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CONTENTS

SESSION A: WATER ENVIRONMENT AND MANAGEMENT

Estimation of Land Surface Evaporation Using Variational Data Assimilation Method: Application Drought Monitoring.
Abedeh Abdolghafoorian, Graduate Research Assistant and Leila Farhadi, Assistant Professor, Department of Civil and Environmental Engineering, George Washington University, Washington, D.C.
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ABSTRACT
Accurate estimation of evapotranspiration (ET) is of significant importance for drought monitoring and climate forecasting. ET can be measured most directly by a number of methods such as Bowen ratio and eddy covariance. But "in situ" measurements are costly and therefore are applicable only to local scales and cannot be extended to large areas relevant to hydrological, weather and climate studies. A suitable alternative to "in situ" measurement of evapotranspiration is utilizing the remote sensing observations for mapping this flux across large areas. Among the numerous techniques developed for this purpose, data assimilation (DA) techniques have gained substantial success in recent years. The DA techniques estimate land surface fluxes by assimilating remotely sensed observations of land surface state variables of soil moisture and land surface temperature within the physical land surface models and provide accurate estimates of surface fluxes at the scale of observation. In this study we apply variational data assimilation (VDA) method to estimate the two main unknown parameters of turbulent heat and moisture fluxes: evaporative fraction (EF) and neutral bulk heat transfer coefficient (CHN). By assimilating land surface temperature observations into the VDA framework, ET can be estimated continuously in time, even for instances in which LST observations are unavailable. This is a significant achievement for monitoring ET as the remotely sensed LST products are typically contaminated by clouds and thus contain temporal gaps. In addition uncertainty of the retrieved ET flux will be retrieved from a Hessian based approach, which utilizes inverse of Hessian of objective function as a measure of error covariance matrix of estimated parameters. Maps of ET and its uncertainty will be used to provide accurate drought index for agricultural drought monitoring.

Investigating the Potential Risk of Hydraulic Fracturing to Water Quality in the Potomac Watershed.
Colin Casey, Master's Degree Candidate, Jessica Balerna, Undergraduate Student, and Karen Knee, Assistant Professor, Department of Environmental Science, American University, Washington, D.C.; and Gabriel Santos, Undergraduate Student, Federal University of Rio de Janeiro, Brazil.
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ABSTRACT
This project aimed to assess whether hydraulic fracturing ("fracking") and activities associated with it could affect water quality in the Potomac River, Washington, DC's water source. Much of the Potomac's watershed overlies the Marcellus shale play in the states of

Virginia, West Virginia, and Maryland; fracking development has already occurred in West Virginia but not in Maryland or in the parts of Virginia that are within the Potomac watershed. We measured specific conductance, pH, radium, and concentrations of dissolved metals that have been associated with fracking in samples from 73 river and stream sites in the Potomac watershed, distributed evenly among the three states, hypothesizing that West Virginia sites would demonstrate evidence of contamination. 224Ra activities were higher in West Virginia and Maryland than in Virginia, partially supporting our hypothesis. No significant differences in 223Ra were observed. Analysis of other Ra isotopes and other parameters is ongoing. Future work includes using strontium isotopes to distinguish fracking pollution from that originating from other sources, such as historical and current coal, oil and gas extraction, as well as combining water quality data with stream discharge to develop a simple model of pollutant loading from fracking within the Potomac watershed.

Predicting Occurrences of Arsenic in Groundwater in Virginia as a Tool for Exposure Assessment. Tiffany VanDerwerker, Master's Student; Madeline Schreiber, Professor, Department of Geosciences, Virginia Tech; Lin Zhang, PhD Student, Department of Statistics, Virginia Tech, Blacksburg, VA
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ABSTRACT
Arsenic (As) is a known toxin and carcinogen that can occur naturally in aquifers. Because As is naturally occurring, exists in many types of aquifers, is odorless and colorless, and generally does not cause immediate illness, it can be difficult to evaluate if As is a concern in groundwater in a particular region. Although public supply wells are routinely tested for As and other contaminants, homeowners are responsible for testing their own wells, and may not be aware of what potential contaminants could be in their groundwater. Currently, we are constructing a logistic regression model, using existing datasets of soils, geology, geochemistry, and hydrogeology to predict the probability of As concentrations above 5 ppb in groundwater across Virginia. Measured As concentrations in groundwater from state databases are used as the dependent variable. Geology soil series and texture, land use, and physiographic province are used as explanatory variables in the model. Relationships between explanatory variables will be evaluated to see under which conditions As is most probable to occur in groundwater. The results will be used to create a risk assessment map in ArcGIS that will identify areas of Virginia that may have elevated As concentrations in groundwater.

Where 'life meets rock': A Critical Zone Perspective on Water Management. Katherine O'Neill, Associate Professor of Environmental Science, Environmental Studies Program, Roanoke College, Salem VA
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ABSTRACT
The Critical Zone represents the upper layer of the Earth's surface, extending from groundwater to the top of the vegetation canopy, that provides the resources and services critical for supporting living systems and human institutions (described by the National Science Foundation as the zone where 'life meets rock'; Dybas, 2013). In 2001, interdisciplinary Critical Zone research was identified by U.S. National Research Council as one of the highest priority research areas in the Earth sciences for the 21st century. In recent years, Critical Zone investigators have called for an expanded view of both ecosystems and ecosystem services that more fully incorporates and values the range of processes occurring within the Earth's Critical Zone. This paper will discuss the frameworks underlying Critical Zone science and Critical Zone services as they relate to water management. Specific examples will be drawn from ongoing research at the Calhoun Critical Zone Observatory, an NSF-funded research site focused on quantifying interactions between historical and contemporary land use management, hydrology, soil quality, and ecosystem function.

Unmanned Aircraft Systems for Water Resources Management. Courtney Greenley, Strategic Communications Fellow, Institute for Water Resources, U.S. Army Corps of Engineers, Alexandria, VA
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ABSTRACT
Unmanned aircraft systems (UAS) offer a plethora of potential for the U.S. Army Corps of Engineers (Corps) Civil Works Program and water resources management. They have been touted to track hurricanes, create 3D maps, protect wildlife, assist farmers, locate archaeological sites, improve metrology, and conduct search and rescue among other applications. Small unmanned aircraft systems offer the potential for cost-effective surveys of remote and/or small areas while offering new and improved tools to collect data and aerial imagery. These tools will change the way that water resources managers do business. This presentation will explore the current and potential uses of small UAS.

