OVERVIEW OF DISASTER MANAGEMENT SUPPORT (DMS) PROGRAMME

(Keynote Address)

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Department of Space (DOS) in the 10th Five Year Plan launched the Disaster Management Support (DMS) programme. Using aerospace systems conjunctively, the programme has responded comprehensively to all the natural disasters the country has faced - including 26 December 2004 Tsunami, monitoring of artificial lake in Sutlej basins impending to flash floods in Himanchal Pradesh, earthquake in J&K and almost all the floods and drought in the recent years in different parts of the country. To organize DMS programme, DOS has developed the critical mass in terms of institutional infrastructure, project management skill and domain expertise. In fact, DOS has placed all its technological and organizational strength in support of DMS programme. While DOS has created a single window delivery system - Decision Support Centre (DSC) to disseminate all space enabled products and services to the end users, it has also got a separate Disaster Management Support (DMS) programme office to develop the institutional interface with policy makers, international organizations and user agencies. DMS programme of DOS is therefore developed as a mission oriented and project based endeavour providing the critical technological and institutional support towards disaster management in the country. DMS programme has also responded well to International Charter for Space and Major Disasters, initiatives of UN OOSA, UNESCAP and BIMSTEC.

Major Activities of DMS are (i) Creation of Digital, Thematic and Cartographic Database for Hazard Zonation and Risk Assessment, and Realization of National Database for Emergency Management (NDEM). (ii) Impact Mapping and Monitoring Support – with improved turn around time and better quality of EO products and services. (iii) Communication Support to Disaster Management – Networking of Central, State and Some of the selected District Emergency Control Rooms; stocking piling of deployable emergency communication equipments in the multi-hazard prone areas. (iv) Strengthening Early Warning Systems (EWS) – enabling the operationalization through key development supports and R&D for Indian Ocean Tsunami Warning System (IOTWS), EWS for Cyclone, floods, drought, landslides and forest fires. (v) Enabling Satellite and Hydro-meteorological Networks by large-scale operationalization of Automatic Weather Stations (AWS), Doppler Weather Radar etc. (vi) Development of Tools and Techniques for Decision Support – taking into account the operational requirements of National, State and District Emergency Operations Centres (vii) Realization of Aircraft Version of Disaster Management SAR (DMSAR) (viii) Pursuing the key areas for R&D – precursor study of Earthquake, extreme rainfall events, flood forecasting models, drought study, vulnerability indexing for desertification/land degradation and forest fire Objective of the programme is to deliver the services emanating from space applications for supporting disaster management, the Decision Support Centre (DSC) has been set up at National Remote Sensing Centre (NRSC), Hyderabad, as a single window service provider. The related centres/ units of DOS [such as Space Applications Centre (SAC), Regional Remote Sensing Service Centres (RRSSCs), and Advanced Data Processing Research Institute (ADRIN)], have been positioned to work in synergy; so that the DSC, with the required institutional back-up will efficiently generate and deliver the variety of services to meet the needs of the disaster management functionaries/ end users.

SPACE TECHNOLOGY FOR DECISION SUPPORT IN NATURAL DISASTER MANAGEMENT – DECISION SUPPORT CENTRE INITIATIVES

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ABSTRACT

Decision Support Centre (DSC) was established under Disaster Management Support Programme by Department of Space to use the space technology for better management of natural disasters. DSC is an operational service provider exploring the synergy and convergence of space and contemporary technologies in pre-disaster, during disaster and post-disaster phases. Space technology provides critical and timely information on various disasters, which play a vital role in disaster management. Floods, cyclones, drought, landslides, tsunami, earthquakes and forest fires are the natural disasters addressed by DSC. Among these, floods are the most widespread and frequent disasters occurring in country. Suitable satellite optical or microwave data was used in generating information on floods in the form of maps and damage statistics. Drought situation was monitored by using NOAA data through biweekly vegetation index for 14 states of the country, IRS WiFS for Andhra Pradesh and Karnataka states. Forest fires are monitored by utilising the multi-resolution, multi-temporal and multi-spectral satellite remote sensing data. Presently mapping and monitoring activities of all the disasters are being carried out on regular basis. Actions were initiated for development of support tools required to utilize the available data for hazard zonation and the vulnerability maps of various disasters. Interfaces are in the process of development for exchange of data / information from the concerned departments through well established protocols. Feasibility studies were also carried out to utilize the data from ALTM and airborne SAR and other future EO missions. The procedures for generation and transmission of the information was streamlined and automated to a significant extent for meeting the required performance, in terms of user-friendly format, information content and turn-around-time. DSC will respond to the disaster situation depending upon the nature of the disaster in providing timely information. It is envisaged that the DSC will be connected to National Emergency Operation Centre (NEOC), State Emergency Operation Centres, selected knowledge institutions and Shadnagar Earth station through satellite based Virtual Private Network (VPN). Thus, DSC will have online interface with these agencies to effectively use the ground observations and the data in conjunction with the space data to derive updated information on disaster events and provides decision support.

