Curriculum Vitae

Upmanu Lall

Global Futures Professor
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Biography

Dr. Upmanu Lall has broad interests in hydrology, climate dynamics, applied statistics, water resource systems analysis, risk management and sustainability. He is motivated by challenging questions at the intersection of these fields, especially where they have relevance to societal outcomes or to the advancement of science towards innovative application. His current research covers 3 major initiatives that were developed through the Columbia Water Center, of which he was the Founding Director. In the 15 years since its inception, the Columbia Water Center became an internationally recognized center for water research.

The ***Global Water Sustainability Initiative*** is focused on an assessment of global water scarcity and risk, and innovations across scales – from farmer's field to reservoir optimization to national policy modifications to international trade – to develop real world solutions to an impending global water crisis. This includes the development of new agro water and chemical sensor systems to improve water use efficiency and reduce non-point source pollution as well as field studies on how to get farmers to use them; comprehensive modeling and optimization of regional crop and energy facility siting to improve water sustainability and income; field experiments of water/energy pricing policy changes; participatory reservoir management using climate scenarios, elicited stakeholder values, option contracts and insurance; and models for replicable community managed rural drinking water systems.

The Global Flood Initiative is motivated by two factors. *First*, the incidence of extreme floods around the world is driven by large scale moisture transport from the tropical oceans, and understanding the climate controls on the generation of such moisture, its transport, and convergence is essential to improving our understanding of the recurrent and concurrent global patterns of floods, as well as their prediction in the short term and under a changing climate. To predict floods one looks at the source of the extreme rainfall rather than the hydrology of floods after it rains. A hypothesis is that floods in many places in the world may be concurrently generated or suppressed by a few underlying mechanisms. Developing a physics based understanding of these processes is critical for statistically modeling the dynamic or time varying risk associated with floods in a changing climate. *Second*, for today's global supply chains, floods that disrupt material sourcing, production, transportation or distribution channels can have significant economic impacts in areas far removed from the locations experiencing direct property loss. Understanding and modeling supply chain losses and their impacts on global food and manufactured goods supplies is important. Ways to predict and manage this risks using physical infrastructure; warning, response and recovery design; inventory and supply chain management and financial instruments such as index insurance, and catastrophe bonds is being explored.

America's Water is driven by the goal of developing sustainable water management and infrastructure design paradigms for the 21st century recognizing the linkages between urban functioning, food, water, energy and climate. It seeks to pull together a comprehensive understanding of the issues facing water infrastructure in the USA. These include: the financing of and investment in the replacement of aging infrastructure; pricing and allocating water given changing values and climate; the management of the total urban water cycle through new technologies and network topologies; groundwater depletion and national food and economic futures; and novel opportunities for flood risk management and non-point source pollution mitigation. The initiative looks back over the last century to understand how man and nature interacted to generate the current state of water in the country to provide a basis for steering future regional and national development and novel technologies targeted at the key issues identified. Current research focuses on technology integration and field testing to assess the feasibility of an urban water future that is highly decentralized, relying on local water capture, treatment and reuse; and more generally on systems modeling and projection of regional water, energy, food and socio-economic futures. This is part of a focus on the Fourth Industrial Revolution, and specifically on its implications for renewable water and energy systems, decentralized networks, and the circular economy.

These programmatic initiatives are backed by research on systems level modeling of hydrology, climate, agronomy and economics. Innovative modeling tools are being developed and field tested. Dr. Lall has pioneered the application of techniques from (a) nonlinear dynamical systems, (b) nonparametric methods of function estimation and their application to spatio-temporal dynamical systems, (c) Hierarchical Bayesian models, (d) systems optimization and simulation and (e) the study of multi-scale climate variability and change as an integral component of hydrologic systems.
He has published in journals that focus on hydrology, water resources, climate, physics, statistics, development, policy and management science. He has taught a wide variety of courses at 3 Universities, and was one of the earliest faculty recruited by the Columbia Earth Institute.

Dr. Lall has been engaged in high level public and scientific discussion through the media, the World Economic Forum, and with governments, foundations, development banks, and corporations interested in sustainability. He has served on several national and international panels. He was one of the originators of the Consortium of Universities for the Advancement of Hydrologic Science, and was the President of the Natural Hazards Focus Group of the American Geophysical Union.

Academic Training

University of Texas @ Austin, TX
PhD. Civil & Environmental Engineering *1980-1981*
Dissertation: Value of data in relation to uncertainty and risk

University of Texas @ Austin, TX
M.S. Civil & Environmental Engineering *1977-1980*
Thesis: Mathematical models for water-energy systems

Indian Institute of Technology Kanpur, U.P., India
B. Tech. Civil Engineering *1971-1976*

Employment Record

Arizona State University

Columbia University

Chair, Earth & Environmental Eng.,	*2018-2020*
Director, Columbia Water Center	*2008-2023*
Alan & Carol Silberstein Professor of Engineering	*2005-2023*
Chair, Civil Eng. & Eng. Mechanics	*2009-2010*
Chair, Earth & Environmental Eng.,	*2003-2006*
Professor, Civil Eng. & Eng. Mechanics,	*2002-2023*
Professor, Earth & Environmental Eng.,	*2001-2023*
Senior Research Scientist, International Research Institute for Climate & Society	*2001-2023*
Visiting Prof., Columbia Earth Institute	*1999-2001*
Adjunct Res. Scientist (LDEO.)	*1997-1999*

Utah State University

Professor, Civil & Environmental Eng.,	*1995-2001*
Associate Director, Utah Water Research Lab.,	*1997-2001*
Associate Professor, Civil & Environmental Eng.	*1988-1995*

U.S.G.S., Salt Lake City, UT *Hydrologist* *1988-1989*

University of Utah

Associate Professor, Civil & Environmental Eng.	*1987-1988*
Assistant Professor, Civil & Environmental Eng.	*1981-1987*

ISMAL, Ranchi, India *Prestressed Concrete Development Engineer* *1976-1977*

Self Employed Architecture *1975-1977*

Honors and Awards

John R. Parks Teachers Fellowship, College of Engineering, University of Utah	*1982-1983*
Outstanding Researcher, Dept. of Civil & Environ. Eng., Utah State University	*1995-1996*
Research Excellence Award, College of Engineering, Utah State University	*1995-1996*
Borland Lecture on Hydrology, AGU Hydrology Days	*2006*
Kim Award for Faculty Involvement, Columbia University	*2008*
ASCE Arid Lands Hydrology Research Award	*2010*
Henry Darcy Medal, European Geosciences Union	*2014*
Fellow, American Geophysical Union	*2017*
Editor's Choice Award: Water Resources Research	*2017*
Fellow, American Association for the Advancement of Science	*2019*
Jelle Zijlstra Award from the European Chamber of Digital Commerce	*2020*
Langbein Lecture, American Geophysical Union	*2022*
ASCE Ven Te Chow Award	*2023*

