in water science? Is there anything you wish you had known when you started your Ph.D.?

I would advise students to stay consistent, disciplined, and resilient throughout the journey. Graduate research comes with challenges, uncertainty, and unexpected setbacks, but continuing to show up and move forward is essential. I have learned that progress is not always immediate, and persistence, patience, and a willingness to learn from difficulties are key to growing as a researcher.



Before the Water Rises: Smarter Flood Warnings for New York City

Shima Kamali

Shima Kamali is a Ph.D. candidate in Civil Engineering specializing in water resources, hydrologic modeling, and artificial intelligence. Her research focuses on developing data-driven tools to improve urban flood prediction, early warning systems, with the goal of helping cities and communities better prepare for extreme rainfall and flooding.

Flooding is one of the most widespread and damaging natural hazards in the world. Heavy rainfall can quickly overwhelm rivers, drainage systems, and city streets, damaging homes, disrupting transportation, and putting lives at risk. As cities grow and intense rainfall events become more common, urban communities face an important question: How can we identify where flooding may occur before the water begins to rise?

This challenge is especially important in New York City. The city’s dense development, large areas of pavement, underground infrastructure, and complex network of streets and buildings leave little space for rainwater to soak into the ground. During intense storms, water can collect rapidly on streets, at intersections, and near buildings. Subway entrances, roadways, and low-lying neighborhoods may become unsafe within a short period of time.

Flooding is also not experienced equally across the city. Some communities are more vulnerable because of their location,

drainage conditions, aging infrastructure, or limited access to resources. Therefore, understanding not only when flooding may occur, but also where it is most likely to happen, is essential for improving emergency response and protecting residents.

My research focuses on developing faster and more detailed methods for predicting street-level flooding across New York City. The work begins with a computer-based flood model that uses information such as rainfall, ground elevation, streets, and drainage-related features to simulate how water moves and accumulates across the city during a storm.

These simulations can produce detailed flood maps showing which streets may be affected, how deep the water may become, and how conditions may change from one hour to the next. However, detailed flood simulations require substantial computing time. This makes them valuable for studying previous storms and planning for future events, but more difficult to use when city officials and residents need information quickly.

