benefits of increased pumping with the costs of decreased spring flow.

H61A-0752 0830h POSTER

Evaluating Wetlands Sustainability Using a Hierarchical Systems Approach

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A hierarchical systems analysis approach, using Geographical Information Systems (GIS)software, is used to integrate and assess the different types of data necessary to characterize the surface and ground-water system as it pertains to the wetlands environment within the landscape context. This hierarchical approach was applied to the Cucumber Gulch wetlands complex, located near Breckenridge, Colorado.

The Cucumber Gulch watershed is currently being studied for proposed expansion and development of the existing Breckenridge ski area. The delineated wetland complex is a jurisdictional wetland and is protected under section 404 of the Clean Water Act. The proposed development has the potential to impact the wetlands complex.

The various data integrated through the hierarchical systems analysis include climate, topography, geomorphology, geology, vegetation, hydrology, and anthropogenic influences to the natural system. A three-dimensional solid computer model of the surface and sub-surface geology was constructed. Through analysis and integration of these various layers, the surface and ground-water hydrological framework and flow models were developed and calibrated. Throughout the process the ground-water modeling performed to assess the sustainability of the wetland was reconciled with the hydrological framework developed from the "soft" data layers, and with the hydrologic system conceptual model developed from the hierarchical systems analysis.

This hierarchical systems approach to modeling provided the Town of Breckenridge with means of assessing the validity of the computer models and potential impact to the wetland complex. Computer modeling was continually refined in response to this process.

H61A-0753 0830h POSTER

Evaluation of the Field Water-bearing Potential Using Geophysical Methods

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There are about 16 villages and the center of the district itself, Bilishti, in the Devolli field with a developed agricultural economy. The actual demand for drink and irrigation water has been considerably increased. As the existing irrigation system is damaged and outdated, it is necessary to have an evaluation of the water-bearing potential of the Quaternary formations of the Devolli Field. These formations are composed of various layers such as clay, sandy clay, sand, coarse-grained sand and gravels. Electrical soundings in a grid of 500 x 500 m and 250 x 250 m have been carried out in an area of 100 km2 to evaluate the water-bearing-potential. Their location along with the geological map is shown in Fig.1. Their interpretation shows that the Quaternary formations thickness varies from some meters to 150 m at the center of the valley. It is shown in Fig.2. It has been made possible to distinguish different layers of various composition and non-homogeneous thickness composing the Quaternary formations, (Figs.3,4,5) but we have been mostly focused on the water-bearing coarse-grained sands and gravels, of higher thickness and consistency. This may help to plan an effective grid of holes to take out water. The history of the Devolli River beds formation during the Quaternary period is treated in this poster as well. This information has been obtained both from the traces of the river beds (which have often changed) and electrical soundings.(Fig.6) We can conclude that the results of the electrical soundings show that there are some waterbearing layers at different hypsometric levels. Two of them are the most important: (Figs.3.4) 1. The uppermost Upper Quaternary sand-gravel formations. 2. The deeper (but almost of the same composition) layer of the Q1 - Q2 formations.

The poster is composed of the explanatory text and six illustrating figures,

H61A-0754 0830h POSTER

Geostructural,Geomorfic and Hydrological Studies at Butrint Region

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During ten last years, there was observed a great interest for the ruins of ancient Butrint which is a world-known archaeological site. Inhabited since prehistoric times this region is now in the focus of our general opinion for its ecological, its heritages and tourist potential, water resources and fishing economy. From 1995 year of special interest are geophysical studies carried out in this area in the framework of integrated geological, archaeological and hydrogeological studies. Throughout its long history, Butrint had an interactive relationship with its hinterland and the even-changing coastline. The geology of Quaternary formation, from late to date, connected with neotectonic phenomena in that area developed intensively during Plioquaternary, the Lake as a tectonic origin, delination of the horizontal and vertical extend of the gravel reservoir and the estimation of water bearing reservoir are some goals of that study. The studies of Quaternary deposits evidenced both the sedimentologic evolutions during the Pleistocene time in which had been occurred sea, lacustrine and fluvial depositions. Histories of terrestrial erosion, near-shore sediment redistribution, times, magnitudes of sea level fluctuations, subsidence and compaction, land-sea interaction are obvious now. Up to now geophysical observation consist of vertical electric soundings (V.E.S.) with a grid 500x 250m and magnetic measurements inside a layout of 20 km2 at Vrina plain. The soundings data, particularly resistivity variations are the base for sedimentologic studies due to the lack of boreholes. For a gravel deposition, in addition to the usual parameter maps as resistivity and thickness maps, combined multiparametric characterization maps have been plotted. These maps are more application on hydrogeologic domain than conventional parameter maps.Based on the sedimentologic and structural factors studied and geophysical maps and cross-sections , plenty of geomorphic problems are obvious now. The evaluations of the regional water bearing are estimated, separating salty waters area. Preliminary research suggests that in the Holocene the lake was a sea inlet which stretched 20 km to north of Butrint, as for as the city of Foinike, later Epiriot capital. Today the Lake is just 7.5 km long, being the result of the gradual silting up of this inlet with soils brought down by Bistrice and Pavlo rivers from the surrounding mountain ranges. Geomorphologic studies show the evidence to the advancement of the coastline is still occurring and the shoreline is still on the move. SEV data are used for compiling of the 100m shallower structure map in the Vurgu and Vrina fields, located in North and South of Butrint Lake. According to specific resistivity the depth interval of 0-100 m shows the great lateral and vertical diversity. Changes in bedding in the basin can be featured by the maps representing mean electric resistivity values weighted by the thickness of the respective beds. These series illustrates mean electric resistivity distribution of beds in three depth interval (10, 30, 80 m).

H61B MCC: Hall C Saturday 0830h

Observations and Modeling of Land Surface Hydrological Processes I Posters *(joint with GC)*

Presiding: **V Lakshmi,** University of South Carolina**; T Cahill,** Texas AM University

H61B-0755 0830h POSTER

Drought and Fire Effects on Evapotranspiration From Sawgrass in Florida

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Drought and fire are recurring natural processes in the extensive sawgrass (*Cladium jamaicensis*) marsh areas of Florida. An understanding of the effects of these processes on evapotranspiration (ET) is critical for evaluation of the hydrologic flow system. ET fluxes were measured using eddy correlation techniques for a two-year period (2000-01) at a site within a sawgrass peat marsh in east-central Florida before, during, and after two droughts. During the second drought, wildfires consumed the sawgrass canopy at the field site. The impact of these droughts and the fire on ET are most easily described through the use of a value of ET normalized for the available radiant energy the evapotranspirative fraction (EF).