WEB GIS FOR EMERGENCY PLANNING & RESPONSE SYSTEM

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The product GEPR is a tool developed for chemical emergency planning and response using the latest technology available so that emergency planners and responders can achieve further improvement in this specialized area and public at large can be benefited to avoid incidences of the types of Bhopal Gas tragedy by adequate planning and tremendously improve the response to contain the damage if such incidences ever occur. GEPR comprises of digitized maps and that of the industrial clusters/surroundings comprising major chemical industries identified as MAH (Major Accident Hazard) units. This system incorporates data on first responders for chemical emergencies such as police, fire, medical and other emergency response agencies and services, resources available in the districts to combat such emergencies along with resources and location specific data. The product was developed for 42 districts with major industrial clusters in 10 states Gujarat, Maharashtra, Andhra Pradesh, Tamil Nadu, Rajasthan, Uttar Pradesh, Haryana, Punjab, Madhya Pradesh, Assam, West Bengal, Kerala, Karnataka and Delhi under phase I and II. Extensive data collection exercise was undertaken to collect the first hand information (primary data) from all the industrial units and district level response agencies for all the major districts in fourteen states. First responders i.e. Police stations, fire stations, hospitals/nursing homes and sensitive areas – schools, colleges, cinemas, etc. surrounding the industrial units, were also identified and mapped. Web GIS for Emergency Planning & Response System (Phase III) is in continuation of the earlier work (GEPR phase I and II) to enhance the software capability with Web enabled technology, more powerful and accurate mapping. The program is user-friendly and can be used along with district level offsite emergency plan not only for planning and mock trials of major chemical emergencies but also during actual emergency. This system will be able to help response agencies namely Central Crisis Group (CCG), State Crisis Group (SCG), District Crisis Group (DCG) and Local Crisis Group (LCG), during both pre-emergency state for planning and rehearsing and also during actual emergency situation so that a well planned response can contain the damage in time to the least possible extent.

INTERNATIONAL CHARTER "SPACE AND MAJOR DISASTERS": RESPONSE TO GLOBAL DISASTERS

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Abstract

Space based Disaster Management System has the distinct advantage of being unaffected by disasters on the ground and provides unbiased, synoptic and timely information on the nature and impact of the disasters. Indian Space Research Organization has developed several applications/programs and techniques with the space imagery to support disaster management. Further, ISRO is a signatory to the International charter "Space and Maior Disasters" along with space agencies of Canada (CSA), Europe (ESA, CNES, DMC), USA (USGS, NOAA), Argentina (CONAE), Japan (JAXA), and China (CNSA). International charter "Space and Maior Disasters" is the maiden initiative of this kind, in which, space faring nations formally participate to pool their space and ground segment resources and deliver data in emergency situations.

The Asian earthquake and tsunami disaster event of December 26, 2004, a rare kind of event in the human civilization, has brought into fore several issues and challenges pertaining to the operational efficiency of International Charter. Charter was placed to a scenario where it had to perform and to demonstrate what it could do for the wounded South East Asian subcontinent. The satellite images acquired under the Charter were distributed to number of rescue and relief agencies, on request. The kind of response the Charter received from the user agencies from all around the world once again established its significance and role for maior disasters and its wider user base.

This paper brings out the objectives of International charter "Space and Maior Disasters" its

operational organization, support mechanism and application for maior disasters such as Flood, Cyclone or Hurricane, Forest-Fire, Volcano and Oil-spill. ISRO plays an active role as a lead agency for the current period in the charter functioning by sharing secretariat, Emergency on Call Officer and Project Manager Support services, a brief account of ISRO's participation in the charter operations is provided. Charter has been active since 2000, providing useful services to humanity during maior disasters all over the globe. Performance of the charter thus far, with illustrative case studies of selected charter activations are included. The paper also highlights contribution made for the Earthquake in India and Pakistan occurred during 2005, as well as recent floods in India.

CUSTOMIZING GEOGRAPHICAL INFORMATION SYSTEMS (ArcGIS) FOR EARTHQUAKE DISASTER MANAGEMENT

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Earthquake Preparedness and mitigation efforts require consistent planning and has become mandatory requirement for implementations for various cycles of natural disaster mitigation and management.. With the advancements in information technology, especially Geo-spatial technologies like GIS, Remote Sensing and GPS, it is possible to address these concerns to a considerable extent in reality scenario. In this context, we have attempted to design & develop an interactive, user friendly Spatial Decision support System (SDSS) to aid the government in their efforts to manage and administer pre-post and during disaster' occurrences as well.. When we narrow it down to the Earthquakes especially, it starts with approach of seismic hazard zones at national and state level and consideration of micro zone factors for high-risk areas. The Information needs as per user need includes Seismic Hazard Identification, Potential Risk Zones, Vulnerability Analysis, Population Analysis, Building Inventory (Property) Analysis, Analysis with User-Supplied Inventory, Query shell development and capability and provision of user-friendly GUI Interface. After visualizing the entire spectrum of requirement. We have customized application modules on Earthquake Hazard Mapping, Potential Risk Zones, Loss Estimation and Planning relief during / Post–earthquake logistics operations etc. These modules were attempted with national level (India), State level (Gujarat), city level (Ahmedabad) and city ward level (Pondicherry) spatial data sets integrated from multiple data where-ever made available / rather data sources that can be complied and used. Thus the entire GIS customization efforts showcased the immense ability to convince the administrators and decision-makers, to go for reliable building up and operationalisation of Geo-spatial Information systems based Natural disaster Mitigation and Management efforts. Extensive data sets at 1: 1million, 1: 250,000, 1: 50000 and higher details where ever possible were collated , integrated, analyzed, visualized and used for creating what-if-scenarios in a crisis management situations at different locales in India. Most of the work was done at Pentasoft Technologies in 2002 and hence could not be presented in detail at earlier occasions, with data sources etc due restrictions policy (Non-disclosures clause) of the company.

HAVES AND HAVE NOTS IN GEO-INFORMATICES FOR DISASTER MANAGEMENT: CAPACITY GAPS OR VOICELESSNESS IN SOUTH ASIA

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Abstract

International Charter on Space and major disasters is a unique cooperative arrangement to provide free of cost access to geo-informatics products while responding to the natural disasters. International Charter, since its inception, has captured several disasters that caused lives and livelihoods. Charter, in its mandated role, has been making efforts to strengthen the hands and minds of civil defense agencies on the ground to manage the events with more contextual and holistic information. The recent South Asian floods, Asian earthquake and tsunami events have brought into fore several issues and challenges pertaining to the operational efficiency of International Charter. Charter was placed to a scenario where it had to perform and to demonstrate what it could do for the wounded South Asian subcontinent.