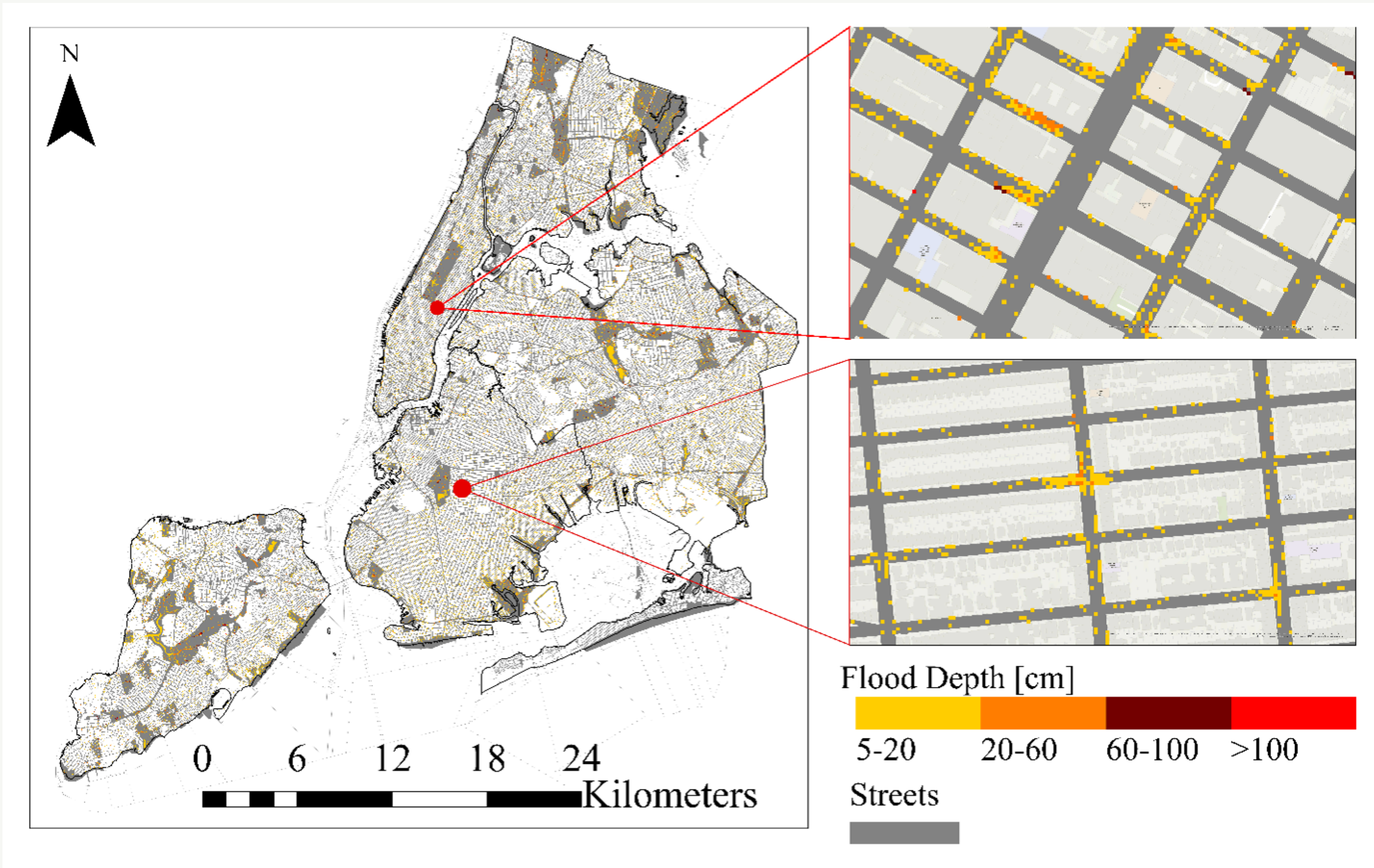


Image: Simulated flood depths across New York City after 12 hours of rainfall on October 30, 2025, generated using the flood model developed in this study. The enlarged panels illustrate localized street-level flooding at two selected locations.

To overcome this limitation, I am using the results of these detailed simulations to train an artificial intelligence model. The AI model learns how rainfall, ground conditions, previous flooding, and other local features influence flood patterns across the city. Once trained, it can generate new flood predictions much faster than the original computer simulations.

The goal is to combine the accuracy and detail of flood modeling with the speed of artificial intelligence. Instead of waiting for a lengthy simulation to finish, the AI model could quickly estimate where water is likely to collect during an approaching storm, how deep the flooding may become, and how conditions may change over the following hours.

In the future, this research could support a neighborhood-scale flood warning system for New York City. Emergency managers could use the predictions to identify streets that may need to be closed, position response teams and equipment, and issue more targeted warnings. Transportation agencies could prepare for possible disruptions, while residents could receive clearer information about flood risks in their immediate area.

A citywide warning system cannot prevent heavy rainfall, but it can help people prepare earlier and make safer decisions. By transforming complex rainfall and flood information into timely and easy-to-understand maps, this research aims to make flood predictions more useful for city agencies, emergency responders, and the communities they serve.

Q & A with Shima Kamali

Can you tell us about your current research and what inspired you to focus on AI-driven flood warning systems? What excites you most about this work?

My research develops an AI-based system to predict street flooding across New York City quickly and in high detail. I was inspired by how rapidly urban floods can disrupt transportation, damage homes, and endanger people. What excites me most is the possibility of creating practical warnings that give communities more time to prepare.

Your research combines artificial intelligence with flood forecasting to improve public safety. Can you explain how your work could help communities better prepare for flash floods and reduce their impacts?

The system could show which streets and neighborhoods are most likely to flood, how deep the water may become, and how conditions may change during a storm. Faster, location-specific forecasts could help residents avoid dangerous routes and allow emergency managers to issue targeted warnings, close roads, and position response teams before flooding becomes severe.

What tools, technologies, or machine learning approaches are you using in your research, and how do they help improve flood prediction and warning systems?

I combine detailed computer flood simulations with rainfall data, elevation maps, street information, and artificial intelligence. The AI model learns how flooding develops across space and over time, then produces predictions much faster than traditional simulations. Geographic information systems also help me organize the data and turn the results into clear, street-level flood maps.

How has your experience at CUNY CREST shaped your growth as a researcher? Are there any mentors, collaborations, or opportunities that have played an important role in your journey?

CUNY CREST has helped me grow by placing my research in a collaborative environment focused on real environmental challenges. Working with advisors, and students from different backgrounds has strengthened my technical skills and my ability to communicate science. Opportunities to present my work and connect with communities have also shaped my goals as a researcher.

As you work toward completing your Ph.D., what do you see as the next step in your career? What kinds of research opportunities or collaborations are you hoping to pursue in the future?

After completing my Ph.D., I hope to pursue a career that combines research, teaching, and public service. I am especially interested in developing practical tools for floods, rainfall, and other water-related challenges. I would like to collaborate with universities, industries, and communities so that scientific advances can support better planning and safer decisions.

What advice would you give to students who are interested in combining artificial intelligence, data science, and water research? Is there anything you wish you had known when you first started your Ph.D.?

My advice is to understand the water problem before choosing an AI method. Learn the science, work carefully with data, and ask how the final tool will help people. I also wish I had known earlier that progress is rarely linear; collaboration, patience, and learning from unsuccessful approaches are essential parts of research.

Connecting Hydrology, Satellites, AI, and Cities to Understand Urban Flooding

Ali Haider

Ali Haider is a Ph.D. candidate in Civil Engineering at The City College of New York and a researcher with the CUNY CREST Institute. His work focuses on urban flood prediction and mapping using remote sensing, artificial intelligence, hydrologic modeling, and multi-source data, with current research spanning Mumbai and New York City. His earlier work in environmental engineering included wastewater-related research, and his experience with the National Institute of Disaster Management in India, including field visits to flood-affected regions, helped shape his interest in disaster and flood research. He is particularly interested in developing high-resolution, transferable approaches that can support better preparedness and decision-making across diverse urban environments. He is also actively involved in teaching, mentoring, and interdisciplinary research collaboration.



Urban flooding is one of the most complex and disruptive challenges facing cities today. A single intense storm can affect transportation, housing, businesses, schools, public infrastructure, and emergency services within a matter of hours. Yet predicting exactly where flooding will occur, how severe it will be, and when it will happen remains difficult.

