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Special Issue on Geospatial data interoperability

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In this Issue

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Send your contributions/ comments to the Chief Editor at the above address.

Editorial

This issue is based primarily on a compilation by Prof. Arup Dasgupta, of articles on Geospatial data interoperability. With the growing number of spatial data providers across the globe and the plethora of open source and commercial software packages to deal with them and the variety in computing and communicating systems from hand-held devices to multi-CPU servers involved with varying processors operating systems, and data storage options and the ever-increasing number of users who are interested in accessing geospatial data both from static and mobile vantage points and the dichotomy in geospatial data itself covering raster and vector data types and country/region specific datum and projection options and the long list of metadata catalogue entries describing the geospatial datasets and their format options, geospatial data interoperability assumes a very important place in Geomatics. OGC and ISO/TC-211 are doing yeoman service in bringing about the necessary standards in this respect, some of which have been addressed in the articles appearing in this Issue.

While Dasgupta's article covers this topic in general, Nayak and Rao write in specific reference to Ocean related data sets and Acharya and Dutta in the context of the NRDMS programme. A couple of other articles from BISAG, Gandhinagar and an odd note on coral reefs and mangroves from SAC also appear in this issue apart from the regular news and events features and Society matters.

Shri CP Singh has designed the cover image of this issue. The Editorial Board, in spite of its best efforts, regrets the delay in bringing out this issue.

R. Nandakumar
On behalf of the Editorial Board

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Standards and Interoperability

A.R. Dasgupta

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1. Introduction

Geospatial information is increasingly becoming a part of the information needs for the daily operations of an enterprise. The enterprise could be a business like a department store, a utility like a power company or a local government entity like a municipality or even a government department like roads and buildings. In each case the importance of 'where' becomes enhanced as enterprises try to maximise their profits or effectiveness in an increasingly competitive and demanding environment. In this milieu Geographical Information Systems play an important role by ingesting, storing, processing and analyzing geospatial information relevant to the operation of the enterprise. GIS utilization began as a standalone operation in the IT or MIS department of an enterprise but, as the technology matured it migrated to the desktop, and now to hand-held devices. GIS operations have thus become more decentralised, democratised and ubiquitous.

This process has major benefits as it puts the information right in the hands of an end user but it also results in problems like fractured databases, lack of synchronization, data duplication, loss of data and ultimately loss of efficiency and accuracy. Unorganised growth also leads to a proliferation of systems with attendant interoperability and compatibility problems. An enterprise therefore requires a system that is designed to provide an integrated and interoperable environment, in which the individual departments and functionaries of an enterprise can create, access, view, and analyze data and information relevant to their tasks. This information could encompass spatial as well as non-spatial data sets. Applications could range from complex spatial models to delivery of services encompassing government, business and citizens.

The first requirement of such a system is standardisation of data acquisition and content and reduction in data redundancy. Data needs to be acquired by focal agencies as per a predefined content and format agreed upon in advance by the data using agencies. Such data has an associated accuracy, integrity and reliability assured by the focal agency. By reducing redundancy in data collection, costs are saved in terms of collection, timely data availability and repeated reuse of the collected data. Standardisation results in better data management and enhanced modelling capabilities as models can be made available across the enterprise resulting in better decision support.

The second requirement of the system is interoperability across applications and systems. Factors which affect inter-operability are heterogeneity at syntactical and semantic levels. Standardisation ensures a higher degree of semantic interoperability since all users will use standard terms to describe geospatial features. This will also enable interoperability across applications. Thus applications like citizen services, road maintenance, health care, market research, etc., can use geospatial data seamlessly with other business processes like Enterprise Resources Planning systems, e-Governance, etc. To enable this GIS needs to be at the core of the organisation with links to all services and applications. These applications may be deployed over a wide variety of systems and devices and accessible over both public networks like the Internet and private networks. To overcome these heterogeneities we require syntactic interoperability which can be achieved by adopting a standardized encoding system for the data and standardised services for data access, analysis and management. These form the Interoperability Specifications.

2. Data Standards

Standards enable harmonious working within and across entities. As technologies evolve, standards also evolve to meet the new specifications. In the field of geospatial data, standards have played an important role and continue to play such a role as new technologies evolve or are adopted and adapted. Geospatial data acquisition has moved from field surveys to aerial surveys to satellite observations. Observation systems have evolved from analogue instruments to digital sensors. Mapping technologies have also evolved from manual plotting to CAD, automated cartography and digital photogrammetry. Spatial analysis is another field where computers and DBMS have brought in a revolution through the development of geographical information systems. Data standards have always been an integral part of these advances.

In the past the process of standardisation had been implemented in parts. Further these standards were dictated by regional, technical and application considerations. Consider the case of the reference ellipsoid. It was well known that the earth's surface was an irregular spheroid and it was necessary to model it in mathematical terms to be able to map it. Initially each country developed its own ellipsoids based on celestial measurements. Thus we had separate ellipsoids for India, America, Europe and so forth. The development of satellite geodesy resulted in the evolution of the WGS global reference ellipsoid which has now become the global standard. All other ellipsoids are now related to the WGS ellipsoid through mathematical models. Similarly, the map projections required to transfer the ellipsoid to a planar surface also evolved as per the needs. Navigators found the Mercator projection most useful as it gave true bearings. However, when area and linear measures were of importance the preferred projections were those that preserved these characteristics. It is therefore not surprising that there are more than 400 projection systems!

Mapping itself involved laborious field observations and then transferring these to a two dimensional representation based on the reference ellipsoid and projection. The advent of aerial photography and satellite remote sensing brought in a new dimension to data acquisition and therefore new standards. Cartography, the technique of creating two dimensional graphic representations from this data, also developed its own standards as it progressed from manual methods to analogue and then digital techniques. Map analysis received a boost as digital methods enabled the creation of databases of different maps and their conjunctive analysis. Here too, the technology progressed from file based systems for fast access on slow computers to geo-relational databases which linked graphic files to standard relational databases. Standards were set by the technology used and were limited to an organisation. Today, fully relational spatial databases and fast desktop computers have made spatial data commonly available. Therefore it has catalysed the development of standards, which cut across institutional, community and regional barriers.

As can be seen from the above description, the process of standardisation must cover all aspects from data acquisition to pre-processing to database creation, usage and information delivery. This is summarised in Figure 1. Standards need to be developed for each module such that the data flow becomes smooth and seamless.

The process of standardisation must begin with the selection of the reference datum and the preferred map projections. Large areas will require the maps to be tiled and referenced to a geographical framework but the provision must exist to be able to access the data seamlessly across tile boundaries. The combination of datum, projection and map tiles form the national spatial framework. The following specific standards need to be addressed:

- Image Standards
- Thematic and Cartographic standards
- Geo database standards
- Output standards

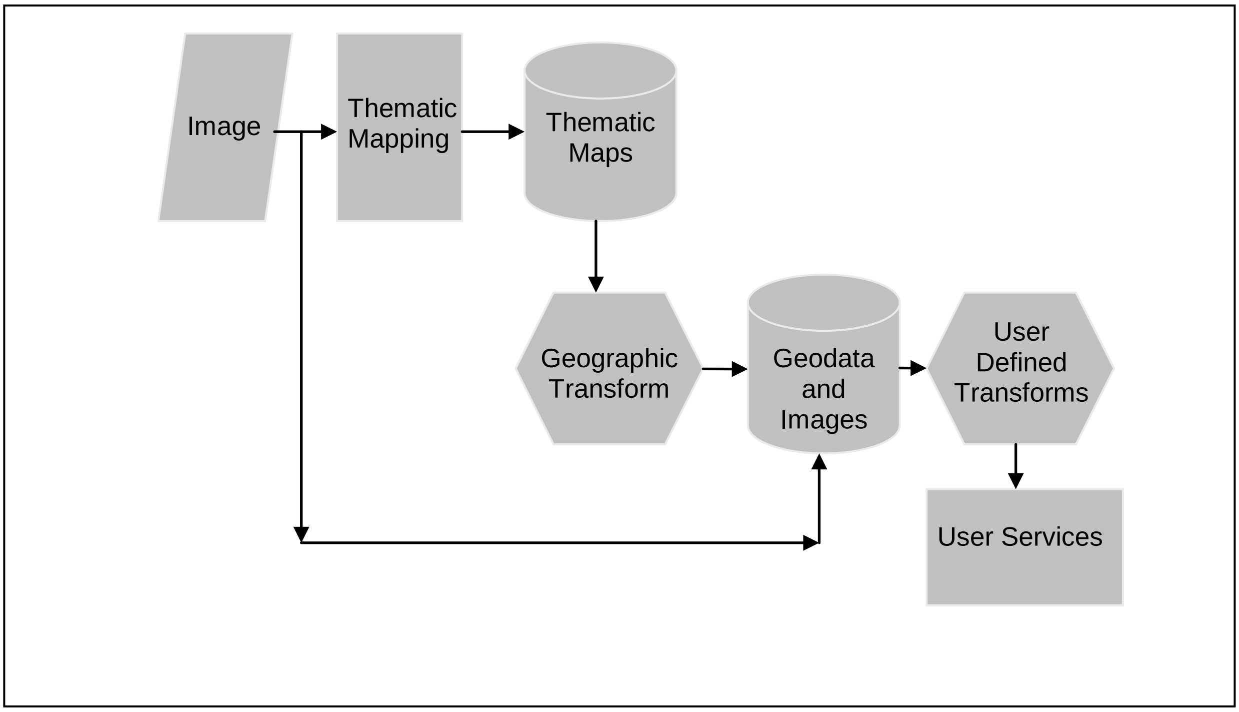

Figure 1: The Data Process Flow [Adapted from 1]

- Accuracy standards
- Contents standards
- Metadata standards
- Standards review and updating mechanism

Image standards should address the data resolution needed at different scales of mapping, referencing to the selected datum and map projection, planimetric accuracy and in case of multispectral data the tolerable band to band registration error. It should be noted that the image standards should not be tied to any one remote sensing system. The specifications should be generic and keep the final objective in view as remotely sensed images are an important input data source these specifications will impact the further products and the final database parameters. Images will be converted to thematic maps through a process of interpretation. The maps will need to be referred and tied to the national framework. Other than the standards, which are inherited from the source image it is also necessary to specify the minimum mappable unit and the planimetric and thematic classification and mapping accuracies. Where height data is involved it is necessary to specify the height accuracy and the resolution. Finally the digital format in which the maps are to be generated should be specified.

The next important step is to specify the geo-database standards. Since the national framework is defined this becomes the geo-database framework. Tie points must be identified on which the input images and maps can be referenced. The tie points are the corner references for the map tiles in the national spatial framework. A typical tie point scheme for a typical database is shown in Figure 2**.**

Other reference specifications are the coordinate units to be used, the coordinate precision and the accuracy with which the input map registers to the framework. Specifications on the registration accuracy, planimetric accuracy and the limit of coordinate movement tolerance resulting from GIS operations are important to ensure that the input maps are consistent and compatible. Other specifications are weed and sliver tolerances. Weed tolerances indicate the minimum distance between two vertices in a feature. Sliver polygons are generated during GIS operations and are removed if they are smaller than the minimum mapping unit. In the case of raster data like images and digital elevation models the pixel size has to be defined for each scale and is usually several orders better then the minimum mapping unit.

Output standards define output formats such as soft copy, hardcopy and output media types. The framework (datum and projection) is usually specified by the user. The data format can also be specified in the case of digital data. An important element is the symbology to be used, the colour schemes and patterns for different features. This is usually standardised nationally but in rare cases the user may desire a unique symbol set.

The quality of data in a database is of prime importance. Quality parameters must be defined for each level beginning with the national framework, planimetry of the input data, classification and mapping accuracies of the input maps, the minimum mapping unit and the scale distortion for analogue outputs. It is necessary that quality checks are carried out at each level to ensure the integrity of the database.

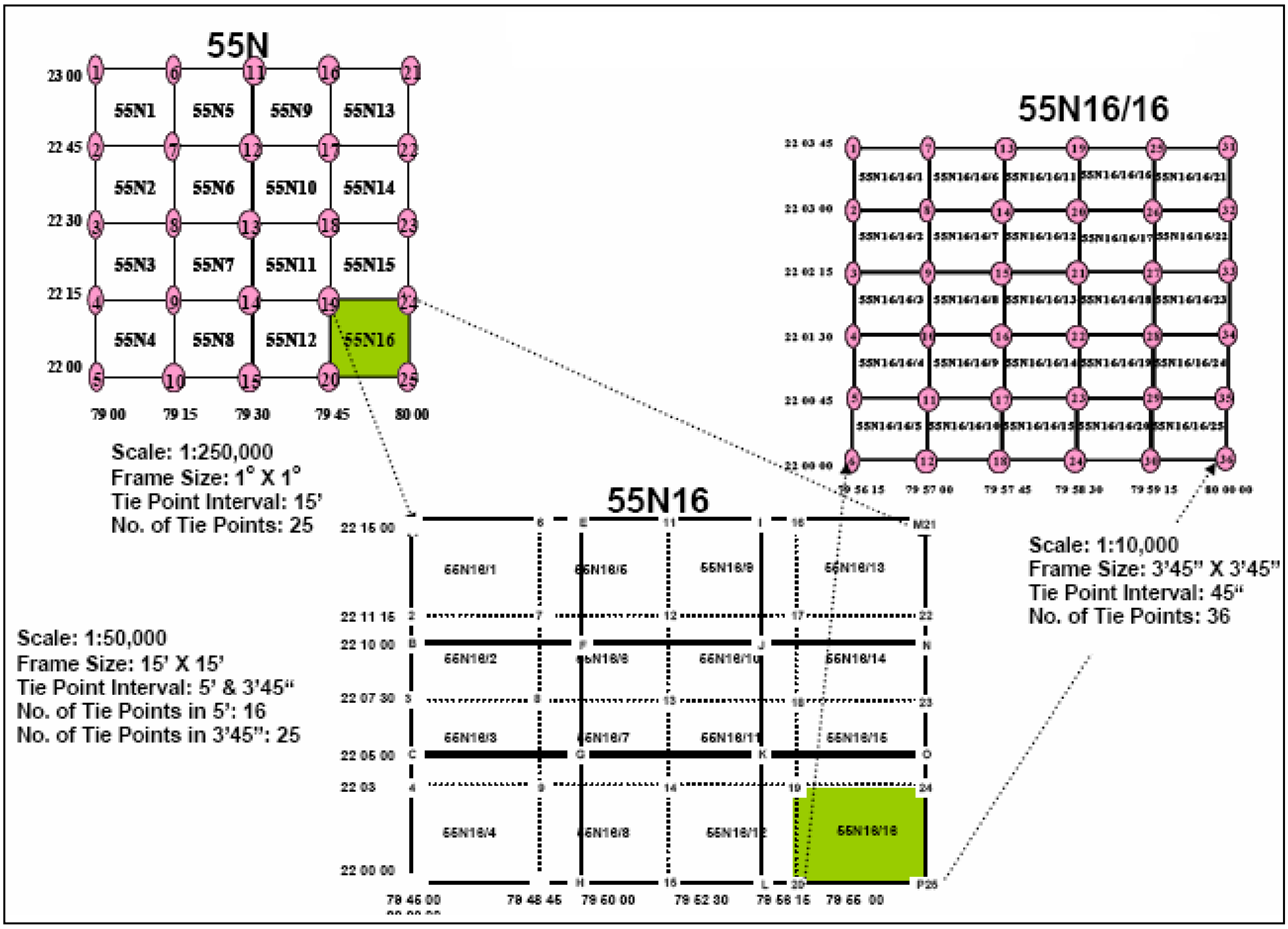

Figure 2: A tie point schematic for different scales of mapping [1]

Each input map has to have its contents defined. Predefined terminologies for features are essential to maintain semantic integrity. Classification should be hierarchical to enable map generalisation. Classification should also be flexible to enable addition, deletion and modification of classes and sub-classes. Content classification can be contentious and requires the participation of data generators and users to arrive at an acceptable solution.

