

## APPLICATION OF DEM GENERATED FROM SRTM FOR LANDFORM CLASSIFICATION IN A MOUNTAINOUS TERRAIN

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### ABSTRACT

*Segmentation of landscape in landform classes/facets is an important step in geo-environmental studies. The landform classes are characterized by unique physical and chemical conditions vis-a-vis geomorphic processes. In developed countries where Digital Elevation Models (DEMs) are freely available, landform classification is routinely being done automatically within the GIS environment. Same is not true for developing countries especially India, where there is no free source of DEM. Only source of elevation information is available from Topographic maps published by Survey of India, which are mostly restricted and copyrighted against scanning. Recently released Shuttle Radar Topography Mission (SRTM) - DEM which is freely available for downloading from USGS website has a potential to help considerably in geo-environmental and other earth related studies. In this paper, a methodology of semi-automatic derivation of landform classes from SRTM - DEM has been described. This study is a part of larger project related to geo-environmental hazard zonation in Eastern Ramganga catchment in Kumaon Himalaya, India. The derived landform /facet map is intended to be used as basic structural framework for inventories of natural phenomena, such as, landslides and erosional features, and that of natural resources. In India, most of such classifications have been based on manual procedures utilizing very few parameters. The data used in the present study include Landsat TM image, IRS IC LISS III image, Survey of India topographic maps and downloaded SRTM - DEM from USGS website, which has a resolution of 90 meters. There are, however, several missing data patches in the SRTM - DEM related to low reflection zones specially in mountainous areas. To make SRTM - DEM usable in the present study, the first step was to fill the missing data patches by creating prediction surfaces from the available 90 meter spacing SRTM -DEM, and subsequently resampling it to 30 meter resolution. Different interpolation methods, viz., Inverse distance weighted (IDW), Spline and Ordinary Kriging methods have been carried out. Ordinary Kriging method has been found to be most suitable in the present study. With this rectified SRTM - DEM, semi-automatic landform classification was then attempted. The GIS capability to automate micro-landform classification from DEM has been investigated. Slope map, curvature map and compound topographic (wetness) index map were prepared from DEM, and used as input for classification. The classified map thus generated represents micro-geomorphic map of the area. Based on this study, the study area could be classified into six landform classes. The resultant landform map was cross-checked by selective field work, and also compared with the landuse/landcover map derived from Landsat TM and IRS IC LISS III images. There is close agreement with the field check and high degree of correlation between landform classification and landuse/landcover map. Further, lineament map of the study area was prepared by using shaded relief maps derived from SRTM - DEM. This has been found to be much better lineament map with reduced error than that obtained by analysis of digitally enhanced Landsat TM and IRS 1C imagery. From this study, it can be concluded that optimized SRTM - DEM data can be successfully used for regional scale landform classification as well as for lineament extraction in extremely rugged mountainous terrains. Thus, SRTM - DEM is an invaluable source of topographic information for regions lacking authentic topographic data or if the region is partly inaccessible.*

## GROUNDWATER MODELLING OF A TYPICAL DROUGHT PRONE HARD ROCK TERRAIN WITH REMOTE SENSING APPROACH THROUGH DATABASE CREATION AND 3D GIS DEVELOPMENT

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### ABSTRACT

*In the present study, an attempt has been made to develop a suitable model for assessment and management of groundwater in a drought prone hard rock terrain. The area chosen for this study is the district of Bargarh, which is the western part of Orissa state in India, covering about 2000 sq km area and bounded by Latitude 21° 00' - 21° 30' N and Longitude 83° 15' - 83° 45' E. It falls in four toposheets of Survey of India: 64 - O/7, O/8, O/11 and O/12 of scales 1: 50,000. Satellite digital data IRS 1B LISS II of March 1995 (path/row 22/53) and IRS 1C PAN and LISS III of June 1998 (path/row 104/57), were processed using various image processing techniques, viz., linear stretching, PCA, image arithmetic, directional filtering and unsupervised and supervised classifications to generate various thematic maps. These maps are geological, lineament, geomorphological, landuse/landcover, drainage pattern and digital elevation model. A few numbers of fracture lineaments have been delineated from the processed satellite imageries. They have two predominant orientations; one along SE-NW, while the other almost orthogonal to it, along SW-NE. Lengths of the lineaments vary from about 25m to 60m. Other structural features present in the study area are bedding planes, joints and folds. Joints are mainly longitudinal; shearing joints at some places are well developed. The intersecting cross points are considered to be suitable zones for groundwater exploitation. The rock types in the area are granites, gneisses, quartzites, dolerite dykes, quartz veins/reefs, shales, limestones and dolomites. Laterites are also exposed at several places. The geomorphological units identified are flood plains, alluvium plains, residual hills, structural hills, shallow buried pediments, moderately deep buried pediments and inter-montane valleys. Residual hills and structural hills act as zones of run-off having poor prospects of groundwater, while pediments and inter-montane valleys are having better prospects. The area is showing low to moderate slopes in general; it is less than 10 m/km, except in the northwestern and northern end of the study area where it varies from 100-200 m/km and 10-20 m/km respectively. High slopes indicate high run-off and causes low infiltration of surface water, while gentle slopes result in high infiltration. The drainage pattern is sub-parallel in the northern end with drainage density varying from 1.5 to 3.2 per km, while the rest of the area is having sub-dendritic pattern with drainage density varying from 0.6 to 2.2 per km. Lower values are indicative of scarcity of stream channels, suggesting gentle slope of the area, which implies less run-off and high infiltration rate. On the other hand, higher value of drainage density is indicative of abundance of stream channels, suggesting steep slope of the area, which implies high run-off and low infiltration. Sub-parallel patterns are developed on steep slopes indicating structural control, while sub-dendritic patterns are developed on gentle slopes indicating lack of structural control. Vertical electrical soundings using Schlumberger configuration were carried out at various locations and results indicate presence of four distinct layers of average thicknesses 2.5m, 18m, 14m and 30m. with corresponding resistivities ranging from 2 to 20 ohm-m, 15 to 50 ohm-m, 30 to 70 ohm-m and 50 to 160 ohm-m. Geographic information system (GIS) offers the integration of spatial and non-spatial data and their management. Various thematic maps have been integrated using GIS to demarcate qualitatively the different groundwater potential zones. Weightages have been given to each of the identified lithological, geomorphological, lineament, slope, landuse, drainage pattern and density parameters based on their groundwater prospects, and a quantitative assessment of groundwater potential zones has been attempted. 3D GIS has been carried out to obtain a 3D view of the thicknesses of different layers by integrating the results of sounding surveys and a few litholog data spread over the area. Rainfall and well inventory data have been used to estimate the total recharge. With all these data, a database has been created and 3D GIS developed for a quantitative assessment of the groundwater resource of the study area.*