The impact of drought on the EF was dependent on the annual life cycle of sawgrass. During the growth stage (spring-summer), EF (averaging about 80 percent) apparently was independent of the water table depth and ET was unaffected by drought conditions. During senescence (fall-winter), EF dropped to as low as 40 percent as the water table declined. Apparently, during the growth stage, root growth allows sawgrass to seek soil moisture, thus preventing moisture limitation on ET during droughts, despite a declining water table. However, during senescence, the absence of vigorous root growth prevents sawgrass access to moisture deeper in the soil profile as the water table declines. In addition, the density of green, transpiring leaves decreases as partial browning of the canopy occurs. The non-expanding root distribution and reduction in green leaf density during senescence reduces the fraction of available energy consumed as ET and increaseds the fraction that generates sensible heat flux from the canopy.

A fire in the study area in February 2001, following three months of drought, removed the sawgrass canopy, but spared the roots. Sawgrass sprouts appeared within a few weeks and the canopy reached a height of two meters within six months of the fire. Despite a continuation of the drought for almost five months after the fire, EF increased from a pre-fire value of about 40 percent to a value of about 90 percent within three months after the fire. The increase in EF can be attributed to the burn-stimulated transition from senescence to growth stage and the associated development of a green canopy, largely free of non-transpiring, dead biomass.

H61B-0756 0830h POSTER

Development and Testing of a Model to Assess Subsurface Moisture Gradients From Diurnal Surface Temperatures and Soil Thermophysical Properties

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A one-dimensional, finite difference coupled heat and moisture transfer model for unsaturated zone porous media flow has been developed and tested. Inputs to the model include soil surface excursions, site topography, meteorological data, and detailed information about the soil thermophysical and hydraulic properties. Assuming homogeneity or knowledge of the stratification of the soil column and steady-state conditions (i.e. no recharge), the output is a profile of moisture gradients in the subsurface extending to the depth of diurnal fluctuations of moisture. This model primarily differs from existing one-dimensional heat and transport models in its incorporation of the 3-dimensional topography and diurnal shadowing of the study site and in its ability to provide information about relatively deep moisture profiles. These profiles are produced through the assumption of a moisture source (a water table or pseudo water table) at a given depth. The model was subject to sensitivity analyses and was calibrated in August 2002 in the Kau Desert, Hawaii, in an unvegetated area with layers of high moisture content in the subsurface. Field work consisted of 24 contiguous hours of monitoring soil surface temperature, meteorological data, and moisture content at several depths of the soil profile. Thermal conductivity of the soil was determined in situ, and field saturated hydraulic conductivity was determined with a Guelph permeameter. The other thermophysical and hydraulic soil properties of interest (specific heat, moisture retention curve, bulk density, porosity, grain axes, and van Genuchten parameters) were determined through laboratory experimentation. Results from the calibration exercise will be presented.

H61B-0757 0830h POSTER

Scaling Effect on Distributed Modeling

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Interests in simulating large-scale hydrologic processes in the climate and hydrology studies prompted the question: what is an appropriate grid scale for the simulation and what is the scaling effect on the simulation? A fine-scale hydrologic model interactively coupled with regional and climate models was used to examine such a scaling effect in the climate and hydrology simulation of North America. The study was conducted in three different size basins (7.3 km^2, 14,710 km^2, and 2957,806 km^2). The scaling effect on the simulation in three basins was evaluated. The results provide information how we can compensate such a scaling effect for the simulations conducted at different scales.

URL: http://hydro.nevada.edu

H61B-0758 0830h POSTER

Estimating Sediment Transport Conditions in the Cosumnes River Drainage Basin From Suspended Sediment Loads

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The purpose of this study was to monitor and assess the variability of suspended load with respect to discharge and stream dynamics within the Cosumnes River drainage basin. Examination of suspended loads in river systems helps to characterize both the erosion and deposition mechanisms acting within the sediment delivery system. The suspended sediment load is dominated by material eroded from a variety of sources within the upstream basin, and the nature and location of the source influences the character and behavior of the load. Over a ten-month period, water samples were collected from sites along the Cosumnes River in the Sierra Nevada foothills and in Rancho Murieta, California. Samples were processed for suspended sediments and correlated with discharge at the Michigan Bar gaging station. In the foothills east of Sacramento, precipitation usually occurs from late fall through the spring. The amount of water in the channel is affected by infiltration capacity of the ground, and runoff related to frequent precipitation events. Suspended load varies with respect to stream discharge dynamics and sediment supply within the Cosumnes River drainage basin. Histograms show the modal average annual discharge for the Cosumnes River at the Michigan Bar gaging station to be 200-400 cfs, moving 1-3 tons of suspended sediment per day. Discharges of 200-400 cfs produce a modern denudation rate of .01-.03 cm/1000 years for the Cosumnes River drainage basin. Based on slip rates of faults along the Frontal Fault System, the present uplift rate of the Sierra Nevada mountain range is 0.5-3 mm/year. Historical records show that the discharge during the sampling period was significantly lower than average. Suspended sediment yields increase with increased discharge, yet remain quite variable. High discharge events are responsible for most of the erosion and transport of suspended sediments within the Cosumnes drainage basin.

H61B-0759 0830h POSTER

A Mesoscale Study of the Role of Snowpack in Climate Variability and Water Resources Over the Sierra Nevada Region

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The Penn Sate-National Center for Atmospheric Research fifth-generation Mesoscale Model driven by a 6-hourly reanalysis dataset from the National Centers for Environment Prediction has been used to study the impact of snowpack on climate variability and water resources over the Sierra Nevada region. The analyses on a one way 48km-12km nested model run during the 1998 snowmelt season (April - June) showed that the underestimated snowpack produced a strong warm bias at the surface and low level atmosphere, which strengthened the convective precipitation, and dried streamflow in the region. An observed daily snowpack dataset collected from the automated Snowpack Telemetry system was assimilated in the model to improve its performance. The results showed that the assimilation processes greatly reduced the warm bias because the tremendous amount of energy used to increase the temperature in the original model run was consumed by snowmelt. Meanwhile, the increased surface albedo that resulted from the assimilated thicker snowpack played a secondary role in the temperature reduction. The cooled surface and low atmosphere led to a more stable simulated atmospheric structure, reduced the intensity of spring storms, and therefore, suppressed the exaggerated convective precipitation. Simulated runoff, based on the observed snowpack, also approached the observed runoff amounts within the model domain studied. Moreover, the origin of the simulated lower snowdepth and the model predictability on snowpack as well as the associated variables in the snowmelt season have been investigated through model sensitivity tests.

