9TH ANNUAL PACIFIC NORTHWEST WATER RESEARCH SYMPOSIUM

abstract book

HYDROPHILES

the value of water

April 8th-9th, 2019

CH2M Hill Alumni Center | Corvallis, OR

Hosted by the Oregon State University Hydrophiles

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5:30 - 6:30	Keynote: Jonathan Soll, Metro	Cascade Ballroom

Breakout Workshops | Monday, April 8th

Workshop Title: Water Transformative Tools You Can Use

Presenter: Lynette de Silva | Director of the Certificate Program in Water Conflict Management and Transformation | Oregon State University

Workshop Description: Accelerated changes in climate, population shifts, political regimes and/or unilateral actions, can exacerbate vulnerable river basin systems and heighten water tensions. Coupled with 40% of humans residing in catchments shared by two or more countries, there is a need for mechanisms that help foster resilience and healthy robust ecosystems. The field of water conflict management and transformation offers techniques and tools that when appropriately applied, can help adapt and provide greater flexibility to dynamic river systems with multifaceted water services. These approaches have the potential to facilitate more harmonious relationships at multiple scales, such as, those between society and Planet Earth, humans and ecosystems, and people and their communities. This workshop provides opportunities to practice these skills, in readiness for professional utilization.

About Dr. de Silva: Lynette de Silva directs the Program in Water Conflict Management and Transformation at Oregon State University (OSU), which includes: the graduate/professional certificate program; the Transboundary Freshwater Dispute Database, an information technology/outreach program; and the University Partnership for Transboundary Waters, a collaborative research program. This involves contributing to issues of topical scientific and societal importance; adding to state, national, and international visibility; consolidating programmatic cores and teaching missions; and recruiting graduate students, and evaluating student applications.

Workshop Title: Economic Viability and Resource Sustainability Analysis

Presenter: Ganti Suryanarayana Murthy | Professor in Biological and Ecological Engineering Department | Oregon State University

Workshop Description: Various aspects of systems analysis for sustainability include assessing technical feasibility, economic viability, environmental impacts, resource sustainability and social aspects of engineered systems. This workshop will provide an introduction to these aspects of sustainability with a focus on case studies that are relevant to biofuels and bioproduct technologies. This course will introduce tools to perform technical feasibility analysis, economic viability analysis, resource sustainability assessment and life cycle assessment (LCA). This workshop will provide an introduction and overview of the LCA methodology, various tools to perform LCA and its use in assessing the environmental impacts. The workshop will consist of lectures focusing on theory and case studies highlighting the use of these methods to assess sustainability.

About Dr. Murthy: Ganti S. Murthy is a professor in the Biological and Ecological Engineering Department at Oregon State University. Dr. Murthy's research is broadly focused on sustainable bioprocessing. For any proposed technology or policy, Murthy group seeks to answer the question: "Is this approach technically feasible, economically viable, resource sustainable and has lower environmental impacts compared to alternatives? If not, how can we make it so?" His group employs a combination of experimental and theoretical approaches using control theory, systems biology, process modeling, economic analysis, and life cycle assessment (LCA) techniques to conduct molecular, cellular, industrial scale and systems-level analyses of technologies to establish a sustainable bioeconomy. Murthy group is researching the nutrient-energy-water nexus at a regional and global scale with a particular focus on building the resilience of agro-ecological systems to pulse and pressure disturbances.

Monday, April 8th // Oral Presentations // Cascade Ballroom

Oral Session 1

11:00 - 11:15	Climate resiliency of small temperature catchments in a changing precipitation regime Emily Crampe | Oregon State University
11:15 - 11:30	Hillslope erosion and soil properties after wildfire and post-fire forest management in California's Northern Coast Range Ryan Cole | Oregon State University
11:30 - 11:45	Headwater dynamics: quantifying spatial differences in flow permanence and network connectivity across diverse landscapes Adam Pate | Oregon State University
11:45 - 12:00	Isotopic and hydrochemical composition of source waters in urban watershed, Portland, OR Michael Tchintcharauli-Harrison | Oregon State University
12:00 - 12:15	Assessing the impacts of stream restoration on groundwater dynamics and potential storage at Indian Creek in the Teanaway Community Forest Nora Boylan | Oregon State University

Oral Session 2

2:15 - 2:30	Technological innovation of irrigation in agriculture from past to future to improve water application rate and crop production Hadi AL-agele | Oregon State University
2:30 - 2:45	Institutional analysis of non-FERC dam removals Matthias Fostvedt | Oregon State University
2:45 - 3:00	Governance ecology surrounding the use of beaver dam analogs for watershed restoration Zach Pike-Urlacher | Oregon State University
3:00 - 3:15	Recommendation for legislative action to establish a comprehensive Oregon CyanoHABs program Theo Dreher | Oregon State University
3:15 - 3:30	Water Policy preferences in Western United States Angela Lavado Alvarado and Zehra Gardezi | Oregon State University

Tuesday, April 9th // Morning Sessions // Cascade Ballroom

Oral Session 3

9:30 - 9:45	In the wake: patterns of resuspension of turbidity and phosphorus by boating Abigail Hale | University of Idaho
9:45 - 10:00	Investigating the potential of slow release nitrogen fertilizer to increase agricultural nitrogen management efficiency for Tall Fescue in the Southern Willamette Valley Jacob Derksen | Oregon State University
10:00 - 10:15	Ecosystem scale desalination Joshua Erkman | Oregon State University
10:15 - 10:30	Dual microbe and primary substrate approach for aerobic cometabolism of 1,4-dioxane and chlorinated solvent mixtures Hannah Rolston | Oregon State University
10:30 - 10:45	A tool for fingerprinting environmental pollution sources Emmanuel Davila-Santiago | Oregon State University

Poster Session 1 // 11:00 -12:00

1. Thermal acclimation influences fitness of freshwater phytoplankton species
Tamara Layden | Reed College

2. Inorganic contaminants and synergistic effects in water supplies
Peter Scruggs | Oregon State University

3. The effects of solar photovoltaics on pollinators in the Willamette Valley
Maggie Graham | Oregon State University

4. Basic beaver biogeochemistry
Josiah Shaver | Oregon State University

5. Assessing peak flow impacts of bed stability in a forested mountain watershed
Arianna Goodman | Oregon State University

6. Global patterns of methane production and oxidation rates in lakes
Sofia D'Ambrosio | Washington State University

7. Land use influence on water quality and anion concentration in the Oak Creek watershed
Keira Johnson | Oregon State University

8. Public perceptions and preferences for water policy in the Pacific Northwest & California
Angela Lavado Alvarado and Zehra Gardezi | Oregon State University

9. Effects of suspended sediment concentration on stream primary production in basins with contrasting lithology
Samantha Cargill | Oregon State University

Tuesday, April 9th // Afternoon Sessions // Cascade Ballroom

Poster Session 2 // 1:00 - 2:00

1. Numerical modeling of lateral erosion during reservoir drawdown
Tessa Artruc | Oregon State University

2. Temporal downscaling of hydrometeorological tracer datasets
Catherine Finkenbiner | Oregon State University

3. Using stream bacterial DNA to estimate macroscale catchment function
Dawn URycki | Oregon State University

4. Degrading contaminants of emerging concern using in situ microbiome
Gouri Mahadwar | Oregon State University

5. The impact of drought on stable water isotopes
Logan Adams | Oregon State University

6. Applying measurements of solar-induced fluorescence to improve transpiration estimates in Oregon hazelnut orchards
Will Richardson | Oregon State University

7. Engineering microbiomes for enhanced methane production using shock loading of anaerobic digestion of fats, oils, and greases
Ashley Berninghasu | Oregon State University

8. Spatial and temporal variability of heavy metals (Pb, Cu & Zn) in stormwater, street dust, and moss in Portland, Oregon
Sophia Bauer | Oregon State University

