be mapped and interpreted in their own right. Beyond the information about the heterogeneity of the surface, the value of one of these parameters also permits identifying geophysical conditions where the surface heterogeneity becomes significant. Structure functions and singularity measures can be employed to describe the non-stationary and intermittent behaviour of geophysical fields. This approach is applied on synthetic height field measurements of a large variety of vegetation canopies. The joint analysis of the shape of the anisotropy function together with the height fields yields remarkable patterns of organization: It is possible for multiangular instruments, like MISR, to deliver information about the type of surface heterogeneity at the subpixel scale, that is in agreement with canopy structure characterizations obtained by other means.

URL: http://www.gvm.sai.jrc.it/stars

B31B MC: Hall D Wednesday 0830h

Land Use and Land Cover Change: Observations and Consequences II

(joint with GC)

Presiding: **N Ramunkutty,** University of Wisconsin**; R Leemans,** National Institute for Public Health the Environment (RIVM)

B31B-0086 0830h POSTER

Controls on Early Rates of Succession in a Virginia Piedmont Old-Field.

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There are many factors that influence plant community production and structure during succession on temperate old-fields. To investigate the effects of proximity to forest edge and method of abandonment on ecosystem properties and community structure during succession, field measurements of leaf area index (LAI), species composition, and soil carbon were collected along four transects within a 14 year old temperate successional field over the 2000 growing season. Additionally, normalized difference vegetation index (NDVI) was calculated from Landsat 7 satellite data at a resolution of 30 m for the entire field. Values of LAI and NDVI were used to examine spatial variations in vegetative biomass and foliar production, while relative frequencies of trees were used to provide information regarding rates of succession. Results show a significant positive relationship between proximity to forest edge and peak season LAI ($r = 0.55$, $p < 0.001$) and NDVI ($r = 0.84$, $p < 0.001$). Additionally, the presence of several key plant species, such as Celastrus orbiculatus (Japanese bittersweet), exhibited a strong control on the variability of LAI. Values of vegetative biomass (LAI and NDVI) taken in mid-August were significantly higher (ANCOVA, $p < 0.05$) in the section of the field plowed at the time of abandonment. In general, frequencies of trees increased with proximity to forest edge suggesting greater rates of succession at these locations. However, soil carbon levels do not show a significant increase at sites in later successional states, suggesting that the recovery period for soil carbon in these systems is greater than 14 years.

B31B-0087 0830h POSTER

Land Cover, Rainfall and Land Surface Albedo in West Africa

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Land surface albedo is an important variable in General Circulation Models (GCMs). When land cover is modified through anthropogenic land use, changes in land-surface albedo may give rise to atmospheric subsidence and reduction of rainfall. In this study we examined albedo time series, derived from AVHRR Pathfinder data, and their relationships with rainfall, land cover, and population in West Africa. This particular region was selected because it has become a focal point in debates over biophysical impacts of desertification and deforestation. Our analyses revealed that albedo and rainfall were related only modestly at short time scales (monthly and annual) and that mean annual albedo values remained relatively stable from 1982-1989 over a wide range of climatic and vegetation zones in West Africa. The relationship between long-term mean rainfall and mean albedo was strong and curvilinear ($r2 = 0.802$). The same was true for the relationship between percent tree cover and mean albedo ($r2 = 0.659$). These results suggest that long-term climate patterns, which control vegetation type and canopy structure, have greater influence on albedo than short-term fluctuations in rainfall. Our results reinforce other recent studies based on satellite data that have questioned the extent and pervasiveness of desertification in West Africa.

URL: http://www.gwu.edu/~geog

B31B-0088 0830h POSTER

Spatial and Temporal Drivers of Fire Dynamics in the Amazon/Tocantins Basin

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This study examines factors and processes explaining the current spatial and temporal distribution of fires in the Amazon/Tocantins basin. It combines mid-1990s observations of agricultural land-use and fires derived from the GOES-8 satellite with natural burned areas simulated using climatic and fuel load limitations. The spatial distributions of observed fires in 1995 and 1997 are generally similar, 1995 having significantly more fires (+10%). In several subregions, we find a significant correlation between spatial distributions of observed fires and land-use. Nevertheless, when considering the entire basin this relationship is not as pronounced due to land-use data set biases, as in Amazonas, or to inadequate spatial and temporal resolution needed to detect all fires, as in Tocantins and along the Andes. When comparing the spatial distributions of fires in 1995 to the different land-use types maps, planted pasture shows the best agreement with fire occurrence; cropland is often not a significant predictor, and natural pasture has an intermediate behavior. The main features of the 1997 minus 1995 differences of fire distribution can be explained by climatic anomalies. The strong 1997 El Niño event has a significant impact on the numbers and patterns of fire, especially in Bolivia and around Manaus where the associated precipitation changes are large. The 1997 minus 1995 differences in fire dynamics in regions with small changes in climate are probably the result of some anthropogenic factors. Interannual differences in climate factors, coupled with maps of land use, provide a strong basis for understanding and potentially predicting fire dynamics in this rapidly changing region.

