Mousa Diabat

University: Oregon State University

Department/Program: College of Earth, Ocean, and Atmospheric Sciences, Water Resources Science, PhD

Title: Diurnal timing of warmer air under climate change affects magnitude, timing and duration of stream temperature change

Abstract: Stream temperature will be subject to changes due to atmospheric warming in the future. We investigated the effects of the diurnal timing of air temperature changes – daytime warming vs. nighttime warming – on stream temperature. Using the physically-based model, Heat Source, we performed a sensitivity analysis of summer stream temperatures to 3 diurnal air temperature distributions of +4 °C mean air temperature: 1) uniform increase over the whole day; 2) warmer daytime; and 3) warmer nighttime. The stream temperature model was applied to a 37-km section of the Middle Fork John Day River in northeastern Oregon, USA. The 3 diurnal air temperature distributions generated 7-day average daily maximum (7dADM) stream temperatures increases of approximately +1.8 ±0.1 °C at the downstream end of the study section. The 3 air temperature distributions, with the same daily mean, generated different ranges of stream temperatures, different 7dADM temperatures, different durations of stream temperature changes, and different average daily temperatures in most parts of the reach. The stream temperature changes were out of phase with air temperature changes and, therefore in many places, the greatest daytime increase in stream temperature was caused by nighttime warming of air temperatures. Stream temperature changes tended to be more extreme and of longer duration when driven by air temperatures concentrated in either daytime or nighttime instead of uniformly distributed across the diurnal cycle.

Tracie Jackson

University: Oregon State University

Department/Program: College of Earth, Ocean, and Atmospheric Sciences, Water Resources Engineering, PhD

Title: The Mean Residence Time of Lateral Surface Transient Storage Zones in Streams

Abstract: Surface transient storage (STS) has functional significance in stream ecosystems because it increases solute interaction with sediments. After volume, mean residence time is the most important metric of STS, but it is unclear how this can be measured accurately or related to other timescales and field-measureable parameters. For natural lateral STS, we characterized residence timescales for 1- and 2-exponential residence time distributions (RTDs) and compared them to physically measureable parameters in the field. We defined, measured, and compared four timescales: volume to discharge ratio (Langmuir timescale); area under normalized concentration curve; characteristic time of exponential decay; and a physically-based hydromorphic timescale derived by Uijttewaal et al. [2001]. Field results show all timescales are equivalent for 1-exponential RTDs; however, for two-exponential RTDs, the best estimate of STS mean residence time is the first characteristic time of exponential decay. The Langmuir timescale, which is less than or equal to the STS mean residence time, is strongly correlated to the main channel velocity and STS length and width (R2 = 0.94). The STS timescale measured in the field can be erroneous and considerably larger than any of the other timescales if probes are placed within secondary gyres or other poorly mixed locations and add apparent residence time to the mean. Field results show the correct STS mean residence time can be predicted by with k = 0.036 ± 0.009.

YunJi Choi

University: Oregon State University

Department/Program: Civil and Construction Engineering, Masters in Civil Engineering

Title: Minimizing Geysers and CSOs in the Portland Combined Sewer System

Abstract: Combined sewer overflows (CSOs) are a major water pollution source for more than 700 cities in the U.S that have combined sewer systems (CSSs). CSOs occur in response to heavy rainfall and/or snowmelt events when the capacity of the storm-sewer system is exceeded or when the flow in the system is highly dynamic even when the system is not full. The overall goal of the proposed research is to develop a model for the prediction and quantification of CSOs that can be applied to the CSS of the City of Portland.

The project area is the combined sewer region within the City of Portland which serves approximately 300,000 people (over 50% of the city's residents) in an area of 42 square miles. The importance of understanding and minimizing the effect of CSOs in this region is directly related to the health and safety of area residents and the sustainable resource management practices of the city.

The proposed research has two main objectives. First, to minimize the occurrence of CSOs caused by transient and geysering events by identifying critical points within the system which are suitable for modificaiton and monitoring. Second, to validate the open source and state-of-the-art Illinois Transient Model (ITM) which is intended to simulate the filling and emptying of CSSs under transient flow conditions. This model can be used worldwide for predicting CSOs and geysering events, and may assist its users towards the goal of developing cost-effective strategies to reduce CSO events.