H61B-0760 0830h POSTER

Modeling Irrigation's Effect on Precipitation using RAMS

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Irrigation in the Texas High Plains represents an enormous hydrologic disturbance in central North America, with over 6 x 109 m^3 of irrigation water applied annually to an area of 16,000 km^2. Previous research has estimated that a 6% to 18% enhancement of summer precipitation is attributable to irrigation, with the maximum impact 90 km downwind of the irrigated region. This phenomenon can be explained by the increase in instability and latent heat flux caused by the irrigation water. Here we test this influence quantitatively through the use of a mesoscale circulation model (RAMS). Simulations of precipitation based on observed irrigation rates produce spatial precipitation patterns similar to observation. We examine what threshold in irrigation is necessary to significantly influence precipitation patterns by employing a series of simulations at various levels of irrigation, ranging from 10% to 100% of current application rates. We also present preliminary results from seasonal simulations that indicate the level of enhanced precipitation for an entire growing season.

H61B-0761 0830h POSTER

Modeling Basin-scale Runoffs with Precipitation Data from Ground-based Observations and Mesoscale Simulations

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The purpose of this study is to investigate the applicability of distributed basin-scale runoff modeling, driven by rainfall data from either ground-based observations or mesoscale simulations, in response to typhoons invading Taiwan. Typhoons Herb (1996) and Zeb (1998) were selected for calibrating the runoff parameters reflecting the landuse conditions in the basin and evaluating the applicability of observed and simulated rainfall data toward runoff estimations, respectively. Upstream basins of Reservoir Shihmen with a drainage area of 764 km2 and Reservoir Feitsui with a drainage area of 303 km2 were the domains of interest in this preliminary study. Ground-based observations of both stream flows and station rainfalls were collected in an hourly resolution. The mesoscale model,MM5, simulation for Herb was conducted in 4-nested grids with the finest resolution of 2.2 km and 2-nested grids with the finest resolution of 15 km for Zeb, and the time resolution for both cases was 5 minutes. Accumulated total rain was accommodated with terrain elevation in MM5 simulations and station data to provide areal rainfall distributions. While the ground-based observations were sparse and incapable of correctly representing areal rainfall characteristics, the MM5 simulated data may introduce great uncertainties in basin-scale hydrological applications. The experience learned from this study is expected to provide an applicable approach with both ground-based observations and mesoscale simulations in basin-scale runoff computations.

H61B-0762 0830h POSTER

Modeling Spatial and Temporal Patterns in Climate-Vegetation-Hydrologic Interactions in Fire-Dominated Semi-arid Shrublands

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In semi-arid regions assessing the combined effect of potential climate change and modified fire regimes on river flow characteristics is important for the management of water resources and associated ecosystem processes. This project is designed to explore the interactions between hydrologic regime, climate and post-fire vegetation recovery using both an existing, physically based hydroecological model (RHESSys) and post-fire LAI trajectories derived from TM-remote sensing imagery. Initial model assessment for a 34km2 chaparral dominated watershed (Jameson) near Santa Barabara, California. compares RHESSys predictions with 1) observed streamflow records, 2) LAI post-fire trajectories derived from TM-remote sensing imagery and 3) predictions from a second hydrologic model, MIKE-SHE. In this model assessment, we also examine the impact of the scale of terrain representation on streamflow and soil moisture predictions. By modeling both hydrologic processes and associated temporal and spatial variation in vegetation carbon dynamics, we explore the role that vegetation plays in mediating hydrologic response in these semi-arid environments. Results from this study suggest that RHESSys captures the major temporal patterns of monthly streamflow for a range of wet to dry years and accurately predicts mean basin LAI. Model estimates of spatial patterns of vegetation, however, are confounded by 1) fine scale heterogeneity in sparse canopies and 2) significant areas of exposed bedrock. We discuss strategies for adapting the model to deal with these issues.

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H61B-0763 0830h POSTER

Understanding the regional controls on stream temperature

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Stream temperature is an important indicator of stream health, especially in the Pacific Northwest where endangered salmon stocks require cool waters for successful spawning. Federal law specifies that seven day running average stream temperature for a healthy stream must remain at or below 16^oC. Determining the seven day average temperature requires the placement of in-situ measurement devices that can record or report temperatures at a sub-daily time step. Because stream temperatures are controlled by a number of factors including shading and groundwater recharge, the placement of measurement sites is important to the understanding of regional stream temperatures. Fifteen minute stream temperatures in the Soos Creek basin have been monitored for over three years by a sparse network of in-stream temperature dataloggers. More detailed surveys of single day temperatures have also been conducted in the basin over the last three years. Time series analysis and the detailed temperature surveys are used to identify reaches of interest in the basin. Geology and land use practice is then used to identify factors controlling stream temperatures in those reaches and to assess their importance. The knowledge gained for this study can improve the placement of loggers in this and other regional streams. For example, significant groundwater recharge has been identified in the lower part of Covington Creek, a tributary to Soos Creek. Water in the upper reaches of the creek is dominated by warm (greater than 20^oC) water released from Lake Sawyer. This cools gradually downstream due to significant shading of the creek, but temperatures remain elevated until just before the convergence with Soos Creek where the water cools suddenly by several degrees C. This region keeps downstream temperatures cool, allowing Soos Creek basin to support hatchery and other salmon stocks.

H61B-0764 0830h POSTER

Characteristics of the Spatial Distribution of Surface Moisture in an Eddy Flux Tower Footprint in Arctic Coastal Plain Ecosystems

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The objective of this study was to both determine the statistical nature of and map the spatial distribution of surface moisture within an eddy flux tower footprint located in an Arctic Coastal Plain ecosystem on the North Slope of Alaska. Knowledge of the spatial distribution of surface moisture within a tower footprint is important for understanding the influence of moisture differences on measured water, carbon, and sensible heat fluxes. In addition, this knowledge can be used to develop methods for representing distributions of surface moisture within hydro-ecophysiological models. The presence of permafrost, variable vegetation cover (vascular and non-vascular species), and the polygonal structure of Arctic Coastal Plain landscapes results in substantial heterogeneity in surface moisture. Slight changes in elevation (sometimes less than 1 m) within the eddy flux tower footprint can lead to substantial variations in surface moisture values with examples of volumetric water capacity varying from 15 to 80 percent over a distance of approximately 5 m. In this study, approximately 2700 measurements of surface moisture were made over a three-day period in August 2002 within an eddy flux tower footprint in Barrow, Alaska. Together with the surface moisture, GPS points were recorded in order to produce a spatially explicit map of surface moisture. Results indicate that the surface moisture (calculated as an average value over the top 5 cm of the moss/soil surface) over the entire footprint is normally distributed with an average moisture content of approximately 50 percent. Additionally, spatial patterns of vegetation were shown to closely follow the distribution of surface moisture at this site.

