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Food and Water Security

Hydro-climatic erodibility modeling for sustainable development within the Lower Benue Trough, Nigeria

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ABSTRACT

Soils landscapes could be achieved by superimposing digital soil maps with slope polygons derived from digital topographic maps. The digital maps of the factors influencing or causing soil erosion are combined to evaluate the climate and geo-potential energy to determine erosivity and resistance of soil types and land cover. Soil Erosion is ravaging most parts of eastern Nigeria and the pressure on the land for infrastructural development is ever increasing and may not ease in the foreseeable future thus a study was carried out to determine the susceptibility of soils in some parts of Eastern Nigeria (within the Lower Benue Trough) to erosion with a view to develop regional scale maps and identify combinations of soils, landforms and land cover that may respond to climate variability. The factors of vegetation, rainfall, soil types and topography that cause or influence land degradation were studied using conventional soil survey, remote sensing surveys and the Revised Universal Soil Loss Equation (RUSLE). The factors were digitized within Geographic Information System (GIS) environment to determine the susceptibility of the study area to soil erosion. Field and laboratory investigations in line with American Standard for Testing and Materials (ASTM) procedure were carried out as well as interpretations from topographical maps and aerial photographs to evaluate the landscape in the study area responses to climatic variability using 37 years (1970-2007) rainfall data. The result of the investigation showed that deforestation is alarming with no reforestation programme, steep slopes abound and the most erodible soil (silt) accounted for 74.75% of the soils analyzed. Similarly, the soils in the area were found to be highly erodible, belong to the same formation and thus have the same engineering behavior. The high Slope-Length factors provide a good plat form for hydro-climatic activities. Similarly, the low values of the Crop factor are suggestive of good ground cover. The study also found out that the vegetation significantly reduced the high risk of erosion to moderate and manageable level. This is evident as Moderately Potential Erosion is almost the same as Actual Erosion. Adequate precaution is therefore necessary if the vegetation is to be disturbed for any form of development especially in the high risk areas where the erosion rate is above 30 tons/ha/year. The total rainfall for the period under study was 82273.3mm eroding 3.72×10^{10} tons of soil at a rate of 1725.13t/ha/yr. The equation derived from this relationship that could be used to predict the amount of rainfall and soil loss at a particular period for the study area and thus land use utilization is: Annual Soil Loss (t/ha) = 924.6912 + 0.9710*Precipitation (mm). During the interpretations of the satellite imageries, it was observed that gully erosion existed in the study area but during the field investigations, the gullies were observed to be mining sites. This is to stress the need for ground truthing. The spatial relationship between resistance and potential disturbance are the basis for determining the sensitivity of the landscapes to soil erosion. The study showed that when soil and geological surveys, land cover data, and digital elevation models are combined in a GIS environment, landscapes can be stratified according to the dominant controls of hydro-climatic erosion. The homogeneous map units could be created by overlaying digital soil, topographic and land cover data in a GIS. The information generated will assist in formulating policies and programmes that will minimize incidences of soil erosion for sustainable development in the study area.

Environmental Sensitivity Index Mapping of Atlas Cove, Lagos Nigeria

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ABSTRACT

Relative sensitivities to oil spill of the various shorelines around Atlas cove Lagos were investigated. The objective of the study is to produce an environmental analysis index map of shorelines of Atlas cove. A rapid assessment approach was employed for the shorelines and the outcome of the rapid assessment was authenticated by the standard ESI validation look up table. Results shows that nine categories of shoreline types are in the area and there are seven ESI types namely; 1b, 2a, 3a, 6b, 9b, 10a and 10c and that the area is relatively highly vulnerable and sensitive to oil spill

KEY WORDS: Environmental Sensitivity Index, Oil spill, Remote sensing

Assessing and modeling the impact of climate variability on the severity of rust diseases and wheat production over Arsi highlands, Ethiopia

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ABSTRACT

El Nino/Southern oscillation (ENSO) is one of the most important and best-characterized mechanisms of global climatic variations. It has tremendous impacts on local, regional and global climatic conditions by disordering the normal patterns. Tropical agricultural practices are very sensitive to climatic anomalies that jeopardize the performance of crop production by generating water stress or excess during various developmental stages of crops.

The Arsi highland is confined within the tropics. Climate of this region is highly influenced by global circulation patterns that govern the local climate. Among crop varieties that grow over the Arsi highland, number of wheat cultivars is widely cultivated both at individual farm levels and mechanized state farmers. Previous studies have revealed that these cultivars are highly sensitive to seasonal rains, temperature and relative humidity occurring during the sowing, germination, vegetative, flowering, and seed-filling and harvesting periods.

Attempt is therefore made to examine among others the coherence or lag-time relationships exist between local climate variables and teleconnection parameters such as ENSO and other prominent atmospheric phenomena. Besides, this study is trying to see whether there exist any linear association between the severity of rust diseases and local climatic variables that affect the overall performance of wheat crop and climatic parameters.

The study results revealed that ENSO has played a great role in modulating the seasonal rainfall over the Arsi highlands, which in turn influences wheat crop performance. In particular, it has induced rust diseases over the regions that significantly affect the quality and quantity of wheat yield. In view of this, we propose that skillful early warning can be well practiced by acquiring appropriate lead-time climate-based forecasting of on the possible occurrence of both climates and diseases on varieties of wheat crops across the Arsi highland. In addition to this, on the basis of our findings it will be possible to identify less climatic sensitive wheat cultivars that may give high productivity over the study region.

The relationship between altimeter lake level data and areal extent of water and vegetation derived from MERIS optical data in the Lake Chad basin

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ABSTRACT

Seasonal water level fluctuations occurring in the Lake Chad are triggered by the river volume discharges from the Chari River system. The seasonal inundation is an important economic activity as it provides impetus for fishing and recessional farming activities. Interannual lake fluctuations lead to dry and wet years with negative and positive impacts on the economic activities of the area. Monitoring the hydrological dynamics of this remote lake is difficult using conventional methods. Remote sensing offers an alternative to examining seasonal lake fluctuations. The feasibility of relating radar altimeter lake height level data to areal extent of water and vegetation is examined using TOPEX/POSEIDON (T/P) altimeter data and visible wavelength, medium resolution MERIS images. Since altimeter data were not available for the MERIS image dates, the altimeter lake level data covering a time series of five MERIS image dates were estimated from regression analyses of (i) Chari river volume discharge data and T/P radar altimeter data and (ii) lake height level data and T/P radar altimeter data. Due to the relatively low resolution of MERIS, the time series MERIS images were spectrally unmixed to three endmember fractions i.e. soil, vegetation and water. The relationships between (i) the areal extent of water and derived altimeter values and (ii) the areal extent of vegetation data and derived altimeter values were investigated over a seven month period for both cultivated and swampy areas of the lake. The coefficients of determination for extent of water and lake level ranged from 0.0983 to 0.8397, while for extent of vegetation and lake level it was negative in four of the six sub-regions and ranged from 0.0027 to 0.7288. Generally, the results revealed that different regions of the lake basin exhibit different relationships between water level and areal extent. The actual relationships are not so apparent when surface distributions alone are examined with the use of visible remote sensing images such as MERIS since factors such as the local ground water regime and seasonal climatic conditions can influence the horizontal spread of water. In the swamp areas, there is no definable relationship between swamp vegetation and water level because the area of swamp vegetation was found to be constant over time in the lake basin. There was also no definable relationship between cultivated vegetation and lake level on polder farms located in the interdune depressions, because the timing of the cropping cycle at the polder farms is influenced by human control of irrigation, rather than the rise and fall of the level of the lake. But the correlation observed on the small coastal farms along the southwestern shoreline indicated that in this sub-region, which is occupied by small scale farming families, the timing of the cropping cycle was influenced by the rise and fall of the level of the lake.

KEY WORDS: Lake Chad, Radar altimeter, MERIS, Lake Level, Areal extent.

Projected changes in mean and extreme precipitation in Africa under global warming

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ABSTRACT

This paper presents likely changes in mean and extreme precipitation in Africa in response to changes in radiative forcing using an ensemble of global climate models prepared for the IPCC Fourth Assessment Report (AR4). Extreme seasonal precipitation is defined in terms of 10-year return levels obtained by inverting a generalised Pareto distribution fitted to excesses above a pre-defined high threshold. Both present (control) and future climate precipitation extremes are estimated. The future to control climate ratio of 10-year return levels is then used as an indicator for the likely changes in extreme seasonal precipitation.

A Bayesian approach to multi-model ensembling is adopted. The relative weights assigned to each of the model simulations are determined from bias, convergence and correlation. Using this method, the probable limits of the changes in mean and extreme precipitation are estimated from their posterior distribution.

Over the western parts of southern Africa, an increase in the severity of dry extremes parallels a statistically significant decrease in mean precipitation during austral summer months. A notable delay in the onset of the rainy season is found in almost the entire region. An early cessation is found in many parts. This implies a statistically significant shortening of the rainy season. A substantial reduction in moisture influx from southwestern Indian Ocean during austral spring is projected. This and the pre-austral spring moisture deficits are possible mechanisms delaying the rainfall onset in southern Africa. A possible offshore (northeasterly) shift of the tropical-temperate cloud band is consistent with more severe droughts in the southwest of southern Africa and enhanced precipitation further north in Zambia, Malawi and northern Mozambique.

This study shows that changes in the mean vary on relatively small spatial scales in southern Africa, and differ between seasons. Changes in extremes often, but not always, parallel changes in the mean precipitation.

There is substantial evidence in support of a positive shift of the whole rainfall distribution in East Africa during the wet seasons. The models give indications for an increase in mean precipitation rates and intensity of high rainfall events, but less severe droughts. Upward precipitation trends are projected from early this (twenty-first) century.

As in the observations, a statistically significant link between sea-surface temperature (SST) gradients in the tropical Indian Ocean and short-rains (October–December) in East Africa is simulated in the GCMs. Furthermore, most models project a differential warming of the Indian Ocean during boreal autumn. This is favourable for an increase in the probability of positive Indian Ocean zonal mode (IOZM) events, which have been associated with anomalously strong short-rains in East Africa.

On top of the general increase in rainfall in the tropics due to thermodynamic effects, a change in the structure of the Eastern Hemisphere Walker circulation is consistent with an increase in East Africa precipitation relative to other regions within the same latitudinal belt. A notable feature of this change is a weakening of the climatological subsidence over eastern Kenya.

East Africa is shown to be a region in which a coherent projection of future precipitation change can be made, supported by physical arguments. Although the rate of change is still uncertain, almost all results point to a wetter climate with more intense wet seasons and less severe droughts.

Analysis of the impacts of urban sprawl on urban agriculture: Case study of Ile-Ife town in Osun State, Nigeria

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ABSTRACT

The present paper aims at assessing the effects of urban expansion on the farmlands in Ile-Ife Township and appraises the changes that occurred in the landscape from 1986 to 2008. It has been observed that the increase in population of Ile-Ife has led to the changes in the land cover trough the conversion of the peri-urban vegetation and farmlands to built-ups in order to meet the accommodation needs of the rapidly increasing population. The conversion is presently affecting the supply of food stuff thereby making food items to be very expensive. Therefore the land cover needs to be properly identified and mapped to support meaningful planning for future food security.

To detect the changes, the study made use of information extracted from Landsat TM 1986, ETM+ 2002, and ALOS 2008. The GPS observations of the existing farmlands around the town were overlaid on the topographic map and on the satellite imageries in order to appraise the changes in the Landuse and land cover over the period.

The change detection analysis using ILWIS software revealed that buildings have occupied what used to be farmlands. The demand for land parcel has gone up. This has led to increased value and cost of the land parcels. Land speculators are fast seizing the opportunity to make brisque business. Many cases of land dispute were noticed during the field data collection. To curb this situation in the study area, education through awareness programmes will be needed for the people and local authorities.

Land Degradation and Food Security in Ghana: Satellite data do not tell the entire story

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ABSTRACT

Remote sensing techniques based on multispectral satellite-acquired data have demonstrated an immense potential as a means to detect, quantify, monitor and map land degradation. However, much of what satellite sensors can detect and capture in the form of vegetation index do not tell the entire story about land degradation. Using the Upper East Region (UER), Ghana as a case study, this research used multispectral remote sensing data from three sensors (AVHRR, Landsat TM, and ETM+) to detect and quantify spatio-temporal land degradation and to validate local observations and perceptions. The study also analyzed data on crop production in search of evidence of land degradation in the study area. Multispectral satellite-acquired NDVI from AVHRR shows that vegetation greenness is on the ascendancy; Landsat TM & ETM+ on the other hand shows widespread localized land degradation. Field evidence suggests that the increasing NDVI was caused by vegetation succession where locally adapted horsetail grasses have been displaced by environmentally efficient, short-lived, quick maturing and dense grasses due to excessive burning, rapid population growth, and inappropriate development policies. Local people's perceptions, supported by crop production data, suggest extensive land degradation. Other evidence gathered includes food insecurity, diseases, rainfall variability and land use extensification.

Land Use and Environmental Dynamics in the Rural Settings: The Case of Lake Nyasa Catchments, Tanzania

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ABSTRACT

Typical to most humid tropics, catchment degradation is common in the Livingston Mountains and Matengo highlands, which are catchments of Lake Nyasa/Malawi on Tanzania side. Since mid 1980s, these catchments have been subjected to undue pressure primarily in the form of severe deforestation from extensive slash-and-burn and uncoordinated farming activities. Despite the significance of the Lake Nyasa, the current situation is not widely acknowledged especially on Tanzania side. This study examined the changing land use and the environment along Lake Nyasa and adaptation that people are making to improve their environment and livelihood. Extensive surveys and farmer exchange visits were employed to collect diachronic information on livelihood, land use and environmental dynamics along Lake Nyasa and in the Matengo highlands. Farmers' exchange visits allowed villagers to share insights and experiences in an attempt to establish mutual strategies for sustainable local resource management. Satellite image analysis was utilized to determine changing land use, vegetation cover and lake's water levels in the study area. Local people perceives that, unprecedented degradation of the catchments has appreciably increased sedimentation in the rivers and the lake itself, thereby disturbing aquatic biomes hence, putting the fishing ecology, food security and livelihood of the people in the area at jeopardy. To adapt to changing environment, lowland and upland farmers have formed a network that helps them organize various joint-activities for the purpose of conserving the lake catchments and diversify livelihoods. Joint-farmer group activities include tree planting, bee keeping and establishment of fish ponds. It was found that this trans-ethnic partnership by resource-poor farmers as a strategy to livehihood transformation and landscape conservation is a new phenomenon and intriguing. In most cases livelihood transformations and land conservation are in situ-based due to financial difficulties to handle inter-communities strategies, cultural disparities and differences in local politics. Indeed, the area calls for immediate integrated adaptive measures to conserve and manage the degraded landscape and tranform livelihood.

KEY WORDS: Livelihood, catchmnent degradation, land use, lowland-upland nexus, farmer groups

Identification and Assessment of Potential Fishing Zones Using MODIS Imagery: Case Study of Western Indian Ocean Region

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ABSTRACT

Potential fishing zones are regions where there is a high likelihood of finding fish. These regions are characterised by different environmental conditions that are required for development of fish species. In this research, sea surface temperature (SST) and chlorophyll-a (Chl-a) derived from Moderate Resolution Imaging Spectroradiometer (MODIS) on board the Aqua sensor have been used to delineate areas that are potential for fishing. Image correction for regions with cloud cover was attempted, with no success. SST isolines were overlaid onto Chl-a distribution, maps and areas with visible Chl-a and SST fronts in the north-western Indian Ocean identified as potential zones for fishing. The region off the Somali Coast has been identified as one such section. Various parameters used in the determination of fishing zones in South China sea, India and the Coast of Java were utilised to obtain potential zones for finding different types of fish species. The Gulf of Aden, bordering Yemen and Somalia to the north, have been found the richest regions, with many varieties of tuna species. Results obtained for the fishing zones were validated against fishermen in the region and have been confirmed satisfactory. Different factors contributing to the spread of these fishing zones have also been studied by comparing Chl-a in 2008 and annual means for the years 2004 to 2008. Besides the seasons as determined by movement of surface monsoons, the 2004 tsunami also had a bearing on the amount of Chl-a. River deposits have also been shown to influence the fishing zones. Potential sites for fishing different fish species have been identified on the Gulf of Aden, coincidentally in regions prone to piracy activity. There is need for proper validation of the fishing sites using fish catch data. Impact of tsunami needs to be studied further using more data and development of a fish forecasting system is proposed. Other parameters may also be included to get precise fishing locations.

KEY WORDS: Potential Fishing Zones, Western Indian Ocean, Image Correction, MODIS Aqua, Sea Surface Temperature, Chlorophyll-a, Assessment of Potential Fishing Zones

Short-term Assessment of Land use Transformation and Shoreline Changes at the Northern Zone of the Nile Delta Coast, Egypt

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ABSTRACT

The Nile Delta in Egypt has been subjected to extensive unplanned development projects. To assess the present environmental status and to detect the short-term adverse impact on the coastal land during the period from 2003 to 2006, high resolution Landsat and Spot images were examined. The study focused on the northern/middle part of the Delta from Abu Quir to the west and Damietta Governorate to the east. This area shows significant changes that are mainly attributed to several coastal processes resulted from the unprecedented human activities during the past few decades. High resolution Landsat and Spot images were used to provide information on coastal land use changes and provided 5 important classes. GIS technique offered a spatial analysis of the detected changes that quantified the rate of changes and helped in defining the controlling factors of such highly populated highly dynamic environment. Results demonstrated a considerable rate of land forms transformation in favor of developing of urban (+28.1 km2), roads (+1174km.) and fish farms (+20.7 km2). The development of such land use classes was unfortunately at the expense of the agricultural land (-32.5 km2), along the north and middle section of the Nile Delta coast. The national economy and the socio-economic status at this highly populated area aided in accelerated such land us transformation and led to several hazards. A drying area of some inland lakes was one of the consequent hazards of such human activities.

An Analysis to Determine the Security of Air and Surface Water Quality in Akwa Ibom State, Nigeria

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ABSTRACT

One of the problems facing humanity today is the lack of accurate and up-to-date spatial data for planning and development. Organizing national surveys to generate baseline datasets can be time consuming and costly. The challenge now is how to update existing datasets and/or generate new ones. This study is on the EIA as a cheaper and cost-effective source of spatial data in Akwa Ibom State, Nigeria.

Environmental impact assessment (EIA) is an important procedure for ensuring that the likely effects of new development on the environment are fully understood and taken into account before the development is allowed to go ahead.

The main steps in the EIA process are: screening, scoping, prediction and mitigation, management and monitoring and audit. The main output report is called an Environmental Impact Statement. It usually contains among other things, a lot of detailed information and data on the condition of the project area prior to the project's implementation.

This study focuses on air and surface water quality because not much is known about the condition of these resources in the State. This is in spite of their relative importance to mankind's continued existence and comfort. For instance, the presence of greenhouse gases in the atmosphere is said to be responsible for global warming [IPCC, 2007]. Furthermore, the ocean is a huge carbon sink, holding about 50 times as much carbon as the atmosphere. A "carbon sink" is a natural system that stores carbon over thousands of years. Ocean ecosystems' ability to sequester carbon is expected to decline as the oceans warm. This is because warming reduces the nutrient levels of the mesopelagic zone (about 200 to 1000 m deep), which limits the growth of diatoms in favor of smaller phytoplankton that are poorer biological pumps of carbon. Now scientists are realizing that the increased thermal stratification of the oceans has caused substantial reductions in levels of phytoplankton, which store CO_2. The tiny plants of the ocean, are suffering from the effects of global warming, which means they are becoming less able to store carbon, further contributing to climate change. As carbon sinks fail, the amount of carbon in the atmosphere climbs.

The southern part of Akwa Ibom State is where most of all the industries in the area are sited. Because of this, there are many EIA reports on projects in the area. Unfortunately, these reports are presently gathering dust in the Ministry of Environment apparently because the necessary approval had been secured.

In this study therefore, the coordinates of air and water sample locations were retrieved from EIA reports. So also were the results of air quality measurements and water samples analyzed. These datasets were overlaid on landuse/land cover maps, soil map, and geological maps of the area to assess the sources of pollutants and the safety/security of air and surface water quality in the study area.

Furthermore, the GIS based overlay analysis using soil map, landuse/land cover maps and maps showing air quality measurement locations and water sample location points also reveals the sources of the air and water pollutants among other things. The paper concludes that because EIA studies and reports are usually based on standardized procedures/Methodologies carried out by experts/consultants in relevant fields as recommended by the appropriate institution or required by legislation and paid for by proponents/owners of projects, it is a cheaper and very reliable source of spatial data for environmental monitoring/management and early warning in countries/regions where there are many development projects as well as laws stipulating that unless an EIA study is carried out, permission for

construction cannot be granted by the local authority. It is recommended that Environmental Agencies especially in developing countries should setup Environmental Management Information Systems and update it regularly with data from different sources including EIA reports. This has become necessary because to deal with the problem of carbon or greenhouse emission and global warming, we need to monitor our surface water [a very important carbon sink] as well as the condition of the atmosphere to determine the source and quantity of greenhouses gases and how long they have remained in the atmosphere.

KEY WORDS: Spatial data, Environmental Impact Assessment, surface water and air quality.

Seeking Multispatial-multitemporal approach to detect and quantify desertification and food security in Africa: A case study of the Upper East Region, Ghana

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ABSTRACT

The causes and effects of desertification are complex and multifaceted, varying from local to regional and from one part of the world to another (Pickup 1998; Veron et al 2006; Prince 2002; Leemans and Kleidon 2002). The severity of desertification impact also varies on a spatio-temporal scale and is difficult to quantify. Remote sensing techniques based on multispectral satellite-acquired data (AVHRR, Landsat TM and ETM+) have demonstrated an immense potential as a means to detect, quantify, monitor and map these changes. However, much of what satellite sensors can detect and capture, especially in the form of vegetation index (NDVI), do not tell the entire story about land degradation due to sensor spatial and temporal deficiencies. This research used multidata, multispatial-multitemporal approach to analyze data from three sensors (AVHRR, Landsat TM, and ETM+ and IKONOS) to detect and quantify the spatio-temporal extent of desertification in Africa, Sahel West Africa and the Upper East Region (UER), Ghana. Analysis of NDVI data over the continent of Africa shows that the mean annual NDVI from 1982-2007 rises and fall every two to three years. The NDVI declined from 1982 to 1983 and rose from 1984 to 1986 and declined again. Periods of low NDVI observed in the 26-year NDVI trend analysis include 1982-1983, 1988, 1994, and the largest stretch of an 8 year period from 1997-2005. The rise and fall of the NDVI trend from 1982-1997 suggest regular drought on the African continent. The general conclusion is that NDVI is increasing on the African continent, yet this does not nullify the possibility of desertification in some parts of the continent, since desertification occurs in arid, semi-arid, and dry sub-humid regions. It was therefore important to focus on regions where there were high possibilities of desertification, such as the Sahel region of Africa.

The mean annual NDVI analysis from 1982-2007 shows that the Sahel is greening, but is subjected to spatial and temporal irregularities. The period 1982-1990 saw NDVI rising and falling, portraying the inter-annual rainfall irregularities of the region, though on the rising side generally. However, the period 1990-1994 saw 4 years of continuous decline in NDVI below average, showing a decrease of about 5.4%, which signifies a period of desiccation. The period of 1995-2001 saw NDVI recovering above average with the highest mean maximum annual NDVI in 1997 and the highest mean annual mean NDVI in 2001. This is followed by another five years of falling NDVI below the period average 2002-2006. Generally, NDVI in the Sahel region has been on the positive side, showing a net average increase of 2.66% over the 26-year period from 1982-2007, with 1982 as the base year. However, the Sahel NDVI data does not suggest the miracle of green landscape as suggested by others studies. We therefore caution that land degradation has not ended in the Sahel yet and must, therefore, be treated with utmost care.

The mean annual NDVI, showing surface greenness of the UER, indicates that greenness in the region has increased steadily, after starting lows of what appears to be drought years of 1982, 1983, and 1984. From the period 1982 to 2007, the NDVI rose steadily from an annual mean NDVI value of about 0.37 in 1982 (the base year) to about 0.45 in 2007, the end year. This indicates a positive NDVI change of about 21.6% over a period of 26 years. On the average, the NDVI has increased by about 6.7% from 1982-2007. Spatially, NDVI for the UER from 1982 to 1990 shows an average of 328 km2 (37.4%) lost greenness measured in terms of NDVI in the UER. Conversely, land area of approximately 2064 km2 (62.6% of land surface) gained or showed an increase in surface greenness. The period 1990 to 1999 saw 816 km2 losing its surface greenness, while 1576km2 gained greenness. However, more land area lost surface greenness from 1990-1999 than the period 1982-1990. Compared to 1982-1990 and 1990-1999, the period 1999 to 2007 lost less vegetation. An average of 152 km2 lost vegetation while 2240 km2 gained vegetation

greenness. The maximum mean gain for 1990-1999 was almost 48% of the maximum NDVI for year 1987 an 2007, and the maximum mean gain for 1999-2007 is greater than the yearly mean NDVI recorded over the 26 year period. In general, surface greenness increased from 1982 to 2007, indicated by the positive mean gains fo 1982-1990; 1990-1999; and 1999-2007, confirming the observation from the temporal NDVI trend that surfac greenness, as depicted by NDVI, shows greening of the UER from 1982-2007.The study also analyzes field dat: including data on crop production, interviews with local farmers observations from the field in search of evidenc proving or disproving degradation in the semi-arid sahel-sudan savannah transitional vegetation zone of the UER Ghana. Field evidence suggests that the increasing NDVI was caused by vegetation succession where locally adaptec horsetail grasses have been displaced by environmentally efficient, short-lived, quick maturing and dense grasses du to excessive burning, rapid population growth and inappropriate development policies. Local people's perceptions supported by crop production data, suggest extensive land degradation. Other evidence gathered includes foo insecurity, diseases, rainfall variability and land use extensification.

Climate Change, Urban Land Use and Water Supply Challenges in Lagos State, Nigeria

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ABSTRACT

In Nigeria, the past and present trends of human activities such as burning of fossil fuels, land use practices and deforestation, continuous release of green house gases especially CO_2 and other heat trapping gases has attributed to human-induced climate change. Climate change impacts depend on changes in climatic parameters, socio-cultural and geographical characteristics. Nigeria is located primarily within the lowland humid tropics and generally characterized by a high temperature throughout the year. In the far north, mean temperature is between 13oC and 37oC while in the south it is between 21oC and 31oC. The mean temperature of the country is between 27oC and 29oC, while annual rainfall ranges between 60cm in the northeastern and over 400cm in the wet coastal area.

In order to examine the future implication of changes in climatic parameters and urbanization on water supply in Nigeria, Lagos Sate that home about 65% of industries in Nigeria, was chosen based on its fast growing population, persistent increase in water demand as against shortage in supply. Lagos urban land use which covered about 6.4% in 1976 increased to 16.1% in 1995 and 21.5% in 2007, while wetlands declined by about 25% between 1995 and 2007 due mainly to urban expansion. The population of Lagos State rose from 5.7 million in 1991 to about 9.2 million in 2006 (i.e. an increase of 38.04% within 15years).

Existing climatic elements data (monthly rainfall and temperature) generated over Lagos between 1960 and 2006 were use to determine temporal climatic index. Landuse /Landcover maps of 1976 &1995 and NigeriaSat-1 satellite imagery of 2005 -2007 were used for landcover change analysis. On the other hand, population data from the National Population Commission of Nigeria, and the records of water production from the Lagos State Water Corporation were also used. Inferential statistics and GIS tools were used to generate the results for the study.

Results from this study shows that in the year 2027, rainfall is likely to decrease by -0.028cm while temperature will increase by 0.349oC. Urban land use is expected to increase by about 20% while suburb (Ikorodu, Epe and Badagry) will be highly congested. The results also revealed that water demand in Lagos state has outpaced the supply over the years. In year 2002, the total water production was about 377ML/D (million litres per day), while the estimated demands for these corresponding year was 533ML/D. Currently, Lagos State has an installed water supply capacity of 712.9MLD and faced with problems of ageing supply lines, ageing water works, poor public electricity, irregular production rate, illegal connections and tapping of pubic water, high damage of water infrastructure and lack of maintenance. Hence, it is operating at 48% capacity or capable of meeting only 36% of water demand. Based on 4% annual growth rate and if the present trend continue, the population of Lagos State is likely to increase to about 20.2 millions while safe water demand is expected to increase to about 2418.9ML/D by year 2026.

The implication of this is that the citizens have to provide about 50% of their required water through boreholes, dug wells in urban areas and, unprotected wells, rivers, streams and ponds in the rural areas. Therefore, for sustainable safe water supply, lots of efforts will be needed to bridge the gap if water demand in Lagos State should be met. The paper also discusses various future associated risks without addressing the threatening climate change scenario, rapid urban expansion problems and fast growing population issues.

KEY WORDS: Climate change, urbanization, population, land use, water supply, Lagos - Nigeria

Feasibility Study for the Analysis of Annual and Inter-Annual Evolution (1998 - 2009) Of Lake Chad with Spot-Vegetation Satellite Images

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Introduction

Sustainable management of water resources is increasingly becoming a major priority in our planet, mainly in regions where these resources are not sufficient for supplying basic needs of its inhabitants. For such reason, it becomes necessary to develop new approaches for researchers and managers to monitor bodies of water gravely endangered by factors like climate change and resource overstress by humans.

The Joint Research Centre (JRC) - Institute for Environment and Sustainability (IES) of the European Commission and the University of Seville have carried out a feasibility study (Romero-Hernandez et al., 2009) with satellite data to monitor the evolution of water surface area in Lake Chad (Niger, Nigeria, Cameroun and Chad) and its aquatic vegetation as indicator of environmental conditions of the lake. This study was built upon a multi-temporal series of SPOT-VEGETATION satellite images for the period of 1998-2009, and constitutes a preliminary phase for the implementation of a data gathering and monitoring system for the use of local and regional authorities in several African river basins.

Methodology

This study used a temporal series of images from the spectral bands of the SPOT-VEGETATION satellite: Normalised Difference Water Index (NDWI) and Normalised Difference Vegetation Index (NDVI). On the Equator, Imagery from SPOT-VEGETATION reaches a 1 Km2 spatial resolution. This kind of spatial resolution is considered appropriate for this feasibility study considering the dimensions of the area (~1500 Km2), and a 10 day temporal resolution for an 11 year period (1998-2009). The Global Land Cover 2000 map of African vegetation cover was also used in the study.

After considering the feasibility study and the amount of data available from the temporal series, data of two precise days per year were processed: 1) one from the rainy season (11 of August); and, 2) another from the dry seasons (11 of January). Through a supervised classification method, geometric data for the 11 years of monitoring were obtained regarding area, perimeter, water surface distribution and aquatic vegetation of the lake. Figures 1 and 2.

Figure 1

Figure 2

Figure1. Water surface area in Km²for the series 1998 to 2009 in the rainy and dry seasons. Figure 2. Aquatic vegetation surface area in Km²for the series 1998 to 2009 in the rainy and dry seasons.

Figure 3 Evolution of the water surface area from 1972 to 2009

Conclusions

This feasibility study showed the evolution of the water surface area over the last 10 years and its correlation with field data. It was possible to observe that, in contrast to the dramatic decrease in water surface area over the last 50 years (in 1960 the extension of the lake was of 26000 Km2, and at present it ranges up to around 1600 Km2), during the period studied, the water surface area showed no significant variation (see Figure 3). It would even be possible to affirm that a small recovery of approximately 3,5% in the mean annual growth rate occurred. Some exceptional inter-annual growth period was been identified, as it was the case in the year 2005 dry season (see figure 1) that showed a 16% increase compared to the year before. In order to analyze more precisely the intra-annual and intra-seasonal variations, the study will continue with a comprehensive review of all the temporal series and its correlation with climate data of the zone. Special attention will be paid to anomalies by exceptional climatologic events relating to increase/decrease of the water surface area during the period of study.

