Advancing Urban Water Resilience: Co-Producing Knowledge Through Civic-Academic Global Partnerships on Water and Climate

Ashish Sharma[1,2,3], Kuldip Kumar[4], Abhinav Wadhwa[1], Ana Mijic[5], Veroneque Ignace[6], Cristina Negri[3], Felicia Marcus[7], Jennifer Cherrier[8], Terri Mathews[9], Jose-Frederic Deroubaix[10], Jean-Claude Deutsch[11], Ilan Juran[12]

[1]Discovery Partners Institute, University of Illinois System, Chicago, IL, USA
[2]Department of Climate, Meteorology & Atmospheric Sciences, University of Illinois Urbana Champaign, Urbana, IL, USA
[3]Environmental Science Division, Argonne National Laboratory, 9700 S. Cass Ave., Lemont, IL, USA
[4]Metropolitan Water Reclamation District of Greater Chicago (MWRDGC), Chicago, IL, USA
[5]Department of Civil and Environmental Engineering, Imperial College London, London, UK
[6]Department of Community Health and Health Policy, CUNY Graduate School of Public Health and Health Policy, New York, NY, 10027, USA
[7]William C. Landreth Visiting Fellow, Stanford University Water in the West Program, USA
[8]Department of Earth and Environmental Sciences, Brooklyn College-The City University of New York, Brooklyn, NY, 11210, USA
[9]NYC Department of Design and Construction
[10]Directeur adjoint chez École des Ponts ParisTech, Romainville, Île-de-France, France
[11]Arceau-IdF, Paris, France
[12]Department of Civil Engineering, Polytechnic Institute of New York University, New York 11201, USA

Corresponding author: Ashish Sharma; sharmaa@illinois.edu

Megacity Alliance for Water and Climate Europe and North America Region Working Group (MAWAC-ENAR) Workshop 2024

What: This 3-day in-person and online gathering brought together more than 40 international experts from five US and European megacities to discuss urban water and climate issues and pathways for partnerships to learn from their peers and develop solutions.

When: 11-13 September, 2024

Where Imperial College London, UK, and Online

Early Online Release: This preliminary version has been accepted for publication in *Bulletin of the American Meteorological Society*, may be fully cited, and has been assigned DOI 10.1175/BAMS-D-25-0065.1. The final typeset copyedited article will replace the EOR at the above DOI when it is published.

1. Introduction

As extreme weather events become more pronounced, the vulnerabilities associated with the urban water supply and wastewater systems in megacities are intensified in multiple interconnected dimensions. These multifaceted water challenges can benefit from enhanced cross-sectoral collaboration and sharing of critical knowledge, which are essential for sustainable and adaptive water governance frameworks.

In this context, the Megacity Alliance for Water and Climate (MAWAC) – Europe and North America Region (ENAR) Working Group convened a workshop in March 2023, followed by a subsequent workshop in London, UK, from 11-13 September 2024. These workshops aimed to investigate and devise solutions for the cascading hazards with water systems. The solutions examined various aspects focused on climate adaptation and mitigation, stormwater management, and the governance of water and wastewater systems. Additionally, discussions highlighted the importance of community engagement, economic considerations, equity, and effective communication in addressing these pressing challenges.

Over the course of three days, experts from academia, government agencies, and industry engaged in meaningful discussions on digital modeling for integrated water management, climate-informed urban planning, and public-private-academic partnerships (Fig. 1). Case studies from cities such as New York, Los Angeles, London, Paris, and Chicago highlighted innovative governance strategies for managing water and wastewater systems, promoting water reuse, planning infrastructure, and fostering stakeholder-driven and stakeholder-informed adaptation. The workshop participants emphasized the need for data-driven decision-making, scalable governance models, and knowledge-sharing networks to enhance urban water governance for sustainability and resilience. This workshop report presents the key takeaways from the three-day convening, providing a roadmap for integrating scientific research, policy frameworks, and emerging technologies to address water challenges faced by megacities.

