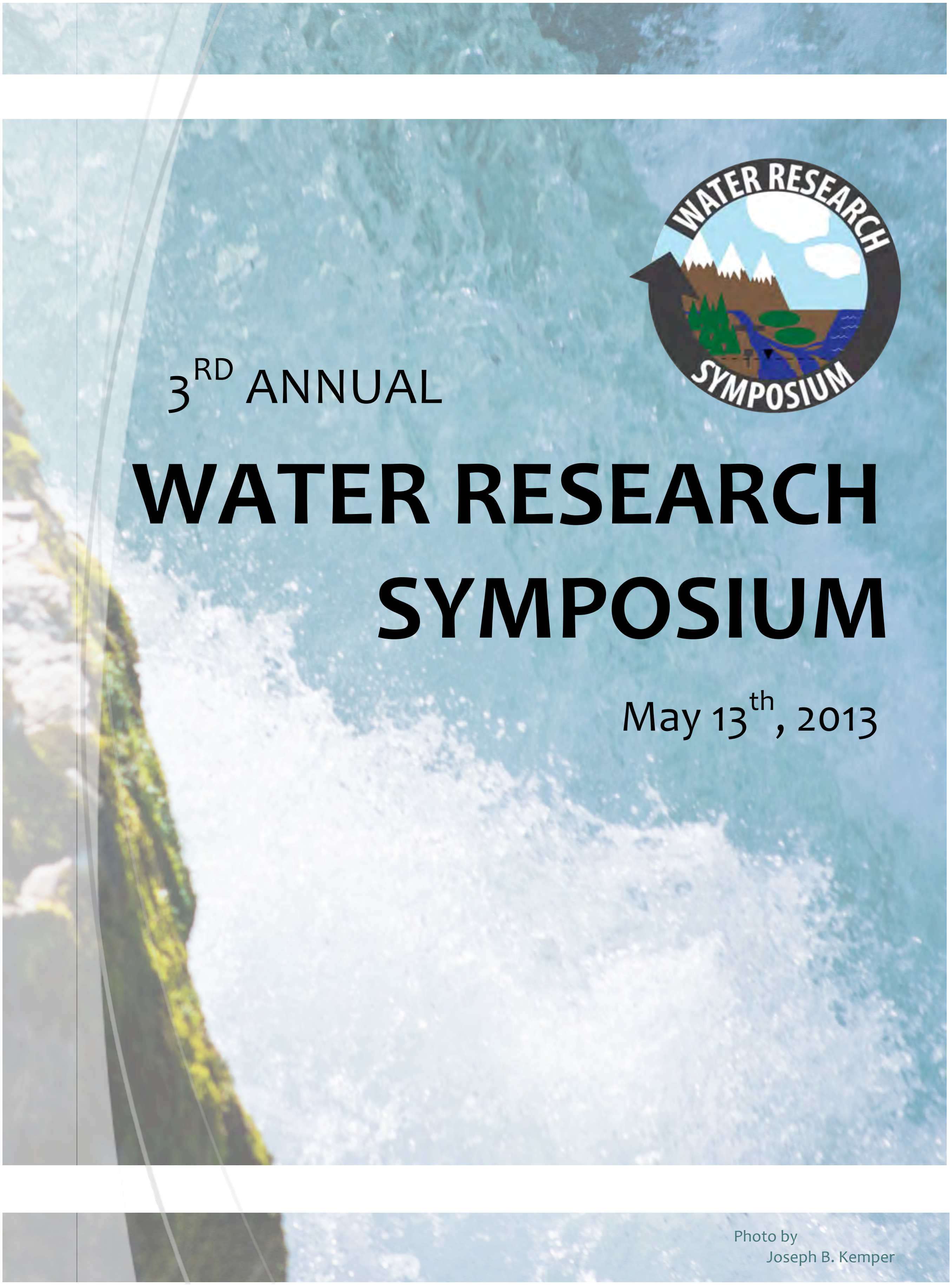

3RD ANNUAL

WATER RESEARCH SYMPOSIUM

May 13th, 2013

Photo by
Joseph B. Kemper

Message from the Planning Committee

Thank you for joining us at the 3rd Annual Water Research Symposium. The Symposium's schedule is packed with great oral and poster presentations. From residence time in streams to bio char applications and models to marine planning these student research presentations cover a wide breadth of water resource topics.

Our goal for the Symposium is twofold. First we want to showcase the water-related research conducted by students across Oregon. Second we hope this event will foster connections within the hydro-community of Oregon, bringing together students, academics, and water professionals.

We would like to extend a special thank you to our sponsors, the Institute for Water and Watersheds, Water Resources Graduate Program, Ann Campana Judge Foundation, the Oregon Chapter of the American Water Resources Association, WSI, West Consulting Inc., and In-Situ Inc. We would also like to individually recognize the efforts made by Todd Jarvis, Julie Bain, Mary Santelmann, Sarah Lewis, Kathleen Martin, and Jennifer Cohen to help us plan this event. Thank you as well to all of our judges and lunchtime panelists.

If you like what you experience at the Symposium and want to play a part in planning next year or if you have identified an area you would like to see improved please talk to one of us on the Planning Committee to share your feedback and get involved with next year's Symposium.

Sincerely,
The Hydrophiles Symposium Planning Committee

Symposium Planning Committee

Ali Marshall (Chair)
Noa Bruhis
Lexi Coons
Kelly Foley
Greer Harewood
Joe Kemper
Becca Miller
Alexis Mills
Kim Ogren
Julia Rask
Andrew Wentworth

About Hydrophiles

Hydrophiles is a Sponsored Student Organization at Oregon State University. Our objective is to provide a forum for academic, professional, and social interactions among students, faculty, and other members of the Oregon State University community who share a common interest in all areas of water resources and hydrology, including science, policy, and engineering.

Hydrophiles - Student Sponsored Organization, Oregon State University

OSU Student Chapter of American Water Resources Association & American Institute for Hydrology

Contact:

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http://groups.oregonstate.edu/hydro/

Sponsors of the 3rd Annual Water Research Symposium

Major support for the Water Research Symposium has been generously provided by the Institute for Water & Watersheds, Oregon's federally-designated water resources research institute.

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Thank you for your support!

Lunchtime Panel:
Pursuing Graduate School in Water Resources

12:15-1:15pm
CH2M HILL Alumni Center, Ballroom

Panelists

Jeffrey Brittain
Environmental Science & Management (Masters)
Portland State University

Kara DiFrancesco
Water Resources Engineering (Doctoral)
Oregon State University

Andrew Dutterer
Environmental Studies (Masters)
University of Oregon

Ricardo González-Pinzón
Water Resources Science (Doctoral)
Oregon State University

Kate Moran
Water Resources Policy and Management (Masters)
Oregon State University

Kelley Rabjohns
Geological Sciences (Masters)
University of Oregon

The Oregon State University Graduate School has provided Hydrophiles with a number of materials on the topic of preparing for and applying to graduate school. Please talk to or email Kim Ogren (ogrenk@geo.oregonstate.edu) for more information about accessing these materials.

Presentation Schedule

CH2M HILL Alumni Center Ballroom & Foyer

8:30		**Registration**
9:00		**Opening Remarks: Dr. David Lewis** *Confederated Tribes of the Grand Ronde Community of Oregon*
9:15	Tracie Jackson	A Mean Residence Time Relationship for Lateral Cavities in Gravel-Bed Rivers and Streams: Incorporating Streambed Roughness and Cavity Shape
9:30	Hazel Owens	Do cutthroat trout go with the flow? Relationships between discharge and cutthroat trout abundance at multiple scales in managed headwater basins
9:45	Mahabub Alam	Upper Limit of Extractable Hydropower
10:00	YunJi Choi	Towards Predicting the occurrence of geysers and CSOs in combined sewer systems - An experimental, theoretical and numerical approach
10:15	Brian Smith	Heteroaggregation of Capped Gold Nanoparticles and Natural Colloids in Aqueous Environments
10:30		**Morning Break**
10:45	Kara DiFrancesco	Bayesian inclusion of climate change projections into flood frequency analysis to assess the robustness of proposed management actions
11:00	Thomas Mosier	Downscaling Global Climate Data: Production and Optimization of 30 Arc-Second Surfaces
11:15	Mousa Diabat	What matters most: Are summer stream temperatures more sensitive to changing air temperature, changing discharge, or changing riparian vegetation under future climates?
11:30	Maria Cristina Mateus	Vulnerability of water resources with changing land use, and climate in the Santiam River Basin, Oregon
11:45	Perry Morrow	Biochar: An ancient usage applied in modern practice: a look at saturated hydraulic conductivity and methylene blue sorption
12:00		**Lunch**
12:15		**Panel Discussion: Graduate Programs in Water Resources**
1:30	Denielle Perry	New Era of Reclamation? Water Storage in the American West in the Context of Climate Change Adaptation
1:45	Daniel Bigelow	A Spatial Analysis of Land and Water Use in Oregon's Willamette Valley
2:00	Andrew Dutterer	An Adaptive Management Assessment: California's Environmental Water Account (EWA), 2000-2007
2:15	Arwen Bird	Why are we meeting? Evaluating stakeholder engagement in marine planning through a conceptual framework lens
2:30	Dan Calvert	Social learning and collaborations, making the glass half full
2:45	Julie Elkins Watson	Beyond cooperation: Structural violence and environmental justice in transboundary water management
3:00		**Afternoon Break**
3:30	Noa Bruhis	Freshwater fluxes into the Gulf of Alaska
3:45	Lexi Coons	Seeing the Snow through the Trees: Towards a Validated Canopy Adjustment for Fractional Snow Covered Area
4:00	Kelli Walters	Spatial-temporal optimization of conservation practices affected by future climate scenarios in agricultural watersheds
4:15	Rachelle Valverde	Engineered log jam roughness and geometry effects on water surface elevation in a hydraulic model
4:30		**Closing Remarks**
5:00		**Poster Session I & Reception**
5:50		**Awards Presentation**
6:00		**Poster Session II & Reception**