Indian Contribution to African Food Security - A Geospatial Solution

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ABSTRACT

Achieving food security in its totality continues to be a challenge not only for the developing nations, but also for the developed world. However, the difference lies in the magnitude of the problem in terms of its severity and proportion of the population affected. Food security is a growing concern in Africa. The most significant concern for improved food security program is the availability of timely, up-to-date and accurate data for planners and decision makers. Such information needs to be effectively created and made available to interested organizations in a comprehensive, consistent, regular, and easy to understand format. This article reviews the Indian contribution to food security through use of geospatial technology. It is found that of the four main elements of food security, i.e., availability, sustainability, effective utilization, and easy access, only the first is routinely addressed in simulation studies. The goal of this paper is to maintain sustainable development, optimize the utilization to endow with access and increase farmer production and therefore, improve the present situation of food security in Africa.

It is interesting to note that many progressive African countries, like Angola, Mozambique, Kenya, Ethiopia, Zimbabwe and South Africa adopt a new agricultural policy which takes care of self sustenance, which is incidentally the first step towards Food Security. Many Indian and Chinese companies are investing in African Agriculture and for them planning become inevitable. In this paper the author mainly focuses on this planning for complete land development planning using Geospatial Technology. A few case studies have also been discussed in the paper.

The Geospatial process models are constructed using basic factors like population, demography, socio-economic condition, natural resources its management and development, land use land cover, and topography-physiography, to estimate inherent environmental capacity to supply sufficient food resources to meet expected demand. Using the intangible GIS modeling, an integrated assessment of the risk and likelihood of food emergencies in Africa can be identified. The article will describe the advantage of geospatial technology in (1) developing a food security database system as an analytical tool to improve the quality of data using remote sensing and GIS technologies, (2) analyze and compute the food balance using DSS model, and (3) design the complete livelihood development plan from baseline survey & data creation till market economics.

The Use of Remote Sensing For Drought Assessment and Monitoring in Nigerian Drylands

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ABSTRACT

The population of Nigeria which was put at about 100 million in 1990s and 140 million by 2006 census, is predicted to exceed 200 million in the year 2100. To feed the burgeoning population, agriculture and livestock grazing have expanded correspondingly, often into marginal areas that are not ecologically suitable for such activities. Such activities have exacerbated ecological problems such as drought and desertification in the Northern Nigeria. Nigeria is presently losing about 351,000 square km2 of its land mass to the desert which is estimated to be advancing southward at the rate of 1 km per year. The outward and visible sign of the desertification process is the gradual shift in vegetation from grasses, bushes, and occasional trees to grass and bush, and in the final stages, extensive areas of desert-like sand. In Nigeria, the extent and severity of drought induced land degradation has not been fully established. Nevertheless, there is a general consensus that drought and desertification are among the leading pressing environmental problems in the country.

Climate variation has been identified as the most important natural cause of drought and desertification in the drylands of Nigeria. For instance, the history of Sudano-Sahelian zone of the country is replete with severe and prolonged drought of 1903, 1911, 1919, 1935 and 1951-1954. The need for proper quantification of drought impacts, monitoring and reporting drought development is of critical importance to food security and sustainable development in Nigeria. At present, there exists no efficient system, which analyses and delivers drought-related information to the stakeholders on the ground. Traditional methods of drought assessment and monitoring rely on rainfall data, which are limited, often inaccurate and difficult to obtain in near-real time.

The primary goal of this study is to utilize time series satellite data to develop a reporting system for the assessment and monitoring of historical drought development in Nigeria at different scales from country level and further to the level of individual states, and local government areas within the country. The converted AVHRR monthly time-series data for 1982-2005 were used for historical drought analysis. In all, a total of 212 images were analyzed for the study. The indices for drought monitoring were derived from the analysis. For instance, severity of drought was determined by the NDVI deviation from its long-term mean (DEVNDVI). Vegetation Condition Index (VCI) which measures the condition/health of the ground vegetation was also generated from the study.

It has been established in literature that the magnitude of drought is directly proportional to the magnitude of deviation below normal. The duration of the successive months below normal conditions and the magnitude of the deviation constitute two powerful indicators of drought severity. Both options were explored in the paper for the development of a national drought monitoring system. Considering the spread and frequency of droughts in the country on one hand, and the lack of reliable ground climate observations and technical capacity to deal with droughts – on the other, such a system possesses enormous potentials for drought preparedness.

Land use land cover Dynamics and Modeling in Gubalafto Woreda using Cellular Automata model

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ABSTRACT

This study aims to examine and analyze the spatial and temporal variations of land use land cover conditions and model trends of change using cellular automata model in Gubalafto Woreda of North Wollo Zone, Amhara region. Its specific objective was assessing the historical patterns of the area for the past 32 years and determines the trend, nature, rate, location and magnitude of land use land cover change. The study also looks the future land use land cover change.

To serve these objectives, field survey, field data collection, three time series image, topographic maps and Arial photo were used. In addition different types of parameters were used to predict the future land use land cover changes. On the other hand the study of this paper was under taken using ERDAS IMAGINE 9.1, Idirisi Andes, and ENVI 4.3 software. The main method used to model land use land cover change in this research was the Cellular automata Markov model.

The finding of the study highlights the impact of resettlement on land use land cover change especially in agriculture and settlement reduction during the time between 1973 and 1986. On the other hand there is a continuous reduction in forest, bush and water bodies for the past 32 years. The projecting land use land cover change also indicates that there is an increment in the forest coverage but the other land use land cover classes follow the trends of the 1986 and 2005.

The result of the work shows a reduction in agriculture and settlement between 1973 and 1986 while the periods between 1986 and 2005 shows an increase in these classes. It was also observed that change by 2020 may likely follow the trend of 1986/2005.But due to the limitation of parameter and image resolution the Kappa index agreement of the validation result was less than that of the standards, therefore the model result may not be highly accurate. Suggestions were therefore made at the end of the work on ways to use the information.

KEY WORDS: GIS, RS, land use /land cover, CA_Markov model, MCE, Resettlement Gubalaf

Multi-Disciplinary Research on Hydro-Climatic Processes to Advance Water Resource Management in the Lake Chad Basin (LCB)

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ABSTRACT

The Lake Chad Basin (LCB), located in West Africa, extends over seven countries – Niger, Chad, Cameroon, Sudan, Algeria, Central Africa Republic, and Nigeria. Lake Chad itself is located along the international borders between four countries - Niger, Nigeria, Cameroon, and Chad. Due to the severe droughts in 1970's and 1980's and following overexploitations of water, the size of Lake Chad has been significantly reduced to about 1/20 of its original size in the 1960's. Successive back-to-back droughts and multiple irrigation-related water impoundments upstream contribute to the reduction of water inflow into the lake from major tributary rivers, including the Logone River and the Chari River, which accounts for over 95% of river inflows to the lake. The droughts have also affected the ground water resources in the basin. With the increasing concerns about the overexploitation of water from the LCB, this area is in desperate need of technical assistance for effective water resource management. With funding from several agencies such as the National Science Foundation, NASA, and the National Space and Research Development Agency (NASRDA) in Nigeria, an interdisciplinary team of scientists led by the University of Missouri Kansas City are investigating the effect of various environmental stressors, including climate variability and change, on surface and groundwater hydrological processes in and around the LCB. This presentation will focus on some early results that demonstrate the potential of improving integrated water resource management in the LCB through innovative use of satellite, hydrological, and climate data and modeling approaches.

Remote Sensing Based Model versus Agro-Meteorological Models for Crop Yield Monitoring and Food Security Assessment

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ABSTRACT

Based on the long and successful experience of the Monitoring Agriculture with Remote Sensing (MARS) project in Europe, the European Commission decided to enlarge their monitoring activities to other regions of the world. The FOODSEC group was established to support the Food Aid and Food Security policies of the European Commission in 2000. The group activities are mainly aimed at improving methods and providing regular information on crop yield prospects. Russia and Central Asia, Eastern Africa (IGAD) and the MERCOSUR region in South America are currently main FOODSEC regions of intervention. Beside collaboration agreement with FEWS-Net and United Nations Institutions (FAO and WFP), FOOD-SEC is also member of the strategy group for the GSE-ESA Global Monitoring for Food Security (GMFS) project, partner in the EC- FP7 GEOLAND Project (Observatory for Crop Monitoring and Food Security), active in the GEO AG Work plan and technical support to the development of the Global Land core service and Food Security thematic component of the EU GMES program.

In Africa, the methodologies currently used operationally by FOODSEC are based on SPOT-VEGETATION data, Global Meteorological Modeling outputs (ECMWF model), satellite rainfall estimations (TAMSAT CCD model) and agro-meteorological crop growth simulation models (FAO-CSWB). The monitoring of the crop conditions is based on the analysis of ten-daily meteorological information, and in parallel on the observation of the ten-daily crop specific Normalized Difference Vegetation Indexes (NDVI) profiles.

SPOT-VEGETATION data are used as a basis for calculation of remote sensing indicators of crop growth. The crop growth indicators are based on NDVI values weighted for specific crops within administrative units. The current season indicators are compared with the previous year values or with long-term average data. Additionally, dry matter production maps based on SPOT-VEGETATION data and information about global radiation, applying the Monteith approach, are used as a crop status indicator.

Meteorological information is used as input to agro-meteorological water satisfaction model. Quantitative yield forecast are also derived from the agro-meteorological indicators with reference to past years. The results of the two crop growth monitoring approaches are summarized in agro-meteorological bulletins, issued monthly at national level for several IGAD countries. End of the season, quantitative yield forecast are also issued based on multiple regressions and similarity analysis when a robust model has been defined.

With its involvement into the multi partners GLOBAM project funded by the Belgian Scientific Policy, FOODSEC in collaboration with the University of Liege is trying to improve the current approach, particularly in Ethiopia where the performance of the classical crop water satisfaction model can be limited in regions where rainfall and water availability does not represent anymore a constraint for crop growth. In this context, the application of a WOFOST type agro-meteorological model is tested. In parallel, the assimilation of remote sensing parameters directly into the agro-meteorological models is also envisaged.

Recommendations can thus be drawn based on the comparison and a critical analysis of the different approaches and models, showing the advantages and limitations of the models but also of the data. The differences and the complementarity of the methods in different agriculture context can be highlighted. At Africa level, the FOODSEC group is participating to the EU-DG JRC Africa Observatory for Sustainable Development initiative. With

the Monitoring of Natural Resources and the Crisis prevention, Food security is one of the three pillars of the observatory. In this context, FOODSEC group could envisage the development of an African Crop Condition Alert System. The system could advantageously rely on the EU GMES Initial Operations (GIO) which will start in 2011. The GIO will produce and will disseminate worldwide a set of core satellite observation parameters essential for the development of crop monitoring system.

Bibliography: FEWS-Net, FAO GIEWS, Agro-Meteorology Modeling, Crop Yield Assessment

Satellite Remote Sensing for Groundwater Targeting in Basement Complex Rocks of Jos, Plateau

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ABSTRACT

Non-sustainable groundwater supply from boreholes and hand-dug wells in the crystalline rocks of Jos Plateau is the research problem. Sustainable groundwater supply in the crystalline rocks requires lineament analyses for proper sitting of boreholes. This study was carried out to illustrate the application and emphasize the importance of remote sensing and Geographic Information System (GIS) techniques for efficient groundwater resources exploration and management.

Remote Sensing and Geographic Information Systems (GIS) techniques were applied in mapping potential areas of groundwater occurrence in the Basement Complex Rocks of Bassa Local Government Area of Jos Plateau, Plateau State, Nigeria.

The main method applied to this study is the lineament analyses of 1987 LandSat image, band 32. Digital image processing techniques, which involves linear/edge enhancement and high – pass filtering were applied on the image to enhance edges of linear features. This was followed by computer aided visual interpretation of lineation. The ILWIS, ERDAS and ArcView image processing and GIS software packages were used.

The processing led to the production of drainage patterns and drainage linears, and water bodies, fractures/lineaments, fracture density, normalized difference vegetation index (NDVI) thematic maps. All the thematic layers were integrated together with existing geological maps following fieldwork. The results showed potential areas of groundwater occurrence.

The lineaments/fracture analyses indicated that the area has numerous long and short fractures. The structural trends of fractures are Southeast – Northwest, north – south and Northeast – southwest. The most prominent structural trends are northeast – southwest and northwest – southeast. The structural trends are related to the regional tectonic stress of the area, which is north – south, northeast – southwest and northwest – southeast. A comparison of the rose diagram of the drainage linear and lineaments indicate that the drainage lines are lineaments. Criss-crossing lineaments are many at northwest and central parts but low in the other areas. The coarse texture of the rocks and dendritic drainage pattern of the area indicates a permeable bedrock material. However, the soils are permeable which favor greater infiltration and less surface run – off. The study has led to the delineation of areas where groundwater occurrence is most promising for sustainable supply, and consequently where further geophysical surveys can be concentrated.

Which Satellite Rainfall Products Should We Use for Hydrological Applications in Ethiopia?

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ABSTRACT

The growing availability of high resolution satellite rainfall products is making them an alternative source of rainfall data for rainfall-runoff modeling, especially in regions where ground-based rainfall measuring instruments are lacking. Depending on whether they use additional rain gauge data or not, satellite rainfall products can be grouped into those that include rain gauge data (e.g., TMPA 3B42) and those that do not include rain gauge data (e.g., TMPA 3B42RT). They could also be grouped into those that are primarily infrared-based (e.g., PERSIANN) and those that are primarily microwave-based (e.g., TMPA 3B42RT). The objective of this study is to compare the performances of different satellite rainfall for hydrological applications in two adjoining watersheds (Koga with drainage area of 299 km2, and Gilgel Abay with a drainage area of 1,656 km2) in Ethiopian highlands. Our methodology consists of using the various satellite rainfall products separately as input into the SWAT hydrological model to simulate daily streamflow, and comparing the simulations to the streamflow observations. Our main conclusions include (1) satellite-only rainfall products are much better than the satellite-gauge rainfall products - this overturns the conventional notion on its head; and (2) microwave-based rainfall products are much better than infrared-based rainfall products.

Geological Application of ALOS Imagery for Mapping and Analysis of Lineaments in Ile-Ife and Environs

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ABSTRACT

Lineaments have been used in many applications including petroleum and mineral exploration, nuclear energy facility sittings and water resource investigations. Before now, lineaments interpretations were done based on the information extracted from aerial photographs. In recent times, geologists have been interested in extracting lineaments from satellite imageries which have wider surface area coverage under practically uniform conditions. Remote sensing techniques have proved to be very useful in lineament identification and mapping. Lineaments obtained through these techniques are often used as indicator of major fractures in near-surface. The study demonstrates the use of multispectral ALOS image and ASTER DEM data for lineaments extraction and mapping in the study area, useable for groundwater surveys, development, and management.

The input multispectral ALOS image acquired on 18/02/2008 was enhanced using ENVI 4.7 software. The enhancement made use of contrast stretching, directional filtering and edge enhancement techniques. The lengths, densities and cross points of the lineaments were determined and used for statistical analysis. Rose diagrams, lineament density and lineament intersection maps of the study area were produced using the result of the statistical analysis. The rose diagram and maps were analyzed, interpreted and compared with the age-long published geological map for the study area.

The result of this study shows that the interpreted lineaments closely correlate with the fault shown on the published geological map (in 1974) of the study area. The study has shown that remote sensing data such as ALOS, in conjunction with ASTER DEM can be used in locating new faults, joint fractures, etc, which may be of socio-economic importance in the area. Therefore, the lineament mapping and analysis from satellite data can provide a new, rapid and stimulating overview for regional structural (lineament) study for hydrogeological exploration and engineering infrastructural development.

KEY WORDS: Lineament, Hydrogeology, Mapping, Remote Sensing, Information Extraction, Image Enhancement, Statistical Analysis, Multispectrla Image

Sustainability of operational processing chains & remote sensing data for crop and rangeland monitoring in Africa

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ABSTRACT

Since the late seventies low resolution satellite sensors have been used operationally to monitor the earth surface [1]. In 1998 the Flemish Institute for Technological Research (VITO) started to operate the processing and archiving facility for one of these low resolution sensors, SPOT-VEGETATION [2]. Over the past decades and through a variety of projects VITO has also gained a lot of experience in the processing, archiving and distribution of other low and medium resolution sensors such as NOAA-AVHRR, TERRA/AQUA-MODIS and ENVISAT-MERIS.

Together with local partners and international organisations VITO deploys a number of activities with respect to the production and distribution of advanced remote sensing based vegetation indicators (EC-JRC MARS-project, GMFS, DevCoCast), [3,4,5]the monitoring of crop growth and food security (MARS, GMFS) [6] and support to capacity building (GARNET-E).

Distribution mechanisms used to provide end users in Africa with ten-daily or monthly composites of these data sets, include the EUMETCast system [7]and the ESA DDS system [8] whereby the data are transmitted to low-cost receiving stations in Africa, facilitating the data availability at national and regional level. These and other international efforts resulted in the development of operational monitoring systems in Africa.

However since the currently used low resolution sensors are reaching the end of their lifespan, one needs to plan for operational continuity to provide the end users with similar data sets. This paper aims to inform the African user community on two of the approaches currently followed by VITO to overcome this problem.

On the one hand, VITO recently started with the operational production of ten-daily global NDVI composites based upon the AVHRR-sensor on board of the METOP satellite which was launched in 2006. This action is realised in close collaboration with EUMETSAT and JRC-MARS.

Although there are still some efforts left for the integration of these data with the archives of SPOT-VEGETATION and NOAA-AVHRR, the global NDVI composites can already be used as a backup when one of the current systems should fail. Data availability of the METOP satellites starts in January 2008 and is guaranteed to continue at least until 2020 [9].

On the other hand, in preparation of ESA's Sentinel missions (to be launched 2012) VITO plans to expand its MERIS processing chain within the framework of the GMFS project. Currently ESA is reprocessing the entire archive of MERIS RR data (Reduced Resolution, 1.2km). Once

this task is finished, the GMFS project will upgrade its MERIS processing chain to supply African users with similar products as currently used by JRC-MARS for agricultural monitoring in Europe (cluster analysis, similarity, etc.). At the same time ESA is also making its MERIS FR imagery (Full Resolution, 300m pixels) [10] available on its "rolling archive", which will permit to provide the indicators for crop and rangeland monitoring in Africa at a much higher resolution.

Based on some preliminary tests, it can be estimated that the first products will become available from September 2010 onwards. In this way, VITO and ESA try to ensure that operational users can directly ingest the new Sentinel data into their monitoring systems and to provide a sustainable access to the data beyond 2015.

KEY WORDS: METOP-AVHRR, ENVISAT-MERIS, DDS, EUMETCast, GMFS

Analyses of East African Vegetation Trends (1982-2008) using NOAA-AVHRR NDVI

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ABSTRACT

Since 1980, the number of undernourished people in eastern and southern Africa has more than doubled. Rural development stalled and rural poverty expanded during the 1990s. Population growth remains very high and declining per-capita agricultural capacity retards progress toward Millennium Development goals. Analyses of satellite observations of vegetation cover have identified another problematic trend. The overall biomass productions during main growing-season have diminished in food-insecure countries clustered along the western rim of the Indian Ocean. Many countries have been affected by rainfall variability and long-term changes in both rainfall amount and distribution over recent decades. While rainfall is only one factor in a complex tableau of factors that influence global climate, it plays an important role in regulating the environmental condition and vegetation cover dynamics of Eastern and Southern Africa significantly. How the seasonal vegetation cover trends do looks like in the area?

The study analysed almost three decades of NOAA-AVHRR NDVI data to analyse trends of vegetation cover in east Africa. The trend is calculated the regular linear trend formula by taking individual dataset in ArcGSIS raster calculator functions. In order to compare the past and recent trends the analyses were done by dividing the period in to two parts. These are the first 15 years (1982 to 1996) and last 15 years (1994 to 2008). The trend values are calculated based 10-days NDVI data and the monthly, seasonal and annual aggregation are prepared by taking the mean values of trends. The trend is further used to depict the future. The general vegetation condition of the region is depicted on Fig 1 is calculated by taking average of 12 months.

Anomaly of average NDVI values is calculated by subtracting the two parts NDVI averages. The average vegetation cover condition is in a continuous dynamics caused by climatic variability and other social factors. It shows that there is improvement of vegetation cover in some of arid areas of east Africa like the north-eastern Kenya, north-western Somali, and very large parts of southern Sudan (see Fig 2). The anomaly depicted the deterioration of vegetation cover near and around Victoria region, most part of central and northern Tanzania significant portion of southern Ethiopia and northern part of the rift-valley escarpment.

Most parts of south Sudan showed positive trend during the 2nd half. On the other hand in Kenya and Uganda with exception in the north east corners, in Tanzania excluding the area near the cost, in Ethiopia with the expectation some pocket areas as well in Rwanda and Burundi the trend is negative. The negative trend values are very high in the northern part of Ethiopia as well as in areas near Lake Victoria and further south. The improvement and deterioration of vegetation cover observed during the 2nd half are larger in their value as compared to the differences in first half. These spatio temporal analyses of the vegetation

Coupling GEONETCast and the ESA Data Dissemination System for Food and Water Security Monitoring in Africa

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ABSTRACT

GEONETCast – a global communication satellite based data dissemination system – provides free near real-time environmental and Earth observation data (in-situ, airborne and space based) and derived products to a worldwide user community. It is part of the emerging Global Earth Observation System of Systems (GEOSS), an initiative led by the Group on Earth Observation (GEO). It is now possible to receive a multitude of environmental related data, highly relevant for food and water security analysis and monitoring at any location – organization in Africa using cheap and off-the-shelf equipment.

Already in 2005 at ITC, a Ku-band based reception station was installed, pointing at EUROBird 9 at 9 degree East. Ku-band signal reception of Geonetcast data is limited to Europe and Northern Africa. In September 2009 a C-band GEONETCast reception configuration was installed at ITC.

This antenna, with a diameter of 1.8 m., is pointing to Atlantic Bird 3, at 5 degree West and receives the GEONETCast C-band data configuration as disseminated over Africa. Apart from the antenna, a C-band LNB and a Skystar-2 DVB board were used. At several premises of various organizations in Africa, these reception stations are now also operational.

In December 2009, the same C-band antenna was used to install the European Space Agency's (ESA) Data Dissemination Service (DDS) at ITC. This service also uses Digital Video Broadcasting and is using for Africa the same communication satellite (Atlantic Bird) to disseminate data recorded by ENVISAT (MERIS, AATSR and ASAR) within 24 hours of sensing. A graphical presentation of the configuration is presented in Figure 1. The low cost C-band ground receiving system consists of two computers, one receiving the GEONETCast data stream and the other one the ESA ENVISAT data and additional products. ESA-DDS data is broadcasted from approximately 20:00 to 10:00 (day +1) Central European Time and about 5 to 10 gigabytes are received on a daily basis. An important added advantage of the DDS is the two way data dissemination capability which will allow organizations to upload data as well.

For use of the data delivered through GEONETCast, a software plug-in was developed under ILWIS v.3.6 and higher, the so-called "GEONETCast-Toolbox". This freely available utility currently supports over 100 satellite image and product import and analysis routines. Together with the existing processing utilities of ILWIS the users can now easily integrate the enormous amount of environmental data, which is delivered via communication satellites on a global scale, into various applications related to weather, atmosphere, oceans, land, vegetation, water and environment.

Through DDS, ENVISAT data and products (from ASAR, AATSR and MERIS) like vegetation indexes, brightness temperatures, reflectances, calibrated TOA radiances, cloud thickness, water vapour and geophysical products, etc, can now be obtained on a regular basis. For processing of the ENVISAT data, use can be made of the Basic Envisat Toolbox for (A)ATSR and MERIS (BEAM). Other relevant products disseminated through DDS can be easily imported using another newly developed freely available plug-in under ILWIS 3.7, the "ESA DDS-Toolbox".

The paper will elaborate on data reception, and illustrate the conjunctive use of EUMETCast and ESA satellite data streams for monitoring and analysing food and water security issues in Africa, For more information and references: http://www.itc.nl/GEONETCast-General-information

The eStation: a comprehensive processing and analysis system for monitoring natural resources in Africa

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ABSTRACT

Relevant and timely distributed geo-spatial data, and effective tools for their analysis, are essential for the monitoring of natural resources in Africa, and for facing the major environmental issues related to climate change impact, water scarcity, food crisis and natural disasters. The EUMETCast system, implemented by EUMETSAT and ESA, and based on Digital Video Broadcasting by Satellites, routinely distributes Earth Observation data, including the SPOT-VEGETATION products prepared for VGT4Africa project. EUMETCast adequately faces the issue of data reception in area of poor internet connectivity and out of easy reach, but difficulties still exists on the data exploitation for monitoring of the environment; e.g. the data delivered by space agencies are often in formats difficult to be managed and homogenized by the End User, who has to deal with technical details rather than to concentrate on the thematic issues.

To face these challenges the Joint Research Centre of the European Commission has implemented the so-called Environmental Station, or eStation, a comprehensive system composed by a Processing Station (PS) and a visualization/analysis component (EMMA). The Processing Station performs in an automated manner three main tasks: 1) retrieves Earth Observation data from an EUMETCast receiving station and, optionally, from other data providers through the internet, 2) converts images from the differing original formats (HDF, grib, netCDF) to GeoTIFF and 3) implements algorithms for the computation of ad-hoc thematic products and indicators, according to the End User needs. All processing steps are easy configurable, in order to allow the user to retrieve and process additional data, both in raster and vector format, to modify the generated environmental indicators and implement new ones. EMMA is a web-enabled tool for data visualization, offering a high degree of customization and allowing the semi automatic generation of environmental reports, either from a single user or in a cooperative manner.

The eStation is implemented on a Linux Ubuntu platform and is completely based on OpenSource software (MapServer, postGreSQL, gdal, python and bash scripts). It is therefore an adapted and cost-effective platform for the implementation of services in different thematic areas, like the monitoring of surface water bodies, natural vegetation and agricultural region status, coastal and marine regions.

The eStation is going to be distributed in the period 2010-2011 to 47 National Centres in all sub-Saharan African countries, in the framework of the AMESD project, funded by the European Commission, as a continuation of the PUMA Project.

National Wetlands Mapping in Uganda

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ABSTRACT

Wetland Management Department (WMD) of the Ministry of Water and Environment in Uganda is the leading Agency for Wetland Management in Uganda. To facilitate the understanding of the evolution of Uganda's wetlands, WMD analysed ASTER and SPOT images for the period 2005-2009. The exercise was done in collaboration with KEYOBS sa, Belgium and Sunshine Projects ltd, Uganda. The methodology included manual- and semi-automatic image classification, field validation and database compilation. Manual methods included visual inspection and screen digitizing while semi-automatic techniques involved use of a 1% slope mask and unsupervised classification. Image analysis was carried out in ENVI while manual digitizing and database creation was carried out in ArcGIS software. The extracted wetland classes in the NBS (National Biomass Study) format were translated to LCCS to facilitate compatibility with other regional/global datasets.

The final results are a complete GIS database presenting all wetlands maps and satellite images. Districts wetland map sheets have also been produced. The updated dataset will be a big step forward in the management of wetlands in Uganda.

KEY WORDS: wetlands landcover mapping remote sensing

Effects of Urban Sprawl on Agricultural productivity in Ile-Ife, Nigeria

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ABSTRACT

Urban sprawl has been a major issue of concern in many cities of the developing countries. Ile-Ife has three tertiary institutions and various small businesses that have attracted increasing population and migration trends. This has led to rapid expansion of uncontrolled, uncoordinated and unplanned settlements along the periphery of the city.

This research work is concerned with the trend, magnitude and effect of sprawl on the agricultural land and natural resources in the study area. It is a Geographic Information System and Remote Sensing-based study carried out to determine the overall trend and extent of urban expansion (sprawl) in Ile-Ife. Key indicators were used to examine the urban sprawl threat to the natural environment, agricultural productivity and to the quality of life of people who live in the town.

LandSAT satellite imageries of 1972, 1989 and 2001 and Alos imagery of 2006 were used for landuse/landcover classification and landuse change detection analysis in order to examine the trend and magnitude of the sprawl over the period of 1972 to 2006 and the effects on agricultural and natural resources of the study area.

The result of the study showed that there has been a notable increase in the growth of urban area of Ile-Ife with the period of the study with sprawl characteristics such as: unplanned development and excessive land consumption. The extent of urban area had increased by over 30% as of 2006, indicating loss of agricultural land, forestland and wetland. Also, urban expansion has been concentrated around the eastern and southern parts of the town.

KEY WORDS: Urban sprawl, Agricultural land, GIS, Remote Sensing, Supervised Classification, MARKOV Change Detection

Modeling Soil Nitrogen Balance Using Geographical Information Systems and Remote Sensing: The Case of Lower Bilate River Basin, Southern Ethiopia

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ABSTRACT

The core objectives were modeling of the soil nitrogen balance and the plant available stock soil nitrogen by using a spatially explicit methodology of Remote Sensing and Geographical Information Systems in lower Bilate River basin within the Ethiopian rift valley. The main inputs used were digital soil map, Landsat-ETM+ satellite imagery, SRTM data, Rainfall data, and Agricultural data. The research found out that in general croplands are endowed with lower amount of plant available stock soil nitrogen than non croplands. The addition of Commercial fertilizers like DAP and Urea were the main inflows in maize land while the fertilizer NPK was the major source of inflow in tobacco farm. Animal manure was the main source of nitrogen inflow in lands of Sweet potato, Cotton and Bush and Scattered shrub land. Harvested crop yield was the major source of nitrogen loss in crop lands.

KEY WORDS: GIS/RS, Inflow, Outflows, Soil Nitrogen Balance, Plant Available Stock Soil Nitrogen

Setup crop growth models in Ethiopia for improvements with earth observation systems

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ABSTRACT

Development of crop growth models and crop yields estimates gain a considerable interest since food security remains a great concerns in most countries of the world (Bouman, van Keulen *et al.*, 1996). Subsequently, with the Earth Observation (EO) systems improvements, with better spatial coverage and improvements of accuracy, natural resources monitoring has grown considerably. Remotely sensed data, when combined with CGMS models, enable estimation of crop yield and forecasting of production. EO data are also intensively used to optimize the CGMS parameter and to improve the performance of crop models at regional and national scales, using data assimilation techniques (Justice et Becker-Reshef, 2007).

The Globam project contribution since 2007 is to reduce the gap existing between the results achieved by research and operational systems to large scale. One of the objectives is setup a crop growth models on existing sites to serve as a baseline for future improvements by EO data assimilation. This paper summarizes this work by focusing on results and accuracy levels achieved by these models in yields estimates on Ethiopia site.

The choice of models has been guided by several criteria: operational capability, extensive use by scientist and the ease of implementation. The model WOFOST built-in CGMS (Jansen, 1994; Wit, Boogaard *et al.*, 2005; Alterra, 2007), operational for several years in Europe and tested in several countries has been selected to serve as a basis for project work. CGMS is the adapted version of WOFOST as part of European Mars food system. Its interface and the existing database make it very user-friendly. One of the important assets of CGMS has motivated this choice is the availability of several tools orbiting system to provide more efficient forecasting. Most of these tools were developed under projects funded by JRC like ASEMARS. They are used mainly for statistical analysis (CGMSstattools), sensitivity analysis (SANPLAT) and calibration (CALPLAT). In connection with EO data use, recent work has been undertaken to develop data assimilation of remote sensing in CGMS (PYWOFOST). With all those tools, CGMS can provide an integrated tool for monitoring crops with the technical possibilities of assimilation.