2. A Global Context

Megacities, due to their immense scale, have the potential to offer large-scale solutions as they confront the global water crisis. The crisis is exacerbated by intensifying climate risks, aging infrastructure, and growing demand for sustainable water management. These urban centers can share their effective solutions with one another while also adapting practices for implementation

Accepted for publication in *Bulletin of the American Meteorological Society.* DOI 10.1175/BAMS-D-25-0065.1.

in smaller municipalities. With over 30 megacities worldwide, many of which are expanding at an unprecedented rate, they face increasingly complex challenges related to stormwater management, wastewater treatment, drinking water supply, and climate adaptation.

By 2050, nearly 70% of the global population will reside in urban areas, further stressing already overutilized water resources (OECD 2012). Climate projections indicate a rising frequency of extreme weather events, including more intense storms, rising sea levels, prolonged droughts, and extreme temperature fluctuations. These risks threaten urban water systems, jeopardize public health, damage infrastructure, disrupt economies, and disproportionately impact vulnerable regions and populations.

Historically, cities have depended on large-scale engineered solutions such as reservoirs, pipelines, and wastewater treatment plants to manage water supply and distribution and wastewater treatment (Burian et al. 2000). While these resource-intensive systems have provided essential services, they are aging and are proving inadequate in the face of climate uncertainties. The limitations of traditional urban water management are evident in crises like Cape Town's "Day Zero" drought, Jakarta's chronic flooding and land subsidence, and water scarcity impacting global megacities. These incidents underscore the urgent need for integrated, adaptive, and decentralized water management approaches that account for hydrological, ecological, and social dynamics.

Recognizing this growing need for resilient urban water systems, several cities are adopting innovative solutions. Cities like New York, London, Los Angeles, and Chicago are combining nature-based strategies (NbS), AI-driven predictive analytics, digital modeling tools, and multi-sector partnerships. Green infrastructure—such as permeable pavements, constructed wetlands, and urban forests—plays a key role in managing stormwater, enhancing overall urban resilience, and contributing flexibly to energy use efficiency (Carlyle-Moses et al. 2020). Additionally, AI-powered monitoring systems and digital twins enable real-time analysis and informed decision-making in water resource management.

Despite these promising advancements, challenges persist in scaling these solutions, securing long-term funding, and navigating the complexities of multi-level governance. Integrating smart water systems, remote sensing technologies, and public-private-academic partnerships drives innovation and drives policy change. As cities face increasing impacts of climate-induced floods, droughts, and infrastructure stress, collaborative governance and knowledge exchange are becoming even more essential. Achieving this vision, however, requires

Accepted for publication in *Bulletin of the American Meteorological Society.* DOI 10.1175/BAMS-D-25-0065.1.

strong political commitment and a collective effort to rethink traditional urban water management practices.