SESSION B. WATER TREATMENT TECHNOLOGIES

Fouling Mechanisms and Control Strategies in Membrane Filtration of Hanford Tank Waste. Ramamoorthy Malaisamy, Research Scientist; Ryan Rollock, Graduate Student; Yaolin Liu, Postdoctoral Research Associate; and Kimberly Jones, Professor, Department of Civil & Environmental Engineering, Howard University, Washington, D.C.
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ABSTRACT
Microfiltration is planned as the primary separation technology for processing of low-level waste retrieved from underground storage tanks at the Hanford Nuclear Reservation near Richland, WA. Cross-flow microfiltration has proven to be an effective method for low-activity radioactive waste volume reduction. However, membrane fouling by inorganic particulates must be overcome to reduce problems with reduced membrane life, reduced flux, altered rejection of particles and increased processing time.
In this study, we analyze the fouling dynamics of boehmite (AlO(OH)), gibbsite (Al(OH)3) and goethite (FeO(OH)), which were identified as the major by-products in Hanford tank waste recovery. These foulants were treated at pH 10, and a transmembrane pressure of 40 psi utilizing a stainless steel, 0.1µM microfiltration membrane in a cross-flow configuration. The fouling behavior was observed in terms of flux decline for the individual foulants and for mixtures of the three foulants. While the feed with boehmite reduced the flux to 50% of the initial level and reached steady state in 2-3 hours, goethite reduced the flux to less than 5% within the first hour of operation. Particle size and SEM analyses revealed that goethite controlled fouling due to the polydisperse nature of the material (particle size ranging from 10-2 to 102 µM). A series of experiments to enhance membrane flux recovery such as the use of powdered activated carbon (PAC) and periodic cleaning of the microfiltration membrane were employed. A combination of the use of powdered activated carbon (PAC) and periodic cleaning helped restore the flux to 70% of the pre-fouling levels. Independently, PAC treatment contributed to a larger percentage of flux recovery than periodic cleaning.

Nanostructured Smart Fluid with UV Switchable Surfactants for Water Pollution Prevention and Removal. Naresh Poudel, Undergraduate Student; Xueqing Song, Associate Professor, Department of Department of Biology, Chemistry & Physics; Jiajun Xu, Assistant Professor, Department of Mechanical Engineering, University of the District of Columbia, Washington, D.C.
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ABSTRACT
Water pollution is a serious problem for human health and the environment and is one of main threats and challenges humanity faces today. In the last decade, many new techniques and methodologies have been proposed to remedy contaminated water which includes using micro/nanostructured membrane/filtration, nanoparticle catalytic, and chemical reaction etc. However, these methods are still evolving and often times, further cleaning/removal of the nanomaterials/surfactants added inside are needed which usually is time-

consuming and expensive. In this study, a new nanostructured smart fluid system with switchable surfactants, which can "smartly" remove the pollutants along with itself under certain external stimulus was synthesized and investigated experimentally. The results have shown that this new material can undergoe a photoisomerization from its trans to its cis form, which alters the molecular packing at the micellar interface. The result is to transform the long micelles into much shorter entities and, in turn, the solution viscosity decreases by more than 4 orders of magnitude. Attaching this with targeted pollutant, it can be used to removal certain pollutant in water at a higher efficiency within existing wastewater treatment facilities.

MCM Based Hybrid Mesoporous Materials for Water Treatment. Vu, Trinh, Undergraduate Student and Xueqing Song, Associate Professor, Department of Biology, Chemistry & Physics; Jiajun Xu, Assistant Professor, Department of Mechanical Engineering, University of the District of Columbia, Washington, D.C.
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ABSTRACT

Water pollution is a serious problem for human health and the environment and is one of main threats and challenges humanity faces today. Developing an efficient and effective water pollution restoration solution which can remove the pollutants in water at a more effective and economical sustainable way is critical. In this study, a new type MCM based hybrid material with embedded metallic oxide nanoparticles was synthesized and investigated experimentally. Two different methods are utilized to synthesize this hybrid water treatment material and the effectiveness of the synthesized material is tested and compared. The results have shown that this new material can not only provide an efficient alternative approach to removing pollutants at a low cost, but also eliminates the risk of nanoparticles contamination and the hassle of post processing. Due to the high porosity and contact surface area of the nanostructure, it can provide nanoscale filtration and pollutants removal at a higher efficiency, which can help water quality impairments to meet established state water quality standards and minimize the impact of chemicals to the environment.

Optimization of Mainstream Deammonification Operation. Heather Stewart and Jamal Alikhani, Research Assistants, Arash Massoudieh, Assistant Professor, Department of Civil and Environmental Engineering, The Catholic University of America; Haydee De Clippeleir and Ahmed Al-Omari, DC Water and Sewer Authority, Washington, D.C.
Contact: Heather Stewart (email: Ms.HeatherAnnStewart@gmail.com)

ABSTRACT

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 nitrogen removal 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

anaerobic and autotrophic and therefore greatly minimizes operational cost. Mainstream deammonification is the successful inclusion of Anammox in municipal nitrogen removal which facilitates cooperation and competition between Anammox and other bacterial groups. Using a previously calibrated activated sludge model for a laboratory-scale mainstream deammonification system, the following operational conditions are analyzed: dissolved oxygen concentration and arrangement of aerobic zones, influent composition, solids retention time, and temperature. The configurations that will result in the best utilization of the Anammox process, maximized nitrogen removal, will be presented and discussed.

Feed-forward Control Scheme to Minimize Operational Cost: A Case Study at the Blue Plains Wastewater Treatment Plant, Washington, D.C. Jamal Alikhani, Research Assistant and Arash Massoudieh, Assistant Professor, Department of Civil and Environmental Engineering, The Catholic University of America; Ahmed Al Omari, Haydee De Clippeleir and Sudhir Murthy, DC Water and Sewer Authority, Washington, D.C.
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ABSTRACT

To meet the effluent quality standards in the wastewater treatment plant while minimizing energy and chemical consumption, a control system must be implemented. However, activated sludge process is difficult to control due to the time-varying influent containing large disturbance, non-linearity of the processes and dynamics varying over a multitude of time scales ranging from seconds to days. The conventional control schemes are not sufficient when system faces with high influent's flow and composition fluctuations. An alternative way to overcome to the problems associated with feed-backward controlling approach, is applying the feed-forward information prior to the process to predict target variables in order to decrease the deviation from set-point(s) or to optimize objective functions. In this presentation development of feed-forward/feed-backward model predictive control (MPC) based on a modified activated sludge model for methanol-fed nitrification-denitrification processes aiming at reducing the aeration power and external methanol consumption will be presented. The feed-forward information consists of the influent's flow and ammonia concentration is used to predict dissolved oxygen (DO) concentration in nitrification stages and methanol loading rate in denitrification stages, while feed-backward measurements of DO in reactors, ammonia and nitrate in effluent is used to re-calibrate the model parameters in order to reduce the model prediction errors. The implemented model is deemed to be applied to the large-scale nitrification-denitrification reactors of 370 MGD Blue Plains advanced wastewater treatment plant in Washington DC to meet the 7.5 mg/L total nitrogen concentration in effluent while minimizing the aeration power requirements and methanol loading rates.

