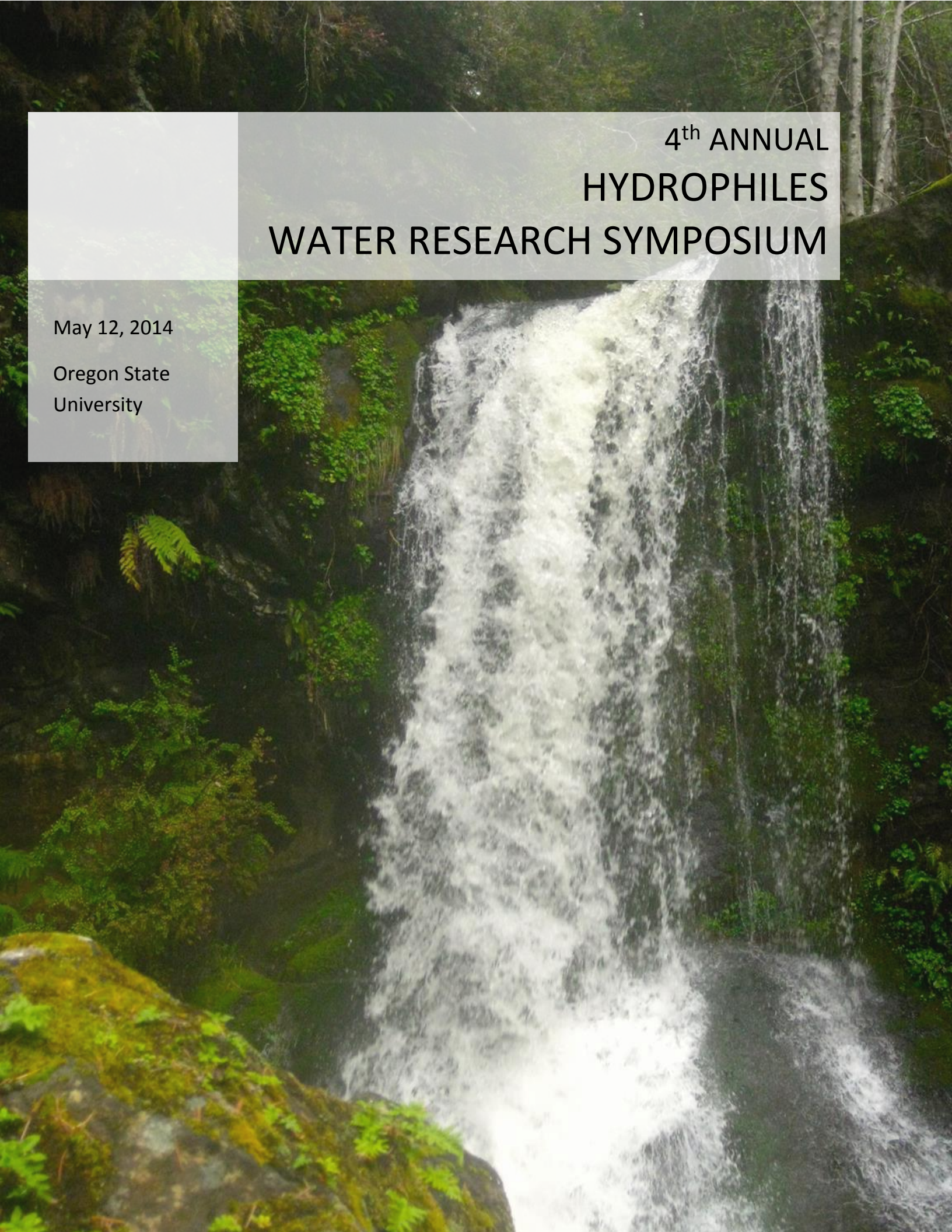

4th ANNUAL HYDROPHILES WATER RESEARCH SYMPOSIUM

May 12, 2014

Oregon State University

A Message from the Planning Committee

This year, the Hydrophiles Symposium planning committee set out with three goals in mind: increase the number of students presenting, increase the number of schools represented, and increase the diversity of outstanding student research expanding the fields of water science, engineering, policy, and management. We're proud to say that we've exceeded expectations for all three. Further, the symposium expanded from a statewide event to a regional event, welcoming students from the states of Washington and Idaho for the first time.

Symposium Planning Committee

Tim Oravec (Chair)
Matt Cooper
Becca Miller
Tom Mosier
Caroline Nash
Kylie Pace
Lauren Smitherman
Leah Tai

By moving the symposium in this direction, we reinforce the Symposium's underlying mission: showcase extraordinary student research to exchange knowledge and foster connections between the next generation of leading water professionals.

This year's symposium would not be possible without the generous support of our sponsors. The planning committee would like to express our deepest gratitude to the Institute for Water and Watersheds, the Oregon State University Water Resources Graduate Program, the Oregon State University College of Earth, Ocean, and Atmospheric Sciences, the Oregon Climate Change Research Institute, WEST Consultants, Inc., Decagon Devices, McMenamin's on Monroe, Michael Campana, Andrea Carson, Todd Jarvis, Vanessa Prachack, and Mary Santelmann. We are also indebted to Jen Cohen, OSU Catering, the OSU Foundation, and CH2M HILL for the assistance and support that helped make the symposium possible.

We hope you enjoy this year's symposium! Please see a planning committee member at the registration desk if you have any questions about the symposium or its sponsors, suggestions for improving the symposium in future years, or would like to help organize next year's event.

Sincerely,
The Hydrophiles Symposium Planning Committee

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.

Contact:

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

WATER RESEARCH SYMPOSIUM 2014 PROGRAM

Sponsors of the 4th Annual Hydrophiles Water Research Symposium

OSU Oregon State University Institute for Water and Watersheds

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WATER RESEARCH SYMPOSIUM 2014 PROGRAM

SYMPOSIUM SCHEDULE

8:30 – 9:00: *Registration*

9:00 – 9:15: *Opening Remarks*

9:15 – 10:30: *Oral Session I*

10:30 – 11:30: *Poster Session I*
Posters may be on display from 8:30 until 12:30

11:30 – 12:45: *Oral Session II*

12:45 – 1:45: *Lunch Break*
Lunch will be provided to registered presenters only.

1:45 – 3:00: *Oral Session III*

3:00 – 4:00: *Poster Session II*
Posters may be on display from 1:45 until 7:00

4:00 – 5:15: *Oral Session IV*

5:15 – 5:30: *Afternoon Break*

5:30 – 6:30: *Oral Session V*

6:30 – 7:00: *Awards, Closing Remarks & Reception*

Notes:

- All poster presentations will be in Cascade Ballroom A.
- All oral presentations will be in Cascade Ballroom B
- Registration, snacks, lunch, and sponsors information will be conducted in the Foyer.

WATER RESEARCH SYMPOSIUM 2014 PROGRAM

ORAL SESSION I **9:15 - 10:30**

Luis Angel Gomez Cunya	OSU	Investment Time for Flood Control Under Uncertainty: A Real Options-Based Framework
Brian Henn	U. of Wash.	Doing Hydrology Backward to Estimate Mountain Precipitation Patterns from Streamflow
Hongxian Yan	PSU	Flood Frequency Analysis: A Spatial Bayesian Hierarchical Model
Stephen Drake	OSU	Wind-Enhanced Vapor Exchange through Surface Snow
Mu Xiao	U. of Wash.	A High Resolution Drought Monitoring and Prediction System for the Pacific Northwest Region

ORAL SESSION II **11:30 - 12:45**

Theresa Ring	OSU	A Comparison of Modeling Schemes for Creating Daily High-Resolution Evapotranspiration Maps Using Remote Sensing
Schyler Reis	OSU	Ecosystem Analysis of Wetland and Riparian Zone Restoration at the Hart Mountain Antelope Refuge over Twenty Years
Becca Miller	OSU	Relating Road Hydrology to Sediment Yield: A Case Study in the Hinkle Creek Watershed
Colleen Barr	OSU	Water Vapor and Carbon Dioxide Fluxes at the Field Edge
Jon Sanfilippo	OSU	Using Passive Integrated Transponders to Represent Sediment Transport in an Active Natural Channel

ORAL SESSION III **1:45 - 3:00**

Andrea Carson	OSU	Investments in People or Technology: A Case Study of Public Participation in the Remediation of Dian Lake in Yunnan, China
Kathleen Moore	OSU	The Value of Stored Water to Summertime Recreational Uses of Reservoirs in the Willamette River Basin
Thomas Ptak	U. of Oregon	Dams and Development: Understanding Hydropower in Far Western Yunnan Province, China

Laura Hempel	OSU	A Comparison of Hydrology and Channel Hydraulics in Headwater Streams of the Central Oregon Cascades
Sheila McAtee	U. of Idaho	Canal Seepage Effects on Water Price for Surface and Ground Water Users: Quantifying Two Conjunctive Use Hydrologic Externalities

ORAL SESSION IV **4:00 - 5:15**

Kiley Seitz	OHSU	Dynamics of Ammonia Oxidizing Archaea in the Columbia River Estuary
Jeff Brittain	PSU	The Response of Plankton Communities in Lakes of Different Fish Stocking Histories to Atmospheric Nitrogen Deposition Simulation
Nicole Alfafara	PSU	Harmful Algal Blooms in Shallow Urban Lakes: Drive by Temperature or Nutrients?
Hayley Corson-Rikert	OSU	Carbon Dynamics in the Hyporheic Zone of a Headwater Mountain Stream in the Cascade Mountains, Oregon
Nicholas Dosch	OSU	Dynamics of Stream and Hyporheic pCO2 in an a Forested Catchment in Western Oregon, USA

ORAL SESSION V **5:30 - 6:30**

Sarah Praskievicz	U. of Oregon	A Hierarchical Modeling Approach to Simulating the Geomorphic Response of River Systems to Climate Change
Mousa Diabat	OSU	Stream Temperature between Climate and Restoration
Chris Frans	U. of Wash.	Modeling the Past, Present, and Future Role of Glacier Melt in the Hood River Basin, OR
John Hammond	OSU	Trends in Streamflow Above and Below Dams Across the Columbia River Basin from 1950 to 2012: Assessing Sub-basin Sensitivity

WATER RESEARCH SYMPOSIUM 2014 PROGRAM

POSTER SESSION I **10:30 - 11:30**

Zhuoran Duran	U. of Wash.	Assessing Climate Change Impacts on Flood Risks at Culverts in Northern Cascadia
Yixin Mao	U. of Wash.	Analysis of the Current Drought in California, a Historical Context
Cody Miller	Wash. St. U. - Vancouver	Modeling Nitrogen Dynamics in the Columbia River Basin
Dan Pike	OSU	Heteroaggregation of Gold Nanoparticles with Model Colloids and the Influence of Environmental Aqueous Chemistry
Ariana Chiapella	PSU	Non-Native Trout and PCBs: A Double Dose of Trouble for Montane Lake Food Webs
Giovanny Mosquera	OSU	Hydrologic-Landscape Interconnections in the Humid Andes: Understanding Hillslope Hydrological Dynamics in a Páramo Ecosystem
Thomas Mosier	OSU	High-Spatial Resolution Projections of Monthly Precipitation and Temperature and Application to Water Resources Forecasting
Kimberly Yazzie	PSU	Estimating Recharge in the Upper Umatilla River Basin for Tribal Water Management using the Precipitation Runoff Modeling System
Austin Hall	OSU	Using DTS to Model and Predict Stream Temperatures on the Middle Fork of the John Day River
Leila Barker	OSU	Effects of Silver Nanoparticle Exposure on Biofilms of the Nitrifying Bacterium Nitrosomonas europaea
Robert Pennington	OSU	Physical and Biological Controls of Stream Respiration in Relation to Stream Morpholog
Elnaz Hassanpour Adeh	OSU	Investigation of the Effect of Wind Turbines of Evapotranspiration Using Satellite Data
Stacey Garrison	OSU	Ecohydrological Optimization of Agricultural Best Management Practices
Grant Livingston	OSU	Green Infrastructure for Stormwater Treatment
Jennifer Lam	OSU	Dose of Reality: What Can We Learn from Pet Owners to Guide More Effective Environmental Stewardship of Pharmaceutical and Personal Care Products (PPCPs)?
Adriana Piemonti	OSU	Feedback Evaluation of a Web-Based Watershed Planning Tool for Distribution of Conservation Practices
April Strid	OSU	The Linkage Between Soil, Soil Water, and a Stream in a Western Cascade Forest, Oregon

