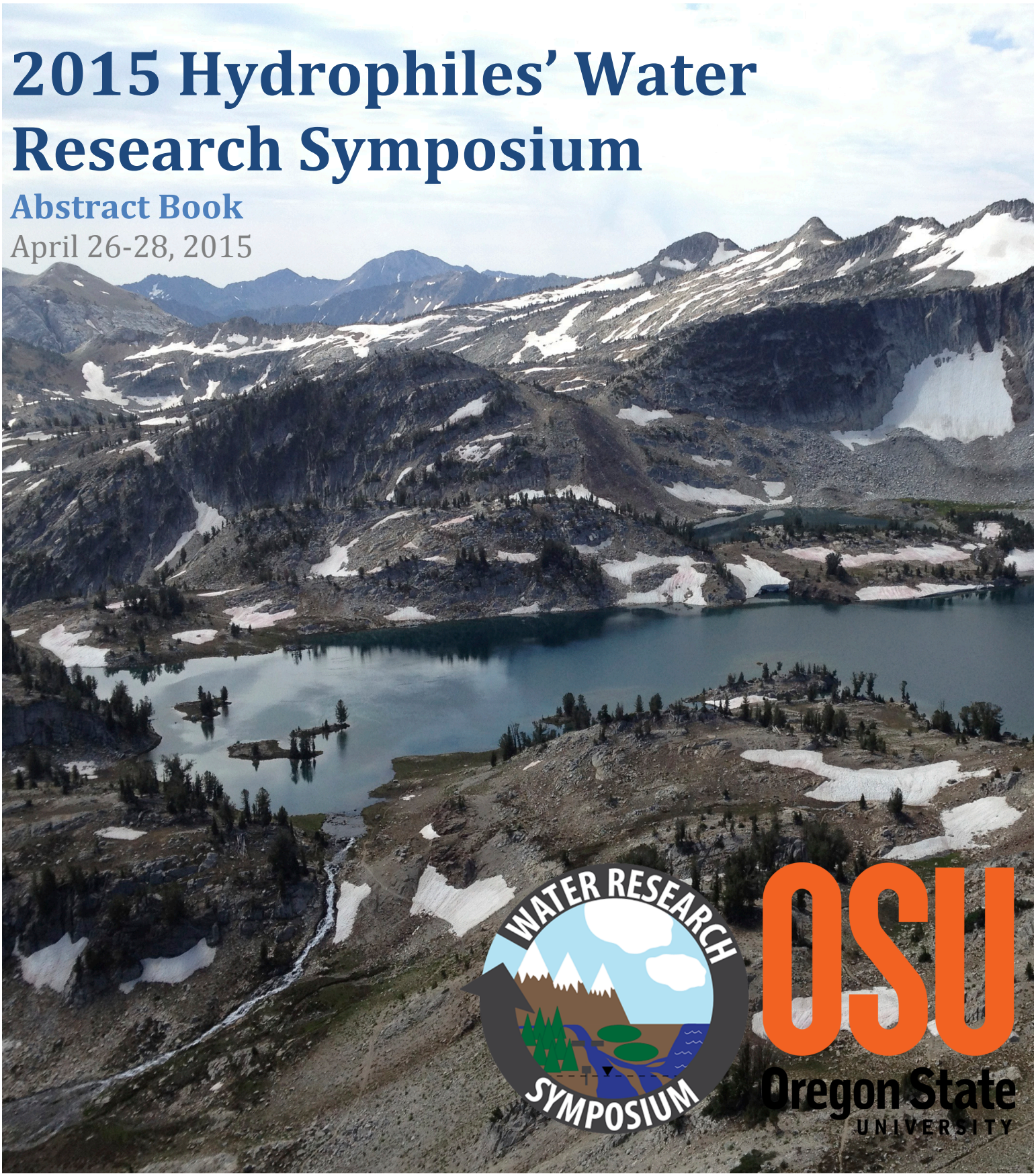
2015 Hydrophiles' Water Research Symposium

Abstract Book

April 26-28, 2015



Previous page: photo by Thomas Mosier

It is with great pleasure that we welcome you to the 2015 Hydrophiles' Water Research Symposium, hosted at Oregon State University (OSU). We decided early on in this year's planning process that our theme would be *connections – ourselves to water, each of us with one another, and our work to others*. Meaningful connections take time to develop, and mainly happen in the time between presentations. With this in mind, we expanded the symposium from one jam-packed day to three – still jam-packed – days. New this year is our Sunday social excursion to Abiqua Falls, where participants can kick off the Symposium by building connections with other students from around the Pacific Northwest.

In 2014, the symposium transitioned its focus from Oregon to the entire Pacific Northwest, and we are thrilled that this year's symposium has such strong representation of student presenters from universities in Idaho and Washington. As is clear from the presentation schedule, symposium participants have a wide breadth of interests and technical expertise. We believe wholeheartedly that solutions to the complex water issues facing us will arise from fluency in, and appreciation of, multiple disciplines and hope this event will foster that spirit of collaboration in us, the next generation of water professionals and researchers!

We are also proud this year to be hosting a Let's Talk About Water (LTAW) event on the Monday evening of the symposium. This event was made possible through a matching grant from the Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI). The LTAW event brings together diverse perspectives to discuss water use, with the purpose of building understanding across viewpoints. This togetherness is imperative in our world, in which water is scarce and climate change threatens to disrupt the status quo.

This year's symposium would not be possible without the generous support of our sponsors. For the full list of our Columbia, Willamette, and Deschutes sponsors, kindly refer to the sponsor page of this booklet. In particular, we would like to express our deepest gratitude to our cornerstone sponsors, without whom the symposium would not be possible: the Institute for Water and Watersheds, CUAHSI, the Ann Judge Campana Foundation, the OSU Water Resources Graduate Program, the OSU College of Earth, Ocean, and Atmospheric Sciences, and the OSU College of Engineering. We are also indebted to Jennifer Cohen, Todd Jarvis, and Mary Santelmann for their support throughout the planning process.

We hope you enjoy this year's Hydrophiles' symposium! And, we look forward to connecting with you during the three-days of events!

Sincerely,

The Planning Committee

Thomas Mosier, Leah Tai, Caroline Nash, Kira Puntennay, Matthew Cooper, Stacey Detwiler, Kylie Pace, Lauren Smitherman, Kelsey Harpham, and Rachael Davee

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Oral Presentations

#	Session Title	Abstract Title	Last Name	First Name	E-mail	School
1	Glacial Hydrology and Climate Change	Assessing trends and variability in the Arctic hydrologic cycle using the Regional Arctic System Model	Hamman	Joe	jhamman1@uw.edu	University of Washington
1	Glacial Hydrology and Climate Change	Estimated snow sensitivity to climate warming in the eastern Oregon Cascades	Cooper	Matthew	mguycooper@gmail.com	Oregon State University
1	Glacial Hydrology and Climate Change	Did climate change cause the 2012-2014 California drought?	Mao	Yixin	yixinmao@uw.edu	University of Washington
1	Glacial Hydrology and Climate Change	Effects of Climate Change on Snowpack in the Western United States	Gergel	Diana	gergel@hydro.washington.edu	University of Washington
1	Glacial Hydrology and Climate Change	High-Resolution Modeling of Coastal Freshwater Discharge and Glacier Mass Balance in the Gulf of Alaska Watershed	Beamer	Jordan	beamerj@onid.oregonstate.edu	Oregon State University
2	Stream Ecology	Terrestrial leaf litter drives the ecosystem metabolism of small, temporary ponds	Holgerson	Meredith	meredith.atwood@yale.edu	Yale University
2	Stream Ecology	The impact of multiple stressors on aquatic macroinvertebrate communities in the Umatilla River	Clark	Hannah	Hannah.Clark@oregonstate.edu	Oregon State University
2	Stream Ecology	Reciprocal interactions between physical river process and a native sedge, Carex nudata, a potential ecosystem engineer.	Goslin	Matthew	goslin@uoregon.edu	University of Oregon
2	Stream Ecology	Consequences of Salmon Hatch Timing in Streams with Variable Thermal Regimes in the Copper River Delta, Alaska	Campbell	Emily	emily.campbell@oregonstate.edu	Oregon State University
4	Sediment transport and Surface Water	Looks are deceiving: Is the dynamic expansion of near-stream surface saturation important for streamflow generation?	Frentress	Jay	frentrej@onid.oregonstate.edu	Oregon State University
4	Sediment transport and Surface Water	Sediment Transport Prototypes: Novel Methods to Disconnect Unpaved Roads from Streams	Kemp	Erica	erica.kemp@oregonstate.edu	Oregon State University

4	Sediment transport and Surface Water	From molecules to watersheds: hydroboigeochemical signals of watershed responses to disturbances	Guerrero-Bolano	Francisco	francisco.guerrero@oregonstate.edu	Oregon State University
4	Sediment transport and Surface Water	Quantifying Stream Bed Erosoin - deposition using temperature time series data	DeWeese	Timothy	deweesetim@gmail.com	University of Idaho
5	Water Quality	The role of internal loading in the phosphous mass balance of willow creek reservoir, OR	Burnet	Sarah	burn6898@vandals.uidaho.edu	University of Idaho
5	Water Quality	Development of Traceable Titanium Dioxide Nanoparticles for Examining Environmental Fate and Transport	Deline	Alyssa	delinea@onid.oregonstate.edu	Oregon State University
5	Water Quality	Synergies of DTS Monitoring and Modeling on the Middle Fork of John Day River: Stream Temperature after restoration	Hall	Austin	hallau@onid.orst.edu	Oregon State University
6	Water Management and Infrastructure	Improving Agricultural Nitrogen Use through Policy Incentivized Management Strategies	Ward	Nicole	ward5576@vandals.uidaho.edu	University of Idaho
6	Water Management and Infrastructure	Terracette Influences on Spatial Patterns of Soil Moisture in a Semiarid Rangeland Environment	Corrao	Mark	mcorrao@nmi2.com	University of Idaho
6	Water Management and Infrastructure	Towards Optimizing Sedimentation Processes in Sand Dams	Viducich	Jon	viducicj@onid.oregonstate.edu	Oregon State University
6	Water Management and Infrastructure	Traditional Infrastructure, Modern Flows: Cultural Politics of Development in the Kathmandu Valley, Nepal	Molden	Olivia	omolden@gmail.com	University of Oregon

Poster Presentations

#	Session Title	Abstract Title	Last Name	First Name	E-mail	School
3	Water Availability and Geomorphology	SETI: A Novel Hydrologic Model for Projecting Long-term Streamflow Trends in Mountain Environments	Mosier	Thomas	mosiert@onid.orst.edu	Oregon State University
3	Water Availability and Geomorphology	Agricultural water sustainability in the midst of climate change: an agent-based modeling approach	Leonard	Andrea	andrealeonard@u.boisestate.edu	Boise State University
3	Water Availability and Geomorphology	Scaling properties of the rainfall runoff generation process in the oregon Cascade Mountains: A nested approach	Nickolas	Lydia	lydia.nickolas@oregonstate.edu	Oregon State University
3	Water Availability and Geomorphology	Modeling impacts of land management activities on future water availability in the Boise River Basin, ID	Steimke	Amy	amysteimke@u.boisestate.edu	Boise State University
3	Water Availability and Geomorphology	Precipitation Recycling in the Columbia River Basin: Lagrangian Models and Historical Analysis	Tai	Leah	taile@onid.oregonstate.edu	Oregon State University
3	Water Availability and Geomorphology	Impacts of future changes on low flow in a highly connected river-aquifer system: The Spokane River	Baxter	Heather	heather.baxter@email.wsu.edu	Washington State University
3	Water Availability and Geomorphology	Iron mobilization in a Willamette Valley Bioswale	Conatser	Christopher	conatsec@onid.oregonstate.edu	Oregon State University
3	Water Availability and Geomorphology	The role of antecedent soil moisture conditions in erosiona nd sediment transport to streams in managed, headwater catchments	Puntenney	Kira	kira.puntenney@oregonstate.edu	Oregon State University
3	Water Availability and Geomorphology	Sediment Pulse Translation and Dispersion in Natural Gravel-bedded Rivers	Pace	Kylie	pacek@onid.oregonstate.edu	Oregon State University
3	Water Availability and Geomorphology	Measuring Gravel Transport in an Active natural System: An analytical framework	Sanfilippo	Jon	sanfilij@onid.oregonstate.edu	Oregon State University
3	Water Availability and Geomorphology	Sediment transport dynamics and its relation to primary production in mountain headwater streams	Katz	Scott	Scott.Katz@oregonstate.edu	Oregon State University
3	Water Availability and Geomorphology	Modeling geomorphic response to large wood introduction as a strategy to restore fish habitat in a managed forest watershed	Bair	Russell	Russell.Bair@oregonstate.edu	Oregon State University

3	Water Availability and Geomorphology	Physical modeling of the feedbacks between invasive riparian species, hydraulics, and bed form evolution.	Elliott	Susan	elliotsu@onid.oregonstate.edu	Oregon State University
3	Water Availability and Geomorphology	Stratigraphy of carbon preservation in reservoir sediments, elwha river, washington	Stratton	Laurel	strattol@onid.oregonstate.edu	Oregon State University
3	Water Availability and Geomorphology	The role of forest harvest practices and extreme events on the sedimentation of an Oregon Coast Range lake	Richardson	Kris	richakri@onid.orst.edu	Oregon State University
3	Water Availability and Geomorphology	Characterizations of near-farm evapotranspiration under wind turbine effects using Surface energy balance algorithm	Hassanpour Adeh	Elnaz	hassanpe@onid.oregonstate.edu	Oregon State University
3	Water Availability and Geomorphology	Measuring the morning transition of the atmospheric boundary layer	Predosa	Robert	predosar@onid.oregonstate.edu	Oregon State University
3	Water Availability and Geomorphology	Monitoring transpiration rates in a semiarid riparian ecosystem	Mendoza	Alek	mendoale@onid.oregonstate.edu	Oregon State University
3	Water Availability and Geomorphology	Active layer depth in permeable snow	Drake	Steve	sdrake@coas.oregonstate.edu	Oregon State University
3	Water Availability and Geomorphology	Examining the relation of outdoor pool water evaporation to the urban density due to wind protection	Antonelli	Eleni	eantonel@uoregon.edu	University of Oregon
3	Water Availability and Geomorphology	Pillows, courses, LiDAR and streamgauges: Assimilating snowpack and streamflow observations into basin water balance infererence	Brian	Henn	bhenn@uw.edu	University of Washington
3	Water Availability and Geomorphology	Water quality trends in the Upper White River Basin, northwest Arkansas	Simpson	Zach	zpsimpso@uark.edu	University of Arkansas
3	Water Availability and Geomorphology	Change in bedload transport frequency with climate warming in gravel-bed streams of the Oregon Cascades	Hempel	Laura	hempell@geo.oregonstate.edu	Oregon State University
3	Water Availability and Geomorphology	Spatial Patterns of Flow and Sediment Transport Dynamics in the Upper Willamette, OR	Langston	Trevor	langston.trevor@gmail.com	University of Oregon