Teaching Experience

Undergraduate: Hydrology[1, 2], Water Resources Eng.[1, 2], Computations & Computer Analysis[1], Fluid Mechanics Lab.[1], Operations Research II[1], Systems Analysis for Civil Eng[1], Water Project Analysis[1], Statistics in Water Resources[1], Water Resource Systems Analysis[1], Groundwater Engineering[2], Earth Resources and the Environment[3], A Better Planet by Design[3], Hydrosystems Engineering[3]

Graduate: Optimization of Large Systems[1], Applied Probability Theory[1], Statistical Decision Theory[1], Hydro-electric Power[1], Stochastic Hydrology[1, 2], Groundwater Hydrology[1,2], Groundwater Contaminant Transport[2], Groundwater Quantity and Quality Modeling[2], Spatial Hydrologic Analysis[2], Physical Hydrology[2,3], Low Frequency Hydro-Climatic Variability[2], Environmental Statistics[2], Hydroclimatology[2], Water Management and Development[3], Hydrosystems[3], Environmental Data Analysis[3], Complexity Science[3], El Nino Southern Oscillation: Dynamics, Prediction and Impacts[3]

Publications: http://scholar.google.com/citations?user=JA0o2TUAAAAJ&hl=en (h index=78, index=251)

Refereed Journal Publications

1. Tarasova, L., Ahrens, B., Hoff, A., & Lall, U. (2024). The value of large-scale climatic indices for monthly forecasting severity of widespread flooding using dilated convolutional neural networks. *Earth's Future*, 12(2), e2023EF003680.
2.
3. Najibi, N., Devineni, N., & Lall, U. (2023). Compound continental risk of multiple extreme floods in the United States. *Geophysical Research Letters*, 50(21), e2023GL105297.
4. Amonkar, Y., Doss-Gollin, J., Farnham, D. J., Modi, V., & Lall, U. (2023). Differential effects of climate change on average and peak demand for heating and cooling across the contiguous USA. *Nature Communications Earth & Environment*, 4(1), 402.
5. Hariri-Ardebili, M. A., Mahdavi, G., Nuss, L. K., & Lall, U. (2023). The role of artificial intelligence and digital technologies in dam engineering: Narrative review and outlook. *Engineering Applications of Artificial Intelligence*, 126, 106813.
6. Nakamura, J., Lall, U., Kushnir, Y. *et al.* A saturated stochastic simulator: synthetic US Gulf coast tropical cyclone precipitation fields. *Nat Hazards* (2023). https://doi.org/10.1007/s11069-023-06245-x
7. Amonkar, Yash, James Doss-Gollin, and Upmanu Lall. (2023) "Compound Climate Risk: Diagnosing Clustered Regional Flooding at Inter-Annual and Longer Time Scales." *Hydrology* 10.3 (2023): 67.
8. Concha Larrauri, P., Lall, U., & Hariri-Ardebili, M. A. (2023). Needs for Portfolio Risk Assessment of Aging Dams in the United States. *Journal of Water Resources Planning and Management*, 149(3), 04022083.
9. M. Amin Hariri-Ardebili, Golsa Mahdavi, Larry K. Nuss, Upmanu Lall,(2023), The role of artificial intelligence and digital technologies in dam engineering: Narrative review and outlook, *Engineering Applications of Artificial Intelligence*, Volume 126, Part A, 106813, https://doi.org/10.1016/j.engappai.2023.106813.
10. Griffith, D., Muneepeerakul, R., Guerry, G., Cabrero, A. C., Johnson, J. C., Munoz-Carpena, R., ... & Homayounfar, M. (2023). Migration and livelihood constellations: Assessing common themes in the face of environmental change in Somalia and among Agro-Pastoral peoples. *International Migration*.
11. Sun, D., Wang, H., Lall, U., Huang, J., & Liu, G. (2022). Subway travel risk evaluation during flood events based on smart card data. *Geomatics, Natural Hazards and Risk*, 13(1), 2796-2818.
12. Schwetschenau, S. E., Kovankaya, Y., Elliott, M. A., Allaire, M., White, K. D., & Lall, U. (2022). Optimizing Scale for Decentralized Wastewater Treatment: A Tool to Address Failing Wastewater Infrastructure in the United States. *ACS ES&T Engineering*.
13. Michalak, A.M., Xia, J., Brdjanovic, D. *et al.* The frontiers of water and sanitation. *Nat Water* 1, 10–18 (2023). https://doi.org/10.1038/s44221-022-00020-1
14. Rahill-Marier, B., Devineni, N., & Lall, U. (2022). Modeling spatial fields of extreme precipitation–a hierarchical Bayesian approach. *Hydrology and Earth System Sciences*, 26(21), 5685-5695.
15. Zhang, M., Rojo-Hernández, J. D., Yan, L., Mesa, Ó. J., & Lall, U. (2022). Hidden Tropical Pacific Sea Surface Temperature States Reveal Global Predictability for Monthly Precipitation for Sub-Season to Annual Scales. *Geophysical Research Letters*, 49(20), e2022GL099572.
16. Wu, Y., Long, D., Lall, U., Scanlon, B. R., Tian, F., Fu, X., ... & Hu, C. (2022). Reconstructed eight-century streamflow in the Tibetan Plateau reveals contrasting regional variability and strong nonstationarity. *Nature Communications*, 13(1), 6416.
17. Yu, Z., Montalto, F., Jacobson, S., Lall, U., Bader, D., & Horton, R. (2022). Stochastic downscaling of hourly precipitation series from climate change projections. *Water Resources Research*, 58(10), e2022WR033140.
18. Zhang, M., Cao, Q., Zhu, F., Lall, U., Hu, P., Jiang, Y., & Kan, G. (2022). The asymmetric effect of different types of ENSO and ENSO Modoki on rainy season over the Yellow River basin, China. *Theoretical and Applied Climatology*, *149*(3), 1567-1581.
19. Haraguchi, M., Davi, N., Rao, M. P., Leland, C., Watanabe, M., & Lall, U. (2022). Estimating return intervals for extreme climate conditions related to winter disasters and livestock mortality in Mongolia. *Natural Hazards and Earth System Sciences*, *22*(8), 2751-2770.