WATER RESEARCH SYMPOSIUM 2014 PROGRAM

POSTER SESSION II **3:00 - 4:00**

Caroline Nash	OSU	Response of Stream/Meadow Hydro-Systems to Artificial Beaver Dams, Silvies Valley, Oregon
Jason Silvertooth	OSU	Evaluation of Copper Removal from Stormwater Runoff using Compost and Apatite II
Michelle Maier	OHSU	Role of Phytoplankton Parasites in Food Webs of the Columbia River Estuary
YunJi Choi	OSU	Three-Dimensional Numerical Study of the Turbulent Flow Structures Present in Air-Water Geyser Flows
Lauren Smitherman	OSU	A Hydrogeographic Groundwater Analysis of Arsenic in Harney County, Oregon
Parnian Hosseini	OSU	A Multi-Objective Optimization for the Operation of Multi-Reservoir Systems under Uncertainty
Erica Kemp	OSU	Sediment Transport Prototypes: Novel Methods to Disconnect Roads from Streams
Luis Angel Gomez Cunya	OSU	A Domain Decomposition strategy for Unsteady Flow Routing in River Systems
Kyle Neumann	OSU	Development of Osmotic Sampling Systems for Chemical and Microbial Characterization of Marcellus Shale Flow-Back Waters
Kaitlin Goldsmith	PSU	Information Needs Assessment for Coastal and Marine Management and Policy in the Pacific Northwest (INACaMMP)
Sam Cimino	PSU	Investigating Shifts in Food Web Position of Benthic Invertebrates Due to New Zealand Mud Snail Invasion in Freshwater Lakes and Brackish Estuaries
Davis Hernandez-Alvarez	OSU	Fluvial Geomorphology of a Newly Constructed River Channel
Alan Stanton	OSU	Influence and Uncertainty: Investigating Interrelations between South Asian Monsoon Season and Flow Extremes in the Himalayas
Claudia Tausz	OHSU	Potential cyanoHAB (Cyanobacterial Harmful Algal Bloom) Threats to Ecosystems of the Lower Columbia River
Amanda Mather	OHSU	Influence of Catchment Characteristics on Event-Based Stream Turbidity-Discharge Loop Behavior
Andrew Wentworth	OSU	Modeling Water Quality for Alternative Future Scenarios
Emily Smith	PSU	Artificial Glaciers in the Northwest

ORAL SESSION I **9:15-10:30**

Luis Angel Gozem Cunya OSU	Investment Time for Flood Control Under Uncertainty: A Real Options-Based Framework

Making decisions for flood control investment is challenging. This difficulty is because some of the variables involved in the problem have uncertainty in them. 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 to evaluate the financial value of having flexibility for deciding the time of investment in flood control. The framework considers the uncertainty associated with future water discharge events. Extreme water discharges are responsible of flooding events. The water discharges are considered as the random variable. The historical information of these variables is used to estimate the probability of future events. A lattice of options based in the probability of future events of the random variable is built. The inputs are: The area of analysis, the design water discharge value for a given return period, the project lifetime, the damage cost for different flood events, the interest rates and, discount rates. The option of delaying the investment is analyzed by calculating the payoffs of cost and benefits of each option. A hypothetical application is presented to validate the effectiveness of the proposed model. The results have shown an optimum time to invest for flood control.

Brian Henn University of Washington	Doing Hydrology Backward to Estimate Mountain Precipitation Patterns from Streamflow

Precipitation in mountain watersheds is difficult to measure accurately over large areas due to its spatial variability, which is not captured well by the sparse network of gauges located at high altitudes. The majority of gauges are located at low elevations, and higher-elevation gauges may have limited accuracy due to maintenance difficulties during the snow season. Therefore, predictions that rely on mountain basin-average precipitation, such as flood and water supply volume forecasts, often have large uncertainty. However, other point observations are made more reliably in these areas, including streamflow measurements. Therefore, we propose a method of retrospectively using observations of streamflow to infer basin-averaged mountain precipitation. We use streamflow observations to estimate basin-averaged annual precipitation for three Yosemite National Park (CA) watersheds. In a Bayesian framework, we assume that errors in streamflow observations were small in comparison with those in precipitation measurements. Thus, we can assess the likelihood of the precipitation observations being representative of the basin, given our observations of streamflow. We apply a conceptually-simple hydrologic model of snowpack, soil water storage and runoff in order to determine this likelihood. We use a Markov Chain Monte Carlo (MCMC) routine to sample the rainfall PDF, providing an improved estimate of basin-average precipitation and its confidence bounds compared to gauge records alone. The results indicate that it is possible to infer precipitation patterns over a watershed from seasonal streamflow quantities and timing. We are able to infer both the climatological basin-average precipitation and examples of year-to-year deviations from the average in the Yosemite region. We compare our findings to other basin-average precipitation estimates (PRISM and weather model output). Annual scale spatial deviations from precipitation climatology are currently difficult to identify; our approach could identify storm patterns that lead to such deviations and thus improve future forecasts.

Hongxian Yan Portland State University	Flood Frequency Analysis: A Spatial Bayesian Hierarchical Model

Statistical analysis of the hydro-climate events (precipitation, flood, etc.) is an important issue for water resources management. The standard at-site flood frequency analysis is generally limited by the few available data. As a result, combing additional types of information into flood frequency analysis has received

increasing attention over the past decade, such as the available historical information, possibly paleofloods, expert judgment, spatial information on floods in neighboring gages, etc. Regional frequency analysis (RFA) is a common method to borrow information from the neighboring gages, with the concept "trading space for time". However, RFA receives criticism because of several unverified assumptions. As an alternative, the Bayesian method can provide an attractive way to estimate the uncertainties of parameters and percentiles by combining various pieces of information, without the implicit RFA assumptions.

In this study, we propose a spatial Bayesian hierarchical model for flood frequency analysis. Instead of relying on the delineation of implicit homogeneous regions, the Bayesian hierarchical method describes the spatial dependence in its inner structure. Like the classical Bayesian hierarchical model, the process layer of our model presents the spatial variability of the parameters by considering different covariates (drainage area, elevation, precipitation, etc.). A standard process of covariates selection is also proposed in the Bayesian hierarchical model. The performance of the Bayesian model is assessed by a case study over the Willamette River Basin in Pacific Northwest (PNW), U.S. The uncertainty of different flood percentiles can be quantified from the posterior distributions using Markov Chain Monte Carlo (MCMC) method. Our results indicated that the combination of historical information in the Bayesian hierarchical model can reduce the uncertainties of the flood percentile estimators. Temporal changes for the 100-year flood percentiles are also examined using a 20- and 30-year moving window method. The calculated shifts in flood risk can aid future water resources planning and management.

Stephen Drake OSU	Wind-Enhanced Vapor Exchange through Surface Snow

Snowmelt is a key water resource across local, regional and global scales. Despite scrutiny by direct field-measurements and model simulations, quantifying wintertime snow loss by sublimation and evaporation has proven difficult partly because we do not adequately understand how wind ventilates surface snow. Since snow is a porous medium, wind-generated momentum can pass through the surface, enhancing mixing between the saturated air within the snow pore space and air above the snowpack surface. We deployed a sonic anemometer to acquire above-snow surface winds and pressure transducers to measure subsurface footprints of the wind and examined correlations between these measurements. We also measured the concentration of a tracer gas (carbon monoxide) released within the snow to examine dispersion characteristics as they related to wind forcing. We anticipate that these results will enable us to better quantify wind-enhanced vapor exchange through the snowpack.

Mu Xiao University of Washington	A High Resolution Drought Monitoring and Prediction System for the Pacific Northwest Region

The Pacific Northwest (PNW) region in North America (defined here as the Columbia and Klamath River basins plus the coastal drainages) is a diverse geographic region with complex topography and a variety of climates. Agriculture (dryland and irrigated), forestry, fisheries, and hydropower provide
significant economic benefit to the region and are directly dependent on the availability of sufficient water at the right time. Additional demands are made on water supplies by recreation, ecosystem services and emerging needs such as hydropower generation in support of wind energy integration. Several major droughts have occurred over the region in recent decades (notably 1977, 1987, and 2001), which have had significant consequences for the region's agricultural, hydropower production, and environment. An emerging need for the region is the coordination of existing regional climate activities, including a better awareness of the current water availability conditions across the region.

The University of Washington has operated a surface water monitor for the continental United States
since 2005, which provides near real-time estimates of surface water conditions at a spatial resolution of 1/2 degree in terms of soil moisture, snow water equivalent, and total moisture based on a suite of land surface

models. We have recently extended this work by implementing a system for the entire PNW region at a much higher resolution of 1/16 degree. The PNW system also provides seasonal volume forecasts based on the ensemble streamflow prediction (ESP) method for selected locations in the Columbia and Klamath river basin. To make the drought measures relevant to water managers, surface water conditions are not only reported on a gridded map, but watershed-level drought summary indices are reported for larger aggregates as Hydrologic Units from USGS and National Hydro Network Work Unit from Geobase. We explore the ability of the system to reproduce historic droughts for the period since 1920 and analyze regional differences in drought dynamics within the PNW. We also evaluate the additional leadtime that the system would have provided had it been available relative to official drought declarations.

ORAL SESSION II **11:30-12:45**

Theresa Ring OSU	A Comparison of Modeling Schemes for Creating Daily High-Resolution Evapotranspiration Maps Using Remote Sensing

METRIC retrieves ET as the residual of the surface energy balance at the time of satellite overpass using visible and thermal infrared (TIR) bands from Landsat satellites together with ground-based measurements. The Fusion scheme differentiates the energy balance into soil and canopy components to estimate energy fluxes with both Landsat and MODIS-retrieved readings. The infrequent Landsat and daily MODIS ET maps are then combined to generate Landsat-scale images at daily intervals. No ground-based measurements are necessary for the Fusion scheme. Both models will be used to estimate surface energy fluxes over Tonzi Ranch in California and Duke Forest in North Carolina. The fluxes at each site will be validated with flux tower observations before being compared to each other. ET resulting from the models will be compared at temporal scales ranging from instantaneous to seasonal cumulative and at spatial scales at the tower footprint and over the whole study domain.

Schyler Reis OSU	Ecosystem Analysis of Wetland and Riparian Zone Restoration at the Hart Mountain Antelope Refuge over Twenty Years

Hart Mountain National Antelope Refuge (HMNAR) was founded in 1936, and the 101,000 hectare refuge was grazed by domestic livestock from the 1870s until their exclusion in 1990. Just prior to removal, photopoints were taken at various riparian and wetland locations throughout the refuge to document degradation due to domestic livestock. The objective of this research was to re-locate and re-photograph these photopoints, collect associated stream channel data in the riparian systems, and estimate the change in channel width and depth with and without livestock. Photopoints (N=23) were selected based on several criteria: (i) sufficient distinct background features necessary to allow relocation, and (ii) evidence of degradation. Of the 23 photopoints, 12 pairs of stream channel data (riparian systems) could be quantified using field data (current) and images (historical and current).

