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Coordinates

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POSITIONING, NAVIGATION AND BEYOND

NEGeo2006 brochure inside!

SiReNT
Positioning Singapore for the future

Benefits of three frequencies for high-accuracy positioning

Interviews

Lt Gen Dilip N Desai

Dr Muneendra Kumar

A cGIT publication

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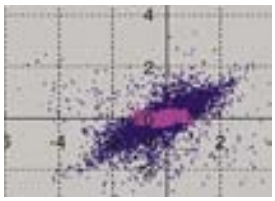
Articles





Columns

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This issue of Coordinates is of 40 pages, including cover.

The information battle

The clout of Indian bureaucracy is demonstrated, again.

On July 20, the Union Cabinet of India approves amendments in Right to Information Act 2005 (RTI).

And these proposed amendments have the potential to kill the spirit behind the RTI Act.

The landmark RTI Act is, otherwise, considered as a piece of progressive legislation and an effective tool to fight against corruption and inefficiency.

Moreover, it can redefine the relationship between a state and its citizens.

The proposed amendment of 'excluding file notings' means that the process of decision making will be kept out of the public domain.

A major point lost.

And a victory of bureaucracy and policy makers who are comfortable with the status quo.

If geomatics is projected as a technology to bring efficiency and transparency in governance, it may also face resistance with similar mindsets and vested interests.

The hope is the vibrant and growing movement of "Right to Information".

The struggle continues…

Bal Krishna, Editor
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SiReNT - Positioning Singapore for the future

An initiative by the Singapore Land Authority, SiReNT infrastructure is based on the Global Positioning System that provides data and services for various surveying and positioning applications

Soh Kheng Peng, Victor Khoo Hock Soon, Loh Sook Yee

The Singapore Land Authority (SLA) will launch a new GPS reference station network in September 2006. The infrastructure known as the Singapore Satellite Positioning Reference Network (SiReNT) will replace the existing system, SIMRSN (Singapore Integrated Multiple Reference Station Network) which was developed in 2000 under a collaboration project between Nanyang Technological University (NTU), University of New South Wales (UNSW) and SLA.

SiReNT is a nation-wide GPS reference station network infrastructure developed to support various positioning businesses and industries. SiReNT ensures a homogeneous geographical reference system for land surveying and mapping activities in Singapore. The system consists of 5 reference stations connected to a Data Control Centre (DCC). Figure 1 shows the location of the reference stations in SiReNT.

SiReNT system adopts the leading-edge technology of Network-DGPS (Differential GPS) both for Real-Time Kinematic (RTK) and code-based DGPS technique. With SiReNT, a user needs only one receiver to carry out DGPS positioning. It supports both real-time and post-processing DGPS.

In geodetic perspective, SiReNT serves as the national geodetic reference frame for surveying and positioning activities. It is regarded as the "Zero" order geodetic control of Singapore which is the reference frame for all mapping, positioning and surveying applications. SiReNT infrastructure is key component in the new SVY21 cadastral survey system, implemented in August 2004. Under the new survey system, surveyors use the SiReNT data for establishment of the Integrated Survey Network (ISN) control marks as the survey control in cadastral survey.

This paper describes the SiReNT system, its components and the services provided.

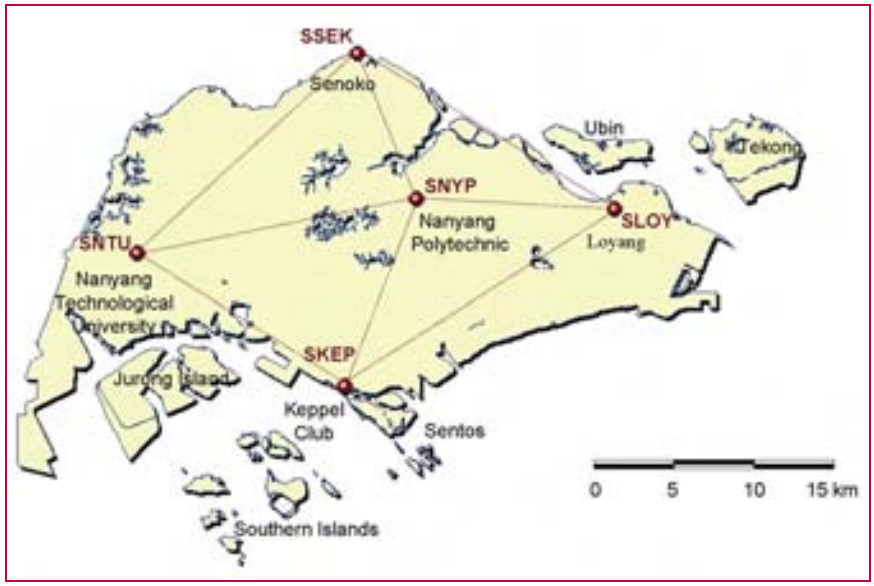

Figure 1: Singapore Satellite Positioning Reference Network

Network- DGPS

Over the last 5 years, Network-DGPS technique has been extensively used for high accuracy positioning all over the world. Network-DGPS is an improvement over the conventional DGPS method. The principle of Network-DGPS is that a significant portion of ionospheric, troposheric and ephemeris errors are estimated over a region and this information is provided to rovers GPS receivers in the field.

In carrier phase, the network technique is known as the Network-RTK. This technique has become very popular due to the short observation time needed and high accuracy obtained.

SiReNT system supports the Network-DGPS technique. It uses the network software, GPSNet from Trimble Terrasat GmbH at the Data Control Centre which supports the Virtual Reference Station (VRS) technique. The GPSNet software performs continuous computation of the following parameters by analyzing double difference carrier observations:

- Ionospheric errors
- Tropospheric errors
- Ephemeris errors
- Carrier phase ambiguities for L1 and L2.

Using these parameters GPSNet software will provide all GPS data and interpolate to match the position of the rover, which may be at any

location within the reference station network. Matching the rover's position provides a very short baseline, which reduces systematic errors for RTK considerably.

SiReNT Configuration

SiReNT network consists of 5 GPS reference stations located at the extreme corners of Singapore Island. This is to maximise the coverage area for the implementation of Network-DGPS. The GPS data is transmitted directly to the Data Control Centre (DCC) for processing, archival and real-time dissemination. System administrator will access the DCC via a remote access terminal. The network uses 256Kbps ADSL connection for communications link between reference stations to DCC. 56Kbps dial-up internet access is used as the back-up communications link.

Each GPS reference station is equipped with a set of dual-frequency GPS receiver and a choke-ring antenna that operates continuously. The GPS equipment is installed on the roof-top of a building. The reference station also consists of other items such as batteries, temperature monitor, terminal server, cooling fans etc for communications and monitoring functions. All the equipments are housed in a weather-proof cabinet on the roof-top near the location of the antenna. The details of peripherals installed at the reference station are as follow:

Item	Description
1	100Ah Sealed lead acid battery
2	BMV 501 Battery Monitor
3	Nport 5210 Terminal server
4	Victron Blue power battery charger
5	Low voltage disconnect
6	APC Telephone line lighting arrestor
7	Ruggedcom RX1000 Industrial Router
8	MOXA EDS-205 Industrial 5 port switch
9	Trimble NetRS
10	Polyphasor Lighting arrestor
11	Choke Ring Geodetic antenna
12	Cooling fan with thermal switch

There are cooling fans in the equipment cabinet which is controlled by a thermal switch. The switch will be activated at 40ºC and deactivated at 30ºC. In the event of an AC power outage, the system will run on 2 batteries (100Ah) for approximately 65 hours. The temperature and power at the equipment cabinets are centrally monitored. In the event of abnormal condition, alert will be generated by the DCC and send via SMS to system administrator. The coordinates of the reference stations will also be monitored by the DCC. The monitoring processes designed to ensure the high reliability of the system.

SiReNT Services

SiReNT offers 3 standard services to meet various positioning needs and accuracy requirements:

- Post-processing (PP) service
- Real-time Kinematic (RTK) service
- Differential GPS (DGPS) service

SiReNT website (http://www.sirent.sla.gov.sg/) provides information about the network which includes the real-time status of reference stations and atmospheric conditions. It also allows Post-Processing (PP) service users to generate and download RINEX (Receiver INdependent EXchange) data.

For RTK and DGPS services, SiReNT offers both single-base and network solution. A user has a choice to select the nearest reference station if he is working near to a reference station.

Besides the standard services, SiReNT DGPS services can also be easily integrated into customised positioning products for other specialised applications such as land transportation, marine applications, structural monitoring, location base services etc. A helpdesk will be available to support users on technical issues related to SiReNT services.

DGPS Data Dissemination

The data dissemination of SiReNT is supported by the iGate for post-

Figure 2: Typical set-up of a GPS reference station in SiReNT

processing applications and NTRIP for real-time applications. NTRIP (Networked Transport of RTCM via Internet Protocol) is an application-level protocol used for streaming Global Navigation Satellite System (GNSS) data over the Internet. NTRIP is a generic, stateless protocol based on the Hypertext Transfer Protocol HTTP/1.1. The standard is meant to be an open none-proprietary protocol. Both the iGate and NTRIP are installed at the DCC. User needs a NTRIP Client to access the real-time services.

For real-time applications of RTK and DGPS services, rover GPS receiver will be connected to SiReNT server via wireless Internet. Currently, rover users can subscribe to GPRS data services provided by any mobile provider. In real-time mode, SiReNT supports RTCM 2.1/ 2.3 and CMR format. Both formats are commonly adopted by major GPS equipment manufacturers.

SiReNT users make use of the SiReNT website to access the post-process GPS data via iGate. RINEX version 2.1 and Compact RINEX can be generated from the website under the PP On-demand product. User is able to generate up to 12 months of data from SiReNT website. RINEX data will be available within one hour after the observation. Data older then 12 months will be archived. To access the old data, users need to put up a request to generate the data on a per-request basis. In post-processing mode, SiReNT's GPS data is distributed via SiReNT website in RINEX 2.1 or Compact RINEX (HATANAKA compression) version 1.0 format. The usage of SiReNT system will be captured in the website. Statement of account is updated daily and available to registered users via web access.

Benefits of SiReNT

SiReNT is a nation-wide GPS reference station network infrastructure. It provides high precision, real-time DGPS (Differential GPS) data and services. The system supports all types of GPS positioning modes and formats. It is flexible and easy for integration with minimum configuration.

With SiReNT:

- Individually owned reference stations are no longer required for GPS surveyors;
- Many types of positioning applications that requires sub-metre accuracy are made possible;
- Real-time high precision and high reliability surveying, mapping, navigation, tracking, applications are supported.

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India cripples RTI act

The Union Cabinet on July 20 gave its approval for the introduction of a Bill amending the Right to Information Act, 2005, to exclude file notings in a few areas, in the monsoon session of Parliament. The proposed amendments would "remove ambiguities and make the provisions of the Act effective and progressive," Information and Broadcasting Minister Priyaranjan Dasmunsi said. The decision follows objections from government organisations such as the Union Public Service Commission that detailed file notings at the Undersecretary and Joint Secretary level cannot be disseminated. "Such exemptions have been granted in the United States, United Kingdom and Australia," Mr. Dasmunsi said.

Civil society organisations, which have been crucial in the enactment of the RTI Act, have reacted sharply to the decision. According to Aruna Roy of the Mazdoor Kisan Shakti Sanghathan, "Section 8 [exemption clause] is an overarching section. If there is a problem with file notings related to the UPSC, why doesn't the Government put it under that schedule? This is a deliberate attempt to cover up for acts of corruption. There is fear among bureaucrats that the widespread use of the RTI legislation will end the arbitrary use of power. I really think this move will weaken the Act and the UPA's promises of a free and accountable government." However, the PMO clarifies that the controversy over the curtailment of the right to access file notings via the Right to Information Act seems to be misplaced. In fact, the so-called 'striking down' of the right to access notings on government files by the Union Cabinet, was actually what would allow access to file notings. PM Manmohan Singh's office has issued an exhaustive clarification to point out that the changes were not "retrogressive" and the criticism was "misplaced" and based on "an incomplete knowledge of facts."

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"We are pursuing the development of an indigenous GIS solution"

says Lt Gen Dilip N Desai, Director General Information Systems, Indian Army while discussing the role, activities of his department

What are the activities of your department?

The Directorate General of Information Systems at Army Headquarters handles the development and fielding of Operational Information Systems (OIS) and Management Information Systems (MIS), proliferation of Information Technology, Military Survey and cartography and the utilization of space assets for the Army. This encompasses a wide spectrum of activities ranging from identifying automation needs, conducting systems studies, interacting with development agencies, monitoring and providing impetus to the spread of IT in the Army and catering to the IT training needs of the Army. Providing hardware and application software to an organization as large as the Indian Army also falls within its charter. Insofar as Military Survey is concerned, the Directorate is responsible for rendering technical advice to Ministry of Defence on survey matters, maintenance of digital cartographic and topographic data of our areas of responsibility (along and across the international borders), supplying maps to the Armed Forces and coordinating policies on mapping with the Survey of India.

