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Con-Current and Poster Sessions

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CONTENTS

Con-Current Sessions

Session A. USGS Special Session: Remote Sensing of Rivers and Surface Water Bodies

Determining River Characteristics Using Remotely Sensed Data with Computational Models.

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Abstract. As part of USGS efforts to complement conventional river measurements with remote sensing techniques, we measured a variety of remotely sensed data sets on several rivers in the continental U.S. and Alaska over the past year. At each site, remote sensing data collection and conventional ground-based techniques were applied to evaluate the applicability of remote-sensing methods, particularly as they relate to water-surface elevation, water-surface velocity, and bed elevation (or, equivalently, depth). These three quantities measured at sufficient spatial/temporal resolution are adequate for characterizing important information about rivers (such as discharge and flood inundation). However, often only partial information on these three fundamental descriptors is actually available from remotely sensed data. In this case, physically accurate models for flow and sediment movement can be used to both fill in missing information and to broaden the interpretation of that data. Drawing from example data sets, we show how the interaction between computational modeling and incomplete remotely sensed data can yield complete characterizations of river reaches. Importantly, these examples present a conceptual framework for assimilating a wide variety of remotely sensed data sets within computational models to infer river characteristics with accuracy that neither modeling nor data collection alone can offer.

The U.S. Geological Survey Dynamic Surface Water Extent product development and evaluation strategy.

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Abstract. To meet broad scientific and resource management needs, the USGS is developing a product named Dynamic Surface Water Extent (DSWE) to document area of inundation from historic and newly collected moderate resolution satellite imagery. A multi-tiered strategy is employed to evaluate and document DSWE uncertainty and utility. Evaluation study areas and time frames are selected to provide the greatest challenges to DSWE performance and to provide coincident, independent sources of inundation information, respectively. Data from passive and active sensing systems from numerous airborne (to include unmanned airborne systems) and satellite-based platforms are processed using automated and manual approaches to yield polygon and point based validation data. In situ data on inundation and water stage collected by the USGS and/or other DSWE project collaborators at key U.S.

study areas are also used both to understand DSWE weaknesses and facilitate DSWE use in science and resource management. To refine the product, foster unbiased product assessment, and stretch development resources as far as possible, the final tier of evaluation is performed collaboratively. The effectiveness of this approach is illustrated through case studies drawn from DSWE prototype product evaluation for hydrologic modeling and flood inundation mapping.

Remote Sensing of River Discharge to Expand the USGS Streamgaging Network.
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Abstract. Streamflow is a metric of the hydrologic cycle, and mapping spatial and temporal variations in streamflow is critical to understanding changing hydrologic systems. The current USGS streamgaging network in the United States, particularly in Alaska, does not provide full coverage in space and time. Given the access limitations to many rivers, methods are needed to increase the coverage of the gaging network including hydrologic modeling, satellite platforms, and low altitude, non-contact remote-sensing platforms (fixed-/drone-based radars and cameras). The USGS is developing and testing methodologies to estimate river discharge from remotely-sensed observations with the goal of establishing discharge records where historical streamflow information is lacking. One method couples the USGS dynamic surface-water extent product with satellite altimetry to estimate water-surface height, slope, and width. Satellite-based products coupled with limited ground-based information, such as direct measurements of reach-averaged thalweg depth, surface-water velocity, acoustic Doppler current profiler observations, and new discharge algorithms will improve the accuracy of discharge estimates in remote regions. Ultimately, the use of satellite-based products will likely reduce the frequency of supplemental ground-based measurements in ungaged and remote basins when compared to the traditional methods used to establish and maintain a conventional USGS stage-, or index-velocity-discharge rating.

Session B. Stormwater and Flood Management

Estimating Impacts of Storm Surge on Inland Flooding Along Rivers Using HEC-RAS 2D

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Abstract. Coastal storm surges travel through inlets and up rivers to cause flooding across inland areas. Storm surge models, such as the ADvanced CIRCulation (ADCIRC) and Simulation of WAves in the Near shore (SWAN) are used to estimate storm surges along coastal areas. Generally, the resolution of the finite element mesh used to model the storm surge in a large regional model is not fine enough to capture the represent the bank topography and bathymetry of channels and likely to underestimate the conveyance of the surge through inlets and up rivers. This underestimation of conveyance can result in overestimation of expected flood elevations and hence the storm surge induced flooding. Finer mesh representation to correctly represent the river channel over bank topography and bathymetry is necessary to remedy this situation. This presentation explores the possibility of using a riverine hydraulic analysis software with a two dimensional modeling capability to analyze storm surge propagation up a narrow river where the floodplain in the surge influenced area is predominantly contained in the river. HEC-RAS 2D has the capability to read in a storm surge water level hydrograph as the downstream boundary condition and an inflow discharge hydrograph as the upstream boundary condition. This presentation will summarize our results for a study conducted for the Buffalo River in the City of Buffalo, New York to study the impact of Lake Erie storm surge propagation up the river. Storm surge hydrographs with exceedance probabilities of 0.01 and 0.002 percentages were developed from Lake Erie storm surge study and observed storm surges. A base flow hydrograph based on the drainage area was assumed at the upstream boundary. A 2D representation of the Buffalo River channel and floodplain was developed using HEC-RAS 2D. This model was used to generate flood elevations associated with 1-percent-annual-chance and 0.2-percent-annual-chance storm surges from Lake Erie in the downstream portion of the Buffalo River.