The Charters were activated for major disasters worldwide including those in South Asia. The best of space imageries, in terms of its spectral, spatial and radiometric contents were made available, without any cost, to support the Charter. To make them actionable on ground, relevant service and value-adding chains were carried out. Finally, Charter proved its relevance and demonstrated the philosophy it is characterized with. There are however lessons to improve the Charter. Lack of capacity has created geo-informatics 'have' and 'have nots' for disaster management, while lack of voice has led to miss out several disaster events especially in South Asia. The paper has made an assessment on these aspects and suggested some feasible mechanisms to address the existing capacity gaps as well as voicelessness of South Asian region in major international cooperation arrangements for the more effective access and outreach of geo-informatices products in support of disaster risk reduction strategies in high risk countries.

MULTI-SOURCE LAND USE LAND COVER CLASSIFICATION IN A HILLY TERRAIN FOR LANDSLIDE STUDY

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The land use land cover information of an area is quite essential for proper planning, management and monitoring of natural resources. It is an important input for many geological, hydrological, ecological and agricultural models. Land use land cover map generally shows distribution of forest cover, water bodies and types of land use practices. Many studies have revealed a clear relationship between vegetation cover and slope instability. Parameters, such as cohesion and friction angle of soil and pore-water pressure, tend to get modified substantially by the presence of vegetation. The incidence of landslide is inversely related to the vegetation density. Therefore, the land use land cover information is considered as one of the factors generally considered for landslide hazard studies.In hilly regions like the Himalayas, particularly in the inaccessible areas due to high altitudes and ruggedness in the terrain, remote sensing images are the only available source for land use land cover mapping. The factors influencing land use land cover mapping in hilly areas using remote sensing data with varying degrees of accuracy may be attributed to the presence of cloud cover, shadows due to high altitudes, steep slopes, low sun angle and differential vegetation cover. Therefore, the approach for land use land cover classification that incorporates ancillary data from other sources may be more effective than that is based solely upon multi-spectral data from one sensor. The topographic maps are useful in generating the DEM, which along with its attributes, such as slope and aspect, provide the basis for multi-source classification Furthermore, the derivatives of multispectral images like Principal Components Analysis (PCA) and Normalised Difference Vegetation Index (NDVI) may also be useful to improve the land use land cover classification from remote sensing data in hilly regions. In this study, the IRS-1C LISS-III data has been used as the primary data source alongwith NDVI and DEM images as additional data layers to implement multi-source land use land cover classification process. Separability analysis using transformed divergence is performed to examine the significance of various spectral bands in the classification process. Most widely used Maximum Likelihood Classifier (MLC) is used to perform the classification. The PAN image is used as the reference data for generating training and testing datasets. The preparation of reference data is ably supported with field data as well as information from topographic maps. The results show a reasonable improvement in accuracy of classification on incorporation of NDVI and DEM as ancillary data over the classification performed solely on the basis of remote sensing data.The land use land cover map thus produced was used for landslide hazard study. High spatial resolution IRS-1C-PAN and PAN-sharpened LISS-III images were used to produce a landslide distribution map which was verified from field surveys. A total of 101 landslides showing areas occupied by sliding activity were identified. The spatial distribution of landslides in different land use land cover categories has been obtained. It is observed that agriculture and tea plantation categories have maximum incidence of landslides in comparison to other categories and water bodies and river sand categories are devoid of landslides. As far as the landslide density is concerned, it is observed that barren lands have the maximum density and is followed by agriculture land, habitated area, tea plantation area and forest covers. Water bodies and river sand categories are found to be devoid of landslides. These results reflect the real field conditions in hilly terrains. The relationship thus obtained was later used as one input data for landslide susceptibility mapping.

GIS-BASED SLOPE STABILITY EVALUATION OF A LANDSLIDE COMPLEX – CASE STUDY FROM PAGLAJHORA, DARJEELING HIMALAYA, INDIA

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Abstract

Detailed mapping (1:5000 or larger) along with finer-resolution (1 m X 1 m pixel) deterministic stability assessment are pre-requisites to understand the behaviour of any active and complex landslide. Geological mapping of the affected slope is the first step towards any such stability assessment which provides fundamental inputs about slope parameters such as morphometry, type and nature of slope forming material (both rock and overburden), geometry of probable failure surface, past landslide movements, their failure modes/ mechanisms, hydrological situation, anthropogenic interferences and land cover, etc. Through detailed geological mapping of above said parameters, probable causal mechanisms involved during the temporal evolution of the slope are ascertained. These thematic maps and related information are used by the planners/geotechnical engineers to understand the slides and design appropriate protective structures in consultation with geologists.

This paper deals with the detailed geological mapping of a large and complex landslide carried out in Darjeeling Himalaya (Paglajhora) revealing various critical slope parameters and relevant geological characteristics, which were subsequently used for the evaluation of the slide and applied as a vital input for the GIS-based stability assessment of the slide complex. Pixel-wise factor of safety (Fs) under three hypothetical saturation conditions were calculated using slope parameters from map and determined shear parameters of representative insitu slope-material. The above stability model confirmed substantial portion of stable slopes (Fs > 1.7) under dry condition becoming unstable (Fs < 1.0) under various increasing saturation conditions. Under dry condition, only 25% of slope was potentially unstable, which increased up to 51% and 65%, respectively, under intermediate and total saturation conditions. This stability modeling could be more effective with use of measured depth-to-failure surface, pore-water condition, and larger spatial variability of the determined shear parameters.