How important are geo-information technologies?

All systems dealing with battlefield management strive to achieve the highest possible degree of shared situational awareness in the given time and space. Geo-information technologies (GIT) play a crucial role in contributing to this, whether it is in analysis of terrain or in assisting exchange of positional information between the various elements operating in the combat zone. It would not be wrong to say that Geographical Information Systems (GIS) are a crucial core component over which other applications for battlefield management systems are based.

How challenging was the adoption of new technology?

Adopting new technologies is as challenging for us as it is for anybody else similarly placed. However, since we deal with the all-important aspect of battlefield management systems, the issues involved are slightly more complex. Our approach can basically be defined as being open to adopting new technologies and yet retaining the flexibility to continue using existing legacy systems and equipment till they are replaced. Thus, major challenge arises in, both, the integration of new and old as well as changing over to new systems. New technologies not only necessitate organizational adaptation and changes in training methodology but, in certain cases, also require review of existing practices, procedures and doctrines in addition to re-structuring of existing organization in some cases. We are justifiably proud of the fact that the Indian Army has a well proven ability to adapt to new weapons and equipment as well as emerging technologies with practiced ease. This will stand us in good stead as we transit to a new era of warfare dominated by the need to achieve information superiority.

How do you see the growth of GIT in India?

The growth of geo-information technology in our country will surely be an extension to the growth in rest of the IT sector. The benefits of this technology need to be exploited for various development programs that the Government is already taking in this direction. Growing aspirations are bound to lead to better geospatial data and suitable applications to exploit that data. The growing demand in the infrastructure development sector, and for a number of other uses such as disaster management, will definitely spur our industry to invest more in research and development activity in this field leading to reduction in our dependence on expensive foreign commercial applications.

What are the challenges you are facing in the field of GIS?

Exchange of geospatial information between different GIS applications remains the biggest challenge in relation to development of battlefield management systems. While the approaches suggested through the utilization of Open GIS Consortium (OGC), such as Geographic Markup Language (GML), are suitable for business enterprises to a large extent, they have major limitations in the context of utilization by armed forces. This is primarily on account of accuracy, which is paramount as also bandwidth availability and computing powers which tend to be restricted at lower levels in a hierarchical organization. Towards this end, we are actively pursuing the development of an indigenous GIS solution which can meet the requirements of a variety of users in the three Services and yet work on a common file format. The other challenge has been in terms of a common geographic reference framework for the three Services in terms of datum and projection.

How far we can depend upon US controlled GPS?

Over the last decade, the NAVSTAR system (or the GPS) has become an international navigation aid used by the US, its allies and others. Shutting down the system or selectively denying its use can have political implications and, as such, appears to be an unlikely proposition. Moreover, with the GLONASS becoming operational and the Galileo programme being in advanced stages of development, the US will not be the only one to have satellite based navigational systems. Our Government is also actively engaged in global efforts in this field, with ISRO actively involved with both the projects, and we do not foresee any situation which will bind us to any one constellation of satellites in the future. Going by recent statements in the press, it appears that ISRO is also considering a regional system using a constellation of geo-stationary satellites for India. This would further augment the facilities provided by existing systems.

Google Earth poses a security challenge. Comments.

Google Earth uses high resolution commercially available satellite imagery. No country can prevent its adversaries from obtaining these images from companies such as Space Imaging. Major international terrorist organizations have enough financial backing and resources to procure such data from commercial vendors of imagery. Therefore, whilst the imagery available on Google Earth do have some security implications, its geo-information technologies are being exploited by the community for interaction and assistance at people-to-people level in a world connected through the Internet.

Should India insist on censorship as China has?

As is well known, the Internet is not owned by any one country and the world community would not appreciate any censorship on it. The services provided by Google have to be seen in the context of other web casts and web logs on other electronic media portals. Many media publications voice their views on policies of the Government on TV, newspapers and their websites in our country. This has not resulted in the Government of India imposing censorship on them. China has a different political system as well as the means to control and monitor the Internet. It may be able to impose such a restriction within their territory, but have no jurisdiction on the free flow of information on the Internet.

Lt Gen Ranjit Singh has observed that "Security concerns about maps are at times overplayed" (Coordinates Jan 2006). Comment.

I am not aware of the exact context in which the statement was made and, hence, can not comment on it. Maps and other forms of geospatial data are crucial to the process of nation building and development. The 2004 Tsunami, the Oct 2005 earthquake in India and Pakistan, as well as Hurricane Katrina in USA have demonstrated that government agencies alone cannot single-handedly handle relief measures during disasters of such magnitude. Nations will have to rely on other agencies to assist in these measures. Unless geospatial data is available to them, and others willing to help, we will not be able to develop safe infrastructure or coordinate effective rescue and relief operations during times of crisis. Moreover, maps of numerous types are required for development purposes. Nonetheless, those agencies which are mandated to look into the security implications relating to mapping are only fulfilling their responsibilities when they express concerns and reservations when commenting upon a more open regime.

Lieutenant General Dilip N Desai, AVSM, VSM

Lieutenant General Dilip N Desai, AVSM, VSM is the Director General Information Systems of the Indian Army since February 2005. In this assignment he guides and directs the efforts of the Indian Army in preparing for the emerging face of future battles that is network-centric warfare. Lt Gen Desai joined the National Defence Academy, Khadakwasla (Pune) in January 1963 and subsequently, was commissioned into the 18th Cavalry of the Armoured Corps after graduating from Indian Military Academy, Dehradun in December 1968. In addition to a number of professional courses, the General officer is an alumini of the Defence Services Staff College, Wellington, the Higher Command Course at the Army War College, Mhow and the National Defence College at New Delhi.

Lt Gen Desai has wide military experience encompassing command, staff and instructional assignments in 37 years of service. He commanded 18 Cavalry from 1989 to 1991 and later the 1st Armoured Brigade during 1996-97. During Operation Parakram (2001 to 2002) he commanded the 1st Armoured Division as part of an offensive strike corps. He has to his credit a number of important staff assignments, mainly dealing with military operations, in each rank. These include three tenures at the Military Operations Directorate, Army Headquarters where his last assignment was Additional Director General Military Operations. He ahs also taught at the Defence Services Staff College, Wellington. Lt Gen Desai has been decorated for distinguished service by the President with the Vishist Seva Medal in 2000 and the Ati Vishist Seva Medal in 2005.

Everest back in India 1822-1825

Everest arrived back in India at the end of 1821 and then had to trek some 300 miles from Hyderabad to meet up with Lambton at Takalhera. This led to Everest starting work on the series from the meridian arc towards Bombay. The countryside and climate here was much more to his liking but it did require the use of towers to achieve long sights. It was here also that Everest converted to making night observations and the use of the vase lamp instead of opaque targets.

By this time Lambton was driving himself to his limits especially considering his advanced years and on 18 September 1822 he wrote to Everest that he was handing the large theodolite over to him together with various other equipment and 26 coolies for their carriage. Lambton expressed his confidence in Everest's ability, so much so that he declined to issue detailed instructions. In 1822 the Takalkhera base of 37 912.56131 feet was measured along the ground by means of a chain stretched between two small wooden capstans placed one at each end [3]

When Everest and his team had reached about 76º E, around halfway towards Bombay on the new arc, he received the news on 3 February that Lambton had died at Hinganghat on 20 January 1823. At the time Lambton had been accompanied by Dr Morton, an assistant surgeon. For the last month of his life he had been declining rapidly, although he had persisted in pushing forward.

Everest immediately ceased his triangulation and returned to Hyderabad. Unfortunately in the interim Dr Morton, as an executor, disposed of Lambton's property as well as a number of Government items before Everest arrived. In addition he had moved a number of public documents to Hyderabad. [2]

Everest assumed immediate control of the Great Trigonometrical Survey although at that time he had yet to be officially appointed to the post. This formality was to come on 7 March 1823 when he became the second Superintendent of the GTS.

Everest was furious but too late to stop the hurried sale of Lambton's effects. In particular among the public papers were apparently the plans, records and manuscripts covering 23 years of field work. Everest made all haste to meet Morton and salvage what he could from the mess that had been created. Acrimonious correspondence was exchanged and the whole affair rumbled on into June. Although Everest considered that he had managed to recover all the official material, he was still unhappy about the disposal of various personal items that he considered should not have passed to outsiders. From the time of taking over until August 1823, Everest was occupied with the mass of accompanying administration and at the same time he had yet another bout of fever, this time accompanied by rheumatism and partial paralysis, so that he was a semi cripple for the next two years. This he graphically described in [1]. Although advised by the medical men to go on leave immediately he was obstinate to the extreme in wishing to carry on with the programme he had set himself.

The subsequent base measurement at Sironj in 1824 gave 38 411.89912 feet and was another of those occasions when Everest considered that he had to do everything himself because of the shortage of staff upon whom he could rely. He even supervised the driving of every picket, the reading of the ten thermometers and checking the free movement of the weight. This base was measured on coffers. On several occasions Everest had bemoaned the fact that among his assistants he had none who had a particle of mathematical knowledge beyond decimals, the use of Taylor's Logarithms, and the square and cube root. [1] After closing the gap to Sironj he had to accept that he needed sick leave and on 25 May he began the journey first to the Ganges and then by river to Calcutta. [1] He sailed on 11 November 1825 bound for England.

Portrait of Lambton

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The benefits of three frequencies for high accuracy positioning

The availability of the third civil frequency has obvious advantages to instantaneous carrier phase accuracy and ambiguity resolution for cm level measurements in the short base-line

Nobuaki Kubo, Akio Yasuda, Isao Kawano Takeshi Ono, Chie Uratani

GPS modernization will expand the area of positioning service and will increase its convenience. Particularly, the third civil frequency namely L5, which will be provided by both modernized GPS and QZSS, is expected to improve the performance of precise positioning using carrier phase observation. This paper reports an experimental result regarding the convenience of additional L5 signal. Actual navigation signals generated from GPS simulator were received by triple frequency GPS receiver in the experiment. Navigation data, pseudo-range and carrier phase observation have been obtained and used for the analysis. This experiment verifies the improvement of ambiguity fixing time and multi-path mitigation using three frequency signals.

Experiment

Configuration of equipments

A GPS simulator designed for the modernized three GPS signals and a GPS/ QZSS receiver developed for the high accuracy positioning experiment were used for this experiment. These equipments have been developed by Japan Aerospace Exploration Agency (JAXA) as a part of QZSS navigation test bed. Equipments used for this experiment are listed in table 1 with their specifications. Figure 1 shows the data flow of this experiment.
A cesium clock was employed to provide stable external reference for GPS simulator in order to generate GPS-like high quality navigation signals. The data analysis software was developed by Tokyo University of Marine and Science Technology. DGPS and RTK solution as well as usual navigation solution can be obtained with this software. It is also possible to evaluate important parameters for precise positioning such as ambiguity fix rate using this software. Data generation by the simulator and the data recording by the receiver have been performed in real time while data analysis was performed off-line.

Scenarios for data acquisition

The possibility of the high accuracy positioning with triple frequencies was investigated by using pseudo-range and carrier phase measurements. The base-line between reference station and rover station is set about 3.7km because we want to assume that the effects of the atmosphere can be disregarded.

Table 1. Equipments used for the experiment

Equipment	Functional Specifications
GPS simulator	Functional Specifications Simultaneous output of QZSS/GPS signal for L1/L2C/L5 12 channel output signal for each frequency QZSS/GPS orbit simulation with appropriate perturbations Simulation of QZSS/GPS clock drift Generation of simulated navigation message for QZSS/GPS Simulation of ionosphere and troposphere Simulation of multi-path environment Simulation of user motion
QZSS/GPS Receiver	Acquisition and tracking of QZSS/GPS L1C/A,L2C,L5 signal Output pseudo-range, carrier phase and navigation message Computation of navigation solution Calibration of inter-frequency bias Signal quality monitor Cross correlation monitor
Cesium Clock	Agilent 5071A

Figure 1. Data Flow in the experiment

Particularly, the effect of L5 frequency in the ambiguity resolution was investigated in the specular multipath condition. The algorithm used in this test is general code and carrier DGPS using double difference. Table 2 shows the details of the data. Table 3 also shows the details of the scenarios. All of the parameters were set GPS simulator. The reason why there are two rovers is to analyze the case of the different multipath delay. Since the band of L5 frequency has high chip rate compared with L1 frequency, the improvement in accuracy is expected in the case that the multipath delay is over 20 m. Figure 2 shows the configuration between the antenna and the wall in the case of medium and large multipath error respectively.