# INITIAL RESULT OF USING REMOTE SENSING DATA FOR STUDY SUSPENDED SEDIMENT DISTRIBUTION IN BACH DANG ESTUARY

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## ABSTRACT

*Bach Dang estuary was affected mainly by sediment discharge from Bach Dang river system, and partly from sediment transport to the north of Van Uc and Thai Binh rivers has created very high turbid water near the coast. Recently, due to deforestation and coal mining in upper section of these rivers cause surface erosion and drift the sediment to lower section and discharge to river mouth. Coastal erosion and channel dredging also induce increasing turbidity of this water. Study the dynamics of suspended sediment in this area has significance for preventing coastal erosion and silting navigational channels. This paper presents the initial result using multi-spectral Landsat satellite data to calculate the concentration and mapping the distribution of suspended sediment in Bach Dang estuary. Landsat satellite data acquired on August 31st, 2002 was processed to calculate suspended sediment. Field survey data at same tidal level at satellite data acquisition collected during 14-17 August 2000 was used to compare with calculated results of Landsat satellite data. Experimental formula  $Y = 4,022 * RAB2 + 4,434 * RAB3 - 11,242 * RAB4 + 0,113$  (1), where :  $Y = \log_{10} TSS$  ;  $RAB2, RAB3, RAB4$  are radiance of channel 2, 3, 4, of Landsat TM satellite data, was used to calculated suspended sediment concentration from three channels of Landsat satellite data. Calculated and analyzed results shows that suspended sediment calculated from satellite data are approximate with field measurement. Suspended sediment was high at near Thai Binh, Van Uc, Nam Trieu river mouths then decreasing to Cat Ba area. However, the distribution of suspended sediment depended on dynamic factors such as tide, current. Monitoring suspended sediment from satellite data bring a highly effects for environmental monitoring and management in Bach Dang estuary. Experiment methods for calculating suspended sediment from satellite data need enough field survey measurements for comparing and registration to find out the coefficient for experimental formula. Monitoring and assessment the suspended sediment dynamics in Bach Dang estuary should be carry out regularly. Remote sensing data will play importance role for this task. Need to continuous collect field survey data for assessing accuracy and coefficient of experimental algorithm to calculate suspended sediment from satellite data.*

# IMPACT OF URBANIZATION IN FLOW CHARACTERISTICS IN AN URBAN RIVER BASIN IN JAPAN USING A GIS BASED DISTRIBUTED HYDROLOGICAL MODEL

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## ABSTRACT

*With the rapid economic development and population growth in the past few decades, the urban area percentage has been tremendously increased in many river basins in most of the Asian countries. Urbanization has major impacts on hydrological cycle and that has caused changes in flow characteristics. It is required to analyze such impacts to properly understand the changing mechanism for efficient water resources management.*

To adequately simulate and analyze the impact of urbanization in flow characteristics by any hydrological model, it is necessary to incorporate the detailed spatial information of built-in environment in the model. GIS based distributed hydrological models are most suitable for such purposes.

This paper presents the results of a case study on impacts of urbanization in river flow characteristics in the Tsurumi River basin, which is a typical urban river basin of Japan with rapid urbanization during the last 45 years. In 1958, only 10% of the basin was urbanized, however in 2000, more than 83% of the basin are urbanized. A physically based distributed model (IISDHM) developed at the University of Tokyo, Japan was used to analyze the changes in flow characteristics due to urbanization. The model considers five major processes of hydrologic cycle: interception and evapotranspiration, river flow, overland flow, unsaturated zone flow and saturated zone flow. Interception is modeled using the concept of BATS model. For all other processes, water movement is simulated using the physically based governing equations. A uniform network of square grids is employed to solve the governing equations with finite difference schemes. The model is integrated with GIS for pre-processing of vast amounts of spatial input datasets and for graphical presentation of distributed model outputs.