H61B-0765 0830h POSTER

Simulating Pan-Arctic Runoff With a Macro-Scale Terrestrial Water Balance Model

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A terrestrial hydrological model, developed to simulate the high-latitude water cycle, is described along with comparisons to observed data across the pan-Arctic drainage basin for the period 1980–2001. Gridded fields of plant rooting depth, soil characteristics (texture, organic content), vegetation, and daily time series of precipitation and air temperature provide the primary inputs used to derive simulated runoff at a grid resolution of 25 km across the pan-Arctic. The Pan-Arctic Water Balance Model (P/WBM) includes a simple scheme for simulating daily changes in soil frozen and liquid water amounts, with the thaw/freeze model (TFM) driven by air temperature, modeled soil moisture content, and physiographic data.

P/WBM-generated maximum summer active-layer thickness estimates differ from a set of observed data by an average of 12 cm at 27 sites in Alaska, with many of the differences within the variability (1 σ) seen in field samples. Simulated long-term annual runoffs are in the range 100 to 400 mm year^{-1}, with highest runoffs found across northeastern Canada, southern Alaska, and Norway. Lower simulated runoff is noted along the highest latitudes of the terrestrial Arctic in North America and Asia. Good agreement exists between simulated and observed long-term seasonal (winter, spring, summer/fall) runoff to the 10 Arctic sea basins ($r = 0.84$). Model water budgets are most sensitive to changes in precipitation and air temperature, while less affect is noted when other model parameters are altered. Increasing daily precipitation by 25 % amplifies annual runoff by 50 to 80 % for the largest Arctic drainage basins. Ignoring soil ice by eliminating the TFM sub-model results in runoffs which are 7 to 27 % lower than the control run. The spatial and temporal variability of freshwater export along continental margins is also explored. This flux represents a merging of simulated discharge and observed data. The results of model sensitivity experiments, along with other uncertainties in both observed validation data and model inputs, emphasize the need to develop improved spatial data sets of key geophysical quantities—particularly climate time series—to better estimate terrestrial Arctic hyrological budgets.

H61B-0766 0830h POSTER

Effects of projected climate change on ecosystem and hydrologic properties in the Big Thompson Watershed, Colorado: Model results from the Regional HydroEcological Simulation System (RHESSys)

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We ran RHESSys, a GIS-based, hydro-ecological modeling framework designed to simulate carbon, water and nutrient fluxes with observed and Global Climate Model (GCM) scenarios for the 42,000 sq. km Big Thompson Watershed in Colorado. RHESSys uses observed meteorology and GIS landscape partitioning layers as input. Three process models are coupled within RHESSys to simulate meteorology over topographically varying terrain, ecosystem canopy processes, and watershed hydrological processes.13% of the Big Thompson catchment is alpine rock and talus, 18% is alpine tundra, 66% is forested, and 3% is mountain meadow. RHESSys simulations using climate warming scenarios for mostly alpine catchments show strong changes in the timing of snowmelt, but they do not suggest large differences in stream discharge. In contrast, we show model results that suggest evapotranspiration in the largely forested Big Thompson watershed will cause greatly reduced discharge under CCC-type warming.

H61B-0767 0830h POSTER

Investigation of Meso-scale Land-Atmosphere Interactions Across the East-West Continental Precipitation Gradient: CASES in the International H20 Project (IHOP)

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As part of a continuing investigation of land-atmosphere interaction known as the Cooperative Atmosphere-Surface Exchange Studies (CASES), CASES participants joined with the International H20 Project (IHOP) to field a coordinated experimental design that combined aircraft, surface flux, and satellite measurement systems. We present an overview of the IHOP observations (13 May 22 June 2002, Kansas, Oklahoma, and Texas) in light of earlier investigations in the region (FIFE, CASES 97, CASES 99) and present some preliminary results. Among those results are clear indications of mesoscale gradients that persisted over the time of a flight pattern (4 h) and the replication of the CASES 97 finding of a persistent area of enhanced surface temperature associated with observations of enhanced sensible heat and moisture fluxes. We also present evidence of the connections and feedbacks between vegetation characteristics and surface- and aircraft-measured fluxes, and satellite measurements such as NDVI.

URL: http://www.joss.ucar.edu/cases/

H61B-0768 0830h POSTER

Modeling, Calibration, and Sensitivity Analysis of Coupled Land-Surface Models

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To better understand various land-surface hydrological processes, it is desirable and pressing to extend land-surface modeling from off-line modes to coupled modes to explore the significance of various land surface-atmospheric interactions in regulating the energy and water balance of the hydrologic cycle. While it is extremely difficult to directly test the parameterizations of a global climate model due to the complexity, a locally coupled single-column model provides a favorable environment for investigations into the complicated interactions between the land surface and the overlying atmosphere. In this research, the off-line NCAR LSM and the coupled NCAR Single-column Community Climate Model (NCAR SCCM) are used. Extensive efforts have been focused on the impacts that the coupling of the two systems may have on the sensitivities of the land-surface model to both land-surface parameters and land-surface parameterizations. Additional efforts are directed to the comparisons of results from off-line and coupled calibration experiments using the optimization algorithm MOCOM-UA and IOP data sets from the Atmosphere Radiation MeasurementCloud and Radiation Testbed (ARM-CART) project. Possibilities of calibrating some atmospheric parameters in the coupled model are also explored. Preliminary results show that the parameterization of surface energy and water balance is crucial in coupled systems and that the land-atmosphere coupling can significantly affect the estimations of land-surface parameters. In addition, it has been found that solar radiation and precipitation play an extremely important role in a coupled land-surface model by dominating the two-way interactions within the coupled system. This study will also enable us to investigate into the feasibility of applying the parameter estimation methods used for point-validations of LSM over grid-boxes in a coupled environment, and facilitate following studies on the effects that a coupled environment would have on the calibration, validation, and inter-comparison of land surface models.

H61B-0769 0830h POSTER

Modeling Turbulence Induced Skin Temperature Fluctuations of a Bluff-Rough Surface Using Surface Renewal Theory

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A recent analysis of high-frequency measurements of the skin temperature, T_S, of a grass surface by Katul et al. [WRR, 1998] reveals that atmospheric turbulence "imprints" its statistical signature on T_S. We present a model that relates the skin temperature of a homogeneous bluff-rough surface to the properties of a turbulent atmospheric surface layer . We extend Brutsaert [WRR, 1975] surface renewal theory by explicitly solving the diffusion equation in molecular sublayers on **both** sides of the air-surface interface. The resulting model for T_S is a linear stochastic differential equation driven by additive colored noise—the surface layer air

temperature, T_a. We demonstrate that T_s has a Gaussian, non-Markovian probability described by a Fokker-Planck equation when T_a is Gaussian. An explicit expression for the 2nd-order structure function of T_s is derived and compared with observations. In contrast with Katul et al. who suggest that a signature of inactive eddy motion in T_s is inconsistent with the dimensional arguments of Owen and Thomson [JFM, 1963] or Yaglom and Kadar [JFM, 1974], we demonstrate that the strong coupling between T_s and T_a at low frequencies predicted by our approach resolves this apparent inconsistency.