ACCURACY ASPECTS IN THE USE OF GPS TECHNOLOGY FOR GEOINFORMATION SYSTEM

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ABSTRACT

In the process of rescue operations and assessment of damage to a specific location during natural and man-made disasters; maps play an important role. The developing countries like India have seen the rapid urbanization and unplanned growth of cities and this requires fast updating of various type maps related to land use. Recent developments of Information and Space Technology have changed the scenario of surveying techniques. High-resolution images can be acquired from the space borne sensors. The US satellite system Global Positioning System (GPS) has revolutionized the positioning and navigation on land, sea, air and space and one can get millimeter level accuracy using this instrument. In place of conventionally used paper and film media, now the map database is preferred in the digital form on computers and known as Geographic Information System (GIS). The above three-geospatial technologies namely, Remote Sensing, GIS and GPS in integration can provide an efficient and cost effective Surveying and Cartography tool for various types of mapping requirements and playing a great role in the development, management and analysis of Geoinformation system. This research paper investigates the accuracy of hand held L1 frequency GPS receiver (Magellan Sport track and Lieca make GS5). Different linear and aerial features in the Bhopal city area have been digitized using hand-held GPS receivers. Accuracy of the above digitized features were determined by comparing the corresponding feature dimensions extracted from Indian Remote Sensing satellite (IRS-P6) LISS-IV sensor images and Leica make Total Station based measurements. The investigation results have shown that even a single frequency hand-held GPS in the stand-alone mode could provide planimetric accuracy in the range of 3 to 6 m. This makes the GPS a very quick and reliable tool for all types of surveying tasks in the development of Geoinformation System.

FREE GEOSPATIAL INFORMATION FOR NATURAL AND INDUCED DISASTER RISK MANAGEMENT- INDIAN PERSPECTIVE

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Abstract

India, as a country experiences diverse natural and induced disasters apart from the frequent epidemics. Natural disasters include earthquakes, cyclones, floods, flash floods, landslides and droughts. Additionally, there are numerous induced disasters like fire accidents, induced landslides, road accidents, nuclear and chemical explosions and terrorism activity. All these natural and induced catastrophes are a spatial phenomenon; and therefore they are best suited for spatial modeling. But spatial modeling requires data in spatial format including social, build up and non build up. However, in India, we do not have large scale spatial data models like developed countries. The quality and format of the existing data base is a hindrance in building better spatial models. Though, there has been a lot of research on hazard identification and analysis but still there are certain gaps such as standardization, vulnerability assessment, emergency planning and preparedness. Historically, disaster management in India meant only responding after the occurrence of a disaster. However, the complete cycle of disaster management includes risk assessment, mitigation planning, preparedness and response. Off late, one can notice some thrust for initial stages of disaster management. For effective disaster management, not only the thorough understanding of disasters is required, but, one must be able to quantify the disaster and its impacts. The reasonable and quick solution to all the above issues is "Free Geospatial Information". As of now, there are very few natural disaster risk models available for India. For any disaster management strategy to be successful, the focus should be to see how the society would be benefited by the strategy. This paper focuses on natural disaster risk management through free geospatial information. It will be a key strategy for the benefit of the society at the time of a crisis.

Key words: *natural disasters, induced disasters, spatial data, spatial model, Free Geo-Spatial-Information*

APPLICATION OF GIS AND REMOTE SENSING FOR DISASTER PRONE AREAS: A CASE STUDY IN COASTAL KERALA

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ABSTRACT

As most of the populated areas in the world are situated near coasts around the world, vulnerability of such coastal areas to disasters like tsunami is a matter of great concern. With the advent of precise earth and environmental monitoring systems, risk due to the natural disasters can be forewarned and regulated. Utilizing modern techniques of geoinformatics such as, Remote Sensing and GIS, actions can be solicited in more systematic and precise way to prevent disasters, mitigate their effect and to make a better preparedness against disasters. Further, rescue and relief, rehabilitation and reconstruction can be planned effectively with the help of geoinformation technology. A study along the coastal belt of Alleppey District in central Kerala has been carried out to understand the effectiveness of the tools of geoinformatics in disaster management. High density of population, important utilities and public installations along the coastal stretch warrants mitigative measures against such natural calamities. With the help of QuickBird images of 0.6m. spatial resolution, high geospatial resolution inventorying and mapping of tsunami disaster vulnerability of the coastal settlements in Alleppey municipality was attempted. Ability of GIS as a mapping tool enhances the depiction of geographical trend and spatial pattern of a natural disaster like tsunami. The vulnerability mapping of the area includes identification of the coastal locations in terms of its nature and human settlements. Appropriate tracking of evacuation routes and modes of evacuation is done in a spatial context. Vulnerability of lowlands and inland water bodies that are connected by creeks that are tidally active proximal to the coast line are mapped. Using ArcGIS software, thematic layers are overlaid, queried and geographically analyzed to derive meaningful information on hazard proneness of the coastal settlements in the area. Resultant maps provide information on the vulnerability of areas, rescue routes and shelters for likely scenarios of tsunami affected locations. A shortest evacuation route finder was developed in Map Objects and VB.NET that will help the first responders to help people reach the nearest shelter quickly. The paper also highlights the need for the implementation of Public Participatory Geographic Information System (PPGIS) for community preparedness and mitigation activities at local level using Open Source Geographic Information Systems (OSGIS).

