The National Capital Region Water Resources Symposium: Water Resources and Water Infrastructure: Emerging Problems and Solutions

Friday, April 4, 2014
8:00 a.m. – 4:30 p.m.

University of the District of Columbia (UDC)
David A. Clarke School of Law
4340 Connecticut Ave., NW, Washington DC

Directions: *The UDC Law School is two blocks north of the Van Ness-UDC Metro station (Red Line). When you exit the escalator, turn left and along Connecticut Ave (the escalator will point you in the right direction). Follow signs to the 5th floor.* ***Campus Map****:* *http://www.udc.edu/about_udc/campus_map (Building #52)*

Introduction

The National Capital Region (NCR), encompassing the District of Columbia, and parts of Maryland, Virginia and West Virginia, has unique and challenging opportunities for sustainable management of water resources and water infrastructures. The region is the gateway to the Chesapeake Bay, the largest estuary in the U.S; provides water for six million people; but also hosts many agencies which consider water resources at a national or international scale.

This one-day symposium at the University of the District of Columbia brings together experts from governmental agencies, academia, the private sector, and non-profits to discuss challenges and opportunities for sustainable management of water resources and infrastructure in the region, as well as nationally and internationally. We hope that you will make the most of the opportunity to meet other water resources professionals across the region.

Program

8:00 a.m.	**~~ REGISTRATION ~~**	**Fifth Floor Lobby**
8:45 a.m.	**Opening & Welcome** • **Stacy M. Langsdale,** AWRA-NCR Section President • **Tolessa Deksissa,** Director, UDC Water Resources Research Institute & Professional Science Master's Water Resource Management Program • **Sabine O'Hara**, Dean, College of Agriculture, Urban Sustainability & Environmental Sciences, UDC • **Rachel Petty,** Interim Provost, University of the District of Columbia • **Tamim Younos**, Symposium Chair & Vice President AWRA-NCR Section, AWRA Fellow Member: Introduction to the Symposium Theme	**Room 516**
9:15 a.m.	**Keynote:** **George Hawkins**, General Manager, District of Columbia Water and Sewer Authority (DC Water) *Introduction by **Erica Brown** – Association of Metropolitan Water Agencies, AWRA-NCR Secretary*	**Room 516**
10:00 a.m.	**~~ Break ~~** **Please visit the posters on display in the break area**	**Fifth Floor Lobby**

10:30 a.m.	**Panel: Water Infrastructure – Emerging Problems and Solutions** **Moderator: Noel Gollehon,** USDA **Panelists:** **Claudia Copeland**, Resources and Environmental Policy Specialist, Congressional Research Service **Emily Fishkin**, Director, Infrastructure Initiatives, ASCE **Benjamin Grumbles**, President, U.S. Water Alliance **Jerry Johnson**, General Manager, Washington Suburban Sanitary Commission	**Room 516**
11:50 a.m.	**Lunch provided** **Information Session: AWRA Annual Conference to be held in Tysons Corner, VA, Nov 3-6, 2014** **Thomas Johnson,** AWRA-NCR Section, President-Elect **Mark Dunning**, AWRA President **Lisa Engelman**, AWRA 2014 Conference Chair	**Room 214**

1:00 p.m. – 2:30 p.m. **CONCURRENT SESSIONS 1**	
1A: WATER RESOURCES USE AND SUPPLIES **Room 506** ***Moderator:*** *Cherie Schultz, Interstate Commission on the Potomac River Basin*	**1B: URBANIZATION IMPACTS & FLOOD ANALYSIS** **Room 516** ***Moderator:*** *Jason Giovannettone, HydroMet*

Solving Groundwater Flow Equations Using Gradually Varied Functions
Li Chen, Assoc. Prof, Dept of Computer Science and Information Technology, UDC; *Xun-Hong Chen*, School of Natural Resources, Univ. Nebraska-Lincoln.

Solar-Powered Membrane System for Emergency Drinking Water Supply
Catherine Birney, Undergraduate Researcher and Baoxia Mi, Faculty Advisor, Civil and Environmental Engineering Department, UMCP

Solar Energy Accessed Groundwater for Urban Food Production
William W. Hare, Assoc. Dean/Director, Land-grant Programs; *Mchezaji Axum*, Director, Ctr for Urban Agriculture and Gardening Education; *Tolessa Deksissa*, Director, Water Resources Research Institute; *Kobina, Atobrah*, Research Associate, WRRI; *Samuel Lakeou*, Assistant Dean, School of Engrg and Applied Science and Chair, Dept of Electrical and Computer Engrg; *Siaka Nuah*, Graduate Asst, Water Resources Management; *Missi Sogbohossou*, *Brice Koukoua*, and *Raju Shrestha*, Undergraduate Students, Dept of Electrical and Computer Engrg, UDC

The Healthy Harbor Initiative of Baltimore: Practical private sector solutions for a swimmable and fishable Baltimore Harbor
Adam Lindquist, Healthy Harbor Manager, Waterfront Partnership of Baltimore

Effect of Urbanization on the Hydrologic Performance
Sergio De Hoyos, Doctoral Student and *Celso Ferreira*, Asst Prof, Civil, Environmental, and Infrastructure Engineering, GMU

Climatic and Geomorphic Influences on Spatial Scaling of Floods
Carolyn Plank; and *Karen Prestegaard*, Assoc.Prof., Geology Department, UMCP

Affordable Flood Forecasting Using FEMA Models
Mathini Sreetharan PhD, PE, CFM 1, Dewberry, Fairfax, VA

MJO Impacts South America Rainfall and Atlantic Hurricanes: A Study using Frequency Analysis & Regression
Jason Giovannettone PhD, Director, HydroMet, LLC, Alexandria, VA

<table>
<tr><td>2:30 p.m.</td><td colspan="2">~~ Break ~~
Please visit the posters on display in the break area</td><td>Fifth Floor Lobby</td></tr>
<tr><td colspan="4">3:00 p.m. – 4:30 p.m. CONCURRENT SESSIONS 2</td></tr>
<tr><td colspan="2">2C: WATER TREATMENT AND CONTAMINANT DETECTION
Room 506