## CAPABILITY BUILDING OF PHILIPPINE LOCAL GOVERNMENT UNITS (LGUs) ON GEOGRAPHIC INFORMATION SYSTEMS

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### ABSTRACT

The Government of the Philippines has recognized and endorsed the use of information management to significantly aid LGUs in decision-making and planning processes, and ultimately in efforts directed towards generating revenues. Even among municipal local governments, there is a great deal of interest in computerization and Geographic Information Systems (GIS). However, information systems have to be carefully created as well as properly maintained and improved over time for it to be utilized to its maximum potentials. The key in achieving their full benefit is the continuous and sustained development and utilization of the systems. To be able to create sustainable systems, the LGUs need to first develop the technical capacity and acquire the Management Information Systems (MIS) training required. The LGU should also understand the relationship between GIS and MIS and how automation of different LGU processes could benefit their organization.

To a large extent, local government units deal with land-related concerns and operations. In this regard, base data would mostly come from land parcel information, which should be spatial in nature, and this is where we can link the MIS database for purpose of analysis. Thus, building the spatial database is imperative in facilitating easier integration of information.

For LGUs to be able to create a good quality base data, they need to be equipped with the technical knowledge and skills, thus, a workshop was conducted. It focused on building technical and management capacity not just using GIS software but also on a number of other disciplines. An intensive training on GPS data gathering, raster registration, digitizing, database design and encoding, polygon building and linking databases, as well as project management was also given in order to build the technical capacity required to create and implement a sustainable, integrated, and incremental information system, with the optimal application of technology. After the workshop, the participants are now expected to have the capacity to apply the newly acquired skills and begin building their own GIS data for different purposes such as real property tax assessment and land use zoning purposes.

*This paper reviews the processes and outputs from the workshop.*

## 1 AND 2 DIMENSIONAL DEBRIS FLOW SIMULATION AND ITS VISUALIZATION ON THE INTERNET

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### ABSTRACT

*Debris flow is a phenomena that high density water with mud and big gravels flows down along a stream at high speed. Because of its high density and speed, it has huge destruction power. Thus damages by debris flows are very severe and sometimes tragic. It destroys houses, bridges and infrastructure and claim people's lives. Numerical simulation is important for planning efficient counter measures. Especially 2D simulation is powerful to evaluate various scenarios and damages in deposition area. 1D and 2D simulation software were developed on FORTRAN. The physical model is based on the series of researches on the mechanism of the debris flow in Japan since 1980's. 1D simulation is for starting point to the top of an alluvial fan 2D simulation is to simulate the movement of debris flow from the top of the alluvial fan. The output of 2D simulation, which is thousands of 2D numerical data in various aspects was converted to animation and then published on the Internet using VRML. The visualization of the simulation result as a 3D interactive animation on the Internet will contribute not only to the evaluation of the simulation result but increasing awareness of the risk among general people.*

## AREA ESTIMATION OF FOREST RESOURCE IN PENINSULAR MALAYSIA ASSISTED BY REMOTELY SENSED DATA AND GIS

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### ABSTRACT

*The use of satellite remote sensing and GIS in forest resource survey in Malaysia is well growth since 1970's. Remote sensing and GIS approaches were identified as the way forward to gain the objective to improve area estimation of forest resources. The main objective of this study is to estimate the area of all forest resources in selected area. A second aim is to investigate methodology used for carry out forest area estimation with the aid of remotely sensed data. This paper presents the main element of the methodology, e.g. ground survey, remote sensing and the combination of the regression estimator method. The importance of GIS technique for combining image data and ground survey as well as statistical derivation of area under investigation is also presented. The result of this study shows that an improvement was gained as a result of using regression estimator from remote sensing. A close relationship and similarity were found between image classification result and the ground survey, producing an average  $r^2$  of 0.90.*

Key words: Forest area estimation, remote sensing, GIS, regression estimator.

## **MANUAL METHODS FOR LAND COVER CHANGE ANALYSIS: MAPPING FOREST COVER CHANGE IN VIETNAM CENTRAL TRUONG SON**

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### **ABSTRACT**

*Manual heads-up digitizing techniques are being utilized to map forest cover change over time in Vietnam Central Truong Son region to aid the understanding of biodiversity and conservation issues for this area. These methods provide an accurate depiction of historical land cover change across a broad scale of time, space, and technology. Historical satellite image data available for this study ranges from panchromatic CORONA film acquired in the 1960 to Landsat (MSS, TM, and ETM+) digital image data from the 1970 to present, as well as recent ASTER imagery. This approach is well suited for mapping the changes in forest cover across the wide variety of data sources. This method entails creating a current land cover map based on the most recent image data, which can be verified through field observations. This map can be created through manual or automated classification techniques, or a combination of the two. The current image and land cover map are then compared to the second most recent image and changes are manually digitized into the current land cover map. This technique is then applied to the remaining images in order of date, from most recent to oldest. The described technique provides reliable maps that illustrate changes in a landscape while utilizing historical data sets that are not well suited for automated land cover change procedures.*