9. The impacts of tide-gates on water quality in Coos Bay, Oregon
Aubrey Myers | Oregon State University

Oral Session 4

2:15 - 2:30	Plant community composition and biodiversity patterns in urban parks of Portland, Oregon Michelle Talal | Oregon State University
2:30 - 2:45	Evaluation of soil moisture active passive (SMAP) soil and vegetation data products for predicting changes in vegetation phonology Bonan Li | Oregon State University
2:45 - 3:00	Estimating evaporation losses from the hazelnut fields in the Pacific Northwest with three drip irrigation treatments using stable water isotope ratios Firas Al oqalii | Oregon State University
3:00 - 3:15	The source of DO sag during deep drawdown at Fall Creek Reservoir Liangang Chen | Nanjing Hydraulic Research Institute
3:15 - 3:30	Geospatial modeling of hybridization risk between native and introduced salmonids Michael Manning | Oregon State University

Keynote Speakers

April 8th | Rose High Bear | Wisdom of the Elders

Wisdom Co-founder and Executive Producer Rose High Bear (Deg Hit'an Dine, Inupiaq) will share traditional Native American stories and spiritual perspectives about water. It is much more than part of Oregon's ecosystems. It has healing power. She believes it is the responsibility of Native people to connect with and care for the water so it can in turn care for us. She will also share her views on today's Willamette River and other rivers of the region. Rose was born and raised in a remote subarctic Athabascan village of McGrath along Alaska's wild Kuskoquim River. Her people, the Alaskan Athabascans are regarded as "River People" as well as "Caribou People." She came to Oregon as a young child and was raised in Coquille, OR near where the Coquille Indian Tribe would be formed years later. Following graduation from Oregon State University, Corvallis, OR (B.S.), she made Portland, OR her home where, in 1993, she co-founded Wisdom of the Elders, Inc. (Wisdom). For the past 25 years, she has dedicated herself to Wisdom's mission and vision as Executive Director and now serves as Senior Consultant to the organization.

April 9th | Jonathan Soll | Metro

Jonathan Soll has been the Science Division Manager for the Portland, Oregon based Metro Regional Government's Natural Area Program since 2009. He leads a team of natural resources scientists responsible for setting natural area acquisition and restoration priorities and for implementing and tracking restoration projects. Jonathan will discuss the role of habitat restoration projects and partnerships in building a healthy community from the perspective of a regional government. The greater Portland metropolitan area is home to the country's first elected regional government, called Metro. Covering parts of Multnomah, Clackamas and Washington Counties, Metro operates in a space between cities, counties and the state to address issues of regional concern. One of those issues is protecting water quality, wildlife habitat and providing access to nature close to home. Metro operates a Parks and Nature System with over 100 parks and natural areas totaling over 17,000 acres. The habitat restoration program especially targets streams and wetlands, often as part of partnerships. Jonathan will show examples of projects Metro has done and discuss some of the elements of success as well as challenges faced in water protection projects.

Art Showcase Featured Artists

Tessa Artruc, Maggie Graham, Hadas Moalem,
Aubrey Myers, Linda Tucker Serniak, Michelle Talal,
Emma Welborn, and Ciera Villegas

Symposium Planning Committee

Michelle Talal (Chair), Skye Steritz, Tessa Artruc, Benjamin Roberts-Pierel,
Max Henkels, Jack Kilbride, Maggie Graham, Ciera Villegas, Ryan Cole,
Samantha Cargill, Aubrey Myers, Emily Crampe, and Nora Boylan

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Monday, April 8th // Oral Presentations

Oral Session 1 // 11:00 - 12:15

Climate resiliency of small temperature catchments in a changing precipitation regime
Emily Crampe | Oregon State University

Catchment subsurface storage provides water to streams during periods of low precipitation and creates a time-lagged buffer that reduces storm-induced runoff. While the influence of storage is recognized, the temporal and spatial dynamics that drive its variability are not well understood. The variables that affect subsurface storage can be separated into two categories: inherit and external characteristics. The inherit variables are the physical attributes of the catchment, such as geology, geomorphology, curvature, soil type and depth, surface roughness, and forest age and composition. The external variables include variations in the inputs to the system, such as precipitation intensity, duration, and type. The purpose of this research is to examine groundwater storage dynamics in several small, temperate watersheds. We expect that the temporal variability of storage will relate climatic changes, while the spatial variability of storage will relate to the physical attributes of the catchments. Using a 25-year record of hydrometric data, we have calculated annual runoff coefficients (area weighted total annual discharge/ total annual precipitation) as a metric to track changes in water partitioning. Runoff coefficient has decreased through time in seven out of ten watersheds, independent of forest management history. Spatial analysis of inherent characteristics will provide insight into why this trend is not observed in all catchments, ultimately assessing if catchments with certain physical attributes are more resilient to changing precipitation regimes because of their greater ability to buffer low flow deficits and storm induced runoff. Analysis of external variables indicate that maximum 15-minute intensity has increased and snow water equivalent has decreased, while precipitation amount and duration has remained constant. Using a statistical model, the relative importance of these external and inherent variables in decreasing annual runoff coefficients will be quantified.

Hillslope erosion and soil properties after wildfire and post-fire forest management in California's Northern Coast Range
Ryan Cole | Oregon State University

High-severity wildfire can increase runoff, erosion, and sediment delivery to streams, producing a range of impacts on terrestrial and aquatic ecosystems and municipal water quality. Due to the broad range of post-fire threats, land managers often undertake active post-fire land management (e.g., salvage logging, subsoiling, revegetation) to promote regeneration and maintain forest and aquatic ecosystem functions. The primary objective of our study was to quantify and compare the sediment masses and yields eroded from (a) burned-only, (b) burned and salvage logged, and (c) burned, salvage logged, and subsoiled plots (~75 m2) in a forest in the northern California coastal ranges. We measured sediment yields, ground cover, precipitation, and soil properties that may influence erosion. We found that burned plots had higher estimated mean sediment yields (28.8 Mg ha-1 yr-1) than salvage-logged plots (6.8 Mg ha-1 yr-1), and subsoiled plots (3.0 Mg ha-1 yr-1) in WY 2017. Burned plots also had higher estimated mean sediment yields (0.9 Mg ha-1 yr-1) than salvage-logged (0.4 Mg ha-1 yr-1) or subsoiled (0.4 Mg ha-1 yr-1) plots in WY 2018. Precipitation was highly correlated with rates of erosion during each cleanout period. WY 2017 had significantly higher rainfall and erosion than WY 2018. It is difficult to say whether lower erosion totals in 2018 are indicative of site recovery or only related to low precipitation. The amount of bare soil within each plotwas not strongly correlated with sediment yields, which was unexpected considering the

importance of precipitation instigating erosion. Logging operations slightly increased bulk density, but subsoiling countered this bulk density increase so that subsoiled soils were similar in bulk density to burned soils.

Headwater dynamics: quantifying spatial differences in flow permanence and network connectivity across diverse landscapes
Adam Pate | Oregon State University

Forested headwater streams are critical for the supply of water, sediment, nutrients, and organic matter to downstream water bodies. Nearly half of all headwater streams display temporary flow regimes (i.e., ephemeral or intermittent), but with climate change they may become more common. Thus, it will be increasingly imperative to adequately represent temporary watercourses and describe the mechanisms that drive flow permanence and stream network connectivity. We conducted an extensive field campaign in streams draining diverse climatic and geologic conditions predominantly within the Anadromous Salmonid Protection Area of California. We visited 101 headwater streams in four distinct geomorphic provinces between late June and August 2018. Streams had contributing drainage areas (DA) ranging from 0.04–3.14 km2. At each stream, we measured channel geometry (bankfull and wetted dimensions) and channel grain size across a ~60 m reach, beginning at the mouth. Additionally, we calculated channel slope, topographic wetness, catchment curvature, and several other geospatially-derived metrics for each stream in our sample. Field and geospatial data were used to estimate network connectivity within a multivariate model. Results provided strong evidence for differences in network connectivity and channel geometry among headwater streams draining different geomorphic provinces. Modelling results indicated that the possible controlling factors of network connectivity were channel slope, grain size, and DA. Furthermore, the results of our model support the use of field-based and geospatially-derived metrics for potentially describing and predicting network connectivity in headwater streams in spatially variable terrain (model prediction accuracy: >70%).