Moderator: Celso Ferreira, Civil, Environmental, and Infrastructure Engineering, George Mason University</td><td colspan="2">2D: WETLANDS AND ECOSYSTEMS
Room 516

Moderator: Sridhar Venkataramana, Biological Systems Engineering, Virginia Tech</td></tr>
<tr><td colspan="2">Contaminant Removal From Water With A Single Pass Advanced Treatment System
William Roper PhD, P.E., Director of Research, Micronic Technologies; Kelly P. Rock, Inventor, CTO, Micronic Technologies

Methylotrophs Process Parameter Estimation of Nitrification-Denitrification Processes of Blue Plains Wastewater Treatment Plant in Washington, DC.
Jamal Alikhani, Dept of Civil Engineering, The Catholic University of America; Sudhir Murthy, DC Water and Sewer Authority; Imre Takacs, Dynamita, Nyons, France; Ahmed Al Omari, DC Water and Sewer Authority; Yalda Mokhayeri, AECOM, Washington, DC, Arash Massoudieh, Dept of Civil Engineering, CUA.

Speciation of Arsenic and Chromium by HPLC/ICP-MS in Water
Tolessa Deksissa, Director, WRRI, and Sebhat Tefera, Laboratory Technician, UDC</td><td colspan="2">Storm Surge Attenuation In Chesapeake Bay Wetlands: Analysis And Modeling
Seth Lawler, Graduate Student; Mithun Deb, Graduate Student; Celso Ferreira, Asst Prof, Civil, Environmental, and Infrastructure Engineering, GMU

Application of Unstructured mesh, SWAN+ADCIRC model to evaluate the role of wetlands in attenuating storm surges, Chesapeake Bay region
Mithun Deb, Graduate Student; Celso Ferreira, Asst Prof, Civil Environmental and Infrastructure Engineering, GMU

Increases In The Supply Of Coarse Sand Changes Sediment Transport Mechanics , Leading To Rapid Geomorphic Channel Changes In The Anacostia River
Karen L. Prestegaard, Assoc Prof; Zack Blanchet and John Kemper, Dept of Geology, UMCP</td></tr>
</table>

Rapid Screening and Quantitation of a Pesticides and Pharmaceuticals in Water and Food Products Using AxION DSA/TOF and Flexar SQ MS *Sebhat Tefera*, Laboratory Technician and *Tolessa Deksissa Director*, WRRI, UDC	**Vegetation-Hydrodynamic Interactions and the Stability of Channel Inlets in Tidal Freshwater Wetlands, Chesapeake Bay System** *Anna Statkiewicz,* Graduate Student; *Karen Prestegaard*, Assoc Prof, Dept of Geology, UMCP

4:30 p.m.	**ADJOURN**	

4:30 p.m.	**Optional Post- Symposium TOUR: UDC Campus Green Infrastructure** Led by **Dr. Tolessa Deksissa,** Director, DC Water Resources Research Institute & Professional Science Master's Water Resource Management Program	Meet in 1st floor lobby

Poster Presentations
8:30 a.m. – 3:30 p.m.
Fifth Floor Lobby

Simultaneous Analysis of Total Organic Carbon and Nitrogen in Water Samples Using TOC-Vch and TNM-L Detectors
Harold Yapuwa, Graduate Student; *Sebhat Tefera*, Laboratory Technician; and *Tolessa Deksissa*, Director, WRRI, UDC

Activated Sludge Parameter Estimation using Inverse Modeling
Heather Stewart, Research Asst; *Arash Massoudieh*, Asst Prof, Civil & Environmental Engineering, The Catholic University of America

Applications of Social Vulnerability Analysis to Water Resources Hazards
Mark Dunning, CDM-Smith; *Susan Durden*, USACE Institute for Water Resources; and *Dave Lanter*, CDM-Smith

The Development And Use Of A Spatio-Temporal Model To Evaluate And Optimize Constructed Wetland Design
Jennifer M. Olszewski, Ben Dyer Research Fellow; *Richard H. McCuen*, Ben Dyer Professor, Dept of Civil and Environmental Engineering, University of Maryland, College Park

Developing a chance-constraint framework for optimization of long-term hydraulic performance of green roofs.
Tri Le, and Peter Horgan, Graduate Students, The Catholic University of America; Pradeep Behera, Associate Professor, UDC; Arash Massoudieh, Assistant Professor, The Catholic University of America.

Enhancing stormwater infiltration to restore urban stream hydro-ecological function
Rosemary M. Fanelli, Marine, Estuarine, and Environmental Science Graduate Program, Univ of Maryland Center for Environmental Science; Karen Prestegaard, Dept of Geology, UMCP; Solange Filoso, Univ of Maryland Center for Environmental Science; Margaret Palmer, Marine, Estuarine, and Environmental Science Graduate Program.

Removal Of Nitrates And Nitrites From Rural Delaware Water Wells Caused By Agricultural Activities Using Advanced Treatment
William Roper PhD, P.E., Director of Research, Micronic Technologies; *Kelly P. Rock*, Inventor, CTO, Micronic Technologies

Bios of Featured Speakers

George Hawkins is General Manager of the District of Columbia Water and Sewer Authority (DC Water). DC Water provides drinking water delivery and wastewater collection and treatment for the District of Columbia, and treats wastewater for millions in several Maryland and Virginia suburbs. The Authority operates the world's largest advanced wastewater treatment plant at Blue Plains.

Under Hawkins' leadership, DC Water has launched a vast 10-year program to improve aging infrastructure and comply with ever more stringent regulatory requirements. DC Water is designing and implementing three massive environmental projects that total in excess of $4 billion.

Previously, Hawkins was the first director of the District Department of the Environment (DDOE). Prior, he was executive director of New Jersey Future, and served as executive director of the Stony Brook-Millstone Watershed Association. He held senior positions with the United States Environmental Protection Agency (EPA) and also served Vice President Gore on the National Performance Review. Hawkins is a member of the Bar in Massachusetts and the District of Columbia. He graduated Summa Cum Laude from Princeton University and Cum Laude from Harvard Law School.

