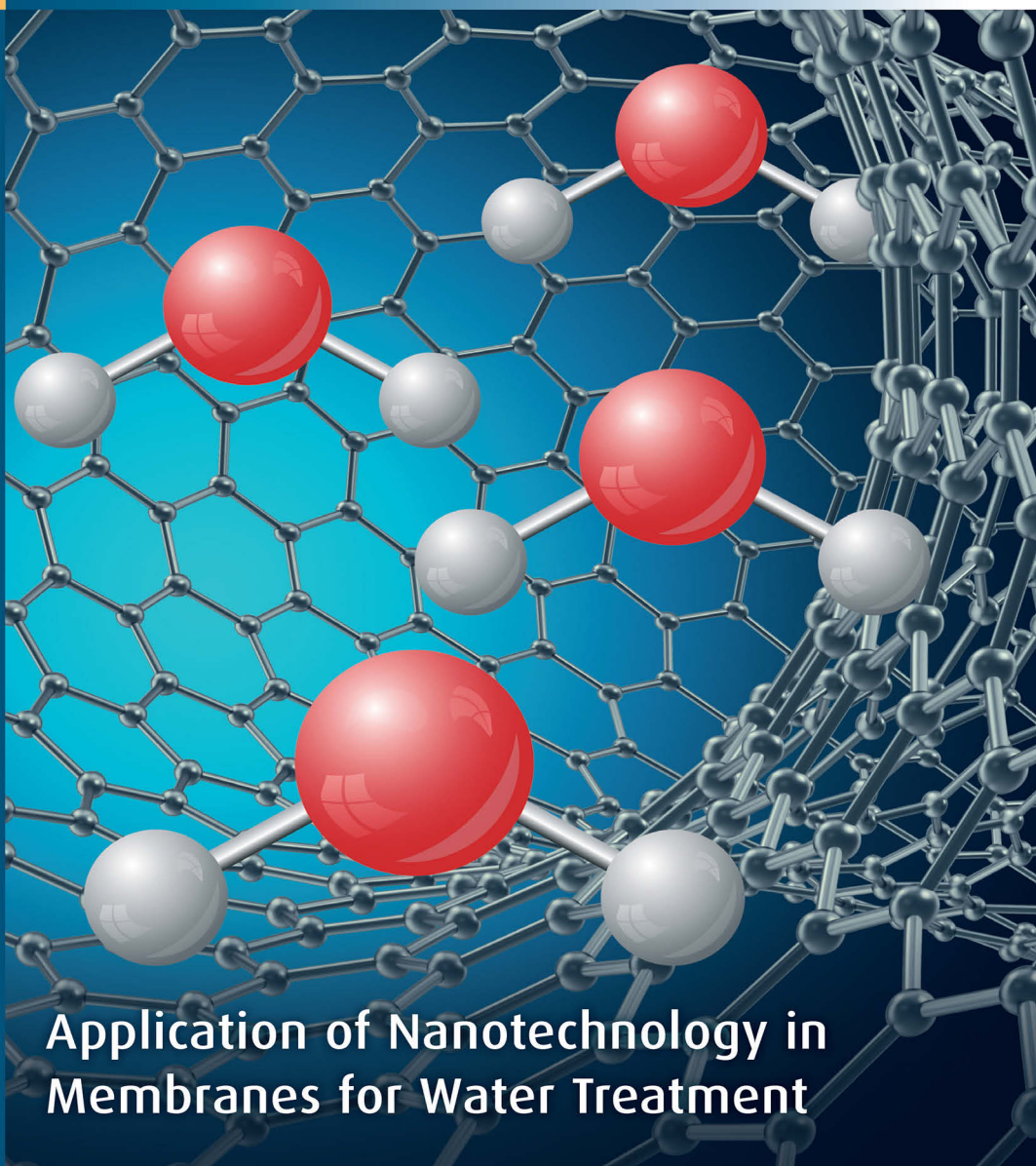




Series: **Sustainable Water Developments**

5



Application of Nanotechnology in Membranes for Water Treatment

Editors:

Alberto Figoli, Jan Hoinkis, Sacide Alsoy Altinkaya & Jochen Bundschuh

APPLICATION OF NANOTECHNOLOGY IN MEMBRANES FOR WATER TREATMENT



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About the book series

Augmentation of freshwater supply and better sanitation are two of the world's most pressing challenges. However, such improvements must be done economically in an environmental and societally sustainable way.

Increasingly, groundwater – the source that is much larger than surface water and which provides a stable supply through all the seasons – is used for freshwater supply, which is exploited from ever-deeper groundwater resources. However, the availability of groundwater in sufficient quantity and good quality is severely impacted by the increased water demand for industrial production, cooling in energy production, public water supply and in particular agricultural use, which at present consumes on a global scale about 70% of the exploited freshwater resources. In addition, climate change may have a positive or negative impact on freshwater availability, but which one is presently unknown. These developments result in a continuously increasing water stress, as has already been observed in several world regions and which has adverse implications for the security of food, water and energy supplies, the severity of which will further increase in future. This demands case-specific mitigation and adaptation pathways, which require a better assessment and understanding of surface water and groundwater systems and how they interact with a view to improve their protection and their effective and sustainable management.

With the current and anticipated increased future freshwater demand, it is increasingly difficult to sustain freshwater supply security without producing freshwater from contaminated, brackish or saline water and reusing agricultural, industrial, and municipal wastewater after adequate treatment, which extends the life cycle of water and is beneficial not only to the environment but also leads to cost reduction. Water treatment, particularly desalination, requires large amounts of energy, making energy-efficient options and use of renewable energies important. The technologies, which can either be sophisticated or simple, use physical, chemical and biological processes for water and wastewater treatment, to produce freshwater of a desired quality. Both industrial-scale approaches and smaller-scale applications are important but need a different technological approach. In particular, low-tech, cost-effective, but at the same time sustainable water and wastewater treatment systems, such as artificial wetlands or wastewater gardens, are options suitable for many small-scale applications. Technological improvements and finding new approaches to conventional technologies (e.g. those of seawater desalination), and development of innovative processes, approaches, and methods to improve water and wastewater treatment and sanitation are needed. Improving economic, environmental and societal sustainability needs research and development to improve process design, operation, performance, automation and management of water and wastewater systems considering aims, and local conditions.

In all freshwater consuming sectors, the increasing water scarcity and correspondingly increasing costs of freshwater, calls for a shift towards more water efficiency and water savings. In the industrial and agricultural sector, it also includes the development of technologies that reduce contamination of freshwater resources, e.g. through development of a chemical-free agriculture. In the domestic sector, there are plenty of options for freshwater saving and improving efficiency such as water-efficient toilets, water-free toilets, or on-site recycling for uses such as toilet flushing, which alone could provide an estimated 30% reduction in water use for the average household. As already mentioned, in all water-consuming sectors, the recycling and reuse of the respective wastewater can provide an important freshwater source. However, the rate at which these water efficient technologies and water-saving applications are developed and adopted depends on the behavior of individual consumers and requires favorable political, policy and financial conditions.

Due to the interdependency of water and energy (water-energy nexus); i.e. water production needs energy (e.g. for groundwater pumping) and energy generation needs water (e.g. for cooling), the management of both commodities should be more coordinated. This requires integrated energy and water planning, i.e. management of both commodities in a well-coordinated form rather than managing water and energy separately as is routine at present. Only such integrated management allows reducing trade-offs between water and energy use.