PREDICTING SEISMIC VULNERABLE ZONES USING GIS

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Abstract

Urban risk is increasing very rapidly in developing countries, where urbanisation is often occurring in areas susceptible to disasters. This is very important to manage effective seismic disaster reduction measures, including preparedness, emergency response activities and seismic retrofit and recovery actions and policies. Number of high rise buildings are increasing day-by-day due to the rapid development in IT, BT and manufacturing sectors. Rate of growth in Chennai city, is high not only in the residential and office segment but also in mall segment. At present, Chennai, Coimbatore and Salem fall under zone III of the Bureau of Indian standards classification. However, till date there is not legal framework to require that all constructions in Chennai must implement seismic code provisions. The results indicate that most buildings in Chennai, are not meeting the codal requirements on seismic resistance. Since the mankind is far from the possibility of being able to successfully predict earthquakes, the only option is to build the houses and other facilities to survive earthquake. The potential extent of damage and the vulnerable points of the city can be identified. The information will be useful to manage activities, seismic retrofit, recovery actions and policies. The main objective of this study is to analyze the seismic hazard and vulnerability of various structures of Chennai city and to serve for seismic disaster mitigation. In this study, different maps like landuse, geology, geomorphology, drainage density, slope and soil are being prepared with the help of Satellite imagery to predict the vulnerable zones. Parameters considered for the generation of compatible building type classifications are roof type, structures, presence of cracks, maintenance, building shape, number of stories, year of construction etc. Based on Indian condition, a damage probability matrix is prepared to evaluate what will happen to buildings during earthquake of various intensities. Finally, amount of vulnerability related to various buildings are calculated and its impact. Based on the above structural parameters the seismic vulnerability of buildings can be determined with the help of geoinformation techniques like GIS, GPS, satellite imagery spatial Data etc. This conceptual model has been developed into an interactive, GIS-based decision support system (DSS) that the region, which has more earthquake vulnerability. The model is unique in which it allows users to think through various levels of risk tolerance and hazard acceptability and allows users to compare the cost effectiveness of different policy alternatives. Based on final guideline document, the Government agencies, universities, and private organizations may carryout the work to increase awareness of the earthquake threat and to reduce loss of life and property in future shocks.

UTILITY MAPPING FOR DISASTER INFORMATION SYSTEMS A CASE STUDY OF RANCHI

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Abstract

The role and relevance of utility maps and real time imageries in disaster management is well understood from the recent disaster experience like Cyclone Aila, Kosi floods, Tsunami 2004, Kashmir Earthquake etc. Utility maps are essential for all stages of the disaster management cycle: prevention, mitigation, preparedness, response and recovery. It is important to undertake a range of activities such as: risk assessment; scenario analysis, analysis of consequences; forecast and projection; dissemination of information; allocation of personnel, equipment and other resources; reaching various affected areas by relief personnel; damage assessment and so on. In the recent years, after the launch of high resolution satellite such as Cartosat 1 and 2 with 2.5m and 1 m spatial resolution from Indian Remote Sensing (IRS) satellite series, and quick bird satellite with 0.65 m the use of remote sensing for rural and urban development activities and Disaster Management has increased in many folds. In general the term utility is considered as an important service that is provided to people of the city or settlement and hence, Utility services like water supply, sewerage, storm water drain and electricity networking are inseparable part of public and daily life in a city, which are owned mostly by the Government authorities. Utility services is one of such important discipline where information derived through satellite based Remote Sensing data Geographical Information System were found extremely useful in image processing and integrating spatial data with non spatial information.

Present paper elaborates the datasets, tools and methodology applied for the development of Ranchi Utility Information System (RUIS) and it's potential applications in Disaster Management. RUIS is developed using QUICK BIRD data covering 175.3 sq km of Ranchi Municipal Corporation. Also the other data used are Existing Khasra / revenue maps, SOI toposheets of Ranchi at 1:50,000 and 1:25000 scale and Primary data from the field survey. Hence, RUIS will facilitate the near real-time data required for assessment of existing utility services, development for future growth, management for better service facilities, updating of data and analysis for better decision-making for Disaster Management Planning and Emergency Response.

FIRE MANAGEMENT SYSTEM USING GEOSPATIAL TECHNOLOGY: A CASE STUDY OF DELHI

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Abstract

Providing instant and efficient support has always been a challenge and with increased pressure of population on Urban Areas, handling frequent Fire Incidents in highly populated areas has become even more challenging. Risk management, preparedness and mitigation have taken on new importance with challenges faced by the fire service today. With increasing demands, the Fire Service needs to utilize the best tools, techniques and training methods to meet public expectations. While nothing will ever replace the single most important asset for fighting fire—people — advances in technology give today's firefighter more capability to protect life and property.One of the emerging tools that are helping fire service optimizes its emergency services delivery is Geographic Information System (GIS) Technology. GIS can help fire agencies optimize their service delivery in all facets of the fire rescue mission including, planning Preparedness, Mitigation, Response and Incident Management. GIS extends the capability of maps — intelligent, interactive maps with access to all types of information, analysis and data for efficient decision making. Enterprise GIS technology provides tools for handling fire fighting services ranging from Web based to Mobile solutions. It provides a framework for organizing data from many sources that relate to the fire strategy development. It can improve fire response by integrating and centralizing various data in different formats.

In this paper, Enterprise GIS Solution for Fire Management Services is proposed where role of Geo-Spatial Technologies is covered at length leveraging advantages of Geo-Web & Geo-Spatial Fusion. In this solution, key factors considered are Dispatch time, turnout time, response time, access time and set-up time for total reflex time sequence, Enterprise GIS Solution is proposed which will utilize Boundary layer like Districts, City etc. with Population Density parameters, Infrastructure layers covering fire station, hospitals, police stations etc., Road Network with other collateral information which will used for developing Multi-modal Networks for Service Areas and Response time analysis. All spatial and non-spatial data are stored centrally. Non-spatial data such as floor plans, preplans, fire fighting equipments availability, occupancy, storage of hazardous materials and other documents, can be linked to features on the map that pertain to a particular building location or other actual features location. This information, can be accessed using Mobile GIS and can provide first response with information essential when sizing up for deployment. Building Plans will provide 3-dimentional view can also be used for planning for required equipments and mobilizing teams. Using GIS, incident trend analysis can be performed which will help decision makers in analyzing risk prone areas, existing service areas and planning for future. Modeling can be used for further analyzing vulnerabilities, preplan development, training, or communicating with the public and policy makers. In a situation of high call volume, GIS can provide a better decision making capability to manage resources. All the above functions of GIS can be utilized for effective and efficient deployment of resources required for reducing losses of life and property due to fire hazard.