Poster Sessions

CH2M HILL Alumni Center Foyer

	Poster Session I: 5:00 PM to 6:00 PM
Keith Jennings	The impact of atmospheric river events on snow water equivalent in the Oregon Cascades
Caroline Nash	Getting to the roots of it: co-evolution in stream banks and riparian vegetation.
Angela Clegg	"Moose Creek Habitat Improvement Project": The effects of large wood placement in a top Steelhead spawning creek
John Hammond	A retrospective trend analysis for streamflows above and below major reservoirs in the Columbia River Basin
Bryant Ruiz	Hydraulic fracturing comparison and the effects on their watershed
Hayley Corson-Rikert	Hydrologic connectivity in carbon transport from hillslopes to streams in a small, forested catchment of the western Cascade Mountains, OR.
Tracie Jackson	A Fluid-Mechanics-Based Classification Scheme for Surface Transient Storage in Riverine Environments: Quantitatively Separating Surface from Hyporheic Transient
Andrea Carson	Institutional and social barriers to implementing effective remediation at Lake Dianchi
Jordan Beamer	A Hydrological Model for Prince William Sound, Alaska
Luis Gomez	The OSU Rivers Model and its Comparison with the Unsteady HEC-RAS Model.
Matthew Cooper	Climate Change, Snow, and Peak Flows in the Oregon Cascades: Present and Future Scenarios
Kathleen Moore	Adaptive reservoir management in response to climate change and population growth in the Willamette River Basin, Oregon.
Mousa Diabat	What matters most: Are summer stream temperatures more sensitive to changing air temperature, changing discharge, or changing riparian vegetation under future climates?

	Poster Session II: 6:00 PM to 7:00 PM
Kate Fickas	Using Dense Landsat Time Series Imagery to Monitor and Analyze Wetland and Land Use Change in the Willamette Valley of Oregon from 1972-2012
Sarah Janjua	Incorporating uncertainty in urban stream restoration: recommendations from Salmon Creek, WA
Jeffrey Brittain	The response of plankton communities in historically fishless alpine lakes to atmospheric deposition simulation along a stocking gradient
Kelley Rabjohns	Geomicrobial Kinetics in Groundwater from Pore-scale to Field-scale
Nicholas Dosch	Examining lateral and temporal variations in stream pCO2 and CO2 efflux rates in the Willamette River Basin
Marissa Matsler	'Plug-and-Play' Ecology: Expertise and Perceptions of Nature in Green Stormwater Management
Pablo Alvarez Tostado	Collaborative Assessment of Transboundary Aquifers: the Santa Cruz (Mexico-United States) and the Chateauguay (United States-Canada)
Nicole Alfafara	Evaluating Effectiveness of Harmful Algal Bloom Management in a Changing Climate
Luis Gomez	A real options-based framework to evaluate investments in river flood control under uncertainty.
Kris Richardson	Capturing a record of catchment events and an expression of their associated delivery mechanisms
Amir Javaheri	A review of rainwater runoff quantity performance of green roofs

Abstracts – Oral Presentations

Listed in order of presentation

A Mean Residence Time Relationship for Lateral Cavities in Gravel-Bed Rivers and Streams: Incorporating Streambed Roughness and Cavity Shape

Tracie Jackson, Water Resources Engineering, CEOAS/Mechanical Engineering, Oregon State University
Roy D. Haggerty, College of Earth, Ocean, and Atmospheric Sciences, Oregon State University

Accurate estimates of mass-exchange parameters in transient storage zones are needed to better understand and quantify solute transport and dispersion in riverine systems. Currently, the predictive mean residence time relies on an empirical entrainment coefficient with a range in variance due to the absence of hydraulic and geomorphic quantities driving mass exchange. Two empirically derived relationships are presented for the mean residence time of lateral cavities—a prevalent and widely recognized type of transient storage—in gravel-bed rivers and streams that incorporates hydraulic and geomorphic parameters. The relationships are applicable for gravel-bed rivers and streams with a range of cavity width to length (W/L) aspect ratios (0.2 to 0.75), shape, and Reynolds numbers (Re, ranging from 1.0×10^4 to 1.0×10^7). The relationships equate normalized mean residence time to nondimensional quantities: Froude number, Re, W/L, depth ratio (ratio of cavity to shear layer depth), roughness factor (ratio of shear to channel velocity), and shape factor (representing degree of cavity equidimensionality). One relationship excludes bed roughness (13) and the other includes bed roughness (14). The empirically derived relationships have been verified for conservative tracers (R^2 of 0.83) within a range of flow and geometry conditions. Topics warranting future research are testing the empirical relationship that includes the roughness factor using parameters measured in the vicinity of the cavity to reduce the variance in the correlation, and further development of the relationship for non-conservative transport.

Do cutthroat trout go with the flow? Relationships between discharge and cutthroat trout abundance at multiple scales in managed headwater basins

Hazel Owens, Water Resources Science, Forest Engineering, Resources, & Management, OSU
A.E. Skaugset, Department of Forest Engineering, Resources, & Management, OSU
D.S. Bateman, Department of Forest Engineering, Resources, & Management, OSU

Due to potential impacts of forest management on the long-term persistence of native salmonids, forest managers across the Pacific Northwest are interested in identifying environmental factors related to the inter-annual variability of cutthroat trout abundance over time. One environmental factor potentially related to cutthroat trout abundance in managed headwater basins of the western Cascades is discharge. While many abiotic and biotic factors may influence the abundance of resident cutthroat trout, discharge is a primary control because it directly and indirectly affects streams at multiple spatiotemporal scales through numerous pathways, including effects on habitat volume, stream velocity, channel hydraulics, water quality, channel geomorphology, bed-load stability, resource availability, and biotic interactions. To better understand environmental controls on abundance over time, this study seeks to answer the question: can discharge explain variation in cutthroat trout abundance in experimental headwater streams from the Hinkle Creek Paired Watershed Study (HCPWS)? Regression analysis was used to model the relationship between the change in Cutthroat trout abundance and hydrologic indices in two experimental sub-basins using eight years of replication to determine 1) if relationships between the change in abundance and hydrologic indices are detectable, 2) if those relationships differ between basins with and without timber harvest, and 3) if those relationships differ when analyzed at the sub-basin or reach level. This presentation will provide preliminary results and possible mechanisms to explain identified relationships.

Upper Limit of Extractable Hydropower

Mahabub Alam, Civil Engineering, College of Engineering, Oregon State University
Arturo Leon, Civil and Construction Engineering, Oregon State University

In the context of both the limitation of the usage of fossil fuel due to the availability on the planet and global warming caused by the combustion of those fuels, there is an increasing demand to exploit renewable energy sources. Hydropower is the largest source of renewable energy in the world. However, only 50% or less power is extractable from available power of a fall or stream. A framework for determining the theoretical maximum limit of extractable power from a fall is proposed. This framework aims to help policy makers and planners to better understand the maximum limit of power extraction through hydraulic turbines. In particular, a dimensionless measure called coefficient of performance or harvesting factor is derived for hydraulic turbines. Overall, this upper bound analysis of hydropower can be used in planning and design of hydropower plants.

Towards Predicting the occurrence of geysers and CSOs in combined sewer systems - An experimental, theoretical and numerical approach

YunJi Choi, Water Resources Engineering, Civil and Construction Engineering, Oregon State University
Arturo Leon, Civil and Construction Engineering, Oregon State University

Combined sewer overflows (CSOs) are a major water pollution source for more than 700 cities in the U.S that have combined sewer systems (CSSs). CSOs commonly occur in response to heavy rainfall and/or snowmelt events which causes the capacity of the storm-sewer system to be exceeded. However, CSOs can also occur when the system is unfilled, but the flow in the system is highly dynamic. The overall goal of the proposed research is to develop a numerical model using an experimental and theoretical approach for the prediction and quantification of geysers and CSOs in CSSs.