## **DEVELOPING A INUNDATION SIMULATION MODEL FOR THE CENTRAL PART OF VIETNAM RIVER BASINS**

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### **ABSTRACT**

*Flooding in the central part of VietNam has specific characters. Its frequency is high, on average 3 - 4 times per year. Propagating rapidly, flooding occurs 2 to 8 hours after heavy rains begin. The inundation may last several days and for up to one week. The rising speed is very high and unsteady, varying in different parts of the river, depending on the rains. The amplitude of water levels during flooding is high, ranging from 2 to 3 m. During extreme events, it may go up to as high as 4 - 5m.*

*Lasting from between 1 to 3 days, the floods can cause serious inundation in lower river basins. The flood forecasting system in Vietnam can only predict the level of flooding. The flood warning is regulated in 2 levels: the first level is a flood warning, and the second level is an urgent flood warning. Currently, in small and medium river basins, the flood prevention work requires urgent instant and updated flood warning information. In the downstream area, where dense population and cultural economical centers are located, the detailed flood warning report does not currently reach the local people.*

*This report aims to introduce the results of flooding simulation technology developed for the river basins in the central part of Vietnam. The technology is based on the linkage between modules of the software: HEC-HMS, HEC-RAS, HEC-GeoRAS, the digital elevation model and geographic information system (GIS). The general scheme of the simulation technology is designed and featured as following: The data, parameters, intermediate outputs were integrated and stored in order to produce an intermediate database. The input of this inundation technology is rainfall data (actual rainfall, rainfall of certain frequencies, and maximum rainfall)*

This technology runs on PC requirements: Pentium II, 500Hz, 256MR, 20 GB or higher Operating system; Windows NT 2000; and software: ArcView 3.2, HEC-HMS, HEC-RAS, HEC-GeoRAS. The output of the model is the hydrologic and hydraulic parameters at each cross section, each tributary, and for the whole river basin. This allows the user to study and to check the information in detail. In particular, the final output of the model is the inundation forecast map of the whole basin, which can support the local authorities in making instant decisions for preventing natural hazards. The model is designed with a Vietnamese interface. It is very simple and convenient for the local user. After applying this model to the river basins of Quang Binh and Quang Tri provinces it was established that the technology is integrated effectively with local GIS data and initially shows its effectiveness.

## **INTEGRATED GEOLOGICAL-GEOPHYSICAL METHODS TO EXPLORE THE GEOLOGICAL NATURE OF THE GA-LANG MAGNETIC ANOMALY IN BINH THUAN, SOUTHERN VIETNAM**

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### **ABSTRACT**

The Ga-Lang magnetic anomaly had been first discovered by a high-altitude aeromagnetic survey in 1967 and then, confirmed by subsequent low-altitude (300 m and 75 m) aero-geophysical surveys and ground magnetic investigations. The anomaly has an isometric shape with quasi-latitudinal orientation, maximum amplitude  $DT = 7,000$  nT and  $20 \times 10$  km in size. As the highest anomaly in the Southern part of Vietnam, the Ga-Lang magnetic anomaly for a long-time had attracted interest of a number of researchers, while the exposed magnetic rock consists of volcanics of Nha-Trang formation that are too weak in magnetism for forming this anomaly. During the 1997–1999 period, the Union of Geophysics had carried out integrated geological-geophysical exploration works in order to explore the geological nature of the anomaly as well as related mineral resources. The applied integrated methods include aeromagnetic, aero-gammamagnetic, ground magnetic, gravimetric surveys, detailed geological, geochemical surveys and rock sampling for physical parameters. The integrated processing and analysis of the geological and geophysical data had pointed to the micro-crystallized tuf-ryolite as the preliminary source of the magnetic anomaly. However, the considerable magnetic residual from the inversed modeling of the measured magnetic field had indicated on the possible existence of a magnetic object at depth, which requires further detailed investigation including quantitative geophysical surveys and exploration drilling. The results of this case study had demonstrated the usefulness and effectiveness of the integrated geological-geophysical methodology in mineral resources prospecting in Vietnam.

## **FORECASTING OF GOLD MINING IN HOA BINH PROVICE BY USING GIS AND REMOTE SENSING TECHNIQUES**

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### **ABSTRACT**

Gold mining had been found in many place at Hoa Binh province of Viet Nam base on tradition investigated methods such as geological surveying or people informations. By integrated using GIS and Remote sensing with LANDSAT- TM and SPOT data, lineaments system has been extracted and processed, also lithological map and geomorphological map are been recorrected. Combine with geochemic distributed circles and limited ground truth data, GIS techniques has been applied to create the relationship between gold

*distribution and related factors as : lithology, lineament density, circle structures, lineament buffers, Geomorphology map of gold mining distribution in Hoa Binh province has been created. In the map, original and deposit minings are located and goal amount also is been calculated. Using the map, the local government can make a planning for gold mining management and exploitation.*

## **UPGRADING PROGRAMS IN FORTRAN USING VISUAL INTERGRATED DEVELOPMENT ENVIRONMENT**

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### **ABSTRACT**

The new diploma curriculum GeoscienIn the past, many programs on scientific computing were written in fortran programming language. These programs have text screen interfaces and are not user - friendly enough to disseminate to common users. Creating the GUI for these programs, making for them a new look and feel is essential to give them new breath. Several approaches to touch upon this problem will be reported. The presentation discuss issues of importing program modules written in fortran into a software project frame work in C, C++ or Visual Basic programming languages. As a real life example, the result of upgrading a computational program in geological domain will be presented.

