January 2024

Edith A. Zagona

Research Professor, Department of Civil, Environmental and Architectural Engineering and
Director, Center for Advanced Decision Support for Water and Environmental Systems
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EDUCATION

University of Colorado, Boulder, CO: Ph.D. in Civil and Environmental Engineering, 1992
Colorado State University, Ft. Collins, CO: M.S., Civil Engineering, 1983: Hydraulics.
University of Arizona, Tucson, Arizona: B.S. Civil Engineering 1978
University of Arizona, Tucson, Arizona: B.A., Philosophy, 1975

PROFESSIONAL ACTIVITIES

Research Professor, Department of Civil, Environmental and Architectural Engineering, University of Colorado, 2010 to present.

Director, Center for Advanced Decision Support for Water and Environmental Systems, Department of Civil, Environmental and Architectural Engineering, College of Engineering and Applied Sciences, University of Colorado at Boulder (CU-CADSWES), 2001 to present.

Research Associate, CU-CADSWES, 1992-2000

Professional Research Assistant, CU-CADSWES, 1989-1992

Graduate Research Assistant, CU-CADSWES, 1988-1989

U.S. Bureau of Reclamation Design and Planning Coordinator, Central Arizona Projects Office, 1986-87

U.S. Bureau of Reclamation Hydraulic Engineer, Engineering and Research Center, 1978-84

RESEARCH AND PROFESSIONAL INTERESTS

Development of decision support tools for water resources management. Principal investigator and head of invention team of RiverWare® used by major water resources management, consultants and institutions for managing river and reservoir systems. Research interests include water resource systems and modeling, planning and operations of multi-objective river and reservoir systems, hydropower optimization, decision making under uncertainty, analysis and adaptive management for climate change. Experience in needs analysis, design, development, testing and deployment of DSS tools for river and reservoir management.

Direction of academic research center, lead investigator for average of $2.0 million per year contracts and grants TVA, Bureau of Reclamation, U.S. Army Corps of Engineers, Bonneville Power Administration and other water managers and utilities. Collaborations with other researchers and guidance of graduate student research. Advisor to modelers and managers of river systems in U.S. and abroad. Developing and teaching water resources classes at CU and training materials for DSS users. Hydraulic engineer in the public sector and experience with design of large projects and public involvement in large projects. Technical advisor to Nile Basin Initiative DSS.

CREATIVE WORKS AND INVENTIONS

RiverWare, a software product developed and maintained at CADSWES and licensed through CU Office of Technology Transfer and used by hundreds of water managers, planners, utilities, consultants and researchers. E. Zagona, PI and Principal Inventor. Release of RiverWare 9.4 in January 2025. Associated software tools, RiverSMART (RiverWare Study Manager and Research Tool), RiverWISE (RiverWare Interactive Scenario Explorer), a tool for stakeholder to independently view, run and share scenarios based on RiverWare models and Demand Input Tool – a SQLite application developed for the Bureau of

Reclamation but usable by anyone. It is used in conjunction with the RiverWare software to allow users to create new future demand scenarios.

TEACHING

Academic classes: Water Resources Management, Applied Fluid Mechanics, Open Channel Hydraulics, Dam Engineering, Water Resources Development and Management**;** Optimization for Water Resources**;** Outreach Courses (recent): RiverWare and River Basin Planning – classes provided on site in India sponsored by World Bank, in Chihuahua, Mexico sponsored by the University of Chihuahua; in Sudan for Nile Basin participants. RiverWare Tech Transfer: Lectures as part of 5-day courses in using RiverWare®, with CADSWES staff, taught to technical people from water management agencies, consulting companies and universities and research institutes. Typically, 3 to 4 courses per year.

RECENT PUBLICATIONS

Bonham, N., Kasprzyk, J., Zagona, E., (2025) "Taxonomy of purposes, methods, and recommendations for vulnerability analysis," Environmental Modelling & Software, Vol183, 2025,106269, ISSN 1364-8152, (https://doi.org/10.1016/j.envsoft.2024.106269).

Woodson, D, Rajagopalan, B., Zagona, E., (2024). "Long-Lead Forecasting of Runoff Season Flows in the Colorado River Basin Using a Random Forest Approach" *Journal of Water Resources Planning and Management,* 150, No. 4, January 31, 2024 (https://doi.org/10.1061/JWRMD5.WRENG-6167).