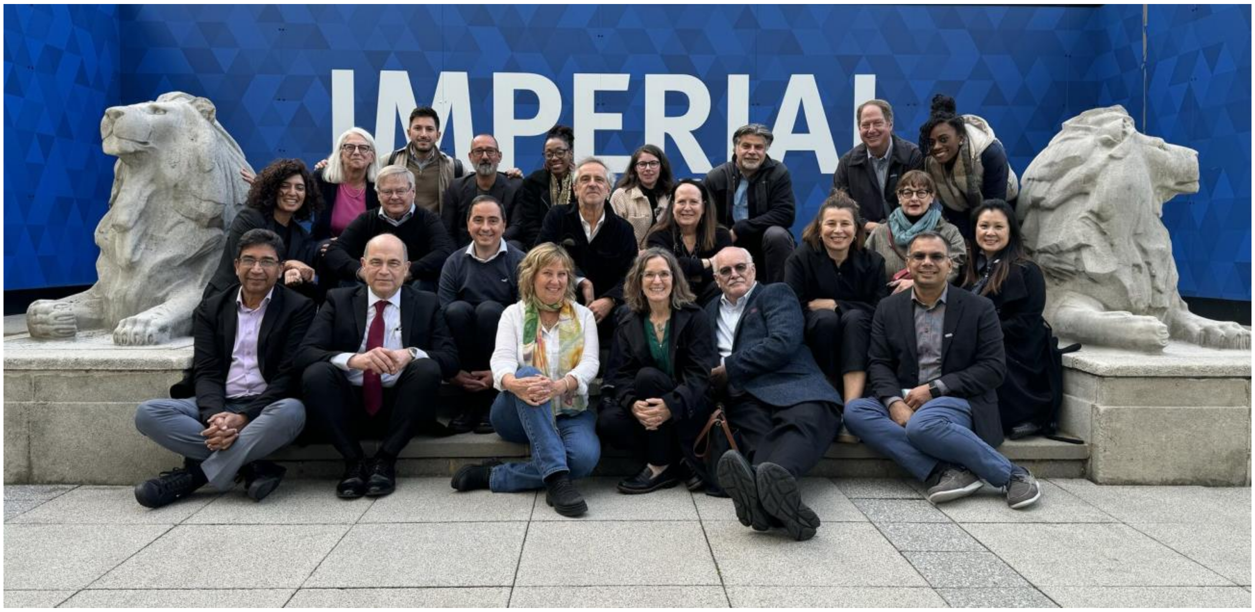

Fig. 1. *MAWAC workshop participants from September 12, 2024, at the Imperial College of London, UK. (Note, some attendees are missing).*

3. Key Challenges and Opportunities

3.1 Urban water resilience & adaptation. Megacities face intensifying extreme weather events threatening their water-related infrastructure and urban surfaces, exacerbating known risks, including rising sea levels, extreme rainfall, and prolonged droughts (2023). Integrated water management approaches must be prioritized to enhance resilience and sustainability. However, governance fragmentation, funding constraints, and public resistance to change must be acknowledged to develop realistic and actionable solutions.

3.2 Governance and policy. As innovative policies are being developed, it is crucial to establish complementary long-term strategies. Cities must explore diverse funding mechanisms, including public-private partnerships (PPPs) and establishing international network projects for peer learning to supplement traditional municipal lenses to support large-scale infrastructure projects (Castelblanco and Guevara 2022). Policy alignment across local and national levels is essential to streamline implementation.

Accepted for publication in *Bulletin of the American Meteorological Society.* DOI 10.1175/BAMS-D-25-0065.1.

3.3 Stakeholder engagement and inclusive planning. Engaging the public in water resilience planning is essential for long-term success. Cities must adopt holistic approaches to ensure all residents are not disproportionately affected by cascading hazards like water scarcity or flooding (Dharmarathne et al. 2024). Expanding community education programs and participatory decision-making will enhance public trust and support for water initiatives.

3.4 Science-driven decision making. Developing and using advanced scientific tools is critical to developing actionable solutions responsive to stakeholders' needs. Improving the spatial and temporal resolution of predictive models and the reach and cost-effectiveness of adaptive observational methods is essential to ensure that urban areas tailor responses to the very heterogeneous conditions in environmental and sociocultural conditions within their jurisdictions (Gann et al. 2019). State-of-the-art scientific tools are also critical to assess the benefits obtained from the actions implemented and thus provide continuous improvement in efficiency and return on investment.