H61B-0770 0830h POSTER

Flux Measurements in the Desert: Sensible Results or Just Sensible Heat?

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We measure the vertical exchange of water, energy, and carbon in these two environments using both eddy covariance and Bowen ratio methods. Evapotranspiration (ET) varies from 5 mm/day following rainfall to less than 0.5 mm/day when the soil is dry. Within several days following a rainfall event, the soil dries out and ET decreases to almost zero. A strong correlation exists between ET and surface soil moisture (0-5 cm), indicating that in these desert environments ET is either dominated by evaporation or by transpiration from shallow roots, or a combination of both. Our eddy covariance measurements compare well with co-located Bowen ratio data.

In desert environments, the large fraction of available energy that goes to sensible heating complicates eddy covariance measurements of water vapor and CO2. Uncertainties in eddy covariance measurements of sensible heat are associated with: (1) rotation of fluxes to natural wind coordinates, (2) density corrections associated with the simultaneous transfer of sensible and latent heat, and (3) instrument accuracy. We examine the impact these considerations have on our eddy covariance measurements.

There are also uncertainties associated with the Bowen ratio method. First, the magnitude of ET depends on available energy, which requires accurate measurements of Rn and G. In desert environments, both of these quantities vary greatly through space, so measured values may not be representative of the mean value in the fetch area. We completed a net radiation survey, which shows that net radiation at the tower location was within 1-2 percent of the average from a 200 m x 200 m area around the station. In contrast, soil heat flux measurements are much more variable and one or two soil heat flux measurements are unlikely to be representative of the entire fetch. Second, when the Bowen ratio is close to negative 1, ET cannot be calculated using the energy balance method and an interpolation method is needed. We assess the uncertainties associated with both spatial variations in soil heat flux and interpolation methods.

H61B-0771 0830h POSTER

Simulation of Surface Water and Groundwater Interaction for a Grassland Catchment in Valdai, Russia

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In this paper, the framework developed by Liang and Xie [2002] that represents dynamically the interactions of surface and groundwater in the Variable Infiltration Capacity (VIC) land surface model is applied to the Usadievskiy watershed, Valdai, Russia. The Usadievskiy watershed is a good test site due to its multiple measurements on water fluxes provided by the Project for Intercomparison of Landsurface Parameterization Schemes (PILPS) Phase 2(d). The VIC simulated groundwater table, surface runoff, snow cover, evaporation, and soil moisture are compared with the Valdai observations. Results show that the simulations of groundwater table match the observations fairly well, especially in the summer when the flux boundary condition is reasonably represented. Also, VIC simulations on evaporation, runoff, and soil moisture compare well with the observations. Comparisons between VIC simulations with and without considering the dynamics of surface and groundwater interactions will also be conducted to study the impact of such interactions on components of the water budget.

References:

Liang, X., and Z. Xie, Important factors in land-atmosphere interactions: surface runoff generations and interactions between surface and groundwater, Global and Planetary Change, accepted, 2002.

H61B-0772 0830h POSTER

An Investigation of Water Loss Mechanisms and the Significance of Open Taliks in the Hydrologic Dynamics of Thermokarst Ponds

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Preliminary analyses have revealed that many ponds near Council, Alaska on the Seward Peninsula are shrinking when compared with aerial photographs taken over the last 50 years. It is important to investigate the cause of this change to determine if this could be a broad scale result of a changing climate. To better understand the loss mechanisms controlling water level dynamics in these ponds, a water balance is being conducted at a unique study site outside of Council, AK. The site encompasses two thermokarst ponds and a network of channels and marshy areas connecting the two ponds. From DC electrical sounding and permafrost boring data, the discontinuous permafrost in the area is typically 20 to 60 meters thick. The downward migration of water through open taliks in the permafrost is suspected to play a significant role in thermokarst pond dynamics by creating an additional water loss mechanism and thereby contributing to the total water loss rate.

The first field season yielded data indicating a significant downward hydraulic gradient beneath one of the two ponds, revealing the presence of an open talik. The significance of the loss mechanism created by the open talik relative to water losses through the marshy channels, evaporation at the pond surface, and evapotranspiration from the encroaching floating mat is being quantified. While it is understood that precipitation is the dominant factor influencing water level dynamics in northern wetlands, a newly formed open talik would result in the addition of a perennially active loss mechanism and could potentially affect water level dynamics dramatically. This extra loss mechanism, if significant, would increase the total loss rate and result in greater water level fluctuations in the pond between recharge periods. Consistently lower water levels will allow for changes in vegetation and other surface conditions and facilitate succession from pond to marsh, evident by noticeably smaller ponds over time.

H61B-0773 0830h POSTER

Modelling of Evapotranspiration at Field and Landscape Scales

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The overall aim of this project is to couple a non-hydrostatic atmospheric model (ARPS) to an integrated hydrological model (MIKE SHE) to investigate atmospheric and hydrological feedbacks at different scales. To ensure a consistent coupling a new land-surface component based on a modified Shuttleworth-Wallace scheme was implemented in MIKE SHE.

To validate the new land-surface component at different scales, the hydrological model was applied to an intensively monitored 10 km2 agricultural area in Denmark with a resolution of 40 meter. The model is forced with half-hourly meteorological observations from a nearby weather station.

Detailed land-use and soil maps were used to set up the model. Leaf area index was derived from NDVI (Normalized Difference Vegetation Index) images.

To validate the model at field scale the simulated evapotranspiration rates were compared to eddy-covariance observations from three 2-m masts representing fluxes from grass, winter wheat and spring barley. Observations from a 40-m mast representing a mixture of the land-use classes in the model domain were used to validate the model at the larger scale. Good agreement was found at both the field and landscape scale. Further validation is being carried out with satellite data.

Initial results from the coupled model will also be presented.

H61B-0774 0830h POSTER

Simulation of Semi-Arid Hydrology

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Semi-arid climatic regions include most of the southwestern US, and are characterized by strong heterogeneities in ecology, topography, and land cover. In the Scripps ECPC (Experimental Climate Prediction Center), we apply the Variable Infiltration Capacity (VIC) macro-scale hydrologic land surface model to simulate semi-arid hydrology for the project of the sustainability of Semi-Arid Hydrology and Riparian Areas (SAHRA). The observed precipitation and the meteorological data from the Regional Spectral Model (RSM) simulation are used to drive VIC. The streamflow observations from the Rio Grande are applied to investigate the quality of the VIC output. In addition, daily Land Data Assimilation System (LDAS) products are being used to validate the VIC model. The results of the validation of the simulation of semi-arid hydrology will be presented.