Results obtain in Ethiopia Site was significant for the entire study site on wheat. RMSE obtained varies according to areas from 147 kg/ ha to 487 kg / ha. The results are also comparable to existing systems. However, the criteria for evaluating these models at both sites indicate considerable scope for improving existing systems by remote sensing or other techniques.

Spatio-temporal Trend of Eco-Climatic Characteristics and Food Security in the Sudano-Sahelian Belt of Nigeria

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ABSTRACT

The escalating variability in rainfall distribution, deforestation and degradation of natural resources in the Sudano-Sahelian belt has significant effects on the eco-climate and the socio economic sector. The extreme rainfall variability in this zone combined with a fragile landscape, causes a high degree of environmental vulnerability thereby complicating human activities in the zone. For this reason, this research investigates intra-annual as well as inter-annual trends in eco-climatic characteristics to visualize adverse impacts on the natural environment for improved quality of life and environmental sustainability. Rainfall-related Onset dates, Cessation dates, Hydrologic Growing Season and Moisture Quality Index were determined from rainfall data (1950–2006), and Aridity Index was computed from temperature and rainfall data over the same period. These were summarized and decadal means were determined and ranked using numerical identifiers for the interpretation of the various moisture situations across the zone. A geospatial database was developed for the indicators and classes were defined using quantitative definitions for decadal time series. The point data were transformed to spatial data (X, Y, and Z); the surfaces were interpolated, subjected to further analysis and the area of moisture effectiveness was used to determine aridity growth rate. The result reveals short-term, middle and long-term deterioration in moisture effectiveness indicated in its southwards shift. Furthermore, areas classifiable as deficient moisture zones are growing significantly; Aridity Index appreciated from 0.3 to 4.5%, MQI from 2.3 to 6.1%, onset from 1.4 to 7.5%, cessation from 1.8 to 6% & Hydrologic Growing Season from 0.4 to 7%, respectively. This deterioration is a principal indicator of land degradation and confirms the generally-held view of southward shift of drier conditions and the eco-climatic zones across West Africa. The import of this in the effort to address the challenge of food security in the zone is discussed.

KEY WORDS: Rainfall variability, Moisture Effectiveness, Vulnerability, Aridity & Food Security

Mapping of Of ada Rice Production Areas

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ABSTRACT

Ofada rice was defined in this study as a local variety of rice with characteristic bold, short, mouth-filling, palate caressing, red coated kernel in its unpolished form. The mapping exercise identified major Ofada rice production clusters in Ogun, Osun and Ekiti States. It identified 254 Ofada rice farmers majority of whom are male, 204 parboilers mostly female, 36 rice mills in 55 villages and 11 local government areas in the three states. Obafemi Owode local government area of Ogun State produced the highest quantity of Ofada rice (140,750 kg) in the study area. This was closely followed by Irepodun/Ifelodun Local government area of Ekiti (134,900kg). These two local government areas host Ofada village and Igbemo Ekiti respectively where there is a long tradition of rice production. The next highest producer is Oriade local government area in Osun State which recorded production level of 70,100 KG. The highest quantity of rice parboiled and milled was 109,800 Kg and this is from Obafem Owode Local government area. The lowest quantity parboiled and milled was 7, 670 Kg and this is from Ijero local government area of Ekiti State. The quantity of Ofada rice sold in paddy form was 7,540.5Kg in Ogun Waterside local government area of Ogun State and 14,560Kg in Ekiti West Local government area of Ekiti State. The total quantity of rice sold in paddy form was 22,230Kg. The distance analyses data consistently show that facilities for rice threshing, parboiling, milling, were readily available at local levels and within a short distance (between 2 and 4 kilometres) of the farmers' farm or residence. Although urban markets may appear to be very far away from rice production locations according to the distance analysis data, farmers did not seem to have problems selling their paddy or milled rice as buyers came directly to these locations to buy. The data further show that locations of Ofada rice production inputs such as seeds, agrochemicals and fertilizer were far away from farmers' field and residence (between 5 and 30 kilometres) and may not be readily available to the majority of rice farmers. This situation points to the need for direct intervention to improve access of farmers to all rice production inputs. In conclusion, the distance analysis maps reveal the importance of spatial targeting and prioritization of interventions. It is hoped that this result will be utilized by PropCom in developing, prioritizing and targeting interventions to positively impact the Ofada rice value chain in south western Nigeria.

KEY WORDS: Ofada rice, Production Areas

Agricultural Landuse Planning Based on Terrain Characteristics Using Remote Sensing and Geographic Information System in The Lower River Benue Floodplain, Nigeria

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ABSTRACT

In order to meet the increasing demand for food, the farming community needs to have a good knowledge of landuse and land cover of the area. This can be achieved with optimal success using space technology which has the ability to provide rapid, timely, accurate and reliable data within a given time framework. This necessitated a study on agricultural landuse planning on the basis of terrain characteristics including slope, soil, drainage and erosion parameters using satellite remote sensing and GIS technologies in the Lower River Benue Floodplain, Nigeria. The area is located between Latitudes 7° 13'N and 8°00'N, and Longitudes 8° 00'E and 9° 00'E with a total basin area of 7685.28km² and a population figure of 947,138 people (NPC, 2006). A combination of digital data, collateral data as well as attribute datasets were integrated and manipulated in a GIS environment using appropriate software packages. This paved the way for the generation of the land use / land cover map, physiographic-soil map, the drainage map, slope map, together with detail morphometric analysis which led to the prioritization of the sub-watersheds from least priority (alluvial plains) to high priority (pediments) ratings. The integration of the results of slope, physiography, landuse as well as morphometric analysis using the FAO/USDA classification schemes led to the genaration of land capability maps, whereas the appraisal of the lands of the various sub-watersheds in terms of their suitability for the cultivation of paddy (rice) crop in turn revealed that the alluvial floodplain and valley fills are highly and moderately suitable for rice cultivation respectively in the Lower River Benue basin. It has become increasingly apparent that computer based GIS and satellite remote sensing data can provide the environment for effective land capability mapping and suitability evaluation for crop production as a stepping stone for sustained land use planning targeted at addressing issues of agricultural intensification, food security and poverty reduction in Nigeria.

KEY WORDS: Land use planning, terrain characteristics, river floodplain, remote sensing and GIS

Projected changes in mean and extreme precipitation in Africa under global warming

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ABSTRACT

This paper presents likely changes in mean and extreme precipitation in Africa in response to changes in radiative forcing using an ensemble of global climate models prepared for the IPCC Fourth Assessment Report (AR4). Extreme seasonal precipitation is defined in terms of 10-year return levels obtained by inverting a generalised Pareto distribution fitted to excesses above a pre-defined high threshold. Both present (control) and future climate precipitation extremes are estimated. The future to control climate ratio of 10-year return levels is then used as an indicator for the likely changes in extreme seasonal precipitation.

A Bayesian approach to multi-model ensembling is adopted. The relative weights assigned to each of the model simulations are determined from bias, convergence and correlation. Using this method, the probable limits of the changes in mean and extreme precipitation are estimated from their posterior distribution.

Over the western parts of southern Africa, an increase in the severity of dry extremes parallels a statistically significant decrease in mean precipitation during austral summer months. A notable delay in the onset of the rainy season is found in almost the entire region. An early cessation is found in many parts. This implies a statistically significant shortening of the rainy season. A substantial reduction in moisture influx from southwestern Indian Ocean during austral spring is projected. This and the pre-austral spring moisture deficits are possible mechanisms delaying the rainfall onset in southern Africa. A possible offshore (northeasterly) shift of the tropical-temperate cloud band is consistent with more severe droughts in the southwest of southern Africa and enhanced precipitation further north in Zambia, Malawi and northern Mozambique.

This study shows that changes in the mean vary on relatively small spatial scales in southern Africa, and differ between seasons. Changes in extremes often, but not always, parallel changes in the mean precipitation.

There is substantial evidence in support of a positive shift of the whole rainfall distribution in East Africa during the wet seasons. The models give indications for an increase in mean precipitation rates and intensity of high rainfall events, but less severe droughts. Upward precipitation trends are projected from early this (twenty-first) century.

As in the observations, a statistically significant link between sea-surface temperature (SST) gradients in the tropical Indian Ocean and short-rains (October--December) in East Africa is simulated in the GCMs. Furthermore, most models project a differential warming of the Indian Ocean during boreal autumn. This is favourable for an increase in the probability of positive Indian Ocean zonal mode (IOZM) events, which have been associated with anomalously strong short-rains in East Africa.

On top of the general increase in rainfall in the tropics due to thermodynamic effects, a change in the structure of the Eastern Hemisphere Walker circulation is consistent with an increase in East Africa precipitation relative to other regions within the same latitudinal belt. A notable feature of this change is a weakening of the climatological subsidence over eastern Kenya.

East Africa is shown to be a region in which a coherent projection of future precipitation change can be made, supported by physical arguments. Although the rate of change is still uncertain, almost all results point to a wetter climate with more intense wet seasons and less severe droughts.

The Role of Geospatial Information Technology in Decision Support for Rural Agricultural Development in the Nebo Plateau, South Africa

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ABSTRACT

Nebo Plateau is situated in the southern part of Limpopo Province of South Africa. It is comprised of rural villages in the communal areas. The type of farming practiced is largely subsistence agriculture, with significant portions of the total land available underutilized. Most areas are highly suitable for agricultural development if an adequate supply of water for irrigation is provided. Approximately 34% of the area (1,370 ha) is suitable only to natural and/or planted pastures. The remaining area (2,642 ha) is potentially suitable to horticulture as well as grain and oil seed production. This area is characterized by rural poverty (NRM Consulting and PriceWaterHouse Coopers, 2009). The large-scale poverty, lack of resources, illiteracy, and unemployment in the Province resulting from the past economic, social, and political policies has prompted government to identify new and sustainable developmental programmes.

One such initiative is the creation of agriculture nuclei in the vicinity of Nebo area. The main objective in this initiative is to exploit the existing natural resources and develop multi-purpose farm facilities and activities that will foster job creation and enhance food security, thus ensuring sustainable economic growth, social justice and a decent quality of life for the participating communities.

This study therefore uses geospatial technologies (remote sensing and geographic information system) to assess the agricultural potential of the Nebo Plateau. This approach entails assessing the suitability in terms of land/soil and climatic variations, which are determinant factors for agricultural development. The environmental requirements of selected crops representing certain agricultural commodities were evaluated and analyzed in a GIS environment. Various spatial modeling methodologies and techniques were used to model and assign classes of suitability based on the most important and yield-limiting parameters such as rainfall, temperature and soil characteristics. Results indicate that the area is potentially suitable to a variety of agricultural commodities with about 65% of the area suitable for cultivation. This is however considerate of environmental and climatic constraints such as the availability of water for irrigation, improvement of the state of the environment, prevention of soil degradation due to erosion and compaction, improvement of soil fertility by means of sound farming and management practices. These outputs are presented within a user friendly GIS platform for a better decision support to the development agencies and government. The results also help to provide inputs in the calculation of financial models to ensure profitable farming practices for commodities derived at a soil unit level for each of the farms. This study therefore emphasizes the importance of geospatial technologies in informing and promoting sustainable agricultural development.

KEY WORDS; geospatial technologies, agricultural potential, rural, sustainable agricultural development

Mapping the Crop Production System Zones of the IGAD Region

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ABSTRACT

Food security monitoring requires effective crop status assessment and yield forecasting methodologies and tools. Such tools need to build on a thorough knowledge of the crop production systems of the region under monitoring. The Food and Agriculture Organization of the United Nations (FAO) published in 1995 a database of the Crop production system zones (CPSZ) of the seven member states of the Intergovernmental Authority on Development (IGAD) (Van Velthuizen et al., 1994). The CPSZ initiative was a breakthrough in the mapping of crop production zones. It has been extensively used by food security practitioners, scientists in agricultural, environmental and epidemiological studies (Malone et al., 2001; Reynolds et al., 2000; Rojas et al., 2005; Temesgen et al., 2009). However, its database is now outdated, either on the content and on the technological solutions used to disseminate it. The Joint Research Centre of the European Union has recently launched a project to upgrade the CPSZ database and its exploitation software package. This papers presents the main characteristics of the new version under development -referred to as CPSZ-2, the main improvements, and the methodology to define the new crop production zones.

The definition of the production zones is based on the climatic conditions and current cropping systems. A large number of variables that describe the agro-climatic conditions, soil and terrain conditions, and cropping patterns (main crops, crop calendar, pests and diseases, etc.) are combined spatially to define homogeneous areas. Those homogeneous areas are then intersected with administrative boundaries to define the basic mapping units of the database. The homogeneity and consistency of the mapping units are cross checked using satellite remote sensing data, namely vegetation index time series. The CPSZ-2 provides further description of the production zones by adding socio-economic information. Since socio-economic variables are published often aggregated by administrative units, specific spatial disaggregation methodologies are developed.

The new version provides also an enhanced database interface with real Geographic Information System (GIS) functionalities, and possibility to update the database online. The CPSZ-2 will be a valuable tool for all actors involved in food security monitoring and will probably serve other scientists interested by detailed description of the agricultural environment of the IGAD region. The methodological developments in the framework of the CPSZ-2 project bring new aspects on the delimitation of homogeneous agro-ecological units and on spatial aggregation and disaggregation.

Mapping Variation in Soil Volumetric Shrinkage Using Aster Imagery

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ABSTRACT

In this paper we presented potential utility of laboratory spectroscopy and multispectral image dataset for estimating geotechnical characteristics of expansive soils. A geotechnical parameter (volumetric shrinkage) is measured in a soil mechanics laboratory. Soil reflectance spectra are acquired using ASD fieldspec full range spectrometer, and derived from Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) imagery. Volumetric shrinkage is estimated from soil reflectance spectra through a multivariate calibration technique. High coefficient of correlation (R2 of 0.91) is obtained for estimation using laboratory reflectance spectra. Much lower coefficient of determination (R2 of 0.52) is obtained in estimation using ASTER derived soil reflectance spectra. Though model performance indices (RMSEP, SEP, Bias and offset) in both cases, indicated good prediction ability; performance of volumetric shrinkage estimation decreased from laboratory to image scales. Variation in volumetric shrinkage is mapped from ASTER data. Measured and mapped soil volumetric shrinkage show moderate spatial agreement.

Proposed relationships were developed on soils having high liquid limit and plasticity indices, high percentage of material passing 0.075mm sieve (up to a 100 %) with most samples having high clay and organic matter content. The presented approach can provide information about project sites that can be useful at reconnaissance and preliminary design stages of infrastructure development. However for wider applications it should be tested on soils with larger range of liquid limit, plasticity indices, fine fractions and organic matter content.

Keyword: Expansive soil, geotechnical characteristics, volumetric shrinkage, PLS, ASTER

Satellite-based monitoring of evapotranspiration in the Nile basin

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ABSTRACT

The development of a land data assimilation system over the Nile basin (Nile LDAS) seeks to integrate various satellite-based observations of the land surface and hydrology of the region to accurately represent water and energy fluxes. An additional methodology for the monitoring of evapotranspiration (ET) is through the use of land surface temperature derived from remote-sensing data in the thermal-infrared (TIR) band (8 to 14 micron). TIR data are valuable for constraining estimates of ET because varying soil moisture conditions yield a distinctive thermal signature: soil surface temperature increases with decreasing water content in the first few centimeters, while moisture deficiencies in the root-zone leads to vegetation stress and elevated canopy temperatures.

The Atmosphere-Land Exchange Inverse (ALEXI) model is a multi-scale TIR-based remote sensing technique for mapping ET and drought at local to continental scales (Anderson et al. 1997; Anderson et al 2007; Hain et al. 2009). ALEXI facilitates regional implementation by exploiting the spatial and temporal coverage available by geostationary platforms, such as Meteosat Second Generation (MSG) over the African continent. ALEXI utilizes time-differential land surface temperature (LST) measurements derived from the 10.8 micron thermal band on MSG. The LST measurements are combined with shortwave measurement of satellite-derived vegetation cover fraction and hourly insolation to directly diagnose evaporative fluxes at spatial resolutions of 3 to 10 kilometers. Using principles of the surface energy balance, constrained by satellite estimates of net radiation (available energy), ALEXI determines the evaporation rate required to keep the soil and vegetation scene components at the observed temperatures. The main advantage of combining the use of a diagnostic tool such as ALEXI with the prognostic tools of the Nile LDAS is that together they provide a more reliable and complete representation of the land surface and hydrology than either method would provide on its own.

Specifically, ALEXI has added utility in the real-time monitoring of regions with sparse rainfall data or substantial delays in meteorological observation. Additionally, ALEXI has the potential to identify signatures of moisture inputs that are not necessarily associated with precipitation events, such as irrigation and phreatophytic vegetation that has access to ground water sources. For example, while irrigation is represented in Nile LDAS, water usage is tied to assumptions within the algorithm, while ALEXI directly diagnoses actual water usage. In a river management tool, ALEXI could be used to estimate diversions used to support rrigation. Early results of the implementation of ALEXI over the Nile basin are promising, yet require additional validation and comparison with ET estimates from Nile LDAS.

Land Cover Response to Changes in Forest Resources Utilisation in South-western Nigeria: GIS Perspective

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ABSTRACT

This study documents the extent of resource use and the level of degradation consequent upon land use with the aid of remote sensing and GIS technology. The study integrated a topographical map of 1969 and satellite imageries from Landsat MSS 1972, and Landsat TM 1991 and 2000 with ground truthing and socio-economic surveys to assess changes in forest resource use and land cover in Oluwa Forest reserve, South-western Nigeria. The study area was demarcated on the map and grided into 5km x 5km, which gives 25 square grids out of which 10 square grids were selected using the table of random numbers. Each selected grid was again grided into 1km x 1km out of which 10 were again selected randomly. Ten quadrants of 40m x 25m were demarcated from each of the selected 1km x 1km grid for vegetation analysis. In essence, hundred quadrants were selected for this study. Digital image processing was carried out for satellite imageries. Land uses were identified and classified from the satellites imageries based on colour, texture, shape and size using the Integrated Land and Water Information Systems (ILWIS) 3.4 software. Training parcels were sampled based on ground survey after the contrast enhancement. The classes of training sites include: the arable crop cultivation, tree crop cultivation, exotic tree plantation, dense forest and settlement/open space. The maximum probability algorithm was used for final classification. The mathematics of the maximum likelihood decision rule, which was applied, has been explained by Tatsuoka (1971). The accuracy assessment was carried out on the remotely sensed data. The total of 30 points each were selected for this operation and the overall accuracy of 90%, 86.7% and 80% were obtained from the three images. This shows that the classification method was reliable. Result obtained shows that agricultural land uses which were non-existent in 1972 increased three folds from 8,176 hectares (4.43%) in 1991 to 112,172 hectares (60.72%) of the total land area in year 2000. The non-agricultural land uses (settlement) increased by about six folds from 4932.6 hectares in 1972 to 30,911 hectares (16.73%) in the year 2000. The most significant contributor to the agricultural degradation of Oluwa forest was the use of land for arable crop, which accounted for more than 30% of the total agricultural land use. This was also confirmed by socio-economic survey. It is also inferred that the forest reserve declined by more than a factor of six of its original size from 130,774 hectares in 1972 to 19,382 hectares in 2000. Over 1,121 km2 of the forest lands got transformed to agricultural land use over the 28 years. The study concludes that it is possible to monitor forest resources with a reasonable accuracy using satellite images because change detection techniques using temporal remote sensing data provide detailed information for detecting and assessing land use and land cover dynamics.

KEY WORDS: Forest resources, land use, land cover, human activities, GIS, sustainability

Land Classification and Mapping: A Guide to Agricultural Development in Adamawa State, Nigeria

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ABSTRACT

Adamawa is one of the many states in Nigeria where detailed soil survey/mapping and systematic agricultural database are generally lacking or at best sketchy and localized. Thus, most agricultural policies/programmes by public agricultural agencies are limited to general advice on application of farm inputs such as fertilizer and herbicides or the provision of tractor services. Such interventions are non area or crop specific and little effort is directed at encouraging location specific specialization and management practices. Hence, the largely illiterate farmers in the state rely on local experience in an ever increasingly volatile environment. Agricultural development in a highly dissected terrain of variable surface water availability and rainfall regime such as Adamawa is must not be ad-hoc, isolated or left to the individual norms of the local farmers. It is, therefore, most imperative that comprehensive land and water resources (the most important variables in crop production) classification and mapping are carried out to provide the necessary database for land use planning and development. This was done with the view to identifying crop production blocks and suitable crop choice/cultivation and land management practices that minimize degradation. With these, agricultural support services can be planned and appropriately directed and uncertainties associated with specific environmental conditions (land, water and rainfall) may be averted. The most convenient and cost effective way of achieving these is through the use of geoinformation technology. Image classification was therefore carried out on a LANDSAT image of Adamawa State Nigeria to determine water bodies, marsh lands and uplands/mountains to create a first layer. A Second layer was created from the water vapour band of meteosat and a third layer was developed from rainfall data of the study area. A weighted linear combination (WLC) was performed with the last two layers (water vapour and rainfall layers). However, since water vapour and rainfall are of equal importance the two layers were given equal weights. The pixel values in the WLC layer provided the computer with the relevant information for rain-fed agriculture but not irrigated agriculture. For this reason, the water bodies and marsh land classes in the first layer were digitized and used to mask the WLC layer to form the water distribution layer of Adamawa State and on which irrigated agricultural potentials were assessed.

Growth in precision agriculture based on rapid temporal capability
of the DMC satellite constellation

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ABSTRACT

Precision agriculture requires timely information on crop health to enable differential application of fertilisers to boost crop yield. The efficiency of satellite constellations for rapid imaging of large areas at closely controlled times, has led to a strong growth in use of this technique. The DMC satellite constellation, launched in 2002, provides a service to multiple companies in Europe and USA. The paper demonstrates the challenges of precision agriculture, and the use of the constellation to meet the needs of the users.

Energy Resources

Tracking logging roads to assess the impact of commercial logging on the forest above ground biomass: the case of South East (JENGI) Cameroon

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ABSTRACT

The South East lowland forest area of Cameroon constitutes part of the lowland Congo basin forest which is highly rich in biodiversity; including large mammals, birds, fishes, butterflies, amphibians, reptiles and rich forest flora.

This rich forest area which is also a huge stock of above ground biomass has continued to decrease due to increasing urbanization, high demand for agricultural land and agricultural practices of slash and burnt, demands for firewood for domestic use, commercial timber exploitation and mining.

Timber exploitation or commercial logging which is the main aspect contributing to forest area decline is a viable economic activity in this region. In recent years the government also lease parts of these logging concessions for mining (gold, cobalt, nickel, iron ore and diamond).

Constructing roads in the forest facilitate logging activities as machinery and staffs are able to move easily in and around the concession and they also facilitate the evaluation of logs. However road construction also needs to be closely scrutinized because of the negative impact they have on the forest. Logging roads leads to habitat fragmentation, habitat loss and deterioration, biodiversity destruction on the area covered by the road, opening up of the forest canopy and access into the forest by poachers.

Through the intervention of NGO's logging roads are nowadays constantly tracked using a GPS and the width of each road taken at regular intervals to access the total forest cover destroyed in the course of constructing these roads. These are map out in GIS presenting the situation before exploitation, the situation after exploitation and the area of forest cover or above ground biomass destroyed through logging calculated.

Assessment of Solar and Wind Energy Potentials in Nigeria

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ABSTRACT

The importance of sustainable energy in the face of recent global warming has brought energy efficiency and reliability to the fore of research and development in the 21st century. Electricity generation in Nigeria has increasingly become unreliable due to several factors limiting the hydroelectricity system predominant in the country. This condition has hampered socio-economic and infrastructural development significantly in the most populous African country which otherwise could have ranked among the developed nations of the world. Among the major causes of the incapacity of hydroelectricity generation of power to meet the countries demand, is the recently records of low flows of the river Niger into the Kainji dam, from where more than 80% of Nigeria's hydroelectric power is sourced. Recent studies have linked this downward trend in river Niger's discharges to climate change.

Globally however, the increasing trends in human population have resulted in increased fossil fuel consumption since the industrial revolution. Such increases have aggravated the impacts of climate change in most regions of the world, particularly impacting greatly on energy sources and supply. In addition to rapid exhaustion, another important problem associated with fossil fuels is that their consumption has major negative impacts on the environment. Hence, many countries around the world have included renewable energy systems in their future energy plans so that they can produce reliable and environmentally friendly energy.

This paper advocates for the employment of solar and wind energy as alternative sources of power generation in Nigeria by developing suitability maps for the entire country. A 1° by 1° resolution monthly average climatic datasets of radiation and wind parameters obtained from the NASA Satellite Observatory GOES-1 were geo-processed and the density maps produced were employed for decision support analysis. The identification of areas technically suitable for renewable generation involved the collection of existing information, such as historical land use/land cover, terrain and slope information. Data was analyzed for currency, accuracy, and completeness. Regional differences were derived from geostatistical kriging after classifying the entire area of study into contiguous units. Sensitivity analysis was conducted to determine the suitability of each alternative and the results were compared to determine the best approach to sustainable power generation by region.

NPP modeling for biomass energy estimation for South Africa

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ABSTRACT

In times of worldwide growing demands of energy and increasing problematic dependence on fossil fuels, the interest of regions and countries on securing their energy supply with renewable energy sources is gaining in importance. Bioenergy is one kind of renewable energy, made available as electricity, heat or fuel. For developing countries or regions with difficult infrastructure for energy supply, this can provide access to affordable and safe forms of energy.

South Africa has the potential to become a relevant player in the production of bioenergy, not at least because of its warm climate and large amounts of fertile land. Together with other African nations the increasing demand for energy of the continent could be supplied.

On the other hand, large-scale land use for energy crops may induce land-use changes that put food security risk or lead to the destruction of natural ecosystems.

Mapping the potential for biomass production for energy supply, considering the influence of land-use for energy crops on environment and food security is the topic of the presented work. For this Net Primary Productivity (NPP) of croplands and forests of South Africa is computed on a spatial resolution of 1 km. From these model results the biomass potential can be computed using specific conversion factors.

The dynamic vegetation model BETHY/DLR (Biosphere Energy Transfer Hydrology Model), is a modification of the JSBACH model which is included in the ECHAM5 global atmosphere circulation model. Here it is used to calculate the contributions from the biosphere-atmosphere exchange. At the German Remote Sensing Data Center (DFD) of the German Aerospace Center (DLR) BETHY/DLR is driven for simulations of the carbon exchange and the water balance between biosphere and atmosphere. For this study the model was adjusted for the special climate conditions of South Africa. We are computing NPP for different regions on regional to national scales. The model is driven by remote sensing data and meteorological input data on a spatial resolution of 1 km in time steps of one hour.

The BETHY/DLR model uses a two-flux scheme to approximate the radiation absorption in the canopy. Photosynthesis is integrated using the combined approach of Farquhar and Collatz. The enzyme kinetics, which are parameterized on leaf level, are distinguished to C3 and C4 plants. This is important, since C3 and C4 plants have significant differences in their way of carbon-fixation. In a second step the photosynthesis rate is extrapolated from leaf to canopy level, taking into account both, the canopy structure as well as the interaction between soil, atmosphere and vegetation. Stomatal and canopy conductance, evapotranspiration and soil water balance are included.

The output is given by time series of NPP in daily steps with the resolution and projection of the land cover classification (1 km x 1 km, latitude – longitude projection with WGS84 (World Geodetic System 1984) datum).

The driving parameters of the BETHY/DLR model are two sets of remote sensing data (derived from SPOT-VEGETATION), meteorological data (provided by ECMWF) and further dataset concerning i.e. soil type information and altitude.

Time series of the Leaf Area Index (LAI) are used to initiate the phenology of vegetation. They are based on CYCLOPES 10 day composite datasets, provided by POSTEL (Pole d'Observation des Surfaces continentales par TELedetection).

The CYCLOPES dataset also provides information of land cover and land use and is available as Global Land Cover 2000 (GLC2000). With GLC2000 a classification with 22 different land cover classes is available which is representative for the year 2000.

In order to make the GLC2000 usable for NPP modelling with BETHY/DLR, the 22 GLC2000 vegetation classes have to be translated to one of the actual 33 inherent BETHY/DLR vegetation classes, which can be regarded as vegetation types. Each vegetation type is linked with biochemical parameters as e.g. the maximum carboxylation rate or the maximum electron transport rate representing light and dark reaction of photosynthesis. The parameterisation of BETHY/DLR allows to translate one GLC2000 class to fractions of two vegetation types.

In addition to remote sensing data BETHY/DLR needs meteorological data input. The ECMWF provides the needed data in a spatial resolution of 0.25° x 0.25° with a temporal resolution of up to four times a day. These are model analysis of 2 m air temperature, wind speed at 10 m above ground, the soil water content of the four upper layers and cloud cover. Daily values of precipitation are derived from the ERA40-reanalysis. From this the daily mean, minimum and maximum of temperature are calculated, as well as the daily mean of cloud cover over all three strata (high, medium and low) and the water vapour pressure.

With the BETHY/DLR model we are able to model the development of carbon sinks and sources depending on the geographical and meteorological conditions of the considered region. The resulting NPP can be converted to energy potentials from aboveground biomass. This is done by using specific conversion factors, first separating above ground biomass (AGB) from below ground biomass and in a second step calculating the fraction of feasible AGB. Further development of the model, which includes the implementation of a phenology model, allocation schemes for the distribution of carbon fixation in plants and finally a method for data assimilation, will lead us to predict the future distribution of carbon sinks and sources. In this context we will take into account future land use/ land cover changes, especially regarding the impacts of large-scale land use for energy crops.

Spectral Remote Sensing of Hydrothermal Alteration associated with Volcanogenic Massive Sulphide Deposits, Gorob-Hope area, Namibia

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ABSTRACT

Multispectral Landsat ETM+, ASTER, hyperspectral (HyMap) and field spectra datasets were used to identify and map hydrothermal alteration patterns and hydrothermal mineral abundances associated with volcanogenic massive sulphide (VMS) deposit in the Gorob-Hope area, Namibia. False colour composite, band ratios, and principal component analyses using multispectral images were used to identify hydroxyl and iron oxide alteration zones. Moreover, integrated analysis of field spectra and airborne data resulted in identifying of VMS deposit lenses and their patterns. Analysis of diagnostic absorption feature (absorption depth and wavelength position) of white micas at and around 2200 nm region was helpful in mapping hydrothermal alteration zones. Analysis of the spectral variability and estimation of alteration indices for white micas and chlorites revealed vectors towards zones with volcanic massive sulphide mineralization. Several band ratios were calculated in the shortwave infrared (SWIR) wavelength region and the creation of band ratio colour composite images were helpful in identifying the hydrothermal alteration zones and in selecting end members useful for surface compositional mapping from the HyMap data. The use of band ratios as predictor variables and field spectra data as predicted variables enabled the development of prediction model for the presence or absence of white micas and for estimating of their absorption wavelengths. The result obtained by the integrated analysis of field spectra data and airborne hyperspectral imagery is consistent with the published geological map of the study area.

KEY WORDS: imaging spectrometry; band ratios; volcanogenic massive sulphide; hydrothermal alteration, white micas.