The outcome of the proposed research will be incorporated in an open source model, Illinois Transient Model (ITM), which will be applied to the Balch Combined Sewer Basin within the Northwest Industrial area of Portland. ITM is a state-of-the-art model intended to simulate the filling and emptying of CSSs under transient and non-transient flow conditions. The open source model produced through the proposed research can also be used by federal agencies, municipalities and practitioners for predicting CSOs and geysering events under current and future climate change scenarios.

The proposed research will allow to assess the impacts of CSOs on the water quality of the receiving water bodies such as streams, rivers and lakes. Furthermore, this model will provide its users with the ability of modifying an existing CSS by assessing various proposed modifications and hence providing suggestions for retrofitting critical areas in the system. This will allow the development of cost-effective strategies that reduce CSO events.

Heteroaggregation of Capped Gold Nanoparticles and Natural Colloids in Aqueous Environments

Brian Smith, Environmental Engineering, Chemical, Biological, and Environmental Engineering, Oregon State University
Jeff Nason, Chemical, Biological, & Environmental Engineering, Oregon State University

Understanding the aggregation behavior of engineered nanomaterials (ENMs) in aqueous environments is essential to understanding their fate, transport, and toxicity. This study is investigating the role of natural and engineered capping agents on the heteroaggregation of gold nanoparticles (AuNPs) with naturally occurring colloids. Initial experiments are being performed with AuNPs stabilized with various organic capping agents and using hematite as a model colloid. AuNP-hematite interactions are being investigated under a matrix of conditions defining relevant particle concentrations and ratios, ionic strength, and pH in the presence and absence of natural organic matter. Heteroaggregation is being quantified using parallel techniques: time-resolved dynamic light scattering, zeta potential measurements, and fractionation (e.g., filtration) followed by total mass measurements using inductively coupled plasma spectrometry. The results of this research will help inform future work toward the development of predictive relationships for ENM behavior based on ENM characteristics and environmental conditions.

Bayesian inclusion of climate change projections into flood frequency analysis to assess the robustness of proposed management actions

Kara DiFrancesco, Water Resources Engr., Biol. and Ecol. Engineering, Oregon State University
Desiree Tullos, Biological and Ecological Engineering, Oregon State University
Alix Gitelman, Statistics, Oregon State University
David Purkey, Stockholm Environmental Institute

The scientific community currently lacks both reliable climate projections at the temporal and spatial resolution required for flood frequency analysis as well as methods to incorporate multiple, highly uncertain future scenarios into flood frequency analysis. This study addresses the later issue by applying a new method using Bayesian statistics to assess the potential changes in flood frequency and flood risk under climate change. With this method, we calculate Expected Annual Damages over a range of plausible future flood frequency curves derived from a Monte Carlo Markov Chain algorithm and use this information to determine the portion of future scenarios under which the system can maintain damages below a threshold. We apply this method to the American River Basin in California, USA to assess the robustness of proposed management approaches in the 2012 Central Valley Flood Protection Plan. Each of the proposed approaches meets the performance threshold under a smaller portion of projected future scenarios than under current conditions and are vulnerable to greater than 70% of the plausible range of future conditions. While the future projections align with historic trends of increasing flood magnitude and variability, due to the uncertainty associated with the currently available downscaled projections, the results do not represent a predictive model of future flood conditions in the American Basin per say. Rather, the method represents a general technique to incorporate multiple sets of future projections into flood risk studies.

Downscaling Global Climate Data: Production and Optimization of 30 Arc-Second Surfaces

Thomas Mosier, Thermal Fluids Science, Mechanical, Industrial, and Manufacturing Engineering, Oregon State University
David F. Hill, Civil Engineering, Oregon State University
Kendra V. Sharp, Mechanical, Industrial, and Manufacturing Engineering, Oregon State University

This study compares variations of static downscaling methods for applications with spatially distributed hydrologic models. The most physically representative downscaling procedure is then implemented using globally available data as inputs, resulting in 30 arc-second resolution surfaces for monthly precipitation and mean temperature with global land coverage. Both the Delta and Bias Correction Spatial Disaggregation downscaling methods are implemented; however, the Delta downscaling method appears to produce more physically representative results and therefore analysis focuses on optimization of the Delta method. The primary step within the Delta method which differs between implementations is the anomaly interpolation step. Bilinear, cubic spline, and piecewise cubic Hermite interpolating polynomials (PCHIP) are examined for the step of interpolating the anomaly field. Comparing the resulting grids to Global Historical Climatology Network station records, it is seen that use of PCHIP anomaly interpolation in the Delta method produces the most physically representative downscaled surfaces. This downscaling procedure is implemented using the 30 arc-second WorldClim climatologies and 0.5 degree time-series grids by Willmott & Matsuura as inputs. The Delta downscaled grids are compared to the corresponding Parameter-elevation Regressions on Independent Slopes Model (PRISM) data using Oregon, USA as a test region. In the case of precipitation, the Delta grids have a root mean square error (RMSE) of 15.6 mm compared to PRISM's RMSE of 12.9 mm. For mean temperature the Delta data performs slightly better than PRISM, with RMSE values of of 0.8 deg C and 1.4 deg C, respectively. A strength of the Delta downscaled dataset discussed herein is that it is freely available for all global land surfaces at a spatial resolution of 30 arc-seconds. Analysis for additional test regions distributed globally indicate that the Delta downscaled grids have a relatively consistent level of accuracy across regions.

What matters most: Are summer stream temperatures more sensitive to changing air temperature, changing discharge, or changing riparian vegetation under future climates?

Mousa Diabat, Water Resources Science, CEOAS, Oregon State University
Roy D. Haggerty, College of Earth, Ocean, and Atmospheric Sciences, Oregon State University
Steve Wondzell, Pacific Northwest Research Station, Corvallis Forestry Science Lab

We investigated stream temperature responses to changes in both air temperature and stream discharge projected for 200-2060 from downscaled GCMs and changes in the height and canopy density of streamside vegetation. We used Heat Source© calibrated for a 37 km section of the Middle Fork John Day River located in Oregon, USA. The analysis used the multiple-variable-at-a-time (MVAT) approach to simulate various combinations of changes: 3 levels of air warming, 5 levels of stream flow (higher and lower discharges), and 6 types of streamside vegetation. Preliminary results show that, under current discharge and riparian vegetation conditions, projected 2 to 4 °C increase in air temperature will increase the 7-day Average Daily Maximum Temperature (7dADM) by 1 to 2 °C. Changing stream discharge by ±30% changes stream temperature by ±0.5°C, and the influence of changing discharge is greatest when the stream is poorly shaded. In contrast, the 7dADM could change by as much as 11°C with changes in riparian vegetation from unshaded conditions to heavily shaded conditions along the study section. The most heavily shaded simulations used uniformly dense riparian vegetation over the full 37-km reach, and this vegetation was composed of the tallest trees and densest canopies that can currently occur within the study reach. While this simulation represents an extreme case, it does suggest that managing riparian vegetation to substantially increase stream shade could decrease 7dADM temperatures relative to current temperatures, even under future climates when mean air temperatures have increased from 2 to 4 °C.

Vulnerability of water resources with changing land use, and climate in the Santiam River Basin, Oregon

Maria Cristina Mateus, Water Resources Engr., Biol. and Ecol. Engineering, Oregon State University
Desiree Tullos, Biological and Ecological Engineering, Oregon State University
Chris Surfleet, Natl. Res. Mgmt. & Envl Science, California Polytechnic State University

Water supply and demand are likely to vary across river basins and across water users in the future as the climate and land use change. Some areas will be more sensitive to these changes than others. In order to explore how hydrologic sensitivity to climate and land use change relates to vulnerability to water scarcity, we investigate the hydrologic responses to climate and land use change across sub-basins with different hydrogeological characteristics within the Santiam River Basin (SRB), in Oregon. Results demonstrated how, for the Santiam River, water demand exerts the strongest influence on basin's vulnerability to water scarcity, regardless of sub-basin hydrogeology. In addition, sub-basins characterized by higher permeability, with greater groundwater recharge, storage, and discharge, are less sensitive to climate and land use changes compared to sub-basins characterized by a mixed groundwater and surface-water system. There is the need for water managers to take into account hydrologic variability and basin characteristics when allocating and distributing water to different users within the basin.

Biochar

Perry Morrow, Water Resources Science, CEOS, Oregon State University

This study evaluated the efficacy of biochar as a filter for source and nonpoint source pollutants in stormwater. Biochar is the solid byproduct of incomplete combustion of biomass under low-oxygen and high temperature conditions (Keiluweit, 2010, Beesley, 2011a, Bracmort, 2010). Biochar is exciting the research community and providing future buyers a potential method to produce energy, sequester carbon, reduce waste organic matter, increase soil fertility, and ultimately may have the potential to improve the quality of our waters through stormwater and wastewater remediation. Properties of biochar depend upon a number of factors, including pyrolysis temperatures, duration and feedstock. Few studies have investigated the hydraulic conductivity of chars. This paper investigated the saturated hydraulic conductivity of three chars; chicken litter, 500°C, Douglas Fir, 550°C, and gasification derived char, 700°C. The study was performed via a constant head column study in the laboratory, and evaluated based on Darcy's Law. In addition, a follow up study was performed investigating the sorption capabilities of the three chars using a methylene blue batch study for three different concentrations for each biochar (2, 5, 10 and 20g for chicken litter). Measurements were taken over a period of three weeks, using a spectrometer. The third study involved screening the three chars in order to investigate the size characteristics of the chars. Results of the hydraulic conductivity test revealed a rough hydraulic conductivity for the Douglas Fir and Gasification char. It is likely that due to particle characteristics, higher flow rates resulted in turbulent flow causing a nonlinear relationship between hydraulic gradient and velocity ($r<0.99$). However, the saturated hydraulic conductivity for Douglas Fir and Gasification char were promising, as the values were within the range of well sorted gravel. The methylene blue sorption studies results indicated that each char showed slightly different sorption patters, as well as a possible saturation limit based on concentrations of the individual chars.