STRUCTURE OF A GEO INFORMATION SYSTEM FOR HOLISTIC USE IN THE STATE OF WEST BENGAL

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Abstract

The Disaster Management (DM) Act, 2005, India, made a paradigm shift from a response and relief centric approach to a proactive and comprehensive mindset towards DM covering all aspects from prevention, mitigation, preparedness to rehabilitation, reconstruction and recovery. Obviously this involves many government departments to act together with full scale coordination with each other across the administrative boundaries and departmental detachment. Materially, this means large amount of data must be available to all related departments and all strata of the administration. Apart from this, as disasters are always spatial in nature, where spatial, aspatial, meteorological data must move in all directions. At this point the necessity for GIS as a management tool has been acknowledged. Disaster damages property, resources, and infrastructure. For disaster preparedness and post disaster rebuilding the whole societal participation is necessary. Only a successful GIS for DM can play here the effective role, where a Relational Database Management System along with intelligent maps will be available in all the departments and administrative levels. The objective of this paper is to present an idea and plan for the preparation of such a technical tool for management. Though the paper concentrated itself within the geographical boundaries of West Bengal, but it also explained the necessity of meteorological and spatial data across the state boundary. Enabled with the power of risk analysis and simulation models for different disasters, this paper showed how regular updating of data in a decentralized way from different points made it possible to control and command centrally. The paper presents a model how a single GIS will empower 1020 nodal points of state government, which includes State, Districts, Sub-Divisions, Blocks, Municipalities, Police Stations and more than 15 departments with this techno-legal tool.

DISASTER MONITORING USING WEB-BASED GIS TECHNOLOGY

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ABSTRACT

This paper presents the use of internet and online GIS technologies for the purpose of monitoring and collaborating on potential and ongoing natural disasters. Through the merging of existing and new technologies it is possible to provide users with a wide range of reporting, tracking and communication tools which allow them to make educated and timely decisions. Users ranging from everyday citizens to public authorities can make use of the information and tools that are available (access level controlled). This technology could easily be used to monitor and collaborate on nearly any form of natural disaster.

Disaster Monitoring using web-based technology GIS has already been implemented in Canada for tracking wildfires in the province of Alberta. The Alberta Wildfire System (AWS) enables users to view, query and edit wildfire information, perform wildfire related spatial analysis and manage wildfire-related documents. The AWS provides GIS capabilities for Public users to use Google Maps to access wildfire information such as FireBans and forest closures;Fire Ban providers to issue, modify and cancel Fire Bans; FireSmart users to prepare, submit and manage Powerline Hazard Assessment Plans and Industry Wildfire Control Plans; Staff level users to plan fire-fighting tasks through on-line GIS viewing and editing, Staff level users to submit, query, and manage wildfire-related documents.

Keywords: GIS, Internet, Monitoring

EARTHQUAKE RISK ASSESSMENT AND MAPPING IN PART OF CENTRAL ALBORZ, IRAN BASES ON RS & GIS TECHNIQUES.

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Abstract

Earthquakes cause huge loss of lives and infrastructure every year in Iran. Many settlement areas (urban & rural) as well as Tehran, the capital city of Iran are located in the hazardous area. This research deals with the earthquake risk assessment and mapping based on recent Remote Sensing information on a GIS plat form. The study area is part of Central Alborz in southern Caspian Sea called Marzanabad area, it is a potentially high-risk zone as several earthquakes have occurred in the past. The study's main objective is to develop an earthquake Risk map at the scale of 1:25,000 to identify high-risk areas to the settlements and infrastructure of Marzanabad area. Digital lineaments wear extraction and analysis for identification the faults using several RADAR and optical image analysis techniques. The probable faults were detected by superimposition of the lithological and geomorphologic features and their variance over the lineaments in a GIS environ. This research work involved fault identification on the remote sensed dataset as well as field studies and the risky areas were classified in the vicinity of the faults by applying different buffer over the GIS software specifying distance of the source/site of risk to fault location. Statistical analysis of Earthquake Risk Map (ERM) by GIS indicated that 32 % of the total area with about 66 % of settlements and 52 % of population is located in strongly high-risk and high-risk zone. Moderately low risk and low risk zones cover 38.67% of total area, which is free of settlements as well as population. The Earthquake map elaborated in this research work will be a useful tool for disaster management as well as urban and regional planning of future activities in the area.

Keywords Alborz – Earthquake Risk - Remote sensing - GIS

APPLICATION OF GEOGRAPHIC INFORMATION SYSTEM FOR SEISMICALLY UNSTABLE SLOPE ANALYSIS

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Abstract:

Landslides are one of the most damaging hazards associated with earthquakes. Predictions of where and under what shaking conditions landslides are most likely to occur are a key element in earthquake hazard assessment. Permanent displacements over a certain limiting value tend to trigger landslides. The magnitude of this limiting value depends on the mechanism of the slope failure, lithology, slope geometry and earlier slope movements. As per the previous research work displacement of 10 cm. is considered as critical displacement for slope failure.Displacement-based methods like the *Newmark Integration Procedure for Sliding Rigid Block* developed by Newmark are the most commonly used seismic analysing method for landslides. In this model slope stability is related to the displacements occurring in a slope as a result of increments of time during pwhich the seismic excitation causes the factor of safety (FS) to drop below one. Using Newmark's model, the displacement of a rigid block can be calculated for any base excitation time history if the critical acceleration (A_c) that causes the initiation of slip is known.California and Jibson methods are popularly used for estimating Newmark type displacement for calculating slope failure in seismic conditions. The reliability of these two methods for seismically induced slope failure has already been checked and published. The displacement map prepared using empirical methods is useful for identifying vulnerable areas in terms of occurrence of landslides and therefore also useful in implementing landslide preventing measures.The empirical method for displacement estimation is used in Geographic Information System (GIS) environment for slope displacement map preparation that shows the change in displacement pattern over the area at defined grid size. Arc GIS is an excellent software that is used to convert the material properties assigned to each of the geological units into layers of raster data set with 10-m cell size. The raster data layers are then used to compute the factor of safety, the critical acceleration, yield seismic coefficient, duration and peak demand coefficient for all soil slope for given slope angle. The prepared data layers are used in California method for displacement map generation.