4. Discussions at the Workshop

The MAWAC-ENAR Working Group workshop in September 2024 resulted from prior efforts by UNESCO's Intergovernmental Hydrological Programme (IHP) to establish a global platform where megacities can share best practices, exchange knowledge, and develop collaborative strategies for urban water resilience. This workshop was held at a crucial time, as the scientific community is actively advancing high-resolution urban climate and hydrological models to enhance predictive capabilities (Sharma et al. 2021, 2020). Researchers and practitioners are working to refine urban-scale modeling frameworks, incorporating climate adaptation strategies, stormwater dynamics, water quality management, and public engagement approaches. This workshop provided a platform for experts to discuss new methodologies for integrating atmospheric processes, land-use patterns, and human interactions into urban-scale modeling efforts. A key focus of the discussions was developing next-generation forecasting and resiliency planning tools, allowing cities to simulate extreme weather impacts, optimize stormwater infrastructure, and improve water supply sustainability. Participants emphasized the need to integrate physical sciences with social, economic, and public policy dimensions, ensuring that urban water and climate resilience strategies are scientifically robust and community-centered. Throughout the presentations, participants identified critical knowledge gaps, collaborative

Accepted for publication in *Bulletin of the American Meteorological Society.* DOI 10.1175/BAMS-D-25-0065.1.

research opportunities, and actionable next steps to improve urban climate adaptation, stormwater resilience, and water sustainability at global, regional, and city scales. This workshop identified the urgency of developing interdisciplinary, high-resolution models that capture the complexity of urban environments while aligning with policy needs and community priorities. Common dialogue on long-term research collaborations, international knowledge exchange, and investment in advanced modeling capabilities emerged during the discussions, which will ensure that cities holistically mitigate climate risks and enhance urban water resilience.

The MAWAC-ENAR Working Group members structured thematic presentations and discussions around the following key questions, drawing on diverse research on urban cities.

- How can megacities mitigate the effects of climate change through adaptation and positive change with real-world urban constraints?
- How can cities integrate stormwater management solutions to reduce flood risks while enhancing urban resilience?
- What innovative approaches can improve water quality, enhance reuse, and ensure the security of urban water infrastructure?
- How can cities ensure that water resilience planning is inclusive, economically viable, and effectively communicated to the public?

4.1 Adaptive strategies for climate mitigation. Megacities face complex constraints such as aging infrastructures, evolving regulatory norms, land-use pressures, socioeconomic inequalities, and urban sprawl. These constraints further complicate climate adaptation efforts. While high-resolution climate models and their interactions with a strategic formulation of solutions have advanced, the integration into urban decision-making still remains inconsistent. In the 3-day MAWAC-ENAR workshop, these constraints and their solutions at the city scale were discussed broadly. Cities like London and New York are leveraging climate modeling tools to integrate heat mapping, storm intensity projections, and flood risk assessments into urban planning. The US Department of Urban Integrated Field Laboratory in the Chicago megaregion called the Community Research on Climate and Urban Science (CROCUS), is putting dedicated research effort to develop a fundamental, two-way understanding of the relationships between its urban and suburban areas with climate, including heat, precipitation, and air quality. The NPCC (New York City Panel on Climate Change) framework provides a model for sustained climate monitoring and

Accepted for publication in *Bulletin of the American Meteorological Society.* DOI 10.1175/BAMS-D-25-0065.1.

regulatory adaptation. The Paris Métropole Rainwater Initiative was highlighted as a model for integrating NbS into high-density urban landscapes. Green corridors, permeable pavements, and urban wetlands are deployed to mitigate heat stress and manage runoff. The NYC-Copenhagen Sister City Model was cited as an example of long-term institutional collaboration that has led to the development of shared urban adaptation frameworks. The exchange of expertise in stormwater management and flood resilience has strengthened capacity-building efforts across both cities. Key takeaways from the discussion on urban constraints highlight that climate adaptation cannot rely solely on infrastructure. Instead, it requires governance mechanisms integrating scientific insights, regulatory flexibility, and financial innovation. The workshop addressed typical water-related issues in urban areas, including stormwater management, wastewater management, and water supply management. Participants provided city-wide insights on these three issues, which are summarized in the following sections.

4.2 Urban stormwater management solutions to reduce floods. Flooding continues to be a major urban challenge, driven by increasing precipitation variability, the prevalence of impervious surfaces, and outdated drainage systems (Kotamarthi et al. 2021). Discussions emphasized the need for stormwater solutions that are both scalable and adaptable to local conditions, helping to balance immediate mitigation efforts with long-term resilience.