Table 2. The outline of the raw data

error	Reference	Rover1	Rover2
Large		3hour (sc1b)	3hour (sc2b)
Medium		3hour (sc1m)	3hour (sc2m)
Small	3hour	3hour	

(b→large m→medium)

Table 3. The details of the scenarios

Reference Position	Lat. 35°40' Lon. 139°48' Ellipsoidal height 40.0m
Rover1,2 Position	Lat. 35°42' Lon. 139°48' Ellipsoidal height 40.0m
Time	7/25/2005 AM3:00-6:00(UTC)
Almanac	YUMA309
Ionosphere	Klobuchar model
Troposphere	Hopfield model
Satellite	No error
Small Multipath	Mask 10 degree
Medium Multipath	Mask 15 degree Mask 40 degree in the west (180-360 azimuth)
Large Multipath	Mask 15 degree Mask 55 degree in the east (0-180 azimuth)
Rover 1	The distance between antenna and wall is 20 m
Rover 2	The distance between antenna and wall is 10 m

* Reflection Loss in the wall is -6dB

Algorithm of precise positioning

Positioning algorithm to analyze observation data is described in this section. The overall flow of analysis is as follows.

1) Read observation data from reference and rover station
2) Cycle slip detection
3) Calculation of satellite position
4) DGPS and RTK

DGPS was carried out respectively by using L1 pseudo-range and L5 pseudo-range. RTK was carried out by using general double difference data. Since there are triple frequency observation data, ambiguity resolution was carried out by using the combination of L1-L2 (wide-lane) and L2-L5 (extra-wide-lane). The reason why we choose these combinations is that the noise level is not so large and the effect of ionosphere is same order compared with L1. Although this linear combination technique in order to resolve ambiguities is not the best way, the object in this paper is to analyze the effects of the three frequencies in the multipath condition. So the conventional method in order to resolve ambiguities is used in this paper. Ambiguity resolution was initialized when the cycle slip was detected in each frequency. In this experiment, cycle slip due to the band of L2 was dominant. This is because that the power of L2 by GPS simulator was set lower than the power of L1 and L5.

Table 4. Summary of the parameters in the ambiguity resolution

	Wide-lane	Extra-wide-lane
Wave length	0.86m	5.86m
Carrier smoothing	no	no
Noise (1σ)	3~6cm	17~33cm
Ionosphere	1.3×L1	1.7×L1
Search space	±3	±2

The measurement errors of L1, L2 and L5 carrier phase is assumed 0.5~1cm.

The flow of ambiguity resolution algorithm is as follows.

1) DGPS position estimate using non smoothed pseudo-range
2) Initial estimate of the ambiguity
3) Ambiguity search (position estimate using all ambiguity candidates)
4) Rejection of candidates due to criteria in both measurements and positioning domains (statistical test)
5) After the one candidate is retained, receiver position is computed

Figure 2. The configuration in the case of multipath condition

with each ambiguity candidate

The algorithm for wide-lane is same as the algorithm for extra-wide-lane. Table 4 shows the summary of the parameters in the ambiguity resolution.

Experimental Results

The experimental results are shown in the following sections.

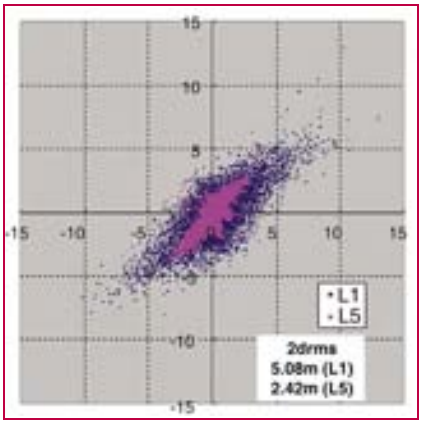

Fig.3 Horizontal error(sc1b)

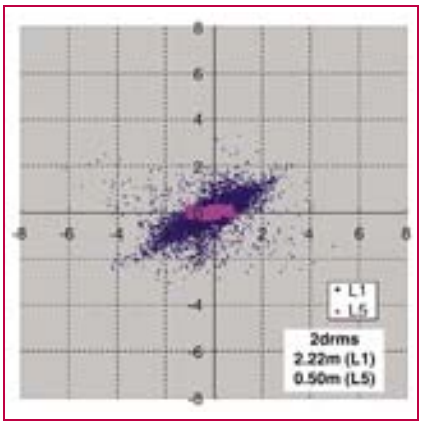

Fig.4 Horizontal error(sc1m)

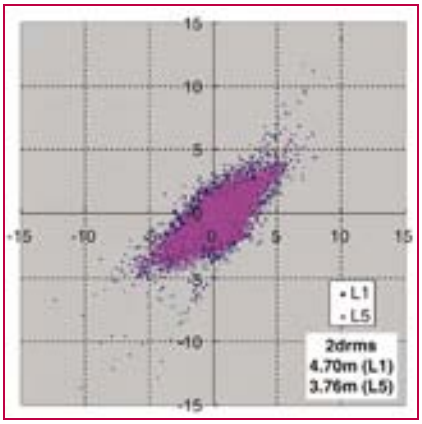

Fig.5 Horizontal error(sc2b)

DGPS positioning results

Fig.3-Fig.5 shows the horizontal positioning error of the base-line between the rover and the reference station for three different multi-path scenarios. Each figure contains the errors for both L1 and L5 DGPS results. In case of no multipath environment, the horizontal positioning error is less than 1 m.

Both Fig.3 and Fig.4 are the experimental results for scenarios in which the distance between the antenna and the wall is 20 m. Although the distance between the antenna and the wall is identical in both cases, the difference of obstruction condition makes a significantly different result. The positioning error for scenario sc1m is smaller than that of scenario sc1b since the obstruction condition for the latter is worse than the former. However, if we employ L5 measurements, the accuracy degradation was improved by 50% or more (Fig.3 and Fig.4).

The Fig.3 and Fig.5 are the result of the same obstruction condition. The difference of the both figures is based on the different distance of an antenna and a wall. In Fig.3, a reflected signal is delayed 20 to 30 m. On the other hand, the delay of reflected signal is within 20 m in Fig.5. Therefore, even if we used L5 signal, which chip rate is high, the multipath errors couldn't be reduced in scenario sc2b.

And all results of positioning error in multipath environment are significantly worse than that of usual DGPS with no multipath environment. For comparison, the relationship between the delay of reflected signal and the multipath error is shown in Fig.6 (reflection loss is -6dB), where the receiver bandwidth is 20 MHz. In these experiments, a GPS receiver equivalent to 0.1 chip narrow correlator was used.

Positioning results using carrier phase

In this section, we show the positioning results using carrier phase observation for both latitude and longitude error components of baseline vector between the reference station and the rover in two scenarios (sc1b and sc2m). Fig.7 and Fig.8 are the results for scenario sc1b, which are obtained by wide-lane (WL) and extra-wide-lane (EWL), respectively.

In the ambiguity resolution, WL utilizes the L1 DGPS positioning result for ambiguity search and EWL utilizes the L5 DGPS positioning result. Fig.7-Fig10 shows that the experimental results using L5 signal are slightly noisier. But the ambiguity fixing success rate is very high in L5 case evidently. In this paper, WL ambiguity resolution based on the EWL was not carried out. However, it will be easy for us to improve the success rate by using the results of EWL in the WL ambiguity resolution. Moreover, in case of using EWL,

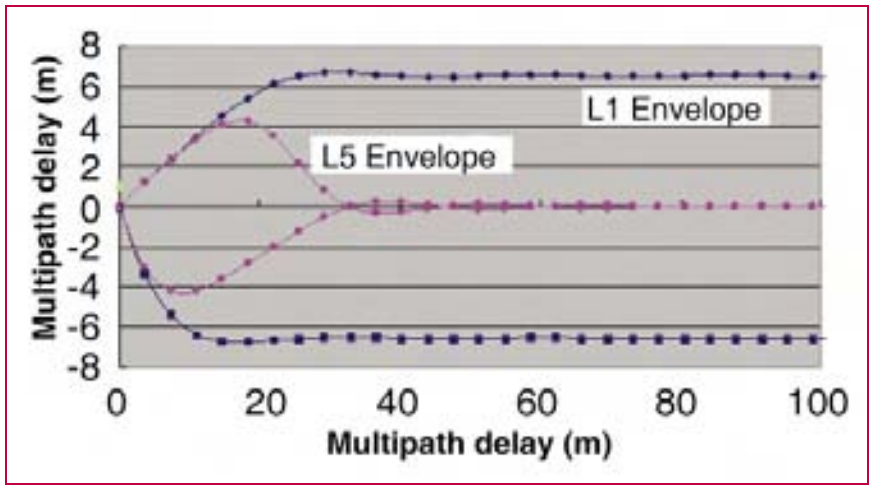

Fig.6 Relationship between delay and multipath error (L1 and L5)

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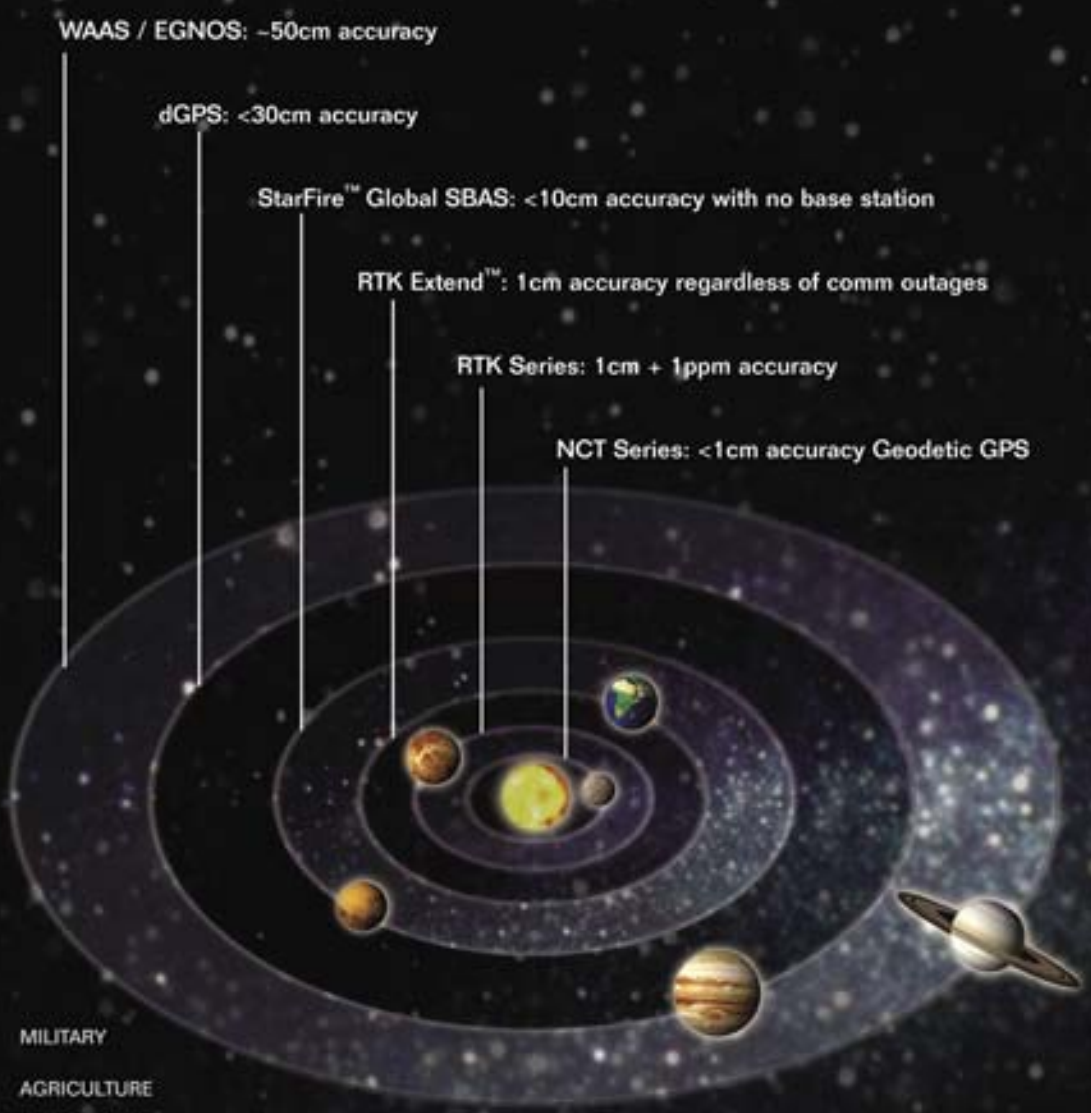

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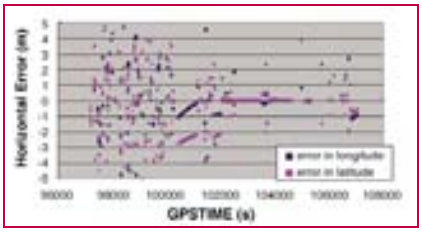

Fig.7 Horizontal error using WL (sc1b)

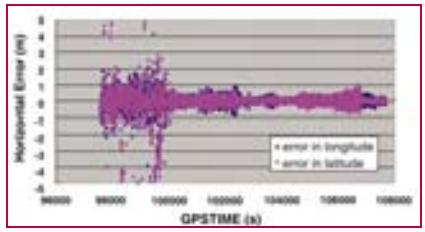

Fig.8 Horizontal error using EWL (sc1b)

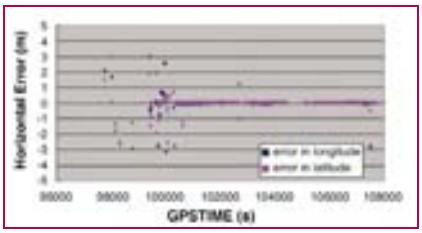

Fig.9 Horizontal error using WL (sc2m)

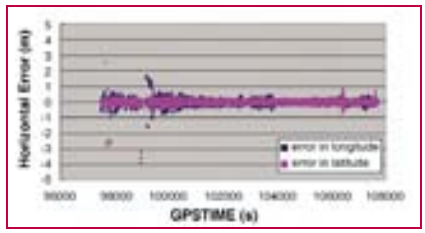

Fig.10 Horizontal error using EWL (sc2m)

the most of ambiguity resolution were determined at 1 epoch. These results mean that L5 signal is really effective for a precise positioning, especially in the urban area.

