SELF-ADAPTIVE MULTIMETHOD SEARCH FOR IMPROVED CALIBRATION OF HYDROLOGIC MODELS

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Presentation Abstract 1

In the last few decades, the field of evolutionary computation has produced many different algorithms for solving complex search and optimization problems. In this research, the main focus has been on the development of a single universal genetic operator for population evolution that is always efficient for a diverse set of optimization problems. Existing theory and numerical experiments have, however, demonstrated that it is highly unlikely that such a universal operator exists. In this presentation, I will highlight a new concept of genetically adaptive multimethod optimization, called AMALGAM-SO. This new algorithm simultaneously uses the strengths of the Covariance Matrix Adaptation (CMA) evolution strategy, Genetic Algorithm (GA), and Particle Swarm Optimizer (PSO) for population evolution and implements a restart strategy with successively increasing population size. We illustrate the usefulness and applicability of AMALGAM-SO using examples from the field of watershed hydrology and subsurface flow and transport modeling. Results demonstrate that AMALGAM-SO is superior in efficiency, robustness, and reliability to current available search algorithms. The new method is relatively easy to implement and is designed such that it can take full advantage of the power of distributed computer networks.

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GEOCHEMICAL EVOLUTION AND APPARENT FLOW RATES OF GROUND WATER IN THE SAN ANDRES LIMESTONE, BITTER LAKE NATIONAL WILDLIFE REFUGE, CHAVES COUNTY, NEW MEXICO

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Presentation Abstract 2

Water-quality samples were collected between 2004 and 2006 from three wells and four springs in and near the Bitter Lake National Wildlife Refuge. Selected data generated from analyses of these samples were used in NETPATH to generate a mass-balance model of the geochemical evolution of ground water in the San Andres Limestone. Model constraints included concentrations of dissolved Na, K, Ca, Mg, Cl, SO_4, and HCO_3. Potential reactive phases in initial models included NaCl, KCl, $CaCO_3$, $Ca_{0.8}Mg_{0.2}CO_3$, $CaMg(CO_3)_2$, $CaSO_4$, $H_2S(g)$, $CO_2(g)$, and Na:Ca$\pm$Mg exchange. More than one unique mass-balance model can be generated if the number of reactive phases exceeds the number of constraints. The best-fit mass-balance model was selected from all generated models by (1) eliminating models requiring precipitation of $CaMg(CO_3)_2$, and (2) comparing calculated and observed aqueous-phase $\delta^{13}C$ values. Best-fit model selection was based on an assumed $\delta\ ^{13}C$ value of 0 per mil for solid carbonate phases and assumed $\delta\ ^{13}C$ values of -7 and -25 per mil for $CO_2(g)$ representing atmospheric and biogenic origins, respectively. The best-fit mass-balance model included dissolution of NaCl, KCl, $CaMg(CO_3)_2$, $CaSO_4$, and atmospheric $CO_2(g)$; precipitation of $CaCO_3$; and exchange of dissolved Na for Ca$\pm$Mg. Using $\delta\ ^{13}C$ values of -1 per mil for $CaMg(CO_3)_2$ and -7 per mil for $CO_2(g)$ in the best-fit model generated calculated and observed aqueous-phase $\delta\ ^{13}C$ values that generally agreed within +0.5 per mil.

The best-fit mass-balance model was used to adjust observed ^{14}C values for the effect of carbon mass transfer during geochemical evolution of ground water allowing apparent ground-water-flow rates in the San Andres Limestone to be calculated based on a ^{14}C half-life of 5,730 years. Calculated apparent ground-water-flow rates ranged between 1.8 and 7.6 meters per year.