Anthony Coleman

University: Oregon State University

Department/Program: College of Earth, Ocean, and Atmospheric Sciences, Water Resources Science

Title: Determining the Relationship between Residence Time Distributions in Lateral Surface Transient Storage Zones in Streams and Corresponding Physical Characteristics

Abstract: Surface Transient Storage (STS) in stream ecosystems serve an important function in retaining nutrients and refugia for aquatic communities. Unfortunately, they can retain contaminants as well. Therefore, it is of importance to determine the time of entrainment in these zones. A Residence Time Distribution (RTD) of a particular STS zone can inform the time it takes for the first pulse of water and associated constituents to leave the STS zone, and for the mean residence time of water in that zone, among other things. The RTD of STS is also useful to subtract from the RTD of the total transient storage in streams in order to determine the hyporheic transient storage of streams, which is difficult to measure.

Currently, there is no definitive method of determining the RTD of STS. They have been determined with tracer injection alone, though this is time consuming and subject to interference from HTS. A relationship between STS physical characteristics and a RTD would be desirable, as this would characterize the time of entrainment of STS based upon a few easily measured physical parameters. This exists for groyne fields and flumes, which both have

artificial STS. However, direct application of these equations to natural STS leads to errors due to simplistic geometries.

The focus of this research determines RTDs in lateral STS, a substantial proportion of STS, and its relationship to physically measurable parameters of lateral STS. Twenty sites throughout Oregon were each injected with NaCl to determine the RTDs Langmuir time (τL), the advection time, and the mean Surface Transient Storage time (τSTS) of each lateral STS zone. The RTDs of these sites were then compared to the length, width, and depth of each lateral STS zone, as well as the velocity of the adjacent main channel. This relationship should be of an exponential order.

Luis Angel Gomez Cunya

University: Oregon State University

Department/Program: School of Civil and Construction Engineering, Masters in Water Resources

Title: Improving the computational efficiency of the hydraulic performance graph for unsteady flow routing in complex river networks.

Abstract: Unsteady flow routing in complex river networks may be computationally demanding, especially when it is used in optimization problems that may require hundreds or thousands of computations for each operational decision (e.g., gate operation under flooding conditions). OSU Rivers, a state-of-the-art unsteady flow routing model developed at Oregon State University, is based on the Hydraulic Performance Graph (HPG) and the Volume Performance Graph (VPG) approach. The HPG of a channel reach graphically summarizes the dynamic relation between the flow through and the stages at the ends of the reach under gradually varied flow GVF conditions, while the VPG summarizes the corresponding storage. Both, the HPG and VPG are unique to a channel reach with a given geometry and roughness, and can be computed decoupled from unsteady boundary conditions by solving the GVF equation for all feasible conditions in the reach. The fact that the performance graph approach is computed decoupled from unsteady boundary conditions means that this approach can be used for different boundary conditions without re-computing the HPG's and VPG's. The performance graph approach has been shown to be accurate, numerically efficient and robust, however there is still room for improvement, especially in the numerical efficiency. The contribution of this paper is a new approach for interpolation of HPGs and VPGs. This new approach consists on assembling matrices for the HPG/VPG for each river reach. The matrices have a tridimensional representation and they are optimized for numerical efficiency. The optimization is based on reducing the matrix size to still achieve the initial accuracy but with much less data. This info is saved as pixels in a binary system. The Delaunay triangulation method for interpolation is being implemented into OSU Rivers among other computational algorithms to increase the numerical efficiency of this model. The expected outcome is to greatly minimize the computational processing time of unsteady routing.

Maria Lewis

University: Oregon State University

Department/Program: CEOAS, Masters in Water Resources Policy and Management

Title: Corporate Engagement in Payment for Ecosystem Services: Barriers and Opportunities in the Business Community

Abstract: The purpose of my project is to develop a tool for corporate engagement in ecosystem services. The research question that I seek to ask is: What are the barriers and opportunities for corporate engagement in local payment for ecosystem services programs in the Willamette Valley?

Currently, the Willamette watershed contains a surplus of potential ecosystem services providers and a scarcity of available buyers. Corporate engagement is one way in which the need for more buyers can be met. Evidence also suggests that the business community potentially has much to gain from payment for ecosystem services programs, such as water and carbon credit trades, resource security, and public relations opportunities.

I anticipate that my project will be done in two phases. The first phase involves interviewing a small sample of businesses in the Willamette Valley, focusing geographically on the areas of Eugene, Corvallis/Salem, and Portland. This initial set of interviews will provide useful information on whether businesses in the Willamette Valley are currently participating in, or plan to participate in, sustainability initiatives that include but are not limited to payment for ecosystem services programs. In addition, I hope to discover through these interviews what some of the barriers and opportunities are for corporate engagement in these types of programs and initiatives.