Estimating papyrus (Cyperus papyrus) biomass using narrow band vegetation indices and the random forest regression algorithm

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ABSTRACT

Accurate estimates and mapping of wetland vegetation quality such as biomass have increasingly been identified as critical components for an efficient wetland monitoring and management system. Traditionally, biomass predictions are made using direct field measurement methods. These methods do not offer real-time, and are inadequate for poorly accessible areas. Methods that take advantage of remote sensing can offer powerful techniques for predicting vegetation biomass. In this study we investigated the use of vegetation indices derived from field spectrometry data to estimate papyrus (Cyperus papyrus) biomass. Papyrus characterizes most of the wetlands in tropical Africa. Spectral and above ground biomass measurements were collected at three different areas in the Greater St Lucia Wetland Park, South Africa. We evaluated the potential of narrow-band normalized difference vegetation index (NDVI) calculated from all possible two band combinations between 700 nm and 1000 nm. Subsequently, we utilized the random forest (RF) algorithm as a modeling tool for predicting papyrus biomass. The results showed that papyrus biomass can be estimated at full canopy level under swamp wetland conditions ($R2 = 0.73$; RMSEP = 276 g/m2; 8.6 % of the mean). From our results, random forest has proved to be a robust feature selection method in identifying the minimum number (n = 4) of narrow-band NDVIs that offered the best overall predictive accuracy. This lowest prediction error (RMSEP = 276 g/m2; 8.6 % of the mean) was obtained using four NDVIs computed from bands at (740 nm and 853 nm), (741 nm and 853 nm), (741nm and 847 nm), and (749 nm and 776 nm). It was recommended that these promising results can be up scaled to spaceborne or airborne sensors such as HYMAP or Hyperion for predicting vegetation biomass in wetland areas using remotely sensed data.

KEY WORDS: Above ground biomass; Field spectrometer measurements; NDVI; Random forest; Variable selection.

Modelling the Spatial Distribution of Above Ground Woody Biomass In Communal Savanna Woodlands

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ABSTRACT

A large percentage of rural communities in southern Africa rely on communal woodlands to meet their domestic energy demand and supply requirements. Fuelwood and charcoal are the predominant sources of bioenergy in most low-income rural and urban households. There is an increased demand for quantitative data on available woody biomass resources for macro-level rural energy planning and modelling. Spaceborne polarimetric synthetic aperture radar (POLSAR) approaches are gaining increasing prominence in estimating above ground biomass (AGB) since woody vegetation is closely related to forestry double bounce, anisotropic (vegetation) scattering, rough surface scattering, dihedral and dipole scattering mechanisms. Access to available woody biomass resources is constrained by land tenure practices and topographic constraints within a given distance from selected households. This paper outlines a detailed biomass distribution model used to analyse the relationship between households and available biomass resources while accounting for a number of factors imposed by land tenure systems and geophysical constraints in the communal woodlands around Welverdiend village (South Africa). The biomass distribution model generates maps showing the location of accessible woody biomass resources within the precincts of Welverdiend village and in potential conflict zones (private farms, game reserves and adjacent villages) within the 10km radius of selected households. The model computes the shortest path distance from households to selected woodlots, which is critical in determining the amount of time it takes to collect fuelwood resources. These results provide important information to meet the requirements of woodland dynamics practitioners, socio-economic analysts and energy modellers working on different aspects of biomass management in rural communal woodlands.

KEY WORDS: POLSAR, woody biomass, land tenure, household, conflict zones, accessible

Disaster Risk Reduction

Assessment of Land Degradation for Watershed Management Using Remote Sensing and GIS: Case of Keleta catchment, Arsi zone Oromia Region, Ethiopia.

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ABSTRACT

Watershed degradation is a global problem, which is more serious in developing countries like Ethiopia. To eliminate the problem considering the watershed conditions in relation to degradation is important. This study examines the use of GIS and Remote Sensing in conjunction with universal soil loss equation (USLE) model for assessing land degradation of Keleta river catchment in Arsi Zone of Oromia Regional State. Here land degradation is considered as a function of forest loss and soil loss. Remote Sensing and GIS had been utilized for land use/land cover mapping and detecting land cover change. Universal soil Loss Equation estimating utilized for soil loss estimation. Four time series data, that Landsat MSS 1973 data, TM 1986, ETM+ 2003 and ASTER 2006 were used to make the analysis of soil loss and land cover change. Land use and land cover are major factors in watershed analysis, particularly in relation to soil erosion and land degradation condition. The result of the work shows the rate of forest degradation of the study area was 1.057 per cent per year, which is too high while considering the sustainability, along with the estimated annual soil loss for the study area ranges from 0.00 to 357375 with the average 219.12 t/ha/year. Suggestions were therefore made at the end of the work on ways to use the information as contained therein optimally.

KEY WORDS: Land degradation (soil erosion), USLE, loss estimated annual soil loss, Post classification change detection, land use/ land cover classes; forest/vegetation loss.

The changing face of the Bale Mountains National Park over 32 years: A study on land cover change

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ABSTRACT

The Bale Mountains National Park provides a number of important ecological and hydrological services locally, regionally, and globally. However, the park and its services are under immense pressure as a result of a rapidly increasing human population settling within and around its boundaries. It is well documented that human pressures can alter and transform land cover. Using GIS and remote sensing, this study examines and describes the changes in land cover throughout the park over a 32 year period, during which, human population pressure is known to have increased over time. We analyzed satellite images from the years 1973, 2000 and 2005 in a Digital Image Processing system to produce a time series of land cover maps and used GIS to advance the analysis and to trace land cover and landscape dynamics during the study period. It was found that montane forest, which comprises more than 40% of the total area, was lost at an average annual rate of 3.74 km^2 during the study period. Nearly 120 km^2 of montane forest was lost during this period. Conversely, glades, clearings within montane forest, were steadily increased in area at an average annual rate of 1.14 km^2. Such dynamics were also observed in the Afroalpine where pasture lands are expanding very rapidly at a rate of 28 km^2 per year, particularly between 2000 and 2005, at a cost of Erica, montane forest and woodland which in turn are shrinking at a rate of 13 km^2, 15 km^2 and 1.77 km^2 every year through out this period. Moreover, this study also found that the numbers of patches in all the land cover classes were increasing while average patch size decreased. This study shows that forest and woodlands are being transformed into grasslands across the study area as well as nearly all land cover classes undergoing fragmentation. We suggest that such landscape transformations are as a result of increased human pressure on the parks land, which appears to be accelerated in more recent times.

KEYWORDS: Bale Mountains, Fragmentation, GIS, Land cover, Remote Sensing

Assessing The Impact of Sea Level Rise on Vulnerable Coastal Communities in a Remote Sensing Environment

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ABSTRACT

Inundation and the episodic flooding caused by spring tide in low-lying coastal environments are expected to increase due to sea level rise caused by global warming. This development threatens both human settlement and natural habitats within such vulnerable areas. Sea level rise is a significant and growing danger to the coastal communities worldwide. The impact of sea level rise will be more pronounced in developing countries where data for sustainable managing the coastal environment is scarce. This paper presents a comprehensive assessment of the expected impacts of sea level rise within the Dansoman coastal community in Accra, Ghana. Impact of future sea level rise was modeled using SIMclim model, which is based on the modified Bruun rule. The IPCC predicted global scenarios, tidal and wave climates, historic rate of erosion and other geomorphic parameters were model input parameters. The simulated results were overlaid on near vertical aerial photographs obtained in 2005 and analysed. It emerged that the shoreline in Dansoman could recede by about 202 m inland by the year 2100 with baseline from 1970-1990, which compared fairly well with an earlier study by Appeaning Addo *et al.,* (2008). The study also revealed that about 84% of the local dwellers in the Dansoman coastal community are aware of the rising sea level in the coastal area. However, a significant percentage of this number do not understand the causes of sea level rise and have poor measures of adapting to the effects of flood disasters. It came out that approximately 645,556 people, 926 buildings and a total area of about $0.78km^2$ of land are vulnerable to permanent inundation by the year 2100. The study has demonstrated that there will be considerable losses to both life and property by the year 2100 in the Dansoman coastal area in the likely event of sea level rise.

KEY WORDS: sea level rise, climate change, inundation, coastal erosion, Accra coast

The use of Geospatial tools in Gully Erosion Assessment and Monitoring in the Zhulube Meso-catchment of the Limpopo Basin

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ABSTRACT

Assement and monitoring of erosion has with the advent of geospatial techniques become more accurate, affordable and less time consuming. This study was based on the use of GIS, remote sensing and field surveys techniques to identify gully erosion within the Zhulube Meso-catchment of the Limpopo Basin in Zimbabwe. GIS, remote sensing and field surveys techniques were used to determine the sedimentation and stream power indices while statistical analysis focused on the correlation between gully, soil and vegetation characteristics as a means of identifying areas susceptible to gully erosion. The results from this study illustrate that 56% and 77% of major gullies are discernible using Landsat TM imagery and Orthophotos respectively. A significant relationship was evident between gully depths, stream erosive power and slope gradient at $r^2=0.62$ ($p \leq 0.05$), while streams sediment loadings showed a significant effect on the gully depth with at $r^2=0.02$ ($p \leq 0.05$). It was therefore concluded that Geospatial techniques are applicable in gully identification, with variable accuracy levels depending on the spatial, spectral and temporal resolution of the imagery. Geospatial techniques can also be used to determine the sediment load and stream power with significant levels of accuracy.

KEY WORDS— Erosion, Gully, GIS, Environment, Satellite, Water

Radiometric and Data Quality characteristics of the 2nd Generation Disaster Monitoring Constellation (DMC) satellites

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ABSTRACT

The DMC satellite constellation operates a comprehensive calibration programme that cross calibrates the individual satellites to achieve a high level of accuracy. This programme incorporates a "gold standard" satellite which carries out detailed vicarious calibration at a well instrumented test site. In late July 2009, two new 2nd Generation DMC satellites were launched with 22m GSD with bands equivalent to Landsat bands 2, 3 and 4. These satellites show a marked improvement in spatial resolution and data quality compared to the first generation systems.

In this presentation the data quality and overall calibration stability of the 2nd generation DMC satellite systems is compared to the 1st generation systems which still form part of the constellation. Direct comparisons in terms of Signal to Noise, effective Spatial Resolution (MTF) and CCD stability will be given. The absolute calibration and relative satellite to satellite inter-calibration will also be described and the uncertainties of the derived data products will be evaluated.

A summary of the results of the inter-comparison between Landsat 7 and the first generation DMC satellites will also be given.

In-Orbit Results of the Second Generation Disaster Monitoring Constellation

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ABSTRACT

Over the last years the Disaster Monitoring Constellation (DMC) has literally changed the way in which we view the world; Providing cost effective, high quality, wide area imagery data to users around the globe. With the launch of the first two spacecraft of the second generation constellation in 2009 and the launch of the second two later this year, affordable Earth Observation (EO) will be taken to the next level.

Next to its technical merits the DMC constellation has also proven to be an extremely effective capability building tool. Over the years it has helped countries such as Algeria and Nigeria build their in-country capabilities. An example of this is that Nigerians engineers, under supervision of SSTL, have built the NX spacecraft. This spacecraft is to be launched with NigeriaSat-2 later this year as third and fourth spacecraft in the second DMC constellation.

The second generation spacecraft provides data at 22 m Ground Sampling Distance (GSD). This means that double the amount of pixels per area is captured in comparison to the first generation DMC that has a GSD of 32 m. Furthermore the amount of on board storage and downlink rate has increased by an order of magnitude compared to the first generation. Where the first generation spacecraft could provide a throughput in the order of 650,000 km^2 per day, the second generation can capture, store and downlink up to 11,000,000 km^2 per day.

This presentation will present an overview of the performance of the second generation DMC based on in-orbit results from the current two spacecraft. It will also provide and outlook on the expected constellation performance once two further spacecraft are launched in late 2010. It will discuss and illustrate, with in-orbit examples, the merits of the system for global disaster monitoring and resource management and will furthermore highlight the DMC's enabling character for in country capacity building.

Numerical Modelling of Flooding and Erosion Using Cellular Automation

Evolutionary Slope and River Model (Caesar) and GIS: A Case Study of Ilaro Town in Ogun State, Nigeria

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ABSTRACT

Flooding/Soil erosion has been one of the challenges man has faced since time immemorial. The wearing away of the surface of man's God-given asset upon which most activities take place can not but be of great concern due mostly to its economic impact. Erosion/flood among other things render a piece of land useless for agriculture, mineral exploration, environmental benefits such as housing, commerce just to mention a few. Effective management of these soils requires complex modeling operations and spatial analysis in support of soil management planning. This will help ameliorate the present situation and forecast the future for better and efficient handling. The research is the numerical modeling of the erosions/flooding in Ilaro town, Nigeria using the cellular automaton evolutionary slope and river (CAESAR) model. CAESAR occupies a unique space in fluvial modelling. It has the capability to simulate timescales that are useful to engineers, researchers of fluvial systems (1-100 years) and to simulate flooding and morphological change of pertinent spatial scales (from 2 km reaches to 400+ km catchments). Indeed, experience of using CAESAR has shown that its greatest robustness is in simulating general patterns of erosion and deposition. Spatial (3-D) data collected at Ilaro town was converted into DEM in GIS software environment and incorporated with flow data into the CAESAR model. The Model simulates morphological changes in river catchments or reaches, on a flood by flood basis, over periods of five years. This was used to simulate the geomorphic response of river catchments to changes in climate and/or land cover. Based upon the cellular automaton concept, repeated iteration of a series of rules on regular mesh of grid cells (that were used to represent the river catchment studied) determines the behavior of the whole system. The results indicate an erosion rate of 2.5cm per year with consequent increase in inundation of 4%. The paper recommends urgent sustainable measures such as tree planting, proper drainage system and waste disposal system.

KEY WORDS: Flooding/Flood, CAESAR, Catchments, Geomorphology, Drainage, Ilaro

Assessment of the vulnerability of water resources to seasonal fires across the Northern sub-Saharan African region

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ABSTRACT

The northern sub-Saharan African (NSSA) region, extending from the southern fringes of the Sahara to the Equator, and stretching west to east from the Atlantic to the Indian ocean coasts, plays a prominent role in the distribution of Saharan dust and other airborne matter around the region and to other parts of the world, the genesis of global atmospheric circulation, and the birth of such major (and often catastrophic) events as hurricanes. Therefore, this NSSA region represents a critical variable in the global climate change equation. Recent satellite-based studies have revealed that the NSSA region has one of the highest biomass-burning rates per unit land area among all regions of the world. Because of the high concentration and frequency of fires in this region, with the associated abundance of heat release and gaseous and particulate smoke emissions, biomass-burning activity is believed to be a major driver of the regional carbon, energy, and water cycles. We acknowledge that the rainy season in the NSSA region is from April to September while biomass burning occurs mainly during the dry season (October to March). Nevertheless, these two phenomena are indirectly coupled to each other through a chain of complex processes and conditions, including land-cover and surface-albedo changes, the carbon cycle, evapotranspiration, drought, desertification, surface water runoff, ground water recharge, and variability in atmospheric composition, heating rates, and circulation. In this presentation, we will examine the theoretical linkages between these processes, discuss the preliminary results based on satellite data analysis, and provide an overview of plans for more integrated research to be conducted over the next few years.

Spatio-temporal Analysis of Land Degradation in Ibadan, Nigeria

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ABSTRACT

Remote Sensing and GIS applications are often considered as cost effective procedures for the collection and processing of large scale data that would otherwise require a very large input of human and material resources. The ease with which satellite remote sensing data can be rapidly processed with computers provides further opportunities for the analysis and interpretation of data, resulting in the acquisition of valuable information over large areas for policy formulation, planning and management decisions.

In most parts of sub-Saharan Africa, land degradation is becoming a serious challenge particularly in the humid rain forest region. Soils, which constitute one of the most important of the world's natural resources, are strongly varied in structure and composition. Life on earth is totally dependent on well managed soils, since, poor soil management reduces agricultural output, disfigures beautiful landscapes, encourages floods and has other catastrophic effects on animal populations. On the other hand, good soil management helps to reverse the trend of desertification in several parts of the world. Land cover types, which reflect the quality of the underlying soil, may be used indirectly as indicators of various levels of land degradation.

This study employs the Revised Universal Soil Loss Equation (RUSLE) to build a raster GIS based model of soil loss by water in the Ibadan region, Nigeria. Landsat TM images were obtained for the three epochs of twenty years between 1968, 1988 and 2008. Input factors were calculated separately and stored as raster layers which were overlain in the GIS model to calculate the soil loss at pixel value for the three epochs. Mapping of vegetation cover was carried out by applying TM-Linear Mixture Modelling and NDVI, while the image difference technique was used in the change detection analysis. The model reveals significant increase in the amount of soil loss in the Ibadan region from 1968 to 2008, as a result of land cover changes.

It was concluded that the degradation of the soil observed during the last four decades, was caused by effects of these land cover changes. In conclusion, an evaluation of the accuracy and limitations of the methods employed are presented in this paper.

Assessing Biomass and Carbon Stocks in War-affected Areas Using Remote Sensing and GIS : Case Study of Darfur Crises

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ABSTRACT

Forest-cover in the tropics is changing rapidly due to indiscriminate removal of timber from many localities, which might be one of the major sources of carbon emission and global climate change in recent decades. Sudan suffers prolonged episode of violent conflicts such as the civil war in the south that ended 2005 and the ongoing tribal conflict in Darfur state which started early 2003. One of the war reasons was the competition upon limited forest and rangeland resources. The conflict led to a death of more than 100000 people and displace of about 2.7 million. Now there is growing concern about the environmental impact of Darfur's conflict upon limited forest resources. The national and international efforts are intending to resettle the displaced people to their home places. Most displaced people were from rural areas where houses are constructed from wood, straw and grasses. As the forest resources are limited, some measures are needed to be taken in advance to the resettlement so as to minimize risk upon environment. Therefore, the study aims to assess and highlight the threats of expected resettlement upon biomass and carbon stocks of Darfur's woodlands resources (mainly forest and grasslands) using remote sensing, Geographical Information System, field survey and documented reports.

Darfur has an annual wood depletion rate 0.8 % and annual allowable cut of 6236776 m^3. The total population of Darfur is about 4.8 million, 70% of them from rural areas and they depend 90% upon fuel wood as main source of fuel. The annual wood consumption (fuel wood and building) was estimated by 3216238 m^3 with average of 0.73 m^3 per capita. The total displaced households in Darfur about 308571.

The study used stratified random sampling design based-on unsupervised classification of landsat ETM data and SPOT Free Vegetation NDVI for field data collection and estimate of above-ground biomass for selected areas. Diameters and heights of trees inside sample plots were measured. Models and equations were developed to estimate the number of stems and wood volume. Later supervised classification and vector queries were used to delineate the inventoried areas and production of wood and grassland classes. NDVI maps and indices were also produced and used for verification and estimation of biomass. ERDAS Imagine,, ArcGIS and SPSS software were used for data analysis and manuplation. CarbonFix Standards and online examples were used for wood and grass conversions and carbon estimate.

Results showed that Darfur has a total area of 81.3 million ha, of which 22 million is a woody resource (including wooded grassland). It has been calculate that each household needs about 0.5 m^3 of wood and 0.45 tones of grass for building a house. Accordingly, the study found that the total wood expected to be removed estimated at 155000 m^3 and this would release about 100000 tons of CO_2. In the same way, about 138000 tones of grass would be removed and this was estimated to release more than 638000 tons of CO_2. The study concludes that there are threats expected to Darfur's biomass and CO_2; hence more research and environmental measures are needed before the resettlement to avoid degradation and protect the greenhouse.

KEY WORDS: biomass, CO2, war, remote sensing

Wetland Mapping using Geo-Spatial Technology

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ABSTRACT

Wetlands are among the world's most productive environment. They are cradles of bio- diversity, providing the water and primary productivity upon which large numbers of plant and animal species depend for survival. Unfortunately, they are also among the world's most threatened ecosystems, owing mainly to continued drainage, urbanization, pollution, over-exploitation or other unsustainable uses of their resources. The lack of baseline wetland inventory and limited accessibility to the available ones have been identified as major limitations for sustainable use and management of wetland resources. This study therefore, utilized multispectral remote sensing data and global positioning system (GPS) for mapping and assessing spatial and temporal variation in the status of wetlands in the study area. The images were processed using ILWIS 3.2 Academic. The combined digital image processing and visual image interpretation were used to identify and segment wetlands in the image data. The coordinates of all identified wetlands and various anthropogenic activities on them were taken using GPS to show the spatial pattern of wetland areas. The result indicated that wetlands are decreasing in the area extent in the study area due to anthropogenic factors, the most important of them is the conversion of wetlands to residential and commercial land use.

KEY WORDS: Wetlands; multispectral images; geospatial technology; anthropogenic   factors

Land Cover (agriculture, pasture, and forest) Societal Economic Zones

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ABSTRACT

A geospatial model has been developed to characterize food growing, pasture, and forested areas as to economic market. Food growing zones are defined combining Ramankutty global agriculture (11 major food group) maps derived from remote sensing and FAO statistical data. Irrigated land mapping is derived from FAO global irrigation maps. In addition, global forest areas are included there have been derived from MODIS. Final characterization categories are: irrigated agriculture, rain fed crop zones, rain fed crop-pasture mix, pasture, and dominantly forest. These land cover categories are of critical importance in supporting agrainian societies largely in developing countries. A geospatial model was then developed to define economic zones (urban, urban fringe, rural developed, rural fringe, subsistence) as a function to varying degrees of market access. Combinations of the land use typing and markets (such as: rural fringe irrigated agriculture, rural fringe rain fed cropping, rural fringe rain fed crop pasture mix, rural fringe pasture, rural fringe pasture, and rural fringe barren) result in the definition of how societies interface with market structures that can be used when abnormal conditions occur whether natural disasters or droughts. This mapping structure has been completed for all of Africa and a number of specific situations will be illustrated.

Modeling the Spatial Distribution of the Anopheles Mosquito for Malaria Risk Zoning using Remote Sensing and GIS. A case study in the Zambesi Basin of Zimbabwe

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ABSTRACT

Malaria transmission can be viewed as a unified system of the vector (mosquito), the human host and the environment.

Application of Remote Sensing and Geographic Information System is increasingly being used in recent years for studying disease epidemiology. These techniques allow an increased use of spatial analysis of environmental factors that contribute to the spread of vector-borne diseases by identifying hot spots, monitoring disease patterns, and defining areas (locations) that need attention in disease control planning.

Data collected by satellites and validated by fieldwork are extensively used for monitoring changes in disease patterns and delineating risk areas. How these data products, when incorporated in a geographic database, could be used to develop a spatial model for malaria risk zoning for effective malaria control planning in Zimbabwe is the subject of this study.

The study took place in 1997 in the Piriwiri, Umfuli and Magondi communal lands which are located in the Hurungwe and Makonde administrative districts of the Mashonaland Province of Zimbabwe, and which form part of the Zambesi Basin.

Specific environmental factors favourable for the habitat of the malaria vector were identified based on expert knowledge and used to predict the suitability of the area for the Anopheles mosquito using Indicator Kriging Algorithm. By this method threshold environmental conditions for the survival of the Anopheles mosquitoes are set. The environmental indicators (conditions) are then transformed into indicator (dummy) values of 1 (favourable) and 0 (not favourable). The probability of exceedance of this threshold condition is then determined by spatial interpolation of the indicator variables using Indicator Kriging algorithm. This allows the prediction of the probability that a particular area (location) is suitable for the malaria vector.

The potential spatial distribution of the malaria vector (An. arabiensis) in the Mashonaland was classified and used to determine areas that are potentially risky for malaria.

The result showed that, except a few areas in the communal lands of Umfuli that were highly favourable for the Anopheles mosquito, most of the study area were moderately favourable for Anopheles mosquitoes. Less favourable areas were mainly located in the Piriwiri Communal lands.

The spatial distribution of malaria was determined using clinical malaria data from 6 health clinics in the study area. As there were only a limited malaria data for the area during field work and also because not all malaria cases were reported at the clinics due to the poor nature of the roads and lack of adequate transport facilities, a travel (accessibility) map was calculated and used to determine potential sources of malaria case recorded at the clinics.

Malaria incidence was expressed as a function of accessibility to clinics, the percentage of reported malaria cases and the size of the population. Population size was determined according to the size of the settlements in the communal lands. The highest malaria incidences were observed in Umfuli ward 18, the lowest in Piriwiri.

Malaria risk areas were determined by comparing the predicted malaria incidences with the potential vector distribution.

High malaria incidences were generally associated with areas which are also favourable for the vector, while in areas which are not so favourable, malaria incidences were low.

Combining GIS and remote sensing applications with geostatistical analysis is a promising approach to define malaria risk areas. However, further quantitative research is needed to validate the relationships within the malaria transmission system, especially on the vector and the human environment aspects.

Risk Assessment of Oil Pipeline Vandalization in the Coastal Areas: A Case Study of Lagos, Nigeria

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ABSTRACT

Oil spill from oil pipeline vandalization on the mangrove vegetation in Ilado coastal area of Lagos, Nigeria remains a critical issue. The oil pipeline has been vandalized and the Right of Way (ROW) encroached upon by settlements. Vandalization of the Oil pipeline and its attendant oil spill, explosion and fires are common occurrences in this area; and it is located between latitudes 6° 24☒ 00☒ and 6° 26☒ 00☒ N and longitudes 3° 20☒ 00☒ and 3° 22☒ 30☒ E . It is a low, marshy area along the shore of the great Atlantic and is in Amuwo-Odofin Local Government Area (LGA) in Lagos state, Nigeria.

The main objective of this study is therefore to demonstrate the application of Remote Sensing and Geographical Information System in determining the proximity of settlements to the pipeline towards efficient monitoring and management of oil pipeline and oil spill induced fire disaster in the study area. The study was with the view of providing oil spill response centres for adequate risk disaster management. The study was conducted using Landsat ETM+ 2005 and Ikonos 2007. A handheld Global positioning system (GPS) (Magellan model; accuracy level = ± 10m) was used to identify the coordinate of obvious (well dispersed) benchmarks as training samples for geo-referencing and identification on the satellite imageries that has been acquired. The Landsat ETM+ 2005 and Ikonos 2007 satellite data were processed using ERDAS IMAGINE 9.2 image processing software. The Ikonos image used for this study was rectified by the selection of distinguishable ground control points (GCP's) in the image, such as road intersections. These points were then assigned the appropriate reference information, such as latitude/ longitude or UTM coordinates obtained from the ortho-photo map, Landsat ETM+ (2005) and from fieldwork utilizing global positioning systems (GPS). After which a subset of the area of interest was extracted from the image, the image was then classified using the supervised classification technique of maximum likelihood algorithm. Also, spatial analysis was performed using the 'buffer operation'. 'Buffer operation' was used to determine the topology and proximity of the pipeline to other land uses. The buffer operation creates a new polygon data set, where a specified distance is drawn around specific features within a layer. The distances varied based on the stipulated attribute values. For this study, buffer zones were created at 50 m and 500 m around the pipeline using ArcGIS 9.2. This was overlaid by the vector map layer containing the cartographic database of the selected communities in the studied LGA. The results of the overlay operation of the vector based cartographic (location) database on the result of the buffer operation were used to determine the extent of the vulnerability of the settlements in the oil pipeline corridor and to suggest and locate six oil spill response centre. Three of these centers were suggested within the most vulnerable settlements, while the other three centers were suggested in the other settlements that are also along the pipeline ROW. Subsequently, geo-spatial database was created for monitoring of oil pipelines Right Of Way (ROW) in the area to facilitate location information, integration, mapping and further analysis within the study area.

This study concluded that the mangrove vegetation and oil pipeline in Ilado coastal area is at risk of being destroyed by settlements that have encroached on the pipeline ROW. The study demonstrated the use of a geospatial technology in providing decision support information for oil pipelines prone to disaster.

Challenges Presented by Application of Remote Sensing in South Africa: A Proposed Case Study for Risk Assessment for Sustainable Development

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ABSTRACT

South Africa produces large quantities of mineral waste (e.g. ~468 million tons in 1997), resulting in the creation of slimes dams (also known as mine dumps) on a large scale by mining companies. These dams are generally not vegetated and therefore provide a major source of dust as well as soil and ground water pollution. Environmental implications of slime dams also include contamination of streams by acidic surface run-off and risk of catastrophic dam failure. Monitoring of mine waste repositories through remote sensing data contributes towards identification and mitigation of these problems. The objective of this study is to investigate the possibility of discriminating between normal waterbodies and slime dams through hyperspectral remote sensing techniques which could not be achieved using more conventional remote sensing techniques.

The challenges which this study addresses are not unique to South Africa but apply also to the rest of developing and under-developed countries in Africa. Remote Sensing technology and techniques evolve quickly and human resources in Africa may have difficulty in keeping pace. One of the growth areas of remote sensing is the development of hyperspectral sensors accompanied by improved techniques in data analysis. Hyperspectral sensors acquire many (> 50) very narrow, contiguous spectral bands ranging from 0.4 to 2.5 micrometers. This contiguous narrow band width allows for detailed examination of Earth's surface features not possible using the relative coarse bandwidth used by multispectral scanners. However, the high cost associated with the acquisition of hyperspectral data is the limiting factor. In this study multispectral ASTER imagery is applied to investigate the differentiation of waterbodies and slime dams through hyperspectral techniques. Preliminary results reveal that hyperspectral techniques applied to multispectral imagery can differentiate between slime dams and normal waterbodies, and also highlight areas which are contaminated by slimes dam effluent.

An Integrated Evaluation of Eco-Environmental Vulnerability in Efon Alaye Using Remote Sensing and GIS Techniques

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ABSTRACT

This study evaluates the eco-environmental vulnerability of Efon Alaye located in Ekiti State, Nigeria, which is a typical mountainous region with steep slope and an upland ecosystem. An integrated Remote Sensing and Geographical Information System approach has been used to analyse the eco-environmental vulnerability of the region. Satellite data of the study area for two periods 1986 and 2002 were used for the analysis. Spatial Multi-Criteria Evaluation operation was used to generate the vulnerability map of the study area. Indicators used are landuse, vegetation map (NDVI) and slope map generated from Digital Elevation Model. The vulnerability distribution was classified into five levels: potential, slight, moderate, high and extreme. The results show that the eco-environmental vulnerability in the study is at potential level and the driving forcings of this change is attributed mainly to the cultural activities of the inhabitants of the study area and from studies which have shown that the study area has low soil water retention capacity. The results of this study have also shown that integrating Remote Sensing, Geographical Information System and using Spatial Multi-Criteria Evalution to evaluate eco-environmental vulnerability in mountainous regions will assist decision makers in environmental management.

KEY WORDS: GIS, Remote sensing, DEM, SMCE, Eco-environmental Vulnerability

Comparative Analysis of Climate Change Vulnerability in Central Rift Valley and Adjacent Arsi Highlands Using Remote Sensing and GIS

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ABSTRACT

The problem of climate change is widely studied currently from various angles that emanate from seriousness of the problem. The recent of most is application of satellite image that analyzed through Remote Sensing and GIS that flourished with the development of Earth Observing satellites. Climate change vulnerability is high in Ethiopia where frequencies of extreme events are increasing.

The Remote Sensing and GIS based analysis of climate change vulnerability in Ethiopia is inevitable where insufficient amount of data is available. This study tries to include all ecological zones of the country that ranges from Peak of Chilalo Mountain to lowlands of Fentalle with the total area of 7758.3 km^2 This study focuses on assessing the degree of climate change, constructing climate change vulnerability index, comparing and contrasting changes in parts of rift valley area with that of adjacent highlands , integrating GIS and Remote sensing application in detecting climate change and trend analysis, and finally preparing composite climate change vulnerability .Data analyzed from 22 meteorological stations found in the study area since 1975-2009 indicates that temperature is getting increased by 0.37°c in rift valley per 12 years and rain is constant and shows insignificant rise. Rift valley areas have vulnerable more to climate change than adjacent highlands though rain fall variation is increasing in highlands than lowlands. Urban heat island is also occurred in largest town within the study area in Adama. Daily river discharge data for middle Awash, ketar and Keleta observed from 1980-2009 is also used to strengthen the analysis. NASA's LANDSAT satellite of 1973, 1986, and 2009 with row 54 and 55 and path 168, have been used.