Ben Grumbles is President of the U.S. Water Alliance, an educational non-profit based in Washington, DC and committed to uniting people and policy for "one water" sustainability throughout the country. Most recently, he led Arizona's Department of Environmental Quality working on air quality and climate change, energy policy and waste management, water efficiency, and wastewater recycling. Mr. Grumbles served as Assistant Administrator for Water at US EPA from 2003 through 2008. He launched EPA's water efficiency labeling program, WaterSense, and initiatives on asset management, green infrastructure, and water and climate change.

Emily Fishkin is Director, Infrastructure Initiatives at the American Society of Civil Engineers. Emily manages the research and development for ASCE's *Report Card for America's Infrastructure*, the *Failure to Act* economic study series, and oversees related infrastructure and advocacy initiatives. Prior to joining ASCE, she was with the Intelligent Transportation Society of America (ITS-America), the Washington State Transportation Center, and a consultant for the Washington State Department of Transportation. Emily has a BA from Duke University and an MPA from the University of Washington.

Claudia Copeland is a Specialist in Resources and Environmental Policy at the Congressional Research Service, U.S. Library of Congress. In this position she works with Member and Committee staffs of the U.S. Congress, providing information and analysis on environmental protection and related issues, with particular emphasis on water quality and water infrastructure issues. She has degrees from the University of Michigan and the George Washington University. Prior to joining CRS, she worked as a journalist and in the Washington, D.C. office of the law firm of Hunton and Williams.

Jerry Johnson is the General Manager and CEO of the Washington Suburban Sanitary Commission (WSSC), the 8th largest water and wastewater utility in the nation, serving 1.8 million residents in Montgomery and Prince George's Counties in the State of Maryland. Johnson was formerly the General Manager of the District of Columbia Water and Sewer Authority. He has held posts in the City of Richmond, Virginia as Deputy City Manager, Public Utilities Director, Community Facilities Director and as Executive Director of the Metropolitan Richmond Convention and Visitors Bureau in addition to the District of Columbia. He also served as Assistant to the City Manager in Alexandria, Virginia and a Senior Planner for the City of Charlottesville, Virginia. Mr. Johnson holds degrees in Business, Urban Affairs and Economics, and has completed the Kennedy School Senior Executive Program at Harvard. He serves on a number of boards and commissions, holds leadership positions in several national organizations, and has numerous honors and awards to his credit.

ABSTRACTS

SESSION 1A: WATER RESOURCES USE AND SUPPLIES

Solving Groundwater Flow Equations Using Gradually Varied Functions
Li Chen, Associate Prof, Dept of Computer Science and Information Technology, UDC; Xun-Hong Chen, School of Natural Resources, Univ. Nebraska-Lincoln.

Finite difference method and finite element method are popular methods for solving groundwater flow equations. This paper presents a new method that us es gradually varied functions to solve such equation. In this paper, we have established a mathematical model based on gradually varied functions for groundwater data volume reconstruction. These functions do not rely on the rectangular Cartesian coordinate system. A gradually varied function can be defined in a general graph or network. Gradually varied functions are suitable for arbitrarily shaped aquifers. Two types of models are designed and implemented for real data processing:
(1) the gradually varied model for individual (time) groundwater flow data, (2) the gradually varied model for sequential (time) groundwater flow data. In application, we used two sets of real data and one set of experimental data to test our methods.

Solar-Powered Membrane System for Emergency Drinking Water Supply
Catherine Birney, Undergraduate Researcher and Baoxia Mi, Faculty Advisor, Civil and Environmental Engineering Department, UMCP

We are conducting research on a sustainable membrane separation system for emergency or household drinking water supply. This system combines two energy efficient membrane processes: forward osmosis (FO) for water purification and membrane distillation (MD) for regeneration of draw solution for FO. The FO process utilizes the osmotic pressure difference between draw solution and feed solution across a semi-permeable membrane to separate water and contaminants. The MD process has a very low energy requirement and can be directly powered by renewable energy sources, such as solar energy. The purpose of this study is to combine FO and MD to enhance energy sustainability while producing high-quality water. Current technologies for desalination and water reuse require substantial energy inputs. Our novel membrane separation system will minimize energy consumption and reduce greenhouse gas emissions during water desalination and purification. Our final product will be a small-scale solar powered FO-MD membrane system, built in our lab. We will monitor membrane flux and product water quality. We will evaluate energy and process sustainability by calculating energy flow and monitoring membrane fouling. Our system is a sustainable solution to water scarcity, as it enhances energy-efficiency and environmental friendliness.

Solar Energy Accessed Groundwater for Urban Food Production

William W. Hare, Assoc. Dean/Director, Land-grant Programs; Mchezaji Axum, Director, Ctr for Urban Agriculture and Gardening Education; Tolessa Deksissa, Director, Water Resources Research Institute; Kobina, Atobrah, Research Associate, WRRI; Samuel Lakeou, Assistant Dean, School of Engrg and Applied Science and Chair, Dept of Electrical and Computer Engrg; Siaka Nuah, Graduate Asst, Water Resources Management; Missi Sogbohossou, Brice Koukoua, and Raju Shrestha, Undergraduate Students, Dept of Electrical and Computer Engrg, UDC.

Aquaponics, hydroponics, and intensive field drip irrigation food production systems require water for operation. Aquaponics systems produce proteins from fish and the fish waste to produce nutrient dense vegetables while hydroponics systems produce vegetable in nutrient enhanced water. Drip irrigation for intensive field vegetable production also requires water with a sensor controlled system. These forms of urban agriculture allow producers to utilize alternative mechanisms for producing nutrient dense food in small spaces. A solar powered water access system was recently installed at the University of the District of Columbia College of Agriculture, Urban Sustainability and Environmental Sciences (CAUSES) Muirkirk Research Farm in Beltsville, Maryland. This paper discusses assesses the effective utilization solar energy accessed groundwater for three urban agriculture systems and implication of their economic and environmental benefits.