In our research, we are exploring ways to improve urban flood prediction by combining traditional hydrologic understanding with newer sources of information such as satellite observations, high-resolution rainfall data, machine learning, physical models, and community-generated data. Working with Prof. Reza Khanbilvardi and Prof. Naresh Devineni, I have been particularly interested in a simple idea: no single dataset or model can fully describe urban flooding. Cities are complex systems, and the tools we use to understand them need to reflect that complexity.

At the same time, we are extending this thinking to New York City, a very different and comparatively data-rich urban environment. Our ongoing research is exploring how multiple sources of information can be brought together, including satellite radar, precipitation, municipal flood information, physical modeling, crowdsourced 311 reports, and sensor observations. Rather than depending on one source, the aim is to develop a more integrated picture of where flooding is occurring and how confidently we can identify it.

One part of our work focuses on Mumbai, India, where limited observations make detailed flood modeling particularly challenging. We analyzed multiple flood events between 2019 and 2024 at a 10-meter spatial resolution, using satellite-based observations together with topographical and rainfall information. The goal is to understand whether high-resolution flood patterns can be identified and modeled even where conventional monitoring networks are limited. This work is currently in the publication phase.

Mumbai is especially important because its challenges are shared by many rapidly growing cities across the Global South. These cities often experience intense rainfall, high population density, rapid urban development, and limited monitoring infrastructure. Approaches that depend entirely on dense sensor networks or highly detailed hydraulic models may therefore not always be practical. Satellite observations, machine learning, and other remotely available information can help fill some of these gaps.

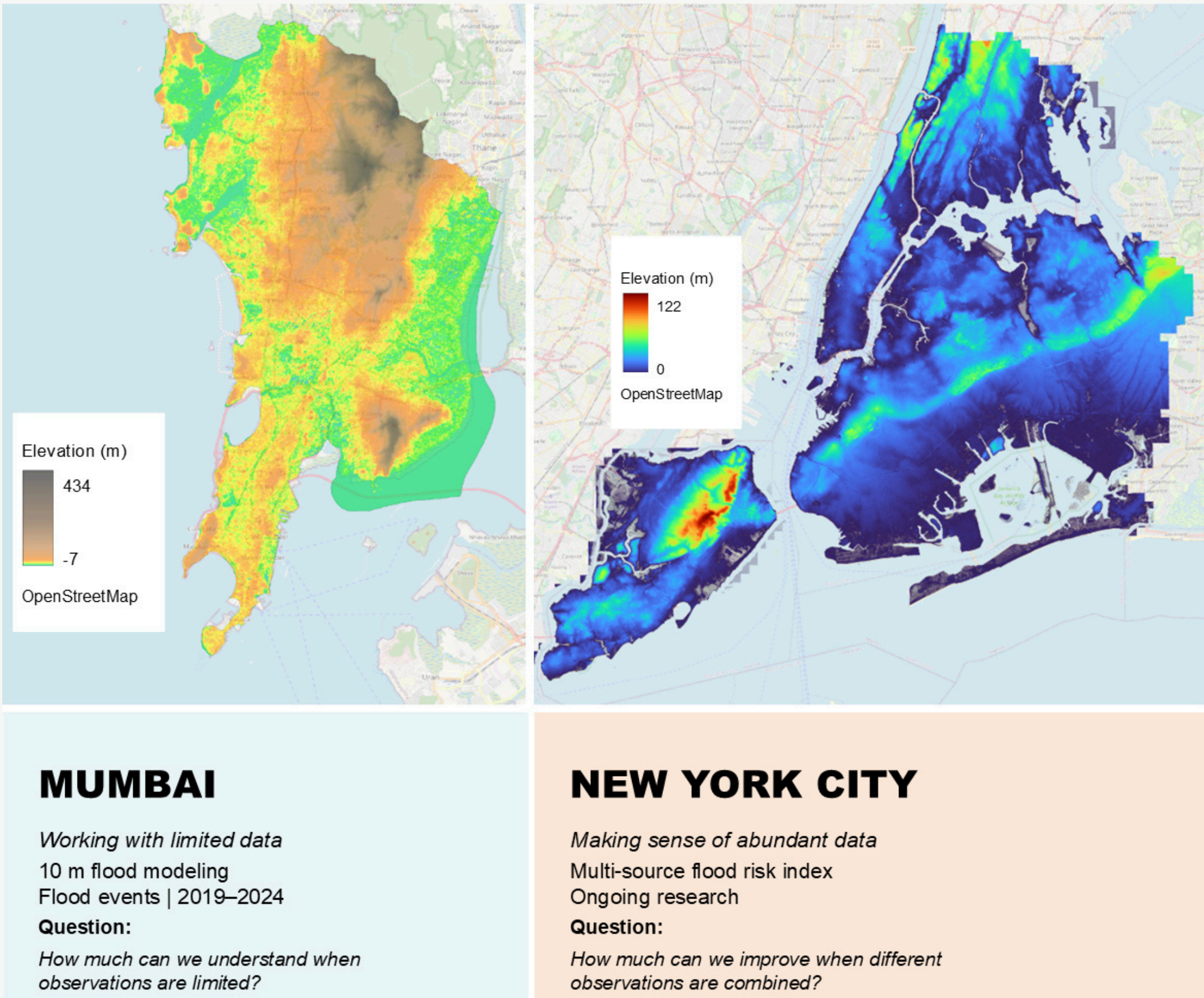


Image: Two contrasting urban laboratories for flood research

This contrast is scientifically valuable. Mumbai asks how much we can learn when data are scarce, while New York asks how effectively we can combine information when many datasets are available. Together, they allow us to explore whether urban flood methods can become more transferable, flexible, and useful across very different cities.