An important feature of the database is the catalogue information, which provides data about the database contents. This is metadata and it also must be standardised to enable easy access to the catalogue information. Metadata must be sufficient to unambiguously specify the data without being too detailed. Typically metadata includes data source, date of creation, accuracies, extent and access information.

In closing it is important to note that the development of standards is a gradual and inclusive process. Standardisation may appear to slow down the work on hand but it pays dividends in the long run with ease of access, consistency and reliability. All stakeholders must be a party to the standards. Further, no standard can be static. It has to evolve as new requirements and new technologies emerge. Thus a standing mechanism to periodically review the standards and bring in changes when needed is an important part of the standardisation process.

3. Interoperability Specification

Data standardisation brings about semantic interoperability. All terms and specifications are well understood. However, differences in the manner of encoding the geographical data, storage, retrieval and modelling may vary from platform to platform and from application to application. Interoperability specification seeks to make such processes independent of platform, operating system and software considerations. The International Standards Organisation Technical Committee, ISO TC-211 has developed several standards for interoperability while the Open Geospatial Consortium; OGC has developed tools and processes to implement these standards.

However, in spite of these efforts the proliferation of interoperable systems is still a far cry. One reason could be the difficulty in understanding the ISO standards and OGC implementation schemas. In this context, an extremely useful document prepared by the Geospatial Applications and Interoperability Working Group of the US Federal Geographic Data Committee is the Geospatial Interoperability Reference Model, GIRM.[5] This document puts the plethora of standards in the context of mechanisms for effective cooperation between software elements. It is a consultative tool to help determine which standards and procedures are applicable in a given context. The model is aligned with the US NSDI but it does give a template for others to follow in their own country contexts.

In brief the Interoperability reference model as evolved by OGC is shown in Figure 3.

As can be seen the model depends on a distributed computing paradigm. Today the best model, which fits this paradigm is the Web based Service Oriented Architecture. Most of the implementations of inter-operable systems follow this route. [3,4] While the GIRM addresses the technical issues there are policy and managerial issues that need to be addressed as well but there are no models to fall back upon. The Return on Investment study [2] lists the possible risks to effective implementation of interoperability. These are stakeholder resistance, industry resistance and government policy.

Stakeholders may fear the openness resulting from an interoperable system. When Google Earth put high-resolution images of critical installations on open access there were fears that such detailed data could be misused. Interoperability entails high costs upfront. It is only the sustained usage that will amortise this cost over a large number of applications. Agencies that operate in a standalone mode are unable to appreciate this fact. At times agencies may adopt a deliberate standalone stance to defend their turf. Where the standards development process is not inclusive, agencies outside the process may ignore the efforts. Standards are also rejected with the excuse that the work schedule will suffer or may be subverted by adopting an ad hoc project based standard. On the industry front the resistance comes from a fear of losing markets, compromising its intellectual property and losing money in supporting standards. These problems are compounded by the fact that geospatial industry tends to be local to a country, unlike global industries that are mandated to follow standards. For example the telecommunications industry has to follow international standards or perish but a geospatial software vendor can remain proprietary and still serve a dedicated local community. At the government level failure can occur if standards are dictated or where key players like industry and other stakeholders are shut out of the process. The government has to protect the interest of all stakeholders to contribute to the success of interoperability. One of the dilemmas facing the government is the issue of software patents. It is globally perceived that this is stifling innovation by disabling open, collaborative methods and procedures for software development and use.

Interoperability is a developing technology and its early practitioners are a part of the learning process. More and more stakeholders need to come on board to accelerate the process of development. However, certain care must be taken to ensure that the imperfections that still exist are understood and anticipated. Some of the steps [6] recommended are as follows:

1. Recognise that data services can go down. In cases of emergency use local or pre-cached data
2. Data providers should not provide access to raw data. Use data aggregation and web services. Educate the user on the overheads of raw data caching and the dangers of multiple versions of the same data.
3. Data access should be regulated by use and user
4. Data quality must be maintained through adherence to standards and proper metadata maintenance
5. Integrate only those data sets that can be integrated. Data providers should include appropriate caveats in the metadata
6. Establish and follow a system-security policy. Web access does have its share of horror stories. Revert to standard processes if doubt exists
7. Protect data privacy through privacy-impact assessment.
8. Be clear as to why interoperability is being implemented in the context of your organisational objectives.

Interoperability as it appears today is web based. Initially it seemed that the web would be used for browsing and data procurement. However, with the proliferation of web services the picture is changing. As Google Maps, Wikimapia and other initiatives have shown, ownership of data is not mandatory. Access through the web and access to services is more important. This requires data providers to change their model for data distribution and data users to learn new ways of obtaining their required information through web services. Such an approach might actually be financially beneficial on the long run. Data providers will not have to manage distribution of huge data volumes on physical media. Data users will need to only store their final results and not intermediate process outputs. Data security will be easier as it will concentrate on one major area - web security. Software vendors and value adders will need to provide web services and their ROI shall depend on per use basis rather than box sales. As geospatial applications proliferate the costs and management issues will drive the industry, users and government in this direction.

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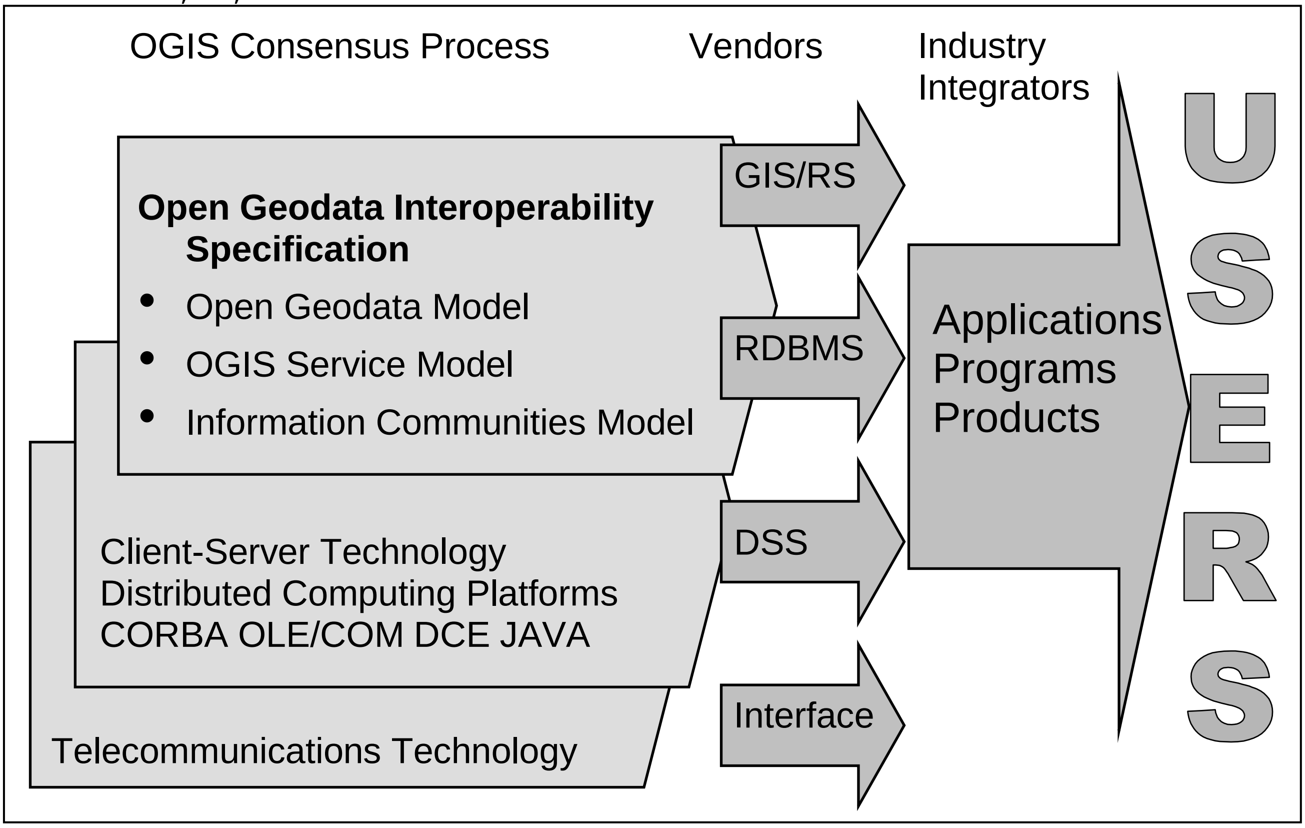

Figure 3: The OGC Interoperability Specification Model

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Ocean Data and Information Management – Open Standards and Interoperability

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1. Introduction

The mission of the Indian National Centre for Ocean Information (INCOIS) is to provide Ocean data, information and advisory services to society, industry, government and scientific community through sustained ocean observations and constant improvements through systematic and focussed research in ocean data, information management and ocean modeling. We have made significant progress in ocean observing systems, with a mix of in-situ platforms and satellite systems and concomitant capability in retrieval of data, use of models, generation of ocean information and advisories, web-based services and value-added services in specific areas. Availability of such information, in near-real-time is essential for spatial analysis, decision support systems and for forcing models that lead to climate predictability, both short-term and long-term.

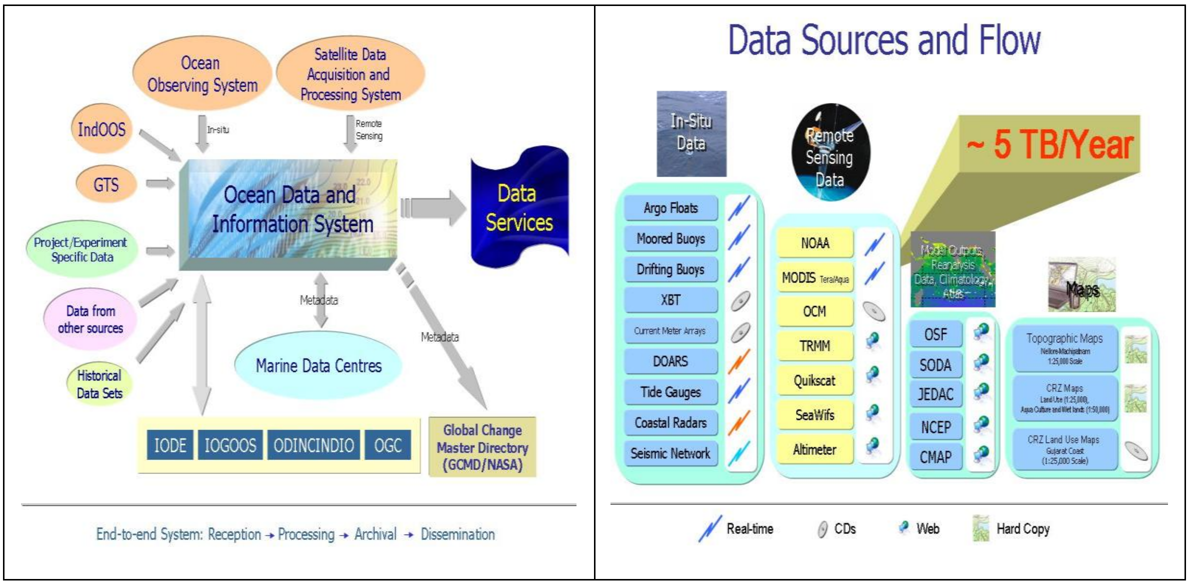
The Ocean Observing System in the Indian Ocean is being implemented by INCOIS by establishing a network of in-situ platforms particularly the cutting edge technology such as Argo floats and other observational platforms. Further, INCOIS is playing a lead role in the Indian Ocean by establishing the Indian Ocean Global Ocean Observing System (IOGOOS), where 25 members from 19 countries are members and also coordinating the implementation of International Argo Programme in the Indian Ocean.

Apart from being the observer of the Indian Ocean, INCOIS serves as the National Oceanographic Data Centre, National Argo Data Centre, Regional Argo Data Centre, and also the regional data centre and clearing house for the Indian Ocean region for the IOGOOS Programme. Each of these programmes has a definite set of standards and protocols for data management, again which are compatible with Intergovernmental Oceanographic Commission (IOC), World Meteorological Organisation (WMO), Global Coastal Observing System (GCOS) and Global Earth Observation System of Systems (GEOSS) data principles. INCOIS, being the member of Intergovernmental Oceanographic Data Exchange Programme (IODE) of IOC implements the standards and protocols as per the guidelines of international standards for data exchange, while meeting its national policy.

INCOIS, being the central repository for marine data in the country, receives voluminous oceanographic data in real time, from a variety of in-situ and remote sensing observing systems. The objectives of the data centre at national and regional levels are acquisition, processing, quality control, inventory, archival and dissemination of data and data products in accordance with national responsibilities and also responsible for international data exchange. To meet these objectives and data demands from wide spectrum of users, it is necessary to harmonise the data in standard formats, applying quality control procedures, generation of meta data and data bases for providing data services and value added data products, while adopting international standards for seamless exchange of data by exploiting the latest advances in the information and communication technology. Further, the data from observing system both in-situ and satellites need to be communicated for developing robust ocean and coastal forecasting system.

2. Ocean Data and Information System

We are developing the Ocean Data and Information System (ODIS), a one stop shop for providing information on physical, chemical, biological and geological parameters of ocean and coasts on spatial and temporal domains that is vital for both research and operational oceanography. The ODIS is supported by the data received from both the in-situ platforms and satellites, Global Telecommunication System (GTS), Project/Experiments funded by the Ministry of Earth Sciences, data from the other sources (web) and the historical data exclusively retrieved for the Indian Ocean from historical data sets viz., World Ocean Data Base 2005 (WODB), World Ocean Circulation Experiment, etc.



INCOIS has strong organisational arrangements with all the agencies involved in ocean observational programmes, so that there is real-time/near real-time flow of data to ODIS. Further, INCOIS plans to strengthen the ODIS with the data generated from the chain of Marine Data Centres, MoES Institutions, Academia, etc., and networking of these centres and enabling them on the INCOIS web-site with appropriate access privileges. The estimated data flow to the ODIS is about 5 TB per year.

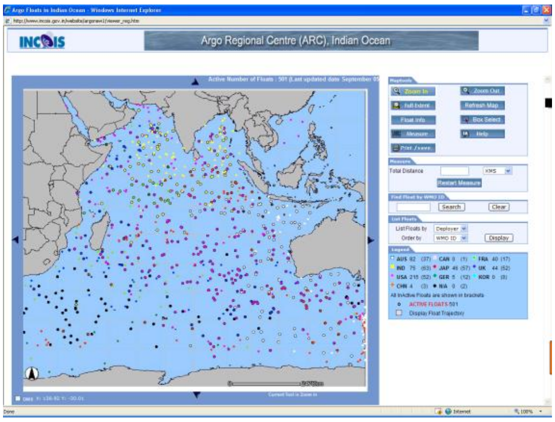
We have developed web interfaces for display of real time data from Moored Buoys, Tide Gauges and Remote Sensing Data (AVHRR-NOAA and MODIS-Terra & Aqua). An application for display of COMAPS Data was also developed. Metadata base was developed using the Marine Environmental Data Inventory (MEDI) Software developed by the Joint Oceanographic Data Centre (JODC), Australia as per the ISO 9115 Standards. This data can be published on the Global Change Master Directory (GCMD/NASA) for global visibility. INCOIS as the National and Regional Argo data centre is providing the argo float data from the Indian Ocean in real time. Individual float-wise data products and monthly girded data products are also made available through Web-GIS application.