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Presentation Abstract 3

WITHDRAWN

ASSESSING CHANGES IN DEPLETIONS FROM RIVER RESTORATION ACTIVITIES WITHIN THE RIO GRANDE FLOODPLAIN

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Presentation Abstract 4

The reasonable and prudent alternative of the 2003 Biological Opinion requires the federal and state agencies to conduct habitat restoration projects on at least 1,600 acres along the middle Rio Grande in central New Mexico. Consequently, the U.S. Bureau of Reclamation (Reclamation), the U.S. Army Corps of Engineers (Corps), and the New Mexico Interstate Stream Commission (ISC) implemented several habitat restoration projects in the Albuquerque and Isleta reaches of the Rio Grande. Most of these projects have been planned and implemented without a clear understanding of how they affect the localized hydrologic budget, particularly their impact on consumptive use by evaporation and evapotranspiration. The purpose of this work is to develop an approach for evaluating the changes in depletions that result from these types of projects. The approach is applied to a habitat restoration project constructed by the Corps in the Los Lunas, New Mexico area since 2002 covering approximately 16.4 hectares (40.6 acres) on the west bank of the Rio Grande. The goal of the project was to mechanically widen the active river channel, create additional shallow water/low velocity habitats for the Rio Grande Silvery Minnow, and revegetate burned areas with native riparian species. The project was evaluated using a high-resolution groundwater flow model for the shallow aquifer along the Rio Grande. The model is linked to a companion surface water model and a regional groundwater flow model to simulate the interaction between surface water and groundwater systems. To evaluate the effect of the restoration project on depletions, model runs were completed for the before and after restoration scenarios. The model results indicate that the restoration project resulted in higher depletions due primarily to an increase in the frequency and spatial extent of overbank flooding.

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DECISION-SUPPORT SYSTEMS FOR EFFICIENT IRRIGATION IN THE MIDDLE RIO GRANDE

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Presentation Abstract 5

Water is the lifeblood of the American West and the foundation of its economy, but it remains its scarcest resource. The explosive population growth, the emerging need for water for environmental uses, and the national importance of domestic food production are driving major conflicts between these competing water uses. The case of Rio Grande illustrates the problem very well. The river is the ecological backbone of the Chihuahuan Desert region and supports the region's dynamic and diverse ecology, including the fish and wildlife habitat. Irrigated agriculture in the Middle Rio Grande diverts large quantities of river water, which is believed to leave insufficient water to meet other societal needs. One approach to meet the diverse societal needs in such ecological systems is to promote efficient and productive water use, especially in the agricultural sector that uses large water quantities.

This paper will present our research on options to make irrigation system operations more efficient. Most irrigation systems can meet their users' needs with decreased river diversions by operating with real-time knowledge of available water supplies and crop water requirements. The paper describes our on-going research in the Middle Rio Grande Valley, to develop a Decision-Support System (DSS) that can assist the water managers to closely match water deliveries to crop water requirements. The DSS uses linear programming to find an optimum water delivery schedule for the service areas in an irrigation system.

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A PERMITTED ARTIFICIAL STORAGE AND RECOVERY PROJECT IN NEW MEXICO?
BEAR CANYON RECHARGE DEMONSTRATION PROJECT, ALBUQUERQUE, NEW MEXICO

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Presentation Abstract 6

Increasing storage capacity is widely viewed by New Mexico water managers as a means of improving management of the state's highly variable seasonal and annual water supply. A number of states in the western United States (Arizona, California, Nevada, Colorado, Texas) have used artificial storage and recovery (ASR) for years with great success; however, there are currently no permitted ASR projects in New Mexico. As the first ASR project in New Mexico to file for application and undergo the permitting process, the City of Albuquerque's Bear Canyon Recharge Project may soon change that. As required by the regulatory agencies (NM Office of the State Engineer and NM Environment Department), a demonstration project is currently being conducted as part of the permitting process. Approximately 3,000 acre-feet of water will be introduced to the surface of an existing stream channel (Bear Canyon Arroyo) and allowed to infiltrate. The water will come from the City's San Juan-Chama Project allocation. Extensive monitoring will be conducted to track water movement and quality, on the surface, within the vadose zone, and within the aquifer. Vadose zone and aquifer characterization already conducted includes geophysical logging of boreholes, continuous core sampling, and determination of hydraulic properties by both in-situ and laboratory methods. A combination of thermistors, heat dissipation sensors, neutron logging, groundwater wells, and lysimeters have been installed to monitor water as it infiltrates from the surface to the saturated zone. Data collected during the project will be used to evaluate how much water reaches the aquifer and to establish a recoverable groundwater right.