The Healthy Harbor Initiative of Baltimore: Practical private sector solutions for a swimmable and fishable Baltimore Harbor

Adam Lindquist, Healthy Harbor Manager, Waterfront Partnership of Baltimore

In 2009 Waterfront Partnership, a nonprofit business improvement district responsible for managing and maintaining Baltimore's Inner Harbor, set the goal of creating a swimmable and fishable Baltimore Harbor by 2020. This goal was announced by the Mayor and included in the City's Sustainability Plan in 2010. In 2011 we released a plan detailing what actions need to be taken by the public and private sectors to reach our 2020 goal. While the public sector must do most of the heavy lifting, we have been relentless in identifying and implementing projects that can be undertaken by the private sector.
In 2012 we installed 2,000 square feet of floating wetlands in the Inner Harbor. In 2013 we created the Healthy Harbor Oyster Partnership to work with downtown businesses and help restore the native oyster population. In the spring of 2014 we will install a solar-powered WaterWheel trash interceptor in the Jones Falls, the main tributary to the Inner Harbor, which will use solar and water power to collect trash flowing into the Harbor. We also fund and produce an annual report card on water quality in Baltimore Harbor. Our projects are designed to engage and educate the public as well as improve water quality – a concept we refer to as the "Inner Harbor Living Laboratory."

SESSION 1B: URBANIZATION IMPACTS & FLOOD ANALYSIS

Effect of Urbanization on the Hydrologic Performance

Sergio De Hoyos, Doctoral Student and Celso Ferreira, Asst Prof, Civil, Environmental, and Infrastructure Engineering, GMU

Rate of urbanization change in the United States between 2010 and 2015 is estimated at 1.2 percent. Urbanization is expected to rise in the future due to continuing population increase and other factors. Land use change due to increase urbanization has the potential to alter the natural environment. Such alterations to the natural hydrologic cycle can potentially alter a watershed's ecological functions, increasing flash flood frequency and damage to property, the natural environment and life.
The purpose of this project is to compare the hydrologic response of two watersheds with similar urbanization characteristics and different restoration philosophies, providing a unique chance to compare two adjacent watersheds with similar urbanization characteristics, asses the effectiveness of stream restoration in protecting the hydrologic eco-functions of the watersheds through quantifying the differences between runoff volume, peak flow, time to peak, time of concentration, lag times and hydrograph duration before and after the restoration project. US EPA SWMM v5 has been used to model the hydrologic components of two watersheds in Fairfax County, Virginia: Difficult Run Watershed and Accotink Creek Watershed. Calibration of the models will be performed using a multi-objective optimization scheme under event-based precipitation scenarios. The resulting product will help Fairfax County asses the feasibility and value of future restoration projects.

Climatic and Geomorphic Influences on Spatial Scaling of Floods

Carolyn Plank; and Karen Prestegaard, Assoc. Prof., Geology Department, UMCP

Climate and land use changes are altering global, regional and local hydrologic cycles. These changes affect the frequency and magnitude of flood events. The type of the hydrometeorological event and characteristics of the watershed determine severity of flooding. Understanding how the hydro-climatology and geomorphology of a river basin network influence flood magnitude can inform flood risk assessments under a changing climate. A downward modeling approach examining the relationship of flood discharge to drainage basin area is used to provide insight into these influences. The relationship of discharge (Q) to drainage basin area (A) can be expressed as a power function: Q = □A□. Scaling exponents (□) and coefficients (□) are compared for floods of varying magnitude across a selection of major Atlantic Coast watersheds. These watersheds capture the hydro-climatic and geomorphic transitions along the Atlantic Coast. Results show that southern coastal plain watersheds have lower scaling exponents (□) than northern watersheds, but that 100-year and other large floods have higher relative magnitudes in the coastal plain rivers. The

Potomac River basin is in a transitional region that has similar flood magnitudes as the Southern coastal plain watersheds, but scaling exponents are similar to northern watersheds.

Affordable Flood Forecasting Using FEMA Models
Mathini Sreetharan PhD, PE, CFM 1, Dewberry, Fairfax, VA

A calibrated watershed model integrated with the forecasted precipitation and snowmelt feeding the hydraulic models of the streams provided the capability to forecast anticipated flows, river stages and reservoir levels and plan the optimal operation of reservoirs within a watershed. The expected water levels tailored to match the anticipated rainfall events make it possible to concentrate flood emergency operations on areas of specific anticipated need. The ability to predict anticipated inflow into a reservoir due to a forthcoming high precipitation event provides more options for the reservoir owners and operators to make decisions regarding keeping, transferring, or discharging water that would serve the priorities of the dam owners and mitigate avoidable flood hazard downstream. This presentation will discuss the options available to develop forecast models based on floodplain models developed for Flood Insurance Studies.
Integrated Flood Analysis System (IFAS) is a flood forecasting and warning system developed by International Center for Water Hazard and Risk Management (ICHARM) founded by the United Nations Educational, Scientific and Cultural Organization (UNESCO). IFAS is developed as a tool for early flood forecasting and flood warning system for developing countries to mitigate flood damage in watersheds where stream and rain gage data is sparse or unavailable. IFAS extracts satellite and ground based rainfall information. Satellite precipitation data published by National Aeronautical and Space Agency (NASA), National Oceanic and Atmospheric Administration (NOAA), and Japan Aerospace Exploration Agency (JAXA) are accessed through internet. Given the latitude and longitude of the watershed extent, IFAS has the capability to download necessary digital information on topography, land use and soil type data available in the public domain. IFAS has the ability to reflect ground water storage. User interface allows the development of and utilization of forecast model most of the inhibited part of the globe.

MJO Impacts South America Rainfall and Atlantic Hurricanes: A Study using Frequency Analysis & Regression
Jason Giovannettone PhD, Director, HydroMet, LLC, Alexandria, VA

In the face of a changing global climate and various modes of climate variability, knowledge of the distribution of rainfall reveals regions that are most vulnerable to an increase in extreme events, such as floods and droughts. The application of new methodology may help to answer the different questions and demands that result from this increased vulnerability. Based on the method of Regional Frequency Analysis (RFA) and L-moments (Hosking & Wallis, 1997), a tool (ICI-RAFT) was developed to estimate the frequency/intensity of a rainfall event of a particular duration using rainfall observations on the ground. In order to analyze the potential impacts of climate variability, a database containing the historical values of several global climate variables is included in the software. The method was applied to three regions within South America, one of which will be discussed here; rainfall data were provided at rain gauge stations throughout this region. The method was also applied to the total annual number of hurricanes in the Atlantic Ocean. Total rainfall for specific periods and the total number of hurricanes were computed and analyzed with respect to various global climate indices stored within ICI-RAFT using lag times from 1 to 6 months. The analysis attempts to identify one index capable of predicting above or below average total rainfall for the upcoming growing season and the total number of Atlantic hurricanes months in advance.