The second phase involves taking this qualitative data and developing an instrument to gauge potential corporate interest in ecosystem services. The exact shape and nature of this instrument is yet to be determined, but it is my hope that a richer data set can be gathered on what motivates businesses to participate in payment for ecosystem services programs, what barriers could potentially be removed to allow for greater participation, and what opportunities for participation are currently under-utilized

Kelly Foley

University: Oregon State University

Department/Program: CEOAS, Masters in Water Resources Policy and Management

Title: Examining the diffusion of innovative best management practices in the Northern Malheur County Groundwater Management Area

Abstract: Over the course of two decades, producers and local groups in the Northern Malheur County Groundwater Management Area have worked to develop and implement Best Management Practices (BMPs), but the extent of voluntary BMP adoption is unknown. The Oregon Department of Environmental Quality (ODEQ) suggests that to reach 7ppm groundwater nitrate, continued and

expanded implementation of BMPs is needed. There are barriers to adoption of BMPs, but understanding why BMPs are adopted and how adoption of innovations spread may help to break down these barriers in Malheur County and elsewhere in Oregon. Thus, the purpose of this project is to examine the adoption and implementation of BMPs in Northern Malheur County. The primary objectives are to determine what communication channels are trusted by producers and to identify what factors influence a producer's decision to adopt a BMP once they have received this information. The proposed research methodology is informed by the diffusion of innovations theory, which has served as the basis for the Extension Service for decades, as well as the theory of planned behavior. Data will be collected through qualitative interviews with producers chosen using non-probability purposive sampling and analyzed using a qualitative network analysis. Results will be used to recommend further local BMP adoption and provide guidelines for other areas.

Lauren Dennis

University: Oregon State University

Department/Program: College of Earth, Ocean, and Atmospheric Sciences, Water Resources Policy and Management, Master's

Title: Can small utility cooperative partnerships make Oregon's coastal water supply more resilient to climate change?

Abstract: Future water supply is of great concern to theOregon coast. As a region predominately inhabited by rural communities, morethan half of the coast's population gets its drinking water from small water supplysystems. While many of the issues these suppliers face are not unique amongwater utilities (e.g. the effects of upstream land use on water quality andquantity, the increasing stringency of regulatory requirements, rising service demandaccompanied with population growth, and aging infrastructure), these challengesare more difficult to address due tothe severe human and financial resource constraints of these small and ruralsystems. Climate change may bring a new array of challenges and vulnerabilitiesto this region. More frequent and severe coastal storms, winter floods, andsummer droughts could damage infrastructure, contaminate source waters, andproduce seasonal scarcity conditions – scenarios from which these systems may difficultyrecovering, jeopardizing public health. The most recent assessments of Oregon'scoastal water supplies have pointed to the potential for local cooperative watersupply partnerships between neighboring coastal communities to alleviate thesechallenges through information- and resource-sharing, and through the provisionof assistance in times of water-related stress. Few currently exist in this region. This studysets out to 1) characterize the potential for increased adaptive capacity amongsmall water suppliers through these partnerships; 2) identify likely barriersto partnership establishment; and 3) develop outcome and process criteria toovercome these barriers and create successful collaborative small water supplypartnerships along the Oregon coast.

Patrick Burns

University: Oregon State University

Department/Program: CEOAS, Masters in Water Resources Science

Title: Calibration of a Distributed Hydrological and Glacier Model: Implications for Water Resources in the Cordillera Blanca, Peru

Abstract: Glacier retreat has been well documented in the Cordillera Blanca of the Peruvian Andes. It is becoming clearer that changes in glacier area and volume will negatively affect water resources in this regional watershed