In historical photos of the riparian areas very little native vegetation is evident, bare ground cover is high, the vegetation is trampled, and the stream channel is highly eroded. In contrast, current images of the photo points show: a reduction in exposed bank, a return of stream side vegetation including willows (Salix spp.),and a widening of riparian vegetation. In the historic photos of the wetlands the ground is bare and disturbed. In the current photopoints vegetation has returned and the total area of the wetland appears to have increased. In the uplands there is encroachment of Western Juniper (Juniperus occidentalis).Over twenty years of cattle exclusion has lead to dramatic changes in stream channel width to depth ratio. The mean width to depth ratio of the remnant channel was found to be much higher (mean 11.3, SD 4.83) than the current channel's ratio (mean 3.8, SD 1.84, p= 0.001).

Becca Miller OSU	Relating Road Hydrology to Sediment Yield: A Case Study in the Hinkle Creek Watershed

Forest roads are a source of fine sediment, transported through roadside ditches during rainfall events to nearby streams and rivers. This increase in the level of suspended sediment particles decreases water quality and puts a strain on aquatic species by altering in-stream habitat suitability. In response to this, many studies have been completed over the last several decades to document the site conditions that most influence sediment production in order to minimize impacts of forest operations. Most of these studies have quantified "lump sum" values of sediment yield, and have not considered how erosion rates change between storms events. In this study continuous turbidity and road runoff measurements were taken within roadside ditches across the actively managed Hinkle Creek Watershed, in the Southern Oregon Cascades during the winters of 2012 and 2013. The high temporal resolution of this data allowed for a quantification of sediment production between sites on a storm-by-storm basis as well as the yield over a period of several months. Road hydrology, defined as being either a seasonally continuous, "intermittent" flow or a rainfall generated, "ephemeral" flow was included in the analysis as a factor that can be used to identify high priority roads that require erosion control structures or additional mitigation.

Colleen Barr OSU	Water Vapor and Carbon Dioxide Fluxes at the Field Edge

Understanding how water vapor and carbon dioxide concentrations vary near a field edge can affect management decisions, as growers seek to maximize yield while minimizing water use in a spatially variable landscape. These conditions are particularly relevant when land surface conditions transition sharply from desert to irrigated field. In this circumstance, advection cannot be neglected and an internal boundary layer of water vapor concentration is predicted to develop. For a step-change in surface humidity conditions, an analytical solution to predict water vapor concentrations has previously been developed and experimentally tested. This solution of the steady-state advection-dispersion equation can be modified to consider more realistic boundary conditions and modeled numerically. Some researchers have hypothesized that plants modulate their stomata to maximize their carbon dioxide uptake while minimizing their water vapor loss. These coupled fluxes are then modeled via Fickian diffusion. The analytical solution predicts that plants will experience the largest vapor pressure deficit at the field edge, which could cause the stomata to close for a greater fraction of the time. This would minimize the evapotranspiration at the field edge while also minimizing the carbon dioxide uptake, leading to reduced yield. This presentation will discuss preliminary modeling results that link the advection-dispersion equation with the flux boundary condition predicted by the stomatal optimization hypothesis.

Jon Sanfilippo OSU	Using Passive Integrated Transponders to Represent Sediment Transport in an Active Natural Channel

To understand sediment transport in mixed sand and gravel fluvial systems, data obtained in natural systems with varying formations consisting of bedrock, cobble, mixed gravel, and sand substrates is required. To create a dataset that will accommodate all of the variables and bed forms necessary to model sediment transport, real time sediment tracking correlated with local hydrologic data will need to be assembled. In a 3rd order channel in the Oregon Coast Range, a study is being undertaken to institute fixed radio frequency antennas (8 antennas spaced along a ~100m reach of stream) alongside pressure transducers (stored in the bank within piezometers located between each antenna) with detailed surveys using Agisoft (a 3 dimensional texture mapping program with results similar to LiDAR) to accommodate the data necessary to better represent, understand, and model sediment transport in varying substrate conditions. This project will correlate stage and discharge relationships to real time individual particle entrainment and movement of over 800 individually

tagged rocks as small as 11mm (the intermediate axis) distributed above and within the antenna array.

ORAL SESSION III **1:45-3:00**

Andrea Carson OSU	Investments in People or Technology: A Case Study of Public Participation in the Remediation of Dian Lake in Yunnan, China

Environmental problems are compounding in China with industrial discharges and household sewage being the main sources of water pollution in the country. From the 1960s to 1990s, the water quality of Dian Lake (滇池), China's sixth largest freshwater lake located outside the capital of Yunnan Province, Kunming City, rapidly declined. This decline resulted in eutrophication, decreased water availability, livelihood disruption, and biodiversity loss. Despite significant investments in pollution-control programs and restoration projects to improve the quality of the lake, only small water quality improvements have been made. In areas where no technical solution seems to fully eliminate the existing water quality issues, social consensus and knowledge exchange between stakeholders are important to the lake basin planning process. In many examples of lake basin management, the general public are stakeholders; however in China's authoritarian system, societal actors such as the general public play a limited role in the management process. Therefore, this study examines the available opportunities in the pollution control projects at Dian Lake for knowledge dissemination and consensus-building between restoration project planners and the residents of two residential areas bordering Dian Lake: Yanjia Village and the town of Haikou. The qualitative assessment of the project planners' and villagers' interactions and participation in the Dian Lake restoration process also elucidates how the level of inclusion of the villagers has affected their knowledge about, support of, and compliance with the restoration efforts on Dian Lake.

Kathleen Moore OSU	The Value of Stored Water to Summertime Recreational Uses of Reservoirs in the Willamette River Basin

The objective of this study is to empirically estimate the value of summertime recreational uses of reservoirs in the Willamette River Basin (WRB) as part of a larger study on optimal reservoir management under climatic and social change. The USACE operates a system of 13 reservoirs in the WRB to serve two main competing purposes: flood control during winter and spring, and storage of spring runoff for summertime recreation, irrigation, municipal supply, and instream flows. Optimal management of the reservoirs to maximize society's net benefits implies balancing the marginal benefits from storage against the marginal benefits from flood control. The choice of reservoir fill levels on any given date can be seen as weighing the expected benefits based on the probability distributions of anticipated future streamflows. This research estimates the marginal value of stored water for summertime (June-August) recreation based on a panel analysis of observed monthly visitation across 11 years and 9 reservoirs. This analysis was able to estimate the response in visitation to changes in reservoir fill level. These results were combined with published estimates of individuals' willingness-to-pay for this kind of recreation (Loomis 2005), to assess the value per acre-foot of water to recreation. The results of this model reflect how the recreational benefits of reservoir management are affected by lower fill levels. Low water levels resulted in declines in visitation in some but not all of the reservoirs. The largest effects occurred at the Fall Creek and Fern Ridge reservoirs, which showed reductions in visitation of 1-3% per foot drop in water level below maximum fill. The average effect across all reservoirs was a reduction of 0.65% per foot. The implicit value of water associated with this response ranges from $4-$19/af given historical visitation levels. In comparison the value of water per acre-foot to irrigated agriculture in the WRB has been estimated to average $17/af. Continuing research will quantify the marginal benefits associated with the other reservoir uses (stored water for summer agricultural and urban uses, and flood control) and investigate adjusting the reservoir rule curves to balance these benefits.

Thomas Ptak University of Oregon	Dams and Development: Understanding Hydropower in Far Western Yunnan Province, China

Studies of Chinese hydropower and the broad range of accompanying influences on community or regional development have focused disproportionally on macro-scale projects, specifically mega-dams. Big projects are an important part of China's transformation, as they have provided large parts of the country with significant amounts of power both in terms of economy and energy and, as a result, continue to feed China's industrial capacity. The very size of these projects should not, however, obscure other developments that are also of significance; small hydropower, specifically dams with an operating capacity under 25 Megawatts. In recent years the development of small dams has increased rapidly, especially in China. Driving the increase is the belief that small dams are an environmentally sound alternative to burning coal, which contributes to China's much publicized air quality issues and global climate challenges. Additionally, small dam infrastructure is scalable; implementation can take place wherever minimal hydrologic resources occur and the deployment of small dams is often technically and economically feasible. However, despite the significance of these small-scale projects, research to date has overwhelmingly focused on mega projects. As a result of this 'tunnel vision,' an integral component of broader China's hydropower picture has received inadequate attention and remains little known. This research investigates small-scale hydropower in a rural and remote corner of the Nu River valley, located in far Northwest Yunnan Province, in order to evaluate how effective they have been in promoting development for small communities. Furthermore, this project analyzes the role small dams play in contributing to China's broader energy security demands, while assessing impacts on local environments.

Laura Hempel OSU	A Comparison of Hydrology and Channel Hydraulics in Headwater Streams of the Central Oregon Cascades

Streams with distinctly different flow regimes can be found within close proximity of each other in the Central Oregon Cascades due to the unique hydrogeology of the region. Spring-fed streams with stable discharge regimes tend to have rectangular cross-sections, uniform grain sizes, and frequent channel-spanning wood. In contrast, flashier surface-runoff channels tend to have more variable cross-sections, a wider grain-size distribution, and woody debris accumulations along channel margins. To examine differences in channel hydraulics, we collected high-resolution 3-D maps of 12 channel reaches from tributaries of the McKenzie and Metolius Rivers, OR. Stream channel maps were then used to run a 2-D channel stability model (MD_SWMS). We also compared stream hydrology using 10+ years of stream gage data. We expect bed particles are mobilized more frequently in spring-fed systems, but the opportunity for channel form development— which occurs when sediment is mobile and when flow reaches or exceeds the active channel flow—is higher in surface-runoff channels. Therefore, each channel-type is characterized by a unique set of hydraulic processes that lead to observed differences in channel form.

Sheila McAtee University of Idaho	Canal Seepage Effects on Water Price for Surface and Ground Water Users: Quantifying Two Conjunctive Use Hydrologic Externalities

The interdependence between groundwater pumpers and nearby surface water users presents a unique conjunctive water use issue. Economic gains or losses caused by interconnected water supplies are called hydrologic externalities. Failing to account for externalities in water regulation conducted by local and federal agencies may result in unintended economic harm for all parties. Existing hydro-economic models incorporate conjunctive use externalities by introducing an ambiguous, non-specified function. The lack of methodology

available in quantification of conjunctive hydrologic externalities is partially due to a disconnect between hydrologic and economic methodologies. Hydrologists may quantify conjunctive water flows in ways that are too complex for use in economic analysis. Alternately, economists may represent hydrologic externalities in optimization models without incorporating an accurate physical processes. This paper explores a model that represent both physical and economic aspects of externalities faced by both surface and groundwater users in a conjunctive use system. This requires close work and compromise between hydrologists and economists, and a lot of complex, unique math. Connecting water supply with cost in a two-way conjunctive setting poses unique challenges in the construction of hydro-economic models. This paper explores the process of quantifying a reciprocal externality using a holistic hydro-economic model, and explains the implications of using a functional form for use in analysis of marginal costs of water.