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Presentation Abstract 7

WITHDRAWN

THE PRODUCTIVITY OF WATER IN IRRIGATED NEW MEXICO PECAN PRODUCTION: MEASUREMENTS AND POLICY IMPLICATIONS

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Presentation Abstract 8

Pecans are a major agricultural crop in New Mexico. Currently there are more than 25,000 acres of pecans in the Mesilla Valley, consuming more than one third of the annual diversion. The research presented here provides previously unavailable broad-scale estimates of pecan ET and the pecan water production function in southern New Mexico. The data which form the foundation of this paper were generated using the Regional ET Estimation Model (REEM) developed at New Mexico State University for agricultural and riparian vegetation (Samani et al. 2005, 2006, 2007). REEM uses remotely sensed satellite data to calculate ET as a residual of the energy balance. This paper extends the results of REEM to an analysis of the productivity of water in irrigated pecan production in the Mesilla Valley. The results of this research provide new insight into pecan water use and the yield results of this water use. This research illustrates the linkages which can be made between remote sensing technology and models and farm-level yields. This research sheds new light on the long-standing practice of deficit irrigation, as well as the yield and conservation impacts of this practice.

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A WATER LEASING FRAMEWORK FOR THE MIDDLE RIO GRANDE WITH A FOCUS ON THE FARMERS DECISION MAKING PROCESS

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Presentation Abstract 9

In the semi-arid southwest there are competing users for a scarce resource, water. Some of these users include agricultural interests, environmental interests, and urban interests with agricultural interests having the largest share of resource allocation. In times of drought the allocations to each user make it difficult to obtain the water necessary to grow a crop, meet environmental concerns, and fulfill urban interests. Currently a market-mediated system that allows these competing users to temporarily transfer (lease) water is not in place. In order for such a system to function properly it is important to understand the factors that influence agricultural water demand for crop production as they have the largest allocation. This research utilizes experimental methods through a double auction that allows participants to voluntarily submit bids and offers for acre-feet of water to the marketplace. Functions for cash crops and capital crops are developed, where capital crop farmers are modeled to be growing pecans and cash crop farmers are given the choice between alfalfa and chili to be planted at the start of each growing season. Twelve experiments have been conducted under four different climatic scenarios. The model yields results on the price per acre-foot of water traded along with income gains and losses to each participant through voluntary market participation while at the same time tracking water movement around the river system. The results show that participants effectively take on the role of their assigned user and they are able to comprehend the cognitive complexity of trading under different climatic scenarios in a sophisticated decision process.

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COLLABORATIVE RESTORATION EFFORTS IN THE MIDDLE RIO GRANDE BOSQUE

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Presentation Abstract 10

This talk will be focused on the Middle Rio Grande restoration efforts currently being undertaken by the U.S. Army Corps of Engineers in collaboration with the Middle Rio Grande Conservancy District, City of Albuquerque, and New Mexico State Parks Division. The Corps, along with its stakeholders, has developed ecosystem restoration concepts and potential educational and recreational enhancements for the bosque (cottonwood riparian woodland) as part of the Middle Rio Grande Bosque Restoration Feasibility Study. This project is part of a comprehensive program to restore the Rio Grande river corridor as it winds through the City of Albuquerque.

The presentation will provide an overview of this project and others in the Albuquerque Reach of the Middle Rio Grande, which are described in greater detail on the project website – www.bosquerevive.com.

Other projects within the District boundaries working on removing non-native vegetation will also be discussed.

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BRACKISH GROUNDWATER IN SHALLOW ALLUVIAL AND BEDROCK AQUIFERS—AN UNTAPPED WATER RESOURCE IN MANY RURAL AND SUBURBAN AREAS OF NEW MEXICO

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Presentation Abstract 11

Recent development by New Mexico State University researchers of a "low-cost, low-energy desalination process" that "can convert saltwater to pure drinking water" for domestic use requires a new assessment of brackish groundwater resources in shallow alluvial and bedrock aquifers in many rural and suburban areas of New Mexico (see 2007 news release by Karl Hill in the NMWRRI Divining Rod, v. XXX, no. 2). Heretofore water-desalination at various scales has required processes, such as reverse osmosis or electrodialysis, that require relatively large amounts of energy and costs of saline-groundwater purification at a "household" scale have commonly been prohibitive. Of primary interest here are slightly saline and moderately saline groundwater classes, with qualities in the 1,000 to 6,000 mg/L tds range.

Our preliminary evaluation of shallow brackish-groundwater sources, many of which are still untapped, is limited to alluvial aquifers in valleys of larger intermittent-stream systems and some local bedrock aquifers in intermontane-basin and/or river-valley hydrogeologic settings. Large saline-spring systems may also be significant resources in some areas. The very important topics of concentrate management and development of deep alluvial and bedrock aquifer systems are not covered in this paper.