However, water is not just linked to energy, but must be considered within the whole of the water-energy-food-ecosystem-climate nexus. This requires consideration of what a planned water development requires from the other sectors or how it affects – positively or negatively – the other sectors. Such integrated management of water and the other interlinked resources can implement synergies, reduce trade-offs, optimize resources use and management efficiency, all in all improving security of water, energy, and food security and contributing to protection of ecosystems and climate. Corresponding actions, policies and regulations that support such integral approaches, as well as corresponding research, training and teaching are necessary for their implementation.

The fact that in many developing and transition countries women are disproportionately disadvantaged by water and sanitation limitation requires special attention to this aspect in these countries. Women (including schoolgirls) often spend several hours a day fetching water. This time could be much better used for attending school or working to improve knowledge and skills as well as to generate income and so to reduce gender inequality and poverty. Absence of in-door sanitary facilities exposes women to potential harassment. Moreover, missing single-sex sanitation facilities in schools and absence of clean water contributes to diseases. This is why women and girls are a critical factor in solving water and sanitation problems in these countries and necessitates that men and women work alongside to address the water and wastewater related operations for improvement of economic, social and sustainable freshwater provision and sanitation.

Individual volumes published in the series are spanning the wide spectrum between research, development and practice in the topic of freshwater and related areas such as gender and social aspects as well as policy, regulatory, legal and economic aspects of water. It covers all fields and facets in optimal approaches to the:

- Assessment, protection, development and sustainable management of groundwater and surface water resources thereby optimizing their use.
- Improvement of human access to water resources in adequate quantity and good quality.
- Meeting of the increasing demand for drinking water, and irrigation water needed for food and energy security, protect ecosystems and climate and to contribute to a social and economically sound human development.
- Treatment of water and wastewater also including its reuse.
- Implementation of water efficient technologies and water saving measures.

A key goal of the series is to include all countries of the globe in jointly addressing the challenges of water security and sanitation. Therefore, we aim to a balanced choice of authors and editors originating from developing and developed countries as well as gender equality. This will help society to provide access to freshwater resources in adequate quantity and good quality, meeting the increasing demand for drinking water, domestic water and irrigation water needed for food security while contributing to social and economically sound development.

This book series aims to become a state-of-the-art resource for a broad group of readers including professionals, academics and students dealing with ground- and surface water resources, their assessment, exploitation and management as well as the water and wastewater industry. This comprises especially hydrogeologists, hydrologists, water resources engineers, wastewater engineers, chemical engineers and environmental engineers and scientists.

The book series provides a source of valuable information on surface water but especially on aquifers and groundwater resources in all their facets. Thereby, it covers not only the scientific and technical aspects but also environmental, legal, policy, economic, social, and gender

aspects of groundwater resources management. Without departing from the larger framework of integrated groundwater resources management, the topics are centered on water, solute and heat transport in aquifers, hydrogeochemical processes in aquifers, contamination, protection, resources assessment and use.

The book series constitutes an information source and facilitator for the transfer of knowledge, both for small communities with decentralized water supply and sanitation as well as large industries that employ hundreds or thousands of professionals in countries worldwide, working in the different fields of freshwater production, wastewater treatment and water reuse as well as those concerned with water efficient technologies and water saving measures. In contrast to many other industries, suffering from the global economic downturn, water and wastewater industries are rapidly growing sectors providing significant opportunities for investments. This applies especially to those using sustainable water and wastewater technologies, which are increasingly favored. The series is also aimed at communities, manufacturers and consultants as well as a diversity of stakeholders and professionals from governmental and non-governmental organizations, international funding agencies, public health, policy, regulators and other relevant institutions, and the broader public. It is designed to increase awareness of water resources protection and understanding of sustainable water and wastewater solutions including the promotion of water and wastewater reuse and water savings.

By consolidating international research and technical results, the objective of this book series is to focus on practical solutions in better understanding ground- and surface water systems, the implementation of sustainable water and wastewater treatment and water reuse and the implementation of water efficient technologies and water saving measures. Failing to improve and move forward would have serious social, environmental and economic impacts on a global scale.

The book series includes books authored and edited by world-renowned scientists and engineers and by leading authorities in economics and politics. Women are particularly encouraged to contribute, either as author or editor.

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Tesfaye Tafesse (transboundary water issues, with emphasis on the Nile; natural resources management and institutions; rural development and agricultural problems in the Third World), College of Social Sciences, Addis Ababa University (AAU), Addis Ababa

Taffa Tulu (watershed hydrology; watershed management; water resources engineering; irrigation engineering; water harvesting), Center of Environment and Development, College of Development Studies, Addis Ababa University (AAU), Addis Ababa

FEDERATED STATES OF MICRONESIA

Leerenson Lee Airens (water supply for Small Islands Development States (SIDS)), GEF-IWRM Focal Point; Manager, Water Works, Pohnpei Utilities Corporation (PUC), Pohnpei State

FIJI

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FINLAND

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FRANCE

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GEORGIA

Givi Gavardashvili (water management; erosion-debris flow processes; floods), Ts. Mirstkhulava Water Management Institute, Georgian Technical University (GTU), Tbilisi

GERMANY

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Heidrun Steinmetz (resource oriented sanitation (nutrient recovery, energy efficiency), biological and advanced WWT; water quality management), Chair of Sanitary Engineering and Water Recycling, University of Stuttgart, Stuttgart

GREECE

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Anastasios Zouboulis (water and wastewater treatment; biotechnological applications), School of Chemistry, Aristotle University of Thessaloniki (AUTH), Thessaloniki

HAITI

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HONDURAS

Sadia Irais Lanza (water resources and climate change; physical hydrogeology; hydrology; water quality), Physics Department, National Autonomous University of Honduras (UNAH), San Pedro Sula, Cortés

HONG KONG

Jiu Jimmy Jiao (hydrogeology; influence of groundwater and rainfall on landslides; impact of human activities on groundwater regimes; dewatering system design; contaminant fate and transport modeling and groundwater remediation design; global optimization approaches for parameter identification in flow and transport modeling; parameter sensitivity analysis and its influence on parameter estimation), Editor Hydrogeology Journal; The University of Hong Kong (HKU), Hong Kong

HUNGARY

László Somlyódy (wastewater treatment; environmental engineering), past President of the International Water Association (IWA), Head, Department of Sanitary and Environmental Engineering, Faculty of Engineering, Budapest University of Technology and Economics (BME), Budapest

INDIA

Makarand M. Ghangrekar (wastewater treatment in microbial fuel cell and electricity generation), Department of Civil Engineering, Indian Institute of Technology – Kharagpur (IIT Kgp), Kharagpur, West Bengal

Ashok Kumar Ghosh (water quality, especially arsenic and fluoride contamination in groundwater resources; fluoride removal technology, bioremediation of arsenic; bio-synthesis of nano-particles through microbes), Chairman, State Expert Appraisal Committee (SEAC-Bihar) and Member, Bihar State Pollution Control Board; Head, Research Department, Mahavir Cancer Institute and Research Centre, Patna, Bihar

Arun Kumar (environmental management of water bodies), Alternate Hydro Energy Centre, Indian Institute of Technology – Roorkee (IITR), Roorkee, Uttarakhand