Safe Conveyance of Rare Storm Events

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Abstract. Two people were washed downstream and drown during a catastrophic flash flood that struck Ellicott City, Maryland on the evening of July 30, 2016. The infrastructure designed to carry stream flow and storm runoff through the historic district was unable to meet the demands of the 1000-year storm event that produced 6.6” of rainfall in a three hour period according a local Nation Weather Service rain gauge. The unprecedented storm event caused damage never seen in the region before. Roads were literally washed away and more than 200 vehicles were damaged. One vehicle floated nearly one mile downstream and several people required rescue

and evacuation. Storms of this magnitude are uncommon, however, when they occur the damage is extraordinary. The power of water is relentless and high velocity flow has the ability to convey enormous volumes of water in moments. The civil engineering community is deeply challenged with designing infrastructure capable of transporting typical design storm rates downstream. The rare yet significant flash flood in Ellicott City provoked an engineering curiosity. How does an event like this compare to the typical design storm? Subsequently, would the typical stormwater management design associated with site development be able to safely convey these infrequent runoff scenarios in a safe manor? The study that is currently being prepared will consider key points such as at what point were dams overtopped, what types of facilities faired the best in the design environment, and what characteristics may improve safe conveyance factors.

Ensemble-based Stormwater Runoff and Water Quality Modeling of A Highway in Suburban Maryland

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Abstract. The US EPA Storm Water Management Model (SWMM) was used to simulate runoff production and the performance of a ponded infiltration basin installed adjacent to a highway in suburban Maryland. In this study, an automatic, split-sample, calibration framework employing Monte Carlo techniques was developed and a multi-parameter sensitivity analysis was conducted to improve model calibration efficiency. The model was used to simulate the performance of the infiltration basin in terms of hydrographs and the pollutographs during 103 separate storm events. The calibrated model showed better skill in terms of reproducing water quantity observations relative to quality, partially due to the different sampling strategy, which suggests that obtaining sufficient in-situ observations that encompass both the entire hydrograph and the entire pollutograph are critical for proper model calibration and validation. Results demonstrated model skill at reproducing in-situ observations across daily, synoptic, and seasonal time scales. The ability of the model to encapsulate the observations between 5% and 95% confidence intervals suggests robust behavior and potential application to other basins.

Symposium on Flooding Around the Washington D.C. National Mall and Potential Solutions

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Abstract. The American Society of Civil Engineers (ASCE) National Capital Section (NCS) is planning a half-day symposium on flooding issues around the Washington D.C. National Mall. This presentation will discuss the upcoming symposium. The goal of the ASCW NCS symposium is to bring stakeholders for the National Mall together to discuss flooding issues along Constitution Avenue and potential solutions. The symposium agenda will include federal and local government organizations, A/E firms, and others.

Session C. Innovative Techniques for Water Management

Future Technologies in Water Resources Management.
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Abstract. Technological innovation will be a key component of real and lasting change within the U.S. Army Corps of Engineers (USACE) and in managing water resources. This presentation is intended to present future technologies for water resources management applications, both potential opportunities and examples of successes within USACE or government. This presentation will include brief overview of some or all of the following technologies: mobile and car apps, social media, Internet of Things, virtual reality, virtual and augmented reality, gaming, driverless cars, water and land robots, unmanned aircraft systems, 3D printing, scanning technologies, etc. For example, driverless cars or robots could help monitor Corps lands and conduct surveys. Alternatively, virtual reality could help teams, leadership and stakeholders envision a future project without travelling or understand their flood risks.