Isotopic and hydrochemical composition of source waters in urban watershed, Portland, OR
Michael Tchintcharauli-Harrison | Oregon State University

Groundwater recharge in urban settings vary significantly from natural settings due to urban water sources such as runoff derived from local, imported, and reclaimed waters. This ongoing project evaluates various source waters within the Crystal Springs Watershed in Portland, OR to understand the extent in which urban source waters influence shallow groundwaters. Initial data of chloride and sulfate distinguished source waters influenced by groundwater. Initial stable isotopes of deuterium and oxygen have demonstrated distinguishable signatures between groundwaters, spring water, creek water sources which demonstrates potential to create mixing models. The data obtained from this study will contribute knowledge regarding the urban hydrologic controls on groundwater systems in relation to natural and potential anthropogenic controls.

Assessing the impacts of stream restoration on groundwater dynamics and potential storage at Indian Creek in the Teanaway Community Forest
Nora Boylan | Oregon State University

With decreasing snowpacks and changing precipitation patterns, Washington State is constantly looking for ways to conserve, store, and protect its water supply. Parties throughout Washington have turned towards stream restoration as a means of utilizing alluvial aquifers for groundwater storage and augmented late season flows. However, the relationship between restoration and augmented storage potential are still under investigation due to unique aquifer characteristics

hindering or enhancing groundwater storage. Indian Creek, a tributary of the Teanaway River in central Washington, provides an excellent opportunity to investigate groundwater dynamics as they react to stream restoration. Due to historic railroads, logging activities, and over-grazing, Indian Creek watershed has been degraded, resulting in an incised stream and disconnected floodplain. Starting in 2014, several parties including the Washington Department of Ecology, Washington Department of Fish and Wildlife, and the Yakama Nation began working on restoring Indian Creek. Since then, over 80 acres of floodplain have been treated with large wood. Currently, ongoing monitoring of the project at Indian Creek involves stage gages, piezometers, and surveyed cross-sections. Through this study we investigate if large wood placement in Indian Creek is having a measureable impact on groundwater dynamics throughout the system. We compound this with calculations of total potential storage of the alluvial aquifer surrounding Indian Creek and present our results through a comprehensive field-base groundwater model. Furthermore, we are able to develop an investigation template for other groundwater storage investigations connected to stream restoration in other montane meadows.

Oral Session 2 // 2:15 - 3:30

Technological innovation of irrigation in agriculture from past to future to improve water application rate and crop production
Hadi AL-agele | Oregon State University

Technological innovation in irrigation, from 6000 BC to present, has been driven by a need to provide water resources for agriculture and support growing populations. This review paper will explore how innovation in irrigation technology changed agricultural methods to progressively improve water application rates; water use efficiency; irrigation water productivity and increased crop production. The anticipated effects of climate change and population growth will require further improvements in irrigation methods to increase crop yields. The inventions have reduced climate change impacts, which have helped to reduce the shortage of water for agriculture, increase irrigation water productivity and raise the production of agricultural crops, in addition to the optimal use of agricultural land ancient civilizations first used irrigation to channel water from the highland springs and rivers to the dryland through the dry season. Technology innovations to irrigation are continuing to develop irrigation methods. Surface irrigation methods include: furrow, basin, and border irrigation, but these methods cannot achieve the goal of increasing water use efficiency and increasing crop yield. Drip irrigation and sprinkler irrigation are two of the best inventions of the twentieth century in the field of irrigation because less water can be used with high efficiency in application to irrigate agricultural crops. Agricultural research applied to these inventions has proved highly efficient in water use and increased agricultural production.

Institutional analysis of non-FERC dam removals
Matthias Fostvedt | Oregon State University

While the most publicized examples of dam removals are large, privately-owned hydropower dams, the majority of dam removals are small structures that produce little to no hydropower, and are thus outside of FERC's jurisdiction. The objective of this study is to characterize the governance that has driven recent decisions to remove these smaller, non-Federal Energy Regulatory Commission (FERC) dams. In the governance literature on non-FERC dam removals, three aspects remain unclear. First, it is unclear what conditions trigger a dam removal discussion. Second, it is unclear how those conditions shape the decision-making forum. Finally, it is unclear how the design of the decision-making forum influences stakeholder opinions on the decision to remove the dam. This

project addressed these questions by using a modified version of Ostrom's Institutional Analysis and Development Framework. The American Rivers' Dam Removal Database provided 243 samples of non-FERC dam removals from 2007-2017, with which a logistic regression was run to determine the likely conditions under which an organization would take on a dam removal project. A questionnaire was then sent to stakeholders involved with two specific dam removals. The questionnaire measured the costs and fairness of the governance process, and how those variables impacted stakeholder opinions on the decision to remove the dam. Small dams will likely continue to be the most commonly removed dams. Understanding the governance behind small dam removals may help reduce conflict and costs of future projects

Governance ecology surrounding the use of beaver dam analogs for watershed restoration
Zach Pike-Urlacher | Oregon State University

Beaver Dam Analogs (BDAs) are artificial beaver dam structures that are becoming increasingly popular means of watershed restoration in the American West. The novelty and excitement surrounding these structures, however, has led to questions regarding their most appropriate use. This research explores the governance surrounding the use of BDAs in Oregon. It looks practically at gaps and inconsistencies in the permitting process for the structures and theoretically at the degree of governance fragmentation surrounding the restoration methodology. Case studies from the Upper Nehalem River Watershed and Upper Klamath Basin are used as primary contemporary examples of BDA governance.

Recommendation for legislative action to establish a comprehensive Oregon CyanoHABs program
Theo Dreher | Oregon State University

Recent events in Oregon have raised awareness of freshwater cyanobacterial harmful algal blooms (CyanoHABs). The most prominent events have been the drinking water crisis in Salem this last summer, the death of 32 cattle on a ranch in SE Oregon in June 2017, the occurrence of toxic blooms in the Willamette River in downtown Portland, and the presence of cyanotoxins in Upper Klamath Lake that flow downstream and can enter the Klamath Irrigation District. Oregon Lakes Association has developed a recommendation for a comprehensive CyanoHABs program in Oregon, based on programs that exist in other states, especially Ohio, Washington, and California. Oregon Health Authority and Department of Environmental Quality currently share expertise in regulating and monitoring CyanoHABs, but both efforts are underfunded and no comprehensive CyanoHABs program exists in Oregon. CyanoHABs present risks to public, animal and ecosystem health that are relevant in the drinking water, freshwater recreation, agricultural, and ecosystems services realms. Our recommendations have helped shape HB 3326 and 3340 that are being considered by the Oregon legislature.

Water Policy preferences in Western United States
Angela Lavado Alvarado and Zehra Gardezi | Oregon State University

In response to changing climatic conditions and pressures of population growth, water security has become an important subject of policy discourse. Since there are limited cost-effective methods of developing new water supplies, demand management and conservation strategies, have received increasing attention. Effectiveness of such strategies, however, depends upon public support and behavior change (Gilbertson et al., 2011). Local governments and municipalities that posit solutions for addressing issues of water scarcity must be cognizant of the policy preferences of their residents. To this end, ideological and ecological attitudes as well as socio-demographic characteristics are

expected to be important determinants of policy support. This research uses household survey data to examine attitudes toward water conservation policies among residents of four Western States – Idaho, Oregon, Washington and California. A total of 1804 responses were obtained, constituting a response rate of 46%. The surveys were completed in February 2018 by the Oregon Policy Analysis Laboratory at Oregon State University. Water policy conservation attitudes were assessed by asking respondents whether they oppose or support a range of policy options that have been proposed to manage water resources. Using an aggregate measure of support for water conservation policies an ordinary least squares regression model was estimated. Findings indicate that individual's willingness to sacrifice for environmental gain, ecological orientation as measured by the New Ecological Paradigm (NEP) scale, assessment of self-efficacy, education and quiz-based knowledge are the most important drivers of public attitudes towards water conservation. Results presented in this study, can be used to update water conservation policies in the region - specifically in California, where citizens appear to be less supportive of traditional water conservation policies even as they face serious water scarcity problems.