ORAL SESSION IV **4:00 – 5:15**

Kiley Seitz OHSU	Dynamics of Ammonia Oxidizing Archaea in the Columbia River Estuary

The Columbia River has a large physical and biogeochemical impact on the Northwest Pacific Ocean coastal ecosystems. The Columbia River estuary, which is temporally and spatially dynamic, acts as a bioreactor with most biogeochemical transformations occurring in so-called “hotspots.” Hotspots occur in adjacent lateral bays containing high populations of microorganisms in sediments, and estuarine turbidity maxima (ETM), which are transient sedimentary features that are retentive, allowing for high activity of particle-attached microorganisms. Particulate and metabolite exchanges between the lateral bays and ETM are thought to potentially impact the cycling of nutrients in the estuary. Aerobic ammonia oxidation, the rate-limiting step in microbial nitrification, is performed by ammonia oxidizing archaea (AOA) and bacteria. Studies conducted during multiple summertime periods revealed high numbers of AOA in lateral bay sediments, but relatively low AOA numbers in the estuarine water column except in estuarine turbidity maxima (ETM). We hypothesized that outwash of particles from the lateral bays sediments supply the AOA which are eventually retained in ETM. The abundance of archaeal amoA genes, a molecular marker for AOA, was therefore measured in the lateral bay sediments and estuarine water masses. While greater archaeal amoA gene copy numbers were observed within ETM, amoA gene abundance was not detected in relation to ebb tide particle outwash from the adjacent bays. Our monthly time series analysis of archaeal amoA gene revealed generally high, but variable, AOA numbers in sediments. A tentative correlation was detected between AOA abundance and Potamopyrgus antipodarum, an invasive New Zealand freshwater gastropod that produces high ammonium concentrations and has been reported at high densities in this estuary. In one of the bays AOA was detected in higher quantities in sediment associated with P. antipodarum, relative to sites where the gastropod was absent, suggesting a potential proximity-dependent relationship between P. antipodarum and AOA. If the outwash lacks P. antipodarum associated AOA it may partially explain the negative results. Understanding how these factors affect AOA dynamics in the sediments and water column will shed light on the source and intensity of nutrient flow and its consequence for the microbial communities of the Columbia River estuary.

Jeff Brittain Portland State University	The Response of Plankton Communities in Lakes of Different Fish Stocking Histories to Atmospheric Nitrogen Deposition Simulation

Non-native fish introductions have drastically reduced the number of naturally fishless lakes and have resulted in cascading food web repercussions in aquatic and terrestrial habitats. Planktonic communities have shown declines in response to predation and shifts in composition as a result of nutrient inputs and acidification. Atmospheric nitrogen deposition has been recognized as an anthropogenic contributor to acidification and eutrophication of wilderness ecosystems. This study identified the response of zooplankton communities from

two lakes (fish present vs. absent) in Mount Rainier National Park to manipulations simulating an episodic pulse in mesocosms. The experiment included a 2 x 2 factorial design with acid and nutrient treatments. Treatments resulted in significantly elevated nutrient and decreased pH conditions from control and reference sites over 42 days. Results indicate that zooplankton abundance of both lake types declined in treatments compared to controls, most notably in tanks receiving both nutrient and acid addition. This work can aid management decisions as agencies look to restore more aquatic montane habitats to their historic fishless states, and assess their abilities to recover and afford resistance to atmospheric pollution.

Nicole Alfafara Portland State University	Harmful Algal Blooms in Shallow Urban Lakes: Drive by Temperature or Nutrients?

Harmful algal blooms (HABs) are an ecological, public health and socio-economic problem that threaten the sustainability of freshwater ecosystems. A great deal of research has been performed to identify factors that drive HAB development. However, these studies have been conducted on a single lake, across limited geographic scales or failed to account for watershed development and land-use. Examination for trends in HAB development at different degrees of watershed development is imperative for adaptive HAB management. Shallow urban lakes are considered to be more sensitive to climatic variation (such as increasing temperatures) and stressors (such as enhanced nutrient loading). Despite recreational value and greater vulnerability to HABs, the single most important factor that drives bloom formation in shallow urban lakes remains unknown. Classification and regression tree (CART) analysis was used to identify the most influential factors in harmful algae presence and density in over 300 shallow urban lakes across North America. Effective HABs management will require acknowledging the synergistic effects and ecological interactions between the primary and secondary drivers in the lake and watershed.

Hayley Corson-Rikert OSU	Carbon Dynamics in the Hyporheic Zone of a Headwater Mountain Stream in the Cascade Mountains, Oregon

This study investigated carbon dynamics in the hyporheic zone of a steep, forested catchment in the Cascade Mountains of western Oregon, USA. Water samples were collected monthly from a headwater stream and well network from July to December 2013. The well network spans the full width of the floodplain (~15 m) along a 25-m reach of stream. We measured pH, temperature and water level on-site, and measured concentrations of major anions, cations, DOC, DIC, and alkalinity in the laboratory. Flow paths, travel time to wells and hydraulic conductivity were available from previous studies. Preliminary analyses indicate that DOC is lost from stream water via hyporheic exchange flow. Loss of DOC increases with median travel time, suggesting that DOC is metabolized in the hyporheic zone. Observed DIC concentrations also increased with travel time, but the magnitude of this increase in DIC was too large to be explained by conversion of DOC. This suggests that there is an additional source of DIC to the subsurface system. During storm events, the riparian zone appears to become a source of DOC to the stream.

Nicholas Dosch OSU	Dynamics of Stream and Hyporheic pCO2 in an a Forested Catchment in Western Oregon, USA

Rivers play an important role in carbon transportation and geochemical processing and may represent a significant source of carbon dioxide to the atmosphere. However, it remains unclear how stream pCO2 varies temporally and which factors influence gas flux. We collected high resolution time-series measurements of stream and riparian-hyporheic pCO2, stream discharge, and stream temperature starting August 2013 in a temperate, forested catchment (HJ Andrews) in Western Oregon, USA. Results show strong seasonal variability in hyporheic pCO2, and strong seasonal and diel variability in stream pCO2. Event-driven discharge (rain and snowmelt) also influence both stream and hyporheic pCO2. Stream pCO2 is elevated during base flow conditions

and at night, and, other conditions being equal, when the stream is warmer. Stream and hyporheic water were found to be supersaturated with respect to the atmosphere at all times.

ORAL SESSION V **5:30 – 6:30**

Sarah Praskievicz University of Oregon	A Hierarchical Modeling Approach to Simulating the Geomorphic Response of River Systems to Climate Change

This research investigates how future climate change may affect the fluvial geomorphology, or physical form, of rivers. Climate change and variability is widely acknowledged as a major factor influencing river flow, particularly in mountainous watersheds in which snowmelt makes a large contribution to the annual discharge. Potential climate change-driven changes in the hydrology of such rivers have been simulated by hydrologic models. This research contributes to better understanding of the geomorphic response of river systems to climate change through development of a hierarchical series of linked models to investigate how climate change influences hydrology, which in turn influences fluvial geomorphology. This modeling framework was applied to three snowmelt-dominated watersheds (the Tucannon River in Washington and the South Fork Coeur d'Alene and Red rivers in Idaho) in the interior Pacific Northwest, with the following objectives: 1) development of downscaled climate change scenarios, which are projections of future changes in climate variables such as temperature and precipitation that are locally specific to the study basins; 2) application of a watershed-scale hydrologic model to project how the study basins' hydrology, including the magnitude and timing of river flow, may change in response to the downscaled climate change scenarios; and 3) examination of the impact of the modeled hydrologic changes on the study rivers' morphology – sediment transport, channel geometry, and planform– using a reach-scale geomorphic model that can simulate an individual river segment in greater detail than that from a watershed model. The downscaled climate change scenarios for the study basins include increases in maximum temperatures of 2.2-2.4°C in January and 3.2-3.5°C in July, increases in minimum temperature of 2.9-3.8°C in January and approximately 2.7°C in July, and changes in precipitation of -2.8% to -1.0% in January and -17.1% to -20.3% in July. Hydrologic modeling results indicate greater seasonal hydrological variability under future climate change, with increases in winter discharge of 16.3-34.4% and decreases in July discharge of 5.2-47.2%. This hierarchical modeling process is an innovative approach to linking physical processes that occur across multiple scales, from global and regional climate to watershed hydrology to local geomorphology.

Mousa Diabat OSU	Stream Temperature between Climate and Restoration

Stream temperature is an essential physical property of aquatic freshwater habitats all over the world. Restoration practices aim to improve the water quality of sites that were negatively impacted by human activities in the past and to mitigate the influence of future climate conditions. Common restoration practices influencing stream temperature include replanting riparian vegetation and reconstructing channel meanders. We examined stream temperature along 1.5-km stream section along the upper part of the Middle Fork John Day River, Oregon, USA. Our study section was straightened due to activities of dredge mining for gold and timber harvest across its floodplain. Restoration designs ask for restoring both the channel structure and the riparian vegetation. We used the software Heat Source to simulate stream temperature in 12 scenarios that represent current climate, 4°C warmer air, current riparian vegetation (low effective shade), medium effective shade, high effective shade, existing channel and restored channel. Our results indicated restoring the channel will increase stream temperature peaks both under low and high effective shade conditions regardless of air temperature. However, restoring the channel decreased stream temperature peaks under medium effective shade, also regardless of air temperature. In addition, results indicated that restoring riparian vegetation was sufficient to mitigate the influence of warmer air on stream temperature, while restoring the channel the channel alone did not. Heat budget analysis showed that the restored channel was longer, narrower, and deeper

than the existing channel and led to more heat accumulation during the daytime, which caused higher stream temperatures.

Chris Frans University of Washington	Modeling the Past, Present, and Future Role of Glacier Melt in the Hood River Basin, OR

In glacier fed rivers, glacier melt can be an important source of stream water during low flow periods. It is especially important during dry years when a greater area of glacier surfaces is exposed to melting for longer durations during the melt season due to a reduction in seasonal snowpack. As glacierized watersheds respond to a warming climate this contribution is expected to increase initially; however eventually declines in glacier area lead to a reduction in glacier derived discharge. We describe an application of a coupled hydrological and glacier dynamics model to predict the implications of glacier change in the Hood River Basin in Northwest Oregon. Melt water from glaciers on the northern flanks of Mount Hood is a vital source of irrigation water for orchards in the basin as diversions for irrigation are located in close proximity to the glaciated headwaters, and there are no large storage reservoirs. Our model construct provides continuous simulations of glaciological processes (mass accumulation and ablation; lateral flow of ice) which are directly linked with seasonal snow dynamics as well as other key hydrologic processes (evapotranspiration; subsurface flow). We apply the model for the historical period 1916-2010, and reconstruct patterns in the glacier melt contribution to summer streamflow throughout the basin. Historically, we find that glacier melt has the highest contribution to dry season discharge at agricultural diversion locations in the Upper Middle Fork during dry years, 1924 (77%), 1987 (73%), 1991 (68%), 1994 (70%), and 2001 (72%), and displays a mean annual maximum contribution of 49%. At these upland sites, decreasing trends in the modeled total dry season discharge (-4%/decade) have occurred due to increases in air temperature (1970-2010). However, these declines can be traced to decreased runoff from snowmelt. In contrast, the contribution of glacier melt to runoff has increased over this period (+23%/decade). We also report on exploratory simulations that track the future trajectory of dry season discharge and the evolving contribution of glacier melt through the 21st century.