Rakesh Kumar (urban hydrology; hydrological modeling; watershed management; drought mitigation and management; flood estimation, routing, management and socio-economic aspects; impact of climate change on water resources), Head, Surface Water Hydrology Division, National Institute of Hydrology (NIH), Roorkee, Uttarakhand

Dinesh Mohan (environmental chemistry; water/wastewater monitoring, assessment, modeling & remediation using physicochemical methods; development of low cost adsorbents/magnetic adsorbents/magnetic nanosorbents for water remediation; biomass fast pyrolysis for the development of bio-oils and biochars, biorefineries; climate change mitigation: development & application of biochar for carbon sequestration; applications of biochars for remediation of contaminated soils), School of Environmental Sciences, Jawaharlal Nehru University (JNU), New Delhi

Abhijit Mukherjee (physical, chemical and isotope hydrogeology; modeling of groundwater flow and solute transport; hydrostratigraphy; contaminant fate and transport; surface water-seawater-groundwater interactions; effect of climate change on water resources; mine-site hydrology; environmental geochemistry), Department of Geology and Geophysics, Indian Institute of Technology – Kharagpur (IIT Kgp), Kharagpur, West Bengal

Nanakkumar Santdasani (sustainable water supply and management; defluoridation as a solution to fluorosis in rural areas; community managed water and sanitation programs), Water, Sanitation, Hygiene (WASH), UNICEF, Patna, Bihar

INDONESIA

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IRAN

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ISRAEL

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Michael Zilberbrand (groundwater resources; hydrogeochemical processes and hydrogeological and hydrogeochemical modeling in aquifers and in the unsaturated zone), Israeli Water Authority, Hydrological Service, Jerusalem

ITALY

Alessandra Criscuoli (membrane science and technology; membrane distillation and membrane contactors; integrated membrane processes; water and wastewater treatment; desalination of brackish water and seawater), Institute on Membrane Technology, ITM-CNR, Rende (CS)

Enrico Drioli (membrane science and engineering; membrane preparation and transport phenomena in membranes; desalination of brackish and saline water; integrated membrane processes; membrane distillation and membrane contactors; catalytic membrane and catalytic membrane reactors; salinity gradient energy fuel cells), Institute on Membrane Technology, ITM-CNR, Rende (CS)

Alberto Figoli (membrane science and technology; membrane preparation and characterization; transport phenomena in membranes; pervaporation; water and wastewater treatment; desalination of brackish and saline water), Institute on Membrane Technology, ITM-CNR, Rende (CS)

Marco Petitta (groundwater pollution, management, and protection), President IAH Chapter Italy, Department of Earth Sciences, Sapienza University of Rome, Rome

Ludovico Spinosa (sludge management), (retired) National Research Council (CNR); Consultant at Governmental Commissariat Environmental Emergencies in Region Puglia; Convenor at ISO/TC275/WG6 (Thickening and Dewatering) and CEN/TC308/WG1 (Process control methods) on sludge standardization

JAMAICA

Arpita Mandal (hydrology; hydrogeology; water resources and impacts of climate change; water supply; climate variability; flood risk and control; hydrochemistry of groundwater; saline water intrusion), Department of Geography and Geology, University of the West Indies (UWI), Mona Campus, Mona, Kingston

JAPAN

Hiroaki Furumai (build-up and wash-off of micropollutants in urban areas; characterization of DOM/NOM in lakes and reservoirs for drinking water sources; fate and behavior of DOM in flocculation and advanced oxidation processes; biological nutrient removal from wastewater; modeling activated sludge in aerobic/anaerobic SBR; characterization of domestic sewage from the viewpoint of nutrient removal), Board of Directors, IWA; Department of Urban Engineering, The University of Tokyo (Todai), Tokyo

Makoto Nishigaki (modeling groundwater and multiphase flow and solute transport in porous media; modeling seepage in the saturated-unsaturated zone; development of methods of measuring hydraulic properties in rock mass), Department of Environmental and Civil Design, Faculty of Environmental Science and Technology, Okayama University, Okayama

Taikan Oki (global water balance and world water resources; climatic variation and the Asian monsoon; land-atmosphere interaction and its modeling; remote sensing in hydrology; temporal and spatial distribution of rainfall), Institute of Industrial Science, The University of Tokyo, Komaba, Tokyo

Yuichi Onda (hillslope hydrology; hydro-geomorphology; radionuclide transfer; forest hydrology), Center for Research in Isotopes and Environmental Dynamics, University of Tsukuba, Tsukuba, Ibaraki

Kaoru Takara (innovative technologies for predicting floods; global environmental changes; risk and emergency management; interactions between social changes and hydrological cycle/water-related disasters; disaster mitigation strategy; policy development; integrated numerical modeling for lakes and surrounding catchments), Director, Disaster Prevention Research Institute, Kyoto University (Kyodai), Kyoto

JORDAN

Fawzi A. Banat (desalination), Department of Chemical Engineering, Jordan University of Science and Technology (JUST), Irbid

Samer Talozi (irrigation and water resources engineering, planning and policy), Civil Engineering Department, Jordan University of Science and Technology (JUST), Irbid

KENYA

Daniel Olago (environmental geology; surface and sub-surface water chemistry and dynamics; water-energy and related nexuses; human impact on the environment, global change processes, vulnerability and adaptation to climate change: past and present; environmental policies, laws and regulations and capacity development in global environmental change), Chairman, Network of African Science Academies (NASAC) Water Program; Member, International Lake Environment Committee; Member and focal point for water, Kenya National Academy of Sciences (KNAS); Institute for Climate Change and Adaptation (ICCA) & Department of Geology, University of Nairobi, Nairobi

Mwakio Tole (water and geothermal energy resources; waste disposal; environmental impact assessment), School of Environmental and Earth Sciences, Department of Environmental Sciences, Pwani University, Kilifi

KOREA

Jaeweon Cho (water reuse; membrane filtration; ecological engineering (treatment wetland); desalination), School of Urban and Environmental Engineering, Ulsan Institute of Science and Technology (UNIST), Ulsan

Yong Sik Ok (bioavailability of emerging contaminants; bioenergy and value-added products such as biochar; waste management; fundamental soil science and remediation of metals in soils and sediments), Director, Korea Biochar Research Center, School of Natural Resources and Environmental Science, Kangwon National University, Chuncheon

KYRGYZSTAN

Bolot Moldobekov (hydrogeology; engineering geology; geographic information systems – GIS; geoinformatics; interdisciplinary geosciences; natural hazards), Co-Director, Central-Asian Institute for Applied Geosciences (CAIAG), Bishkek

LATVIA

Māris Kļaviņš (aquatic chemistry; geochemical analysis; environmental pollution and its chemical analysis; environmental education, including also political and social sciences), Head, Department of Environmental Science, University of Latvia (LU), Riga

LITHUANIA

Robert Mokrik (groundwater resources, flow and transport modeling; hydrogeochemistry and groundwater isotopes; palaeohydrogeology), Department of Hydrogeology and Engineering Geology, Faculty of Natural Sciences, Vilnius University, Vilnius

LUXEMBOURG

Joachim Hansen (wastewater treatment; micropollutants; wastewater reuse; water-energy nexus), Engineering Science – Hydraulic Engineering, Faculty of Science, Technology and Communication, University of Luxembourg – Campus Kirchberg, Luxembourg