Applications Discovery: Potential Water Management Applications Using the Upcoming NASA Ice, Cloud and land Elevation Satellite-2 (ICESat-2) Measurements
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Abstract. NASA's Ice, Cloud and land Elevation Satellite-2 (ICESat-2) mission will orbit the planet to measure elevation changes in our Earth's surface. With a target launch in 2018, ICESat-2 will continue important observations of ice sheet elevation change, the above-water height of sea ice, and vegetation canopy height begun by the first ICESat mission, which operated from 2003 to 2009. It will also take height measurements over inland water bodies, including lakes and reservoirs. ICESat-2 will advance our knowledge on key observations for ecosystem, climate, and water applications. This talk will provide an overview of the ICESat-2 mission and discuss how the measurements of inland water surfaces will be developed into data products the public can use. We will describe how ICESat-2 measurements may be used by the water resources community using examples from the ICESat-2 Early Adopter program. The talk will include a description of how the data products will work and how water managers and others could use these data

products to make key decisions. We will provide the water resources community with information on the ICESat-2 Applications program and identify opportunities for using and leveraging the use of the planned data products.

Open Science in Water Resources with the Jupyter Notebooks.
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Abstract. With the ever increasing availability of data and ever more complex computational models, the computational and coding needs of water resources professionals is greater now than ever. However, water resources community currently has no 'lingua franca' for scientific computing and coding is being done in a wide variety of specialized environments computer languages. This has created a situation where the complexity of these computing environments is inhibiting many from being able to easily share their code with colleagues across various countries and organizations. The open source community is addressing this issue by developing innovative programming tools and environments which allow for a universal interface for computing in a variety of languages. Jupyter Notebooks, developed by the Jupyter Project, enable the combination of rich multimedia documentation and interactive code within a standard web browser interface, they facilitate the setup and sharing of customizable computing environments in a variety of programing languages, and eliminate the need for expensive licensing in many scientific computing applications. This presentation introduces Jupyter Notebooks as applied to a variety of problems in water resources engineering. Examples notebooks include applications for coastal and inland water resources projects as well as statistical and data analysis tools.

USGS Elevation-Hydrography Pilot Study.
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Abstract. Dewberry is developing lidar-derived hydrography data to three incrementally more detailed levels of quality in five differing landscapes for a pilot study for USGS. Five 10-digit Hydrologic Units cover approximately 808 square miles in areas in Colorado, Virginia, and Delaware and cover rugged, flatter, and coastal terrains. The three levels of detail and quality are as follows: (1) existing 1:24,000-scale National Hydrography Dataset (NHD) data updated to a positional accuracy of approximately +/- 7 feet on the ground, (2) 1:5,000-scale data with new features added and type codes added using a draft (simplified) NHD coding scheme provided by USGS, and (3) 1:5,000-scale data with FType and FCode values per the published NHD coding scheme. As a final step we will use the USGS NHD conflation tools and upload the 1:5,000-scale hydrography data into the NHD database. For each process step and landscape area we are recording the time spent to accomplish the improved data and noting any issues encountered along with their resolution. The information gathered in these pilot activities will be used by USGS to develop implementation scenarios for an enhanced National Hydrography program.

Session D. Remote Sensing: Applications

Assimilating Remote Sensing land Surface State Data into the Coupled Water and Energy Balance Models

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Abstract. Accurate estimation of land surface fluxes of heat and moisture is crucial in various hydrological, meteorological, and agricultural applications. "In situ" measurements of these fluxes are costly and cannot be readily scaled to large areas relevant to weather and climate studies. Therefore, there is a need for techniques to make quantitative estimates of heat and moisture fluxes using remotely sensed land surface state variables.

In this work, we applied a novel approach based on the variational data assimilation (VDA) methodology to estimate land surface fluxes and soil moisture profile from the land surface state variables, namely soil moisture and land surface temperature. The estimation methodology accounts for the strong coupling between the terrestrial water and energy cycles by coupling the dual source energy balance equation with the water balance equation through the mass flux of evapotranspiration (ET). Heat diffusion and moisture diffusion into the column of soil are adjoined to the cost function as strong constraints. This coupling results in more accurate prediction of land surface heat and moisture fluxes as well as soil moisture at multiple depths with high temporal frequency, as required in many hydrological, environmental and agricultural applications. The assimilation algorithm is tested with a series of experiments using synthetic data sets generated by the simultaneous heat and water (SHAW) model. We demonstrate the VDAperformance by comparing the (synthetic) true measurements (including profile of soil moisture and temperature, land surface water and heat fluxes, and root water uptake) with the VDA estimates. In addition, the feasibility of extending the proposed approach to use remote sensing observations is tested by limiting the number of land surface temperature and soil moisture observations.