In all this work arcGIS9.3, ERIDAS IMAGINE 9.2, IDRISI KILIMANJARO and ENVI software have been used. The resultant climate change vulnerability map along with the land use /land cover and structural dynamics can serve local planners and scientists as a primary source of information and for policy makers.

KEY WORDS: GIS, RS, climate change vulnerability, vulnerability index, Normalized maps, land use central rift valley, adjacent highland, rift valley, agricultural damage

Remote Sensing and GIS Application in The Study of Gully Erosion and Landslides in Anambara State, Nigeria

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ABSTRACT

Gullying is one of the most serious environmental problems in the southeastern region of Nigeria, particularly in Anambra state. The entire state is characterized by wide and deep gullies. These gullies are dynamically expanding into agricultural lands at an alarming rate. This paper attempts to examine the impact of gully erosion/landslide on arable land in Anambra state of Southeast Nigeria. Two field trips were conducted to collect representation sample for land use and land cover types. One trip was within the rainy season (July, 2006) and the other during the dry season (March, 2007) periods. Datasets assembled during the fieldwork include: (i) Ground truth of the representative classes {built-up Areas, farmlands, bare surfaces (exposed areas or bare flood plains) forested Areas (especially those prone to gully development), water bodies (wet areas)}; (ii) Geometric characteristics of major and minor gully sites (geographic location, depth, length, cross-section); (iii) Rainfall data, farming practice, conservation and control methods for checking gullies as additional information. Utilizing the opportunities offered by Remote Sensing and Geographic Information System (GIS), this research project came up with vital spatial datasets on the spatial distribution, development and impact of gully erosion/landslide on arable land in southeastern Nigeria. LandSat ETM+ (2001) and NigeriaSat-1 (2005) images covering Anambra State in southeastern Nigeria, was used to map gully erosion/landslide as a threat to food security. All the images were georeferenced in WGS-84 Coordinates System. Parts of the datasets collected during the fieldwork were used for the spectral training classes for digital image classification. Images were classified accordingly using the maximum likelihood classifier. High level of agreement exists between the two images in built-up-areas, forest/vegetation, and water bodies. The gullies were classified into severe, moderate and mild according to their magnitude or degree of development in a GIS environment. The result revealed among others that Anambra state is greatly degraded, with severe gulling/landslide covering an area of 1758.63 km^2, moderate gullying (1316.58 km^2) and mild gullying (1661.38 km^2). The commonest and most dominant crops are yam, maize, rice and pinaple. Today, the gully/lamdslide development have pose a formadeable threat to the widespread and intensive cultivation of these crops which have a strong negative implications to food security within the region. However, tree plantation such as palm tree,cashew,mango,orange,kolanut and whisting which are also widely grown is less threathened. As the population increases, the land available for farming is increasingly being fragmented. Thus, the growing pressure on arable land has led to continue degradation and human induced erosion in most parts of the state. The agents of soil erosion in the study area are principally running water and human activities identified as laterite extraction, bad farming practices, unplanned road construction and urbanization, wood harvesting for fuel and bush burning, preparation for farming among others. The study also revealed that gully developments are more pronnounced in areas with high terrain undulation where slopes are steep and vary thereby increasing the rate of detachment and transportation of soil particles. The soil particles are not consolidated and therefore detach easily when impacted with floodwater. Poor agricultural practice of exposing the soil by clearing the vegetation cover making it incapable of resisting the erosive action of the rainwater. The continuing action of the rain favours high rate of infiltration, enough to lubricate the underlying strata. Consequently, this provokes heavy carrying away of the soil and leads to run off. It is therefore recommended that, the situation be checked immediately by employing soil erosion planning measures, extensive chemical analysis of the soil structure to confirm whether a chemical treatment of the soil will help to consolidate it and make it more resistant to the impact of rainwater, strengthening agriculture research and extension systems in the state and the country at large, construction of check dams, channelization of flash flood waters. Also, extensive public enlightenment to re-orientate the citizenry on the damaging effects of gullies is imperative.

Geo-visualization and Spatial Analysis of the Environmental Impacts of Ife – Modakeke Communal Clash after a Decade

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ABSTRACT

Ile-Ife, the cradle of Yorubaland, is located around the centre of southwestern Nigeria. The study assessed the environmental impacts of the communal clash it had with her closest neighbour – Modakeke town – about a decade ago and took a look at the magnitude, trend and pattern of urban growth of the city and Modakeke before and after the clash. The effect of the Obafemi Awolowo University campus on the expansion of Ile-Ife has also been examined. The study covers the period 1986 to 2008. Satellite images (SPOT, LANDSAT and ALOS) of the study area were processed and analysed. Fieldwork data were synthesized with the processed satellite data sets for spatial analysis in a GIS environment. The study revealed that both communities have no physically defined boundaries between them because houses had been built across the boundaries more than a century ago. The corridor of the war front has been abandoned and deserted in some sections. Meanwhile, the two communities continue to increase in spatial extent in spite of the communal clash that ravaged them. The recent spatial urban growth has frog-jumped away from easy reach of possible future re-occurrence of the communal clash. Almost all Yoruba non-natives of the two communities have relocated away from the corridor of the war front to the community outskirt with which individuals have sympathy. From this experience, it could be established that satellite remote sensing data and application of GIS can provide a means of rapidly geovisualizing and assessing the dynamics of urban growth so that timely action can be taken to control and coordinate urban sprawl. The factors attracting the axial/sectoral expansion have been developed to provide a guide for Urban Planners, Local Planning Authorities and developers for improved planning of infrastructural facilities. The study supports the much advocated 5-year period for urban monitoring so as to stem slums in our urban centres.

KEY WORDS: Geovisualization, Urban growth, Environment, Remote Sensing, Landuse monitoring, Vegetation degradation, Geo-information, Assessment

Comparison of remote sensing and meteorological drought monitoring indicators in the Greater Horn of Africa

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ABSTRACT

Drought is a complex and insidious natural hazard remarkably different from other disasters and that may be defined in meteorological, agricultural, hydrological or socio-economic terms depending if the type of issue addressed is rainfall deficit, soil moisture, hydrological low flow or human water supply. While indices based on precipitation are frequently used for drought monitoring, the first environmental signs of drought are normally given by vegetation due to its dependence on stored soil water. Hence it is reasonable to suppose that remote sensing indices that are well known by monitoring vegetation could also be used as drought indicators.

Development of integrated indicators using both meteorological and remote sensing drought indicators could help to detect faster and better the onset of drought, to monitor more efficiently its evolution in time and space, and therefore to better trigger timely and appropriate actions on the field.

In this study, meteorological and remote sensing based drought indicators were compared over the Greater Horn of Africa in order to better understand: (i) how they depict historical drought events; (ii) if they could be combined into an integrated drought indicator.

The meteorological indicator selected for our study is the well known Standardized Precipitation Index (SPI). This statistical indicator is evaluating the lack or surplus of precipitation during a given period of time as a function of the long-term average precipitation and its distribution (McKee et al., 1993 and 1995). The SPI time period chosen for this study was 3 months in order to identify vegetation response to soil water availability and compare the 3-monthly SPI with remote sensing derived drought indices. SPI was calculated using a continuous, long-term (more than 30 years) series of historic monthly precipitation records. SPI is based on a probability transformation of cumulated monthly precipitation into a standard normal variable with zero mean and variance equal to one (McKee et al., 1993). In this equi-probablitity transformation, as proposed by Panofsky and Brier (1958), the conversion of a variate from one distribution (e.g. gamma) to another (e.g. standard normal) is performed in a way that the probability of being less than a given value of the original variate shall be the same as the probability of being less than the corresponding value of the transformed variate. SPI results are given in units of standard deviation. This is an advantage since the SPI is normalized in such way that wetter and drier climates can be represented equally.

Two remote sensing based indicators were tested: the Normalized Difference Water Index (NDWI) derived from SPOT-VEGETATION and the Global Vegetation Index (VGI) derived form MERIS. The NDWI is a remote sensing based indicator sensitive to change in the water content of leaves (Gao, 1996) useful for drought monitoring and early warning (Gu et al., 2007 ; Ceccato et al., 2002). It is computed using the near infrared (NIR) and the short wave infrared (SWIR) bands which makes it sensitive to changes in liquid water content and in spongy mesophyll in vegetation canopies (Gao, 1996 ; Ceccato et al., 2001). The MGVI is based on the transformation of the calibrated spectral directional reflectances into a single numerical value while minimizing possible disturbing factors (Gobron et al., 2000; Verstraete and Pinty, 1996). The MGVI is constrained by means of an optimization procedure in order to provide an estimate of the fraction of Absorbed Photosynthetically Active Radiation (fAPAR) of a plant canopy. It can be used to monitor the presence of live green vegetation over all types of terrestrial surfaces (Gobron et al., 1999). For both indexes, anomalies were estimated using available satellite archives.

Cross-correlation between the two remote sensing index anomalies and between these and SPI were analyzed for five land covers (forest, shrubland, grassland, sparse grassland, cropland and bare soil) over different regions in the Greater Horn of Africa. The time window for the statistical analysis was set to the rainy season, as it is the most critical period for vegetation growth. Moreover the behaviour of those indicators was also investigated during major historical droughts. Results of the analyses showed that although significant correlations exist between SPI-3 and both NDWI and MGVI anomalies they are generally low (R< 0.5). Both NDWI and MGVI anomalies seem to have the same correlation with SPI-3 when considering all the land cover classes together but there are some differences that should be investigated when considering specific land covers such as cropland, grassland, or sparse grassland.

It can be concluded that the information given by each indicator regarding drought occurrence is not exactly the same. If further investigation enables to better understand how and in which circumstances each of the indicators can be used for drought monitoring this could pave the way to build an integrated drought indicator using indices such as SPI-3, NDWI and MGVI as complementary information.

Detection and Analysis of Vegetation Fire Using Earth Observation Data in the Central Part of Benin Republic

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ABSTRACT

In most African ecosystems, fire is a natural and beneficial disturbance of vegetation structure and composition. In Benin, and particularly in the northern and central part of the country, burning represents a cultural tradition, which is not easy to overcome. Used as a work tool generally by rural populations, fires serve for land clearing for agricultural purposes, pasture management for breeding, and animal tracking for hunters. It has been noted that 95 percent of wildfires in forestland are human-caused and are usually followed by damages such as: devastation and reduction of the area of forest lands, disappearance of sensitive species, exposure of soils to wind and water erosion, destruction of wildlife habitats, destruction of living conditions and harvests (cotton, yam, maize, sorghum, etc.) in rural land, Etc.

The present study aims at analyzing the dynamics of land-use and bush fire with the aid of satellite imagery of Landsat TM 1986 and ETM+ 2000 both of 30m resolution, combined with those of Nigeriasat-1 of 2006 with 32m resolution and image data from MODIS (Moderate Resolution Imaging Spectroradiometer) from 2000 to 2009.

The study area falls in the Savè of the topographic map sheet of 1/200 000 scale, located in the center of the Republic of Benin. Results from our analysis show a correlation between the dynamics of the land-use and bush fires between the periods 1986, 2000 and 2006. The burnt zone surfaces have increased between 1986 and 2000 showing an increase from 95,691 ha to 127,128 ha. This shows an increase of 14.10% within the burnt area. Within the land-use units, the sparse shrubby savanna was the most affected by fires. This study has permitted us to understand the dynamics of bush fires in the center of the Republic of Benin. These fires start in the west and spread progressively toward the east-central.

KEY WORDS: Vegetation Fire, Land use/ Land cover, MODIS, Landsat

Pre-Dredging and Navigational Potential Analysis of the Niger-Benue Confluence Area, Lokoja, Nigeria Using Remote Sensing and GIS

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ABSTRACT

The physical, industrial and socio-economic development derivatives of water transport system in a multi-resourced country like Nigeria is invaluable. Therefore, the Federal Government of Nigeria has indicated a significant interest and recently awarded a contract for the dredging and expansion of its inland waterways along the River Niger from Baro to Onitsha and the Delta region of the country in order to boost its inland water transport and navigation systems; which will enhance its industrial, international maritime and socio-economic services. In view of this renewed interest in water transport and navigation in Nigeria, coupled with the cost-effective, timely, flexible and synoptic advantages of data and information infrastructure from space-based and geospatial technologies for the sustainable spatial management of its coastal and inland waterways, this study attempts a pre-dredging and navigational potential analysis of the Niger-Benue confluence area using remote sensing and geographic Information System (GIS). Indeed, applications of space-based geospatial technology to the deep ocean, coasts, estuaries, marginal seas and inland water ways have progressed from applications that merely collect and display data to complex simulation, modeling, and the development of new coastal and marine research methods and concepts (Wright and Halpin, 2006). The study area is geographically located between latitudes 7° 45' N and 8° 00' N of the equator and longitudes 6° 45' N and 7° 00' E of the Greenwich meridian (figure 1). The study therefore aims at pre-dredging and navigational potential analysis of the Niger-Benue Confluence Area, Lokoja using remote sensing and geospatial information system (GIS) to provide relevant basis for the qualitative and quantitative socio-economic and ecological post-dredging impact and waterway monitoring and assessment of the area. The specific objectives include (i) the right of way (ROW) and waterway and water corridor mapping of the Niger-Benue Confluence Area from NgeriSat-1, Landsat TM, and SPOT-5 imageries, in order to determine the surface area of the water and non-water surfaces in its right of way; (ii) creating the digital terrain model (DTM) from Shuttle Radar Topographic Mission (SRTM) data to be used to extract the flood plain along the right of way of the River Niger; and (iii) to carry out the navigational potential assessment of the dredging and expansion of the river water ways, in and around Lokoja area using geospatial database analysis.

The methods of data collection and analysis include: satellite image data and base-map data collection (NigeriaSat-1, Landsat TM, SPOT-5, topographic/soil/geological maps, etc), ground truthing/fieldwork and river ROW analysis, data/information from interdisciplinary interactions and expert questionnaires, production of the DTM of the waterway corridors from SRTM, satellite image/map data processing and spatial analysis, and GIS database development and analysis. The processing software used includes Erdas Imagine 9.1, ArcGIS 9.2, ILWIS 3.3, ArcView 3.2a and Surfer 8 software respectively.

The preliminary results of the research include land use map of the Niger-Benue Confluence Area produced, digital terrain model (DTM) and contour maps, GIS database of the area, volume and depth profiles for the dredging operation at minimum width and depth of 100m and 3m respectively, pre-dredging impact assessment on the environment, settlers and navigation. The primary effects of channel straightening and enlargement on the environment, people and navigation are the removal of riparian vegetation and changes in channel stability and in the hydraulic and hydrologic regime. Therefore, the study will further highlight the spatial consequences of the

proposed dredging on the lower Niger channel instability, hydrologic and hydraulic effects, aesthetics, recreation, water quality, terrestrial habitat, aquatic habitat and fishing, the ecology and bank erosion, navigation, and socio-economic derivatives. In the pre-dredging impact assessment, the assessment of the effect of dredging and expansion of navigation right of way (ROW) on the confluence area and transport patterns in Lokoja and the surrounding area is important. Of particular interest is whether there are more or less gradual or rapid destruction of the natural river bank defence, which may lead to serious river bank erosion and slope failures.

Automatic Identification of Buildings Demolished by Disasters Using Oblique Images

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ABSTRACT

When Tsunami, earth quakes or such disasters happen, information on the demolished buildings is not only very important but also urgently required, in the first place for rescue purposes and later for redevelopment planning. Data for this purpose is remote sensing satellite images for coarse resolution or airborne aerial capture for more details. Technologies are also already allowing acquisition of multiple oblique images at the same time. Examples are the PFIFF camera system (Grenzdörffer et al., 2008) for side views and the Pictometry system which captures five images at the same time (Wang et al., 2008).

Oblique images are rarely used for automatic topographic data acquisition and update due to variations of scale and the need for multiple images due to occlusion. However, side views allow better identification of imaged objects and may be useful for verification of buildings. It has also been shown that accurate exterior and interior orientation information can be improved by using the method that incorporates scene constraints in triangulation of oblique images (Gerke and Nyaruhuma, 2009) where it was shown that the RMSE at check points in object space was around 20cm for all three components after the self-calibration bundle adjustment.

This paper presents a method for automatic identification of buildings or building parts (walls) that are demolished or still exist at a location given multiple overlapping oblique images. A cadastral map of buildings in the area is assumed to be available and up to date before the disaster.

In the developed method, for each line segment of a building footprint in the 2D map, a hypothesis vertical plane is constructed and images of different perspectives are projected to this plane. The resulting rectified image patches are compared. For the current implementation, the comparison is done by matching SIFT features (Lowe, 2004). Experiments done using existing and demolished (simulated) buildings show that if a wall is demolished, there are no matches while if the wall exists there are considerable matches.

The data used was captured for an area with existing buildings but the results using these existing buildings and simulated demolished buildings are potentially useful for identifying buildings affected during disasters.

Input data: a) The 2D map for verification, b)One of the oblique images used - Image: ©Blom

Existing wall identification: a) A wall in two images from different perspectives b) rectified images c) lines pointing on SIFT-matched points

Spatial modelling of vulnerability to floods in Central Mozambique: Integration of community and expert perceptions in a spatial manner

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ABSTRACT

Mozambique is regularly affected through natural hazards such as droughts, cyclones and floods. A major disaster even has been the floods in the year 2000, which led to various initiatives in regard to disaster response and early warning. Recent events have shown that these initiatives showed the successful direction of these measures.

In the District of Búzi a community based flood early warning system has been initiated. Precipitation and water level measurements are carried out upstream of the Rio Búzi by local community members, which are then transmitted to the local warning centre in the town of Búzi and then transmitted via radio to the possible affected communities. A central element has been the establishment of disaster risk reduction committees where volunteers were identified which were specifically trained and assigned certain tasks.

Next to that, the district level is furthermore empowered to conduct disaster risk reduction measures which are linked to different decentralization policies. Therefore certain need arises, to target the community and district level with appropriate (spatial) information to successfully conduct their risk reduction and response activities.

To support the local disaster committees within their local risk reduction strategies a hazard/vulnerability mapping method has been developed and published in an end-user's manual. The specific objectives for the case study have been identified as the compilation and design of a community vulnerability map which should assist the community members within their disaster risk reduction measures, to map the community according to the needs of the communities in a participatory manner, to define, analyse and prioritise the driving forces of vulnerability according to the perception of the communities and to enhance the 'maps' through spatial analysis results for different community characteristics related to disaster risk reduction. In the proposed and developed methodology it has been demonstrated that the assessment of risks through the integration of community knowledge in a spatial manner through the application of paper-based satellite images is valid. It is clear that such mapping approaches, which include a representative group of a community, has to be seen as a snapshot. But for the purpose of a participatory approach it is appropriate to start such a process within the community. This has been highlighted through the identification of vulnerability factors and their weights, which may also be applied in a monitoring sense for project implementers to assess their objectives within community-based disaster risk reduction programs. Results of course have to be critically interpreted again as there might be biases due to the facilitator's input or just because of the composition of different groups or certain characteristics of specific communities. However, this actually represents a cost-effective approach, to obtaining an understanding of the needs, challenges and priorities from a community-perspective, which might, on the other hand only be possible through long-lasting research and field works, which are practically not implementable in current project designs.

Additionally, it has been aimed at supporting the district level with an integrated modelling of vulnerability which takes expert and community knowledge into consideration. Therefore the central objectives of district modelling have been to provide the district level with an integrated, spatial modelling of the different dimensions of vulnerability at a sub-district level, to allow for decomposition of vulnerability and for exploration of the underlying factors of vulnerability and to integrate the knowledge of experts (researchers, decision makers, district managers etc.) and of local communities in identifying appropriate measures and weights for representing vulnerability. The

methodology builds on the concept of geons, which describe generic spatial objects that are homogenous in terms of varying spatial phenomena under the influence of, and partly controlled by, policy actions. In this case it was aimed to derive homogenous regions of vulnerability for the district of Búzi. An indicator framework has been established which integrates different indictors for the environmental, social, economic and physical dimension of vulnerability which integrates data from census and earth observation. The set of indicators and its weights have been identified together with experts and community members, which also allows the exploration of different views of vulnerability from the community and the expert perspective.

KEY WORDS: Vulnerability Assessment, Integrated risk management, Spatial modelling, GIS, Remote, Sensing, Participatory methods

Geospatial Analysis of accident Prone areas on Roads-
A pilot study of mararraban jama,a to forest

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ABSTRACT

A study of road accident trends in Nigeria between the period 1960 and 1989 revealed a sharp increase in fatal accident occurrence. During this period, over 18,000 deaths occurred as a result of road accidents. Between 1980-1989, the figure had increased to about 5 times i.e. more than 92,500 deaths (oluwasanmi, 93).

Road accidents have been shown to cost around 1% of annual gross national product (GNP) resources of the developing countries, which they can ill-afford to lose. Hence it is necessary to incorporate steps, which can reduce road accident rates and implement mitigating actions, which can be taken to reduce the number and severity of road accidents. (Baguley et al, 1994) Various road safety strategies and countermeasures have been used at different stages of road network development. This method of seeking to prevent road accidents mainly involves conscious planning, design and operations of roads. One of the most important factors in this method is the systematic identification and treatment of hazardous locations. The main objective of the this project is to develop a model necessary to identify these hazardous locations on roads commonly termed as black spots. In general, the various factors that cause accidents can be broadly categorized into road related, vehicle related and driver related. In this project, an attempt is made to implement the road related factors for predicting the accident prone points (black spots) on the mararraban jamaa to forest junction as a pilot project and thus help in identifying the required remedial measures (Kalga and Silanda 2002).

Utilizing the opportunities offered by Remote sensing and GIS, this research came up with vital spatial datasets on the spatial distribution of black spots on the road under investigation. A road network is distributed over a given area. Hence it always posses a 'spatial characteristic' i.e., it always has the geographic locations associated with it. Thus, in order to model a road network, an information system capable of processing spatial data is required. A GIS can easily handle, store, analyze, manipulate and retrieve spatial data. Therefore a model for identifying accident-prone location on roads can be easily implemented using a GIS.

This project describes a model developed to identify black spots on roads using database creation from Landsat satellite image using remote sensing and GIS. The specific methodology used in carrying out the project is the acquisition of a Landsat satellite image covering the project area. After obtaining the satellite image, records of accident black spots was collected from the Nigerian Federal Road Safety Commission. After obtaining the information, two field works were conducted whereby the pictures and GPS coordinates of the black spots were recorded.

ILWIS version 3.3 software was used to overlay the black spots noted from the field work conducted on the satellite image. A database of the number of accidents and number of people involved and other details of the different black spots was created using Microsoft access version 2007 software package, the database created in access was then exported to Arcview GIS version 3.2 where it was joined with the table in Arcview, which was earlier exported from ILWIS .

Conclusion

The main advantage of using this approach for identifying accident black spots on roads is that it requires very less additional data other than the road network map. So the results obtained from this model can easily be used for

planning road safety measures. Also these can be supplemented with the results obtained by using other approaches. Moreover the results can act as a quick guideline for road network planners and the authorities concerned with accident mitigation measures.

An Assessment of the Suitability Of Abandoned Mine Pits for Solid Waste Management and Sustainable Development of the Affected Area, Central Nigeria

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ABSTRACT

The problem of waste management in most Nigerian cities is directly related to the ever increasing urban populations. The solid waste disposal capacity of Jos South in central Nigeria has not been developed to accommodate the rising population. It is well known that creating a sustainable and healthy urban environment involves good management of the available infrastructures as well as effective solid waste disposal system in the urban areas. This paper examines the suitability of abandoned mine pits for solid waste management and sustainable development of the affected area especially when the environment has been highly degraded as a result of past mining activities.

Factor and constraint criteria analysis integrated with geographic data sets obtained from topographic maps of the area in a GIS environment was carried out and SPOT satellite image of 5m spatial resolution was acquired and processed to update the various land use types in the study area. The factor criteria were used to determine areas of coincidence between the abandoned mine pits, geology, relief and land use while the constraint criteria were used to establish pits that are unsuitable for solid waste disposal.

The results showed that the abandoned mine fields are comprised of mine ponds and pits. The area covered by mine pits is about 254.91m2 while the ponds cover 303.38m2. The mine pits cover only 1.64% of area and twelve of these pits, representing 0.36% or 56.62 m2 of the area under investigation are suitable for handling solid wastes.

Tropical Forest monitoring using the international DMC satellite constellation

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ABSTRACT

The international DMC satellite constellation has, since 2005, been active in annual monitoring of the world's largest rainforest in the Amazon Basin as part of the Brazilian PRODES system for monitoring deforestation. The ability of the satellites to rapidly acquire large areas of high resolution imagery in cloudy tropical areas has extended in 2010 to monitoring the 2nd largest tropical forest in the world, in the Congo Basin, and to areas of concern in Guyana and Indonesia. The progress of REDD+ to support the management of deforestation relies upon Governments implementing an operational forest monitoring programme. During the next five years the DMC satellite constellation provides an important operational system capable of imaging global tropical forest areas to provide the information required support REDD+ programmes. This paper demonstrates the operational use of the DMCii system for monitoring change in tropical forest regions, and the relevance to REDD+ monitoring systems.

Determination of River Channel Morphological Changes Using GIS Techniques

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ABSTRACT

Most geomorphological investigations involving channel morphometry are concerned with the definition, measurement and analysis of quantitative indices describing the cross section, the bedform and long profile as well as the plan geometry of rivers. The investigation of river channels and the attendant features is an interesting aspect of geomorphology which is of immense importance in understanding the processes affecting landforms. However, changes in the morphological characteristics of alluvial rivers are difficult to determine in most of sub-Saharan Africa where most of the river basins are ungaged. The lack of consistent systematic data on the nature and character of the rivers have created serious gaps in knowledge, particularly in the sub-discipline of fluvial geomorphology. The form, shape and size of the river channel largely determine the features of the floodplain around the course through which the river flows. Unfortunately, assessment of the river channel form and processes is difficult without field investigations.

This paper explores alternative GIS methodology for the estimation of channel morphological variables in a manner suitable and replicable in the determination of the long-to-short term changes occurring along the river. Considering the lower sections of the Ogun River, the paper estimated the primary morphological elements (i.e. gradient, width, depth and discharge) for the four year periods of 1984, 1990, 2000 and 2006. Landsat TM imageries for the four year periods were obtained and geo-processed. Digital Elevation Model of the area was generated from spot heights at 5m resolution of the entire area surrounding the river channel in other to produce the terrain through which the river flows. Other morphologic variables which describe the channel geometry were derived from the estimates of the primary elements and the temporal variations were computed. Meander geometry and the longitudinal profile were also assessed within the ArcMap environment and the quantitative relations established for the lower Ogun river channel.

Results show that the waveform configuration of the river changes significantly with time, a change which was detected more on the long term decadal scale. A significant reduction in the sinuosity of the channel was also detected over the years of investigation, indicative of the channel adjustments to the temporal trends. The amplitude and concavity of the loops of the lower Ogun river channel also increase dramatically suggesting a sweeping of dense eroded material towards the inside of the bend, leaving the outside of the bend unprotected and therefore vulnerable to accelerated erosion deduced from the distribution of point bars and other depositional features downstream.

Spatial Modelling and Timely Prediction of Salinization using SAHYSMOD in GIS Environment (a case study of Nakhon Ratchasima, Thailand)

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ABSTRACT

Salinization is a complex process, often initiated from subsurface. For that matter it is so difficult to trace it at its earliest stage of development, using a wide range of techniques and methods. Hence agricultural productivity is observed being hampered by root zone salinity development either by use of brackish irrigation water and/or capillary rise of saline water table. Salinity problem of northeast of Thailand in general and that of the Korat area in particular is from rise of saline groundwater table and deposition of salts on the surface through capillary action. Thus, it is difficult to trace back its early stage using optical remote sensing (RS) alone. In this study we apply an integration of (hydrological) modelling and remote sensing (RS) to track down the temporal and spatial soil salinization process in the area.

The numeric hydrological model, SAHYSMOD, is used to image the subsurface solute movement by parameterizing the surfaces and subsurface water movement through the interaction of climate, soil, crop and human responses factors. Use is also made of RS, which addresses the status of the soil salinity event at time of surveillance. Through the 'give and take' type process of both techniques in GIS environment modelling of the salinization process became possible, both in space and time dimension. Here, GIS plays the role integration the results of the two techniques. The results are then extrapolated to the unsampled section of the study area using the devised decision support system (decision tree). By doing so the intended objectives of the study: detecting salinity change in time and spaces and modelling salinization as a process have been achieved.

The model has answered two basic questions of the research, 1), to define the source of salinity of the area; the rise of saline groundwater table, and 2) geopedological mapping units which are prone to salinization. The supervised image classification has made it clear that the low lying areas have been invaded at time of imaging. The model predictions have identified those areas which were less salt affected soils or not at all in the image classification are now prone to be affected due to the rise of saline groundwater table.

According to 20 years of prediction from the model salinization route (development) is towards the west side of the study area, which is currently none saline, with a rate of 20% per year per geomorphic unit area coverage. That means areas which are currently (non saline=NS) and have total area coverage of 234.20 km2, is endangered and could be changed into salt affected soils if and only if the existing conditions have not changed to the favour of the environment.

KEY WORDS: spatial modelling, prediction, SAHYSMOD, ECFC and DSS 451

Applications of Integrated Spatial Technologies in Flood Prediction for Abeokuta city Metropolis

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ABSTRACT

Integration of high resolution satellite remote sensing data and Global Positioning Systems with Geographical Information Systems as an early warning system in disaster management have been shown to be an excellent tool for providing hydrological information required to prepare against flood disasters. While Global Positioning Systems and topographical maps can supply quantification of catchment physical characteristics, such as topography and land use indices, the high resolution imageries such as Ikonos and Quickbird can provide detailed assessment of cadastral land cover type vis-à-vis properties most likely to be affected in the next flood. Many demonstrations of the operational use of integrated spatial technologies for detailed monitoring and mapping of floods and post-flood damage assessment have been recorded. In this paper the use of Earth Observation satellites data, geo-positioning and spot heights in a GIS for flood management in Abeokuta city was presented as a means of prediction and analysis of flood in a susceptible community. Spot heights were created from the contours on a 1:50,000 scale topographic map sheet of the city metropolis. The spot heights were used to generate a digital terrain model which was used in the hydrologic modeling of the city. Positions liable to flooding were identified from the land use/cadastre map digitized from the Ikonos imagery of the city. The depth and extent of flooding were estimated. Obstructions to natural drainage were identified and it was recommended for immediate removal before the zenith of the rains.

KEYWORDS: Flood prediction, integrated spatial technologies, Abeokuta city

Geospatial Analysis of Water Security and Oil Spills in the Niger Delta Area of Nigeria

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ABSTRACT

Geospatial Analysis and its application to environmental monitoring and situational awareness with particular focus on Oil Spill Disaster Risk Reduction (DRR) viz-a-viz food, health and water security are addressed in this paper. The opportunities for information systems leveraging geospatial information analysis on exploration and exploitation of oil in Nigeria and their impact on the natural environment are presented. Oil spills resulting from exploration have had decadal adverse effects such that food, health and water security is threatened, due to toxicity of oil. This environmental problem seems to be well recognized by people in the oil-producing areas of Nigerian Niger Delta. There is no doubt that some attempts have been made to manage this problem, especially following the establishment of the National Oil Spill Detection and Response Agency when the government acknowledged the fact that Oil spillage has continued to constitute very serious danger to the inhabitants of the oil-producing areas thereby resulting in civil unrest in the Niger-Delta. This has resultant effects on the income of the government in so doing affecting the socioeconomic wellbeing of Nigerians in the long run. Nevertheless, flaws in these attempts suggest the need for Geospatial Information Technology approach to complement and strengthen current conventional methods. This is particularly true in the case of oil pollution that has entirely overwhelmed the control of present management techniques.