Cities have adopted various stormwater strategies. For instance, London's Integrated Flood Risk Strategy combines GIS-based stormwater modeling with real-time monitoring to predict areas at high risk of flooding. Workshop participants highlighted the importance of integrating hydrologic modeling with socio-economic vulnerability mapping to guide investment in flood infrastructure. In Los Angeles and Chicago, stormwater capture systems utilize bioswales, green roofs, and underground retention basins to slow runoff and alleviate stress on sewer networks. Additionally, Chicago has implemented a large-scale system called the Tunnel and Reservoir Project (TARP), often referred to as "the deep tunnel." This system consists of large-diameter tunnels and extensive reservoirs designed to reduce flooding, improve water quality in local waterways, and protect Lake Michigan from pollution caused by sewer overflows (Scalise and Fitzpatrick 2012). The New York Sea Grant Community Flood Watch Project is an example of participatory stormwater governance, where residents photo-document flooding incidents, integrated with satellite data, to enhance forecasting and better help communities understand their

Accepted for publication in *Bulletin of the American Meteorological Society.* DOI 10.1175/BAMS-D-25-0065.1.

risks. Los Angeles County is implementing a voter-approved $300 million per year multi-benefit stormwater program to achieve flood control, water quality benefits, enhance groundwater recharge, and add much-needed urban green space SCWC Stormwater Task Force (2019).

Overall, as various cities initiate these projects, it is evident that stormwater solutions must be multi-functional. They should align urban drainage systems with broader climate adaptation, energy efficiency, and optimization goals while prioritizing community involvement in risk assessments.

4.3 Innovative approaches for wastewater management. Urban water resilience necessitates a transformative approach toward circular water management, where wastewater emerges as a vital resource rather than a burden. Nonetheless, policy gaps, public perception issues, and infrastructure constraints impede the widespread adoption of these practices. During the workshop, participants explored key strategies for planning and implementing circular water management in urban areas. For instance, the Los Angeles Pure Water initiative aims for 100% wastewater recycling, establishing a benchmark for both potable and non-potable reuse. London and Paris are also piloting decentralized treatment plants that employ localized water purification systems, which help reduce reliance on centralized infrastructure.

As urban centers advance digital technologies, cybersecurity concerns have become increasingly prominent. Cities are investigating AI-driven threat detection and multi-layered security protocols to safeguard their digital water networks from potential cyberattacks. Cities like Chicago are working on developing real-time water quality monitoring systems that combine IoT sensors, remote sensing, and machine learning to detect contamination risks and optimize treatment processes (Maity et al. 2023).

The workshop underscored that integrated water management must prioritize resilience, security, and equity, ensuring vulnerable populations can access clean, affordable, and sustainable water systems. A key tool discussed was WSIMOD (Water Systems Integration Modeling Framework), developed by Imperial College London (Dobson et al. 2024). This innovative model facilitates baseline assessments by simulating flow and river water quality at catchment outlets. It can also simulate various scenarios related to drivers of change (e.g., climate change, future urban development) and integrated water system interventions (e.g., abstraction reductions, NbS, water infrastructure upgrades, and water and wastewater reuse).

Accepted for publication in *Bulletin of the American Meteorological Society.* DOI 10.1175/BAMS-D-25-0065.1.

Current advancements in WSIMOD include utilizing the resilience assessment and planning model amidst deep uncertainties while exploring the added value of artificial intelligence and machine learning approaches. The modeling team is keen on applying WSIMOD to additional megacities to enhance decision-making with robust evidence. Future collaborative research may involve developing a coastal module to simulate the impacts of rising sea levels. This comprehensive approach to circular water management, driven by innovation and equity, could pave the way for more resilient urban water systems.