SESSION C. GREEN INFRASRUCTURE

A Flexible Framework for Process-Based Hydraulic and Water Quality Modeling of Stormwater Green Infrastructure Performance. Arash Massoudieh, Associate Professor and Saba Gharavi, Graduate Student, Civil Engineering Department, The Catholic University of America, Washington, D.C.
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ABSTRACT
Models that allow for design considerations of green infrastructure (GI) practices to control stormwater runoff and associated contaminants have received considerable attention in recent years. While popular, generally, the GI models are relatively simplistic. However, GI model predictions are being relied upon by many municipalities and State/Local agencies to make decisions about grey vs. green infrastructure improvement planning. Adding complexity to GI modeling frameworks may preclude their use in simpler urban planning situations. Therefore, the goal here was to develop a sophisticated, yet flexible tool that could be used by design engineers and researchers to capture and explore the effect of design factors and properties of the media used in the performance of GI systems at a relatively small scale. We deemed it essential to have a flexible GI modeling tool that is capable of simulating GI system components and specific biophysical processes affecting contaminants such as reactions, and particle-associated transport accurately while maintaining a high degree of flexibly to account for the myriad of GI alternatives. The mathematical framework for a stand-alone GI performance assessment tool has been developed and will be demonstrated. The process-based model framework developed here can be used to model a diverse range of GI practices such as green roof, retention pond, bioretention, infiltration trench, permeable pavement and other custom-designed combinatory systems. We demonstrate the utility of this GI modeling framework to simulate flow and transport in bioretention and permeable pavement GI systems. We also describe the flow and transport over a parking lot surface and a small stream.

Urban Soil Quality Assessment as Green Urban Stormwater Management Strategy. Tolessa Deksissa, Director; Sebhat Tefera, Project Specialist; and Yacov Assa, Program Coordinator for Environmental Quality Testing Laboratory, DC Water Resources Research Institute, CAUSES, University of the District of Columbia, Washington, D.C.
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ABSTRACT
Urban soil quality assessment is crucial for designing and implementing urban green infrastructures. Soil based green infrastructures need soil testing for both physical, chemical and biological quality to assess their ecological performance. Urban soils are presumed to have high levels of contamination, and require a proper soil test to remediate contaminants. Even if, urban gardening is considered as a green storm water management strategy, many cities, including the District of Columbia, do not require licensing to install or

operate an urban farm. Monitoring soil quality prior and after installation of an urban garden is of paramount importance. The objective of this study is to test and assess soil quality at home and community gardens in the District of Columbia. We also assessed the potential impacts of the measured soil quality on the health of gardeners and the environment. In July 2014 through October 2015, we collected more than 550 soil samples and analyzed for major nutrients and trace metals using standard method and Inductive Couple Plasma Mass Spectrophotometer, respectively. Based on the selected soil quality parameters such as pH, phosphate, arsenic and lead, some gardens need soil remediation in order to serve as a green stormwater management strategy.

Institutionalizing Green Infrastructure. Sara Hoverter, Senior Fellow, Emily Griffith, J.D. Candidate; Austin Castellano, J.D. Candidate, Harrison Institute for Public Law, Georgetown Climate Center, Georgetown University.
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ABSTRACT
Communities across the country are moving from using gray infrastructure to manage stormwater to green infrastructure approaches, including techniques such as permeable pavements, green roofs, and rain gardens, to both capture rainfall and retain it on site. Green infrastructure can provide a less costly means of managing stormwater while also providing co-benefits: reducing urban heat islands, improving air quality, providing recreational space, etc. While vanguard communities are innovating, many others are struggling to know where to begin, and, in most cities, municipal policies have not yet effectively incorporated these practices. The Georgetown Climate Center (GCC) is working with an advisory group of leading communities (e.g., Cambridge, MA; Detroit, MI; Denver, CO) to identify best practices for deploying and institutionalizing green infrastructure into city plans, infrastructure investments, and land-use decisions. The toolkit will also include strategies for incorporating climate projections and ensuring equitable implementation of green infrastructure. GCC is developing an online toolkit (to be launched in summer 2016) of ways to incorporate green infrastructure into city decisionmaking. GCC staff and students will preview this new and exciting tool and some of the examples of the leading green infrastructure practices that will be featured in the tool.

The Community-Based Public-Private Partnership (CBP3) Model: A New Way to Scale Up Green Stormwater Infrastructure Investments While Driving Costs Down and Benefiting Communities Along the Way. Seth Brown, PE, Principal/Founder, Storm and Stream Solutions, LLC, Alexandria, VA
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ABSTRACT
Stormwater runoff is now recognized across the U.S. as a major water pollution source – and the only source that continues to grow in many watersheds across the country. Rising impacts lead to increased regulation – and increased costs. The traditional method to plan, design, construct, inspect and maintain stormwater infrastructure is through a piecemeal project-oriented fashion using almost

exclusively public funding. This approach is littered with cost inefficiencies, which drives up costs, and often limits the scale of implementation efforts. A new approach, known as a "Community-Based Public-Private Partnership" (CBP3), has developed through an effort led by EPA Region III to enable communities to more readily and cost-effectively meet stormwater (MS4) and wet weather (CSO) regulatory obligations. The CBP3 model can accelerate the implementation of green infrastructure (GI) as well as greatly reducing the costs of urban stormwater retrofits by streamlining inefficient procurement processes, focusing on outcome-based efforts (rather than piecemeal project efforts) to meet goals, leveraging stormwater utility fees, and maximizing economies of scale. A hallmark of the CBP3 approach is the commitment to social goals through setting robust requirements for local jobs, and providing a platform for economic growth and revitalization associated with large-scale GI investments. Additionally, in this framework (based upon the military housing private investment model), the community benefits through the structure of the CBP3 to reinvest savings through efficiencies in implementation back into more "greened" acres rather than simply taking the savings as profits realized. The first application of the CBP3 approach for GI investments is being led by the Clean Watershed Partnership in Prince George's County, Maryland to retrofit 2,000 acres of impervious cover in three years, with the goal of addressing an additional 6,000 acres. Interest in CBP3s has been growing across the country, as there is recognition of the universal applicability of this approach. This presentation will provide an overview of this new stormwater infrastructure investment model and share some initial results from the Prince George's County program.