The global climate index that was found to have the greatest impact on rainfall and hurricane development was the MJO (Madden-Julian Oscillation), which is the focus of the current study. The MJO is considered the largest element of intra-seasonal (30 – 90 days) variability in the tropical atmosphere and is characterized by the eastward propagation of large areas of convective anomalies near the equator. The anomalies are modeled using ten separate indices measured at the equator on lines of longitude around the globe. The MJO locations that are the focus of the current study are located over central Africa (MJO9) and the western Indian Ocean (MJO10). Linear equations are developed in an attempt to quantitatively predict seasonal rainfall totals and hurricane numbers in advance based on the corresponding MJO index.

SESSION 2C: WATER TREATMENT AND CONTAMINANT DETECTION

Contaminant Removal From Water With A Single Pass Advanced Treatment System

William Roper PhD, P.E., Director of Research, Micronic Technologies; Kelly P. Rock, Inventor, CTO, Micronic Technologies

Over one billion people lack access to clean water, and almost 2 million die each year from water-borne illness. The resulting chemical contamination, environmental degradation, and insufficient supply cause escalating health risks.
Micronic Technologies has developed and patented MicroDesalTM, a mechanical evaporation system that removes contaminants from any source water including surface, ground, sea, brackish, turbid, and industrial water. The treatment unit mechanically creates a highly dynamic, rapid-evaporation process by increasing the speed and surface area of the water droplets. Using low-pressure and recycled thermal energy, the water/air flow processor vaporizes micron-size water particles into water vapor and then later during the condensation process water vapor is reconstituted into pure water. With the global stress for water increasing, MicroDesalTM can make a major contribution.
The paper will describe the results of bench-scale testing with the MicroDesalTM system over the last two years for a variety of industrial wastewater, sea water and stormwater samples. Results showed significant reductions in total dissolved solids, total suspended solids, chemicals, and bacteria to within EPA drinking level standards without using filters, membranes, or chemicals. It promises little maintenance and no pretreatment, a small footprint, and energy efficiency compared to alternative technologies.

Methylotrophs Process Parameter Estimation of Nitrification-Denitrification Processes of Blue Plains Wastewater Treatment Plant in Washington, DC.

Jamal Alikhani, Dept of Civil Engineering, The Catholic University of America; Sudhir Murthy, DC Water and Sewer Authority; Imre Takacs, Dynamita, Nyons, France; Ahmed Al Omari, DC Water and Sewer Authority; Yalda Mokhayeri, AECOM, Washington, DC, Arash Massoudieh, Dept of Civil Engineering, CUA.

At Blue Plains wastewater treatment plant (BPWWTP) and in most of the advanced wastewater treatment plants, methanol serves as carbon source in the denitrification stages. The methylotrophic bacteria are the main agents utilizing methanol and perform the denitrification. Methylotrophs have different growth and endogenous respiration rates than the conventional heterotrophic bacteria. In this study a mathematical model based on newly released code SUMO1 (Dynamita, France) have been proposed and modified for specific nitrification-denitrification (Nit-DeNit) process. A Bayesian hierarchical modeling framework was used for probabilistic parameter estimation of methylotrophic the biokinetic parameters of methylotrophic processes in addition to of Autotrophic nitrification processes using real data collected from BPWWTP. Bayesian parameter estimation approach is capable of explicitly considering different sources of uncertainty and providing the Joint Probability Density Functions (JPDFs) of stoichiometric and kinetic parameters. Parameter JPDFs can then be used for chance-constrained design and optimization of the reactor. The results indicate that data from full-scale systems can narrow down the ranges of some parameters substantially while the level of information they provide regarding other parameters can be small due to either large correlations between parameters or lack of sensitivity with respect to them under the operational condition of the reactor. The study also shows strong correlations among some biokietic and stoichiometric parameters under the operational condition of the reactor.

Speciation of Arsenic and Chromium by HPLC/ICP-MS in Water

Tolessa Deksissa, Director, WRRI, and Sebhat Tefera, Laboratory Technician, UDC

The toxicity and carcinogenicity of arsenic and chromium depends on their species. Appropriate determination of different species of these elements is crucial in regulating drinking water supplies. Arsenic and chromium are widely distributed in water, air and soil. These two elements can exist in a variety of states. Arsenic exists in a variety of forms, in air and drinking water is found in the form of inorganic arsenic (iAs), whereas in seafood contains high levels of organoarsenic compounds such as arsenobetaine(AsBe), dimethylarsinic acid (DMA), arsenocholine(AsCho),and arseno sugar(As Sugar). Arsenic (As^{+3}) and Arsenic (As^{+5}) are toxic. Chromium (Cr^{+3}) is an essential nutrient while Chromium (Cr^{+6}) is a toxic. It is necessary to quantify the individual species of these elements rather than the total element content for an accurate assessment of their impact. In this work, a speciation method using liquid chromatography with inductively coupled plasma mass spectrometer (HPLC-ICP-MS) was developed. The separation was accomplished using the PerkinElmer series 200 Binary HPLC pump, autosampler and vacuum degasser. A 3 cm Pecosphere Column with 3 C8 packing was used for separation. The method allowed separation, identification and quantification of As^{+3}, As^{+5}, Cr^{+3} and Cr^{+6}.