MADAGASCAR

Désiré Rakotondravaly (hydrology; hydrogeology; hydraulics; geology; rural water supply; vulnerability mapping; water and sanitation; GIS; project management; capacity building; community development; conservation; development cooperation), Ministry of Mines, Antananarivo

MALAWI

Victor Chipofya (urban water utility operation and management; groundwater development, monitoring and management; groundwater quality; rural water supply; water and sanitation in peri-urban and rural areas; water reuse; hygiene promotion), Executive Director, Institute of Water and Environmental Sanitation (IWES); National Coordinator of the Malawi Water Partnership (MWP); Steering Committee Member: Water Supply and Sanitation Collaborative Council (WSSCC) for Eastern and Southern Africa, Blantyre

MALAYSIA

Mohamed Kheireddine Aroua (separation processes; water and wastewater treatment), Director, Centre for Separation Science & Technology (CSST), Department of Chemical Engineering, Faculty of Engineering, University of Malaya (UM), Kuala Lumpur

Hamidi Abdul Aziz (water supply engineering; wastewater engineering; solid waste management), School of Civil Engineering, University of Science Malaysia (USM), Engineering Campus, Nibong Tebal, Penang

Ali Hashim (separation processes – flotation; liquid-liquid extraction; water and wastewater treatment; ionic liquids – synthesis and applications), Department of Chemical Engineering, Faculty of Engineering, University of Malaya (UM), Kuala Lumpur

Ahmad Fauzi Ismail (development of membrane technology for reverse osmosis, nanofiltration, ultrafiltration and membrane contactor), Deputy Vice Chancellor (Research & Innovation) & Founder and Director, Advanced Membrane Technology Research Center (AMTEC), University of Technology – Malaysia (UTM), Johor Bahru, Kuala Lumpur

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Mohd Razman Bin Salim (water and wastewater treatment), Deputy Director, Institute of Environmental and Water Resource Management (IPASA), Faculty of Civil Engineering, University of Technology – Malaysia (UTM), Johor Bahru, Johor

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MALTA

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MAURITIUS

Arvinda Kumar Ragen (wastewater engineering; constructed wetlands for household greywater; water pollution control in sugar factories; environmental impact assessment), Department of Chemical & Environmental Engineering, Faculty of Engineering, University of Mauritius (UoM), Le Reduit, Moka

MEXICO

Ma. Teresa Alarcón Herrera (water resources; water treatment using artificial wetlands), Director, Durango Unit of the Advanced Materials Research Center (CIMAV), Durango, Dgo.

Maria Aurora Armienta (hydrogeology; trace element contaminants; water treatment using geological materials), Institute of Geophysics, National Autonomous University of Mexico (UNAM), Ciudad Universitaria, Mexico City, D.F.

Sofia Garrido Hoyos (drinking water; collection and treatment of rainwater; biological wastewater treatment; treatment and/or utilization of sludge and biosolids), Mexican Institute of Water Technology (IMTA), Jiutepec, Mor.

Luz Olivia Leal Quezada (environmental engineering; environmental chemistry; automation of chemical analysis techniques for environmental monitoring, particularly for the determination and speciation of trace elements; techniques for determining water quality and chemical aspects of their treatment), Advanced Materials Research Center (CIMAV), Environment and Energy Department, Chihuahua, Chih.

MOROCCO

Lhoussaine Bouchaou (hydrology; water quality; aquatic ecosystems; environmental impact assessment; climatology; climate change), President IAH Chapter Morocco; Applied Geology and Geo-Environment Laboratory, Faculty of Sciences, University Ibn Zohr (UIZ), Agadir

MOZAMBIQUE

Catine Chimene (municipal water and infrastructure; water supply engineering; agricultural water; rural development), Higher School of Rural Development (ESUDER), Eduardo Mondlane University (UEM), Inhambane, Vilankulo

MYANMAR

Khin-Ni-Ni Thein (hydroinformatics, integrated water resources management, river basin management, coastal-zone management, sustainable hydropower assessment, disaster risk reduction, climate change; sustainability; capacity building; community development; water and environmental policy; public policy analysis; green economy and green growth), Secretary, Advisory Group, Member, National Water Resources Committee; Advisory Group Member, National Disaster Management Committee, Founder and President, Water, Research and Training Centre (WRTC); Visiting Senior Professor, Yangon Technological University (YTU), Yangon, Myanmar; Regional Water Expert for Green Growth, UNESCAP

NAMIBIA

Benjamin Mapani (groundwater recharge and vulnerability mapping; groundwater development, management, monitoring and modeling; environmental hydrogeology; climate change), Board of Trustees, WaterNet; Department of Geology, University of Namibia (UNAM), Windhoek

NEPAL

Bandana K. Pradhan (environment and public health), Department of Community Medicine and Public Health, Institute of Medicine, Tribhuvan University (TU), Maharajgunj

NEW ZEALAND

David Hamilton (modeling of water quality in lakes and reservoirs; sediment-water interactions in lakes; boom-forming algae, particularly cyanobacteria; ice cover in lakes), Environmental Research Institute (ERI), University of Waikato, Waikato

NICARAGUA

Andrew Longley (hydrogeology; groundwater engineering; catchment studies and groundwater modeling; international development: projects in the water, geothermal, agriculture, environment and health sectors; rural water supply; arsenic contamination: mapping, hydrogeology, epidemiology; bridging the gap between academia, industry, public and charity sectors), Director, Nuevas Esperanzas UK, León

Katherine Vammen (aquatic microbiology; climate change and water resources; water supply and sanitation for the poor; urban waters), Co-Chair of the Water Programme of the Interamerican Network of the Academies of Science; Nicaraguan focal point for water programme in the InterAmerican Network of Academies of Sciences (IANAS); Central American University, Managua

NIGERIA

Peter Cookey (sustainable water/wastewater management in developing countries), Rivers State College of Health Science and Technology, Port Harcourt, Nigeria and Earthwatch Research Institute (EWRI), Port Harcourt

NORWAY

Torleiv Bilstad (water, oil and gas separation; environmental science and engineering), Former President of EWA-Norway; Department of Mathematics and Natural Sciences, University of Stavanger (UiS), Stavanger

Hallvard Ødegaard (water and wastewater treatment; innovative solutions for integrated approaches to urban water management), Department of Hydraulic and Environmental Engineering, Norwegian University of Science and Technology (NTNU), Trondheim

OMAN

Mohammed Zahir Al-Abri (thermal desalination; water and wastewater treatment; nanotechnology), Petroleum and Chemical Engineering Department, Sultan Qaboos University (SQU), Al Khoudh, Muscat

PAKISTAN

Ghani Akbar (agricultural engineering; integrated water management; soil & water conservation and climate smart agricultural practices), Program Leader, Integrated Watershed Management Program (IWMP), Climate Change, Alternate Energy and Water Resources Institute (CAEWRI), National Agricultural Research Centre (NARC), Chak Shahzad, Islamabad

PALESTINIAN AUTONOMOUS AREAS

Marwan Haddad (interdisciplinary approaches to water resources and quality management; renewable energy; recycling), Director, Water and Environmental Studies Institute, An Najah National University, Nabus

PANAMA

José R. Fábrega (sustainable water and wastewater management; environmental fate of chemicals in water and soil systems), Panamanian focal point for water in the InterAmerican Network of Academies of Sciences (IANAS); Hydraulic and Hydrotechnical Research Center (CIHH), Technological University of Panama (UTP), Panama City