A New Era of Reclamation? Water Storage in the American West in the Context of Climate Change Adaptation

Denielle Perry, Department of Geography , College of Social Science, University of Oregon
Sarah Praskievicz, Geography, University of Oregon

For most of the 20th century, Western water policy was driven by reclaiming water to support agriculture in arid lands, particularly through the construction of large dams and other infrastructure projects. In 1987, the Bureau of Reclamation declared that "The arid West essentially has been reclaimed." Today, however, climate change and its associated increased hydrological variability pose challenges for water resource managers. Consequently, governments and institutions are advocating water storage as a possible adaptation strategy. In this research, we address the question: what are the advantages and disadvantages of increasing water storage as a climate change adaptation strategy? We approach the question through two case studies: the Merced Irrigation District's Lake McClure Expansion Plan in California and the Umatilla Basin Aquifer Recharge Project in Oregon. These case studies provide a useful comparison because both projects aim to ameliorate water scarcity related to climate variability and change in semi-arid regions of the American West, primarily for the purpose of irrigated agriculture. The Merced project seeks to expand surface water storage, while the Umatilla project aims to amplify groundwater storage. The projects differ in their advantages and disadvantages, for example in their relative cost, risk, evaporative losses, legal implications, and impacts on energy, recreation, and sensitive species. As large-scale reclamation projects, both projects would provide additional irrigation water and would therefore create disincentives for conservation, changing crop types, and other demand-side adaptation strategies. We argue that, rather than focusing on water reclamation as a climate change adaptation strategy, decision-makers should consider the energy-water-food nexus in an integrated way.

A Spatial Analysis of Land and Water Use in Oregon's Willamette Valley

Daniel Bigelow, Applied Economics, Agricultural and Resource Economics, Oregon State University
Andrew Plantinga, Agricultural and Resource Economics, Oregon State University

Understanding the economic linkages between land use decisions and the natural environment is critical for informed resource policy decisions. A particularly important connection is between water and land, a relationship that is determined by the associated human decisions that govern how these two resources are used. Given the mounting evidence that humans are entering uncharted territory with respect to climate, where water scarcity may necessitate shifts away from historical land use regimes, more insight is needed into what factors jointly determine patterns of land and water use and how policies directed at land and water can mitigate future scarcity. The Willamette Valley of Oregon is an area characterized by urban influences, traditional resource lands, unique natural ecosystems, and perhaps the most comprehensive land use planning system in the United States. This makes it a rich study area for an analysis of land use change, water use, and the influence of water policy and land use regulations.

For policy analysis, the modeling strategy developed here is flexible in that it can handle policies aimed at influencing the economics returns to landowners (e.g., subsidies targeted to particular land uses) and also those geared towards regulating land use patterns (e.g. growth controls such as urban growth boundaries). Specific policy-relevant questions that we will examine include: How would land and water use in the study area change if growth controls were relaxed in the future? How sensitive is the decision to convert agricultural land to the holding of irrigation rights? In times of severe water scarcity, how likely are junior holders of irrigation water rights to convert agricultural lands to developed uses? What combinations of water and land policies are most effective at mitigating water scarcity under unfavorable future climate conditions?

An Adaptive Management Assessment: California's Environmental Water Account (EWA), 2000-2007

Andrew Dutterer, Environmental Studies Program & Planning, Public Policy, and Management, University of Oregon

In 2000, California implemented an innovative program aimed at reconciling distributive water conflicts in the San Joaquin Delta. The Environmental Water Account (EWA) convened state and federal agency water operators and fisheries biologists in a collaboration tasked with ensuring ESA-listed fish species' habitat needs while simultaneously maintaining a reliable water supply for municipal and agricultural users. The EWA functioned on a real-time basis, guided by adaptive management principles and fisheries science in the Delta. A water budget, consisting of an annual baseline quantity combined with water acquired through voluntary market transfers, allowed the EWA to adjust the Delta's freshwater pumping regime to fisheries needs without compromising deliveries. However, the EWA was plagued with operational challenges and shut down in 2007. This research employed a discourse analysis to address the question: How do accounts of the EWA regard adaptive management efforts as facilitating perceived successes or creating limitations for the program?

Why are we meeting? Evaluating stakeholder engagement in marine planning through a conceptual framework lens.

Arwen Bird, Marine Resource Managment, CEOAS, Oregon State University
Flaxen Conway, Marine Resource Management, Oregon State University

Formal marine reserve discussion began at the state level in Oregon in 2000. In 2010 the Department of Fish and Wildlife engaged eight distinct stakeholder groups in an eleven-month community team process to deliberate and forward recommendations for siting three marine reserves. OSU conducted a rapid evaluation of the ninety-six participants in the community team process. Our findings illuminated lessons learned regarding team formation and function, meeting management, team decision-making, and built human and social capital. Research results were then viewed through the conceptual framework of ecosystem-based management lens to help inform the design and implementation of future processes.

Social learning and collaborations, making the glass half full

Dan Calvert, Environmental Sciences Graduate Program, Oregon State University

Social learning is recognized as a critical component of resilience thinking and is underpinned by several key concepts: Soft systems thinking, looped learning and critical reflection. Oregon has a variety of collaborative watershed partnerships utilizing social learning to facilitate ecological and economic uplift in rural communities. This presentation examines the role of social learning as it relates to decision making about land use management strategies by private landowners. A set of case studies were performed through a series of semi-structured interviews (N=80) with private landowners and watershed council staffs in the Upper Willamette River basin. Results indicate that: (1) among private landowners the source, type and delivery of information plays a critical role in willingness to adopt new land management practices; and (2) iterative learning between private landowners and watershed council staffs is driving adaptive co-management leading to more robust, resilient social and ecological systems. Information dissemination by non-governmental collaborative watershed partnerships can be a powerful tool to make inroads with individuals from rural, traditionally conservative natural resource dependent communities. The reality is that in watersheds with large areas in private ownership ecological and social change are inextricably connected; restoration and management approaches should reflect this. The watershed council model is an important policy mechanism that while time and resource intensive can generate tangible results that might not be achieved by other means. I will discuss lessons learned and implications for future water resource management strategies.

Beyond cooperation: Structural violence and environmental justice in transboundary water management

Julie Elkins Watson, Geography, College of Earth, Ocean, & Atmospheric Sciences, Oregon State University

Cooperative transboundary water management has been the gold standard in the water community ever since Aaron Wolf's transformative approach to measuring conflict and cooperation in international river basins (Wolf, Yoffe, & Giordano, 2003). This method involves categorizing events on a scale from most conflictive (e.g. war or extensive casualties) to most cooperative (voluntary unification into one political unit). While this research provides significant insight into the nature of cooperation and conflict over water, its shortcoming lays in its inability to address structural violence. A basin can exhibit an impressive level of cooperation, yet beneath the surface display tremendous environmental injustice to sub-populations within the basin. The purpose of this proposed work is to develop a scale of structural violence in transboundary basins that compliments the work of Wolf and colleagues. The proposed scale will draw from Wolf's (2008) more recent work on water and spirituality, mirroring Maslow's Hierarchy of Needs and Eastern spiritual traditions. The second purpose of this work is to develop a linked method to assess structural violence/environmental justice using the scale. Finally, this proposed dissertation work involves testing the scale and methodology in one or more case studies, drawing conclusions about additional insight that this method can provide to water conflict facilitators and water managers.

Freshwater fluxes into the Gulf of Alaska

Noa Bruhis, Water Resources Engineering, Civil & Construction Engineering, Oregon State University
David F. Hill, Civil Engineering, Oregon State University
Stavros Calos, University of Virginia

Regression equations for mean monthly streamflow in watersheds running off into the Gulf of Alaska have been determined. The equations were obtained by regressing observed streamflow at 246 USGS and Environment Canada gaging stations against a number of relevant meteorological and basin physical parameters. Meteorological parameters include mean monthly precipitation, cumulative water year precipitation, and mean monthly temperature. High-resolution grids of these parameters were obtained through statistical downscaling methods. Basin physical parameters include area, mean elevation, and percent forest cover, and were selected from a larger set based upon initial regression efforts. Regionalization was used in order to organize the entire ensemble of gaged watersheds into several hydrologically similar groups. When comparing regression-calculated flow to measured flow the groups showed typical average errors of 40%, a value consistent with previously obtained equations for other runoff quantities such as peak flows. Once the regression equations were finalized, they were applied to a set of ungaged watersheds making up the entire Gulf of Alaska drainage. This yields predictions of freshwater runoff to the Gulf, with watershed-scale spatial resolution and monthly temporal resolution.