URL: http://ecpc.ucsd.edu/projects/uastc/index.html

H61B-0775 0830h POSTER

Modeling Hydrologic Processes in Boreal Watersheds: The Proof is in the Pattern

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Hydrologic processes in boreal watersheds present particular challenges to modelers. While several distributed hydrologic models have been developed, none have been applied to the boreal landscape, where hydrologic processes shift in dominance from surface to subsurface pathways. This shifting dominance occurs both spatially, from the relatively rugged relief near the ridge to the relatively gentle relief with nested topographic depressions in the valley, and temporally, as climatic conditions are characterized by droughts interspersed with periodic floods. We applied one distributed hydrologic model, the Regional HydroEcological Simulation System (RHESSys), to a boreal watershed located in northern Alberta, Canada. We adapted the model to incorporate the dynamic nature of drainage networks, as topographic depressions disconnect and connect to the stream depending on climatic conditions. We calibrated the model using aspatial data collected in the watershed. While we were able to achieve significant correlations between the estimated water budgets and the timing of peak and base flows, we recognized that we might have achieved right aspatial calibrations for the wrong spatial reasons. Thus, we corroborated the model using satellite imagery (RADARSAT S1) estimates of the spatial distribution of surface saturated areas. Our research findings highlight the importance of using monitored data of both aspatial and spatial measurements in the development of hydrologic models.

H61B-0776 0830h POSTER

Constrasting styles of erosion along the western slope of the Central Andean Plateau

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We examine the western slope of the central Andes Mountains between 17S and 30S in an effort to elucidate the effects of along strike climate variability on landscape process and form. This region is most opportune for study because the mountain front is, to a first order, a relatively simple monoclinal structure

and several lines of evidence point towards the general stability of todays observed climatic zones since 15 Ma. In the central part of the study region (22-25S), relict landscape preservation is extremely good, much of the relict middle Miocene surface (erosional and depositional) between 18S and 25S remains intact. This surface becomes progressively more dissected moving north and south of the central segment. We present data from satellite imagery and geomorphic analyses of a 90 m digital elevation model, which suggest that three independent erosion styles exist in the study area (excluding the central region where no significant rivers exist). The first order differences in erosional style are accounted for predominantly by where precipitation is falling. In southern Peru and northern Chile, almost all moisture is in the form of high elevation, easterly-sourced precipitation falling on the Altiplano Plateau and Western Cordillera. This results in groundwater controlled drainage networks in northern Chile and the existence of a large active salar, the Salar de Atacama, which apparently has trapped groundwater originating from the plateau. Available geologic evidence shows that these features are of greater antiquity than the Pleistocene glacial period in the Central Andes. South of 27S, westerly derived, orographically enhanced precipitation falls directly on the mountain front producing an erosional regime more typical of actively eroding mountain fronts.

H61B-0777 0830h POSTER

Comparison of Different Approaches for Estimating Recharge in the High Plains Aquifer, Texas

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Recharge is a critical issue for evaluation of groundwater resources and for assessment of groundwater vulnerability to contamination. We compared a variety of approaches to estimate recharge in the High Plains Aquifer in Texas, including soil physics, environmental tracers, and numerical modeling. The different approaches complement each other and provide information over varying space and time scales. Environmental tracers such as tritium and chloride in groundwater provide spatially and temporally integrated estimates of groundwater recharge. Previous estimates of recharge based on groundwater 3H concentrations in the southeastern part of the High Plains aquifer resulted in recharge estimates of 13 to 80 mm/yr. The average groundwater Cl concentration in non-irrigated regions was 19 mg/L that resulted in an average recharge rate of 7 mm/yr based on annual precipitation of 452 mm/yr and Cl input of 0.3 mg/L (about 3 times Cl concentration in precipitation). The average groundwater Cl concentration in irrigated regions (15.5 mg/L) was lower than that in non-irrigated regions. The Cl data are insufficient to constrain recharge rates beneath irrigated regions.

Soil physics and environmental tracer data in the unsaturated zone provide more detailed information on spatial variability in recharge. Deep penetration of bomb pulse 3H, Cl flushing, low calcium carbonate, and high water potentials indicate that playas focus recharge. Water fluxes estimated from 3H profiles in playas were up to 120 mm/yr. In contrast, Cl bulges, calcic soils, low water potentials, and upward water potential gradients indicate negligible recharge in non-irrigated, interplaya settings. The bulge shaped Cl profiles in interplaya settings indicate that water fluxes were higher during the Pleistocene (up to 5 mm/yr) and that Cl has been accumulating during the Holocene. Numerical simulations of nonisothermal liquid and vapor flow using the HYDRUS-1D code indicate that the water potential and Cl profiles can be reproduced by downward flux during the Pleistocene followed by an order of magnitude reduction in downward flux, zero flux, or upward flux during the Holocene. Information on recharge from this study is extremely valuable in predicting groundwater resources during the next 50 yr and for delineating aquifer regions that are particularly susceptible to contamination.

H61B-0778 0830h POSTER

Assessing Hydrologic Impacts of Land Configuration Changes Using an Integrated Hydrologic Model at the Rocky Flats Environmental Technology Site, Colorado

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The Rocky Flats Environmental Technology Site (RFETS) in Golden, Colorado, a former Department of Energy nuclear weapons manufacturing facility, is currently undergoing closure. The natural semi-arid interaction between surface and subsurface flow at RFETS is complex and complicated by the industrial modifications to the flow system. Using a substantial site data set, a distributed parameter, fully-integrated hydrologic model was developed to assess the hydrologic impact of different hypothetical site closure configurations on the current flow system and to better understand the integrated hydrologic behavior of the system. An integrated model with this level of detail has not been previously developed in a semi-arid area, and a unique, but comprehensive, approach was required to calibrate and validate the model. Several hypothetical scenarios were developed to simulate hydrologic effects of modifying different aspects of the site. For example, some of the simulated modifications included regrading the current land surface, changing the existing surface channel network, removing subsurface trenches and gravity drain flow systems, installing a slurry wall and geotechnical cover, changing the current vegetative cover, and converting existing buildings and pavement to permeable soil areas. The integrated flow model was developed using a rigorous physically-based code so that realistic design parameters can simulate these changes. This code also permitted evaluation of changes to complex integrated hydrologic system responses that included channelized and overland flow, pond levels, unsaturated zone storage, groundwater heads and flow directions, and integrated water balances for key areas. Results generally show that channel flow offsite decreases substantially for different scenarios, while groundwater heads generally increase within the reconfigured industrial area most of which is then discharged as evapotranspiration. These changes have significant implications to site closure and operation.