PARAGUAY

Alicia Eisenkölbl (environmental management; environmental impact assessment; trans-boundary aquifers; rural development), Faculty of Agricultural Sciences Hohenau, Catholic University Our Lady of the Assumption (UCA), Campus Itapúa, Encarnación

PERU

Nicole Bernex Weiss de Falen (integrated water resources management; human sustainable development; climate change adaptation; integrated ecosystemic services, water management and risks (droughts and floods) with land planning at a water basin, regional and national level), Peruvian focal point for water in the InterAmerican Network of Academies of Sciences (IANAS); member of the technical Committee of Global Water Partnership GWP; LAC Chair in the CST of the UNCCD; Center of Research in Applied Geography (CIGA), Pontifical Catholic University of Peru (PUCP), Lima

PHILIPPINES

Victor Ella (surface and groundwater hydrology; irrigation and drainage engineering; water quality; simulation modeling; wastewater engineering; contaminant transport in soils; geostatistics; hydraulic engineering), Land and Water Resources Division, Institute of Agricultural Engineering, College of Engineering and Agro-Industrial Technology, University of the Philippines Los Baños (UPLB), College, Laguna

Nasreen Islam Khan (water quality assessment; modeling and mapping geogenic contaminants; arsenic in food chain and mitigation; human health risk assessment and mapping; willingness to pay; climate change impact on land use; GIS and remote sensing), GIS Social Science Division, International Rice Research Institute (IRRI), Los Banos, Laguna, Philippines & Fenner School of Environment and Society, Australian National University (ANU), Canberra, ACT

POLAND

Marek Bryjak (adsorption based water treatment), Department Polymer & Carbon Materials, Wrocław University of Technology, Wrocław

Wiesław Bujakowski (geothermics), Mineral and Energy Economy Research Institute, Polish Academy of Sciences (PAN), Kraków

Jacek Makinia (wastewater treatment; nutrient removal and recovery from wastewater), Faculty of Hydro and Environmental Engineering, Vice-Rector for Cooperation and Innovation, Gdańsk University of Technology (GUT), Gdańsk

Barbara Tomaszewska (monitoring of the aquatic environments; geothermics; scaling of geothermal systems; membrane technologies for geothermal water treatment for water resource purposes), AGH University of Science and Technology; Mineral and Energy Economy Research Institute, Polish Academy of Sciences (PAN), Kraków

PORTUGAL

Maria do Céu Almeida (sewer processes and networks), National Laboratory of Civil Engineering (LNEC), Lisbon

Helena Marecos (water reuse), Civil Engineering Department, Lisbon Engineering Superior Institute (ISEL), Lisbon

Helena Ramos (water-energy nexus; energy efficiency and renewable energies; hydraulics; hydrotransients; hydropower; pumping systems; leakage control; water supply; water vulnerability), Department of Civil Engineering, University of Lisbon (ULisboa), Lisbon

QATAR

Farid Benyahia (immobilized nitrifiers in wastewater treatment; membrane distillation desalination; water quality and energy efficiency analysis; airlift bioreactors; low-grade heat in membrane distillation for freshwater production; bioremediation of oil spills; development, design and evaluation of advanced refinery wastewater treatment processes), College of Engineering, Department of Chemical Engineering, Qatar University (QU), Doha

Patrick Linke (design, engineering and optimization of efficient processes, integrated systems and associated infrastructures; efficient utilization of natural resources (energy, water and raw materials); water-energy-food nexus), Chair, Chemical Engineering Program, Texas A&M University at Qatar (TAMUQ), Managing Director of the Qatar Sustainable Water and Energy Utilization Initiative (QWE), at TAMUQ, Qatar Environment and Energy Research Institute (QEERI), Doha

REPUBLIC OF GUINEA

Hafiziou Barry (integrated water resources management), Polytechnic Institute, University Gamal Abdel Nasser, Conakry

ROMANIA

Anton Anton (pumping stations; municipal water networks), Hydraulics and Environmental Protection Department, Technical University of Civil Engineering (UTCB), Bucharest

RUSSIAN FEDERATION

Sergey Pozdniakov (water resources; water quality; hydrogeology; contaminant transport; geostatistics; water balance; climate change), Faculty of Geology, Moscow State University (MSU), Moscow

RWANDA

Omar Munyaneza (hydrology; climate change and water resources management), College of Science and Technology, Department of Civil Engineering, University of Rwanda (UR), Kigali

SAUDI ARABIA

Noreddine Ghaffour (renewable energy for desalination and water treatment), Water Desalination and Reuse Research Center, King Abdullah University of Science and Technology (KAUST), Thuwal

Mattheus Goosen (renewable energy for desalination and water treatment; membranes), Office of Research and Graduate Studies, Alfaisal University, Riyadh

SENEGAL

Alioune Kane (water quality; hydraulics; water-poverty relationships; climate variability and water availability), Director of the Master Programme GIDEL (Integrated Management and Sustainable Development of Coastal West Africa); Coordinator of WANWATCE (Centres Network of Excellence for Science and Water Techniques NEPAD), Department of Geography, Cheikh Anta Diop University (UCAD), Dakar

SERBIA

Petar Milanović (karst hydrogeology; theory and engineering practice in karst), President IAH Chapter Serbia and Montenegro, Belgrade

SINGAPORE

Vladan Babovic (hydroinformatics; data assimilation; data mining), Department of Civil and Environmental Engineering, National University of Singapore (NUS), Singapore

Jiangyong Hu (water treatment technology; water quality; water reuse; health impacts), Department of Civil and Environmental Engineering & Co-Director, Centre for Water Research, National University of Singapore (NUS), Singapore

SLOVAKIA

Ján Derco (environmental engineering; nutrients removal; ozone-based oxidation processes; water resources protection; water and wastewater technology), Department of Environmental Engineering, Faculty of Chemical and Food Technology, Slovak University of Technology (SUT), Bratislava

SLOVENIA

Boris Kompare (wastewater treatment; modeling), Past President EWA-Slovenia; Faculty of Civil Engineering and Geodesy, University of Ljubljana (UL), Ljubljana

SOMALIA

Abdullahi Mohamed Abdinisir (water resources management; groundwater governance; water supply), Ministry of Water, Petroleum, Energy and Mineral Resources, Mogadishu

SOUTH AFRICA

Tamiru A. Abiye (community water supply problems; water quality assessment and monitoring; hydrochemical modeling; groundwater flow and solute transport; trace metals in groundwater; surface and groundwater interactions; climate change impact study on groundwater; spatial and temporal variability of groundwater recharge), School of Geosciences, Faculty of Science (East Campus), University of the Witwatersrand (Wits University), Johannesburg

Hamanth C. Kasan (sustainable water and wastewater management in developing countries), General Manager, Scientific Services Division, Rand Water; President, African Water Association (AfWA), Johannesburg

Sabelo Mhlanga (water-energy nexus; nano-structured materials for water purification and recovery; energy-efficient and antifouling membrane filtration technologies for water treatment; community involvement in water related problems in rural communities; green chemistry), Deputy Director, Nanotechnology and Water Sustainability (NanoWS) Research Unit, College of Science Engineering and Technology, University of South Africa (Unisa), Johannesburg