(the Cajellon de Huaylas, pop. 267,000), particularly during the dry season (May to September). To quantify these changes we use the Distributed Hydrology Soil Vegetation Model (DHSVM), newly coupled with a dynamic glacier model, in a 90 km2 test basin called Llanganuco. First, we used the Normalized Difference Snow Index (NDSI) to map the change in glacier area for this test watershed and for the Huascaran-Chopicalqui Massif. We acquired 7 Landsat scenes from the end of the dry season, spanning from 1975 to 2010. Unlike most other glacier change studies, we performed atmospheric correction using Second Simulation of a Satellite Signal in the Solar Spectrum (6S). We also based our choice of an NDSI threshold on calibration and validation of the NDSI on separate glaciers. The rate of glacier area change and percent area change (~25% loss from 1975 to 2010) in this test basin mirror that of the entire Cordillera Blanca where glaciers lost an estimated 22% of their area between 1970 and 2003. We are running DHSVM with forcing data from the Tropical Rainfall Measuring Mission and downscaled data from the Sheffield et al. (2006) reanalysis dataset. The model is being run from 1998-2010 on a 3-hr time step. The Digital Elevation Model (DEM) is from the Shuttle Radar Topography Mission (SRTM), whose 90 m cell size defines our model resolution. Vegetation classes were defined by classification of a Normalized Difference Vegetation Index (NDVI) from Landsat TM. Soil classes, derived from dry season field data, are highly simplified. We attempt to take the model calibration a step further by incorporating a two component isotopic mixing model which utilizes water samples collected during the 2011 dry season. Using these isotopic measurements coupled with additional stream discharge measurements, we incorporate a geochemical check on the model to ensure that physical processes are being accurately represented by the new DHSVM. We continue to refine this model so that we may implement it in other regions of the world where glacier melt is crucial at certain times of the year with the end goal of making future projections about water resources in glacierized basins under different climate scenarios.

Shahrbanou Madadgar
University: Portland State University

Department/Program: PhD in Civil and Environmental Engineering

Title: Improving the Long-lead Hydrological Forecast using Copula-based postprocessing

Abstract: Postprocessing of hydrological forecasts regardless of the inherent dependencies among model forecasts and real-time observations is subject to several errors that may even degrade the original forecasts. The operational agencies in charge of river flow forecast, National Weather Service (NWS) River Forecast System (NWSRFS) and Natural Resources Conservation Service (NRCS), use traditional statistical methods for postprocessing of the primary forecasts with structural bias and errors. This study addresses the major drawbacks of the frequently applied bias correction method, the so called Quantile Mapping (QM) in adjusting hydrological forecasts, and then introduces an auxiliary index (failure ratio) to identify the incapability of QM in improving forecasts prior the forecast period. In order to establish a relationship between hydrological forecasts and real-time observations, a set of multivariate distribution functions (i.e. copula functions) are employed. The copula method characterizes the joint behavior of forecasts and simulations. Both QM and copula-based methods are primarily tested on a set of 2500 hypothetical cases with parametric marginal distributions for the observed and forecast variables. The analysis is followed by a real-case study of the streamflow forecast of the Sprague River Basin located in southern Oregon, US. Results show that the failure ratio is a

controlling factor on the performance of QM method while the copula-based method is not sensitive to the failure ratio, hence is the preferred method in postprocessing of forecast ensembles. The point-verification metrics illustrate the definite superiority of copula-based approach in adjusting forecasts especially in cases with large values of failure ratio. Comparing the results of both postprocessors demonstrates the remarkable ability of the multivariate postprocessor in bias correction of hydrologic forecasts comparing to the QM approach.

Christopher Gifford-Miears

University: Oregon State University

Department/Program: Civil and Construction Engineering, Masters in Civil Engineering - Water Resources

Title: Applicability of Three-Dimensional Flow Modeling in the Construction of Hydraulic Performance Graphs for Unsteady Flow Routing in Complex River Networks

Abstract: River networks present complex flow features (e.g. eddy structures) and hence complex head losses that are difficult to quantify using one-dimensional models. Three-dimensional flow models may be more accurate for these conditions as they are capable of modeling eddies and complex flow features. The applicability of three-dimensional flow modeling in the construction of Hydraulic Performance Graphs (HPGs) for unsteady flow routing in complex river networks is investigated in this research. The HPG of a channel reach graphically summarizes the dynamic relation between the flow through and the stages at the ends of the reach under gradually varied flow (GVF) conditions. The hydraulic routing for the entire system consists of dividing the river system into reaches and pre-computing the hydraulics for each of these reaches independently using a steady three-dimensional flow model. Then, a non-linear system of equations is solved that is assembled based on information summarized in the systems' performance graphs, the reach-wise equation of conservation of mass, continuity and water stage compatibility conditions at the union of reaches (nodes), and the system boundary conditions. An application of three-dimensional HPGs is performed using a section of the Fraser River network in British Columbia where complex flows are known to occur. The HPGs are built using the commercially available computational fluid dynamics (CFD) package FLOW-3D, a state-of-the-art three-dimensional CFD model. Use of three-dimensional flow modeling is exemplified for unsteady flow routing in this complex river network and its simulation results are compared with those from the well-known unsteady HEC-RAS model.