Tuesday, April 9th // Oral Presentations

Oral Session 3 // 9:30 - 10:45

In the wake: patterns of resuspension of turbidity and phosphorus by boating
Abigail Hale | University of Idaho

Eutrophication, excessive growth from an overabundance of nutrients, is a pressing threat to surface waters worldwide. Traditionally, nutrient budgets are calculated to identify where nutrients originate and thus pinpoint special management concerns. The internal loading, or release, of phosphorus (P) and especially that directly resulting from human activities like recreational boating, has been largely ignored in this process because it is poorly understood. Coeur d'Alene Lake is ideal for studying release from recreational boating thanks to many shallow bay and high levels of recreation. In this study, water samples were collected at set times after the passing of watercraft and tested for turbidity and P concentrations to relate the number, size, and speed of watercraft to turbidity and P resuspension. In Kidd Island Bay, even after considering rising background P concentrations throughout the day, increased boating raised the concentration of total P in the nearshore areas to eutrophic levels. This project contributes data necessary to begin understanding of internal P dynamics of the lake ecosystem in Coeur d'Alene in the face of increasing recreational disturbance caused by rising human population and affluence.

Investigating the potential of slow release nitrogen fertilizer to increase agricultural nitrogen management efficiency for Tall Fescue in the Southern Willamette Valley
Jacob Derksen | Oregon State University

Nitrogen (N) fertilizer application has been linked to nitrate leaching below the root zone and into groundwater in many agricultural settings. The proper management of N application is crucial in minimizing non-point source nitrate pollution to groundwater. This study will examine the use of slow release nitrogen fertilizer to improve agricultural nitrogen management in tall fescue fields in the southern Willamette Valley. My thesis work will be part of a study led by scientists at Portland State University and the US Environmental Protection Agency, comparing crop yield, crop nitrogen (N) uptake, trace gas fluxes and nitrate leaching in plots of tall fescue with side-by-side comparisons of conventional and slow release fertilizer. The overall study will determine whether the replacement of conventional nitrogen fertilizers like urea with slow release urea fertilizer is a viable solution for decreasing nitrate leaching below the root zone, while maintaining crop yield and minimizing trace gas losses. Slow release urea and conventional urea applications will be compared using four replicates of two 1-acre plots of tall fescue grass in the Southern Willamette Valley. Four lysimeters were installed in each plot at a depth of 1 meters; lysimeters are porous devices installed in the soil at depth that are placed under vacuum allowing us to collect soil solution for analysis for ammonium and nitrate. Lysimeter sampling will occur every two weeks from the Fall of 2017 to the summer of 2018. Isotope analysis of seeds and stalk will be used to determine crop N uptake. Crop yield and nitrogen uptake will also be used to assess the treatment's effect on grass seed production and crop nutrient use efficiency. A water budget will then be created using physical characteristics of the soil, local precipitation data, and soil moisture measurements.This study will provide information about potential approaches to reduce groundwater nitrate contamination in the Southern Willamette Valley.

Ecosystem scale desalination
Joshua Erkman | Oregon State University

In a time of increasing water scarcity in many global communities and increasing environmental impacts by human activities many feel there is simply not enough water. This research investigates the feasibility of producing a cubic kilometer of water (km^3) through Multi Effect distillation (MED) or Multistage flash (MSF). Included is a technical feasibility analysis, a techno-economics analysis, and a proposal of possible social effects. The technical feasibility analysis focuses around the energy requirements for producing such a large quantity of water by scaling existing plants. The Techno-Economic Analysis compares the value of the water in different form factors to the capital cost and energy costs of producing it. This is in the context of water scarcity near coastal regions especially those with heavy agriculture and high reliance on contested river basins. Possible applications for use in climate change mitigation or for reducing human impact on natural water resources is also considered.

Dual microbe and primary substrate approach for aerobic cometabolism of 1,4-dioxane and chlorinated solvent mixtures
Hannah Rolston | Oregon State University

1,4-dioxane (1,4-D), a probable human carcinogen, has emerged as a common groundwater contaminant due to historical use as a stabilizer in industrial formulations of 1,1,1-trichloroethane (TCA). Bioremediation, specifically cometabolism, is an attractive remediation approach because environmental concentrations of 1,4-D are often low and it could be implemented in situ. Previous work has shown 1,4-D is cometabolized by isobutane-grown microorganisms, including Rhodococcus rhodochrous strain ATCC 21198. However, 1,4-D contamination often occurs in mixtures of chlorinated solvents such as TCA, trichloroethene (TCE), and their transformation products. Some co-contaminants are also transformed by isobutane-grown bacteria, however others are only slowly transformed or exert a toxic effect. As such, isobutene-grown Mycobacterium ELW1 was investigated for its complementary transformation capabilities. Transformation rates determined from batch studies were used to develop a Michaelis-Menten/Monod kinetic model to predict contaminant mixture cometabolism by the two microorganisms and their primary substrates. The model includes the influence of transformation capacities and competitive inhibition. 21198 rapidly cometabolizes 1,4-D and several chlorinated co-contaminants, including 1,1-dichloroethene (1,1-DCE). 21198 cometabolizes 1,1-DCE more rapidly than it metabolizes primary substrate (isobutane). However, this inhibits 21198 biomass growth because 1,1-DCE transformation produces a toxic epoxide. By contrast, isobutene inhibits 1,1-DCE cometabolism by ELW1, allowing for microbial growth prior to detrimental cometabolic transformation. Isobutene-grown ELW1 also cometabolizes TCE faster than 21198, however it does not transform 1,4-D or chlorinated ethanes. Therefore, both microorganisms are needed to transform complex contaminant mixtures, though cometabolism of the other microbe's primary substrate also impacts system dynamics. Modeling analysis allows for assessment of the pulsed of delivery of primary substrates (isobutane and isobutene), and estimation of primary substrate and/or biomass required to remediate a given contaminant mixture. Model simulations are compared with the results of batch microcosm studies. The kinetics were also incorporated into an advection-dispersion model to assess the spatial distribution of primary substrates, contaminants, and biomass that that would develop in a transport environment better representative of an aquifer.

A tool for fingerprinting environmental pollution sources
Emmanuel Davila-Santiago | Oregon State University

Water bodies are chemical data loggers for watersheds, containing tens of thousands of chemicals that discharge from overland runoff or subsurface seepage. While many compounds are widespread and are derived from multiple sources, we hypothesize that all sources contain highly unique suites of compounds or unique compound ratios. When transported to receiving bodies of water, we predict that these chemical "fingerprints" can be used as forensics tools to unequivocally identify the dominant pollution sources contaminating surface bodies of water. Our aim is to extract non-polar organic compounds from both water samples at/near pollution sources, and then use high-resolution mass spectrometry (HRMS) data in conjunction with machine learning tools to identify the non-target chemicals that are diagnostic of each source. Grab samples (n = 18) were collected and analyzed in triplicate from different sources including headwater streams and runoff from urban, suburban, and industrial surfaces. Preliminary machine learning results indicate that each sources is entirely separable with near perfect classification. Future fingerprints will be developed for agricultural runoff, and together, these chemical libraries will be used to identify dominant sources of pollution to surface bodies of water in the central Willamette Valley of Oregon.