3. Open Standards and Interoperability

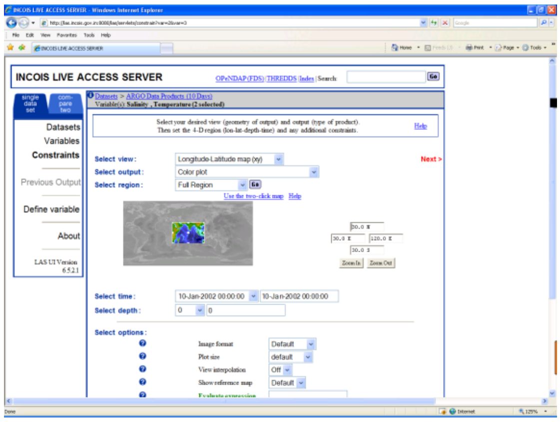
The main challenge of the data centre is managing highly heterogeneous and voluminous data, developing open standards and addressing the interoperability issues for seamless exchange of data. Open standards and interoperability are being widely used for the land based GIS applications and now gaining wider acceptance in marine community. The recent international projects in ocean sciences deals with compliance with open standards and interoperability for exchange of the data.

Some of the issues pertaining to open standards and interoperability in ocean data information management have already been addressed in the Argo Programme, where INCOIS is playing a lead role in the

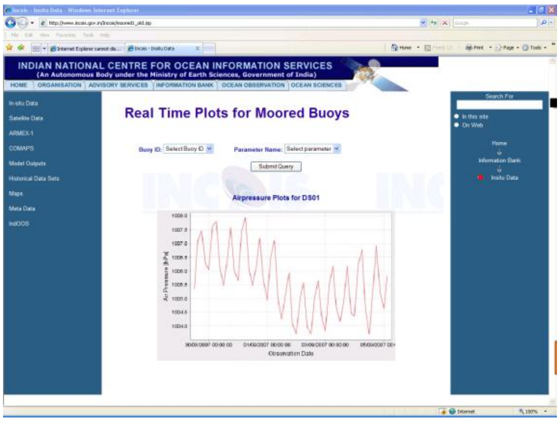
Indian Ocean region. Argo is a pioneering, internationally coordinated effort to establish a global array of 3,000 free-drifting profiling floats that measures the



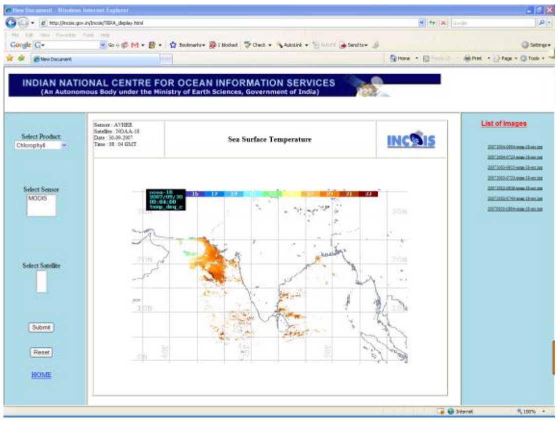
Argo Float Data on Web



Live Access Server



Real-time display of in-situ observations



Real-time display of remote sensing observations

temperature and salinity of the upper 2000 m of the ocean. This allows, for the first time, continuous monitoring of the temperature, salinity, and velocity of the upper ocean, with all data being relayed and made publicly available within hours after collection globally. The Argo Data Management System, finalised by the International Argo Science Team (IAST) and its Data Management Group is configured around three levels of Data Centres viz. national, regional and global. These data management practices, indirectly address open standards and data exchange among the participating members.

INCOIS has been providing a wide variety of ocean information and advisory services especially in the areas of Potential Fishing Zone, Ocean State Forecast, Indian Argo Project, IOGOOS besides facilitating users with information Bank, various projects and programmes. INCOIS Website (www.incois.gov.in) matured as a prime vehicle for delivery of ocean data, information and advisory services and it has been widely used website among wide spectrum of users. The web-based multi-lingual on-line information delivery system with Web-GIS capability enables the users to query, analyse, visualise and download ocean data, information and advisories for their regions of interest. Location based services are need of the hour.

INCOIS has developed the Live Access Server (LAS), a highly configurable Web server designed to provide flexible access to geo-referenced scientific data. The LAS allows the user to download and visualise data using a simple graphical user interface. LAS enable the Web user to visualise data with on-the-fly graphics, request custom subsets of variables in a choice of file formats, access background reference material about the data (metadata) and compare variables from distributed locations. LAS enable the data provider to unify access to multiple types of data in a single interface, create thematic data servers from distributed data sources offer derived products on the fly and offer unique products (e.g. visualization styles specialised for the data). LAS is emerging as a promising web application for providing the oceanographic data with open standards and addresses interoperability issues.

INCOIS joined the Ocean Science Interoperability (Ocean IE) Project evolved by the Open Geospatial Consortium (OGC), in its early stages to play a major role in developing open standards and addressing the interoperability issues. These developments certainly facilitate enormous potential for sharing oceanographic and meteorological data with common standards for providing web-based and location based services. Our data and information management would focus on the standards, protocols for data, metadata, data discovery, transport, on-line browse and archival policies. It should facilitate the use and exploitation of open standards and interoperability addressed by international community, promote coordination and cooperation with other data programs, participate in and proactively coordinate with relevant national, regional and international data management activities.

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Contents

Progress on 'Geo-spatial Interoperability' under DST's 'Natural Resources Data Management System' (NRDMS) Programme

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1. Introduction

Geo-spatial Interoperability is the ability of systems to access, display and analyze data from a number of distributed but inter-connected sources/ databases residing in different organizations/ agencies/ user communities. It is a pre-requisite to effective on-line sharing of geo-spatial data between the databases in a Spatial Data Infrastructure (SDI) environment. Several international standards or interface specifications like Geography Mark-up Language (GML), Web Map Service (WMS), Web Feature Service (WFS) and Catalogue Service on Web (CSW) etc., are available from the Open Geo-spatial Consortium (OGC)/ International Standardization Organization (ISO) for ensuring Geo-spatial Interoperability. Under the Natural Resources Data Management System (NRDMS) Programme of Department of Science & Technology, pilot studies have been undertaken to test the utility of these standard specifications and deploying those in our data management practice.

Natural Resources Data Management System (NRDMS) is a multi-disciplinary and multi-institutional R & D Programme to help operationalise the concept of Decentralised Planning. Conceived and launched by the Department in 1982, the Programme seeks to develop and demonstrate requisite tools/ technologies/ methodologies in support of this need. With the recent changes at the policy level (e.g. National Map Policy, Constitution of National Spatial Data Infrastructure, Right to Information Act etc.) and advancements in various fields of Information & Communication Technologies, activities of NRDMS are being re-oriented to better address user's geo-spatial data/ information needs. The task of Decentralised Planning – being a multi level effort involving several Institutions or Line Departments and their data sets - requires geo-spatially interoperable data/ information systems for smooth on-line data sharing.

Realising the above need, a Working Group has been constituted on 'Geo-spatial Interoperability' with the task of conducting test bed experiments on Indian data sets and working out strategies for ensuring interoperability. Considering the utility of this emerging concept in setting up of SDIs for Decentralised Planning, three OGC/ ISO specifications like GML, WFS, and WMS have been chosen for testing.

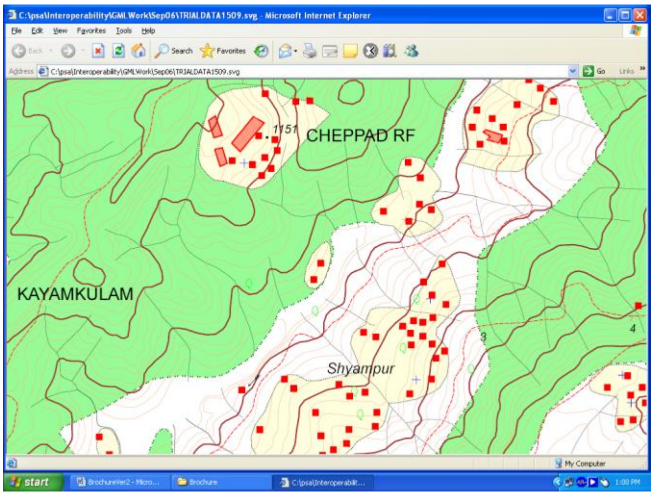

Figure 1: Zoomed display of the Geography Mark up Language (GML) Prototype of a sample 1:50,000 topographic sheet in Scalable Vector Graphics (SVG) format on MS Internet Explorer

GML defines a technique of encoding geographic data and its attributes in Extensible Mark up Language (XML) for their transport and storage using web technologies. It is extensible, supporting a wide variety of geo-spatial tasks, from portrayal to analysis. It separates content from presentation (styling), and permits easy integration in a GIS environment. The Interoperability Working Group has developed a GML prototype (Figures 1 and 2) out of a test topographic sheet provided by Survey of India (SOI) and the prototype has been used in demonstrating interoperability. A GML Relay was organised for this purpose with the participation of leading vendors like ESRI, ROLTA, and Oracle-India in January 2006 [Lead Research Agency: National Spatial Data Infrastructure, Survey of India, New Delhi].

The Web Map Service (WMS) specification helps provide access by users to maps rendered by map servers on the Internet. It enables dynamic construction of a map as a picture or as a 'packaged' set of geographic feature data. It answers basic queries about the content of the map and informs other programs about the maps it can produce and which of those can be further queried. A prototype on Indian test data implementing WMS specifications of OGC has been developed and tested using the sample GML data of the topographic sheet. As a part of this experiment to serve maps/ data to the Line Departments at districts/ blocks/ panchayats from the district NRDMS Enterprise GIS server, DEEGREE – a freely downloadable OGC-compliant software package in the R & D domain - has been used to demonstrate provision of block level maps of Bankura and Purulia districts (West Bengal) (Figure 3) [Lead Research Agency: Indian Institute of Technology, Kharagpur].

In contrast to the WMS specification that helps deliver a picture, a WFS implementation in a web client supports dynamic access and use of feature (vector) data and associated attributes by the user community. The Working Group has developed and tested a prototype of WFS specifications capable of sharing GML data with a WMS server for rendering of the map and serving to a user agency.

Be it national level Survey Organisations or NRDMS data centres at Districts, well-organised databases are necessary for proper maintenance of data sets, querying and on-line sharing. Formal description of a database based on the user's need, called schema development, is an essential pre-requisite. A Schema Generator Framework has been developed for preparing GIS database schema in an RDBMS, populating the schema from GML data, and then providing web-based feature/ map service. Consisting of a set of automated tools, the Framework has been tested and demonstrated on the GML prototype of the sample topographic data mentioned above in creating a relational database to facilitate sharing. The resulting database has been integrated with DEEGREE Web Feature Server package for demonstrating provision of feature service (Figure 4) [Lead Research Agency: Indian Institute of Technology, Bombay].

Spatial data sets are produced by different organisations using different data models and standards. Experiences indicate that different organisations, in their data models, at times, use different feature names with the same meaning or the same feature name with different meanings or different classification hierarchies. Automated integration of spatial data sets from different organisations is thus a challenging task. Such differences in the meaning of the spatial data – called semantic heterogeneities – are resolved by creating ontologies (ontology is 'an explicit specification of a shared conceptualisation') from the available meta-data and establishing a knowledge-based mapping between them. A framework for resolving semantic heterogeneities in spatial data has been developed and demonstrated to facilitate integration of spatial data from different data sources/ agencies. Semantic interoperability in spatial data sets will lead towards establishing an intelligent geo-semantic web capable of supporting quicker data/ information access and discovery [Research Agency: Indian Institute of Technology, Bombay].

Based on the outcomes and observations of the above tests and experiments, the Working Group has recommended implementation of organisational information systems using the above specifications so that SDIs at different levels or in domains become a reality. NRDMS Project Teams and Groups are currently working towards defining domain-oriented conceptual data models in sectors like biodiversity, ground water, and infrastructure facilities (roads) so as to build well-organised SDI data nodes while ensuring syntactic & semantic inter-operability.

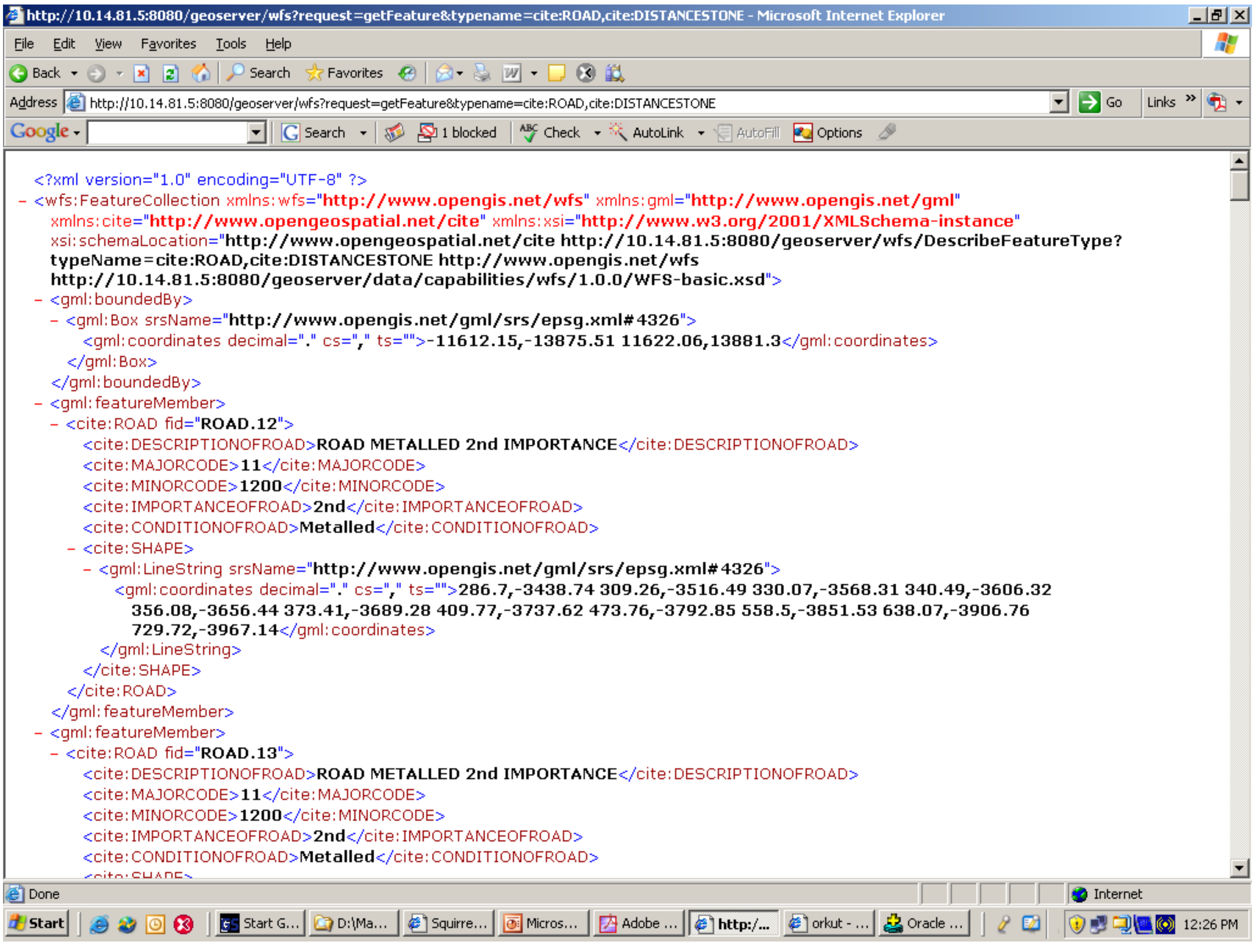

Figure 2: An extract of the GML prototype (text mode) created out of 1:50,000 topographic sheet