John Hammond OSU	Trends in Streamflow Above and Below Dams Across the Columbia River Basin from 1950 to 2012: Assessing Sub-basin Sensitivity

The Columbia River Basin (CRB) is a large topographically and climatologically heterogeneous area with distinct sub-basins. I am continuing to research trends in streamflow above and below dams across the CRB between 1950 and 2012. A total of 30 gauge pairs were analyzed across the basin and each study site within each sub-basin of the CRB had a headwater gauge above dams with a long-term streamflow record, a long-term streamflow record at a gauge downstream of the dam, and a nearby climate station with a long-term record of maximum and minimum air temperature and precipitation. Areas above reservoirs in the CRB are dominated by what may be referred to as the ecological resiliency of natural systems, whereas areas below reservoirs are dominated by the engineered resiliency of primarily anthropogenically-controlled systems. By conducting parametric linear regression and non-parametric Mann-Kendall tests for trend on daily time series of discharge by day of year, it is possible to detect changes in streamflow timing at the temporal resolution of one day. Conducting similar analyses on precipitation, maximum temperature, and minimum temperature from proximal climate stations I aim to assess the ability of various basins to sustain streamflow given changes in climate as well as the sensitivity of representative basins to these changes in streamflow. By comparing the trends in streamflow and climate above and below dams it is possible to assess the capacity of reservoir and dam management to overwrite the signal from headwater flows. Systems with larger reservoirs may have a greater capacity to overwrite a changing signal of above dam flows. This capacity is affected by the primary management goal of the reservoirs including hydropower, flood control, agricultural withdrawals, and recreation. Finally, wavelet and cross-wavelet analyses are used to assess the changes in cyclical activity at each gauge from the

period of 2 days to more than 5 years. These wavelets and subsequent analyses of streamflow correlations aim to assess the relationship between streamflow trends and climate oscillations and wind speeds across the CRB.

POSTER SESSION I **10:30 – 11:30**

Zhuoran Duran University of Washington	Assessing Climate Change Impacts on Flood Risks at Culverts in Northern Cascadia

The long-term success of culverts during their lifespan is critical for both transportation and stream system functions. In this research we use regional hydrologic model data to aid in decision making related to road infrastructure (initially culverts) associated with flooding risks under climate change for North Cascade region of WA. Simulated runoff and baseflow at 1/16 degree using the Variable Infiltration Capacity (VIC) hydrologic model under current climate (1916-2006) were routed and high flows (Q2, Q10, Q25, Q50, Q100) were identified at culvert locations. Comparison between VIC model output and the observed discharges indicates that model results dramatically underestimated the peak flow. Correction factors were derived from relations of historical VIC annual daily peak flows, observed annual daily peak flows, and observed annual instantaneous peak flows. Watershed characteristics are incorporated into the calculation of correction factors and peak discharge is mapped on the DEM. Future work will apply the correction factors for projected peak flow estimations at culvert locations under 2040s and 2080s climate scenarios and thereby, evaluate potential impacts of climate change on culvert performance as well as guide culvert replacement design.

Yixin Mao University of Washington	Analysis of the Current Drought in California, a Historical Context

California is currently experiencing a severe drought that threatens the state's agricultural production, drinking water supply and other sectors dependent on adequate water resources. While it is clear that California's current water crisis is severe, the causes of the drought are still subject to investigation. An ongoing debate focuses on whether the drought can be attributed to climate change, or whether it is simply the result of natural variability, particularly since similar droughts have occurred in the past (e.g., the 1977 drought). To investigate the causes of the drought, we analyze the current drought in California in the context of historical droughts. The analysis is based on gridded precipitation (P), snow water equivalent (SWE), temperature and runoff data from 1920 to 2014 at a spatial resolution of 1/16 degree as generated by the Surface Water Monitor system, operated in near real-time by the University of Washington. Since snowmelt runoff is the primary source of water supply in California, the analysis focuses on areas with significant snow accumulation, which are important to water resources management. Annual time series of cumulative winter precipitation (Nov-Mar), SWE on Mar 23, the ratio of SWE to cumulative winter precipitation, average winter temperature (Nov-Mar) and spring runoff (Apr-Jul) are analyzed for the entire study area. The relationships between SWE versus both winter precipitation and winter temperature are also examined. Since the temperature on days with high precipitation would have the largest impact on snow accumulation, the average temperature anomaly (relative to the average temperature on a given day over the whole period of record) on precipitating days with the largest daily total in each winter is analyzed for grid cells with the highest average SWE. We find that water year 2014 is among the driest five years since 1920 in terms of Nov-Mar precipitation and Mar 23 SWE. The SWE/P ratio in 2014 is the lowest in the 95-year record. Both the average winter temperature and temperature anomaly are above average this year. SWE shows a clear relationship with winter precipitation, but there is no clear relationship between SWE and either winter temperature or temperature anomaly.

Cody Miller	Modeling Nitrogen Dynamics in the Columbia River Basin

Washington State University - Vancouver	

Excessive nitrogen (N) loading in the form of dissolved inorganic nitrogen (DIN) to coastal systems has been linked to significant environmental impacts such as eutrophication and fish kills. Here we present results from a downscaled version of the Global Nutrient Export from WaterSheds DIN model applied to the Columbia River Basin (CRB) and select subbasins. Our regional model performed reasonably well at predicting DIN yield (NSE = 0.55), ranging from 9.5 to 349.2 kg N km-2 yr-1. Both the model output and observed data predict the highest per area DIN yields occurring in the Willamette river subbasin. Total DIN export to the coast was modeled as 0.04 Tg N yr-1 compared to 0.07 Tg N yr-1 calculated from the observed data. Based on current model inputs biological N2 fixation is the dominant source of exported DIN in 12 of the 21 subbasins. N fertilizer is the dominant source of exported DIN for 7 of them, including the CRB as a whole. Sewage and non-agricultural N deposition are the dominant sources for the remaining two subbasins. The model will be used to explore management options that could significantly reduce N export from the CRB.

Dan Pike OSU	Heteroaggregation of Gold Nanoparticles with Model Colloids and the Influence of Environmental Aqueous Chemistry

Nanotechnology is becoming an increasingly important facet in many fields. As this trend continues, it is likely that the volume and variety of nanoparticles released into environmental systems will also increase. Many studies show that nanoparticles can be toxic to an assortment of organisms. This could have a detrimental effect on critical ecosystems. To predict fate and transport in the environment, association of these particles to naturally occurring particles must be examined. These heteroaggregates may settle out of solution and become incorporated with sediment material. Sedimentation also affects the bioavailability of these substances by transporting nanoparticle mass out of the bulk liquid. Stable particles that do not participate in this process will likely be transported over greater distances. This study primarily used citrate-capped gold nanoparticles (Cit-AuNPs) as a model. Hematite and silica were chosen as model colloids because of their prevalence in the environment. Additionally, the role of natural organic matter, pH and ionic strength in the heteroaggregation process was examined. Instrumental analysis was conducted using a combination of dynamic light scattering and electrophoretic mobility measurements. A size-exclusion filtration technique has been combined with inductively-coupled plasma spectroscopy to quantitatively describe the attachment of nanoparticles to colloids. Experimental findings suggest that organic matter has a stabilizing effect in solutions containing hematite and Cit-AuNPs in 1mM KCl solution. However, heteroaggregation was witnessed in relatively high ionic strength conditions. Systems containing Cit-AuNPs and silica were destabilized only in high hardness standard test water. Future work will involve a wider variety of capping agent functionalities and aqueous chemical conditions.

Ariana Chiapella Portland State University	Non-Native Trout and PCBs: A Double Dose of Trouble for Montane Lake Food Webs

High elevation lake ecosystems serve as early warning systems when it comes to understanding how organic contaminants, such as polychlorinated biphenyls (PCBs), affect food webs. The complex interactions of variables that influence energy flow are often difficult to describe, however studying the simplified structure of montane food webs provides for a more tractable method. A data-mining approach was used to assess general trends between PCB burdens in fish tissue and feeding habitat as a means of investigating which areas are associated with higher rates of contaminant uptake. Benthic habitats appeared to be related to higher contaminant burdens, but this exercise yielded a small number of studies, limiting statistical inference. In order to further explore the movement of contaminants in food webs in the context of invasions, food webs of stocked and fish-less montane Cascade lakes will be analyzed for PCBs and stable isotope signatures. By conducting field study in high elevation lakes, this project will seek to further the ecological understanding of contaminants in aquatic

systems by identifying how PCBs enter and move through food webs, and how species invasions affect the distribution of PCBs across food webs.

Giovanny Mosquera OSU	Hydrologic-Landscape Interconnections in the Humid Andes: Understanding Hillslope Hydrological Dynamics in a Páramo Ecosystem

Despite the critical role that water stemming from the Páramo ecosystems plays in the socio-economic development within the Andean region, still very little is known about the hydrological processes which govern their hydrologic functioning. Recent studies have provided a better insight in relation to the sources of water contributing to discharge in these ecosystems, but the role of water moving through the landscape steep slopes in the ecosystems water yield still remains unknown. The study area is the Zhurucay River basin located in the Andes of southern Ecuador. The catchment's drainage area is 7.53 km2 and ranges in elevation from 3200 to 3900 m a.s.l. The soil distribution in the catchment correspond to Andosols mainly located in steep slopes, and Histosols located at the valley bottoms. Information from 34 water content reflectometers and 5 tensiometers will be used for measuring soil moisture content and matric water potential, respectively, in a 20% hillslope located at approximately 3800 m a.s.l. The sensors will be spatially distributed into two gradients within a 24 x 22 m hillslope plot. An electronic rain gauge will be used for recording precipitation intensity. In addition, isotopic (i.e., deuterium and 18O) data from precipitation and soil water will be collected to model the mean residence time (MRT) of water circulating through the organic and mineral horizons of the Andosols (i.e., hillslope soil). Hydrometric data are available at a 5-minute resolution from December 2010, and isotopic data are available at a weekly resolution from May 2011. The objectives of the proposed study are to: 1) estimate the MRT of the water in the hillslope; and 2) model the soil water dynamics. Results will be used to address the following research question: Does water drains preferentially laterally at the top of the hillslope and tend to infiltrate vertically as it moves downslope? Understanding the influence of the hillslope hydrological behavior can help improving the understanding of the Páramo hydrology, and further provide stakeholders and decision-makers with valuable information to improve the management of the water resources at local and regional scale in the Andean mountain range.

Thomas Mosier OSU	High-Spatial Resolution Projections of Monthly Precipitation and Temperature and Application to Water Resources Forecasting

High-spatial resolution climate data are critical for many hydrological and earth science studies. Multiple groups have developed high resolution climate projection datasets for regions of the world such as the United States (e.g. Multivariate Adaptive Constructed Analogs data); however, analogous datasets have not been produced for most data-scarce regions. Herein, a methodology for downscaling General Circulation Model (GCM) data is presented. The methodology can be used with any GCM run associated with the Coupled Model Intercomparison Project Phase 5 (CMIP5). The resulting data are monthly time-series available for all global land surfaces, gridded spatially to 30-arcseconds. The downscaling method uses quantile mapping to bias correct the GCM data and a Delta downscaling approach to distribute it spatially while adding high-spatial resolution climatic relationships to the data. An ensemble of the downscaled projection data are produced, which assists in quantifying the range of possible future scenarios. As an example of these data, downscaled hindcast and projection data are produced for Northern Pakistan and compared to available station data obtained from the Pakistan Meteorological Department for the historic period. The ensemble of projection data is compared to the historic period to highlight a plausible range of future trends in Northern Pakistan. In this region seasonal snowpack and glacier mass balance contribute significantly to seasonal runoff. These data are therefore integral for projecting plausible future trends in seasonal stream water availability in the region.