B31B-0089 0830h POSTER

Detection and Mapping of Desertification

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The extent and severity of desertification is an important issue that affects economic development, and is significant in the context of global climate change and the global carbon cycle. The need for a measure of desertification that can also be used to map the extent and severity of the problem has long been recognized, but there is a lack of any readily measured, objective indicators applicable at a regional. Amongst the definitions of desertification many make clear the central role of the carbon cycle. Satellite remote sensing has partly supplied the need for data by providing techniques that can detect variables related to net primary production (NPP). We have developed procedures for mapping desertification using satellite data and a carbon cycle model (GLO-PEM) that allows monitoring the actual and potential NPP. We will discuss work in southern Africa where we have shown that negative deviations from the potential (undesertified) NPP provide an effective indicator of desertification. Three approaches to measurement using reduced NPP will be presented. The first is the Rain Use Efficiency, the ratio of NPP to rainfall over a five-year period. Deviations from the conservative value of RUE provides a useful index of degradation, independent of the rainfall. A second, more mechanistic technique using a comprehensive biogeochemical model to estimate potential NPP is used to overcome the limitations of estimating potential NPP with rainfall alone. The index of degradation in this case is the difference between potential and actual NPP. One problem with both RUE and Potential-Actual NPP is a limitation on spatial resolution caused by data; meteorological stations are sparsely distributed and local rainfall can be spatially highly variable in semi-arid regions. To avert this problem, a third technique has been developed, Local NPP Scaling (LNS), in which the NPP of each pixel is expressed as a proportion of the maximum observed in all land falling into the same terrain type. Stratification by terrain type allows climate, soil and land cover differences to be normalized and degradation to be detected relative to the maximum observed NPP. Cultural factors can also be included, such as commercial or communal land tenure. The results suggest that the deviation of NPP was quite variable throughout the region during the period of study. Thus, in parts of the region, NPP seems to be significantly less than the potential productivity, and it is these that we have identified as desertified.

B31B-0090 0830h POSTER

Closing the System: Carbon Storage and Cation Uptake to 10 m Depth Along a Gradient of Precipitation and Vegetation Change

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Shifts of woody and herbaceous vegetation with deforestation, afforestation, and woody plant encroachment alter above- and belowground allocation of plants and the depth and distribution of roots, in turn influencing soil nutrient distributions, net primary production, and carbon storage. This study compared adjacent grassland and shrubland communities along a precipitation gradient in the central United States (230-1100 mm mean annual precipitation). Paired fenceline comparisons at six sites were used to compare differences in carbon storage and cation uptake as a consequence of woody plant encroachment to 10 m depth in the soil. Along the gradient there was a clear negative relationship between precipitation and the amount of SOC stored in the top 3 m of soil after conversion to woody vegetation. Woody plant encroachment increased soil organic carbon (SOC) content at the three drier sites and decreased SOC at the wetter sites, with a crossover point for this linear decline of 500 mm precipitation (approximately the point of canopy closure). While none of the three desert sites gained more than 1.3 kg m-2 of SOC, the three wetter sites lost =1, 4, and 6 kg m-2. Sr signatures of the grasses matched the signatures in the shallowest soil layers almost perfectly at sites with more than 300 mm precipitation, but the integrated depth of Sr uptake was a surprisingly deep 2 to 3 m for the two driest grasslands. Overall, desertification and woody plant encroachment altered the depth of Sr uptake substantially at all sites except Vernon, most prominently a dramatic 2.5 m shift at Riesel.