Caleb DeChant

University: Portland State University

Department/Program: PhD in Civil and Environmental Engineering

Title: Utilizing Remotely Sensed Data and Ensemble Data Assimilation to Quantify and Reduce the Uncertainties of Operational Hydrologic Forecasting

Abstract: Ensemble Streamflow Prediction (ESP) has become a popular method for operational seasonal streamflow predictions. ESP relies both on the estimation of initial conditions and historically resampled

forcing data to produce seasonal volumetric forecasts. In the Western USA, the accuracy of initial condition estimation is particularly important due to the large quantities of water stored in mountain snowpack. In order to improve the estimation of snow quantities, this study explores the use of ensemble data assimilation to improve snow state estimates with the aid of remotely sensed passive microwave radiance. Rather than relying entirely on the model to create a single deterministic initial snow water storage, as is currently implemented in many operational forecasting systems, we incorporated remotely sensed data along with model predictions to create an ensemble based probabilistic estimation of snow water storage. This creates a framework to account for initial condition uncertainty in addition to forcing data (model input) uncertainty. The results presented in this study suggest that using remotely sensed data through ensemble data assimilation has a great potential to improve ESP for probabilistic volumetric streamflow forecasts.

Allison Danner

University: Oregon State University

Department/Program: CEOAS, Masters in Water Resources Engineering

Title: Will we need to change the rules? The implications of climate change for dam operations in Oregon's McKenzie Basin

Abstract: Multipurpose flood control dams are operated with the primary objective of storing peak flows and reducing or eliminating flood damage downstream. Secondary goals may include generating hydropower, supplying water for irrigation or municipal use, and providing recreation opportunities. For many dams, rule curves and other operating rules are developed when the project is authorized. These rules, along with short- and long-term forecasts, provide guidance for day to day operations of the dam. Because rule curves are not intended to change, they must reflect the typical conditions that the dam will experience and allow for storage of the design flow. Some years may be wetter or drier than average, but use of the rule curve indicates the implicit assumption that the average climate is not changing. However, many climate projections indicate that there will be significant changes to hydrology and streamflow in the future. Therefore, it is critical to consider how dam operations may be affected.

With two US Army Corps of Engineers dams in Oregon's McKenzie river basin as case studies, I am using both historical data analysis and modeling to examine this question. First, with measured streamflow data from above and below the reservoirs and measured reservoir elevations, I am characterizing streamflow conditions and

reservoir operations and identifying extremes. I will then use the results of this analysis to compare actual operations to the rule curve and to assess performance. Second, I will use a combination of stochastic streamflow modeling and reservoir modeling to simulate potential climate change scenarios and reservoir operations. The simple, rule curve-based reservoir model will be a useful environment in which to examine the stochastically generated streamflow scenarios and make inferences about potential future dam performance under climate change.

This project will contribute to our knowledge of potential effects of climate change on water resources systems, provide guidance to the climate and streamflow modeling community by identifying characteristics that are important to understand and accurately model for use in dam operations studies, provide an alternative method for assessing climate change impacts on dam operations, and provide information for future dam management and operation decisions

MohammadReza Najafi

University:Portland State University

Department/Program: Civil and Environmental Engineering, PhD in Water Resources Science

Title: Analysis Of The Climate Change Impact On Hydro-Climate Extremes

Abstract: We utilized data provided by the North American Regional Climate Change Assessment Program (NARCCAP) in order to investigate the occurrence of extreme precipitation events in the Willamette river basin. The dynamically downscaled datasets reveal positive overall bias that is removed through quantile mapping bias correction method. We applied a newly developed performance metric called Added Value Index (AVI) to compare the results of higher resolution RCMs with respect to their parent GCMs. Results from AVI metric reveal that not all of the RCMs outperform their host GCMs in terms of correlation skill. Extreme value theory by means of Generalized Pareto Distribution (GPD) is applied to both historic, 1980-1998, and future, 2038-2069 daily datasets to provide estimates of changes to precipitation events return periods.

Sarah Praskievicz

University: University of Oregon

Department/Program: PhD in Geography

Title: Hierarchical Modeling as a Method for Investigating Climate Change Impacts on Fluvial Geomorphology: Tucannon River, Washington

Abstract: Anthropogenic climate change is likely to significantly affect water resources, particularly in snow-dominated river basins, where increased temperatures and altered precipitation patterns result in lower snowpack and increased hydrologic variability. While these hydrologic impacts have been studied using basin-scale models, few studies have examined how changes in the magnitude and timing of discharge resulting from climate change may influence the morphology of river systems. Geomorphic factors are major determinants of the value of river systems, including their suitability for threatened and endangered species and for human uses of water.