Rapid Screening and Quantitation of a Pesticides and Pharmaceuticals in Water and Food Products Using AxION DSA/TOF and Flexar SQ MS

Sebhat Tefera, Laboratory Technician and Tolessa Deksissa
Director, WRRI, UDC

Hundreds of pesticides have been synthesized in the last century and used widely to protect crops. Newer pesticides continue to be synthesized for crop usage which makes it important to analyze both targeted (or expected analysis) and non-targeted pesticides in food and in the environment. The Food Quality protection Act in the United States (US) and the European Union (EU) directive 91/414/EEC require that if pesticides are present in food they are below agreed levels due to the health risk posed by pesticides. To address human and environmental health, we need rapid analytical techniques with the lowest possible detection limits. The objective of this study is to apply the time-of-flight mass spectrometer with Direct Sample Analyzer and Liquid Chromatography to develop a rapid screening and quantification of pesticides and pharmaceuticals in water and food products. Unlike a triple quadrupole instrument that only measures targeted analytes, the time-of-flight mass spectrometer (TOF MS) can measure both targeted and non-targeted analytes. TOF MS collect full spectrum information and hence the data can be re-examined for the presence of these “non-targeted” analytes. Direct injection analysis of organic contaminants in water is a fast and powerful analytical tool for general screening purpose with limits of detection in the ppb range. Combining this technique with chemometric statistical analysis provides a reliable peak-finding algorithm that is important for non-target screening. This approach could be used in water quality applications, such as open and groundwater monitoring in remediation of contaminated sites, monitored natural attenuation, evaluating the process steps during drinking water treatment, and for following the impact of extended waste water treatment.

SESSION 2D: WETLANDS AND ECOSYSTEMS

Storm Surge Attenuation In Chesapeake Bay Wetlands: Analysis And Modeling
Seth Lawler, Graduate Student; Mithun Deb, Graduate Student; Celso Ferreira, Asst Prof, Civil, Environmental, and Infrastructure Engineering, GMU

Hurricanes are one of the most costly natural disasters impacting the US coastal areas and the Chesapeake Bay area has historically faced severe impacts from these storms. The sea-level rise is one of the most significant factors of climate change that will impact coastal areas and is also expected to have substantial impacts on the patterns and process of coastal wetlands, thereby affecting surge generation and propagation inside the bays. To improve our fundamental knowledge of tide and storm surge hydrodynamics in wetlands ecosystems, we installed a high density sensor network (3-5 pressure transducers per site) in natural reserves in the Chesapeake Bay eastern shore to thoroughly monitor water levels within wetlands ecosystems and performed field surveys to measure vegetation structural characteristics contributing to flow resistance (i.e. height, diameter and stem density). This information is used to support the calibration of a multi-model, multi-scale, multi-resolution modeling approach integrating High Performance Computing (HPC) of large scale and high resolution hurricane storm surge modeling (ADCIRC+SWAN) and small scale high fidelity models (DELFT3D) to simulate storm surge flow over wetlands and evaluate the benefits of these ecosystems to reduce storm surge. Multiple model simulations were performed using historical hurricane data and hypothetical storms to compare the predicted storm surge inundation resulting from various levels of wetlands expansion or reduction.

Application of Unstructured mesh, SWAN+ADCIRC model to evaluate the role of wetlands in attenuating storm surges, Chesapeake Bay region
Mithun Deb, Graduate Student; Celso Ferreira, Asst Prof, Civil Environmental and Infrastructure Engineering, GMU

The Chesapeake Bay is subject to storm surge from extreme weather events nearly year-round; from tropical storms and hurricanes during the summer and fall, (e.g., hurricanes Isabel [2003] and Sandy [2012]), and from nor'easters during the winter (e.g., winter storms Nemo and Saturn [2013]). Coastal wetlands and vegetation shape the hydrodynamics of storm surge events by retaining water and slowing the propagation of storm surge, acting as a natural barrier to flooding. Three wetland sites were chosen in the Chesapeake Bay for detailed cataloging of vegetation characteristics, including: height, stem diameter, and density. A framework was developed combining these wetlands characterizations with numerical simulations. Storms surges were calculated using a hydrodynamic model (ADCIRC) coupled to a wave model (SWAN) forced by an asymmetric hurricane vortex model using an unstructured mesh (comprised of 1.8 million nodes) under a High Performance Computing environment. Multiple model simulations were performed

using historical hurricane data and hypothetical storms to compare the predicted storm surge inundation resulting from various levels of wetlands expansion or reduction. The results of these simulations demonstrate the efficacy of wetlands in storm surge attenuation and also the outcome will scientifically support planning of wetlands restoration projects with multi-objective benefits for society.

Increases In The Supply Of Coarse Sand Changes Sediment Transport Mechanics , Leading To Rapid Geomorphic Channel Changes In The Anacostia River

Karen L. Prestegaard, Assoc Prof; Zack Blanchet and John Kemper, Dept of Geology, UMCP

Urban and suburban developments alter land surfaces leading to a cascade of changes in hydrologic and geomorphic processes. Urban surfaces and soils have low infiltration capacitie , leading to high runoff ratios, increased peak discharges, and associated decreases in groundwater recharge. These shifts in flood magnitude and frequency cause channel morphological adjustments, which may lead to new equilibrium channel forms. Although these process changes are often linear, changes in sediment characteristics can lead to significant non-linear feedbacks among stream hydraulics, sediment transport, and channel form. Urban development occurs over a span of time & space and can generate non-simultaneous changes in sediment supply and discharge that drive channel morphological changes. These non-linear adjustments to discharge and sediment supply have been observed in the Anacostia River system. Anacostia River channel adjustments have been both gradual and abrupt. Recent changes in the supply of coarse sand has increased the mobility of gravel bedload, resulting in rapid channel change due to downstream transport of coarse material and deposition of gravel bars. A failure to understand the mechanisms of and consequences of these changes could lead to unnecessary erosion control and channelization measures that eliminate sediment storage areas and further perturb the system.