20. Devineni, N., Perveen, S. & Lall, U. Solving groundwater depletion in India while achieving food security. *Nature Communications* 13, 3374 (2022). https://doi.org/10.1038/s41467-022-31122-9
21. Cioffi, F., De Bonis Trapella, A., Giannini, M., & Lall, U. (2022). A Flood Risk Management Model to Identify Optimal Defence Policies in Coastal Areas Considering Uncertainties in Climate Projections. *Water*, 14(9), 1481. MDPI AG. Retrieved from http://dx.doi.org/10.3390/w14091481
22. Haraguchi, M., Nishino, A., Kodaka, A., Allaire, M., Lall, U., Kuei-Hsien, L., ... & Kohtake, N. (2022). Human mobility data and analysis for urban resilience: A systematic review. *Environment and Planning B: Urban Analytics and City Science*, 23998083221075634.
23. Rahill-Marier, B., Devineni, N., & Lall, U. (2022). Modeling Spatial Fields of Extreme Precipitation–A Hierarchical Bayesian Approach. *Hydrology and Earth System Sciences Discussions*, 1-18.
24. Baru, C., Pozmantier, M., Altintas, I., Baek, S., Cohen, J., Condon, L., ... & Zhang, P. (2022). Enabling AI innovation via data and model sharing: An overview of the NSF Convergence Accelerator Track D. *AI magazine*, *43*(1), 93-104.
25. Mauerman, M., Tellman, E., Lall, U., Tedesco, M., Colosio, P., Thomas, M., ... & Bhuyan, A. (2022). High-Quality Historical Flood Data Reconstruction in Bangladesh Using Hidden Markov Models. In *Water Management: A View from Multidisciplinary Perspectives* (pp. 191-210). Springer, Cham.
26. Tellman, B., Lall, U., Islam, S., & Bhuyan, M. A. (2022). Regional Index Insurance using Satellite-based Fractional Flooded Area. *Earth's Future*, e2021EF002418.
27. Amonkar, Y., Farnham, D. J., & Lall, U. (2022). A k-nearest neighbor space-time simulator with applications to large-scale wind and solar power modeling. *Patterns*, 100454.
28. Rising, J., Josset, L., Troy, T., & Lall, U. (2022). The importance of infrastructure and national demand to represent constraints on water supply in the United States. *Global Environmental Change*, 73, 102468.
29. Wang, W., Dong, Z., Rao, M. P., Lall, U., & Jia, B. (2021). Last two millennia of streamflow variability in the headwater catchment of the Yellow River basin reconstructed from tree rings. *Journal of Hydrology*, 127387.
30. Zhang, M., Hu, P., Wang, J., & Lall, U. (2021). Four-level compensation standards and calculation techniques for water ecological protection in the river source regions in China. *Ecohydrology*, e2366.
31. Bonnafous, L., & Lall, U. (2021). Space-time clustering of climate extremes amplify global climate impacts, leading to fat-tailed risk. *Natural Hazards and Earth System Sciences*, 21(8), 2277–2284.
32. Stephens, C. M., Lall, U., Johnson, F. M., & Marshall, L. A. (2021). Landscape changes and their hydrologic effects: Interactions and feedbacks across scales. *Earth-Science Reviews*, 212, 103466.
33. Maxcy-Brown, J., Elliott, M. A., Krometis, L. A., Brown, J., White, K. D., & Lall, U. (2021). Making waves: Right in our backyard-surface discharge of untreated wastewater from homes in the United States. *Water Research*, 190, 116647.
34. Merz, B., Blöschl, G., Vorogushyn, S., Dottori, F., Aerts, J. C. J. H., Bates, P., Bertola, M., Kemter, M., Kreibich, H., Lall, U., & others. (2021). Causes, impacts and patterns of disastrous river floods. *Nature Reviews Earth \& Environment*, 1–18.
35. Ossandón, Á., Rajagopalan, B., Lall, U., Nanditha, J. S., & Mishra, V. (2021). A Bayesian hierarchical network model for daily streamflow ensemble forecasting. *Water Resources Research*, 57(9), e2021WR029920.
36. Siegel, J., Concha Larrauri, P., Bonnafous, L., & Lall, U. (2021). Multi-dimensional and Interacting Water and Climate Risks and Pricing Them in the Industry Context. In *Water Risk and Its Impact on the Financial Markets and Society* (pp. 303–327). Palgrave Macmillan, Cham.
37. Haraguchi, M., Davi, N., Rao, M., Leland, C., Watanabe, M., & Lall, U. (2021). Estimating Return Intervals for Extreme Climate Conditions Related to Winter Disasters and Livestock Mortality in Mongolia. *Natural Hazards and Earth System Sciences Discussions*, 1–26.
38. Amini, A., Abdollahi, A., Hariri-Ardebili, M. A., & Lall, U. (2021). Copula-based reliability and sensitivity analysis of aging dams: Adaptive Kriging and polynomial chaos Kriging methods. *Applied Soft Computing*, 107524.
39. Doss-Gollin, J., Farnham, D. J., Lall, U., & Modi, V. (2021). How unprecedented was the February 2021 Texas cold snap?. *Environmental Research Letters*, *16*(6), 064056.
40. Nakamura, J., Lall, U., Kushnir, Y., Harr, P. A., & McCreery, K. (2021). Early Season Hurricane Risk Assessment: Climate Conditioned HITS Simulation of N. Atlantic Tropical Storm Tracks. *Journal of Applied Meteorology and Climatology*.