4.4 Ensuring effective water supply planning. Water supply planning is crucial to urban resilience, especially as climate change affects precipitation patterns, groundwater availability, and surface water resources. Megacities face growing challenges related to water supply due to drought, groundwater depletion, aging distribution networks, and the need for inter-basin water transfers. Climate change is diminishing freshwater availability, prompting cities to reconsider how they obtain, store, and distribute water.

Cities like Los Angeles and Singapore are investing in water use efficiency, wastewater reuse, and stormwater harvesting to lessen their dependence on traditional freshwater sources. For example, London has implemented the Thames Water smart network, which uses artificial intelligence (AI) and Internet of Things (IoT) sensors to detect and repair pipeline leaks, reduce non-revenue water losses, and enhance overall system efficiency (Chow and Pierce 2024). New York City's water demand management plan employs tiered pricing, consumer education, stormwater harvesting, and incentives for high-efficiency appliances to encourage water conservation without compromising supply reliability. Chicago's Water Infrastructure Renewal Program emphasizes upgrading aging pipelines with real-time monitoring sensors.

In conclusion, workshop participants agreed that climate-resilient water supply planning must integrate these technologies, conservation incentives, and infrastructure improvements.

5. Future Advances in Predictive Capabilities in Urban Water and Climate Systems

Participants recognized the urgent need to enhance the predictive capabilities of urban water and climate resilience. Discussions underscored the necessity of improved modeling frameworks, developing methodologies and technologies to prioritize and evaluate NbS, real-time data integration, and cross-sector collaborations to strengthen climate adaptation, stormwater

Accepted for publication in *Bulletin of the American Meteorological Society.* DOI 10.1175/BAMS-D-25-0065.1.

resilience, and sustainable water governance. A shared vision emerged around key priorities, including enhanced urban modeling, high-resolution simulations, AI-driven frameworks, short- and long-range forecasting, remote sensing applications, and robust public-private-academic partnerships. However, further investment is needed to scale these technologies across different socioeconomic and climatic contexts. A structured research agenda focusing on predictive analytics, real-time monitoring, and circular water systems is essential for long-term success. Participants also discussed the need to find better evaluative and financing tools to make the enormous investments needed to adapt to increasing droughts, floods, or sea level rise, with Los Angeles having commissioned UCLA to estimate the cost of disruption of the water system (i.e., the cost of inaction) compared to the cost of such investments. Finally, a need for benchmarking was emphasized, especially in the context of integrated water systems performance across megacities.

Based on the above discussions, the following key priorities were identified to enhance predictive capabilities and develop more resilient, adaptive, and sustainable water management systems for our cities in the context of climate change.

(i) Integrated data platforms for urban water resilience

- develop centralized repositories for water and climate data to enhance model calibration and inform policy decisions.
- leverage existing Big Data infrastructure and research efforts in cities like Chicago, London, and Los Angeles as testbeds for real-world validation of urban climate and water models.
- ensure data accessibility to facilitate multi-city collaborations and cross-regional knowledge sharing.
- develop shared views and plans for instrumenting sensors and networks for fine-grained data collection to improve cyber threats in water systems and monitor water quality and flow.

(ii) In-situ observations and multi-scale modeling

- expand urban hydrology and climate field campaigns incorporating satellite, sensor-based, and community-reported data encompassing the entire urban hydrological cycle.
- strengthen partnerships with municipal agencies, research sponsors, and local stakeholders to support long-term climate risk modeling and monitoring.

Accepted for publication in *Bulletin of the American Meteorological Society.* DOI 10.1175/BAMS-D-25-0065.1.

- extend research beyond urban centers to examine rural-urban water interactions and watershed-scale impacts.

(iii) Multi-city research networks for knowledge sharing

- establish cross-sector networks that connect scientists, policymakers, and urban planners to advance urban water resilience.
- facilitate knowledge-sharing on NbS, stormwater management innovations, public engagement, economic evaluation, finance, and integrated climate strategies.
- align urban resilience planning with global climate adaptation frameworks to ensure consistency in policies and investments.