Table 5 shows the number of successful ambiguity fix and its success rate, for both WL and EWL, respectively. In this table, the right side number shows the number of times with five or more visible satellites. Based on this table, in case of scenario sc1b, in which multipath effect is large, the ambiguity fixing success rate is only 25% and even in case of scenario sc2m, in which mutlipath effect is medium, that rate is 69%. On the other hand, when using EWL, the rate of that is 95% or more. Therefore, it is confirmed that EWL in ambiguity resolution is effective.

Conclusion

This paper introduced the effectiveness of new L5 frequency for precise positioning based on the experiment using three frequency GPS simulator and three frequency QZSS/GPS proto-type receiver. Data analysis result shows that the new L5 signal contributes to the improvement of positioning accuracy for DGPS and RTK under the severe multi-path environment. It is also verified that the ambiguity fix rate of RTK is significantly improved.

Table5. Ambiguity success rate using WL and EWL

Scenario	WL	EWL
sc1b	2092/8307 (25.2%)	8044/8307 (96.8%)
sc2m	6241/9043 (69.0%)	8675/9043 (95.9%)

Acknowledgement

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NEGeo 2006

Northeast India's first
conference and exhibition on
Geo-information Technologies

21 – 22 September, 2006

Assam Administrative Staff College
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- IIT Guwahati
- North Eastern Space Application Centre
- North Eastern Regional Institute of Water and Land Management
- Department of Science and Technology
- National Informatics Centre
- Survey of India
- Geography Department, Gauhati University
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- Mizoram University
- Forest Survey of India
- Assam Administrative Staff College
- North Eastern Hill University
- Meghalaya S&T Council
- Brahmaputra Board
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Theme

Developing North East Geospatially

Conference Focus

- Infrastructure
- Security Applications
- Natural Resources
- Water Resource Management
- Urban Planning
- Agriculture & Tea Plantation
- Land Records
- Governance
- GIS for mountainous terrain
- Tourism
- Awareness and Capacity Building
- Disaster Management
- Environment & Forests
- Health Applications
- Oil & Mineral Exploration
- Spatial data infrastructure

Background

The North Eastern Region comprises 8 states: Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Sikkim.

The Region has different habitat, heavy rainfall, extremely rich bio-diversity, mountains and hills, high seismicity and a drainage pattern marked by lateral valleys in the north and transverse valleys in the south, dissected by major rivers. The region has the potential of its own natural resources for economic development. The development of the North East Region arises from its unique situation. There is a need of identification and removal of infrastructure bottlenecks, provision of basic minimum services, and optimization of natural resources for development purposes without compromising environmental issues.

Why NEGeo 2006

- To explore the interface of developmental focus and priorities with Geoinformation Technologies (GIT) like GIS, GPS, Remote Sensing etc
- To understand the potential, limitations and challenges of GIT in local context and circumstances
- To bring together the technology practitioners and decision makers of the region
- To exchange ideas among regional streams with national trends
- To provide a platform to discuss and deliberate
- Education and awareness

We present the views of some of our co-organizers on the importance, pertinence and challenges involved.

NEGeo 2006

Issues, perspective and a

"Integrating GIT will be important"

Maj Gen M Gopal Rao
Surveyor General
of India

The NE region may be economically less developed but is very rich in natural resources. Geo-information technology has a major role to play in achieving fast track development of the region. It can assist not only in developmental planning but also in addressing environmental issues. There is a need to explore the interface between the potential of these technologies and regional developmental needs.

The challenge is to act together

Prof Gautam Barua
Director, Indian Institute of Technology, Guwahati

The NE region can benefit a lot by recent advances in geo-spatial technology. It is prone to recurring floods, and attendant problems like soil erosion and landslides. Further this is a highly seismic zone. GST can help provide information on river flows, landslides, river damming by landslides, removal of forest cover etc. The main challenge is to get the various stakeholders and monitoring agencies to co-ordinate their activities, to adopt common standards of information collection and dissemination so that the different efforts can build on each other to provide the leap forward that can be achieved.

"Need of awareness and sustained efforts"

KC Bhattacharya
Director, North Eastern Space Application Centre, Meghalaya

One of the focuses of the North Eastern Space Applications Centre is to develop capacity of geo-information technologies in the NE region. This area needs more attention and sustained efforts. Decision makers are not very aware about the potential and scope of geo-information technologies for developmental planning. Even if there are defined projects, many are of the opinion that they do not have the trained man power to execute the projects.

It also has been seen that the trained manpower is posted at a position where such training is not of much use. In addition, there is a tendency to give the projects to private sectors who are not necessarily the best ones.

NE-SDI prospects should be explored

Brig R Sivakumar
Head, NRDMS and NSDI Division, Dept of Science and Technology

There is a need for better awareness about the potential and application of geospatial technologies in the NE region. I hope that NEGeo 2006 shall attempt to deliberate on having NE-SDI involving major data producers and users making them aware about its importance and potential.

Awareness of spatial database required

Prof S C Patra
Director, NERIWALM

The NE Region is mountainous and hilly. Landslides and poor condition of roads makes accessibility and collection of geo-spatial information difficult. Geo-Information Technology (GIT) is useful for preparing spatial data of different themes. The NERIWALM has already started work in this direction during the Xth Five Year Plan. Resource mapping was one of the thrust areas of the Institute. The Institute will strengthen its capability and also is proposing to network within the region and at national level for use of GIT.

However, some of the difficulties that I foresee is that of transmission of data through internet from different CD blocks or other local areas will be difficult as there is frequent power failure. The instruments and back up power supply through UPS may often face problems and rectification will take time. It will slow down data flow process. Another difficulty in the NE region is non-availability of cadastral maps and other revenue related maps. Village boundaries are often not available or plotted. Plot boundaries which is usually depicted in the cadastral maps are not available. Some of the difficulties can be sowed due to efforts of NEC, NERIWALM, DST and other academic Institutions engaged in capacity building on Geo-Informatics. A lot of awareness is required both for creation of spatial data base and its full utilization for planning and development activities.

"g-governance has to reach to decision makers"

Saurabh Gupta
Technical Director and State Informatics Officer, National Informatics Centre, Guwahati

In NE Region many organizations like National Informatics Centre (NIC), Space Application Centre, and State Remote Sensing Application Centre are contributing towards growth of GIT. NIC has conducted several training courses for government officials with an emphasis on awareness. GITs can be used as bottom-up approach for planning. It will be important to involve people at local level for decision making. At NIC, we have done the data digitized up to plot level in many districts like Tezpur, Kamrup, Tinsukia. There is a high utility of Web based open-source GIS solutions for micro-level planning as it can be a catalyst for improving the quality of planning process. The government has also to move now from the concept of e-governance to g-governance.

"Nothing can beat geomatics"

Prof BS Mipun

Department of Geography, North Eastern Hill University, Shillong

Geography as a subject became very interesting with the advent of technology like GIS and Remote Sensing. These tools enable visual presentations of various geographic features like mountains and valleys and help in simulating different scenarios. At our University we have conducted several studies in assessing and measuring in urban sprawls, landuse/ landcover mapping. Our concerns have been on two issues. First, these technologies are too expensive and second, the lack of availability of data like high resolution satellite imageries. Although that nothing can beat this technology, both of these issues need immediate attention.

"Geomatics is used in many state departments"

R D West
Member Secretary, State Council of Science, Technology & Environment, Meghalaya

The State Council of Science, Technology & Environment promote and looks after the Science and Technology activities in the state. We need to employ geo-information technologies in various planning and developmental activities in Meghalaya.

NE Space Application Centre extends us full support in executing many of the state projects that involve these technologies. Many departments like forest, agriculture, etc have taken initiatives to use these technologies in their activities. However, I would like to emphasize that still there is a long way to go. NEGeo is a much needed initiative to educate and aware the potential users of geo-information technologies.

Managing biodiversity and water resources

Prof A K Bhagabati
Department of Geography, Gauhati University

The North East region is abundant in biodiversity and water resources. For the most part, the ecosystem remains the same for all the eight states. We need to utilize and conserve these resources with a perspective of long term plans.

Geo-information technologies provide such a tool that assist not only in proper planning but may also help in predicting various scenarios, for example, the scenario after 20 years. Many research institutes in the region are now focusing on building capacity of these technologies. The NEGeo 2006 will provide an opportunity to share, learn and understand the knowledge pertaining to this field.

Important dates

Full paper submission: 30 August, 2006

Training programme: 18 - 20 September, 2006
Conference: 21 - 22 September, 2006

Organizations expected to participate

- North Eastern Council
- State Forest Departments
- State IT Departments
- Institution of Engineers
- Planning Commission
- State Universities
- Central Water Commission
- National Power Training Institute
- Assam Science, Technology and Environment Council
- Coal India
- Geological Survey of India
- Defense Research Development Organization
- ONGC
- North Eastern Electric Power Corporation

Intended participants

- Academia
- Scientist
- Product and Solution providers from Industry
- Researchers and Students
- Government Organisations
- Policy Makers
- End users

Training Programme

A three-day training programme on Geoinformation Technologies and their applications shall be held on 18-20 September, 2006 at IIT Guwahati. Faculties and experts in the field of Geographic Information Technologies shall conduct the program. IIT Guwahati shall be the academic partner for this training program.

For details or enquiry, please contact Sam or Bal Krishna

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Exhibition

An exhibition will be organized for technology demonstration and product display by various industry players, software and hardware vendors. Also participating will be government organizations, academic institution projects using GIS, GPS, Remote Sensing and allied technologies.

Coordinates, a monthly magazine on Positioning, Navigation and other related technologies like GIS, Remote Sensing etc is an initiative of Centre for Geo-Information Technologies (cGIT). cGIT, an NGO, is engaged in promotion of geo-information technologies to existing and potential user groups in various application segments. In addition, it also organizes workshops, conferences and training programmes.

www.mycoordinates.org/negeo

What you can do at NEGeo2006

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- Attend the Training Program
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- Become a sponsor
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Applications

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"India is locked in wrong and outdated datum"

Instead of copying WGS 84, India should explore the opportunity of being a leader in realizing better geodetic system, Dr Muneendra Kumar emphasizes in a tête-à-tête with Coordinates

What are your views about New Indian Map Policy?

To have two map series is a bold and ambitious approach to satisfy both the defense and civilian users. But, based on my experience of working with countries round the world, I have four observations:

1. Selection and use of datum and mapping system are linked with future development and thus should not be "frozen" into any policy. Here, I will point out an example where a particular datum was "protected" under a national constitution. This provision created many roadblocks for the timely development of Geospatial information of that country.
   In the present case, Government of India has been advised to "lock-in" the wrong and outdated datums, projections, and grid systems. This would create additional hindrances to jeopardize improvement(s) in India's future modernization.
2. Multiple datums, projections, and grid systems in the two series will create operational problems.
3. Selection and depiction of Geospatial information in any DSMs should be decided one map at a time. I have a very educative experience, which I got in 1967 during my service with Directorate of Military Survey. A feature, otherwise completely "innocent" had to be deleted in one map.
4. It would be practically not possible for India to maintain two map series for its large area. Extent coverage of DSMs should be only over special areas; this would be cost saving also.
   Finally, considering the geodetic aspect, the most serious problem is that the "Everest/WGS 84" is NOT a valid datum.