This paper attempts to contribute by building a geodatabase of major oil spill incidents and their impact on the environment in the Niger-Delta using ArcGIS 9.3.

These include assessing water quality from a 2006 SPOT 5 satellite data of Niger-Delta by analyzing oil spill as it affects food, health and water security using ILWIS 3.6 for a detailed vulnerability assessment.

It also examines efforts that have been made to effectively and professionally respond to spills, especially those that contaminate surface and ground water. Lastly a framework is presented which could be valuable in mitigating and reducing food, health and water disaster risk in the Niger Delta region of Nigeria in achieving the Millennium Development Goals (MDGs).

Analysis of Major Threats to Global Warming in Akwa Ibom State, Nigeria

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ABSTRACT

Global Warming is defined as the increase in the average temperature of the Earth. The Intergovernmental Panel on Climate Change concludes that the observed temperature increase today is caused by increasing concentrations of greenhouse gases resulting from human activities such as deforestation, industrialization, urbanization etc. [IPCC, 2007].

Furthermore, the list of countries that have been called upon to cut down on carbon emission does not include many developing countries. This is in spite of the fact that they are involve in some of the human activities that led to the present predicament.

This underscores the need for different nations of the world [developing and developed] to identify and deal with those activities that are contributing to global warming in their area. This paper uses Geographic Information System [GIS] and Remote Sensing based techniques in analyzing the situation in Akwa Ibom State, Nigeria.

Applications of Remote Sensing for Hydrological Modeling and Prediction in Africa

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ABSTRACT

Motivated by the increasing availability of global remote sensing data for estimating precipitation and describing land surface characteristics, we have developed and implemented a near real-time, satellite remote sensing-based NASA-OU CREST distributed hydrologic model to simulate hydrological state and flux variables (runoff, ET, soil moisture, and TWS) at 1/8th degree and 3-hourly space-time scales (http://oas:gsfc.nasa.gov/CREST/). The high-resolution version of the CREST model has also been implemented for the regional decision-making support and capacity building system SERVIR-Africa (www.servir.net) in East Africa at 1-km resolution. In this presentation, we utilize the high-resolution CREST distributed hydrological model to retrospectively simulate water cycles in several African nations spanning the period of 1985-2009. The objective of this study aims to facilitate practical applications of remote sensing products and predictive models to advance water resources management in African nations. The ultimate goal is to build and transfer the hydrological modeling capacity to African countries for supporting their decision-making processes of water resources management and disaster prevention activities. This project directly address the first objective of GEOSS: Enabling the use of Earth observations and predictive models for timely disaster decision making to benefit society.

The future of water availability in the Nile Basin: Decoupling the effects of agricultural land development from climate change

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ABSTRACT

Climate change is expected to fundamentally alter the hydrological fluxes and water availability in the Nile Basin. Equally important are the changes in agricultural water use through irrigation and water needs of other land development including urban areas.

What is less known, however, is the contribution of each of these confounding factors to the availability of water in the basin. For example, as the upstream countries (e.g. Ethiopia, Sudan) move towards intensive land development with the help of irrigation, what will be the impact of this development on water availability in the downstream countries like Egypt? Further exacerbating this situation will be the projected climate change. Will the impact of climate change have a similar magnitude or eclipse the impact of agricultural land development? To answer these critical questions, our research investigates the combined and individual effects of climate change and land development using a spatially explicit land use model coupled with an advanced hydrologic model.

For predicting the intensity and the spatial distribution of land development in the upstream countries, we are using the Conversion of Land Use Change and its Effects (CLUE) model (Verburg et al, 2001). The objective of CLUE is to make a spatially explicit, multi-scale, quantitative description of land-use changes through the determination and quantification of the most important bio-geophysical and human drivers of agricultural land-use on the basis of the actual land-use structure. In our case, the bio-geophysical drivers include existing land-cover (from remote sensing), topography, soil, climate, and protected areas and the human drivers include, population, GDP, and Foreign Direct Investment. We will incorporate the results of this analysis into a dynamic land allocation model, which describes changes in the area of the different land-use types (Veldkamp et al., 2001). Our primary objective is to explore possible land-use changes in the near future under different development scenarios and to assess the hydrologic cost of land development coupled and uncoupled from climate change.

For hydrologic simulations, we are using the Variable Infiltration Capacity (VIC) model (Liang et al 1994) which is a macroscale hydrologic model that solves full water and energy balances by taking into account the soils, land use, and atmospheric forcing. VIC is a research model and in its various forms has been applied to many watersheds globally. We will run the VIC model under changing land-use and climate conditions with the main objective of separating the effects of climate change from land development in terms of their effects on water availability and, by extension, food security in the basin over the course of next several decades.

Potential terrestrial ecosystem response and feedback to future climate change in western Africa

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ABSTRACT

A number of previous studies have shown that a changing climate due to increasing anthropogenic greenhouse gas concentrations over the coming decades may substantially affect the world's ecosystems. However, most regional climate modeling studies on the impacts of greenhouse warming for West Africa, a region where climate is highly sensitive to land surface conditions and feedback from vegetation dynamics has been demonstrated to substantially influence climate, do not consider the impact on/of vegetation dynamics. Here, the International Centre for Theoretical Physics (ICTP) regional climate model (RegCM3) is nested in the National Center for Atmospheric Research (NCAR) global climate model (CCSM3.0), and then RegCM3 is linked to a dynamic vegetation model (CLM-DGVM) to allow transient (yearly) feedback between vegetation and climate in simulation of future climate over western Africa. The focus here is on the response of vegetation to climate changes and the effects of feedback from such vegetation changes on surface hydrology and climate in West Africa. Our main findings include:

(1)   A widespread increase in leaf area index (LAI) in West Africa under future climate change, with an increase of drought deciduous trees at the expense of evergreen trees in the south and an expansion of grass cover in the north;

(2)   The physiological and radiative effect of elevated CO_2 leads to a decrease in precipitation in most areas of West Africa; feedback from vegetation changes mediates this rainfall reduction, leading to a smaller reduction over the Guinean coast and an increase in rainfall over the Sahel (Fig. 1);

(3)   The hydrological effects of vegetation feedback are of magnitudes comparable to those attributable to the radiative and physiological effects of CO_2.

These results demonstrate the critical importance of accurate satellite monitoring of vegetation, and show the complementarity of modeling and remote sensing research tools.

Rapid Response Flood Water Mapping

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ABSTRACT

Since the beginning of operation of the MODIS instrument on the NASA Terra satellite at the end of 1999, an exceptionally useful sensor and public data stream have been available for many applications including the rapid and precise characterization of terrestrial surface water changes. One practical application of such capability is the near-real time mapping of river flood inundation.

With the launch of the MODIS sensor aboard the NASA Aqua satellite in 2002, the two MODIS sensors provide nearly global daylight acquisitions twice daily of calibrated multispectral optical radiance and reflectance values at three spatial resolutions: 250 m, 500m, and 1000 m.

The primary obstacles to using these data for surface water characterization are: 1) cloud cover obstruction, and 2) the lack of higher spatial resolution. Other properties of these data are, however, exceptionally useful: including the wide area, frequent-repeat coverage (twice daily, on a global basis), and the precise geolocation information provided by the well-characterized orbital geometry (positional accuracies of the image pixels are at a nominal +/- 50 m with reference to a global datum and geoid).

We have developed a surface water mapping methodology based on using only bands 1 (620-672 nm) and 2 (841-890 nm). These are the two bands at 250 m, and the use of only these bands maximizes the resulting map detail. In this regard, most water bodies are strong absorbers of incoming solar radiation at the band 2 wavelength: it could be used alone, via a thresholding procedure, to separate water (dark, low radiance or reflectance pixels) from land (much brighter pixels) (1, 2). Some previous water mapping procedures have in fact used such single band data from this and other sensors that include similar wavelength channels. Adding the second channel of data (band 1), however, allows a band ratio approach which permits sediment-laden water, often relatively light at band 2 wavelengths, to still be discriminated, and, as well, provides some removal of error by reducing the number of cloud shadow pixels that would otherwise be misclassified as water. The most desirable outcome of a water mapping algorithm for flood surveillance is complete coverage from one image: because floods are a dynamic phenomenon, and surface water extent can change over a few hours of time. On the other hand, cloud cover commonly obscures significant land areas during flooding, so that accumulating data from more than one image is necessary in order to expand spatial coverage. Also, cloud shadow removal can be facilitated by combining data from at least two images (cloud shadows that vary in location can be distinguished from surface water present in both images). Our procedure provides a flexible approach in which raster image processing of at least four MODIS images is the initial input, and then, once the water area data are translated into GIS vector format (water polygons), accumulation of water area can be extended over several days, or more, in time: in the case when cloud cover is heavy and only relatively small areas of the ground surface are captured in even four images.

The resulting GIS files, outlining surface water, are then best used in comparison to other data obtained through identical processing but on dates prior to flooding and when surface water was at approximate mean conditions. This constitutes a change detection approach, but occurs within the GIS environment: one flood water layer, perhaps colored red, can be displayed below a normal water layer, perhaps colored light blue. All areas of visible red then represent defined parcels of land that are under water in the flood image and were not in the comparison scene. In our mapping, we normally superimpose these GIS water layers over reference map information, such as shaded relief and cultural feature files such as cities and towns, and over all of these layers we superimpose a layer showing the persistent cloud cover. Because of the importance of having the latest information for disaster management

applications, we are developing a prototype automated system to implement the processes described above. We expect to draw on near real time data from the recently implemented

NASA MODIS LANCE system to provide MODIS based flood maps with a latency time of less than six hours. We expect to focus our future work in this area toward developing a global near real time capability, and investigating the addition of satellite radar data and higher resolution optical data sources as available.

Space Technology for Disaster Management and Sustainable Development in NE-Africa - Reconciling Nature With Knowledge

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ABSTRACT

The ways in which remotely sensed data can be used to manage and alleviate the consequences of natural disasters have never been fully exploited. If prediction of impending disaster is to be useful, those affected by catastrophe and those who come to their aid must work together. Adequate planning to manage disasters that come with little or no warning is difficult but many problems are entirely foreseeable and can be tackled at community level. A person's ability to survive disasters is more likely if he or she lives in a safe environment and has access to good food and water. Satellite data can help achieve this. It can be used to plan infrastructure: the best routes for roads, the whereabouts of building materials, agricultural possibilities, mineral wealth to finance projects, areas best avoided and safe water supplies. Although local people affected by hazards and disaster are generally unaware of the potential for space technology and the usefulness of remotely sensed images for disaster mitigation, they are experts in ground truth and quickly grasp the essentials of image interpretation in the context of their lives or duties. All that is needed is for those with expertise in remote sensing to pass on their skills, knowledge and data in a way that can be understood and valued. To do this, those threatened by catastrophe must be given the chance through community education schemes to understand how freely available satellite data can be used with confidence to prepare for local hazards and rehabilitation and how to apply information that can help lessen the effects of catastrophe. This can be achieved by making available remotely sensed images with simple explanations that enhance vegetation, topography and geology as well as those features that typify hazards - volcanoes, landslides, active faults, flash floods, and areas desiccated by drought. With timely, reliable information, preventative measures can be taken, hazards can be anticipated and contained and plans can be made for sustainable development and disaster risk reduction.

Marine and Costal Management

Why the Somali Coast? A Satellite Perspective

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ABSTRACT

The Gulf of Aden and the region off the Somali coast is a haven for many sea fairing activities. Its proximity to Europe and the Far East as well as a linkage to several ports in East and Southern Africa makes it ideal as a conduit for movement of goods. There are also prevailing factors that make the area suitable for development of natural resources that are attractive to foreign interests. One of these resources is phytoplankton, a key resource in marine aquaculture. Phytoplankton is fed upon by marine biology and occurs in regions where there is a convergence of currents that cause upwelling. This component can be detected using satellite imagery by studying chlorophyll, the component used by phytoplankton for photosynthesis. This study analyses the concentration of phytoplankton off the Somali coast and the Gulf of Aden for 5 years. MODIS AQUA satellite imagery has been utilized to extract data for statistical analysis. Using the data, mean Chl-a levels of around the region were obtained for each year, which were generally high levels compared to those of other regions such as the East African coast. This may have been due to upwelling caused by south East Monsoon winds (Swallow, Scott, & Fieux, 1991) and the Coriolis Effect off the coast of Somalia at around June. There is also an interesting shift in Chl-a level from 2005 to 2006. The prevalence of phytoplankton has also been analyzed for a particular period. Potential zones for fishing various fish species including Tuna have been identified and found to coincide with suspect pirate sites as determined by United Nations University. The region has been concluded to have high prevalence of Chl-a, which sustains consistent zones for fishing.

KEY WORDS: Somali Coast, Gulf of Aden, Chl-a, Fishing, MODIS Aqua, Ocean Colour Remote Sensing, Potential Fishing Zones

Using Meris for Monitoring Eutrophication and Water Quality in Southern African Inland Waters: Demonstration Products from an Empirical Algorithm

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ABSTRACT

Detection of water quality parameters such as chlorophyll *a* (Chl *a*) and total suspended matter which are indicators of eutrophication might be achieved using relatively simple top of atmosphere empirical algorithms with the Medium Resolution Imaging Spectrometer (MERIS). This paper gives demonstration products from one such algorithm derived from an eutrophic South African lake for the detection of eutrophic conditions (Chl *a*) in a southern African reservoir. Further application and validation of the algorithm presented here could lead to rapid and effective assessment of eutrophication in inland waters throughout Africa. The routine generation of such products will have a broad range of conservation, trend analysis, status determination, quality auditing, and ecosystem analysis applications.

KEY WORDS: Eutrophication, water quality, cyanobacteria, MERIS, southern Africa, optical remote sensing.

A Primary Validation of Meris Case2Water Products in the Natal Bight, South Africa

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ABSTRACT

The Natal Bight is an extremely dynamic area - whilst predominantly influenced by the fast-flowing oligotrophic waters from the Agulhas current, this unique environment of riverine influxes, retention mechanisms and topographically induced upwelling makes it highly optically variable and a fascinating environment for ocean colour applications. Seasonal and event scale fluctuations in freshwater inputs, combined with the influence of Agulhas waters, produce substantial bio-optical variability: water types across the Bight can range from highly riverine influenced Case 2 waters to oligotrophic. The nature of the system, and the historic lack of regional bio-optical observations, presents challenges for ocean colour applications. This study aims to characterise the variability of the Natal Bight region with regard to the primary optical constituents, undertaking both radiometric and geophysical validations of the MERIS standard and Case 2 Regional products, and developing regional algorithms based on these data. This first regional validation exercise uses co-incident MERIS, and in situ radiometric and bio-optical data from two different seasons: firstly the summer rainy season of 2009 (November), specifically targeting high Case 2 water type occurrence associated with flood events; and secondly the dry autumn season of 2010 (May) that tends to be associated with low riverine input. A first assessment and validation of MERIS algorithm performance in the area is presented, with a demonstration of ocean colour use to assess freshwater impacts on the Natal Bight and recommendations for regional ocean colour application.

KEY WORDS: Coastal waters, ocean colour, MERIS, southern Africa, optical remote sensing.

Assessment of Land Degradation Processes for Sustainable Environmental Management of Natural Resources in the costal Areas, Egypt

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ABSTRACT

Deterioration of natural resources, and their losses, are increasing the stresses felt by communities benefiting from them. Land degradation leading to direct loss of soil, and indirect impacts on plant cover, with resultant desertification, is the major concern of this paper. This work focuses on assessing coastal land degradation on some hot-spot costal Areas of Egypt, using parametric approach, geo-statistical and modelbuilder methods. Universal Soil Lose Equations (USLE) was used to calculate five major of land degradation for assessment of land degradation processes in the study area. The area is selected based on being representative of most of the physiographic units of North Sinai and the eastern outskirts of Nile Delta region. It is located in the two sides of Sues Canal and in between latitudes 31°22′11.30 and 30°54′0.12 and longitudes 32°3′5.93 and 32°33′18.90, with total area 135008.14 hectars (321448 feddans). In order to understand the variation of land degradation types, graphical interpretation of parametric factors of land degradation performed using geostatistics. All spatial models were created using Arc GIS 9.2 a software from ESRI. The soil degradation by water erosion in the studied area was obvious, that the slight water erosion (less than 0.02 t/ha/year), while the whole area is subjected to slight wind erosion (less than 2.63 t/ha/year) while the present state of salinization in the area is Slight to very high while the present state of Alkalinization in the area is Slight to very high while the whole area is subjected to slight to high physical degradation (from 0.01 to 7.5 t/ha/year). The dominate land degradation were Salinization and alkalization.

Keyword: Land Degradation, USLE, Geostatistics, ModelBuilder, Port Said, Egypt

Identifying potential fishing grounds in the Gulf of Guinea using remote sensing

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ABSTRACT

Current trends in global climate indicates a gradual warming of tropical oceans, which has the potential of increasing stratification leading to reduced spatial extent, duration and intensity of major upwelling centers. The direct impact of this situation will adversely affect migratory pathways, spawning and recruitment, and abundance of economically important fisheries. Sea surface temperature (SST), surface chlorophyll a (Chl a) distribution and sea surface height (SSH) are important parameters of the marine environment that are directly related to production and dynamics of fish populations. In this study SST, Chl and SSH obtained from DevcoCast will help identify potential fishing grounds in the Gulf of Guinea. By correlating upwelling indices from SSTs and SSH anomalies with Chl a levels, a correlation matrix will be generated providing an index for delineating potential fishing grounds. Such geospatial information has numerous management benefits for fishery resource management by aiding in the identification of areas to concentrate surveillance efforts on for monitoring illegal fishing activities and areas that are likely to be impacted negatively in an event of an environmental disaster. Also, the fishing industry will also benefit immensely by reducing time spent on searching for fishing grounds.

A Multidisciplinary Framework for Assessing the Environmental and Socio Economic impact of Resource Extraction in the Niger Delta

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ABSTRACT

This study employed a multidisciplinary framework for detecting and understanding the dynamics and processes of ecological change in mangrove ecosystems and their effects on the human populations they support. The Drivers – Pressures – State – Impacts – Response (DPSIR) framework was considered critical in integrating vital indicators (environmental, social and economic) for change detection in ecosystems, highlighting drivers of change, and the resultant socio-economic impact from the change process. The implementation of DPSIR framework for assessing and analyzing human impacts on the mangrove ecozones in the Niger Delta region of Nigeria was described. This was carried out in five phases involving change estimation over time with remote sensing and GIS methodologies, identifying the pressures responsible for the change through participatory and field research methods, delineating the principal drivers behind the pressure, determining the impact of change on livelihoods through economic valuation methods, and identifying the appropriate policy response. Results show a significant change in the spatial extent of mangrove formation between 1986 and 2003 with a loss of 21, 340 hectares of Mangrove vegetation. Urbanization, dredging, oil industry operations, invasive Nypa Palm, and resource extraction for consumption and livelihood support in mangrove communities were identified as the primary pressures responsible for change in the stock and spatial extent of Mangrove vegetation. The drivers behind the pressure were identified to be rooted in rapid population growth and increase in global and local demand for energy resources. A significant decline in the economic productivity of the Mangrove was observed in the study which translated into huge loss in revenue in Mangrove communities. Policy response put forward to combat threats to Mangrove ecosystem and the communities dependent on its resources include establishing a Mangrove replanting programme, job creation in Mangrove communities, building capacity of Mangrove dwellers in deep sea fishing to relieve pressure on mangrove resources, cessation of gas flaring in the ecozone, and legislative instruments to minimize impact of dredging on the mangroves.

Keyword: Marine and Coastal Management

Characterisation of the Dabus Marshes in Ethiopia using optical and SAR data

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ABSTRACT

Both coastal and inland wetland ecosystems are found extensively across Africa. The recognition of their values, both environmental and socio-economic, has recently been gaining momentum in the Nile Basin in particular. The Nile Transboundary Environmental Action Project has recently completed an inventory and mapping of wetlands at the basin scale (Nile Basin Initiative and Nile Transboundary Environmental Action Project, 2009). In Ethiopia, inland wetlands found within the highlands present unique characteristics due to their geographical location as well as their socio-economic environment (Sutcliffe, 2009). A recent report (Wetlands International, 2009) highlights that the current drought in eastern Africa has been worsened by the loss and degradation of wetland ecosystems. In addition to being rich centres of biodiversity, wetlands in the Ethiopian highlands are an important resource for rural livelihoods and their sustainable management is thus critical. In order to prevent depletion of resources and the ecosystem services and functions provided by these wetlands, a balance is required between ecological and socio-economic factors.

The sustainable management of wetlands requires information describing these ecosystems at multiple spatial and temporal scales, and as a result remote sensing is frequently seen as a fundamental component in the development of wetland management plans (Rosenqvist et al 2007). However, many African countries do not have national wetland inventories, and lack regional baseline information on the temporal extent, distribution, and characteristics of wetlands. As a result there are large discrepancies in available estimates of wetland extent and characteristics across much of Africa (Rebelo et al 2009). The establishment of a national inventory and regional baseline information on wetland ecosystems is still at its infancy in Ethiopia. Techniques are required that can fill the gaps in baseline inventory, as are effective means of assessing and monitoring change both temporally and spatially (Davidson and Finlayson 2007). In order for seasonal variations in wetland extent to be accurately identified, spatial information is required during both the dry and wet season. While remote sensing data from optical satellites provides a useful information source which has traditionally been used to map wetlands and characterize the vegetation, it is not always suitable due to the frequent cloud cover which occurs across tropical areas during the rainy season, at the time of greatest wetland inundation and spatial extent. In contrast, the cloud penetrating as well as day and night capability of Synthetic Aperture Radar (SAR) systems make them extremely attractive data sources for wetland mapping. The combination of both optical and SAR remote sensing images provides a powerful dataset for the characterization of wetlands.

The ALOS Kyoto and Carbon Initiative is an international collaborative project led by the Japanese Aerospace Exploration Agency (JAXA) which aims to build on the experiences of the Global Rain Forest and Global Boreal Forest Mapping (GRFM/GBFM) project. The aim of the initiative is to support the information needs of carbon cycle science and environmental conventions through the use of data acquired by the Advanced Land Observing Satellite (ALOS). Launched in January 2006, ALOS carries, amongst other sensors, the Phased Array L-band Synthetic Aperture Radar (PALSAR) instrument. Led and coordinated by JAXA, the Kyoto and Carbon Initiative is being undertaken by an international Science Team and focuses primarily on defining and optimizing the provision of data products and validated thematic information derived from in-situ and satellite sensors, focusing on data acquired from PALSAR. Using the Dabus Marshes as a case study, this paper reports on analysis planned under the Wetland Theme of this Initiative to map wetlands in Ethiopia that are intensively used for agricultural activities and are an important natural resource for local communities.

KEY WORDS: ALOS PALSAR, wetlands, Ethiopia, vegetation, livelihoods

Capacity-building: achievement and challenges

Capacity building issues: Demand, as challenges on the application of Earth Observation Systems in Ethiopia

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ABSTRACT

The first introduction of earth observation systems and technologies to some of the Ethiopian institutions goes to the early 1990s. In fact Mapping institutions like the Ethiopian Mapping Agency have been applying airborne products since the WWII. In early times the application was mainly for production of topographic maps. Currently different institutions have started application the earth observation system products such as satellite imagery, GPS, Radar and LIDAR data. The demand, therefore, is tremendously increasing from time to time. On the other hand, there exist very critical issues such as limitation in capacity building, diversity of application areas, limitation of source of the data, prices of high resolution remote sensing data, ICT infrastructure challenges and so on. There exists range of coping mechanisms to overcome those challenges such as non-formal trainings, use of freeware, and etc. This paper compares and analyzes the trends in development of the applications with the increasing demands in relation to future solutions qualitatively and quantitatively. Institutions playing active role in the earth observation technology at different levels are also incorporated.

KEY WORDS: Earth observation systems/ technologies, satellite images, remote sensing, GIS, capacity building, challenges, solution mechanisms.

Institutional Capacity Building in Disaster Management: The National Emergency Management Agency (NEMA) experiment in Nigeria

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ABSTRACT

Capacity building involves making available through training, a critical mass of skilled manpower as well as provision of necessary equipment and infrastructure about an activity. In Nigeria, the National Emergency Management Agency (NEMA) recently initiated a capacity building programme in disaster management through the selection of six federal universities across the six geopolitical zones of the country to establish a collaborative post-graduate programme in disaster risk management and development studies.

Generally, the action taken by NEMA is timely and is in the right direction especially as there is inadequate manpower in disaster and risk management in the country, in addition to the fact that in recent times, disaster occurrences and emergencies have increased in frequency and intensity not only in Nigeria but all over the world. Furthermore, the spread of the selected universities across the country's political and coincidentally ecological zones is commendable given the wide range of hazards in the different zones, from coastal and gully erosion to drought and desertification in the northern part of the country.

Nevertheless, there is the need for all stakeholders involved in the NEMA experiment to focus more on Geospatial information technology (GIT) in their curriculum, especially in terms of acquisition, use and dissemination in order to improve early warning systems and minimize disaster occurrence in the country. The paper also addresses the need to put in place education networks and partnership not only among participating and relevant non-participating institutions at national level, but also at the international level involving both south-south and north-south networks and collaboration.

KEY WORDS: Capacity building, Disaster management, National emergency management agency, Geospatial information technology, early warning systems.

Geoinformation-based Monitoring and Sustainable Management of Secondary Schools in Ife Central Local Government Area, Osun State, Nigeria

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ABSTRACT

The building of critical capacity in the Surveying and Geoinformatics profession has now been accepted to start from the required subjects at secondary school level (*"catch them young"*) but the quality of secondary education in many third world countries such as Nigeria has been said to be on the decline over the past two decades as portrayed in the students' poor performance in the entrance examinations into the universities and other higher institutions of learning. For example in Nigeria, the students' University Matriculation Examination (UME) results have been very poor (especially in the subjects required for studying Surveying and Geoinformatics, Engineering and other allied disciplines) over these past years. The UME results for 2010 showed that only 41% of the entire students passed (scored 50% and above). Many reasons have been adduced to this poor performance but they are subjective and no attention has been paid to the geo-information aspect in all the considerations by the government and other stakeholders. The geoinformation complement is required so as to have a good picture of the spatial organisation and other associated characteristics of the secondary schools. This will ensure proactive and effective monitoring and sustainable management of the schools. An attempt has been made in this investigation to integrate geo-information with other non-spatial information to come up with an innovative decision support system (DSS) that will raise the performance of the students to the expected level in the university matriculation examinations in particular and their good performance in their chosen course of study in the higher institutions after gaining admission. The secondary schools in Ife Central Local Government Area, southwestern Nigeria, have been examined as a case study. High resolution IKONOS satellite image has been processed and analysed for the necessary geoinformation extraction while field observations including administration of structured questionnaires were carried out. These data were organised and used to create a relational geo-database in a GIS environment. The geo-database was queried and could further be queried as a decision support system for government's monitoring and sustainable management of secondary schools in the study area.

KEY WORDS: Remote Sensing, Geographic Information Systems (GIS), Monitoring, Sustainable Management, Decision Support System (DSS), Image Processing, Global Positioning (GPS), Geoinformation

Geoinformatics-based Mapping Philippine's Higher Education Institutions and Programs

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ABSTRACT

Geoinformatics is a useful tool for environmental scanning and project planning which uses GIS, GPS, remote sensing, and the internet. The outputs of the project are needed not only for the design and implementation of rationalization measures but also for the conceptualization of financial/resource management reforms in higher education, including the introduction of normative financing in the Philippines. Thus, a commissioned study was conducted to develop a geoinformatics-based decision support system to establish geo-referenced data and information of higher education institutions (HEIs) and programs in the Philippines for policy research and development.

KEY WORDS: Geoinformatics, GIS, GPS, remote sensing, ubiquitous and internet mapping

GIS: A Spatial Analysis Tool for Electoral Mapping and Planning (Sierra Leone case study)

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ABSTRACT

As part of the UNDP-Sierra Leone funded programme on "Strengthening Electoral Management Capacities" the Centre for Remote Sensing and Geographic Information Services (CERSGIS), University of Ghana, Legon was contracted by the National Electoral Commission to develop and implement a GIS based Mapping and Spatial Data Management System for the National Electoral Commission (NEC) in line with its 5-year Strategic Plan. The assignment included knowledge transfer in the use of GPS and GIS to selected staff of Commission and recommendations for setting up a GIS Unit within the Information Technology (IT) Directorate.

Thirty-one (31) Electoral Officers comprising of 3 Regional Officers from the Eastern, Western and Southern Regions and 27 District Officers from all 14 Districts were trained in the use of GPS receivers for mapping and assigned to capture GPS data and related key attributes of all Polling Centers in their respective Districts as base input for the GIS development. Additionally, four IT officers from the NEC Head-Office in Freetown received training at CERSGIS in GIS and GPS data processing. The IT officers also provided useful input for the design and development of a customized database application for capturing, maintaining, analyzing and presenting elections data at politico-administrative level.

Spatial data processing of various geographic features and the integration of GPS data captured in the field by the District Field Staff culminated in the development of an electoral geodatabase useful for planning monitoring and evaluation of electoral resources. By this development, NEC is now able to use the GIS based spatial analysis tools for planning elections, analyzing resource need and allocation, and communicating the outcome of elections in a spatial context.
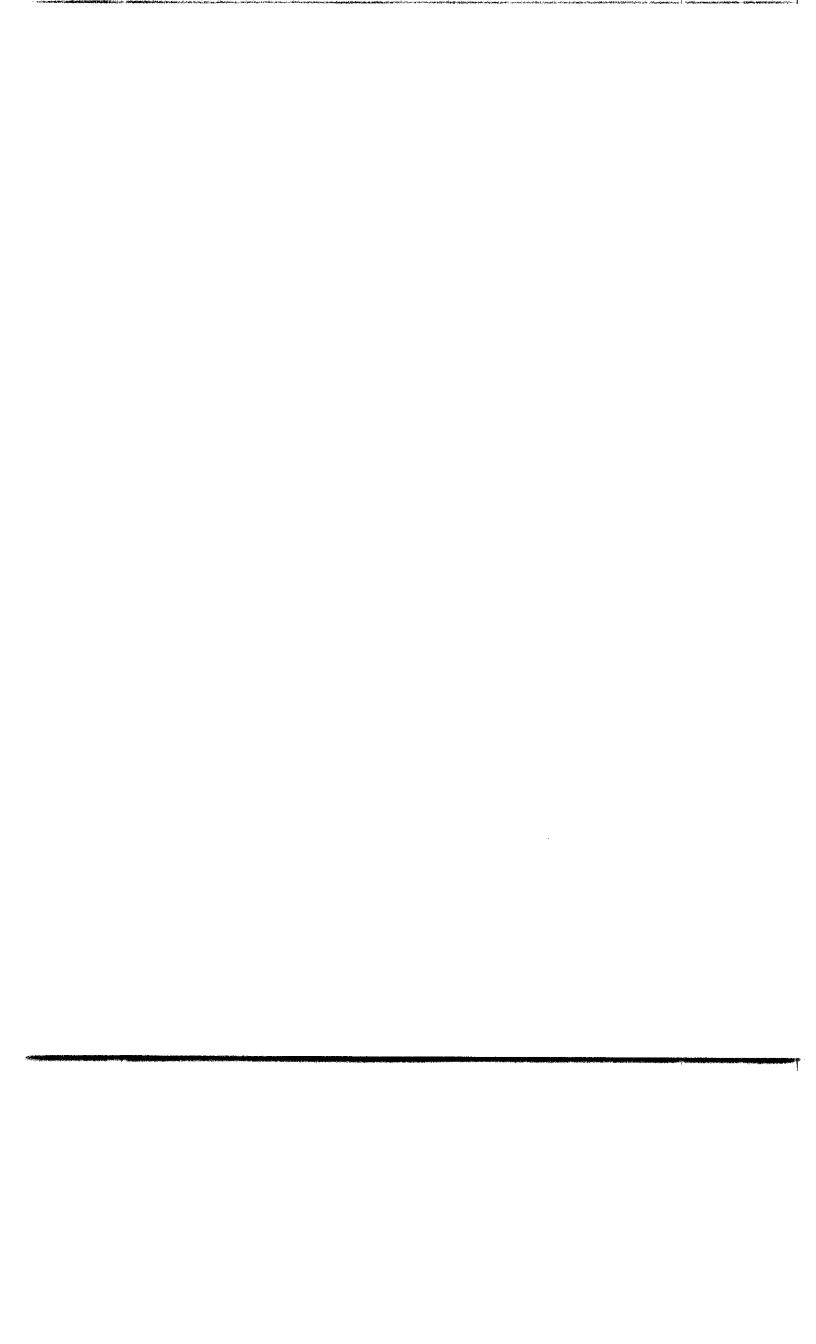
RECTAS Capacity Building:
Strategies, Achievements and Challenges

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ABSTRACT

The Regional Centre for Training in Aerospace Surveys (RECTAS) was established in 1972 under the auspices of the United Nations Economic Commission for Africa (UNECA) as a joint Institution of African countries currently constituted by Benin, Burkina, Cameroon, Ghana, Mali, Niger, Nigeria (host country) and Senegal. RECTAS' vision is to be a leading centre of excellence providing one-stop solution for quality geospatial science training, education and research and critical capacity for sustainable development in Africa. The mission is to contribute to rapid sustainable development of member states in particular and Africa in general, through the development of critical capacity for timely delivery and responsible use of appropriate geospatial information. In this presentation the strategies and synergy of accomplishing the objectives, vision and mission of the Centre as well as prospects and challenges are discussed.