Oral Session 4 // 2:15 - 3:30

Plant community composition and biodiversity patterns in urban parks of Portland, Oregon
Michelle Talal | Oregon State University

Urban parks are biodiversity hotspots and are integral components of green infrastructure in urban areas. The purpose of this study was to better understand the relationships between plant community composition, structural patterns, biodiversity, and environmental and species traits by using a standardized data collection method across different types of urban parks in Portland, Oregon. We examined the potential ways that different types of urban parks preserve native species and/or harbor non-native and invasive species. We used a stratified random sampling design to select 15 parks of different types based on use: 1) recreational-active use parks, 2) natural-passive use parks, and 3) multi-use parks. Within each of the selected parks, data were collected in five 400-m2 square plots. One-way analysis of variance was used to test hypotheses about variables associated with diversity. Multivariate analyses such as ordinations, cluster analysis, and hilltop plots were used to explore vegetation composition data and associations of different species assemblages with environmental variables. We found a total of 178 plant species belonging to 141 genera and 65 families. The largest number of native and invasive species were herbaceous, while most non-native species were saplings/shrubs. Statistically-significant differences in species richness and biodiversity indices were found between different park types. More native species were found in natural-passive use parks than other park types, more non-native species are found in multi-use parks than the other park types, and more invasive species were found in natural passive-use parks than in recreational-active use parks. Attributes such as wetland habitat, natural-passive use park type, steep slopes, native species origin, and vine and tree physiognomy were those most strongly correlated with the ordination, indicating that these attributes exert the strongest influence on species abundance and distribution with Portland's urban parks. The findings can assist park managers in aims to promote native species cover, reduce invasive species presence, or achieve other goals for urban parks. Improved management of plant community composition, structure, and cover within all park types has the potential to improve the habitat quality for animals, microorganisms, and fungi, as well as a range of benefits for people in urban areas.

Evaluation of soil moisture active passive (SMAP) soil and vegetation data products for predicting changes in vegetation phonology

Bonan Li | Oregon State University

Defined as the projected one-sided green leaf area over a unit area of land, the leaf area index (LAI) of a vegetation canopy is a key ecophysiological indicator of plant status since it measures the photosynthetic active area and often subjects to transpiration. It is also an essential parameter required by most of the land surface models. The Soil Moisture Active Passive (SMAP) mission is focused on inferring surface moisture conditions based on a L-band microwave radiation transfer in both soil and plant canopies, though the primary retrieval algorithm assumes a seasonally varying climatology for vegetation opacity. Here we examine the utility of different SMAP retrieval algorithms for predictions of changes in LAI in time (dLAI/dt), including SMAP's dual channel algorithms which estimate vegetation and soil properties simultaneously. In this study, three-year daily precipitation, temperature and shortwave downward radiation flux data from SMAP L4 geophysical forcing fields were obtained at twenty National Ecological Observation Network (NEON) core terrestrial sites. Correspondently, five different options of soil moisture and vegetation opacity time series and LAI data were acquired from SMAP level two data at a daily scale and MODIS level four data at four-day scale, respectively. Linear interpolation and a Savitzky-Golay filter were applied to generate the change of MODIS LAI time series at daily scale. Multiple regression approaches were tested to investigate how much more information SMAP soil and vegetation estimates can provide in predicting dLAI/dt. Our results suggested that soil moisture generally contains more information than the SMAP dual-channel vegetation opacity retrievals for dLAI/dt estimation. Afternoon soil moisture observations improve estimates of dLAI/dt more than morning soil moisture observations. Overall, the option 1 and option 2 of SMAP soil moisture observations contain more information than the other options. Our analysis results provide baseline assessment of the use of SMAP soil moisture and vegetation time series for accurately modeling and monitoring drastic change in LAI.

Estimating evaporation losses from the hazelnut fields in the Pacific Northwest with three drip irrigation treatments using stable water isotope ratios

Firas Al oqalii | Oregon State University

Quantifying the fraction of non-productive water losses, particularly soil evaporation, is fundamental for assessing water use efficiency. In this study, soil evaporation from a hazelnut field in the Willamette Valley of the Pacific Northwest is estimated based on the hydrogen and oxygen isotope ratios of soil moisture. Soil samples from a hazelnut field under three varying treatments of drip irrigation lines were collected once in mid-summer 2018 at multiple depths from different positions in the planting line. The stable isotope ratio of soil water in these samples was measured using H2O liquid - H2O vapor equilibration laser spectroscopy. Such measurement approaches are lower cost and are faster than conventional isotope ratio mass spectroscopy (IRMS). This technique can measure the O18/O16 and D/H isotope ratio of soils with water contents as low as 6%. Two hundred and twenty-five soil samples were collected in August 2018: 3 treatments of the single line, double line and triple line; 5 line replicates of each treatment; at 3 depths of 5cm, 30cm, 45cm; at all lines in the field. These soil samples are being investigated to detect geochemical markers of the magnitude of water that has evaporated to the atmosphere after irrigation. The stable water isotope can potentially become a powerful tool for evaluating irrigation practices; facilitating improved water use efficiency strategies, minimizing evaporation losses, and fostering rapid decision on how irrigation requirements.

The source of DO sag during deep drawdown at Fall Creek Reservoir

Liangang Chen | Nanjing Hydraulic Research Institute

In order to decrease the mortality of juvenile salmon swimming from upstream to downstream at Fall Creek Reservoir, a deep drawdown operation has been performed during the fall season since 2011. However, a fast dissolved oxygen (DO) sag lasting several hours occurred downstream near the dam, which did not satisfy the DO need for salmon. In order to determine the sources of the DO sag, a three-dimensional numerical model for hydrodynamic, temperature, and DO was developed using Environmental Fluid Dynamic Code (EFDC). The model adopts SIGMA-Z vertical coordinates to control spurious currents in shallow regions and decrease cell amounts. Three possible sources have been preliminarily discussed to explain the DO sag. The first possible reason was the suspended sediments and oxygen demand mainly by reduced substances, while the second possible reason is that the hypoxia bottom layer water was induced by benthic sediment oxygen demand. Another possible explanation is anaerobic pore water release. It is presumed that the drainage of anaerobic pore water is the most probable source of DO sag, but more research is needed to determine the real source.

Geospatial modeling of hybridization risk between native and introduced salmonids

Michael Manning | Oregon State University

The overlap of native salmonids is not uncommon, and while hybridization may still occur at low rates between sympatric species, hybridization between native and introduced species have contributed to the extinction of native species. Differences in temporal and spatial use of spawning habitat may present a reproductive barrier that may be influenced by habitat characteristics such as water temperature, flow, and streambed composition. Anthropogenic impacts on disturbance regimes, changing environmental conditions, and land use practices may influence the risk of hybridization by altering stream characteristics in a manner effecting distribution overlap and the occurrence of hybridization between native and introduced species. This study will use geospatial modelling of physical characteristics and thermal regimes, in conjunction with species presence/absence data, to identify those stream characteristics that alter distribution and potentially influence hybridization between native Bull Trout (Salvelinus confluentus) and introduced Brook Trout (S. fontinalus). Our modelling approach will use existing species distribution data to identify stream reaches with co-occurrence of these two species, as well as the occurrence of hybridization. Stream assessment data for selected reaches will be assessed to identify differences in characteristics between reaches that exhibit differing rates hybridization. It may be possible to extend our approach to other species and regions. Study outcomes will include spatially-explicit maps of low, medium and high risk of hybridization. In addition, we will downscale global climate models to project changes to thermal regimes and areas where the risk of hybridization might change in the future.