With respect to alluvial-valley fills, important target aquifers include those in the lower valleys of the Rio Puerco (East and West), Chaco River, Jemez Creek, Galisteo Creek, and the Mimbres River. Very significant bedrock aquifer systems occur in the valleys of the Pecos River and its major tributaries below Colonias, the eastern Estancia Basin, and the northern Tularosa Basin.

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HYDRUS SIMULATIONS OF SOIL SURFACE TEMPERATURES

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Presentation Abstract 12

In recent years thermal infrared (TIR) imaging has come in focus as a promising technique for the detection of landmines and other unexploded ordinance. The advantages of thermal IR sensing over other techniques are its ability to detect mines from longer ranges and to scan large areas at once. Since the penetration of optical wavelength electromagnetic radiation in soils is marginal, TIR can only image soil surface temperatures Tsfc. Potential landmine thermal signature at the surface (LTS) depends on differences in transportation and storage of heat. The LTS at the surface is a complex interplay between a number of factors. Soil texture and water content control the thermal conductivity and volumetric heat capacity of the soil overlying and surrounding the landmine. The thermal properties and burial depth of the landmine also play a role in the LTS. The situation becomes more complex as a result of the diurnal and annual heat flux cycles that drive the transport of heat to and from the surface. The strength and the phase shift of the LTS are also affected by the thermal properties of land mine and soil and by the burial depth of the land mine. To examine soil surface temperature evolution, a soil heat and water transfer model (HYDRUS-1d) is coupled to an atmospheric surface layer scheme. Idealized simulations are carried out for different meteorological conditions (wind speed and temperature). From the simulation results, the coupling between soil properties, surface temperature, and sensible heat flux is examined, and implications for landmine thermal signatures are derived.

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INTERCOMPARISON OF SENSIBLE HEAT FLUXES MEASURED BY LARGE APERTURE SCINTILLOMETERS

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Presentation Abstract 13

Accurate quantification and mapping of sensible heat fluxes from remote sensing algorithms is a major challenge for hydrologic sciences. Since large aperture scintillometers measure sensible heat fluxes over distances of 500 to 5000 m, they hold much promise for the validation of sensible heat flux maps derived from optical Landsat and MODIS images. For such validation studies it is critical to know the accuracy of sensible heat fluxes measured by different scintillometers. Therefore, two field studies were performed in New Mexico along nearly identical adjacent transects, with a total of six large aperture scintillometers (LAS)'s. The random errors in LAS measurements are very small since correlation coefficients between adjacent measurements are on the order of 0.99. However, regression slopes between sensible heat fluxes measured with different LAS's indicate significant inter-instrument differences on the order of 10% with individual regression slopes ranging from 1.02 to 1.18.

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USE OF LANDSAT 5 TM IMAGERY FOR IMPROVED DISTRIBUTED HYDROLOGICAL MODELING

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Presentation Abstract 14

Remotely sensed imagery is a useful source of spatiotemporal data for hydrologic models. However, the input datasets used in hydrologic models typically lack spatiotemporal variations. Remote sensing can be a mean to obtain model inputs of time-varying surface characteristics, such as land cover and also to test the model predictions as various products provide indirect measurement of hydrologic properties. The goal of this project is to estimate land surface characteristic parameters such as albedo and vegetation fraction from Landsat imagery and incorporate them into distributed hydrologic model (tRIBS, TIN-based Real-time Integrated Basin Simulator) for the 2005 monsoon season in Valles Caldera National Preserve. This project will also estimate a qualitative soil moisture index from Landsat imagery using a relationship between the observed surface temperature and vegetation indices (NDVI) for testing of the model predicted soil moisture. Landsat imagery of May, July, August, and September are acquired for this project. The albedo is estimated using all visible and short wave spectral bands except the green band, while the vegetation fraction is obtained using NDVI and a damping coefficient. The multi-temporal analyses of albedo and vegetation fraction indicate the temporal change in albedo and vegetation fraction for different land cover units during monsoon season. We directly incorporate the time-variable spatial fields of albedo and vegetation fraction into the tRIBS. The hydrological model simulations will be compared against the stage data at Redondo and La Jara Creek, as well as to the soil moisture estimated by fieldwork during late July of monsoon season.