Remote Sensing Technologies in the Environmental Monitoring and Management of Water Resources Pollution of the Caspian Sea from Petroleum and Gas Industry

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Abstract. The main goal of this research was to study a spatiotemporal distribution of man-made oil pollution and natural seepage slicks, regular oil spill hotspots, determine temporal repetition of oil spills, approximate daily oil spill rates and oil leak sources from oil spill hotspots in the Caspian Sea using multi-temporal 351 satellite images acquired from SENTINEL-1, LANDSAT-8, RADARSAT, ENVISAT, ERS and TerraSAR-X sensors during 2006-2015 (Figure 1). The secondary goal was to perform the stochastic modelling for the prediction of water contamination probability from oil spill hotspots with the consideration of determined

daily oil spill rates to quantitively assess environmental impacts to water column, water surface, shoreline, and total risk of contamination in the Caspian Sea. The third goal was to validate the predictions of water contamination probability from stochastic model based on the detected oil pollution hotspots from the satellite images.

The man-made oil spill hotspots were observed at the oldest oil platforms of Oil Rocks Settlement, Chilov and Pirallahi Islands of the Caspian Sea (Figure 2-4). The following temporal repetition of oil spills were observed at these hotspots: 1-20 (6632 sq. km.), 21-40 (644 sq. km.), 41-60 (212 sq. km.), 61-80 (95 sq. km.), 81-100 (32 sq. km.), 101-120 (20 sq. km.), 121-148 (16 sq. km.). The most critical 89 oil leaking wells were observed at the Oil Rocks Settlement under the oil spill frequency class of 121-148. Daily oil spill rate was approximated to be 1275 cubic meters. The stochastic modelling results with more than 50% of surface oil contamination probability revealed identical shapes and correlation with the total coverage of detected oil spills from multi-year satellite images. The length of the Caspian Sea shoreline with more than 50% of contamination probability was assessed to be 256 km out of total 2478 km shoreline and these areas cover high environmental and social sensitivities


Figure 1

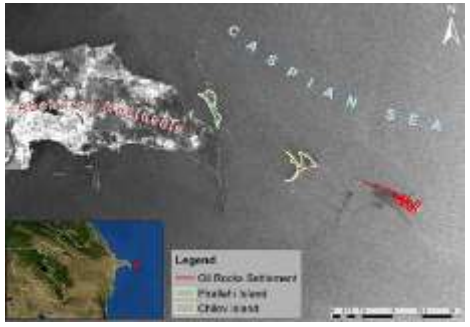

Figure 2


Figure 3


Figure 4

Fig. 1 Map of Man-made Oil Pollution and Natural Seepage Slicks in the Caspian Sea; **Fig. 2** Map of Oil Rocks Settlement, Pirallahi & Chilov Islands; **Fig. 3** Pictures of Oil Rocks Settlement; **Fig. 4** Oil Spill Detection from Radar Image at Oil Rocks

Lessons Learned from Nutrient Management: Remote Sensing

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Abstract. Satellite-based remote sensing is a tool that has made it possible to derive numeric nutrient criteria, specifically chlorophyll a criteria, using data from SeaWiFS, MODIS, and MERIS where limited field data are available. For example, Florida's coastal numeric nutrient criteria, which are based on satellite data, became effective in their regulation in 2016. Satellite remote sensing technologies are providing opportunities for states such as Florida, Georgia, New Jersey, and New Hampshire, to analyze historic remotely-sensed data for use in creating numeric criteria for their coastal and estuarine waters. Satellite remote sensing data can also be used in monitoring and assessment programs for determining the health of these larger water bodies. Inland waters are typically too small to capture sufficient data through satellite imagery. Satellite and aerial images could aid more states in developing numeric nutrient criteria. However, there are some caveats to consider such as the specific spectral and spatial resolution of data collected from the satellite sensors; field data necessary to calibrate the satellite data with site-specific conditions; and considerations for interfering factors such as seagrass, colored dissolved organic matter, or suspended matter. Remote sensing as a tool for developing numeric criteria and monitoring water bodies has promise, but its limitations should be considered when evaluating it. Using examples and case studies, this presentation will discuss the opportunities and challenges that state water quality managers face when considering the use of remote sensing as a tool to manage nutrients in their waters.

Correlating Watershed Remote Sensing Observations with Source Water Quality

W. Josh Weiss, Luke Wang, Kinsey Hoffman, Justin Bartlett, Dustin West (Hazen and Sawyer); Robert Allen (Riverside Technology, Inc.); Amita Mehta (NASA-UMBC JCET); Christine Lee (NASA, Applied Sciences Program, Water Resources)
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Abstract. Despite the strong influence of watershed conditions on source water quality, most water utilities do not currently have the capability to monitor watershed sources of contamination with great temporal or spatial detail. Typically, knowledge of source water quality is limited to the treatment plant intake and periodic grab samples. While important, such observations do not provide enough information for proactive watershed or source water management. Satellite remote sensing data can provide a snapshot of an entire watershed at regular intervals, helping utility analysts characterize watershed conditions and identify trends that could signal changes in source water quality. Funded by NASA's ROSES program, our team is investigating correlations between satellite remote sensing observations of watersheds and source water quality, at a variety of spatial and temporal scales and lags. Predictor variables under evaluation include parameters that describe vegetative conditions; parameters that describe climate/weather conditions; and non-remote sensing, in situ measurements. Predictands under investigation include nitrogen, phosphorus, organic carbon, and turbidity. In this presentation, we will describe results of statistical analyses and discuss how these results are being used to inform development of a desktop decision support tool to support predictive application of remote sensing data.