41. Gao, S., Liu, P., & Lall, U. (2021). Seasonal Precipitation Predictability for the Northern Hemisphere Using Concurrent and Preseason Atmospheric Water Vapor Transport and Sea Surface Temperature. *Journal of Hydrometeorology*, 22(1), 183–199.
42. Jain, Meha, Ram Fishman, Pinki Mondal, Gillian L. Galford, Nishan Bhattarai, Shahid Naeem, Upmanu Lall, and Ruth S. DeFries. "Groundwater depletion will reduce cropping intensity in India." *Science Advances* 7, no. 9 (2021): eabd2849.
43. Zhai, R., Tao, F., Lall, U., & Elliott, J. (2021). Africa would need to import more maize in the future even under 1.5 C warming scenario. *Earth's Future*, 9(1), e2020EF001574.
44. Orton, P. M., Conticello, F. R., Cioffi, F., Hall, T. M., Georgas, N., Lall, U., Blumberg, A. F., & MacManus, K. (2020). Flood hazard assessment from storm tides, rain and sea level rise for a tidal river estuary. *Natural Hazards*, 102(2), 729–757.
45. Quinn, N., Blöschl, G., Bárdossy, A., Castellarin, A., Clark, M., Cudennec, C., Koutsoyiannis, D., Lall, U., Lichner, L., Parajka, J., & others. (2020). Invigorating hydrological research through journal publications.
46. Su, Z., Ho, M., Hao, Z., Lall, U., Sun, X., Chen, X., & Yan, L. (2020). The impact of the Three Gorges Dam on summer streamflow in the Yangtze River Basin. *Hydrological Processes*, 34(3), 705–717.
47. Concha Larrauri, P., Campos Gutierrez, J. P., Lall, U., & Ennenbach, M. (2020). A City Wide Assessment of the Financial Benefits of Rainwater Harvesting in Mexico City. *JAWRA Journal of the American Water Resources Association*, 56(2), 247–269.
48. Kim, Y.-T., So, B.-J., Kwon, H.-H., & Lall, U. (2020). A multiscale precipitation forecasting framework: Linking teleconnections and climate dipoles to seasonal and 24-hr extreme rainfall prediction. *Geophysical Research Letters*, 47(3), e2019GL085418.
49. Doss-Gollin, J., Farnham, D. J., Ho, M., & Lall, U. (2020). Adaptation over fatalism: Leveraging high-impact climate disasters to boost societal resilience. *Journal of Water Resources Planning and Management*, Volume 146 Issue 4 - April 2020, American Society of Civil Engineers.
50. Su, Z., Sun, X., Devineni, N., Lall, U., Hao, Z., & Chen, X. (2020). The effects of pre-season high flows, climate, and the Three Gorges Dam on low flow at the Three Gorges Region, China. *Hydrological Processes*, 34(9), 2088–2100.
51. Conticello, F. R., Cioffi, F., Lall, U., & Merz, B. (2020). Synchronization and delay between circulation patterns and high streamflow events in Germany. *Water Resources Research*, 56(4), e2019WR025598.
52. Zhai, R., Tao, F., Lall, U., Fu, B., Elliott, J., & Jägermeyr, J. (2020). Larger drought and flood hazards and adverse impacts on population and economic productivity under 2.0 than 1.5 C warming. *Earth's Future*, 8(7), e2019EF001398.
53. Lall, U., Josset, L., & Russo, T. (2020). A snapshot of the world's groundwater challenges. *Annual Review of Environment and Resources*, 45, 171–194.
54. Cioffi, F., Conticello, F. R., & Lall, U. (2020). Stochastic Scenarios for 21st Century Rainfall Seasonality, Daily Frequency, and Intensity in South Florida. *Journal of Water Resources Planning and Management*, 146(8), 4020058.
55. Zhu, W., Jia, S., Lall, U., Cheng, Y., & Gentine, P. (2020). An observation-driven optimization method for continuous estimation of evaporative fraction over large heterogeneous areas. *Remote Sensing of Environment*, 247, 111887.
56. Bonnafous, L., & Lall, U. (2020). Space-time clustering of climate extremes amplify global climate impacts, leading to fat-tailed risk. *Natural Hazards and Earth System Sciences Discussions*, 1–19.
57. Xuan, Y., Ford, L., Mahinthakumar, K., De Souza Filho, A., Lall, U., & Sankarasubramanian, A. (2020). GRAPS: Generalized Multi-Reservoir Analyses using probabilistic streamflow forecasts. *Environmental Modelling & Software*, 133, 104802.
58. Rao, M. P., Cook, E. R., Cook, B. I., D'Arrigo, R. D., Palmer, J. G., Lall, U., Woodhouse, C. A., Buckley, B. M., Uriarte, M., Bishop, D. A., & others. (2020). Seven centuries of reconstructed Brahmaputra River discharge demonstrate underestimated high discharge and flood hazard frequency. *Nature Communications*, 11(1), 1–10.
59. Stephens, C. M., Lall, U., Johnson, F. M., & Marshall, L. A. (2020). Landscape changes and their hydrologic effects: Interactions and feedbacks across scales. *Earth-Science Reviews*, 103466.
60. Rojo Hernández, J. D., Mesa, Ó. J., & Lall, U. (2020). Enso dynamics, trends, and prediction using machine learning. *Weather and Forecasting*, 35(5). https://doi.org/10.1175/WAF-D-20-0031.1
61. Lall, U. (2019). Disruptions by 2030. *The Future of Water*, 45.