In your opinion Indian Datum is inadequate. Please elaborate.

During my service with NGA, I studied and worked with over 250 datums of the world and there I came to know all about the Indian Datum. Not only it is more than a century old, for today's accuracy requirements, it is extremely "weak" in definition. It has also got distorted. I can elaborate other geodetic inadequacies and accuracy deficiencies, but this interview would not be the right place.

Here, I would add a straightforward factual observation: The 19th century Indian Datum cannot provide "Good Coordinates", which are critical to satisfy the 21st century high accuracy requirements.

What about the security issues regarding this?

The Survey of India (SOI) has over emphasized the security issue for use of the 19th century Indian Datum. All the pertinent details about it are well known like an open book.

I have certain details, which are very important for protecting India's national interest. SOI does not know about them. My offer to share and explain the intricacies is still on.

If Indian datum is to be replaced, then why not WGS 84 or a new one like NAD 83?

WGS 84 is a global system developed by U.S. Defense Department for its own requirements. In the absence of any other "global" geodetic system, IHO in 1983 and ICAO in 1989 recommended the use of WGS 84 for sea and air navigation. Other small countries also adopted it as a matter of convenience. Many large countries and/or two continents have realized their own geodetic systems. And, one continent with 50+ countries is still trying to accomplish the same.

However, in recent years, WGS 84 has been realized with incorrect definition. Additionally, there have been new geodetic researches since the 1980ss. Thus, India should not copy the WGS 84, but now has the opportunity to be the leader in realizing a better geodetic system.

As for copying the NAD 83, I had explained to Indian geodesists and also at INCA 2003 that this datum was established as a special effort to replace the NAD 27. It was the most practical solution at that time. I would point out that there was no GPS; otherwise NGS geodesists might have adopted a different approach. I was very much involved in the

development of both the NAD 83 and WGS 84 and thus know all about their strengths and limitations.

When India can define and realize a 21st century geodetic system, more so when it is launching new map series, there cannot be any geodetic reasons to copy the 1984 geodetic system or 1983 datum.

What will be the advantages by realizing a new Indian Geodetic Reference System?

The new Indian Geodetic Reference System, if defined correctly with the latest fundamental constants and temporal modeling, and the IAG Resolution No. 16 of 1983, will be the best possible realization, which others would like to copy. It will also become the most accurate foundation for the two map series, nautical and aeronautical charts, height and ocean depth systems, national cadastre and urban mapping, and other Geospatial information.

What are the "logistics" involved?

Based on the experience acquired from the South American project, I would say that a network of about 20-25 fundamental GPS stations would be needed. If the need of principal control stations for airport conversion under ICAO mandate is still there, during actual design process this GPS network can be appropriately expanded by another 10-15 stations. Including safety factor, data collection time at each station will be a maximum of 7 days. Another important point is that the logistic, size, and time for the project for new geodetic system is not to be "tied" to the requirements for dense geodetic control for India's other projects.

This project is realizable and affordable, if properly designed and executed under good management. The South American SIRGAS 1995 and 2000 projects are good examples. These projects also show the importance of consultation and international cooperation. A few neighbors are waiting for this Indian project.

Whether India needs a new vertical datum of the type like NAVD 88.

Here, I will first point a few specific features and geodetic issues pertaining to NAVD 88. This datum was established as a practical solution to replace the NGVD 29, which had become non-usable due to poor "zero" definition and excessive distortions. Though Canada participated in the project, it later on did not implement it due to a possible slope of about three meter from East to West. The Helmert's height system is also geodetically not the best. There are many other zero definition issues, which have full scope for improvement. Thus, NAVD 88, which was established 18 years back, is not the right type to be copied by India.

Since the 1980s there has been new research, which shows that GPS surveyed ellipsoidal heights can replace the orthometric heights and thus India does not need a completely readjusted another BIG vertical datum with orthometric heights.

However, India should maintain the present datum by redefining with geoid as the zero reference.

Dr Muneendra Kumar

earned MS, in Mathematics with three gold medals and PhD, in Geodetic Sciences. He is Fellow of the International Association of Geodesy and Marine Technology Society. He served in Survey of India, Indian Military Survey, US National Geodetic Survey, and National Geospatial-Intelligence Agency, from where he retired as Chief Geodesist. Dr Kumar has occupied the Research Professor Chair at the U.S. Naval University, has been Special Consultant to 100+ countries, and Geodesy Advisor to UN Food and Agriculture Organization. He is an authority on marine positioning and geodesy, and GPS surveying. He is known as Dr. or Senor "WGS84".

Dr Kumar has numerous presentations, publications, special geodetic and GPS seminars, and workshops to his credit. His pioneering and innovative concepts and researches include Projection and Distortion Free and Seamless Kumar Mapping (KMap) System, GPS Surveyed Time-Invariant Seafloor Depths, and use of ellipsoidal heights in place of orthometric.

The list of projects where he has been consulted is too long. We can put them in five broad categories (1) 55+ countries "ADOS" project for IAG, "AFRICOVER" for UN Food Agriculture Organization, and "AFREF" for IAG Commission for Africa; (2) 25+ countries "SIRGAS" for IAG and PAIGH; (3) 12+ countries "WHS" for the East European countries; (4) 100+ projects for countries, individually and/or in groups, around the world to update and modernize their geodetic infra-structure, mapping, and height systems; (5) IHO's adoption of WGS 84 for nautical charts and ICAO's conversion of Airports.

He is probably the only person who has all the pertinent detailed information about the Indian datum and its various updates used by neighboring countries and also a very critical issues for DSMs. He is also the only expert who participated in the development, defining, and realization of the WGS 84, NAD 83, SIRGAS, NAVD 88, KGS 95, PRS 92, and geodetic systems, vertical datums, and mapping projects of many countries. He is a Guru of marine positioning and boundaries and knows all about the geodetic aspects for the Law of the Sea. He has also researched the best mapping system, survey technique for ocean bottom, and use of ellipsoidal heights. He has the unique combination of highest level of theoretical knowledge and expertise in geodetic systems and mapping with worldwide practical experience.

Does India need a big spirit-leveling project towards updating the existing datum?

To maintain the existing datum, new leveling on a big scale is NOT needed. But, re-leveling of week sections and of lines, mostly in areas of crustal movement, should be carried out to replace the existing lines. This re-leveling effort, if carefully planed and executed, would save lot of time, money, and resources. The updated network is to be adjusted using weighted constraint technique with geoid as zero reference.

For using ellipsoidal heights, what type of a vertical datum is needed?

The 3-D geodetic system is the "datum", which defines the three position coordinates, viz., latitude, longitude, and ellipsoidal height, of any surveyed point. Here, the reference ellipsoid, as defined within the 3-D geodetic system, is then considered as the "zero" reference for the heights.

This 3-D composite approach thus enables us to replace the centuries old practice defining two separate datums, horizontal and vertical, using two separate ellipsoids.

If ellipsoidal heights can do the job, why they have not been used earlier?

Firstly, the ellipsoidal heights were not used earlier, because they were not available. Secondly, when we started getting them with necessary and sufficient accuracy from GPS surveying, nobody showed any new enterprise to research whether they can be used or not.

My two research papers in COORDINATES show that ellipsoidal heights not only do the jobs, but they do them better, especially in mountainous and remote areas. The "zero" definition is globally consistent and there will be NO conflicts.

For India, the using ellipsoidal heights will have many advantages. Indian users have just to check and test them. After this there should not be any "bar" for not using the new GPS surveyed product.

Here, I would like to point two important issues pertaining to the use of orthometric heights in India. It needs (1) gravity "g" observed at close intervals, and (2) average "g" computed along the plumb line from the ground to the geoid. First requirement is extremely costly and practically very difficult for areas along the Himalayas. The second can never be met. As India did not participate in the NIMA- NASA project of 1996, it still does not have a geoid over its territory with good absolute accuracy. As it now seems that India might not release its gravity data for a global solution, I am sure that Indian geodesists are aware of that theoretical modeling is a very poor option to improve geoid. Furthermore, India only has normal orthometric heights. This means that it requires the quasi-geoid and not the geoid.

Thus, considering the above limitations and fact that India only has normal heights system, the change over to ellipsoidal heights should be a very practical and money saving option.

Is there any security risk?

There is no security risk in using ellipsoidal heights and/or depths. I do not think that there is anyone who can prove it other way.

Why there should be a new "format" for Indian maps and charts?

First, I would bring out the serious limitations of the currently used projection mapping. In this centuries old traditional approach, the distortions are inevitable. In Universal Transverse Mercator (UTM) projection, which has been accepted for the first time under India's new map policy, a 10 km E-W distance could distort enormously as map coverage moves towards the N- or S-Pole from the Equator. At 80-degree latitude, the distortion is about 600%. The associated grid system has "breaks" at zone boundaries and each zone has its own grid North. In addition, the most serious disadvantage for military operations, discontinuity in grid coordinates is inevitable and occurs frequently at zone junctions within the area covered by any ellipsoid and also at the junctions between two adjoining ellipsoids. Incidentally, in many problems in this global grid system, one major breakdown occurs pertaining to the area covered under the Everest ellipsoid. And, India would have to bear it, just for copying the UTM.

From all this, we had no "escape" before my research of the KMAP System. In this "no-projection" system, maps and charts are seamless with practically zero distortion. They also will have true orientation, no discontinuity in coordinates, and contours drawn with ellipsoidal heights. This new approach is the biggest breakthrough in all making large-scale topographic maps and nautical and aeronautical charts.

In view of the above "real" advantages, I would propose to SOI and all other Indian cartographers to check and test the KMap System for the two new DSMs and OSMs.They will find it a cartographic miracle. Then, adopting the KMap System, India would lead the world in producing the best possible quality DSMs and OSMs.

If the "problems" were there, why they have been and are still in use?

There was NO other alternative mapping system(s). Everyone accepted the projection mapping as the inevitable solution. In case of the U.S. Military Grid Reference System (MGRS), which is now) used with UTM, the problems have kept mounting since its invention in 1949. But, no consensus and improved solution could be found. With no other option available, users still have to use the same system.

Starting its new map series, India has the opportunity to avoid the MGRS, the problematic grid system, which comes with use of WGS 84 and UTM.

Why KMap System?

The KMap System, a 21st century cartographic miracle, provides at least thousands of times better solution compared to any projection(s). It will produce the best quality DSMs and OSMs, including all charts.

What about using Absolute Gravimeter in India. Any comments.

The absolute gravimeter is like a "white elephant". After buying and surveying a few absolute gravity stations, a country hardly has any substantial use for this extremely costly meter.

However, there are a few friendly countries, which might help India. This would be the most practical approach to get the absolute gravity value established in India.

If India has already committed its funds, there is another alternative to consider building a newly researched "small" absolute gravity meter. This meter can replace the relative gravity surveys and has some potential for selling.

Does India need a big gravity survey campaign?

Under NASA's gravity mission program, two special satellites have already been successful in collecting gravity data globally. Third satellite is planned for launching in the near future and that will provide, if successful, very dense coverage. All this data will be available to everyone.

In view of the above, Indian gravity survey plans should be drawn accordingly.

Why India should not be "copying"?

Of course, no one should be "reinventing the wheel". But, copying a solution for geodetic system or datum from USA, UK, Europe, or any other country might not the best. Instead, with "Good" consultation, countries should come up with better solutions to specifically meet or suit their own needs.

What are the implications of your proposal on Indian security?

I am an independent scientist with my own innovative research ideas and concepts and have experience and expertise to generate "Good" geodetic solutions. I have no ties and hidden motives and am working as a consultant with clean slate with no intention of getting involved with any type of security issues. My proposed solutions are geodetic and scientific with everything crystal clear.

Demeter micro-satellite

A dedicated mission to observe the ionospheric precursors of earthquakes

AK Gwal, Abhishek Shrivastava and Kalpana Malhotra

Early warning of earthquakes has actually become the main goal of seismology. And though seismic prediction started as a purely seismological discipline, it now involves hydrology, hydro -geochemistry, measurement of telluric and magnetic fields etc. The parameters under observations for the purpose of diagnosing seismic regimes include hydro -chemical parameters, atmospheric electrical disturbances, electromagnetic emissions, anomalous disturbances in the ionosphere and the magnetosphere recorded by satellite.

Among different precursory phenomena mentioned in the different publications on the predictions the ionospheric predictions are probably the youngest due to its unique ability to indicate the approximate position of the earthquake epicenter using ground and space-based observations. The study of seismicity and underlying processes could be essentially improved by using the satellite methods, as it happened with climate and weather study, when proper satellite information are made available. Local probes installed onboard artificial satellites are able to register the variations of near-earth plasma parameters associated with the preparing earthquakes. Probably, the first report on the satellite measurements of ionospheric precursors of the earthquakes could be attributed to the beginning of 1980s. Conditionally, the precursors observed by satellites can be divided into following groups

i) Electromagnetic fields and noises;
ii) Plasma parameters variations;
iii) Particle fluxes.