## **USING GIS AS A TOOL TO DETERMINE GROUND WATER POTENTIAL AREA**

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### **ABSTRACT**

*Nowadays, development of socio-economic in mountains is very important task in our country. The priority demand is water supply. Due to deforest in many area, surface water is not only enough but sometime running away. Prospecting and exploration of ground water for water supply in the areas need to be done. As we known the most area in Vietnam territory is distributed as hard rock aquifers. The best way to approach where distributing ground water potential area in the aquifers is GIS tool. By Arcview software with difference layers of factor such as lithology, runoff, slope, lineament, spring, and rainfall...e.t.c groundwater potential area could be found. This methodology is very advanced to site drilling points for groundwater exploration.*

## AN GENERATION EXAMPLE OF DEM USING THE STRIPE METHOD

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### ABSTRACT

*In GIS, DEM -Digital Elevation Model- is utilized as a data for expressing the ruggedness of the earth surface. It is made from laser scanning from the airplane and stereo analysis of the aerial photography. However, the topographic map may be utilized in the generation of DEM, because the cost depends on these methods. As a method for making DEM using the topographic map, there is the STRIPE method (Noumi et al., 2002). The STRIPE method is the DEM generation technique based on the new approach using height information which exists between contour lines of topographic map. Actual application of STRIPE method reported until now is on the narrow range within several km. Using this method, wide range DEM -length 5km and over width 10km over- was constructed. This DEM has the 10m grid space and is possible to express the landform of the object town in detail. In this presentation, got through this DEM generation would reported concrete methods of application of STRIPE method.*

## REDUCING VULNERABILITY IN DISASTER MANAGEMENT USING GEOSPATIAL TECHNOLOGIES

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### ABSTRACT

*The history witness that the countries of South Asia have been facing the onslaught of natural disasters such as flood, cyclone, earthquake, landslide, etc. causing severe human and material losses. The sustained efforts for economic growth in low-income countries are often interrupted by recurrent natural disasters causing vulnerable impact on exacerbating poverty conditions. Among various disasters, earthquake is considered to be the most dangerous due to its sudden impact with little or no warning, which causes destructive damages on the built environment. For example, devastating earthquakes in Bhuj, India (2001) and recently in Turkey (2004) have revealed our limitation to combat against these natural calamities.*

*The emerging trends in Information Technologies, especially geodesy and satellite imaging, entrust that the scope for applications of these technologies has widened and gained world-wide acceptance to reduce vulnerable effects of natural disasters. The use of modern technologies such as GIS, GPS and RS can help to create base-line information for identification of disaster prone area, real-time monitoring and warning system as well as post-earthquake planning and management. This presentation illustrates vital role of modern geospatial technologies in evolution of integrated disaster management strategies.*

## DEVELOPMENT OF LAND USE LEGEND SYSTEM IN MAPPING USING REMOTE SENSING APPROACH

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### ABSTRACT

*There are dozens of land use classification systems currently used in Vietnam as well as throughout the world, of which the applicability depends on specific mapping methods, geographic location of target area and economic development features of each nation. In Vietnam, land use mapping has been developed in a traditional way, that is, the district-scale map is synthesized from commune-scale maps, the province results from district then the national derives from province. The method has a very detailed set of unit land use on one hand but takes time (normally 5 years) on the other hand. In addition, several soil types are too difficult to map due to their small area at certain scales of development. The land use mapping using remote sensing approach has become a universal tendency since it costs less time for a greater area, information is directly processed, location and shape of targets are objectively presented, the area of soil types is easy to calculate, etc. The greatest shortcoming of remote sensing data falls into their spatial and spectral resolution that might cause unit land use to be displayed not so detailed as the traditional. Thus, it requires to develop a set of land use legends that consists with both remote sensing data and existing criteria of the traditional while ensures the geographic features of, and habitual land use in, Vietnam. In this manner, the author exercised to set forth a system of legends for mapping using remote sensing data, which can be used for scale series currently applied in Vietnam. In particular,*

- Level I (regional and national) consists of 12 units land use with scale range in 1/250.000 – 1/1.000.000;
- Level II (provincial and municipal) consists of 31 units land use with scale range in 1/50.000 – 1/100.000;
- Level III (district and provincial town) consists of 65 units land use with scale range in 1/10.000 – 1/25.000; and
- Level IV (basic or equivalently communal) consists of 75 units land use with scale range in 1/5.000 – 1/10.000./.