URL: http://www.rfets.gov

H61B-0779 0830h POSTER

A Multiparameter Approach for Measuring Flood-Induced Aquifer- and Bank-Storage Changes Along the San Pedro River, Arizona.

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The San Pedro Riparian National Conservation Area (SPRNCA) is a federally protected area in Cochise County, Arizona, USA. Base flow in the San Pedro River and shallow depths to ground water in the floodplain aquifer are essential for maintaining the health of the riparian system within the SPRNCA. These elements are potentially threatened by pumping of regional ground water for residential and municipal use.

Direct recharge to the flood-plain aquifer during high flows of the San Pedro River may be an important factor in maintaining base flow through subsequent dry periods (Pool and Coes, 1999). This study was designed to measure the storage of water in the floodplain aquifer and river banks during high-stage events and to determine the duration of increased flow supported by the release of stored water.

Sixteen study sites have been established along a 65-km stretch of the river. This discussion is about the conditions at one site, near Palominas, Arizona. Streamflow at this site is "intermittent perennial." The river may or may not maintain continuous flow depending on how preceeding climatic conditions affect the direction of the hydraulic gradient between aquifer and river. Earlier studies generally have focused only on perennial reaches. Instrumentation at the site includes seven continuously recording piezometers grouped in three nests at various distances from the river, a stream-stage recorder, and temperature sensors installed both in the river and at several depths in one piezometer. Additional data collected include stream-discharge measurements, $\delta^{18}O$ and δD values, and concentrations of major ions and sulfur hexafluoride.

Collected data were analyzed using multiple approaches to determine the relation between flood-water storage and the long-term elevation of river stage above pre-flood levels. A visual evaluation of piezometer water levels and river stage through time showed when the river was gaining or losing, how the aquifer responded to high stage, and how the river stage responded to the release of stored water. A simple analytical model applied to water-level data provided an estimate of storage generated by elevated stage. The USGS variably-saturated simulation software, VS2DHI, enabled the synthesis of water-level and temperature data into a comprehensive model of aquifer- and bank-storage response to stage changes. Electrical conductivity, $\delta^{18}O$, δD, and major-ion values obtained from well and river samples enabled calculations of mixing percentages between flood water and ground water in the flood-plain aquifer.

References:

Pool, D.R. and A.L. Coes. 1999. Hydrogeologic investigations of the Sierra Vista subwatershed of the Upper San Pedro Basin, Cochise County, southeast Arizona: U.S. Geological Survey Water-Resources Investigations Report 99-4197, 41.

H61B-0780 0830h POSTER

Actual ET Rates derived by SEBAL in the Middle Rio Grande Valley

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SEBAL stands for Surface Energy Balance Algorithms for Land. It is a remote image-processing model for predicting actual evapotranspiration using thermal infrared, visible, and near-infrared data from each observation satellites such as LandSat 7, MODIS, and AVHRR. SEBAL performs well under irrigated conditions but little is known about its performance in riparian and desert areas. A preliminary test on three days in 2000 yielded SEBAL derived actual evapotranspiration rates for riparian areas with 1-33 percent of the rates measured with the eddy covariance technique. Evapotranspiration rates for the desert areas determined by SEBAL were quite low and similar to the low values measured with eddy covariance. The objective of this study is to make more comparisons between SEBAL and field measurements to verify the performance of SEBAL for prediction of instantaneous, daily, and seasonal ET rates in the riparian and desert areas of the Middle Rio Grande Valley.

H61B-0781 0830h POSTER

Can Your Global Climate Modeling Project Use a Global Soil Moisture Data Set?

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Soil moisture is a critical component of the hydrological cycle and plays an important role in determining land surface / atmosphere interactions. However, scientists currently lack sufficient observational data to characterize large scale soil moisture distributions. The GLOBE Soil Moisture Project aims to mobilize the global K-12 with the larger scientific community to participate in periodic, near-surface, gravimetric soil moisture measurements.

The GLOBE Project (see http://www.globe.org) is an NSF-funded effort that supports a worldwide hands-on, primary and secondary school-based science and education program. GLOBE is a cooperative effort of schools, federal agencies, universities, and non-government organizations in partnership with 95 countries worldwide. Soil moisture is one of the many measurements conducted by GLOBE schools. Soil moisture measurements based on gravimetric methods are conceptually and operationally simple, offering the opportunity for K-12 students to make scientifically valid and much needed measurements.

Keeping in mind the constraints of K-12 teachers, the requirements of their lesson plans, and the length of a traditional school year, we aim to mobilize as many as possible of the 10,000 GLOBE-affiliated schools worldwide to collect synoptic soil moisture data twice per year, every year. The two target dates we have selected are during World Space Week/U.S Earth Science Week

(October 5-13, 2002) and Earth Day Week (April 20-29, 2003).

To ensure that the soil moisture data collected is of scientific use, we are seeking the guidance of the scientific community - especially the global land surface modeling and soil moisture remote sensing community - to identify the optimal timing and spatial distribution of the semi-annual, coordinated soil moisture measurement campaigns.

URL: http://www.globe.org

H61B-0782 0830h POSTER

Climate Change Impacts on Hydrology in Taiwan

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The impacts of climate change on streamflows and groundwater recharge were evaluated for Taiwan. Rainfall unevenly distributes in a year in Taiwan Island, which May through October is a wet season and contains 67% and 90% of annual rainfall for North and South Taiwan, respectively. Increasing of frequencies of both flood and drought has been observed in recent years, which is coincided with the previous climate change impact study in Taiwan based on climate change scenarios from Country Studies Program. Further analysis of the influence of climate change on streamflows and groundwater recharge were evaluated based on IPCCs SRES scenarios in this study for providing more information of hydrologic conditions under possible future climates. Impacts on streamflows were assessed in a watershed scale by using the streamflow component of the GWLF model, while impacts on groundwater discharge was evaluate in an island wide scale by calculating water balance. Climate change scenarios were derived from three General Circulation Models (GCMs), including CGCM2 by Canadian Center for Climate Modelling and Analysis, HADCM3 by Hadley Centre for Climate Prediction and Research, and CSIRO-Mk2 by Commonwealth Scientific and Industrial Research Organization. These GCMs simulate climate based on SRES scenarios, which A2 and B2 scenarios were adopted in this study. The uncertainty of applying the predictions of global scale models and applying different GCMs are also concerned.

H61B-0783 0830h POSTER

Hyporheic Potential as a Mechanism for Variation in Stream Temperature Along the Umatilla River, Oregon.