Artificial intelligence is accelerating this work, but the objective is not to replace hydrology with AI. We see the future in combining physics, observations, computing, and data-driven methods. The challenge is ensuring that these tools remain reliable and transferable rather than producing predictions that look precise but cannot be trusted elsewhere.

Ultimately, better flood science should lead to better decisions. If we can identify flood-prone locations more accurately, forecast them earlier, and communicate that information effectively, cities can prepare sooner and respond more efficiently. For us, that is the larger goal: moving from better data and models toward better urban flood intelligence.

Q & A with Ali Haider

What is the central question behind your research?

My research asks how we can better predict where urban flooding will occur, how severe it may be, and when it will happen. Urban flooding is a complex system shaped by rainfall, drainage, topography, infrastructure, and human activity. By working in both Mumbai and New York City, we are exploring approaches that can work across very different urban environments and support better, more timely decisions.

When did you realize the real-world importance of flood research?

A defining moment came in 2022, when I visited flood-affected areas in Assam and Gujarat while working with India's National Institute of Disaster Management. In Assam, I met schoolchildren who had missed classes because their school was damaged, and I saw small businesses struggling to recover. It made the human impact of flooding very real to me. Since then, I have always tried to look beyond maps and numbers and remember the people behind them.

What has been the most challenging part of your research journey?

Limited data, uncertainty, publishing, negative feedback, and the feeling that research is never really finished are all challenging. I have also learned that small setbacks are part of research and often teach you the most. Supportive mentors, collaborators, persistence, and asking for help have made a big difference.

Which new developments in water research excite you most?

I am most excited about physics-informed AI, high-resolution observations, community-generated data, and operational flood forecasting. I see the future as a combination of AI, physical understanding, observations, and computing rather than AI replacing hydrology. These tools are also allowing researchers to spend less time on routine coding and more time on scientific questions.

How has CREST shaped your growth as a researcher?

CREST has taught me the value of collaboration and interdisciplinary research. Prof. Reza Khanbilvardi has given me the freedom and support to explore new ideas and opportunities, while Prof. Naresh Devineni has been instrumental in my research and scientific thinking. I am also grateful to Dr. Shakila Merchant for opportunities to mentor students through CREST HIRES. Beyond research, CREST has exposed me to teaching, mentoring, conferences, summer programs, and a very welcoming research environment.

What inspired you to work in water science, and what advice would you give students?

My interest in water began during my undergraduate years, when I realized how fundamental it is and how many challenges are connected to it. I first worked in environmental engineering and wastewater treatment, and later moved into flood research. What keeps me interested is the combination of science, technology, climate, and societal impact. My advice to students is simple: come with curiosity and a willingness to learn. You do not need to start as an expert programmer or modeler; those skills develop along the way.

What do you hope to do after your Ph.D.?

After my Ph.D., I hope to continue in academia and research, while remaining open to opportunities where I can contribute meaningfully. In the long term, I would like to lead my own research group and connect academic research with operational applications. Teaching and mentoring are equally important to me. Ultimately, I want to see the research I contribute to being used in real decision-making and helping communities become better prepared for flooding.



CREST Project Highlight



Advancing Hydroclimate Resilience in the Caribbean through the Caribbean Collaborative Action Network (CCAN)

Reza Khanbilvardi

The Caribbean is one of the most climate-vulnerable regions in the world, experiencing increasingly frequent and intense extreme rainfall events, inland flooding, landslides, hurricanes, and coastal hazards. These events threaten lives, infrastructure, water resources, agriculture, and local economies, underscoring the need for improved prediction, monitoring, and decision-support systems. Responding to these challenges requires interdisciplinary science, advanced technologies, and close collaboration with local communities and decision-makers.

The CUNY CREST Institute is addressing these challenges through its participation in the Caribbean Collaborative Action Network (CCAN), part of the NOAA-RISA program supported by the National Oceanic and Atmospheric Administration (NOAA). CCAN is one of twelve regional climate adaptation partnerships established across the United States to strengthen climate resilience through collaborative research, stakeholder engagement, and the co-development of practical solutions. Within Puerto Rico (PR) and the U.S. Virgin Islands (USVI), CCAN brings together researchers, government agencies, and community organizations to improve preparedness for extreme hydrological events while supporting long-term climate adaptation.

The work of CCAN closely aligns with the mission of the CUNY CREST Institute to advance the understanding and prediction of hydroclimate and hydrological extremes through innovative modeling and remote sensing technologies. By integrating radar observations, satellite products, artificial intelligence, geographic information systems (GIS), hydrologic models, and community knowledge, the project contributes directly to CREST's goals of improving climate prediction, developing advanced Earth observation tools, supporting resilient communities, and providing science-based guidance for policymakers.

Our research focuses on several interconnected areas, including improved precipitation estimation and forecasting, flood hazard mapping, landslide susceptibility assessment, hydrologic modeling, and the development of decision-support tools for community resilience. Together, these activities are strengthening the scientific foundation needed to better anticipate and manage water-related hazards throughout the Caribbean.



Pictures: Storm-damaged roadway and flooded street (Picture Credit: Dr. Eric Harmeson, from UPRM).