62. Doss-Gollin, J., Farnham, D. J., Steinschneider, S., & Lall, U. (2019). Robust Adaptation to Multiscale Climate Variability. *Earth's Future*, *7*(7), 734-747.
63. 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*(7), 6268-6284.
64. Wang, W., Dong, Z., Lall, U., Dong, N., & Yang, M. (2019). Monthly streamflow simulation for the headwater catchment of the Yellow River basin with a hybrid statistical-dynamical model. *Water Resources Research*, *55*(9), 7606-7621.
65. Ravindranath, A., Devineni, N., Lall, U., Cook, E. R., Pederson, G., Martin, J., & Woodhouse, C. (2019). Streamflow Reconstruction in the Upper Missouri River Basin Using a Novel Bayesian Network Model. *Water Resources Research*, *55*(9), 7694-7716.
66. Zhu, W., Jia, S., Devineni, N., Lv, A., & Lall, U. (2019). Evaluating China's water security for food production: The role of rainfall and irrigation. *Geophysical Research Letters*, *46*(20), 11155-11166.
67. Concha Larrauri, P., Campos Gutierrez, J. P., Lall, U., & Ennenbach, M. A City Wide Assessment of the Financial Benefits of Rainwater Harvesting in Mexico City. *JAWRA Journal of the American Water Resources Association*.
68. Kim, Y. T., So, B. J., Kwon, H. H., & Lall, U. A Multiscale Precipitation Forecasting Framework: Linking Teleconnections and Climate Dipoles to Seasonal and 24-Hour Extreme Rainfall Prediction. *Geophysical Research Letters*.
69. Su, Z., Ho, M., Hao, Z., Lall, U., Sun, X., Chen, X., & Yan, L. (2020). The impact of the Three Gorges Dam on summer streamflow in the Yangtze River Basin. *Hydrological Processes*, 34(3), 705-717.
70. Allaire, M., Mackay, T., Zheng, S., & Lall, U. (2019). Detecting community response to water quality violations using bottled water sales. *Proceedings of the National Academy of Sciences*, 116(42), 20917-20922.
71. Yu, Z., Miller, S., Montalto, F., & Lall, U. (2019). Development of a Non-Parametric Stationary Synthetic Rainfall Generator for Use in Hourly Water Resource Simulations. *Water*, 11(8), 1728.
72. Pournasiri Poshtiri, M., Pal, I., Lall, U., Naveau, P., & Towler, E. (2019). Variability patterns of the annual frequency and timing of low streamflow days across the United States and their linkage to regional and large-scale climate. *Hydrological Processes*, 33(11), 1569-1578.
73. Altobelli, F., Lall, U., Dalla Marta, A., Caracciolo, F., Cicia, G., D'Urso, G., & Del Giudice, T. (2018). Willingness of farmers to pay for satellite-based irrigation advisory services: a southern Italy experience. *The Journal of Agricultural Science*, 156(5), 723–730.
74. Dong, Q., Zhang, X., Lall, U., Sang, Y.-F., & Xie, P. (2019). An improved nonstationary model for flood frequency analysis and its implication to the Three Gorges Dam, China. *Hydrological Sciences* Journal. 64 (7), 845-855
75. Zhu, W., Jia, S., Lall, U., Cao, Q., & Mahmood, R. (2019). Relative contribution of climate variability and human activities on the water loss of the Chari/Logone River discharge into Lake Chad: A conceptual and statistical approach. *Journal of Hydrology*, 569, 519–531.
76. Josset, L., Allaire, M., Hayek, C., Rising, J., Thomas, C., & Lall, U. (2019). The U.S. Water Data Gap A Survey of State-Level Water Data Platforms to Inform the Development of a National Water Portal. *Earths Future*. https://doi.org/10.1029/2018ef001063
77. Schlef, K. E., Moradkhani, H., & Lall, U. (2019). Atmospheric Circulation Patterns Associated with Extreme United States Floods Identified via Machine Learning. *Nature Scientific Reports*. https://doi.org/10.1038/s41598-019-43496-w
78. Rözer, V., Kreibich, H., Schrter, K., Müller, M., Sairam, N., Doss-Gollin, J., … Merz, B. (2019). Probabilistic Models Significantly Reduce Uncertainty in Hurricane Harvey Pluvial Flood Loss Estimates. *Earth's Future*. https://doi.org/10.1029/2018ef001074
79. Federgruen, A., Lall, U., & Simcsek, A. S. (2019). Supply chain analysis of contract farming. *Manufacturing & Service Operations Management*. 21 (2), 361-378
80. Günter, Q., András, B., Attilio, B., Martyn, C., Christophe, C., Demetris, C., … others. (2018). Joint Editorial Invigorating Hydrological Research through Journal Publications. Vodohospodársky Časopis.
81. Kim, S., Devineni, N., Lall, U., & Kim, H. (2018). Sustainable Development of Water Resources: Spatio-Temporal Analysis of Water Stress in South Korea. *Sustainability*, 10(10), 3795.
82. Mishra, V., Asoka, A., Vatta, K., & Lall, U. (2018). Groundwater depletion and associated CO2 emissions in India. *Earth's Future*.

83. Quinn, N., Blöschl, G., Bárdossy, A., Castellarin, A., Clark, M., Cudennec, C., … others. (2018). Invigorating hydrological research through journal publications. *Ecohydrology*, 11(6), e2016.
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REFEREED BOOK SECTIONS AND CONFERENCE PROCEEDINGS

1. Lall, U. and B. Rajagopalan, (2016), Nonparametric Methods, in *Handbook of Applied Hydrology, Ed. V. P. Singh*
2. Rajagopalan, B. and Lall, U., (2016), Stochastic Streamflow Simulation and Forecasting, in *Handbook of Applied Hydrology, Ed. V. P. Singh*
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Presentations and Invited Presentations (too many to list)

Grants Awarded:

1. *HDR Institute: Geospatial Understanding through an Integrative Discovery Environment (Shaowen Wang, PI),* ***NSF, $510K****, Columbia portion) 10/21-9/26.*
2. *Data-driven Disaster Planning in New York, Tokyo, and Taipei, (U. Lall, PI, Masa Haraguchi, co-PI),* ***United States-Japan Foundation, $375000****, 9/1/21-8/30/24.*
3. *Engaging Young Black and Latino Students in Data Science Through Water Security, (U. Lall, PI, Laureline Josset, Nancy Degnan, co-PIs),* ***NSF: $1,488,914****, 6/1/21-5/30/24.*
4. *Belmont Forum Collaborative Research: Data-driven Disaster Response Systems Dependent on Time of Day, Season and Location for Megacities (U. Lall, PI, Masa Haraguchi, co-PI),* ***NSF, $299,933****, 4/15/2021-4/14/2023.*
5. *NSF Convergence Accelerator– Track D America's Water Risk: Water System Data Pooling for climate vulnerability assessment and warning system),* ***NSF, $999,982*** *(U.Lall, PI, Casey Brown, Scott Steinschneider, Ken Kunkel, co-PIs), 7/10/2020-6/30/2022.*
6. *Towards a Multi-Scale Theory on Coupled Human Mobility and Environmental Change (U. Lall Columbia PI, Michael Puma, co-PI),* ***USDOD-MURI, $1,535,860*** *(Columbia portion), 4/1/2018-6/30/2021*
7. *Hurricane Interactive Track Simulator with Wind and Precipitation Scenarios (U.Lall, co-PI),* ***Jupiter, $338,381****, 3/6/18-3/39/21.*
8. *Collaborative Research: P2C2-Inferring Spatio-Temporal Variations in the Risk of Extreme Precipitation in the Western United States from Tree Ring Chronologies (U.Lall, co-PI),* ***NSF, $248,208,*** *7/1/2019-8/31/2021*
9. *Baseline Assessments and SECURE Water Act Report 2021 (U. Lall, PI, Naresh Devineni, co-PI),* ***US Bureau of Reclamation, $81,627****, 10/1/19-3/31/2021.*
10. *Successful Implementation of Decentralized Reuse and Treatment Systems, (U. Lall, PI, William Becker, co-PI),* ***Water Research Foundation, $149,979****, 2/1/2020-7/31/2021.*
11. *Climate Extremes: Aging Dams and Failure Impacts (Lall, U PI),* ***Global Risk Institute $140,000*** *04/01/2018-03/31/2020*
12. *Creating a Generalized Approach to Risked-Based Water Valuation for Mining (U. Lall, PI)* ***BHP Billiton****,* ***$156,466*** *12/01/2017 - 11/30/2018*
13. *Building Capacity for Rapid Financial Response to Natural Hazards* (Lall, U., PI) **World Bank, $149,493.** 10/16 to 5/17.
14. *A Water Resources Decision Support System To Reduce Drought Vulnerability And Enable Adaptation To Climate Variability And Change In Pernambuco* (Lall, U., PI) ***Inter-American Development Bank, IDB C0106-15*****, $630,318***, 7/15/2015-6/17/2017.*
15. *Feasibility of Decentralized Water Systems in Mexico City***, Rotoplas, $96,284***, (U. Lall, PI), 2/5/2016-11/14/2016*