Vegetation-Hydrodynamic Interactions and the Stability of Channel Inlets in Tidal Freshwater Wetlands, Chesapeake Bay System

Anna Statkiewicz, Graduate Student; Karen Prestegaard, Assoc Prof, Dept of Geology, UMCP

Recent acceleration of sea-level rise raises concern for the survival of coastal marshes, which are important sites for denitrification, habitat for young aquatic life, and protection from storm surges. For these tidal wetlands to survive, net sediment accretion must keep pace with sea-level rise. Net accretion requires that deposition of organic matter and mineral sediment must exceed erosion and organic matter decomposition. The amount of sediment deposited and retained in the marsh is a result of complex relationships among vegetation, channel hydrodynamics, and channel morphology. Seasonal variations in emergent plant height and density influence deposition and erosion of both types of sediment. We hypothesize that vegetation-hydrodynamic interactions generate alternate channel configurations (end-members at summer vegetative maxima and spring vegetative minima). Net accretion, therefore, only occurs when warm season accretion exceeds cool season erosion. In this study, we examined tidal freshwater wetland inlets on the Patuxent River, MD, 30- 60% covered by emergent species: Nuphar luteum, Zizania Aquatica, or Hydrilla verticullata. We measured stem density and depth distribution for each plant species and made bimonthly measurements of channel morphology, flow, and vegetation architecture. We determined seasonal variations in organic and mineral accretion for tidal freshwater marshes in the Patuxent system and the proportion of deposited sediment that remains in the channel, contributing to marsh accretion. The results of this study should provide information on the relative sustainability of different aquatic communities in tidal channels and provides an evaluation of the importance of specific vegetation species in tidal freshwater marsh maintenance.

POSTER SESSION

Simultaneous Analysis of Total Organic Carbon and Nitrogen in Water Samples Using TOC-Vch and TNM-L Detectors
Harold Yapuwa, Graduate Student; Sebhat Tefera, Laboratory Technician; and Tolessa Deksissa, Director, WRRI, UDC

Determination of total organic carbon and nitrogen in environmental samples is crucial for mainly two reasons. First, the fate and transport of organic contaminants depends on the availability of organic carbon in environmental samples. Secondly, the quality of organic farming or sustainable agriculture for sustainable water resources managements requires appropriate determination of C:N ratio. Recent research indicates the application of compost for stream restoration and water quality improvement by stabilizing stream channel and filtering organic and inorganic contaminants. The objective of this work is to develop the analytical technique and quality assurance procedure for Total Organic Carbon and Total Nitrogen analysis in environmental samples. Using Shimadzu TOC-VC/TN analyzer and SSM - 5000A Furnace, we developed analytical method for analyzing total carbon, inorganic carbon, total organic carbon, and total nitrogen in liquid and solid samples including compositing. The TN unit allows for simultaneous total organic carbon and total nitrogen analysis. Carbon content was measured as CO_2 by non-dispersive infrared gas analysis. For nitrogen analysis, the sample was combusted to NO and NO_2, then reacted with ozone to form NO_2 in an excited state. The method was tested for quality assurance and quality control based on standard solutions. The result shows the usefulness of this approach for advancing composting technique for organic farming and sustainable water resources management.

Activated Sludge Parameter Estimation using Inverse Modeling
Heather Stewart, Research Asst; Arash Massoudieh, Asst Prof, Civil & Environmental Engineering, The Catholic University of America

Algal blooms, eutrophication and unfishable waters are detrimental results of excess nutrients such as nitrogen entering surface water. A major anthropogenic source of nitrogen is municipal wastewater in the form of ammonium. In modern wastewater treatment plants deammonification is performed by various bacteria called activated sludge and requires costly aeration and carbon addition (such as methanol). New processes have been developed to encourage a type of ammonia-oxidizing bacteria called Anammox which is anoxic and autotrophic and therefore greatly minimizes operational cost. Mathematical Activated Sludge Models are used to evaluate the biological and chemical processes of full-scale plants and to find optimal operating conditions. These models require many parameters, several of which cannot be directly measured. In particular oxygen affinities (ko) for competing bacteria groups are difficult to isolate, so default values are often assumed. We are using small-scale batch experiments to estimate parameter values that are most likely to reproduce observed data using inverse modeling and Markov Chain Monte Carlo simulations. The widths of the resulting probability distributions are indicative of uncertainty and can assess the reliability of predictions made by models using these parameters. More realistic models lead to improved effluent quality and reduced operation cost.

Applications of Social Vulnerability Analysis to Water Resources Hazards

Mark Dunning, CDM-Smith; Susan Durden, USACE Institute for Water Resources; and Dave Lanter, CDM-Smith

The experiences of Hurricanes Sandy, Katrina, Rita, and Ike, as well as extensive flooding in the Upper Midwest, have again emphasized the reality and significance of the social impacts of floods and coastal storms. While all people living in hazard areas are affected, the social impacts of hazard exposure often fall disproportionately on the most vulnerable people in a society—the poor, minorities, children, the elderly, and the disabled. One of the lessons learned has been that effects on socially vulnerable populations have been overlooked and underestimated.

Information on social vulnerability is essential to enrich understanding of issues and factors that are critical in addressing the needs of these populations. Vulnerable groups often have the fewest resources to prepare for a flood, live in the highest-risk locations, occupy substandard housing, and lack the knowledge or social and political connections necessary to access resources that would speed their recovery.

This display will illustrate a web based tool, Social Vulnerability Index Explorer (SOVI-X) developed to facilitate the application of the SOVI approach. It is designed to help the user understand how social vulnerability, the drivers of vulnerability, and their spatial distribution can be used to address public safety and community resiliency needs. The web-based tool provides a consistent, user friendly approach to input, analysis and displays/outputs of social vulnerability data to support priority decisions. It is based on nationally available, consistent and meaningful data.

The tool developers will be available to engage with participants.

The Development And Use Of A Spatio-Temporal Model To Evaluate And Optimize Constructed Wetland Design

Jennifer M. Olszewski, Ben Dyer Research Fellow; Richard H. McCuen, Ben Dyer Professor, Dept of Civil and Environmental Engineering, University of Maryland, College Park

A spatio-temporal model of a constructed wetland was developed to optimize the design of constructed wetlands based on geographical location, influent water characteristics, and the specific concerns (i.e., wildlife habitat, water quality treatment, etc.) of invested stakeholders. This design tool will enable policy-makers and engineers to evaluate policy elements and design practices from the perspective of wetland sustainability. In the context of this study, sustainability will be defined as the maintenance of a stable, healthy, and resilient ecosystem within the wetland as well as downstream from it. The model can be optimized across an array of wetland functions, each defined in terms of performance criteria relevant to sustainability. These criteria are evaluated with quantifiable metrics such as effluent nitrogen concentrations and flowrates. Stakeholders will be able to weight each metric in order to maximize wetland sustainability for the wetland functions that most concern them. For example, a wastewater treatment plant may place greater weight on nitrogen removal, while wildlife organizations may assign more weight to wildlife habitat and internal wetland water depths. The proposed model can identify an optimal wetland design for each stakeholder, keeping in mind the limitations of each design due to uncertainty.