In this research, I am using a hierarchical, multiple-scale modeling approach to investigate potential impacts of climate change on the fluvial geomorphology of the Tucannon River in southeastern Washington. I am developing scenarios of future climate change based on the North American Regional Climate Change Assessment Program (NARCCAP). I use these climate change scenarios as input to the Soil and Water Assessment Tool (SWAT) basin-scale hydrologic model. The resulting hydrologic scenarios are used to run the Cellular Automaton Evolutionary Slope and River (CAESAR) reach-scale geomorphic model, which I initialized based on topographic and sediment grain-size data obtained in the field. The results from the CAESAR model include changes in planform, including average sinuosity and meander amplitude; in channel morphology, such as width and depth; and in total and suspended sediment transport. This hierarchical modeling approach allows for investigation of the interactions among physical processes operating at a range of spatial scales, from global climate to reach-scale morphology.

Brendan Galipeau

University: Oregon State University

Department/Program: Department of Anthropology, Masters in Applied Anthropology

Title: Socio-Ecological Vulnerability in a Tibetan Village on the Lancang River, China

Abstract: This presentation describes ethnographic research examining vulnerabilities to resettlement from a large hydropower dam and agricultural commodification in a Tibetan village in Yunnan Province, Southwest China. After providing an initial background on the dynamics of the research region and hydrodevelopment on its rivers, the research framework of examining vulnerability through a lens of political ecology and local knowledge is outlined. Utilizing this framework, the socioeconomic strategies surrounding agriculture and commodified forest products within the study village are initially studied through the use of oral histories, previous literature, and quantitative household survey data. After providing a detailed background on these income strategies, vulnerabilities to resettlement are examined through qualitative analysis of individual household interviews. This analysis shows that village households are highly reliant on the village's specific location in order to collect the resources and pursue they agriculture that they do; making them vulnerable to future resettlement. The analysis also shows that in the opinions of villagers, a good standard of living is significantly defined by their ability to pursue specific economic strategies. Next, interview results are analyzed to show how agricultural commodification and a very high reliance on one government sponsored company to purchase crops has also made the village highly vulnerable economically. The research concludes with reflections on future hydrodevelopment and resettlement

scenarios within the village, and provides recommendations to improve local level resilience and promote better capacity to adapt to change.

Mark Ingman

University: Oregon State University

Department/Program: CEOAS, Masters in Water Resources Policy and Management

Title: The Role of Water Conservation Techno-policies For Desert Oasis Communities of Northern China

Abstract: China's Minqin Oasis once welcomed traders of the ancient Silk Road with rivers, lakes, and lush forests, yet today the region's farmland is being increasingly engulfed by the sands of the Gobi Desert. The severity of this incremental catastrophe for a declining population of 400,000 Chinese residents has brought forth a host of recent water policies to include agronomic water conservation through plastic mulch use, computerized regulation and pricing of groundwater, and coveted water diversions from the Yellow River. This study analyses recent Minqin County farmer interviews and surveys to better understand farmer's risk perception of transformational environmental and social change as it relates to water policy implementation.

Zachary Dunn
University: Oregon State University

Department/Program: BS in College of Engineering

Title: Water for Lela: Engineers Without Borders and the Lela Community Water Project

Abstract: In January 2008 the community of Lela, Kenya submitted an application to Engineers Without Borders USA requesting assistance with the Lela Community Water Project. Lela, like much of sub-Saharan Africa, lacks access to a reliable source of potable water. Engineers Without Borders at OSU adopted the Lela project in May 2009 and has since sent two travel teams to Kenya. The first team arrived in December 2009 to conduct a community needs assessment and health survey. The second team traveled to Lela in June 2011 to conduct a technical assessment of the available water resources within the community. The first implementation of the project is scheduled for July 2012, during which five OSU students and one professional mentor will oversee the construction of a borehole and the expansion of a rainwater catchment system within the Lela community. The purpose of this talk is to demonstrate the role that students and professionals have in helping to solve one of the most pressing water related issues of our time: the continued lack of access to safe drinking water that nearly one billion people face globally.