Anthony Turton (water-energy-food nexus; hydropolitical risk model; mine water management; mine closure planning and strategies; groundwater governance; wastewater reuse), Director, Environmental Engineering Institute of Africa; Centre for Environmental Management, University of Free State (UFS), Bloemfontein; professor at UNESCO Chair in Groundwater, Department of Earth Sciences, University of Western Cape (UWC)

SPAIN

José Ignacio Calvo (membrane technologies; modifications of structure and surface properties of membranes to increase selectivity), School of Agriculture, Food Technology and Forestry, ETSIIAA, University of Valladolid (Uva), Palencia

Jesús Colprim (small water supply and wastewater systems), Laboratory of Chemical and Environmental Engineering (LEQUIA), Institute of Environment, University of Girona (UdG), Girona

Elena Giménez-Forcada (hydrogeology; hydrogeochemistry; water quality; groundwater contamination; trace elements), Geological Survey of Spain (IGME), Salamanca

J. Jaime Gómez-Hernández (stochastic hydrogeology; geostatistics; inverse modeling; nuclear waste disposal), Head of the Group of Hydrogeology, Research Institute of Water and Environmental Engineering, UPV, Valencia

Aurora Seco Torrecillas (nutrient removal and recovery from wastewater; anaerobic membrane bioreactor for wastewater treatment (WWT); microalgae cultivation for WWT), Chemical Engineering Department, University of Valencia (UV), Valencia

Guillermo Zaragoza (solar energy for desalination; thermal and membrane technologies for water treatment), Solar Platform of Almería (PSA-CIEMAT), Almería

SRI LANKA

Nadeeka S. Miguntanna (urban stormwater quality and monitoring; surrogate water quality parameters; urban water pollution; rainwater harvesting), Environmental Engineering Laboratory, Department of Civil and Environmental Engineering, Faculty of Engineering, University of Ruhuna (UOR), Hapugala, Galle

Meththika Suharshini Vithanage (water quality; water chemistry; impact of tsunamis on aquifers; groundwater modeling; soil and water monitoring for pollution; mechanistic

modeling of biochar and nano materials for water and soil remediation (landfill leachates, nutrients and toxic metals)), Group Leader – Chemical and Environmental Systems Modeling Research Group, National Institute of Fundamental Studies (NIFS), Kandy

SUDAN (REPUBLIC OF)

Abdin Mohamed Ali Salih (environmental sciences with emphasis on water resources management in arid and semi-arid zones), Board Member at UNESCO-IHE; Civil Engineering Department, Faculty of Engineering, The University of Khartoum (UofK), Khartoum

SURINAME

Sieuwnath Naipal (hydrology; climate change impact on climate variability; marine and coastal engineering), Anton De Kom University of Suriname (AdeKUS), Tammenga

SWAZILAND

Absalom M. Manyatsi (land and water resources management; environmental impact assessment; remote sensing; GIS and spatial climate change impacts; climate change adaptation and mitigation; climate smart agriculture; climate change and climate variability impacts on water resources and agriculture), Head of Department, Agricultural and Biosystems Engineering Department, University of Swaziland (UNISWA), Luyengo

SWEDEN

Prosun Bhattacharya (groundwater resources; hydrogeochemistry; arsenic), Coordinator, KTH-International Groundwater Arsenic Research Group, Department of Sustainable Development, Environmental Science and Engineering, Royal Institute of Technology (KTH), Stockholm

Joydeep Dutta (application of nanotechnology for water treatment; water-environment-energy nexus; photocatalytic materials, electrocatalysis and capacitive desalination of water, plasmon resonance sensors for heavy metal ion detection), Chair, Functional Materials Division, Materials- and Nano Physics Department, ICT School, Kista, Stockholm

Gunnar Jacks (hydrology; hydrogeology; hydrochemistry; groundwater chemistry; groundwater arsenic and fluoride; acidification of soil and groundwater; artificial groundwater recharge; water supply and sanitation in suburban areas), (retired), Department of Sustainable Development, Environmental Science and Engineering, Royal Institute of Technology (KTH), Stockholm

Erik Kärrman (sustainable wastewater management; decision support and multi-criteria analysis of municipal and local water and wastewater systems), Director of Research and Development, Urban Water & Royal Institute of Technology (KTH), Stockholm

Andrew Martin (membrane distillation for desalination and water purification; biomass and municipal solid waste; polygeneration), Department of Energy Technology, Royal Institute of Technology (KTH), Stockholm

Aapo Sääsk (development of polygeneration and zero liquid discharge), CEO, Scarab Development AB, Stockholm

Nury Simfors (geothermal exploration, geogenic trace contaminants, GIS and hazard mitigation), MVI/MTA, Swedish National Defence University (FHS), Stockholm

SWITZERLAND

Annette Johnson (geochemistry of inorganic contaminants in surface- and groundwater; chemistry of the mineral-water interface; geogenic contamination of groundwater and

drinking water; waste management), Leader, Department of Water Resources and Drinking Water, Swiss Federal Institute of Aquatic Science and Technology (Eawag), Dübendorf

Rick B. Johnston (drinking water treatment (arsenic removal), public health impacts; sanitation and wastewater treatment; nexus between sanitation, wastewater, and drinking water supply), Joint Monitoring Programme for Water Supply and Sanitation (JMP), Department of Public Health, Environmental and Social Determinants of Health (PHE), World Health Organization, Geneva

Eberhard Morgenroth (biological wastewater treatment using activated sludge, granular biomass, or biofilm based systems; biological drinking water treatment; mixed culture environmental biotechnology for bioenergy production; mathematical modeling; sustainable development of urban water management), Chair of Process Engineering in Urban Water Management, ETH Zurich & Swiss Federal Institute of Aquatic Science and Technology (Eawag), Dübendorf

Thomas Wintgens (water reuse), Institute for Ecopreneurship, School for Life Sciences, University of Applied Sciences and Arts Northwestern Switzerland (FHNW), Muttenz

TAIWAN

How-Ran Guo (epidemiology; environmental health and medicine; health impacts of water contaminants; cancers and chronic diseases in endemic areas of arsenic intoxication; epidemiologic characteristics of diseases associated with arsenic), Department of Environmental and Occupational Health, College of Medicine, National Cheng-Kung University (NCKU), Tainan

Tsair-Fuh Lin (analysis and monitoring of algae, cyanobacteria and metabolites; water treatment; site remediation; adsorption technology), Director, Global Water Quality Research Center, Department of Environmental Engineering, National Cheng-Kung University (NCKU), Tainan

Jyoti Prakash Maity (water and wastewater treatment with microbes and algae), Department of Earth and Environmental Sciences, National Chung Cheng University (CCU), Ming-Shung, Chiayi County

TANZANIA

Felix Mtalo (environmental impact assessment; ecohydrology; climate change; hydrological data management; hydrology; water resources engineering and management; integrated river basin management; flood and hydraulic modeling; (hydro)geochemistry including arsenic and fluoride; rainwater harvesting), College of Engineering and Technology, Department of Water Resources Engineering, University of Sar el Salaam, Sar el Salaam

Jamidu H.Y. Katima (sustainable wastewater management), College of Engineering and Technology, University of Dar es Salaam (UDSM), Dar es Salaam

THAILAND

Nathaporn Areerachakul (rainwater utilization; photocatalytic hybrid systems), Graduate School, Suan Sunandha Rajhabhat University (SSRU), Dusit, Bangkok