URL: http://www.biology.duke.edu/jackson

B31B-0091 0830h POSTER

The Use of Biofilter to Reduce Atmospheric Global Warming Gas (CH4) Eemissions from Landfills

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The emission of greenhouse gasses resulting from anthropogenic activities is increasing the atmospheric concentration of these gases, which can influence the climatic system by changing the temperature, precipitation, wind and other climate factors. Methane (CH4) is a very potent greenhouse gas and CH4 emission from landfills in US has been reported as 37% of total anthropogenic source of CH4 emission. Properly designed soil biofilters may reduce atmospheric CH4 emissions from landfills and help reduce the accumulation of greenhouse gasses in the atmosphere. Biofilter performance was tested under a variety of environmental and design conditions. The results showed that biofilters have the potential to reduce CH4 emissions from landfills by as much as 83%. A quadratic equation was developed to describe the dependence of methane oxidation rate in a sandy loam textured soil as a function of soil temperature, soil moisture and ammonium nitrogen concentration. Using this equation and the averaged soil temperature and moisture contents, and census data for the largest cities of each of the 48 contiguous states, oxidation rates was calculated. A methane emission model was also developed to estimate the methane emission from municipal waste landfills with different covers. Older landfills with soil covers emitted an average of 83% of the generated CH4. Landfills with RCRA covers emitted 90% of the generated CH4 without biofilters and only 10% with biofilters. Thus, the installation of properly sized biofilters should significantly reduce atmospheric CH4 emissions from landfills.

B31B-0092 0830h POSTER

Application Of Remote Sensing And GIS For Landuse / Land cover Change Analysis In a Mountainous Terrain . A Case Study Of Part Of Kohima District, North East India.

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Landuse / Land cover change is critically linked to the intersection of natural and human influences on environmental change. The changes in the state of the biosphere and bio-geochemical cycles are driven by heterogeneous changes in landuse and continuation of these uses. Information on existing landuse / land cover, its spatial distribution and change are essential pre-requisite for developmental planning. Difficult terrain and inaccessibility makes it almost impractical to obtain reasonably accurate information required for efficient management of the natural resources. Integration of remote sensing data with other non-spatial data was carried out using GIS. A simple classification technique was adopted for landuse / land cover changes in relation to elevation, slope, drainage, aspects and bioclimatic classes. The study was carried out in part of Kohima district, for the year 1989, 1999 and 2001 and the changes in landuse / land cover estimated. Visual interpretation techniques was used to delineate various landuse / land cover categories. Suitability assessment of land was made using GIS software. The study area has been experiencing land use changes due to degradation of natural resources during the past years. The data sets used for the present study are IRS ID LISS III of 1989,1999 and 2001. Various thematic maps were prepared from topographic maps and imagery. The major changes identified and quantified are decreased forestland, increased urban area and agricultural landuse which led to increased soil erosion and landslides. Using GIS, best management plans were suggested for sustainable management of land utilization.

B31B-0093 0830h POSTER

Siberian Landscape Disturbance Study

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Landcover change in Siberia is driven by natural and human factors. Important factors affecting forest cover are wildfire, insect outbreaks, logging, pollution and mineral exploration and exploitation. The MODIS sensor is very good for tracking changes across a wide expanses of territory if the changes expressed at resolutions of 250m to 1 km or larger. It is useful to know at what scale disturbances such as insects, fires and logging can be located and identified in MODIS image data. In this paper, an area in western Siberia where diverse disturbances are present was studied using MODIS and Landsat 7, as well as imaging radar data.

B31B-0094 0830h POSTER

IMPACT OF LAND USE / LAND COVER CHANGES ON WATER QUALITY USING REMOTE SENSING AND GIS A CASE STUDY OF KATEDHAN INDUSTRIAL AREA, ANDHRA PRADESH, INDIA.

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Land Use, the anthropogenic use of the land and Land Cover, the physical state of such land, are among the most evident impacts of human activities on natural resources. Rapid global industrialisation during the last two decades in general and in the Katedhan industrial area in particular has a profound adverse effect on the land use / land cover practices and the water quality. Remote sensing and GIS techniques have been employed to identify and quantify measures for mitigating the adverse impacts of industrialisation on the quality of environment. The specific objective of this paper is to study the correlation between impact of land use and water quality. There are about 400 500 industries in this area whose effluent outlet is directly mixing into the near by canal or stream. Due to this the lakes present in this catchment area are being polluted. The methodology employed in this study involves the generation of various thematic layers so as to find out the impacts on water quality. According to the results, total dissolved solids, chlorides, sulphates and some heavy metals are very high in the surface water near to Noor Mohammad lake. When compared with ground water, all the above parameters are high near to Sivarampally lake which is around 1 km form Noor Mohammad tank. This is because of the slope of the area due to which the ground water is polluted in lower region of this area. To control further degradation of the water quality it is recommended that a common effluent treatment plant should be constructed so as to control the pollution at the source itself.