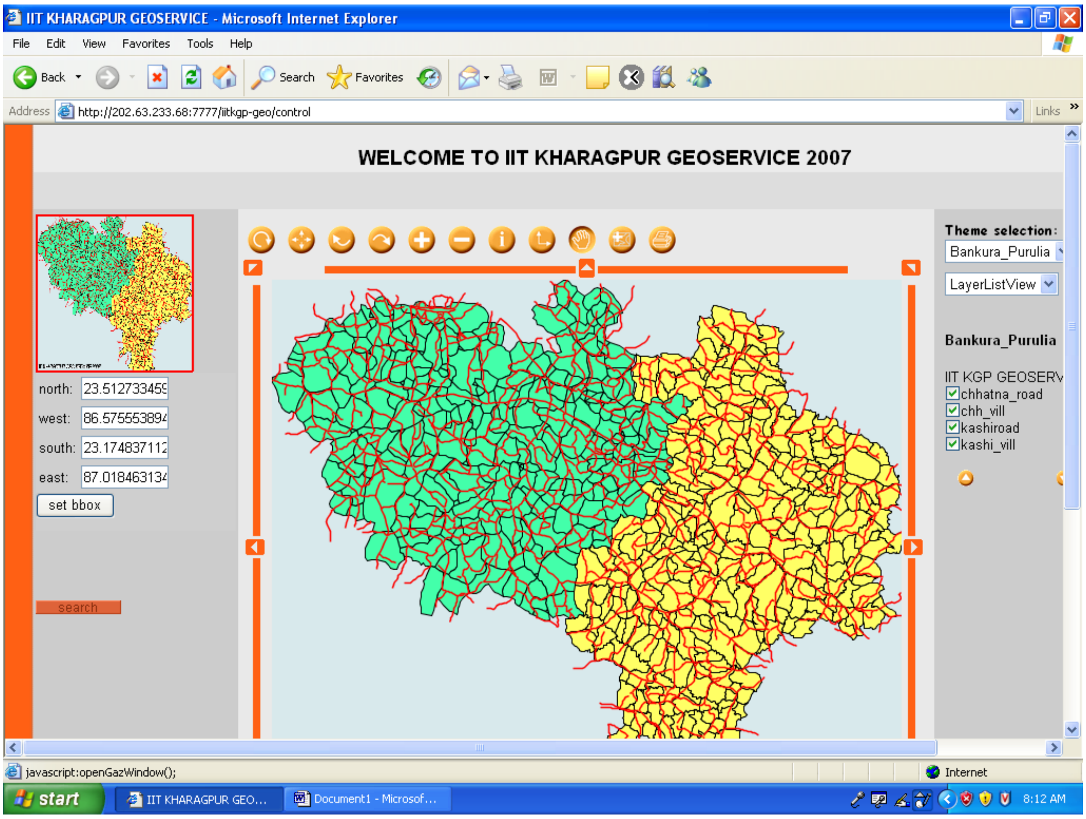

Figure 3: Mouza and road data layers of Kasipur and Chhatna blocks of the adjacent Purulia and Bankura districts of West Bengal on display on MS Internet Explorer retrieved over the web using the OGC-compliant DEEGREE Web Map Server

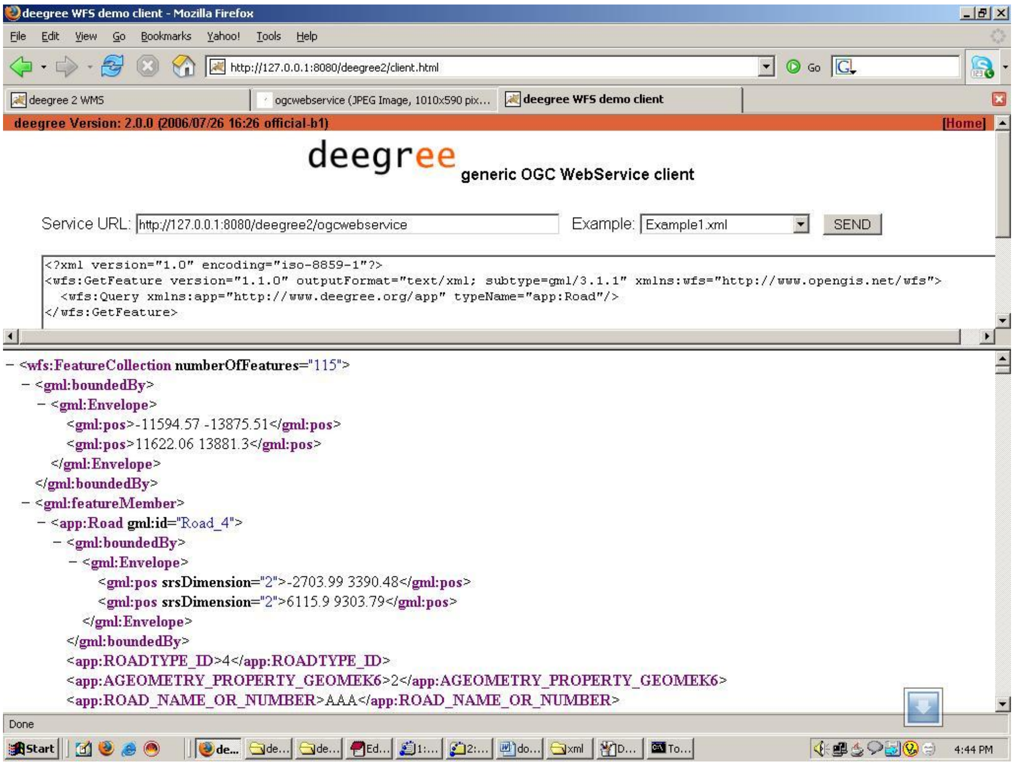

Figure 4: An extract of the GML prototype downloaded from the Relational Database using DEEGREE Web Feature Server

Implementing a Geospatial Web Server

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1. Introduction

Bhaskaracharya Institute for Space Applications and Geoinformatics (BISAG) has developed geospatial applications for different departments. These are deployed as web based applications which can be accessed using a standard browser. However, these web servers require the use of proprietary GIS software in the back end server. Currently, several commercial desktop GIS software systems are used in BISAG. Some of them are ESRI ArcInfo and ArcView, GeoMedia and Autodesk Map depending on specific project requirements. Each software has its own proprietary data model and database storage structure. Thus, geographical databases based on these softwares cannot communicate with each other without data conversion. In order to exchange information and share geo-database resources among different users, conversion tools have to be developed to transfer data from one format into another. Furthermore, these diverse desktop GIS database structures make remote data exchange and sharing more difficult because of limited accessibility and required data conversion. This paper describes a geospatial web server developed at BISAG using Geography Markup Language (GML) and OGC compliant Web Map Servers**.** GML provides an encoding scheme that enables representation and manipulation of geographic information on the web. The objective of the project was to develop a geospatial web server that could be used with any GIS software.

2. Geography Markup Language (GML)

The GML is an extension of the Extensible Markup Language (XML) developed by the World Wide Web Consortium. As the name implies it is an extension which is specific to geographical data. GML has been developed by the Open Geospatial Consortium(OGC) as an encoding language for geographical data for storage and transport across heterogeneous systems.

Any document has three components, its structure, its content and its style of representation. Consider this article. It has a structure in terms of paragraphs and headings. It has content in terms of words, and it has a style in terms of fonts, font sizes, margins, etc. Usually, all three components are mingled into one document. However, in XML these three components are represented by three files. The structure is stored in a schema file, the content in a data file and the representation style in a stylesheet file. The advantages of this representation is that we need to define the schema once only; for example we can define a schema for land use data and refer all land use data files to this schema. Complex data structures seen in geographical data is very well represented by XML Schemas. Given a schema and data file we can have different stylesheets to meet the requirements of different users. All the three files are written in XML. As XML is text based a simple text editor is sufficient to edit these files. In practice, however, it is better to use tools as these files can be very large and therefore difficult to manage in simple text editors.

The power of XML lies in the fact that it is machine readable hence systems can communicate with each other without human intervention. Secondly, XML has many features like XQuery, XPath, XPointer which can be used to manipulate and query the XML files. Simple GIS functions can be realised using these calls. Therefore many times XML is considered to be a database language or a programming language. This is not correct. XML is not a database or programming language but it can be used in a database and it can be accessed using Java or C++. XML is an encoding language which provides very versatile capabilities.

GML defines various geographical data types. For our implementation we have used the OGC Simple Feature Model which is meant for vector data in a 2D framework. GML provides three schemas; feature, geometry and links. These are known as base type schemas. Using these we define application schemas for our specific application like land use.

3. Using GML

In actual practice we had databases created in ArcInfo in the form of shape files. We used tools to convert these datasets to GML. Although GML is in version 3.1.1 but we decided to use the Simple Feature Model which is the same as GML 2.0.

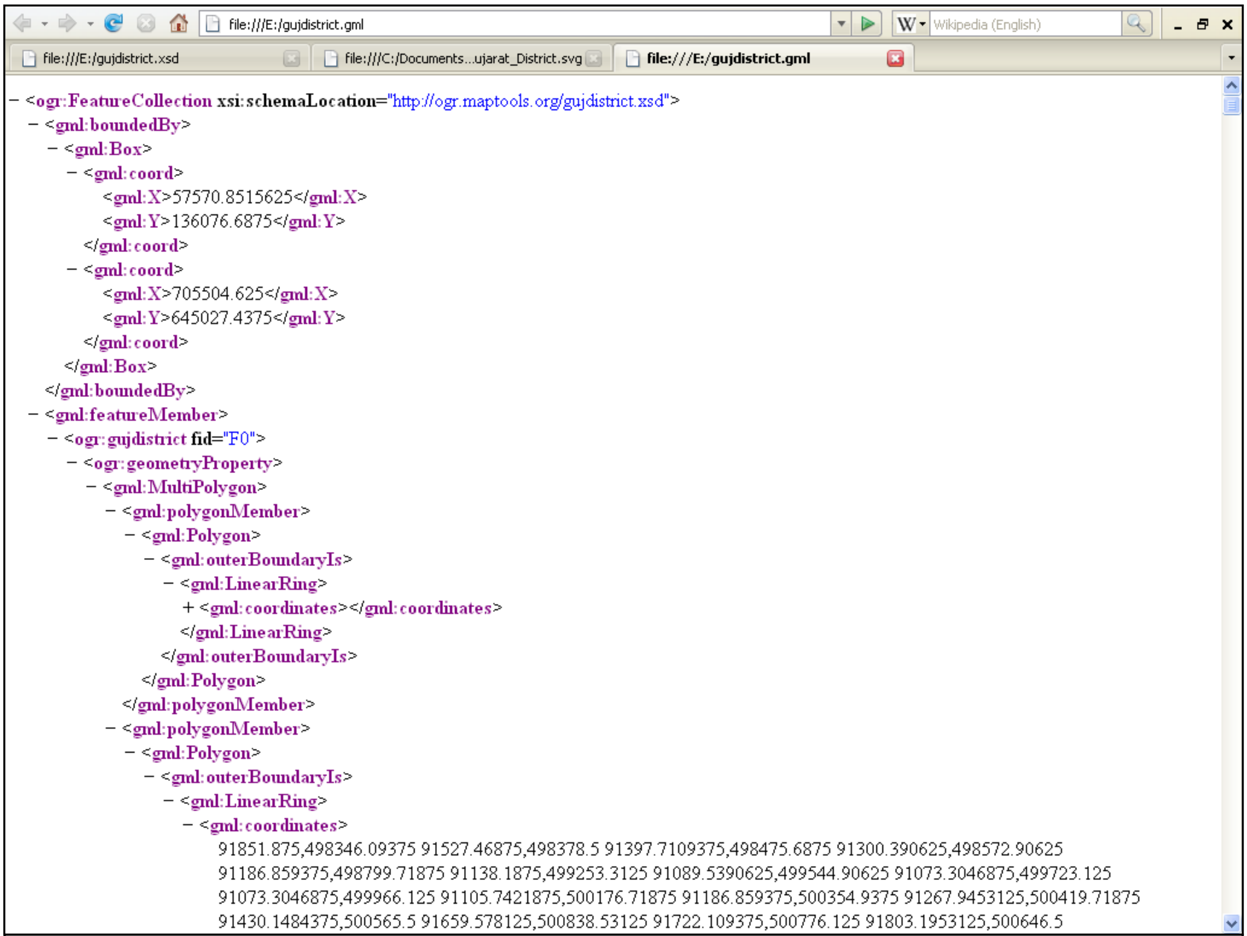
```
- <xs:schema targetNamespace="http://ogr.maptools.org/" elementFormDefault="qualified" version="1.0">
    <xs:import namespace="http://www.opengis.net/gml" schemaLocation="http://schemas.opengeospatial.net/gml/2.1.2/feature.xsd"/>
    <xs:element name="FeatureCollection" type="ogr:FeatureCollectionType" substitutionGroup="gml:_FeatureCollection"/>
  + <xs:complexType name="FeatureCollectionType"></xs:complexType>
    <xs:element name="gujdistrict" type="ogr:gujdistrict_Type" substitutionGroup="gml:_Feature"/>
  - <xs:complexType name="gujdistrict_Type">
    - <xs:complexContent>
      - <xs:extension base="gml:AbstractFeatureType">
        - <xs:sequence>
            <xs:element name="geometryProperty" type="gml:GeometryPropertyType" nillable="true" minOccurs="1" maxOccurs="1"/>
          - <xs:element name="D2K" nillable="true" minOccurs="0" maxOccurs="1">
            + <xs:simpleType></xs:simpleType>
            </xs:element>
          - <xs:element name="SUM_AREA" nillable="true" minOccurs="0" maxOccurs="1">
            - <xs:simpleType>
              - <xs:restriction base="xs:decimal">
                  <xs:totalDigits value="19"/>
                  <xs:fractionDigits value="4"/>
                </xs:restriction>
              </xs:simpleType>
            </xs:element>
          + <xs:element name="SUM_PERIME" nillable="true" minOccurs="0" maxOccurs="1"></xs:element>
          + <xs:element name="FIRST_DNAM" nillable="true" minOccurs="0" maxOccurs="1"></xs:element>
          + <xs:element name="DNAME" nillable="true" minOccurs="0" maxOccurs="1"></xs:element>
          + <xs:element name="NAME_GJR" nillable="true" minOccurs="0" maxOccurs="1"></xs:element>
          + <xs:element name="COSTAL" nillable="true" minOccurs="0" maxOccurs="1"></xs:element>
          </xs:sequence>
        </xs:extension>
      </xs:complexContent>
    </xs:complexType>
  </xs:schema>
```

Figure 1: The Application schema file gujdistrict.xsd showing description of the data structure

As an example we will describe the design of an application schema for district boundaries of Gujarat. Figure 1 shows the schema file gujdistrict.xsd. The first line indicates that the schema names are from Maptools. The second line shows that the schema is an OGC GML and is based on the OGC feature.xsd generic schema file. The feature type is complex as it contains many elements. Each element is described. As an example the description of the element Sum_Area is shown. It is specified as a floating number with 19 digit integer and four digit mantissa. In general each application schema should begin from the top level and work down to each simple element component.