Electromagnetic emissions in the low frequency ranges that are related to seismic activities are known since long time, but their generation mechanisms are not well understood. Two types of emissions can be considered; first, precursor emissions occur a few hours before earthquakes in a large frequency range from one-hundredth hertz up to several mega hertz; secondly emissions observed after the shock generally are attributed to the propagation of acoustic-gravity waves (Pokhotelov et al., 1995 and Parrot et al., 2002) However, all hypothesis concerning the generation mechanism of precursor emission are also valid after the shock, when Earth's crust returns to the equilibrium state. The emissions can propagate up to the ionosphere; and observations made with low – altitude satellites have shown variations of low frequency waves above seismic regions. The above mentioned points can be well understood through the block diagram given in Figure (1) which gives the seismo-ionospheric coupling and thereby atmospheric and ionospheric effects at different channels.

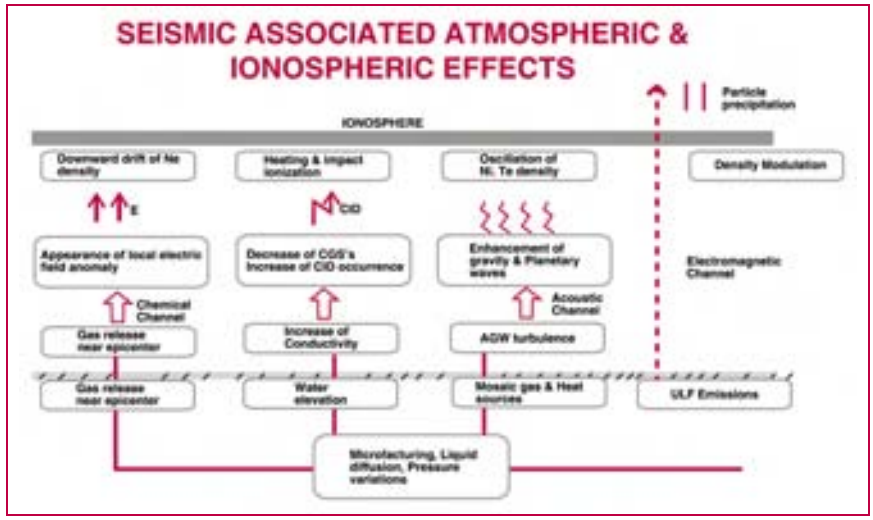

Figure (1) shows the seismo-ionospheric coupling at different channels.

Substantial progress has been made in developing the methods for earthquakes hazards analysis on a timescale in last few decades and it has been realized that satellites and ground based facilities may detect earthquake precursors in the ionosphere a few hours or days before the main shock (Pulinets et al., 1998b). Further, while forecasting the time of the earthquake, forecasting of the magnitude and seismic center may also be possible. But still there is need to describe the ideal (in our view) system of ionospheric precursor monitoring which can demonstrate that ionospheric precursors satisfy all the requirements of short term prediction i.e. able to determine the place, the time and intensity of the approaching quake. The main problems now are lack of regular global data and paucity of funds .Low cost small satellites offer a solution to these problems. The low cost of the spacecraft offers a financially low –risk approach to the next step of this research (Jason et al., 2003). At present several countries viz. Russia, France, USA and Ukraine have already launched dedicated satellites or at the threshold of launching the satellite.

After new results obtained onboard Intercosmos –19(February 27th, 1979), Intercosmos-Bulgaria 1300(August 7th, 1981), Cosmos 1809(December 18th, 1986) and Aureol-3 (September 21st, 1981), it was confirmed that the

satellite observations have the major advantage of covering almost all the areas of seismic activities throughout the world in short duration, and such observations are useful only in case we could demonstrate their seismo-tectonic origins and define all their characteristics/properties, and their variability according to the conditions of the rupture and their environment. Considering these above facts, the scientists had decided to create dedicated satellite missions specially low cost small satellites. Russians took the initiative in eighties and proposed two projects: Preduprezhdenie (Warning) and DEMETER (Detection of Electromagnetic Emissions Transmitted from Earthquake Regions). But due to financial constraints, later in nineties the projects were handed over to the partners: the Warning mission to Ukraine and DEMETER to France.

DEMETER Micro-satellite

DEMETER Satellite is the first of its kind developed by the CENTRE NATIONAL D'ETUDES SPATIALES (CNES), France and launched on 29 June, 2004 from Baikonour, Kazakhstan .The scientific objectives of DEMETER are related to the investigation of the ionospheric perturbations due to the seismic activity, and also to the global study of the Earth electromagnetic environment. The main objectives of the DEMETER experiments are to study the disturbances of the ionosphere caused due to the seismo-electromagnetic effects , and due to anthropogenic activities as shown in Figure(2).

There are two modes of operation: -
(a) A survey mode to record low bit rate data all around earth; and
(b) A burst mode to record high bit rate data above seismic regions.

Sensors are associated to an electronic block in order to digitize the signals and to perform onboard data processing.

- ICE (Instrument Champ Electrique), Measurement of quasi-continuous electric fields and the electric components of waves, three electric sensors from DC up to 3.5 MHz;
- IMSC (Measuring the magnetic components of waves), three magnetic sensors for measuring magnetic field from a few Hz up to 18 kHz;
- IAP (Instrument Analyseur Plasma), measurement of plasma parameters, an ion analyser;
- IDP (Measurement of energetic particle spectra), an energetic particle detector; and
- ISL (Measurement of the characteristics of thermal plasma), a Langmuir probe.

Proposed Ionospheric parameters for measurement

Based on retrospective analysis of existing satellite measurements of seismo-ionospheric variations and existing models, the following set of measurements has been proposed -

- Measurements of the six components of the electromagnetic wave field;
- Determination of the plasma parameters at an altitude of 710kms;
- Measurement of ion composition ;
- Electron and ion temperature measurements ; and
- Determination of energetic particle precipitation.

(The technical details related to DEMETER satellite can be obtained from the website: http://www.demeter.cnrs-orleans.fr/).

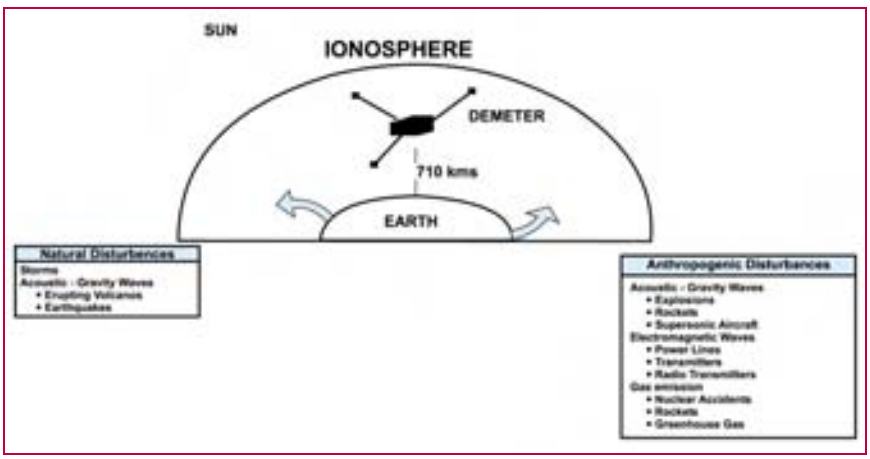

Figure (2) pictorial display of scientific objectives of DEMETER

Result

Figure (3) shows the plasma parameter variations and VLF electric field burst recorded by the DEMETER satellite on 7th January, 2005 seven days before the earthquake (Mb=6.1) occurred on 14th January,2005 at 08:33:30UTC in the New Britain Region P.N.G(Lat. -4.33N Long. 152.73E) .The closest approach to the epicenter of the earthquake (dark red triangle) is encircled . The data is presented as a function of the Universal time (UT), the Local time (LT), geographic latitude and longitude and the L values. The bottom panel shows the earthquake monitored by the satellite along the orbit. The Y-axis represents the distance between the epicentre and the satellite from 750 km to 2000 km. The green squares are for post seismic events, red triangles for pre-seismic events and filled with blue circles for earthquakes occurring during the half orbit. The empty symbol denotes the conjugate points with respect to the epicentre of earthquake. The size of the symbol indicates the magnitude of the seismic events. The colour scale on the right represents the time interval between the earthquakes and the DEMETER orbit with a colour gradation from >30 days up to [0 – 6h].

Limitations

DEMETER has almost all the onboard experiments necessary to register the plasma seismic precursors up to an altitude of 710 km. But the only

thing lacking in the DEMETER satellite is the measurement of electron concentration in the F-layer peak due to low frequency of the installed receiver (3.5 MHz), use to measure the critical frequencies .It could be done with the HF radiospectrometer scaling as suggested by Pulinets et al., 2002c.

Conclusion

Among the dedicated satellite missions the DEMETER micro-satellite looks to be first of its kind in terms of earthquake prediction from space. It has almost all the components/properties necessary to register seismo- ionospheric effects, except the measurement of F-layer critical frequency (foF2) – the most sensitive parameter. Pulinets in his book ' Ionospheric Precursors of Earthquakes' suggested that it is possible to detect the critical frequency with the HF radiospectrometer scaling the HF noises from broadcast transmitter penetrating into topside ionosphere at frequencies higher than the critical frequency. The authors wish to suggest that if the frequency of the onboard receiver increases to measure the critical frequency of the F-layer peak the device would probably become a promising tool in this invaluable research and soon we could have a dedicated network of small satellites for the earthquake prediction studies.

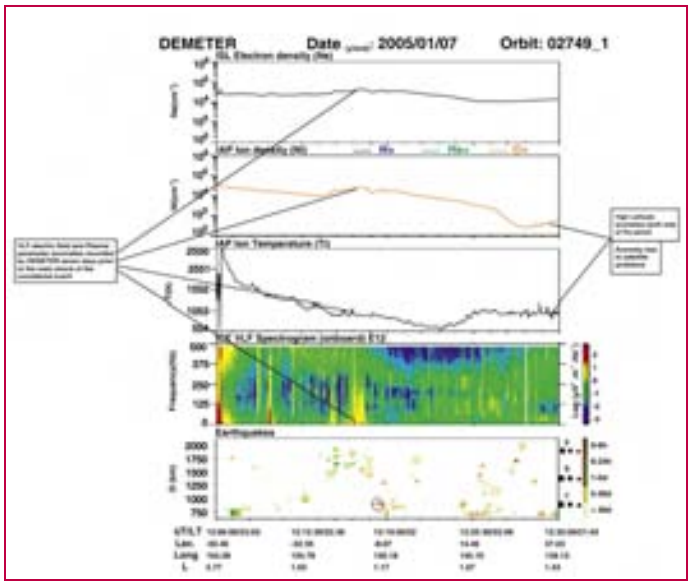

Figure (3) shows the plasma parameter variations and VLF electric field burst recorded by the DEMETER

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SDI: Lots of talk and little involvement

As to how much longer India still has to go down this road to creating a fully inclusive SDI for the nation, you need only look to the UK and USA for examples

Roger Longhorn

I just wanted to congratulate you (and lead article author Mukund Rao) on the excellent wrap-up and exposition of India's NSDI, NMP, status of OSM etc. in the July issue of Coordinates (http://www.mycoordinates.org/cgi-bin//click.cgi?id=69). Very well done, especially the publication of both congratulatory and dissenting statements concerning NMP and the new Guide, from a wide range of stakeholders. Reviewing the statements and articles, as an outsider who has some familiarity with prior history of NSDI development in India, it would appear that the NMP is just the first step - and may still need lots of 'fixing' before it satisfies a much wider portion of the GI stakeholder community in India. This should surprise no one, given the scope of the policy and its potential impact on Indian society and economy.

I noted especially in the "Policy" section (pp. 25-27) the complaint that the NMP appears to be driven almost exclusively by SOI to the possible exclusion of many other organisations, both public and private, who generate vast amounts of important geospatial information in India. We faced (and still face today?) a similar problem in the UK, where many feel that Ordnance Survey GB has too great a say in most issues relating to the national SDI for the UK, compared to the needs of a much wider geospatial data stakeholder community.

In the UK, a truly national SDI still does not exist, although several of the autonomous regions in the UK have their own SDI strategies, typically implemented in regional legislation, i.e. in Scotland, Wales and Northern Ireland.

