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with dynamic spatial modeling, which provides insights in landscape level implications. The approach is illustrated with a case study at the forest frontier in the Philippines.

Keywords: land use, modelling, actor-based, CLUE, Philippines

**Dr. Amy Owen, Delta State University. Email: aowen@deltastate.edu; Community Use Of GIS For Water Protection: Field Studies On An Idaho Indian Reservation**

States are using Safe Drinking Water Act Legislation and United States Environmental Protection Agency (EPA) guidance to determine protection zones for municipal water sources. This study explores the use of State-generated GIS data by these communities, including protection zones, infrastructure, land use and contaminant inventory data. Nine communities with populations under 10,000 within the boundaries of the Nez Perce Indian Reservation selected data and helped create mapping tools that they deemed useful for water protection. Additionally, four of these communities participated in a study of the use of options for improving community notification and involvement in developing drinking water protection plans. The study offered options within the existing plan development framework that leads to State of Idaho certification of a protection plan. The results recommend participant-centered options for increasing rural community involvement in resource planning and protection within existing regulatory frameworks.

Keywords: GIS, Communities, Water Resources, Idaho, Indian Reservations

**Tim Owen, NOAA's National Climatic Data Center. Email: Tim.Owen@noaa.gov; Climate Services Partnerships: NOAA's National Climatic Data Center and Regional Climate Centers**

NOAA's National Climatic Data Center (NCDC) and the affiliated Regional Climate Centers (RCCs) have been working closely with climate community partners, including NOAA's National Weather Service/Climate Services Division, to enhance its data quality assurance and data dissemination protocols. With the maturation of its Applied Climate Information System (ACIS; <http://www.rcc-acis.org/>), the RCCs are synchronizing their near-real-time data ingest and dissemination capabilities with the NCDC archive to deliver end-to-end climate information. This talk will focus on three critical advances in the RCC-NCDC architecture: i.) a formal data feedback mechanism for reporting data quality concerns; ii.) RCC-NCDC data quality assurance synchronization; and iii.) a web-based data query system for easy access to climate information by climate community partners and the public. In addition, the status of joint RCC-NCDC climate services delivery through the NOAA/NESDIS e-Commerce System (NeS) will be discussed. The benefits of the resultant improved information delivery for scientists, engineers, decision makers, the educational community, and the public will be highlighted.

Keywords: climate, data, archive, applied meteorology

**Bronwyn Sigrid Owen, University of Colorado. Email: owenb@colorado.edu; Modified biotic interactions at meadow edges in southern Sweden: the influence of site factors.**

Much of the research on forest-meadow boundary 'edge effects' has focused on the forest side of the boundary. To date, it seems only a handful of studies specifically address the non-forested side of a forest-meadow boundary. In southern Sweden, the landscape is a mosaic of agricultural lands, hay-meadows and grasslands, deciduous and coniferous forests. Semi-natural, traditionally managed meadows are an important cultural, historical, and ecological feature of this landscape. Much ecological research has addressed management implications (i.e., mowing vs. grazing) and other human activities (i.e., fertilization, pollution) on these areas. However, little is known about the vegetation at meadow edges and the abiotic effects on them. Effective management of these areas relies on an understanding of how individual species as well as community-level attributes respond to the edge environment. In addition, it is necessary to understand the site factors that might influence meadow edge characteristics. This study focused specifically on meadow edges that differed with respect to site factors: adjacent forest cover type (coniferous vs. deciduous), intensity of acidic deposition, and boundary orientation. In most cases, edge effects did not penetrate beyond ten meters into meadows. However, edge effects did vary depending on site factors.