Myles Gray
University: Oregon State University

Department/Program: Soil Science/Water Resources Engineering, Soil Science/Water Resources Engineering dual masters

Title: Creating Designer Biochars: Factors affecting water holding and hydrophobicity in biochars

Abstract: This research investigates factors and mechanisms controlling the water holding capacity and hydrophobicity of biochars produced from different feedstocks and at different production temperatures. Biochar properties depend on feedstock and production temperature, and given that water entry into biochar pores is necessary to produce useful char products, the relationship between water holding, hydrophobicity, and production conditions is of critical importance. Biochars were produced from two locally available waste biomass feedstocks (douglas fir chips and hazelnut shells) at three production temperatures (370, 500, and 620 C) using a prototype industrial-sized retort. Basic biochar characterizations include pH, volatile matter and ash content, and BET-N2 surface area analysis. Preliminary results will be presented from a water and ethanol holding trial, suggesting that high temperature douglas-fir chars exhibit the highest water holding capacity and the least degree of hydrophobicity.

Ryan Stewart

University: Oregon State University

Department/Program: Biological and Ecological Engineering, PhD in Water Resources Engineering

Title: Runoff Thresholds in Shrink-Swell Clay Soils

Abstract: Overland flow (runoff) is generally assumed to be dependent on both the intensity of rainfall and the infiltration capacity of the soil. Infiltration capacity is considered to be a function of soil properties, such as porosity and hydraulic conductivity, and antecedent soil moisture content. Normally these soil properties are assumed to be invariant in time, which implies that soil moisture content should explain the temporal variability in overland flow, all other things being equal. However, we present plot-scale results from a rainfall simulation experiment in South-Central Chile which show that for shrink-swell clay soils soil moisture is a poor predictor of runoff response. Instead, we find that runoff is more closely correlated with near-surface crack volume, and that the cumulative amount of rainfall may function as an adequate indication of the degree of crack closure.

Luke Pangle

University: Oregon State University

Department/Program: Forest Engineering, Resources and Management, PhD in Water Resources Science

Title: Seasonal rainfall and an ecohydrological feedback offset the potential hydrological impact of climate warming in a Mediterranean ecosystem.

Abstract: The potential impact of future climate warming on the terrestrial hydrologic cycle is uncertain. This

problem has evaded experimentalists due to the overwhelming challenge of measuring the entire water budget in open environmental systems, and of introducing experimental treatments that mimic projected changes in climate. Yet, experimental results are critical for qualitatively evaluating models and for identifying key system interactions. Here, we present new data from the terracosm experiment that examined the combined responses of evapotranspiration (ET), soil moisture (θ), and groundwater recharge (R; using lysimeter drainage to represent this flux) to a 3.5˚C temperature increase in a grassland ecosystem experiencing a Mediterranean climate. The temperature increase was applied both symmetrically throughout the day, and asymmetrically such that daily minimum temperature was 5˚C greater than ambient and daily maximum temperature was 2˚C greater than ambient. We hypothesized that increasing air temperature would accelerate plant growth and enhance ET during the spring season, causing an associated reduction in R. Additionally, we anticipated greater soil drying during the summer drought period, resulting in a greater cumulative rainfall requirement to initiate R at the onset of the fall rains—both effects resulting in increased ET and reduced R at the annual time scale. Our results, spanning three water years, showed that symmetric and asymmetric warming enhanced ET during the spring, causing earlier reductions in soil moisture. Groundwater recharge was reduced during late-spring storms relative to the ambient temperature treatment, though the reductions amounted to less than 4% of total-annual R among all years, and were offset by slightly greater R that occurred at other times of the year under both warming treatments. As a consequence of enhanced ET in the spring, grasslands experiencing warming treatments also reached wilting-point soil moisture more rapidly, and senesced earlier in the summer, whereas those experiencing ambient temperatures continued to transpire later into the summer. Due to this negative feedback under climate warming scenarios, total ET was similar among both warming treatments and the ambient temperature treatment. The net result was no statistically-significant difference in annual R or ET among all three temperature treatments—contrary to our hypothesis. These findings reveal the potential for ecohydrological feedback mechanisms to moderate, or offset, the potential hydrological impact of climate warming, particularly in semi-arid environments where soil moisture may limit ET and where precipitation is seasonal and temporally out of phase with temperature.