#	Session Title	Abstract Title	Last Name	First Name	E-mail	School
7	Water Quality and Policy	Comparing Management Strategies on the Columbia and Colorado Rivers	McCracken/Davee	Melissa/Rachael	mccrackm@onid.oregonstate.edu	Oregon State University
7	Water Quality and Policy	Policyscape Patterns in River Networks: Riparian Buffers in the Oregon Coast Range	Boisjolie	Brett	boisjolb@onid.oregonstate.edu	Oregon State University
7	Water Quality and Policy	Incorporating biophysical and social processes in an integrated modeling framework to predict future water availability	Han	Bangshuai	bangshuaihan@gmail.com	Boise State University
7	Water Quality and Policy	Combining Community Conflict Management with Water Resources Engineering to Improve Stormwater Management	Kemper	Joseph	kemperjo@onid.oregonstate.edu	Oregon State University
7	Water Quality and Policy	Mycofiltration: Fungus as a New Frontier in Biological Based Water Filtration Systems	Emeson	Micco	emesonm@onid.orst.edu	Oregon State University
7	Water Quality and Policy	Research on Stream Water Temperature in Semiarid Riparian Systems	Leonard	Jaycee	leonard.jca@gmail.com	Boise State University
7	Water Quality and Policy	Enhancing VELMA's watershed delineation and performance with ancillary stream data	Halama	Jonathan	halamaj@onid.orst.edu	Oregon State University
7	Water Quality and Policy	Water Treatment Technologies for the Developing World	Burleson	Grace	burleson.grace@gmail.com	Oregon State University
7	Water Quality and Policy	Forensic Hydrogeography: Assessing Arsenic Contamination in Domestic, Livestock, and Agricultural Wells in Harney County, Oregon	Smitherman	Lauren	smithela@onid.oregonstate.edu	Oregon State University
7	Water Quality and Policy	The role of flow rate and moisture content on colloid mobility in unsaturated porous media	Brueck	Chris	brueckc@onid.orst.edu	Oregon State University
7	Water Quality and Policy	The influence of hydrologic and biogeochemical factors on quantity and quality of DOC and quantity of DIC in the hyporheic zone	Serchan	Satish	satish.serchan@gmail.com	Oregon State University
7	Water Quality and Policy	Treatment of giardia favoring the reduction of cancer as comorbid disease	Freitas Terra Silva	Adolfo	freitaad@onid.oregonstate.edu	Oregon State University

7	Water Quality and Policy	Oxygen-Carbon Method for Measuring Gas Exchange Rates in Streams	Pennington	Robert	robertopennington@gmail.com	Oregon State University
7	Water Quality and Policy	Vadose Zone as a Potential Carbon Source: A Look at Seasonal spikes in Hyporheic Zone pCO2	Brandes	Jason	brandesj@onid.oregonstate.edu	Oregon State University
7	Water Quality and Policy	Using Stable Isotopes to Reveal Nutrient Flowpaths at Big Spring Run, a low order stream in Lancaster County, Pennsylvania	Audie	Michelle	wolfganm@onid.oregonstate.edu	Oregon State University
7	Water Quality and Policy	A Watershed Scale Spatial Statistics Approach for Development of Nutrient Criteria and Classification Scheme for Oregon Lakes	Brenner	Jacqueline	jacqueline.brenner@gmail.com	Oregon State University
7	Water Quality and Policy	A landscape-scale Characterization of vegetation-soil water interactions in Semiarid Juniper Woodlans of Central Oregon	Ray	Grace	Grace.Ray@oregonstate.edu	Oregon State University
7	Water Quality and Policy	Investigating the relationship between snowpack and tree growth in the Oregon Cascades, via Stable Carbon Isotope Analysis	Ratcliff	Christopher	ratclifc@onid.orst.edu	Oregon State University
7	Water Quality and Policy	Testing the ideas of Walter White	Kollen	Jacob	kollenja@onid.orst.edu	Oregon State University
7	Water Quality and Policy	Comparing Management Strategies on the Columbia and Colorado Rivers	Melissa/Rachael	McCracken/Davee	mccrackm@onid.oregonstate.edu	Oregon State University
7	Water Quality and Policy	Evaluating Effects of Conservation Practices on Sediment Transport in Agricultural Watershed with Cohesive Sediments	Rittenburg	Rebecca	brittenburg@uidaho.edu	University of Idaho
7	Water Quality and Policy	Microcosm Studies to Evaluate Biodegradation of Chlorinated Solvents and 1,4-Dioxane	Rolston	Hannah	rolstonh@onid.oregonstate.edu	Oregon State University
7	Water Quality and Policy	Characterizing and Assessing the Researcher-Stakeholder Engagement Process for Water Sustainability: The Willamette Water 2100 Project	Ferguson	Laura	fergusla@onid.oregonstate.edu	Oregon State University

Schedule

Sunday April 26

9:30 am - 5:00 pm	Natural Networking: Hike with local freshwater education and conservation advocate Jeremy Monroe	Meet at Wilkinson Hall, OSU Campus
6:00 pm - 8:00 pm	Symposium Welcome Potluck	TBD

Monday April 27

8:00 am - 8:30 am	Registration	Foyer of Alumni Center
8:30 am - 9:00 am	Welcoming Remarks	Cascade Ballroom of Alumni Center
9:00 am - 10:30 am	Session 1 Oral Presentations: Glacial Hydrology and Climate Change	Cascade Ballroom of Alumni Center
10:30 am - 10:45 am	Coffee Break	Foyer of Alumni Center
10:45 am - Noon	Session 2 Oral Presentations: Stream Ecology	Cascade Ballroom of Alumni Center
Noon - 1 pm	Lunch	Foyer of Alumni Center
1:00 pm - 3:00 pm	Session 3 Poster Presentations: Water Availability and Geomorphology	Cascade Ballroom of Alumni Center
3:00 pm - 5:00 pm	Networking Reception (hors d'oeuvres & drinks)	Foyer of Alumni Center
5:00 pm – 6:00 pm 5:30 pm – 6:00 pm	Dinner for Symposium attendees Doors open for LTAW	Foyer of Alumni Center
6:00 pm - 8:15 pm	Let's Talk About Water film showing of "Who Owns Water" followed by panel discussion	Cascade Ballroom of Alumni Center

Tuesday April 28

9:00 am - 10:30 am	Session 4 Oral Presentations: Sediment Transport and Surface Water	Cascade Ballroom of Alumni Center
10:30 am - 10:45 am	Coffee Break	Foyer of Alumni Center
10:45 am - Noon	Session 5 Oral Presentations: Water Quality	Cascade Ballroom of Alumni Center
Noon - 1:00 pm	Lunch	Foyer of Alumni Center
1:00 pm- 2:00 pm	Session 6 Oral Presentations: Water Management and Infrastructure	Cascade Ballroom of Alumni Center
2:00 pm - 4:00 pm	Session 7 Poster Presentations: Water Quality and Policy	Cascade Ballroom of Alumni Center
4:00 pm - 4:30 pm	Awards and Closing Remarks	Foyer of Alumni Center

Session 1: Glacial Hydrology and Climate Change

Joe Hamman	University of Washington	**Assessing trends and variability in the Arctic hydrologic cycle using the Regional Arctic System Model**

In recent decades, we have observed significant changes in Arctic temperature, precipitation, runoff magnitude and seasonality, and snow cover. We apply the Regional Arctic System Model (RASM) in order to better understand the observed trends and natural variability in the Arctic hydrologic cycle. We use the recently completed RASM version 1.0, a high resolution, regional, coupled atmosphere - land - sea ice - ocean model that uses the Community Earth System Model (CESM) coupling infrastructure over a pan-Arctic domain. RASM is composed of the Weather Research and Forecasting (WRF) atmospheric model, the Variable Infiltration Capacity (VIC) hydrology model, the RVIC streamflow routing model, the Parallel Ocean Program (POP) model, and the Los Alamos Sea Ice model (CICE). We evaluate RASM's abilities to capture key features of the hydrological cycle over the modern era (1979-2014) through comparisons with reanalysis data sets, satellite estimates and in-situ observations. Of particular interest is the model's ability to capture trends, and seasonal and interannual variations in hydrologic fluxes and states at the land surface.

Matthew Cooper	Oregon State University	**Estimated snow sensitivity to climate warming in the eastern Oregon Cascades**

In the mountains of the Western US, shifts in the timing and magnitude of snow water equivalent (SWE) over the past century are well documented and attributed to climate warming, but the magnitude of sensitivity appears to depend on elevation. We estimated the spatial distribution of SWE and its sensitivity to climate warming in the 1500 km2 Upper Deschutes River Basin, Oregon, with a spatially distributed snowpack energy balance model forced by a gridded meteorological dataset. The 1/16o spatial-scale gridded meteorological data was downscaled to a 100-m spatial-scale digital elevation model using two sets of temperature lapse rates, and with and without bias-correction applied prior to downscaling. The bias-corrected and original data were each downscaled with 1) a spatially uniform and temporally constant -6.5oC km-1 lapse rate, and 2) with monthly varying lapse rates that were computed from long-term records of temperature from weather stations in the study region. Model parameters that control empirical estimates of incoming irradiance and the partitioning of precipitation into rain and snow were estimated independently with each dataset to optimize the agreement between modeled and observed SWE. We then estimated the sensitivity of the snowpack to +2oC and +4oC warming with each of the four downscaled temperature datasets and optimized parameters. Interdataset differences during the historical period were largely driven by differences in estimates of longwave irradiance. The sensitivity of SWE to +2oC and +4oC warming differed significantly at all elevations between the bias-corrected and original data, but did not depend on choice of lapse rates. At low to mid elevations, SWE sensitivity was largely driven by shifts from snow to rain, while at high elevations increased mid winter snowmelt was driven by increased estimates of longwave irradiance. Our results revealed a previously unrecognized positive feedback between prescribed lapse rates and empirical estimates of incoming longwave irradiance, and demonstrate the challenges of modeling SWE in data sparse regions.

Yixin Mao	University of Washington	**Did climate change cause the 2012-2014 California drought?**

California has experienced severe drought over the last three years, with especially deficient winter precipitation and mountain snowpack in 2013-2014. While the severity of California's water crisis last year is not in question, the causes of the drought are less clear. There has been debate as to whether last year's anomalously low winter precipitation (P) and snow water equivalent (SWE) result from human-induced climate change or whether they fall within the range of natural variability as manifested in previous severe droughts in California. To evaluate this question, we used the Variable Infiltration Capacity (VIC) hydrologic model to reconstruct SWE and runoff from 1920 to 2014 at a spatial resolution of 1/16 degree over the Sierra Nevada range of California. We forced the VIC model with a temporally consistent set of precipitation and temperature stations that are also used in the University of Washington's Drought Monitoring System for the West Coast Region (http://www.hydro.washington.edu/forecast/monitor_cali/index.shtml). We carried out trend analysis and examined empirical cumulative distribution functions for accumulated winter P, average winter temperature (T), Apr 1 SWE and spring runoff. We also performed a correlation analysis between SWE and P as well as SWE and T. In addition, we used detrended temperature data to force the VIC model to analyze the role of a warming climate on SWE and runoff. Our results show that while winter 2014 was among the driest years in the 1920-2014 record, it was not without precedent; similar droughts have occurred in the last century. Although long-term warming is one of the main contributors to the long-term decreasing trends in SWE and runoff, it is not the main cause of the recent drought event. Removal of the warming trend only slightly affects the frequency and magnitude of the most severe drought events. Thus, while the warming trend may have slightly exacerbated the ongoing 3-year drought (and winter 2013-2014 in particular), our analysis points to variability in precipitation (which lacks a long-term trend) as the main cause of this particular drought.

Diana Gergel	University of Washington	**Effects of climate change on snowpack in the Western United States**

A key concern about climate change is the potential to impact water resources and agriculture. In the Western United States, many regions depend primarily on snowpack for water storage, making them particularly sensitive to warming conditions. Recent studies have resulted in considerable disagreement over the extent to which snowpack will decline under climate change. We explore these questions using downscaled output from ten Global Climate Models (GCMs) from the Coupled Model Inter-Comparison Project 5 (CMIP5) for historical forcings (1950-2005) and future Representative Concentration Pathways (RCPs) 4.5 and 8.5 (2006-2100). Our study domain is comprised of five mountain ranges in the Western US: the Sierra Nevada, Cascades, Northern Rockies, Southern Rockies, and the White Mountains (located in Arizona). We use archived output from the Integrated Scenarios Project (ISP)1, which uses the Multivariate Adaptive Constructed Analogs (MACA) method for statistical downscaling of the GCMs. MACA-downscaled output from each GCM was then used to force the Variable Infiltration Capacity (VIC) hydrology model with a 1/16th degree spatial resolution and at a daily time step.

Drawing from our ISP VIC runs, we evaluate aggregate April 1 snow water equivalent (SWE) and August 1 soil moisture (SM) for each mountain range. All ranges show a pronounced decline of snowpack, with projected disappearance of SWE in the Whites by the end of the twenty-first century. Changes in snow accumulation as a function of elevation and winter temperature are often used as metrics for categorizing the effects of climate change on SWE. We use these in two ways. 1) We examine the changing relationship between elevation and SWE to compute the elevation above which 50% of SWE occurs each year and examine how this elevation will change. 2) We regress April 1 SWE on total winter precipitation for snow-dominant, transient and rain-dominant grid cells over each region (classification based on Hamlet and Lettenmaier 2007) and look at how the CDFs for each classification are projected to change.