Spatial Data Infrastructure, SDI

Nigeria National Geospatial Data Infrastructure Update: Pilot Implementation Phase I

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ABSTRACT

In the effort to make progress on the implementation of the National Geospatial Data Infrastructure (NGDI) in Nigeria, the National Space Research and Development Agency (NASRDA) – the Secretariat and lead Agency of the NGDI in partnership with indigenous consultants implemented a pilot phase of the NGDI initiative in the country. The pilot phase was implemented with four node agencies which are actively participating in the initiative. One of the main strengths of the project was the involvement of indigenous consultants and developers to carry out the process. The result of the pilot implementation is a scalable geo-portal for the Nigerian NGDI with metadata from the four pilot agencies. This is a significant development in African SDI and an important milestone in Nigeria.

KEY WORDS: National Geospatial Data Infrastructure (NGDI), Metadata, Geo-portal

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The African Regional Spatial Data Infrastructure (ARSDI)

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ABSTRACT

The United Nations Economic Commission for Africa (UNECA) has been assisting member States to develop spatial data infrastructures as the appropriate mechanism for the production, management, dissemination and use of spatial data and information products. At the national level, the Commission works with member States to: set up institutional arrangement so that to assign custodianship and responsibilities as appropriate; build fundamental, core and thematic datasets; develop capacity and retain a critical mass of expertise in Africa; develop Standards and interoperability streamlining and enforcement for common base themes, geodetic reference, metadata production. To date, more than 30 African countries have embarked on the development and implementation of these policies and plans and are at various stages in this process.
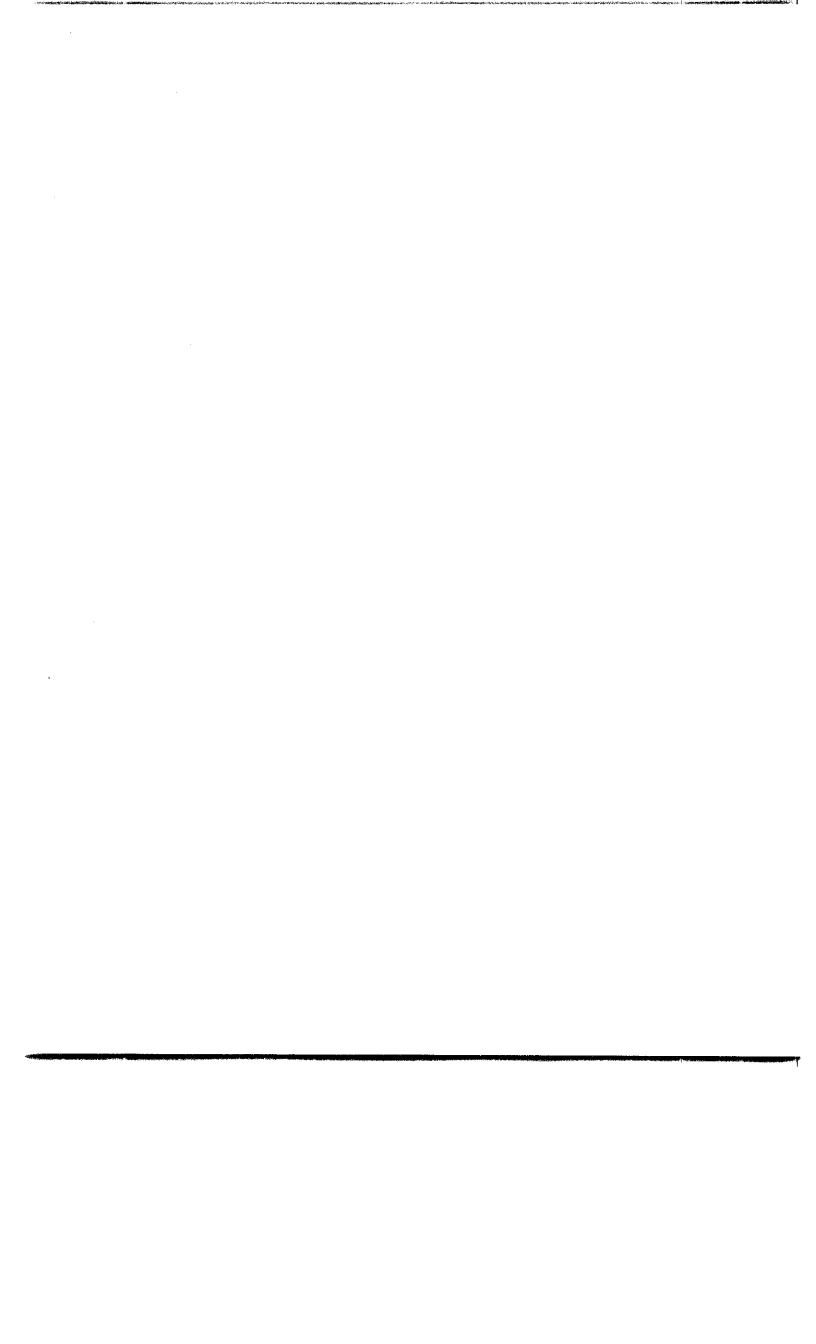
ECA has also long proposed the establishment of an African Regional Spatial Data Infrastructure (ARSDI) to ensure that reliable spatially enabled information is easily made available in support of needs and priorities at regional and regional and national levels.

Despite the efforts of ECA and other partners, progress in developing SDIs in Africa has been very slow, due mainly to poor awareness and understanding of the link between the content and components of the SDI on the one hand, and the day-to-day decisions and activities of society on the other. Developing an SDI has sometimes been seen as an end in itself. Therefore, given the limited financial resources available to governments, priority is given to supposedly more pressing activities without realizing the dependence of most of them on the availability of timely, accurate and reliable geoinformation resources. ECA has responded by seeking to integrate SDI policies into the very successful work on National Information and Communication Infrastructure (NICI) plans and strategies. This is still at the policy level and there remains a need for closer linkage between the geoinformation products and societal needs. The paper further looks on the nascent fields of spatially enabled government services (SEGs), discussing how to develop knowledge, skills and capacity to advise African governments on spatially enabling their services to citizens (G2C), businesses (G2B) and other government departments and agencies (G2G).

KEY WORDS: Spatial Data Infrastructure (NGDI), Spaially-enabled Governement Services, e-Application, Africa

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National and regional programs
and projects

SERVIR-Africa: an earth observation platform for collaboration

Kate Lance

ABSTRACT

An agricultural extension officer in western Uganda may feel he is worlds away from a hydrological modeler at NASA's Marshall Space Flight Center in Huntsville, Alabama. SERVIR is lowering the degrees of separation between those who need information where the action is and those who are immersed in developing technologies to observe and model the Earth. This NASA/USAID supported project is establishing an integrated web portal and geoportal to provide a searchable and viewable 'one-stop shop' for earth observation data, geospatial services, data documentation (metadata), animations, visualization, analysis, and reports. The evolving platform supports dissemination of scientific knowledge in a range of application areas (e.g., biodiversity conservation, disaster management, agricultural development, climate change adaptation, etc.). This paper describes, from a user's perspective, the components of the geospatial platform that enable discovery, acquisition, use, and sharing of geospatial data and information. The paper also discusses the methods and results of the needs assessment that the SERVIR-Africa team conducted in 2009 to guide platform and product development.

SERVIR-Africa: advancing operational flood prediction and post-event flood mapping

Kate Lance

ABSTRACT

SERVIR-Africa is an ambitious regional visualization and monitoring system that integrates remotely sensed data with predictive models and field-based data to monitor ecological processes and support response to disasters. It aims to address a wide range of thematic areas that are important to communities in Africa, by turning data into actionable information for decision-makers. Floods are a form of disasters that commonly plague Africa, second only in impact to drought. This paper summarizes the development thus far of an integrated platform to support flood prediction and monitoring in the Lake Victoria Basin. The process starts with the identification of flood potential and flood forecasting using satellite data and hydrologic modeling. It continues with the mapping of flooded areas using satellite data via the MODIS Rapid Response System and EO-1 tasking. The predictive and post-event outputs are combined with field-based data collection and analysis of the socio-economic and ecological conditions of the area, and result in the dissemination of synthesized information products to aid in disaster management.

Monitoring earth observation sector in Africa

Kate Lance

ABSTRACT

The Earth observation field offers new capability for forecasting, multi-temporal analysis, and real-time intervention, as well as increased business and employment opportunities. Recent investments in digital mapping products and mobile services in African countries lend support to the growth and potential of the earth observation market. While it is clear that Earth observation applications are on the rise in Africa, it is still difficult to assess the magnitude of the community and trends within specific sectors such as energy, health, and agriculture. Typically, in global assessments of the geospatial industry, the African continent is lumped into a category marked as 'other' or 'rest of the world.' This paper considers various methods and mechanisms that could support systematic monitoring of Earth observation activity in Africa and enable reporting on the sector to African Cabinet/policy-makers and the global industry at large. Data collected in a standardized way would allow for comparisons over time, comparison between nations, and comparisons between segments of the market (e.g., academic, government, and commercial end users).

Digital Aerial Photography of Shabelle and Juba rivers and associated main irrigated areas

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Background

SWALIM (Somalia Water and Land Information Management System) is a European Union Funded Project requested by various Somali Administrations, NGO's, developmental agencies and UN organizations on behalf of Somali communities whose life directly depend on water and land resources.. One and a half decades of civil strife in Somalia has resulted in the loss of most land information collected in the previous half century. SWALIM is trying to recover lost information from all over the world and at the same time re-establish data collection network in collaboration with partner agencies. During the 2006 floods, organizations struggled with trying to assemble the rudimentary information on river morphology, dike conditions and basic flood information. Realizing the need for more accurate topographic and morphologic information, SWALIM prepared a proposal titled – Somalia projects for "Increased capacity to respond effectively to a disaster through a strengthening of the Somalia information Base". One of the key components of the project was "Digital Aerial Photography of Shabelle and Juba rivers and associated main irrigated areas" this Project included the creation of a detailed DEM and Orthophotos of the river basins as the basic vital input. The creation of this input was awarded to Genesys International Corporation in January 2008-09 for execution.

Significance of data modelling along Juba and Shabelle rivers

Juba and Shabelle rivers originate in the Ethiopian highlands where the main streams and the tributaries are deeply incised on the steep slopes of the upper sections. However in the middle sections and lower sections in Somalia there is a virtual absence of tributaries and other drainage channels; there are some springs fed streams, some local run off and seasonal streams / gullies, but these contribute to significant flow only in times of heavy rainfall. The river banks lie above the level of surrounding lands so that any spillages are lost permanently from the river and no return flow occurs

Objective of the project was to acquire aerial orthoimagery and accurate ground elevation that meets important information needs for planning and development in the Shabelle and Juba Rivers. The works and the products which are the subject of this project were intended to provide an urgently needed up to date highly resolved topographical picture of Somalia on its two large rivers (Juba and Shabelle) essential for all aspects of flood management and irrigation development.

Methodology

Genesys performed aerial flights over Juba and Shabelle basins using a VexcelUltracam-X mounted in an aircraft equipped with 'Aerocontrol Global Positioning System /Inertial Navigation System' (GPS/INS) linked to the OMNISTAR Satellite system. Aerial Triangulation was performed using ABGPS / IMU as well as the ground surveyed control points by applying appropriate weightages based on the challenges faced during GCP collection. An accurate DTM was modelled which would support flood modeling as required by SWALIM. RGB as well as CIR Orthophotographs were also prepared for the study area.

Challenges and project significance

Genesys initiated the Ground Survey and collected 23 GCP's using the Milindi and Adis Abba Reference stations for processing. However the Ground survey was interrupted with the abduction of the Survey Team leaders on 1st April 2008 by Somali terrorists. The paper will describe in detail about the many challenges that can come across while executing an aerial photography / survey project in politically disturbed regions. The paper is intended to describe the technical / operational and financial challenges faced due to the same and how they were overcome to produce a hydrologically correct elevation Model which suited SWALIM's requirement..

Results

Implementation of the project greatly enhanced the capacity of FAO Somalia Emergency Co-ordination unit and all other humanitarian actors to respond more effectively in livelihood and food security areas to humanitarian agencies in Somalia

Investigating the geometric and radiometric properties of DMC-Nigerisat-1

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ABSTRACT

The DMC-Nigerisat-1 is among the group of satellites called the Disaster Monitoring Constellation (DMC) satellites designed and built by Surrey Satellite Technology Ltd (SSTL) in the UK. The geometric and radiometric quality of the DMC-Nigerisat-1 including sensor inter-calibration of datasets acquired at different dates in the year 2005/2006 were evaluated over different targets in the UK. The purpose of this evaluation is to test the consistency and adequacy of the datasets for quantitative analysis of time-series environmental change. Geometric correction was performed using Ground control points (GCPs) derived from Ordnance Survey maps in British National Grid reference system and transformed to UTM coordinates while the atmospheric correction was carried out by using the Cosine of the Solar Zenith Angle (COS(TZ)/COS) model and spectrally invariant targets were utilized to develop linear regression equations for establishing inter-sensor relationship, also included were the dynamic range and the effective spatial resolution of this satellite sensor. The results shows that DMC-Nigerisat-1 has a good geometric fidelity with Root Mean Square Errors (RMSE) of less than 0.5 pixel, strong linearity and high correlation co-efficient of the sensor inter-calibration equations ranging from R^2 0.76 to 0.96 is promising since they were statistically significant at 95% confidence level. The results obtained indicates that the DMC satellites having the characteristics of high temporal resolution of daily revisits and spatial resolution of 32 metres may provide the first time-series datasets at medium spatial resolution for applications in phenology, resource management, environmental monitoring and climate change detection.

KEY WORDS: Investigating geometric radiometric properties dmc-nigerisat-1

Use of hyperspectral data "SWIR HySpex-320m" for the identification and mapping of minerals and carbonate rocks in Jurassic formations of the basin of Agadir (South western Morocco)

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ABSTRACT

The development of sensors for acquiring hyperspectral images has contributed greatly to the identification of different constituents of the earth's surface and therefore to the improvement of cartographic products.

Carbonate rocks are considered the seat of diagenetic processes and alteration, which can reach all of the rock. These processes lead to the formation of new carbonate minerals with a high variability phases of crystallization. Frequently, the optical microscope, the precise identification and discrimination of these phases is beyond the resolving power of the eye, which makes the mineralogical mapping of facies difficult. It requires, first, the use of staining techniques.

This work proposes to study the carbonate formation of Jurassic age in the Agadir Basin, using hyperspectral imagery provided by the camera HySpex SWIR-320m, in wavelengths ranging from 1300 to 2500 nm. These images offer the possibility to identify with precision the different carbonate minerals and to allow the characterization diagénitique facies.

The approach involves the development and implementation of a standardized index of carbonates (NDCI) and a supervised classification by the method "Spetrcal Angle Mapper (SAM). This method allowed the preparation of a wide mineralogical mapping of samples sufficient to identify the mineral phases and their degrees of crystallization by overcoming the different states of the geometry of the sample surface. It is a method that proved useful for detection and precise on a scale never achieved until now in the region.

Atlas of African Hydrogeology: a proposal

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ABSTRACT

Being the continent with the greatest shortage of clean drinking water, Africa needs comprehensive information about its groundwater endowment to relieve that fundamental want. Yet the greater part of Africa lacks geological maps at scales better than 1:250 000. Even where geological maps are available, many do not necessarily give much assistance in assessing groundwater potential. That applies especially to superficial deposits that traditionally have been favoured for wells: many different unconsolidated materials are generally combined under a single category in geological map legends.

The whole continent is now covered by low-cost 15-90 m resolution image data from the geologically-oriented US-Japanese ASTER system aboard the NASA *Terra* satellite. This includes superb medium-resolution stereoscopic images, which together with 5 well-placed spectrally narrow SWIR bands allow lithological and mineral mapping at 1:50 000 scale. The multispectral thermal infrared sensor carried by ASTER offers an opportunity to map lithologies on the basis of spectral signatures of rock-forming felsic, mafic and carbonate minerals. ASTER stereo data has been used to construct a global DEM (GDEM) with 30 m spatial resolution that permits detailed hydrological and topographic surveys in areas that are poorly known geomorphologically.

Together with other free or low-cost data, ASTER potentially enables geologists to fill the information gap that faces groundwater evaluation across much of Africa. It makes it feasible to create useful maps systematically at a pace never possible before the first decade of the 21st century. Producing such a vital resource as an *Atlas of African Hydrogeology* that involved geologists from across the continent would form the basis for comprehensive training of participants in geological image interpretation techniques. Such 'on-the-job' training, motivated by the social urgency and universal popularity of the task, would 'spin-off' to other geoscience issues that are less urgent: hazard assessment; soil evaluation; physical resource exploration, etc.

As well as sharpening the geological focus of water exploration, being suitably equipped with Earth Observation skills also helps to address other vital issues in water supply:

- Convenience – both the proximity of targets to long-established communities and the possibility of siting refuges for displaced people at points of supply of their most urgent need;

- Water quality – avoiding natural and human-induced contamination;

- Yield and sustainability – depending on aquifer properties and on opportunities for recharge that match water demand;

The presentation will show examples of a range of applications drawn from the author's own experience, and outline the requirements for a multinational programme of work.

Application of Geospatial Database for Sustainable Mineral Development in Nigeria

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ABSTRACT

Over the years, Nigerian Geological Survey Agency has generated and acquired lots of digital dataset such as geological, geophysical, geochemical, core samples and mineral occurrences information.. In this multi dataset environment, field scientists currently face a huge challenge of combining and analysing dataset from different sources to meet their objectives.

The present work deals with the development of a geological and mineral information system capable of carrying out the integration of the various available digital dataset using ArcObject, ArcMap and relational database. An interactive GUI was created to enhance interaction with the Geodatabase. This will facilitate the spatial analysis of multiple layered dataset and provide access to all the digital dataset within the Agency at the click of a mouse. These integrated dataset gives the user a unified view of these data and satisfies the need for efficient data storage, management, manipulation, retrieval and analysis of multiple dataset. It will also meet the need to spatially link field observation with ancillary data for the purpose of mapping and modelling. The geodatabase provides a platform to access, query and produce report of various kinds from the database. It also affords an investor an opportunity to preview the information on any mineral occurrence within the country.

The conceptual design of the geodatabase was carried out followed by the development of the graphical user interphase (GUI), training of test dataset, plotting and population of test database, prototype testing and correction and finally database implementation. The overall focus of the project is to establish an operational information system supporting specific requirements of mineral resources studies. The system design, allow manipulation of data by means of intelligent queries and to provide information in different forms. Most importantly it can be used for mineral prediction modelling.

The implementation of this information system will sustain the country's economic performance and support the current drive to promote sustainable development through mineral production.

A Pan-African Space Agency or An African Space Forum?

Etim Offiong

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ABSTRACT

The utilization of outer space, as well as the development of space capability, is very low in Africa. A few countries in the continent have Earth Observation and Communication satellites. Only South Africa has demonstrated some level of capability in building a satellite while Egypt, Morocco, Algeria and Nigeria engaged the services of the advanced countries in building and launching their satellites. There is no space transport/propulsion capability nor is there any launching pad in Africa. Most of the countries neither have a space policy nor a space program.

In view of the benefits derivable from the exploration and exploitation of space, how best can individual countries in Africa, develop capacity in space science and technology applications, especially in the field of Earth Observation? What modalities can be worked out, so that Africa can be recognized as a contributor to advances in space? How best can Africa harness the resources - knowledge, facilities, funds and so on – available in the different countries in Africa?

There are resources and potentials which will not only enable Africa contribute to space research and technology development, but will also have immense socio-economic impacts across Africa. These, and more, can be achieved with the right platform and strategy.

Space Policy in Africa: The Nigerian Space Policy and Programmes

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ABSTRACT

Space activities around the world have been flourishing in the last few years of the 20th century. The role of space activities in a country's overall development strategy is becoming increasingly salient and their influence on human civilisation and socio-economic progress is increasing.

In realisation of the unique role of space science and technology in national development, the Federal Government of Nigeria approved the establishment of the National Space Research and Development Agency (NASRDA) in April 1999 and subsequently approved the National Space Policy and Programmes in June 2001. The National Space Research and Development Agency (NASRDA) is responsible for the co-ordination of the Nigerian space programme and is entrusted with a mandate to consolidate all space related activities in order to make greater impact on development efforts in Nigeria.

The policy statement is that Nigeria shall vigorously pursue the attainment of space capabilities as an essential tool for its socio-economic development and the enhancement of the quality of life of its people. The Nation shall achieve this through research, rigorous education, engineering development, design and manufacture of appropriate hardware and software in space technology, including transport and payloads, such as satellites, telescopes and antennas for scientific research and applications.

Government shall also foster Bi-lateral and international cooperation in all aspects of Space Science and Technology to ensure that Nigerian Scientists and Engineers benefit from global developments in the space enterprise.

The major thrust of the Nigerian National Space Policy and Programme is to make space research and development activities parts of the overall strategies for sustainable national development. The space programme is classified into two: short and long term programmes.

The vision of Africa is to attain competence and capabilities in relevant areas of space science and technology that would impact on sustainable socio-economic development and improve the quality of life of citizens, and to make Africa pro-active and also compete in space exploration.

The Urban Climate and Land use Change in case of Addis Ababa Ethiopia

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ABSTRACT

This paper presents with the aims to identify and compare the development pattern of land use change in relation with climate of Addis Ababa, Ethiopia to highlight the underlying process by utilizing Land-sat satellite images. The spatial analysis of total population and density of each sub-city obtained from the State Statistics Institute. The national and the city climate change were studied using temperature and rainfall observation data. Surface temperatures pattern were also studied to investigate the urban heat island (UHI) effect associated with increasing impervious surfaces both spatially and temporally.

The results indicate that urbanization pattern of the city of Addis Ababa not only has a great impact in looses agricultural land and of natural and semi-natural forest and its eco-system also it has a grate impact on UHI. Urban coverage in Addis Ababa was significantly changed from 35% in 1973 to 74% in 2005. The 2006, total density of the city as compared with year 2000 increased by 1624 person/km². The annual surface warming induced by urbanization at Addis Ababa (OBS) station has been increasing by about 0.71 °C for the period 1981-2003 analyzed. Significant warming of minimum and maximum temperature at Addis Ababa (OBS) Station and the rural Bole station can be found from 1965 to 1983, but the warming at Addis Ababa (OBS) station is larger than that at the rural station of Bole. The result of this change can have significant effects on city local weather and its climate. The study also recommends an adaptation and mitigation measures to reduce the negative effects of urban climate change.

An analysis of the changing land use of settlements around Abuja Nigeria: Its physical planning implications

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ABSTRACT

The capital of Nigeria was moved from Lagos to a central location in Abuja in 1976. The movement was gradual until 1991 when the then Head of State finally relocated. This movement set in series of activities within and around Abuja. The rate of infrastructural development was lagging behind population increase occasioned by the movement of all government activities. The medium and low income workers, who are not able to secure accommodation in Abuja, move to surrounding settlements like Madalla and Dakwa. Employing Landsat TM of 1987 and Landsat ETM of 2001 this paper show that the built-up area of Madalla which is 33km from Abuja grew by 17.55% and Dakwa which is 44KM away grew by 13.99 %. The result of the analysis indicates that the closer a non built-up land is to Abuja the more likely it is to change to built-up. The growth in built up area, from the result, is inversely proportional to change in arable land. The arable land of Madalla and Dakwa shrank by -3.63% and -6.04% respectively. This rapid but unplanned expansion of the two settlements is posing a serious challenge to government and exposing the residents to many environmental hazards.

GlobWetland II, A regional pilot project of the Ramsar Convention on Wetlands

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ABSTRACT

The overall objective of Globwetland-II (GW-II) is to facilitate the integration of remote sensing techniques into the conservation and management of wetlands. GW-II will develop a G-WOS (Global Wetland Observing System) pilot system for the production of a number of wetland related geo-information maps and indicators but also demonstrate the capability of the system for 200 wetland sites and surrounding areas of the Southern and Eastern part of the Mediterranean basin.

The project is intended to serve the needs of many wetland conservation practitioners from the wetlands managers up to the stakeholders of the Ramsar Convention. The targeted user communities of the project are the Ramsar Administrative Authorities and National Focal Points of the subject countries and their supporting conservation agencies.

The project team will apply three major instruments to achieve the ambitious objectives of GlobWetland II, the active involvement of users, capacity building and the provision of prototype products together with instruments to integrate and extrapolate the use of Earth Observation within the users range of activities.

To demonstrate and ensure the use of the GW-II system the user will be provided with the system software and prototypes. The user will also be trained to the use of the prototype products and software.

Wetlands conservation and management is one of the many thematic domains in which satellites observations together with novel and cutting edge geo-spatial technologies have contributed to improve the assessment and monitoring of essential wetland ecosystem variables by wetland managers and local territorial authorities.

Geo-spatial analysis and modelling tools as used in the predecessor project GlobeWetland I has demonstrated how satellite Earth Observation technology can be a cost-effective and productive tool for the Ramsar Convention and for the conservation and management of wetlands in overall. In GlobeWetland II the establishment of EO-based services to support the inventory, mapping, monitoring and assessment of wetlands ecosystems will be evaluated especially to build the foundation in the Ramsar community for a wide scale deployment of a Global Wetland Observing System.

The GW-II system which is based on satellite Earth Observation technologies and state-of-the-art geo-spatial technologies can support the inventories especially in the countries in the coastal catchment basins of the Southern and Eastern of the Mediterranean Sea that have not achieved their national inventory. Inventory and delineation of wetlands is one of the major basic steps to establish their conservation and management. The coastal catchment basins of the Southern and Eastern part of the Mediterranean Sea, from Morocco to Turkey, are of particular interest for biodiversity due to the fact that several endemic species listed as critically endangered or extirpated by the IUCN.

The GlobWetland II project is funded by the Data User Element (DUE). The Data User Element (DUE) is a programmatic component of the 3rd Earth Observation Envelope Programme (EOEP-3), an optional programme of the European Space Agency.

KEY WORDS: wetlands, land cover, mapping, remote sensing

Supporting monitoring of forests, rangelands and natural parks in Kenya with remote sensing

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ABSTRACT

Natural ecosystems in East-Africa have been changing drastically in the last decades [1,2]. The 'Kenya Atlas of our changing environment' of UNEP [3] illustrates how rapid changes are taking place due to pressures from human activities. As a result, there is an increased demand from ecosystem managers, both government agencies and environmental NGO's, for updated information on these changes. Regularly updated vegetation indicators derived from satellite images allow to monitor the vegetation status and the dynamics over time. They may be used to assess the extent and the drivers of change and to evaluate policy measures.

The ENDELEO project [3], supported by the Belgian government, wants to enable stakeholders involved in management of forests, rangelands and natural parks in Kenya to use this crucial information from Earth Observation data. A web-based ENDELEO monitoring tool was developed which is updated every ten days with data obtained from SPOT-VEGETATION [4] and MODIS [5] (obtained from MARS [6]). It consists of an image viewer, interactive graphs and the calculation of statistics. The tools allow a broad range of users to easily derive relevant information from the images, including those users without much experience in Remote Sensing.

User involvement is a key aspect of the ENDELEO project. Stakeholders have been involved since the beginning to define their information needs and based on the feedback during workshops, the services have been constantly improved. The help desk supports users with their analyses of field data in combination with vegetation indicators from satellite images. In every newsletter and on the website, a number of case studies are elaborated, illustrating the practical use of the ENDELEO tools and data and giving inspiration to other users.

To make this vegetation monitoring system sustainable, ENDELEO aims to operate the web services locally in Kenya. The system will be moved to the Department of Remote Sensing and Resource Surveys (DRSRS) of Kenya's Ministry of Environment, who will provide the tools to users such as the Kenya Forest Working Group (KFWG), the Northern Rangeland Trust (NRT), etc. In the near future, an EUMETCast [7] reception station is going to be installed at DRSRS, through which they will receive the necessary 10-daily image updates. This also links ENDELEO to other initiatives (e.g. DevCoCast [8]) involved in data reception and capacity building on distribution to downstream users.

KEY WORDS: ecosystem monitoring, web based tools, user involvement, ENDELEO

African Monitoring of the Environment for Sustainable Development (AMESD)

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ABSTRACT

The overall goal of the African Monitoring of the Environment for Sustainable Development (AMESD) project is to establish panafrican environmental information services using satellite remote sensing data. Four specific results are aimed at in this project :

(i)   Improve data access in Africa. This is achieved by implementing in most African countries a reception station capable to acquire in near real time environmental and meteorological satellite data through the so-called EUMETCast satellite telecommunication system,

(ii) Establish environmental information services, one in each of the 5 Regional Economic Communities (RECs) : CEMAC, CEDEAO, IOC, SADC, IGAD, in Regional Implementation Centres (RICs) chosen by the RECs, associated to a specific thematic area ("Thema")),

(iii) Sensitize institutional decision makers and stakeholders at continental, regional and national level on the interest of the use of satellite data for environment ressources management and for the implication of African stakeholders in global environmental treaties,

(iv) Build capacity, through training actions, in each of the RICs as well as in their network of partners at national level to be able to process the data and produce environmental information suitable for institutional decision makers.

The five Themas in the RICs are the following :

(i)   Water Resource Management in Central Africa, with the development of radar altimetry products and river height bulletins for monitoring river navigability, and of bulletins analysing mesoscale rainfall and evapotranspiration satellite products for monitoring elements of the hydrological cycle in the Congo basin,

(ii) Water Management for Cropland and Rangeland Management in West Africa, with development of drought indicators, small water bodies and fire products, and associated environmental bulletins at the regional scale,

(iii) Land Degradation Mitigation and Natural Habitat Conservation in East Africa, with one service of provision of land degradation risk maps at regional scale, together with land cover change assessment at higher resolution in the natural parks and protected areas of the Region,

(iv) Coastal and Marine Management in the South West Indian Ocean, with the production of potential fishing zones for fishing authorities and of oceanographic indicators such as primary production and temperature anomalies for a variety of users,

(v)   Agricultural and Environmental Resource Management in Southern Africa, with development of products and services providing crop monitoring status, drought indicators and fire alarm products to the ministries of agriculture and environment of the Region.