GIS : A Modern Day Tool in Disaster Management & Mitigation

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ABSTRACT

India has been a big hunting ground for both manmade and natural disasters from the wrath of tsunami to the curse of Kosi, we have seen them all. Important lesson learnt from all these disasters was the urgent need for accurate, updated and timely geo-spatial information for various agencies involved in rescue and relief operations. Cutting edge technologies such as Google Earth have made geospatial information today accessible even to a common person having little or no exposure to advanced technologies. It is however seen that despite India's great strides in both technical training and data creation for geospatial use, deriving any real benefits from this vast resource of data especially for disaster management is still elusive. Our reliance on obsolete and archived geospatial data for fighting modern day disasters has not decreased. Accurate and updated maps down to 1:1000 scale are essentially required for planning and executing relief operations for large cities and metros whereas getting maps of even 1:50,000 scale is difficult. The only way we can overcome this requirement of geospatial information is by maintaining an updated data warehouse at a national level from which various agencies involved in disaster management/mitigation can get access. The first step towards this has already been taken by creation of the NSDI or national spatial data infrastructure. a similar proposal is also under consideration by the defence forces by having a DSDI or defense spatial data initiative. Various government agencies who are participating in the NSDI share and update geospatial data concerning their departments thus making it available to various users. The defense forces have traditionally been the backbone of all disaster management activities in the country. This is primarily because of their ability to mobilize and reach the affected areas for a quicker response. One of the key reasons for this response is the availability of maps and other geospatial information of the areas with them. The world today is rapidly moving from paper maps to intelligent digital maps which are the key components for building a nation wide GIS database. Mathematical modeling of geospatial data can also give critical information like areas likely to be inundated due to breach of a river bank or dam and the timeline of the flooding. Such information especially in flood affected areas can prove to be invaluable in saving countless lives and mitigate losses due to such disasters. It is time now for us as a nation to exploit geospatial information to its maximum in disaster mitigation and management. The technologies are here so are the well trained professionals, all it needs is a concerted joint effort to put in place these to work.

USE OF GIS, GPS AND REMOTE SENSING FOR DISASTER MANAGEMENT

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The World wide internet network is effective tool for communication as it provides a platform for people across the world to exchange their ideas, knowledge and technology. It is very useful for studying Geographical features at various locations. This knowledge is also helpful for protecting the life of thousands of people in every year around the world due to natural disasters. The use of Remote sensing, GIS, GPS plays an effective role in communication; remote sensing can also help a great deal in planning, exchange and dispatch training of various stages in natural disaster management. The use of remote sensing has an outstanding progress in different stages of disaster management. Satellite communication GIS and internet today has an undeniable role in post disaster management and relief and rescue activities, because of improvement in satellite photography, the evaluation of life losses and damages has been facilitated. This paper discusses about application of internet-based remote sensing and GIS, GPS, in different natural disasters like, flood, earthquake, landslide, drought, tsunami, volcanoes etc.

GEO-MORPHOLOGICAL MAPPING, ABIDING DISASTER MANAGEMENT AND CONSERVATION EFFORTS

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Abstract

Geomorphology deals with surface features of the earth, their forms, nature, their origin and development. The most important causes of disasters and damage to natural forest ecosystems in Himalayas are both natural and man-made. The increasing application of geomorphic interpretation through aerial photographs and satellite data facilitates the understanding of the relationship between landforms, habitat and planning processes. The study was conducted in Great Himalayan National Park Conservation Area (GHNPCA, 1,171 km^2) in Himachal Pradesh. Mapping of major units were done by using satellite imageries (FCC of IRS 1-B LISS II Sept/Oct 1993, scale 1:50,000). Geomorphological mapping of the area was the main aim to understand the habitat and its relation with impact on management and conservation schemes.. Nine categories have been delineated taking into account the topographical features also. Area under different categories has been determined- the total length of the major water divides and prominent facets calculated, about 723.08 km^2.). Aerial estimation of escarpments was about 33.82 km^2 (3%). Exposed Rocks (2%), Alpine Exposed Rocks (13%), Escarpment (3%), Glacier (2%) and Moraines cover about 2% area. Besides that other topographical features have also been generated like; slope aspect, contour, drainage density, terrain complexity and digital elevation model. The geomorphology is one of the important disciplines because various landforms are the result of intersecting causes. Their significance is related to disaster management and conservation efforts. This will not only help to understand the distribution of species but also to understand any development plan in hilly terrain. The landslides and poor constructions have a negative impact because of their destructive nature. It is well known that it is not the seismic shaking that kills the people but the quality of the house construction. With appropriate design and construction techniques, facilities can be protected so that they remain in operation after a hazardous event. Disaster does not consider holidays, they will continue to occur, and mitigation should be on priority by all means. It is reflected through study that for hill development or landscape planning, geomorphology and its mapping should be on priority for proper understanding of Disaster mitigation and management planning, species distribution, habitat suitability, protected area management as far as overall conservation is concern.