## GROUNDWATER VULNERABILITY MAPPING IN NAMDINH AREA

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### ABSTRACT

*Fresh water resource of Quaternary aquifers in Namdinh area is very crucial source for socio-economical development of the most density population of Vietnam. Groundwater quality issues are increasingly receiving widespread attention while groundwater abstraction is developing rapidly*

*In this paper, ground water vulnerability map using DRASTIC methodology with Arcview as GIS software has been applied. It is also required to evaluate the method and results with respect to hydrogeological relevance, uncertainties and need for background information and also to make recommendations for how to use the map in planning and decision making.*

# A 3D GEOSCIENCE INFORMATION SYSTEM AND AN EXEMPLARY APPLICATION

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## ABSTRACT

*Why are 3d GIS needed? The increase of digital geodata and the possibility to create regional 3d geomodels result in new, specific needs for geodata management, and extended possibilities for geodata analysis and query:*

*Current 2d GIS provide specific solutions for data management of 2d raster and vector data in relational databases. Recent developments focus on interoperability and standards (OpenGIS consortium). On the other hand, appropriate solutions for unified storage and query of geological observation data and 3d geomodels do not exist to date. From these facts the issue to develop a data management system for 3d GIS data can be deduced. The underlying data model needs to efficiently cover the information associated with both geological observations and interpolated 3d geomodels. 3d structural and property geomodels are commonly created for visualisation and reservoir modeling purposes. The use of GIS tools may result in new insights from these models. Thus, one primary concern of this work is to develop query functionality based on geological, geometrical and topological properties and relationships in 3d space which are virtually impossible in 2d GIS.*

*A two-level solution. We use a system composed of user applications, a XML database server, and a data model compatible with OpenGIS standards. An application server acts as middleware for complex 3d spatial queries to the database. The 3d geomodeling software gOcad is the core user application. It has been extended by a 3d GIS plug-in which facilitates and enables additional 3d geometrical, topological, and geological property queries.*

*Exemplary application. Using a geological model from the Zwickau area/ Germany the new 3d spatial and geological query functionality is demonstrated. This area is subjected to mining-induced subsidence and hydrogeological problems. Using GIS functionality, regions with a high risk can be detected.*

# GLOBAL PLATE TECTONICS WITH GIS

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## ABSTRACT

*The objective of our presentation is to exemplify the useful application of geoscience information systems in global plate tectonics. Data from different sources as e.g.*

*· International Earth Rotation Service(IERS) for Euler pole calculations,*

*· National Earthquake Information Centre(NEIC) for the spatial distribution of earthquakes of given magnitude,*

*· Catalogue of Active Volcanoes of the World (CAVW) for their distribution on the Earth surface*

*· plates Project for plate boundaries, isochrone maps of the seafloor, and hot spots,*

*· Globe Project for world maps in terms of digital elevation model and digital bathymetry model, respectively,*

*· etc.*

*have been organized and made accessible in a unique GIS using ArcViewVer3.2. Our first application put special emphasis on absolute Euler poles of plate rotations*

Different sets of absolute Euler poles according to different models (*Nuvel*, *APKIM*) and own geodetic calculations based on IERS data have been visualised and compared. This comparison revealed a good agreement with *APKIM* Euler poles which seems plausible as they are based on the same rather recent station data sets, and a fair agreement with *Nuvel* Euler poles which have been derived by inferring absolute from relative Euler poles by velocity matching. If only long term data as normals of transform faults and spreading velocities of mid ocean ridges are available, the geodetic adjustment does not apply and has to be replaced by least squares approximation.

To fit the simple model of rigid plate rotation only data originating in stations sufficiently distant from active plate boundaries are entered into the calculations. Forward calculation of velocities according to the modeled Euler poles allow comparison with the actual velocities measured in stations close to active regions. With a simple GIS function as buffering the size and spatial distribution of their deviations can be visualized, and analysed and associated to specific regions otherwise characterized by either tectonic activities or postglacial isostatic uplift.

## SUSCEPTIBILITY TO FOREST DEGRADATION A CASE STUDY OF THE APPLICATION OF REMOTE SENSING & GIS IN BACH MA NATIONAL PARK - THUA THIEN HUE PROVINCE - VIETNAM

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### ABSTRACT

Worldwide, forest degradation is more common than forest improvement in many countries. Like many other national parks in Viet Nam, the illegal exploitation of wood as well as excessive and destructive harvesting of non-wood forest products are threats that exist in Bach Ma National Park. As a result of that, forest cover has been being degraded in some areas of this Park. The objective of this study is to contribute to the achievement of the management objective of Bach Ma National Park authority to maintain forest resources by determining the areas susceptible to forest degradation within the national park. In this research, first of all, the factors need to be identified for determining susceptibility to forest degradation. They are chosen based on the three elements of forest degradation, those are: 1) the influence of local people on forest resources – the group of factors forcing people to deplete the forest, 2) the forest resources value – the factors to be degraded, and 3) the accessibility to the forest – the ridge between the local people and forest resources. The importance levels of the selected factors in term of forest degradation susceptibility are calculated by using Pairwise comparison method based on a number of questionnaires completed out by the staff of the Bach Ma National Park. With the support of GIS technology, all of the factors involved are mapped, and finally they are combined in order to come up with a map showing the forest compartments with their level of susceptibility to forest degradation. Sensitivity analyses are also performed to examine the influence on the result when changing the input value of selected factors one by one. This study indicates that the percentage of poor households is the most influential factor on the impact of local people on forest resources, while the distance from the forest guard stations is the most influential factor on accessibility to the forest. Among the three principal elements of forest degradation, accessibility to forest is the most influent factor on its susceptibility.