Historic Chapel Site: Meadows, Meanders and Meditation. Harris Trobman, Green Infrastructure Specialist, Center for Sustainable Development, University of the District of Columbia, Victoria Chanse, Assistant Professor, Dept. of Plant Science & Landscape Architecture, University of Maryland; Jonathan Gemmell, Penny Jacobs, Nick Yoder (Landscape Architecture); Jaison Renkenberger, and Yan Wang (Civil Engineering). Mr. Dennis Nola, Dr. Lea Johnson, Dr. Peter May, Dr. David Myers (Faculty); and Karen Petroff (Facilities), University of District of Columbia, Washington, D.C.
Contact: Harris Trobman (email: harris.trobman@udc.edu)

ABSTRACT

The design is centered on a seven-acre site next to the campus chapel. This site's location serves as a gateway campus entrance on the slope just below the campus Chapel, a site for commencement, academic functions, and weddings. The plan seeks to capture and treat stormwater from adjacent parking lots and rooftops. The project redesigns the stormwater system by disconnecting storm pipes and replacing traditional lawn cover with a meadow landscape that includes bioretention, bioswales and rain gardens to treat 100 percent of a one-year storm event. The project was initiated through the EPA's Campus RainWorks Challenge, a design competition that promotes innovative applications of green infrastructure on campus landscapes as a tool for sustainability education. The Chapel project serves as an innovative dry and wet meadow garden landscape that provides habitat for vanishing pollinator and beneficial insect species, as an outdoor classroom, and as a contemplative landscape for visitors and the university community. This design treats 55% of a five-year storm event and 100% of a one-year storm event.

SESSION D. WATER AND CLIMATE

ENSO 2015 - 2016: How to Act Based on Lessons Learnt from Past ENSOs in Peru. Jorge Escurra, Adjunct Faculty, University of District of Columbia, Washington, D.C.
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ABSTRACT
In the last thirty years, Peru has been affected by two ENSO events in which each one represented a 50-year rainstorm. These ENSO events occurred in 1982-1983 and 1997-1998, they generated economic damage of US$ 3.28 billion and US$ 3.50 billion, respectively. In the agriculture sector infrastructures collapsed due to floods. Agriculture land with irrigation systems was flooded and crop yields were lost, causing an increment of food prices which has a higher impact in the population with lower income. Currently, Peru has been achieving an economic growth and the increment of its agriculture products exports. Therefore, there is an ongoing interest to develop a master action plan for prevention, mitigation, and adaptation to natural disasters including the ENSO event which strongly affect the agriculture production and livelihood. The paper attempts to propose some country-wide actions pre, per, and post the ENSO to ensure the lowest impact on life losses and economic damage. These actions are presented in two main plans: (1) the master plan that involves a set of long-term actions for a period of years; and (2) the annual contingency plan that involves a set of short-term actions which feed the master plan.

Statistical Downscaling of Precipitation in the Occoquan Watershed Using Different Climate Models. Ayden Baran, Doctoral Student; Glenn Moglen, Professor, Adil Godrej, Research Associate Professor, Occoquan Laboratory, Virginia Tech, Manassas, VA
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ABSTRACT
The Occoquan Watershed, with an area of 570 square miles, is a source of drinking water for more than 1.7 million residents in the Washington, DC suburbs of northern Virginia. Climate change and its impacts on runoff, flooding, and water supply are growing concerns in the US and internationally. One of the future resiliency factors of freshwater resources is the mitigation of climate induced changes. Adaptation policies of local utilities require assessment of the effects of precipitation, in particular, rainfall at the scale of regional water supply-oriented watersheds such as the Occoquan watershed/reservoir system. General Circulation Models (GCMs) are widely used to project future climate changes. However, because of the coarse spatial resolution of GCMs, different downscaling methods have been developed to translate climate information from coarse resolution model outputs to local and regional scales. This presentation will demonstrate the use of two common statistical methods to downscale precipitation in the Occoquan Watershed. Two methods: the Delta Change method and the Quantile Mapping method, will be compared to each other as well as to observed data. In addition, different climate models will be employed with two diverse greenhouse gas emission scenarios namely A2

and B1. Climate model output from these analyses support the study of characteristics of runoff, mitigation of floods, and the development of future water supply plans and policies.

Using Climate Variability to Predict the Inter-annual Variability of Precipitation for Major Urban Areas and Regions within the USA and Abroad. Jason Giovannettone, CEO, HydroMetriks, PLLC, Alexandria, VA
Contact: Dr. Jason Giovannettone (email:giovanja@live.com)

ABSTRACT
Links between climate variability and total precipitation in several regions and urban areas throughout the United States are developed using one of nearly thirty global climate indices tested. Precipitation data from over 1200 stations are obtained from the United States Historical Climatology Network maintained by the National Climate Data Center, NOAA. All data are temporally averaged over an extended period (up to five years), and attempts are made to correlate the data with climate indices averaged over a period of equal length using lag times also up to five years. The length of the period and the lag time are varied until the highest correlation is achieved. The index that demonstrates the best correlation with precipitation is identified for each urban area and used to create regions that are dominated by a particular index; strong correlations (r2 values > 0.70) were found to exist in all regions. A map of the United States is constructed that displays the spatial distribution of each region. The final results of this study will not only allow a greater understanding of the major mechanisms that are responsible for inter-annual rainfall variability throughout the United States, but will also allow improved predictability of precipitation and the estimation of persistence for a given above- or below-average event.

Impacts of Extreme Precipitation on Flood Frequency in Southeastern Virginia. Mirza Billah, Postdoctoral Associate, Prasanth Valayamkunnath, Graduate student; and Venkataramana Sridhar, Assistant Professor, Biological Systems Engineering Department, Virginia Tech, Blacksburg, VA
Contact: Dr. Venkataramana Sridhar (email: vsri@vt.edu)

ABSTRACT
Periodic precipitation assessment is important for upgrading the design and safety standards of built infrastructure in urban areas. Using the observed precipitation data over 13 locations from southeastern Virginia, we found increases in the number and magnitude of high precipitation events during the period of 1950-2010 and the last 20 years showed significant increases in precipitation in the study area. We present the results that include the magnitudes of the annual maximum precipitation and their variability geographically. We also analyze the Coupled Model Intercomparison Project Phase 5 Multivariate Adaptive Constructed Analogs (CMIP5 MACA)-based models to investigate the uncertainty in the estimation of precipitation events. Evaluation of over and underprediction of future projections will be presented. Additional validation using the Weather Research and Forecasting (WRF)

model with the high resolution (hourly) data will be discussed. Preliminary results showing the ability of the model in reproducing actual events confirms the prediction performance of the model for the future precipitation assessment

Updated Precipitation Frequency Estimates for the Northeastern States. Sanja Perica, Director, Hydrometeorological Design Studies Center, National Water Center (NWS), NOAA, Silver Spring, MD; Sandra Pavlovic, Hydrologist, Michael St. Laurent, Carl Trypaluk and Dale Unruh, Atmospheric Scientists, NWS, NOAA, Silver Spring, MD and University Corporation for Atmospheric Research, Boulder, CO; Deborah Martin, Atmospheric Scientist and Orlan Wilhite, Intern, NWS, NOAA, Silver Spring, MD
Contact: Sandra Pavlovic (email: sandra.pavlovic@noaa.gov)

ABSTRACT
A team of scientist from the NOAA's National Water Center that includes hydrologist, engineers, meteorologists, statisticians and programmers has been tasked with providing high resolution gridded precipitation frequency estimates for the U.S. These estimates are published as volumes of the NOAA Atlas 14 based on geographic sections of the country and affiliated territories. The Volume 10 that includes the states of Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island and Vermont was published on September 30, 2015. The precipitation frequency estimates had been used in engineering applications for more than 60 years. Today, they are used for a wide variety of design and planning activities such as the design of drainage for highways, culverts, bridges, parking lots, in sizing sewer and stormwater infrastructure, for delineating regulatory floodplains, and managing and mitigating urban flooding. This presentation will cover the methodology and the major tasks required to develop the precipitation frequency estimates. In addition, the presentation will discuss differences between the updated and superseded study and other studies developed for the region.