Figure 2 shows a small portion of the GML file gujdistrict.gml. Note that both the files are using XML syntax. The GML file refers to the relevant schema file, gujdistrict.xsd at the beginning. The xsd file has an element 'geometryProperty' which is of the GML 'GeometryPropertyType' class. In the XML file the 'geometryProperty' is further expanded as type 'MultiPolygon' containing several 'polygonMembers' and a typical member is a 'LinearRing' whose coordinates are then specified.

Creating these file manually is a daunting task but there are excellent tools available. The tools we used are a converter and editors. The converter we used is an Open Source tool, ogr2ogr from MapTools [2]. There are many editors like XML Writer, Stylus Studio, Exchanger XML Editor and Oxygen Editor. These are priced products.



```xml
- <ogr:FeatureCollection xsi:schemaLocation="http://ogr.maptools.org/gujdistrict.xsd">
  - <gml:boundedBy>
    - <gml:Box>
      - <gml:coord>
          <gml:X>57570.8515625</gml:X>
          <gml:Y>136076.6875</gml:Y>
        </gml:coord>
      - <gml:coord>
          <gml:X>705504.625</gml:X>
          <gml:Y>645027.4375</gml:Y>
        </gml:coord>
      </gml:Box>
    </gml:boundedBy>
  - <gml:featureMember>
    - <ogr:gujdistrict fid="F0">
      - <ogr:geometryProperty>
        - <gml:MultiPolygon>
          - <gml:polygonMember>
            - <gml:Polygon>
              - <gml:outerBoundaryIs>
                - <gml:LinearRing>
                  + <gml:coordinates></gml:coordinates>
                  </gml:LinearRing>
                </gml:outerBoundaryIs>
              </gml:Polygon>
            </gml:polygonMember>
          - <gml:polygonMember>
            - <gml:Polygon>
              - <gml:outerBoundaryIs>
                - <gml:LinearRing>
                  - <gml:coordinates>
                      91851.875,498346.09375 91527.46875,498378.5 91397.7109375,498475.6875 91300.390625,498572.90625
                      91186.859375,498799.71875 91138.1875,499253.3125 91089.5390625,499544.90625 91073.3046875,499723.125
                      91073.3046875,499966.125 91105.7421875,500176.71875 91186.859375,500354.9375 91267.9453125,500419.71875
                      91430.1484375,500565.5 91659.578125,500838.53125 91722.109375,500776.125 91803.1953125,500646.5
```

Figure 2: A snippet of the GML data file gujdistrict.gml

4. Web Map Services

To get a web based application with geospatial data we have used two web services, Web Feature services (WFS) [3] and Web Map Services (WMS) [2] which provide facilities to discover, access, query and manipulate data in the form of maps. The development of such a standardised web application to access geospatial data will ultimately reduce the dependence on costly proprietary client side software to access such data. Thus this application would ultimately scale down the cost factor associated with access to such data and hence make it available even for the common person. The simplest server is the WMS, which allow data discovery, access, display and query and thus provides the human interface. The WFS also allows data editing and is therefore more complex and used for machine to machine interface. For human access the WFS talks to a WMS.

4.1 WMS: A Web Map Service (WMS) produces maps of georeferenced data. We define a "map" as a visual representation of geodata; a map is not the data itself. The OGC Web Map Service allows a client to overlay map images for display served from multiple Web Map Services on the Internet.

The OGC WMS Standard specifies the behaviour of a service that produces georeferenced maps. This standard specifies operations to retrieve a description of the maps offered by a service, to retrieve a map, and to query a server about features displayed on a map. This Standard is applicable to pictorial renderings of maps in a graphical format. This standard is not applicable to retrieval of actual feature data or coverage data values. These maps are generally rendered in a pictorial format such as PNG, GIF or JPEG, or as vector-based graphical elements in Scalable Vector Graphics (SVG) or Web Computer Graphics Metafile (WebCGM) formats. This specification standardizes the way in which maps are requested by clients and the way that servers describe their data holdings. This document defines three operations, the first two of which are required of every WMS.

1. **GetCapabilities** (required): Obtain service-level metadata, which is a machine-readable (and human-readable) description of the WMS's information content and acceptable request parameters. In other words, tell other programs about its holdings, what maps it can produce and which of those can be queried further.
2. **GetMap** (required): Obtain a map image whose geospatial and dimensional parameters are well-defined. Produce a map (as a picture, as a series of graphical elements, or as a packaged set of geographic feature data). To produce a map, the query parameters indicate which area of the Earth is to be mapped, the coordinate system to be used, the type(s) of information to be shown, the desired output format, and perhaps the output size, rendering style, or other parameters.
3. **GetFeatureInfo** (optional): Ask for information about particular features shown on a map.Answer basic queries about the content of the map, the URL parameters indicate what map is being queried and which location on the map is of interest.

4.1.1 *Get Capabilities:* A WMS client (e.g. a standard Web browser) can ask a WMS server to do these things just by submitting requests in the form URLs. The content of such URLs depends on which of the three tasks is requested. All URLs include the WMS Specification version number and a request type parameter.

First, a WMS client needs to find out what it can request from a particular WMS server. These are known as the WMS server's service capabilities. A WMS client makes a "Capabilities Request" in order to find out the map layers, associated styles, projections and available output formats a WMS server supports. A typical GetCapabilities request looks like this:

http://www.opengeospatial.org/wms/process.cgi?REQUEST=GetCapabilities&VERSION=1.1.0&SERVICE=WMS

This request can be broken up into URL components, as shown below:

URL Component	Description
http://www.opengeospatial.org/wms/process.cgi?	URL Prefix of server
VERSION=1.1.1&	Request Version
REQUEST=GetCapabilities&	Request Name

The Get Capabilities request returns an XML document describing the WMS service's general information and specific information about the available maps and acceptable request parameters in terms of layers, styles and formats. This is also known as the WMS server's service-level metadata.

4.1.2 *GetMap:* The Get Map request returns a map image whose geospatial and dimensional parameters are well defined. The map operation of the GetMap request is invoked by a client to get an image. The image contains a picture of a map covering a geographic area or a set of graphic elements that lie in a geographic area. The picture could be a bit map or vector graphics. The Get Map request allows the WMS client to specify distinct layers, the spatial reference system (SRS), the geographic area, and other parameters describing the returned map format. Upon receiving the GetMap request, a WMS server will either satisfy the request or return an exception in accordance with the exception instructions contained in the GetMap request.

4.1.3 *GetFeatureInfo* The GetFeatureInfo request returns information about particular features shown on a map. If a WMS server supports this operation, its maps are said to be "queryable," and a WMS client can request information about features on a map by adding to the map URL additional parameters specifying a location (as an X, Y offset from the upper left corner) and the number of nearby features about which to return information.

4.2 WFS: The OGC Web Feature Service allows a client to retrieve and update geospatial data encoded in Geography Markup Language (GML) from multiple Web Feature Services. A WFS can only talk to another machine. If a human has to access a WFS it does so through a WMS or a proprietary interface supplied by OGC compliant proprietary software. Apart from the WMS capabilities a WFS also has the following features:

4.2.1 *GetGmlObject*: A web feature service may be able to service a request to retrieve element instances from a larger GML file. It should be noted that a WFS returns actual GML encoded data corresponding to the request.
4.2.2 *Transaction*: A web feature service may be able to service transaction requests. A transaction request is composed of operations that modify features; that is create, update, and delete operations on geographic features.
4.2.3 *LockFeature*: A web feature service may be able to process a lock request on one or more instances of a feature type for the duration of a transaction. This ensures that serialisable transactions are supported. WFS always returns actual data and not styles maps as in the case of a WMS. WFS data is therefore only machine-readable. WFS access has to be regulated through an authentication procedure. Based on the operation descriptions above; three classes of web feature services can be defined:
4.2.4 *Basic WFS*: Basic WFS would implement the GetCapabilities, DescribeFeatureType and GetFeature operations. This would be considered a READ-ONLY web feature service.
4.2.5 *XLink WFS*: An XLink WFS would support all the operations of a basic web feature service and in addition it would implement the GetGmlObject operation for local and/or remote XLinks, and offer the option for the GetGmlObject operation to be performed during GetFeature operations.
4.2.6 *Transaction WFS:* A transaction web feature service would support all the operations of a basic web feature service and in addition it would implement the Transaction operation. Optionally, a transaction WFS could implement the GetGmlObject and/or LockFeature operations.

5. Realising Web Servers

The BISAG web servers run on Internet Information Services. The WMS and WFS features are realised using Microsoft DotNet with Carbon Tools extensions. The home screen opens on invoking the URL of the web server. The system allows access to the map server and restricted access to the feature server. The map can be queried for different attributes using a Query Builder. Figure 3 shows a district map queried to show all districts larger than a specified area. The system also allows multiple features to be shown superimposed on a common geographic reference frame.

6. Conclusions

It is important to note that a simple web browser is being used to work with a GIS database on a remote server. This system thus frees the end user from having to invest in a costly GIS package. Such systems can be used to deploy spatial information services and also be used for remote database maintenance.

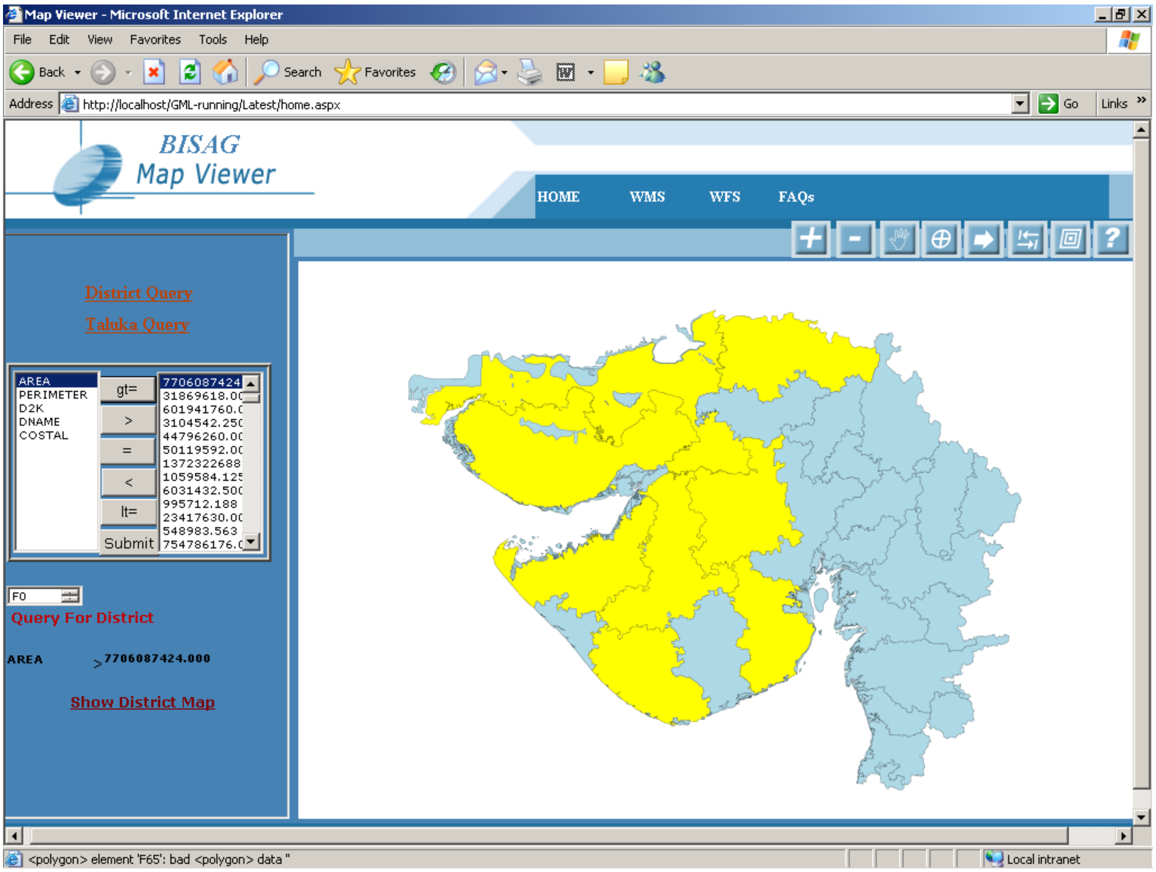


Figure 3: A query for districts larger than a specific area

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Village-wise Micro Watershed-wise Land and Water Resource Development Plans on Satellite Images

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Abstract

The paper portrays the effort of the Gujarat Government to take the applications of space technology to the grass-root level. The initiative was the preparation of a software with user interactive display system providing land and water resource action plans along with other information of desired area of interest with just one click. The paper describes the basic objectives, methodology, the salient features of the software and how the sustainability of the project was ensured. It also briefly describes the various functions of the software. The software is a modest attempt to take IT to the rural man of Gujarat.

1. Motivation

We are a developing nation and along with the advent of new technologies and solutions, it becomes extremely important that we extend its advantages to the grass root level. There should be a fair chance provided for all for apportioning access to development. Villagers and local level officials (i.e. Public at grass root level) with their treasure of indigenous knowledge are able to conceptualise solutions for their problems. The need therefore is to expose them to the possibilities of development through the use of advanced science and technology techniques. This was aptly considered by the Government of Gujarat, and reflected in their efforts.

Water and Land Planning and Management have always been areas of concern, since water shortage, more than its management has been an issue for a very long time. Every year, to overcome the unemployment occurring out of water scarcity, 'Rojgar Yojna' programmes are organised involving construction of various structures. Identifying sufficient number of appropriate sites is the main area of concern for such projects. It is a task which involves various conventional surveys. The usage of geo-informatics has immense potential for such works as it greatly reduces the overall cost and time of the project. With due directives from Honourable C.M. and Secretary – Science and Technology, Government of Gujarat, a task force was set up to fulfil the objectives of the demand.

2. Objectives

Considering the background of the work, the main objectives were defined as shown below:

- To Propose and suggest measures for water and land conservation which are implement able at village level.
- To provide information on micro-watershed boundaries at village level to the local level officials.
- To prepare an interactive system for the use by general public in an easy to use and understandable format.
- To provide necessary support through interactive training and capacity building to the officials concerned with Rural Development.
- To accomplish the work in such a way so as it also addresses the issues of District Rural Development Authorities concerning the 'Rojgar Yojna'.