B31B-0095 0830h POSTER

INTEGRATED APPROACH FOR KESHAMPET WATERSHED MAHABUBNAGAR DISTRICT, ANDHRA PRADESH, INDIA -USING REMOTE SENSING AND GIS

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The present study area deals with the application of Remote Sensing (RS) and Geographical Information Systems (GIS) techniques of keshempet watershed for suggesting the two treatment plans namely engineering and gully control work and biotech treatment measures for water resource development and catchment area treatment with a view to control soil erosion from the watershed as well to increase the ground water recharge. The study area falls in the co-ordinates 780 8 30 and 780 13 E longitudes and 160 20 and 160 24 N latitudes in part of Mahbubnagar district, Andhra Pradesh, India. The present study area occupies an area of 2870 ha. The satellite data used is IRS 1C PAN and LISS IV merged data, dated March 1997 and April 1997. GIS software used are ARC / INFO and ARCView. Land Use / Land Cover map , Hydrogeomorphology map and soil maps are prepared by interpreting the imagery visually and through intensive ground truth. The other relevant maps namely slope, drainage maps are prepared with the help of 1:50000 scale, Survey of India toposheets. A critical examination of each one of the thematic maps is carried out to identify various land resources and their spatial distribution to assess the watershed for its sustainability. The information obtained from this study is then integrated to develop an action plan for land and water resources development. Based on this action plan check dams (14), mini percolation tanks (7), farm tanks (4), desiltation tanks (13) are proposed for the treatment plans. This action plan can be used for the upliftment of socio-economic condition of the study area. In this research paper, a number of thematic layers and relevant data are presented.

B31B-0096 0830h POSTER

IBIS Yield and Nitrate Loss Predictions for Maize Agroecosystems Receiving Varied N-Fertilizer

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Agriculture in the Midwest US faces the formidable challenge of improving crop productivity, while simultaneously mitigating the environmental consequences of intense management. This study examined the simultaneous response of nitrate-nitrogen (NO3-N) leaching losses and maize (Zea mays L.) yield to varied fertilizer-N management using field observations and the IBIS model. The model was validated against 6 yr of field observations in maize plots receiving an optimal (180 kg N/ha) fertilizer-N application and in N-unfertilized plots on a silt loam soil near Arlington, Wisconsin. Predicted values of grain yield, harvest index, plant N uptake, residue C:N ratio, LAI, grain-N, and drainage were within 20% of observations. However, simulated NO3-N leaching losses, NO3-N concentrations, and net N-mineralization exhibited less interannual variability than observations, and had higher levels of error (20-65%). Potential impacts of 30% higher (234 kg N/ha) and 30% lower (126 kg N/ha) fertilizer-N use (from optimal) on NO3-N leaching loss and maize yield were simulated. A 30% increase in fertilizer-N use increased annual NO3-N leaching by 56%, while yield increased by only 1%. The NO3-N concentration in the leachate solution at 1.4 m below the soil surface was 30.7 mg/L. When fertilizer-N use was reduced by 30% (from optimal), annual NO3-N leaching losses declined by 42% after 7 years, and annual average yield only decreased by 8%. However, NO3-N concentration in the leachate solution remained above 10 mg/L (11.3 mg/L). Clearly, non-linear relationships existed between changes in fertilizer use and NO3-N leaching losses over time. Simulated changes in NO3-N leaching were greater in magnitude than fertilizer-N use changes.

B31B-0097 0830h POSTER

Arid Species Distributions Determined by Topography, Geology, and Hyperspectral Imagery in the White Mountains, Eastern California

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This research investigates plant species distributions across the arid White Mountains in eastern California. The environmental ranges of major plant species were modeled using multivariate analyses of vegetation species and environmental variables obtained from over 600 ground control points. The species distributions relative to geologic, topographic, and hyperspectral (AVIRIS) data were determined and used to predictively map and validate species distributions across 830 km2 in the White Mountains in eastern California.