Tuesday, April 9th // Poster Presentations

Poster Session 1 // 11:00 - 12:00

1. Thermal acclimation influences fitness of freshwater phytoplankton species
Tamara Layden | Reed College

Organisms living in lake and pond ecosystems of the Pacific Northwest exist in environments that vary both through time and space. Yet, understanding how the variation in environmental conditions influence important ecological rates of organisms, such as birth and death rates, remains unclear. Such an understanding is relevant for accurately predicting the response of organisms in aquatic ecosystems to climate warming. Currently, models predicting how organisms might respond to climate change do not incorporate the potential influences of phenotypic plasticity (e.g., acclimation) and therefore do not fully represent an organism's ability to cope with environmental variation. Here we emphasize the importance of considering an organism's thermal history when attempting to understand how it will be impacted by current temperature environments. In this study, we focused on the thermal performance of two phytoplankton species, the freshwater green algae, Chlamydomonas reinhardtii, and the freshwater cyanobacteria, Microcystis aeruginosa. For each species, we first measured the fitness (measured as population growth rate) of phytoplankton populations acclimated to nine different temperatures (ranging from 14 degrees C to 40 degrees C) as they experienced new temperature environments over time. Second, we exposed populations acclimated to different temperature conditions (high versus low temperatures) to different sequences (increasing versus decreasing) to test predictions made by our initial results. Our results suggest that the temperature each phytoplankton population experienced in the past (i.e. acclimation temperature) had an effect on their growth rates in their current thermal environment. We then evaluated the extent to which these results could have been predicted from our initial experiment. Overall, our study suggests that acclimation is capable of influencing population dynamics of phytoplankton within lake systems and is an important component to consider when making ecological forecasts.

2. Inorganic contaminants and synergistic effects in water supplies
Peter Scruggs | Oregon State University

Exposure of zebrafish scales to inorganic contaminants added separately produces classic dose-response effects. In combination, however, two new toxic effects have been discovered. Zebrafish, as many other fish, have colorful cells on the scales called chromatophores. The chromatophores consists of pigmented granules that move along a microtuble network by use of motor proteins. These chromatophores can depict the health of the fish, but also react when exposed to toxins or common contaminants.

3. The effects of solar photovoltaics on pollinators in the Willamette Valley
Maggie Graham | Oregon State University

Little is known about the effects of ground-mounted solar arrays on vegetation, and even less is known about the effects on beneficial insects, including pollinators. Solar panels create a unique microclimate which alters the temperature, solar irradiance, soil moisture, and plant biomass underneath their canopies (Hassanpour, 2018). Pollinator community structure is known to be sensitive to flower density, which is dependant on these microclimatic variables (Hamblin, 2018). We predict that the drivers of pollinator community structure within solar arrays are analogous to those

outside solar panel arrays, but there is no peer-reviewed data on this relationship. The proposed research will document the microclimatic conditions, vegetative community, and beneficial insect populations within a 482 kW solar array in Corvallis, Oregon.

4. Basic beaver biogeochemistry
Josiah Shaver | Oregon State University

Since European arrival in North America, it has been estimated that at least 90% of the beaver population has been killed off (Naiman et al., 1988). Given the the myriad impacts that beavers have on stream geomorphology, groundwater, and both terrestrial and aquatic ecology, this extermination has undoubtedly altered this continent in profound ways. This student research project was a literature review on how beavers and their dams affect biogeochemical cycles. My team and I focused on the Nitrogen Cycle, the Carbon Cycle, the Phosphorus Cycle, as well as sediment dynamics and a few other chemical processes. Our findings indicate that beavers may help reduce fluvial carbon and phosphorus fluxes, nitrogen pollution, eutrophication, and excessive sediment flow in streams. At the same time, there are some interesting carbon dioxide and methane gas emissions that happen at beaver ponds, and more research is needed to fully understand these biogeochemical patterns.

5. Assessing peak flow impacts of bed stability in a forested mountain watershed
Arianna Goodman | Oregon State University

Communities across the Pacific Northwest rely on streams in forested mountain watersheds for both drinking water supplies and ecosystem services. The stability or mobility of these stream channels is strongly influenced by peak flow events. These extreme events can rearrange bed materials with substantial impacts on aquatic ecology. Yet empirical studies of long-term channel stability are relatively uncommon due to the rarity of long-term monitoring data. This study uses historical data sets on channel morphology, sediment, and wood from the HJ Andrews Experimental Forest, a Long Term Ecological Research Site on the western slope of the Oregon Cascade Range. The project investigates effects of peak discharge events and channel slope on channel stability and cross-sectional change in three mountain streams. Recent moderate-sized flood events in the Andrews Forest have increased the inventory of extreme events on record and will help refine our ability to describe thresholds of change in stream channels. This study expands on, updates, and refines previous work conducted twenty years ago at the same sites in the Andrews Forest. Using larger data sets, improved computational methods, and previously underutilized data sets, including grain size distributions, historical stage-discharge relationships and LiDAR-derived land surface characteristics, this project aims to broaden and clarify our understanding of how, when, and where streams respond to extreme hydrologic events.

6. Global patterns of methane production and oxidation rates in lakes
Sofia D'Ambrosio | Washington State University

Collectively, lakes are an important source of the greenhouse gas methane (CH4). Previous efforts to synthesize CH4 measurements from lakes on a global scale have focused on CH4 emission measurements. However, there have been no efforts to-date to analyze global trends in the two microbial processes that primarily control CH4 emission in lakes: (1) CH4 production and (2) CH4 oxidation. In this study, we use a meta-analysis approach to compare incubation-based measurements of CH4 production and oxidation rates from over 200 lakes around the world. In addition to rate measurements, we also compile information on methods, sampling design, and lake characteristics. We uncover a strong sampling bias towards temperate, boreal, eutrophic, and

oligotrophic lakes in the Northern Hemisphere, with little information from tropical and mesotrophic systems. Despite previous work linking lake CH4 emissions to latitude, we find no relationship between latitude and rates of CH4 production or oxidation. Biome and trophic status appeared to be stronger controls, with temperate lakes exhibiting higher rates of sediment CH4 production and oxidation than boreal systems and eutrophic lakes reporting higher sediment CH4 production rates than oligotrophic or dystrophic systems. Lastly, we discuss how incubation methodology—namely the decision to incubate slurries or intact cores—may bias CH4 transformation measurements.

7. Land use influence on water quality and anion concentration in the Oak Creek watershed
Keira Johnson | Oregon State University

Multiple land uses associated with Oak Creek, from its headwaters at the McDonald-Dunn forest through agricultural and urban settings until it meets Mary's River, may influence water quality indicators (e.g., temperature, conductivity, nutrients). Objectives of this study are to: 1) determine various land use influence on stream water-anion concentration along the Oak Creek longitudinal gradient; 2) assess stream-aquifer interaction potential effects on nutrient concentration of stream water; and, 3) determine potential origins of surface water and groundwater flows influencing streamflow-water quality relations in Oak Creek. A total of 49 sites were selected in the Oak Creek Watershed spanning from forested land in McDonald-Dunn forest through agricultural fields to urban development near the mouth. Of these 49 sites, 28 are shallow geotechnical boreholes (<20 ft), 4 are stream tributaries, and 17 are on the main stem of Oak Creek. Water quality parameters (i.e., temperature, pH, turbidity, dissolved oxygen, specific conductivity) are collected monthly to better understand the fluctuations in Oak Creek Watershed. Quarterly, water samples are analyzed for anion (i.e., nitrate, phosphate, sulfate, bromide, chloride, fluoride) concentration. Water samples are analyzed for stable water isotopes quarterly to determine potential origin of surface and ground water. This project is part of a broader long-term study aimed to investigate land use - water quantity/quality relations within the Oak Creek watershed near Corvallis, OR.