3. Project Components

- Identification and Geo-referencing of satellite datasets.
- Preparation of Base-maps at 1:50,000 scales for each of the 18,500 villages of Gujarat State comprising information on

settlement, road, rivers, water bodies, etc.
- Feature marking on the satellite image (of various elements like road, settlement, fields, railway, wasteland, etc), for 18,500 villages of Gujarat State.
- Identification of existing water harvesting structures for all the villages of Gujarat State using multi-temporal satellite imagery.
- Proposing water resource conservation actions.
- Proposing land resource conservation measures.
- Team identification and methodology for quality checks and standardization of information.
- Conceptualisation and designing of a map layout so that a common man can also interpret it.
- Village wise Automatic Map layout preparation Software
- Exporting all the maps in JPEG format.
- Designing and preparing of software which combines all the information in different formats and displays it with a demonstrative display menu in local language, as well as allows retrieval of information at both taluka and village level.
- Preparation of support systems for the software with due consideration to its operability independently after its deployment at various places.
- Accomplishing a task of huge magnitude i.e. of writing and inspecting each CD for various Talukas of Gujarat State.
- Replication of the taluka wise CDs for all panchayats of Gujarat State.
- Dispatching of panchayat wise CDs.
- Capacity building / training the officials.

4. Human Resources

A team of 15-20 Project Scientists from multidisciplinary backgrounds like Urban and regional planning, Agriculture, Geology, Environmental Planning, Water resources, Civil engineering, Computer Technology, Information Technology etc were involved in preparation of land conservation measures, water Resource Action Plans and software.

For the purpose of efficient co-ordination and working, the work force was divided into three main teams. Three teams of supporting staff of 25 strength worked under the Guidance of the Project scientists to accomplish the work of feature marking, registration, digitization, CD writing, dispatching, etc.

5. Methodology

5.1 Identification and Geo-referencing of Satellite datasets:

Multi temporal satellite imagery was used for the exercise. To map the existing checkdams, post monsoon LISS-III satellite data of October 2005 was identified. For proposing water resource action plan, land resource action plan, base map were prepared and features were marked on LISS-IV data (5 meter resolution) of January 2004. A team of scientists and supporting staff worked for geo-referencing the required datasets.

5.2 Preparation of Base-maps:

Preparation of base-maps at 1:50,000 scales for each of the 18,500 villages of Gujarat State comprising information on location of settlement, roads, rivers, water bodies was undertaken. Attributes like names of the rivers, settlements, and types of roads were also incorporated in the datasets. Using the geo-referenced image the base layer was prepared using visual interpretation. Details like major roads, rail, major rivers and large water bodies, important settlements, were mapped from satellite imagery. The settlement names, specification of roads, name of the rivers are taken from collateral data. Collateral data in the form of maps, charts, census records, reports and topographical maps on 1: 50,000 scale was used.

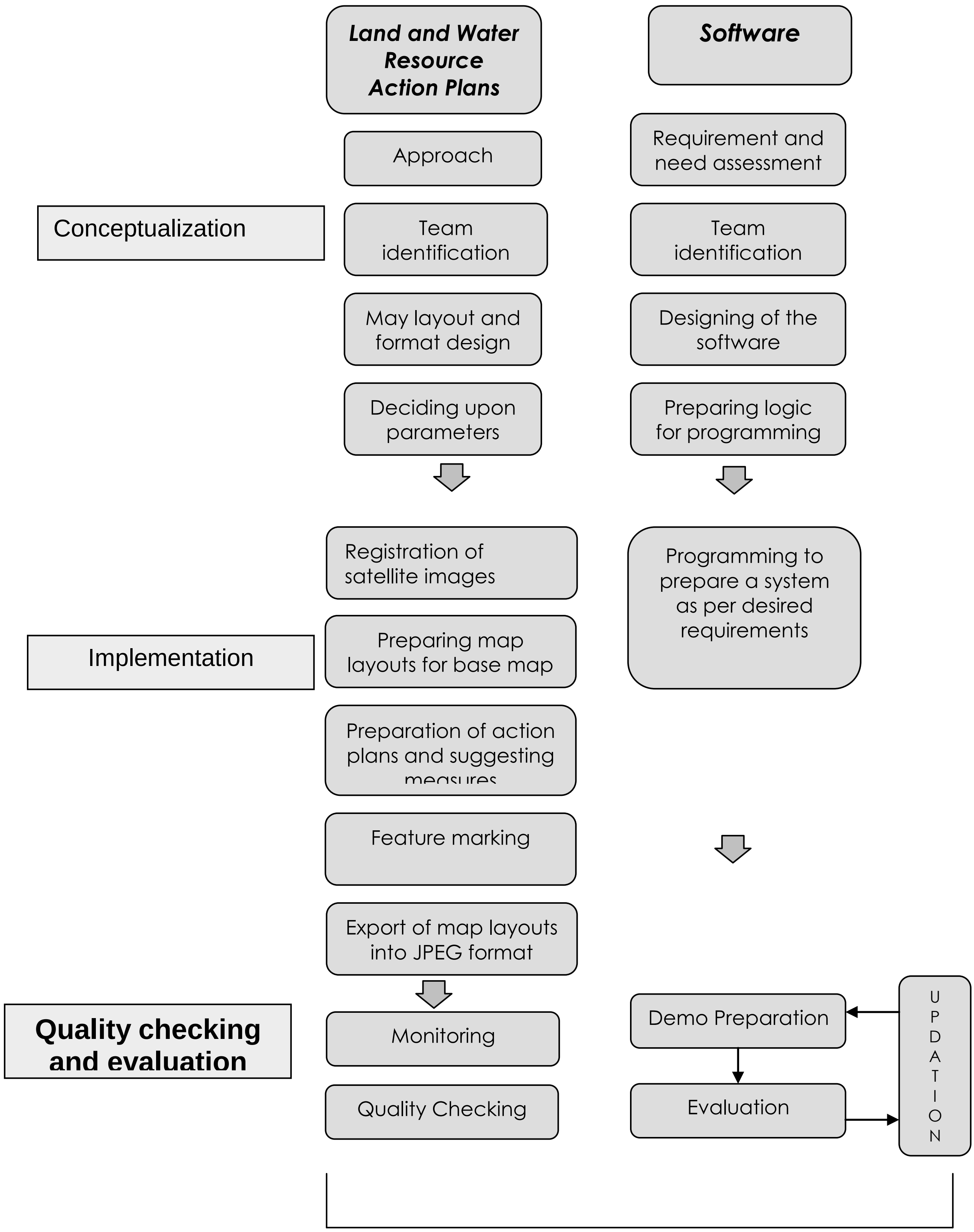

Figure 1: A system for data display, retrieval and print for land and water conservation measures at village and taluka level

5.3 Feature marking on the satellite image: Realizing the fact that just giving a key to image would not solve the issue of easy interpretation of the satellite image by a layman, it was decided to actually mark prominent features like roads, *gamtal* areas, wasteland areas, railways, water bodies, agriculture fields, etc. This was done for 18,500 villages of Gujarat in Gujarati language.

5.4 Water Resource and Land Resource Action Plans: The aim of preparing these plans are to identify the various tasks which can be carried out under the *Gramin Rojgar Yojana* and other rural development program implemented by the State and Central Government for the development of rural areas in Gujarat state. GIS and remote sensing technology was used to prepare these plans. Information technology was used to distribute these at village level and satellite communications technology was used for providing the training for Taluka level official and common man at village level.

Possible land and water conservation measures were suggested for each village. Possible actions are suggested taking into consideration the local status of natural resources and technical guidelines for different structures. Checkdams, nalaplugs, bori bandhs and construction of ponds are the actions suggested under the water conservation measures and land resource management areas are identified which require plantation with water conservation measures, land conservation and drip irrigation.

The following criteria were adopted for suggesting specific measures:

Bori bandh: Bori bandh is a type of embankment constructed from *'bori'* using available local material for blocking the active and erosion prone first order drains.
<u>*Specific Site Conditions*</u>

- Upstream of check dam/reservoir.
- Across 1st and 2nd order of stream and on slope up to 2 %.
- Where foundation conditions are weak for masonry or loose rock structures.
- In places where the flow rate of runoff is low.

Nala plug: *Nala* (a natural water course) plugs are structures constructed across drains for checking velocity of runoff, increasing water percolation and improving soil moisture in rock regime constructed from the rock available locally.
<u>*Specific Site Conditions:*</u>

- Upstream of check dam/reservoir.
- Across Nalas on 1st and 2 nd order of stream and on slope up to 5 %.
- Area needs for soil and water moistures conservation measures.
- Availability of construction material in nearby areas.

Check Dams: A check dam is essentially a masonry or Earthen overflow type barrier constructed across a stream having a good base flow after rainstorms.
<u>*Specific Site Conditions:*</u>

- Down steam of catchments where sufficient water is available
- Good embankment height is available and supports the dam foundation.
- To minimise the construction cost, a narrow stream width is preferred.

Plantation with water conservation measures
<u>*Specific Site Conditions:*</u>

- Waste land which are not under any particular use, but can be brought under the use by small effort.
- Where sufficient land is available.

Land conservation measures and Drip irrigation method

These measures are suggested for area under agriculture. Land conservation is suggested in single crop area where possibility of land erosion is identified using the satellite images. Drip irrigation is suggested where areas are under excess irrigation and chances of water logging are present. Satellite images of Rabi season is used for the identification of irrigated areas.

5.5 Standardization of Datasets and Quality Checks: The database contents, formats were standardized for all the layers being created. The system design involved deciding about database contents, the sources of datasets, the scale at which the information was needed, entities-what objects exist, relationships-how their geometry and attributes interrelate, descriptions of term, terminology used, output format/ deliverables. This allowed easy compatibility, accessibility and interoperability of the datasets.

The quality check was done regularly. A multi disciplinary quality assurance team was identified. Each scientist on the quality assurance team was responsible for one of the major tasks being carried out.

As part of the control checks, the QAS team regularly checked the datasets being prepared in terms of the contents, the codification and the accuracy levels. The corrections suggested were incorporated immediately. The databases created were finally checked when the various datasets like water resource action plan, land resource action plan, feature marking, settlements, rivers and water bodies were all integrated together in the system.

6. Conceptualisation and designing of the map layout

In this phase the idea was to conceptualise and design the layout so that the information is depicted in a manner that a common man can also understand and interpret it. This was achieved by using interactive symbols that a village person can understand.
This involved research and revisions before the output could be finalised. The depictions made were pictorial and their description was given in Gujarati language so that they could be interpreted by a villager.

Aspects of a quality cartographic presentation and visual appeal were taken care of. This included a proper title, map legend, scale bar or representative scale, and north arrow, as well as the proper, standardized use of symbols, patterns, and colours.

7. Village wise Automatic Map layout preparation Software

Once the map layout was standardized the need was to generate 18,000 maps based on the standardized formats. The available software had the facility to prepare maps one by one, which was not sufficient to prepare 18,000 maps in a time period of one month. Therefore, an inhouse software was developed called the 'Automatic map Generator.' This software was used for the map preparation and this reduced the time and proved to be more cost effective.

7.1 The salient feature of the software:-

Automatic Integration and displaying of various datasets

- For the base map
  - Settlement – Location and name (in Gujarati)
  - Rivers and Water bodies – Extent and name (in Gujarati)
  - Roads – Categories of roads
- For Satellite Map
  - Satellite image
  - Land Resource Action Plan
  - Water Resource Action Plan
  - Settlement – Locations and names
  - Existing features like wastelands, water bodies, built-up areas, etc on the image.
- For Taluka level micro watershed map
  - Satellite image
  - Micro watershed boundaries
  - Existing check dams location of the satellite data
  - Automatic Loading standard legends

- Automatic village wise preparation of map layouts
- Exporting the prepared map layouts

8. Software for showing water resource action plan at Village level

The issue which concerned us was that of communicating the action plans at local level. A system was required which can display and communicate the information in a simple straight forward way and that too in a local language so that it is also understood by a common man. A flexible and easy to use system was required which can run on a computer without any complicated requirements of the system.

The software was developed at BISAG which combined all the information on one platform and displayed it in the 'Gujarat' language so that the local people could understand it. The software can be used to view, display, retrieve and print the resource management plans at village level. It displays the information at both Taluka and Village level. No special expertise is required to operate the software. With just one click a Base map of the desired village is displayed providing information on roads, settlement, rail, canal, river, agriculture area, etc. an attractive window is designed for people who do not possess any prior image interpretation skills, so as to familiarise them with satellite images.

8.1 Operation of the Software

- The software is prepared to show the water and land resource management actions at village level.
- Once the software is opened, the screen shows three buttons on the left. The first one is of **District** selection. A selection box is provided along with it to choose from the options. After selecting District, the user has to select the Taluka from the selection box of the '**Taluka**'. The selection box will show Talukas falling in that particular District. The selection box of the **Village** will show all the villages of the selected Taluka. The user will choose a particular village from the selection box.
- After the selection of the village is done, two options are provided to see the **village base map** and the **satellite image** of the village being selected.
- On clicking the option, a base map of the selected village opens up showing the settlement, village boundary, Rivers, Railway and Road for the selected Village. The explanation and the legend are also provided on the right side of the screen.
- The second option provides the land and water related actions on the satellite image at village level. On clicking the option, the user gets to see the probable locations of 'Bori bunds", 'Nala plugs', Checkdams, 'places where ponds should be constructed, places for tree plantation, water conservation and land conservation. The existing water harvesting structures are also shown on the image. The legend on the right of the screen explains the whole symbology.
- Tools like **Zoom in**, **Zoom out** and **Zoom to** original are also provided.
- On the bottom left of the screen a picture of an Indian remote sensing satellite and earth is shown. On the clicking the button below, a flash movie appears showing how a satellite takes pictures of the earth below as it follows a certain path.
- On the bottom, few photos are shown with legends like Field, Water, Plantation, Settlement, River and Wasteland. On clicking each of them, a Satellite Image will be opened in the screen at the centre of the displayed window, showing each feature as it appears in the image.

Figure 2: The system displaying the base map of the selected village

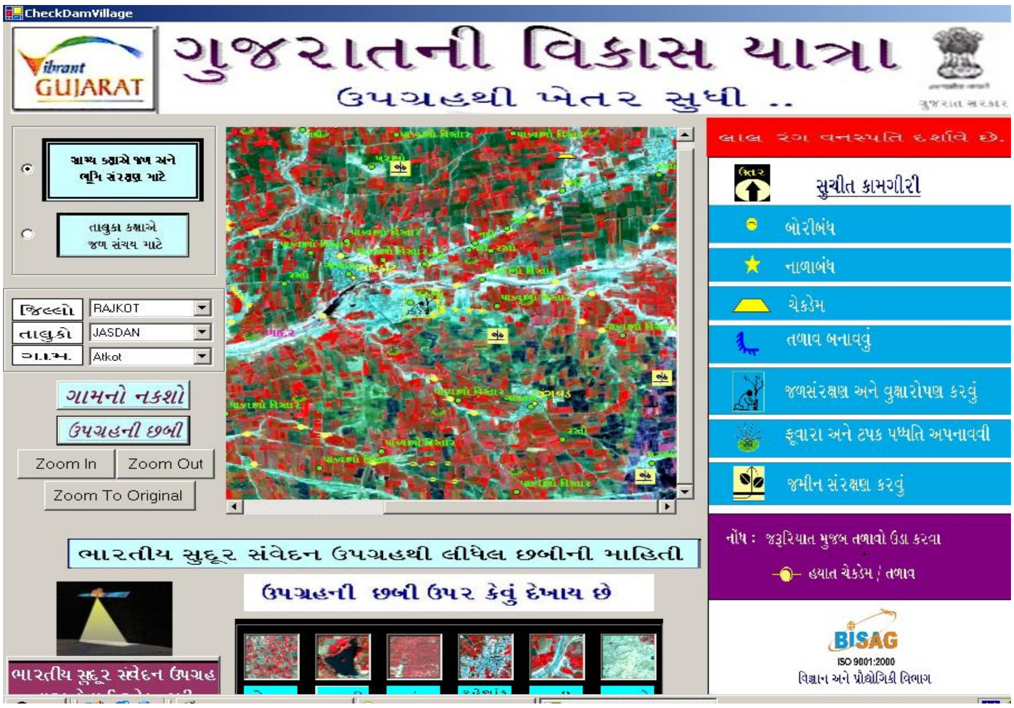

Figure 3: Water conservation and land conversation measures at Village level being displayed along with necessary legend for explanation

8.2 Interactive mode of the software for acquainting the villagers about the Indian Remote Sensing Satellite Data: On clicking on any of the buttons, the enlarged image is displayed. This shall help the villager to understand how various features like waterbody, built-up area, plantation, agriculture area, river look on a satellite image.