As to how much longer India still has to go down this road to creating a fully inclusive SDI for the nation, you need only look to the UK and USA for examples. We held the first major stakeholder meeting on a possible NSDI for the UK in June 1995 in London, hosted by Ordnance Survey GB. Now, in 2006, the recently formed "GI Panel" (http://www.gipanel.org.uk/gipanel/) issued a contract for a consultancy to develop a "GI Strategy for the UK" (http://www.gipanel.org.uk/gipanel/gistrategy/index.html). This is 11 years following on from acknowledging the perceived need to create a national SDI in the UK, and 3 full years after one of the UK regions (Wales) announed and began implementation of its own regional SDI strategy (see "GI Strategy Action Plan for Wales" - http://www.agi.org.uk/SITE/UPLOAD/DOCUMENT/Reports/GIS_strategy_for_wales_english.pdf).

Many people feel that the global drive towards creating national SDIs was highlighted in 1994 due to the Clinton Executive Order 12906 to create the USA NSDI, even though some nations, such as Canada and Australia were already on the road to creating SDIs in 1992 or even earlier.

Yet as recently as 2004, ten years following this act, we find the Federal Geographic Data Committee publishing the report

"NSDI Future Directions Initiative: Towards a National Geospatial Strategy and Implementation Plan" (FGDC, June 15, 2004 - http://www.fgdc.gov/policyandplanning/future-directions/reports/FD_Final_Report.pdf).

This interesting document sets such goals as achieving a greater degree of partnership with *all* geospatial data stakeholders, including private industry, states and tribes, "by 2006" (not yet achieved); making the "framework data real" by 2007 (a target also likely to be missed due to delays in success of The National Map project); and communicating the importance of NSDI as "the primary mechanism for assuring access to reliable geospatial data" to "government, business and academia" by 2007. These seem to me to be pretty basic principles underpinning the whole rationale for an SDI, yet even the USA is still striving to achieve them more than a decade after officially recognising the importance of NSDI, via government order.

It appears that creation of SDIs is *always* accompanied by lots of talk (some useful and some merely delaying tactics), re-inventing of the wheel, lots of posturing (political and otherwise), in-fighting for 'control' of the initiative/programme, etc. - and far too little involvement of the wider GI stakeholder community, regardless of whether the SDI is being created in the developing or developed worlds.

Roger Longhorn
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Info-Dynamics Research Associates Ltd, Belgium, **ral@alum.mit.edu**

Products

Trimble tracks Galileo GIOVE-A test satellite signal

Trimble has announced that it has successfully acquired and tracked the L1 BOC (1,1) Galileo GIOVE-A test satellite signal using a combined GPS, GLONASS, and Galileo prototype receiver. In addition to tracking the test satellite, Trimble has also announced that its Zephyr Geodetic II antenna is compatible with all current or planned GPS and GLONASS frequencies and the planned Galileo signals now. *www.trimble.com*

Pythagoras GIS+CAD for surveying

Pythagoras GIS+CAD is a new product from ADW Software. Its graphical interface is based on Pythagoras, the known software for surveying and civil engineering applications. The new software is dedicated to the implementation of Geographical Information Systems. Pythagoras GIS+CAD has been designed for local authorities, cadastral services, utility companies, urban planning and for scientific research. Its application is to analyse and visualise spatial information, without being limited to geographical objects only. *www.pythagoras.net*

MAPublisher 7.0 for Adobe Illustrator

Avenza Systems Inc., producers of MAPublisher cartographic software for Adobe Illustrator and Geographic Imager spatial tools for Adobe Photoshop announced the release of MAPublisher 7.0 for Adobe Illustrator. MAPublisher 7.0 is the latest version of the mapmaking software used to produce maps from GIS data. *www.avenza.com*

Pocket PC GPS Phone gains An FM Radio

Taiwanese ODM (original design manufacturer) E-TEN has released an upgrade to its Pocket PC phone with built-in GPS receiver. The new G500+, the successor to the G500 introduced in January, features twice as much flash memory, plus an FM receiver that supports RDS functionality. *www.windowsfordevices.com*

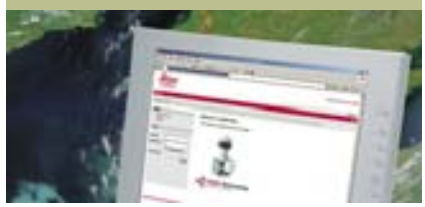
Topcon introduces GPS/GLONASS GIS and survey hand-held

Topcon, introduced new GMS-2 GIS hand-held mobile GPS receiver. It functions as a GIS data collector, L1 static survey receiver or a data collector for L1/L2 receivers and total stations. Aimed at the surveying and GIS professional market, Topcon's new GMS-2 GIS hand-held mobile GPS receiver is the industry's first GIS-GPS product with dual-constellation tracking. *www.topconpositioning.com*

Leica Geosystems introduces an RTK GPS System

Leica Geosystems, introduces Leica GPS900, a mid-range RTK GPS system that delivers outstanding productivity. The new Leica GPS900 uses Leica Geosystems' proven GPS technology. Consisting of a Leica RX900 Controller and a Leica ATX900 GPS Antenna the all-on-the-pole GPS900 RTK rover is ideal for one-person stakeout and topographic tasks. *www.leica-geosystems.com*

Leica SpiderWeb Version 2.0



In the new version 2.0, Leica SpiderWeb has been extended with additional features and valuable services that improve the usability and efficiency. Leica SpiderWeb is easy to use and its powerful software through which administrators can quickly present GNSS data sets for public or internal access via standard web browsers. *http://spiderweb.leica-geosystems.com/*

LEA-4S ROM-based module with SuperSense

u-blox AG has announced the release of its new LEA-4S GPS module which combines unrivaled sensitivity, exceptionally low power consumption and a USB port for flexible connectivity in a module measuring just 17 x 22 mm. The LEA-4S brings unrivaled sensitivity without the need for a costly external Flash EPROM, a dream combination for compact, battery-operated products. *www.u-blox.com*

Business

Thales Navigation to be called Magellan Navigation

An investment group led by Shah Capital Partners (SCP), US, announced that they have reached a definitive agreement to acquire Thales Navigation, a division of Thales, France. The agreement was regarding the divestment from Thales most of its navigation business. Under the agreement, Shah Capital Partners will fully acquire Thales Navigation for 170M$. Co-investors who participated with SCP in the transaction included Tudor Group, Galleon Group, Consolidated Press Holdings, AIG SunAmerica, and Eli Broad. The transaction is expected to close in the third quarter of 2006. The new Company will be named Magellan Navigation, Inc. and will be headquartered in San Dimas, California. *www.thalesnavigation.com*

US air force awards Boeing $138m GPS satellite contract

Boeing has been awarded a $138 million contract by the U.S. Air Force to build three additional GPS satellites under the GPS Block IIF contract. The exercised contract brings to 12 the number of Block IIF satellites Boeing is building under contract to the military's NAVSTAR GPS joint program office. *www.boeing.com*

Google offers live traffic maps on cell phones

Google has announced that it is offering mobile phone users to view highway maps with live traffic data. Available initially in 30 U.S. cities, Google Maps for mobile will show traffic, with road conditions highlighted in three colors: red means congested, yellow & orange means slowdowns and green for open traffic. The service combines satellite imagery, directions, and traffic data -- completely free. One can check out the service by going to http://google.com/gmm on mobile phone. Currently, it's only available in the U.S. market.

Navicore Personal available for Nokia mobile phones

Navicore Ltd, a mobile navigation providers in Europe, has announced that it has further extended the compatibility of its Navicore Personal mobile navigation software, to include the range of latest Nokia smart phones from E-series and N-series, based on Symbian S60 3rd edition platform. Navicore now offers compatibility across a wide range of platforms like Symbian S60, S80, S60 3rd edition and UIQ and there are over 30 devices compatible with Navicore Personal. *www.navicoretech.com*

Market research study on LBS

The new C.J. Driscoll & Associates 2006-07 LBS, Telematics and Navigation Systems Study is based on a nationwide survey of nearly 5,000 U.S. consumers and a series of focus groups in key U.S. metropolitan areas. Key findings of the study were

- The majority of consumers favor portable navigation systems over factory-installed systems.
- Owner satisfaction with both portable and vehicle-installed navigation systems is very high (over 4.0 on a 5-point scale).
- Over one-fourth of the motorists surveyed (26%) expressed strong interest in a service that would provide traffic information for their route or vicinity.
- Early adopters of cell phone based navigation services are generally pleased with these services, though satisfaction ratings for these services are not as high as for portable or installed navigation systems.
- The study rates interest of cellular phone users in 22 cellular applications, including text messaging, downloading video clips, watching live TV on cell phones, email and several location-based services. Seven of the 10 top rated applications are location-based services. *www.cjdriscoll.com*

CISCO launches track and trace service

Singapore will soon be able to trace almost everything, from loved ones to company property, once a new tracking system is launched later this year with the launch of CISCO's Track and Trace service. The tracking device is imbedded into a mobile phone. People who want to find where the user is, has just to call in the company's operation centre. The users will need to enter their pin in their mobile phone menu. Once registered, the mobile phone signal will appear on screen at the operation centre. Another home monitoring device aimed at worried parents allows subscribers to see real time pictures inside their homes using certain 3G phones. After logging on, pictures are beamed over broadband internet to a standard mobile phone account from one or more cameras in the home. *www.channelnewsasia.com*

Sprint Nextel and Motorola Released i580

Sprint Nextel, USA, and Motorola, USA, released i580, a walkie-talkie cell phone with a rubberized exterior that meets military spec 810F for rain, dust, shock, vibration resistance, and more. Features include a 1.3-megapixel digital camera, and supports GPS-based services such as TeleNav, MapQuest FindMe, and Trimble Outdoors. This clamshell-style phone comes with a removable 64MB SD Card, Bluetooth support, and a color display. *www.pcworld.com*

Raytheon completed preliminary test for GAGAN

Raytheon Company, UK successfully completed the Preliminary System Acceptance Test for the GPS Aided GEO Augmented Navigation-Technology Demonstration System (GAGAN-TDS). "This test was significant because the GAGAN-TDS ground elements supplied by Raytheon were installed and integrated ahead of schedule," said Andy Zogg, Vice President of Raytheon's Airspace Management and Homeland Security Business. "More importantly, the system functioned properly and exceeded the accuracy requirements.

The GAGAN-TDS network monitors the Global Positioning Satellite signals for errors and then generates correction messages to improve the accuracy of end-users' position solution.

During the test period, average accuracy was better than one meter (3.3 feet) horizontally and only slightly more than one meter vertically, thus surpassing the 7.6 meter (25 feet) requirement by a significant margin. GAGAN-TDS is the first phase of a project sponsored by the Indian Space Research Organization (ISRO) and Airports Authority of India (AAI) to implement a space-based navigation system in Indian airspace. *www.prnewswire.com*

Lockheed Martin completes fifth modernized GPS satellite

Lockheed Martin has completed the fifth in a series of eight modernized GPS IIR satellites that the company is developing for the US Air Force. The spacecraft are the most technologically advanced GPS satellites ever developed and will provide significantly improved navigation performance for US military and civilian users worldwide. The modernized program, known as GPS IIR-M, is being performed at Lockheed Martin's facilities in Valley Forge, Pa., and ITT Industries in Clifton, N.J. *www.spacedaily.com*

In India

- The child tracking device, based on the GPS, is developed by the Indian Institute of Science (IISc), Banhalore. It is going to be the size of a sleek mobile phone, costing eventually about Rs 5000, and can be fitted into the child's shoe, belt or worn like a wristwatch. Information from this device is periodically transferred to the General Packet Radio Service (GPRS) linked to a central server. *www.hindustantimes.com*

- The Indore City Transport Services Limited, India is running a fleet of ultra-modern buses equipped with GPS, which helps in regulating their movement, especially in maintaining the crucial time factor. *www.zeenews.com*

- GPS is being introduced in trains on three sections under a pilot project, government told the Lok Sabha, India. The project Satellite Imaging for Rail Navigation (SIMRAN) is to be completed by March 2008 and will incur a cost of Rs 2 crores, Minister of State for Railways R Velu said in a written reply. The project is being carried out jointly by Research Designs and Standards Organization (RDSO), Lucknow, and Indian Institute of Technology (IIT), Kanpur. *www.hindu.com*

- A fleet of 30 Taveras fitted with GPS will keep a check on fatal accidents on the 23-km long, eight-lane Noida-Greater Noida Expressway in the next few days in India. The 30 vehicles to be fitted with GPS include fire tenders, ambulances, and vehicles involved in supplying water and removing carcasses of animals from roads. Besides these, 5-6 police vehicles would be deployed for patrolling. *http://cities.expressindia.com*