SESSION E. WATER SUPPLY MANAGEMENT

Improving the Reliability and Risk Management of Water Supply Systems Using an Integrated Modeling Platform. Adnan Lodhi, Graduate Student; Adil Godrej, Research Associate Professor; Dipankar Sen, Faculty Advisor, Thomas Grizzard, Professor Emeritus, Occoquan Watershed Monitoring Laboratory, Virginia Tech, Manassas, VA
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ABSTRACT

A major consideration in indirect potable water reuse is the reliable operation of the water reclamation facility (WRP), especially if the reclaimed water is a major portion of the safe yield of the receiving reservoir. It requires timely and effective decision-making to manage WRP operations dynamically, particularly in response to changing weather patterns. This objective can be achieved by employing advance modelling techniques to simulate the interaction of the entire water supply chain and develop reliable operational strategies to alleviate risk associated with water availability and quality.
One such WRF facility, the Upper Occoquan Service Authority (UOSA), is located in northern Virginia and discharges directly into the headwaters of the Occoquan Reservoir. IViewOps (www.aquifas.com), an intelligent process simulation software, has already been implemented at UOSA for performance optimization and operational assistance. This paper presents how this simulator is coupled with an existing Occoquan watershed model using new supervisory software called URUNME. This software application provides a platform for interoperability of different models (runoff, reservoirs, wastewater, etc.) and employs a sophisticated analytical, statistical and graphical engine, using an informative GUI based on drag-and-drop functionality.

Water Supply Planning and Potential for Innovative Solutions. Sarah Ahmed, Water Resources Engineering Analyst; Karin Bencala, Senior Water Resources Planner; Cherie Schultz, Director, Cooperative Water Supply Operations, Interstate Commission on the Potomac River Basin (ICPRB)
Contact: Karin Bencala (email: kbencala@icprb.org)

ABSTRACT

The 2015 iteration of the Washington Metropolitan Area (WMA) Water Supply Study indicates that by 2035, under a repeat of conditions similar to a severe historic drought, the WMA's current water supply system will be adequate, but mandatory water use restrictions will be likely. By 2040, a key system reservoir, Little Seneca, may be emptied during drought. In both 2035 and 2040, there is a small chance that flow in the Potomac River will drop slightly below the minimum environmental flow level of 100 MGD at Little Falls dam. Factoring in the potential effects of climate change adds considerable uncertainty to study results. Under some climate change scenarios, serious water supply shortages are projected to occur during a severe drought. Given the long planning horizon needed to develop additional storage, the region’s water suppliers are exploring their options now. Water markets are a

promising tool for managing scarcity. A market may be feasible in the Potomac basin and may contribute to a more efficient use of regional resources. Regulatory drivers are already in place which requires certain water users to secure water storage to mitigate consumptive use of water.

Application of Two-Dimensional Analyses in Modeling Flat Terrains- A Case Study in Harney County, Oregon using FLO-2D.
Brett Laplante P.E., Prabharanjani Madduri P.E., C.F.M, Water Resources Engineer, Stantec Consulting Inc., Laurel MD
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ABSTRACT
Traditionally, the modeling of riverine areas to determine the extents of floodplains has generally been conducted using one-dimensional flow applications like HEC-2 and HEC-RAS. These applications have been shown to work very well where the flow paths are relatively well defined within confined floodplains. However, when the topography is flat resulting in multiple split flow paths with situational lateral flow, one-dimension modeling applications lack the ability to accurately model channel storage, reach routing and the interaction of flow between channel and floodplain. In these flat terrain areas, two-dimensional modeling platforms are more suitable and are a more cost effective approach to predicting the behavior of the flow patterns. The Silvies Watershed in Harney County is located in south-eastern Oregon where the climate and topology has been described as a vast desert prairie, marked by low annual rainfall, narrow channels, and vast floodplains. The average annual precipitation for the area is approximately 10.6 inches while the one-percent annual return rainfall is approximately 2.6 inches. FLO-2D was used to study the hydraulics of the river basin and associated floodplain. FLO-2D is a flood routing model that can calculate flow gradient in eight directions, which enables it to more accurately simulate the interaction of channel and overland flows within unconfined and complex topography. Inflow hydrographs were determined using the HEC-HMS 4.0 modeling application and were input into the FLO-2D grid. Historical lake levels recorded from Malheur Lake was included as the downstream boundary condition, as the watershed is part of a closed basin system (i.e. it doesn't drain into the ocean). This presentation will discuss the necessity of using two-dimensional models to aid floodplain modeling in flat areas, the methods used to define the two-dimensional models, as well as the experiences and lessons learned undertaking this task. In addition, the presentation will discuss some of the current limitations to two-dimensional modeling, and will provide comparisons between the ease of construction and accuracy of results to alternate two-dimension applications available

Incorporating PET Sensitivity in the Assessment of Streamflow in the Chesapeake Bay Watershed. Chounghyun Seong, Postdoctoral Associate and Venkataramana Sridhar, Assistant Professor, Biological Systems Engineering Department, Virginia Tech, Blacksburg, VA
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ABSTRACT
Consistent signals in projected streamflows under various climate scenarios will aid in planning proper water management strategies and/or to mitigate expected impacts on water resources. Estimating evapotranspiration (ET) is critical since the choice of potential ET (PET) equations to use can substantially vary the assessment of water budget and streamflow projections. Sensitivity analysis of PET under climate change conditions is presented using the Hydrologic Simulation Program – Fortran (HSPF) for the Chesapeake Bay Watershed. Commonly used six PET equations are employed for the comparison: temperature (Hamon, Thornthwaite, Hargreaves, Blaney-Criddle), radiation (Priestley-Taylor), and combination (Penman-Monteith) methods. The daily reanalysis weather data which provides all weather components enabling the calculation of PET using the six PET equations are implemented. The hydrologic model is calibrated and validated for each PET equation, ensuring that the models were equally performing well for the historical period. We will present the preliminary results of statistical comparison for uncertainty in streamflows driven by PET variations.