16. *Collaborative Research: P2C2--Multi-Site Paleo-Reconstruction of Missouri River Streamflows from Tree Ring Data AGS-1404188,* ***NSF, $268,050****,* (PI: Cook, E., CO-PIs: Lall, U., Pederson, N.), *7/14 to 6/2017*
17. *Climate-Informed Estimation Of Hydrologic Extremes For Robust Adaptation To Non- Stationary Climate Conditions,* **DOD-SERDP/Univ of Massachusetts, Amherst, $388,575***,* (Lall, U., PI), *9/21/2015-9/20/2018.*
18. *America's Water– The Changing Landscape of Risk, Competing Demands and Climate,* **NSF**, **$2.49 million,** U. Lall (PI), L. Goddard, N. Devineni, M. Gerrard, E. Cook, T. Troy, B. O'Flaherty, M. Levy (co-PIs), 9/1/14 to 7/31/17.
19. *Mining & Water Risk: Diagnosis, Benchmarking, and Quantitative Analysis Of Financial Impacts*, **NBIM**, **$2.36 million**, U. Lall (PI), G. Iyengar, J. Blanchet, S. Thomashaussen (co-PIs), 11/1/14 – 12/31/17.
20. *Development Of Adaptable Web Modules To Stimulate Active Learning In Hydrology Using Data And Model Simulations,* **NSF, *$*98,324,** U. Lall (PI), 10/1/11-9/30/15.
21. *Water Risk And Sustainability: Managing Water Risks Through The Supply Chain*, **PEPSICO, $546,014**, U. Lall (PI) 2/11-1/16.
22. *Improving Food And Livelihood Security Through Water-Energy-Agriculture Management Under Climate Change And Variability: A Field Demonstration In India*, **IDRC, $150,967**, U. Lall (PI), 4/12-3/15.
23. *Water-Agriculture-Livelihood Security in India, (PI: Vatta, K., U. Lall),* ***USAID, $1.73 million***, 6/1/2012-5/31/2017.
24. *Columbia Water Center's 'Aquanauts' Education Program*, **Veolia Foundation, $26350,** U. Lall (PI), 6/12-5/13.
25. *Climate Informed Global Flood Risk Assessment And Updates,* **AIG**, **$331,439**, U. Lall (PI), N. Devineni and T. Troy (co-PIs), 9/1/12, 8/31/13.
26. *A Water Management Knowledge Network For The Urban Northeast,* **NOAA, $79,658**, U. Lall (PI), N. Devineni (co-PI), 1/1/13-12/31/14.
27. *Water Resource And Flood & Erosion Risk Mitigation Planning In Assam,* **Assam State Disaster Management Authority, $333,903**, U. Lall (PI), T. Troy (co-PI), 1/13-1/15.
28. *Multi-Purpose R&D Pilot Projects For Assessing The Feasibility Of Cost Effective And Sustainable Technologies For Drinking Water Storage And Distribution In Rural Areas Of Jharkhand*, **Government Of Jharkhand, India: Drinking Water & Sanitation Dept, $347,076,** U. Lall (PI), Modi, V., Perveen, S. (co-PIs), 11/12-10/13.
29. *Building Capacity To Manage Water Resources And Climate Risk In The Caribbean*, **LAC: ECPA/CRCA, $741, 463,** Baethgen, W., (PI); Goddard, L., Lall, U., Perveen, S., Kelsey, R., co-PIs, 7/1/2012-6/30/2015.
30. *Decadal Prediction And Stochastic Simulation Of Hydroclimate Over Monsoonal Asia*, **DOE, $355,204,** Robertson, A., (PI), D'arrigo, R., Cook, E., Lall, U., Greene, A Co-Pi's), 9/1/11-8/31/2013
31. *Northeast Urban RISA,* **NOAA, $3,499,924,** C. Rosenzweig (PI), U. Lall, P. Kinney, S. Someshwar, L. Goddard, R. Chen, and Y. Kushnir (co-PIs), 10/1/2010 – 9/31/2016.
32. *Climate Predictability of Extreme Floods,* **NOAA, $439,230**, U. Lall (PI), Y. Kushnir, A Robertson, J. Nakamura (co-PIs), 6/1/2010 – 5/31/2013.
33. *Reconstructing Climate From Tree Ring Data* ***NSF,*** **$598,084**, A. Gelman (PI), E. Cook and U. Lall (co-PIs), 10/1/2009 – 9/30/2012.
34. *Paleoclimate Shocks: Environmental Variability, Human Vulnerability, and Social Adaptation During The Last Millennium In The Greater Mekong Basin,* **NSF, $1,401,351**, 8/1/2009-7/31/2013. Buckley, B., (PI); Anchukaitis, K., Cook, B., Heikkila, T., Lall, U., Cook, E., Levy, M.; (Co PIs)
35. *How Can the Contribution of Climate Variability, Water Release Patterns, and Hydrologic Performance Indices towards Ecological Restoration Measures at the Everglades National Park be Best Quantified and Predicted?* **National Park Service, $151,721**, U. Lall (PI), 4/08 to 5/13.
36. *Improving rural water and livelihood outcomes in India, China, Africa, and Brazil,* **PepsiCo Foundation**, **$6,000,000**, U. Lall (PI), T. Heikkila, V. Modi, J. Sachs (co-PIs), 1/01/08-5/31/10.