Mukand S. Babel (hydrologic and water resources modeling as applied to integrated water resources management; watershed modeling and management; water resources allocation and management; water resources and socio-economic development; water supply system and management; climate change impact and adaptation in water sector), Coordinator, Water Engineering and Management (WEM), Director, COE for Sustainable Development in the Context of Climate Change (SDCC), Asian Institute of Technology (AIT), Pathumthani

Thammarat Koottatep (sustainable wastewater management in developing countries; decentralized waste and wastewater treatment systems; eco-engineering technology for wastewater treatment and management; environmental health and sanitation), Environmental Engineering and Management, School of Environment, Resources and Development, Asian Institute of Technology (AIT), Khlong Luang, Pathum Thani

Chongrak Polprasert (sustainable wastewater management technology; hazardous waste minimization and control; global warming and climate change mitigation and adaptation), Department of Civil Engineering, Faculty of Engineering, Thammasat University (TU), Bangkok

Wipada Sanongraj (water and air pollution control and modeling), Chemical Engineering Department, Ubon Ratchathani University (UBU), Ubon Ratchathani

Sangam Shrestha (hydrology and water quality model development; water and climate change impacts and adaptation; water-energy-climate change nexus; impacts of climate change on: agriculture and food security, urbanization, land use and forestry, water supply and sanitation, infrastructure, and energy security), Water Engineering and Management, School of Engineering and Technology, Asian Institute of Technology (AIT), Pathumthani

THE NETHERLANDS

Arslan Ahmad (removal of arsenic, chromium, fluoride, iron, manganese, pharmaceutical residues, emerging compounds from drinking water, and industrial water treatment for recovery of salts through eutectic freeze crystallization process), KWR Watercycle Research Institute, Nieuwegein

Tony Franken (membrane technologies; nanofiltration; reverse osmosis; membrane distillation), Director, Membrane Application Centre Twente (MACT bv), Enschede

Antoine J.B. Kemperman (membrane technology), Faculty of Science and Technology, University of Twente (UT), Enschede

Doris van Halem (sustainable drinking water treatment), Sanitary Engineering Section, Watermanagement Department, Faculty of Civil, Engineering and Geosciences, Delft University of Technology, Delft

TONGA

Taaniela Kula (water supply for Small Islands Development States (SIDS)), GEF-IWRM Focal Point; Deputy Secretary for Natural Resources Division, Ministry of Lands Survey and Natural Resources, Nuku'alofa

TRINIDAD AND TOBAGO

John Agard (wetland restoration; tropical small island ecology; socio-economic climate change mitigation and adaptation scenarios; ecosystem services; marine benthic ecology; pollution control), Tropical Island Ecology, Faculty of Science and Technology, The University of the West Indies (UWI), St. Augustine Campus

Everson Peters (water resources; water management; rainwater harvesting in Small Islands Developing States (SIDS); wastewater reuse; willingness to pay), The Faculty of Engineering, The University of The West Indies (UWI), St. Augustine Campus

TURKEY

Ibrahim Gurer (surface and groundwater engineering; snow hydrology; flood hydrology; ecohydrology; transboundary waters; climatic trend analysis; water politics), Department of Civil Engineering, Faculty of Engineering, Gazi University, Ankara

Nalan Kabay (water and wastewater treatment by ion exchange and membrane processes (NF, RO, ED, EDI, MBR); water reuse; desalination; boron separation), Chemical Engineering Department, Engineering Faculty, Ege University, Bornova, Izmir

UGANDA

Albert Rugumayo (hydrology; water resources engineering and management; energy management, policy and planning project design; renewable energy), Faculty of Engineering, Ndejje University and School of Engineering, CEDAT, Makerere University – Kampala (MUK), Kampala

UK

Rafid Alkhaddar (wastewater treatment; water reuse and conservation), Head, Department of Civil Engineering, Liverpool John Moores University (LJMU), Liverpool

J.A. [Tony] Allan (water resources and the political economy of water policy and its reform; water resources in food supply chains; hydro-politics), Department of Geography, King's College & SOAS Food Studies Centre, University of London, London

Vinay Chand (rural development; renewable energy cogeneration water purification; water reuse and recycling in the semiconductor industry; remediation of arsenic-contaminated well waters; developing polygeneration as a way of overcoming both technical and economic impediments to the food-energy-water cycle; low grade waste heat for membrane distillation), CEO of Xzero AB, Chairman of HVR Water Purification AB, Stockholm, Consultant Economist, London

Ian Griffiths (mathematical modeling of strategies for water purification, including membrane filtration and contaminant removal via magnetic separation), Mathematical Institute, University of Oxford, Oxford

Nidal Hilal (water treatment; desalination; membrane separation; engineering applications of atomic force microscopy; fluidization engineering), Director, Centre for Water Advanced Technologies and Environmental Research (CWATER), College of Engineering, Swansea University, Swansea

Chuxia Lin (acid mine drainage; water-soil-plant interaction), College of Science & Technology, University of Salford, Manchester

Victor Starov (influence of surface forces on membrane separation: nano-filtration, ultra- and microfiltration (fouling and/or gel layers formation)), Department of Chemical Engineering, Loughborough University, Loughborough

James Wilsdon (social science of the 'nexus': joined-up approaches to food, energy, water and environment; politics of scientific advice; interdisciplinarity, particularly between natural and social sciences; governance of new and emerging technologies; science and innovation policy; public engagement in science, technology and research), Science Policy Research Unit, University of Sussex, Brighton

UKRAINE

Valeriy Orlov (technology for potable water; water supply and sewerage; intakes; drilling; environmental aspects of water supply; system analysis), Academician of the International Academy of Ecology and Life Safety, Academician of the Academy of Building of Ukraine; Academician of the Academy of Higher Education of Ukraine; National University of Water Management and Natural Resources (NUWMNRU), Rivne

UNITED ARAB EMIRATES

Fares M. Howari (water and soil management; environmental quality; fate and transport of contaminants; natural resources assessment and development; heavy metals; uranium geology; salinity; geochemistry; hydrology; remote sensing), Department of Natural Science and Public Health, Zayed University (ZU), Abu Dhabi

URUGUAY

Maria Paula Collazo (water resources management; water quality; hydrogeology; hydrogeochemistry; environmental awareness; sustainable development; groundwater remediation), Regional Centre for Groundwater Management for Latin America and the Caribbean (CeReGAS), MVOTMA/UNESCO; Faculty of Sciences, University of the Republic (UdelaR), Montevideo

USA

David Austin (emerging sustainable wastewater treatment technologies: design and operation; low-energy and positive-energy yield wastewater treatment; tidal-flow wetlands; improving raw water quality in reservoirs for drinking water plants), President (2015–2016), American Ecological Engineering Association; David Austin, Global Technology Lead Natural Treatment Systems; CH2M, Mendota Heights, MN

Leslie Behrends (decentralized wastewater technology; tidal-flow reciprocating wetlands), President, Tidal-flow Reciprocating Wetlands LLC; Consultant/Partner for ReCip systems, Florence, AL

Harry R. Beller (environmental engineering and microbiology; renewable fuels and chemicals; design and engineering of novel biofuel pathways in bacteria; biological treatment of contaminated groundwater; physiology and biochemistry of anaerobic bacteria; biodegradation and biotransformation of organic and inorganic contaminants (environmental biogeochemistry); development of mass spectrometric and biomolecular techniques to document *in-situ* metabolism; hydraulic fracturing and water quality; water-energy nexus), Director of Biofuels Pathways in DOE's Joint BioEnergy Institute (JBEI); Senior Scientist in Earth & Environmental Sciences Area (EESA), Lawrence Berkeley National Laboratory (LBNL), Berkeley, CA