Noa Bruhis

University: Oregon State University

Department/Program: Civil Engineering, Masters in Water Resources Engineering

Title: Estimating Freshwater Discharge into the Gulf of Alaska

Abstract: Estimates of coastal freshwater discharge into the Gulf of Alaska are necessary for a variety of stakeholders. Freshwater fluxes play a role in controlling nearshore salinity and temperature fields and resultant circulations. These abiotic parameters, in turn, are part of the foundation for understanding observed biological patterns. Discharge estimates require high-resolution meteorological information such as precipitation and temperature as input. High-resolution grids of these parameters on a monthly time scale were produced during the first year of an NPRB-funded study of the discharge into the Gulf. Extensive weather station time-series data were synthesized with existing climatological norms to produce these grids. Generated results over a 50 year period demonstrated strong annual and inter-annual variability in conditions. The precipitation estimates were overlaid on the three principal watersheds of Alaska (Gulf, Bering Sea, Arctic Ocean) in order to provide an 'upper bound' on the water available for runoff into those water bodies. The results were favorably compared to other recent estimates of precipitation and temperature. At the outset of the second year of the project, these weather

grids are being used to estimate discharge from delineated watersheds comprising the entire Gulf of Alaska drainage. Rainfall-runoff relations will be calibrated using gaged basins in the drainage and the results will be applied to the remaining ungaged basins in the drainage.

Jay Frentress

University: Oregon State University

Department/Program: Forest Engineering and Resources Management/Forestry, PhD in Water Resources Science

Title: Some Like it Hot: Combining infrared imagery and classic isotopic and geochemical tracers to differentiate sources of streamflow in a small headwater stream (Luxembourg, Europe)

Abstract: Hydrologic sources during precipitation events have often been partitioned using simple mixing models that differentiate stored and event water in stream discharge. However, such models suffer from invalid assumptions and it is difficult to distinguish among multiple hydrologic processes. In an effort to better constrain end-members for mixing models, we investigated the potential to differentiate streamflow sources according to temperature and geochemical and isotopic composition. Near-stream zones with persistent surface saturation offer the opportunity to test the feasibility of such a classification of surface and subsurface sources of streamflow in situ. A hand-held thermal infrared camera was used to generate infrared images of multiple near-stream areas in the 50 ha Weierbach catchment (Luxembourg). Infrared (7 – 13 µm) images of saturated areas (4 - 200 m2) were taken before, during, and after a significant rain-on-snow event. In order to validate thermal imagery results and to better identify source end-members, water samples throughout the photographed areas were collected for major cation/anion concentrations and δ 18O and δ 2H analyses. Results indicate that infrared imagery greatly enhances our ability to 'see' saturated areas in the riparian zone and to infer the direct sources of water to these areas. Under low-flow conditions, groundwater sources in near-stream saturated zones were readily identifiable in infrared imagery. Persistent groundwater sources typically reflected a temperature of ~ 6 °C while other subsurface sources, probably reflecting shorter flowpaths, were more temporally and thermally variable with temperatures ranging from 3 to 5 °C. Many subsurface runoff sources only appeared during the peak of snowmelt. As snowmelt increased during a precipitation event, the channel network extended considerably upslope and patches of overland flow were visible beneath the snowpack. Surface saturation outside the perennial channel areas (snowmelt resulting in overland flow) ranged in temperature from 1 to 3 °C. Direct comparison of isotopic and geochemical analyses with temperatures derived from infrared images allowed us to infer connectivity in the study area at different moments along the hydrograph. Near-stream saturated areas differed by as much as 4 °C from stream channel temperatures. Geochemical and isotopic results and sample temperatures were poorly correlated across time but showed distinct trends at specific points on the hydrograph. Groundwater sources were dominant runoff producers under low-flow conditions while overland flow produced from snowmelt dominated during the hydrograph peak. Additionally, a new tracer approach based on living diatoms as indicators of surface water sources was used to corroborate evidence of overland transport in riparian and hillslope areas where surface saturation occurred.

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University: Oregon State University

Department/Program: College of Earth, Ocean, and Atmospheric Sciences, Water Resources Policy and Management, Master's

Title: The Lost Time: A Review of Tribal Water Rights Settlements and Instream Flows

Abstract: Tribal water rights and instream flows for species listed under the Endangered Species Act (ESA) have been a source of tensions in the western United States, particularly when tribes have undetermined water rights to support tribal fisheries listed under the ESA. While tribal water rights settlements are generally the preferred approach to resolving tribal water right claims, there has not been a complete analysis of the role of instream flows in settlements. Understanding the mechanics of past tribal water rights settlements will allow parties in the future to evaluate these agreements as an avenue for protecting instream flows. An analysis of the 27 congressionally approved tribal water settlements for instream flow and ESA provisions revealed that when instream rights were established, they were typically subordinated to existing uses or given a junior priority date. In addition, while the ESA was a factor in many of the settlements, only one actively incorporated ESA tools as part of the benefits of the agreement. I conclude that tribal water rights settlements are not likely to result in senior instream rights as would be awarded through courts, but rather will include voluntary actions under state law that minimize the harm to existing uses.