Session E. Water and Environment Management

Riparian Areas Mapping

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Abstract. Riparian areas offers wildlife habitat, preserve water quality, bank stability, protects against erosions, provides aesthetics and recreational value, and other numerous valuable ecosystem functions. The ability to identify and accurately map riparian areas extent is a crucial part of effective riparian areas and watershed managements. Two staff areas at the US Forest Service have coordinated on a two phase national project to support National Forests in their forest planning revision efforts and rangelands riparian business needs at the National, Regional, National Forest, and watershed scales. Phase one will include a national fine scale inventory of riparian areas on National Forest Service Lands in Western United States with riparian land cover utilizing GIS capabilities and open source geospatial data. This approach recognizes the dynamic and transitional natures of riparian areas by accounting for hydrologic, geomorphic and vegetation data as inputs into the delineation process. the results would suggests incorporating functional variable width riparian mapping within watershed management planning to improve protection and restoration of valuable riparian functionality and biodiversity.

Investigating the potential impacts of hydraulic fracturing, an analysis of the Potomac River Watershed

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Abstract. The process of hydraulic fracturing (fracking) has come under heavy public scrutiny in recent years as it has expanded across the United States. Fracking has enabled a new form of continental energy independence reliant on shale oil and gas development. The process ensues a series of post extraction effects related to both the disposal of wastewater and groundwater seeping that have resulted in higher concentrations of Ra226 in sediments downstream of fracking wells as well as elevated mean concentrations of Sr. When analyzed by individual state, mean surface water Ra224, Ba, Sr, and SO4 were found to be significantly lower in Virginia, a state without fracking in the Potomac Watershed. These results could indicate a natural baseline that could separate the underlying geology from the add-on effects of fracking technology, providing a useful guide for quantifying contamination in the future.

Decentralized Rainwater Capture: A Case Study of Potential Energy and Greenhouse Gas Reductions on a College Campus
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Abstract. Water usage in urban settings is intrinsically linked to energy and climate change due, in part, to the embedded energy and greenhouse gas costs associated with water treatment, transportation, and disposal (the water-energy nexus). Quantifying these embedded costs is critical for effective and sustainable resource management. This study examines the potential energy and greenhouse gas costs associated with the use of treated municipal water on an urban college campus (Roanoke College, Salem VA) along with the potential energy savings associated with implementing decentralized rainwater capture systems. The area of impervious surfaces available on campus for rainwater capture was measured through GIS analysis and combined with estimates of the energy costs associated with treatment, transportation, and disposal of treated water. These models were then applied to assess the feasibility of reducing energy consumption and mitigating greenhouse gas emissions using decentralized rainwater capture systems. - Although decentralized rooftop rainwater harvesting systems are unlikely to meet the full water demand for an urban setting, reduction of municipal water use offers the potential to offset water-associated energy and greenhouse gas costs while also aiding in stormwater management.

Predicting Residential Low Impact Development Adoption at the Homeowner Level
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Abstract. In this paper, we present a statistical model for predicting low impact development adoption at the homeowner level. Environmental engineers and economists have studied the patterns of adoption for green technology such as hybrid vehicles, wind power and rain barrels. Most of these studies have relied on data aggregated at census tract, county, or state levels. One related case study attempted to build a predictive model for rain barrel adoption for the city of Chicago (Ando and Freitas 2011). This model used several variables collected at the census tract level, including: median income, owner occupied units, green party voters, property type, residences with >10 units, and distance from rain barrel distribution. The response variable was the number of rain barrels installed per tract. In this paper, we consider similar variables for Washington D. C. at the home owner level. To develop our predictive model, we use a zero-truncated negative binomial regression model. Our model indicates that the property tax, parcel size and proximity to other LID installations were significant variables in predicting the total number of different LID on a property. Next we studied the configuration of LID types on individual properties. We used networks and sammon plots to explore trends in LID system configurations.