Kimberly Yazzie Portland State University	Estimating Recharge in the Upper Umatilla River Basin for Tribal Water Management Using the Precipitation Runoff Modeling System

Groundwater recharge in the Columbia River Basalt Group in the Umatilla River Basin, OR, is poorly understood. The long-term decline of groundwater storage and water levels in the basalt aquifers combined with increasing groundwater withdrawals present a serious environmental challenge for the Confederated Tribes of the Umatilla Reservation (CTUIR). This study will provide a groundwater recharge estimate to help CTUIR better understand the hydrologic budget in the upper basin and inform water management decisions for present and future needs. A watershed model using the Precipitation Runoff Modeling System (PRMS) will determine components of the hydrologic budget in a study area that is 913 mi2 over a 30-year period to predict climate change scenarios 30 and 50 years from present. The relationships between hydrologic processes at the surface and soil zones will be studied and defined to estimate groundwater recharge. The effects of increased land use and unusual rain events will be explored as well. This study will contribute to an ongoing collaboration between CTUIR and the U.S. Geological Survey.

Austin Hall OSU	Using DTS to Model and Predict Stream Temperatures on the Middle Fork of the John Day River

Temperature is a key factor for salmonid health and is an important restoration metric on the Middle Fork of the John Day River. In past years, Oregon State University has been involved in a planned-to-be 10-year stream temperature monitoring study to assess peak temperatures during low-flow summer months. Through the use of fiber optic cables it has been possible to record high resolution temperature data at temporal and spatial scales; data which can be used to assess the efficacy of restoration efforts on the reach. Current research has focused on large scale DTS (distributed temperature sensing) installations in the Middle Fork of the John Day River on the Oxbow, Forrest, and RPB properties. In the summer of 2013, 16 km of river was monitored in these regions. Analysis of the data has focused on temperature changes due to recent habitat restoration projects and will seek to connect various hydrological processes in the stream. Predictive models are also being developed to better understand these processes and to predict how stream temperatures might change from variations to the stream and its environment. This can direct stream management actions for the future. The current model uses HeatSource, a tool for managing energy fluxes into and out of the stream. Data collected from onsite weather stations combined with in-stream measurements and physical topography are incorporated into the model to set up boundaries and predict heating and cooling of the stream. This modeled data and then be compared to actual data taken with high precision distributed sensing technology where remaining stream variables can then be calibrated.

Leila Barker OSU	Effects of Silver Nanoparticle Exposure on Biofilms of the Nitrifying Bacterium Nitrosomonas europaea

Silver nanoparticles (AgNP) are increasingly being incorporated into a wide range of consumer products due to their effectiveness as broad-spectrum antimicrobial agents. Research has found that AgNP can be released from consumer products, entering wastewater streams and ultimately reaching wastewater treatment plants. Ammonia oxidizing bacteria (AOB) play a key role in the removal of nitrogen from wastewater influent through the oxidation of ammonia (NH3) to nitrite (NO2-). AOB are sensitive to a range of contaminants. Previous research has shown that Nitrosomonas europaea, a model AOB, is inhibited by both silver ions (Ag+) and AgNP. Most research has dealt with suspended bacterial cells. In biological wastewater treatment systems, N. europaea

often grow in biofilms attached to solid surfaces. Biofilms consist of multiple layers of cells embedded in a matrix of extracellular polymeric substances (EPS). Biofilms have been observed to be more resistant than suspended cells to a range of inhibitors. In this study, N. europaea cells were cultured and grown as biofilms for 4-6 weeks and exposed to either silver ions (Ag+) or AgNP at 0.5 ppm and 1.5 ppm concentrations for 48 hours. Batch-grown suspended cells and resuspended biofilms were exposed to Ag+ or AgNP for 3-hour exposures. Nitrite production was monitored prior to and during exposure and compared to controls to determine the extent of nitrification inhibition. Biuret protein assays and inductively coupled plasma were used to determine the ratio of bound silver to biomass, which was graphed against inhibition levels. Results indicate a correlation between inhibition and the extent of silver uptake by biofilms. Silver ions inhibit nitrification to a greater degree than silver nanoparticles. Intact N. europaea biofilms were found to be much more resistant to silver inhibition than suspended cells or resuspended biofilms. Results indicate that biofilm resistance to silver toxicity may be largely a result of mass transfer limitations. Given the residual activity maintained by N. europaea biofilms during exposure to Ag+ and AgNP, silver nanoparticles are unlikely to cause significant disruption of nitrification processes in wastewater treatment plants.

Robert Pennington OSU	Physical and Biological Controls of Stream Respiration in Relation to Stream Morphology

The hyporheic zone is the interface of groundwater and surface water beneath and adjacent to a stream. The hyporheic zone is a hotspot for biogeochemical reactions and is a component of healthy streams; for this reason significant effort has been given to the study of physical controls of hyporheic exchange flows (HEF) and biogeochemical reaction kinetics of the HZ. My research investigates controls of stream respiration by stream morphology. The hypothesis is stream respiration in morphologies with high potential HEF and greater channel complexity is limited by nutrients and microbial biomass, while stream respiration in morphologies with low potential HEF and lesser complexity is limited by mass transfer. To test this hypothesis, a coupled groundwater/surface water model (PFLOTRAN) with reactive transport capabilities will be applied to Watershed 1 of the HJ Andrews Experimental Forest. Preliminary analysis and model simulations will be presented.

Elnaz Hassanpour Adeh OSU	Investigation of the Effect of Wind Turbines of Evapotranspiration Using Satellite Data

Wind turbines have been introduced as an energy source that does not require a large expenditure of water. However, recent simulation results indicate that wind turbines increase evaporation rates from the nearby land. When wind turbines are co-located with irrigated agriculture, the additional water demand due to wind turbine existence must be met through increased irrigation. The goal of this research is to determine the effect of wind energy on irrigated agriculture using satellite data to estimate evapotranspiration (ET). A Surface Energy Balance Algorithm (SEBAL) technique is applied to Landsat data that spans a 30 year interval allowing the characterization of ET before and after wind turbine installations. In the future, the implemented approach will be automated using satellite image processing methods in Matlab to derive the time history of ET from Landsat data at several major wind farms across the US.

Stacey Garrison OSU	Ecohydrological Operation of Agricultural Best Management Practices

Through alteration of natural hydrology, agricultural landscapes introduce challenges in terms of water quality and flood storage management. One of the Best Management Practices (BMP) often initiated to address these challenges is the restoration, reclamation or construction of wetlands to store and treat runoff collected from agricultural landscapes; another is the restoration and preservation of riparian buffers to slow and filter water

through interception and other physical and chemical processes. However, setting aside a large portion of land for a wetland or riparian buffer can be financially burdensome to landowners, and there may be greater participation if these practices take up less space on an individual level. Prior research has shown that many small wetlands distributed throughout a watershed can have the same hydrological impact on peak flow reductions as a few large wetlands, and potentially the same effect on water quality parameters. Additional benefits of wetlands and riparian buffers are ecological; providing crucial edge habitat for aquatic and terrestrial species, while improving hydrology for aquatic organisms downstream. These dual benefits may not occur simultaneously as tradeoffs may occur at temporal and spatial scales. Potential conflicts to consider are increased exposure of organisms to pollutants at the BMP sites; creation of small, isolated areas that function less as habitats and more as species sinks through island dynamics. The watershed-scale placement of habitats must be considered to insure there is sufficient size, proximity and connectivity among individual habitats; BMP design must allow for rapid decomposition of potentially harmful compounds. Computer modelling approaches will be used in order to optimize the multiple goals of: minimized land dedicated to BMPs; peak flow reduction; pollutant decomposition; high quality habitat generation; connectivity among habitats. This will be accomplished using multiple models, including a hydrological model and a combination of GIS-based connectivity, metapopulation and biodiversity models. Genetic algorithm techniques will be implemented to select the most 'fit' alternatives based on combinations of parameters for the multiple goals. The models will be reconfigured to reflect these alternatives, and determine what the outcomes are by measuring them against the status quo, and potentially against the pre-disturbed state.

Grant Livingston OSU	Green Infrastructure for Stormwater Treatment

Peaks flows from urban runoff can cause localized flooding and combined sewer overflows. Bioretention facilities (rain gardens, bioswales, etc.) are a form of green infrastructure for stormwater treatment that both reduce pollutant loads and peak flows. While several studies have compared water quality effects due to vegetated and non-vegetated swales, there is a lack of research that quantifies the hydrologic changes caused by vegetation. In some of the cities using these practices, such as Portland, Oregon, the vegetation is removed and replanted every year, as opposed to becoming established. This not only leads to higher maintenance costs, but it also neglects any potential benefits that vegetation has on peak flow mitigation. In this field scale study, newly constructed vegetated and non-vegetated (bare soil) bioretention units will have their hydrology monitored and compared throughout the establishment period. The project site will be instrumented for continuous flow rate, evapotranspiration, and volumetric soil moisture measurements for a real time water budget analysis. Additionally, the data will be streamed onto our website for public access of this long term bioretention monitoring project. As of March 2014, this collaborative project is being funded by the Oregon Water Resources Department, Benton County, the City of Corvallis, and Oregon State University. The project is currently in the planning and design phase. The 6 acre site has had a runoff analysis completed using lidar data, which was confirmed with field evaluation. Preliminary modeling in Hec-HMS of how the bioretention facilities could mitigate peak flows with an optimal drainage design has also been completed. A literature review is currently underway to determine the optimal soil media for reducing peak flows and pollutants. The site design includes 4 bioretention units, each approximately 100ft by 13ft. This will allow for both this study and future scientific research at the site to easily compare results from one swale to the next. Site excavation and construction is expected to begin in June 2014.

Jennifer Lam OSU	Dose of Reality: What Can We Learn from Pet Owners to Guide More Effective Environmental Stewardship of Pharmaceutical and Personal Care Products (PPCPs)?

Improper disposal of unused human and pet pharmaceuticals and personal care products (PPCPs) are an emerging public and watershed health threat around the world. PPCPs are used by people in increasing volumes every year. More than one-third of households in the USA owned pets in 2011 and that trend is increasing (AVMA, 2012). Since the mid-1990's, a limited but increasing number of studies (Morace, 2012 & Boxall, 2012) have consistently documented low concentrations of PPCPs accumulating in watersheds and their acute impacts to aquatic organisms. Current programs on reducing the entry of PPCPs into watersheds take a precautionary approach. They direct stewardship actions such as voluntary take-back programs, not flushing unused human medications, and PPCPs waste reduction. Unfortunately, these programs are typically only used by a small segment of the population. These programs are also not geared towards pet owners and little research exists on what motivates people - specifically pet owners - to take stewardship actions with their PPCPs. We are conducting research through an online survey to: 1) determine pet owners' current PPCPs use and disposal trends, 2) examine and identify attitudes, actions, concerns, barriers, and solutions to PPCPs use and disposal, and 3) use research results to guide further research, education, and policy to improve stewardship of PPCPs use and disposal.