8.3 Technical Aspects of the Software:

- Hardware Requirements
    - A minimum processor speed of 300 Megahertz.
    - A minimum of 64 MB of Random Access Memory (RAM).
    - A monitor with at least 16-bit color depth. 24-bit color is recommended.
- Software Requirements
    - Operating system: Win9x, WinNT, Win2000, WinXp.
- Technology
    - The System is developed in VB.Net Technology

8.4 Distribution of CDs:

- A demo CD of software for Rajkot District was submitted to the Rural Development Department for evaluation and their suggestions were requested.
- The software CDs for the six backward districts where Gramin Rojgar Yojana is in operation was submitted to Rural Development Department.
- The software CDs for all the districts of Gujarat State (3 sets for each district) was submitted to Rural Development Department.
- Copies of CDs as per the number of talukas for further duplication, distribution has been given to the Rural Development Department.
- A copy of respective software CDs was collected by all District Collectors / development officers from BISAG office.
- This software CDS is then distributed at Taluka level officer to make it available for villagers by District Collectors / Development officers

Along with the Software a Document was also sent, which explains user manual on how to install and operate the CD. This help document also comprises information regarding the available features in Software and how to run and use it.

9. Characteristics / Special Aspects of the Project

9.1 Capacity Building / Training through GUJSAT: A training Programme was organised in the GUJSAT studio of BISAG at May 10, 2006, which facilitates one way live Video and Two way Audio Telecommunications. The programme was telecasted at various places, where several Taluka District Officers, representatives from leading NGOs, *Sarpanchs, Talatis*, Village level watershed Self help groups and other villagers were able to witness it. It provided training and directions on the use and installation of the software CD. The programme also featured expert advice on various aspects and was conducted by a team of experts from BISAG and Rural Development Department.

The queries from the receiving end were answered immediately and their respective suggestions for further improvement in the deliverable were noted and the needful is being done.

9.2 Significance to the Common People of the State: The work has achieved and opened new areas in terms of reaching the information at local level. With the opening of the realms of the e-Governance, we are providing opportunities for the common citizen of the state to provide their inputs in the development process.

The distribution of the CDs at local level will give an opportunity to the people at grass-root level to have a say and give opinions, in the process of their development. The approach is very similar to the idea of e-

Governance. A concept in which the government is not only electronically controlled through the use of computers and newer technologies but it emphasises the fact that people at grass-root level are more aware and conscious of the facts and issues concerning their development.

9.3 An Asset for the Decision Makers of Rural Development: The software is an important asset concerning the decision making activities for the officials working for rural development. The application prepared provides information on the existing checkdams and that too on a spatial basis; it thus forms an important tool for spatial comparisons. The image is also provided along with the information, this way the decision makers can get evaluate the existing condition and water status of the area. Further, the application also provides several sites for the construction of water harvesting structures as suggested by the experts and decided on the basis of pre-decided criteria and parameters. This would help the concerned officials to decide upon the site for construction, which immensely reduces the time and cost requirement.

9.4 Extension Education for Trainers and Trainees: The application prepared can also be used as a teaching medium for imparting knowledge regarding the water resource and its conservation measures. It is an excellent example of information technology used for the grass root level.

9.5 Efficiency: The endeavour envisages saving large amount of resources that are spent on the construction of water harvesting structures each year, which involves complicated surveys and ground truth sessions. After the marking of the features and structures on satellite image the issue that arose was that of dissemination of such knowledge and information. It would have been practically impossible to visit each place and explain the map layouts; further printing of such large scale information would also have been costly. Thus an in-house software application was thought of which not only substituted the process of printing more that 1,80,000 maps but also solved the purpose of distribution. Also, for capacity building and to educate people a video teleconferencing programme was organised through GUJSAT (Gujarat Satellite Communication Network) which supports two way audio and one way video.

9.6 User Convenience:

- The front end of the system is displayed in Gujarati for the convenience of the rural populace. Also, the user manual is provided in Gujarati.
- The programme telecast through GUJSAT was specially prepared for providing the necessary capacity building of the rural populace, to familiarise them with the use of software and provide them with expert advice on the topic of water conservation and related subjects.
- While designing and preparing of the software utmost care was taken to see that it can operate on systems with a simple configuration and do not require any sophisticated supporting devices or programmes for its functioning.

9.7 Citizen Centric: Each year *'Rojgar Yojana'* Programmes are organised to cope with unemployment and poverty due to drought and scarcity of rainfall. Construction works are taken up to provide employment to the rural poor. In this project, various sites are identified and located spatially in each village and access is given to the local population to participate in the final decision on the selection of the suggested sites where the work can be carried out.

9.8 Reduction of Touch Points: The CDs were distributed during the *'Krishi Mahotsav'* at each village. Further they were also sent to each *Gram Panchayat* through Rural Development Department. The dissemination of such information at such a vast scale simultaneously to each village was possible only through approaching the work in such a way so as to optimally utilise the resources and also cover major areas.

10. Sustainability of the project

For the sustainability of the project, the institutionalisation of the application was required from top level to grass root functionaries. This also required the application to be simplified and made easily customisable to encourage the user to conceptualise, formulate and implement the applications independently as per their requirement. BISAG has ensured the internal and external sustainability of the application through the following efforts:

10.1 Creating environment for utilization of the project: An environment was created where in the initiative was demonstrated and its relevance was discussed at the highest level in government. Repeated demonstrations and discussions were held with the Honourable Chief Minister as well as higher level government officials.

10.2 Involving Stakeholders: The application was developed as per stakeholders' specifications and requirements through partnerships and collaborations. Capacity building training programmes were held for the Taluka District Officers, representatives from leading NGOs, *Sarpanchs, Talatis*, Village level watershed Self help groups and other villagers. The programme enabled the relevant departments to use the available spatial information for decision-making. This created a sense of ownership in stakeholders through partnerships with the various functionaries involved in watershed and rural development.

10.3 Technology transfer mechanism:

- A mechanism has been developed for transferring the technology. The application has been linked with other government programmes. It is being used extensively by the Rural Development Department in the *Hariyali* Project for watershed management and rural development.
- The software developed for demonstrating the application is platform independent, low cost and user friendly. This allowed sharing of information through the distribution of the CDs from top level functionaries to the village level functionaries on such a large scale.
- The demand has been raised by the field level functionaries to extend the application from village level to field level. Efforts for the same have been taken into consideration.
- Updating of the information shall be done every year.
- It is also envisaged that the information which now is made available through CDs to the village functionaries shall be made available through the internet to the villages through GSWAN Connectivity.
- The methodology is such that it can be replicated anywhere.

11. Cost effectiveness

The major project component involving high costs are short-listed below to demonstrate the cost effectiveness of the application.

11.1 Satellite data: BISAG is a state nodal agency to utilise space technology and geo-informatics for various developmental activities in Gujarat State. For carrying out various developmental applications, BISAG regularly procures satellite data for the whole State of Gujarat. The satellite data is being used for various sectors like rural development, land resources, water resources, agriculture, disaster management, urban, coastal environment. The cost of the satellite data is recovered over time through multiple usages for various developmental activities.

11.2 Creation of Comprehensive standardized spatial data of water harvesting structure and land resource action plan: The Institute conceptualised and organised a multi-purpose common digital database for sectoral/ integrated decision support systems. This has provided impetus to developmental planning at grass root level and monitoring and management activities in various disciplines. The common usage of inter-sectoral data removes data gaps in various sectors and it prevents duplication of efforts during execution and planning by different departments/agencies and this ensures cost recovery.

11.3 Development of Indigenous software solution: Indigenous software was developed to make the technology widely available, customisable in local language and also low cost. This reduced the cost effectively, as the software developed was plate–form independent and could run on any PC.

12. Future Applications

In future more we can improve and expand the scope of the existing system through addition of the information like that of road infrastructure, its type, width etc. Such an application will provide necessary insight and support to those involved in providing accessibility through road connectivity. Similarly by updating the datasets at cadastral level we can also add and provided land conservation measures at farm level, site for inland fisheries, etc.

The world is getting closer through the use of Internet and it is known to be a great source of communication. In future such an application can be developed to formulate it as a web based application. This would greatly reduce the overall costs involved as map printings and hard copies of such applications at a large scale are too costly and tedious.

Importance of Coral Reefs and Mangroves

R.S. Rao
Remote Sensing Applications Area, Space Applications Centre, Ahmedabad-380 015

Coral reefs and mangroves are important and fragile ecosystems. They are both found along the coast. They are both very specific in their requirements. Mangroves require saline and muddy environment for their growth, which is why they thrive along the coast, along the banks of the estuaries and inter-tidal areas. For a coral reef to develop certain conditions have to be met: a hard substratum on which the corals can settle, a water temperature above 20°C, good light penetration and uniform salinity. For this reason coral reefs are found only in tropical seas and along the coastlines.

Nowadays people have come to know about these two ecosystems. Yet, few appreciate the importance, the ecological functions and the great number of uses of these fragile ecosystems. The purpose of this article is to describe the important and special characteristics of coral reefs and mangroves and to highlight their important uses and ecological functions.

Coral Reefs: A coral is a coelenterate animal (also called a polyp), which is no more than a few mm in size. Two traits make a coral different from other animals. Firstly they secrete calcium carbonate skeleton outside their body, somewhat like a cup within which the coral lives. Secondly, most of them carry algal cells within their own cells. If we put together a number of coral cups of a single species we get a coral colony and if we put together a number coral colonies (of assorted species) then we get a reef.

Some of the major Indian coral reefs are in Palk Bay (fringing reefs), Gulf of Mannar (fringing reefs), Gulf of Kachch (fringing reefs), Lakshadweep islands (atoll) and Andaman and Nicobar islands (fringing reefs).

Now we will cite some of the important uses of coral reefs. Coral reefs are sometimes referred to as rainforests of the sea as they harbour so much biodiversity.

(a) Coral reefs have been known to be hundreds of meters in height with many different animals providing shells to the reef mass. The irregular surface provides habitat for many different animals and the most diverse ocean communities. Coral reefs grow because reef building organisms produce more calcium carbonate than is removed through erosion.
(b) Coral reefs are home to more than 4000 different types of fish and thousands of species of plants and animals (more than 25% of all marine life). Coral reefs can supply upto 10% of all the food fish caught in the world and the present day trade in ornamental reef fish in tens of millions of dollars.
(c) Corals are used in ornamental jewellery.
(d) Coral reefs prevent shoreline erosion.
(e) Coral reefs offer from the human perspective thousands of unique chemicals for a wide variety of medical uses (anticoagulants and anti cancer agents).
(f) Corals are an important source of seafood and protein and provide habitat and nursery for 10 to 20% of the world's fisheries.
(g) The potential yield of calcium carbonate from the coral reefs is 600 million tons per year.

Therefore the destruction of coral reef means the loss of significant employment through tourism marine recreation and fishing.

Mangroves: Mangroves are tropical forest plants. While 'mangal' is the name for the whole community 'mangrove' represents the constituents of the community. The mangrove plants are found from below the mean low tide water level mark to beyond the mean high tide water level mark; along the estuaries, backwaters or protected sea shores with muddy substratum. These plants are inundated almost daily once or twice and the water salinity that the plants tolerate ranges from slightly saline (near to fresh water) to more than sea water.

There are herbaceous plants as well as woody trees in this community. All these plants face a dual stress. Salt stress due to excess of dissolved salts, mainly sodium and chloride and soil aeration or water logging stress. These plants face physiological drought conditions though they are flooded with water. The flooding water is loaded with salt and the problem of fresh water availability is posed for the mangroves.

To overcome both the problems stated above these plants undergo morphological modifications, which are referred to as ecological adaptations. Mangroves are adapted to reduce the water loss and achieve water economy. This is done by the xeric nature of the leaves. They try to keep the water loss to minimum by wide opening of the stomata only in the early hours of the day. The water loss is also checked by the presence of trichomes on lower epidermis of species of Avicennia. Thick cuticle is still another means. The other metabolites in mangroves which appear to be the modifications under saline conditions are amino acids carbohydrates and polyphenols. Very high levels of carbohydrates are reported in the leaves of mangroves. The uncommon sugars like xylose, arabinose and rhammose have been found in the leaves of mangroves. It is felt that carbohydrates possibly take part in osmoregulatory process of mangroves to overcome the potential harmful effects of salts in the substratum. Also it is being realized in recent years that polyphenols play some role in salt tolerance of mangroves.

Now we can list some of the important uses of mangroves.

(a) Mangrove forests and estuaries are the primary nursery area for a number of commercially important shrimp, crab and fish species. They are also important nursery areas for other species which are themselves not used commercially but which form part of the food chain for commercial species offshore.
(b) Mangroves prevent erosion
(c) Mangrove vegetation stabilizes shorelines and the banks of rivers and estuaries providing them with some protection from tidal bores ocean currents and storm surges.
(d) Mangroves are used commercially for the production of timber for building, firewood and charcoal
(e) Many timber products are obtained from mangrove forests.
(f) Mangroves help in the recycling of nutrients.

Because of the above multifarious and important uses of corals and mangroves they need to be managed and protected from natural and anthropogenic degrading circumstances.

References

[1] Coral Reefs-R.S.Rao (Signatures Vol12, No. 1&2 March 2000)

[2] Physiology of mangroves- L.G. Bhosale and N.G.Mulik Shivaji University, Tropical Ecosystems:Ecology & Management, pp 315-320

[3] Application of remote sensing data to monitor mangroves and other coastal vegetation of India- Shailesh Nayak & Anjali Bahuguna, Indian Journal of Marine Sciences, Vol. 30(4) Dec 2001, pp195-213.