37. *Sustainable Development of Water Resources in Ethiopia: Learning from doing in Koraro,* **Pulitzer Foundation**, **$690,000** , U. Lall (PI), V. Modi, F. Montalto, P. Schlosser, P. Culligan (co-PIs), 7/01/07-10/31/11
38. *Climate-Informed Adaptive Management and Planning to Meet Urban Water Supply and Flood Mitigation Goals in the Delaware River Basin*, **NOAA, $299,842**, G. Gong (PI), C. Brown, P. Kolesar and U. Lall (co-PIs), 7/01/07-6/31/09
39. *Water Security in Asia: Meeting the Challenge through Infrastructure Development & Climate Risk Management*, **Asian Development Bank, $180,000**, J. Sachs (PI), C. Brown, T. Heikkila, U. Lall and T. Siegfried (co-PIs), 7/01/07-12/31/08
40. *Climate and Weather Scenario Driven Strategies for the Adaptive Management of Everglades National Park Operations to Achieve Hydrologic and Ecologic Restoration Targets,* **National Park Service, $498,000**, U. Lall (PI), 4/05 to 4/08.
41. *Reforming Undergraduate Education in Environmental Engineering: Urban Studios as Knowledge Delivery Systems and Vehicles for Service Learning, **NSF**,* **$999,494**, J. McGourty (PI), M. Castaldi, P. Culligan, G. Gong and U. Lall *(co-PIs). 9/15/04-8/31/08*
42. *Impacts of Water Resource Management Choices in Ceará, Brazil: Roles of Streamflow Forecasts, Rainfall Forecasts and Participatory Decision Making*, **NOAA**, **$445,833**, K. Broad, PI, A. Pfaff and U. Lall, co-PIs, 10/03-9/05.
43. *Climate Informed Water Resources Management for Ceara,* **FUNCEME, $100,000**, S. Zebiak (PI), U. Lall, K. Broad, A. Pfaff, L. Sun (co-PIs) 9/03-12/04.
44. *Analysis of climate variations and hydrologic prediction for the Everglades National Park,* **National Park Service, $152,000**, 3/1/2003-2/28/2005. U. Lall (PI)
45. *Attracting and Retaining Undergraduates to Engineer the Built Environment*, **NSF, $375,000,** 9/1/2002-8/31/2004, U. Lall (PI), M. Garvin, A. Smyth, P. Sommer (co-PIs).
46. *Climate Change and Variability: Assessment and Prediction for Streamflow in the Hydroquebec Region,* **Hydroquebec, $200,000**, 6/1/2002-5/31/2004.
47. *A Joint Graduate Program in Applied Mathematics and the Earth and Environmental Sciences*, **NSF, $2,641,325,** L. Polvani (PI), V. de La Pena, U. Lall, D. Phong, M. Visbeck (co-PIs).
48. *Infrastructure for the Advancement of Hydrologic Science*, **NSF, $ 678,730,** 9/01-8/04, R. C. Bales (PI), J. S. Selker, U. Lall, M. B. Parlange, M. W. Williams, C. J. Duffy (co-PIs)**.**
49. *Systems Approach to Earth and Environmental Engineering*, **Academic Quality Fund, Columbia Univ., *$380,000***, 6/01-6/04, *U. Lall (PI), co-PIs : A. Sobel and M. Spiegelman, P. Sommer , A. Bagtzoglou, P. Duby, A. Gelman, P. Schlosser, P. Somasundran, N. Themelis, R. Versteeg & T. Yegulalp, A. Pfaff, D. Krantz*
50. *Development of a Benchmark Hydroclimatic Data base for N. America,* **NSF, $15,000**, 5/01-4/02. , U. Lall (PI), E. Cook (co-PI).
51. *Reconstruction of drought and streamflow over the coterminous United States from tree rings, with extensions into Mexico and Canada*, **NSF, $310,947**, 8/00-7/03. , E. Cook (PI), U. Lall (co-PI).
52. *Interannual and Interdecadal climate variations of floods in the Western United States,* **NSF**, **$262,227**, 11/99-11/04, U. Lall (PI), B. Rajagopalan (co-PI).
53. *Atlantic Basin Tropical Cyclones: Risk assessment using climate indicators,* **NOAA**, **$125,689**, 9/99-9/01, Y. Kushnir (PI), B. Rajagopalan and U. Lall (co-PIs).
54. *Devils Lake, N. Dakota- Climate Connections and Forecasts***, USACE, $12,000***,* 1/99-2/00. U. Lall (PI)