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SOL-GEL DERIVED MESOPOROUS ADSORBENTS FOR FLUORIDE REMOVAL FROM DRINKING WATER

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Presentation Abstract 15

One of the most serious problems along the U.S.-Mexican border is the lack of access to adequate quality drinking water. The groundwater from wells in Columbus, NM and Palomas, Mexico border region contains significantly high levels of fluoride and arsenic that could potentially cause many serious diseases for the residents, especially young children in this border region. There is an urgent need for purifying the drinking water supplied by the municipalities to protect the health of the residents in this area. MnO_2 and CaO were used to modify the sol-gel derived alumina to enhance its adsorption for fluoride. Kinetics studies were performed on industrially available alumina, pure sol-gel derived alumina, and MnO_2 and CaO doped alumina adsorbents in batch/constant concentration adsorption experiments. An adsorption kinetics diffusion model was established to describe the experimental data. The fluoride adsorption kinetics was found to be dependent on the sample concentration, favoring MnO_2-AA. The adsorption of fluoride on the sol-gel derived adsorbent can be described by a Freundlich type of adsorption isotherm equation. The estimated effective pore diffusivities of fluoride in the MnO_2-AA and fluoride in the CaO-AA are 4.5x10-7 cm^2/s and 4.3x10-7 cm^2/s, respectively. These values are about 10 times higher than the effective pore diffusivities of fluoride in the pure sol-gel derived alumina.

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WATER TRANSPORT THROUGH THE VADOSE ZONE AND SHALLOW GROUNDWATER RESPONSE FOLLOWING FLOOD IRRIGATION

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Presentation Abstract 16

Deep percolation from surface irrigation may be important for groundwater recharge in irrigated corridors. In 2004, a study was initiated to measure and simulate flood irrigation seepage effects on shallow groundwater levels in an alfalfa-grass crop field with Fruitland sandy loam soil. The study site is at the NMSU-Alcalde Sustainable Agriculture Science Center, located in the agriculture corridor between the Alcalde main irrigation ditch and the Rio Grande in northern New Mexico. Results from ongoing research show good agreement between field-measured and simulated deep percolation. Currently, this research effort has been expanded by including three pairs of infiltration plots in three different soil types, Fruitland sandy loam, Werlog clay loam, and Abiquiu-Peralta complex. The 12 m by 12 m infiltration plots overlie an aquifer that ranges from 1.5 m to 4 m deep depending on distance from the river. Two experimental wells per plot were installed and instrumented with water level loggers for measuring water level response following flood irrigation. Also, soil moisture and temperature sensors were installed every 50 cm all the way down to the water table for capturing the wetting front movement through the soil profile. The end result will be to calculate a water balance for the three different soil types under different levels of irrigation and to estimate the return flow from the different soil type-irrigation amount combinations. Field-measured data will be compared to simulated results obtained by using Hydrus-2d to determine if it is possible to expand local results to the entire irrigated corridor.

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COMPARISON OF WATER USE AMONG CROPS IN THE TEXAS HIGH PLAINS ESTIMATED USING REMOTE SENSING

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Presentation Abstract 17

Identification of suitable cropping systems is important for efficient use of limited irrigation water resources. Suitability of crops can be determined based on their water use. On regional scale, water use can be estimated through a combination of remote sensing and crop modeling. In this study, daily and seasonal water uses for the major cropping systems in the Texas High Plains were determined during the 2006 and 2007 growing seasons. Remote sensing data used to estimate water use in this study were obtained from Landsat and high-resolution airborne multispectral imagery. Vegetation indices determined from remote sensing data were used to estimate crop ground cover. Ground cover was used in place of conventional crop coefficients in estimating crop water use from potential evapotranspiration. Remote sensing estimates of crop ground cover were tested against ground based measurements obtained in the field. Eddy covariance measurements of evapotranspiration made in the field were used to test the accuracy of this approach.