Jordan Beamer	Oregon State University	**High-Resolution modeling of coastal freshwater discharge and glacier mass balance in the Gulf of Alaska Watershed**

A comprehensive study of the Gulf of Alaska (GOA) drainage basin was carried out to improve understanding of the coastal freshwater discharge (FWD) and surface mass balance (SMB) of glaciers. This FWD is an important driver of the Alaska Coastal Current. Coastal FWD and SMB for all glacier surfaces were modeled using a suite of physically based, spatially distributed weather, energy-balance snow/ice melt, soil water balance, and runoff routing models at a high resolution (1 km horizontal grid; daily time step). A 30 year hindcast was performed, providing complete records of air temperature, precipitation, snow water equivalent (SWE) depth, surface runoff, and glacier SMB. Meteorological forcing was provided by the North American Regional Reanalysis (NARR) and Modern Era Retrospective Analysis for Research and Applications (MERRA) datasets. A third dataset was created by bias-correcting the NARR data to recently-developed monthly weather grids based on PRISM climatologies (NARR-BC). This ensemble of runs provides a unique look at the range of variability in the Alaskan hydrologic system. The modeling system was validated at each step of the modeling process in several catchments using available weather, snow, streamflow, and glacier datasets . Simulated mean annual runoff range from 580 km3 yr-1 using NARR to 800 km3 yr-1 from NARR-BC. Glacier ice melt runoff, generated once the seasonal snowpack melts away, ranged from 230 km3 yr-1 from NARR-BC to 290 km3 yr-1 from NARR, highlighting the important contribution of glacier ice melt to the regional surface water budget. The simulated regional water storage compared favorably with GRACE satellite-based estimates, indicating that GRACE accurately detects the major hydrological signals in the GOA.

Session 2: Stream Ecology

Meredith Holgerson	Yale University	**Terrestrial leaf litter drives the ecosystem metabolism of small, temporary ponds**

Small temporary ponds are abundant throughout eastern and northern North America. These ponds typically occupy forested landscapes and are small (< 1,000 m2) and shallow (< 1 m deep), with a high perimeter to surface area ratio. These characteristics could mean that small ponds are very sensitive to the surrounding terrestrial environment. I studied the effects of terrestrial inputs on the ecosystem metabolism of small ponds in northeastern Connecticut, USA across two seasons. I found that the ponds received between 188 and 253 g m-2 of dry leaf litter each year. To evaluate effects on ecosystem metabolism, I studied oxygen and carbon dynamics in the ponds. Dissolved oxygen concentrations were always undersaturated and declined seasonally to the point of anoxia. Diel oxygen curves were only observed early in the season, indicating that respiration swamped out any daytime peaks in productivity as the season progressed. Interestingly, nighttime reaeration events were observed on 40% of nights due to convective mixing and invasion of atmospheric oxygen. The oxygen was quickly used up in the ponds, suggesting high respiration and oxygen demand. Carbon dioxide (CO2) and methane (CH4) concentrations were highly supersaturated, among the highest ever reported for lakes and ponds globally. The CO2 and CH4 concentrations were driven by high respiration rates and anoxic conditions, both of which can be attributed to terrestrial inputs of leaf litter. Overall, the metabolism of small temporary ponds is strongly heterotrophic and driven by large inputs of terrestrial leaf litter.

Hannah Clark	Oregon State University	**The impact of multiple stressors on aquatic macroinvertebrate communities in the Umatilla River**

Agricultural land use can negatively impact rivers and streams by adding pollutants and altering flows. Researchers have called for further study of land use linked stressors on river and stream communities because their effects can be complex and difficult to predict. Restoration efforts to create healthier streams should consider the complex interactions of multiple stressors to develop more comprehensive restoration plans. Two common agriculturally linked stressors in river systems are reduced water discharge from surface water withdrawal for irrigation and fine sediment inputs from field and bank erosion. Aquatic macroinvertebrates are commonly used to study the health of streams and rivers, due in part to the fact that there are a large number of aquatic macroinvertebrate species, with a broad spectrum of responses to environmental variables.

I used in-stream techniques to study how reduced water discharge and sediment addition impact aquatic macroinvertebrate communities in the Umatilla River in eastern Oregon. I hypothesized that: 1) reduced water discharge and sediment addition would decrease aquatic invertebrate richness and abundance and change functional group proportions within the community, 2) multiple interacting stressors would have a greater effect on the invertebrate community compared to single stressors. This study has the potential to identify some of the drivers of community change in aquatic invertebrate communities faced with multiple agriculturally-linked stressors.

Matthew Goslin	University of Oregon	**Reciprocal interactions between physical river process and a native sedge, Carex nudata, a potential ecosystem engineer**

Carex nudata, a riparian sedge ("torrent sedge") that occurs in rivers in Oregon and California, may play the role of an ecosystem engineer in rivers where it is abundant and may serve as a model of coupled biogeomorphic development in river systems. In the Middle Fork of the John Day River in eastern Oregon, C. nudata has exploded across the landscape following the removal of cattle grazing in the late 1990s. C. nudata forms fringes along the edges of the low flow channel and may grow as islands within the river. C. nudata appears to be altering channel morphology and planform, enhancing the complexity of the river in ways that facilitate restoration goals. I have employed multiple methods to investigate changes in channel morphology and planform in association with C. nudata: aerial imagery analysis, repeated topographic surveys, and erosion pins in cut banks with C. nudata fringes. Preliminary results suggest that C. nudata stabilizes the edges of the low flow channel, but cut banks behind C. nudata fringes continue to erode such that the bankflow width and boundaries of the channel continue to move. As these processes continue, the interaction between C. nudata, bank composition and hydrology may catalyze the potential for alternative developmental pathways in the river's morphology. In addition to investigating the influence of C. nudata on channel morphology, I have developed species distribution models for C. nudata in order to determine the drivers of C. nudata distribution within the river basins where it occurs.

Emily Campbell	Oregon State University	**Consequences of salmon hatch timing in ttreams with variable thermal regimes in the Copper River Delta, Alaska**

Temperature is an important factor influencing the timing of Pacific salmon life history events because it directly affects development rates. Salmon have complex lifecycles and phenology is a crucial determinant of individual fitness because transition timing to new life stages and habitats will place constraints on subsequent growth opportunities. Although we know that temperature and phenology interact to affect salmon fitness and survival, little work has been done to elucidate these mechanisms empirically. We tested hypotheses relating stream thermal regimes to coho salmon (Oncorhynchus kisutch) hatch timing and subsequent juvenile growth. Coho hatch timing and growth was measured in five streams with variable thermal regimes on the Copper River Delta, Alaska from May-October in 2013 and 2014. Thermal regimes ranged from groundwater dominated streams with relatively constant annual temperatures (3-5° C), to surface-water dominated streams with much greater thermal variation (0- 17°C). Coho salmon hatched 2-4 weeks earlier in groundwater streams, likely due to greater accumulated thermal units. Juvenile growth rates were nearly twice as fast in groundwater streams, suggesting these systems offer better growth opportunities for developing salmon. Understanding the interactive effects of temperature, salmon phenology and fitness is important as climate change continues to alter thermal regimes worldwide.

Session 3: Water Availability and Geomorphology

Thomas Mosier	Oregon State University	**SETI: A Novel Hydrologic Model for Projecting Long-term Streamflow Trends in Mountain Environments**

Mountains act as natural reservoirs of water, accumulating water during winter months and releasing it during the summer. Climate change is impacting seasonal snowpack and glacier mass balance in many mountain environments, in turn jeopardizing this historically relied upon natural reservoir system. In mountain environments, which are typically data-scarce, analysis of climate change impacts on surface water availability are often conducted using simple degree-index or enhanced temperature index (ETI) hydrologic models. The parameterizations of snow processes in these models are not robust through time, significantly increasing the uncertainty associated with making long-term projections using these models. The reason simple degree-index and ETI model structures are not robust is that they parameterize melt as a linear function of temperature, perhaps also including a shortwave radiation term. Additionally, these methods generally do not account for the snowpack's thermal properties. I have developed a novel hydrologic model structure, termed the Significantly Enhanced Temperature Index (SETI) method, which both accounts for each mode of heat transfer independently and explicitly accounts for the snowpack and glacier energy balances. The purpose of these model structure additions is to make the SETI model more robust for long-term applications. Here the SETI model is implemented for a partially glaciated watershed draining into the Cook Inlet, Alaska to demonstrate the model's efficacy. The SETI model is validated using multiple independent snow observations and discharge data. An ensemble of downscaled global climate model projection data for representative concentration pathways 4.5 and 8.5 are then used to project seasonality of streamflow in the example watershed through 2100. For many watersheds draining into the Cook Inlet, seasonal snowpack is projected to change minimally; however, total projected streamflow is found to deviate from historic levels due to changes in glacier mass balance and changes in the timing and magnitude of projected precipitation. The SETI model is designed to be easy-to-use and can be straightforwardly implemented for any mountain environment because the primary forcing data required to implement the SETI model for any global land area are freely obtainable from GlobalClimateData.org.

Andrea Leonard	Boise State University	**Agricultural water sustainability in the midst of climate change: an agent-based modeling approach**

Agricultural sustainability will become a greater priority for farmers, stakeholders, and land managers in the near future as climate change and population growth continue in the semiarid West. Regional hydrology in the Lower Boise River Basin (LBRB) of southwestern Idaho will vary with climate change, altering the spatiotemporal water demands in domestic food production areas. For instance, increased drought frequency and severity may increase the interannual variability in demand for water. It is important to understand and quantify the impacts of human decisions and policies on agricultural production in the midst of these changes. To accomplish this we use an agent-based modeling framework (Envision) that explicitly couples human and biophysical systems to create alternative future scenarios, allowing us to model decadal scale outcomes of agricultural activity in the LBRB. We can then assess potential trends associated with climate and population change in important variables such as irrigation use per unit acre, overall agricultural water use in the LBRB, crop yield, and urban growth impacts. Key required

developments to the modeling framework include: (1) a locally relevant but generalized model of crop choice that integrates key local drivers such as water rights, soil properties, and precipitation, (2) a robust, process-based crop growth model, and (3) representative scenarios of future climate change to drive the crop choice and growth models. By conducting a suite of scenario analyses, we hope to identify key farm management decision variables that, at the scale of the entire LBRB, will reveal regional implications on water demand and use, as well as crop distribution and yields. Ultimately, the modeling framework will be a useful tool to evaluate regional impacts of various policies on water use. Although this study is targeted toward understanding the Lower Boise, the generality of the modeling approach is potentially more broadly applicable to domestic food production systems across the semiarid West.

Lydia Nickolas	Oregon State University	**Scaling properties of the rainfall runoff generation process in the Oregon Cascade Mountains: A nested approach**

Although it is widely recognized that water quality and availability are crucial to society and the natural environment, we are still unable to predict how much water is moved through a given catchment after a storm event nor what nutrients, solutes, and contaminates are mobilized. This lack of understanding is particularly challenging for forested headwater streams in which the availability of hydrometric records is sparse. The objective of this study is to investigate seasonal and spatial variability of the delivery of water from hillslopes to streams and its relation to the transport of nutrients in a small forested headwater catchments in the HJ Andrews Experimental Forest, Blue River, OR. Our approach is innovative because it considers a nested framework and simultaneously incorporates hydrometric information, measurements of water stable isotopes as natural tracers, and nitrogen (N) concentrations. We hypothesize that: 1. the degree of hydrologic connectivity depends on the soil moisture state, 2. drainage area has a strong controlling effect on transit time of event water during dry conditions, 3. the relative contributions of event water to streams is correlated to the concentrations of nitrate during large storm events, especially under dry conditions, and 4. hydrologic connectivity is related to the extent of recent landslide history, which in turn controls the depth of unconsolidated material available for transient water storage. Sampling and analysis will focus on storms occurring in the fall, winter, and spring of 2014-2016. Isotopic and nutrient analysis will include baseflow samples collected every 3 weeks, precipitation collected at 3 separate elevations, and stream samples collected automatically over the duration of storm events from the 4 gauging sites (WS1, Mack, McRae, and Lookout). Analysis will also incorporate long-term storm response dynamics (magnitude, duration, intensity, antecedent moisture conditions) at these 4 locations. Ultimately, we will create a model that enables the prediction of hydrologic response and dissolved nitrogen flux under alternative scenarios based on the identified relationships between the relative contributions of pre-event and event water, the shapes of the pre-event and event transfer functions, LiDAR derived landscaper predictors, and the temporal and spatial variability of nitrate and ammonia concentrations.

Amy Steimke	Boise State University	**Modeling impacts of land management activities on future water availability in the Boise River Basin, ID**

Changes in land use and land cover play a critical role in climate change and water resource availability. However, feedbacks between land management strategies and regional hydroclimate are poorly understood. There exists a need for improved representation and quantification of human activities on hydroclimate under diverse management scenarios. Here, I will summarize how we plan to isolate the effects of various land management scenarios on water availability under several projections of climate change within the upper Boise River Basin, a mostly federally-managed landscape. Working closely with regional land managers, we will build a

realistic suite of management scenarios which will be constructed in the Envision agent-based modeling framework to assess impacts on key variables like snow cover, runoff, and soil moisture. This spatially-explicit framework treats the managed landscape as a dynamically coupled human and natural system where management activities and biophysical processes can be simulated on the landscape. To examine potential shifts in vegetation with climate change, we will also couple a dynamic global vegetation model, MC1, to our Envision model. We will examine outputs of timing and magnitude of water delivery under the various modeled scenarios. The results from this study will allow us to quantify and identify potential causal relationships between management activities and regional hydrology in the context of a changing climate.

Leah Tai	Oregon State University	**Precipitation Recycling in the Columbia River Basin: Lagrangian Models and Historical Analysis**

The linkage between land cover characteristics, such as soil moisture and vegetation type, and patterns of precipitation has been a long-standing question in hydro-meteorology since Charney first posed the problem in 1975. The factors affecting rainfall are complex and numerous, but large-scale manipulation of land-cover may exert influence on atmospheric conditions triggering precipitation. For example, what is the impact of the Columbia River Basin's 2,700 km^2 of irrigated area on down-wind continental rainfall? Similarly, can we identify places where large-scale forestation is most likely to increase precipitation, or regions where rainfall recycling is affected by complex topography? This research presents an analytical Lagrangian framework for the estimation of incremental increases in down-wind precipitation due to land surface evaporation and transpiration. These predictions are compared to recently published rainfall recycling values from the literature and statistical analysis of precipitation trends in the Columbia River Basin.

Heather Baxter	Washington State University	**Impacts of future changes on low flow in a highly connected river-aquifer system: The Spokane River**

The Spokane, Washington-Coeur d'Alene, Idaho Corridor contains the Spokane Valley-Rathdrum Prairie (SVRP) Aquifer, which is a sole source of drinking water for more than 500,000 people. This aquifer is highly connected to the Spokane River, making the river relatively vulnerable to climate and anthropogenic changes such as pumping. Recent studies have found a decline in minimum daily flow in the Spokane River in the last 100 years, raising concern for the sustainability of human and ecosystem water usages in the next decades. In this research, we investigated the potential impacts of future changes in both climate and human activities on low flows in the Spokane River – SVRP system. A distributed, physically-based hydrological model, the Precipitation Runoff Modeling System (PRMS), and a Modular three-dimensional finite-difference ground-water model (MODFLOW) were used to estimate recharge into the SVRP and the interaction of surface water and groundwater. The model was calibrated and validated at a daily time-step using 16 years of both observed streamflow and observed well data from 1990 to 2005. To assess future climate change impacts, statistically downscaled climate projections of temperature and precipitation between 2010 and 2050 from four general circulation models were used. The results from the coupled model provide insight on the interplay between climate and human activities on groundwater recharge and low flow discharge in the highly connected Spokane River – SVRP Aquifer system. Results can be used to help direct long term water resources management and planning in the region.