Turning climate observations into actionable risk information

One of the team's most significant accomplishments during the past year has been the development of updated high-resolution Depth-Duration-Frequency (DDF) curves for Puerto Rico and the U.S. Virgin Islands. Using more than twenty years (2002–2023) of NEXRAD Level III radar precipitation data at a spatial resolution of 1 km and an hourly temporal resolution, we performed frequency analyses to generate pixel-level DDF curves for multiple rainfall durations and return periods. These products represent one of the most detailed regional characterizations of extreme rainfall currently available and provide an important foundation for hydrologic design, flood risk assessment, and infrastructure planning.

Building upon these rainfall analyses, the DDF curves were transformed into design rainfall hyetographs using the Alternating Block Method (ABM), providing critical inputs for hydrologic simulations. The modeling framework incorporates soil properties, land use and land cover, and high-resolution digital elevation models to simulate watershed response during extreme rainfall events. As an initial case study, the Añasco watershed was selected for model calibration and testing, where simulations of multiple design storm scenarios successfully estimated flood extents. These modeling capabilities are being expanded to support regional flood hazard mapping and improve preparedness for future extreme precipitation events.

An equally important advancement has been the development of an artificial intelligence model for predicting landslide susceptibility at a spatial resolution of 10 meters. Puerto Rico's steep topography and frequent tropical storms make rainfall-triggered landslides one of the region's most significant natural hazards. The AI model integrates precipitation forecasts, real-time soil moisture and saturation estimates, digital elevation models, terrain attributes, and other landscape variables to generate dynamic landslide susceptibility maps before major storm events occur.

From Prediction to Community Action

Tools and partnerships for Caribbean resilience



Pictures: Left: CCAN Annual Meeting in US Virgin Islands 2026. Right: regional rainfall analysis.

The model was trained using one of the most comprehensive landslide inventories available, consisting of more than 70,000 documented slope failures triggered by Hurricane Maria in 2017. By combining historical observations with remote sensing products and meteorological forecasts, the model provides emergency managers with a powerful tool for identifying areas at elevated risk, improving early warning capabilities, and supporting emergency response planning.

Another major accomplishment has been the development of a Composite Flood Vulnerability Index (CFVI) for Puerto Rico. This GIS-based multi-criteria framework integrates six key indicators, including social vulnerability, NOAA flood frequency observations, FEMA coastal flood hazard zones, rainfall, hydrologic flow accumulation derived from the MERIT-Hydro dataset, and land use and land cover information. The resulting index identifies municipalities where both physical flood hazards and socioeconomic vulnerability combine to create elevated flood risk.

Beyond identifying vulnerable communities, the CFVI provides an analytical framework for prioritizing investments in flood mitigation and evaluating the effectiveness of community-driven nature-based solutions. These products support local governments and planners as they develop long-term adaptation strategies that reduce flood risk while strengthening environmental resilience.

Complementing these research efforts, our team has conducted detailed evaluations of operational precipitation products used for hydrologic applications in Puerto Rico. Specifically, we assessed the performance of NOAA Stage IV and Multi-Radar Multi-Sensor (MRMS) quantitative precipitation estimates using rain gauge observations as reference data. The evaluation examined precipitation estimates from October 2020 through December 2023 under a range of rainfall intensities while also investigating how radar distance influences estimation accuracy. The findings will help improve the selection of precipitation datasets for flood forecasting, hydrologic modeling, and climate applications throughout the Caribbean.

An important component of our research is the development of a community-driven decision-support framework for Nature-Based Solutions (NBS) to reduce flood impacts. Using EPA's Storm Water Management Model (SWMM) together with PySWMM automation, the framework evaluates combinations of green infrastructure practices under historical and future rainfall scenarios. Potential implementation sites are first screened using environmental suitability criteria while excluding areas with high landslide susceptibility.

This approach ensures that infiltration-based practices, such as infiltration trenches or constructed wetlands, are not recommended where they could increase soil saturation and potentially destabilize slopes. By integrating hydrologic modeling, hazard assessment, and stakeholder input, the framework helps identify practical and environmentally appropriate flood mitigation strategies for local communities.

Scientific advances alone are not sufficient to build resilience. Effective climate adaptation requires meaningful engagement with the communities and agencies responsible for managing water-related hazards. During the past year, our research team conducted an extensive field visit to Puerto Rico to strengthen partnerships with organizations actively involved in flood monitoring, hazard assessment, and emergency management. Meetings were held with the National Weather Service in San Juan, the U.S. Geological Survey (USGS), Proyecto ENLACE del Caño Martín Peña, and several municipal emergency management offices. These discussions provided valuable insights into local flood monitoring systems, existing mapping efforts, emergency response priorities, and community resilience initiatives.

The field visit also included an assessment of a dune restoration project in Isabela, where nature-based solutions are being used to reduce coastal flood impacts while restoring critical ecosystems. Observing these projects firsthand reinforced the importance of combining engineering, ecological restoration, and community participation in comprehensive climate adaptation strategies.