The White Mountains form the western boundary of the Basin and Range province rising over 4000 meters above sea level along range-bounding normal faults. The varieties of substrates across this sharp

topographic relief provide classic examples of the effects of geology and topography on vegetation. The well-mapped mosaic of dolomite, limestone, metasedimentary rocks (argillite, phyllite, and quartzite), granitoids, and volcanic rocks affects chemical, thermal, and physical properties of the overlying soils. In addition, topography drives the local climate. As elevation increases, precipitation increases and temperature decreases. Aspect, slope, and surrounding topography determine potential insolation, so that south-facing slopes are warmer and north-facing slopes cooler at a given elevation. Topographic position (ridge, slope, canyon, or meadow) and slope angle affect sediment accumulation and soil depth. These factors form complex environmental gradients that have profound effects on plant distributions. Hyperspectral AVIRIS data provide information about the vegetation itself. They provide snapshots of existing vegetation structure and relative health across broad areas. Species are mapped throughout the White Mountains based on the environments they grow in. CCA models species envelopes in multidimensional environmental space, which can then be projected across entire landscapes and used to map where each species can be expected to be found. These analyses not only provide information regarding where plants grow, but also defines the environments each species tolerates. Two-thirds of the ground control sites were used for calibration of CCA models, and one-third were reserved for evaluation using an independent measure of fit (kappa). This study strives to determine the most accurate and efficient combination of hyperspectral, geologic, and topographic variables to describe the environmental and spectral envelopes of species distributions.

B31B-0098 0830h POSTER

Methane Cycling and Flux in Mangrove Ecosystems: A Comparison of Natural and Impacted Coastal Lagoons on the Yucatan Peninsula, Mexico

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Tropical and subtropical wetlands are thought to be the dominant natural source of methane to the atmosphere, and mangrove ecosystems cover approximately 170,000 square kilometers of tropical and sub-tropical land, and dominating approximately 75 percent of the coastline between 25 degrees N and 25 degrees S. Previous studies have shown extremely wide ranges of methane flux from mangrove ecosystems, and have indicated that anthropogenic disturbances such as pollution, sewage discharge, and alteration of freshwater influx can have significant impacts on methane flux from mangrove ecosystems. Due to rapid population growth in tropical and sub-tropical areas and increasing impacts to coastal zones, it is important to obtain information regarding both natural and anthropogenic factors influencing methane cycling and flux within mangrove ecosystems, and to create a better estimate of the contribution of mangrove ecosystems to the global methane budget.

Sampling for this study was conducted in three tropical coastal lagoons surrounded by mangrove vegetation located on the Yucatan Peninsula, Mexico. The three lagoons, Chelem, Celestun, and Terminos have similar vegetation and underlying geology, and are affected by similar seasonal patterns of temperature and precipitation. Significant differences in groundwater discharge and type and extent of anthropogenic impacts exist between the three lagoons. Chelem has moderate to low pollution and little to no ground water discharge. Celestun has very little pollution and large ground water discharges, while Terminos has relatively high impacts from pollution and human disturbance and varying ground water discharge. Previously reported data from these lagoons show distinct differences in methane concentrations in the sediment and water from Chelem in comparison to the concentrations measured in Celestun. Data collected over three seasons from Chelem and Celestun will be presented, providing information about seasonal variability in sediment and water methane concentrations and estimated methane flux to the atmosphere from these mangrove ecosystems. Additionally, methane concentrations in sediment profiles and surface waters of the three lagoons will be compared in order to examine differences in methane cycling and flux potentially related to human impacts.

B31B-0099 0830h POSTER

Biogeochemical Characterization of Constructed Wetland Functions

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Agricultural productions areas of the Midwestern United States are recognized as significant contributors of nonpoint source pollution and influence many aspects of water quality at both local and regional scales. In addition, ambitious land improvement programs stemming back to the mid-1800s have resulted in widespread loss of wetlands throughout the U.S., including heavy losses in agricultural production areas of the Mississippi River Basin. The combination of these two factors has been directly implicated as a contributing factor to high-profile environmental problems such as exacerbation of the zone of hypoxia in the Gulf of Mexico. Constructed wetlands are recognized for their potential to help mitigate the effects of agricultural nonpoint source pollution and previous loss of wetlands. The vast majority of previous studies of constructed wetlands have focused on the bulk movement of water quality constituents such as nitrogen, phosphorus, total carbon and sediment. While insightful, these studies do not address more detailed aspects of wetland function as it pertains to carbon flux and storage. In this study, we present results from biogeochemical analyses of influent and effluent of an experimental wetland constructed near row crop and animal production facilities in North-central Indiana. Cross flow utrafiltration and chemolytic techniques were used to collect and characterize organic components of wetland influent and effluent. Biomarker molecules were used to describe functions of the constructed wetland.