Bonham, N., Kasprzyk, J., Zagona, E., Smith, R., 2024 "Interactive and multimetric Robustness Tradeoffs in the Colorado River Basin". ASCE J of Water Res Planning and Management, Vol 150-3 https://doi.org/10.1061/JWRMD5.WRENG-6199

Bonham, N., Kasprzyk, J., Zagona, E., Smith, R., 2024 "Interactive and multmetric Robustness Tradeoffs in the Colorado River Basin". ASCE J of Water Res Planning and Management, Vol 150-3 https://doi.org/10.1061/JWRMD5.WRENG-6199

Woodson, D., Rajagopalan, B., Zagona, E., Forthcoming. "Long lead forecasting of runoff season flows in the Colorado river Basin using Random Forest". ASCE Journal of water Resources Planning and Management.

Bonham, N.., Kasprzyk, J., Zagona, E., & Rajagopalan, B. (2023). "Subsampling and space-filling metrics to test ensemble size for robustness analysis with a demonstration in the Colorado River Basin," Environmental Modelling & Software, 2023, 105933, (ISSN 1364-8152, (https://doi.org/10.1016/j.envsoft.2023.105933)

Bonham, N., Kasprzyk, J. and Zagona, E. (2022). "post-MORDM: Mapping Policies to Synthesize Optimization and Robustness Results for Decision-maker Compromise," *Environmental Modelling & Software*, 157, November 2022, 105491, (https://doi.org/10.1016/j.envsoft.2022.105491).

Thapa, S.; Magee, T.; Zagona, E. (2022) "Factors That Affect Hydropower Flexibility". Water 2022, 14, 2563. https://doi.org/10.3390/ w14162563

Magee, T, Turner, S, Clement, M., Oikonomou, K., Zagona, E., and Voisin, N. (2022) "Evaluating Power Grid Model Hydropower Feasibility with a River Operations Model" *IOP Environmental Research Letters*, 08 August, 2022, (https://doi.org/10.1088/1748-9326/ac83db).

Wheeler, K., Jeuland, M., Strzepek, K., Hall, J., Zagona, E., Abdo, G., Basson, T., Blackmore, D., Block, P., &Whittington, D. (2022) "Comment on 'Egypt's water budget deficit and suggested mitigation policies for the Grand Ethiopian Renaissance Dam filling scenarios'" Environ.Res. Lett.17(2022) 88003. https://doi.org/10.1088/1748-9326/ac7e5e.

Baker, S.A., A.W. Wood, B. Rajagopalan, J. Prairie, C. Jerla, E. Zagona, R.A. Butler, and R. Smith. (2022). "The Colorado River Basin Operational Prediction Testbed: A Framework for Evaluating Streamflow Forecasts and Reservoir Operations." JAWRA Journal of the American Water Resources Association1–19. https://doi.org/10.1111/1752-1688.13038.

Smith, R., Zagona, E., Kasprzyk, J., Bonham, N., Alexander, E., Butler, A., Prairie, J. & Jerla, C. (2022). "Decision Science Can Help Address the Challenges of Long-Term Planning in the Colorado River Basin," Journal of the American Water Resources Association, 22 January 2022 (https://doi.org/10.1111/1752-1688.12985).

Woodson, D., Rajagopalan, B., Baker, S., Smith, R., Prairie, J., Towler, E., Ge, M. & Zagona, E. (2021). "Stochastic Decadal Projections of Colorado River Streamflow and Reservoir Pool Elevations Conditioned on Temperature Projections," Water Resources Research, 57 (12), https://doi.org/10.1029/2021WR030936

Wheeler, K.G., Jeuland, M., Hall, J.W., Zagona, E.A., & Whittington, D. (2020). Understanding and managing new risks on the Nile with the Grand Ethiopian Renaissance Dam. Nat Commun 11, 5222. https://doi.org/10.1038/s41467-020-19089-x

Basheer, M., Wheeler, K.G., Elagib, N.A., Etichia, M., Zagona, E.A., Abdo, G.M., & Harou, J.J. (2020). Filling Africa's Largest Hydropower Dam Should Consider Engineering Realities, One Earth, [Commentary] Volume 3, Issue 3, 18 September 2020, 277–281. DOI: https://doi.org/10.1016/j.oneear.2020.08.015