Keywords: edge effects, semi-natural meadows, atmospheric deposition

**Tom Owens, United States Geological Survey. Email: tom\_owens@usgs.gov; Jill Baron, U.S. Geological Survey. Email: ; William Langer, U.S. Geological Survey. Email: ; L.R.Arnold, U.S. Geological Survey. Email: ; Richard Conant, Colorado State University. Email: ; Patti Orth, Colorado State University. Email: ; Development and Application of Human and Environmental Indicators in the Colorado Front Range**

The Colorado Front Range is a rapidly changing region where land use change, water and energy development, and public lands management policies are

beginning to overlap and conflict. While a tremendous amount of environmental information is produced each year for this region, not all of it is technically credible, policy relevant, and politically legitimate. The USGS is well-known and respected for producing objective, credible data. However, USGS has less experience knowing what information and at what level of detail are relevant to the questions facing regional policy and decision makers. When issues emerge, policy makers can build upon the common understanding of environmental condition to focus on legitimate public policy debates rather than on the quality of the underlying information. Working iteratively with policy makers from local to regional levels and using the Heinz Report as a blueprint, USGS will define and develop environmental indicators that meet the criteria of being technically credible, policy relevant, and politically legitimate. Small thematic workshops are being held to develop a set of regional environmental and natural resource indicators that objectively describe the state of this region. These indicators will serve as the unbiased core around which regional environmental policies are debated. The Colorado Front Range will serve as a test case for this approach, which, if successful, will be exported to other regional place and topic priorities. This paper will present the results obtained by the workshops to date and plans for completion of this project.

Keywords: environmental indicators, Colorado Front Range, public policy

**Mr. Kwadwo Owusu, . Email: Kowusu@ufl.edu; Professor Peter Waylen, . Email: prwaylen@geog.ufl.edu; Analysis Of Rainfall Variability In Sub-Humid Ghana**

This study analyzes the characteristics of rainfall regime and its variability in sub-humid mid-Ghana, using daily rainfall data from the Wenchi meteorological station, 1950-2000. Prior research in the area, suggests that the major causes of climatic variability occurs at lower frequencies than the typical ENSO signal and may be more closely related to noted shifts in global climatic patterns. A regional analysis of annual and monthly data is first conducted to place the study in its national context. In each year of record, "growing cycles" are established commencing at day 30 (Jan. 30) and finishing day 305 (Oct. 31), at 5-day intervals. The quantity and distribution of rainfall in each is described by three variables: total rainfall, number of rainy days and relative entropy. Given the widely noted global climatic shift in the 1970s and the results of the regional analyses, the 50 year record at Wenchi is sub-divided into two 20 year periods, 1950-1969 (period I) and 1980-2000 (period II). The means and variances of the three variables in each growing cycles, between periods, are compared to identify any times in the year when the significant changes in rainfall characteristics are most noticeable within the rainfall regime. Results from all three variables are consistent in suggesting that the main rainy season and the long dry season are relatively unchanged, however the short dry spell is becoming wetter and the minor rainy season becoming drier and shorter in period II.

Keywords: Rainfall Variability, Ghana

**J. Henry Owusu, University of Northern Iowa. Email: owusu@uni.edu; New Trends in Ghana's Timber Trade.**

Ghana's adoption of a free-market based economic recovery program in 1983 marked a major watershed in the volume, content and direction of its timber trade. This paper utilizes qualitative analysis to closely examine the new patterns of change. It attempts to document the emerging patterns, and identify and assess the domestic and international factors that account for the change. A preliminary observation is that the traditional European market continues to erode as markets in the Middle East, Asia/Far East, North America, Oceania, as well as some West African countries steadily become relatively more important. This market diversification and expansion is also associated with a diversification of the content of trade, especially after the traditional log exports were curtailed in favor of non-traditional teak exports and increased emphasis on the export of processed wood. Government policy plays a major role in the new trends in the timber trade in combination with new realities rooted in the process of globalization on the international arena.

Keywords: Ghana, Timber trade, Forestry sector

**Francis Owusu, Iowa State University. Email: fowusu@iastate.edu; Multiple Livelihood Strategies in African Cities: Implications For Planning And Development**

The African economic crisis of the 1970s and early 1980s led to the intensification of poverty, particularly among urban residents. Yet the neoliberal economic reforms that were later implemented across the continent did not address problem of urban poverty; in fact, the reforms were informed by the "urban bias" assumption. As a result, the living standards of many urban dwellers, especially those on fixed incomes have continued to decline substantially. Many individuals and households, including those with salaried employed, responded by becoming more involved in multiple economic activities that often combined the formal sector employment with informal sector activities to supplement their incomes. Despite the proliferation of such activities, the practice has remained