8. Public perceptions and preferences for water policy in the Pacific Northwest & California
Angela Lavado Alvarado and Zehra Gardezi | Oregon State University

In response to changing climatic conditions and pressures of population growth, water security has become an important subject of policy discourse. Since there are limited cost-effective methods of developing new water supplies, demand management and conservation strategies, have received increasing attention. Effectiveness of such strategies, however, depends upon public support and behavior change (Gilbertson et al., 2011). Local governments and municipalities that posit solutions for addressing issues of water scarcity must be cognizant of the policy preferences of their residents. To this end, ideological and ecological attitudes as well as socio-demographic characteristics are expected to be important determinants of policy support. This research uses household survey data to examine attitudes toward water conservation policies among residents of four Western States – Idaho, Oregon, Washington and California. A total of 1804 responses were obtained, constituting a response rate of 46%. The surveys were completed in February 2018 by the Oregon Policy Analysis Laboratory at Oregon State University. Water policy conservation attitudes were assessed asking respondents whether they oppose or support a range of policy options that have been proposed to manage water resources. Using an aggregate measure of support for water conservation policies an ordinary least squares regression model was estimated. The model included sociodemographic, values, willingness to scarify and knowledge about water policy variables. Findings indicate that individual's willingness to sacrifice for environmental gain, ecological orientation as measured by the New Ecological Paradigm (NEP) scale, assessment of self-efficacy, education and quiz-based knowledge are the most important drivers of public attitudes towards water conservation. Results

presented in this study, can be used to update water conservation policies in the region - specifically in California, where citizens appear to be less supportive of traditional water conservation policies even as they face serious water scarcity problems.

9. Effects of suspended sediment concentration on stream primary production in basins with contrasting lithology
Samantha Cargill | Oregon State University

Stream primary production is an important driver of aquatic food webs and an important influence on overall carbon and nutrient dynamics in headwater ecosystems. Light and nutrients are well-established drivers limiting primary production. However, flow magnitude and frequency influence sediment mobility, resulting in physical disturbances that can also affect primary producers. The underlying lithology controls sediment size and strength, which can influence the disturbance mechanism, from movement and associated scour of larger, competent rocks to abrasion caused by sand particles originating from more friable material. Understanding how the size, frequency and severity of sediment mobility disturbance events can affect stream primary production will provide insight into how physical characteristics of the underlying lithology can influence stream productivity. We compared the effects of abrasion on stream primary production in a basalt-dominated versus a sandstone-dominated catchment. We collected daily suspended sediment samples for suspended sediment concentration (SSC) analysis and deployed dissolved oxygen and light sensors to model stream metabolism. So far the highest observed flows were ~1/3 of bankfull discharge. We hypothesize that high SSC will lower primary production in both catchments, but that in the sandstone-dominated catchment, disturbances will be more frequent and of greater magnitude due to a higher supply of fine-grained sediment. Preliminary results indicate that in general, high SSC results in a lowering of primary production rates, but the disturbance history (i.e., the frequency of high flow events) modifies the effect. Consecutive storms events result in a lower SSC for similar discharge levels, and a lower impact on primary production given sediment transport hysteresis processes. Understanding how suspended sediment influences stream metabolism will aid in improving a mechanistic understanding of the effects of the movement of small grain sizes mobile at intermediate flow levels, which could be used to inform management to enhance or reduce primary production.

Poster Session 2 // 12:00 - 1:00

1. Numerical modeling of lateral erosion during reservoir drawdown
Tessa Artruc | Oregon State University

Reservoir drawdown is a management technique increasingly used to maintain aging infrastructure, decommission dams, and promote the flushing of fish and sediment. Typically, models of the reservoir's geomorphic response have been limited to 1D incisional erosion without the incorporation of lateral widening. The proposed research aims to understand how the drawdown rate may affect the magnitude, timing, and mechanism of lateral erosion processes in a reservoir. It is hypothesized that an increased drawdown rate (the water level is reduced over a relatively shorter period of time) will increase the volume and rate of lateral erosion and will be dominated by geotechnical failure. Field observations will be coupled with a hydrodynamic and bank stability model to conduct numerical experiments of the processes leading to erosion with varying drawdown scenarios. Bishop's Method will be utilized in a limit equilibrium model to evaluate planes of slope failure at various water levels, in addition to shear stress transfer at the bank toe for hydraulic failure. The incorporation of retrogressive bank erosion in this model will be a new contribution to address sequential slumping, which is expected to play a critical role in improving the accuracy of modeling

reservoir erosion. Four monitored case studies will provide input data for robust verification of the model, including the Elwha Dam removal in Washington, Bloede Dam removal in Maryland, Marmot Dam removal in Oregon, and Fall Creek Reservoir drawdown in Oregon. Predicting the rate of sediment delivery from a reservoir is important to manage the impacts of sediment on downstream ecosystems and infrastructure.

2. Temporal downscaling of hydrometeorological tracer datasets
Catherine Finkenbiner | Oregon State University

Geochemical tracers within precipitation are commonly used to understand ecohydrologic function, yet because processes such as infiltration and percolation are dependent on input rates, fine temporal resolution is often needed to properly model ecohydrologic dynamics. However, many tracers are only collected at aggregated time intervals due to their relatively small concentrations. This research presents a methodology for the temporal downscaling of geochemical tracer inputs with a multivariate gaussian copula framework. Using stable isotopes (d2H and d18O) as an example precipitation tracer, patterns in correlation structure across temporal aggregation levels were assessed at 1- to 84-day running means. The results indicate lower frequency observations can be used to define a copula linking tracer and precipitation amounts at daily timescales. This copula was then applied to generate daily synthetic tracer timeseries and evaluated against daily precipitation and tracer datasets from around the world. We also present a conditional copula methodology that can be applied where precipitation and tracers are recorded at different sampling frequencies. For the unconditional and conditional methods respectively, synthetic daily isotope ratios temporally downscaled from 7-days to 1-day had means with a root mean squared error (RMSE) of 4.47‰ and 4.46‰ for d2H, and 0.30‰ and 0.29‰ for d18O. For 14-days to 1-day, the RMSE values in the means were 3.73‰ and 3.68‰ for d2H, and 0.35‰ and 0.35‰ for d18O. Overall, the RMSE in the standard deviations increased while the correlations showed little change in RMSE as the temporal aggregation increased. The results suggest temporal downscaling with copula functions provides an accurate method for constructing high frequency synthetic time series datasets from aggregated time intervals that also maintain known statistical relationships. This method is sufficiently general to be applied to other hydrometeorology tracers and can enhance our understanding of physical processes without collecting fine temporal in-situ data.

3. Using stream bacterial DNA to estimate macroscale catchment function
Dawn URycki | Oregon State University

The stream microbiome, as identified by sequencing DNA collected from the stream, has been shown to be related to catchment hydrology and has recently been used to estimate stream discharge. Given that most aquatic bacteria in streams originate in upslope environments and that stream water at outlets integrates runoff from across catchments, we posit that the stream microbiome also carries information about the macroscale catchment environment. In this study, we refine and extend methods to relate the stream microbiome to the hydrology, ecology, and geochemistry of catchments. To explore this hypothesis, we extracted, amplified, and sequenced bacterial 16S rRNA gene fragments collected at 10 stream sites in the HJ Andrews Experimental Forest in the Cascade Mountains of Oregon. We then clustered very similar sequences into operational taxonomic units (OTUs), resulting in over 4000 different OTUs present throughout our 10 study streams. We used statistical models developed through machine learning techniques to relate the bacterial community composition (i.e., relative abundance of OTUs) to hydrology, ecology, and geochemistry in the catchment and then apply these models to estimate catchment characteristics. Our models for discharge and stand age were very sensitive to the subset of OTUs used in the model. Beyond threshold values, models were less sensitive to the free parameters in the machine

learning algorithms. Our approach could be used in other studies applying machine learning techniques relating bacterial DNA to ecohydrological characteristics in order to take advantage of the wealth of information contained within the stream water bacterial DNA fragments.