Developing a chance-constraint framework for optimization of long-term hydraulic performance of green roofs.

Tri Le, and Peter Horgan, Graduate Students, The Catholic University of America; Pradeep Behera, Associate Professor, UDC; Arash Massoudieh, Assistant Professor, The Catholic University of America.

During heavy storm, large portion of storm runoff and municipal wastewater can flow into Anacostia and Potomac Rivers through combined sewer outfalls causing substantial adverse effects on the water quality of these receiving waters. Green roofs provide a way to mitigate storm runoff volume and delaying peak flow rate. One of the issues facing the application of green roof is that its capacity may be filled up during high intensity or duration precipitation events and therefore its effectiveness may be diminished. In order to evaluate the effectiveness of various designs of green roofs over large time scales, we have been collecting long-term data on precipitation, temperature, humidity, runoff from green roofs and soil humidity using six pilot green roofs since May of 2013. A detailed mechanistic model of green roofs was developed and equipped with deterministic and Bayesian parameter estimation capability for simulation of green roofs. The goal of this research will be to use the data collected so far to estimate the parameters of the mechanistic model and then using the estimated parameters to evaluate the long term performance of green roofs in DC area and to provide guidelines for effective design of green roofs in DC area.

Enhancing stormwater infiltration to restore urban stream hydro-ecological function

Rosemary M. Fanelli, Marine, Estuarine, and Environmental Science Graduate Program, Univ of Maryland Center for Environmental Science; Karen Prestegaard, Dept of Geology, UMCP; Solange Filoso, Univ of Maryland Center for Environmental Science; Margaret Palmer, Marine, Estuarine, and Environmental Science Graduate Program.

Urbanization drastically modifies the watershed hydrologic cycle and impacts urban stream ecosystem structure and function. Stormwater runoff, conveyed into streams via storm sewer systems, significantly alters the flow regime, which in turn influences nutrient processing rates and shapes aquatic communities. Innovative stormwater management (SWM) techniques that enhance watershed infiltration may potentially mitigate the impacts of urban runoff in headwater streams, but the influence of enhancing watershed infiltration on the urban stream flow regime is still poorly understood. This study assesses whether infiltration-based SWM restores components of the pre-development flow regime (e.g., flashiness or frequency of high flow events). We measured high-frequency stream stage and precipitation rates in nine Maryland Coastal Plain headwater streams (three forested; three urban degraded with no SWM; three urban with infiltration-based SWM) and developed stage-based metrics to quantify components of the flow regime. We observed the SWM practices reduced the frequency of small flow events (1-inch depth or less). However, they had little effect on preventing runoff from entering the downstream channel during larger events, due to their limited storage capacity and low topographic position in the landscape, suggesting that the spatial distribution of SWM may be an important factor for effectively restoring urban stream ecosystems.

Removal Of Nitrates And Nitrites From Rural Delaware Water Wells Caused By Agricultural Activities Using Advanced Treatment

William Roper PhD, P.E., Director of Research, Micronic Technologies; Kelly P. Rock, Inventor, CTO, Micronic Technologies

Population increases and economic growth have imposed ever-increasing demands on water resources, making the agricultural sector key in protecting these resources. Protecting and restoring surface and groundwater resources for drinking and other uses is a major challenge. Agricultural operations add significant amounts of pollutants, from water run-off into watersheds, including the Chesapeake Bay, and infiltrate the groundwater. Wastewater that is discharged, either to a receiving water body or reused in farm operations should be free of excessive nutrients, bacteria and other contaminants to protect private and public water supplies.
Micronic Technologies has developed and patented MicroDesalTM a low-pressure, low-temperature, rapid-evaporation water treatment technology to remove pollutants from water. This technology uses no chemicals, filters, or membranes. It is low cost and highly efficient while producing minimal waste volume for disposal.
Micronic Technologies received a USDA grant to evaluate the feasibility of MicroDesalTM, to remove nitrates and nitrates from rural well water in Delaware. Test results will be summarized showing effective removal of nitrates and nitrites, as well as, phosphorous and bacteria. This research has shown good potential to benefit the agricultural community and the public by providing an efficient technology to remove pollutants associated with agricultural operations.

The American Water Resources Association National Capital Region Section Leadership 2013-14

AWRA-NCR Program Planning Committee	Board of Directors
Nate Beil Erica Brown Tolessa Deksissa Mark Dunning Jason Giovannettone Noel Gollehon Tom Johnson Paul Koch Stacy Langsdale Maria Placht Chuck Podolak (co-chair) Kendra Russell Cherie Schultz Cat Shrier Tamim Younos (co-chair)	**President**: Stacy Langsdale, PE, PhD **Imm. Past President**: Nathan Beil, PE **President-Elect**: Tom Johnson, PhD **Vice Pres. / Program Committee Chair**: Chuck Podolak, PhD **Vice Pres. / Symposium Program Chair**: Tamim Younos, PhD **Membership**: Jason Giovannettone, PhD **Secretary**: Erica Brown **Treasurer**: Paul Koch, PhD **Directors-at-Large**: Cherie Shultz, PhD and Norm Starler, PhD

www.awrancrs.org

Thanks to Our Sponsors

UNIVERSITY OF THE DISTRICT OF COLUMBIA
COLLEGE OF AGRICULTURE, URBAN SUSTAINABILITY AND ENVIRONMENTAL SCIENCES

KCI

The Cabell Brand Center for Global Poverty and Resource Sustainability Studies
www.cabellbrandcenter.org

MICRONIC TECHNOLOGIES