(iv) Advancing urban water modeling and digital twins

- enhance predictive urban water models by integrating spatially explicit land use, hydrology, and infrastructure data at scales that enable decision-making.
- scale up the deployment of Digital Twins—such as those piloted in Chicago and New York—to simulate urban water system responses to extreme weather events.
- ensure model adaptability to future urban growth, policy shifts, and climate uncertainties.

6. Conclusions and Recommendations

This workshop underscored the urgent need to transition from reactive crisis management to proactive, integrated planning for urban water resilience. Achieving sustainable and climate-resilient urban water systems requires a holistic, interdisciplinary approach that bridges scientific research, policy frameworks, technological advancements, and community engagement. Key research gaps include the integration of urban water resilience into broader decarbonization strategies and the intersection of circular economy principles with water management.

To strengthen the connection between scientific advancement and decision-making, cities must leverage high-resolution models, real-time data, sensing, and predictive analytics. Benchmarking the performance of water systems —considering aspects like water supply, wastewater management, and environmental quality—can yield valuable insights into adaptable solutions that address various environmental and socio-technical perspectives. These tools can guide infrastructure planning, stormwater governance, and climate adaptation strategies, promoting a transition from short-term risk management to long-term resilience planning. A significant outcome of the workshop was the acknowledgment of the necessity for a dedicated

Accepted for publication in *Bulletin of the American Meteorological Society.* DOI 10.1175/BAMS-D-25-0065.1.

international forum to foster ongoing collaboration among researchers, municipal authorities, and industry leaders. Establishing a global knowledge-sharing platform will:

- Support cross-city partnerships,
- Create standardized data-sharing frameworks and scientific tools
- Promote best practices for climate adaptation while fostering capacity-building initiatives.

At the same time, decision-makers must be mindful of the limitations of current urban climate and water models, many of which operate at coarse resolutions. Future research should focus on integrating urban-scale hydrological models with regional climate projections to enhance accuracy and policy relevance for urban resilience planning. Moving forward, success will depend on sustained investment, effective governance, and the ability to scale innovative solutions across multiple cities. Key priorities include:

- Advancing predictive modeling and high-resolution simulations to understand cities' heterogeneous environments,
- Embedding scientific research into policy frameworks, and
- Strengthening cross-sector collaboration to accelerate climate adaptation efforts.

During the snowball synthesis, the group identified key research needs for water resources management in megacities, including gathering baseline data, conducting comparative analyses of current and future conditions, developing toolkits for adaptive management, promoting engagement, exploring circular economy solutions, adopting systems approaches across themes, and addressing technical challenges.

Cities must leverage multiple funding sources, including international climate funds, development banks, and municipal green bonds. By integrating technological innovation, regulatory flexibility, financial incentives, and community engagement, megacities can build adaptive, equitable, and climate-resilient water governance frameworks. The critical challenge remains in translating scientific insights of value to city and utility managers. into actionable policies, ensuring urban water resilience is embedded in both local decision-making and global sustainability agendas.

Accepted for publication in *Bulletin of the American Meteorological Society.* DOI 10.1175/BAMS-D-25-0065.1.

Acknowledgments

We thank all the participants for actively participating in the workshop. We thank Megan Mullin (University of California, Los Angeles), Venkat Venkatakrishnan (Discovery Partners Institute, University of Illinois System), and Joseph Kratzer (Metropolitan Water Reclamation District of Greater Chicago) for reading the summary manuscript and verifying the factual description of the workshop and the accuracy of the content. The workshop was partially funded by US National Science Foundation award #2348284. We acknowledge Imperial College London, UK, for hosting the workshop and providing the logistic and administrative support. This material is based upon work supported by the U.S. Department of Energy, Office of Science, Office of Biological and Environmental Research's Urban Integrated Field Laboratories CROCUS project research activity, under Contract Number DE-AC02- 06CH11357.