South Korea launches Arirang-2

Rockot, the Russian rocket containing the Arirang-2, a multi-purpose Korean satellite - lifted off from a launch pad at the Plesetsk Cosmodrome, about 800 kilometers northeast of Moscow.. The Korea Aerospace Research Institute (KARI) that developed Arirang-2 said the three-stage rocket took off at 4:05 p.m. (Korean Time) as planned. A multi-spectral camera (MSC) embedded in Airrang-2 will provide high-resolution images for Earth mapping, which can be utilized for geographical surveys, environmental observation and natural resource searches. *http://times.hankooki.com*

Global coral reef assessment built on NASA images

A first-of-its-kind survey of how well the world's coral reefs are being protected was made possible by a unique collection of NASA views from space. The global satellite mapping effort is called the Millennium Coral Reef Mapping Project and was funded by NASA. The study was reported on recently in the journal Science. The assessment found that less than two percent of coral reefs are within areas designated to limit human activities that can harm the reefs and the sea life living in and around them. *www.nasa.gov*

Satellite captures creation of new continental crust

A new sea is forming in the desert of northeastern Ethiopia. Millions of years from now, the pulling apart of the Arabian and Nubian tectonic plates will allow waters to rush in and widen the Red Sea. And thanks to the availability of satellite imagery, scientists have been able to get an unprecedented glimpse of the workings of stretching plates, the rock crust moving across Earth's surface at up to 12 centimeters per year. Tim Wright of the University of Leeds and his international team of colleagues collected ground- and space-based observations of a widening rift in the Afar Desert of

Ethiopia. Between September and October last year, a 60-kilometer-long stretch of rock spread by as much as eight meters. *www.sciam.com*

Malaysian state to track leatherback turtles

A Malaysian state is to conduct a million-dollar satellite study of turtle migration, focusing on the leatherback which is close to extinction, a report said. The coastal state of Terengganu, famed for exotic islands and beaches, has allocated five million Ringgit (1.35 million dollars) for the exercise, the Star newspaper said. Mohamad Jidin Shafee, Terengganu State Executive Councillor, said the study would cover several turtle species, particularly leatherback sea turtles that are on the verge of extinction. "The exercise is expected to be held this September," he told the Star. Terengganu conducted a similar study last year, attaching transmitters on four turtles to study their movements after laying eggs. The study showed that the turtles migrated to Vietnam, the Philippines and Indonesia after laying eggs in Terengganu, Mohamad said. In the new study, officials will install transmitters on turtles at the same place chosen last year, Kemaman, to see where the turtles go this year, Mohamad added. *www.physorg.com*

ISRO shows the way for urban waste management

The RRSSC of ISRO at Jodhpur has developed a customised geographical information system package called 'Package for Optimum Routing, Interactive Resource Allocation and facility Management' (Parikrama). This helps in network-related applications and can be customised for efficient management of solid waste disposal. The Ranchi Municipality in Jharkhand, which has 37 wards with an area of 177.19 sq km, is using customised solutions of ISRO in tracing suitable landfill sites, the areas that generate the highest amount of waste and the shortest possible route to transport them to the landfill sites. *www.business-standard.com*

Galileo update

Galileo – the European Programme for Global Navigation Services for civil purposes is an initiative led by European Union. We provide regular updates to our readers on the Galileo programme.

Five Nation Consortium focuses on receivers for Galileo GPS system

British consultancy PA Consulting Group, London, is to lead a five nation consortium to look into the enabling technologies needed to develop receivers for Europe's Galileo GPS location based system. The two year project, funded to the tune of Euros 6 million by the European Commission through grants from the sixth Framework Programme, is dubbed GREAT, for Galileo REceiver for the mAss market. The Consortium comprises Spanish group Acorde, a specialst in RF design for satellite and communications systems; German Aerospace Center DLR, the Tampere University of Technology, specifically the Finnish University's group specializing in algorithm design for GNSS systems; and u-blox AG - a Swiss fabless developer and manufacturer of GPS chipsets and GPS receiver modules. The project will comprise three distinct phases - core technology development, prototyping and testing - achieving major blocks of demonstrable baseband IP that, the group says, will allow further developments to be kick-started. Initial target of the project is the development of front-end RF designs, as well as the algorithms and baseband technology to allow the Galileo signal to be used in indoor locations. *www.eetimes.com*

Europe's Galileo satellite's secret codes cracked

Members of Cornell's GPS laboratory have cracked the so-called Pseudo Random Number (PRN) codes of Europe's first global navigation satellite. This will provide free access to consumers who use navigation devices, including handheld receivers and systems installed in vehicles that need PRNs to listen to satellites. GPS satellites, put into orbit by the Department of Defense, are funded by U.S. taxpayers, and the signal is free. Galileo, on the other hand is charging a fee for PRN codes. The codes were extracted by Mark Psiaki, an associate professor of mechanical and aerospace engineering at Cornell and co-leader of Cornell's GPS Laboratory and his team. By mid- March the team had derived their first estimates of the codes. *www.news.cornell.edu*

ESA's Navigation Facility ready for the future

ESA's recently opened Navigation Facility has fast become a world-class provider of highly accurate navigation information, significantly enhancing data from cornerstone systems including GPS, EGNOS and – soon – Galileo. In full operation since February 2006, ESA's Navigation Facility, located at ESOC, the European Space Operations Centre, is producing a growing series of processed data products providing some of the world's most accurate orbit and clock calculations related to GNSS, or global navigation satellite systems. The facility is directly connected to a network of 44 GPS signal receivers located worldwide, and can receive data from several hundred others. These receivers monitor signals from GPS satellites and relay them to just a handful of highly specialised processing centres, including ESOC's Navigation Facility. These in turn process the raw data into valuable atmospheric and geoscience information sets.

Global GIS revenue to reach $3.6 billion this year

Worldwide GIS/Geospatial revenue is forecast to reach $3.6 billion in 2006, up from $2.82 billion in 2004. Core-business revenue includes software, hardware, services and data products. The breakdown for these areas for 2004 is as follows: Software comprised over one-half of total revenue, with revenues from GIS software vendors reaching $1.5 billion.

Data was the second largest component of core-business revenues, accounting for a quarter of total revenue, or $677 million. Services came in third, with core-business vendors being accounting for one fifth of total core-business revenues, or $536 million. Hardware accounted for just 4% of total core-business revenues, or $113 million. *www.daratech.com*

Ministry of Earth Sciences in India

In a significant development in India, the Ministry of ocean Development has been recently named as the Ministry of Earth Sciences. The notification (Doc.CD-384/2006) dated 12th July, 2006 was issued formally by the Cabinet Secretariat on July 17, 2006. The Union Cabinet had earlier approved the renaming of the Ministry in May 2006. The Ministry of Earth Sciences will be in charge of matters relating to Ocean Sciences & Technology, Meteorology, Seismology, Climate & Environmental Science and related Earth Sciences.

Unlocking secrets of earthquake prediction

Researchers say they have come closer to unlocking the secrets of earthquake prediction by uncovering a link between tiny, almost imperceptible, tremors deep inside the Earth and devastating quakes capable of wiping out cities. Key to the find are so-called silent earthquakes that move so deeply and gradually that they produce no seismic waves. A three-year joint project by the University of Tokyo and Stanford University has found a way of accurately mapping the epicenters of these minuscule pre-quakes, researcher Sho Nakamula of University of Tokyo said. The results, published earlier this month in the journal Nature, could lead to improved earthquake prediction.

2005 population estimates for South Africa now available

SAtoZ has released its first dataset for 2006 - an update of the 2001 Census population estimates for the country, generated at various spatial levels, including enumeration areas, municipalities and provinces. The data is also available in tabular format. All of the information is in a GIS format. *www.bizcommunity.com*

ESRI releases 'A to Z GIS

'A to Z GIS - An Illustrated Dictionary of Geographic Information Systems' from ESRI Press serves as a handy guide to define the unique language of GIS technology. Packed with 1,800 definitions, A to Z GIS helps users understand key GIS terms such as geocoding, polylines, and georeferencing. *www.esri.com*

Nepali capital prepares digital map to help locate roads

Nepal's Kathmandu Valley Town Development Committee (KVTDC) has prepared a CD-Rom of the valley's map to help inform people about the Guided Land Development Program (GLDP) of the committee. The committee is also preparing to upload the map in its official website. *http://english.people.com.cn*

GIS developed for Thailand's tourism industry

The Software Industry Promotion Agency (SIPA) has developed an infrastructure for GIS, which contains information on tourism and related services in five provinces, for distribution to travel websites free of charge. *http://nationmultimedia.com*

In India

- There are plans to map all this information on GIS and have an income tax map of Pune city. Armed with data from the Annual Information Return, the Income Tax Department is going to tighten its surveillance on defaulters. *http://cities.expressindia.com*
- The Municipal Corporation of Hyderabad is planning to use digital cameras for the classification of residential and commercial properties. *www.thehindu.com*
- GIS mapping has helped BSES teams in Delhi to unearth power theft of 4300 KW. The penalties imposed on the defaulters amount to around Rs. 17 crore (USD 3.6 million). BSES has started mapping all its licensed areas and customers. *www.thestatesman.net*
- The BMP (Bangalore Mahanagara Palike) in partnership with eGovernments Foundation plans to integrate GIS with the property tax. *http://timesofindia.indiatimes.com*
- The Survey of India, Tamil Nadu branch, is introducing digital guide maps of Chennai in the form of CDs. The digital maps score over the paper variety in including some of the data so far restricted to the public. *www.hindu.com*
- The Department of Biotechnology under the Union Ministry of Science and Technology, India has developed a set of nine CDs. Called `Jeeva Sampada,' the first-ever digitised inventory of India's vast bio-resource provides data on 39,000 species and offers images, distribution maps and an interactive data retrieval system. It as also released an atlas of maps of the biodiversity of East Coast, Eastern Ghats and Central India. *www.thehindu.com*

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- Application Technology of GNSS
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Important Dates

Submission of Abstracts:	May 31, 2006
Submission of Full Papers :	August 31, 2006
Notification of Authors:	July 7, 2006
Early-Registration:	September 22, 2006

*Authors should register by August 31, 2006

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info@bakosurtanala.go.id, marketing@ptmediatama.com.
http://www.geospatial-exh.com

Digital Earth 2006
27-30 Aug
www.digitalearth06.org.nz
james@eventdynamics.co.nz

September 2006

3rd National Cartographic Conference GeoCart'2006
4-6 September, Auckland, New Zealand
www.cartography.org.nz/

ISPRS Technical Commission VIII on: "Remote Sensing Applications and Policies" 2004-2008
4-7 September, Haifa, Israel
www.commission8.isprs.org/

13th ESRI South Asia User Conference
6-8 September, Subang Jaya, Malaysia

WALIS Forum
14 - 15 September Perth
Convention Centre, Australia
davidls@walis.wa.gov.au
www.walis.wa.gov.au

17th UNRCC for Asia and the Pacific/ 12th Meeting of the PCGIAP
18-22 September, Bangkok
http://www.gsi.go.jp/PCGIAP/

5th Trans Tasman Survey Conference
19-23 September, Cairns, Australia
cairnsspatial2006@icms.com.au
http://www.icms.com.au/cairnsspatial2006/

GIScience 2006
20-23 September, Munster, Germany
giscience@uni-muenster.de

NEGeo2006
21-22 September, Guwahati, India
negeo@mycoordinates.org
www.mycoordinates.org/negeo

Second International Symposium on Geoinformation and Disaster Management
25-26 September, Goa, India
subhan_kp@sac.isro.gov.in
http://www.commission4.isprs.org/

ION GNSS 2006
26 - 29 September, Fort Worth TX, USA
www.ion.org/meetings#gnss

October 2006

27th Asian Conference on Remote Sensing
9-13 October, Ulaanbaatar, Mongolia
www.acrs2006.mn

Intergeo 2006
10 -12 October, Munich, Germany
ofreier@hinte-messe.de
http://www.intergeo.de

XXIII International FIG Congress
8-13 October 2006, Munich Germany
http://www.fig2006.de/

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16-17, October
San Francisco, CA, USA
marketing@marcusevansmo.com

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http:// 203.230.240.83/

Geoinformatics 2006
28-29 October, Wuhan, China
lilyshi@lmars.whu.edu.cn

November 2006

GSDI-9 - Geospatial Information: tool for reducing poverty
03-11 November, Santiago de Chile, Chile
gsdi9@igm.cl
http://www.igm.cl/gsdi9

Trimble Dimensions
05 - 08 November, Las Vegas NV
http://www.trimble.com

AFITA-2006
9-11 November, 2006
The Indian Institute of Science, Bangalore
http://www.afita2006.org

GIS-IDEAS 2006
9-11, November
Ho Chi Minh City (HCMC), Vietnam
http://wgrass.media.osa-ka-cu.ac.jp/gisideas06/

The 12th IAIN World Congress 2006
18-20 November, Korea
jkinpr@mail.hhu.ac.kr

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