Mohamed F. Dahab (water reuse; pollution prevention; sustainable systems for water quality improvement including biological treatment; nutrients removal; biosolids and energy management; use of natural systems for wastewater treatment), College of Engineering, Civil Engineering, University of Nebraska – Lincoln (UNL), Lincoln, NE

Benny D. Freeman (membrane science; oxidatively stable desalination and forward osmosis membrane materials; bioinspired membranes to control fouling of water purification membranes; physical aging of glassy polymeric materials and membranes), Richard B. Curran Centennial Chair in Engineering, Department of Chemical Engineering, University of Texas at Austin (UT Austin), Austin, TX

Pierre Glynn (groundwater geochemistry and integrated modeling; behavioral biogeosciences & policy; green urban infrastructure; multi-resources analyses; ecosystem services; citizen science), Branch Chief for National Research Program in Hydrology; Water Mission Representative to USGS Science and Decisions Center, US Geological Survey (USGS), Reston, VA

James Kilduff (application of sorption and membrane separations to water purification), Department of Civil and Environmental Engineering, School of Engineering, Rensselaer Polytechnic Institute (RPI), Troy, NY

Thomas R. Kulp (microbiological cycling of environmentally relevant trace metal(oids); novel microbial metabolisms involving metalloids that permit bacterial life at extreme conditions; microbiologically mediated reactions), Department of Geological Sciences and Environmental Studies, Binghamton University (BU), Binghamton, NY

Dina L. López (hydrogeology; water quality; environmental geochemistry; geochemistry of hydrothermal systems; fluid flow and heat transfer; acid mine drainage (AMD) and arsenic contamination in water; environmental causes of chronic kidney disease of unknown etiology), Department of Geological Sciences, Ohio University, Athens, OH

Lena Ma (phytoremediation and stabilization of contaminated soil and water), Soil & Water Science Department, University of Florida (UF), Gainesville, FL

Rabi Mohtar (quantify the interlinkages of the water-energy-food nexus that is constrained by climate change and social, political, and technological pressures; design and evaluation of international sustainable water management programs to address water scarcity), Founding Director of Qatar Environment and Energy Research Institute (QEERI); TEES endowed professor, Department of Biological and Agricultural Engineering and Zachary Civil Engineering, Texas A&M University (TAMU), College Station, TX

Lee Newman (phytoremediation; plant nanoparticle interactions; phytoremediation of groundwater contaminated with industrial organic pollutants; hyperspectral imaging of plants to determine contaminant exposure and plant microbe interactions to increase plant productivity and decrease stress responses), Past President, International Phytotechnology Society; College of Environmental Science and Forestry, State University of New York (SUNY), Syracuse, NY

Bethany O'Shea (geogenic contaminants in groundwater; water-rock interactions), Department of Environmental and Ocean Sciences, University of San Diego (USD), Alcalá Park, San Diego, CA

Faruque Parvez (human exposure and consequences to geogenic trace contaminants), Department of Environmental Health Sciences, Mailman, School of Public Health, Columbia University (CU), New York, NY

Madeline Schreiber (chemical and contaminant hydrogeology: environmental fate of trace elements; biodegradation processes; epikarst hydrology and geochemistry), Department of Geosciences, Virginia Polytechnic Institute and State University (Virginia Tech), Blacksburg, VA

Arup K. Sengupta (water and wastewater treatment: preparation, characterization and innovative use of novel adsorbents, ion exchangers, reactive polymers and specialty membrane in separation and control; hybrid separation processes), Department of Civil and Environmental Engineering & Department of Chemical Engineering, Lehigh University (LU), Bethlehem, PA

Shikha Sharma (stable isotope geochemistry with focus on issues related to the water-energy-environment nexus and isotope applications in unconventional and sustainable energy resources), Director, WVU Stable Isotope Laboratory, Department of Geology & Geography, West Virginia University (WVU), Morgantown, WV

Subhas K. Sikdar (water quality regulations; clean and sustainable technologies; environmental policy; measurement of sustainability; chemical engineering; water-energy and related nexuses; process development; separation processes), Associate Director for Science, National Risk Management Research Laboratory, U.S. Environmental Protection Agency, Cincinnati, OH

Vijay P. Singh (surface water and groundwater hydrology; groundwater and watershed modeling; hydraulics; irrigation engineering; environmental quality and water resources; hydrologic impacts of climate change), Distinguished Professor and Caroline & William N. Lehrer Distinguished Chair in Water Engineering, Department of Biological & Agricultural Engineering (College of Agriculture and Life Sciences), Texas A&M University (TAMU), College Station, TX

Shane Snyder (identification, fate, and health relevance of emerging water pollutants and contaminants of emerging concern (ECEs)), Department of Chemical and Environmental Engineering, College of Engineering, University of Arizona (UA); Co-Director of the Arizona Laboratory for Emerging Contaminants, Tucson, AZ

Paul Sullivan (water-energy-food nexus; water and conflict; economics of water resources; water-insurgency-revolution-war nexus; the political economy of water), National Defense University (NDU), Georgetown University; National Council on US-Arab Relations, and Federation of American Scientists, Washington, DC

Paul Sylvester (drinking water; wastewater and nuclear waste treatment; ion exchange; materials chemistry; radiochemistry; product commercialization; research management), Consultant, Waltham, MA

Maya A. Trotz (sustainability; water quality, ecotourism and small scale mining impacts on sustainable livelihoods; climate change; environmental engineering education in formal and informal settings in the US and in developing countries), Civil and Environmental Engineering Department, University of South Florida (USF), Tampa, FL

Richard Tsang (sludge treatment), Senior Vice President, CDM Smith, Raleigh, NC

Nikolay Voutchkov (desalination and water reuse – applied research; advanced technology development and expert review; project scoping, feasibility analysis, planning, cost-estimating, design, contractor procurement and implementation oversight; operation, optimization and troubleshooting for desalination plants), President of Water Globe Consulting, Stamford, CT

Zimeng Wang (water quality; water chemistry; biogeochemistry; water treatment; environmental engineering; soil and groundwater; contaminant transport; geochemical modeling), Department of Civil and Environmental Engineering, Stanford University, Stanford, CA

Y. Jun Xu (ecohydrology; watersheds hydrologic and biogeochemical processes; riverine sediment and nutrient transport; water quality; impacts of land use and global climate change on hydrologic and biogeochemical cycles), School of Renewable Natural Resources, Louisiana State University (LSU), Baton Rouge, LA

Yan Zheng (water, sanitation, and hygiene; hydrochemistry; biogeochemistry of chemical compounds and elements in the environment and their effects on human and ecosystem health; arsenic in groundwater and mitigation), Queens College, City University of New York (CUNY), Flushing, NY & Lamont-Doherty Earth Observatory, Columbia University (CU), Palisades, NY

VENEZUELA

Ernesto Jose Gonzalez Rivas (reservoir limnology; plankton ecology; eutrophication of water bodies), Venezuelan Focal Point for the water program of the InterAmerican Network of Academies of Sciences (IANAS); Institute of Experimental Biology, Faculty of Sciences, Central University of Venezuela (UCV), Caracas