Christopher Conatser	Oregon State University	**Iron mobilization in a Willamette Valley Bioswale**

Stormwater best management practices (BMP's) such as bioswales are increasingly applied throughout the Pacific Northwest to detain and treat urban storm runoff, as Municipal Separate Storm Sewer System (MS4) permitting regulations are phased in. Common practice throughout

the United States emphasizes utilizing native soil in these green stormwater control structures for cost and conservation reasons. However, this poses some unique challenges in the Willamette Valley, where a large portion of urban areas facing runoff issues and regulation are built on areas that were formerly seasonally saturated floodplains and terraces. The soils in these seasonally saturated areas tend to accumulate relatively soluble amorphous iron oxides on soil ped surfaces, which may then be reduced and mobilized during saturated stormflow conditions at concentrations harmful to aquatic organisms. This potential problem has not been addressed in previous bioswale research, which generally focuses on heavy metals that are problematic at much lower concentrations. It is compounded by several factors: soil disturbance during construction exposes new preferential flow paths; high levels of organic matter included in the engineered soil mixes (to increase drainage and cation exchange capacity) can bind and mobilize iron cations; and plant root exudates chelate and mobilize iron to promote nutrient uptake. Furthermore, facilities constructed with underdrain structures may then deliver this mobilized iron directly to storm sewers and streams. At the Oregon State University/Benton County Green Stormwater Infrastructure Research Facility, measured total iron concentration (dissolved and colloidal) in bioswale effluent is over three times the concentration in stormwater influent, and at 800ppb risks exceeding EPA total iron discharge limit of 1000ppb. Characterization of the detailed chemistry and mechanisms of this transport may lead to new bioswale construction guidelines in the Willamette Valley and where similar conditions are found elsewhere.

Kira Puntenney	Oregon State University	**The role of antecedent soil moisture conditions in erosion and sediment transport to streams in managed, headwater catchments**

Fixed-width riparian buffers have been widely adopted as a forest harvesting guideline to minimize the amount of eroded sediment that is transported from harvested cutblocks to streams. However, there is still uncertainty on the effectiveness of these buffers at controlling runoff, erosion, and sediment transport, especially during infrequent, high intensity precipitation events. The objective of this research is to examine the influence of antecedent soil moisture conditions on rainfall infiltration, runoff, and erosion following land cover alteration from timber harvesting. Research will occur in high elevation (~ 1482 to 2657 m), snow dominated, forested catchments on the eastern slopes of the Rocky Mountains. Sites are dominated by Pinus contorta var. latifolia at lower elevations and Picea engelmannii and Abies lasiocarpa at higher elevations. The catchments, Star Creek West (variable retention with reserves), Star Creek East (strip cut), and McLaren Creek (shelterwood) will be harvested with 30 m, fixed width buffers, while North York Creek will serve as an unharvested, reference catchment. Data collection in spring/summer 2015 will be used to assess the a) spatial and temporal variation in soil moisture within a riparian buffer, b) sediment yield from the harvested hillslopes to the riparian buffer, and c) runoff response to simulated, high intensity, rainfall events (using a rainfall simulator) under different antecedent soil moisture conditions. Comparisons will be made between plots within the undisturbed control catchment and the three harvested catchments. Site features such as slope, aspect, soil texture, vegetation cover, and ground cover will be characterized and serve as independent variables to help describe differential erosion and sediment responses. This study will improve understanding of riparian buffers effectiveness at mitigating sediment transport from harvested areas to streams, specifically in steep, snow-melt dominated, headwater catchments, which are vital to healthy aquatic habitat and drinking water supply.

Kylie Pace	Oregon State University	**Sediment Pulse Translation and Dispersion in Natural Gravel-bedded Rivers**

The lifespans of many dams are now nearing their ends, prompting a need to predict where and how accumulated sediment will move following barrier removal. Flume studies suggest that sediment may be expected to disperse in place, except in the case of a low Froude number or relatively fine pulse grain size. However, quantitative analyses of sediment pulse behavior have not been widely conducted in field settings. This research seeks to quantify the behavior of bed

load following barrier removal at four sites in Oregon and to evaluate the flume-derived hypothesis that dispersion dominates the movement of sediment pulses.

Changes in pulse volume were calculated from bathymetry data collected at sites on the Rogue River, Calapooia River, and Oak Creek. Pulse behavior was evaluated by two analyses of the cumulative volume distribution. In the first, the slopes of the cumulative volume distribution at each time step were compared, with the magnitude of the difference between slopes indicating strength of dispersion. Secondly, the median and interquartile range of the cumulative volume distribution were calculated for each timestep and plotted against each other, with the value of the slope proportional to the strength of dispersion. Finally, the shape and scale parameters of a gamma distribution are fit to each pulse. Tentative results provide quantitative evidence of translation at two of the sites. This indicates that dispersion may not be only key process at play in the evolution of sediment pulses and illustrates the need for further evaluation of flume-derived hypotheses, as well as further development of methods for quantifying pulse behavior in natural environments.

Jon Sanfilippo	Oregon State University	**Measuring Gravel Transport in an Active natural System: An analytical framework**

In order to measure sediment flux in Porter Creek, a small tributary to the North Fork of the Siuslaw River near Florence Oregon, we have deployed ~600 pieces of tracer gravel embedded with passive integrated transponder (PIT) tags, 8 fixed antennas, and 9 logging pressure transducers spaced along 130 m of channel comprising 3 wood jams and substrates of sand, gravel, cobble, and bedrock. Tracer deployment is uniform along the instrumented reach, analogous to constant-source solute or dye injection, so that sediment flux [L3/T] for the ith grain size class is Qi = niVpiFi/fTi, where ni is count rate, [T-1], Vpi is particle volume, and Fi and fTi are fractional coverage of the ith size class of grains and tracers, respectively. Tracer concentrations, fTi, must be large enough for accurate estimation of ni = 1/TAi where TAi is the mean inter-arrival time of tracers at an antenna, during a period of nearly constant discharge. A square wave or constant sediment injection is undertaken by placing a concentration of tracers dispersed upstream of the study reach, such that it will add to the concentration within the study reach as gravels migrate downstream, replacing the gravels within the antenna network. Preliminary results show dispersion values ranging from ~0.305 m2/day for 8-16mm size fraction, to ~0.13 m2/day for >64mm size fraction, with travel distances ranging from 96 meters for the 8-16mm to 40 meters for the >64mm size fraction. Since there is a high level of variability in dispersion within the antennae array given the heterogeneity of substrates and wood placed within the system, it is likely that some tracers will need to be added within the regions between antennae after high water events. The tracer concentration within the regions occupied between antennae must remain at such a level as to provide viable statistical relationships between tracer and non-tracer gravels, and percent mobile versus percent stationary to provide robust data for validating sediment fluid interactions.

Scott Katz	Oregon State University	**Sediment transport dynamics and its relation to primary production in mountain headwater streams**

This study explores how the spatial variability of stream flow and sediment transport influence the growth and recovery rate of benthic primary producers during different seasons in a mountain headwater stream. Sediment transport processes control the distribution of habitat for benthic organisms such as periphyton, which comprise a key resource at the base of the food-web. Previous studies indicate that habitat disturbance caused by sediment transport can be a controlling factor on periphyton accrual rates, with the magnitude of the influence varying with the frequency of floods and the availability of additional biotic and abiotic growth factors (macro-invertebrates, temperature, nutrient availability and light). We hypothesize that the physical disturbance of benthic periphyton vary spatially within a given reach due to the heterogeneous

distribution of flow forces and velocity and that this disturbance, caused by particle movement, will be an important controlling factor of chlorophyll-a accrual rates during the spring and fall seasons when necessary growth conditions are optimal.
The study site encompasses a 165m reach of Oak Creek, Corvallis, OR. Discharge, channel geometry and grain size distribution will be measured and used as boundary conditions in a two dimensional hydrodynamic model which will allow quantifying the spatial variation and magnitude of stream bed (habitat) disturbance. Disturbance maps will be generated and used to select habitat patches with varying disturbance levels for monitoring. Benthic periphyton will be collected bi-weekly in these patches and analyzed for chlorophyll-a to assess accrual rates. Background nutrient concentrations, light intensity, and stream temperature will be measured throughout the study. Accrual rates after storm events will be analyzed in conjunction with disturbance levels and abiotic growth factors to quantify how habitat disturbance controls algal growth. The conclusions of this study will inform scientists and managers about how anthropogenic actions affecting sediment transport will influence stream ecosystems.

Laura Hempel	Oregon State University	**Change in bedload transport frequency with climate warming in gravel-bed streams of the Oregon Cascades**

Previous modeling studies have predicted that high flows in the Oregon Cascades will become larger and shift towards earlier in the winter season with climate warming. The impact of those changes on bedload transport frequency and channel morphology remains unknown, however. We examined changes in the timing and magnitude of bedload transport under modeled flow scenarios to identify which rivers draining the Cascades with different hydrologic regimes are most vulnerable to increased frequency of bedload transport. Such increases in the frequency or magnitude of gravel entrainment might lead to disturbance of fragile salmon or bull trout habitat.
We calculated bedload transport rates using field measurements of surface sediment size, channel geometry, and channel slope along 14 reaches that included streams with a range of drainage areas and flow regimes (i.e., spring-fed and surface-runoff dominated). Our findings suggest that both spring-fed and surface-runoff streams are vulnerable to predicted changes in the flow regime, but in different ways. Spring-fed streams, characterized by relatively uniform discharge, will likely experience changes in both the timing and magnitude of transport. Spring-fed streams are poised just above the critical transport threshold for a large portion of the year, therefore small changes in the highest flows may lead to marked changes in transport rates. Transport events in surface-runoff streams, which are already characterized by flashy flows, will likely become larger and more frequent. Changes in the frequency and timing of bedload transport in both spring-fed and surface runoff streams will impact bed stability and texture and should be considered for managing these watersheds in the future.

Russell Bair	Oregon State University	**Modeling geomorphic response to large wood introduction as a strategy to restore fish habitat in a managed forest watershed**

Large wood (LW) additions are often part of fish habitat restoration, however their relative success is rarely reported in terms of ecological significance. Under natural conditions, northwest coastal streams recruit LW and develop forced-pool-riffle morphologies in reaches that would otherwise exhibit plane-bed characteristics. This creates ideal habitat for anadromous fish. Historic forest operations allowed clear-cutting and removal of in-stream LW limiting contemporary natural recruitment.
ODFW is implementing a basin wide LW addition in Mill Creek, a salmonid life cycle monitoring site. This presents an opportunity to study LW effects on geomorphic processes relevant to fish habitat and link them to long-term data.
Three reaches on commercial timberland were selected based on uniform, plane-bed geometry,

and lack channel spanning LW. LW will be added after one year and pre and post geomorphic data is being collected to build and calibrate a flow model. Geomorphic data includes: channel topography, surface and subsurface grain size and erosion and deposition measurements near LW additions.
A 2D hydraulic model will be used to calculate spatial distributions of shear stress and investigate sediment transport before and after LW addition. We will use the modeling results in combination with a basin wide geomorphic survey to extrapolate the results to other sites within the basin.
We hypothesize that most change will occur near new LW. Finer sediment will increase directly downstream of the LW whereas coarse material will be more frequent upstream. The sediment flux through the reach will decrease but will be more spatially variable.
Reaches are ~100m in length, range in width from 4 - 10 m, have drainage areas between 2.2 and 16 km2 and slopes between 0.025 and 0.033 , surface median grain size D50 varies ~ 0.030 - 0.045 m and subsurface is ~0.026 m in all reaches. Rating curves for each site were made based on at least 10 discharge measurements
This study will contribute information on geomorphic change triggered by LW additions interpreted in the context of long-term biological data. It will enhance our ability to define concrete and effective restoration targets allowing forest management while maintaining and/or recovering habitat.

Susan Elliott Oregon State University

Physical modeling of the feedbacks between invasive riparian species, hydraulics, and bed form evolution.

This study examines the effects of the invasive riparian ecosystem engineer Phalaris arundinacea, or Reed Canary Grass (RCG), on riverbed form evolution and subsequent feedback cycles. Recent studies propose the biogeomorphology concept, a reciprocal linkage between the interdependent processes in biological communities and fluvial geomorphology that work simultaneously to alter the aquatic landscape (Gurnell, et al. 2011). Previously, it was thought that physical processes drive the evolution of plant ecology in a one-way direction. However, it is found that many riparian vegetation species act as ecosystem engineers by creating pioneer landforms that impact channel morphology (Gurnell et al., 2012). This alteration of the river's physical landscape results in accelerated reach scale morphological changes such as an increase in flow velocity, alterations to the Manning's roughness (Luhar and Nepf, 2013) and an increase in the availability for riparian colonization sites. In the case of P. arundinacea, propagation results primarily from rhizome shoots, floating rhizome mats and seed dispersal in a wide range of ecological conditions (Lavergne and Molofsky, 2004). With the highest germination rates in saturated soils (Coops and Van Der Velde, 1995), RCG can easily spread in many aquatic habitats.
This research will investigate the invasive Reed Canary Grass' control of fluvial landform development by quantifying the change in bed form topography as a result of changing velocities and vegetation patch density. Through the implementation of a physical model, I will explore the feedbacks associated with bed form evolution that further link biological and physical processes. A primary hypothesized feedback is as patch density increases, P. arundinacea increasingly contributes to bed form development in the low velocity wake region, which leads to increased surface for further colonization. A second possible feedback of the bedform expansion includes the narrowing of the river channel and increased lateral velocities (Follett and Nepf, 2012), maintaining a transport mechanism for further downstream rhizome and seed dispersal. The results of the proposed research will ultimately contribute to the fundamental understanding of biogeomophology concepts and linkage between fluvial geomorphology and riparian ecology, as well as the management of invasive species. A greater understanding of vegetation resistance is also essential for flood risk assessments (Luhar and Nepf, 2013).