Session F. Building Resiliency in Water Management

Valuing the Protective Ecosystem Services of Natural and Nature Based Features in the Mid Atlantic Regions of the US

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Abstract. Coastal communities and cities in Mid-Atlantic regions of the US are frequently threatened by flood damages and erosion due to hurricane wind, storm surge and waves. With a changing climate, sea level rise (SLR) and intensified storms, the damage due to hurricanes is expected to increase. Hard structures have long been used for coastal flood protection, but scientists and coastal managers are learning that natural and nature-based features (NNBF) can play a significant role in attenuating storm surge and waves in many coastal areas. In this study, we applied high resolution coupled storm surge and wave models (ADCIDC+ SWAN) to evaluate current and future coastal flood vulnerabilities in Maryland and Virginia under the impacts of sea level rise, marsh migration and climate change. The coastal models are further integrated with careful economic valuation exercises in order to calculate the value of coastal protective services from NNBF. The results of the integrated coastal modeling and economic framework show that for strong hurricanes the projected flood extent will increase up to 78% and 122 % in the coastal counties in Maryland and Virginia respectively. And the protective ecosystem service of wetlands varies from 70 USD to 275 USD per acre for low to high intensity storm occurring in Maryland.

Quantifying Impacts of Upstream Reservoirs on the Potomac River due to Consumptive Use

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Abstract. The Potomac River basin is home to more than six million residents and has experienced moderate and severe droughts in the past (e.g., 1930, 1966, 1999, and 2002). With population growth and consequential increasing water demands, net water withdrawals by upstream users can impact the water supplies for downstream populations, as for example in the Washington Metropolitan Area (WMA). Three reservoirs, Jennings Randolph, Savage, and Little Seneca, are part of the WMA water supply system, and are used to augment Potomac River flow during droughts. This study focuses on investigating if upstream reservoirs which are not part of the WMA system partially mitigate the impacts of Upstream Consumptive Use (CU) on the Potomac River. Therefore, a GIS inventory of the ten largest reservoirs located in West Virginia, Pennsylvania, Maryland, and Virginia was created. The GIS database includes the following information: location, owner, storage capacity, reservoir inflows, and current water supply

demands. Each parameter listed above was analyzed along with a safe yield calculation for each reservoir. All of this information is useful and must be considered in order to properly determine the impacts upstream reservoirs. Therefore, through this study we aim to support the planning and management of water resources in the region.

Modeling the Recovery of Multiple Prioritized Capabilities in Critical Infrastructure Post-Distribution

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Abstract. The Department of Homeland Security defines 16 critical infrastructure sectors. Regulated rivers systems such as the Tennessee River Valley, intersect at least 6 of these sectors, Transportation, Dams, Energy, Nuclear Reactors, Food and Agriculture, and Water. An event that disrupts normal river operations has the potential to impact the performance of multiple sectors simultaneously. Existing frameworks for assessing resiliency do not account for the recovery of multiple system capabilities. This research proposes a framework for assessing a system's ability to return multiple capabilities to a minimum-acceptable level of performance. We develop this framework on historical reservoir operation data and simulate 50 years of river operations under climate change (RCP 4.5) to identify potentially troubling trends in the Tennessee River Valley. We will present a historical case to illustrate our proposed measure and a simulated case on the same reservoir project in order to assess future resiliency.

Application of a Simple Water Allocation Model

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Abstract. Water is the focus of discussions among decision makers, international organizations, scientific community, civil society, NGOs, and private sector to ensure a sustainable development. The reason is the high risk of water deficit in some areas due to population growth and land use change. One of the needed approaches for an effective water management, which is starting to get consensus and will come sooner or later, is to reform globally water price. In 2015, the International Monetary Fund published the report "Is the Glass Half Empty or Half Full? Issues in Managing Water Challenges and Policy Instruments". The report mentions the need to get prices right for different water users. To create an environment which allows the implementation of water pricing, a clear understanding of the amount of allocated water among different users need to be known. The paper attempts to propose a straightforward model for quantify water allocation based on different algorithms (Kostiakov's infiltration, generalized loading function equation, among others). The idea is to have a versatile and open source model which is simple to use and easy to modify for implementing the unique physical characteristics of basins. The paper also involves a description of a study case.

Poster Session

Vulnerability of Thermoelectric Power Generation in the United States and the Implications of Climate Change

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Abstract. This study explores the interactions between climate and thermoelectric generation in the U.S. by coupling an Earth System Model with a Thermoelectric Power Generation Model. We validated model simulations of power production for selected power plants (represents ~44% of total existing thermoelectric capacity) against reported values. In addition, we projected future usable capacity for existing power plants under two different climate change scenarios. Results indicate that climate change alone may reduce average thermoelectric generating capacity by 2%-3% by the 2060s. Reductions up to 12% are expected if environmental requirements are enforced without permits to discharge water hotter than regulated standards. This study concludes that the impact of climate change on the U.S. thermoelectric power system is less than previous estimates due to an inclusion of a spatially-disaggregated representation of environmental regulations and provisional variances that temporarily relieve power plants from permit requirements. This work highlights the significance of accounting for legal constructs in which the operation of power plants are managed, and underscores the effects of provisional variances in addition to environmental requirements.