A Nearest-Neighbor Method (NNM) for Annual Streamflow Prediction. Tilaye Alemayehu, Graduate Student, Omar Abbas, Undergraduate Student, Nian Zhang, Assistant Professor, Electrical and Computer Engineering Department; Pradeep Behera, Professor, Civil Engineering Department, University of District of Columbia, Washington, D.C.
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ABSTRACT
Prediction of river stage has been an interesting research topic in hydrologic engineering, from water supply, flood forecasting, and water quantity and quality management viewpoint. For example, long-term evaluation on the potential impact of climate change on the water supply resources of the Washington, D.C., metropolitan area is very important. In order to predict the future river stage based on the current information is very much necessary for water supply managers. The Nearest-Neighbour Method (NNM) is data driven and non-parametric, with potential priority, and needs no assumption about the form of the dependence and probability distribution, or estimation of many parameters. One of the important parts of NNM is to choose a proper distance measure, as different distance measures may behave quite differently. Instead of using the commonly used Euclidean distance (EUD), we adopted the cosine angle distance (CAD) method for similarity estimation, which is sensitive to the direction of the feature vector, but has not been used in hydrological time series. We illustrate our approach to comparing EUD and CAD using a 2-dimensional space. The proposed cosine angle distance (CAD) is a promising popular distance measure that will help improve the prediction accuracy in the nearest-neighbor method (NNM).

SESSION F. FLOOD AND STORM WATER MANAGEMENT

Revised Guidelines For Determining Flood Flow Frequency – Overview of Bulletin 17C (*invited talk*). Wilbert O. Thomas, Jr., Professional Hydrologist, American Institute of Hydrology, Senior Technical Consultant, Michael Baker International, Manassas, VA
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ABSTRACT
The Subcommittee on Hydrology of the Advisory Committee on Water Information is proposing an update to Bulletin 17B, ***Guidelines For Determining Flood Flow Frequency***, that was published in March 1982. At that time, it was recognized that continued investigation and improvements of flood frequency techniques were needed. In fact, Bulletin 17B (pages 27-28) included a list of areas where additional research was recommended. The Subcommittee on Hydrology tasked the Hydrologic Frequency Analysis Work Group (HFAWG) with preparing an update to Bulletin 17B. The proposed update will be distributed as "Bulletin 17C, ***Guidelines For Determining Flood Flow Frequency"***. A draft of Bulletin 17C is complete and the document is in the review stage. The HFAWG developed a plan for investigating major improvements in Bulletin 17B. As discussed in the plan, "The concept is to maintain the spirit of Bulletin 17B through fitting the Pearson Type III distribution to the logarithms of the annual peak flows using a method of moments approach. Any deviation from the base method would require significant testing and evaluation." The major improvements in Bulletin 17B include the following:

- A new approach for analyzing data sets with historic information and paleoflood data called the Expected Moments Algorithm (EMA) (Cohn et al., 1997),
- Use of EMA for analyzing data sets with low outliers and zero flows (Griffis et al., 2004; Lamontagne et al., 2013; Cohn et al., 2013),
- Improved procedures for estimating regional skew (Reis et al., 2005; Gruber and Stedinger, 2008), and
- Improved procedures for defining confidence limits (Cohn et al., 2001).

The use of EMA gives more flexibility in analyzing nonstandard flood data. Annual peak flows can be characterized as standard point values as well as an upper or lower bounds or as interval estimates. In addition, EMA permits analysis of historic data, zero flows, or low outliers in a single and consistent framework. The use of the MGB test provides an objective approach in identifying and adjusting for multiple potentially influential low floods as often occurs in the more arid regions of the United States. Although significant improvements were made in Bulletin 17C, recommendations for additional studies are provided. Among the future studies include estimating flood frequency curves for streams whose flows are regulated by upstream detention structures and for developing procedures for incorporating climatic indices, changing basin characteristics, and addressing potential nonstationary climate conditions.

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Field Study of Hydrodynamics Modification by a Coastal Wetland of the U.S. Mid-Atlantic. Anne-Eleonore Paquier, Post-Doctoral Research Fellow; Jana Haddad and Seth Lawler, Graduate Students; Celso M. Ferreira, Assistant Professor, Department of Civil, Infrastructure and Environmental Engineering, George Mason University, Fairfax, VA
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ABSTRACT

Coastal vegetation - submerged as sea-grass, or emerged, as marsh - is expected to protect coastal areas but few field studies quantifying their role in storm surge attenuation exist. This study explores the interactions between a marsh in the Chesapeake Bay and the components of storm surge (waves, current, water level) to determine how a wetland can decrease the impact of these processes and reduce flooding. We are currently collecting data on morphology (topo-bathymetry using a Differential GPS), vegetation biometry (stem density, height, stem diameter) and hydrodynamics (current velocity and direction using Acoustic Doppler Current Profilers, waves and water level using pressure sensors). Instruments are deployed on a 250 m transect to compare currents, wave height and water levels as water interacts with the marsh. Preliminary results indicate a net decrease of current velocity over the marsh and a strong attenuation of waves by the marsh front edge. Water level impacts appear strongest at the shoreward edge of the marsh, but also along streams which may generate secondary flooding, and increased surge height. The energy of waves and currents decrease a short distance from shore, however the resulting interactions effect on water levels in the marsh is still a subject of discussion.

Building and Applying a Modeling Tool to Develop and Inform the District of Columbia's Consolidated MS4 TMDL Implementation Plan. Benjamin Crary, Limno Tech; Jonathan Champion Stormwater Management Division, District of Columbia Department of Energy and Environment, Washington, D.C.
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ABSTRACT
As part of its updated municipal separate storm sewer system (MS4) National Pollutant Discharge Elimination System (NPDES) permit requirements, the DC Department of Energy and Environment (DOEE) was required to develop a Consolidated Total Maximum Daily Load (TMDL) Implementation Plan (IP) to "attain applicable wasteload allocations (WLAs) for each established or approved Total Maximum Daily Load (TMDL) for each receiving waterbody." DOEE developed a regulatory compliance strategy that involved the development and use of a loading model to calculate updated baseline loads that reflected the most up-to-date information on stormwater pollutant concentrations and watershed delineations. The model also calculated load reductions through implementation of structural and non-structural best management practices (BMPs). Use of this consolidated modeling approach ensured that the modeling was consistent and transparent and incorporated the best and most current data and science available. This allowed development of a Consolidated TMDL IP with the following benefits to DDOE:

- A performance-based approach for reducing stormwater pollution;
- Flexibility in setting compliance schedules and selecting BMPs; and
- A more cost-effective approach than developing individual IPs which may not be as well coordinated

The presentation will examine the development of the model and its use in developing the Consolidated TMDL IP.

Stormwater Quantity Control of Impervious Surfaces through the Use of Vegetated Buffers. Raymond Green, Certified Floodplain Manager, Prime AE, Baltimore, MD, and Subra Das, P.E., Gannett Fleming, Baltimore, MD
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ABSTRACT
Vegetated buffers have long been recognized to moderate the impact of development through the control of soil erosion, creating visual screening and shade, and reducing glare, noise and heat. There are numerous references in the literature regarding the use of vegetated buffers to provide for water quality improvement. The presentation will examine the dynamics of sheet flow and the formulation of overland routing computations based on a Finite Difference scheme, and the flow attenuation provided by the vegetated buffers. Vegetated buffer scenarios will be modeled with the Finite Difference methodology and compared with flows computed from the National Resource Conservation Service unit hydrograph methods. Recommendations will be made regarding the optimum physical characteristics of the buffer for flow attenuation.