A SATELLITE DATA BASED APPROACH OF 2-D KINEMATIC WAVE FLOOD PLAIN MODELLING

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Abstract

This paper describes the suitable methodology for research of raster based treatment of a 2-D diffusion wave for estimating the flood envelope that results from flood hydrographs. The model adopts an explicit solution of the 2-D diffusion wave equation, that introduces processes to represent both wetting and drying and, for situations where no channel data are available. It provides a significantly simplified channel representation conducive for modelling. The goal of the paper is to assess the extent to which this simplified channel representation is sufficient to provide first estimates of inundation extent. The channel simplification was based upon estimation of how much flow is conveyed to the portion of river channel, not represented in the DEM (i.e. below water level) and to remove this from the inflow hydrograph, such that the flow input represents the over-bank flow only. This requires an estimate of bankfull flow and a method of partitioning the actual flow between, which is delivered to the floodplain and which is conveyed by the channel. The formulation is based on the principle that it has a characteristic return period which can be applied to a magnitude-frequency relationship for a given river reach and hence used to determine a first approximation of bankfull flow. The Weighted Divided Channel Method after Bradbrook et al. has been applied to the bankfull flow to work out the residual flow delivered to the floodplain. Whilst some floodplains undoubtedly act as a single, two-stage channel, many of the more extensive and topographically-complex floodplains exhibit river-independent flow paths and/or ponding. The analysis holds promise that the simplified channel representation is expected to give good results for potential application for simulating flood plain flows developed on the aforesaid simplified approach.

***Keywords*:** Floodplain flows; diffusion wave modelling; flood extent.

SATELLITE DATA BASED ANALYSIS OF WETLAND DYNAMICS FOCUSING ON FLOOD MANAGEMENT

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Abstract

The Deepor Beel is one of the largest wetlands in Assam. This wetland is a Ramsar heritage site and is closely interlinked with mitigation of flooding problem of urban and semi-urban areas adjoining the highly populous Guwahati city in Assam. However, in recent decades the Deepor Beel has undergone rapid degradation due to various reasons and thereby affecting its flood absorption capacity along with loss of bio-diversity. In the above context, satellite data based analysis of the wetland dynamics of the Deepor Beel areal extent has been conducted making use of ERDAS Imagine (digital image processing) and ArcGIS (GIS) software. The satellite images of 1987, 1997 and 2007 have been processed and analyzed to quantify the progressive reduction of the wetland area as well rapid fragmentation of the wetland over the period of study. Furthermore, the reduction in flood absorption space of Deepor Beel over the study period has been quantified. The meteorological data of the adjoining catchments area have been analyzed to yield the resultant surface runoff or peak flood with the help of simplified approaches available in literature.The above study brings to the fore the alarming scenario of progressive and rapid depletion of flood absorption capacity of Deepor Beel wetland, which would adversely impact on the urban and semi-urban flooding problem of the greater Guwahati area. The findings of the present case study highlight the urgency to evolve and implement appropriate measures for restoration of about 4000 wetlands in the Brahmaputra basin to favourably impact on the chronic flood problem in Assam.

Keywords: Flood Absorption, Wetland Dynamics, Deepor Beel, Satellite Image

OVERVIEW OF DEGRADING AGRICULTURE IN CANAL COMMAND: A GIS & REMOTE SENSING BASED APPROACH

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ABSTRACT

The most populous state, Uttar Pradesh, is also endowed with the largest water resources in the country. Over the years, one of the world's largest irrigation systems has been developed in the state to support predominantly a rice-wheat crop cycle. Agriculture in the state is currently threatened by sustained water-logging and consequent soil salinity and sodicity in canal command. In contrast, some areas also suffer from unsustainably depleting groundwater table. This is more so in tail reaches of canal command. Obviously, these ill-effects reflect in terms of poor crop intensity and productivity. As part of a broader World Bank loan program for water sector restructuring of the state (UPWSRP), SMEC was commissioned in 2004 by the UP Irrigation Department (UPID) to develop the Basin Plans and Decision Support System for the Ghaghra-Gomti Basin. This study is a part of the whole exercise. The remote sensing technique is used to extract the current land use in about 5,50,000 hectare command area of Jaunpur Branch Canal using LISS III and CARTOSAT satellite data. Jaunpur Branch is one of several branch canals of 94,22,960 hectare Sarda Sahayak canal system in the Ghaghra-Gomti Basin. Groundwater level data obtained from UPID piezometers installed under this very program is used along with crop productivity and soil data from the UP Department of Agriculture to assess correlation among water table and crop intensity and productivity. Most exercises are carried out on ERDAS and ARC GIS platforms. The study reveals that significant correlation appears to exist between them and the conjunctive irrigation management practice may be a realistic option to address the issues.

USE OF GEOMATIC TECHNOLOGY FOR DISASTER MANAGEMENT

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ABSTRACT

Natural disasters are those elements in the physical environment which are harmful to man and caused by forces extraneous to him. The socio economic costs of natural disasters have reached unprecedented levels and globally it appears that these damages and losses in natural disasters are increasing. India has been traditionally vulnerable to natural disasters on account of its unique geomatic conditions and hence there has been a considerable concern over natural disasters. Monitoring natural disasters with ultimate aim of predicting them and managing the rescue and rehabilitation operations during and after such calamities has gained importance over the time. Traditionally maps were being used for this purpose, as an efficient tool, since ancient times. However, with the introduction of computer aided techniques in map making, and the space geodetic techniques in surveying and mapping, the utility of geodetic and map data for disaster management activities has increased many-fold. The paper focuses on how this geomatic technology in terms of GIS and GPS can be well utilized for disaster management. GIS mapping and GPS can help us mitigate the effects of every type of natural disaster. In order to harness their potential, it is imperative not only to understand the technology but also appreciate their advantages and disadvantages.