Rajagopalan, B., Erkyihun, S. T., Lall, U., Zagona, E., & Nowak, K. (2019). A nonlinear dynamical systems-based modeling approach for stochastic simulation of streamflow and understanding predictability. Water Resources Research, 55, 6268–6284. https://doi.org/10.1029/2018WR023650

Neumann D., Zagona E., Short J., Sidlow M., Wunsch M., Hunter J., "River and Reservoir Operations using RiverWare within the Corps Water Management System (CWMS)" Proceedings of the Federal Sedimentation and Hydrologic Modeling Conference, June 24 - 28, 2019, Reno, Nevada, USA

Wheeler, K. G., Hall, J. W., Abdo, G. M., Dadson, S. J., Kasprzyk, J. R., Smith, R., &Zagona, E. A. (2018). Exploring cooperative transboundary river management strategies for eastern Nile Basin. Water Resources Research, 54, 9224–9254. https://doi.org/10.1029/2017WR022149.

Basheer, M, K Wheeler, L Ribbe, M Majdalawi, G Abdo, and E Zagona (2018). Quantifying and Evaluating the Impacts of Cooperation in Transboundary River Basins on the Water-Energy-Food Nexus: The Blue Nile Basin, Science of The Total Environment, Volume 630 (15 July 2018), 1309-1323, ISSN 0048-9697, https://doi.org/10.1016/j.scitotenv.2018.02.249

Witt, Adam, T. Magee, K. Stewart, B Hadjerioua, D Neumann, E Zagona, M. Politano (2017) Development and Implementation of an Optimization Model for Hydropower and Total Dissolved Gas in the Mid-Columbia River System, *J. Water Resour. Plann. Manage,* Published online 10 August, 04017063 1-15, DOI: 10.1061/(ASCE)WR.1943-5452.0000827. © 2017 American Society of Civil Engineers.

Erkyihun S.T., E Zagona, B. Rajagopalan, (2017) Wavelet and Hidden Markov-Based Stochastic Simulation Methods Comparison on Colorado River Streamflow, *J. Hydrol. Eng* 2017, 22(9): 04017033 1-12, DOI: 10.1061/(ASCE)HE.1943-5584.0001538. © 2017 American Society of Civil Engineers.

Erkyihun, S.E., B. Rajagopalan, E. Zagona, U. Lall, and K. Nowak (2016). Wavelet-based Time Series Bootstrap Model for Multidecadal Streamflow Simulation Using Climate Indicators, *Water Resour. Res.*, 52, 4061–4077, doi:10.1002/2016WR018696.

Frevert, D., J. Prairie and E. Zagona, Hydrology of the Colorado River Basin, Chapter 110 in the Fiftieth Anniversary Edition of Handbook of Applied Hydrology, edited by Vijay Singh. McGraw-Hill, New York, October 11, 2016.

Wheeler, K.G., M. Basheer, Z.T. Mekonnen, S.O. Eltoum, A. Mersha, G.M. Abdo, E.A. Zagona, J.W. Hall and S.J. Dadson (2016). Cooperative Filling Approaches for the Grand Ethiopian Renaissance Dam, *Water International,* Published online 11 May, DOI:10.1080/02508060.2016.1177698.

Yanto, Rajagopalan, B. & Zagona, E. (2016). Space-time Variability of Indonesian Rainfall at Inter-annual and Multi-decadal Time Scales. *Climate Dynamics*, 1-15, DOI 10.1007/s00382-016-3008-8.

Brown, C., J. R. Lund, X. Cai, P. Reed, E. Zagona, A. Ostfeld, J. Hall, G. Characklis, W. Yu, L. Brekke (2015) The Future of Water Resources Systems Analysis: Toward a Scientific Framework for Sustainable Water Management, Water Resources Research, 51,6110-6124, doi:10.1002/2015WR017114.

Smith, R., J. Kasprzyk and E. Zagona (2015), Many Objective Analysis to Optimize Pumping and Releases in a Multi-Reservoir water Supply Network. *J. Water Resour. Plann. Manage.*, 04015049-1—04015049-14, dx.doi.org/10.1061/(ASCE)WR.1943-5452.0000576.