POSTER SESSION

Challenges in Field Data Acquisition and Processing for Wetland Characterization and Hydrodynamic Measurements. Alayna Bigalbal1, Beverly Lanza, Lindsey Keller, Tenzin Jigme and Evan Reznicek, Undergraduate Students; Anne-Eleonore Paquier, Post-Doctoral Research Fellow; Celso M. Ferreira, Assistant Professor, Department of Civil, Infrastructure and Environmental Engineering, George Mason University, Fairfax, VA
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ABSTRACT
Hurricanes throughout the years have revealed the United States' vulnerability to extreme weather events leading to severe infrastructure damages and loss of lives. This has led to an increase in research on the natural defenses against storm surge, such as the restoration and creation of wetlands. Although studies are exploring the benefits of wetlands as a natural defense, fewer studies are focusing on field data collection and publishing; likely due to challenges in data acquisition and processing required for wetland characterization and accurate hydrodynamic measurements. Here, we aim to identify the challenges faced collecting and interpreting data at the following four marshes along the Chesapeake Bay (CB): Dameron Marsh Natural Area Preserve, Magothy Bay Natural Area Preserve, Eastern Shore National Wildlife Refuge, and Monie Bay CB National Estuarine Research Reserve. The challenges include field deployment conditions, vegetative inconsistencies, and data processing and organization. The focus of the investigation is to identify the current and potential problems that must be considered in order to properly determine the hydrodynamic, vegetation, and morphology properties of wetlands to obtain a valid dataset allowing the study of storm surge attenuation.

Stream Flow Analysis of Potomac River to Understand the Flow Rate Trends. Bhrahim Sidi Mhamed, Civil Engineering Major; Pradeep K. Behera, Professor, Department of Civil Engineering, University of the District of Columbia, Washington D.C.
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ABSTRACT
A stream flow analysis of the entire Potomac River Basin, which covers five US states, was performed to understand the streamflow characteristics over several decades. Long-term streamflow and precipitation data were collected from USGS and NOAA website databases and used in this research. The annual and monthly streamflow data of 137 stations, from upstream to downstream, were analyzed. Flow duration curves were developed at each of the stations to understand the relationship between magnitude of flows and percent exceeded of that flow rates. In order to understand the trends of streamflow rates over several decades, Mann-Kendall test was performed for annual flows and seasonal flows. The outcome of the research will provide the insight into the understanding of streamflow characteristics from upstream to downstream during the severe land development of the watershed and possible

precipitation variation from the climatic change. Analysis of streamflow is important for water supply, flood control, and water resources engineering purposes.

Development of Rainfall Storm Event Analysis Tool based on Cloud Computing. Geetanjali VSSL, Graduate Student Computer Science; Pradeep K. Behera, Professor, Civil Engineering Department; Dong H. Jeong, Assistant Professor, Computer Science and Information Technology, University of the District of Columbia, Washington D.C.
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ABSTRACT
To protect society and environment adequately from these stormwater impacts engineers and professionals use stormwater management models for planning and design of urban stormwater management systems. Rainfall is the key primary input parameter for any hydrologic analysis and stormwater models. Therefore, understanding the rainfall characteristics is critical for the development of effective stormwater management systems. In this study, a storm event analysis tool is developed based on the inter-event time definition (IETD). To support an efficient computational analysis on the rainfall data, cloud computing technology is utilized. In detail, Hadoop Map/Reduce framework is utilized to manage the rainfall data and the computation. Since it handles much larger volumes without any traffic, latency, and performance issues, it benefits to produce the computational IETD results in real-time to support an interactive analysis of the rainfall data. The research methodology is as follows: (1) various sources of freely accessible rainfall records were explored such as (NOAA and NCDC websites); (2) Class and relationship diagrams were developed for the overall system architecture (note that the system is separated into a back-end parsing engine, the overall system architecture (note that the system is separated into a back-end parsing engine, and a series of front-end applications); (3) The data which we get from the mentioned sources is fed to the Hadoop Input file (4) Other required inputs like Station Code, From Date, To Date, HPCP value etc. are passed through the Hadoop Configuration object (5) IETD Analysis is performed on the data from different sources along with the user input with some modifications to the data like the String dates are converted to JAVA Date etc.; (6) The results are stored in a Hadoop output file; and (7) The data retrieval and computation is faster as it is being performed in the MAC cloud. Overall, the conducted rainfall data analysis and the designed computational method to measure IETD results will be presented with addressing research challenges to be considered in the development of interactive data analysis system with cloud computing technology.

The Mason Tidal Potomac Flood Monitoring Program: Towards a Real-Time Flood Warning System in Tidal Environments. Shahriar Abdsharifabadi, Undergraduate Student; Seth Lawler, Graduate Student, Celso Ferreira, Assistant Professor, Department of Civil, Infrastructure and Environmental Engineering, George Mason University, Fairfax, VA.
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ABSTRACT
The National Capital Region (NCR) is at risk from flooding from the Potomac River, storm surges and high tides from the Chesapeake Bay and urban stormwater from the adjacent watersheds. Understanding and accurately modeling the flood risk in this region is a complex task. It requires the integration of several computational models (e.g., hydrological, riverine hydraulics, coastal hydrodynamics and urban runoff) and a comprehensive understanding of the physics impacting flood water levels in the region. Despite nearly 80 years of data collection and monitoring in the region by National Oceanic and Atmospheric Administration (NOAA) and United States Geological Survey (USGS), there currently exist a long stretch of the Potomac river between the Alexandria and Lewisetta monitoring stations where there is no permanent water levels monitoring. In order to develop, calibrate and validate hydrodynamic models that accurately represent flood levels in this region, specifically at real time, additional information of water levels is needed in this stretch of the river. Hence, this project is setting up a flood level monitoring campaign for the ungauged stretch of the tidal Potomac River. Data will be collected during storm events and will be publically available at the Mason Water Data Information System (MWDIS).

Integrated Planning Model for Low-Impact Development. Domenico Amodeo, Graduate Research Assistant, Department of Engineering Management and Systems Engineering; Royce Francis, Department of Engineering Management and Systems Engineering, George Washington University, Washington, D.C.
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ABSTRACT
Previous research by the authors investigated the potential for low-impact development (LID) technologies to reduce stormwater runoff in the District of Columbia using an objective value hierarchy to rate stakeholder requirements and a statistical model to predict household-level customer adoption. The present work builds on these results by developing an optimization procedure for determining placement of LID and green technology throughout the District of Columbia with the goal of maximizing stormwater runoff reduction while minimizing cost. From a set of spatial and physical criteria for the 7 principal LID technologies, we will apply basic spatial analysis to identify feasible locations for these new technologies. Eliciting expert opinion, we will weigh areas with a more severe need for abatement with a higher pay off value. We will create a linear goal program to optimize the difference between the realized and desired run off coefficient and optimize this objective function with respect to costs incorporating physical and geographical considerations.