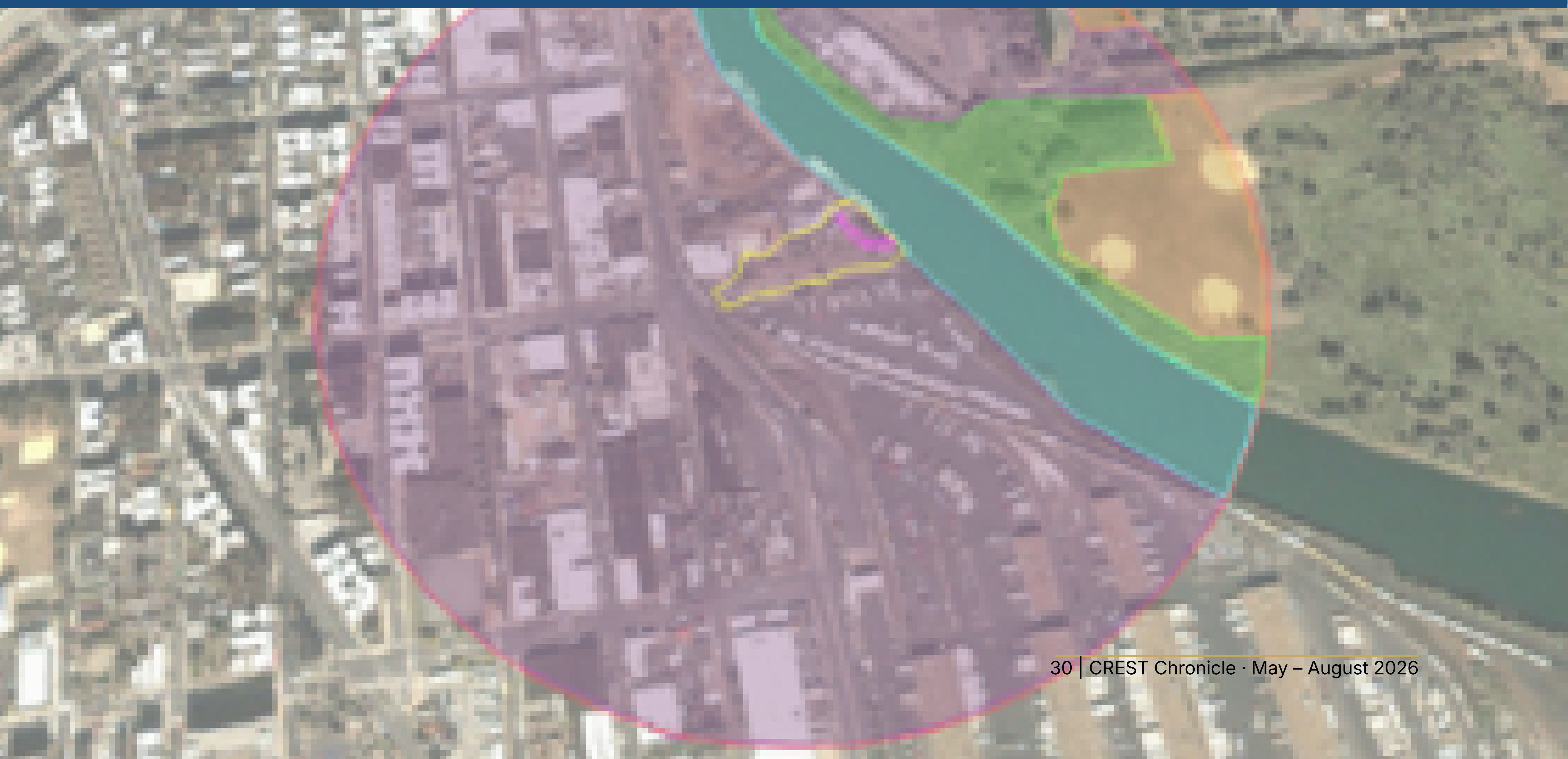
Stakeholder engagement continues beyond these visits through surveys, workshops, and collaborative discussions with emergency managers, municipal officials, and community organizations. Their input is being incorporated directly into the development of the decision-support framework, ensuring that scientific tools address local priorities, reflect operational needs, and support practical implementation.

Together, these accomplishments demonstrate how the integration of artificial intelligence, advanced remote sensing, hydrologic modeling, geographic information systems, and stakeholder collaboration can significantly strengthen the Caribbean's adaptive capacity to climate change. The research not only advances scientific understanding of hydroclimate extremes but also provides operational tools that support decision-making before, during, and after extreme weather events.

As climate change continues to intensify water-related hazards across the Caribbean, partnerships such as CCAN illustrate the value of combining cutting-edge science with community engagement to build more resilient societies. Through its leadership in hydroclimate research and its commitment to collaborative adaptation, the CUNY CREST Institute continues to develop innovative solutions that help safeguard lives, protect infrastructure, and support sustainable water resource management for Puerto Rico, the U.S. Virgin Islands, and the broader Caribbean region.



CREST Summer Highlight



The Next Generation Takes on Water

High School Initiative in Remote Sensing of the Earth Systems Engineering and Sciences (HIRES)

Principal Investigator (PI): Shakila Merchant

The CUNY CREST HIRES Program introduces high school students to college-level STEM research through hands-on training, mentorship, and exposure to real-world environmental challenges. Each summer, students work with faculty, research scientists, graduate students, and undergraduate mentors on interdisciplinary projects connected to climate, water, ecosystems, remote sensing, GIS, and community resilience.

This summer, four of 12 HIRES research projects focused on water-related challenges, expanding students' experiential learning and research experience. Guided by CREST researchers and faculty mentors, six of 26 interns explored water issues in New York City and Chicago through field observations, environmental data, mapping tools, and satellite imagery. They experienced how scientific questions are investigated from the ground to space.