Progress Assessment for the Restoration of the Missouri River, Applications to the Chesapeake Bay and the Potential for Remote Sensing as an Evaluation Tool

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Abstract. The 2002 National Research Council (NRC) Report on the Missouri River revealed the need for drastic changes to sediment and flow management in response to substantial reductions in the river's sediment loadings, ecological conditions and channel stability. The report examined the alteration of the river from pre-industrial times to 2002, and proposed modifications to effectively return the river to a "healthy", productive and sustainable state. Several of the proposed modifications were to introduce pulse flows, remove dams, widen and meander river channels, reconnect floodplains, add emergent sandbars, and install green infrastructure. An adaptive management methodology for the proposed modifications was also mentioned.

The current study began with an extensive literature review to identify and assess tried practices to restore the Missouri River over the last 14 years, and the successes and failures were highlighted. These practices were then compared to the 2002 NRC proposed modifications. Presented findings include how this study design can be used to analyze restoration practices of other threatened large-scale watersheds, like the Chesapeake Bay. Findings also illustrate how the highlighted successes and failures can advance the restoration practices of other watersheds, and the potential for remote sensing observations to aid in identifying or evaluating restoration sites.

FloodNOW: Enabling Real-Time IoT Flood Forecasting on the George Mason Watershed

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Abstract. Flooding from extreme events are the primary natural hazard threatening many regions throughout the world with devastating economic consequences and loss of life. In the last decade, there have been multiple extreme storm events, causing over $50 billion in damages in the U.S. alone. While numerical models to predict flood hazards have evolved significantly; hindcasting and forecasting local flooding from extreme events still could improve. Although progress has been made in the area of flood warning systems, these recent events demonstrate that our local communities are in danger. A new paradigm in flood alert systems is ahead of us with the developments of extremely low cost sensors connected by the Internet of Things (IoT). These new systems have the potential to revolutionize flood alert systems by conveying flood information at real time to every mobile phone in a community, calibrate inundation models and validate remotely sensed data. The purpose of this project is to experiment with small, low cost IoT sensors that collect and send flood hazards data directly to a Gateway via mesh radio network. Successful implementations of the sensors will result in faster and cheaper methods for collecting real time data to prevent the devastating consequences of flooding.

Engaging the Applications Community of the Future Surface Water and Ocean Topography (SWOT) Mission

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Abstract. NASA and CNES, with contributions from the Canadian Space Agency (CSA) and United Kingdom Space Agency (UKSA) are developing new wide swath altimetry technology that would cover most of the world's ocean and surface freshwater

bodies, and have the capability to make observations of surface water (lakes, rivers, wetlands) heights, as well as measurements of ocean surface topography with unprecedented resolution compared to existing technologies. These data would be useful for monitoring the hydrologic cycle, flooding, and climate impacts of a changing environment.

The applied science community is a key element in the success of the SWOT mission. The SWOT Applications framework includes a working group made up of applications specialists, SWOT science and project team members, and academics to engage potential SWOT data users. A written SWOT 'Early Adopters' plan to promote using proxies for SWOT data for potential applications is available. A user survey and outcomes of the first and recently held second user workshop will be discussed. The science and engineering advances provided by SWOT could be transformed into valuable services to decision makers and civic organizations focused on addressing global disaster risk reduction initiatives, and science-based mitigation activities for water resources challenges of the future.

A Stormwater Runoff Collection and Treatment System for Urban Agriculture and Food Security

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Abstract. With the fast increase of urban population, vast quantities of energy and water are being consumed whilst harmful quantities of wastewater and stormwater runoff are generated through the creation of massive impervious areas. Food security is becoming an increasingly important issue, especially urban residents here in US. There is an urgent need of developing effective and economical feasible solution for the best management practices to minimize storm water runoff, reduce soil erosion, maintain groundwater recharge, and minimize surface water and groundwater contamination from combined sewer overflows. In this study, a novel stormwater collection and treatment system is developed, which can harvest and store stormwater from densely populated urban areas and use it to produce food at relatively low costs. This system consists of an expandable storage tank that has a minimum volume and occupied space of 5 cubic feet and can expand to a theoretical maximum volume of 9 cubic feet almost doubling the size of the tank. The filtration system is a mechanical filtration with a filter size of 250 microns and a chemical filtration system with a mesoporous nanostructured material to filter heavy metals and other pollutants. This proposed system will help reduce food miles (carbon emissions) and virtual water consumption and serves to highlight the need for more sustainable land-use planning.