Laurel Stratton	Oregon State University	**Stratigraphy of carbon preservation in reservoir sediments, Elwha River, Washington**

Incision following dam removal on the Elwha River, Washington provides the first in situ opportunity to examine the facies architecture and distribution of carbon in sediments deposited in a large reservoir, providing insight into the processing and storage of organic carbon in reservoir environments. Glines Canyon Dam (64 m, river km 26.1) impounded Lake Mills (area ~1.6 km2, capacity 5.12 x 107 m3, watershed area 636 km2) from 1927 to 2011, over which the Elwha River deposited an estimated 1.56 x 106 m3 sediment primarily in a steep-fronted, Gilbert-style delta built ~0.5 km into the reservoir. Following dam removal, topset and foreset beds persist only as as poorly-exposed remnant terraces, but smaller delta fans built out from two tributary creeks provide well-preserved analogues for the main Elwha delta. Allochthonous carbon is preserved in foreset and prodelta sands with secondary lenses of coarse-grained organics deposited as channel-lag in migrating topset channels. Organic units tend to be coarse-grained, clast-supported lenses and beds consisting of well-preserved branches, cones, and needles in the topset and foreset beds, while prodelta sands consist of well-sorted, well-preserved needles and leaves associated with fine sands and silts. Fine-grained lacustrine beds in the main body of the reservoir are mineral sediment dominated. The older but smaller Elwha Dam (33 m, river km 7.9) impounded Lake Aldwell (area ~1 km2, capacity 9.99 x 106 m3, watershed area 815 km2) for >85 years prior to removal in 2011. Coarse-sediment-starved downstream of Lake Mills, the Elwha deposited only ~3.0x106 m3 sediment in Lake Aldwell, primarily in an elongate delta. Lake Aldwell's delta exposures are similar to Lake Mills but lower angle, with finer, more organic-rich topsets. Evaluation of weight-percent carbon samples from discrete reservoir facies will apply stratigraphic context to estimate a total volume of organic content in Lake Aldwell's and Mills' sediments. The Elwha reservoirs probably represent an endmember of carbon stratigraphy in reservoirs, dominated by oligotrophic waters and run-of-the river operations. Future work will evaluate facies architecture and carbon deposition patterns in reservoirs along this continuum to develop understanding of the range of variability of carbon storage in water reservoirs.

Kris Richardson	Oregon State University	**The role of forest harvest practices and extreme events on the sedimentation of an oregon coast range lake**

Timber harvesting and road building in steep mountainous landscapes alter hydrologic routing and sediment delivery to streams. Fires and earthquakes destabilize hillslopes. However, how closely coupled these disturbances are to extreme precipitation throughout an entire catchment is not well understood. We use lake sediment as a record of catchment events through time. By analysis of sediment cores, we quantify historical changes in sedimentation after large-scale timber harvest as well as after implementation of Best Management Practices (BMPs) in contemporary forest harvest. Measuring sedimentation rate and characterizing sediment by particle size, %C, C/N, and magnetic susceptibility, we show changes in the system in response to disturbances. Applying the instrumental and reconstructed hydroclimate record, we analyze the impact of extreme precipitation events and their interaction with disturbance. We also consider changes during and after earthquakes, of which four have likely occurred during the lifetime of this landslide-dammed lake. We examine the stratigraphic fidelity of lake sediments as a record of catchment events. Preliminary results suggest that mean sedimentation decreased after Oregon Forest Practices Act. Sedimentological changes offer a glimpse over a 1500+ year time period of fluvial and lacustrine processes of a single catchment, and how the system may respond to increasing precipitation intensity under different management regimes.

Elnaz Hassanpour Adeh	Oregon State University	**Characterizations of near-farm evapotranspiration under wind turbine effects using Surface energy balance algorithm**

The potential indirect water usage through higher evapotranspiration in near wind turbine farms may put this procedure of energy production as a high water demanding one compared to other sources. In the current research the overtime changes in near-farm evapotranspiration are investigated through different image bands from Land Sat satellite, before and after wind turbine installations. For this purpose, a computer code is developed based on a Surface Energy Balance Algorithm (SEBAL 2010) and statistical analysis methods to characterize the evapotranspiration data. The first revision of the code considers automatic footprint areas as ellipses and compares the evapotranspiration inside the footprints and outside the wind farm. The parametric study for different variables in the problem will be done for several major wind farms in the US including Texas, Oregon and Indiana wind farms. In this regard, the first analyses from Indiana wind farms demonstrate an evapotranspiration increase during the last fourteen years after wind turbine installation.

Robert Predosa	Oregon State University	**Measuring the morning transition of the atmospheric boundary layer**

The Atmospheric Boundary Layer (ABL) is the lowest part of the atmosphere that directly interacts with the planet's surface. The development of ABL plays a vital role, as it affects the transport of atmospheric constituents such as air pollutants, water vapor, and greenhouse gases. The activities such as morning and evening transitions in the ABL is one of the least well understood aspects of atmospheric meteorology. Modeling the transition mechanics is complex, and the measurement of the transition processes has been difficult due to the limitations in the spatial and temporal resolutions of the equipment as well as the height of the traditional flux tower. Recently, the development of unmanned aerial vehicle (UAV) and distributed temperature sensing (DTS) technologies shed a new light on the measurement of morning and evening transitions in ABL. In this study, a system consisting of a fiber optic DTS cable fixed to a UAV was tested for its feasibility in taking high temporal resolution ABL measurements. The fiber optic DTS cable has a diameter of 900 μm and provides 1s and 12.5cm in temporal and spatial resolutions, respectively. The UAV provides a stable platform while lifting the cable to an elevation of 100m. The results showed that the DTS-UAV system is capable of capturing the vertical temperature profiles of the morning and evening transitions, especially the rapid changing periods due to the high temporal and spatial resolutions of the DTS cable. This pioneer study provides a new method with great potentials in the field of ABL measurement.

Alek Mendoza	Oregon State University	**Monitoring transpiration rates in a semiarid riparian ecosystem**

Authors: Alek Mendoza, Julianne Robinson, Carlos Ochoa
Proper quantification of plant evapotranspiration in riparian areas is critical for assessing water availability. This is even more necessary in arid and semiarid landscapes, such as those located in Central and Eastern Oregon. One of the main objectives of this study being conducted in a semiarid watershed in North Central Oregon is to assess water uptake by riparian vegetation along the streamside. Overstory riparian vegetation uptake will be determined based in measurements of xylem sap flow. EXO-Skin sap flow sensors will be used to estimate transpiration rates by dominant tree species in this riparian area. Lab testing and calibration of sap flow sensors prior to field deployment is currently underway. Preliminary results indicate that these sensors can produce reliable information, and can be further implemented in the field. Results of this study will provide insight and further knowledge of factors affecting water availability in water-limited riparian ecosystems. Part of this research is supported by the URSA-ENGAGE and URISC programs at Oregon State University. The work described here is part of a larger research program focusing on understanding climate-vegetation interactions and ecohydrologic processes in arid and semiarid landscapes.

Steve Drake	Oregon State University	**Active layer depth in permeable snow**

Wind generates turbulent eddies and topographically induced pressure fluctuations that cause air movement in permeable snow. The effect of wind on snow changes with depth in the snow. In the "active" layer near the surface, turbulence and local pressure gradients enhance vapor exchange with the atmosphere. By measuring the spectral attenuation of pressure perturbations with depth we determine the active layer depth in snow, which in turn, may regulate sublimation enhancement by wind ventilation.

Eleni Antonelli	University of Oregon	**Examining the relation of outdoor pool water evaporation to the urban density due to wind protection**

With more than 7.4 million swimming pools in the U.S. alone, and roughly 100% of their water being evaporated on a yearly basis, pool water evaporation accounts for a significant amount of water being wasted every day throughout the world. Several studies have been conducted to create a proper equation for the evaporation rate on the pool surface, based on the wind speed, water temperature, and relative humidity. However, little research has been done to explore the way in which the local conditions of the pool surroundings can affect the pool water evaporation rate. This study aims to examine the relation of the urban density to the evaporation rate of outdoor swimming pools, by studying the way the urban density of a neighborhood affects the wind speed over the pool surface. Through CFD simulation of select suburban neighborhoods of the three largest cities in California, where water is scarce but swimming pools are abundant, the current conditions of pool water evaporation rates will be assessed. Moreover, for each of these neighborhoods four theoretical scenarios will be also simulated and assessed, two for a lower urban density, and two for a higher one. Thus, the way that urban density affects the water evaporation rate in each neighborhood will become clear. It is assumed that this study will prove that in more dense neighborhoods the water evaporation decreases, while in more sparse neighborhoods the water evaporation increases. Besides, another assumption is that when the swimming pools are on the leeward side of the surrounding buildings the evaporation rate is not affected so much as in the swimming pools located on the windward side. By running simulations to select neighborhoods and their more sparse or dense alternatives, we will be able to compare the evaporation rates more accurately.

Brian Henn	University of Washington	**Pillows, courses, LiDAR and streamgauges: Assimilating snowpack and streamflow observations into basin water balance infererence**

Snow pillow and course observations of snow water equivalent (SWE) are point measurements, but SWE averaged across a basin's area is generally needed for water resources forecasting and hydrologic modeling. Research has been devoted to determining whether point SWE observations are representative of the broader landscape. Studies have often concluded that, in the elevation range of the observations, point measurements overestimate area-average SWE, and that a lack of high-elevation point measurements may result in underestimation of late-season SWE. However, the recent development of the Airborne Snow Observatory (ASO) provides extensive, high-resolution, distributed SWE estimates, which allows for robustly relating point and basin-average SWE.

Thus, we use ASO data to develop an understanding of basin-average SWE, which is critical to constraining the water balance. Water year precipitation may be inferred if other components of the water balance, i.e., SWE, streamflow, and evapotranspiration (ET), are known. We apply this approach to multiple watersheds in and around Yosemite National Park, using the calibration of an ensemble of lumped hydrologic models to infer the more uncertain terms (precipitation and ET) from those with greater certainty (SWE and streamflow).

We examine how SWE at courses and pillows compares with distributed ASO SWE in the

Yosemite basins. How does the ratio between these types of observations vary in time and with elevation? For the years prior to ASO, can this relationship be used to retrospectively scale point SWE to the basin average? Second, we test the extent to which assimilating SWE observations constrains uncertainty in hydrologic modeling of water balance components. Models calibrated using uncertain precipitation forcing to streamflow observations may have substantial uncertainty in internal SWE states and ET fluxes. Does assimilation of appropriate SWE observations reduce this uncertainty? We hypothesize that this approach can improve understanding of water balance components in high-elevation, sparsely-measured basins.

Zach Simpson	University of Arkansas	**Water quality trends in the Upper White River Basin, Northwest Arkansas**

The Arkansas Natural Resources Commission (ANRC) Nonpoint Source Management program, under section 319 of the Clean Water Act, has designated priority watersheds in Arkansas where programmatic funding should be targeted. One of these watersheds is the Upper White River Basin (UWRB) in Northwest Arkansas, which includes the drinking water supply to northwest Arkansas and parts of southwest Missouri. A past study showed that chemical concentrations were decreasing at select sites across Northwest Arkansas through June 2009, suggesting water-quality was improving. This study focused on detecting trends in nutrient and sediment concentrations across six sites in the UWRB, using data collected from July 2009 through June 2014. The sites of interest had a record of daily mean flow data available from the US Geological Survey, and water samples during base flow and storm events were collected and analyzed by the Arkansas Water Resources Center approximately 46 times per year. Trend analysis was performed on flow-adjusted concentrations of the constituents using both parametric and non-parametric procedures to detect a significant upward, downward, or lack of trend. This study will provide organizations concerned with watershed management, such as Beaver Watershed Alliance, Beaver Water District, ANRC and others, useful information on how management efforts are potentially influencing water quality.

Session 4: Sediment Transport and Surface Water

Jay Frentress — Oregon State University

Looks are deceiving: Is the dynamic expansion of near-stream surface saturation important for streamflow generation?

Saturation excess overland flow (SEOF) generated in near-stream, saturated areas is a mixture of rainfall and exfiltrating groundwater that can be quickly transported to the stream network during rainfall events. Rainfall is presumed to dominate SEOF composition and much research has focused on predicting and quantifying surface saturation using topographic and subsurface information. Near-stream saturated zones expand and contract during events but capturing such variability has proven highly challenging. Moreover, controls on SEOF composition and mixing processes within these zones are poorly understood. Here, we seek to expand our understanding of controls on mixing within near-stream saturated zones and composition of SEOF as well as determine the relative impact of SEOF on streamflow generation.

We quantified surface saturation dynamics in a near-stream area during rainfall events using high frequency, ground-based, thermal infrared imagery. Temperature differences between exfiltrating groundwater, stream flow and surrounding vegetation were used to classify areas of saturation within this area. Stream discharge above and below the saturated riparian area, as well as hydraulic gradients within, were quantified throughout a series of rainfall events between December 2013 and January 2014. Specific discharge generated within the 100-m2 reach was nearly three-fold larger than at the 6-ha outlet. However, surface saturation dynamics determined using the infrared imagery were poorly correlated to discharge. Furthermore, cumulative rainfall on near-stream saturated areas alone was insufficient to explain the difference in flow generated within this small reach. Instead, groundwater exfiltration within the near-stream zone generated large streamflow contributions as well as persistent saturation throughout the event. This persistent saturation in turn facilitated saturation expansion during intense precipitation. Work presented here expands our understanding of the composition of SEOF during rainfall and how this in turn affects the stream hydrograph response.

Erica Kemp — Oregon State University

Sediment Transport Prototypes: Novel Methods to Disconnect Unpaved Roads from Streams

Unpaved roads are a critical form of infrastructure in forested landscapes. Multiple industries benefit from their low cost and ease of construction. Despite their practical utility, unpaved forest roads are a potential source of fine sediment that can be transported to nearby aquatic habitat and degrade sensitive ecosystems. Improved management of aggregate road surfacing can reduce sediment generation, lengthen its useful life span, reduce maintenance costs, and more importantly, mitigate the impacts of road sediment on hydrologically connected ecosystems. This study reconstructed an unpaved forest road in Dunn Research Forest to test novel applications of geotextile materials and their effect on road aggregate performance and road sediment sequestration. Three road construction treatments were evaluated: an aggregate-only control (no treatment), a biomass waddle-type filtration bale, and a geotextile-wrapped filter sand berm with a geogrid underlay. Two different aggregate varieties were used totaling six road treatment sections. A worst-case sediment scenario was produced with simulated rainfall and heavy truck traffic to mimic wet-weather timber hauling. Ditch runoff was collected to determine filtration effect of each road treatment and surface aggregate was testing for degradation

through time to determine rate of sediment production. Data analysis is ongoing and preliminary findings are presented herein. The geogrid reinforcement effectively reduced subgrade stress and improved aggregate performance. The geotextile-wrapped sand filtration berm produced variable results in the field, but follow-up laboratory testing indicated a substantial reduction in effluent turbidity. In contrast, the biomass filtration bale provided no discernable filtration benefit from road aggregate sourced runoff. Investigators are currently developing recommendations for new best management practices employing the use of geotextile materials in unpaved forest road construction as a means of improving runoff water quality, and aggregate performance.