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Groundwater and surface water interaction create patterns of thermal diversity crucial to normative ecosystem function. Native salmonids utilize upwelling hyporheic water, which both, create and expand critical cold water refugia. Using several known factors for hyporheic exchange, we created a potential hyporheic influence using 30-meter Digital Elevation Model data. Trend in valley width, stream slope, trend in floodplain width, variance in slope and sinuosity were derived from the DEM data and combined in to an estimate of hyporheic potential. We compared several known stream temperature influences to hyporheic potential. These influences include riparian shade, topographic shade, tributary influences, irrigation dam influence, and reservoir releases. FLIR - Forward Looking Infrared Radiometer data was used to create a longitudinal temperature profile for mainstem Umatilla River. Potential thermal influences were compared to a continuous temperature profile of the river. Hyporheic potential explains the majority of thermal variation during a peak temperature loading period. These results suggest, at river basin scales, that hyporheic exchange is an important driver in thermal variation.

H61B-0784 0830h POSTER

Surface Energy Balance and The Mixed Layer at Lake Tanganyika

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Lake Tanganyika is a very large (670 by 50 km) and deep rift lake (max depth 1.5 km) in East Africa between 3.5 and 9 degree south of the equator. Mixing of the upper layers in this meromictic lake is most intense in the trade wind season (May - September). Apart from increased wind speeds, lower air temperatures and evaporative cooling of the surface layer combine to enhance mixing. Previous work indicated that correlation of evaporation and heat loss from the lake leaves room for a significant portion in the variability of heat content to be explained by other factors. The components of the energy balance which contribute to mixing were compared among seasons and between the north and south ends of the lake, over diel and annual cycles. Sensible heat and latent heat fluxes were estimated with bulk aerodynamic formulas and the heat storage change in the surface water layer was determined. Solar radiation was measured and longwave and all-wave net radiation calculated. Evaporation provided a major contribution to mixing but varied per site and over seasons. Mixing intensity was related to oxygen and nutrient cycles. Apart from evaporative cooling, sensible heat transfer and the emission of long wave radiation were important mechanisms in cooling the surface layer at night. Sensible heat transfer and outgoing longwave radiation were relatively more important at the north end of the lake, compared with the south end, in explaining nocturnal heat loss from the surface.

H61C MCC: Hall C Saturday 0830h

Water Quality of Natural Systems Posters *(joint with B)*

Presiding: **J Kirchner,** University of California, Berkeley**; X Feng,** Dartmouth College

H61C-0785 0830h POSTER

An Overview and Preliminary Data of a Five-year Water Quality Study of the Yukon River

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The U.S. Geological Survey is conducting a five-year water quality study of a 3000 km reach of the Yukon River from its headwaters in the Yukon Territory, Canada to Pilot Station, Alaska near its mouth and just above tidal influence. The water quality of the Yukon River, the fourth largest river system in North America, is poorly documented and may be changing in response to warmer temperatures. Permafrost regions in the Yukon River drainage basin are melting. As permafrost melts, the frozen soil is transformed into biogeochemically active zones. Runoff moving through and across these active zones is hypothesized to increase the flux of solutes to Yukon tributaries and the main stem, ultimately changing the Yukon River water chemistry. The objectives of the five-year study are: 1) Establish a baseline describing the general water quality of the Yukon River and its major tributaries as a reference to measure future changes. This objective will be achieved by sampling the Yukon River and two of its major tributaries at five fixed sampling sites every two weeks from March through September for a total of five years; 2) Identify processes that affect or control the water quality of the Yukon River and its tributaries. This objective will be achieved by intensive sampling campaigns at high flow in June and low flow in late August during 2002-2004. The first reach and its tributaries from Eagle, AK to the Dalton Highway were sampled during the summer of 2002. The second reach, from the highway to Pilot Station will be sampled during the summer of 2003. The third reach from Whitehorse, Canada to Eagle, AK will be sampled during the summer of 2004.

Along with discharge, a suite of geochemical parameters, including suspended sediment, quantitative mineralogy, major ions, trace elements and nutrients are being measured with emphasis on dissolved and particulate carbon, gas flux and generation of methyl mercury. Discharge and water quality sampling using equal discharge increments provide instantaneous fluxes. In addition, the occurrence and fate of constituents of environmental concern, such as mercury and other toxic metals, are being addressed. Identification of the sources and sinks of these constituents, in addition to the processes controlling their fate and reactivity, will provide an important frame of reference to assess water quality changes in the basin that may result from permafrost melting and a warmer climate. Preliminary data from fixed station sampling and the 2002 summer sampling campaign indicate that water quality in the Yukon River drainage basin is sensitive to the hydrologic state of the river. Seasonally and spatially, dissolved organic carbon (DOC) ranges from 1 to 54 mg/L, carbon dioxide ranged from 33 to 735 umols/L, and major ions such as sulfate and calcium range from 4 to 74 mg/L.

H61C-0786 0830h POSTER

Export of Carbon From the Yukon River and Some of its Major Tributaries

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The fate of carbon (C) in the Yukon River, select headwater streams, and major tributaries is being investigated as part of a five-year study of the water quality of the Yukon basin. Preliminary calculations of C exports from the basin indicate that the Yukon River discharged an estimated 7.37 Tg of C during 2001, as measured at Pilot Station, just upstream of the Yukon delta. Approximately 70% of the C load was transported as inorganic C and 30% as organic C. The inorganic C load was almost entirely comprised of dissolved inorganic C (DIC). The relative importance of suspended particulate carbonates in the inorganic C load increases upstream, with the corresponding carbonate content of bar sediment increasing from about 2% by weight at Pilot Station to about 12% at Eagle, AK, about 2400 km upstream, near the Canadian border. Downstream reduction of sediment carbonate content, depletion of dissolved CO_2 in Yukon River water during summer, and under-saturation of river water with respect to calcite suggest dissolution of particulate carbonates in the river. Organic C load at Pilot Station is nearly equally divided between dissolved organic C (DOC) and suspended organic C (SOC). The relatively high proportion of organic C associated with suspended material is most likely due to adsorption of DOC onto suspended sediment and not to particulate biomass. DOC:SOC ratios are much greater in tributaries of the Yukon, such as the Porcupine River, that have relatively small suspended-sediment concentrations. C loads at Pilot Station for 2001 indicate a yield of about 0.46 moles DIC m^{-2} yr^{-1}, 0.10 moles DOC m^{-2} yr^{-1}, and 0.10 moles SOC m^{-2} yr^{-1} from the Yukon basin as a whole.

URL: http://water.usgs.gov/nasqan

H61C-0787 0830h POSTER

Atmospheric Deposition Effects on the Water Quality of High-Elevation Lakes in Grand Teton National Park, Wyoming.

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Atmospheric deposition is the primary cause of acidification in lakes and streams in the United States. Mountainous watersheds tend to have a low buffering capacity for nitrogen-based acidifying compounds