Bracken, C., B. Rajagopalan, E. Zagona (2014). A Hidden Markov Model Combined with Climate Indices for Multi-decadal Streamflow Simulation, *Water Resources Research*, 50, 7836-7846.

Ibanez, E., T. Magee, M. Clement, G. Brinkman, M. Milligan, and E. Zagona (2014). Enhancing Hydropower Modeling in Variable Generation Integration Studies. *Energy*, 74 (2014), 518–528.

Clement, M., T. Magee, E. Zagona (2014), A Methodology to Assess the Value of Integrated Hydropower and Wind Generation; Wind Engineering 38 (3), 261-276.

Rajagopalan, B., C. Brown, A. Mishra, S. Demuth, E. Zagona, J. Salas, A. Sharma, U. Lall and A. Polebitski (2012). State of the resource: Quantity. In: Chapter 15 of *Managing Water under Uncertainty and Risk*, United Nations World Water Development Report 4 (WWDR4), UNESCO

INVITED TALKS

Water Resources Management: Objectives, Technologies and Best Practices. Presented to faculty and students of Yerevan State University, National University of Architecture and Armenian National Agrarian University Armenia, during a USAID – sponsored visit to Armenia, May 20, 2024

Towards Sharing Waters of the Blue Nile River. Presented to the CVEN 5393 class April 24, 2024.

New Approaches to Decision Making for the Colorado River Basin, Presented to the Water Engineering and Science Seminar Series, Department of Civil and Environmental Engineering, Colorado State University, October 16, 2024.

Texas Water Development Board: (remote presentation) Overview of the RiverWare Hydropolicy Modeling Tool and applications in state of Texas. April 5, 2022.

Sustainable Hydropower Generation and Reservoir Operations under Changing Climate. Climate Extremes and Societal Resilience in Serayu River Basin, Indonesia, 9-12 August, 2021.

Use of RiverWare for Modeling Drought Management. Nile Basin Workshop on Water Management under Drought, University of Khartoum, Sudan, October 29-31, 2019.

River System Modeling with RiverWare, Invited talk at the Lower Mekong Initiative, Technical Workshop on Integrating River Planning for Energy and Environment, Oak Ridge Nation Laboratory, June 10-14, 2019

Invited Panelist: Department of Energy Workshop on Representation of Hydropower in Production Cost Models, Salt Lake City, March 6-7, 2019

Keynote address to the Chinese Hydraulic Engineering Society annual meeting, Nanchang, China, October 21, 2018

Keynote address to the International Symposium on Water System Operations, China Institute of Water and Hydropower Research, Beijing, China, October 17, 2018.

Keynote Address to the Fifth Nile Basin Development Forum, October 23, 2017, Kigali, Rwanda

“From Research to Application: Examples on the Colorado, Rio Grande and Columbia Rivers,” invited talk to the Colorado River Hydrology Research Symposium, May 22-23, 2017, Las Vegas

“The surprising past and uncertain future of the Colorado River – thoughts for earth day,” talk to the Boulder Rotary Club, April 21, 2017.

Keynote Address “Modeling for River System Planning and Management" to the University of Chihuahua Faculty of Engineering Conference, October 24, 2016.

Address to World Bank Ministerial Tour for water ministries of Egypt, Sudan and Ethiopia: “Technical strategies and mechanisms for cooperative filling approaches for dams in inter-state and international drainage basins,” August 9, 2016, Las Vegas, NV.

Nile Basin Initiative, Second national Experts Group meeting on Strategic Water Resources Analysis, Addis Ababa, Ethiopia: “Addressing Potential Imbalances between water demand and supply – experiences from the Colorado River Basin,” April 28, 2016.

University of Khartoum, Sudan, Conference on Scientific Research and Innovation for Sustainable Development in Africa, “Model and Analysis Tools for River System Planning and Management” February 22, 2016.

PROFESSIONAL AFFILIATIONS AND MEMBERSHIPS: American Geophysical Union, American Society of Civil Engineers, American Water Resources Association, Colorado Foundation for Water Education, Society for Decision Making Under Deep Uncertainty