URL: http://www.eas.purdue.edu/~filley/

B31B-0100 0830h POSTER

A Record of Vegetation Change in Chinese Loess Plateau Inferred From Biomarker Study

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A knowledge of the response of terrestrial vegetation to climate change in the past is central to the construction of global carbon budgets, and to the prediction of the terrestrial biosphere response to anthropogenically forced climate change in the future. The Chinese loess-paleosol sequence constitutes an important record of variation in Asian monsoon climate during the past. Long-chain n-alkanes are biomarkers from high plants and thus can reflect vegetation cover.

The typical loess profile in central Chinese Loess Plateau was sequentially sampled at 10cm interval for 5m, in order to understand the relationship between vegetation (type and biomass) and climate during the past 40k years. There is significant difference in the concentration of n-alkanes between Holocene and last glacial. Total alkane concentration is higher in marine stage 3 samples than in last glacial maximum (LGM) and Holocene samples. Individual n-alkane presents even clearer clue. n-C31 concentration is significantly higher in stage 3 samples than LGM and Holocene samples. n-27, 29 and 33 has the same trend but with less variation. It was argued that the Chinese loess plateau experienced wet weather during stage 3. Our data seems to support it. n-alkane concentration is low in LGM samples, related with the cold and dry weather. The variation of n-alkane concentration in Holocene samples may be due to anthropogenic intervention. ACL (average chain length) shows high value in last glacial. It may be related with differential preservation of long-chain alkanes. CPI (carbon preference index) also has a higher value in last glacial but show variation. The ratio of n-C33/n-C32 is obviously higher in last glacial.

The primary result is encouraging. Further work on the carbon isotopes of individual n-alkanes will help trace the C3/C4 vegetation change during the last 40ka.

B31B-0101 0830h POSTER

Monitoring and Modeling Land Use Change and Future Scenarios in the Baltimore - Washington Metropolitan Region

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Recent land use change patterns were mapped with Landsat satellite imagery and used to calibrate a model of future land use change in the Washington, D.C.- Baltimore - Northern Virginia metropolitan region. The SLEUTH cellular automata model, which is spatially explicit, was used to simulate the influence of various policy scenarios and land management practices based on a variety of environmental, transportation, and other data sources. The model was calibrated on four urban extent time steps from 1986-2001 Thematic Mapper imagery and a new impervious surface mapping algorithm developed by the mid-Atlantic Regional Earth Science Applications Center (RESAC) at the University of Maryland. Future growth patterns were predicted based on variable specific growth coefficients derived during the calibration phase. An excluded layer, which is the primary tool used to model different conservation policies, was manipulated to simulate different land conservation scenarios recommended by Chesapeake Bay restoration efforts, both public and private. The three different regional policy scenarios included current trends, smart growth, and environmentally sustainable. The first scenario incorporated current conservation and land use policies, including currently protected lands and identified Priority Funding Areas. In the smart growth scenario, growth was concentrated around existing growth centers and some additional natural resource protection policies were included. The environmentally sustainable development scenario, in addition to focusing growth into existing centers, implemented stricter controls to preclude forest fragmentation, wetland loss, and development adjacent to riparian areas. Results from these three scenarios were assessed and compared, and the sensitivity of the model to cell size and exclusion probabilities was examined.

URL: http://www.geog.umd.edu/resac

B31B-0102 0830h POSTER

Exploitation of Surface Albedo Derived From Meteosat Data to Characterise Land Surface Changes due to Vegetation Fires

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An advanced algorithm for the characterisation of land surface properties on the basis of Meteosat-5 data has been developed and applied to year 1996 observations. Surface albedo values corrected from atmospheric effects and computed for a fixed Sun location have been derived for every day of 1996. A simple composite procedure has been applied over consecutive 10-days periods to produce geographically complete maps of surface albedo over Africa. The temporal variation analysis of these data has shown the high sensitivity of surface albedo to biomass burning activities during the dry season at continental scale.

Seasonal variations of surface albedo have been investigated over the African Central Republic in more detail. At the beginning of the dry season, a sharp decrease of albedo is observed over areas where active fires are detected with NOAA-AVHRR data. These low albedo values last during the entire dry season and then slowly increase from January to March. A specific algorithm has therefore been designed to evaluate the probability that a pixel is affected by biomass burning, based on the temporal profile analysis of surface albedo. Such probability is delivered for each 10-days period. When applied systematically over the African Central Republic, the temporal dynamic of fire activities appears clearly, progressing southward during the dry season. These results are in good agreement with burnt area maps produced with NOAA-AVHRR data.