Future Events

Date	Place	Event	Email/URL
Jan. 7-8, 2008	Hong Kong, China	Virtual Geographic Environments 2008 on "Virtual Visualisation"	http://www.iseis.cuhk.edu.hk/vge/
Jan. 14-16, 2008	Bangkok, Thailand	Second International Conference on HealthGIS	http://www.e-geoinfo.net/hgis.html healthgis08@gmail.com
Jan. 17-18, 2008	Tokyo, Japan	ESRI Asia Pacific User Conference	http://www.esri.com/events/apuc/index.html
Jan. 25-28, 2008	Borovets, Bulgaria	Second International Conference on Cartography	http://www.datamap-bg.com/conference2008/
Feb. 6-8, 2008	New Delhi, India	Map India 2008	http://www.mapindia.org/
Feb. 6-8, 2008	Nagpur, India	International Conference on Water Quality Management	http://www.cbip.org
Feb. 10-14, 2008	Muscat, Sultanate of Oman	Mountains of the World – Ecology, Conservation and Sustainable Development	Contact: Ms. Rahma Al-Siyabi, Sultan Qaboos University, P.O. Box 17, PC 123. Sultanate of Oman, Tel: +(968) 2414 1442, Fax: +(968) 2441 4012, rsiyabi@squ.edu.om
Feb. 18-20, 2008	Bhopal, India	Geomatics-2008	
Feb. 21-22, 2008	Denver, Colorado, USA	International LIDAR Mapping Forum 2008	http://www.lidarmap.org/
Feb. 25-29, 2008	St. Augustine Trinidad	GSDI 10: tenth International Conference for Spatial Data Infrastructure on "Small Island Perspectives on Global Challenges"	http://www.opengeospatial.org/node/782
Mar. 12-14, 2008	Burswood, Australia	WALIS International Forum 2008 on "Management of Geographic Information"	http://www.walis.wa.gov.au/forum
Mar. 15-19, 2008	Riyadh, Saudi Arabia	International Conference on the use of Space Technology for Water Management	http://www.emwis.net/thematicdirs/events/sev914991

Apr. 16-18, 2008	Moscow, Russia	Remote Sensing – The Synergy of High Technologies	http://www.sovzondconference.ru/eng/
May 28-30, 2008	Hainan, China	2008 International Congress on Image and Signal Processing CISP2008	http://210.37.44.250/
Jun. 4-7, 2008	Istanbul, Turkey	EARSEL & GISDECO Joint Workshop on Integrating GIS & RS in a Dynamic World	http://www.earsel-dc.uni-hannover.de/
Jun. 5-7, 2008	Tokyo, Japan	Global Mapping Forum 2008	http://www.iscgm.org/
Jul. 1-5, 2008	Beijing, China	Spatial Accuracy 2008	accuracy2008@spatialaccuracy.org
Jul. 3-11, 2008	Beijing, China	XXI ISPRS Congress	Chen Jun, congressdirector@isprs2008-beijing.org http://www.isprs2008-beijing.org/
Jul. 3-11, 2008	Beijing, China	4th International Symposium on Geospatial Information for Disaster Management (Gi4DM 2008)	Sisi Zlatanova, s.zlatanova@otb.tudelft.nl.
Sep. 29 - Oct. 3, 2008	Darwin, Australia	14th Australasian Remote Sensing & Photogrammetry Conference (ARSPC)	

GEOMATICS – 2008

National Conference on "Geomatics for Planet Earth"

& Annual Convention of Indian Society of Geomatics

18-20 February, 2008 at **Bhopal**

hosted by
M.P. Council of Science and Technology, & *ISG-Bhopal Chapter*

Pre-Conference Tutorials planned on **Feb. 16-17, 2008** on RS, GIS & GPS

- **ADDRESS FOR CORRESPONDENCE:** Prof. PRAMOD K. VERMA, Organising Secretary–GEOMATICS 2008 Director, Remote Sensing Applications Centre, M P Council of Science & Technology, Vigyan Bhawan, Nehru Nagar, Bhopal – 462 003. MP, India. Phone : 0755 - 2671602 Fax: 0755 - 2671602 Email: directorrsac@gmail.com Web: **www.geomatics2008.org** E-mail: **geomatics2008@gmail.com**

From ISG Secretariat

i) National Geomatics Awards

The details of these awards were announced in ISG Newsletter, March 2007 as well as June-September 2007 issue. These details are also available in ISG website. The members are requested to send their applications for awards for the year 2006-07 if they have any outstanding contributions in the field of Geomatics. **The date for receiving the applications has been extended to 31-Jan-2008.**

ii) Chapter activities and related issues

a) Active Chapter of the Year Award (2006-07)

Each chapter Chairman/Secretary is requested to send the application for this award in the prescribed format to the President/Secretary, ISG. The prescribed format for this award is available on ISG website. **The date for receiving the applications has been extended to 31-Jan-2008.**

b) Chapter Audit Statements

- All the ISG Chapters are requested to get their accounts audited at the earliest and send them to ISG HQ to include in the audited report of the Society.

c) Chapter Elections for the Term 2008-2011

- As per the constitution of the ISG, the term of Executive Committees (EC) of the Chapters should coincide with the Executive Council of ISG (HQ). The term of present ISG EC for the term 2005 -2008, expires on 31-March-2008. Therefore, ISG (HQ) has already announced elections of office bearers and members of executive council for the term 2008-2011. Therefore, all the Chapters (except recently formed chapters) are requested to announce elections for their respective Chapter executive committees.

Chapter Activities

I. News from Ahmedabad Chapter

Indian Society of Geomatics – Ahmedabad Chapter organised a one day workshop on '*GIS--A Tool for Sustainable Development'* on 23rd November 2007 as part of the GIS Week celebrations, jointly with School of Planning, CEPT. On behalf of Dr. S.K. Pathan, Chairman, ISG-AC, Prof. Anjana Vyas, Vice-Chairman, ISG-AC welcomed the delegates to the workshop and emphasised the significance of GIS technology for carrying out various kinds of applications and decision making processes. Prof. C. N. Ray, honoured the occasion as chief guest.

Prof. A.R. Dasgupta, BISAG, Dr. R.N. Vakil, CEPT, and Dr. S.D. Naik, delivered lectures to the workshop audience. The day included a students' paper presentation cum competition. Eleven presentations were made on topics ranging from GIS Applications in Oceanography, GIS in Sustainable Development Management, and

Sustainability in Urban Systems. Ms. Shrutika Parihar whose topic was Geo-referencing was awarded first place and Ms. Sangeetha Raghuram's presentation was ranked as second. The judges based their decision on students maintaining the allotted time limit, organisation of their presentations and their delivery. The workshop concluded with a student quiz competition on GIS wherein four teams participated.

Prof. C.N. Ray inaugurates the GIS Day Workshop at CEPT, Ahmedabad organised by ISG-AC jointly with CEPT, marking the beginning of GIS Week celebrations at CEPT.

II. News from Pune Chapter

GIS Day-2007 was celebrated by ISG, Pune Chapter along with Indian Society of Remote Sensing (ISRS), Pune Chapter on December 19, 2007 at Symbiosis Institute of Geoinformatics, Pune. Dr. S.D. Naik, former Scientist from Space Applications Centre, Ahmedabad, was the chief guest, who addressed the gathering on the topic ***Smile with GIS*** with his collection of cartoons on GIS*.* Shri R K Suryawanshi, Chairman, ISG, Pune Chapter welcomed the guests and briefed about the ISG activities as well as the future role of Geoinformatics in various sectors, particularly stressing the industry-academia interaction. Smt Sampada Joshi, Secretary, ISRS, Pune Chapter briefed about the ISRS activities in Pune. Brig. Khanzode, Director of the Symbiosis Institute of Geoinformatics, Pune also spoke on the various avenues available in GIS and the role played by his institution in capacity building. Dr. S.K. Srivastava, Secretary, ISG-Pune Chapter proposed a vote of thanks. The function ended with *High-Tea.*

Highlight of the function was the presentations by the Students on the essay written by them on the earlier circulated topic ***Role of Geoinformatics in Disaster Management***. Students' coverage of the topic was excellent. Three selected best essays were awarded with cash prizes along with certificates by ISG, Pune Chapter by the chief guest. Another highlight of the function was the ***Spot Quiz Competition*** conducted by Dr. Gautam, Treasurer, ISG Pune Chapter, to which all participants gave an excellent response. All successful participants of the quiz competition were awarded with prizes by the chief guest.

The function was attended by over 100 eminent participants, including ISG & ISRS members, invitees and a large number of students from various colleges in Pune.

Just before starting the function the gathering was informed about the sad demise of two eminent GIS personalities, **Smt *V. Deosthali*** and ***Prof. Madhav Kulkarni***. As a mark of respect to the departed souls, two minutes silence was observed.

III. News from Vadodara Chapter

Technology Day: On the occasion of *Technology Day* on May 11, 2007, a celebration was jointly arranged by Indian Society of Geomatics (Vadodara Chapter) and Regional Community Science Centre, Vadodara at the premises of the Regional Community Science Centre, Vadodara. Every year, Technology Day is celebrated to commemorate the event of Nuclear Test by Government of India on this day in 1998 at Pokhran.

As part of the celebrations, Dr. D.I. Bhatt, Director, Regional Community Science Centre, Vadodara explained the activities and future plans of the Centre. The chief guest Dr. Karahdkar, Reader, Department of Mechanical Engineering, M. S. Univ. of

Baroda delivered a lecture on ***Conservation of Energy*** in an interesting way. Children enjoyed the lecture very much as he explained in a very simple language, the scientific basis of the routine day to day activities in our life. President of ISG, Vadodara Chapter, Dr. (Mrs.) G. Sandhya Kiran, delivered a lecture on ***Geomatics made easy*** and also gave an idea of the colours of different features in a satellite image. She explained it in a very simple way so as to make the school going children understand it, with the help of a Microsoft PowerPoint presentation, using both English and Gujarati.

At the end of this lecture, the students were given a questionnaire to answer, which had about 30 objective questions based on the two lectures delivered till then. All the students very enthusiastically participated in it. Three prizes were won by the school children. After this competition another activity on map colouring was arranged for the students by Dr. D.G. Shah.

Lastly, a vote of thanks was proposed by Dr. (Mrs.) Pracheeti Paradkar, an active member of ISG Vadodara Chapter. The programme was well supported by all the members of the Chapter and M. Sc. students of Botany Dept., M. S. Univ. of Baroda, by their gracious presence. Overall the whole programme was a great success.

World GIS Day: A half day seminar was organised on November 21, 2007 by ISG, Vadodara Chapter along with Computer Society of India, Vadodara Chapter and Vadodara Internet Promotion Council to celebrate *World GIS Day*.
Chairman ISG, Vadodara Chapter, Dr. (Mrs.) G. Sandhya Kiran welcomed the gathering. The following four lectures were arranged on this occasion.

1. Emerging technology - Dr. Buch
2. Telemedicine - Shri Ravi Saxena
3. Basics of GIS - Shri Yogesh Manohar
4. Location based Services-Shri IC Matieda

The seminar was attended by a 140 odd gathering of students, professors and local people, which reflected that such celebrations will definitely aid in bringing awareness about this technology. Moreover it was also notable that students doing Masters degree and research from RS-GIS lab had actively participated in making this function a success. This was acknowledged by Shri R.D. Khamboj, the secretary of the Society in his vote of thanks. The seminar was concluded with the University song.

A Glimpse of the GIS Day celebration at ISG Pune Chapter

A few Glimpses of Technology Day Celebrations at ISG, Vadodara Chapter

World GIS Day Seminar at ISG Vadodara Chapter

ISG FELLOWS

1) ISG-F-1: Shri Pramod P. Kale, Pune
2) ISG-F-2: Dr. George Joseph, Ahmedabad
3) ISG-F-3: Dr. A.K.S. Gopalan, Secunderabad

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Ms. Shivangi J. Darji	25, Shivsagar Society, Near Kamala Nehru Park, Nizampura, Vadodara 390002. shivangidarji@yahoo.com	A-78
Ms. Sneha S. Burse	A/14, Shreedarshan Society, Behind Pancham Park, Opp. Voltamp, Maneja, Vadodara 390013. snehaburse@yahoo.co.in	A-79
Ms. Sneha Chandrprakash Singh	G-9, Heera Laxmi Park, Chanakyapuri Char Rasta, New Sama Road, Vadodara. simmy_sneha@yahoo.co.in	A-80
Ms. Suranjana Das	A/71, Palash Tower, Prathamesh Complex, Andheri (W), Mumbai 400053. sdas02@hotmail.com	A-81
Ms. Vibhuti Jansari	503, Pawanveer Apts., Pratapgunj, Vadodara 390002. hkjansari@gsfcltd.com	A-82
Dr. Shahid E. Murtaza	Ratnipora Pulwama Via Pampore 192 121	A-83
Mr. Naseer Ahmed Lone	Dept. of Geology and Geophysics, University of Kashmir, Hazaratbal, Srinagar, Jammu & Kashmir – 190 006, email: naseergeol@yahoo.com	A-84
Mr. Waseem Raja	C/o Cattle Research Station, Manasbal, Safapora, Ganderbal, Srinagar (Jammu & Kashmir)	A-85
Mr. Shahnaz Ahmad Najar	Dept. of Geology and Geophysics, University of Kashmir, Hazaratbal, Srinagar, Jammu & Kashmir – 190 006, email: shanu@yahoo.com	A-86

INDIAN SOCIETY OF GEOMATICS (ISG)
(www.isgindia.org)

MEMBERSHIP APPLICATION FORM

To: **The Secretary, Indian Society of Geomatics**
Building No. 40, Room No. 36,
Space Applications Centre (SAC) Campus
Jodhpur Tekra, Ambawadi PO, AHMEDABAD – 380 015

Sir,
I want to become a Life Member/ Sustaining Member/ Patron Member/Annual Member of the Indian Society of Geomatics, Ahmedabad from ------------Month of --------- year.

Membership fee of Rs./US$ ______ /- is being sent to you by Cash/ DD/ Cheque (In case of DD/ Cheque: No.___________, drawn on Bank _________________________________ payable at Ahmedabad. For outstation cheques add clearing charges Rs 65.00/US$ 10.00). I agree to abide by the constitution of the Society.
Date:

Place: Signature

1. Name: (Dr / Mr / Mrs/ Ms) ____
2. Address: ______________________________________
   ____
   ____ PIN: _______
   Phone: ___________ Fax: ___________
   Email: _____________________
3. Date of Birth: __________
4. Sex (Male/Female): ______
5. Qualification: ___________
6. Specialisation: ___________
7. Designation: _____________
8. Membership in other Societies: __________________________________
   ____
9. Mailing Address: _________________________________
   ____
   _________________________________ PIN: _______

Proposed by:
(Member's Name and No) Signature of Progposer

For Office Use
ISG Membership No: ISG- -
Receipt No.: **Date:**

MEMBERSHIP SUBSCRIPTION				
Sr. No.	Membership Category	Admission Fee Rs. (Indian)	US $ (Foreign)	Annual Subscription Rs. (Indian)
1.	Annual Member	10.00		200.00
2.	Life Member a) Admitted before 45 years of age b) Admitted after 45 years of age	 1000.00 750.00	 250.00 200.00	
3.	Sustaining Member	---	----	2000.00
4.	Patron Member	15000.00	2500.00	----
5.	Student Member	10.00	---	50.00

MEMBERSHIP GUIDELINES

1. Subscription for Life Membership is also accepted in two equal installments payable within duration of three months, if so desired by the applicant. In such a case, please specify that payment will be in installments and also the probable date for the second installment (within three months of the first installment).

2. A Member of the Society should countersign application of membership.

3. Subscription in DD or Cheque should be made out in the name of '**INDIAN SOCIETY OF GEOMATICS'** and payable at Ahmedabad.

4. Outstation cheques must include bank-clearing charges of Rs. 65.00/US$ 10.00.

5. For further details, contact Secretary, Indian Society of Geomatics at the address given above.

6. Financial year of the society is from April 1 to March 31.

7. ISG has chapters already established at the following places: Ahmedabad, Ajmer, Chennai, Hyderabad, Indore, Mangalore, Mumbai, New Delhi, Pune, Tiruchirappalli and Vadodara. Applicants for membership have the option to contact Secretary/Chairman of the local chapter for enrolment. Details can be found at the website of the society: www.isgindia.org

8. Journal of the society will be sent only to Patron Members, Sustaining Members and Life Members.