## **GEOGRAPHICAL INFORMATION SYSTEMS A TOOL FOR RURAL ELECTRIFICATION PROJECTS IN DEVELOPING COUNTRIES : POTENTIAL APPLICATIONS**

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### **ABSTRACT**

*Electrification Projects in Developing Countries are increasingly including a spatial dimension (planning at a regional or national level, and a cross-sectoral approach. Geographical Information Systems (GIS) offer an interesting tool for energy planning and decision making. GIS allows the end-user to view a range of socio-economic and energy characteristics through a visual medium thus illustrating the present situation, mapping out potential solutions and illustrating attractive investment opportunities. The different datasets (layers of information) that can be superimposed include demand, socio-economic characteristics, existing and planned electric, telecommunication and road networks, distribution of public services and the abundance of natural resources, etc. This information plus analytical tools integrated within the GIS programme can help identify options for any given locality, village or town in terms of the technical and economic viability for grid extension or decentralized rural electrification (including technical choice). This information is also important for potential investors who are looking for business opportunities (clusters of economically active towns) with a low risk portfolio. The GIS is a tool that can easily be made accessible on the internet and can be used as a basis for monitoring of project implementation.*

*This paper aims to provide an overview of the basic characteristics and functionalities of GIS, the potential applications for electrification (with specific project examples), the present challenges for its wider application and finally a set of recommendations on the way forward*

## **SEEING SPACE, MAPPING TIME: SCHOLARS, CULTURAL RESEARCH, AND GIS**

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### **ABSTRACT**

*Geographic Information Systems are widely used around the globe for managing information on our resources, our cities, our transportation networks. But scholars in a range of non-traditional fields are discovering that GIS can be useful at many levels, from information management to visualization to spatial analysis. The development of the field of Historical GIS has opened up GIS for use by scholars in the social sciences and humanities. The marriage of spatial and image databases has invited the development of spatially referenced digital museums. With GIS able to accommodate a range of digital resources, GIS has become an organizing principle for collections of data in varied forms and drawn from varied sources. Finally, scholars are discovering the power of GIS to make visible patterns and phenomena, and applying this to a range of academic problems. This presentation discusses case studies in which GIS has been applied to problems in humanities, social sciences, and museum work. Examples demonstrate the strengths of GIS in integrating and visualizing data, and its uses in education and research. Scholars in non-traditional fields are only beginning to explore the potential of GIS. From national projects to individual scholars, GIS is an enabling technology of power and promise.*

## USING REMOTE SENSING DATA FOR STUDYING DISTRIBUTION AND SEASONAL VARIATION OF CHLOROPHYLL-A AND SEA SURFACE TEMPERATURE IN GULF OF TONKIN

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### ABSTRACT

*Gulf of Tonkin located between 16°10'-21°30'N, 105°40'-110°00'E, in continental shelf of Vietnam and China. Due to locating between two countries, so it is very difficult to carry out field survey in the Gulf. Almost survey was carried out in small area near the coast. Remote sensing provide synoptic view, particular provide information of the Earth surface at the area that difficult to carry out the field survey. Using remote sensing for studying the natural phenomena and biological processes in Gulf of Tonkin is suitable. In this paper, SeaWiFS and NOAA/AVHRR satellite data was used to calculate Chlorophyll-a (Chl-a) concentration and sea surface temperature (SST). Field survey Chl-a data collected from April 29th to May 30th, 1999 of multi-government SEAFDEC project, SST data collected from 8-13 January and 29th October to 2nd November, 2003 was used to compare and register with satellite data. SeaWiFS-derived Chl-a was processed by OC4 algorithm. NOAA-derived SST was calculated by nonlinear McClain algorithm. Seasonal changes of Chl-a and SST distribution was assessed by comparing the longitude and latitude cross sections in specific month.*

*Study results show that OC4 algorithm for calculated Chl-a obtained high accuracy for Vietnam water ( $R^2=0.888$ ). Some area near the coast, due to high concentration of suspended solid was decreased the accuracy of derived Chl-a concentration. Nonlinear McClain algorithm for processed NOAA data provided high accuracy for Vietnam waters ( $R^2=0.9026$ ). Distribution of Chl-a in the Gulf depended on nutrient sources, climate and season. In winter season, Chl-a concentration in center of the Gulf was higher than in summer. SST field vary by location and season. The difference of SST was high at transitional period of seasons. Variation of SST was low in summer and high in winter. SeaWiFS-derived Chl-a by OC4 and NOAA-derived SST by McClain algorithm was standardized in method and accuracy. These data can be used for study the physical and biological processes in Vietnam waters. Strengthen utilizing these data set for different purposes such as fishing ground prediction, water circulation, pollution monitoring. SeaWiFS and NOAA data should be update normally for building SST and Chl-a data set. Building Chl-a and SST is critical need for management and exploitation for research and management of Vietnam water. Continue collect field survey data for standardized and identified necessary parameters for processing Chl-a from SeaWiFS satellite data at coastal turbid water.*