Trevor Langston	University of Oregon	**Spatial Patterns of Flow and Sediment Transport Dynamics in the Upper Willamette, OR**

The Willamette is a gravel-bed river that drains ~28,800 square kilometers between the Coast Range and Cascade Range in northwestern Oregon before entering the Columbia River near Portland. In the last 150 years, natural and anthropogenic drivers have altered the sediment transport regime, drastically reducing the geomorphic complexity of the river. The purpose of this research is to assess the relationship between flow and sediment transport in the section of the Willamette spanning the McKenzie confluence to the town of Corvallis. Cross sections were extracted from a 1 meter bare earth digital elevation model created from LIDAR flown in the summer of 2008. Bathymetry below the LIDAR water surface was created for four different simplified channel models (rectangular, trapezoidal, triangular and parabolic) by solving Manning's equation. 1D steady-state flow within the channel was modeled using HEC-RAS. Floodplain surfaces outside the main channel have considerably greater hydrodynamic complexity. For this reason, overbank flow was modeled using the 2D flow capabilities available in the latest version of HEC-RAS. Sediment transport was modeled for the main channel in HEC-RAS using the surface-based equation of Wilcock and Crowe. Sediment size distribution was parameterized using measurements collected on 20 gravel bars over the summer of 2014. Sensitivity of the model to channel bathymetry was tested using the four simplified channel models.

Francisco Guerrero-Bolano	Oregon State University	**From molecules to watersheds: hydroboigeochemical signals of watershed responses to disturbances**

Long-term historical records of biogeochemical processes in forested watersheds are essential to understand their adaptive capacity to human and climate induced disturbances. We hypothesize that variability in discharge, suspended sediments and particulate organic matter chemistry (POM) could be used as a cross-scale indicators of watersheds to disturbances. Our overall objective is to understand the role of variability in hydro-biogeochemical signals as a source of information that could be used to reconstruct historical responses of forested watersheds to land-use practices and climate disturbances. . To test our hypothesis we are going to study variability in hydro-biogeochemical signals encompassing different spatial (1-1000 km2) and temporal (days-hundreds of years) scales, as well as different scenarios of land-use and management practices. Our general approach is to characterize hydro-biogeochemical variability from an information theory perspective. We are going to explore the relationship between hydro-biogeochemical variability and landscape attributes in the watersheds as modulated by climate and land-use scenarios. After completing this research, we expect to obtain a set of biogeochemical indicators of forested watersheds responses to climate and human induced perturbations supported by informational analysis at different resolution levels, from molecules to watersheds.

Timothy DeWeese	University of Idaho	**Quantifying Stream Bed Erosoin - deposition using temperature time series data**

Dynamicity is inherent to a river bed, and many ecological processes within the river bed rely upon this natural phenomenon. River restoration activities often involve significant changes in stream bathymetry, thus affecting river ecology. Monitoring of bed movement in real time can significantly improve understanding and help monitor and verify proper river restoration activities. Here we present a new, simple and economical method to continuously monitor and record local stream bed erosion and deposition. The method uses naturally occurring daily temperature oscillations in stream water as a signal to detect changes in stream bed elevation. Paired temperature measurements between stream water and stream bed sediment can be analyzed to solve for any change in stream bed elevation between sensors.

Laboratory applications predict stream bed erosion-deposition, compared with actual measured or imposed values. Experimentation uses a sediment tank to mimic stream bed processes, where surface water temperature is controlled to mimic stream temperature oscillations, and pore water fluxes through the sediment are controlled similar to a constant-head permeameter. A temperature probe is buried vertically, with sensors spaced evenly over the tank depth to obtain time-series temperature profile data. Change in sediment height is manually imposed, representing erosion and deposition processes, and testing is performed under gaining, losing and neutral conditions of the stream surface water. Quantification of bed elevation change is predicted and compared to imposed values using water temperature oscillation and the associated amplitude and phase differences among temperature sensors in the vertical bed profile.

The field study site is a debris fan along the South Fork Boise River, a significant fishery and Bull Trout habitat. It recently experienced heavy debris flow due to post wildfire erosion. River managers performed dam release sediment flushing flows, and our method was used to quantify time dependent changes in stream bed elevation at a debris flow location.

The outcome of this research will provide a single powerful tool for monitoring surface-subsurface flow interaction, downwelling and upwelling fluxes and erosion-deposition in critical or restored river reaches.

Session 5: Water Quality

Sarah Burnet	University of Idaho	**The role of internal loading in the phosphorus mass balance of willow creek reservoir, OR**

Humans and life in general, as we know it, depend on access to clean water. The continuing expanding human population and associated altered patterns of land use negatively affect water resources because of the transport of sediment and associated nutrients to aquatic ecosystems where they alter the ratio of available nutrients, particularly nitrogen and phosphorus, moving systems to N-limitation. This shift favors dominance of phytoplankton by cyanobacteria because they can fix atmospheric nitrogen to overcome the N-limitation. Cyanobacteria decrease aesthetics due to surface scums, but more importantly they produce some of the most potent toxins known to humans resulting in closures of water bodies due to harmful algal blooms (HABs). Nutrients associated with sediment are typically transported to the lake bottom where they are buried and removed from circulation; unless bottom waters become anoxic, when changes in REDOX allow P to solubilize and re-enter the water column contributing to high P concentrations and N-limitation. My MS thesis aims to quantify the magnitude of internal loading under anoxic conditions in Willow Creek Reservoir (WCR) using a field and laboratory approach. In the field study I directly measure profiles of oxygen and P concentration seasonally to determine internal loading in the reservoir to obtain whole-lake rates. The laboratory study is aimed to quantify the release of P of sediments at different sites in the reservoir under anoxic conditions to i) corroborate rates from the field study and ii) examine if any spatial differences exist, as this is important for models to predict anoxia and internal loading. In 2014, WCR was anoxic below 10 m after July 29th. Hypolimnetic P concentrations reached up to >765 ug L resulting in an internal load of 655 kg P m-2 per day on November 4, 2014. Overall, this internal load represents approximately 50% of the P load that enters the reservoir annually, suggesting that with continued anoxic conditions, Willow Creek Reservoir will continue to experience HABs.

Alyssa Deline	Oregon State University	**Development of Traceable Titanium Dioxide Nanoparticles for Examining Environmental Fate and Transport**

Titanium dioxide nanoparticles (TiO2 NPs) represent an important class of nanomaterial with a wide range of commercial and industrial applications. A growing body of research has shown that TiO2 NPs have the potential to negatively impact both aquatic ecosystems and water treatment processes, while the nature of many TiO2 NP-containing products (e.g. sunscreen) ensures that these materials will find their way into natural waters and wastewater streams. Researchers now face the challenge of tracking the fate of TiO2 NPs in complex environmental matrices, a task complicated by relatively high background concentrations of titanium. This study demonstrates the utility of rare-earth labeled, core/shell particles for tracking TiO2 NPs in natural and engineered systems. Methods were adapted from Goebl et al. (2013) for the synthesis of TiO2-coated gold nanoparticles (Au@TiO2 NPs), as well as the corresponding unlabeled TiO2 NPs. The core/shell structure was confirmed using transmission electron microscope imaging, and the coating procedure was optimized with respect to particle size, electrophoretic mobility, and Au:Ti ratio. The synthetic process was then scaled-up eightfold with no reduction of particle quality in order to facilitate the production of enough particles for use in fate and transport studies. Experiments are underway to compare the behavior of the labeled and unlabeled particles in simulated drinking water treatment.

Austin Hall	Oregon State University	**Synergies of DTS Monitoring and Modeling on the Middle Fork of John Day River: Stream Temperature after restoration**

Temperature is a key factor for salmonid health and is an important restoration metric on the Middle Fork of the John Day River, northeast Oregon. The longest undammed tributary to the Columbia, the headwaters of the Middle Fork holds crucial spawning and juvenile rearing habitat for steelhead and spring Chinook salmon. In the past century the river has been altered by dredge mining, overgrazing, logging activities, and irrigation which resulted in bank erosion, low effective shade, and channelization. These factors decreased fish habitat and led to increased stream temperature maxima. Restoration has focused on restoring fish habitat, creating thermal refugia, and planting native vegetation. The most recent completed restoration project diverted the flow into the historic, meandering stream channel from the dredged, straightened channel. Over the past seven years, Oregon State University researchers (Tara O'Donnell-2012, Julie Huff-2009) have been involved in a planned-to-be 10-year stream temperature monitoring study to assess maximum temperatures during low-flow summer months. The use of fiber optics through distributed temperature sensing (DTS) made it possible to record high resolution temperature data at both temporal and spatial scales; data which is used to assess the efficacy of restoration efforts on the reach. Furthermore, DTS provided temperature data that reveals subtle hydrologic processes such as groundwater or hyporheic inflows and quantifies their effect on the stream. Current research has focused on large scale DTS installations on the Middle Fork of the John Day River on the Oxbow, Forrest, and the upstream Galena ("RPB") conservation properties. In the summers of 2013 and 2014, 16 km of river were monitored. Our study compares temperatures before and after the restoration project and provides essential guidance for future restoration projects. Direct comparisons coupled with a deterministic modeling using HeatSource assist in better understanding the responsiveness of the stream to restoration. Results showed that reconstructing the stream channel influenced stream temperature as a function of modifying channel geometry, hydraulics, and riparian conditions.

Session 6: Water Management and Infrastructure

Nicole Ward University of Idaho **Improving Agricultural Nitrogen Use through Policy Incentivized Management Strategies**

Though nitrogen is vital to agricultural production, the negative environmental and economic costs associated with its use necessitate improving agricultural nitrogen management. Precision agriculture, which focuses on applying variable inputs (such as fertilizer) to match the field-variability of crop needs, has been identified as a promising strategy to decrease the environmental harm due to excess nitrogen while maintaining high yields. Adoption of precision agriculture techniques can have high initial costs, but conservation cost-share programs, created through Farm Bill legislation provide financial assistance to farmers with the goal of increasing adoption and decreasing the negative environmental impacts of agricultural nitrogen use. Well-targeted, voluntary conservation agriculture programs have proven instrumental in curtailing erosion, though little assessment has been done on the economic and environmental effectiveness of nitrogen-specific incentives. This study will use an advanced cropping systems model, CropSyst-MicroBasin, to examine field scale nitrogen management in the high precipitation zone of the wheat-producing Palouse region in North Idaho by: (1) assessing the impact of policy incentives on the profitability of adopting nutrient management practices, (2) quantifying changes in nitrogen export to the environment as a result of adopting nutrient management practices, and (3) evaluating how effectively the policy incentives address nutrient management issues in the region.

Mark Corrao University of Idaho **Terracette Influences on Spatial Patterns of Soil Moisture in a Semiarid Rangeland Environment**

Interactions of surface topography and soil water often play a defining role in public land management and land use in in the semiarid western U.S.. For example, within the State of Idaho 15 million acres (~28%) of public lands are managed directly as grazing allotments, the majority of which are in semiarid areas. Sustainable use of these lands includes balancing many ecosystem services, which can be accomplished through a more complete understanding of soil, water, and microtopographic interactions. The most prominent microtopographic feature in these systems are 'cat steps' or 'terracettes'. Terracettes are soil surface variations of < 1m commonly consisting of repetitious 'benches', path-like, and 'riser', slope-like, features on hill sides of greater than 15°. Soil moisture differences between terracette bench and riser features as well as between terracette and non terracette sites have been observed on semiarid rangelands, however the influence of these patterns at the hillslope or watershed scale is not known. The goal of this research was to further our understanding of terracette influenced soil moisture patterns in semiarid rangelands. To accomplish this objective we used the simultaneous heat and water (SHAW), a one-dimensional soil-vegetation-atmosphere transfer (SVAT) model, to simulate the soil water environment and to provide information that could be used to understand the impact of terracette soil moisture patterns on ecological processes. Time-of-flight terrestrial laser scanning (TLS) was used to up-scale the point-specific modeling results for a broader hillslope application through the classification of bench and riser fractional area on differing slope gradients and aspects.

Olivia Molden	University of Oregon	**Traditional Infrastructure, Modern Flows: Cultural Politics of Development in the Kathmandu Valley, Nepal**

The Kathmandu Valley's public water company barely meets half of annual water needs. Most households in the Valley rely on multiple water sources including, tankers, private wells, rainwater harvesting, stone spouts, and communal wells. Recognizing that spouts serve approximately 10% of the Valley's population, this research investigates the contemporary use and management of Lalitpur District's spouts to question the role of traditional infrastructure in modernization and development efforts. Stone spout water systems date back to 560 C.E. and continue to act as important public spaces for cultural activities, communal organizing, and domestic water services. Interviews, archival sources, court cases, and the International Center for Integrated Mountain Development's 2013-14 water supply survey provide a multidimensional perspective on the role of stone spouts. Findings discuss the ways spout modifications and governance work within Kathmandu's larger infrastructural and institutional networks to argue that water systems beyond the grid are not temporary, but rather, legitimate modes of development.

Jon Viducich	Oregon State University	**Towards Optimizing Sedimentation Processes in Sand Dams**

Rainfall scarcity and variability present serious challenges to water security for many rural communities throughout the world's drylands. Sand dams— small weirs built across seasonal and ephemeral rivers— provide an appropriate water harvesting and storage option for many regions. The structures, which derive their name from the rapid deposition of sediment during rainy season flow events, store water underground in interstitial pores, thereby limiting evaporation, contamination, and the prevalence of disease-carrying vectors. The quality of deposited sediment largely determines sand dam effectiveness; fine materials do not yield usable quantities of water. Some organizations propose building sand dams in stages, raising the height of the spillways over time to limit capture of fine particles. My research seeks to identify the hydraulic conditions required to optimize sediment deposition by applying HEC-RAS flow models and field data collected in East Africa. The modeled results will be used to develop a method for assessing the potential benefit of sand dam spillway staging for a given site.