The training program aims at establishing capacities in each of the five RICs and associated network of partners at national level for (i) using and maintaining the satellite reception stations and associated processing software, (ii) mastering the knowledge necessary to handle the processing of satellite data and the production of environmental bulletins usable for decision making. National workshops of sensitisation of decision makers are also foreseen. Altogether more than one thousand people should benefit of this training and sensitisation program throughout Africa.

The AMESD project is an ambitious institutional construction gathering the African Union Commission, which manages the program, the European Union that provides funding through its 9th European Development Fund, the five Regional Communities which provide programme guidance together with the ACP Secretariat, and international partners such as the European JRC and EUMETSAT. The project started in 2008 and is now underway, the construction of the 5 Themas has begun, the implementation of satellite reception stations throughout Africa is foreseen in the second semester 2010, and the project should last until the beginning of 2013.

The paper will present the project, detail the expected achievements in terms of use of remote sensing data and of derived environmental products and services, and discuss some of the challenges faced by the programme to reach sustainability.

The DevCoCast project – Impact on decision making processes in Africa

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ABSTRACT

Many African countries face serious environmental risks and need accurate Earth Observation (EO) data and derived environmental information for their sustainable development. GEONETCast provides reliable, worldwide and fast access to information and can be an easy and low cost way for countries to receive satellite and environmental data. The "GEONETCast for and by Developing Countries" (DevCoCast) project, funded by the European Community's 7th Framework Programme for Research (FP7), involves developing countries more closely in the GEONETCast initiative. Many EO data products, some produced in Latin America and Africa, are freely shared via GEONETCast. These products can be received using simple and low cost ground reception infrastructure. More importantly, the actual use of the products by a broad user community is supported through training and building on the existing networks and capacities. This is done across continents and application themes such as vegetation and agriculture, fires and floods, water resources and ocean and weather/climate. The goal is to embed GEONETCast and the data it offers into research, environmental monitoring and planning and decision making processes, in support of sustainable development.

This paper presents an example of the integration of operationally received DevCoCast data into decision making processes in Africa. Each year the UN-FAO and UN-WFP receive the request from African governments to perform a Crop and Food Supply Assessment Mission (CFSAM). These missions are performed by a team of international and national experts making an assessment of the agricultural and food supply situation in a specific country resulting in a report that supports the national government(s) in their decisions influencing the agriculture in the country. Partially based upon the data operationally provided by DevCoCast, VITO has developed and tested methodology over Southern Sudan to support the CFSAM experts in their analysis. The CFSAM support kit consists of a qualitative analysis section and a yield estimate section with a synoptic overview of the different products based upon time series graphics and maps.

The qualitative analysis is based on 4 sources of information:

- vegetation indicators (NDVI) from SPOT-Vegetation (SPOT-VGT); - water body detection from SPOT VGT (source: "Small Water Body Product, Developed by the Joint Research Centre, produced by VITO, with contribution from the Geoland 1 and 2, and VGT4Africa projects (FP6 and FP7)). - phenology detection from SPOT VGT (source: "Phenology Product, Developed by the Joint Research Centre, produced by VITO, with contribution from the Geoland 1 and 2, and VGT4Africa projects (FP6 and FP7)).

- rainfall estimate from METEOSAT (source: FEWS NET); All of these products are distributed by GEONETCast, except for RFE (2009). However, from February 2010 the RFE from TAMSAT/ MARS are disseminated via GEONETCast. The analysis is mainly focused on the detection of anomalies (vegetation stress, excess of water, …).

For the vegetation indicators like NDVI, classical graphs evolution analysis were made with comparison with the long term average and +/-2SDT after aggregation at administrative level and main land cover. It shows the vegetation development and cycle compare to the reference situation.

These graphs were superimposed with the corresponding MSG (Meteosat Second Generation) cumulative rainfall of the ongoing season and the long term average. In order to summarise the whole campaign evolution for arable and pasture a cluster analysis of the difference between the ongoing season with the average were made. This gives a synthetic overview of the campaign evolution with a straightforward identification of the area with vegetation stress during a significant period.

From the ten day water body two types of analysis were performed.

- The duration over the season of each pixel were calculated and compared with the long term average duration to derive the analysis of the extension and length of the rainy season.

- For each administrative units a graph was generated to show the number of detected water body pixels over the time with the historical average to detect the water body occurrence particularly in rangeland area.

The phenology products give an indication of the main phase of vegetation growth and duration. The analysis was mainly focused on the anticipated or delay in the start of the season and on the duration of the whole vegetative cycle to better understand if the season was shorten or under normal duration.

Several training session have been organised to enable African experts to perform the above mentioned analysis based upon the DevCoCast data they are already receiving.

New estimation of Kibera population using Remote Sensing

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ABSTRACT

Satellite imagery constitutes an interesting support or alternative to ground surveys in many fields. Concerning population estimates, it can be of great help to provide a rapid updated assessment of a population. Low cost, comprehensive vision of a region which may be otherwise inaccessible, time sparing and updated situation are incentives to resort to this kind of technique.

In the case of Kibera (Nairobi, Kenya), one of the biggest informal settlements in the world where people live in an extremely dense urban context, the challenge was to provide an updated estimate of the population where many varying figures have been suggested. On basis of a satellite image acquired in February 2009, buildings were extracted and helped supporting field surveys and estimates. Field surveys were organised randomly throughout the slum and collected figures were then extrapolated for the whole Kibera on basis of the information extracted from the image.

Comprehensive field surveys should be made in order to further validate our result and to answer some questions:

- To what extent is the satellite imagery useful with regards to field survey? What is the best combination to reach the most accurate estimate?

- Is the degree of error in estimating the population proportional to the level of detail extracted from the satellite imagery?

- Can we draw rules for any kind of urban settlement?

Keyobs experts are now developing operational techniques in order to propose new services for population estimates and follow-up in rural and urban areas.

KEY WORDS: remote sensing, population estimate, landcover

Land-Use Decision Making and Local Stakeholder Perceptions in the Copperbelt Province of Zambia

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ABSTRACT

The use of spatial data and the application of modern spatial analysis techniques in Africa have enabled the improved monitoring and modelling of the environment on the continent. Several governmental and non-governmental institutions around the continent are using satellite images in conjunction with local information obtained from various sources for spatial decision-making purposes with respect to the development and planning of mitigation measures and integrated sustainable natural resources management.

The major challenge is twofold: [i] the encapsulation of local stakeholder perspectives into a GIS-based digital decision-making process; [ii] the production of operational scenarios based on a local model. This paper addresses these challenges and evaluates the potential benefits of using a decision tree-based toolbox in the spatial analysis of land use decision-making in informal settlements encroaching on protected forests. It utilises agricultural activity as a basis for the analysis of local stakeholder land-use decision-making in the Copperbelt Province of Zambia. The findings suggest that decision trees in conjunction with spatial analytical approaches have an important role to play in the modelling and understanding of spatial land-use decision-making in the informal settlements where information is likely to be scant and disparate.

KEY WORDS: decision tree, bayesian belief networks, decision support, soft systems methodology

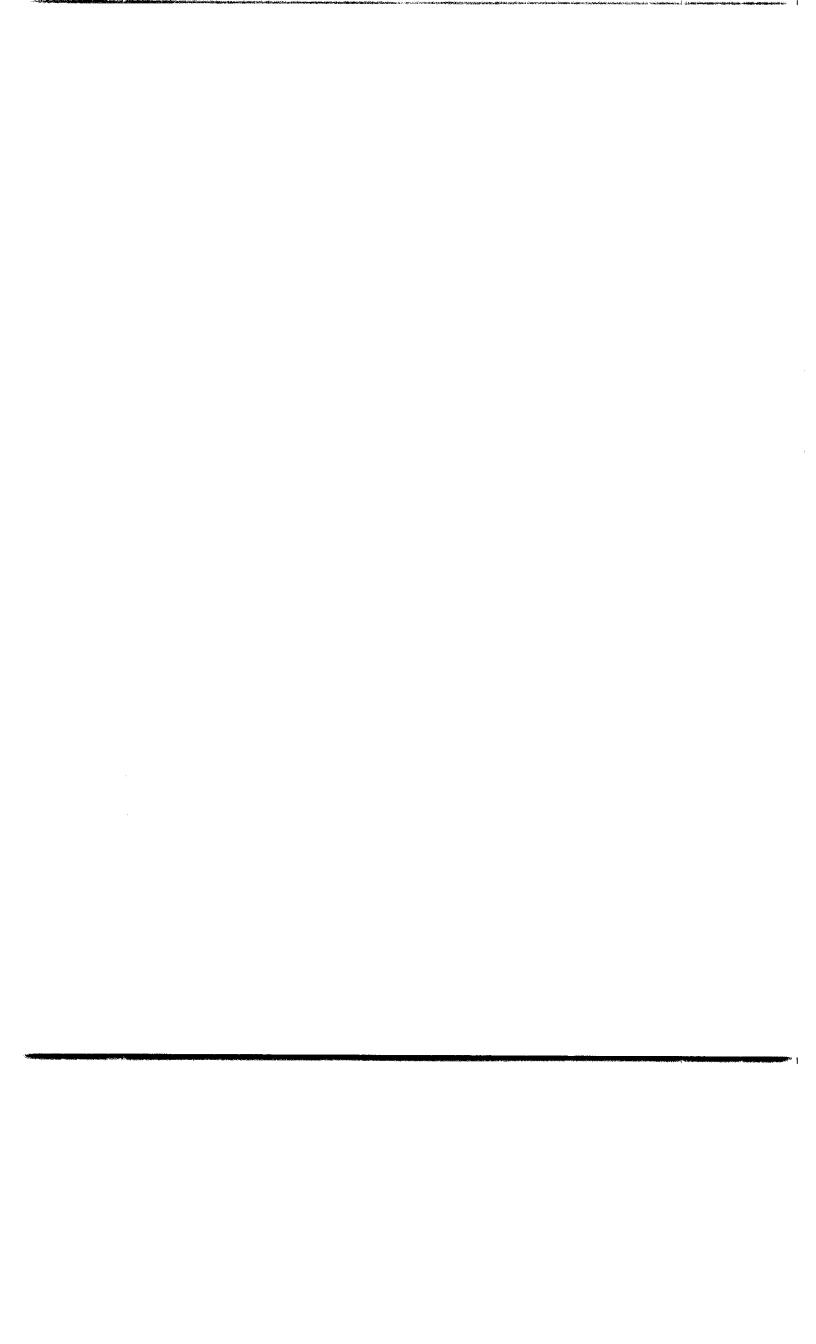# A GIS Mapping of Farmland in Sabon Gari Local Government Area of Kaduna State-Nigeria

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ABSTRACT

In recent times, the world has been experiencing a scarcity in food thereby resulting in a dramatic rise in food prices. One of the ways to tackle this problem is to shift from traditional farming to sustainable farming by investing in research and technology. GPS and GIS technologies were combined to carry out this study. A GPS hand held receiver (Garmin 76S chart plotting receiver) was used to acquire the boundary coordinates (waypoints) of each farmland and attribute data were collected by the use of questionnaire. A database was created using Ms Access 2007 and converted to dbase (IV) format that is compatible with the ArcGIS 9.0 software. It identified farmland ownership, crops grown, source of farm input, soil type, system of farming, storage facility, and farmland yield. The database was queried and the results of the queries were analyzed. Simple spatial (distance) analyses were performed to provide an idea of the proximity of the farmland to roads and rail tracks (means of farmland produce distribution) that transverse it. The farmland mapped were 15 with a total size of 649.42 hectares. The river Kubani was found to be a major source of irrigation for the farmland along it, and by which, the latter can be related to the concept of Fadama. This can be linked to the National Fadama Development Project under World Bank financing. The study will help provide timely, consistent and accurate information to decision makers for use in planning for the present and future of agriculture in the local government area.

KEY WORDS: Food Security, Fadama, GIS & Mapping

Miscellaneous Themes

Space Technologies to Support HIV/AIDS Treatment in Africa

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ABSTRACT

Considering the dramatic situation of HIV/AIDS in Africa, there is a growing international consensus to amplify and boost the comprehensive response to HIV. The access to the Antiretroviral Therapy (ART) has been proven to be an effective way to treat infected people. However, in most African countries the demand of ART as a daily and lifelong treatment is outstripping the capacities to supply it. One one hand, the logistics management of a constant supply of ART, involving forecasting, procurement, supply and delivery is a challenging task, particularly in remote rural regions. On the other hand humanitarian organisations are extremely interested in knowing and representing how HIV/AIDS epidemics evolve in space and time. And improving methods for the collection, diffusion of patient's information have their importance in that context.

With the support of ESA, pilot projects are carried out aiming at investigating to what extent satellite communication, navigation/localisation, GIS and remote sensing can contribute to a more efficient treatment of HIV/AIDS in the in Sub-Sahara Africa.

The GISA project is carried out by UNOSAT, KEYOBS with World Health Organization (WHO) and Medecins Sans Frontieres (MSF) as the main users.

We plan developments at two different levels.

- With MSF we'll mainly work in Malawi (Thyolo district) on the link between the medical data and the geographical information for analysis, capitalisation and communication on the HIV/AIDS issues.

- With WHO some developments will be done on the (tele)communication aspects (space or not) to enable teams to exchange information efficiently

The need for reliable communication system to support logisticians' work is an evidence. In particular it is essential to be able to transmit patient aggregate data collected from health centres to district hospitals, then to regional centers and finally to national authority where decisions have to be taken.

The solutions presented, will serve as the basis for the technical solution to be adopted on a case by case basis, after inventory of the transmission/reception needs (volume and frequency) for each network point.

Hyperspectral Analysis of Carbonates in the Moroccan Atlantic High Atlas: Application to the Liasic Formation of Arigh Ouzla in the Bassin of Essaouira (Western Morocco)

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ABSTRACT

Today, the hyperspectral remote sensing, through the field spectrometry, is a powerful tool to discriminate and identify mineral surfaces with a reasonable cost. The aim of this paper is the spectral identification of carbonate facies in the Moroccan Atlantic High Atlas basin to establish a regional spectral library with a view to preparating a campaign of airborne remote sensing. The spectra acquired were used to characterize and monitor the diagenetic state of dolomites of the Lower Lias in the Arigh Ouzla formation. The separation of facies and the consideration of the diversity of the alteration phenomena imposed standardization and the limitation of the spectral window to avoid overlapping information. The absorption bands vary between 2.319 and 2.323 µm. These values reflect the total dolomite characters and estimate the degree of diagenesis. The analysis of the spectra showed that a relationship could be established between the degree of crystallinity and depth of the absorption band.

The Internet: a new prospect for GIS in Africa

Rolf Becker

ABSTRACT

This presentation concentrates on the Internet and its foreseeable impact on distribution, controlled access and exploitation of spatial data, be it on a local, national or international level.

But apart from pointing to the collection, management and controlled distribution of spatial data, for instance in connection with a NSDI, the presentation is mainly to draws attention to the fact that internet allows for analyzing a multitude of different data regardless of their format, accuracy origin etc.,all tasks that can only be performed by very specialized personnel. Ie. Personnel that is less and less available on the level the required information is needed.

However, the internet enables the forester, the town planner, the irrigation engineer, the geologist, name him what you want, without being an GIS expert to benefit from the wealth of information GIS can provide, and this without first having to become a GIS.

A call for an accelerated implementation of internet access for Africa

Affordable Access to Synthetic Aperture Radar (SARSATS)

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ABSTRACT

Recent developments in RF technology are making space based Synthetic Aperture Radar (SAR) an affordable alternative to optical systems. The advantages and uses of such systems are widely known, but their high cost has until now prevented the widespread use of SAR, limiting it to the military and institutional users of a few countries. Furthermore, even countries that can afford such expensive systems find it economically difficult to deploy constellations of SAR systems, required for some of the more interesting applications. Based on its long experience of innovative use of technology, Surrey Satellite Technology Limited (SSTL) is currently completing the design of a SAR system, offering two different levels of performance. The system is designed to follow the same fundamental principles of the DMC spacecraft designed by SSTL: high data quality, wide coverage, designed to work in constellation mode, affordable. The system price will be considerably less than existing systems. Wide swath modes of up to 150km and resolutions comparable to DMC support environmental and disaster management tasks, and can also be used for maritime law enforcement. Narrow swath modes offer a higher resolution capability for surveillance. In both cases a multi-polar capability is available further increasing the rage of applications of the SAR. Modes can easily be switched, providing a significant level of operational flexibility. Based on the avionics of the SSTL300 platform, the space segment incorporates mostly heritage avionics and all the data handling is based on a tried and tested chain, compatible with the latest generation of SSTL ground segment. The radar instrument components also have extensive test and flight heritage. The system is capable of real time downlink of data in broadcast or ARQ modes, or store and forward data capture for future download. Two structural configurations are possible for the platform, with one being optimised for shared launches of two or three spacecraft, hence reducing the costs of constellation deployment. The platforms are designed to be compatible with different types of small launcher, offering the opportunity for further launch cost savings. With an expected first launch in 2013, the system will ultimately include several spacecraft, operated in a similar way to the Disaster Monitoring Constellation, with distributed ownership of spacecraft and cooperative use of part of the system capacity. This paper provides an overview of the technical solution, concept of operations (CONOPS), applications and current status of the development, as well as a summary of planned extensions of service and capabilities of the system.

A Fuzzy Based Decision Support System for Evaluating Land Suitability and Selecting Crops

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ABSTRACT

Evaluating land suitability and selecting crops in modern agriculture is of critical importance for sustainable agricultural production. This is because the narrower area of land, the more effectiveness in planting is required in accordance with the desires of the land. Process of evaluating land suitability class and selecting plants in accordance with decision marker's requirements is complex and unstructured.

In this study a fuzzy-based Decision Support System (DSS) is to be used for evaluating land suitability and selecting crops to be planted. A fuzzy rule is to be developed for evaluating land suitability and selecting the appropriate crops to be planted considering the decision maker's requirements in crops selection with the efficient use of the powerful reasoning and explanation capabilities of DSS.

As a result, effective decisions can be made for land suitability evaluation and crop selection problem.

Fuzzy based model can represent and manipulate agriculture knowledge that is incomplete or vague and it can be used to determine land limitation rating. The rating value is to be used to determine limitation level of the land and used to determine what the most suitable crops to cultivate for the existing condition of the land.

KEY WORDS: Decision analysis, decision support systems, fuzzy

An integrated database for Location Based Service (LBS): A case study of Obafemi Awolowo University Ile Ife, Nigeria

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ABSTRACT

In ancient times, places where located based on paper maps, stone markings and landmarks including pictorial representation of places on the earth surface. The advancement in technology in recent times has allowed for the development of digital databases of locations on the earth covering various areas of interest to man, thus allowing easy access to information on places on the earth surface. Location Based Service (LBS) seeks to give positional (geometric) and semantic (attribute) information to end users based on positional Information of the user, through mobile devices and depending on the request of the user.

This work seeks to provide an LBS database for Obafemi Awolowo University (OAU), Ile-Ife, Nigeria. Location, attribute and route information of key places in OAU campus were presented for movement within the University campus. This information will be very useful to all stake holders in the University community and the public in general.

Data was derived from both primary data source and secondary sources such as GPS point collection of key locations in the campus, scanned topographic map of OAU, ALOS image of Ile-Ife, and field survey.

GIS software was used to create, and update a Digital database, ArcGIS Network Analyst tool was employed to create route information between places in the university and SVG map view to present the integrated data.

Sustainable Wetlands Management (In the Wake of Climate Changes) Using Remote Sensing Techniques: A Case of Usangu Wetlands in Mbeya, Tanzania

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ABSTRACT

Assessment of Vegetation Cover degradation and regeneration of Usangu wetlands ecosystem in Tanzania is so imperative for its sustainable management, protection, and strategic functioning. The Usangu Wetlands are socio-economically valuable to both Human and Nature. In recent years it has been said that Usangu Wetlands vegetation cover have been degraded due to increasing number of livestock and agricultural activities in the wetlands to the extent of threatening its existence of as an ecosystem. This is attributed mainly to global climatic changes which have led to depletion of vegetation cover as due to degradation in some parts of Tanzania, forcing indigenous and particularly, pastoralists to move to fresh areas such as the Usangu Wetlands. This called for The Tanzania Government intervention by evicting pastoralists and agro-pastoralists and small scale holding communities from the wetlands. Despite the interventions, no quantitative researches have been carried out to assess the effectiveness of the interventions to the effect that the strategies should be uphold or not.

This study investigated vegetation cover degradation and regeneration in Usangu wetlands in the period between 1994 and 2006 (i.e. before the interventions) and Vegetation Regeneration in the period between 2006 and 2008 (i.e. after the interventions), so as quantify the extent of degradation and regeneration. Remote sensing Techniques have been applied to analyze both primary and secondary data. Ground-truth information "reference data" and satellite images from Landsat TM of 1994 and Landsat 7 ETM of 2006 and 2008 have been used. Data processing has been done by using ERDAS IMAGINE software version 9.1.

These results shows that there was a decrease in area by 14.1%, ha of Grassland, 5.4%, ha of Bushy Grassland and 0.5%, ha of Swamps between 1994 and 2006 which is an indication of vegetation cover degradation, while between 2006 -2008 there was an increased in area of 2.6%, ha of BushyGrassland, 2.1% ha of, WoodedGrassland, and 1.3% ha of Swamps indicating vegetation regeneration taking place in the wetlands.

Remote sensing Technology have proved to be an appropriate tools in analyzing changes in an ecosystem thus, suitable in assisting decision-makers in undertaking informed decisions and effecting sustainable management of the wetlands.

It is being recommended that in the light of global climatic changes (i) the government should develop effective policies on wetlands management, as there is growing interests in wetlands as climatic changes continue to pose harder survival conditions (ii) participatory management of wetlands should be embraced, as wetlands are multifunctional, (iii) The Government should promote of utilization of space technologies in ecosystem management.

Accuracy Assessment of Landuse/ Landcover Analyses in South Western Area of Nigeria

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ABSTRACT

Remote sensing data types are now available for environmental studies. The variety has increased as many nations including some African countries to invest in satellite remote sensing. However, each data type has its own peculiar features that may limit or enhance its relevance to capture for specific range of information. This study used geo-information techniques based on multi-source imageries to enhance the utilization of images with coarser resolutions in landuse analysis in Ekiti west area of south western Nigeria. The objective of the study is to evaluate accuracy assessment with multi-source satellite data sets. The remotely sensed data sets used included Landsat TM 1986, SPOT XS 1995 and NigeriaSat-1 2007 satellite images. To make the images comparable, they were georeferenced, re-sampled and enhanced for visualization in a GIS environment. The tonal values recorded in the images with the features on the ground were validated by ground truthing. The data from ground truthing were combined with visual image interpretation for "supervised" classification. The classes defined and analyzed included "built-up area", "bare rock", "farmland", secondary forest regrowth" and "water body". The results show that there were variations in levels of accuracy among the three sets of imageries from landuse characterization. For instance NigeriaSat-1 had the highest accuracy (97.3%) followed by Landsat TM (82.8%) and SPOT (81.9%) for "built-up area". While "farmland" (88.1%) and "secondary forest regrowth" (78.3%) were more accurately classified in NigeriaSat-1, other landuse such as "bare rocks" (89%) and "water body" (85.5%) were more accurately classified in SPOT imagery. The study confirms the relevance of the growing interest in the use of geo-information techniques for landuse analysis.

KEY WORDS: landuse/landcover; accuracy assessment; remote sensing imageries and classification

Crop Intensification Implications for Food Security amongst Rural Households in the Northern Guinea Savanna of Nigeria

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ABSTRACT

Agriculture development is being increasingly recognized to be central to sustained improvement in the economic development of Nigeria. This is more so as agriculture plays significant role in her food security, poverty alleviation and human development chain. However in recent years, marked deterioration has been documented in the performance of Nigeria's agriculture. The contribution of agriculture to the gross domestic product (GDP) which averaged 56 percent between 1960-64 declined to 47 percent and 35 percent between 1965-69 and 2002-2004 respectively (Amaza and Maurice, 2005). Consequently food insecurity has remained a fundamental challenge in the country. The Food and Agricultural Organisation in 2005 enlisted the country among countries faced with serious food insecurity problems.

In this vein, crop intensification which is the process of raising yield and or land productivity over time by increasing inputs of one form or another on a per unit area basis in many SSA has become one of the major challenges to sustainable agricultural production for food security. This will be the case for the 21st century and beyond because of increasing population pressure, declining agricultural productivity, environment degradation, food insecurity and wide spread rural poverty (Eswaran *et al*, 2001). Farmers in SSA have not sufficiently improved their land management practices to the condition of continuous cultivation and shorter fallow periods which were caused by increasing population pressure. In the past, long fallow periods have traditionally been used to restore soil quality and yield levels in SSA. In the recent years, demographic pressure on land has shortened the number of years farmlands are kept to fallow to the point that fallowing alone is insufficient to maintain soil fertility.

The broad objective of this research work was therefore to investigate crop intensification vis –a-vis food security situations among majority farming households in the Northern Guinea Savannah of Nigeria, using Kwara state as a case study. Specifically the study estimated the levels of crop intensification among farming households; determined the major factors influencing crop intensification; determine food insecurity status of rural households; and investigated implications of prevalent crop intensification on majority rural farming households in the study area. The study target population was the rural farm households in the Northern Guinea Savannah zone of Nigeria. The study is focused on the rural households/farm households. This is because a sizeable proportion of Nigeria's population resides within the rural areas. In spite, of the invasion of the urban sector by rural and semi-rural population, about 70% Nigerians depend on agriculture and live in the rural areas (Okolocha, 1993; Abdullahi, 2002). Also, the bulk of those suffering from food insecurity remain in the rural areas (Fresco, 2000). The study sample comprised two hundred rural households who were drawn via a three stage sampling procedure. Analytical tools employed were the crop intensity index, multiple regression analysis, food security index and correlation coefficients analyses. Results revealed three categories of farmer crop intensification practices- low, medium and high intensity farmers. factors influencing crop intensification included number of years of household head education, adjusted household size and land tenure system. Amongst significant factors determining the food security situation /status of the rural area were farmers the kinds of crops cultivated by the farmers whether cash or foods and the farmers extent of crop intensification practices

KEY WORDS: - agricultural production, gross domestic product, population pressure, household size, high intensity farmers

The Use of Satellite Data in Detecting and Predicting Climate Change and Desertification in Africa: Case study of the Sahel Region

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ABSTRACT

Desertification and climate change are two primary issues affecting the fertile lands of the Sahel and its people. This Sahel region stretches all the way from Senegal to Somalia or the Horn of Africa while cutting across over ten different African countries within the Sub-Saharan Africa. It borders the "Sahara desert" in the North and the "Sudan Savannah" in the South. This region has an annual rainfall of an average of 50-55 cm in the late 1960's and has drastically dropped to an annual average of 35-40 cm per annum since the late 1990's. While the Sahara desert of the region keeps expanding from an average 0.5 kilometers per annum in the late 1980's to 0.8 kilometers per annum since the last decade.

In view of the above mentioned desertification and climate change situations the agricultural out puts and pastoral activities as well as the sizes of lakes, rivers and ponds upon which the inhabitants of this region depends has drastically reduced significantly over the last two decades and further keeps increasing the rate of rural-urban migrations, job losses, poverty and land disputes.

Considering the above dynamic changes going-on in the Sahel region a faster, precise and reliable data are required by researchers conducting research in this field and such data can only come through space application such as applying the GNSS Technologies to water resource management as well as thematic mapping and forest management in the region.

NigeriaSat-2: Africa's Commercial Earth Observation System

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ABSTRACT

To date Africa has been poorly served by commercial earth observation satellite systems. The NigeriaSat-2 satellite is the 1st such system designed to service the commercial, research and humanitarian needs of Africa, and the wider world. Developed by the Nigerian National Space Research and Development Agency (NASRDA) in conjunction with Surrey Satellite Technology Ltd. (SSTL) this system represents a huge leap in the availability and quality of commercial satellite imagery supply in Africa. The 2.5 metre high resolution, high capacity satellite will revolutionise commercial applications of satellite imagery throughout Africa.

Through an international collaboration of NASRDA, Nigerian company GeoApps Plus and UK company DMCii the NigeriaSat-2 system will be brought to market within Africa and the rest of the world to serve growing demand for high resolution satellite imagery. This paper discuss' the system, its market and the unique opportunities it provides to meet demand for high resolution satellite imagery in Africa for Environmental and Security monitoring.

KEY WORDS: Africa, Satellite, NigeriaSat-2, Commercial EO

Mapping sub-Saharan Africa with the DMC satellite constellation

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ABSTRACT

The DMC satellite constellation, formed in 2002, has significantly increased capacity with the launch of the latest 22 metre 650km wide swath multispectral imaging satellites in 2009. The constellation, coordinated by DMCii Ltd., UK, includes African satellites operated by Algeria and Nigeria, as well as those from UK, Spain and China. The award of a contract by the EC GMES programme for the acquisition of full image coverage of sub-Saharan Africa during a single year demonstrates the success of the constellation in providing a high quality rapid imaging service on a continent scale, and the commitment of the EC to the Africa GMES programme. This paper reviews the 32metre and 22metre sensor systems, the quality of the imagery, and discusses the coverage achieved and how access to the data can be acquired.

Wetland Utilization and Development in Mayegun Area of Lagos

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Problem Definition

Wetlands are productive and dynamic systems of flora and fauna and biological diversity supporting millions of people by related ecosystems services (Nidhi, 2007). As a vital ecological resource, wetland is significant in respect of their functions and services. These functions and services are well known and documented and can be classified as positive uses or negative. Positive uses include withdrawal of clean water for domestic uses, and fishing. Also, some plants within the wetlands provide medicinal service while some are used as fodders for cattles, for roofing, and crafts among others.

On the other hand, negative uses include wetland conversion, draining for agriculture, filling for urban uses such as industrial, commercial, residential, transportation; reclaiming from wetland, degrading from polluted waste water (industrial effluents), and eutrophication. It should be noted that negative uses impair ecohydrological capacity to yield or provide its benefits. It also depletes groundwater, increases local temperatures, deteriorate environmental conditions and generally affect the environmental sustainability of wetland. Over utilisation of wetlands has led to falling water table levels, ecological deterioration and the loss of critically important functions and benefits. In consequence, most wetlands have been under serious threats of going into extinction or outright extermination and at a fast rate.

However, realising the dangers and great consequences trailing the deteriorating environmental conditions following constant over utilisation and destruction of wetland resources, the global team of scientists and intergovernmental bodies were brought together to ratify wetland treaty in 1971 during Ramsar convention. The basic thrust of this management initiative was to conserve the wetland resources of significance. Central to this initiative was 'wise use' of wetland resources in order to maintain the ecological character achieved through implementation of ecosystem approaches within the context of sustainable development since wise use cannot be achieved in the absence of resource planning and development. Thus, the increasing urban encroachments on wetlands in Lagos megacity call for concern if sustainable development is to be achieved.

Methodology

In this study, both topographic and satellite imageries of parts of Lagos were used to estimate the various imprints of wetland conversion activities and their consequences using Remote Sensing and the related techniques.

Conclusion

Landuse resulting from urban expansion is the single human imprint accounting for the loss of wetland in Lagos. In view of 'wise use' element inherent in the sustainable principle of the Ramsar convention, there is absolute need to deploy a more advance technology with Remote Sensing and Geographic Information Systems (GIS) in wetland inventory. This important information will be most useful for development and sustainable management of the wetland resources in Africa and Nigeria in particular.

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