The temporal analysis of surface albedo derived from Meteosat observations appears therefore appropriate for the monitoring of burnt areas. It reveals the importance of biomass burning impact on surface albedo at the continental scale. Since almost 20 years of Meteosat data is currently archived, these data represent an unprecedented source of information to study the inter-annual variability of such process.

B31B-0103 0830h POSTER

Land-cover Change Mediating Nitrogen Trace Gas Emissions From Savanna Soils of North Texas

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Soils of savanna ecosystems are known sources of nitrogen (N) oxide trace gases (nitric oxide: NO and nitrous oxide: N_2O). However, little is known about the spatial and temporal variation of N oxide emissions in southwest US rangelands, and no regional analyses have produced well-constrained estimates of the effect of large-scale woody encroachment of the N-fixing shrub, *Prosopis glandulosa*, on trace gas emission. The primary difficulty has been in determining range of N oxide emission values associated with changes in woody cover and variation in soil type.

Soil fluxes of NO and N_2O were measured during six observations over one year on nine sites spanning a range of plant canopy cover on two soil types. Local variability at a given site was examined through stratified measurements beneath tree canopy and in grass interspaces between canopies. Soil and air temperature as well as soil water content and canopy area were measured in conjunction with each sampling period. Relative measures of N availability were determined through laboratory assays of inorganic N content and nitrification potential.

Proportion of plant canopy cover was the dominant control on N oxide emissions. Soil NO fluxes increased linearly from 0.1 to 5.2 kg N-NO ha^{-1} yr^{-1} across a range of plant canopy area extending from 5 to 340 m^2. Soil NO fluxes were six times greater from sites located on clay loam soils than on shallow clay soils. However, soil NO fluxes were not statistically different from under the tree canopy and in the grassy inter-space within a given soil type. NO emissions were largest from all sites during the growing season (sampled May, July, August) when temperatures were warm and the canopy was in full foliage. Temperature was the dominant abiotic control on NO emissions from all sites soil moisture content was a poor predictor of NO emissions, however, volumetric soil water contents below 20% appeared to restrict the response of NO to temperature.

Linking these relationships with regional scale data from MODIS and AVIRIS will contribute greatly to our understanding of biogenic nitrogen production, transport and redeposition issues in the Southwestern U.S.

B31B-0104 0830h POSTER

A Regional Modeling Study of the Influence of Urban Land Cover Change on the Lower Atmosphere in Baltimore-Washington DC

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The land-use and land cover (LULC) history of the Baltimore-Washington region has been intensively studied through a variety of environmental research collaborations and regional partnerships. One such partnership, the Baltimore-Washington Regional Collaboratory, involved multiple Federal and local agencies cooperating on a 200-year urban growth study in the Chesapeake region. Information from this study on pre-1900 and current LULC conditions for the Baltimore-Washington DC area was integrated with data from other sources to construct different lower boundary conditions for a series of simulations using the Colorado State University (CSU) Regional Atmospheric Modeling System (RAMS). We use the RAMS simulations to diagnose the extent and nature of the effect of urban anomalies in surface heat, moisture, and momentum on mid-summer local and regional climate.

The experimental design adopted for this study takes advantage of the grid-nesting capability of RAMS. A fine grid with 1km horizontal resolution was nested into a coarser 5 km grid, which extends from southern Pennsylvania, Maryland, to parts of Virginia, and West Virginia. Two sets of month-long simulations for July 2000 were conducted with RAMS running in parallel on a 26-processor cluster of computers at the Cooperative Institute for Research in the Atmosphere (CIRA), CSU. In the first set of simulations, we initially used satellite-derived current land cover data as the lower boundary condition in a 31-day RAMS run. We then replaced this data with the pre-1900 land cover data for the same region and ran a similar RAMS simulation. Identical observed meteorology was retained for the lateral boundary conditions in both cases. The model results for the initial run were validated with July 2000 surface climate data and flux measurements of sensible and latent heat from sites located within the fine grid model domain.

Additional simulations were conducted to compare RAMS model performance using prescribed land surface conditions with results from a physically based scheme for urban energy budget coupled to RAMS. The urban surface scheme used here is the Town Energy Budget (TEB) model recently developed at the Center for Meteorological Research (CNRM), France. The TEB model allows for a refinement of model computed radiative budgets, heat and momentum based on a generalization of the classic canyon approach. Results from both sets of simulations, and the implications, for surface climate, of the driving human-induced land cover transformations are discussed.