Seeing the Snow through the Trees: Towards a Validated Canopy Adjustment for Fractional Snow Covered Area

Lexi Coons, Water Resources Science, CEOAS, Oregon State University
Anne Nolin, CEOAS, Oregon State University

Satellite remote sensing is an important tool for monitoring the spatial distribution of snow cover, which acts as a vital reservoir of water for human and ecosystem needs. Current methods exist mapping the fraction of snow in each image pixel from NASA's Moderate Resolution Imaging Spectroradiometer (MODIS) and Landsat Thematic Mapper (TM). Although these methods can effectively detect this fractional snow-covered area (fSCA) in open areas, snow cover is underestimated in forested areas where canopy cover obscures the snow. Accounting for obscured snow cover will significantly improve estimates of fSCA for hydrologic forecasting and monitoring. This study will address how individual trees and the overall forest canopy affect snow distributions on the ground with the goal of determining metrics that can parameterize the spatial patterns of sub-canopy snow cover. Snow cover measurements were made during winter 2011-2012 at multiple sites representing a range of canopy densities. In the snow-free season, we used terrestrial laser scanning (TLS) and manual field methods to fully characterize the forest canopy height, canopy gap fraction, crown width, tree diameter at breast height (DBH), and stand density. We also use multi-angle satellite imagery from MISR and airborne photos to map canopy characteristics over larger areas. Certain canopy structure characteristics can be represented with remote sensing data. These data serve as a key first step in developing canopy adjustment factors for fSCA from MODIS, TM, and other snow mapping sensors.

Spatial-temporal optimization of conservation practices affected by future climate scenarios in agricultural watersheds

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Modifications of the hydrologic cycle, including changes in flood and drought patterns, rainfall intensity, and impairment of rivers and streams due to pollutants, are consequences of land use alteration. Eagle Creek Watershed (ECW) is a typical Midwestern agricultural watershed with a growing urban land-use that has been affected by these problems. Structural solutions have helped in the past to reduce the flooding problem in the upland agricultural area, but also led to intensive flooding and water quality problems downstream. It has been suggested elsewhere that re-naturalization of watershed hydrology through a spatially-distributed implementation of non-structural practices, such as wetlands, riparian buffers, grassed waterways, etc., will help to reduce these problems by improving the upland storage of runoff in watersheds. However, spatial implementation can be a challenge due to the large number of possible alternatives offered by physical models. Additionally, social attitudes and behavior of communities living in these watersheds, as well as the economic factors, can constrain which alternatives are actually adopted and implemented. The first part of this study investigated how stakeholder attitudes can affect the design of "optimized" alternatives for spatial identification of best management practices. By using multiple scenarios of socio-economic objectives and constraints, each of which is built on a typical stakeholder attitude and preference in the watershed, the study investigated how these attitudes can affect the multi-objective spatial design of restoration strategies and the quality of the ecosystem services provided by the watershed. The second part of this project will focus on developing a simulation-optimization model for evaluating the long-term effects of these conservation practices on river flow and sediment transport. The model will provide an adaptive decision-making tool for managing extreme runoff affected by climate change, which will incorporate stakeholders interested in long-term planning. The study will include an analysis for current and future climate scenarios from regional climate models run with atmospheric-ocean general circulation models. A watershed flow and sediment transport model based on the Soil and Water Assessment Tool (SWAT) will be used for simulating multiple scenarios of conservation practices, which will be incorporated in an optimization algorithm to create a stochastic model that is capable of designing optimized alternatives for watershed planning with future climate scenarios.

Engineered log jam roughness and geometry effects on water surface elevation in a hydraulic model

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Desiree Tullos, Biological and Ecological Engineering, Oregon State University

Re-introduction of large woody debris (LWD) into streams and rivers for stream restoration purposes is growing exponentially. Currently, the design of LWD structures, know as engineered log jams (ELJs), is based on the concept of mimicking natural LWD structures for a more sustainable design. While the use of ELJ as a restoration technique is fast growing, few guidelines exist for the design of ELJs. LWD can be an important component of flow resistance that can alter channel properties and morphology at the local and reach scale. The current design methods developed to estimate debris resistance are limited since they are based on uncertain empirically derived coefficients. LWD has been shown to create a flow obstruction and locally raise water surface elevations upstream of LWD structures. Design guidelines recommend using hydraulic models to evaluate the flooding impact of proposed ELJ designs. In practice ELJs are represented as high ground in one-dimensional hydraulic models. However, the accuracy of vertical channel adjustments to channel geometry has not been evaluated. In this analysis we present a case study of an ELJ for which channel geometry and hydraulic flow properties were collected and calibrated in a hydraulic model. The focus of this study is to present an evaluation of the uncertainty in the modeled water level due to uncertain roughness parameters and channel geometry. Six models were developed to represent a combination of roughness coefficients and channel geometries for evaluation.

Abstracts – Poster Presentations

The impact of atmospheric river events on snow water equivalent in the Oregon Cascades

Keith Jennings, Water Resources Science, CEOAS, Oregon State University

Originating in the sub-tropical zone of the southern Pacific Ocean, atmospheric rivers (ARs) are long, narrow bands of water vapor transport that provide a significant amount of precipitation to the west coast of the United States. Despite their potential to cause extreme rain and snowfall events and initiate flooding, the impact of these storms on the snowpack of the Oregon Cascades has been overlooked. This study examines data from Oregon SNOTEL sites in conjunction with delineated AR event dates to determine their contribution to snow water equivalent (SWE) and to examine differences between AR and non-AR events. An analysis of the data revealed that AR events are significantly warmer and deliver more precipitation than standard storm events, but lead to less SWE accumulation.

Getting to the roots of it: co-evolution in stream banks and riparian vegetation

Caroline Nash, Water Resources, CEOAS, Oregon State University

Despite the prevalence of riparian re-vegetation in stream restoration projects, the specific geotechnical mechanisms by which riparian vegetation contributes to soil cohesion and strength in stream banks is poorly understood. Moreover, the differences in added stabilization amongst plant species is often overlooked, or generalized, when considered as a geomorphic factor. My proposed research will be digging into the relationship between the roots of riparian vegetation plants, and the morphology of the stream channel--specifically, whether roots and banks co-evolve.

The root size, architecture, and resistive strength of riparian vegetation on streams with relatively constant hydrographs will be compared to the roots of vegetation surveyed alongside streams with flashy hydrographs in three different climates: semi-arid, temperate, and coastal. The surveyed stream reaches will be selected for similar average discharge and widths across all climates, and for similar soil types within the climate regions. Root size and architecture will be assessed through a combination of excavation and extrapolation. Root resistive strength will be assessed using a calibrated jet-test which will measure the critical shear stress at bank failure. Results will be analyzed to determine if root architecture and strength is related more the climate, or flow conditions in and near which they grow.

Moose Creek Habitat Improvement Project: The effects of large wood placement in a top Steelhead spawning creek

Angela Clegg, Environmental Science, Linn Benton Community College; South Santiam Watershed Council
Eric Hartstein, South Santiam Watershed Council

Moose Creek is the top Steelhead producing tributary in the upper South Santiam watershed. However, Moose Creek lacked large woody debris in its channel, reducing the quality of Steelhead habitat. In 2008, the Moose Creek Steelhead Habitat Improvement Project (a US Forest Service/South Santiam Watershed Council partnership) aimed to improve habitat by adding approximately 66 trees to the channel by direct felling and helicopter assistance. High-water events in the winters of 2008 and 2009 resulted in the movement of some of this woody debris. Another high water event in January 2011 mobilized many of the logs in the creek and deposited them in bends, behind boulders, and at natural pinch-points in the channel. These multiple large log jams resulted in the accumulation of gravel beds with grain sizes suitable for steelhead spawning conditions.

Repeat photography, measurement of longitudinal profiles and channel cross sections, and pebble counts were conducted at previously designated locations to assess the impact on habitat quality. When compared to the surveys done before project implementation in 2008, the surveys conducted in 2009, 2011, and 2012 show increased accumulations of spawning-sized gravels in the project area indicating the addition of large woody debris into Moose Creek is positively impacting steelhead spawning habitat.