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RELATING FISH ABUNDANCE AND CONDITION TO ENVIRONMENTAL FACTORS IN DESERT SINKHOLES

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Presentation Abstract 18

When relating fish populations to environmental variables, numerous studies have utilized a multiple-lake approach. These studies have largely been performed in north-temperate locations. Although some multi-lake studies have been conducted on tropical lakes, information on other warmwater fish communities, like desert species, is lacking due to scarce water resources and the rarity of multiple lakes within a relatively confined geographic region. We hypothesized that fish abundance is primarily determined by abiotic factors, as these can have extreme values in desert environments. We investigated abundance (mark-recapture and catch-per-unit-effort estimates) and condition (length-weight relationship) in 23 sinkholes in New Mexico and correlated those factors to physical, chemical, and biological factors. The sinkholes are located within a few square kilometers on Bitter Lake National Wildlife Refuge and provide habitat for 6 native fish species. Despite their proximity, the sinkholes differ greatly from each other in terms of abiotic factors. For example, total depth varies between 0.5 and 15 m, Secchi depth lies between 0.25 and 4 m, and salinity between 4 and 120 ppt. Using regression analyses, we found that fish abundance and condition are primarily influenced by biological factors, particularly the presence of other fish species and chlorophyll a.

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SPATIAL VARIABILTY OF HILLSLOPE VERTICAL PROFILE AND ITS EFFECT ON RUNOFF GENERATION MECHANISMS: IMPLICATIONS FOR LAND SURFACE MODELS

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Presentation Abstract 19

Lumped hydrological models (e.g., VIC) calculate the runoff produced in a river basin using a physical representation of the hillslope vertical processes (infiltration, changes in soil moisture, evaporation, deep percolation, etc.). These models use the underlying assumption of spatial homogeneity amongst hillslopes. However, the homogeneity assumption is rarely valid, and modelers are forced to use "effective parameters" that represent the aggregated response of the ensemble of hillslopes present in the basin. In this paper the role of spatial variability of the landscape-forms on runoff production via saturation excess overland flow (SOF) during large intensity storms was studied by analyzing runoff hydrographs at three scales: (i) hillslope scale (~0.05 km^2), (ii) the catchment scale (~20 km^2) and (iii) the basin scale (~100 km^2). Numerical simulations were conducted using the sub-hillslope physically based tRIBS model to determine the level of non-linearities introduced by the spatial variability found in real landscapes. Also, idealized elevation models, with controlled landscape forms (concavity), were created to test the potential of the hypsometric curve as an indicator of the system's aggregated response. This research shows how a better understanding of the micro-scale physical processes can lead to better formulations of lumped models, and better understanding for their capabilities and limitations.

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COMMUNITY AND ECOSYSTEM EFFECTS OF COMPETITION BETWEEN NATIVE AND NON-NATIVE FISHES IN AN INTERMITTENT CHIHUAHUAN DESERT STREAM

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Presentation Abstract 20

Intermittent streams of arid to semi-arid lands have isolated pools that are important refugia for fishes during seasonal drought, but non-native species can compete with natives in these habitat patches and complicate species conservation. We investigated interactions of non-native longfin dace (*Rhinichthys chrysogaster*) with two native species of concern, Rio Grande sucker (*Catostomus plebeius*) and Rio Grande chub (*Gila pandora*), in Las Animas Creek, New Mexico, during summer intermittency. Two replicated enclosure experiments (*R. chrysogaster* vs. *C. plebeius*; *R. chrysogaster* vs. *G. pandora*) were conducted in pools isolated by dry streambed. Each experiment included three treatments with an equivalent biomass of one or two species and a control with no fish. Lengths and weights of fish were measured and benthic samples of invertebrates, periphyton and detritus were collected pre- and post-experiment, 28 days later, to evaluate direct and indirect effects of competition. Both native species had reduced growth and elevated mortality in enclosures with longfin dace. Reductions in abundance of invertebrates and biomass of periphyton and detritus were affected more by longfin dace than either native species. Interactions between longfin dace and the native fishes appeared to favor the non-native. Longfin dace affected community and ecosystem properties of the isolated pools, which affected their capacity as refugia for the native fishes during seasonal drying. Successful restoration of the native fish assemblage will likely require complete removal of longfin dace.

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RESIDUAL MAINTENANCE AND REMOVAL OF BIOFILMS USING MIXED OXIDANTS

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Presentation Abstract 21

The US EPA requires a chlorine residual to be maintained in potable water systems in order to prevent recontamination within the distribution system. This residual can be challenged by excessive distances, long detention times, and build-up of oxidant-demanding organic matter in the lines. Common solutions include combining ammonia with chlorine to form chloramines for a longer-lasting total chlorine residual, dosing very high levels at the plant in an attempt to maintain sufficient residual in distribution, or installing chlorine booster stations down the line for additional chlorine injection. All of these alternatives have drawbacks.