Pugsley Creek, Bronx · Water, Ecology and Community



Photos: Ia Sofocleous, Sienna Gaetani and Harlet Lopez

At Pugsley Creek, students took their research into the field to explore the connections among a tidal wetland, water conditions, flooding, and the surrounding community. Through environmental observations, water quality measurements, mapping, and community engagement, they learned that understanding a water ecosystem requires attention to both the physical environment and the people who rely on it.

PROJECT TEAM

Ia Sofocleous and Sienna Gaetani (HIRES Scholars)
Harlet Lopez (Undergraduate Student Mentor)
Furhana Husani (Co-Mentor, Waterfront Alliance)
Shakila Merchant (Faculty Mentor)

Broad Channel, Jamaica Bay · Understanding Coastal Flood Risk



Photo: HIRES project team

In Broad Channel, students investigated flooding in one of New York City's distinctive waterfront communities. They used rainfall, water-level, flood-scenario, and exposure data to examine how multiple sources help explain coastal flood risk and how communities build resilience. The team also studied Jamaica Bay's ecological importance. Its 13,000 acres of water, salt marshes, meadowlands, beaches, dunes, and upland buffer woodlands support hundreds of bird species and marine flora and fauna.

PROJECT TEAM

Amy Salinas and Jeremy Lora (HIRES Scholars)
Tasnim Islam (Undergraduate Co-Mentor) · Vasu Mittal (Graduate Co-Mentor)
Niloofer Nejatian (Graduate Mentor) · Reza Khanbilvardi (Faculty Mentor)

Chicago · Seeing Urban Flooding from Space



Photo: Chicago Sun-Times

Looking beyond New York, another HIRES team explored how satellite observations can help identify urban flooding in Chicago. Students worked with Sentinel-1 Synthetic Aperture Radar (SAR), mapping techniques, and independent flood observations. This work introduced both the possibilities and challenges of using Earth observation in a complex urban environment. The team replicated a model developed by the 2025 HIRES scholars for urban flooding in New York City.

PROJECT TEAM

Timothy Ebegbe and Kayla Chin (HIRES Scholars)
Yuneeb Awan (Undergraduate Mentor)
Ali Haider (Graduate Mentor)
Reza Khanbilvardi (Faculty Mentor)

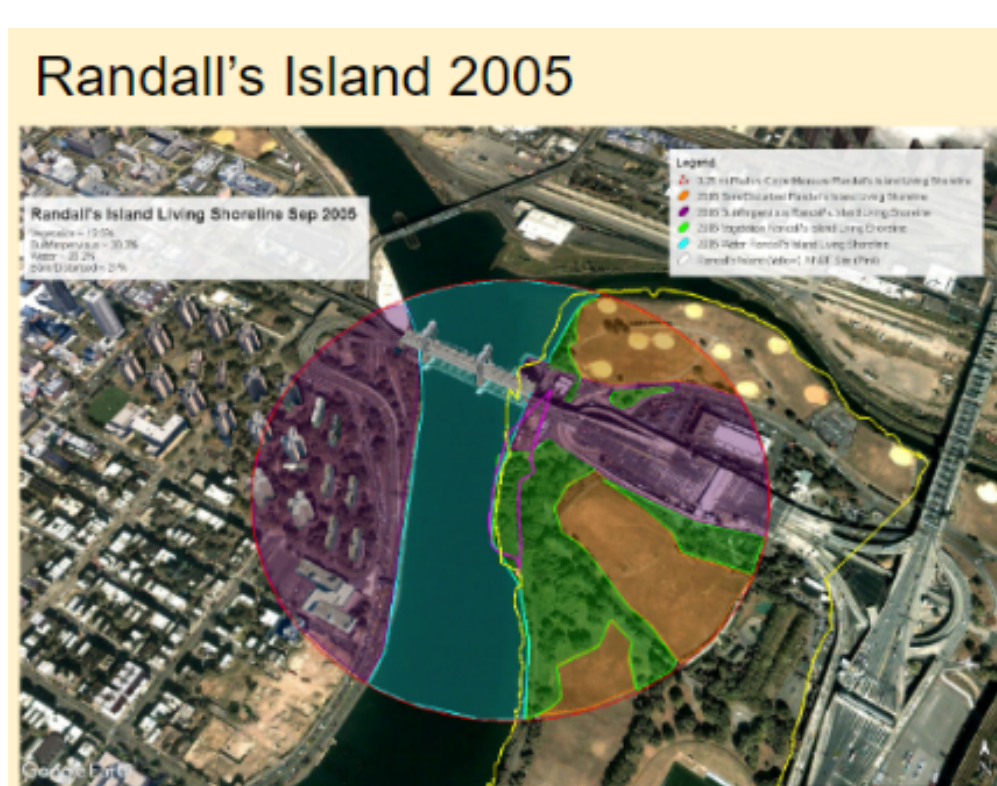
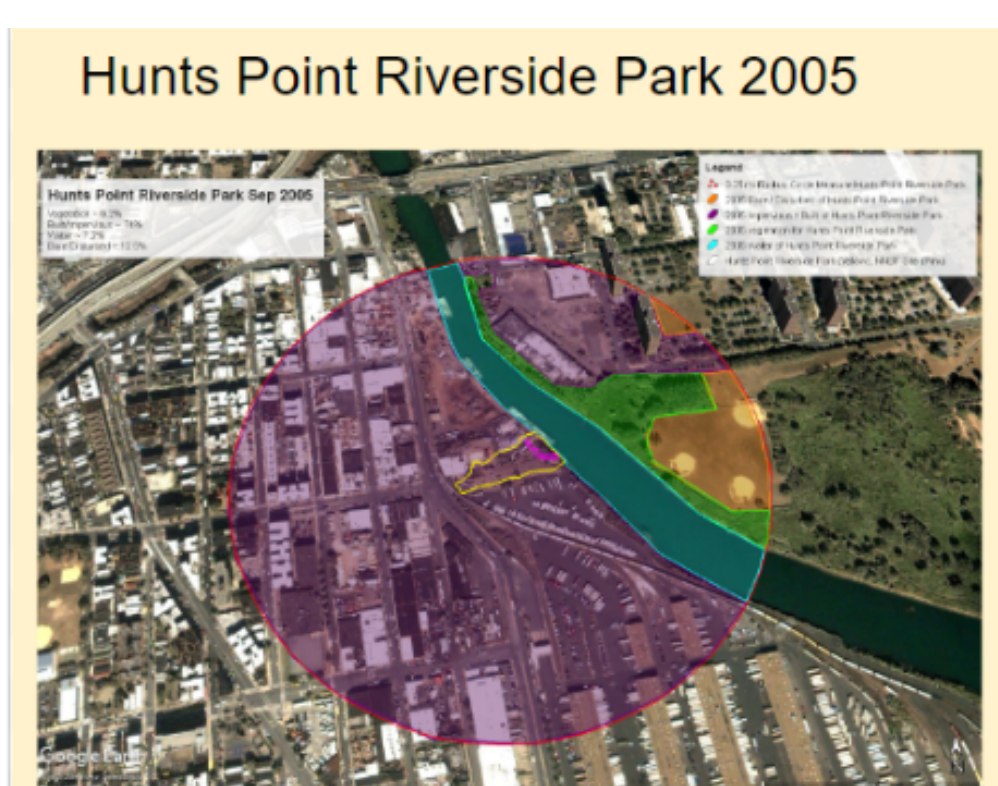
Ecosystems and Habitat Connectivity Matter