A retrospective trend analysis for streamflows above and below major reservoirs in the Columbia River Basin

John Hammond, Water Resources Science, CEOAS, Oregon State University
Julia Jones, CEOAS, Oregon State University

Areas above reservoirs are dominated by what may be called the ecological resiliency of natural systems whereas areas below reservoirs are dominated by the engineered resiliency of primarily anthropogenically controlled systems. Reservoirs, at least in the United States portion of the Columbia River Basin (CRB), tend to lie at an interface between federally managed forests (above) and privately managed forests and agriculture (below). Headwater basins represent places where it is possible to detect climate change signals with less interference from land use changes than basins below reservoirs where climatic change and land use changes occur simultaneously making separating their signals difficult if not impossible. My research will be a retrospective data analysis of trends in streamflow above and below major reservoirs for the past 50 years in the Columbia River Basin, both in the United States and British Columbia. In the trend analysis, resiliency will be considered to be the ability of a system to sustain past yields. The sub-basins of the Columbia that will be selected will be "undisturbed" in nature and represent the variety of the landscape which is the CRB. Trends in streamflow will then be compared to changes in land use and land cover over time as well as modeled streamflows for the CRB.

Hydraulic fracturing comparison and the effects on their watershed

Bryant Ruiz, Earth Science, Geology, Portland State University

Hydraulic Fracturing (Hydro-Fracking) is the process of extracting natural gas from tight play shale beds beneath the surface of the earth. Hydro-Fracking wells are being drilled all over counties across the country that lies over one of these shale beds. Many of these wells require millions of gallons of water for production. In many cases, the wells pull their water from the watersheds that they are in, surrounding watersheds, and by recycling some of the water that they have previously used. This project looks at the effect that the well consumption of water has on the water balance for the watersheds that they reside in. An analysis is being conducted to see how the overall size of the watershed, and the number, the depth, and the amount of water that each well consumes, as well as other statistical and spatial correlations. Two counties in different parts of the country are being analyzed and later compared. The analysis (Statistical and modeling) and comparison will be conducted using GIS software. These two counties are Susquehanna County, Pennsylvania and Garfield and Mesa County, Colorado. The overall model of the project will follow the same concepts as the project being conducted by the Environmental Protection Agency.

Hydrologic connectivity in carbon transport from hillslopes to streams in a small, forested catchment of the western Cascade Mountains, OR

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Steve Wondzell, USDA Forest Service, Pacific Northwest Research Station
Mary Santelmann, Geosciences, Oregon State University

This study will investigate carbon transport from terrestrial ecosystems to streams in a steep, forested catchment in the Cascade Mountains of western Oregon, USA. Carbon fluxes to streams are increasingly the focus of study because streams process and export a significant amount of terrestrial carbon, evading much of this back to the atmosphere as CO_2. In doing so, streams and rivers may play a significant role in the global carbon cycle. This poster will review prior studies of DOC and DIC cycling and transport in headwater streams, which will help frame the specific objectives of my thesis project. Research will focus on sampling carbon and water flux from lower hillslopes, across riparian zones, and into a small headwater stream, using an existing network of well transects. Samples will be collected to measure concentrations of DOC, DIC, pCO_2, pH, and major cations. Cations will be used to identify major sources of water using an end-member mixing analysis. Results of the mixing analysis will be used to discern the relative importance of deeper groundwater, hillslope soil water, and riparian/hyporheic water as sources of DOC and DIC to the stream.

A Fluid-Mechanics-Based Classification Scheme for Surface Transient Storage in Riverine Environments: Quantitatively Separating Surface from Hyporheic Transient

Tracie Jackson, Water Resources Engineering , CEOAS/Mech. Engineering, Oregon State University
Roy Haggerty, CEOAS and Institute for Water and Watersheds, Oregon State University
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Surface transient storage (STS) and hyporheic transient storage (HTS) have functional significance in stream ecology and hydrology. Currently, tracer techniques couple STS and HTS effects on stream nutrient cycling; however, STS resides in localized areas of the surface stream and HTS resides in the hyporheic zone. These contrasting environments result in different storage and exchange mechanisms with the surface stream, which can yield contrasting results when comparing transient storage effects among morphologically diverse streams. We propose a fluid mechanics approach to quantitatively separate STS from HTS that involves classifying and studying different types of STS. As a starting point, a classification scheme is needed. This paper introduces a classification scheme that categorizes different STS in riverine systems based on their flow structure. Eight distinct STS types are identified and some are subcategorized based on characteristic mean flow structure: (1) lateral cavities (emerged and submerged); (2) protruding in-channel flow obstructions (backward- and forward-facing step); (3) isolated in-channel flow obstructions (emerged and submerged); (4) cascades and riffles; (5) aquatic vegetation (emerged and submerged); (6) pools (vertically submerged cavity, closed cavity, and recirculating reservoir); (7) meander bends; and (8) confluence of streams. The long-term goal is to use the classification scheme presented to develop predictive mean residence times for different STS using field-measureable hydromorphic parameters and obtain a theoretical STS residence time distribution (RTD). The STS RTD can then be deconvolved from the transient storage RTD (measured from a tracer test) to obtain an estimate of HTS.

Institutional and social barriers to implementing effective remediation at Lake Dianchi

Andrea Carson, Water Resources Policy and Management, Oregon State University

As development and population increase in China, the efficient use and management of the country's water resources is a growing concern for both the Chinese government and local Chinese communities, particularly in areas where no technical solution seems to help . The work presented for this poster is a proposal for exploratory research on participatory water management involving non-governmental and governmental organizations and local communities via an eutrophication remediation project at one of China's most polluted lakes, Lake Dianchi in Yunnan Province, China. Using a mixed methods approach, I will research how non-governmental and governmental organizations and local communities in China perceive the costs and benefits of the collaboration between groups in order to address the eutrophication which is affecting the biodiversity, public health, and local livelihoods. My research will examine the politics and perceptions surrounding the management and restoration of this lake, and ultimately strive to understand the institutional social conditions necessary for effective and sustainable pollution remediation and lake management between local community members, non-governmental organizations, and Communist government partnerships. My project will lead to a qualitative analysis of the perceived limitations and benefits to participatory collaboration and how these perceptions affect the participants' willingness to participate in these partnerships projects. My research will contribute to the global understanding of the social conditions necessary for effective and sustainable water management by adding to the existing knowledge on ways in which stakeholders can work together within a traditionally top-down government structure and the manifestation of the outcomes.

A Hydrological Model for Prince William Sound, Alaska

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Oregon State University

In Prince William Sound (PWS), Alaska, there is a pressing need for accurate freshwater discharge (FWD) estimates. FWD into PWS is important because it helps establish spatial and temporal patterns in salinity and temperature, and is an important time-varying boundary condition for oceanographic circulation models. Our interdisciplinary team will develop and validate a new operational hydrological model of PWS. Runoff models for coastal Alaska have lagged well behind coastal areas in the continental United States, due largely to the data deficiencies mentioned above. Previous efforts to model FWD into PWS have been heavily empirical, in that many physical processes were absorbed into calibration coefficients that, in many cases, were calibrated to streams and rivers not hydrologically similar to those found in the Sound. Our effort will adapt state-of-the-art, highly distributed, physically-based weather, snowmelt, and hydrological runoff models to the PWS watershed in order to improve projections of discharge into the Sound. A gridded regional reanalysis product (NARR) will be used as the primary atmospheric forcing data. In addition to this modeling component, we will deploy a strategic array of instrumentation aimed at validating the weather estimates and the calculations of freshwater discharge. To date, most of the scientific discussion of freshwater discharge to PWS has focused on the oceanographic manifestation (freshwater content, salinity profiles, etc.) of it. The primary advantage of this approach is that streamflow at the coastline is the direct boundary condition (i.e. the input) for the oceanographic processes in the Sound. We will compare our hydrological model both to the acquired streamflow field data and to the existing hydrological model to determine timing and magnitude of FWD into PWS. Upon successful validation of our model, it will join established and ongoing computational and observational efforts centered on a comprehensive understanding of the physical behavior of PWS.

The OSU Rivers Model and its Comparison with the Unsteady HEC-RAS Model

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OSU Rivers, a state-of-the-art unsteady flow routing model developed at Oregon State University, is based on the Hydraulic Performance Graph (HPG) and the Volume Performance Graph (VPG) approach. The HPG of a channel reach graphically summarizes the dynamic relation between the flow through and the stages at the ends of the reach under gradually varied flow GVF conditions, while the VPG summarizes the corresponding storage. Both, the HPG and VPG are unique to a channel reach with a given geometry and roughness, and can be computed decoupled from unsteady boundary conditions by solving the GVF equation for all feasible conditions in the reach. The fact that the performance graph approach is computed decoupled from unsteady boundary conditions means that this approach can be used for different boundary conditions without re-computing the HPG's and VPG's. The results of this simulation are compared with those produced using the widely known HEC-RAS model. The expected outcome is to greatly minimize the computational processing time of unsteady routing.