55. *Seasonal To Interannual Ensemble Streamflow Forecasts For Improved Sydney Water Supply Management*, **Sydney Water**, **AU$90,000**, 2/98-11/98, A. Sharma (PI), U. Lall and I. Cordery (co-PIs).
56. *Development Of A User Driven Decision Support System For Water Availability And Quality Management*, **DOE-INEEL**, **$2.38 million**, 1/98-9/02, U. Lall (PI), D Stevens, Q Weninger, T Glover, J Kaluarachchi, D Tarboton co-PIs
57. *The Changing Seasons? Detecting and Understanding Climatic Change*, **NSF**, **$264,000**, 9/97-9/03, U. Lall (PI), B. Rajagopalan, M. Cane, M. Mann and J. Park (co-PIs).
58. *Droughts in the Southwest and Large Scale Climate: Inferences and Prediction using Nonparametric Statistical Methods with Tree Ring and Historical Climate Data*, **NOAA Earth System History**, **$219,400** , 9/97-1/01, E. Cook (PI), B. Rajagopalan, B. Ray and U. Lall (co-PIs).
59. *Nonlinear Time Series Methods for Forecasting Yakima River Flows*, **U.S. Bureau of Reclamation**, **$93,600**, 4/97-12/00, U. Lall (PI).
60. *Field Investigations into Infiltration and Runoff Under Extreme Rainfall***, Utah Division of Water Resources**, **$25,000**, 1/96 -12/98, U. Lall (PI).
61. *Nonlinear Dynamics of Streamflow: Classification, Predictability and Forecasting*, **NSF**, **$212,000**, 7/95 to 7/98, U. Lall and H.D. I. Abarbanel (PIs).
62. *Assessing Aquifer Heterogeneity and Groundwater Contamination Potential: Data, Methods and Utah Applications*, **USGS**, **$122,000**, 7/94 to 7/96, U. Lall (PI).
63. *Site Subsurface Characterization at Hill A.F. Base*, **U.S.A.F**., **$7,200**, 6/94 to 10/94, U. Lall (PI).
64. *Non-Parametric Stochastic Simulation Of Streamflow In The Colorado River*, **USGS**, **$189,000**, 10/92 to 9/95, D. Tarboton (PI), U. Lall (co-PI).
65. *Predictability And Variability Of Climate And Hydrology: Inferences From Great Salt Lake Dynamics*, **USGS, $185,447**, 10/92 to 8/95, U. Lall (PI).
66. *The Dynamics of Closed Basin Hydrology and Climate Variability,* **NSF**, **$104,000**, 10/92 to 4/95, U. Lall (PI).
67. *Subsurface Characterization Using Drill Log Data*, **Utah Division of Water Rights, $5,500,** 6/92 to 6/93, U. Lall (PI).
68. *Sharon Steel Groundwater Contamination Investigations and Remediation Design*, **Utah Division of Environmental Health, $30,000** , 12/90-12/91, U. Lall (PI), M. W. Kemblowski , G. Urroz (co-PIs).
69. *Kennecott Tailings - Groundwater Remediation And Natural Resource Damage Assessment*, **Utah Division of Environmental Health, $30,000** , 10/90-6/91, U. Lall, (PI), L. D. James, M. W. Kemblowski (co-PIs).
70. *Evaluation of hydraulic interconnections in heterogeneous multi-aquifer systems*, **USGS, $74,900**, 9/90-9/92, M. W. Kemblowski (PI), U. Lall (co-PI).
71. *Climatic variability and hydrology, inferences from the dynamics of the Great Salt Lake*, **Utah Mineral Lease Funds, $13,133**, 7/90-7/91, U. Lall (PI).
72. *Sharon Steel Groundwater Investigations*, **Utah Division of Environmental Health, $30,500,** 4/90-12/90, M. W. Kemblowski (PI), U. Lall, G. Urroz (co-PIs).
73. *Development of a mountain climate generator*, **U.S. Forest Service, $800,000**, 9/89-12/95, D.S. Bowles (PI), G. Bingham, U. Lall, D. Tarboton (co-PIs).
74. *Estimation of the space and time variability of non-point source ground water contamination*, **USGS, $262,262**, 9/89-9/91, U. Lall (PI), K. Bosworth (co-PI)

75. *Robust, efficient estimation and prediction of groundwater quality in Salt Lake County*, **Utah Mineral Lease Funds, $18,585**, 7/89-7/91, U. Lall (PI).
76. *Anaerobic Biotransformation and fate of heterogeneous organic pollutants in groundwater*, **USGS, $109,500**, 7/88-7/90, S. Ghosh (PI), D. Schamber & U. Lall (co-PIs).
77. *Parameter Estimation Models for Stream Drainage Systems***, Utah Division of Water Rights, $9, 200**, 4/85 - 3/86, U. Lall (PI).
78. *Strategies for the Conjunctive Management of Ground and Surface Waters*, **U.S. Bureau of Reclamation, $122,000**, 9/84-9/87, U. Lall (PI).
79. *Optimization Models for Multi-Reservoir Systems with Lower Bear River Basin Applications*, **Utah Div. of Water Resources, $9,900**, 5/84 - 2/85, U. Lall (PI).
80. *A Bilevel Optimization Model for Integrating Fare and Service Structures to Minimize Urban Transit Operation Deficits***, Urban Mass Transit Authority, $96,703,** 8/83 - 2/85, J.C. Yu (PI), U. Lall (co-PI).
81. *Optimization Model for Conjunctive Regional Water Resource Development*, **University of Utah Research Committee, $3,070**, 1/83-1/85, U. Lall (PI).

Other Information

Corporate Advisory Boards: Xylem, Waterfund, Ketos, Climate.ai, Cloud to Street

Editor in Chief: *Water Security, 2016-date.* ***Associate Editor:*** *Water Resources Research, 1993-2002, ASCE J. of Hydrologic Engineering, 1994-2004.*

Selected committees served*: Member NRC Panel on American River Floods. Member NRC Panel on Forecast Uncertainty and NWS. Member NRC Panel on NAWQA, Member NSF Working Group on Water, Earth and Bios. Member NSF Advisory Committee to the Director on Env. Research and Education. Contributions to IPCC, and National Climate Assessment. Member World Economic Forum Global Agenda Council on Water. President, AGU Natural Hazards Section.*

Selected Invited talks and Keynotes *at* ***non-academic public events****: World Bank, Stockholm Water Week, Singapore Water Week, American Water Intelligence, Water 2.0, NY Academy of Science, World Leaders Forum, UN World Water Forum; Shell Water-Energy Summit, American Water Summit, EU General Assembly, Sustainalytics, US Water Partnership, Rubin Museum, US Water Partnership, Water Innovations Alliance Foundation; American Water Summit; Financial Times Event on Water; Circle of Blue Webinars on Choke Point USA, Mining and Water; Water and Climate; Woodrow Wilson Center; USAID; Municipal Analysts Group of New York; CERES Investor Water hub; Interfaith Center on Corporate Responsibility; OECD-FICCI-ADB-2030WRG Seminar on Water Risk and Stewardship; NOAA MAPP; White House Water Forum; World Bank Water Week; Nature Conservancy Global Water Summit; Pro Publica-New America; Barclays Water-Energy Forum; several water and climate related movie screenings.*

Interviews (Selected)*: World Economic Forum, European Commission; CBS Marketwatch; Statistics Views; Business Insider; CSR Wire; Bloomberg News; The Mcbride Network; Crains New York; Environment & Energy News; Circle of Blue; Big Think; Huffington Post; Vice.com; Growing Blue; RWL Water; Pro Publica Press; FACE HD; The Guardian; Reuters, Xinhua News Agency; Economist, National Geographic, The Atlantic Magazine, Financial Times, NY Times, Washington Post, USA Today, Desert Sun; Asian Development Bank magazine, Christian Science Monitor; Times of India, The Hindu, The Tribune, Popular Science; GE Reports; Associated Press. Wall Street Journal, CBS, ABC News, CNN, PBS, NPR, BBC, WNYC, WNBC, Mundo TV, Rede Globo, CGTV, Al Jazeera, ARISE TV, R-TV America; WLIW Documentary: Plagues and Perils of Salton Sea; Earthsky.org; Namibia Press Agency; Apocalypse Now; National Public Radio*