Another disinfection technology gaining popularity is the on-site generation of mixed oxidants with over 1,400 installations to date. Mixed oxidants are able to maintain a higher chlorine residual in distribution than provided by traditional chlorination technologies, even at a lower free available chlorine (FAC) dose. The FAC residual with mixed oxidants is very durable, lasting for miles beyond the residual maintained by traditional chlorine technologies and over extensive periods of time. This phenomenon is tied to removal of oxidant-demanding biofilms that are resistant to traditional chlorine disinfection but are readily killed by mixed oxidants. A side benefit of using mixed oxidants at a lower FAC dose is the associated reduction in DBPs such as TTHMs and HAA5.

Various site examples experiencing these phenomena would be presented, along with the scientific explanation for the observed improvements.

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FIELD VERIFICATION OF A LANDSAT-BASED ANALYSIS OF IRRIGATED ACREAGE IN SOUTHERN NEW MEXICO

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Presentation Abstract 22

New Mexico Governor Bill Richardson has funded a series of innovative water projects intended to advance solutions to water supply and quality problems throughout New Mexico under his Water Innovation Fund program. INTERA was awarded a grant to apply a remote-sensing based method to evaluate irrigated acreages and agricultural water use in Southern New Mexico. This project meets a specific goal outlined in the New Mexico State Water Plan (Plan), which is to apply remote sensing technology for the purpose of water accounting, management, and conservation. The New Mexico Office of the State Engineer (NM OSE) and the New Mexico Interstate Stream Commission (NM ISC) published the Plan on December 23, 2003. One of the implementation strategies is to acquire "…the technology and scientific tools necessary for efficient administration and management." Specifically, the Plan calls for development of "consistent standardized remote sensing technologies."

This project involved applying and refining a remote-sensing-based method developed by the NM ISC and performing an accuracy assessment of the method using crop data collected in the field during the active growing season, which were compared against remotely-sensed data. In addition, statistical relationships were developed between a remote-sensing-derived vegetation index and more traditional measures of crop growth and consumptive use, namely crop coefficients and crop evapotranspiration (ET).

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WATER RESEARCH RESOURCES IN THE NEW MEXICO STATE UNIVERSITY LIBRARY, ARCHIVES AND SPECIAL COLLECTIONS DEPARTMENT

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Presentation Abstract 23

Scientists and researchers alike will greatly benefit from available resources for historical research in the NMSU Library, Archives and Special Collections Department. Since 1972, one of our specific areas of interest has been collecting in the areas of water resources management. Much of our local history and the success of our local economy are based heavily on the use of water both in agriculture and business.

Our goal is not only to collect materials and records documenting this area, but also to make this material available to our wide array of research constituent - from the citizen researcher to the veteran research scientist.

It is the purpose of this session to offer discussion on what collections we have available and how they may be accessed in the department. Along with the records and papers of these organizations such as the Zuber Draw Watershed and Elephant Butte Irrigation District, the department has some 500,000 images documenting the visual history of the area, including many of the early images of water irrigation in the area. In addition, we have a number of maps and land surveys documenting the history of water in this area.

Interested researchers will enjoy knowing what is available to aid in their continued professional interest.

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GIS MODELING OF BRACKISH AND SALINE GROUNDWATERS OF THE PERMIAN BASIN, NEW MEXICO

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Presentation Abstract 24

Brackish and saline ground waters are becoming a viable resource for both commercial use and human consumption. One source of unused brackish groundwater is produced wastewater from the oil and gas industry. The handling of this waste incurs additional cost to the oil and gas industry due to the re-injection into non-productive aquifers. When fresh ground and surface waters are exhausted, these produced waters along with natural saline/brackish groundwater will be needed. In the Permian Basin of southeastern New Mexico, these waters are currently being investigated for aquaculture—the growth of saltwater algae to produce bio-diesel, return flows to the Pecos River, and a source of commercial salt.

This study will employ geostatistical and deterministic modeling techniques, through the application of Environmental Science Research Institute (ESRI) ArcGIS 9.2 software, the extent of both the brackish (10K to 30K total dissolved solids (TDS)) and saline (>30K TDS) extrapolated from specific conductivity data of the Permian Basin within Eddy and Lea County, New Mexico. A depth to groundwater model will also be produced using the same modeling techniques.