4. Degrading contaminants of emerging concern using in situ microbiome
Gouri Mahadwar | Oregon State University

Contaminants of emerging concern (CECs) such as pharmaceuticals, pesticides, and personal care products pose a health threat to ecosystems and society. Removal of these contaminants in natural systems can occur through synergistic action of microbial communities. This study investigated the ability of microbial communities to degrade a suite of 21 known CECs across time and space in the wastewater and stream environments. Target chemicals were identified using mass spectroscopy, and microbial community composition was identified using 16S Illumina sequencing. The machine learning tools such as support vector regression and random forest were used to determine which microbial taxa best predicted decreasing concentrations of the target CECs. The result was a core microbiome most important to CECs removal. Identification of such a core microbial community can be utilized to seed wastewater treatment plants such that CECs removal can be improved prior to wastewater discharges to surface water.

5. The impact of drought on stable water isotopes
Logan Adams | Oregon State University

This presentation investigates the relationship between stable water isotopes (deuterium and oxygen-18) and the occurrence and severity of drought defined using the Palmer Drought Severity Index (PDSI). Currently there are only three studies that investigate the relationship between drought and stable isotopes (Marchina et al, 2019;Wu et al., 2017; Grossman and Roark, 2016) and they are limited to specific geographical areas (rivers and catchment basins) and relatively small time-scales (three months to one year), meaning that no metadata analysis of the relationship between drought and stable water isotopes has been performed. Recent datasets published from the University of Utah's Center for High Performance Computing and NASA's Tropospheric Emissions Spectrometer include stable water isotope data across three key areas of the hydrologic cycle (precipitation, surface water, and the atmosphere), throughout the globe across several years. This presentation examines the impact of including stable water isotopes on the ability of a model to accurately predict the PDSI for a given region in real-time and one, two, three, and six months into the future compared to a model that only includes standard physical variables (latitude, longitude, elevation) and time. Analysis was performed using a multivariate Root Mean Square Error (RMSE) method and examines the differences in model accuracy across areas of the hydrologic cycle and geographical regions.

6. Applying measurements of solar-induced fluorescence to improve transpiration estimates in Oregon hazelnut orchards
Will Richardson | Oregon State University

Growers in the Willamette Valley of Oregon produce 99% of the U.S. hazelnut crop and often must use irrigation to keep trees healthy and maximize yield. Knowledge of crop water use (transpiration) can be used for implementing precise irrigation strategies to conserve water and for predicting yield, yet little work has been done to quantify transpiration rates in hazelnut trees. Transpiration estimates via sap flow measurements are often not feasible due to the high cost of commercial sensors, while estimates from the Penman-Monteith equation can be inaccurate. A potential solution to this problem lies in the measurement of solar-induced fluorescence (SIF), a

phenomenon in which a small quantity of light is re-emitted by plants in the spectrum between 640 and 850 nm during photosynthesis. SIF can be measured both in fields and remotely via satellite and potentially provides information on plant transpiration due to stomatal coupling of carbon and water exchange. In the upcoming growing season I will explore the relationship between SIF and transpiration through a field campaign in a hazelnut orchard near Amity, Oregon. During this campaign I will simultaneously measure SIF at the Oxygen-A absorption band (~760 nm) with a field spectrometer, estimate transpiration with sap flow sensors, and monitor the site's micrometeorology. From this work I expect to determine the suitability of SIF for estimating transpiration under a variety of environmental conditions, to assess SIF's ability to estimate transpiration when compared to traditional models like the Penman-Monteith method, and to improve knowledge of hazelnut hydraulic strategies.

7. Engineering microbiomes for enhanced methane production using shock loading of anaerobic digestion of fats, oils, and greases
Ashley Berninghasu | Oregon State University

As the global population continues to increase, concerns surrounding the energy-water-food nexus are rising. Anaerobic digestion (AD) sits prominently in this nexus through the co-digestion of fats, oils and greases (FOG). The productivity and stability of FOG co-digestion is highly dependent upon the FOG composition and loading rate. However, efforts to intensify the FOG co-digestion process, increase its predictability to process changes, or to produce alternative high value products (e.g. hydrogen, or bioplastics precursors) have been hampered by a limited fundamental understanding of how the anaerobic digester microbiome responds to process disturbances. In order to test the effects of a shock loading regime on enhanced methane productivity of the anaerobic digester microbiome, one lab-scale digester (1.5L) was set up at 37C and operated at a 15 day hydraulic retention time. The reactor was fed three different sized "shocks" consisting of a mixture of FOG and waste activated sludge to produce three different organic loading rate values. Following each shock period, the reactor was allowed to recover and was only fed waste activated sludge. Subsequent shocks of equal size were tested in order to see the effects of repeated shock periods. The largest shock tested resulted in process failure after which the reactor was allowed to recover and the productivity of the system was checked. Productivity parameters were measured such as biogas productivity and composition in order to calculate methane production rates and yields. Operational parameters were also measured such as pH, ammonia and dissolved phosphorous concentrations, as well as organic acid abundance and composition in order to evaluate the stability of the process. The results show that subsequent shock periods of equal organic loading rate values can help improve process stability. It was also observed that a cycle of process failure followed by recovery may produce increased methane yields when co-digesting FOG.

8. Spatial and temporal variability of heavy metals (Pb, Cu & Zn) in stormwater, street dust, and moss in Portland, Oregon
Sophia Bauer | Oregon State University

With a global trend of urbanization it is important to understand the geochemistry of urban centers. Population growth and changing technologies impact sources, transport, and fate of heavy metals in cities. Lead (Pb) isotope fingerprinting techniques can be used to determine Pb contamination sources in a city. Stormwater, moss, and street dust were collected at 21 locations in Portland, OR during spring, summer, and fall of 2018 to assess spatial and temporal variability of heavy metals including Pb, copper (Cu), and zinc (Zn). The 21 locations are located in 9 different zoning types spanning from low density residential to heavy industrial. When analyzing stormwater both unfiltered and filtered samples were collected to determine the percentage and affinity of each analyte to

occur in the dissolved phase as opposed to being adsorbed onto a suspended solid (which affects the behavior and transport of that analyte). Moss is used as a passive sampler of atmospheric deposition. Preliminary results show that unfiltered stormwater samples have Pb levels of 0.052-112 ppb with a mean of 12.0 ppb, Cu levels of 5.34-186 ppb with a mean of 28.0 ppb, and Zn levels of 12.3-2830 ppb with a mean of 232 ppb. Moss samples had Pb levels 0.052-52.2 ppm with a mean of 8.29 ppm, Cu levels of 2.95-52.1 ppm with a mean of 22.89 ppm, and Zn levels of 5.95-249 ppm with a mean of 84.6 ppm. Street dust samples had Pb levels of 21.8-482 ppm with a mean of 141 ppm, Cu levels of 49.0-1090 ppm with a mean of 304 ppm, and Zn levels of 182-2290 ppm with a mean of 905 ppm. Preliminary Pb isotope results show 208Pb/204Pb ratios to range from 37.6-39.1 for all samples and 207Pb/204Pb ratios ranging from 15.6-15.8 for all samples. This study presents an overarching analysis of heavy metal pollutant concentrations coupled with Pb isotopes of stormwater in both the unfiltered and dissolved phase, moss, and street dust in Portland, OR.

9. The impacts of tide-gates on water quality in Coos Bay, Oregon

Aubrey Myers | Oregon State University

Tide-gates are commonly used along the coast of the Pacific Northwest to prevent agricultural and grazing fields from being inundated by saltwater. The mixing between freshwater and salt water in a roving-like movement is characteristic to estuaries. These areas often experience increased levels of biological productivity because the circulation patterns obtain large amounts of organic nutrients of both river and marine origin. The extensive alterations in river-estuary connectivity caused by tide-gates have dire impacts on the ecology, as well as, the resources available for juvenile fish. This study looks at two different tide-gate designs in systems with similar characteristics, Palouse Slough and Larson Slough in the Coos Estuary, and the impacts they have on the nearby water quality.