Session 3: Water Quality and Policy

Melissa McCracken and Rachael Davee	Oregon State University	**Comparing Management Strategies on the Columbia and Colorado Rivers**

The Colorado River and the Columbia River are two of the largest interstate and international river basins in the continental United States. The Colorado River has a complex management and governance structure known as the Law of the River. This is constituted of numerous compacts, treaties, statues, regulations, and case law that provide for the allocation, appropriation, development and management of the river. Management on the Columbia differs from the Colorado, as it is primarily an international treaty between the U.S. and Canada that allows for the coordination and flexibility to optimize power generation and protect U.S. cities from floods. Domestic management is governed by the individual states through laws and regulations with no overarching interstate compact. This poster will consider the interstate management of the two rivers through comparison in the context of changing social, economic, ecological, and political factors. This comparison will allow us to identify benefits as well as issues that were previously not a priority or even recognized by historical governance. The current timing of the Columbia River treaty, provides an opportunity to anticipate future demands on the river and increased variability on flows. This poster concludes by examining the potential need and functionality of governing through an interstate compact on the Columbia River.

Brett Boisjolie	Oregon State University	**Policyscape Patterns in River Networks: Riparian Buffers in the Oregon Coast Range**

Environmental policies are ideas about nature projected onto the landscape. A culmination of social, economic, and scientific factors, policies result in baseline requirements which affect the function of ecological systems. In the case of riparian buffer policies in the Oregon coast range, fixed width requirements vary considerably among federal, state, and private land ownership classifications. This variation creates patterns of connectivity and fragmentation throughout river networks. While riparian buffers are intended to preserve stream habitat and thermal conditions, the "policyscape" designations may not align with areas of concern. This is problematic due to the high amount of thermally impaired river systems in Oregon, as well as the recent decision by the EPA to reject the state's nonpoint source pollution program. It also complicates the management of threatened anadromous fish species such as coho salmon (Oncorhynchus kisutch), which require suitable habitat segments throughout the river network. The goal of this proposed study is to quantify patterns in riparian buffer policy designations, stream thermal condition and areas of intrinsic potential for coho salmon habitat. Using a geographic information system (GIS), the project will develop a database of river networks in the Oregon Coast Evolutionary Significant Unit. Models of intrinsic potential for coho salmon habitat (Burnett et al 2007) and mean August stream temperature (Isaak et al 2010) will be used to assess present and projected thermal condition in stream reaches where flow, valley constraint, and channel gradient are appropriate for coho habitat. Summary statistics will be calculated for total river kilometers, average segment lengths, and number of segments within each ownership class. These values will be used to assess fragmentation in policy distribution within and among river networks in the Oregon Coast range.

Joseph Kemper	Oregon State University	**Combining Community Conflict Management with Water Resources Engineering to Improve Stormwater Management**

Falls City, a small town in the foothills of Oregon's Coast Range, experiences severe surface and groundwater flooding during heavy winter rains. Existing drainage networks are insufficient to dewater several properties in south Falls City, but expanding the drainage system will put downstream landowners at risk for flooding. The community reached out to OSU for assistance in finding solutions to conflicting interests. Current weather, stream and geologic data were combined with valuable local knowledge to provide a preliminary picture of flooding dynamics. A monitoring well was constructed to investigate subsurface processes in south Falls City. Pressure transducers installed in the monitoring well give high temporal resolution of water table fluctuations in response to rain. Pumping tests and slug tests were conducted to characterize the hydraulic properties of the region. A future seismic refraction study will expand the monitoring well results to the entire flooding zone. These investigations will be combined with elevation data to create and calibrate a MODFLOW representation of south Falls City to determine feasibility. This model can be combined with surface water modeling software to evaluable several dewatering techniques. LiDAR imaging will be used to evaluate potential surface diversions to channel stormwater directly to the adjacent Little Luckiamute River. Results will form a pre-engineering report with several flood mitigation options for south Falls City. These technical solutions will be presented through conflict management frameworks to reach a compromise that reduces stormwater flooding for all landowners in south Falls City. This process could then be applied on a broader scale for other small communities if predicted climate change increases storm intensities in the Pacific Northwest.

Micco Emeson	Oregon State University	**Mycofiltration: Fungus as a New Frontier in Biological Based Water Filtration Systems**

Biological water filtration systems such as constructed wetlands, which minimize cost, maintenance, and pollution, have taken ahold in the global move towards sustainable development. Mycofiltration biotechnology – the use of fungus innoculated substrates for water-filtration purposes – is an area of exciting new research and development. Improved understanding of the mechanisms underlying this biological system will allow for more effective designs. A ten-day water filtration trial using two separate 200-gallon feed troughs filled with fungus innoculated wood chips was conducted at the site of the Oregon Country Fair in Veneta, Oregon. Graywater from an outdoor kitchen ran through the filters in sequence, and the effluent wastewater was screened for e. Coli, the main health concern of the Oregon Department of Environmental Quality. It was found that the effluent wastewater contained more E. Coli than the influent. This is likely due to the temperature of the wastewater, which was held around 30 °C, perfect for e. Coli. bacteria, but too warm for the fungus. Preliminary studies of this new biotechnology have shown promising results, but further research needs to be performed in order to determine the best combination of flow rate, temperature, substrate, pH level, and other variables, before we can begin to design water treatment systems using fungus as the main filtration agent.

Jaycee Leonard	Boise State University	**Research on Stream Water Temperature in Semiarid Riparian Systems**

Agricultural sustainability will become a greater priority for farmers, stakeholders, and land managers in the near future as climate change and population growth continue in the semiarid West. Regional hydrology in the Lower Boise River Basin (LBRB) of southwestern Idaho will vary with climate change, altering the spatiotemporal water demands in domestic food production areas. For instance, increased drought frequency and severity may increase the interannual variability in demand for water. It is important to understand and quantify the impacts of human

decisions and policies on agricultural production in the midst of these changes. To accomplish this we use an agent-based modeling framework (Envision) that explicitly couples human and biophysical systems to create alternative future scenarios, allowing us to model decadal scale outcomes of agricultural activity in the LBRB. We can then assess potential trends associated with climate and population change in important variables such as irrigation use per unit acre, overall agricultural water use in the LBRB, crop yield, and urban growth impacts. Key required developments to the modeling framework include: (1) a locally relevant but generalized model of crop choice that integrates key local drivers such as water rights, soil properties, and precipitation, (2) a robust, process-based crop growth model, and (3) representative scenarios of future climate change to drive the crop choice and growth models. By conducting a suite of scenario analyses, we hope to identify key farm management decision variables that, at the scale of the entire LBRB, will reveal regional implications on water demand and use, as well as crop distribution and yields. Ultimately, the modeling framework will be a useful tool to evaluate regional impacts of various policies on water use. Although this study is targeted toward understanding the Lower Boise, the generality of the modeling approach is potentially more broadly applicable to domestic food production systems across the semiarid West.

Jonathan Halama — Oregon State University

Enhancing VELMA's watershed delineation and performance with ancillary stream data

VELMA (Visualizing Ecosystems for Land Management Assessments) is a spatially-distributed ecohydrological model that simulates the fate and transport of water and nutrients within watersheds, for example, to quantify the effectiveness of riparian buffers and other green infrastructure for protecting stream water quality (McKane et al. 2014). VELMA's spatial framework is a uniform grid (e.g., 30x30 m) derived from digital elevation model (DEM) data. For VELMA to function properly, a DEM processing tool, JPDEM (modified from Pan et al. 2012), is used to calculate flow paths, stream channels and the boundary of the watershed contributing to a specified outlet. A limitation of JPDEM and similar tools is inaccuracies in the representation of flow paths and stream channels in low relief landscapes such as floodplains. Research presented here describes how we modified JPDEM to accept ancillary stream network data to address these inaccuracies. To do this we used a rapid digitization method to establish a sequential multi-polyline (stream) network representing both the up-stream sequential direction of major stream channels and the priority (order) of each of these channels within the polyline network.
When applied to extremely low relief landscapes in the Kansas River Valley, KS, the ancillary stream network data greatly improved JPDEM's accuracy in locating major and minor stream channels, including those near and far from the digitized polyline network. In addition, this method proved to be computationally more efficient, reducing JPDEM's DEM processing time significantly, which for large (>1000 km2) low-relief landscapes previously difficult to process to become well within the JPDEM's abilities. Furthermore, preliminary VELMA results show improved stream flow predictions when JPDEM first has pre-processed the DEM data using our ancillary stream network approach.

Grace Burleson — Oregon State University

Water Treatment Technologies for the Developing World

Access to safe drinking water is one of the greatest international public health concerns. In many undeveloped communities and emergency situations, access to safe water is not readily available. This research looks at various water treatment technologies specific to areas of low resources. In my research I am identifying the different types of water contaminants, climate concerns, and general social norms of the following regions: Sub-Saharan Africa, Southeast Asia, and Central America. With this, I then look at different technologies and access compatibility with these regions. Current research is focused on David Manz's Biosand Filter, Puralytics' Solarbag, and Vestergaard's LifeStraw. In greater detail, I am presently working with the

Biosand Filter to assess its current performance and implement improvements. There are currently over one million Biosand filters in use in over 100 countries around the world. This household-sized water treatment unit uses rock, sand, and a biolayer to purify contaminated water. The biolayer is essential to the purification of the water. As time goes on, the biolayer becomes very thick and eventually restricts the flow rate of the unit. The current method of cleaning the filter is insufficient. The user simply agitates the top layer and removes the thick media and water. Unfortunately, the current design makes it impossible to clean out the lower layers of the filter without removing all sand and rock media and rebuilding the layers. We are looking at implementing a back-flow system that will allow for water to flow up the filter and clean the thick biolayer. The goals of the new system include increasing the turnover time, more effectively cleaning the unit, and allowing for a more efficient cleaning process. We are testing the effectiveness of a current back-flow design by comparing the flow rate and purification quality of the filter without the back-flow implemented, with the back-flow implemented (prior to a cleaning), and with the back-flow implemented (directly after a cleaning). We hope the design changes to the Biosand filter will improve the lives of many families around the world who lack access to clean water.

Lauren Smitherman	Oregon State University	**Forensic Hydrogeography: Assessing Arsenic Contamination in Domestic, Livestock, and Agricultural Wells in Harney County, Oregon**

This project will review the relationship between elevated arsenic levels in groundwater and the regional hydrogeography within the Harney Basin in Harney County, Oregon. An additional comparative analysis between field arsenic tests and Inductively Coupled Plasma Mass Spectrometry (ICP-MS) was performed. Harney County's location in the western United States, unique closed basin and volcanic geology, and seasonal groundwater level fluctuations are positively correlated to the occurrence of arsenic within groundwater. Due to the low population density and prevalence of agriculture, water resources are extracted through wells. Previously conducted regional water quality investigations and independent sampling identify Harney County as containing elevated groundwater arsenic concentrations. However, due to the lack of current, reliable statistics and limited access to data, I investigated the relationship between the geographic location of wells, the underlying geology, and total arsenic concentrations. I collected water quality samples throughout the Harney Basin and performed analysis for total arsenic, pH, conductivity, and Biological Activity Reaction Test. Well records were utilized to produce a model connecting the geography, geology, and the presence of arsenic.

Chris Brueck	Oregon State University	**The role of flow rate and moisture content on colloid mobility in unsaturated porous media**

Understanding the mechanisms controlling colloid transport and deposition in the vadose zone is an important step in protecting our water resources. Colloids are particles that range in size from 1 nanometer (nm) to 10 micrometers (μm). Examples of colloids that exist in natural and agricultural soil systems include clay particles, metal oxides, pathogenic bacteria, viruses, radionuclides, pesticides, antibiotics, and animal hormones. Not only may these particles themselves be undesirable contaminants, but they can also aid in the transport of smaller, molecular scale contaminants by chemical attachment. Besides transporting contaminants, colloids can accumulate in the soil profile which increases the complexity of the flow paths and increases the frictional resistance to pore water flow. A variety of physicochemical interactions influence the attachment and detachment of colloids in a porous medium, including electrostatic, van der Waals, Lewis acid-base, hydration, steric forces and others. Additionally, under unsaturated conditions, capillary forces exist at the air-water interfaces and air-water-solid contact lines that act to mobilize colloids. As saturation decreases, increased interfacial area and contact lines result in greater capillary forces. Using synchrotron based computed x-ray microtomography (CMT), we investigate the role of flow rate and moisture content on colloid

mobility. CMT is a non-destructive imaging technique that provides three-dimensional images of colloids within partially saturated glass bead systems at a resolution on the order of 3 μm/pixel. A potassium iodide dopant and silver particle coating provide the necessary k-shell absorption edges to isolate each phase during segmentation of the reconstructed images.

Satish Serchan	Oregon State University	**The influence of hydrologic and biogeochemical factors on quantity and quality of DOC and quantity of DIC in the hyporheic zone**

Aerobic respiration of organic carbon in streams and delivery of carbon dioxide (CO2) by groundwater to streams account for major fraction of stream CO2. However, in small headwater streams where ~75% of streamflow may pass through the hyporheic zone (HZ) during baseflow conditions, hyporheic exchange flow (HEF) may be critically important in delivering CO2 produced in the HZ to streams. A recent study (Dosch, 2014) conducted in a 29 m by 14 m reach of a headwater stream draining Watershed 1 in the HJ Andrews Experimental Forest located in Western Oregon concluded that HZ was the biggest contributor of dissolved inorganic carbon (DIC) to the stream. However, large values of hyporheic DIC could not be explained by stream-source dissolved organic carbon (DOC) alone (Corson-Rikert, 2014). Corson-Rikert hypothesized the presence of other sources of hyporheic DIC and/or DOC (e.g., buried organic matter, groundwater input, etc.). We will seek answers to several questions: 1. How do the quantity and quality of hyporheic DOC vary in relation to depth and as a function of travel time in the HZ? 2. How do the quantity and quality of hyporheic DOC vary across the floodplain? 3. What are the fluxes of DOC and DIC into or out of the HZ? 4. How do storm-events influence carbon dynamics in the HZ? We will monitor chemical composition of HZ water during baseflow periods over twelve months using a well network that spans the site. We will also monitor three storm-events. In addition, we will build two identical hyporheic mesocosms, fill them with stream sediment, and run controlled experiments that will help us understand some of our research questions along fixed flow paths. I will highlight instrumentation design, sampling and lab methods, and present a general outline of PhD research work in this presentation.