Adriana Piemonti OSU	Feedback Evaluation of a Web-Based Watershed Planning Tool

A web-based, interactive, watershed planning system called WRESTORE (Watershed Restoration Using Spatio-Temporal Optimization of Resources) (http://wrestore.iupui.edu) have been developed to allow stake-holder communities to participate in a democratic, collaborative form of optimization process for designing best management practices (BMPs) on their landscape. This system utilizes multiple computational approaches including: SWAT (Soil and Water Assessment Tool) hydrologic model, for watershed simulations, interactive genetic algorithms (IGA), for the searching process, and reinforcement-based machine learning algorithms, for user's real time modeling, to combine landscape physical conditions and users' subjective criteria in the optimization process. A substantial study of the WRESTORE system was conducted recently involving multiple real users varying from students, researchers, consultants, government officials, watershed alliance members, etc., with the objective of gaining insight about WRESTORE's usability and utility. In particular, we want to determine preference criteria from the user, required time to develop a solution, frequency of use of different web-page components, and agreements among different users in final designs. Simultaneously, a user's model component is generated based on real-time user-provided ratings for a subset of possible designs (similar to the idea of user profiling commonly done for Information Filtering Systems). The user model constructed based on the real user's personalized feedbacks can then be used to influence the automated search for and optimization of BMP alternatives in WRESTORE. In this work, we describe the overall WRESTORE system architecture, the methods used to evaluate user's feedback and the experimental set-up. These results clearly demonstrate that development of user models for such personalized, interactive optimization is both feasible and valuable for developing community-based computational water sustainability solutions.

April Strid OSU	The Linkage Between Soil, Soil Water, and a Stream in a Western Cascade Forest, Oregon

Fluorescence and UV-Vis spectroscopy were used to characterize dissolved organic matter (DOM) in water-extracted soils, lysimeter samples, and stream water at an old-growth Douglas–fir stand in the H. J. Andrews Experimental Forest. Soil samples and lysimeter water were collected to a depth of 30 cm from the Detrital Input and Removal Treatment (DIRT) site where litter manipulations, including control, double litter, double wood, no inputs, no litter, and no roots, began in 1997. Although variation in dissolved organic carbon (DOC) concentrations in lysimeter solutions at DIRT has diminished, the optical properties suggest differences in DOM composition among treatments. The fluorescent and redox indices (RI) were inversely related in soil. Protein

portions of soil DOM were high in three exclusion treatments. Overall, the site has more oxidized than reduced quinone-like DOM. The lowest RI is at the no roots site with the highest freshness index (β/α). The optical properties between soil and the nearby stream were similar; however, β/α was slightly higher in lysimeter water. Observed variations could reflect long-term changes in DOC dynamics and function induced by litter manipulations.

POSTER SESSION II **3:00 – 4:00**

Caroline Nash OSU	Response of Stream/Meadow Hydro-Systems to Artificial Beaver Dams, Silvies Valley, Oregon

Stream incision is a natural and important erosional process that has caused great environmental damage throughout the American West for over a century. An increasing number of restoration projects are focused on reversing the impact of incision through plug-and-pond restoration. Despite the ubiquity of these techniques, there has been little effort to rigorously evaluate their impacts. The proposed research will: 1.Characterize mechanisms and timescales of incisional processes through trends in channel planform, stratigraphy, sediment yields, and ecological succession; 2. Evaluate the hydrologic, geomorphic, and ecological impacts of specific restoration projects intended to reduce or reverse channel incision; 3. Predict hydrologic sensitivity and resilience of restored streams under a variety of future climate scenarios. We anticipate that by measuring restoration impacts over time, a numerical model can be fit to quantitatively describe patterns in the geomorphic, hydrologic, and ecological responses of an incised channel to these implementations, and will help to predict the effect of future climate scenarios on restored streams.

Jason Silvertooth OSU	Evaluation of Copper Removal from Stormwater Runoff using Compost and Apatite II

Highway stormwater runoff contains significant amounts of copper, primarily resulting from brake pad wear. The harmful effect copper has on aquatic organisms has been well documented, with recent research highlighting impairment of the olfactory system of juvenile salmonid species at copper concentrations as low as 2 µg/L. Because stormwater runoff can represent a significant source of copper to surface waters, cost-effective alternatives to current best management practices (BMPs) should be explored that address the need to lower copper concentrations. This study examines the potential efficacy of copper removal from stormwater using compost, a current choice in many stormwater BMPs, and Apatite II™, a biogenically derived hydroxy calcium phosphate mineral. Batch and column tests were performed to assess the equilibrium and continuous removal capacity of Apatite II™ and compost, and in both cases they demonstrated viability as media for copper removal. Due to favorable results in laboratory settings, a field site has been designed and constructed to test copper removal in actual stormwater runoff. Flow-weighted composite influent and effluent samples were taken for each storm event, and samples were characterized to assess the effect the media had on copper concentrations as well as common water quality parameters. A complete sampling season is presented for Apatite II™, along with preliminary field results for compost.

Michelle Maier OHSU	Role of Phytoplankton Parasites in Food Webs of the Columbia River Estuary

The Columbia River has been dramatically altered from its natural state due to extensive regulation of river flow for hydropower, irrigation, and shipping. The associated decrease in turbidity and increase in water clarity due to the input of dams have led to an ecosystem conducive to pelagic phytoplankton growth. From 2009-2013, in situ biogeochemical sensors at Beaver Army Terminal (river mile 53) have captured annual chlorophyll blooms

in the spring and summer in the lower Columbia River. Adaptive sampling has allowed for species composition analysis of bloom events and revealed a dominance of large diatoms in the phytoplankton community. Additionally, fungal parasites of phytoplankton ('chytrids') have been observed annually during spring blooms. Although often overlooked, parasitism in aquatic systems may play an important role in food web dynamics and biogeochemical cycling. Chytrids efficiently re-package organic material from the large, often inedible, colonial diatoms they infect into fungal zoospores, which are easier for zooplankton to consume. In this study, we evaluated both prevalence of infection of the phytoplankton community and developed a specific quantitative PCR assay to quantify zoospores. Field samples were collected from 2010-2013 and size fractionated to separate host-attached and free-swimming parasite life stages. The dominant diatom in spring blooms, Asterionella formosa, was infected consistently between 30-40% each year. Free-swimming zoospore concentrations were low in the summer, fall, and winter. However, in spring, when host diatoms bloom, zoospores were detected at levels up to 1600 per mL, accounting for 17.1 µg L-1 of particulate organic carbon. The data indicate that up to 15% of the carbon biomass tied up in the dominant spring bloom diatom may be released into the environment and available for filter feeding grazers. Parasites of microalgae may actively shape the Columbia River food web by increasing the availability of large diatom carbon to higher trophic levels, in addition to influencing species composition and the density of primary producers.

YunJi Choi OSU	Three-Dimensional Numerical Study of the Turbulent Flow Structures Present in Air-Water Geyser Flows

An air-water geyser in a closed conduit system is a high frequency oscillatory release of a mixture of air and water that occurs at drop shafts and other relief points. The oscillating jet of gas-liquid mixtures issuing from pipe systems may reach a height of the order of few to tens of meters above ground level. Geysers are often observed in combined sewer systems (CSSs) in the form of explosive releases of mixtures of air and water. Traditionally, investigations on geysers have been conducted through laboratory experiments. Challenges arose in these experiments as 3D flow structures of a two-phase flow are difficult to resolve through laboratory observations. Also, one and two-dimensional numerical models have been developed to study geysers. However, geysers are highly three-dimensional. Hence, 3D models are necessary in order to gain an understanding on the turbulence flow structures present in these flows. In the present work, turbulent flow structures present in geysers are studied numerically using a three-dimensional (3D) Computational Fluid Dynamics (CFD) model. The CFD model was calibrated using a laboratory experiment that exhibited characteristics of a geyser. The resulting numerical data is then analyzed to study the turbulent flow structures, such as vortices and eddies, that are present in the oscillatory release of the air-water mixture. Additionally, vertical acceleration of the air-water mixture in the drop shaft and velocity fluctuation across the flow field over time are analyzed to support the analysis of turbulent flow structures that are present in geyser flows.

Lauren Smitherman OSU	A Hydrogeographic Groundwater Analysis of Arsenic in Harney County, Oregon

A Hydrogeographic conceptual model will be developed to display the relationship between arsenic contamination, geology, and geography in Harney County, Oregon. Seasonal arsenic well sampling on private and public land will be conducted in addition to a review of well construction, maintenance, and pumping logs. Harney County depends solely on groundwater for personal consumption, ranching, and farming demands. Previous well testing revealed an anomalous relationship between location and arsenic concentrations. Through this research, the geography of arsenic contaminated wells and the geology in Harney County, Oregon will be examined.

Parnian Hosseini OSU	A Multi-Objective Optimization for the Operation of Multi-Reservoir Systems Under Uncertainty

In this study, a multi-objective optimization framework is presented for the operation of multi-reservoir systems accounting for uncertainty. The only source of uncertainty considered in this study is due to stream inflows. The uncertainty associated with stream inflows can lead to strategies that are far from optimal operation. A multi-objective evolutionary algorithm is used for maximizing hydropower generation and minimizing ecological degradation in ten dams of the Columbia River system, which is located in the Pacific Northwest of North America.

Erica Kemp OSU	Sediment Transport Prototypes: Novel Methods to Disconnect Roads from Streams

Unpaved roads are a critical form of infrastructure for forest management and access. The forest industry appropriately uses unpaved roads for timber harvest due to their low cost, ease and speed of construction and expectation of low traffic volume. Despite their practical utility, forest roads are a potential source of ecological disturbance, especially for aquatic habitats, like spawning grounds for salmonids. This study will focus on the generation and sequestration of sediment in forest roads. Improved management of aggregate resources can reduce sediment generation, lead to improved infrastructure life, reduced maintenance costs, and most importantly, lessen the impact of road sediment on road-connected aquatic ecosystems. The experimental design for proposed research seeks to understand how sediment is generated in forest roads and enhance how sediment may be prevented from entering hydraulically connected aquatic environments with construction techniques and novel best management practices. Six test tracks will be employed to study the effects of truck traffic on sediment generation during simulated rainfall and simultaneously measure turbidity in surface aggregate runoff. Road designs include no treatment (control), treatment with a geosynthetic wrap-berm and treatment with a waddle-type biomass filter. A cost-benefit analysis of each track will determine recommendations for new best management practices in forest roads.

Luis Angel Gomez Cunya OSU	A Domain Decomposition Strategy for Unsteady Flow Routing in River Systems

This research presents an optimization-based domain decomposition strategy for unsteady flow routing in river systems. This strategy couples the domain decomposition technique with the performance graphs approach, which utilizes pre-computed solutions along defined reaches on a river system. While efficient and robust, these performance graphs could require extensive memory allocation, especially for high resolution simulations. Decomposing or partitioning the river system into sub-domains reduces computer memory constraints as each sub-domain is solved independently. The computational efficiency of the performance graphs approach, in turn, allows an optimization-based scheme to be competitive. The presentation will discuss the results of the application of the domain decomposition strategy to a large region of the Columbia River system. The outcome is promising as the domain decomposition strategy could be used to reduce the overall CPU time for large scale problems.

Kyle Neumann OSU	Development of Osmotic Sampling Systems for Chemical and Microbial Characterization of Marcellus Shale flow-back waters

The Marcellus Shale formation in the North Eastern United States has seen a significant increase in domestic oil and natural gas production as a result of hydraulic fracturing (fracking). As much as 18,000 m3 of fracking fluids are pumped under pressure into a well to open fractures in the shale. When pressure is released, 10%-40% of this fluid returns to the surface as flow-back waters. Flow-back fluids contain high concentrations of

potentially harmful dissolved solids including chloride, barium, strontium and arsenic. The biogeochemical processes by which these solids dissolve into the fracking fluids are not well understood. The purpose of this study is to utilize osmotic samplers (osmosamplers) to obtain high temporal resolution data about flow-back chemistry and microbiology. These samplers have been used with great success in the deep ocean, but this method has not been widely utilized to study surface waters. We are currently developing osmotic pumps which are optimized for surface water deployment and allow for high flow rates and large sample volumes. Osmosamplers use a pump comprised of a chamber of highly concentrated salt water separated from a chamber of D.I. water by a semipermeable membrane. The D.I. chamber is connected to a long coil of Teflon tubing. As the D.I. water diffuses across the membrane, a sample of fluid is drawn into the sample coil. Because the diameter of the sample tubing is small the fluid sample does not mix, but rather travels with "plug-like" flow. When retrieved, the sample coil can be divided into sections representing water conditions at a specific time point. Combining individual analysis of each section grants a continuous record of flowback chemistry and microbiology over time. This data will be useful in constraining the biogeochemical processes by which solids become mobile in hydraulic fracturing fluid.