Monitoring Semi-volatile Organic Chemicals in Drinking Water By Solid Phase Extraction And Capillary Column Gas Chromatography

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Abstract. The Sustainable DC initiative sets water resources management as one of its primary goals in in making all DC water ways hundred percent fishable and swimmable. Currently most rivers and creeks are impacted by pollution from upstream sources and city storm outflows. Sustainable DC plan as well as the need for increasing the DC resident's confidence in the safety of their drinking tap water requires the District Agencies to monitor and test water resources. To support this local effort for compliance tests, there is a need for an accredited lab that could serve the DC government as well as DC residents. To that end, the UDC Environmental Quality Testing Laboratory is working for the national accreditation of environmental sample analysis for organic contaminants in potable and non-potable water. The purpose of this paper is to present the result of this effort and method development processes to get accredited at the standard of the National Environmental Laboratory Accreditation Conference (NELAC) in EPA method 525.3 for determination of Semivolatile Organic Chemicals In Drinking Water By Solid Phase Extraction And Capillary Column Gas Chromatography/ Mass Spectrometry (GC/MS).

Assessing the Effects of Fish Waste Addition to Composting of Vegetable Waste

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Abstract. Compost is essential for improving soil health thereby protecting local watershed. Healthy soil supports good vegetation cover that provides important stormwater functions, such as infiltration, sediment and pollutants biofiltration. Firebird Farm of the University of the District of Columbia has embarked on a mission to compost its nutrient-rich organic wastes from its aquaponics and hydroponic systems as one of its food hub components. The objective of this study is to analyze the effect and potential benefits of composting fish waste with vegetable and other organic wastes. Vegetable waste and wood chip mixture were used as the control pile while the experimental piles were sprayed with fish waste. The quality of the compost piles was analyzed based on germination index, organic matter decomposition, final C:N ratio. Since fish waste contains nutrients in a more-readily available form for bacteria, we assessed if fish waste accelerated decomposition and hence produced stable compost in a shorter time than the control pile. This paper will present the results and provide new insight about the application of fish waste in enhancing the quality of compost and processing time.

Advancing Soil Moisture Sensors Based Irrigation System

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Abstract. Water use efficiency or water conservation is important component of sustainable water resources management. As irrigation uses up to 70 % of freshwater resources, seeking for automated irrigation system that uses soil moisture and crop data is crucial. The objective of this study is to compare the calibration carve of six soil moisture sensors. Soil samples were collected from the UDC Muirkirk Research farm and set up the calibration set up in the greenhouse of UDC. The calibration setup was implemented in five replicates of soil bins and with six sensors (Acclima TDR315L, Campbell Scientific CS655, Decagon 5TM, Decagon 5TE, Vegetronix VH400, and EC5). Two CR1000 data loggers were used to collect data. The calibration carve of each sensor were compared and the results showed that TDR315L is the most consistent sensor for automatic irrigation system among all sponsors under consideration. This paper will present the result of the analysis and recommendation of further research.

Analysis of Perchlorate in Waters by TOF Mass Spectrometer with AxION Direct Sample Analysis

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Abstract. High dose of perchlorate in drinking water or food can affect the function of the thyroid gland that controls normal growth and development of the central nervous system. Perchlorate is a naturally occurring and manmade chemical that is used to produce rocket fuel, fireworks, flares and explosives that can ultimately contaminate the drinking water system. Environmental regulators and public water system managers are seeking for the availability of rapid and cost effective screening method to address human health concern. Current available methods are slow and expensive. This paper will present a rapid way of quantifying perchlorates in waters, which allows rapid and greatly simplified analysis, helping lead to faster decisions regarding the presence of perchlorate. This method will apply Time of Flight and Mass Spectrophotometer (TOF MS) with AxION Direct Sample Analysis (DSA). The paper will provide insight about the presence and level of perchlorate in DC water system.

Development and Calibration of automated Class A Evaporation Pan

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Abstract. Automatic evaporimeter was designed and constructed by introducing set of pre-set sensors and transducer such as 0.71 EAP, carbon resistor, semi-carbon conductor-IN4007 and lighting diode-4v 60mm amp for automated/self-recording evaporation rate. The working principle of evaporimeter was developed using 10 values of ILP,8 FLP,150.4 and 12.3 refractive value respectively. The output of equipment calibration using different statistics validations of refractive index values, voltage and calibration index show strong agreement of R2=0.999, 0.869 and 16.4 respectively. Measurement sensitivity of 0.1 ± 0.018 cm-1 of evaporation. The instrument's time response to a step change in water level from the evaporation was calibrated to every level (0.1 cm) of water change in pan. Maximum evaporation value of 0.3 cm, refractive index value is 15.0 and voltage (v) of 225.6v respectively. Statistics validation indicates that there was strong relationship between the initial evaporation reading (IER) and final evaporation reading (FER) with R2=0.9718 and 0.9635.