Impacts of Urban Water Bodies on the Transportation Networks for the District of Columbia. Laura Rojas, Undergraduate Student, Pradeep K Behera, Professor, Yao Yu, Assistant Professor, Department of Civil Engineering, University of the District of Columbia, Washington D.C.
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ABSTRACT
Climatic conditions (i.e., precipitation, temperature) and water ways (i.e., streams and rivers) can impact the transportation infrastructure (i.e., roads, highways, culvers and bridges) from planning, design and operation and maintenance viewpoint. Transportation infrastructure has been typically developed under the assumption that climate and weather patterns remain constant through its service life. However, under climate change scenario, there is a need to analyze the interaction between urban water ways and transportation infrastructure from not only public safety view point but also operation and maintenance of transportation systems. In the last few decades, Washington DC area has been affected by several weather events based on flooding and storm surge. These weather events impacted the transportation infrastructures, at the same time produce a challenge for the engineers to endure the worst weather scenarios and improve the quality of life in DC area. Therefore, there is a need to analyze the vulnerability of the transportation infrastructures to a range of wet weather events. In this research, transportation infrastructure of a portion of the District of Columbia near water ways has been analyzed. The research methodology include analysis of flow condition of water bodies close to the federal triangle area under extreme climatic conditions and its impacts on the transportation network. The research used the available USGS data, DC GIS Maps and analysis tools. The surface water elevation of waterways for various return periods was interfaced with transportation network to understand the relationship between them and to understand the risk of flooding.

Evaluation of a Rapid Detection and Quantification Method of Organo-Chlorine Pesticides in Water Samples Using Gas Chromatography Mass Spectrometer. Harold Yapuwa and Rahil Fofana, Graduate Students; Tolessa Deksissa, Director Water Institute, Professional Science Masters in Water Resources Management, CAUSES, University of the District of Columbia, Washington D.C.
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ABSTRACT
The determination of pesticides in environmental samples is critical for sustainable management of water resources in a number of ways. One, they poses human, environmental and ecological threat due to their bioaccumulation and biomagnification tendency. Two, pesticides have numerous exposure routes to the aquatic environment from non-point agricultural and storm run-off to point-based industrial discharges making their management more complex. Third, as they move through the environment, these pesticides are transformed into other products that maybe difficult to detect and thus manage. The challenge in analyzing for organochlorine pesticides is not only to have the appropriate extraction solvent and protocol capable of yielding high extraction efficiencies into the organic phase, but also the proper instrument settings that can give better separation of the analytes. The objective of this work was to develop an analytical method encompassing sample preparation and analysis for organochlorine pesticides in environmental water samples. Using a Perkin Elmer Clarus 600 Gas Chromatograph-couple-Mass Spectrometer (GC/MS) in electron ionization (EI) mode, we implemented a comprehensive method for analyzing lindane, heptachlor and γ-chlordane in water. In this paper, we present the

findings of our preliminary result. The results show the usefulness of this method to detect and quantify organochlorine compounds in water samples.

Chlordane Accumulation in Anacostia River Fish via the Tributary Food Chain. Sania Rose, Undergraduate Student and Harriette Phelps, Biology Professor Emeritus, University of the District of Columbia, Washington, D.C.
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ABSTRACT
Chlordane is an EPA PBT Priority Pollutant because it is Persistent, Bioaccumulative and Toxic and can bioaccumulate in fish, fish-eating animals and humans. The high chlordane of DC Anacostia fish is not obvious but toxic. Our earlier survey located chlordane sources in Maryland (MD) subtributaries, due to long-ago dumping. Recent research found chlordane-contaminated minnows from MD tributaries resulting in toxic levels in nearby Anacostia River fish being caught for food. Our Anacostia River survey is finding chlordane bioaccumulation up the full Anacostia fish food chain. This suggests chlordane food chain transfer may be a highly significant factor in endangering DC fishing. There are known methods to halt the downstream transfer of chlordane from its ssources but they will have to be applied in MD.

Studies on Water Quality Monitoring and Physical Characteristics of Urban Trees' Along the Appomattox and James Rivers. Latia Jackson, Undergraduate Student, Shobha Sriharan, Professor and others. Environmental Sciences Program, Department of Agriculture, Virginia State University, Petersburg, VA
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ABSTRACT
The Appomattox River is an important source of drinking water for several counties and a habitat for wildlife. The James River Basin starts where the Appomattox River ends and it is the second largest phosphorus contributor to the Chesapeake Bay. Our objectives are two folds: First objective is to monitor water quality at selected study sites including temperature, dissolved oxygen, salinity, pH, turbidity, hardness, total nitrogen, phosphate, nitrite, and chemical oxygen demand. At the study sites, physical features of urban trees including tree height, canopy cover, and root area were measured to make connection with riparian zone. Second objective is to train undergraduate minority students with field monitoring techniques: water quality, urban ecosystems, and geospatial techniques. The students mapped the study area with ArcMap to display current and historical data around Appomattox and James Rivers and surrounding topography that were linked with the water testing. Water temperature increased steadily through the summer while dissolved oxygen levels and pH were consistent at all study sites. Turbidity levels were consistently higher at City Point than other sites. The continuation of the above-mentioned studies will help in understanding the role of urban trees in reducing runoff of nutrients into the Chesapeake Bay.

Parcel Scale Storm Surge Modeling for Anne Arundel County: A Comprehensive Dataset of Historical Flood Maps.

Juan L. Garzon, Graduate Student and Celso Ferreira, Assistant Professor, Department of Civil, Infrastructure and Environmental Engineering, George Mason University.
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ABSTRACT

Coastal areas of the US East Coast are highly vulnerable to coastal flooding driven by tropical cyclone storm surge events. In an effort to comprehend regional vulnerability and resilience to this repeated hazard, a multi-disciplinary team is developing a novel agent based modelling (ABM) framework, the Integrated Hazard, Impact, and Resilience Model (IHIRM). Storm surge modelling has a key role in this framework as agents' (individuals, government or business) decisions and choices are based on simulated parcel scale inundation datasets. For first stage of the project, we developed a comprehensive inundation dataset for all 41 historical events around Anne Arundel County from 1938 to the present calculated using the hydrodynamic model Advanced Circulation, (ADCIRC). This modelling effort builds upon the USACE North Atlantic Comprehensive Study by increasing mesh resolution in the study area, including detailed topographic and bathymetric features. This parcel scale inundation database will not only contribute to the IHIRM modeling, but also provides a county specific, storm surge inundation record on a GIS portal to support local resilience planning by providing information on historical events in Anne Arundel County during the last decades.