Kaitlin Goldsmith Portland State University	Information Needs Assessment for Coastal and Marine Management and Policy in the Pacific Northwest

Changing climatic conditions are projected to alter the provisioning of ecosystem services in estuarine, coastal and neashore marine ecosystems, further necessitating mitigation and adaptation policies and management. The current paradigm of siloed research efforts occurring in parallel to, but not in collaboration with, decision-makers will be insufficient for the rapid responses required to adapt to and mitigate for changing climatic, land use and demographic conditions in coastal areas. Here, we suggest a different paradigm- one where research occurs through an interactive and iterative process of engaging decision-makers in the identification of priority research needs (e.g. biophysical, economic, and social), and which researchers analyze and present data in a format that is most likely to be utilized to implement immediate changes. Interviews were conducted with decision-makers ranging from policymakers to managers. Data collected from interviews with decision-makers was analyzed and synthesized to develop a portfolio of current scientific research needs and important ecosystem services to protect. From our analysis we were able to compile a list prioritizing data gaps for coastal and marine decision makers and made accessible to the research community, both scientists and funding agencies, from which future research questions and funding opportunities can evolve.

Sam Cimino Portland State University	Investigating Shifts in Food Web Position of Benthic Invertebrates due to New Zealand Mud Snail Invasion in Freshwater Lakes and Brackish Estuaries

The New Zealand mud snail (Potamopyrgus antipodarum) is an invasive, aquatic macroinvertebrate in the United States. Although efforts are being made to prevent New Zealand mud snail (NZMS) spread, NZMS have been found to thrive in a variety of habitats including brackish estuaries and freshwater lakes. Understanding of the different roles that NZMS play in the various invaded environments is limited. The focus of this study is to compare the magnitude of the differences in food web position and feeding niche fulfillment (specialized or generalized) of the NZMS and benthic invertebrate competitors in six freshwater lakes and six brackish estuaries. In this study, abundance gradients of NZMS in the sampled lakes as well as in the sampled estuaries were compared. At each site, benthic invertebrates, zooplankton, and primary producers were sampled and quantified. Additionally, the feeding niche fulfillment and trophic position of NZMS and other components of the benthic food web were estimated using stable carbon and nitrogen isotope ratio analyses. Initial findings suggest that NZMS at differing abundances consume different carbon sources in both lakes and estuaries.

Feeding niche fulfillment may be determined by invasive NZMS abundance relative to its benthic macroinvertebrate competitors.

Davis Hernandez-Alvarez OSU	Fluvial Geomorphology of a Newly Constructed River Channel

In the summer of 2012, the owners of a property inclusive of the South Fork Sprague River, in cooperation with the United States Fish and Wildlife Service and Balance Hydrologic, relocated the river channel in order to reintroduce it to its historic floodplain, rectify major erosion and water quality issues, and increase habitat for wildlife. Plans are moving forward to relocate approximately 4 more river miles in the near future. Therefore, understanding the responses to the channel design experienced by the reach could help in the design of the remaining relocation projects. Data was collected in order to determine what effect the dynamic nature of the hydrologic cycle has had on the newly constructed channel bed. Piezometers were installed preconstruction and groundwater levels are continuously being monitored. We collected data along a 1.3 mile section of a relocated river and compared it to design drawings. In the late winter through summer of 2013, two surveys were conducted to measure cross sectional profiles at thirteen locations, and to produce a longitudinal profile of the thalweg through the reach of the new channel. Regression lines of the designed and surveyed thalweg showed increased R2 value. This is indicative of a decrease in the variability between the scour pools and glides. At ingress to the reach the river scoured almost three vertical feet at a glide and there were other instances of scour in glides and deposition in pools. A point bar is now forming shortly downstream of the unexpected scour. In some areas, a clay layer, which was identified as being important to the reconnection of the river to the flood plain, was breached. The region is in a second year of drought and no significant rain events have acted upon the reach. The study is ongoing, as we hope to see flows of greater volume and velocity. To date the system has seen only below average flows. Greater flows will better help us understand the effects of the hydrologic cycle upon the designed channel and better guide future designs.

Alan Stanton OSU	Influence and Uncertainty: Investigating Interrelations between South Asian Monsoon Season and Flow Extremes in the Himalayas

The South Asian Monsoon season (June-September) contributes 70-90% of India and Nepal's annual mean rainfall, and exhibits large year-to-year variability (Kumar 2013; Shresta 2004). Observed floods and droughts associated with the monsoon have had catastrophic effects on agriculture, water availability, food security, economics, and social life in South Asia. Several studies have shown significant relationships between El Niño/Southern Oscillation (ENSO) and mean monthly streamflows in Nepal and India (Whitaker et al. 2001; Shresta 2000); however, there has been little research that identifies how streamflow extremes may change spatially and temporally throughout the Himalayas, given the uncertainty of the South Asian Monsoon. This research will investigate the uncertainty and relationship between the South Asian Monsoon and the occurrence of streamflow extremes in three of the glacio-hydrologic regimes of the Himalayas: (1) the Himalayan Catchment east of the Chenab basin where runoff from summer precipitation is the primary flow component, (2) the Alpine Region dominated by winter snow, and (3) the cold, arid Landakh range. While general assumptions about the relationships between the driving processes and catchment state can be derived from our current understanding of hydrological processes, the detection of exceptional situations in the observed time series is not straightforward; however, different statistical analysis tools can reveal how the timing and the magnitude of the events are related (Schaefli 2007). Nonstationary hydrologic variables can be modeled stochastically to determine time series trends and their uncertainties, and to develop forecast that address a changing climate (Milly 2008). Long range forecasting practices and theory often use some form of pattern recognition regression, or correlation of time dependence of system behavior to forecast time series data such as stream discharges

(Bender 1992). Understanding how the timing and variability of extreme flow events are associated with the South Asian Monsoon may provide insight into the underlying hydrological processes that drive flows in the Himalayas, and help to identify regions which are more sensitive to a changing climate.

Claudia Tausz OSHU	Potential cyanoHAB (Cyanobacterial Harmful Algal Bloom) Threats to Ecosystems of the Lower Columbia River

Phytoplankton and zooplankton samples were collected approximately monthly between April and July from four shallow water habitat sites along the lower Columbia River over a three year period (2011-2013) as part of an Ecosystem Monitoring Program to assess status and trends of salmonid habitat characteristics. Significant contributions of cyanobacteria were observed in the two sites furthest upriver (Campbell Slough in Ridgefield National Wildlife Refuge and Franz Lake Slough), with dramatic abundance increases (both relative and absolute) during summer months (June and July). Included in the cyanobacterial populations were the known microcystin-producing genera Anabaena and Microcystis. Microcystin is a potent hepatotoxin known to be fatal to wildlife and livestock if ingested, as well as humans if concentrations are high enough. Since cyanotoxins are known to bioaccumulate in zooplankton, high cyanobacteria concentrations pose a toxin exposure risk to fish via food web transfer pathways, including direct consumption of zooplankton or by consumption of invertebrate prey that may feed on zooplankton and cyanobacteria. High cyanobacteria abundances were associated with warm temperatures, and preliminary data showed a positive correlation between total dissolved phosphorus concentrations and cyanobacteria abundance. To assess the potential risk of wildlife exposure to cyanotoxins, we recommend additional monitoring of phytoplankton abundances during the warm summer months as well as monthly measurements of cyanotoxins, especially microcystin. Analysis of relationships between cyanobacteria population dynamics, toxicity, and environmental variables will aid in the identification of seasonal patterns and drivers of toxin production for potential prediction and mitigation of this emerging public health threat.

Amanda Mather OHSU	Influence of Catchment Characteristics on Event-Based Stream Turbidity-Discharge Loop Behavior

Turbidity often forms a hysteretic loop when plotting against discharge over the course of a single hydrologic event. The shape and direction of the event loop has been observed to vary both between events and catchments (i.e., in time and space). Here we use a 4-parameter loop model to quantitatively characterize event turbidity responses for 5928 events from 110 stream gages across the US. Our aim was to understand how median turbidity-discharge behavior varies between catchments and to investigate correlations between the magnitude of the model parameters and the characteristics of the catchment draining to the gage. The results show that two of the model parameters are related predominantly to catchment land cover characteristics. A third parameter is highly related to topographic and baseflow characteristics, while the fourth parameter remains somewhat poorly understood in terms of catchment characteristics. The collective parameter sets reveal distinctive groups of catchments that behave similarly and display spatial organization. This research steps us closer to deciphering how catchment and hydrologic processes are reflected in event loop characteristics.

Andrew Wentworth OSU	Modeling Water Quality for Alternative Future Scenarios

Surface water quality is a growing concern in the Willamette River Basin and elsewhere; the region's growing population is dependent on water quality for market and non-market amenities that include drinking water, irrigation, wastewater dilution, and wildlife habitat. Agricultural practices can affect water quality by modifying surface runoff, soil erosion, and nutrient budgets. Managing large basins like the Willamette to provide

necessary economic products as well as ecosystem services is inherently complex and land managers require sophisticated knowledge of system dynamics as well as tools to forecast the impacts of decisions on critical components like water quantity and quality. A number of tools have been developed over the past 20 years that enable resource managers to compare the effects of land use/land cover (LULC) change on water quality. Although existing models have been used successfully to model water quality for alternative future landscapes, they lack a platform to interact with other models of biophysical processes and human actions that affect landscape composition and function. The objective of this project is to develop a plug-in for the Envision modeling framework that can accurately simulate the effect of changing LULC and agricultural practices—fertilizer application rates and timing, crop type, and runoff modification—on the system's sediment and nutrient budget. Envision is a GIS-based tool that is uniquely capable of integrating biophysical and multi-agent models to simulate alternative future landscapes for regional planning and environmental assessment (J. P. Bolte et al. 2006). Once completed, the plug-in will be used to explore water quality response to changing LULC, agricultural practices, and conservation actions for three future scenarios in the Calapooia River Basin.

Emily Smith PSU	Artificial Glaciers in the Northwest

This is a feasibility study to locate potential sites on the north side of Mt. Hood to possibly apply glacier growing techniques derived from civil engineer Chewang Norphel. The north side of Mount Hood homes the Eliot, Coe and Langille glaciers. These glaciers contribute water to the Upper Middle Fork of the Hood River. These glaciers are declining fast, resulting in concerns about future water supply to the river. This location is an excellent area to study for applying the artificial growing methods of Chewang Norphel. Mr. Norphel's technique involves diverting water runoff from an existing glacier and dispersing and cooling the water to a shaded, low grade location on a mountain. In time the water collects and forms into an artificial glacier. With the abundance of rainfall in the Pacific Northwest, we will look for cold water springs as the source of water for creating an artificial glacier. Methods of data collecting will include soil and air temperature sensors at research sites. Aerial and ground surveys of cold water springs as well as mapping and measuring volume and temperature of glacier run-off water will be analyzed. Once data is analyzed, it is expected that a suitable location will be found for growing a glacier. The results will be presented in poster presentations to interested parties.