References

Burian, S. J., S. J. Nix, R. E. Pitt, and S. R. Durrans, 2000: Urban wastewater management in the United States: Past, present, and future. *J. Urban Technol.*, **7**, 33–62.

Carlyle-Moses, D. E., S. Livesley, M. D. Baptista, J. Thom, and C. Szota, 2020: Urban Trees as Green Infrastructure for Stormwater Mitigation and Use. *Forest-Water Interactions*, *Ecological studies: analysis and synthesis. Berlin, Heidelberg, New York NY*, Springer International Publishing, 397–432.

Caretta, M.A., A. Mukherji, M. Arfanuzzaman, R.A. Betts, A. Gelfan, Y. Hirabayashi, T.K. Lissner, J. Liu, E. Lopez Gunn, R. Morgan, S. Mwanga, and S. Supratid, 2022: Water. In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 551–712, doi:10.1017/9781009325844.006.

Castelblanco, G., and J. Guevara, 2022: Building bridges: Unraveling the missing links between Public-Private Partnerships and sustainable development. *Project Leadership and Society*, **3**, 100059.

Chow, N., and G. Pierce, 2024: The Resilience Value of Recycled Water for Los Angeles: How

Accepted for publication in *Bulletin of the American Meteorological Society.* DOI 10.1175/BAMS-D-25-0065.1.

Does Pure Water LA (Operation Next) Prepare the City for an Uncertain Future?
Dharmarathne, G., A. O. Waduge, M. Bogahawaththa, U. Rathnayake, and D. P. P. Meddage, 2024: Adapting cities to the surge: A comprehensive review of climate-induced urban flooding. *Results Eng.*, **22**, 102123.
Dobson, B., L. Liu, and A. Mijic, 2024: Modelling water quantity and quality for integrated water cycle management with the Water Systems Integrated Modelling framework (WSIMOD) software. *Geosci. Model Dev.*, **17**, 4495–4513.
Gann, G. D., and Coauthors, 2019: International principles and standards for the practice of ecological restoration. Second edition. *Restor. Ecol.*, **27**, https://doi.org/10.1111/rec.13035.
Kotamarthi, R., C. Negri, R. Graham, and T. Wall, 2021: *Assessing climate risks to Midwest infrastructure workshop*. Argonne National Laboratory (ANL),.
Maity, A., and Coauthors, 2023: Scalable graphene sensor array for real-time toxins monitoring in flowing water. *Nat. Commun.*, **14**, 4184.
OECD, 2012: *OECD Environmental Outlook to 2050: The consequences of inaction*. OECD: Organisation for Economic Co-Operation and Development, Ed. Organization for Economic Co-operation and Development (OECD), 310 pp.
Sharma, A., D. J. Wuebbles, R. Kotamarthi, K. Calvin, B. Drewniak, C. E. Catlett, and R. Jacob, 2020: Urban-Scale Processes in High-Spatial-Resolution Earth System Models. *Bull. Am. Meteorol. Soc.*, **101**, E1555–E1561.
——, ——, and ——, 2021: The need for urban-resolving climate modeling across scales. *AGU Advances*, **2**, https://doi.org/10.1029/2020av000271.
Scalise, C., and K. Fitzpatrick, 2012: Chicago Deep Tunnel Design and Construction. *Structures Congress 2012*, Structures Congress 2012, Reston, VA, American Society of Civil Engineers.
SCWC Stormwater Task Force, Innovations in Stormwater Capture (2019). https://socalwater.org/wpcontent/uploads/scwc_2019_whitepaper_innovations_in_stormwater_capture-a_59496.pdf (Accessed March 8, 2025).
Wadhwa, A., A. Sharma, A.F. Hamlet, P. Li 2025: Effectiveness of nature-based solutions to reduce flooding in Quad Cities Metro Area (QCMA) using SWMM-HEC-based flood model. *Front. Earth Sci.* (in press).

Accepted for publication in *Bulletin of the American Meteorological Society.* DOI 10.1175/BAMS-D-25-0065.1.