Adolfo Freitas Terra Silva	Oregon State University	**Treatment of giardia favoring the reduction of cancer as comorbid disease**

Ozonation in water treatment is one of the methods used to remove Giardia in water bodies. According to Kehr (2014), a cancer researcher from the Independent Cancer Research Foundation, ozonated water, through ozone, can provide oxygen singlets (such as O2 and O1) into the blood; these oxygen singlets, work as a supplemental treatment for cancer. The reason is the more oxygen an organism has, the less cancer is be able to spread throughout the body. Also according to his study, the ozonated water can kill some cancer cells. Therefore, the ozone, a disinfectant used to eliminate giardia in drinking water, can also help people to block the development of cancer in their bodies. This proposal research intends to study the relationship of ozonated water in both giardia and cancer treatments.

Robert Pennington	Oregon State University	**Oxygen-Carbon Method for Measuring Gas Exchange Rates in Streams**

Gas exchange rates between streams and the atmosphere are critically important to measurement of in-stream ecologic processes, as well as fate and transport of hazardous pollutants such as mercury and PCBs. Methods to estimate gas exchange rates include empirical relations to hydraulics, and direct injection of a tracer gas such as propane. Empirical relations are inconsistent and inaccurate, particularly for lower order, high-roughness streams. Gas

injections are labor-intensive, and the gas exchange rate changes with discharge and stream geometry. We propose a novel method for calculation of gas exchange rates utilizing O2, pCO2, pH, and temperature data. Gas exchange rates are calculated from a solution to the transport equations for oxygen and dissolved inorganic carbon. Collection of these data is increasingly common and continuous over the long term. The method can therefore be used to measure gas exchange rates through time, and can be automated for interactivity with databases.

Jason Brandes	Oregon State University	**Vadose Zone as a Potential Carbon Source: A Look at Seasonal spikes in Hyporheic Zone pCO2**

Stream chemistry studies conducted in the forested Watershed 1 of the HJ Andrews Experimental Forest show a contribution of CO2 from the hyporheic zone. Hyporheic CO2 concentrations , measured as pCO2, have a seasonal trend as well as a responsiveness to storm events. Concentrations are highest at the end of the dry season (~14,000 µatm) and lowest during the wet season (~6,000 µatm). Hyporheic pCO2 responds to winter storm events with a decrease followed by an increase in pCO2. The increase in pCO2 exceeds pre-storm levels, suggesting a flushing of pCO2 into the hyporheic zone. Concentrations gradually return to pre-storm levels as stream discharge levels decrease. We hypothesize that surplus pCO2 is flushed into the hyporheic zone from the vadose zone during a storm event. We plan to test our hypothesis by: sampling soil gas (pCO2) at equilibrium with soil moisture at various depths in the vadose zone, installing suction cup lysimeters in the vadose zone to take storm samples, and causing a controlled, artificial wetting event at the end of the dry season.

Michelle Audie	Oregon State University	**Using Stable Isotopes to Reveal Nutrient Flowpaths at Big Spring Run, a low order stream in Lancaster County, Pennsylvania**

Excess nitrogen concentrations are common in streams draining to the Chesapeake Bay estuary on the mid-Atlantic seaboard and have resulted in extensive environmental and human health-related issues. Recent evidence has related high suspended sediment yields to the erosion of 17th to 19th century mill-dam pond deposits along steep-faced stream banks. Investigations at the site of a partially restored low order tributary have established that nitrification processes occurring in upland and surface soils of legacy sediments are responsible for the presence of elevated nitrate concentrations, however the spatial and temporal aspects of nitrate dynamics remains unclear.
An evaluation of stable water isotope (δ18O and δ2H) compositions has been conducted for Big Spring Run, a partially restored low order tributary located in Lancaster County, Pennsylvania. Variation in the isotopic composition of groundwater, surface water, and precipitation is used to characteristically rank subsurface residence time at installed groundwater wells and piezometers within restored and unrestored portions of the floodplain. Residence time combined with archived nutrient data measured on a bimonthly basis relates the spatial variability of nutrient cycling to temporal nitrate contributions to the stream channel. Results from this study have successfully designated zones prone to greater nitrogen transformation occurring along the more active paths of groundwater flow. Denitrification potential is lowest in legacy sediments and significantly higher in exhumed wetland soils. The monitoring aspect of the restoration project at Big Spring Run aims to find appropriate restoration methods that mitigate nitrate source contributions to downstream tributaries and estuarine degradation. A fundamental understanding of nutrient-stream dynamics in regions affected by historic land use and mill-pond sediment bank erosion is essential to identify feasible ecosystem recovery goals along unrestored portions of the Chesapeake Bay watershed.

Jacqueline Brenner	Oregon State University	**A Watershed Scale Spatial Statistics Approach for Development of Nutrient Criteria and Classification Scheme for Oregon Lakes**

The anthropogenic addition of nutrients, like nitrogen and phosphorous, manipulates the structure and function of aquatic ecosystems, and causes noxious algal blooms, fish kills, and reduction in water clarity. National EPA policies regarding nutrient criteria for lakes and reservoirs have been determined to be too broad to effectively protect water quality in some areas, and too stringent to effectively address background concentrations in others. The purpose of this study is to propose an Oregon statewide criterion for nitrogen and phosphorous limits in lakes and reservoirs by way of managing different lake classifications. Narrowing a list of over 330 lake watersheds, 98 lakes were selected to represent reference condition - least and minimally disturbed areas - for all Oregon lakes (>1 hectare) across ecoregions by analysis of confined animal feeding operations (CAFOs), agriculture and urban development land use, road density, population density, and lakeshore disturbances in each watershed. The lowest 75th percentile of phosphorous and nitrogen concentrations were calculated for each ecoregion. These reference lakes were then sorted into categories of different lake watershed classifications based on their physical attributes, such as ecoregion, water residence time, soil types, elevation, depth, precipitation, forest types, and interconnectivity to wetlands. A classification scheme was established by implementing these variables in a categorical and regression tree (CART) and pruning the tree to group like watersheds together for management purposes. This will determine which nutrient criteria for the varying lake watershed classifications are compatible with background concentrations, and are also effective at protecting designated uses of lakes. To demonstrate the effectiveness of the criteria and analyze the current state of Oregon's lakes and reservoirs, a random sample of 50 Oregon lakes and reservoirs will be selected and held to the selected criteria. The proposed criteria can influence Oregon state nutrient criteria policy development and methods in the future.

Grace Ray	Oregon State University	**A landscape-scale Characterization of vegetation-soil water interactions in Semiarid Juniper Woodlans of Central Oregon**

There is an increasing concern by range managers for understanding the effects that western juniper (Juniperus occidentalis) has on the ecologic and hydrologic state of western rangelands. This paired watershed study considers hydrologic function while investigating the long-term effects of juniper removal on vegetation composition and soil water availability at the watershed scale. Juniper under 140 years of age were removed from one watershed in 2005 after 12 years of reconnaissance monitoring. Analysis of historical data revealed precipitation as a trigger for increasing soil water content (SWC) at the deepest soil profile measured (80 cm). This soil response and subsequent shallow groundwater level rise observed in selected piezometers indicated a possible direct connectivity between precipitation, soil, vegetation and groundwater. These results were more evident in the treated when compared to the untreated watershed and led us to further our investigation of the understanding of the hydrologic connectivity between precipitation, vegetation, and soil water response. Objectives of this ongoing study are to 1) characterize the understory vegetation composition of a previously treated and untreated watershed, and 2) determine shallow soil-water-vegetation interactions in relation to soil texture at the subbasin-scale. 289 monitoring transects were established to determine vegetation-soil texture-soil water content relationships in both watersheds. Each transect was used to derive estimates of vegetation cover, species richness, SWC (repeated July, November, and January), and soil texture. Approximately 1,445 soil cores were collected for an analysis of Gravimetric Water Content and Particle-Size distribution. A geospatial interpolation method was used to create a predicted surface that displays the spatio-temporal distribution of SWC and clay content across both watersheds. Preliminary results show SWC to be higher in the treated vs. the

untreated watershed over all 3 measurement periods. Linear models show the main effect of canopy cover to be significant ($P \leq 0.05$) in influencing SWC for each treatment and measurement period. These findings may have implications for ecohydrologic management decisions in juniper woodlands, and a further investigation into the results will attempt to strengthen these linkages.

Christopher Ratcliff	Oregon State University	**Investigating the relationship between snowpack and tree growth in the Oregon Cascades, via Stable Carbon Isotope Analysis**

Declining snowpacks and increasing summer temperatures pose a significant threat to mountain forests. Droughts increase water stress in forest ecosystems, while additionally increasing the frequency of forest fires, pest outbreaks, and tree-killing pathogens. Previous studies in the interior western United States have shown that snowpack acts as a critical moisture subsidy to mountain forests. Snow water equivalent (SWE), the total amount of water represented by the snowpack, contributes to soil moisture during the summer growing season. Forests are vital regulators of global hydrologic and carbon cycles; therefore, we need to know how declining snowpacks and increasing temperatures will impact their mortality and functionality. The objective of this project is to examine and characterize the relationship between snowpack and subsequent summer tree growth in selected areas of the Oregon Cascades. This research focuses on the annual winter SWE of each water year and the formation of latewood, the late summer growth primarily produced by moisture stress in Coniferous trees. Inter-annual variation of both latewood width and stable carbon isotopic ($\delta 13C$) signals will serve as proxies for moisture stress and will be correlated with variation in snow water equivalent over the years 1980 to the present. SWE, precipitation, and temperature values will be attained from two mid-latitude snow telemetry (SNOTEL) sites. A ring width chronology and latewood stable carbon isotope record will be attained from tree core samples collected in the vicinity of each SNOTEL site. We hypothesize that SWE of the preceding winter will be inversely correlated with moisture stress.

Jacob Kollen	Oregon State University	**Testing the ideas of Walter White**

In arid and semi-arid systems the riparian zone boarding a stream has high evapotranspiration rates compared to uplands. Evapotranspiration (ET) is difficult to estimate, but accounts for much of the water loss from landscapes. Walter White (1932) introduced a method using the diurnal fluctuation of groundwater depth to estimate ET. With the advent of accurate data logging pressure sensors, the White method has recently reemerged as an important strategy. A persistent challenge of the White method is knowledge of how much water is released per unit fall in the water table (the "specific yield"). Specific yield is highly variable, and there exists no validated method for its measurement. Our experiment will directly measure this term using soil moisture probes, spaced 2cm apart along the vertical axis of a soil column to measure the volumetric change in water content accompanying changes in water table. We will compare estimations of evapotranspiration derived from groundwater table depth and soil texture data that have been calibrated using a series of soil moisture probes against values from micrometeorological stations equipped with a 3D ultrasonic anemometer and high-speed humidity sensor based on the "eddy covariance" method. The deliverable by the end of this project will be a simple method to install and calibrate a groundwater table depth observation well to produce an accurate estimation of evapotranspiration and groundwater upwelling in areas with shallow water tables such as riparian areas.

Rebecca Rittenburg	University of Idaho	**Evaluating Effects of Conservation Practices on Sediment Transport in Agricultural Watershed with Cohesive Sediments**

In response to impacts from excess sediment, widespread improvements in upland soil conservation practices nationwide have aided in reducing field-sourced sediment delivery to streams. Many soil conservation measures reduce sediment concentrations, but do not attenuate hydrologic discharge, and therefore cleaner runoff into streams has greater capacity to erode streambeds and banks. As a result, erosion and sediment sources may be shifting from agricultural fields to the stream channels and edge of field gullies in cultivated watersheds. The role of gullies and stream channels in the overall watershed sediment budget, however, are not well understood. This study seeks to address this limitation through by linking the spatiotemporal aspects of upland erosion and runoff events to fluvial processes using a hillslope hydrologic and erosion model (WEPP-UI v2012.8) and a sediment transport and stream bank stability model (CONCEPTs). By pairing these two models, stream channel erosion and sediment transport within a fluvial system in north Idaho was simulated in response to upland erosion and runoff. The objectives of the study were to evaluate CONCEPTs' ability to simulate channel evolution in highly disturbed agricultural watershed with cohesive sediments , to compare hillslope and stream channel sediment contributions to the annual sediment budget, and to compare the simulated sediment lag time and sediment sources under different soil conservation practices. By better understanding how stream systems respond to varying upland managements, conservation practices and stream channel restoration practices can be more effectively targeted to reduce overall sediment loading.

Hannah Rolston	Oregon State University	**Microcosm Studies to Evaluate Biodegradation of Chlorinated Solvents and 1,4-Dioxane**

Due to its use as a stabilizer for chlorinated solvents, 1,4-Dioxane (1,4D), a probable human carcinogen, is a common co-contaminant in solvent spills at industrial and military sites and landfills. Its persistence in large groundwater plumes at relatively low concentrations makes it a good candidate for in-situ biological treatment via cometabolism. Microcosm studies are being performed to evaluate the capability of isobutane-utilizing microorganisms to degrade 1,4D and chlorinated solvent mixtures prior to push-pull tests at Fort Carson, Colorado, a contaminated site. Microcosms are constructed using aquifer solids from Fort Carson to assess the isobutane-utilization and solvent degradation capacity of the microorganisms native to the site. Additional microcosms are augmented with Rhodococcus rhodochrous, a bacterium shown to degrade chlorinated solvents and 1,4D, for comparison. Initial microcosm test results indicate that microorganisms are present at Fort Carson that grow on isobutane, and 1,4D is transformed in bioaugmented microcosms. Studies are currently being conducted to determine if microorganism native to Fort Carson will transform 1,4D and if a mixture of 1,4D and TCE (a chlorinated solvent) can be cometabolized in both bioaugmented and native microcosms. Results from the microcosm tests will be used to design field tests to be performed at Fort Carson this summer.

Lauren Ferguson	Oregon State University	**Characterizing and Assessing the Researcher-Stakeholder Engagement Process for Water Sustainability: The Willamette Water 2100 Project**

Societies depend on water. They also depend on knowledge, science and experiences to anticipate responses from water management. Increasingly, through institutional requirements for broader impacts and/or the desire for improving societal relevance, academic researchers collaborate beyond their disciplines to comprehensively answer water management questions. The NSF-funded "Climate Change and Water Sustainability - Willamette Water 2100" (WW2100) project brings together scientists from twelve disciplines in a co-learning realm with a diverse array of water users and managers to develop a transdisciplinary model and define future

scenarios within that model in order to anticipate future water scarcity. Scientific and lay-knowledge and questions have been incorporated into the model as a result of this five year-long collaboration. Through semi-structured interview, this research takes a grounded-theory approach to understand the social dynamics on an interdisciplinary project such as this. The results lend a voice to the researcher and stakeholder participants as they define their expectations for and results of the project and how it has impacted them personally and professionally. While this study focuses on participants in Oregon's Willamette River Basin, the lessons learned from this project can inform future interdisciplinary researcher - stakeholder engagement efforts to research water or any other shared natural resource.