Climate Change, Snow, and Peak Flows in the Oregon Cascades: Present and Future Scenarios

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Anne Nolin, College of Earth, Ocean, and Atmospheric Sciences, Oregon State University

Mountain snowpack is an important water reservoir in many regions of the world, particularly in Mediterranean climates such as the Pacific Northwest (PNW) where strong seasonality in precipitation leads to a reliance on winter snowfall to provide summer runoff for water supply. In the Cascade Mountains of the PNW, rising temperatures over the last century have led to a decline of 20 – 40% of winter snow accumulation, earlier snowmelt and spring runoff, and decreased summer flows. Historic trends and models predict continued shifts in the region's hydrologic regime toward less snow, more rain, and earlier snowmelt. In order to anticipate the implications of this change, we need a better understanding of how climate change will affect snowpack at the watershed-scale. Furthermore, scientists lack an understanding of the effects of these shifting dynamics on peak flows – those flows that result from significant snowmelt events – which may become more common in the future. This research seeks to extend previous work modeling climate change effects on snowpack in the western Cascades to the eastern Cascades, Metolius River basin. Our goal is to compare and contrast modeled climate change effects on snow cover across the east-west divide of the Cascades, and across watershed scales. This work will have implications for further research examining the effects of changing snow-cover dynamics on streamflow dynamics – in particular, peak flows.

Adaptive reservoir management in response to climate change and population growth in the Willamette River Basin, Oregon

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Julia Jones, College of Earth, Ocean, and Atmospheric Sciences, Oregon State University
William Jaeger, Agricultural & Resource Economics, Oregon State University

A central characteristic of large river basins in the western US is the spatial and temporal disjunction between the supply of and demand for water. Water sources are typically concentrated in forested mountain regions distant from municipal and agricultural water users, while precipitation is super-abundant in winter and deficient in summer. To cope with these spatial and temporal disparities, systems of reservoirs have been constructed throughout the West. These reservoir systems are managed to store winter and spring precipitation in mountain areas, and deliver it to populated valleys during the summer, providing multiple benefits, including flood control, irrigation, recreation, hydropower, municipal water supply, and instream flows for stream ecology. These basins are thus coupled natural-human systems in which people and ecosystems have adapted to, and rely upon, environmental conditions as modified by the management of the reservoir system. The proposed research develops and tests a novel approach to adaptively manage reservoirs in light of uncertainty and anticipated changes in water supply and demand, focusing on the Willamette River Basin, Oregon. Employing a public policy framework that maximizes total social welfare, the research will (1) estimate the values associated with reservoir uses, (2) analytically derive economic efficiency conditions for reservoir operation, and (3) estimate the resulting operating rules under future trajectories of climate, land cover, population, and economy. The findings of this analysis will be used to address the following research questions: I. How do the derived operating rules compare to existing rule curves? II. How does the shape of the derived rule curves change under different scenarios of global change? III. What is the change in social welfare resulting from the use of these derived rule curves as compared to existing rule curves? IV. What are the distributional and social justice implications of the derived changes in the rule curves?

What matters most: Are summer stream temperatures more sensitive to changing air temperature, changing discharge, or changing riparian vegetation under future climates?

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We investigated stream temperature responses to changes in both air temperature and stream discharge projected for 200-2060 from downscaled GCMs and changes in the height and canopy density of streamside vegetation. We used Heat Source© calibrated for a 37 km section of the Middle Fork John Day River located in Oregon, USA. The analysis used the multiple-variable-at-a-time (MVAT) approach to simulate various combinations of changes: 3 levels of air warming, 5 levels of stream flow (higher and lower discharges), and 6 types of streamside vegetation. Preliminary results show that, under current discharge and riparian vegetation conditions, projected 2 to 4 °C increase in air temperature will increase the 7-day Average Daily Maximum Temperature (7dADM) by 1 to 2 °C. Changing stream discharge by ±30% changes stream temperature by ±0.5°C, and the influence of changing discharge is greatest when the stream is poorly shaded. In contrast, the 7dADM could change by as much as 11°C with changes in riparian vegetation from unshaded conditions to heavily shaded conditions along the study section. The most heavily shaded simulations used uniformly dense riparian vegetation over the full 37-km reach, and this vegetation was composed of the tallest trees and densest canopies that can currently occur within the study reach. While this simulation represents an extreme case, it does suggest that managing riparian vegetation to substantially increase stream shade could decrease 7dADM temperatures relative to current temperatures, even under future climates when mean air temperatures have increased from 2 to 4 °C.

Using Dense Landsat Time Series Imagery to Monitor and Analyze Wetland and Land Use Change in the Willamette Valley of Oregon from 1972-2012

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Warren B. Cohen, USDA Forest Service, Pacific Northwest Research Station
Zhiqiang Yang, Forest Ecosystems and Society, Oregon State University

Most wetland maps in the United States are established through a mixture of aerial photographs, field work, and cover classes such as soils and hydrology. While aerial photointerpretation balances the need for efficiency and accuracy, these maps often yield low categorical and spatial accuracy, high errors of omission, and coarse cover classes. This study combines the efficiency of manual aerial photointerpretation with the accuracy and high spectral, temporal, and spatial resolution available through remote sensing data by mapping annual change in wetland cover in Oregon's Willamette Valley over a 40 year period.

Wetland sites are collected using a two-year return flood inundation map of the main-stem Willamette River derived from a Digital Elevation Model (DEM) using Light Detection and Ranging (LiDAR) data. Annual Landsat satellite time series images of the Willamette Valley are collected from 1972 to 2012 and processed to display the Tasseled Cap Index values of brightness, greenness, and wetness. Integrating the full temporal depth of Landsat imagery yields a comprehensive characterization of land use change and creates a methodology that integrates the underutilized Multispectral Scanner (MSS; 1972-1983) data with Thematic Mapper (TM/ETM+; 1982-present) data into a single time series.

Annual time series imagery for specific wetland sites are viewed simultaneously using TimeSync, a dense Landsat time series visualization and data collection tool. Annual disturbances are noted and drawn as polygons in a GIS database. Additionally, the spectral trajectories of the valley's wetland mitigation banks will be viewed through Timesync in order to compare vegetative stability between restored and created wetlands with natural and undisturbed sites. This offers a potential approach for long term ecological monitoring of wetland mitigation practices. The end result is a land use change map with insight into trends and information not easily known through data gathered from the common two-date change detection methodology.

Incorporating uncertainty in urban stream restoration: recommendations from Salmon Creek, WA

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Zbigniew J. Grabowski, Environmental Science and Management, Portland State University
Michael Swamer, Geography, Portland State University

Understanding the implications of land use change on water quality shifts resist simple categorization despite a voluminous body of literature seeking to disentangle the watershed scale drivers of flow alterations, channel restructuring, quality degradation and biotic shifts in riparian systems. Water managers and those interested in riparian restoration are often faced with the need to dispense limited resources under time constraints in order to address those drivers in a regulatory environment that is structured to reduce harms but not necessarily maximize benefits. We undertake a critical review of the restoration literature and methodology in an attempt to create a more systematic framework for pursuing watershed restoration practice. We underpin our review with a series of analyses of land use, flow and water quality shifts in the Salmon Creek watershed in Clark County Washington. In particular, we analyzed the change in an index of flow flashiness across years in sub-catchments with variable development patterns, performed exploratory regressions of the relationship between land use change, septic system density, storm water infrastructure and water quality change in our sub-catchments. Because of our detection of noticeable but uncertain impacts of water quality change due to land use shifts we propose a further set of analyses that take into account effects of distance, stream network characteristics and underlying soil variability. These further steps are necessary preparations for building a hydrological model that can predict riparian and vegetative restoration impacts on flow and a select group of widely measured water quality variables.

The response of plankton communities in historically fishless alpine lakes to atmospheric deposition simulation along a stocking gradient

Jeffrey Brittain, Envl. Sciences and Management, School of the Environment, PSU
Angela Strecker, Portland State University

Non-native fish introductions have been widespread in the western United States since the 1800s. Thousands of historically fishless western US lakes are estimated to have received stocking of some type. The introduction of a top predator to these environments has proven to have cascading food web repercussions aquatically and terrestrially. Community structure has shown responses to non-native introductions as well as allochthonous nutrient inputs. In recent decades, atmospheric deposition has been recognized as an anthropogenic contributor to acidification and eutrophication of remote wilderness ecosystems. Aquatic alpine lakes in particular have proven to be vulnerable due to limited buffering capacities. This study seeks to identify the response of lakes of differing fish stocking histories to acidification and nitrification manipulations in experimental tanks.

Geomicrobial Kinetics in Groundwater from Pore-scale to Field-scale

Kelley Rabjohns, Biogeochemistry, Geological Sciences, University of Oregon

Geomicrobial kinetics is important in understanding groundwater chemistry, bioremediation, and reactive transport because microorganisms are pervasive and active in the subsurface. Microbial metabolic rates in a confined aquifer depend on the physical and chemical characteristics of the aquifer, geochemical reactions, and biological factors of the microorganisms. In this study, we numerically investigate the impact of aquifer heterogeneity in porous media on geomicrobial kinetics. Organic material from the surface degrades and moves into the subsurface where it is fermented into organic carbon molecules, such as acetate. Microorganisms use that organic carbon as an electron acceptor in redox reactions. By oxidizing the organic carbon, microorganisms create energy for cell maintenance and production of biomass. Our model is a 3-D porous box that represents a sandy aquifer with groundwater flowing through it. Microbes are randomly distributed, acetate is supplied by groundwater flow through, and the microbes react with and consume the acetate according to Michaelis-Menten kinetics and the Monod equation. We simulated the rates of acetate oxidation under pore-scale condition with heterogeneous parameters and continuum scale with homogenous parameters. Our results demonstrate a significant gap in geomicrobial kinetics between pore-scale field-scale calculations. We propose that microbial parameters should not be directly applied to field-scale biogeochemical modeling of groundwater.