Data to support this project is acquired from the Petroleum Recovery and Research Institute and the U.S. Geological Survey-Water Resource Division. This data is manipulated from text delimited files brought into x,y tables and converted to raster layers using geographical information system (GIS) tools. The layers are modeled to produce representative water quality surfaces through inverse distance weighting and kriging modeling techniques. Other geostatistical and 3D GIS analyses will be reviewed and evaluated to determine those that best represent these groundwaters.

Based on the kriging model, saline and brackish groundwaters are aerially extensive at a wide range of total dissolved solids to support aquiculture and commercial salt production. This groundwater will require an economical desalinization process to be a viable resource for both return flows and beneficial use.

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FUEL REDUCTION TREATMENT EFFECTS ON ECOHYDROLOGY IN A SEMIARID WOODLAND

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Presentation Abstract 25

Mechanical fuel reduction treatments are increasingly used to reduce hazardous fuels and improve forest health within wildland-urban interface areas. However, effects of various techniques on the ecology and hydrology of Southwestern woodlands are largely unknown. In many projects, biomass resulting from the thinning is chipped and applied as mulch to the treated area in an effort to promote reestablishment of herbaceous cover and as an efficient method of disposal.

I will present preliminary results of an investigation of soil and vegetative responses to a fuel reduction treatment within piñon-juniper woodlands in central New Mexico. Using paired plots in mulched and un-mulched patches, I measured vegetation changes over one year following a thinning project. Continuous measurements of precipitation, soil moisture, and soil temperature were collected using in-situ sensors. Observed differences in soil moisture and temperature patterns indicate that woody mulch significantly alters growing conditions in this water-limited ecosystem and may affect vegetation patterns and local hydrology over time.

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Presentation Abstract 26

WITHDRAWN

WHAT'S GOING ON WITH THE DATA? AN ANALYSIS OF METEOROLOGICAL DATA QUALITY IN THE MESILLA AND RINCON VALLEYS OF NEW MEXICO

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Presentation Abstract 27

Automated weather stations located throughout the Mesilla and Rincon valleys of New Mexico present a unique opportunity to study localized weather and climate variations due to the varied topography of the region. Information provided by these stations is used in many applications that include crop/plant water use modeling, agricultural research, pest management, and many other types of decision making. These weather stations are owned and operated by multiple agencies and/or individuals all of which may have different siting requirements, sensors, data processing algorithms, maintenance schedules, documentation, data formats and communications, and data retrieval. Because the data provided by these stations are widely distributed via the internet for many different types of users, it is important to identify and document these differences and their implications for data quality and management decisions. In an effort to begin this process, weather station locations in the Mesilla and Rincon valleys were mapped to determine their spatial representativeness and key meteorological variables were compared to identify data quality issues.

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VADOSE ZONE FLUID FLOW IN THE SUGAR SHACK SOUTH ROCK PILE AT MOLYCORP, QUESTA, NEW MEXICO

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Presentation Abstract 28

A number of temperature logs have been made in drill holes in the waste rock piles at Molycorp, Questa, New Mexico. These temperature data are typically in the vadose zone and are interpreted to estimate thermal sources and fluid flow in the rock piles. At the Sugar Shack South rock pile, the temperature logs show a large temperature source probably due to heat generated by pyrite oxidation. Highest temperatures are recorded at depths coincident with zones, indicating clay sample coloration suggestive of pyrite oxidation. The highest temperature measured along Sugar Shack South was about 75^{o}C at about 150 ft depth. This generated heat appears to be advected, most likely by a considerable vapor flow of magnitudes suggested at other rock piles around the world. Observations of vapor discharge from the ground at a number of locations support the suggestion of vapor heat transport. Curvatures in the temperature logs are fitted by expressions from which estimates of possible vertical and/or horizontal vapor flows are calculated; these vapor flow estimates are of the magnitude of 10-100 m/day. The flow pattern in the rock pile appears to be quite complex with in-homogeneities smaller than the distance between the drill holes. From general flow considerations along and normal to the uphill profile it appears that three-dimensional flow is quite possible.

Disclaimer: Any opinions, findings, and conclusions or recommendations expressed are those of the author and do not necessarily reflect the views of Molycorp.

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