A fourth HIRES project evaluated four living shorelines in the Bronx and Harlem that provide habitat for plants and wildlife. Students used Google Earth Pro and satellite imagery to examine whether these sites are becoming disconnected as New York City faces increasing flood risk and habitat loss. Understanding whether shoreline restoration reconnects fragmented green spaces and protects nearby communities can guide future investments in Natural and Nature-Based Features (NNBF).

PROJECT TEAM

Pragya Sharma and Henry Romero-Gibbs (HIRES Scholars)
Dorian Guzman-Lora (Undergraduate Mentor)
Nigah Raja (Graduate Mentor)
Shakila Merchant and Brett Branco (Faculty Mentors)



Images: Nigah Raja, Pragya Sharma and Henry Romero-Gibbs

Learning science by doing

Scientific Project that are focused on key environmental issues such as water – capture the spirit of HIRES that has been in existence for last 14 years. Young researchers from across the five boroughs of the New York City spend each summer immersing into real-world challenges, inquisitively ask questions, work with earth and environmental data, learn from mentors, use emerging tools, and experience science through practice. The locations and methods differ, but the goal is shared.



Preparing the next generation to investigate the water challenges of tomorrow.

LOOKING AHEAD.....

AIR: Sensing Our Changing Atmosphere

Our next issue turns its attention to something that surrounds us, connects us, and shapes our everyday lives—AIR.

From satellites observing Earth from space to sensors and instruments monitoring the atmosphere from the ground, CREST brings together unique capabilities in Earth observation with advanced modeling, data science, and emerging AI applications. These interconnected tools are expanding how we observe and understand the atmosphere and how scientific information can support our cities and communities.

Through the work of CREST and its collaborators, we will follow this journey from space to ground, from observation to understanding, and from understanding to action. Along the way, we will explore research and applications, emerging technologies, education and training, community perspectives, international collaboration, and the next generation of scientists.

How do we observe what we cannot see? How are satellites, ground-based sensors, modeling, and AI changing what we can learn about our atmosphere? How can these capabilities translate complex observations into useful information for communities and decision-makers?

From space to street level, our next issue will showcase the science, technology, people, and partnerships shaping how we sense and understand the atmosphere around us.

Stay tuned. We will be back with AIR.

CREST Chronicle

Advancing science. Connecting communities.
Shaping resilient futures.

The City University of New York Remote Sensing Earth System Institute, widely known as CUNY CREST, is a leading hub for research, education, and innovation in Earth system science, with a strong emphasis on remote sensing. Founded in 2010 as a sustainability initiative to institutionalize nearly a decade of NOAA-funded Earth system science, CREST has grown into a multidisciplinary institute at the intersection of remote sensing, atmospheric science, environmental engineering, and social science to address challenges from New York City to the global stage.

CREST operates across five intersecting strategic pillars: Research & Applications, Education & Training, Community Resilience & Stakeholder Engagement, Entrepreneurship, Innovation & Ventures, and International Collaboration. Through these core pillars, CREST prepares the next generation of scientists while advancing solutions that inform policy and practice.

From City College to the world, CREST connects science with society and demonstrates that impactful research can emerge from and serve diverse urban communities.

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