Examining lateral and temporal variations in stream pCO_2 and CO_2 efflux rates in the Willamette River Basin

Nicholas Dosch, College of Earth, Ocean, and Atmospheric Sciences, Oregon State University
Roy Haggerty, College of Earth, Ocean, and Atmospheric Sciences, Oregon State University

Rivers play an important role in global carbon transportation and geochemical processing. It has been established that evasion of carbon dioxide from inland waters may represent a significant source of carbon dioxide to the atmosphere, but it remains unclear how CO_2 evasion rates from streams and rivers vary across drainage networks and which factors influence efflux. This project will investigate efflux rates and pCO_2, their seasonal and lateral changes, and will estimate the annual inorganic carbon flux across a drainage network. I will conduct a series of water sample collections which will analyze river water pH, temperature and alkalinity. This data will be used to estimate CO_2 evasion rates, which can be compared with those measured in the field using eddy covariance techniques. When completed, the project will estimate inorganic carbon flux within a sub-basin of the Willamette River on an annual time scale based on physical measurements and modeling techniques. The poster will include both research objectives and preliminary pCO_2 data based on long-term water chemistry data from three points within the Willamette Basin.

'Plug-and-Play' Ecology: Expertise and Perceptions of Nature in Green Stormwater Management

Marissa Matsler, Urban Studies and Planning, Portland State University

The objective of this research proposal is to describe changing perceptions of, and relationships with, nature embedded in the recent popularity of green infrastructure as a sustainable approach to addressing environmental degradation and climate change in cities. My goal is to examine the collision and integration of knowledge systems into the current 'plug-and-play' approach to ecology currently occurring in green infrastructure design and implementation, wherein each component (i.e. species, soil type) is separated from its larger ecological context.

Urban infrastructures have been developed and evolved over time to mediate human interaction with nature; these systems provide relative stability in otherwise dynamic natural systems. They deliver a steady supply of critical services such as clean water, food, and energy to cities, while increasingly abstracting the production of these services. Paul Edwards states that this "…permit[s] us, and perhaps compel[s] us, to approach nature as a consumable good, something to be experienced (or not) as and when we wish."

I propose to examine the influence of this perspective of nature within the design and management of green infrastructure facilities at the municipal government level. As part of a larger water infrastructure discourse analysis, I will employ Q-methodology to survey and interview technical experts regarding the knowledges they employ. I hypothesize that consumptive views of nature, and the growing commodification of nature generally, will be an important driver in the selection of different types of green infrastructure schemes (i.e. Low Impact Development, Green Streets), resulting in differing ecological consequences on-the-ground.

Green infrastructure is often viewed as a departure from a command-and-control approach to natural resource management. However, I argue that the use of ecological components, in a 'plug-and-play' fashion, is an extension of the command-and-control approach and should be examined in order to refine and guide sustainability policy-making at all levels of government.

Collaborative Assessment of Transboundary Aquifers: the Santa Cruz (Mexico-United States) and the Chateauguay (United States-Canada)

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Groundwater is the most extracted natural resource. Humans have extracted groundwater for thousands of years. Today, around fifty percent of the world's population relies on groundwater to meet its drinking water needs. Computer models and numerical models are powerful tools that allow the analysis and understanding of aquifers. However, groundwater systems are inherently hidden and uncertainty in characterizing them remains. Political boundaries add complexity to an already complicated system, and often countries find themselves with different interpretations of the aquifer. That is the case of the Santa Cruz Aquifer, shared by the American state of Arizona, and the Mexican state of Sonora. Despite collaborative language and discussion forums a joint assessment has not been completed. In order to adequately manage groundwater it is imperative to know and understand the aquifer. I will conduct an assessment of the process following a conflict assessment. One of the main aspects in the conflict is power; thus, I will use Zeitoun and Warner's Hydro-hegemony framework to conduct a comprehensive analysis of the problem. In addition I will look at the Chateauguay aquifer, which was assessed collaboratively by the United States and Canada. I will be able to highlight the principle obstacles to successful cooperation, and possible aids from the analysis and the case study.

Evaluating Effectiveness of Harmful Algal Bloom Management in a Changing Climate

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Projected climate changes such as elevated temperatures, extended drought period, and altered wind and precipitation patterns may compound management efforts on aquatic ecosystems with harmful algae blooms (HABs). Progress in identifying and forecasting the best management practices for HAB control will only be achieved by integrating the influence climate has on biological, chemical and physical interactions and identifying trends over time. Multiple rehabilitation attempts have been made to improve water quality and control eutrophication and HABs in shallow urban lakes. The proposed research will evaluate the influence of climate on the effectiveness of cutting-edge lake management practices (alum injections and aeration) used to control HABs in shallow urban lakes. A long-term data set of HAB density and climate conditions (e.g., temperature, precipitation, cloud coverage) for a shallow urban lake will be used to examine trends through time allowing for the impact of climate on HAB dynamics both prior and post current lake management practices to be revealed. Data will be used to develop a model that can predict the effects of climate on the ability of current lake management measures to prevent and mitigate HABs. The proposed research can heighten knowledge about HAB management and serve as a role model to evaluate future management practices. This will allow for the most promising and appropriate management practices in future climatic conditions to be identified, selected and developed; possibly expanding successful efforts to decrease growth and abundance of HABs. Management practices aimed to prevent or control HABs are imperative to protect human health and maintain healthy and sustainable aquatic ecosystems.

A real options-based framework to evaluate investments in river flood control under uncertainty

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Making decisions under uncertain flood events to invest in river protection is challenging. Real Options theory is an approach to handle future uncertainties in risk management by providing flexibility in investment decisions. This work presents a real options-based framework for investments in flood control to evaluate the financial value of having flexibility in the system by incorporating the uncertainty associated with future water discharges values of flooding events. A case study is presented to validate the effectiveness of the proposed model in flood control decision making.

Capturing a record of catchment events and an expression of their associated delivery mechanisms

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Lakes are a useful sedimentary sink to study catchment ecosystem changes and perturbations such as earthquakes, fires, floods, and human land use. Sedimentary stratigraphy records changes in the mass accumulation rate, and the composition and source of materials delivered to the lake over time. The questions addressed in this research are, how are perturbations recorded in the stratigraphy of lake sediments, and what determines the fidelity of the record? The study site is Loon Lake and its catchment in the Oregon Coast Range portion of the Umpqua River basin. During the summer of 2013, four sediment cores will be removed from this 1400 year-old landslide dam lake, where much natural and anthropogenic disturbance in its catchment has occurred over its lifetime. The coring location and the cores' subsequent analysis will test several hypotheses. One hypothesis is that it is expected that different events in the catchment will result in identifiable, characteristic deposits in the sediments. For example, earthquakes will produce two types of deposits, and each can be distinguished based on their material composition, grain size, and gradation. Different characteristics are expected for deposits of other types of events (i.e. land clearance, fire, and flood). Also, it is expected that of the many variables which may affect the fidelity of the record, the magnitude of the event, the temporal position of the event relative to other events, and the in-lake conditions will be the critical variables. To test these and other hypotheses, the cores will be analyzed (including tests of mineral magnetic susceptibility, bulk density, grain size, absolute dating, charcoal abundance, elemental analysis, 210Pb spectroscopy) and then correlated by strata between cores. Possible outcomes of this work include informing land use impacts and better understanding the attenuation of signals through the fluvial sediment delivery system.

A review of rainwater runoff quantity performance of green roofs

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A green roof (eco-roof) is a roof of a building that is partially or completely covered with plants and a growing medium over a waterproof membrane. Rapid urbanization and tremendous growth in population and buildings in cities caused many environmental problems. As a result, green areas are displaced by the impervious surfaces such as streets and buildings. This event greatly intensifies storm water runoff and increasing stream channel and river erosion. Green roofs are one the tools for reducing runoff and increasing water retention. Green roofs are investigated more and more often to determine how they can improve the quality of the urban environment. A green roof offers many benefits to reduce environmental problems of urbanization in comparison to conventional roofs which can be summarized as: Storm water management, improving water run-off quality, improving urban air quality, saving energy, reducing the thermal stresses in roof, mitigating effect of urban heat island, sound propagation and reducing noise pollution, providing food and a safe place for living many kinds of plants and animals and also aesthetic value which make city more beautiful. Ability to reduce problems of urban stormwater runoff quantity consists in absorption of water and delay the initial time of runoff. Green roofs reduce the total volume of runoff by retaining part of the rainfall in growing media and increase the time of runoff through a relative slow release of the excess stored water in the pores of the soil. Since green roofs are more frequently being used as a tool for managing storm runoff, the objective of this study is to prepare a complete literature on green roofs and their rainwater runoff quantity performance.