## RESOURCE AND ENVIRONMENTAL MANAGEMENT INFORMATION SYSTEM FOR PROVINCE LEVEL

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### ABSTRACT

*Resource and environmental management in Viet Nam is faced with many challenges: the base inventory data is increasing and carried out by different organizations, meanwhile, the decision making for resource and environmental management in order to determine strategic development socioeconomic that request continuous and comprehensive data, which can help to assess the status, predict the trend of natural resources; environmental change and degradation, as well as environmental impact assessment of development socioeconomic project Establish the Resource and Environmental Management Information System (REMIS) aims to integrate and systematic the data on physical environment, natural resources; Integrate query tools for seeking information; Develop models for simulating and predicting the natural hazard and risk assessment; Also establish expert system such as: environmental assessment, agricultural suitability assessment supporting*

for natural resources management in our country. The REMIS is an important system as a powerful tool for decision making, to solve all the inadequate problems at local level towards sustainable development. REMIS was built on GIS base, include three components: informatic technology (hardware and software), database and expert to operate the system. These components must be organized flexibly, and easy to use, that can support for the managers to handle the system and become their powerful instrument in decision making, rational use of natural resource and environmental management. The characteristic of environmental resources, manufacture system, and decisions about natural resources management are not the same from different provinces. So that the structure of the REMIS should be designed differently depends on the demand of each local authorities. This following paper introduce some results of establishing the REMIS for Quang Tri province, which would describe in particular the characteristic of the province, included:

1) The database with more than 40 layers, which are structured in 5 themes: baseline data, physical condition and natural resources, environmental data, socio-economical data, and data of Con Co island at the scale of 1/100.000 - 1/10.000 (mostly is at the scale 1/50.000);

2) Tools for data management: edit, modify, update data.. which can be easily manipulates by the local users;

3) Tools for query and seeking information in one or multi layers

4) Simulating models for predicting natural hazard;

5) Expert system integrate information support for decision making in resources and environmental management;

6) Output tools (printed map, Internet map, atlas).

With a comprehensive database, simple tools for manipulating and integrating data, Vietnamese interface so the system is very easy and friendly for the local user. The REMIS for Quang Tri has become a useful tool for natural resources and environmental management at the province level, towards the new technology and the trend of digital world, economical knowledge, intelligent management, and e-government of Vietnam.

## **ANALYSIS OF SPATIAL AND TEMPORAL CHANGES OF FOREST COVER IN THE MOUNT PULAG NATIONAL PARK, PHILIPPINES**

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### **ABSTRACT**

Mount Pulag National Park lies in the Grand Cordillera Central in the northern part of the Philippines at 1<sup>o</sup>60' 30" N and 120<sup>o</sup> 50'20" E covering an approximate area of 11,550 hectares. It is considered to be the last frontier of the Philippine Mossy Forest. During the past decade, a considerable amount of forest cover had been lost leading to some negative impacts such as loss of biodiversity and soil erosion. Mitigating the impacts entails the generation of relevant data and information on current land management and spatial-temporal land use changes.

The study aims to quantify the spatial and temporal changes of forest cover in the Mount Pulag National Park from 1988 to 1998, and to identify the different variables such as road networks, drainage networks, residential houses, aspect, slope, and elevation associated with these changes. The study used several maps such as topographic maps, land use and forest type maps and two Landsat Thematic Mapper images taken on January 31, 1988 and January 10, 1998 respectively. The data were processed using image processing and Geographic Information System. Post-classification scheme was done based from the supervised maximum likelihood classification to map out forest cover changes. Thematic maps resulting from the single time classification were compared with each other quantitatively. Land cover classes were lumped into forest and non-forest categories (binary format). Buffer distances were created and overlaid to the deforested area map to

investigate the degree of relationship to deforestation by using distance from road, household, and river channel as indices. Landscape attributes such as slope, elevation, and aspect were also used to investigate the degree of relationship to deforested area. During the period of ten years, about 652 hectares were changed from forest to non-forest area. Regression analysis was employed to determine the amount or degree of deforested area in relation to distance from the road, the distance from household, and the distance from river channel. Results showed that there was a high significant degree of relationship between distance from road, household, and river channel to the amount of area deforested. Most of the deforested areas were concentrated from 0- 40% slope, within 1700 - 2200 m above sea level and to the west to southern aspects.

## THE PREVALENT POLICY ISSUES EXISTING AROUND SPATIAL DATA INFRASTRUCTURE DEVELOPMENT

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### ABSTRACT

*This paper is mainly based on the most prevalent policy issue, which purely involves the utilization of Geoinformatics for spatial infrastructure development in earth and allied sciences.*

*The main aim of the paper is to focus government attention across the various national, provincial and local government spheres with the goal of ensuring that investments are fast-tracked, allied sciences are maximized and there should be synergies between the various types of investments.*

*So, that Remote sensing, GIS Agencies, other organizations and Stakeholders working on spatial data infrastructures development (SDID) merge together to rule the entire world and come out to facilitate the availability of information's in such a way that the needs of the agencies, organizations, citizens, commerce and society in general are almost solved which is necessary for spatial infrastructure development (SID) of earth and other allied sciences.*

*This paper covers some of the most prevalent policy issues existing around spatial datainfrastructure development.*

*The whole process goes through two different stages.*

*Firstly*

*It highlights ongoing projects and is mainly focused on "creation of a regional spatial data infrastructure" (RSDI).*

*Secondly*

*Insights are provided that how "two different legal and economic spatial data infrastructures (SDI) settings can still allow for and serve very similar infrastructure functions".*

*The combination of the first and the second stage will provide the understanding of a sampling policy and the legal frameworks for spatial infrastructure development in earth and allied sciences.*