B31B-0105 0830h POSTER

Quantitative Reconstruction of Grassland and Forest Cover in Southern Sweden Inferred from Fossil Pollen Records

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When reconstructing past land-cover changes induced by humans at local to regional scales, primary interest is to quantify vegetation cover of forest and grassland. Fossil pollen records have great potential in that respect. However, quantitative reconstruction using pollen always require well-established pollen/vegetation relationship in the region of interest. In particular, pollen productivity and dispersal are two major factors, controlling the pollen representation of the surrounding vegetation in a basin (lake or bog), thus need a better understanding. Based on empirical studies in the ancient cultural landscape of southern Sweden, we have obtained pollen productivity estimates (PPE) for major taxa relevant for that region. These PPE show that arboreal taxa produce 10-40 times as much pollen as non-arboreal taxa. Considering significant input of background pollen dominated by arboreal taxa the area of open grassland in the past could often be underestimated when estimated directly from non-arboreal pollen percentages in fossil pollen records. To better understand the problem, we compare quantitative estimates of vegetation cover inferred from fossil pollen records in two regions of southern Sweden, where vegetation composition and structure are significantly different. One region is dominated by cultivated and grazed open-land with scattered wood patches (OPEN), while the other region is mostly forested with scattered patches of cultivated and grazed land (SEMI-OPEN). The reconstruction follows the "Landscape Reconstruction Algorithm" (LRA) approach, which estimates vegetation cover within a given catchment area around the pollen site using PPE and estimates of background pollen for that region. The results are compared to the historical records in the region at several time horizons to validate the LRA approach. Our results show that open grassland cover is always underrepresented when only NAP percentages are used, with various degrees depending on regional vegetation composition and structure.

B31C MC: 122 Wednesday 0830h

Nonlinearity and Complexity in the Biogeosciences I *(joint with NG)*

Presiding: **J F Reynolds,** Duke University**; P Canadell,** GCTE International Project Office

B31C-01 0835h INVITED

Nonlinear Changes in Soil Properties and Their Impact on Ecosystems

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Soils are open systems that act as a membrane at Earths surface. Water and dissolved acids are the main materials transferred into soils, whereas water and lithogenic solutes dominate the output with the net result being depletion of rock forming constituents such as silica and base cations that are also ecosystem nutrients. The time-dependent coupling of water flux and chemical reactions determines the nature of the colloidal phase that is responsible for nutrient retention. Pedogenesis is a biogeochemical process that is constrained by thermodynamics, but still maintains considerable flexibility as a result of parallel reaction kinetics and a spatially heterogeneous matrix. In the open system, there are many processes that are governed by nonlinear response to changes in environmental variables and/or internal soil properties. From a thermodynamic perspective, the chemistry of pedogenesis is characterized by a number of thresholds. Simultaneous acid-base, ion exchange, redox and mineral transformation reactions interact to determine the direction and rate of change. Over time, the reaction of atmospheric acids with soil bases changes the acid neutralizing capacity of soil to an extent that is controlled by the prevailing buffering reactions. The amount of buffering reaction and effect on pH depend on the nature of the reactive species, their relative amounts, and their respective rates of reaction. Ion exchange and surface complexation reactions consume protons in the short term but long-term buffering derives from mineral weathering. The nature of the governing reactions is such that soils are well buffered to pH change in the alkaline and acid regions but far less so in the neutral to slightly acid zones. In an analogous fashion, organic matter may drive oxidation-reduction processes through a stepwise consumption of electron acceptors (thereby producing thresholds). Mineralogical change tends to occur in a serial, irreversible fashion that, under favorable environmental conditions, can lead to large accumulations of specific minerals whose crystallinity changes over time. These accumulations and associated ripening processes can channel soil processes along existing pathways or they can force thresholds by causing changes in water flux and kinetic pathways. Examples of the influence nonlinear pedogenic change on ecosystem properties can be well illustrated using chronosequences and climosequences sampled on the Hawaiian Islands.

B31C-02 0855h

Extremes and Threshold Controls on Rangeland Ecosystems and the Evolution of the Non-Equilibrium Paradigm

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The dynamics of rangeland ecosystems involve many factors whose simultaneous action and complex interactions are poorly understood at the relevant temporal and spatial scales. Nonlinear, complex interactions among the drivers of change are some of the main sources of this uncertainty. This includes regime shifts in climate, water movement across landscapes (e.g., key feedbacks between rainfall interception, soil erosion, and nutrient transport), exotic species invasions, and plant physiological responses to episodic rainfall events. In recognition of these nonlinearities, during the past several decades there has been a